

Chemical Technology

Infra-Red Spectroscopy and Molecular Structure. An outline of the principles. Mansel Davies, Ed. Elsevier, New York, 1963. xiv + 468 pp. Illus. \$13.50.

In this compilation Mansel Davies, the editor, has attempted to provide an introduction to infrared spectroscopy and to present recent developments in the field. In many respects, he has achieved this difficult goal. Theoretical aspects are lucidly presented in a well-written introductory survey. The chapters on instrumentation and general experimental methods, the infrared spectra of simple molecules, force constant calculations for small molecules, and raman spectroscopy will serve as valuable references for those who are beginning their infrared studies. The detailed examples of force constant calculations have a similar utility. The other chapters, which are concerned with recent advances in several areas, present outstanding and detailed interpretations of the topics considered and, in effect, are complete monographs in themselves. The topics so considered are low-frequency infrared spectroscopy, characteristic features in the spectra of organic molecules, infrared spectra of solids (dichroism and polymers), inorganic applications of infrared spectroscopy, quantitative intensity studies and dipole moment derivatives, the methods and results of dispersion studies, hydrogen bonding, and solvent effects.

The volume suffers from the plight prevalent in many multiauthored books—a great deal of redundancy, an inconsistent format (for example, in some chapters the equations are not numbered), too few cross references, and the use of different assumptions by the authors (for example, the validity of Lorentzian line shapes).

Despite these editorial deficiencies, the contents make this book a valuable text for one engaged in infrared spectroscopy. Particularly noteworthy chapters are those by Krimm on the infrared spectra of solids and dichroism and polymers, and by Fahrenfort on the methods and results of dispersion studies. These two chapters, which present the first comprehensive discussion of these subjects in book form, will be received with enthusiasm by the scientific community.

The only major disappointment is the inferior chapter (18 pages) on in-

frared emission spectra. The abundant recent developments in the field of solid and gas infrared emission are not presented, and discussion of measurement techniques and methodology is totally ignored. Among the papers cited, the only recent ones were published in 1961 (two papers), and Coblenz's pioneering work (1909) is not discussed at all. These deficiencies severely limit the usefulness of this chapter.

In spite of the shortcomings described here, the net appraisal is that this volume is a valuable source of information for those interested in most areas of infrared spectroscopy.

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Botany

Flora of Missouri. Julian A. Steyermark. Iowa State University Press, Ames, 1963. lxxxiii + 1725 pp. Illus. \$18.50.

To date, Julian A. Steyermark's *Flora of Missouri* is certainly the most voluminous of the state floras. In this work, of 1725 double-column pages, Steyermark considers more than 2400 species of vascular plants that grow wild in Missouri. The author has devoted more than 30 years to the exploration and classification of the vegetation of Missouri, and this presentation of the results of his study will be of incalculable value to those interested in the plants of Missouri.

The introductory section contains an historical sketch, general remarks concerned with the use of the book, and a 10-page treatment entitled "Flora and vegetation." This is followed by a 50-page key to the families.

The main body of the work provides keys to the subdivisions within the families. After the genus is reached, additional keys lead to species, varieties, and forms found in Missouri. Maps show geographical distribution, and more than 2300 excellent line drawings supplement the keys and aid in identification. The illustrations are interspersed throughout the text but usually appear within one or two pages of the descriptions of given species. A very exhaustive treatment of the literature is presented and subjected to an analysis which reflects the author's

opinions, basic philosophy, and wealth of knowledge of the subject.

Synonyms as well as the accepted scientific name are given, and common English names are supplied where these exist. Dates of flowering are provided, and so are data of an ecological nature. For many species, the value of the plants to wild life is indicated, and frequently uses of the plants by man are also noted. The total known ranges of native plants are given.

No general descriptions of the species are given. In most cases the information presented by the keys and by the illustrations is so complete that nothing more is needed. But there are instances where it would be helpful to know such facts as the height of the plant, although scales are given to indicate the size of certain features, for example, flowers and leaves.

This work alone constitutes virtually a library on the plant life of Missouri, and it would be difficult, without resorting to the vagaries of personal opinion, to suggest ways in which it might be improved.

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Vacuum Equipment

Vacuum Technology. Andrew Guthrie. Wiley, New York, 1963. xii + 532 pp. Illus. \$12.50.

Andrew Guthrie's extensive, well-organized volume for beginners in vacuum technology, a book that abounds in tables as well as in text and numerical examples, begins with a chapter entitled "The nature of vacuum" and most appropriately ends with one entitled "Finding and repairing leaks" (chapter 15). Guthrie covers various types of components—vacuum pumps, valves, gauges, and the like—and discusses the merits and the applications of these items to the vacuum system. The real value of this text is that it can be used by an intelligent reader who has little or no background in the field but needs a working knowledge of vacuum equipment and apparatus.

