BOOK REVIEWS

Inorganic Chemistry. By R. B. HESLOP, Lecturer in Chemistry, The Manchester College of Science and Technology, and P. L. ROBINSON, Emeritus Professor in the University of Durham. Elsevier Publishing Company, 52 Vanderbilt Avenue, New York 17, N. Y. 1963. Second Edition. 14.5 × 22 cm. VIII + 591 pp. Price, $9.00.

This book, like most textbooks of inorganic chemistry, has two main parts. The first part, 210 pages, is devoted to the theory and the physical chemistry of inorganic chemistry. This includes discussions of the atomic nucleus, radiochemistry, electronic structure of atoms, valency, shapes of molecules, the solid state, thermodynamics, kinetics, and acids and bases. The second part deals with the descriptive factual chemistry of the elements and their compounds. The authors have used good judgment in the selection of examples to illustrate the chemical and physical properties of the elements and their compounds.

Readers familiar with the first edition of this book will find little change in the second edition. The authors attribute having made no gross changes to the fact that the first edition required four printings and had met with general approval. The only major additions are a brief description of phosphonitrilic compounds, a section on complexes in aqueous solution, and a short chapter on inorganic polymers. It is claimed that, in other parts, modifications were made to bring the treatment into line with the results of recent research.

Unfortunately this claim of revision to keep step with recent research results is not fulfilled. Full advantage was not taken of the opportunity to markedly improve the book. Readers (including students) will be most surprised to find no mention of the fluorides and oxides of xenon in the chapter on inert gases. The chapter on hydrides would be improved if it contained a brief discussion of hydride ion as a ligand in metal complexes and at least mention of the carboranes.

The treatment of the chemistry of metal complexes leaves much to be desired. The chief criticism is that the current bonding theories have not been used sufficiently to account for the properties of these systems. There is a brief description of the crystal field theory and mention is made of the ligand field and molecular orbital theories. Unfortunately very little use is made of these theories in the chapter on coordination compounds. The only mention made to the mechanism of substitution reactions of metal complexes is that of the reaction of *l-cis*-$[Co(en)_2Cl_2]^+$ in methanol solution with various reagents. The interpretation given to the data of Fig. 286 is wrong (*J. Am. Chem. Soc.*, **79**, 5382 (1957)). The statement on page 552 that $[Fe(phen)_3]^{3+}$ is a high-spin complex is incorrect as are also the formulas $Ru_2(CO)_9$ and $Os_2(CO)_9$ on page 301 (*J. Am. Chem. Soc.*, **83**, 2203 (1961)).

The book is well written, the printing and paper are good, and the illustrations are satisfactory. There are relatively few typographical errors and none of these is too serious. The authors have succeeded in their expressed purpose that "this book is addressed to students and intended to provide in a single small volume an outline of current inorganic chemistry sufficient for basic reading up to honours degree standard." Translated to our language, this is a textbook of inorganic chemistry suitable for a course at the undergraduate level.

THE DEPARTMENT OF CHEMISTRY FRED BASOLO
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Infrared Absorption Spectroscopy. By KOJI NAKANISHI. Holden-Day, Inc., Publishers, 728 Montgomery St., San Francisco 11, Calif. 1962. 19 × 26 cm. 223 pp. Price $8.00.

This book was originally published in Japan in 1960, and was made available in the English edition through the suggestion of Dr. C. Djerassi.

The sole and important purpose of the author is to teach students how to interpret infrared spectra of organic molecules.

A student who studies the contents of the book will gain an excellent proficiency in the interpretation of the spectra of organic molecules. The reviewer, who serves on the staff of various summer infrared institutes, found universal acclaim of the book by the students who used it.

The author has divided the book into four sections entitled, Qualitative Data, Problems, Answers, and Appendices.

In the Qualitative Data section he includes a very brief introduction to the theory of infrared absorption. Several paragraphs are used to discuss prism-window materials, instrumentation, and useful solvents. A chart showing the regions of usefulness for 34 solvents is included. A summary chart of positions of characteristic frequencies is given.

The rest of the qualitative section is composed of tables and discussions concerned with the spectral position, intensity, and assignment of the various absorbers found in alkanes, alkenes, aromatics, $x = y$, $x = y = z$, alcohols, and phenols, hydroxyl, ethers, amines, carbonyl, nitro, nitroso, nitriles, heterocyclics, sulfur, halogen, and inorganic groups. A chapter discusses the shift of absorption band frequencies under several conditions.

