Book Reviews

Molecular Vibrations. The theory of infrared and Raman vibrational spectra. E. Bright Wilson, Jr., J. C. Decius, and Paul C. Cross. McGraw-Hill, New York–London, 1955. xi + 371 pp. Illus. $8.50.

The book on molecular vibrations by Wilson, Decius, and Cross has been awaited with keen interest by molecular spectroscopists throughout the world. The fundamental contributions that the authors have made to this subject led us to expect a presentation of unique qualities, and we are not disappointed in this expectation.

Up to the present time, there has been no detailed and comprehensive presentation available of the theory of molecular vibrations, of the methods of solution of the secular equations and the applications of this theory to an understanding of infrared and Raman vibration spectra. Such a presentation is provided by the authors in the present book.

The central problem discussed in this book is the derivation of the normal vibrations of a polyatomic molecule. The theory is developed with mathematical rigor and elegance. Starting from the simplest cases step by step, more and more complicated and general cases are dealt with. The powerful tools of group theory and matrix algebra are introduced, explained, and used in the derivations. This is a difficult subject to explain to the student. The authors have been notably successful in arriving at a satisfying presentation that is as readable as one can expect for such a complex subject. However, by the very nature of the subject, the book, particularly in the later parts, is not easy to read.

In addition to the solution of the vibration problem (both in classical mechanics and wave mechanics), the book gives derivations of selection rules, discussions of the anharmonic terms in the potential energy, the isotope effect, Fermi resonance, and the problem of several equilibrium positions. With regard to some of these items, particularly the anharmonic terms, one might have wished for more detail. The theorems derived in the book are illustrated in Chapter 10 by a detailed discussion of their application to the benzene molecule.

The main part of the text is supplemented by 16 appendixes, which present such things as character and correlation tables of the point groups, proofs of certain theorems, and, in the last appendix, a brief treatment of rotation and rotational selection rules.

All those interested in the fundamentals of molecular spectroscopy and all those who want to carry out calculations of force constants and potential functions from observed vibrational frequencies should turn to this book for guidance. They will find in it an authoritative and complete presentation written on a very high level.

G. Herzberg

Division of Pure Physics, National Research Council, Canada

Numerical Methods. Andrew D. Booth. Academic Press, New York; Butterworths, London, 1955. vii + 195 pp. Illus. $6.

This new book on numerical analysis is based on a series of lectures given by the author at Birbeck College, London. Although it approaches its subject from the point of view of a person interested in learning the art and science of programming for an automatic digital computer, classical material is presented on virtually all the subjects treated. The book is peppered with "cautions and precautions," desirable warnings to students who have not experienced the hazards implicit in letting the machine obey orders that have not been thoroughly and carefully and explicitly formulated or follow computational designs that ignore some of the more elusive hypotheses necessary for the validity of the theorem.

The book is rather more ambitious in its coverage than most recent books on the subject, including treatments of the nature and purpose of numerical analysis, tabulations and differences, interpolation, numerical differentiation and integration, summation of series, ordinary and partial differential equations as well as integral equations, linear and nonlinear algebraic equations, approximating functions, and Fourier synthesis and analysis. Although the initial chapter devotes less than two pages to a discussion of precision, accuracy, and errors, there is a treatment of error estimates for most of the methods presented; and there is constant concern for methods of checking solutions.

The topics listed here cannot convey the wealth of detail covered. For example, the chapter on partial differential equations devotes only 31 pages to a set of topics including the classification of partial differential equations, methods for the numerical solution of parabolic and hyperbolic equations in two and in more than two variables, the method of characteristics, multipoint boundary conditions and elliptic partial differential equations, practical aspects of the relaxation method, Monte Carlo methods, and "more complicated" partial differential equations. This extraordinarily compact coverage is achieved partly by simplification and generalization from the classical treatment but largely by handling only the salient features of the problem and expecting the reader to seek fuller information from the bibliography (which is given for each chapter as well as for the book as a whole).

The detailed chapter bibliographies should prove very helpful. The author's objective is to present only the mathematical basis of his subject. He presents essentially a guide to numerical analysis, including detailed computation only in the chapter on simultaneous linear equations where the purpose is to illustrate the sort of behavior that may be expected in a calculation "rather than any detailed form of layout."

If there are some subjects (such as the rather specially oriented chapter on Fourier synthesis and analysis) that seem to be included more because the author is expert in the subject than because of their general importance, and if there are lapses from the most complete scholarly precision, such as the reference to Monte Carlo methods as methods that make use of the theory of games, the reader can forgive the author; for the book provides a useful and stimulating guide to a subject that has changed so rapidly during the past decade that the potential user of high-speed machines is sorely in need of informed and understanding help in finding his way through the maze of new literature on the subject.

Mina Rees

Hunter College

Electrons, Atoms, Metals and Alloys. William Hume-Rothery. Philosophical Library, New York; Iliffe & Sons, London, ed. 2, 1955. 387 pp. Illus. $10.

This is an excellent book, which aims at giving a qualitative understanding of the cohesion and the electronic properties of solids, particularly of metals and alloys. The book consists of a dialog be-