Reviews of Books

Advanced Inorganic Chemistry—A Comprehensive Text. By F. ALBERT COTTON and G. WILKINSON. (John Wiley and Sons, London and New York, 1962.) Pp. xv+959. Price 105s.

Although the modern approach to inorganic chemistry is now widely accepted, there has been, and still is, only a limited choice of comprehensive text-books on inorganic chemistry to recommend to students reading chemistry at a Part I degree standard. Few of those available are satisfactory and even these suffer from the lack of adequate discussion of the chemistry of the transition elements. The publication of a comprehensive text written from a contemporary viewpoint is therefore an event of some importance, especially when the authors can be rated amongst the foremost modern inorganic chemists.

The book is divided into three major parts. The first, covering general theory, occupies slightly more than 100 pages and deals, in a very clear and readable fashion, with atomic and molecular structure and the nature of bonding. Quite a lot of discussion that is usually included in a section of this type has been distributed around the other parts of the book. This is, psychologically, a most satisfying innovation since it brings the principles into close juxtaposition with the facts that best illustrate them. Part 2 is entitled, The Chemistry of the Non-transitional Elements, and devotes about 400 pages to the chemistry of the "*s*-block" and "*p*-block" elements. In this section the elements of the first row are discussed separately from their congenitors and the two parts are separated by a chapter on molecular stereochemistry in compounds of non-transitional elements. The rest of the book deals with the transitional, lanthanide and actinide elements and reflects, quite blatantly, the interests of the authors.

There is no doubt that this book over-emphasizes the transition elements at the expense of the rest and one would have liked to see the middle part providing a little more information. Nevertheless, this unbalance is one of the strengths of the book, since, although there are numerous sources of information about the chemistry of the "*s*" and "*p*-block" elements, no collective treatments of those of the "*d*" and "*f*-blocks" are available.

The proof reading could have been done more thoroughly and one hopes that many of the errors that crept in will have been put right in the second printing. Fig. 2-6 has been put in upside down and the structure for $C_{12}O_9$ contains only six carbon atoms. The authors also appear to be under the misconception that quinol is o-dihydroxobenzene, although the error is not carried over into the diagram of the pertinent clathrate, reprinted with permission from Palin and Powell.

The subject has been treated from the point of view of structure. The bringing together of macrochemical and molecular scale information has been done with great competence and the information supplied is as up-to-date as possible in a rapidly expanding subject. There is no doubt that this book is by far the best of its type that is available at the moment and will not be easily bettered. One hopes perhaps that, in the distant future, when much more information is available, the mechanistic aspects of inorganic chemistry will be given more prominence in a comprehensive text-book.

M. L. T.

Received 15*th March*, 1963

Handbuch der Physik—Encyclopedia of Physics Band 37/1: Atoms III—Molecules 1, Ed. S. FLÜGGE. 1959, Pp. vi+439. Price DM 120.

Band 37/2: Molecules II. (Springer-Verlag, Berlin-Göttingen-Heidelberg. Pp. vi+303. Price, DM 98.

These two volumes which are part of the series of volumes under the general heading Atoms, are almost wholly devoted to molecules. They must, however, be dealt with separately.

The first—and also the longest—article in volume 1 is by Kusch and Hughes on atomic and molecular beam spectroscopy. This seems to the reviewer to do all that such an article should do. It is clearly written, and traces the development of atomic and molecular beams up to their present position as a very effective and accurate tool for molecular dipole moment measurement, g-value determination and nuclear quadrupole study. Excellent diagrams and a comprehensive bibliography, together with just enough theory to make clear what is being done, make this a first-rate survey which deserves to be widely used.

This is followed by an article of 140 pages by H. H. Nielsen on molecular vibration-rotation spectra. Prof. Nielsen always writes with great distinction and economy; the present is no exception. In this account we are given a precis of the symbolic algebra of operators, then the derivation of the wave equation for rotation-vibration, and the associated matrix components and selection rules, with scarcely any reference to the detailed form of the various wave functions. Some excellent illustrative spectra round off a complete and convincing story.

