The treatment in general is adequate for a graduate student of mathematics, and is accessible on a rather elementary level, in principle. In fact the author does not cater to everyone who might use functional equations. His applications are not to kinematics, to economics, to computing, and to logic, but to mathematical analysis. From the standpoint of the research mathematician, the book is a compendium of useful techniques, results, and references. For undergraduate study it needs additional motivation and exercises.

Finally, I consider from my limited viewpoint the question of coverage. It seems to me that inequalities might have been used to better advantage. For example, subadditive functions satisfy a functional inequality. So do convex functions. Embedding the equalities deliberately in inequalities even when emphasizing the former would have definite advantages in techniques, proofs, and generality.

Next, the general principles are often obscured in techniques. I hold to the opinion that a theorem or result is best presented in the most general fashion available, provided this does not generate an unbearable degree of complexity in the conditions. Much of the theory presented holds in a context of partially ordered semigroups or groups. I have discussed several Boolean functional equations which are analogous to certain ones considered here. Such functional equations, implicit in definitions of topology, for example, are not discussed. However, on the grounds he has chosen, those of classical analysis, the author has done a thorough job.

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Elemental Concepts of Science

Philosophical Foundations of Physics. An Introduction to the Philosophy of Science. RUDOLF CARNAP. Martin Gardner, Ed. Basic Books, New York, 1966. 310 pp., illus. $6.50.

Rudolf Carnap is the greatest living philosopher of science in America. He is justly famous for fundamental contributions to formal logic and semantics, the theory of scientific meaning and explanation, inductive logic and probability, and the philosophy of physics. His work is unmatched in scope and significance. It embodies the highest degree of technical precision and has been widely influential in setting standards of exactness in contemporary philosophy of science. His writings, although always models of clarity and thoroughness and much prized by professional philosophers of science, have not often been easily accessible to the general reader.

The present book is a very different sort of work. It is a sustained exhibition of Carnap's talent as an inspired teacher who can make the most abstract technicalities intelligible to the uninitiated. It is the remarkable fruit of collaboration with Martin Gardner, a well-known science writer. Using transcriptions of Carnap's seminar talks on philosophy of physics, Gardner, who had earlier attended a similar course by Carnap, composed the book. Carnap made revisions and checked the accuracy of the manuscript. One has the feeling that the outcome is distinctively Carnap in content and tone. This is a tribute to Gardner's skill and sensitivity. The result is an extremely readable and relatively nontechnical presentation of a wide range of fundamental material in philosophy of science.

The book is actually much broader in scope than its title may suggest. The illustrations are usually drawn from physics, but most of the issues discussed have applicability to all of the empirical sciences—physical, biological, or social. It is mainly concerned with the nature of laws, theories, explanation, confirmation, probability, measurement, and causation. In addition, there are discussions of space, time, and indeterminism in modern physics.

It is a rare and delightful occasion when a great man produces a well-constructed introduction to his field. Until now, we have not had such a book in recent philosophy of science. There have been popularizations and introductory textbooks, but the popularizations have often been contentious and the textbooks have often failed to be elementary. Books of each type have frequently bought simplicity at the price of inaccuracy. The present book does not share these disadvantages. Carnap's views are set forth in clear, intelligible, undogmatic terms; though many may disagree with them, they are serious theses soberly presented. Technical details are often omitted, but supplementation rather than correction is needed to provide the full account. The simplicity has been achieved, moreover, without sacrificing the basic issues. Carnap constantly has his finger upon the essentials, and for this reason the book is elementary in all of the best senses of that term. It is, in my opinion, by far the best book available for the intelligent reader who wants to gain some insight into the nature of contemporary philosophy of science. By virtue of its scope, its accuracy, its penetration, and its stylistic excellence, this book seems likely to achieve recognition as the classic introduction to mid-20th-century philosophy of science.

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Studying Animal Populations

Ecological Methods. With Particular Reference to the Study of Insect Populations. T. R. E. SOUTHWOOD. Methuen, London; Barnes and Noble, New York, 1966. 409 pp., illus. $13.50.

Southwood, who is reader in insect ecology at the University of London, has given us an excellent book, one which should be of lasting value to ecologists. One of its important features is that the large and scattered literature in this field has been gathered and analyzed critically. There are 14 chapters. Following an introduction, the sampling program and measurement and description of dispersion are considered. This is followed by a series of chapters dealing with absolute population estimates: by use of marking techniques, and by sampling a unit of habitat (air, air plants, plant products and vertebrate hosts, soil and litter, fresh water). Then comes a chapter on methods for relative population measurement and for derivation of absolute estimates. Estimates based on products and effects of insects are considered. Both observational and experimental methods for estimating natality, mortality, and dispersal are examined. Construction, description, and analysis of age-specific and time-specific life tables occupy two chapters. The construction of life tables is done in such a manner that only a modicum of background experience is needed to understand the procedures. These chapters are followed by a short one on the experimental component analysis of population processes. Then a much longer chapter on

measurement of association between species and the description of a fauna. The final chapter, of especial value to this reviewer, is on productivity estimation and construction of an energy budget. Each chapter is heavily documented, with its own bibliography. A single comprehensive bibliography would have been of more value, in my opinion.

