for constants. In *Principia* the propositional function vacillates vaguely between this status and the status of a property or relation "in intension," the latter status being the one relevant to the formal developments; but Tarski follows the current trend of dispensing with propositional functions in the latter sense in favor of ordinary classes and relations.

W. V. QUINE

Projektive Geometrie. By Karl Doehlemann. New one-volume edition by Heinrich Timerding. (Sammlung Göschen, no. 72.) Berlin and Leipzig, de Gruyter, 1937. 131 pp.

Earlier editions of this title in the Sammlung Göschen consisted of two parts, nos. 72 and 876, written by Karl Doehlemann. One familiar with them will find in the volume under review a new book, entirely rewritten and differing from its predecessors in size, content, and style. It goes by the same title, however, and bears the same number in the collection as Part I of former editions.

For example, the third edition of no. 72, published in 1912, contains 179 pages and an index, and is divided into seven sections of which the first six carry the reader through the pole-polar theory of conics, that is, through the elements of projective geometry, customarily so-called. The seventh section is devoted to cones and ruled surfaces of the second order.

The present volume, on the other hand, attempts a more ambitious program. This will be sufficiently indicated by a list of its chapters: 1. Projektive Grundgebilde in der Ebene; 2. Kurven zweiter Ordnung; 3. Projektive Geometrie des Raumes; 4. Flächen zweiter Ordnung; 5. Raumkurven dritter Ordnung; 6. Kollineationen und Korrelationen. There is no index, but the Inhaltsverzeichnis, in a volume of this size, seems to be sufficient as a guide to particular items.

The first two chapters (59 pages) are devoted to the projective geometry of the plane, swiftly developed in the synthetic manner with considerable appeal to intuition. The double ratio is introduced immediately after central projection and ideal elements (in the plane); and the projective relationship is defined in terms of equal double ratios. Then, after harmonic points have been defined as four points whose double ratio is -1 (when they are taken in a certain order), Desargues' Theorem for two coplanar triangles is given, and is followed by brief discussions of involutions, duality, and the projective ordering of points on a line. With this introduction, the theory of conics, Pascal's Theorem, and poles and polars are developed. Thus, after a short interlude on imaginary elements, the first and second chapters dispose of the material usually considered in an elementary course on projective geometry.

This more or less detailed examination of the two first chapters indicates the nature of the whole treatment. Everything is directed toward one end, to cover ground with the strictest economy of expression. Consequently, the arrangement of topics is found to be somewhat different from the usual arrangement; and the principle of duality is seldom invoked after its initial statement. We find, for example, Brianchon's Theorem, in the second chapter, discussed only as an illustration of the theory of polar reciprocals; and, in the fourth chapter, ruled surfaces are introduced as particular types of surfaces of the second order.

Whatever the disadvantages of such a rapid flight over the field (and I am inclined to feel that much of the essence of geometry is missed by such an enumeration of its facts only, without mentioning its logical implications), it does take one to unfrequented places. Thus I would note the fifth chapter, on space curves of third order,

a topic whose inherent possibilities are too frequently overlooked. It remains as a particularly pleasant memory of the flight!

The sixth and last chapter, with its discussions of plane collineations and correlations, quadratic transformations, linear and tetrahedral complexes of lines, and space collineations, brings the book to a close. This chapter is rather sketchy, perhaps by necessity, but it does round out the whole very nicely.

In general, then, the book is not for the beginner. It is a resumé of a portion of the field of projective geometry, intended for a reader who has had some previous acquaintance with the details. The approach, one might say, is in the manner of Reye, and there is little of the concern for logical detail usually so evident in the postulational developments of the present day. However, although some may raise objection on the ground that it is not in the modern fashion, it does present quantity in a small package and does it well.

B. C. PATTERSON

Quantentheorie. By Clemens Schaefer. (Einführung in die theoretische Physik, vol. 3, part 2.) Berlin and Leipzig, de Gruyter, 1937. 7+510 pp.

With this account of quantum theory, Schaefer's colossal "Introduction" is concluded; in its more than three thousand pages present and future generations of students will find a good, solid, uninspired presentation of the foundations on which rest the structure of modern physics and its astronomical, chemical, and technological applications. In approaching this concluding part, one must view it as a unit in the broader undertaking, rather than as an up-to-date treatment of quantum mechanics for its own sake; otherwise, it would be difficult to justify the selection of topics and the relative space assigned them.

The first five chapters, almost one-half the book, are devoted to an historical account of the development of quantum theory during the first quarter of the century; as such, depicting as it does the struggle upward from the difficulties of the old radiation theory, through Planck's quantum postulate and the Bohr theory of the atom to the semi-empirical Hund theory of spectroscopy, it is excellent. But from the logical, and perhaps from the pedagogical, standpoint this approach suffers from certain more or less serious disadvantages; thus, the theory of atomic and molecular spectra is left, for the most part, at the stage at which it was stranded almost a decade and a half ago, with only the assurance that things will really turn out all right in terms of the newer, much more satisfactory, theory.

This newer development is, appropriately enough, given mainly in terms of the de Broglie-Schrödinger formulation; after an introductory Chapter 6 on the particle-wave dilemma and its resolution with the aid of the wave theory of matter, almost a hundred pages are devoted to the solution of the more elementary problems, such as the harmonic oscillator and the hydrogen atom with and without external fields, and to an elementary consideration of helium and the hydrogen molecule. The statistical interpretation of wave mechanics, illustrated by the uncertainty principle and the theory of radio-active decay, is treated next, but without touching upon the deeper question of the meaning of observation in quantum mechanics. This is followed by a penultimate Chapter 9 on radiation, leading up to but not including the Dirac theory of radiation and the important developments based thereon. The book closes with a very readable chapter on Dirac's relativistic theory of the electron.

Judged from the standpoint of the present, Schaefer's text seems quite inadequate; it includes, in the main, only those successes enjoyed by the new mechanics in the first five years of its existence. Almost no space is given to the more mature