The final article in volume 1 is a discussion of the collisions of electrons with molecules by Craggs and Massey. Prof. Massey has already written two other articles on scattering in atoms (vols. 35 and 36 in the *Handbuch*). As a result most of the basic theory could be omitted. It is shown how much more difficult molecular excitation and ionization processes are than corresponding atomic ones. Yet the analysis of fragments in a molecular beam spectrometer is of very great practical importance. Some of the particular examples described in this chapter show very clearly how great are the difficulties still to be overcome before any complete account can be given for any except the simplest (diatomic) molecules.

The second volume is rather shorter, and contains only two articles. But these two are remarkably different. The first, and longer, one is by Kotani, Ohno and Kayama, and deals with the electronic structure of small molecules. The second, by John Platt, bears the title The Chemical Bond and the Distribution of Electrons in Molecules; it is an essay on simplifying the more elaborate concepts and calculations of the first article.

The Japanese group of theoretical chemists have made many contributions to our knowledge of molecular structure. Their article is a sound, widely-based and very clearly set-out account of what can be done by solution of the wave equation. Almost everything that could be expected is to be found: the Born-Oppenheimer separation of nuclear and electronic motions, group theory, molecular-orbital and valence-bond theories, configuration interactions, atoms-in-molecules, semi-localized orbitals, overlap populations. It is a formidable story, with an emphasis more physical than chemical. Thus hybridization plays a minor role, and not very much is said about the valence state. In one or two places there seems a rather tedious amount of algebra, but this article, which starts right at the beginning, covers nearly all the ground one would wish to see, except topics like the Jahn-Teller effect, the Renner effect, n.m.r. and e.s.r., which are presumably to be found in other volumes of the *Handbuch*.

The situation is quite different with Platt's chapter. He is against calculations, protests about the " plague of non-observables " (such as a bond, hybridization, population analysis), and tries to see how far one can go with very simple models. So we have a full account of the free-electron model, and simple electrostatic calculations of bond lengths and frequencies. One feels that if only Isaac Newton had thought of the idea of a charge-cloud instead of point particles, and if the Hellmann-Feynman theorem had been proved (it is a pity that this follows from the wave equation!) we need never have heard the name of Schrödinger. But it is wonderful what can be achieved in this way, and as an original presentation, gathering up many ideas not often put together, this is a stimulating piece of work.

In their respective ways these two volumes admirably fulfil the functions for which the *Handbuch* is intended.

C. A. C.

Received 21*st March*, 1963

Reaction Heats and Bond Strengths. By C. T. MORTIMER. (Pergamon Press, Oxford, London, New York, Paris, 1962.) Pp. xii+230. Price 35s.

Many books on thermochemistry describe developments in the experimental methods and provide critical tables of data, but do little else. A welcome feature of the present volume is that the emphasis is on the interpretation and meaning of the thermochemical information it contains. Its plan is admirable. Successive chapters are concerned with: strain energies in saturated and unsaturated organic compounds; stabilization energies in non-aromatic compounds; strain and resonance energies in aromatic compounds; polymerization energies; molecular addition compounds; bond dissociation energies and heats of formation of free radicals; metal-carbon and metal-halogen bonds; ionization energies in aqueous solution; bond strengths in silicon, phosphorus and sulphur compounds.

In general, the treatment is balanced and informed but, in chap. 3, the approach of Dewar and Schmeising to the problem of the energy effects associated with hybridization changes might have received more attention. It is at least as plausible as that of Bloor and Gartside. The chapter on molecular addition compounds is an excellent survey of the present status of this important thermochemical field. It is no reflection on the author, but rather an illustration of the rapidity

with which new thermochemical data are accumulating, that the values quoted in chap. 7 for the formation heats of thioalkoxy radicals have already become obsolete.

