

REVIEWS OF BOOKS

Annual Review of Physical Chemistry, Volume 4, (Annual Reviews, Inc., 1953). Pp. 450. Price \$6.

The fourth volume of the Annual Review of Physical Chemistry follows the same general pattern and has maintained the high standard of the earlier volumes. It includes a welcome review on Magnetism by Selwood, dealing with its application to oriented polymer molecules, free radicals, the actinides and catalysis, and to a lesser extent, co-ordination compounds and ferromagnetism; and a very short one, of 8 pages, by Dailey on Microwaves and Nuclear Resonance. Of particular interest is the scholarly review of Lennard-Jones on Quantum Theory and Theory of Molecular Structure and Valence; current theories and their applications, particularly the molecular orbital method, are discussed and the difficulties encountered are critically reviewed. Other contributors from the United Kingdom are Weiss on Radiation Chemistry and Kemball on Contact Catalysis and Surface Chemistry. The particularly difficult subject of the co-operative aspects of these transitions has been well treated by Zimm, Oriani and Hoffman. The usual sections on Thermodynamic Properties (Stout), Heterogeneous Equilibria (Boque and Newkirk), Electrolytes (Fuoss, R. M. and A. S.), Nonelectrolytes (Wood), Isotopes (Thode), Radioactivity (Turkevich), Spectroscopy (Sutherland), Molecular Structures (Bauer and Andersen), Crystallography (Lipscomb), Kinetics (Taubes), High Polymers (Ferry), Ion Exchange (Juda, Marinsky and Rosenberg), Photosynthesis (Lumry, Spikes and Eyring), are included. In all, 450 pages of valuable material which would repay study by physical chemists of all interests. These first 4 volumes not only provide an excellent basis for a reference section in one's own library, but also provides in many cases a personal assessment of modern trends in research by recognized authorities.

Kinetics and Mechanism (A Study of Homogeneous Chemical Reactions). By A. A. FROST and R. G. PEARSON. (John Wiley & Sons, New York, and Chapman and Hall, London). Pp. vi + 343. Price 48s.

This book fills a serious gap in the existing literature. As the authors point out in their preface, existing text-books on kinetics give only a perfunctory treatment of mechanisms, while books on organic mechanisms often content themselves with phrases like "the kinetics show that . . .". The present book aims at giving a clear picture of how much (and how little) can be deduced about the mechanism of reactions by a study of their kinetics, and how this information can often be supplemented from non-kinetic sources. In this aim it succeeds admirably, being clearly and critically written, and assuming a minimum of previous knowledge on the part of the reader.

The first three chapters describe the fundamentals, definitions and laws of reaction kinetics, the third containing a valuable account of methods for deriving velocity constants from experimental data. The next three chapters deal with gases: kinetic theory, transition state theory, and comparison with experiment for simple gas reactions. Chapters 7-9 treat reactions in solution, including the mathematical treatment of consecutive and simultaneous reactions, and an account of homogeneous catalysis. After a brief account of chain reactions, the book closes with a fairly detailed treatment of eight classes of reaction whose mechanisms have been investigated by kinetic and other means. Since the other chapters are copiously illustrated by reference to specific reactions (and are followed by numerical

examples taken from the literature), the book as a whole covers a wide range of chemistry and gives an excellent survey of the powers and limitations of the kinetic methods. It will be invaluable to those with special interests in kinetics or in reaction mechanisms, and much of it is suitable for reading by any Honours chemistry student.

R. P. B.

Oxidation of Metals and Alloys. By O. KUBASCHEWSKI and B. E. HOPKINS. (London: Butterworths). Pp. xv + 239. Price 35s.

As W. H. J. Vernon suggests in his Foreword to this work, a critical review of the available information on metal-gas reactions is long overdue. The present work succeeds in this only to a limited extent since, although a very large volume of information has been collected together (549 references), the treatment tends to be uncritical.

The first section deals with Basic Information in a sporadic manner. Excellent tables of fundamental information are presented but in contrast the treatment of Diffusion and Electrical Conduction is inadequate and leaves the impression that their significance is not fully appreciated. The treatment of semi-conductivity dispenses with conventional consideration of surface states and impurity levels, an omission which might be acceptable were it not that it becomes apparent that the full implications have not been appreciated. Thus on page 50 the conductivity of cuprous oxide is attributed to ionic conduction rather than the generally accepted *P*-type semi-conduction. The assessment of the activation energies for diffusion being no better than ± 7 kcal would appear to be rather pessimistic.

The following section deals with experimental methods and will be of considerable assistance to newcomers to the field. The limitations of the various methods might well have been more clearly defined. The influence of the ionization (or atomization) of gases on page 79 is inaccurate.

