much has actually settled into final form, the book is a useful review of the current state of the art and contains an appropriate supporting bibliography. The word "art" is used deliberately. As Piddington correctly notes, many of the problems currently under examination are being investigated by a judicious combination of firmly established theory, physical intuition and suitable approximations. And there is, of course, a paucity of experimental data.

Piddington has contributed actively to many of the areas treated, and this is apparent in the concise yet clear manner in which he has reduced a large bulk of material to sensible proportions.

The principal merit of the book is that it provides a ready orientation in the various topics subsumed by the title. All a potential reader requires is a reasonable background in electromagnetic theory at the graduate level. The book provides a kind of précis indicating methods; it states general results and provides a supporting bibliography. It should be clearly understood that the book is not intended as a test for either class room work or for self-improvement. For instance, its 16-page chapter on "Principles of Cosmic Electrodynamics" is certainly not intended to compete with any of the presently available 400–500-page texts on the electrodynamics of plasmas. It is an introduction and guide to a number of related research areas. The detailed study must be based on other text and literature materials.

Three introductory chapters outline the basic results from theoretical magnetohydrodynamics, their application to plasma physics and their utilization in the treatment in a general way of the specific problems to be encountered. There then follows discussion of the electrodynamic aspects of solar activity, the solar-planetary interspace, the planetary fields and radiation belts, and, finally, galactic dynamics, radio galaxies and the array of quasars and other mystifying cosmic objects.

The book has a stated point of view. It is concerned primarily with the magnetic field in determining the structure of the phenomena discussed. This leads to a treatment of such topics as galactic dynamics and other cosmic phenomena that is somewhat one-sided. The uninitiated reader should be aware of these matters and the currently wide diversity of opinions among experts.

A book that deals with a particular aspect of largely unsolved problems will not only present, as indicated, a single point of view; it will be necessarily quite subjective as to choice and weight of material. Universal agreement as to the topics to be included, the extensiveness of the treatment and the choice of bibliographic support is not to be expected. These are all constraints to be understood rather than bases for objections. Piddington has made a useful and successful effort.

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Electronic Principles: Physics, Models, and Circuits

By P. E. Gray, C. L. Searle
1016 pp. Wiley, New York, 1969. $15.95

The prominent feature of this book is that, in accordance with the present trend in the development of electronics, the whole exposition is based on semiconductors rather than on vacuum tubes, the description of the operation and uses of the latter being deferred to appendices. It was found convenient to introduce the behavior of semiconductors by means of the qualitative valence-bond model rather than through wave mechanics and the band-energy model. This approach is satisfactory, from the electronic-engineering point of view, in providing a quantitative presentation of semiconductor junctions. No quantitative background in quantum theory is thus required. "The book begins with the physical principles that are involved in the operation of semiconductor components, proceeds through the physical electronics, modeling and circuit characteristics of these components, and engages the questions and problems that arise in the computer-aided design of complex multistage amplifiers and functional assemblies of the type found in modern integrated-circuit packages." The text, based on courses taught at Massachusetts Institute of Technology, is very carefully presented, with numerous worked-out examples and problems and with suggestions for demonstrations. It is so well framed that it appears to be suitable even for self-study.

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Physics of Sound in the Sea

By Lyman Spitzer, Jr, P. G. Bergman, A. Yaspan, E. Gerjuoy, J. K. Major, R. Wildt
566 pp. NAVMAT P-9675, US Government Printing Office, Washington, D. C., 1969. $7.00

Oceanography, although a recognized discipline in the 1930's, underwent a rapid acceleration in the 1950's and 60's to take its place today as one of the most talked-about fields of scientific endeavor. Much of the initial impetus for this burst was derived from the close wartime association between the oceanographers of the Woods Hole and Scripps Institutions of Oceanography and the physicists who came from their many laboratories to join the Columbia University and University of California underwater-sound research group

at New London, Connecticut and San Diego, California, respectively. In 1946, as these various groups were closing their operations sponsored by the National Defense Research Council, they produced a set of summary reports. The recent growth of oceanography and its strong dependence on acoustic techniques has led to the reprinting of two of these, which are particularly remarkable documents still of great use to anyone beginning to work with sound in the sea. One of the two reports, edited by Carl Eckart (Associate Director of the University of California group), was reviewed in these pages in March, 1970 by Robert Shankland. The other, treated here, was edited by Lyman Spitzer in his capacity, at that time, as Director of the Sonar Analysis Group of Division 6 of NDRC.

