

with respect to rigor of the theoretical treatment, up-to-dateness of instrument design, or practical interpretation of data that fall short of achieving a minimum level of sophistication. The subject, Light Scattering, appears in wholly new form as a separate chapter (Oster).

For organic chemists, the timeliness of the chapter, Optical Rotatory Dispersion (Klyne and Parker), will be a focal point of interest. The general discussion is very brief; most of the chapter is taken up with a survey of data. The chapters Polarimetry (Heller and Fitts) and Streaming Birefringence (Scheraga and Signer) have been extensively revised and new chapters have been added on the Kerr Effect (Lefevre and Lefevre) and Determination of the Faraday Effect (Waring and Custer). Altogether these five chapters provide more information on applications of polarized light than is available to the organic chemist in any other single source.

The two concluding chapters, Measurement of Dielectric Constant and Loss (Powles and Smyth) and Dipole Moments (Smyth), have changed little since the earlier edition.

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### Les Réactions entre Ions Positifs et Molécules en Phase Gazeuse. Application à la Chimie des Rayonnements.

By J. DURUP, Docteur ès Sciences. Gauthier-Villars, 55, quai des Grands Augustins, Paris VI, France. 1960. 78 pp. 15.5 × 24 cm. Price, broché, 14 Nf; cart., 17 NF (\$3.75).

In this short monograph, the reader will find an interesting introduction to the subject of ion-molecule reactions. The early work, the experimental approaches and the quantum and classical theories are reviewed briefly. The bibliography extends to the end of 1959. The available information concerning about two hundred reactions is summarized and classified in an extensive table. Applications to radiation chemistry are discussed in the last chapter.

About one third of the book deals with theoretical considerations mainly about energies and mechanisms. Endothermic or highly exothermic processes are shown to have low probabilities. The author develops interesting ideas of his own without confusing his contributions with those of others.

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**The Encyclopedia of Microscopy.** Edited by GEORGE L. CLARK, Research Professor of Analytical Chemistry, Emeritus, University of Illinois, Urbana, Illinois. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1961. xii + 693 pp. 18 × 26 cm. Price, \$25.00.

This book is arranged in encyclopedia style, in double columns with 26 large topics and numerous subtopics in alphabetic order, and with cross references under most of these, but with no index.

It reminds one of a gigantic symposium of symposia, with papers that include reviews, some systematic and correlated developments in textbook style, and highly specialized reports on personal researches or novel instruments. As is inevitable in symposia, the level and scope of the papers vary widely, and the allocation of space is certainly open to question; for example, kidney ultrastructure gets as much as electron optics, and 4 pages are devoted to the ultrasonic absorption "microscope," a device which can detect a 25 $\mu$  energy-absorbing discontinuity but is hardly an image-former.

To a considerable degree, the general emphasis is on "appreciation" or potential application, rather than concrete techniques that might be followed by the user. On the other hand, there are many striking illustrations of micro-radiography and electron microscopy, somewhat slanted in the direction of biology. The editor contributes about 15 pages on various topics.

Chemists will be interested in sections on Lyophobic Colloids (20 pages), Refractometry (40 pages, 247 references,

but little on microscopical methods), Resinography (12 pages) and on General and Industrial Microscopy. Chemical Microscopy occupies over 50 pages, with major reference to precipitation reactions for a variety of drugs. The portion on morphology and birefringence avoids the correlation between these which is essential for intelligent and reliable description.

For those who like to read encyclopedias this one should be fascinating, but the alphabet is a poor guide for systematic study. Even much digging about in the table of contents may lead to very spotty information, as compared with what is accessible in fewer words, in more prosaic and orderly books. If the microscopist has studied these in his own field, then he may find the "Encyclopedia" a valuable supplement on selected topics, and a suggestive sampling or preview of what is new or "far out" in the ever-expanding horizons of techniques applied to ever-decreasing details of structure.

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**Proceedings of the Symposium on Active Networks and Feedback Systems.** New York, N. Y., April 19, 20, 21, 1960. Microwave Research Institute Symposia Series. Volume X. Edited by JEROME FOX, Assistant Editor, MARTHA CROWELL. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1961. xxiv + 658 pp. 15.5 × 23 cm. Price, \$8.00.

It is a treat indeed to find a nostalgic paper reminiscing about the early thoughts and developments in the field of feedback amplifiers theory. It is especially welcome if it is authored by one of the communication field's pioneering theoreticians, H. W. Bode. This article and two others constitute a presentation of the state of the art and future trends in the proceedings of the symposium on Active Networks and Feedback Systems.

Bode's article, "Feedback—The History of an Idea" takes us back to 1923 and discusses the need for distortion-free repeaters which had existed in the telephone industry at that time and described Black's early invention of feedback amplifiers which helped satisfy the need. The author then discusses the work of Nyquist and MacColl and others and views the wartime marriage of feedback amplifier theory and automatic control. He states that "This marriage has lasted 20 years; perhaps an amical divorce is in order."

The remainder of the articles on Feedback Networks and Systems, however, do not indicate that this divorce is imminent. In fact, the only paper on the subject of adaptive control "AN Appraisal and Critique of a Class of Adaptive Systems" by I. M. Horowitz seems to indicate that there are a few cases where ordinary feedback is not just as effective as a much more costly and complex computer controlled or adaptive system.