In the next section the reaction mechanisms are considered. The Wagner theory for the parabolic oxidation of metals is reproduced in detail and other theoretical appreciations are mentioned. The most interesting and important aspect of this section is the information on mixed oxides and the oxidation of alloys. This is of considerable applied interest and should be found most stimulating. In the final section a large number of individual cases of pure metals and of alloys are treated and much useful data are tabulated.

In many respects this work has considerable merit but the large number of references introduced somewhat uncritically into the text, makes reading difficult. However, although failing to achieve distinction, its immediate value in tabulating and correlating a very large volume of information makes it of considerable importance to all workers in this field of ever-growing interest.

T. J. G.

Associated Measurements. By M. H. QUENOUILLE. (Butterworth Scientific Publications, 1952.) Pp. 231. Price 35s.

Statistical methods for dealing with associations between observations have increased in number, refinement and distribution, and this collection is timely. For his immediate purposes the author has generally ignored the wider conception of statistical science as an essential part of the heuristic discipline of much scientific research and, regarding statistical methods as tools, has presented a variety of techniques and examples of their applications. Many readers will accordingly require a supplementary text to obtain full value from this work.

The graphical methods, first discussed, of detecting and estimating associations are useful as preliminaries to numerical investigation and on occasions as sufficient

statistical treatments. The tests in chapter 3, however, will probably be new to many non-professional statisticians so that a less sketchy treatment of Tukey's corner test would have been preferable.

Under "Numerical methods" there follows an exposition of orthodox regression analysis. A test whereby the significance of extreme observations relative to a fitted regression may be examined is included—together with the warning that decisions to include or exclude such values are more firmly based on considerations external to the observations themselves.

Third comes a section on "Rapid estimation and analysis", generally covering methods of dealing with large bodies of data. The effects of grouping in regression analysis are discussed, and there is a helpful chapter on the organization of large-scale analyses. The analysis of covariance is fully treated in this, rather than, more logically perhaps, in the preceding section.

The last section is headed "Analytical complications". There are chapters on time series and multivariate analyses, both likely to become more useful in biological research as their techniques become more familiar. The estimation of the association between two variables when both are subject to error and dependent on a common third parameter is discussed here and elsewhere in the book. The description of the process as the estimation of underlying relationships could, however, be misleading, considering that only a proportion of solutions so obtained are likely to provide truly fundamental relationships.

Although it is claimed that the amount of mathematics has been kept to a minimum it may reasonably be doubted if this minimum will readily be assimilated by the majority of potential readers. This, of course, is one of the fundamental difficulties of the subject, and one not solely due to mathematical symbolism, but to some extent associated with other idiomatic expressions of mathematical thought. An advantage of the book in this respect is the number of fully discussed examples; these are drawn mainly from biological sources, but the selection is wide, incorporating an example on earthquake activity and another on the incidence of forest fires.

Amongst a number of relatively unimportant errors, a surprising one is the description of an X -value as an ordinate on pages 65 and 66. A carefully selected bibliography is included and there are thirteen useful tables but the production is somewhat expensive considering the number of text pages. Each book of this kind helps to spread statistical ideas and methods, and though this one may present more complicated techniques to fewer workers than most, it would undoubtedly be a valuable addition to library shelves.

C. P. C.

The Mathematical Theory of Non-Uniform Gases. By S. CHAPMAN and T. G. COWLING. (Cambridge University Press, 1952.) Pp. 431. Price £3. Notes added in 1951, with the indices, pp. 40, price 5s.

This is essentially a reprint of the first (1939) edition of the authors' well-known standard work, which has been unobtainable for several years, together with some 26 pages of notes added in 1951 and an enlarged subject-index.

It is a tribute to the first edition that the authors have found it necessary to make very few alterations and corrections to the original text; only four minor changes were noted by the Reviewer, so that the chief interest lies in the notes, of which there are ten. Four of these are concerned with thermal diffusion, and include a summary of elementary theories of the phenomenon, together with an outline of Waldmann's work upon the diffusion thermo-effect: note is also taken of the equations developed by Hellund and by Hirschfelder to describe diffusion and thermal diffusion in a multiple gas mixture, and of Chapman's (1940) investigation of the dependence of the thermal diffusion ratio upon the

concentration and mass ratio and the laws of force in a binary mixture. Recent results upon diffusion and thermal diffusion are conveniently collected in tables, and the discussion of these figures includes some comparison of the Lennard-Jones 9:5 and 13:7 models: the work of de Boer and van Kranendonk and of Hirschfelder, Bird and Spotz upon the latter is dealt with in more detail in a separate note. One section is given to a consideration of the basic equations and assumptions used by Born and Green and by Kirkwood in their papers on the kinetic theory of liquids, and another to Grad's method of obtaining the third approximation to the velocity-distribution function in a simple gas: in dealing briefly with these important recent advances the clarity and economy of the authors' text is marked. An account is given of the relationship between internal energy and volume viscosity of a gas, following Kohler's treatment using the rough spherical model.