The book is well produced and worth the money. There is a misprint on the third line of p. 46 and the preposition " of " is missing from the second last line of p. 37. There is a mis-statement on p. 12; lines 4, 5, 6 of the second paragraph should read " since the heat of combustion per CH_2 group is a measure of the strength of *one* carbon-carbon bond and two carbon hydrogen bonds "

H. M.

Received 25*th March*, 1963

Diffuse X-Ray Reflections from Crystals. By W. A. WOOSTER. (Clarendon Press: Oxford University Press, 1962.) Pp. xi+200. Price 35s.

Crystal structure analysis is based on the data provided by the discrete spots which appear on X-ray diffraction diagrams (Bragg-Laue reflections). The crystal structure so determined refers to the average position of the atoms, i.e., the positions they take up in an ideal static lattice. All departures from perfect order in crystals, such as thermal vibrations, static distortions of the lattice, or various types of imperfection in packing molecules, lead to diffuse X-ray scattering. This shows up as regions of blackening between the discrete reflections.

This book contains a general account of these phenomena. It describes the experimental methods of recording this diffuse scattering quantitatively, a field in which the author has himself been most active, and contains a useful account of the diffractometer designed by him. Moreover, there is a fairly detailed account of the methods of analyzing the scattering to determine such crystal properties as elastic spectra and the nature of the structural imperfections in a real crystal. This is the first book to be devoted solely to this field. It is clearly written and its appearance is therefore to be welcomed. The balance of the book reflects the author's own interests, which are chiefly those of the elastic properties of crystals. It is a pity, therefore, that the author confines himself strictly to X-ray diffraction, since elastic spectra of crystals can nowadays be obtained more directly (at least in principle) by neutron diffraction. But within its chosen limits the book is to be recommended to all those interested in the properties of *real* crystals. An attempt is made to keep the mathematics down to a minimum, but even so, the background assumed is rather large, so that it would not be suitable for beginners in the field. A most useful feature of the book is the extensive use of optical diffraction patterns to illustrate the effects described. These form a nice counterpart to the rather heavy, but essential, mathematical sections.

A. K.

Received 28*th March*, 1963

Chemistry of Extraction Processes. By V. V. FOMIN. Translated from the Russian text, Khimiya ekstraksionnykh protsessov, Moscow, 1960; by the Israel Program for Scientific Translations, and published for the National Science Foundation, Washington, D.C., in Jerusalem, 1962. Pp. 145. Price 60s.

At the present time one wonders whether much that is translated is worth the effort and expense involved. For once the reviewer feels that there is no doubt that the effort has been worth while. Notwithstanding the extensive studies made in recent years of the physical chemistry underlying the solvent extraction of compounds of the metals from aqueous solutions, the few English text books covering this topic approach the subject largely from the point of view of the analytical chemist. With the exception of one review, no attempt has been made at a systematic treatment of the physical chemistry of the processes. The translation of a Russian text treating the subject in this way is therefore especially welcome.

While considering the fundamental thermodynamics of the processes first, the author does not omit to analyze the molecular significance of the activity coefficients found in the various systems. The translation, although perhaps lacking any literary merit, generally makes the original author's ideas and intentions quite clear. As is invariably the case some re-translated references suffer curious transformations, Hosford, Ridberg and Moelwyn-Hyges are a little unfamiliar at first.

However, the book has been published as a paper back, at a relatively low price, not too long after the appearance of the original. These virtues, together with the importance of the contents make this book a welcome addition to the literature.

A. G. M.

Received 3*rd April*, 1963

Group Theory and its Application to Physical Problems. By M. HAMERMESH. (Pergamon Press, Oxford; Addison-Wesley Publishing Co. Inc., Reading, Mass., U.S.A., 1962.) Pp. xv+525. Price £5 5s.

This is a book that has been needed for a long time. A knowledge of group theory and its applications is a necessary part of the mathematical equipment of a theoretical chemist or theoretical physicist but few suitable books have been available to teach it. This book will undoubtedly become one of the standard reference books on the subject.

