

Book Reviews

A New Exposition of Nuclear Physics

Nuclear Structure. Vol. 1, Single-Particle Motion. AAGE BOHR and BEN R. MOTTELSON. Benjamin, New York, 1969. xiv + 474 pp., illus. \$25.

Bohr and Mottelson were already well into the writing of *Nuclear Structure* in 1961, when I visited Copenhagen. Now the first of the three volumes of this work has finally appeared, and it is fully as revolutionary as had been expected by those who were familiar with the lectures and publications of the authors. The set of volumes is evidently going to be the standard of reference in nuclear structure physics for many years.

Usually, the evolution of books in a particular field is gradual, with each resembling its more immediate predecessors in scope and outline but differing in detail. In nuclear physics, the progression started with the articles by Bethe and Bacher in *Reviews of Modern Physics* in 1936. From 1936 through the most recent books, the evolution is of the gradual type; undoubtedly the most enduring contribution of this period was Blatt and Weisskopf's *Theoretical Nuclear Physics*. Now we have a sudden change in the progression—*Nuclear Structure* is not much like what has gone before. The amount of really new material is impressive. Moreover, the authors exploit fully new techniques of exposition. It seems likely that they will influence not only nuclear physics texts, but texts in all branches of physics.

Each of the three volumes of *Nuclear Structure* is to have three chapters. A chapter is further subdivided; there are expository sections, each followed by illustrative examples, and at the end of the chapter there are numerous appendices. Nonnuclear theory, such as the general theory of beta decay, is discussed in the appendices. Long digressions on various aspects of quantum theory are thus avoided in the main

body of the text. More novel is the use of illustrative examples to present as much as half of the material. The advantage of this procedure is that in the examples there is not the pressure for logical order that exists in the expository sections. Hence in the discussion of a particular phenomenon, such as, for example, neutron widths or particular nuclear spectra, the authors can bring to bear a full arsenal of theoretical tools and relevant experimental data, some of which may not have already been considered in the text. Each section of this type is more self-contained and therefore more useful for reference purposes than is usually possible when strict logical precedence is observed. Not only do the authors use these sections to dramatize the interconnections between the branches of nuclear physics, but they also give the reader a feeling for the sort of unraveling process that is an important part of current research.

The method of presentation makes a good background in nuclear physics a prerequisite for the reader. Truly this is nuclear structure for nuclear physicists. Thus, it is not a text for a course on nuclear physics; on the other hand it will be read and reread by all serious students and practitioners of nuclear physics.

This first volume of *Nuclear Structure* is titled *Single-Particle Motion*. It begins with a chapter on "Symmetries," a necessary preliminary to the consideration of intrinsically nuclear properties. Many readers will go directly to the second and third chapters, "Independent-particle motion" and "Single-particle configurations." Throughout, the approach is in terms of actual nuclei, rather than in terms of models. Elaborate formalism is relegated to the appendices and not allowed to interfere with the physical arguments. The essential reference formulas and expres-

sions are carefully presented, and the notation is designed to set the standard for the future.

There remains the problem of how best to assimilate the great wealth of information presented in this volume. Probably all methods of attack are good, save only starting at the beginning and plodding through to the end. It is not an easy volume to digest by any means, but one must measure the time spent in reading it against the 40 years of experience in nuclear-structure physics that it summarizes.

The second and third volumes will be titled *Nuclear Deformations* and *Nucleonic Correlations*. The first volume alone demonstrates clearly that *Nuclear Structure* will take precedence on the bookshelves of all nuclear physicists, both theoretical and experimental.

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Kinds of Motion

Annual Review of Fluid Mechanics. Vol. 1. WILLIAM R. SEARS and MILTON VAN DYKE, Eds. Annual Reviews, Palo Alto, Calif., 1969. viii + 462 pp., illus. \$8.50.

Rarely is an annual review more than a random collection of embroidered re-statements of recently published work. Here is such a rarity, for this is the first such "annual" in fluid mechanics and provides a perspective of a rapidly maturing discipline. In the first article, Sydney Goldstein paints an impressionistic picture of the field to the mid-century mark. Then follow contributors to the modern art from many lands. I choose to group their topics into those of aerodynamic origin, those of biophysical origin, and those of planetary-physical origin.

Traditional aerodynamic problems of laminar separation, boundary layer transition, drag reduction, and hydrodynamic noise are reviewed by authors (S. N. Brown and K. Stewartson, I. Tani, J. L. Lumley, J. E. Ffowcs Williams) whose novel assessments of these topics are significant contributions to the literature. None of these problems are finally solved. Yet the authors' discontent with past empiricism and their search for deductive pathways bode well for future studies. One might complain that higher-order boundary layer theory (M. Van Dyke) is less relevant

to the unresolved experimental data than are nonlinear effects. However, determining the limits of validity of singular perturbation theory is an important part of freeing fluid dynamics from its heuristic past. Shear-flow turbulence (O. M. Phillips) is an "elementary" problem that one expects will remain an annual review topic for many years. Phillips applies quasilinear theory to rationalize aspects of the energy-releasing processes and to test his enriched "eddy viscosity" model. Recent studies by L. N. Howard and F. Busse, which are not reviewed, provide an alternative, and more quantitative, route to the exploration of turbulence energetics.