The Problems section shows 85 spectra which are to be studied. Each problem is designed to illustrate a definite point. For instance, problem 7 shows three spectra which are to be correlated with the *o*-, *m*-, and *p*-xylenes. In most cases empirical formulas are included to aid in the interpretation.

The Answers section repeats each problem with the reasons for the assignments given by the author. The discussion of these is of great value. The absence of specific absorption, which often is as valuable as the presence, is often noted.

The Appendix contains some n.m.r. data on chemical shifts, spin–spin coupling constants, and the dependence of J on the dihedral angle. A Wave-number/Wavelength Conversion Table is included. There are general subject and compound indexes. There are many references throughout the book.

The title word "Practical" may be misleading. This word to this reviewer, a practicing infrared spectroscopist, denotes the interpretation of the spectra of articles of commerce such as plastics, elastomers, greases, adhesives, paints, packaging materials, etc. There is nothing concerning these in the book. There is also very little concerning the sample preparation necessary to obtain infrared spectra. This is very practical.

It also was found, during the summer institutes, that the book does not contain the spectrum of a single inorganic substance.

The book is definitely directed toward teaching the organic chemist the interpretation of the infrared spectra of pure compounds. This it does admirably and consequently should be in the library of every chemist using infrared spectroscopy.

RIDGEFIELD, CONNECTICUT ROBERT C. GORE

Technique of Organic Chemistry. Volume VIII, Part II. **Investigation of Rates and Mechanisms of Reactions.** S. L. FRIESS, E. S. LEWIS, and A. WEISSBERGER, Editors. John Wiley and Sons, Inc., 605 Third Ave., New York 16, N. Y. 1963. 15.5 × 23.5 cm. xii + 879 pp. Price, $30.00.

Chemists will welcome this new volume of the well known "Technique of Organic Chemistry" series. This second edition contains a considerable amount of new material, much of which is not available elsewhere. Roughly the first half of this book is concerned with methods for studying fast reactions in solution, while the second half describes more familiar methods of dealing with reaction rates and mechanisms. Because of the many authors and the heterogeneity of the material covered, a brief review of the individual chapters will be given.

The first chapter (Chapter XIV in this volume) is entitled "Rapid Reactions" and is authored by F. J. W. Roughton and B. Chance. This chapter describes rapid mixing (flow) techniques and is an up-to-date version of the same subject treated in the earlier edition. The discussion is quite complete from an experimental and theoretical point of view and will be useful to anyone wishing to employ these methods. Following this is a series of new chapters introduced by M. Eigen concerned with very fast reactions in solution. "Electrochemical Methods" by H. Strehlow is lucidly written and from a practical kineticist's viewpoint is probably the most useful and critical presentation of this material to be found. The next chapter on "Photostationary Methods," by R. M. Noyes and A. Weller, is a good exposition of the rather special photolysis and fluorescence techniques which have been so successfully employed by the authors. "Magnetic Resonance Methods" by H. Strehlow is a good introduction into the techniques and methods involved. The chapter on "Relaxation Methods" by M. Eigen and L. de Maeyer is considerably longer than other presentations (almost 200 pp.). This length is justified by the fact that a unified treatment of these new important methods is not available elsewhere. Even so, the discourse is compactly written and the novice will find this difficult, but rewarding, reading. Included are the theory and experimental aspects of relaxation techniques, and some experimental results. "Flash Photolysis" by G. Porter is an extremely clear and complete exposition of the method and will be of value to anyone interested in doing flash photolysis experiments. The next two chapters are complementary and together provide a good sum-

mary of some interesting types of solution reactions. "Determination of Active Intermediates in Reactions" by G. M. Burnett and Sir H. H. Melville is concerned almost exclusively with chain (free-radical) reactions. "Polymerization and Polymer Reactions" by G. M. Burnett provides a résumé of the various aspects of polymerization and degradation reactions. Chapter XXII is entitled "Enzymic Reactions." Part 1 by F. M. Heunnekens is mainly concerned with steady-state methods. The material is clearly presented, but is unfortunately somewhat incomplete and out-of-date. Part 2 by B. Chance is essentially an exposé of the author's interesting transient-state studies with rapid mixing devices of catalase and peroxidases.

