SHORTER NOTICES

The Theory of Atomic Collisions. By N. F. Mott and H. S. W. Massey. (The International Series of Monographs on Physics.) Oxford, Clarendon Press, and New York, Oxford University Press, 1933. xv+283 pp.

This book contains a detailed account of the methods of treating collision problems by means of the quantum theory together with applications to the experimental material. Although for most of the problems discussed there are available exact equations, the practical problem of finding their solutions is usually very difficult. The scattering of a particle by a central field is an exception to the rule. Solutions by the method of Rayleigh as first applied in this field of Faxèn and Holtsmark are available for the purpose. This method and its main applications to electron scattering and polarization are developed first. In this connection Dirac's relativistic equation for the electron is introduced and its implications as to electron spin are discussed. Bohr's discussion of the spin of the free electron is brought into prominence and the theoretical possibilities of producing polarized electron beams (Fues-Hellmann) are considered.

The validity of the popular Born method and its limitations are illustrated by comparison with exact solutions for central fields following a paper of Mott. For the cases where exact solutions are not available other procedures such as the method of distorted waves and of the perturbed stationary state are systematically presented. The results of calculations are given not only as formulas but in the form of graphs and numerical tables as well. Although most of the emphasis is on slow collisions, the results of calculations on fast electrons and ions are also described. The discussion of the physical meaning of the calculations and the frequent reference to experimental material are refreshing. The book is very practical inasmuch as the language used is clear and concise, the methods of treatment are definitely classified, and the mathematical manipulations are brief and to the point.

In reading a book on a modern subject it is usual to come upon special features which one wishes were presented differently. They may be due either to limitations of time and available page space or to personal differences of taste. Some of these are mentioned below. In the discussion of the penetrating power of fast particles the work of Bloch [Annalen der Physik, (5), vol. 16 (1933), p. 285] is mentioned only in a footnote. A more detailed discussion would have served to show how far the picture of virtual oscillators applies. The reference to the paper of Bethe and Fermi given on page 269 is an obvious mistake and must have been meant for another paper of Bethe. The relativistic two electron problem is presented clearly enough from the point of view of stating rules of calculation. The "correspondence method" of Klein is used as in Møller's paper. It is not necessary to invoke such extreme symbolism as is shown by the fact that the interaction energy used by Møller was known for identical particles during the development of the Dirac-Heisenberg-Pauli quantum electrodynamics. In the discussion of transition probabilities by the method of variations of parameters the exponentially decaying types of solutions introduced by Weisskopf and Wigner in radiation theory are not in-

cluded and no detailed discussion of the somewhat analogous exponentially decaying solutions introduced by Gamow for radioactive nuclei seems to be available. The resonance discussions of Morse and Stueckelberg and London's considerations on the method of perturbed stationary state functions are, on the other hand, considered in some detail and should prove of value to chemists. The discussion of nuclear scattering at the end of the book shows the nature of the mathematical methods used but it not sufficiently detailed to indicate whether the theory is applicable to the nucleus. The authors content themselves with brief statements about very good agreement with experiment. Although it is certain that for distant nuclear collisions wave mechanics works, too much optimism about its universal applicability can be scarcely justified at present. Thus Taylor's results indicate a systematic variation of nuclear radius of helium with velocity, and the interpretation of the results seems to be largely a matter of faith.

G. BREIT

Höhere Algebra. By Helmut Hasse. Volume I, *Lineare Gleichungen.* Sammlung Göschen. Berlin and Leipzig, de Gruyter, 1933. 152 pp.

This is a second edition of an excellent book first published in 1926 and reviewed in this Bulletin, vol. 33 (1927), p. 251. It contains an introduction to the study of algebraic systems; fields, domains of integrity, and groups. The principal part of the book is devoted to the solution of systems of linear equations. The author in Chapter 3 departs from the usual presentation in first developing the theory without the use of determinants by means of the notion of equivalence of systems and the Toeplitz procedure of reduction. Chapter 4 contains the usual treatment in terms of determinants. The changes from the first edition consist chiefly in the correction of typographical errors.

H. T. ENGSTROM

Minimum Decompositions into Fifth Powers. By L. E. Dickson. Mathematical Tables, British Association for the Advancement of Science, vol. 3. London, 1933.

A great number of numerical investigations have been carried out in connection with Waring's problem. There is the table of Dase (1851) on the representation of numbers as a sum of cubes for all integers up to 12000 and von Sterneck's extension (1903) to 40000. For biquadratic representations Bretschneider (1853) gave a table to 4100, and for fifth powers there is Wieferich's table to 3011.

Dickson's table extends to the imposing number 300000. Through various new and ingenious short-cuts it has been possible to reduce the computations and also the tabulation of the results. The table is constructed to supplement the analytic theory of Waring's problem and to verify a hypothesis of Dickson, that the integers for which a maximal number of components is required are relatively small. Those interested in the present state of the problem can find an excellent account in Dickson's review: *Recent progress on Waring's theorem and its generalizations* (this Bulletin, 1933, pp. 701–727).

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