The author begins with some elementary chapters which lay the foundations of the subject and could be read profitably by anyone interested in the subject. Most of the text, however, demands considerable facility in handling abstract mathematics and some background knowledge of quantum mechanics. For the person with some experience of the subject this will, nevertheless, be an invaluable reference book both because of its unique coverage of the subject and because of its rigorous but lucid treatment of many complex problems. There are substantial chapters on the groups which are of greatest importance to quantum-mechanical applications including the point symmetry groups, the symmetric groups, continuous groups and linear groups. There are also sections on less familiar topics such as the magnetic symmetry groups, multiple-valued representations, projective representations, Lie algebras, Clebsch-Gordan coefficients, seniority and crystal field theory. The physical applications are integrated into the text and used to illustrate the theory as it is being developed.

G. G. H.

Received 3rd April, 1963

Mathematical Theory of Sedimentation Analysis. By H. FUGITA. (Academic Press, New York and London, 1962.) Pp. xii+315. Price 88s.

In 1923, Svedberg, working at the University of Wisconsin as a Visiting Professor, carried out fundamental work, with J. B. Nichols, on the construction of an ultracentrifuge equipped with optical means of observing sedimentation. Since that time many advances in ultracentrifuge design and performance have been accomplished and the various commercial forms of the instrument are now routinely applied to a wide range of problems involving macromolecules. For many years the classic *The Ultracentrifuge* by Svedberg and Pedersen provided adequate theoretical background, but with the expansion of the field and extension to new types of problem, complications and doubts became apparent and the need for more detailed theory became apparent. The present book provides such mathematical background and it is fitting that, to a very large extent it originated from the University of Wisconsin.

The author aimed at providing " the technical worker (physical and biophysical chemist) with an intermediate treatise on the mathematical theory of ultracentrifuge analysis ", but it is doubtful if his use of the word " intermediate " corresponds with the normal meaning. Though much of the book involves mathematics of a type familiar to Honours Science students, the author does not hesitate to plunge much deeper and quite frequently, a considerable amount of mathematical manipulation between the lines is to be understood. In short, no one in the field will find the book easy and many will find it very difficult. However, this is probably unavoidable, but even so, some of the real problems of ultracentrifugation are such that " it appears almost hopeless to overcome them with the aid of present mathematical techniques".

The book falls naturally into two parts concerned with Transport (I) and Equilibrium (II) respectively; the author's contributions in the former are already well-known and it is useful to have the substance of several important papers within the covers of a single book. The chapter on flow equations, dealt with in terms of thermodynamics of irreversible processes, is followed by a major chapter on Two-Component Systems, which deals with the various possible solutions of the Lamm differential equation and their applicability. Although account has been taken of the variation of sedimentation coefficient with concentration, it has not yet been possible to deal also with a concentration-dependent diffusion coefficient. The extension of theory to multicomponent and to reacting systems is dealt with in two further chapters. Part II, though shorter than part I, provides a comprehensive treatment of sedimentation-diffusion equilibrium and of the approach to equilibrium, for systems of varying degree of complexity.

The book is clear, well-written and provides just enough description of experimental matters to illustrate the application of the mathematical relations. Illustrations are few, but well-chosen. Few mistakes remain. Undoubtedly, this book is fundamental to ultracentrifugation and it will remain so for a considerable period. However, its price as well as its mathematical content will restrict its sale.

P. J.

Received 8th April, 1963

Fifty Years of X-ray Diffraction. Edited by P. P. EWALD. (A. Oosthoek Publishing Co., Utrecht, Holland, 1962.) Pp. ix+720. Price D.Fl. 40.00 (£4).

This delightful book, which is dedicated to the International Union of Crystallography on the occasion of a commemoration meeting in Munich, July 1962, to celebrate the fiftieth anniversary of X-ray diffraction, is a record of the reminiscences of those who have contributed to the theory and application of X-ray Diffraction since its discovery by Von Laue in 1912. Paul Ewald is the editor of the book and quite fittingly, in light of his own significant contributions to the discovery of X-ray diffraction and to its subsequent development and consolidation as a subject, he has contributed some 147 of its 715 pages.

