view, and to other natural sciences, in particular, biology. He goes on to consider the implications of the theory of relativity for a consistent picture of the universe. He then deals with the criticisms of Einstein, Bohm, and others. Finally he investigates the effects of quantum theory on theories of matter and on the development of language and logic. The book, originally the Gifford Lectures for 1955–56, is wholly a philosophical treatment, at the so-called semipopular level, of the present state of problems of materialism, existence, and reality in the light of modern physics.

Heisenberg makes the well-known statement that classical physics applies for velocities much smaller than the velocity of light, and for actions much larger than Planck's constant. He goes on to suggest the possibility of a third natural dimension to combine with these two constants, a length of the order of 10^{-13} cm. Then classical concepts would apply only for dimensions much larger than this. To reduce the mental difficulties of picturing atomic events, he suggests applying the Aristotelian concept of "potentia". On this basis pictures in our minds would "represent only a tendency toward reality".

So excellent a book could be considerably improved by the inclusion of even a brief index of the terms used, to indicate the depth of their meaning, and the breadth of their applicability. For instance, what is the variety of examples that make vivid the concept of complementarity? It is unfortunate that Heisenberg's text, marked by clarity and conciseness, should be preceded by an unclear editor's introduction and an unconcise philosopher's introduction.

An Introduction to Scale Coordinate Physics: An Introduction to the Formalization of the Macro Operational Point of View. By William Bender. 340 pp. Burgess Publishing Co., Minneapolis, Minn., 1958. $7.50. *Reviewed by R. Bruce Lindsay, Brown University.*

In this book the author presents what he terms the macro operational point of view in physics. By this he appears to mean the attempt to describe all physical phenomena in terms of quantities immediately measured by laboratory apparatus. He feels that this program can be carried out most effectively by reducing all analytical formulas in physics to nondimensional form. In this process, however, the author retains a special symbol for the dimensional factor and expresses the numeric in the form of the sum of two symbols, one an integer and the other a proper fraction. This has the effect of replacing the single symbol, usually associated with a physical coordinate, with three symbols, or what he refers to as a scale coordinate. The resulting increase in complexity in the writing of the equations of physics is obvious and unfortunately the author does not make clear any compensating gain in clarity or understanding. Most of the book is devoted to a rewriting of physical equations in terms of the new coordinates. There is a good deal of discussion of physical methodology but it is unsystematic, repetitious, and with little or no reference to the large body of literature now extant on the nature of physical theory and physical concepts. Numerous typographical errors render the reading of the book difficult.

Exterior Ballistics of Rockets. By Leverett Davis, Jr., James W. Follin, Jr., Leon Blitzer. 457 pp. D. Van Nostrand Co., Inc., Princeton, N. J., 1958. $8.50. *Reviewed by S. F. Singer, University of Maryland.*

This book develops the ballistics during burning and during atmospheric flight of simple rockets, i.e., rockets having no moving surfaces. It thus deals with rockets whose stability depends either on fins or on spin. The volume, therefore, contains no discussion of servo loops, errors in control systems, etc. There is no treatment of rocket propulsion as such (this belongs to interior ballistics) nor of terminal ballistics. Neither is it a textbook of aerodynamics. (In fact references to drag coefficients and similar aerodynamics data seem strangely antiquated.) Therefore, drag coefficients for a given rocket configuration must be obtained from other sources.

The volume had its origin in the Cal Tech OSRD project during World War II when rapid strides were made in the development of small solid-fuel rockets. The accompanying theory was developed as needed and subsequently published as a classified document. The present volume is a declassified version which has been corrected and to which new figures have been added.

The first half deals with fin-stabilized rockets. The forces acting on the rocket system during and after burning are carefully discussed and then the equations of motion derived and solutions obtained. To give an indication of the detail of the treatment there are sections entitled: Effect of a Constant Linear Thrust Malalignment, and as a subsection: Effect of Launcher Length.

The all-important problem throughout is the dispersion of the rocket, i.e., its accuracy. There are many factors responsible for inaccuracies such as bent fins, moving launchers, and high winds at launching. These and others are discussed in detail and their effects evaluated. If all care is taken, the final inaccuracy is still produced by the nonuniform flow of the rocket gas through the nozzle which gives rise to a thrust misalignment. This in turn causes a torque which points the rocket away from the proper direction. Rotation will average out this thrust asymmetry to a certain extent and larger fins are also helpful since they provide a greater aerodynamic restoring moment. Unfortunately, the fins are not very useful in the critical launching phase since the velocity and therefore the aerodynamic forces are very small. (This latter objection does not apply to aircraft-launched rockets since here the rocket already has a high initial velocity, namely that of the airplane.)

For this reason it is often desirable to spin the rocket extremely rapidly and eliminate the fins altogether.