Biophysical fluid dynamics is included in a thorough review of blood flow studies (R. T. Jones) and a superbly synthesized assessment of aquatic animal propulsion (M. J. Lighthill). Lighthill concludes that we can understand the evolutionary shaping of fish and marine mammals from known principles without resort to any mysterious control of drag by these animals. An article on surface-tension-driven phenomena (V. G. Levich and V. S. Krylov) is not specifically addressed to biological problems, but certainly can be of value to the biophysicist.

Planetary fluid dynamics reviews include recent work on buoyant plumes (J. S. Turner), the fascinating behavior of nonviscous stratified flows (C.-S. Yih), shock waves and radiation (Ya. B. Zel'dovich and Yu. P. Raizer), and electrohydrodynamics (J. R. Melcher and G. I. Taylor). Applications of shock wave theory range from studies of melting transitions in solids to the emission of x-rays from neutron stars—that is, they range from tested deductions to implausible speculation. Electrohydrodynamics is the study of flows induced by coulomb forces. In the review critical comparison is made of analytical models of waves, convection, and instability with experiments in weakly conducting laboratory fluids. One foresees numerous applications in both biophysics and astrophysics.

The editors promise survey articles on geophysical fluid dynamics (flow in rotating systems, tides, and atmospheric boundary layers) in a forthcoming volume. I hope they can include more of the recent work on nonlinear flow and nonlinear stability theory.

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Weak Turbulence

Theory of Turbulent Plasma. A. A. VEDENOV. Translated from the Russian edition by Scripta Technica. S. Chomet, Transl. Ed. Iliffe, London; Elsevier, New York, 1968. 128 pp. \$5.50.

Modern plasma physics, it is generally conceded, began with the controlled thermonuclear reactor programs initiated in the U.S., the U.S.S.R., and elsewhere in the early 1950's. A major preoccupation of the next ten years was the problem of plasma stability. This period saw a considerable development, based upon linearized theories, of our understanding of how plasmas unstably amplify small amplitude waves. An International Atomic Energy Agency conference on controlled thermonuclear fusion, held in 1962 in Salzburg, marked the beginning of a new important phase. Three papers, two American and one Russian, laid the foundation of weak-turbulence theory, wherein the effects of various instabilities are analyzed. (In many cases, the nonlinearities in plasma turbulence are weak, permitting use of the extensive body of linear theory and elegant perturbation schemes.) A rapid development of formal weak-turbulence theory followed, particularly in Russia. Now we have available three monographs—Kadomtsev's *Plasma Turbulence* (Academic Press, 1965), Sagdeev and Galeev's *Nonlinear Plasma Theory* (Benjamin, 1969), and Vedenov's *Theory of Turbulent Plasma*, under review here—by some of the leading Soviet weak-turbulence theoreticians which reflect the state of Russian understanding in 1966. Regrettably, this knowledge is still not completely disseminated in the U.S. Several things have happened since 1966, such as the increased interest in large amplitude single waves, which are not completely covered in these volumes. In addition, there are very few references to experimental verifications of weak-turbulence theory. For these reasons, these monographs are unlikely to become authoritative reference books. Their greatest value is in training theoretical intuition about various nonlinear plasma processes. The books are essential for advanced graduate students and researchers primarily because of their elegant presentation of the Russian philosophy of plasma physics. Vedenov's book has several important virtues. First and foremost is its spare simplicity. The author has eschewed complicated or controversial

topics to concentrate upon simple derivations of fundamental processes. He presents intuitive and simple derivations of many basic instabilities so that students will not be lost in the later sections devoted to their nonlinear consequences. In the nonlinear discussion, Vedenov stresses only the basic processes and their theoretical structure such as the quasilinear theory and mode-coupling. The nonlinear analysis of various instabilities are more thoroughly discussed in the Sagdeev and Galeev book. The nonlinear wave-particle interaction, such as nonlinear Landau damping, treated in both Kadomtsev's and Sagdeev and Galeev's books, is completely omitted here. Despite these omissions, this is an excellent introduction, for whatever is treated here is presented with elegance and lucidity. Physical concepts, and not mathematical techniques, are emphasized throughout. For these reasons, then, this book is in some ways the most accessible of the three to students. Of course, it may be said that Vedenov's arguments are so sophisticated that his book is deceptively simple; nevertheless it is simple.

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Progress Reports in Meteoritics

Meteorite Research. Proceedings of a symposium, Vienna, Aug. 1968. PETER M. MILLMAN, Ed. Springer-Verlag, New York; Reidel, Dordrecht, Holland, 1969. xvi + 944 pp., illus. \$48. Astrophysics and Space Science Library, vol. 12.

Current research on the origin and history of meteorites is represented by 73 papers delivered to this symposium sponsored by the International Atomic Energy Agency. The majority of the papers clearly are progress reports, containing new data which raise as many new questions as they offer solutions to problems and which give few final answers.

The discussion sessions included Early History of Meteorites, Composition and Structure (5 sessions), Isotope Studies and Chronology (3 sessions), and Orbits. These broad topics are closely interrelated, and papers in all sessions have bearing on the central problems of meteoritics, which remain unsolved. For instance, new Monte Carlo calculations