It must have been difficult arranging the material of such wide scope from so many contributors in a subject that has expanded beyond all recognition in these five decades but Ewald has done this extremely well, keeping an unobtrusive sense of the flow of time throughout the volume. Far from being just an historical treatise he has given the book a personal and human touch and the many personal anecdotes in it make it as absorbing reading as the more erudite chapters on X-ray crystallography itself.

The book is divided into eight sections, in which sections I-IV, comprising 16 chapters, deal with the early history and background that led to the discovery of X-ray diffraction, the immediate sequel resulting in the early triumphs of the Braggs, father and son, in their analysis of crystal structures, the subsequent almost inevitable division of the subject into its various fields, inorganic, organic, metallurgical, mineral and biomolecular. Then follows a brief but concise description of the dynamical theory of X-ray diffraction and ending with a chapter on the complementary discipline of X-ray spectroscopy. The authors in this section are Ewald himself, with excellent articles on the theory of X-ray diffraction, Bragg summarizing almost a lifetime's work, Linus Pauling not often so widely known as a crystallographer, although second to none, J. M. Robertson, F. Laves, W. Hume-Rothery, Dame Kathleen Lonsdale and Manne Seigbohm. Here is a wealth of material, so lucidly described that some chapters could almost be models for textbooks.

The remaining four sections have the following headings: V In Memoriam, VI Schools and Regional Developments, VII Personal Reminiscences and VIII The Consolidation of the New Crystallography. The emphasis here is more on the personal and sometimes lighthearted aspects of those who have played, or are still playing, their parts in the development of X-ray crystallography. There are references to the efforts being made in various parts of the world to extend this knowledge by teaching and research, showing how widely indeed has Von Laue's discovery been appreciated. It is the last but one section, however, that gives the book its warm touch. Here we find in the personal reminiscences the human failings, foibles, likes and dislikes of some of those who have made the subject what it is today. For light or bedside reading, this is indeed both the most entertaining and enlightening part of the book. Notable contributors here are Bernal, Belov, Bijvoet, Bunn, Bragg, Patterson, Wyart, Wooster, Wyckoff to name but a few.

The last section is a description by Ewald of the successive steps that have led to the formation of the International Union of Crystallography in 1947 which has since then held five successful triennial Congresses; in Harvard, U.S.A. 1948, Stockholm 1951, Paris 1954, Montreal 1957, Cambridge 1960. The next, 1963, is to be in Rome. The first was attended by 310 members, the fifth by 1250. Perhaps a better description of its growth is in the official membership list which now totals over 3500 compared with the forty or more that used X-ray diffraction before the first World War. So much for the expansion of a subject that was started on a suggestion made by Von Laue and so ably carried out by his assistants Friederich and Knipping in 1912. It is a thousand pities that Von Laue did not live to see the latest achievement of X-ray crystallography, the first unravelling of the structures of some protein and virus molecules that led in 1962 to the award of Nobel prizes to five X-ray crystallographers, bringing the total to nine prize-winners in this field since 1912. What a triumph for a discipline that is sometimes disparagingly referred to as a " technique "!

It would be difficult for any reviewer not to find fault with a book of this scope and magnitude. That there are some is undoubtedly true, but taken against the background and the message that the book is meant to convey to the present and coming generation of crystallographers, and other scientists interested in the field, these faults and perhaps some minor omissions pale into insignificance. The point is that the book reveals both the growth of the subject and its techniques that still know no boundaries and a vivid description of the international fellowships, friendships and co-operations that have led to such striking results wherever the discipline has been applied. It is a readable book from start to finish for all those interested in the subject and for the wealth of material it contains it is not an expensive one to add to one's library.