This book is nearly twice as thick as Eckart's and consists of four major parts (originally published as four separate volumes): transmission, reverberation, reflection of sound from submarines and surface vessels and acoustic properties of wakes. While there is naturally some duplication, the two books are in fact complementary. Eckart stresses passive sonar (listening) and environmental aspects, including particularly the naturally occurring noises of the sea. Spitzer emphasizes active sonar (echo ranging), and hence the extensive treatment of reverberation and target-reflection characteristics. The most useful portion of the latter volume over the years, however, has been in providing beginners with one of the most compact, yet professionally satisfying, treatments in print of the theoretical aspects of sound propagation in fluid media. In two chapters, written jointly by P. G. Frank, A. Yaspan and P. G. Bergman, the basic physics is developed to provide insight into such topics as energy transfer, normal-mode theory and the ray-acoustics approximation. This last topic, which is very well handled, is a particularly important one to the user of underwater sound because the nature of the medium and most equipment place most calculations in the range in which the ray approach is valid.

There was considerable activity in this field in that period, and cooperation was good among the several groups in the UK, Canada and the US. This is particularly evident in the manner in which the editors drew extensively from many sources. The lists of references are extensive, although most are to technical reports not now available. They do, however, serve to indicate the research groups and individuals who were active. Some sections of the text can be read with a similar viewpoint because they document the kinds of experiments that were performed by these very capable people as they moved into a relatively untouched field and learned to cope with the problems of bringing back useful information from the sea.

Although a number of texts have been published in this field since these reports were written, the reports nevertheless still remain very useful as introductions to underwater acoustics and informative historical documents.

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Initiation à la Physique Relativiste

By Régis Dutheil

150 pp. Gauthier-Villars, Paris, 1969. 19F

Here is a real "introduction" that is concise, informative and that looks back to the first principles and leads towards the ultimate limits of today's exploration. Regis Dutheil, a professor at the Facultés de Médicine, University of Paris, has here mastered this bold undertaking. He leads the reader up the steep path of a mathematical, most lucidly presented derivation of all the essential aspects of the theories of relativity.

In a brilliant exposition Dutheil tells us how, since the days of Neanderthal Man up to the end of the 19th century, the time concept had remained unchanged; how the flow of absolute time, running on inexorably, always in the same rhythm, was a real archetype impregnated into the human species since its very beginning. He details how, with Einstein's introduction of relativistic mechanics, light was thrown on the haunting problems of time, space and determinism; how absolute time was replaced by a new concept—different time for each single observer; and how Hermann Minkowski was able to declare: "Von Stund' an sollen Raum für sich und Zeit für sich völlig zu Schatten herabsinken und nur noch eine Art Union der beiden soll Selbständigkeit bewahren."

The reader is shown how, since then, the whole of physics has become relativistic; how, for instance, today's nuclear physicists write their accounts of energy balance in nuclear reactions in the language of relativistic dynamics; how the laws of mechanics are now adapted to high accelerations; and how, unfortunately, the production of atomic and hydrogen bombs became another "preuve éclatante" of the validity of Einstein's physical world. These are only a few of the examples presented by the author, who, when encouraging the reader to make the necessary extra effort for a proper understanding of the deductions of his book, reminds him that the real obstacles are not just of a mathematical nature, requiring the mastery of unusual disciplines, but lie essentially in the "révision d'un véritable condi-