It is a fitting comment upon the times that the new book is exactly twice the price of the 1939 edition, but by present-day standards it is good value; the publishers have maintained their customary high quality of printing and binding.

E. R. S. W.

Flames, their Structure, Radiation and Temperature. By A. G. GAYDON and G. H. WOLFARD. (Chapman and Hall, London, 1953.) Price 55s.

In his *Chemical History of a Candle*, Faraday remarked: "There are such curious conditions of flames, that it requires some cleverness and nicety of discrimination to distinguish the kinds of combustion one from another," This remains true today, for recent work on flames, though it has increased our knowledge greatly, has not reduced in number or difficulty the problems with which we are presented. It is therefore most valuable, at this time, that a book should be written on the subject of flames by two authors who are actively engaged in studying them at the bench. Moreover they have decided to write on those particular subjects which appear to them most interesting, even though, or perhaps because, they are the most controversial. The material presented is up-to-date as is evidenced by the fact that half the references given are to articles published during the last six years. This also demonstrates the wide interest that exists in this subject at the present time.

In the first few chapters the authors describe the general appearance and properties of flames, concentrating their attention on stationary burner flames, but considering laminar and turbulent flow. In chapter 4 they describe the methods of measuring burning velocities, and give a valuable discussion of the relative merits of the various methods. A selection of the results obtained is also included in this chapter. In chapter 5 the various attempts to account for the propagation of flames are presented and examined. Chapters 6 and 7 deal with diffusion and unstable flames. The next chapter is entitled "Solid Carbon in Flames" and consists of a most interesting survey of a topic which, though fascinating and important, has not received the attention that might have been expected. The next chapter gives a brief account of radiation processes in flames, and the following three a very complete examination of the methods available for temperature measurement in flames together with the results obtained. This is a subject about which various differences of opinion exist, and it is valuable to have such a full discussion of it by two authors who have been so actively and successfully engaged in this field. The next chapter considers ionization in flames about which much work has recently been published. Lastly there are two chapters on "Some Unusual Flames" and on "Some Flame Problems" which are likely to stimulate interest, and, it is to be hoped, encourage new work.

In their preface the authors say that they "have little enthusiasm for abstract mathematical treatments of combustion". They are first and foremost experimentalists though they have a thorough appreciation of the various treatments

of the mechanism of flame propagation. It is this quality that makes the book such a useful one, for it is impossible to write successfully about flames without a very close and wide experience in the laboratory of their behaviour. The book contains many excellent and instructive photographs, both coloured and black-and-white, and provides a most readable and lively account of the structure, radiation and temperature of flames both for the specialist and for the more general reader.

J. W. L.

The Origin of Metamorphic and Metasomatic Rocks. By HANS RAMBERG. (University of Chicago Press, 1953.) Price 75s. Pp. xvii + 371.

The mineral species in rocks may be formed by crystallization from magmas. They may also be formed by recrystallization, without melting, of other crystals. If this latter process does not change the overall chemical composition the reactions are described as metamorphic; if the overall chemical composition changes by migration of chemical elements in and out of the zone of recrystallization the reactions are described as metasomatic. Thus these terms have as real a significance for the chemist as for the geologist. In a general sense one may assume that the train of processes is such as to decrease the free energy and increase the entropy of the earth, but this tells us little concerning variations in local conditions or about mechanisms and velocities of change. One is indeed face to face with the limitations in our knowledge of solid state reactivity. At the same time the chemistry and physics of such reactions is receiving more attention from various centres of physical chemistry, and interesting and fundamental advances have been made over the past twenty-five years. The enrichment of geology through physical chemistry has thus proceeded steadily, and particularly in recent years vigorous efforts have been made in this field, for example by the late Prof. Goldschmidt, by the Geophysical Survey in Washington and still more recently by an active group in Chicago, of which Dr. Ramberg is a member.

This book is an interesting and authoritative account of theories and data on geological solid state reactions. A balance has been held between the chemical and geological problems involved in these processes and between laboratory and field studies. The author has presented rival viewpoints in the many issues still undecided. Typical chapter headings will give, as clearly as can be done in a few words, the content of the book: thermodynamics of metamorphic processes; equilibrium diagrams; chemical kinetics of metamorphism; kinetics of deformation of rocks and minerals; stress-antistress minerals; mineral facies; mechanism of metasomatic transfer of matter; metamorphic differentiation, etc. There is an interesting appendix on chemical bonds in crystals and on the way in which crystal energy may be used to predict directions of reaction. This is a topic which Dr. Ramberg has made particularly his own.

Of the book as a whole it can be said that there appear to be few misprints and that the format is attractive. Dr. Ramberg's book may be strongly recommended to all interested in mineral and geochemistry, and in solid state reactions.