Like most good books, *Vacuum Technology* suffers from some weaknesses. In general, the presentation of fundamental physical derivations is neglected in favor of a practical applied basis. I wish the author had presented

more derivations of equations rather than depending so very heavily on the presentation of final equations. Another example of overemphasis on the rule-of-thumb approach is the rather light treatment given to the x-ray effect in ionization gauges and that given to the significance of the development of the Bayard-Alpert gauge.

The author should be complimented on the overall accuracy of his statements and examples. Some statements do not reflect the latest literature, but these are primarily in the field of ultra-high vacuum. In general, the text is a valuable one not only for the beginner but also for the more experienced worker. I enjoyed reading it and think that this book would be a valuable addition to the library of anyone who devotes much of his time to using or designing vacuum equipment.

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Rutherford of Nelson

The Collected Papers of Lord Rutherford of Nelson. vol. 2, *Manchester*. Published under the direction of Sir James Chadwick. Interscience (Wiley), New York, 1963. 590 pp. Illus. \$17.25.

The first volume of Rutherford's *Collected Papers* was reviewed in this journal [*Science* **137**, 1044 (1962)] on 28 September 1962. We now have the second volume, which covers the Manchester period from 1907 to 1919, the most fruitful and the happiest epoch of Rutherford's life. In 1931 he said, "I owe a great debt to Manchester for the opportunities it gave me for carrying out my studies. I do not know whether the University is really aware that during the few years from 1911 onwards, the whole foundation of the modern physical movement came from the physical department of Manchester University." The statement is not modest, but it is truthful and reflects, I believe, Rutherford's personality. What were these foundations of modern physics? The discoveries of "the nature of the α -particle" (p. 134); "the scattering of α - and β -rays and the structure of the atom" (p. 212); "collision of α -particles with light atoms" (p. 547)—in plainer words, the discovery of the nucleus, of the structure of the

planetary atom, and of the artificial disintegration of the nucleus.

When these momentous discoveries are followed in the *Collected Papers* they appear in a very different light from the textbook presentation with which every physicist is acquainted. In school we learn one hypothesis and all the facts that buttress the hypothesis and make it into an accepted theory, but to the discoverer there are always innumerable choices and the path to the final result is far from straight and clear.

Every physicist will gain something from the perusal of these papers, not factual information but an education on the qualities needed to be a great investigator. Humble, tedious, and apparently pedestrian investigations are the daily routine, even of a Rutherford, but once in a while this struggle, which tests the endurance and patience of the experimentalist, leads to supreme achievements. Perhaps it will also be a comfort to common mortals to realize that even Rutherford occasionally made mistakes or followed false leads. On the whole, Rutherford's already legendary figure is made much more human by these papers, but his personality does not lose anything in the process. In developing our personal acquaintance with the author we are helped very much by essays written by N. Feather, H. Geiger, E. N. da C. Andrade, and A. B. Wood, for the authors communicate effectively their own experiences in the exhilarating surroundings of the Manchester Laboratory. These essays give an intimate view of Rutherford, of the unique assembly of young talents surrounding him at Manchester, and of their personal relations.

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Solid-State Physics

Quantum Theory of Solids. C. Kittel. Wiley, New York, 1963. xii + 435 pp. Illus. \$13.50.

During the last decade very few domains of physics advanced as successfully as solid-state physics. This may be verified by studying Kittel's *Quantum Theory of Solids* and then comparing it with a book which has the same title but was written a generation ago by R. Peierls. The older book is

essentially a study in applied quantum mechanics. The new book could perhaps also be called that, but under that guise it presents a very large number of new experimental and theoretical ideas. The most impressive aspect of Kittel's book is the number of advanced theoretical techniques that he presents. Many of these techniques were originally designed to solve problems in other fields, a context in which they sometimes met with indifferent success. Kittel's book demonstrates to those who are inclined to doubt that these methods do extremely well in solid-state physics.

Since the book deals with the most advanced topics in an active field, it is a difficult book to read. But it can be recommended to advanced graduate students and research workers, or to average graduate students who have expert guidance available. It must have been a difficult book to write. Only an author with a truly encyclopedic knowledge could think of doing it. Kittel shows that he has such knowledge.

In addition he shows that he has a strong physical intuition which helps elucidate many difficult passages. However, the task is so hard that uniform success cannot be expected. Every once in a while we find that a close argument on a physical point has been terminated by a reference because a complete account would be too long. And of course, the recapitulation of involved mathematics means a number of misprints. It might be useful to publish a table of such errors at some future date. For this book may very well become a standard reference work for research workers in solid-state physics.

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Crystallography

The Art and Science of Growing Crystals. J. J. Gilman, Ed. Wiley, New York, 1963. x + 493 pp. Illus. \$20.

One of the most remarkable trends in contemporary physical science, a trend which is still gathering momentum, is the increased interest in single crystals. Long gone are the days when man's interest in crystals was largely esthetic, or when their chief economic use was as gems; gone, too, are the days when