

BOOK REVIEWS

Principles of Classical Mechanics and Field Theory. Vol. 3, Part 1 of Encyclopedia of Physics. S. Flügge, ed. 902 pp. Springer-Verlag, Berlin, 1960. DM 198.00. Reviewed by E. H. Dill, University of Washington.

THIS volume contains a 226-page article entitled "Classical Dynamics" by J. L. Synge, a 568-page treatise entitled "The Classical Field Theories" by C. Truesdell and R. A. Toupin, and a 65-page appendix on tensor fields by J. L. Ericksen.

Professor Synge needs no introduction to workers in dynamics. His contribution continues the high standard and lucid expository nature of his previous books. Although the general theory of the dynamics of particles and rigid bodies is summarized, this article is more than a summary of known facts and should be recommended reading for all serious students of the subject.

A nicely done but brief axiomatic comparison of Newtonian mechanics and the special theory of relativity is followed by a complete and concise treatment of the kinematics of a rigid body, dynamics of a particle, and the dynamics of systems of particles and rigid bodies. Nearly one half of the article is devoted to the "General Dynamical Theory" in which the author gives "geometrical intuition its just place in general dynamical theory by systematic use of representative spaces in which the motion of a representative point corresponds to the motion of a dynamical system". This includes event space, momentum-energy space, configuration space, space of states and energy, space of states, and phase space. The discussion is based on a Hamiltonian which needs to be a quadratic function of the momenta. The emphasis is on general mathematical structure, but some specific examples are discussed which illustrate the general principles. A brief treatment of the important parts of the special theory of relativity concludes the article.

Truesdell and Toupin present a treatise on the general theory of continuous media. The material is organized as follows: kinematics, conservation of mass, balance of momentum, balance of energy and thermodynamics, balance of electromagnetism, and constitutive equations.

The discussion of electromagnetism is an axiomatic presentation using a four-dimensional formulation. The theory is based upon an invariant integral equation statement of conservation of charge and magnetic flux which is independent of the geometry of space-time. This implies the existence of a charge-current potential and an electromagnetic potential which satisfy the field equations. The usual three-dimensional form of Maxwell's equations follows under a special assumption about the geometry of space-time. The relation between

the electromagnetic and charge-current fields is then stated in the usual way (called, by the authors, the Maxwell-Lorentz æther relations) and a world tensor form is deduced. All of these results are independent of the nature of the media. The auxiliary fields of polarization and magnetization which are useful in the discussion of constitutive equations for various materials are presented. World-invariant forms of the conservation of energy and momentum are given.

The study of kinematics is the most exhaustive, complete, and elegant treatment ever published. It is a scholarly study of a kind seldom seen in scientific writing. It is a tensor formulation in Euclidean three-dimensional space of everything that is known about the kinematics of continuous media, together with an exhaustive bibliography and references. The treatment of strain is unusual in that the concept of a double tensor field is used. A four-dimensional formulation of kinematics is also presented.

An unusual aspect of this treatise is the careful treatment of singular surfaces and waves. This leads to jump conditions which must be satisfied by the field variables in addition to the field equations.

Although no attempt has been made at a complete statement of the various possible constitutive equations, the last chapter contains a valuable, unified, and careful statement of the basic relations describing the behavior of the more common materials.

This reviewer considers the present volume to be the most valuable single volume in his possession. It is not, however, for the beginning student. It requires a certain sophistication on the part of the reader, or else considerable effort, for which the reader is amply rewarded. It is suitable for study by second-year graduate students and should be required reading for them.

The Principles of Nuclear Magnetism. By A. Abragam. 599 pp. Oxford U. Press, New York, 1961. \$13.44. Reviewed by H. Y. Carr, Rutgers University.

FOR many readers this will unquestionably be the most important existing book on the collective macroscopic properties of large assemblies of nuclear moments. Very appropriately, it has been prepared for the distinguished International Series of Monographs on Physics.

A rigorous quantum-mechanical description is used from the outset in the presentation of basic concepts. The author's exceptional competence and clarity are consistently revealed.

This book will be an invaluable resource in both experimental and theoretical studies. Although the author,


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Edited by Howard S. Seifert, Stanford University and United Technology Corp.; and Kenneth Brown, John Wiley & Sons, Inc. 1961. 526 pages. \$12.00.

* Also available in textbook edition for college adoption.

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By Dunstan Graham, Princeton University and Systems Technology, Inc.; and Duane T. McRuer, Systems Technology, Inc. 1961. 482 pages. \$9.75.

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By H. Dean Baker, Columbia University; E. A. Ryder, United Aircraft Corp.; and N. H. Baker, Columbia University. A comprehensive guide to temperature measurement problems and their solution in the laboratory, shop, and field. 1961. 510 pages. \$13.00.

Progress in Very High Pressure Research

Edited by F. P. Bundy, W. R. Hibbard, Jr., and H. M. Strong, all of the General Electric Research Laboratory. Proceedings of an International conference held at Bolton's Landing, New York, in June of 1959. 1961. 314 pages. \$12.00.

Iterative Arrays of Logical Circuits

By Frederick C. Hennie III, M.I.T. An M.I.T. Press Research Monograph. 1961. 242 pages. \$4.95.

Electromagnetic Theory

By Erick Hallén, Royal Institute of Technology, Sweden. 1961. In press.