R. M. B.

Fatigue of Metals. By R. CAZAUD (translated by A. J. FENNER). (London, Chapman and Hall, Ltd., 1953.) Pp. xiv + 334. Price 60s.

This is a translation of an already well-established book, the third French edition of which was published in 1948, by someone highly esteemed not only in France but throughout the industrial world as an authority on the fatigue of metals. The author is an engineer and the book is intended as a work of reference on the engineering aspects of fatigue failure. It succeeds admirably in

this. Roughly one-half of it is concerned with surveying the characteristics of various metals and alloys in laboratory fatigue tests, illustrated profusely with carefully selected data covering a wide range of materials and conditions. The other half deals with the application of knowledge about fatigue to engineering construction; in particular it explains how one can help to prevent fatigue failure by better design, by more suitable methods of manufacture and workshop finishing, and by improved systems of inspection. Special effects which arise from the influence of temperature, corrosion and chemical action, and various kinds of service conditions generally, are all discussed.

With such emphasis on the engineering aspects of fatigue it is not surprising to find the scientific aspects dealt with rather perfunctorily. Accordingly, this is not, and was never intended to be, a book for the reader who is seeking metallurgical and physical principles to guide him in the design of fatigue-resistant alloys.

The translator has not interpreted his duties narrowly. As well as providing a skilful and accurate translation of the text, he has also taken the opportunity to include some work completed since the 1948 edition was finished. Mostly this is based on information supplied by the author, although some new results from the National Physical Laboratory are also included.

A. H. C.

Modern Radiochemical Practice. By G. B. COOK and J. F. DUNCAN. (O.U.P., Geoffrey Cumberlege.) Pp. xx + 407. Price 42s. net.

Over fifty years have elapsed since nuclear radiations were first observed. When, more than a decade later, the radioactive displacement law was formulated and Soddy coined the word "isotope", chemists were not slow to appreciate the potential uses of radioactive isotopes in the elucidation of chemical problems. At that time it was assumed that there was complete identity in the chemical behaviour of the various isotopic forms of the element; an assumption we now know to be only partly true. The realization of these potentialities was delayed (a) because only limited amounts of the naturally radioactive isotopes of only a very few elements were known and available and (b) because of the primitive methods of radiochemical assay. Almost twenty years ago induced radioactivity was discovered, which enormously increased the potentiality without affecting the realization. The really rapid development and expansion of radiochemistry began only ten years ago when the first self-sustaining nuclear reactor was successfully operated. Radioactive isotopes of nearly all the elements have now been prepared, either by neutron or particle bombardment or by extraction from fission products. Keeping pace with the increased range and availability of radio isotopes has been an increase in the precision and scope of the measuring devices for nuclear radiations. The book under review represents the first English attempt to collect and describe these modern methods in a form suitable to enable any science graduate to decide whether the way to a solution of his problem may be assisted by the use of radioactive measurements and, if so, to carry out these measurements.

The book is a most clearly written and well organized account which should be of great practical value. One can imagine that the fate of many of the volumes to be issued will be to be well thumbed by chemically-stained fingers, ultimately to perish by excessive use in a corrosive atmosphere. Whilst not a *vade mecum* it would be almost as indispensable.

The first part of the book follows the course which might be expected of a manual. In chapter I the subject is outlined. In chapter II the characteristics of radioactive decay and of the emitted radiations are specified and chapter III is devoted to the methods of measurement of α , β and γ rays and of neutron fluxes.

The next three chapters are concerned with experimental errors, electronic devices and aspects of radioactive isotope production. Health precautions and laboratory design comprise the final chapter.

The second part is an account of thirty different experiments which may be carried out with radioactive material, mostly requiring very little more experimental facilities than University laboratories already possess. This is a most valuable section and clearly illustrates the power and limits of the radioactive method. Some of the experiments will not be possible in places geographically remote from a nuclear pile, but such unfortunately placed readers will at least find in the pages of this book the instructions for constructing a home-made neutron generator and examples of the pedagogically valuable experimentation which such a generator permits.

The book is remarkably free from errors, is pleasantly printed and illustrated and is strongly bound. The reviewer wishes it the high success which its contents deserve; his only regret, tinged with surprise, is that the name of Soddy is nowhere to be found within its pages.

F. S. D.

Polarized Light in Metallography. Edited by G. K. T. CONN and F. J. BRADSHAW. (Butterworths Scientific Publications, London, 1952.) Pp. 130. Price 21s.

The polarizing microscope is a routine tool for the examination of materials by transmitted light in the domains of petrology and crystal studies. Many excellent works on this application exist and a working knowledge of transmitted polarized light for the examination of thin sections can be obtained with some ease. It has long been obvious that the properties of polarized light can be used by the metallographer and indeed many applications have been spasmodically recorded in the literature over the last 30 years. Progress in the routine use of this technique by the metallographer has been slow due to the complications of the theory, the inadequacy of equipment available, and the lack of suitable books stating the fundamental principles given in a metallographic context.

