

magnetic field. Chapter 7 is a detailed account of the properties of the coherent states. Among the topics discussed are the completeness (apparently first noted by John von Neumann) and over completeness of these states, their relationship to Segal-Bargmann Hilbert spaces of entire functions and the differential-operator representation of the creation and annihilation operators.

Especially noteworthy is the discussion in chapter 8 of a particular coherent-state representation of the density operator that specifies the statistical state of the radiation field and is known in the literature as the diagonal or P representation. As Glauber has remarked, the question of the generality of this representation "lies in mathematically rather deep waters," and has provoked a fair amount of controversy and confusion in the past. The authors' rigorous formulation of the optical-equivalence theorem, and their discussion, particularly on page 192, of its physical implications should

prove valuable in illuminating the relationship between the quantum and semiclassical theories of optical coherence.

The last two chapters deal with special states of the radiation field and intensity interferometry in quantum optics. There is a discussion of various laser models and J. P. Gordon's interesting approach to the model developed by M. Lax is considered in some detail.

The level is suitable for advanced students and research workers in quantum optics. It is written in a clear style with a careful attention to mathematical and physical subtleties not often considered in the literature, and it is highly recommended to those who wish an authoritative account of recent work in this area.

* * *

The reviewer is assistant professor of electrical engineering at Purdue University specializing in quantum optics and electronics.

A review of reviews

ANNUAL REVIEW OF PHYSICAL CHEMISTRY, VOL. 19, 1968. H. Eyring, C. J. Christensen, H. S. Johnston, eds. 645 pp. Annual Reviews, Palo Alto, California, 1968. \$6.50

by E. E. MUSCHLITZ, JR

Volume 19 of *Annual Review of Physical Chemistry* is the 1968 edition of a long and successful series. The current volume contains 20 articles and presents the reviewer with a difficult task in doing justice to the efforts of all the authors involved. Physical chemistry includes a wide variety of topics, and the breadth of the subject is amply demonstrated by individual review titles in the volume. The reviews are well written and documented, most having 100 or more references and many having over 200.

Periodic short reviews of progress in active areas of research are of value not only to the experienced investigator but also to the graduate student. Especially for the latter, a good review article should be instructive as well as informative. Most of the reviews in this volume have achieved this objective.

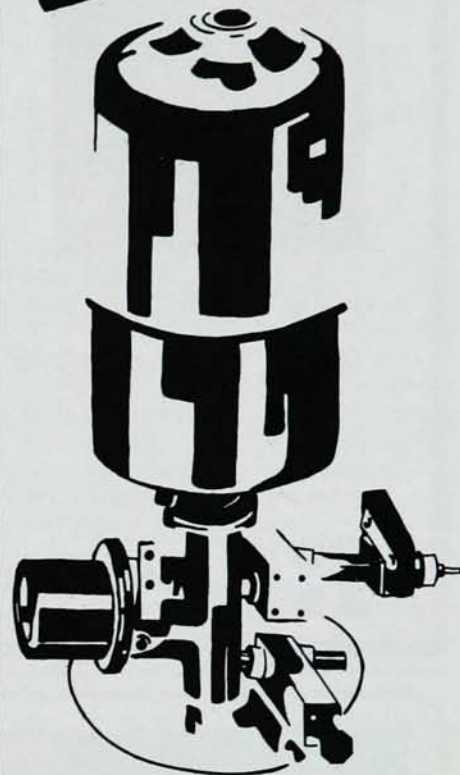
A. N. Frumkin and N. M. Emanuel of the USSR Academy of Sciences are the authors of an interesting survey,

"Fifty Years of Soviet Physical Chemistry," which heads the list of articles. This is followed by reviews on "Electric Paramagnetic Resonance" by Alan Carrington and Geoffrey Luckhurst; "Fused Salts" by S. J. Yosin and H. Reiss; "Electrochemistry" by Fred Anson (perhaps too broad a field for a short review article) and "Experimental Inorganic Thermochemistry" by W. N. Hubbard, P. A. G. O'Hare and H. M. Feder. Recent developments, particularly new experimental techniques, in studies of "Fast Reactions in Solution" are described by Edward Eyring and Bruce Bennion.

R. Henry and Michael Kasha have written a penetrating review on "Radiationless Molecular Electronic Transitions" in which they give a critical historical summary of the theory of these processes and develop the stationary-state approach to excited-state interactions of Rhodes, Henry and Kasha and of Jortner that eliminates radiationless transitions. "Ligand Substitution Dynamics" by Cooper Langford and Thomas Stengle is the next review, and it is followed by a thorough analysis of recent theory and experiment on "Vibrational and Rotational Relaxation" by Roy Gordon, William Klemperer and Jeffrey Stein-