**The Mechanics of Inertial Position
and Heading Indication**

By Winston Markey and John Hovorka, both of M.I.T. 1961. 92 pages. \$3.95.

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By Werner Brügel, Badische Anilin & Soda Fabrik, Germany. 1961. In press.

Microwave Ferrites

By Peter J. B. Clarricoats, The Queen's University of Belfast. 1961. 260 pages. \$8.00.

**An Introduction to the Theory
and Practice of Transistors**

By J. R. Tillman and F. F. Roberts, both of The Post Office Engineering Research Station, London. 1961. 340 pages. \$8.00.

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a theorist, has emphasized rigorous theoretical analysis, he has given a brief but good review of experimental methods. Most significant, however, is the excellent connection which he shows between theory and experimental results.

The large number of existing nuclear magnetic resonance applications imposes a severe limit on the fraction of topics which can be discussed in a single volume. Typical of the topics included are the motion of free spins, spin temperature, line width and fine structure, quadrupole effects, electron-nucleus interaction, and thermal relaxation. The selection and organization of the material has been done judiciously. Nuclear magnetism is presented as a fascinating realm of modern physics. The book should be welcomed not only by specialists in the field, but by physicists and chemists in general who will find here a wealth of precisely measured macroscopic phenomena whose explanations provide beautiful and significant examples of quantum-mechanical analysis.

The author's goal was to attempt for nuclear magnetism what Van Vleck so skillfully accomplished for electric and magnetic susceptibilities. The present usefulness of the new text is a successful step toward this formidable goal. Whether or not, in so rapidly developing a field, it can achieve the long-term significance attained by Van Vleck's work is a question time must answer. This much is certain: The scientific community is already deeply indebted to the French physicist A. Abragam for an outstanding contribution to the development of modern physics.

Relativistic Electron Theory. By M. E. Rose. 302 pp. John Wiley & Sons, Inc., New York, 1961. \$9.50. *Reviewed by W. G. Holladay, Vanderbilt University.*

ALTHOUGH many of the standard works on quantum mechanics devote some space to one-particle relativistic quantum theory, a clear need has existed for some time for a volume that presents a more comprehensive and detailed treatment of this subject. It is gratifying that an author with such expository skill and first-hand knowledge of the subject as M. E. Rose has written such a volume, one that should be useful both as a text for those just learning the subject and as a reference as well.

The book is concerned with the relativistic one-particle theory of particles with spin $\frac{1}{2}$, i.e., with the Dirac equation. Therefore, much of the contents has relevance to the 23 (of the 30 known or overwhelmingly suspected) relatively long-lived elementary particles known or strongly suspected to have spin $\frac{1}{2}$. However, since strong interactions are not discussed, the electron, mu meson, neutrino, and their antiparticles, which possess only electromagnetic and weaker interactions, are the primary objects under consideration.

There are seven chapters and five appendices in the book. After an excellent introductory chapter on the

nonrelativistic theory of spin, the postulates of the theory are stated. The Dirac equation is then developed, and the algebra of the γ matrices and the covariance of the Dirac equation under proper Lorentz transformations are discussed. The plane-wave solutions of the Dirac equation, the properties of free positrons, the Foldy-Wouthuysen transformation, energy and spin projection operators and the theory of nuclear beta decay constitute the next group of topics. Although the book does not purport to include the quantization of fields, the Lagrangian of the beta-decay interaction is displayed, a fact which is likely to be confusing to the reader uninitiated in such matters. The interaction of Dirac particles with classical electromagnetic fields, and charge conjugate and space-time reflection transformations are thoroughly discussed. The main subject considered in Chapter 5 is the Dirac particle in a central field with particular emphasis on the bound and unbound states of the Coulomb field and the formal theory of scattering polarized electrons. The following chapter is concerned with approximation methods: the WKB method, the retarded and Breit interaction between particles, the Sommerfeld-Maue approximation, finite-size nuclear effects, and the high-energy limit of the Dirac equation. The last topic serves as an introduction to Chapter 7 on neutrino theory, i.e. the Dirac theory of massless particles with special prominence given to the two-component theory. Appendices on notation, Lorentz transformations, the Heisenberg picture, an alternative approach to the γ matrices, and the retarded electromagnetic interaction end the body of the book.

A very useful adjunct are the fifteen or so problems at the end of each chapter, where there are also select references to the material of the chapter. These references are almost entirely to papers of a theoretical character, a fact which mirrors accurately the orientation of the exposition.

The choice, organization, and treatment of the material are excellent. The author has succeeded in giving a very clear presentation of one of the most elegant and remarkable theories of physics.

Relations de Dispersion et Particules élémentaires. U. of Grenoble Summer School of Theoretical Physics (Les Houches, 1960). C. DeWitt and R. Omnès, eds. 672 pp. (Hermann, Paris) John Wiley & Sons, Inc., New York, 1961. \$20.00. *Reviewed by D. Keefe, Lawrence Radiation Laboratory, Berkeley, California.*

THIS report of the Summer School in Theoretical Physics, held in 1960 at the University of Grenoble, comprises eight courses of lectures, each of which averages almost a hundred pages apiece. The dispersion theory approach to the description of elementary-particle interactions has gained enormous popularity in recent years and many believe that it will lead to a more fundamental theory of strong interactions than would be possible from the standpoint of conventional field theory.

By modern standards, the basic ideas of dispersion