In 1950 the British Iron and Steel Research Association co-opted a small group of specially interested people to prepare a survey of the subject and the book under review represents the joint efforts of this group, with chapters written by those of the group having some special experience.

Metals in bulk are opaque and their examination must in general be by light reflected from a polished surface. Reflection of polarized light by such surfaces is not understood by the average metallurgist engaged in metallographic studies, so the first two chapters are concerned with the general properties of polarized light and anisotropic materials and then with the principles of reflection and absorption. This latter is a subject that the metallographer would otherwise have to study in works on physical optics, to which he may not have ready access.

There is a chapter on equipment and procedure for microscopy by reflected polarized light. This is particularly important since few metallographic microscopes have been satisfactorily provided with accessories for polarized light studies. A further chapter deals with the results obtained by the examination of metal specimens with polarized light and the identification of phases. Another chapter deals with the use of the technique for the examination of inclusions in metals. There is also a brief account on the use of reflected polarized light in the examination of ores.

Several attempts by metallographers to use polarized light microscopy recorded in the literature have shown an appalling ignorance of the basic physical optics. This book has the object of providing this information in a simplified form. One has the impression that the technique has only been superficially explored and that much further progress could be made by its elaboration and its continued use. The techniques for the examination of isotropic materials by deep

etching and the production of elliptical polarized light, and the production of anisotropic surface films appear to offer attractive possibilities. For these to be realized the metallographer must be equipped with the technique and apparatus. This book should serve to stimulate the interest of a metallurgist and to provide a suitable background with an up-to-date survey of work already carried out.

H. M.

Fluorescence of Solutions. By E. J. BOWEN and FRANK WOKES. (London: Longmans Green and Co., 1953.) Pp. vii + 91. Price 25s.

The increasing use of fluorimetry as a quantitative analytical method has created a need for a monograph covering the practical side, which has been largely neglected in previous treatises on fluorescence. Perhaps more than most analytical procedures, fluorimetry is subject to many serious errors, both instrumental and chemical. The second half of this book is mainly concerned with a description of such errors and the means whereby they may be minimized with various types of instrument. Those employing, or considering the employment of, analytical fluorimetry will find in this part much valuable instruction and be warned of the difficulties which may be encountered.

The earlier chapters are for those who wish to understand the principles of the phenomenon of fluorescence. The essential theory of the excitation, quenching and spacial and spectral distribution of fluorescence has been skilfully condensed into 45 pages. Some readers may find these chapters somewhat indigestible; for them and for those wishing to delve more deeply there are adequate references to original sources.

The reviewer was shocked by the price.

D. W. G. S.

Radioactive Isotopes. By W. J. WHITEHOUSE and J. L. PUTMAN. (Oxford University Press.) Pp. 424. Price £2 10s.

The recent rapid expansion in the use of radioactive isotopes has naturally been accompanied by a spate of text-books setting out the necessary elementary nuclear physics and describing the current techniques in the estimation and handling of radioactive materials. This volume is directed at a wide audience, including users of radioisotopes in industry, medicine and biology as well as in chemistry; and benefits from the practical experience of the Harwell organization, with which both the authors are associated, in producing radioisotopes and advising others in their applications. Two chapters in particular stand out favourably when the inevitable comparisons are made with other similar works of recent date. These are chapter iv, entitled *The Production of Radioactive Isotopes*, which includes a description of the uranium pile in some detail and much useful practical information on the techniques of pile and cyclotron irradiations; and chapter vii, entitled *Applications of Radioactive Isotopes*, covering a wide variety of such applications with a maximum of attention to general principles and a minimum of irrelevant detail. Other chapters worthy of note are chapter iii, entitled *Properties of the Radiations*, a lucid presentation of physical principles which are often made to appear unnecessarily abstruse; and chapter v on *The Detection and Measurement of the Separate Particles*, which includes, for the first time in any corresponding work, an adequate treatment of scintillation counting techniques using photomultiplier tubes. The health hazards in the ill-advised use of radioactive tracers are rightly stressed in the concluding chapter. Dangers of this sort are commonly less in large organizations where radioactive materials are handled at a high level of activity than in small tracer laboratories where discipline tends to be lax and standards of housekeeping low.

The authors have been wise not to include too much detail concerning the electronic circuits used in particle counting. The less fortunate workers who have to service their own apparatus need far more such information than any similar volume can be expected to supply. The reviewer would like to question the advisability of the current practice, evident here, of including lengthy tables of nuclear data as appendices to works of this type. These tables soon become out of date and are now included in readily accessible handbooks of chemistry. The decrease in the size and expense of the publication which would result from their omission is worth consideration. Some chemical readers might have wished for more details as to the separation procedures in use for the commoner radio-isotopes, but it must be borne in mind that this volume is intended for a wide range of workers and certainly not exclusively for chemists.

