

Elements of Classical Thermodynamics for Advanced Students of Physics. By A. B. Pippard. 165 pp. Cambridge U. Press, New York, 1958. Clothbound \$4.75; paperbound \$2.75. *Reviewed by C. Kittel, University of California.*

This is an excellently written and well-organized little book. The author has accomplished his announced intention to write a short account of the fundamental ideas of thermodynamics, excluding details of experimental methods and a multiplicity of illustrative examples. One might wish for a fuller account of magnetic energy, with a comparison of the two common definitions of the magnetic energy of a system, but it is difficult to keep any discussion of magnetic energy within bounds.

The book appears to have been written to provide an adjunct to advanced undergraduate lectures at Cambridge. One may regret as a teacher that the objectives of the book are so severely detached from the illumination and physical insight provided by statistical mechanics.

La Théorie de la Mesure en Mécanique Ondulatoire: Interprétation usuelle et Interprétation causale. By M. Louis de Broglie. 130 pp. Gauthier-Villars, Paris, France, 1957. Paperbound \$7.42. *Reviewed by J. C. Polkinghorne, University of Edinburgh.*

M. de Broglie is the grandfather of wave mechanics. However he feels that the statistical interpretation of the wave function makes the associated waves play too metaphysical a part. This book is the latest in a series of researches extending over the past thirty years in which he has developed an alternative theory that seeks to restore causality to mechanics and to give a greater measure of objective reality to the wave function.

The first three chapters give a summary of the usual interpretation of wave mechanics. In particular he gives a critical account of von Neumann's celebrated proof that causality can not be restored to the theory by the introduction of hidden variables. This conclusion is to be avoided by drawing a distinction between the initial state of the system, which contains indeterminacies due to probability distributions over the hidden variables, and the final state of the system after the measurement of some dynamical variable. The probability distribution for the values obtained by measuring this variable arises causally from the probability distributions in the initial state but in a manner that depends on the nature of the appropriate measuring apparatus. It is argued that there is no inconsistency in the fact that not all dynamical variables are simultaneously free from dispersion, because their probability distributions in fact correspond to different final states. In short, these probability distributions are a property not of the unique initial state, as in conventional theory, but of the diverse final states.

His theory of the wave function is based on his discovery of *la double solution*, that is that to every regular solution, ψ , of the Schrödinger equation there corre-

sponds a solution u_0 having the same "lines of flow", along one of which moves a point singularity. The association of these two functions in a physical problem is thought to arise from $u_0 + \psi$ being the asymptotic form of the solution of an equation having nonlinear terms large in the neighborhood of the singularity of u_0 . This singularity represents the position of the particle. On the other hand ψ is to represent the probability distribution of the position of the particle. These two contradictory notions are to be reconciled by the introduction of small, frequent, arbitrary perturbations that displace the singularity to give the distribution. The discussion of this important point is the least satisfactory part of the book.

In the closing chapters M. de Broglie develops his theory of measurement. He stresses that all our measurements on elementary particles arise from some macroscopically observable localized phenomenon, e.g., a blob on a photographic plate. This enables him to assign a special place to probability distributions over positions as opposed to other dynamical variables. In his penultimate chapter he discusses the interaction of two particles. Since his theory preserves, of course, the uncertainty relations (though giving them a rather different metaphysical interpretation) it would have been interesting to see how he would discuss the Einstein, Rosen, and Podolsky paradox.

This is an engagingly written, stimulating book.

Angular Momentum in Quantum Mechanics. Vol. 4 of Investigations in Physics. By A. R. Edmonds. 146 pp. Princeton U. Press, Princeton, N. J., 1957. \$3.75. *Reviewed by H. Mendlowitz, National Bureau of Standards.*

So many problems in modern physics require for their solution a knowledge of the quantum mechanical properties of angular momentum that it should seemingly invite a more thorough treatment in the standard texts. However, most textbooks are written with certain space limitations and so an adequate treatment must be looked for elsewhere. Until recently, except for Condon and Shortley (*Theory of Atomic Spectra*, Cambridge University Press, 1935) there was no book which emphasized angular momentum in quantum mechanics. A few years ago, however, Feenberg and Pake published *Notes on the Quantum Theory of Angular Momentum* (Addison-Wesley Publishing Company, 1953). As the title implies, it was a short treatment, but still very nice to have in one's library. Another difficulty, in addition to the lack of pedagogical literature, was that many contributors to this field would use their own approaches and notations. The confusion of the novice would be compounded by learning of the existence of the Racah coefficient after having "mastered" the use of the Wigner coefficients and then find that the definitions would depend on the various authors.

The author attempts to present the quantum mechanical theory of angular momentum in a rather complete way. He begins with an elementary introduction

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MECHANICS, WAVE MOTION, AND HEAT

By FRANCIS WESTON SEARS, *Dartmouth College*

This new book covers essentially the same ground as the author's *Mechanics, Heat, and Sound*, but at a somewhat higher level. It should thus be of especial interest to schools that wish to offer a somewhat more rigorous course in the subject, but that want to retain the emphasis on physical principles and the clear teachable manner of presentation which characterized the earlier book. *Mechanics, Wave Motion, and Heat* is intended as a text for the first of a two-year course in general physics, although it will serve also as a text for an intermediate-level course in mechanics. The student is assumed to be studying calculus concurrently.

