tubes and tubes with complex geometries. The section on flow through porous material has been removed. The authors believe that "this subject is comprehensively treated elsewhere and has become too specialized for adequate coverage in the space available."

Chapter 3 describes the major classes of vacuum pumps and their mode of operation. All the material on mechanical and vapor pumps has been reorganized and covered in this one chapter. Those interested in ultra-high vacuum will welcome the sections on ion and getter pumps and cryogenic pumping.

Chapter 4 treats vacuum pump applications, their proper selection, system design, and the use of traps and baffles. The discussion of the "choice and stability of work fluids for vapor stream pumps" should clarify any misunderstandings regarding the utility of "oils" as pump fluids and their almost universal use in place of mercury.

Chapter 5 remains as a comprehensive survey on the many different types of gauges for low gas pressure measurement. Major revisions have been made in the section on ionization type gauges and leak detectors. New material has been added on ultra-high vacuum ionization gauges, spectrometers and leak detection methods.

One might view Chapter 6 on the treatment of sorption of gases and vapors by solids as a special field and better omitted from this text as was the flow through porous material. However, since one of the most important problems in high vacuum technique is the removing of gases and vapors which are present both on the surface and in the interior of glass walls and metal parts, it seems fitting to include this material in the text.

In Chapter 7 "typical data are given on the sorption of various gases on non-metallic materials which are of importance in vacuum technology." The relative activities of materials like cellulose, charcoal and glass, and the effect of methods of preparation are discussed. Although the authors state that the chapter was not intended to be comprehensive but rather to present typical data together with a few interpretive comments, the chapter is sufficiently complete to give a theoretical understanding and a practical working knowledge of sorption techniques.

The subject of occluded or dissolved gases on metals is presented in Chapter 8. A knowledge of the manner in which metals may take up gases and of the condition under which these gases may be removed is of extreme importance in vacuum technology. A new section has been added on the behavior of rare gases propelled into metals by ion bombardment and nuclear processes. New experimental work in diffusion studies using nuclear magnetic resonance, internal friction measurements, and radioactive and stable isotopes has been added.

Chapter 9 on chemical and electrical clean-up and ultra-high vacuum contains several new sections on gas sorption. Extensive data are given for rates and total quantities of gas that can be sorbed under vacuum tube conditions. New getter materials are discussed and comparisons made with older types. Even though the section on ultra-high vacuum has been expanded, there may be some readers who would like to have seen an even greater expansion of this increasingly important phase of high vacuum.

Chapter 10 deals with vapor pressures and rates of evaporation. Data have been brought up to date and tables recalculated on the basis of recent available determinations. For those particularly interested in thin films, new material has been added to the section on vacuum distillation of metals and deposition of films.

Chapter 11, "Dissociation Pressures of Oxides, Hydrides, and Nitrides," treats principally the "non-elementary modes" of dissociation of oxides and of the reduction of the oxides of metals. The editors have removed the section on oxidative rates from the new edition, but they feel that the increasing interest in the properties of materials at high temperatures justifies the continuation of a section on dissociation. Although this chapter may seem peripheral to some, it is a handy reference for those who may have need for dissociation data.

In keeping with the thorough coverage of subject matter, each chapter ends with a generous list of references and notes. Also, there is a complete name and subject index at the end of the book. Anyone interested in vacuum technology either from a scientific or practical viewpoint will find the second edition a broad and solid foundation of pertinent information and data clearly and expertly presented. The specialists who combined their knowledge to revise the individual chapters and the editors are to be congratulated on the excellent results of their collaboration. Having known Dr. Dushman personally, I am sure he would have been pleased with their accomplishment.

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Physics in the Soviet Union. An Exposition of Theoretical Physics. By A. S. KOMPANEYETS. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. 1962. 592 pp. 14.5 × 22 cm. Price, $7.50.

The title of this book is somewhat misleading. It is actually a summary of certain areas of Theoretical Physics and is stated by the author to be aimed at engineer-physicists and to specialists working in fields associated with physics. According to the author the reader is assumed only to be acquainted with the course of general physics and analysis. If this is the real intent, it is this reviewer's opinion that the book has failed: This does not imply anything about its quality, which is high, but only that it appears not to accomplish its aim realistically.