Typographical and other errors are commendably few and the general production is up to customary Oxford University Press standards. This work can be commended highly to all those contemplating the use of radioactive isotopes, as also to those entering atomic energy work for the first time. At the price of 50s. it compares favourably with American text-books which are its chief potential rivals.

N. M.

Rechenmethoden der Quantentheorie, Part I. By S. FLUGGE and H. MARSHALL. (Berlin, Springer-Verlag, 1952). 2nd ed. Pp. viii + 272. Price 29.80 DM.

This is the second edition of a treatise on the methods and techniques of quantum theory, and it is to be followed in due course by a second volume. It differs from most text-books on quantum theory by assuming that the basic principles are all known; the authors have selected a series of particular problems, which they state and for which they provide typical solutions.

There are advantages and disadvantages in this scheme. One great advantage is that by concentrating on problems to the exclusion of theory, it is possible to illustrate the detailed application of a variety of methods in a manner which is not possible in more normal texts. This is achieved with considerable success, so that if, for example, a research student is anxious to know how to use some particular technique, he will almost certainly find help in seeing the details of how it is used here.

But there are disadvantages too. The text lacks continuity, and can hardly be read from cover to cover without mental indigestion. There is also a notable lack of considered criticism on the relative merits of different techniques, or any statement about the degree of accuracy to be expected in approximate methods. Thus although the variation method for obtaining approximate energies is illustrated by three or four examples, no guidance is provided about the type of function which should be chosen in the variation function in order to get most rapid convergence of the calculated energy values.

The variety of problems is quite wide, and it includes the case of a uniformly accelerated particle, and motion under certain rather unusual types of force, which are not commonly found except in their original published form in scientific journals. One or two techniques appear to be missing (e.g. the iteration technique, and conversion to momentum space) but on the whole the selection is good.

In the present volume there are 206 pages devoted to one-electron problems, and only 63 to many-body problems. These 63 pages contain a good account of spin functions, but there is a good deal of technique which is useful in these many-body problems and which we must hope to see in the second volume.

This is a rather unusual book whose chief value seems to be in Departmental libraries and on the desk of a lecturer preparing a course of lectures and needing sound illustrative examples.

C. A. C.

Cationic Polymerization and Related Complexes. Ed., P. H. PLESCH. (Heffer, Cambridge, 1953.) Pp. vi + 166. Price 20s.

In March 1952 a conference was held at the University College of North Staffordshire on Cationic Polymerization and Related Complexes. The papers which were read at this conference, and the contributions to the discussion, have been collected together and are now published in this volume, with a foreword by Sir Eric K. Rideal, F.R.S., and a preface by Dr. P. H. Plesch.

The material is presented in two sections. Part I, to which Dr. D. D. Eley contributes an introduction and a summing-up, deals with the ability of metallic salts to form complexes. Experimental and theoretical research on the formation of such complexes with aromatic substances, with olefins, amines and oxygen-containing compounds is discussed by several workers in this field. Part II, to which Prof. F. S. Dainton contributes a summing-up, deals with the cationic polymerization of arylenes and alkenes.

In an appendix, Dr. G. Salomon gives a review of a Symposium on Carbonium Ion Reactions held at Leiden in March 1952, and a table containing the overall activation energies of some cationic polymerizations is also given. A detailed author and subject index is included.

This book will be of great value to those interested in cationic polymerization and Friedel-Crafts reactions. From the papers and from the discussion, the recent advances which have been made in the understanding of these reactions are clearly seen. The many aspects of this field on which clarification is still required are also made evident by a reading of this book, and because of this, it should prove to be a great stimulus to research work on this subject.

The papers and the contributions to the discussion are well arranged; the diagrams and formulae are clearly presented, and much credit goes to the editor, who organized the conference, for the fact that its proceedings have been published in so much detail. The book should be read by all who are interested in this field of work; it collects together new material which is not available in so compact a form elsewhere.

A. G. E.

Modern Mass Spectrometry. By G. P. BARNARD. (Institute of Physics, London, 1953.) Pp. 326. Price 50s.

The early researches on the mass analysis of rays of positive electricity by J. J. Thomson and F. W. Aston were followed by a division of the subject into two main fields of investigation. In one, the exact mass of the particles composing an ion beam was determined by focusing the beam on a photographic plate in a mass spectrograph. In the other, the relative currents carried by particles of different masses were determined by collecting separated ion beams. This latter field—that of mass spectrometry—has been largely developed in the U.S.A., and A. O. Nier in particular has made notable contributions.