Some of Bode's original work on multiloop feedback amplifiers is very lucidly explained by J. H. Muligan, Jr., in terms of transistor amplifier models and general matrix parameters. In the simple analysis of feedback systems the unilateral "block box" is used. However, for a more realistic approach non-reciprocal bilateral elements should be used. In his article on "Signal Transmission in Non-reciprocal Systems," he treats the concepts of return ratio and return difference for a general system matrix and shows the great utility of these ideas. Since many process control systems are multivariable, there is no doubt of the fruitfulness of applying these concepts in the analysis and synthesis of the control of multivariable systems. Process control systems usually have "plants" which are distributed in nature so that non-rational transfer functions develop. In particular, there is usually a distance velocity or dead period lag. A. Papoulis briefly treats this subject and gives stability limits. He apparently has ignored the great quantity of material on this subject, since no bibliography appears.

Since the introduction of the tunnel diode, negative resistance has become another basic active circuit element. Reports of research in this area constitute the main interest of the group of papers concerning active networks.

Non linear and time-varying systems constitute the remainder of this collection of papers. The control engineer

has made quite a dent in this complex problem, in particular his contributions concerning the stability aspects. It is perhaps in this area of time-varying systems that the flow of information and ideas may be from the control engineer to the networks designer.

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**The Theory of Transition-Metal Ions.** By J. S. GRIFFITH, Professor of Chemistry, University of Pennsylvania; Berry-Ramsey Fellow in Mathematics, King's College, Cambridge. Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 1961. h + 455 pp. 18 × 26 cm. Price, \$17.50.

No field of chemistry has in the last decade been any more exciting in its decisive conquest of old problems, its development of new ideas, and its rise to new levels of sophistication than the chemistry of the transition elements, especially their coordination chemistry. This revolutionary surge of vigor is due in considerable part, as practically everyone knows, to the rediscovery and practical extension by chemists of those theories developed by physicists such as Bethe, Schlapp and Penney and most particularly J. H. Van Vleck during the 1930's. Known today in its various interrelated forms as crystal field theory or ligand field theory, it provides a powerful conceptual framework and, *mirabile dictu*, computationally practical tools for the solution of many problems of spectroscopy, magnetism, bonding, structure, reactivity and thermodynamic stability of transition metal compounds and complexes.

But for the chemist to use this new power he must pay a price. That price is the acquisition of some more difficult and sophisticated physics and quantum mechanics than he perhaps ever thought would be necessary for a chemist. Rapid as it may have seemed in the last decade, the spread of the ideas and techniques of ligand field theory has not been as rapid as it might have been because the lack of textbooks, on any level, inflated this price beyond the resources of many.

It seems to this reviewer that for several years the need has existed for three different books. For those whose goal (not necessarily their final one) is acquaintance with the important qualitative ideas and pictorially expressed concepts and the relationship of these to the better known experimental facts, a short catechistic book putting emphasis on results rather than reasons and principles is required. This need has recently been met by L. E. Orgel's articulate monograph. On the next level, one would desire a book covering basic principles and quantitative techniques written for the willing but mathematically untutored and undistinguished chemist—in short, a practical but unpretentious book. Regrettably, no such book yet exists; it is to be hoped that one will appear soon. Finally, there has been a need for a mathematically sophisticated and rigorous book presenting "a unified and deductive introduction to that part of theoretical physics...known as ligand-field theory" and directed "primarily to mathematical physicists and

theoretical chemists." This last book, described in the preceding sentence partly by quotations from its preface and its dust-jacket, has now been written, and very masterfully written indeed, by J. S. Griffith.

After a brief introduction apparently intended for physicists who know absolutely no chemistry for whose benefit, apparently, the book is also graced with a table of the names, atomic numbers and symbols of the elements), the book proceeds to some chapters *ostensibly* directed to chemists who know no physics. However, in the first of these chapters which cover relatively elementary considerations of angular momentum and electronic structure of atoms, the author remarks that while he "starts from the beginning" (which is true) "it is rather desirable that the reader should possess already a little knowledge of quantum mechanics: §§ 1-22, 27, 42 and 43 of Professor Dirac's book *Quantum Mechanics* probably cover all that is really necessary." Thus these chapters cover what a chemist knowing no physics would have to learn before tackling ligand field theory *per se* but it seems no small understatement to say that these chapters would be a very formidable challenge for the true neophyte. These remarks will serve, I hope, to convey a lively impression of the general level of sophistication of the entire book.

Following the chapters (2-5) on atomic structure there is an elegant chapter on group theory, only marred in spots by the unfortunate confusion of the terms symmetry element and symmetry operation. Beginning with Chapter 7, ligand field theory *per se* is developed brilliantly and incisively in three longish chapters. Chapter 10 gives a whirlwind resume of magnetic susceptibility theory including post-Van Vleck developments such as Kotani's method and the author's own ingenious modification of it. Chapter 11 presents a relatively non-mathematical discussion of the optical spectra of complexes and should be of interest to many chemists, even those who would not get much benefit from earlier chapters. The final chapter is a rather long and thorough one on paramagnetic resonance, covering both theory and representative examples of its application. The book closes with 68 pages of appendices most of which are tabulations of data, formulas and matrix elements useful in performing computations. While this reviewer did not attempt to check these tabulations for accuracy, if one makes the likely assumption that they are relatively free of errors, it can be said that they constitute an extremely valuable feature of the book.

The author has entirely omitted discussion of the  $f^n$  configurations.

The entire book has the distinguished format typical of Cambridge University Press publications and in over four months on my shelf in muggy Massachusetts the covers have not buckled as covers on English books so often do. It has lately become one of the most tiresome clichés of book reviewers to note in closing how outrageously a book is priced—right out of reason and reach. In the present case, I can happily make just the opposite observation: this book seems to me to be worth every bit of the \$17.50 that is asked for it.

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