C. H. C.

Received 8th April, 1963

Metallurgy of Elemental and Compound Semiconductors. Edited by RALPH O. GRUBEL. (Interscience Publishers, New York, London, 1961.) Pp. 494. Price $13.00 (98s.)

The present volume contains thirty papers presented at a specialized semiconductor conference held during August 1960, with verbatim discussion remarks included after each paper. The general tone of the volume is technological rather than fundamental, though those papers which show signs of careful preparation manage to strike a useful balance in this respect. Two or three papers, however, are merely hastily prepared, uncritical accounts of ill-evaluated data obtained on apparatus of unoriginal design described at length. They spoil the whole book.

An Esaki-diode is formed at the junction of degenerate *p*-type and degenerate *n*-type semiconducting material provided it is sufficiently narrow for tunnelling to occur. Such diodes are of great interest because they exhibit a region of negative resistance in the forward region. The material requirements of these diodes are discussed, and methods of preparation and characterization are described in the first seven papers. The next group of seven papers, dealing with the growth of dendritic germanium, takes one via a lucid description of the fundamentals of the art, through some special cases of solute segregation in highly doped dendrites to one of the most valuable papers in the volume—the role of surface tension during the growth of single crystals of controlled dimensions from an inductivity heated melt.

The next four papers discuss the growth of silicon and germanium single crystal layers by pyrolysis of volatile compounds such as the iodides, and the fourth section contains five papers on the growth and properties of doped III-V compounds. Section V is notable for papers on the preparation of pure boron filaments and two forms of silicon carbide, and the volume concludes with an X-ray investigation of the perfection of silicon.

The value of this volume to physical chemists lies in the wealth of practical hints and tips it contains. The solid-state physics content is quite high.

D. A. Y.

Received 9th April, 1963

Advances in X-ray diffractometry and X-ray spectography. Ed. W. PARRISH. (Eindhoven, Centrex Publishing Company. London, Cleaver-Hume Press Ltd., 1962.) Pp. xv+233. Price 21s.

During the past five years or so, the techniques of X-ray diffractometry and X-ray spectrography have improved in a spectacular way. A crystallographic analysis of the molecular structures of proteins and other macromolecules would now hardly be contemplated without the availability of an automatic or semi-automatic diffractometer, the designs of which, together with computational methods, preoccupy a large number of workers. The present volume reflects some of the progress which has been made in diffractometry, being a collection of papers written by members of the staff of the North American Philips laboratories. Ostensibly, it was designed for use in X-ray schools and claims to " provide the reader with a rather broad background in modern X-ray counter tube methods ". Some crystallographers may find this claim somewhat pretentious, little or no specific discussion being made to the particular problems of single-crystal diffractometry. There is an unreasonable amount of repetition of subject matter, the volume illustrating well the inherent dangers to any author of having his reprints collected together under one cover.

A particularly useful feature of the book is the collection of tables of such data as absorption coefficients, quantum counting efficiencies of counter tubes and X-ray spectra. The price is more than reasonable.

R. M.

Received 10th April, 1963

Advances in Chemical Physics, Vol. 4. Ed. by I. PRIGOGINE. (Interscience Publishers, New York and London, 1962.) Pp. ix+400. Price 124s.

Vol. 4 of this young, but already well-known, series contains seven articles. Two are on theoretical aspects of optical activity, one is on the effects of high pressures on the spectra of solids, one on metal-ammonia solutions and three on statistical mechanics.

Moscowitz has written lucidly, and simply enough for most experimentalists who use the technique, on the theory of the optical activity of small molecules. Tinoco has dealt with polymer chains, and urges spectroscopists and theoretical chemists and physicists to tackle the problems in this field. An extended form of Kirkwood's polarizability theory is used to calculate the optical

rotation of aligned rigid polymers; the approximations and steps in the calculation are very carefully explained.

Drickamer and Zahner have described the important work done at the University of Illinois on the effect of pressure on the electronic absorption spectra of solids. They paid particular attention to the spectra of rare earth and transition metal ions and Tl^+ in alkali halide lattices.