As is obvious from the title of the new book, more emphasis is placed on wave motion in general, and less on sound waves as such. The material on wave motion has been extended to include waves in a dispersive medium, and to lead up to the concepts of phase and group velocity. Vector notation is introduced at the start of the book, the vector product is defined in connection with moments, and the scalar product in connection with work. The concept of a tensor is introduced by way of the stress tensor. In the subject of heat, blackbody radiation is discussed more extensively, beginning with Planck's law and showing how the Wien displacement law and Stefan's law may be derived from it. Considerably greater emphasis is placed on the First and Second Laws of Thermodynamics, and on the Kinetic Theory of Gases.

The volume retains all the strongest features of *Mechanics, Heat, and Sound* (which is being kept in print), while incorporating many revisions proved desirable through extensive teaching experience with the latter book. A careful selection of thought-provoking problems has been provided, and many improvements have been made as, for example, in the treatment of units and of friction.

c. 600 pp, 311 illus, 1958—\$9.00

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to some of the group theoretical concepts and, in particular, their applications to rotations. (Incidentally, in stating the amount of preparation the reader must bring to this book, the editorial copy writer slipped. On the dust cover he states, "The book assumes a knowledge of non-relativistic quantum mechanics and the principles expounded in such classical works as those of Wigner and Weyl." The author, however, in his preface writes, "The reader is assumed to have a general knowledge of quantum mechanics; an acquaintance with the theory of group representations should not be necessary." Actually I feel the preparation necessary is somewhere in between the two.) Then there is a discussion on the quantization of angular momentum. The author begins by treating the angular momentum classically before turning to the quantum mechanical aspects. (This is a very nice feature of the book which is used in many places where new topics are brought up. A similar approach is suggested to other authors of texts on quantum mechanical subjects who many times lose contact with classical theory.) The general theory of angular momentum is then developed. This includes such topics as: the coupling of two or more angular momenta, the representations of finite rotations, angular momentum eigenfunctions, spherical tensors and tensor operators, factorization of the matrix elements of tensor operators, computation of vector coupling coefficients, and applications to the evaluation of matrix elements in atomic, molecular, and nuclear physics. A very helpful feature of the book is the tabulation of the various notations used by many authors and the correlation of the various symbols utilized. A number of tables of the vector coefficients are given and many references to other tabulations are cited. A well-rounded bibliography which includes texts as well as original papers is given, and it shows how wide are the applications attendant upon a study of angular momentum. I was surprised, however, that there is no reference to the book by Feenberg and Pake which appeared in 1953.

In general, I found that I could readily follow the motivation in the developments and proofs, but found it necessary to insert a number of relevant steps in the author's procedures. This is not objectionable when the audience to which the book is offered consists only of those experienced in these calculations, but the experimentalist and novice may find some of the treatments rough sledding. However, if one is interested in computations only, without necessarily mastering the various derivations, the fact that the author is careful in his notation and phase convention does make the book a valuable tool. Probably, if the author had allowed himself more space the subject could have been developed in a more leisurely fashion and would have been more pleasing to a wider audience.

This book is in the Princeton *Investigations in Physics* series. The earlier volumes were paperbound and typewritten offset, but this volume is hardbound and letter press. The publishers should be congratulated for finally deciding that these volumes are to make a last-

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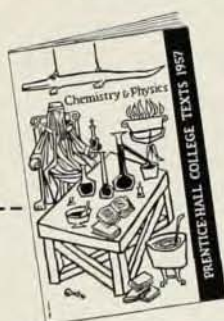
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ing contribution to physics and should be put in a more permanent form. However, in spite of this great improvement the detailed work of some of the other publishing houses is lacking, such as legibility of some subscripts or superscripts, and, in some cases, proof-reading errors are quite obvious.

In spite of these objections, this reviewer feels that the author has made a definite contribution, and that those whose interests lie in this field will find the book helpful.

Nuclear Stripping Reactions. By S. T. Butler in association with O. H. Hittmair. 130 pp. (Horwitz Publications Inc., Australia) John Wiley & Sons, Inc., New York, 1957. \$8.75. Reviewed by E. M. Henley, University of Washington.

The field of nuclear physics has reached the stage of revising and refining many general and long-held concepts. For example, the belief that all reactions proceed through a well-defined compound nucleus has had to be considerably modified, since it has become clear during the past few years that many nuclear collisions take place without such an intermediate state. These processes are often called "direct reactions".

This book, for the specialist in nuclear physics, discusses direct processes in general, but is primarily concerned with the deuteron stripping reaction, in which a deuteron incident on a nucleus loses a proton or neutron to a definite bound state. The chief application of these reactions to date has been made in the field of nuclear spectroscopy, and particularly in the study of spins and parities of nuclear states.

After an introductory chapter in which a semi-classical exposition is used to give a clear physical picture of deuteron stripping and other direct reactions, the theoretical derivation of the cross section is developed quantitatively and systematically by successive stages. It is first given for a hypothetical deuteron of spin zero, stripped by a nuclear potential, with neglect of Coulomb forces, and for incident and final plane waves. These approximations are dealt with in successive chapters, and are followed by a discussion of the additional information obtainable from measurements of coincidence gamma rays and polarization of the outgoing particle. The development up to this point follows the method of Butler. Subsequently, alternative derivations of the theoretical expectation for the stripping process are briefly described. This reviewer found one of these, the "matrix formulation", not only more elegant, but also physically simpler than all other derivations. He thus could not help but wish that the development had been carried out with this formulation. In the final few chapters the authors develop the relationship of other direct processes to the deuteron stripping reaction.

The book should prove useful to both experimental and theoretical nuclear physicists. The latter will appreciate the formal development of the stripping cross section. The accompanying quantitative and qualitative discussions of the validity of various theoretical ap-