predict from afar exactly what a moon-traveller may find, some day soon perhaps, cannot but transmit itself to the reader. Throughout there runs the vein of wonderment voiced by Captain Boyle: "*What* is the moon? And *what* is the stars?" [sic]

This book is meant mainly for the layman. We have had for a long time a great deal of information about the moon from visual observations—from the point of astronomical distances it is incomparably closer than any other celestial object. Yet its inertness and impassivity present a peculiar and fascinating challenge in that it is extremely difficult to obtain very much more information than can be gotten by visual observation. The author describes how optical, infrared, and radio spectroscopy allow certain properties of the lunar atmosphere and surface to be determined. These techniques are all explained quite simply and clearly. He discusses in detail the extraordinary activity in the crater Alphonsus observed two years ago by Kozyrev; the "cold" moon school whose disciples hold that the lunar craters were the result of impacts and the "hot" moon adherents who favour volcanic activity as the explanation both used this new evidence with equal persuasion in renewed polemics.

When it comes to describing space probes, and circumnavigating and photographing the rear face of the moon, Professor Kopal becomes really enthusiastic. There are none of the usual conservative words of restraint here. Clearly the sooner a human being can get up there and take a look at things the better he will like it. This is more, however, than just refreshing optimism, for he has taken considerable pains to think through the problems (and also the simplifications) of life for the man on the moon.

This is an attractively produced book, and has an excellent selection of photographic plates.

**Manual of Mathematical Physics.** By Paul I. Richards. 486 pp. Pergamon Press, London & New York, 1959. $17.50. *Reviewed by R. Bruce Lindsay, Brown University.*

THE extent of theoretical physics is now so vast that the urge to provide manuals, handbooks, collections of basic formulas, brief encyclopedias, dictionaries, etc., for ready reference is not surprising. In fact, many such works have appeared during the past few years. The volume under review is unique among these compendia in that it is the work of a single author and as such constitutes a veritable tour de force. In less than 500 pages the author has managed to present in highly condensed form the contents of a whole library. Unlike some recent reference manuals the book is divided into two parts of about equal length, the first devoted primarily to physics and the second to mathematics. It is not simply a collection of formulas, but attempts to introduce a connected account of each topic through the deduction of the most important results from basic assumptions and princi-

ples. To this extent the book almost serves the purpose of an advanced text. The coverage is indeed impressive: in physics, respect is paid not only to classical mechanics of particles, rigid and elastic bodies and fluids; but thermodynamics, statistical physics, electromagnetic theory, relativity, and quantum theory are also included. The mathematics part covers not only the standard material on series, vector analysis, differential equations, complex variables, etc., but also treats such topics as unitary spaces, integral equations, group theory, eigenvalue problems, and probability and game theory. In general the treatment appears to be sound and the notation well thought-out and adequate.

In any attempt to cover such a large body of material in a condensed fashion, certain shortcomings are almost certainly apt to creep in. An obvious one that might be corrected in a later edition is the absence of an adequate bibliography. References are few and are confined almost entirely to journal articles. The use of footnotes and small print is excessive. The list of physical constants is inadequate for a reference book. The index is good but hardly constitutes the dictionary intended by the author. More serious, perhaps, is the lack of definition of such important quantities as force and mass, electromotive force, intensity of a wave, virial of a system (though the virial theorem is given in a number of forms). Not enough is said about the nature of the averages used in the discussion of statistical physics, and there is no mention of the ergodic hypothesis. Notational variations may get in the way of the understanding of some readers, e.g., vectors are sometimes represented by the standard boldface notation and at other times by a caret over an italicized letter. There is occasional carelessness in the expression of some theorems, e.g., the work-kinetic energy theorem, where it is not emphasized that the force in question must be the *resultant* force on the particle, a difficulty that has caused many an elementary student to stumble.

These specific criticisms are not intended to depreciate the value of the book. It is in general very well put together and should prove useful for the working physicist.

**Hydrodynamics of Oceans and Atmospheres.** By Carl Eckart. 290 pp. Pergamon Press Inc., New York, 1960. $9.00. *Reviewed by J. Gillis, The Weizmann Institute of Science.*

"THE differential equations of hydrodynamics are partial, but the general ideas of perturbation theory remain applicable. . . . It is often said that they do not lead to useful results in hydrodynamics. Two reasons for this may be considered: either the basic equations of hydrodynamics may be wrong, or the perturbation method may have been used with inadequate care. A survey of the literature tends to support the second surmise. In any event it is premature to accept the first alternative without a much more thorough investigation than has yet been made. The following papers contain the beginnings of such an investigation. . . ."

This succinct and forthright declaration of belief sets the tone from the start, but it certainly understates the scope and achievement of the book under review. What it contains is much more than the beginning of an investigation. We are introduced in fact to all the more important problems and the methods by which they are attacked. For the reader who wants to know what meteorology and oceanography can mean to a mathematician, the answer is here; but he will not come by it easily. This is serious stuff and presented with quite formidable power and conciseness.

The first part of the book is devoted largely to an analysis of large-scale atmospheric motion and includes some general chapters on the equations of hydrodynamics, some of their simpler solutions, and various modes of perturbation of such solutions. The physical realities of the problems are never lost from view, and the work constantly keeps referring back to the real atmosphere for criticism as well as for support. There is an extremely interesting, though all too brief, chapter on the earth's atmosphere, oceans, and lakes. With an easy mastery of the subject the author summarizes the main physical features and their significance for such central questions as stability and cyclogenesis. The subsequent discussion of isothermal atmospheres, both with and without rotation, is very practical in spirit. Traditional meteorological calculations have all neglected the horizontal component of the Coriolis vector. Here it is shown that this cannot be justified, since however small, it plays a critical role in the propagation of Lamb waves.

The second half of the book concentrates on dynamical oceanography. For the first time in a textbook the problems of oceanography are treated by quantitative mathematical methods rather than in terms of physical generalities. Wave motions are discussed from the point of view of ray theory and also by the eigenfunction analysis of the residual equations. Both methods lead to significant results.

The Laplace theory of tides is quoted, chiefly to show how the traditional approximations enable separation of the variables. The numerical solution of the full equations by Pekeris and Dishon was subsequent to the appearance of the book and is not mentioned.

The methods displayed in this book are taken from almost the whole field of mathematical analysis. There are no trivial solutions and no easy plums. There are useful bibliographies at the end of each chapter, selected so as to enable the reader to find what he wants and without unnecessary duplication. This is a refreshing change from the practice of those authors who regard the bibliography not only as information to help the reader, but also as an opportunity to display erudition.

This book is very strongly recommended to all who are prepared to invest some effort in the study of the subjects within its scope.