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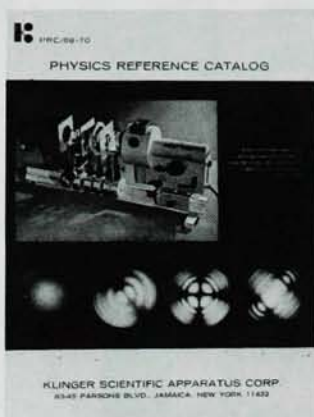
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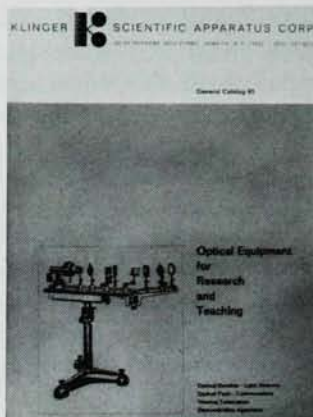
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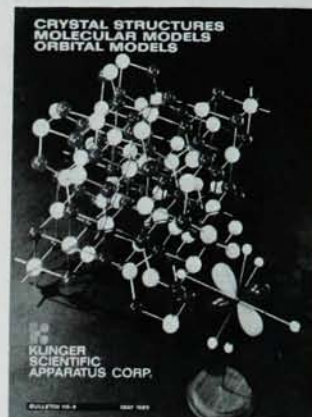
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feld. These authors have included several valuable tables collating the various systems that have been studied with the experimental methods.

Only in recent years with the advent of ultrahigh-vacuum techniques has it been possible to carry out surface studies on clean single-crystal surfaces. Gabor Somorjai reviews the experiments on surface structure, surface dynamics and gas-surface interactions in his article on "Surface Chemistry." Lewis Friedman's review on "Ion-Molecule Reactions" emphasizes the new experimental techniques with tandem mass spectrometers (measurements of the product-ion energies and angular distributions have recently been made for several reactions), ion cyclotron resonance for studies of reaction mechanisms and photoionization as a means of producing reactant ions in known internal-energy states.

The review "Mass Spectrometry" by Kenneth Rinehart Jr and Thomas Kinstle attempts to cover too large a topic for a short review article. The emphasis is on high-resolution mass spectrometry and structure of organic positive ions. Alan Haught writes a very instructive review on "Lasers and their Applications to Physical Chem-

istry." This is followed by reviews on "Gas Reactions Yielding Electronically Excited Species" by B. A. Thrush, "Statistical Mechanics—A Review of Selected Rigorous Results" by Joel Lebowitz, "Vibrational Spectroscopy" by Herbert Strauss and "Nuclear Magnetic Resonance" by J. Jonas and H. S. Gutowski.

D. W. Urry's review "Optical Rotation" is centered on applications to peptides and polypeptides. This is followed by an article on "Quantitative Conformational Analysis; Calculation Methods" by James Williams, Peter Stang and Paul Schleyer and one on " $\text{He}^3\text{--He}^4$ Solutions" by Norman Phillips.

The editors are to be congratulated on their selection of authors for this volume, for each is an acknowledged expert in his field. These authors have treated their subjects not only in a comprehensive but also a critical fashion. In the current era of a burgeoning literature, good reviews such as these are filling a role that is becoming more and more essential.

* * *

E. E. Muschlitz Jr is a chemistry professor and head of physical chemistry at the University of Florida.

Machine calculations

COMPUTING METHODS FOR SCIENTISTS AND ENGINEERS. By L. Fox and D. F. Mayers. 255 pp. Oxford Univ. Press, New York, 1968. \$6.25

by NORMAN A. BAILY

The authors, members of the Oxford University Computing Laboratory, state that the primary purpose of this book is to enable its users to improve their use of the computer and to obtain more accurate and meaningful solutions. If one restricts its application to that of a handbook, it should have no difficulty in achieving the authors' aims. However, the mathematics are complex enough that even physical scientists who are primarily experimentalists would have to spend considerable time studying the suggested methods to determine the proper one for a particular problem.

The field of automatic computation is of prime importance in all branches of science, and the book emphasizes the proper selection of methods for the numerical solution of many different mathematical forms. The book,

therefore, makes a very valuable contribution because a vast majority of computer users have not ordinarily delved deeply into the problems discussed. Sections of the book are quite sophisticated and possibly would be difficult for the occasional machine user to apply properly. It is specifically designed for persons thoroughly familiar with computing but who perhaps do not have either the training or experience to obtain the best results. In general, the book is an excellent review of the methods for handling common difficulties.

Some of the more important topics covered are: error analysis, floating-point arithmetic, recurrence relations, finite differences and the usual common operations such as polynomials, matrices and numerical integration. The authors have stressed the important difference between inherent and induced stability and have treated fundamental theory where they felt that it was not well known by most computer users. The book does not em-

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Elements of Advanced Quantum Theory

J. M. ZIMAN

In this newly published work, Professor Ziman uses the same kind of approach he employed successfully in his *Principles of the Theory of Solids*.

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Edited by J. M. ZIMAN

Part 1 of this two-volume work treats the electronic properties of metals and contains articles on the calculation of band structures (V. Heine), observation of the Fermi surface (D. Shoenberg), effects of a magnetic field (A. B. Pippard), surface and size effects (R. G. Chambers), conduction of heat and electricity (J. M. Ziman), liquid metals (T. E. Faber), alloys (P. J. Brown and W. H. Taylor), and special properties of transition metals (J. Friedel).

Part 2, in preparation, is subtitled *Defects* and is being edited by P. B. Hirsch.

Part 1: Electrons \$14.50

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