several telescopes with apertures of 120 to 200 inches each.

In attempting to answer such questions, the reviewer believes that, at the present time, most of our knowledge of the universe rests upon results obtained with large ground-based optical and radio telescopes; also that the range of important problems that can be studied with such existing telescopes is enormous. Hence, it is reasonable to conclude that ground-based telescopes will continue to play an important role in astronomy for hundreds of years, and that their improvement must continue along with the development of the more spectacular types of space telescopes, or of telescopes that may some day be built on the moon.

It is much more difficult to make specific recommendations, and the reviewer is undoubtedly "sticking his neck out" in making the following proposals:

1. The construction of one very large reflector with an aperture of 400 or 500 inches can probably be justified, even now, in the light of existing technological knowledge and in the light of existing problems requiring solution.

2. The construction of special-purpose telescopes of appropriate size should be encouraged. The US Naval Observatory project for an astrometric reflector of fairly large size is a step in this direction. There should be other special-purpose telescopes, for example, one for the determination of accurate optical stellar radial velocities, one that will be treated as a precision measuring instrument devoid of many systematic and accidental errors that arise when one and the same telescope is used for many different types of observations.

Small Particle Statistics. An Account of Statistical Methods for the Investigation of Finely Divided Materials (2nd ed.). By G. Herdan, with a Guide to Experimental Design by M. L. Smith, W. H. Hardwick, and P. Connor. 418 pp. Academic Press Inc., New York, 1960. $14.50. *Reviewed by E. J. Öpik, University of Maryland.*

THE universe is built into a discontinuous assemblage of material particles, from atomic nuclei to stars. The size distribution of the nonquantized particles, or those above atomic dimensions, is a common ground for diverse disciplines, such as astronomy, geophysics, chemistry, biology, medicine, agriculture, technology of various materials, and above all physics, which encompasses all of them. Statistics provides the common instrument of representation and interpretation. Although the book does not mention meteors (which are small enough), or asteroids, planets, and stars (which, of course, are too big), and the names of only two astronomers appear in the author index of this monographic study, the reviewer finds himself here on familiar ground, with theoretical methods he has used himself, and with experimental data directly applicable to astrophysical problems. This may serve as a measure of the usefulness of the book to all those concerned with populations of particles (not necessarily small), whatever part of the universe they are interested in. Monographic literature on the subject is virtually nonexistent; Herdan's treatise thus fills an important gap and is an answer to urgent demand.

It is written with the utmost consideration for the unprepared reader, of whom little previous knowledge of mathematics is required. The formulae of statistics and their use are explained clearly and often in more detail than is necessary for workers in the exact branches of natural science. A considerable portion of the book is dedicated to giving an equivalent of an easy textbook on conventional statistics, theory of errors, and linear correlation. The mathematically, although not practically, more sophisticated notion of nonlinear correlation is, however, nowhere mentioned—a common though unfortunate practice since Pearson's time. Nature's correlations are nonlinear as a rule; the linear approximation usually works, but sometimes it may fail altogether.

Great care is also taken in describing and evaluating the absolute and relative methods of measuring and counting particle diameters: by direct microscopic measurements, by sedimentation, by permeability to liquid flow, and by optical extinction. However, in the treatment of the optical methods, the different processes of extinction by reflection, diffraction, and absorption are not considered; here the application of astrophysical theory could have helped to remove some basic uncertainties.

Consideration of meteor statistics could have enriched the subject by a new type of frequency function, without a maximum and with a monotonous increment of numbers for decreasing size, which can be schematized by a power law. This may be a more universal law of size distribution than the Gaussian or pseudo-Gaussian distributions analyzed in the book, with a diameter of maximum frequency, as is the case with terrestrial samples influenced by various natural selection factors.

The book is a unique and valuable contribution to the methodology of the study of particle sizes and their distributions and can be recommended as indispensable to all those concerned with the statistics and physical properties of particulate matter.

