University. His untimely death removes from the scene one of the early American workers in statistics.

J. WOLFOWITZ

Die Grundlagen der Quantenmechanik. By G. Ludwig. Berlin, Springer, 1954. 12+460 pp., 52 figures. Paperbound, 49 DM; clothbound, 52.60 DM.

This book gives a clear and interesting account of the quantum mechanics of a non-relativistic system with a finite number of degrees of freedom. This is a subject whose main lines, particularly consistency and uniqueness, are relatively well established. Roughly the first half of the book is devoted to a careful laying of the foundations of the subject from both the mathematical and physical sides. The second half develops the crucial applications and techniques in a thoroughgoing and readable way. The material of the book is well integrated and evenly presented, there being a good balance between the demands of intelligibility and those of brevity, with most doubtful situations being resolved in favor of the former. Though much of the mathematical and some of the physical material is essentially contained in von Neumann's well known book, the present work by its larger size and more limited scope provides a more spacious and elementary exposition. While its emphasis is on the physical side, its attitude is primarily logical, so that the mathematics is treated as a basic part of the scheme, rather than as a necessary evil. On the whole the book is solid and spirited, eclectic rather than pure, and should be unusually useful for some time to come.

The book includes somewhat condensed but readable treatments of Hilbert space and of group representation theory, in so far as they are used by it. Elsewhere in the book the mathematics makes use of assumptions that are generally clearly formulated so that the whole work is essentially quite rigorous. Important developments involving a relatively high level of mathematical sophistication are however omitted, among them von Neumann's theorem on the uniqueness of the Schrödinger operators and Kato's recent work in the Transactions on n-particle systems.

It is a significant anomaly that there is no material in this treatment of foundations on either quantum fields or relativistic invariance. The foundations that are presented are roughly as valid, from a physico-mathematical viewpoint, as the usual foundations of the Newtonian dynamics of a finite set of particles. Either theory is logically consistent as well as mathematically categorical and self-contained. But neither is ultimately physically self-contained, and this is particularly the case for quantum mechanics. Such a basic phenomenon as the dual particle-wave aspects of light and matter, treated in the first chapter, cannot be well understood without the introduction of systems with an infinite number of degrees of freedom. And it is generally believed that the nature of the interaction between light and matter can be comprehended successfully only in a relativistic theory, although as yet there is no wholly satisfactory mathematical treatment of the matter. In other terms, quantum mechanics is logically more indivisible than classical mechanics—which manifests itself in the circumstance that more of the physics is in the mathematics. But a book of reasonable size will probably never be able to go into all such matters with anything like the exceptional thoroughness and clarity with which this book illuminates the fundamentals of "classical" quantum mechanics, i.e. the part of quantum mechanics thought by most informed persons to be in fairly definitive form.

I. E. SEGAL

Methods of algebraic geometry. Vol. III. *Birational geometry.* By W. V. D. Hodge and D. Pedoe. Cambridge University Press, 1954. 10+336 pp. $7.50.

The book we are reviewing is the third volume of a series devoted to the methods of algebraic geometry. Since a common spirit animates these books, the present review would be incomplete without a glance at the three volumes.

The first part of Volume I (reviewed in this Bulletin vol. 55 (1949) pp. 315–316) contains various algebraic preliminaries, ranging from linear algebra, matrices and determinants to field-theory and the study of polynomials along classical lines. Its second part presents an account of the "linear geometry" in projective spaces, with a full analytic treatment of Grassmann coordinates, collineations and correlations, and with a long side-trip into synthetic projective geometry.

With the second volume (reviewed in this Bulletin vol. 58 (1952) pp. 678–679) begins algebraic geometry proper. Irreducibility, generic points, dimension and associated forms are discussed. A chapter on algebraic correspondences introduces a theory of intersection multiplicities which, without being as generally applicable as more sophisticated sister-theories, is however sufficient for most purposes. As an illustration we find two remarkably exhaustive chapters on quadrics and Grassmann varieties.

In the third volume the emphasis shifts from projective to affine space, from a study in the large to a local theory. After an introduc-