Dr. Barnard has written a valuable manual for those engaged in using and constructing mass spectrometers. Approximately half his book discusses the theory, design, construction and operation of mass spectrometers of modern type. A part of this discussion is useful chiefly to workers with very good laboratory facilities. It seems to the reviewer, however, that for certain specific problems less elaborate research instruments are still of some value, and in fact Aston obtained quite accurate results with methods which are far from elegant by modern standards.

The remaining chapters discuss the application of the instrument to hydrocarbon analysis, studies of molecular structure, chemical kinetics, biochemistry, geology and nuclear chemistry. A particularly valuable feature of the book is a discussion of the errors in mass spectrometry, which draws on the previously

unpublished experiences of Barnard himself, and on those of J. Blears and his colleagues. It is becoming increasingly clear that the ratio of ion beams measured in an isotopic analysis is not precisely equal to the ratio of molecules originally ionized for various reasons, and furthermore for a mixture different mass spectra are not strictly additive, because the presence of one component can interfere with the mass spectrum of another component. Indeed, many phenomena are noted in the ordinary electron bombardment ion source which have not yet been explained. The effects caused by pyrolytic reactions on the electron-emitting filament, surface phenomena on the electrodes and space charge effects in the ion source remain to be fully explored.

Valuable references to about 500 papers are given. Appendices give a list of reviews on mass spectrometry, and advice on the establishment of a mass spectrometer laboratory.

A. J. B. R.

Wood Chemistry. By LOUIS E. WISE and EDWIN C. JAHN (Editors). American Chemical Society Monograph No. 97 (Reinhold Publishing Corporation, New York, U.S.A. (1952).) 2nd ed., 2 vols., pp. 1343. Price £6.

The first edition of this book, published in 1944, has deservedly come to be recognized as the standard work in English on this subject. This, the second edition, is to be welcomed in that it brings more nearly up to date a subject of rapidly expanding technological and scientific importance. The new edition has expanded the book from 900 to some 1300 pages and it is now divided into two volumes. As before, the chapters have been written by recognized experts in particular fields. The chapters have been slightly rearranged to give a more logical development of the whole, and have been grouped into seven main parts.

Part I, on the Growth, Anatomy and Physical Properties of Wood, and part II, on the Components and Chemistry of the Cell Wall, follow in the main the lines of the first edition, though many of the chapters are now fuller. Part III, on the Extraneous Substances in Wood, has been doubled in length and, instead of making a single chapter, it now comprises six, giving separate treatment to such subjects as the volatile oils, wood resins, tannins and colouring matters, and the phenolics of coniferous heartwoods.

The remaining four parts appear in volume 2. Part IV, on the Surface Properties of Cellulosic Materials, is again written by A. J. Stamm and includes fuller treatments than formerly of swelling, dimensional stability, hysteresis, and degree of crystallinity. It ably deals with advances in these and other subjects up to the year of publication. One may question the appropriateness of continuing to use "surface" in preference to "colloidal" properties in the title of the chapter. The extended surface is an inevitable result of colloidal dispersion, but it is the latter which is the root cause of many of the physical properties here discussed.

Part V, on Industrial Wood Chemistry, has been considerably revised and extended, and more space is allotted to the subject of de-lignification. The chapter, originally in this section, on Decomposition by Micro-organisms, is now given separate treatment in Part VI, by the late W. G. Campbell, much more attention being paid to beetle attack. This has the effect of drawing proper attention to the importance of wood-destroying agencies of all types. Part VII, on the Chemical Analysis of Wood, has been completely re-written and extended into seven chapters by B. L. Browning, with whom I. H. Isenberg co-operates. The book is completed by an index of some 50 pages, again by C. J. West.

The editors state in their introduction that "the purpose of the Monograph remains the same, i.e., to present a clear and coherent picture, interpreted from accumulated data, of the chemical nature and behaviour of wood and its various

components". In this they have again been remarkably successful though, in a book involving 22 authors, some differences in outlook and interpretation are inevitable and probably desirable. In the opinion of the reviewer, chapter 2 by H. P. Brown on the Origin and Anatomy of Wood, and Campbell's part VI on Decomposition, should serve as models of the clarity and conciseness required by scientists seeking enlightenment on new subjects. The short chapter by L. F. Hawley on Combustion, is also near perfection in these respects. With the exception of chapters such as these, the book is not for the beginner.

Though much new material has been added, little old matter has been expurgated and the editors might be well advised, in future editions, to consider the advisability of consolidating the treatment of such earlier work as is now no longer under serious dispute.

It is perhaps unfair for a physicist to level criticism at a work which is avowedly chemical in bias, but, if physics is to be included, it is disturbing to find (p. 133) that the relation between the "modulus of elasticity" (*sic*) and the modulus of shear is given by an equation which is quite inadmissible for materials so obviously anisotropic as wood and cellulose.

