

The succeeding chapters are concerned with applying some of these ideas on stability to investigations of various systems. They include sections on beam-plasma interactions in one-dimensional systems (in both cold and warm plasmas), transverse interactions, the effect of finite dimensions, and the interaction with ions in a hot electron plasma. There is a tendency to go from one case to another, write down the dispersion equation, derive the results, classify them with respect to the nature of their instabilities, and make perhaps too few comments about the physical aspects of each case. I did find that the

practice of comparing some of the interactions to known microwave amplification mechanisms, such as the reactive wall and resistive wall amplifier, backward-wave amplifier, and the like, was useful and that it provided clarification for some cases which would otherwise be a little less comprehensible.

All in all, I think the book will be valuable as a reference source that, in a systematic and useful way, lists and classifies a majority of the interactions which can occur between streaming particles and a plasma.

MARVIN CHODOROW

*Microwave Laboratory,
Stanford University*

Annotated Problems in Physical Chemistry

Numerical Problems in Advanced Physical Chemistry. J. H. Wolfenden, R. E. Richards, and E. E. Richards, Oxford University Press, New York, ed. 2, 1964. xvi + 258 pp. Illus. \$4.80.

The working of problems, usually requiring numerical answers, is justifiably regarded as an essential part of a college course in physical chemistry. Most college teachers rely on problems found at the ends of chapters in the textbooks that they use, often supplemented with their own collections of problems, home-grown or picked up here and there. Some local collections have given rise to published books that serve as additional sources for teachers and students. In addition to the volume reviewed here, these include Adamson's *Understanding Physical Chemistry* (Benjamin, 1964); Bareš, Černý, Fried, and Pick's *Collection of Problems in Physical Chemistry* (Pergamon, 1962); Guggenheim and Prue's *Physicochemical Calculations* (North-Holland, 1955); and Sillén, Lange, and Gabrielsson's *Problems in Physical Chemistry* (Prentice-Hall, 1962).

The present book is a second edition, considerably revised and somewhat expanded. The problems contained in it are relatively few in number (144 with answers plus 15 short exercises without answers, compared with 400 to 700 problems in some of the other books mentioned), but they are high in quality, intellectual content, and research flavor. They are based on real (and often relatively raw) experimental data taken from important papers in the original literature. Most of them are annotated with addi-

tional remarks and references. The subject matter represents reasonably well the main areas of "classical" physical chemistry (equilibria, thermochemistry, solutions, electrochemistry) as well as modern developments in physical chemistry and chemical physics (chemical kinetics and photochemistry, spectroscopy and molecular structure, crystal structure, radiochemistry). The level is generally within reach of undergraduate introductory physical chemistry courses in the better institutions. The book should be well suited to honors or advanced undergraduate courses or graduate review courses. (In all of these respects the book resembles that by Guggenheim and Prue, except that the latter contains not problems but completely worked-out examples.) The problems are naturally somewhat harder, and take longer to work, than most problems placed at the ends of chapters in introductory textbooks, but these problems are a welcome contrast to the multitudes of the latter that are constructed with synthesized or hypothetical data, pruned of side issues and complicating factors, and somewhat out of touch with the real world of research and practice.

The book is decidedly Oxonian in flavor; all three authors are or were at Oxford. Not surprisingly, the name of C. Hinshelwood is mentioned in more problems than the name of any other person. The section on crystal structure, with seven problems, was contributed by D. Crowfoot Hodgkin, 1964 Nobel laureate in chemistry.

DAVID P. SHOEMAKER

*Department of Chemistry,
Massachusetts Institute of Technology*

Applied Physics

Optical Masers. George Birnbaum. Academic Press, New York, 1964. xii + 306 pp. Illus. \$9.50.

Like a well-known cigarette, the book *Optical Masers*, by George Birnbaum, might be described as a "treat" instead of a "treatment." Therein lies some of its strengths and some of its weaknesses.

True to the title and the author's intent, the book is concerned mainly with the physical principles and technology of optical masers or lasers and gives only fleeting attention to associated technology such as detectors and modulators and possible applications. The subject of nonlinear optics (optical mixing, harmonic generation, and scattering) is described with a detail that is on a par with the description of optical masers.

The organization of the book is extremely good, with the not unique arrangement of theory first and then experimental description. The book reads extremely smoothly, and the reader is carried forward at a pace somewhat uncharacteristic of a treatise. Examination of the author's style indicates how this is accomplished. The material is described in a fairly intuitive or physical way and the more detailed or rigorous treatment that can be found in the original literature is sketched very lightly.

It would be extremely unkind to characterize the book as merely an annotated bibliography, but to some extent it can be and was intended to be used that way, especially by someone active in the field. On the other hand, the reader new to the field can develop a quick but shallow appreciation of the fundamentals; the book was not intended to be, nor is it, a definitive treatise on the subject.

For my own taste the treatment of gaseous optical masers is somewhat meager and contains some erroneous statements. For example, the gain dependence on diameter of the discharge tube is generally attributed to the need to destroy certain metastable states of the atom by wall collisions. A more careful study of the literature would indicate that the metastable states are quite efficiently destroyed by electron collision and that the variation of electron temperature, and hence excitation rate, produces the dependence on diameter. Another lapse occurs in a paragraph on photography. The entire subject of holography, which is one of the more fascinating applications of laser technology, is discounted with the statement

that no knowledge of phase can be obtained by photographic techniques.

