BOOK REVIEWS

Nuclear Shell Theory. By Amos de-Shalit and Igal Talmi. Vol. 14 of Pure and Applied Physics, edited by H. S. W. Massey. 573 pp. Academic, New York, 1963. $14.50. *Reviewed by Eugene P. Wigner, Princeton University.*

"IN this book we treat the mathematical theory of a system of Fermions in a central field." This is the first sentence of the Introduction, and it describes the contents and aim of the book more precisely than its title. It traces the consequences of the assumption that most of the very complex interaction between the nucleons can be replaced by a "central field" or, stated more accurately, by a sum of single particle potentials. Each of these depends only on the spin and isotopic spin of a single nucleon and on the distance of that nucleon from the center of mass of the whole nucleus. This last point, though mentioned in the Introduction, is not taken very seriously in the bulk of the book, and the center of mass is replaced by a fixed point in space. It is assumed that the wave functions of the stationary states can be calculated with reasonable accuracy, using a model Hamiltonian in which the interaction is simplified in the manner indicated, and that, at any rate, the energy levels can be obtained as the expectation values of the true Hamiltonian for the characteristic functions of the model Hamiltonian. In other words, it is assumed that the difference between true and model Hamiltonians is small enough for the first approximation of the Rayleigh-Schrödinger perturbation theory to be sufficiently accurate. Since our knowledge of the true interaction between nucleons is incomplete—and the authors do not review closely even what we do know about this interaction—the calculation of the energy levels cannot be carried out completely. Rather, the main content of the book is the derivation of regularities between the positions of the energy levels which follow from the preceding assumptions no matter what the interaction between the nucleons is, as long as this interaction is a sum of interactions between pairs of nucleons which satisfies the usual rotational and reflection invariances.

There are many attempts in the literature to justify the aforementioned approximation. In the opinion of this reviewer, none of these attempts is fully successful, and the book does not review them. Instead, it points to the empirical evidence which shows that the general regularities which are consequences of the model actually do hold. This evidence is simply amazing—in many cases almost too good to be believed. One compares, for instance, the calculated and observed values of the Cl^{38} spectrum on page 237, or the binding energies in the $1d_{3/2}$ and $1f_{7/2}$ shells on pages 458 and 352. Nevertheless, the book does not review the experimental material systematically and, in particular, the very instructive limitations of the model are dealt with only briefly in the last, the 37th, section. As mentioned before, the book deals principally with mathematical methods.

These methods are largely due to the Israeli school and in particular to G. Racah. If Talmi and de-Shalit write on the underlying, very beautiful mathematical theory, the value of their presentation cannot depend on the knowledge and competence of the authors—they have themselves invented much of the contents of their book—but on the care and skill with which they are writing. In the opinion of this reviewer, they were remarkably successful. The three chapters dealing with a single particle, a pair of particles, and several particles in a central field, subdivide the subject in a natural fashion. There is a wealth of interesting and well-assimilated information in each chapter, but the most important results are in the last one. Most of these are derived first, without the use of group theory, but the group-theoretical significance of the methods and also of the results is always at least indicated. Nevertheless, the reviewer has the impression that the group-theoretical motivation was somewhat shortchanged and that its presentation is so compressed that the uninitiated will not be able to follow it in detail. He will only sense the flavor of it.

The most important concepts which are not fully developed in any other book with which this reviewer is familiar, are the even and odd tensors, the seniority number, and the coefficients of fractional parentage. The introduction of the seniority concept (Racah), in particular, required profundity as well as imagination, and it has not been fully assimilated by the mathematical literature. Equally interesting are the many detailed rules, such as those of Section 33, which deal with electric and magnetic dipole transitions. Although the authors disclaim to have incorporated any new results into their book, the reader who is familiar with the subject will discover many new consequences of the shell model derived in a systematic, easy, and natural way.

The book can be recommended without reservation to all who wish to work on the nuclear shell model and to those who wish to become acquainted with Racah algebra.

Formal Structure of Electromagnetics. General Covariance and Electromagnetics. By E. J. Post. 204 pp. North-Holland, Amsterdam, 1962. Distr. in US by Wiley, New York. Paperbound $7.50. *Reviewed by Jacques E. Romain, General Dynamics/Fort Worth.*

THE subject of this book is the generally covariant formulation of the electromagnetic equations, in space-time and in three-dimensional space. The author, and the publisher in the descriptive material, claim that this treatment "de-emphasizes the customary close