Where feasible, Southwood has drawn data from insect population studies, but studies on other invertebrates of aquatic and terrestrial habitats are included. The emphasis is on field techniques, but of necessity some laboratory experiments are cited. Throughout the text the ecological methodology is based on the biotic aspects of insect populations and relatively little is said concerning mensuration of physical factors or the important interplay between physical and biotic phenomena. This is a perfectly legitimate point of departure, but it would have been helpful to have it indicated in the book's title.

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Text in Plasma Physics

Introduction to Electrical Discharges in Gases. SANBORN C. BROWN. Wiley, New York, 1966. 296 pp., illus. $9.95.

The dramatic growth of plasma research and of the physics of ionized gases in recent years has generated new interest in the study of electrical discharges. The need for modernized textbooks covering this subject is therefore apparent. In this volume Sanborn C. Brown of M.I.T. has managed at least partially to fill this need. Being a direct descendant of Brown's earlier *Basic Data of Plasma Physics*, this new version is still classical, in the sense that it emphasizes the fundamental ingredients such as elastic and inelastic collisions, mobility, diffusion, ionization, and recombination coefficients as well as surface effects and breakdown criteria. This material is treated well and systematically, and purposely on a fairly elementary level. The description of actual types of discharges is rather fragmentary, however, and at times disappointingly sketchy. The author's own interest in high-frequency phenomena is apparent throughout the volume, and in view of their general importance this may be an asset rather than a disadvantage. Contact with several modern developments is established by inclusion of the effects of magnetic fields in the treatment of diffusion, ionization, and breakdown, as well as by brief remarks about hollow-cathode arcs and electrically driven shocks. Unfortunately, these remarks are so sketchy that they may be misleading. In fact, the discriminating reader may find fault with several passages in this book which are not altogether satisfying (such as an improper derivation of the Debye length in the discussion of ambipolar diffusion). Some readers may also be disappointed not to find discussions of recent advances in our understanding of striations, fluctuations, and instabilities, or of new developments in discharge types, as for instance brush-cathode glows, reflex discharges in magnetic fields, or high-power pulsed discharges such as theta pinches. All such material is to be considered beyond the scope of this text and is left to the student for supplemental reading in the original. It should be noted that the literature cited barely extends into 1963. The author's intentions are best summarized by his own opening statement in the preface: "This book is written as a text for a one-semester introductory course in gas discharge physics at the advanced undergraduate or early graduate level. It makes no attempt to be complete but rather attempts to survey the areas of physics involved and to illustrate the types of problems and techniques used in this branch of physics." The author certainly succeeds in keeping the book short by restricting his material mostly to the essentials of discharge physics.

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Permian Palynology

The Systematics and Distribution of Permian Miospores. GEORGE F. HART. Witwatersrand University Press, Johannesburg, South Africa, 1965. 260 pp., illus. $12.05.

The purpose of this book is to bring order out of nomenclatural chaos by presenting a uniform classification for Permian miospores. The book contains an introduction, a discussion of fundamentals of Permian palynology, 129 pages devoted to systematics, 6 pages concerned with distribution of Permian miospores, a bibliography of 199 entries, an index, and more than 400 line drawings, charts, and tables. Whether or not the author has resolved many of the nomenclatural problems is open to question. One hundred thirty-five new combinations are proposed, two new genera and two new species are described, and two genera are emended.

The classification used by Hart utilizes supergeneric categories advocated by Potonié, such as ante-turma, turma, sub-turma, and infra-turma. The major subdivisions are ante-turma Pollenites for pollen grains and ante-turma Sporites for spores.

One hundred seven of the 199 publications listed in the bibliography are Russian. A number of genera and species are described in these publications, and, to my knowledge, the illustrations in the publications are chiefly drawings. Drawings may or may not convey the proper concept of a taxon, although when used in conjunction with photomicrographs, they can serve a useful purpose, that of conveying the author's interpretation. Hart, in his acknowledgments, writes, "I have studied and photographed holotype and paratype material of Soviet permian species and examined the bulk of Soviet permian palynological literature." Thus he presumably could have illustrated the taxa proposed by Russian palynologists by means of photomicrographs. Not a single photomicrograph appears in the entire book, however. There are 410 drawings and diagrams representing pollen grains and spores. More than 30 of these drawings are duplicates serving no useful purpose. For example, figure 274 represents *Laricoidites*, whereas figure 275 is the same drawing turned upside down and represents *L. levis*. A photomicrograph of the holotype, *L. levis*, would have been of much greater value, since the original description of the species by Luber and Waltz in 1941 was illustrated only by means of a drawing.

Although some papers appearing in 1963 are cited in the bibliography, the significant contribution by Klaus, published in May 1963, is missing. Obviously Klaus's 130-page paper was not available to Hart. This is most unfortunate, for some important differences between the two authors remain unresolved. These include, for example, the acceptance of *Platysaccus*, *Striatites*, and *Strotersporites* by Klaus, with the last two genera emended, and the re-