SHORTER NOTICES

Atoms, Molecules and Quanta. By Arthur Edward Ruark and Harold Clayton Urey. New York, McGraw-Hill Book Co., International Series in Physics, 1930. xvii+790 pp.

This substantial volume is an outstanding contribution to the rapidly growing list of books on the quantum theory of atomic structure. Its value to the student consists not only in its vast scope—it far outreaches any recent text in the English language in this respect—but mainly in the method of attack, the reasons for which are clearly set forth in the preface and with which the reviewer is in entire sympathy. From the pedagogical point of view it is very clear that the only understandable way to proceed to the newer theories of atomic structure is through the Bohr theory. In spite of its difficulties the latter presents a vivid picture which can be grasped by the student taking up the subject for the first time. Moreover many will be found to agree heartily with the authors' opinion that the "modelmässig" mode of approach to the understanding of atomic structure will for some time to come continue to be of fundamental importance to workers in physical science. This does not at all imply a lack of sympathy with the newer program with its more highly abstract postulational treatment. Physical theories will continue to be judged on the fundamental bases of simplicity of structure and the utility and verifiability of the predictions implied in them. But there are psychological factors involved and it seems that physicists will not soon forego the use of pictures in the construction of theories.

For these reasons it is particularly refreshing to find in the present work a thorough survey of the Bohr theory and the problems which led to its formulation as well as a good introduction to wave mechanics and matrix mechanics. The experimental physicist will welcome the careful discussion of fundamental experiments, and the correlation of a wealth of data hardly available elsewhere in a single volume. The theoretical physicist will find a satisfactory review of advanced dynamics adequate for the understanding of the mechanics of multiply periodic systems. A particularly strong feature of the work in the eyes of many physicists will be the chapters on spectroscopy, embracing almost one half of the whole volume, and covering very fully optical line spectra, molecular spectra and X-ray spectra. The authors here have not hesitated to draw heavily on the vector model for their discussion, but have also emphasized the increasing contributions being made in this field by the applications of the new quantum mechanics.

The formal treatment of the new quantum mechanics which occupies the last two hundred pages of the book is clear and logically presented. The wave mechanics is first introduced through de Broglie's theory of matter waves, and the transition is then made to the Schrödinger assumption in pointing out Hamilton's original treatment of the similarity between geometrical optics and the dynamics of a particle. The "eigenwert" problem is treated in a way which, while not entirely rigorous, will be clear to the average student. More com-

plete mathematical references are given in an appendix. The same is true of a number of other purely mathematical topics, such as complex integration, orthogonal functions, curvilinear coordinates, etc. A whole chapter is devoted to the study of hydrogen atoms by the wave mechanics method with sufficient concrete details and applications to make clear to the student the utility of the method.

The matrix mechanics is then introduced and developed as an independent theory, with detailed study of applications. This is followed by a discussion of the connection between the wave and matrix mechanics, and the method of constructing the quantum matrices from the solutions of the wave equation. In the chapter on the general theory of quantum dynamics, there is a thorough treatment of Heisenberg's indetermination principle, and the transformation theory of Jordan and Dirac. The frequent introduction of concrete illustrations greatly enhances the value of this chapter.

The book is concluded with chapters on the treatment of non-hydrogenic atoms and molecules by the new mechanics, spectral intensities and the diffraction of electrons and atoms by crystals.

The style of the book is in general clear and concise. The typography is excellent and the text is well illustrated by a large number of well-made diagrams. On the whole it is a work which may be heartily recommended to all those interested in the problems of atomic structure.

R. B. LINDSAY

Leçons sur les Ensembles Analytiques et leurs Applications. By Nicolas Lusin. With a preface by Henri Lebesgue and a note by Waclaw Sierpinski. Paris, Gauthier-Villars, 1930. xvi+328 pages.

This volume in the Borel series contains a systematic survey of the present knowledge of analytic sets, a knowledge which is chiefly due to the researches of the Russian mathematician who is the author of this book. In fact the only results which are not due to Lusin or his pupils come from members of the Polish school of Sierpinski and Mazurkiewicz. The analytic sets of Lusin, which are a generalization of Borel sets, have been briefly mentioned previously in several books (Hausdorff's *Mengenlehre*, for instance), but this is the first book devoted entirely to their study.

Lebesgue in his preface humorously points out that the origin of the problems considered by Lusin lies in an error made by Lebesgue himself in his 1905 memoir on functions representable analytically. Lebesgue stated there that the projection of a Borel set is always a Borel set. Lusin and his colleague Souslin constructed an example showing that this statement was false, thus discovering a new domain of point sets, a domain which includes as a proper part the domain of Borel sets. Lebesgue expresses his joy that he was inspired to commit such a fruitful error.

Of the five chapters of approximately equal length into which the book is divided, the first two are devoted to Borel sets. Here and throughout the book, Lusin considers as his fundamental domain the set of irrational points of a linear space. By excluding the rational points, certain simplifications in statements and proofs of theorems are obtained. After mentioning several different methods of defining Borel sets and showing their logical equivalence, a study is