The last section in this book contains a description of some nonkinetic methods of elucidating reaction mechanisms. "Thermodynamics and Reaction Mechanisms" by M. M. Kreevoy has virtually nothing to do with thermodynamics, unless one considers, as the author does, that transition-state theory is thermodynamics. A formal derivation of the usual equations is given, and the results are discussed in terms of mechanistic implications. The following four chapters, "The Product Criterion of Mechanism" by E. S. Lewis and C. E. Boozer, "Evidence for the Formation of Intermediates in Organic Chemical Reactions" by M. L. Bender, "Use of Isotopes and Tagged Groups" by W. H. Saunders, Jr., and "Sterochemistry and Mechanism of Reactions" by S. L. Friess present different, but related, methods of elucidating organic mechanisms. All are well written and instructive. Of particular note is the general chapter by M. L. Bender.

Taken as a whole, this book would be a valuable asset to the book shelf of any person interested in kinetics and reaction mechanisms. Unfortunately, when this opinion is tempered with the price of this volume, one would perhaps be more prudent to recommend it as interesting library reading.

DEPARTMENT OF CHEMISTRY GORDON G. HAMMES
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Chemical Applications of Group Theory. By F. ALBERT COTTON, Department of Chemistry, Massachusetts Institute of Technology. John Wiley and Sons, Inc., Interscience Division, 605 Third Ave., New York 16, N. Y. 1963. 23.5 × 15.5 cm. 295 pp. Price, $12.50.

More than 30 years ago, Wigner, Weyl, Wilson, Bethe, and others showed that group theory is useful in the study of certain quantum mechanical problems. At that time, some chemists and physicists were disturbed by what appeared to be excessive formalism in the mathematics involved, and symmetry arguments were often avoided. In recent years, they have been used freely, especially by chemists. The simple methods and rewarding results have made group theory almost routine in many kinds of problems. Without its use, our present knowledge of the polyatomic molecule and the solid would probably be meager indeed. Unfortunately, some still believe the subject to be difficult and hard to understand. Nothing could be more untrue for it can be easily understood by those with only a modest amount of mathematical prerequisite. This book will help to dispel such ill-founded fears.

Let us first ask why the chemist should know something about group theory. Unless one is satisfied with the few systems that can be solved exactly by quantum mechanics, the only present alternatives appear to be intuitive, qualitative approximations or lengthy, laborious, numerical calculations. To its devotees, group theory seems to be the magic panacea, for it derives many exact answers with the simplest kinds of manipulations. It may be very difficult, for example, to evaluate the integrals which determine the infrared or Raman activity of certain spectral lines. By symmetry arguments alone, however, one may predict with confidence that such integrals do or do not vanish and thus the selection principles are known. As a second example, we note that secular determinants occur in many problems. Solving them can be a formidable task even for simple cases, but symmetry again may be used to factor the problem into smaller and more manageable determinants.

The physical chemist must now ask himself a question. If he is interested in theory and expects to contribute in that field, he should begin a serious study of group theory along with other mathematical techniques which he will need. This book will be of little help to him. On the other hand, if he wants to understand the results of others and to apply group theory methods to his own problems, his task is relatively simple. He will find it much easier to learn what he needs than he did to get a working knowledge of calculus. The present book is designed for such students and it will be of great help to them.

Written as a text for seniors or first-year graduate students, the basic principles are presented in the first part of 86 pages. Its five chapters include discussion of formal definitions and theorems, a detailed and understandable description of molecular symmetry and symmetry groups, and a less satisfactory consideration of group representations and what they mean in quantum mechanics. Here, as elsewhere, the serious reader will want to consult other sources. The author himself admits his lack of mathematical elegance and rigor, he is often verbose, and he sometimes omits proofs, especially when the going gets rough. Nevertheless, most of the necessary material is present and it is always easy to follow.

When the reader feels comfortable with this part of the book, he will be ready for the more exciting second part. Its four chapters discuss the construction of hybrid orbitals, molecular orbital theory, ligand field theory, and molecular vibrations. In each case, the examples are well chosen, beginning with simple ones and progressing to more complicated cases so that the reader should be able to envisage the variety of problems that can be attacked. In view of current interests, it is regretted that color groups and others used in studying the solid state are omitted. A separately bound table of group characters, together with the customary auxiliary information, has been thoughtfully provided as an appendix. Additional material appended is so trivial that one wonders why it was included.

With the reservations noted, this book is recommended to the class of readers for which it was intended. If some are bored with the many intermediate steps given, others will thank the author for the lack of remarks such as "it is obvious that . . . ."

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