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. Sumner 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

vibrations of the whole earth that confirm exactly the previously developed theory of an earth core and shells. Elsasser and Bullard suggested that the earth's magnetic field is related to a self-excited dynamo in the core. Paleomagnetic orientations were found to vary between continents. The paleomagnetic data have revived Wegener's hypothesis (1911 to 1922) of continental drift. Perhaps Antarctica, South America, Africa, Australia, and peninsular India, carried on the backs of deep convection cells, began to separate approximately 250 million years ago.

Isotopic ages indicate that plants go back about two billion years, animals 600 million. The juvenile earth was probably unable to hold atmosphere or hydrosphere, and gases that were later expelled from the rocks probably did not include free oxygen, so that the first oxygen may have come from the decomposition of carbon dioxide during photosynthesis by the oldest plants. Animal life became possible after oxygen had accumulated.

Exploration of the upper air has shown that the earlier theories of atmospheric circulation were incorrect. At high latitudes the upper winds blow mostly east, a result of the Coriolis effect. A north-south exchange of heat and moisture is nevertheless effected, in Antarctica by high-level movements of air toward the pole and lower level movements away from it, in the northern hemisphere through the occasional whipping back and forth of the eastward moving jet stream (p. 122). Oceanographers have shown that turbid flows rush down submarine canyons (p. 71 and plate XIII), and that bottom currents, such as the counter current to the Gulf Stream (p. 142), move sand and silt on the floor of the deep ocean.

This book describes new knowledge. It does not emphasize sufficiently the incomplete or uncertain state of some theories, including the theory of continental drift.

A. O. WOODFORD
Department of Geology, Pomona College, Claremont, California

Pure and Applied Mathematics Series

Point Set Topology. Steven A. Gaal. Academic Press, New York, 1964. xiv + 317 pp. Illus. $9.75.

This is a textbook for a first-year graduate course and is therefore neither a treatise nor a one-semester affair for juniors and seniors. It has aspects of the former in its systematic treatment of some topics, but few of the latter; it would be difficult to carve an introductory one-semester course out of these rather firmly riveted 300 pages.

Beginning graduate texts on topology must treat certain topics—types of sets in topological spaces (open, closed, connected, compact, and locally compact), the various separation properties, continuous maps, metrizable spaces and metric spaces, convergence (sequences, and filters or nets), and processes for building new spaces from old ones. The introductory treatments for these being now well standardized, the distinguishing question is—what else appears in the text? As indicated by the subjects of the five chapters (topological spaces, separation properties, compactness and uniformization, continuity, and theory of convergence), the author has restricted himself essentially to the topics that have been mentioned; however, he has discussed some in considerable detail or in depth, notably uniform structures, the relation between paracompactness and full normality, and the relations between various separation properties. He has chosen to exclude algebraic topology, in sharp contrast to Hocking and Young, and to go into topological algebra no farther than the theorems of Stone-Weierstrass, Arzela-Ascoli, and Banach-Steinhaus, in contrast to Kelley. (He has, however, included material on real functions on linearly ordered spaces, with an eye to real variables.) In brief, here are 300 pages of general point set topology, done in detailed epsilonic style.

For each section there are exercises; these include too many explanations of solutions for my tastes. To postpone the treatment of functions to page 175 also seems questionable. There are excellent indexes of notation, authors, and subjects, and at the end of each chapter useful notes and a bibliography.

B. J. PETTIS
Department of Mathematics, University of North Carolina, Chapel Hill

Commentaries on the Literature

International Review of Forestry Research. vol. 1. John A. Romberger and Peitsa Mikola, Eds. Academic Press, New York, 1964. xii + 404 pp. Illus. $13.

In the preface to this first volume of a new series, the editors state that the series is addressed primarily to research workers, teachers, and advanced students, is academic and fundamental in its approach, and emphasizes biological principles. The articles published will contain reviews, summaries, commentaries, and syntheses based on the world literature, or they may deal with newly recognized problems. In any case, it is intended that they shall contain adequate and accurate surveys of existing literature. Although the publication is international in scope, the papers will be published in English, and a special effort will be made to keep the style simple. Authorship will be by invitation. Both authors and subjects will be selected with regard to study and research in forest science, whether or not they are attached directly to professional forestry proper. The editors are aided by an internationally constituted editorial advisory board.

The present volume contains seven articles: Kurt Mantel (University of Freiburg), "History of the international science of forestry with special consideration of Central Europe"; Leo Heikurainen (University of Helsinki), "Improvement of forest growth on poorly drained peat soils"; Carl Olof Tamm (Royal College of Forestry, Stockholm), "Determination of nutrient requirements of forest stands"; Charles W. Ralston (Duke University), "Evaluation of forest site productivity"; Lalit M. Srivastava (Harvard University), "Anatomy, chemistry, and physiology of bark"; Ken-ichi Hatano (University of Tokyo) and Suminiko Asakawa (Government Forestry Experiment Station, Tokyo), "Physiological processes in forest tree seeds during maturation, storage, and germination"; and A. D. Voûte (Institute for Biological Field Research, Arnhem, Netherlands), "Harmonious control of forest insects."

The editors' maiden voyage suggests that their ship will be a happy one. The book contains a wealth of valuable material, on several subjects, gathered together in one place for ready reference. It is well printed, illustrated,