The text is divided into four principal sections entitled: I,Mechanics; II,Electrodynamics; III,Quantum Mechanics; IV,Statistical Physics. It should be noted that the section on Mechanics is restricted to point and rigid body mechanics. The level is high in all four sections and the coverage is quite extended and proceeds from a fundamental point of view. It is for this reason that the real utility of the book for its stated audience (at least by U.S. standards) seems questionable. The level of treatment of all the subjects is that of graduate level instruction in this country and with the compression required in this presentation, the above conclusion follows. On the other hand, it is certainly an excellent summary and reference for the individual who has had some exposure to the fields covered. The level of sophistication is similar to that attained in the series of texts on Theoretical Physics by Landau and Lifshitz and the author expresses his indebtedness to them.

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Reagent Chemicals and Standards with Methods of Testing and Assaying Them; also the Preparation and Standardization of Volumetric Solutions and Extensive Tables of Equivalents. Fourth Edition. By JOSEPH ROSIN, Member, American Chemical Society; the U. S. Pharmacopoeia Revision Committee; Formerly Chief Chemist and Chemical Director, Merck and Co., Inc. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, New Jersey. 1961. 557 pp. 16 × 23.5 cm. Price, $14.50.

In its previous three editions this book has become so well known—and respected—that there is no need to review the present fourth edition at length. It follows the same pattern, and maintains the same high standard, as its predecessors. Specifications have been added for about thirty new reagents and for ten of the amino acids that are most commonly used therapeutically or in special food products.

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Spectroscopie Infrarouge. Partie I. Vibrations Moléculaires. By M. PIERRE BARCHEWITZ, Professeur à la Faculté des Sciences de Paris. Gauthier-Villars et Cie., 55, Quai des Grands-Augustins, Paris 6, France. 1961. vi + 238 pp. 16 × 24.5 cm. Price, NF. 42.–.

This brief account of the theory of molecular vibrations and their spectroscopic activity is based on a course of lec-

tures given by the author to doctoral students in physical chemistry at the University of Paris. Of its nine chapters, two are devoted to the basic classical and quantum mechanical theory of molecular vibrations, five to symmetry and group theory, one to perturbation treatment of anharmonic vibrations, and one of thirty pages to the theory of infrared absorption spectra. The only molecule considered in this last chapter is carbon dioxide. The treatment is clear throughout but is all familiar to students of "Molecular Vibrations" by Wilson, Decius and Cross (1955).

The last sentence in the book ends with a semicolon. Perhaps this is the author's way of indicating more to follow. In the preface, it is stated that "the second part of this work will discuss the calculation of vibrational frequencies by Wilson's method, the calculation of vibrational frequencies of functional groups, the determination of transitions that are made possible by electrical anharmonicity, and an important chapter on chemical spectroscopy illustrating the possibilities of applying infrared to qualitative and quantitative chemical analysis." It is to be hoped that Part II will discuss the spectra of other molecules in addition to carbon dioxide and that the chapter on chemical applications will justify to the student the mathematical treatment of vibrations by showing him its power and utility in the understanding of infrared spectra.

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Ultra-violet and Visible Spectroscopy. Chemical Applications. By C. N. R. RAO, Ph.D., D. Sc., A.R.I.C., Indian Institute of Science, Bangalore, India, formerly of Purdue University, Lafayette, Indiana, U.S.A. Butterworth Inc., 7235 Wisconsin Avenue, Washington 14, D. C. 1961. xiii + 164 pp. 15.5 × 25 cm. Price, $5.25.

The years 1949–1950 marked the turning point in our understanding of the electronic spectra of organic molecules. This was when H. Kuhn showed the central role of alternating bonds in conjugated-chain spectra; when Kasha gave the n-π-explanation of Burawoy's regularities; when McClure proved the identification of triplets by spin-orbit perturbations; when Clar's regularities in condensed-ring spectra and Stern and Wenderlein's regularities in porphyrin spectra were rationalized; when the Benesi–Hildebrand molecular-complex spectra were published, with Mulliken's charge-transfer interpretation; and when, on the theoretical side, the free-electron and perimeter approximations were developed, and the numerical applicability of the molecular orbital theory to spectral energies, to aza-perturbations and to the general double-bond twisting problem became established.

These advances and their subsequent more quantitative developments all showed the power of a new approach—the "chemical perturbation" approach—which used chemical systematics phenomenologically both as the crucial test and as the prime objective of the proper quantum-mechanical classification of the observed spectra. This approach had been pioneered by Pauling in interpreting Zechmeister's *cis–trans*-polyene changes, by Sklar in explaining substituted-benzene spectra, and by Lewis and Kasha in their triplet interpretations, but it had been neglected for many years and is still not understood by many experimentalists and by many otherwise competent spectroscopic theorists.