Das has discussed the properties and theories of solutions of alkali and alkaline-earth metals in liquid ammonia. He believes that the data can be explained in terms of a " unified " model in which single electrons may be found in cavities that are independent of the ammoniated cations or clustered around the ions.

Ree, Ree, Ree and Eyring have contributed an interesting, though sophisticated, article on the random walk problem and its relation to non-equilibrium rate processes. In a short article entitled 'The One-dimensional Plasma', Prager evaluated the partition function of the very simple, though fictitious, system of ions on a line interacting through long-range Coulomb forces only. Friedmann has written 78 pages on quantum effects on some equilibrium thermodynamic functions of fluids.

There are good author and subject indices to the entire volume. The book will be valuable to many chemists, but the price is so high (it might have been significantly lower had a cheaper paper been used) that few would be expected to buy their own copies, and this is a pity.

A. D. B.

Received 30*th April*, 1963

Theory and Applications of Ultraviolet Spectroscopy. By H. H. JAFFÉ and MILTON ORCHIN. (John Wiley and Sons, Inc., New York and London, 1962.) Pp. xv+624. Price 113s.

There has been a dearth of good books on the interpretation of ultra-violet spectra of polyatomic molecules. A new book whose purpose is stated to be " to facilitate an understanding of electronic absorption spectra " is therefore opened with interest. A glance at the contents pages shows the scope to be enormous. After an introductory chapter on the general nature of light absorption and its measurement, come chapters on various theoretical matters such as atomic orbitals, molecular orbitals, symmetry considerations, intensities of transitions and comparison of the molecular orbital and valence-bond theories. Then come chapters on the spectra of particular classes of organic compounds. A chapter is devoted to the free-electron model for the interpretation of the spectra of polyenes, and another to molecules in which twisting is important. The rest of the book is occupied by chapters on ligand field theory, on fluorescence and phosphorescence, and on spectroscopy applied to quantitative analysis.

With such a vast scope it is hardly surprising that some matters are treated less well than others. The weakest part of the book is that dealing with small (i.e., triatomic, tetratomic) molecules. Errors are frequent here. Thus, on pp. 151-2 the $^1A_2$ state of H_2CO is stated to be planar; but it has been one of the triumphs of theory that experiment has shown this state to be pyramidal as predicted. No mention is made of the importance in some small molecules of inversion effects. The Renner effect receives no mention. On p. 154, Ingold and King are said " to have investigated the geometries of several small organic molecules ", but the series of papers cited deals only with acetylene. The name of Dr. Ramsay is misspelt in 6 places on pp. 451-2. The ascription of the longest wavelength absorption system of HCO to $^2\Sigma^+ \leftarrow {}^2A''$ is out-of-date and fundamentally opposed to theoretical expectations; the correct assignment is to $^2\Sigma^- \leftarrow {}^2A'$. On p. 452, CF_2 is stated to be a linear molecule; but this is not the conclusion reached in the papers cited. A preliminary paper dealing with the spectrum of NCO is mentioned, but the major paper on the subject—published early in 1960—is not cited. NH_2 and PH_2 receive a mention (oddly under the heading Organic . . . Free Radicals), but small inorganic molecules, free radicals and ions (e.g., NH_3, PH_3, NO_2, NO_2^-, HNO, ClO_2) in general form a noticeable omission.

One has a feeling that the authors are happiest when dealing with large, rather than small, molecules. One suspects this at the outset of their book, when in the introductory chapter under Instruments they cite only a spectrophotometer incorporating a photo-cell for detecting and measuring spectra; and not surprisingly their book has nothing to say about high-resolution work and rotational analysis which have played such a big part in the interpretation of triatomic and tetratomic molecular spectra.

Nevertheless, the basic theory given in the book is in general soundly presented and the reviewer found much that was stimulating. The book could be recommended to post-graduate students for selective reading.

A. D. W.

Received 1*st May*, 1963