The Theory of Brillouin Zones and Electronic States in Crystals. By H. Jones. 268 pp. (North-Holland, Amsterdam) Interscience Publishers, Inc., New York, 1960. $9.50. *Reviewed by Nicholas Chako, Queens College.*

THIS is an extremely interesting and valuable book on the theory of electron energy states in crystals. The material is presented clearly and requires only a limited background in mathematics. It provides an account of the theory and methods which are of general validity rather than a detailed analysis of specific topics requiring long and complicated calculations. The subject matter is developed along the theory of Brillouin zones, which has proved so useful in the theory and interpretation of electron energy bands in metals. Essentially, it is a study of the wave properties of the solutions of Schrödinger's equation for periodic potential fields, which depend on the degrees of symmetry (group properties) associated with various crystallographic forms. Therefore, the theory and its applications for the determination and classification of energy states in crystals is based on the single-electron model, which, in spite of its shortcomings, has been very successful in the understanding and interpretation of the experimental data.

The author begins with a discussion of the solution of the one-dimensional Schrödinger equation in a periodic field, the Block functions, a detailed account of Brillouin zones for various crystallographic groups, and symmetry properties of the wave functions of these groups. This is followed by a detailed analysis of group operations and their reduction to regular representation for point groups, and tables of characters of point groups, and the classification of electronic states associated with different crystallographic groups. Of particular importance is the discussion and analysis of electron states in space groups containing slide and screw displacements with application to closely packed structures (especially the diamond) and the extensions of the theory to large zones. The last two chapters contain a treatment of the determination of the wave functions and energy bands by using such methods as the linear combination of atomic orbitals, the method of superposition of plane waves, and the so-called cellular method. The latter procedure has yielded successful results when the degree of symmetry is high. A discussion of the effects on the structure of the states brought about by the coupling of the spin with the angular momentum of the electron is also included. The references accompanying each chapter, although not exhaustive, provide the reader with sources on recent developments.

Theorie des Aufbaues der Materie. By Friedrich Hund. 313 pp. B. G. Teubner Verlagsgesellschaft mbH, Stuttgart, 1961. DM 37.60. *Reviewed by R. Landshoff, Lockheed Missiles and Space Company.*

INTERATOMIC forces play an important role in determining the structure of matter; they are responsible for the binding of atoms into molecules and for their association in crystals, as well as less regular solids or liquids. The long-range electrostatic forces between ions are a familiar concept of classical theory; most other forces between atoms or molecules can only be explained with quantum theory.

This book introduces the reader to the most important ideas which give an understanding of how the various types of association come about. After a discussion of condensation, the book turns to crystal lattices and to the factors which influence the type of lattice formed by specific atoms and ions.

After a brief introduction to quantum theory, it is shown how one can explain interatomic forces. The formalism is developed for the diatomic molecule and then extended to more complicated types of chemical binding. An important aspect of this theory is the existence of symmetries and their utilization by means of group theory. The latter part of the book deals with properties of solids, particularly those which are influenced by the grouping of electronic energy levels into bands. The Bardeen-Cooper-Schrieffer theory of superconductivity has unfortunately been omitted.

The book emphasizes a qualitative rather than a quantitative understanding and steers away from detail which might detract from the main argument. Such a program has an obvious appeal, but in the process of eliminating detail, the book occasionally goes a bit too far. For the trained physicist, who can reproduce missing links, this presents no difficulty, but the novice may require a helping hand or additional source material. With such help, the presentation will indeed give him a clear understanding of the basic concepts which are used to explain the structure of matter.

Enrico Fermi

Notes on Quantum Mechanics. A Course Given by Enrico Fermi. 171 pp. U. of Chicago Press, Chicago, Ill., 1961. Paperbound $1.50. *Reviewed by Kamal K. Seth, Duke University.*

ALMOST all of the creators of quantum mechanics have at one time or another written a book on the subject, and most of these books, for example Heisenberg's or Dirac's, have become classics. They vary in their approaches as well as in level of presentation. Consequently, a teacher of quantum mechanics usually has to formulate his own approach to the subject. Several excellent texts in the field also exist (for example Schiff's, which has in its own right become a classic)