The principal reason for this wide lack of understanding has been the lack of any systematic treatise in the last 12 years explaining these new developments and showing how they lead to numerical predictions of organic spectra and their solvent and substituent effects. Two or three such books are said to be in the offing, but in the meantime students are dependent on Brode's "Chemical Spectroscopy" of 20 years ago, or on books such as "Electronic Absorption Spectroscopy" by Gillam and Stern (1958) or the present little book by Rao and several collaborators (1961), which are still in the early tradition of empirical and analytical emphasis.

For practical organic chemists and students who want such a guide, especially for the smaller chromophores, Rao's book is not a bad one. It has short chapters on the spectra of "simple" molecules, conjugated chains, aromatics, heterocyclics, steric effects, vacuum ultraviolet spectra, fluorescence, and charge-transfer spectra, with several pages on proteins, ligand-field theory, rotatory dispersion and other subjects, and with a long chapter on "Applications" (though only 11 of its 98 references are later than 1955). It is up-to-date in many ways, notably in its numerous assignments of n-π-spectra, and in its treatment of steric twisting effects. And the chapter on charge-transfer spectra, by a collaborating author, Dr. R. M. Mallya, is a good brief introduction to the Mulliken and Orgel theories of molecular complexes.

The most serious flaw in the book is its lack of breadth and balance. The discussion of fluorescence, by another collaborating author, Miss N. Rajalakshmi, is weak; and phosphorescence is essentially ignored. Needless to say, any author's selection of subject matter from the 5000 or so papers on organic spectra in the last 10 years, or from the 10,000 or so papers that must have been published since about 1930, is bound to be highly personal. But in a book with "Visible Spectroscopy" in the title, it is surprising to find 8 pages devoted to dienes and their homologs but only two pages to carotenoids and only one to the condensed-ring aromatics and one to porphyrins and chlorophyll. The Chicago school, I must admit, is treated very well, but the theoretical interpretations of the English Cambridge school are generally neglected as well as the important spectral studies of the Amsterdam group, the Stuttgart group and the Munich group. And out of 500 or so different references, I could find only 4 to Kasha, 3 to Sidman, 2 to Moffitt, 2 to Brooker, 1 to Förster, and none to Sponer. There is no reference to Förster's "Fluorescenz Organischer Verbindungen" nor to Clar's "Aromatische Kohlenwasserstoffe." (And there are numerous misspellings of proper names.)

All in all, it is a limited little book. But it is readable by any chemistry student and, until some more comprehensive volume comes along describing the new systematic approaches, it may be the best book we have for introducing students to the empirical singlet absorption spectra of the smaller conjugated systems.

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Cahiers de Synthèse Organique. Méthodes et Tableaux d'Application. Volume IX. Cyclisations. By JEAN MATHIEU, ANDRÉ ALLAIS and JACQUES VALLS. Published under the direction of Léon Velluz. Masson et Cie., 120, Boulevard Saint-Germain, Paris 6, France. 1962. 325 pp. 15.5 × 22.5 cm. Price, broché, 90 NF.; cartonné toile, 100 NF.

The increasing importance of heterocyclic compounds in all fields of organic chemistry, particularly those of pharmaceuticals and natural products, has resulted in the production of a voluminous periodical literature on the subject. This has been accompanied by the publication of many books, dealing for the most part with individual ring systems, or with related series of such systems. One might consider the next logical step to be an attempt to systematize, to provide keys to make this mass of information more readily available. The book under review creditably endeavors to provide such systematization in the field of monomolecular heterocyclization.

This ninth in the series of "Cahiers de Synthèse Organique" is the third volume to treat cyclization, Volumes VII and VIII having dealt with carbocyclization of the monomolecular and polymolecular types, respectively. Structurally it is divided into three parts, Texte, Tableaux, and Table des Cycles.

The Texte is in discursive form with a progressive marginal ring index. The structures are codified in terms of substituents split out during cyclization. Syntheses representative of each type structure are described. Reactions and yields are given, with literature references conveniently placed at the bottom of the page.

The Tableaux are indexed by the rings formed in cyclization, progressing from tetraphenylepoxyethane to the complex nine-membered ring 1H-dibenzo[f,h][1,2,4,5]-tetrazonine. Starting materials, final products, condensing agents and solvents, yields and references are provided.