Chapter 3, on the Mechanical and Physical Properties of Wood, is disappointing, in that it deals at considerable length with the strength properties determined by standard testing, which are concerned almost entirely with rupture conditions, and overlooks the elastic and plastic properties of wood below this stress value. No mention is made of the recent work on these subjects, carried out in England and the U.S.A. during and since the war, which might be expected to be of more intrinsic value in linking up with the chemical structure and behaviour of wood, so fully reported in the other chapters. No literature references later than 1941 are given in this chapter. May we hope that the editors will see their way to producing a separate book on The Physics of Wood, where these and other important matters may be given the space and consideration they deserve?

The text is well printed, though on inferior paper, and the figures and tables are well displayed. The literature references now appear at the foot of the page to which they refer instead of at the end of each chapter, which makes for easier reading but, as a result, a general author index, referring to these pages, is badly needed. The quickest way of tracking down every mention of a particular subject in a diffuse book of this size, is to look up the names of the principal workers in the field, as no subject index is so perfect as to give one confidence that every allusion has been traced. For example, the present index makes reference to hysteresis only under "water vapour, sorption, hysteresis effects in, . . . 694" (which demands some perseverance to discover) although mention is made of this phenomenon on other pages.

These minor criticisms should not be taken as detracting from the great value of this book in its own field. It is to be expected that it will continue to serve its purpose in the future and to run into many more editions.

W. W. B.

Experimental Nucleonics. By E. BLEULER AND G. J. GOLDSMITH. (London: Sir Isaac Pitman and Sons, Ltd., 1952.) Pp. 393. Price 30s. net.

This volume represents a new departure in the literature on radioactive materials: it is a practical manual intended to accompany a laboratory course in nuclear research methods and tracer techniques, and is the outcome of a number of such courses which have been held in the past few years at Purdue University.

The authors have had well in mind the widely different fields from which prospective candidates for such courses can be expected to have proceeded. For this reason, the book is subdivided into an introduction and general section,

covering the health hazards of working with radioactive materials and the more elementary aspects of counting procedures, and two sections entitled Chemical and Physical Techniques respectively, which are of more interest to future specialists in the corresponding fields. This arrangement allows of considerable latitude in emphasis. The experimental work is obviously designed to be accompanied by a lecture course, and some knowledge of elementary nuclear physics is assumed. Most of the experiments involve readily available radioactive bodies, but a few are included which require accelerator-produced activities, as it is wisely felt that in those laboratories where these facilities are available the students should become familiar with them.

The purpose of the work having thus been made clear, it can be said at once that it is well thought-out and produced, and that the experimental approach adopted is rigorous without being pedantic. The experiments have of course been planned with current American equipment in mind, but this should not deter workers in other countries. The modifications necessary for the substitution of existing British apparatus, for example, would be straightforward.

The student is introduced early in the course to the appropriate statistical methods of evaluating his particle counting measurements. Similarly, he is soon told of the paramount importance of back-scattering, absorption, and dead-time corrections. A section on absolute counting of *beta*-emitters is added at this stage, presumably to emphasize these points, but no mention is made of modern techniques using 4π solid angle counters; while the experiment on the mean life of neutrons in water, introduced shortly afterwards, might have been better postponed to the end of the general section.

The section on chemical techniques is thorough, and includes separations by ion-exchange, solvent extraction, and electrochemical methods, as well as studies on Szilard-Chalmers processes and on the two isomeric states of ^{80}Br . The student is also introduced to the estimation of ^{14}C activity using an ionization chamber. The Physical Techniques section includes studies on range and energy-loss of *alpha*-particles, experiments with nuclear emulsions and scintillation counters, and examinations of the decay schemes of *beta*- and *gamma*-ray emitting nuclei by coincidence and other methods. A chapter on cosmic rays concludes the work.

The authors have endeavoured to familiarize the student with the various units to be found throughout the literature on radioactive materials by refraining from any standardization of form, as in expressing decay rates, for example. This principle, although worthy in itself, leads on occasions to a lack of rigour: in one chapter, for instance, the student is exhorted to calculate the mass of $\text{CaH}_2^{32}\text{PO}_4$ containing 1 mc of ^{32}P , and in the next he is told to prepare a solution containing about 100 mg of $\text{Na}_2^{35}\text{SO}_4$ of a given specific activity. No lengthy table of nuclear data is included, this being sensibly replaced by a folded Segré chart in a pocket in the cover: in the copy supplied for review, however, the chart ante-dated the remainder of the book by four years.

Despite the somewhat trivial faults mentioned, the authors are to be congratulated on the successful production of a pioneer type of work. There is little doubt that it will find useful application in the growing field of education in nuclear research methods, while the publishers have co-operated with them in providing a British edition at the attractive price of 30s.

N. M.