On the whole, the book is a reasonably useful addition to the literature on optical masers. Unfortunately its usefulness will be short-lived because the literature on the subject is accumulating at an increasing rate. According to a recent survey, the rate has doubled in the past six months.

E. I. GORDON

*Bell Telephone Laboratories,
Murray Hill, New Jersey*

Electrical Engineering

Quantum Physics of Electronics. Summer N. Levine. Macmillan, New York, 1965. xiv + 301 pp. Illus. \$8.95.

With the advent of the transistor and, more recently, the maser and laser, it has become increasingly important for electrical engineering students to obtain a background in modern physics. This is particularly true for Ph.D. students who intend to continue in the field of research and, to a lesser extent, for the electronics design engineer who will use the devices. The latter must have some understanding of the underlying physical principles on which the devices operate in order to exploit their potential most effectively. It therefore seems highly desirable today for the engineer to study the Hamiltonian and Lagrangian forms of classical mechanics, quantum mechanics, thermodynamics, classical and quantum statistical mechanics, solid-state physics, and the quantum theory of radiation and acoustics. Of course, this curriculum sounds like that of a physics major, but it is the physics used in modern electronics devices.

The present book goes a long way toward providing the student an introduction to most of the required topics. In chapter 1 the author introduces, in an abstract way, the operator algebra necessary for quantum mechanics, and in chapter 2 he develops the underlying principles of quantum mechanics, including such topics as spin and angular momentum, a particle in a three-dimensional box, and the harmonic oscillator. The approximation methods that are applicable to many particle systems are developed in chapter 3. A knowledge of this material is required for understanding lasers and masers. In chapter 4 a few topics in statistical

mechanics and thermodynamics are introduced, including an introduction to the ideas of transport theory. In chapter 5 various types of electron emission are discussed, using statistical methods. The band theory of solids is given in chapter 6, and transport theory is developed further in chapter 7, while the final chapter provides a very brief introduction to lasers. The appendices include introductions to classical mechanics, theory of small oscillations, Maxwell field theory, and transformation of operators.

The topics included could well involve a book ten times the size of this one, but the author does a fairly good job in giving the reader a flavor of the topics covered. In order to cover some rather difficult material, he has had to simplify some derivations. This leaves a rather large gap between the analysis and the physical interpretation of the results which may be difficult for beginners to bridge. Although the book is relatively easy to read, the instructor will have to supply quite a bit of detail as well as a more physical interpretation of the results for the student.

WILLIAM H. LOUISELL

*Bell Telephone Laboratories,
Murray Hill, New Jersey*

Statistics for Biologists

Multivariate Statistical Analysis for Biologists. Hilary L. Seal. Wiley, New York, 1965. xii + 207 pp. Illus. \$7.75.

The author, Hilary Seal, presupposes that biologists, the intended audience of this slim volume of selected recipes, have a "nodding" acquaintance with normal, chi-square, and F distributions as well as the ability to differentiate between a parameter value and its sample estimate. His *modus operandi* consists of explication by illustration, utilizing data obtained from published biological and biometrical research. Typically a set of data is presented and then analyzed, often by several alternative statistical models which are in turn explained in some detail. Unfortunately, Seal frequently neglects to state for which population, implied by the model, the inference that he draws is valid, not a trivial point for the investigator. Vectors and matrices are introduced quite early and in a natural manner for the purpose of simplifying the algebraic manipulations. Computer routines

necessary for the calculation of the various estimates and tests of significance are given ample discussion.

The first half of the book, in which the case of a single dependent variate is discussed, consists of the following chapters: (i) "The linear model and its least squares analysis," (ii) "Orthogonal vectors and the analysis of variance," (iii) "Analysis of covariance," and (iv) "Multiple regression." Although all this, the author admits, is within the customary purview of the univariate analysis of many variables, he implicitly maintains that it is a necessary introduction to the main burden of the book, multivariate statistical analysis. In the second half of the book there are the following chapters: (v) "The p-variate linear model," (vi) "Principal components," (vii) "Canonical analysis" (chiefly a mixture of multivariate analysis of variance, discriminatory techniques, and canonical correlation), and (viii) "Factor analysis." There is also an appendix on computer routines and another on block designs with missing observations.

The book abounds with "Quotations from an Unfamiliar Bartlett," but, strangely enough, there is not a single reference to the foremost pioneer of multivariate analysis, Harold Hotelling. The very terms, principal components, and canonical correlations, as well as the methods, are entirely due to him. Indeed, we have here the first book on multivariate analysis that does not mention Hotelling's T^2 statistic, although it is implicitly used in a disguised form.

I feel that at the very most the impact of this text will be modest, and then only because of its chief attribute—exposing the numerical guts of particular techniques.

SEYMOUR GEISSER

*National Institutes of Health,
Bethesda, Maryland*

Earth Sciences

The Habitable Earth. Ronald Fraser. Basic Books, New York, 1965. 155 pp. Illus. \$4.50.

This book is a clear and vivid summary of recent geophysical, geochemical, meteorological, and oceanographic discoveries that are transforming the earth sciences. The years from 1950 to 1963 were notable ones in geophysics. Benioff recognized seismic