Books

The Spectrum of Atomic Hydrogen. By G. W. Series. 88 pp. Oxford U. Press, New York, 1958. $2.00. *Reviewed by C. C. Kiess, National Bureau of Standards.*

The title of this book might lead one to expect more in it than it actually contains. However, its brevity is an indication that it is limited in its choice of subject matter. Its 81 pages of text, divided among 12 chapters, deal mainly with "the successive formulation of quantum theory" in the attempt to interpret the fine structure of hydrogen spectral lines as revealed by successive refinements in experimentation. For each hydrogen line postulated by Bohr's theory is in reality a multiplet of several narrowly spaced lines arising from the permitted transitions between the fine-structure levels of the various Bohr orbits.

The first three chapters use only 12 pages to present the historical setting of the fine-structure problem. Then follow seven chapters in which theory and experiment are alternately compared. In each case theory explains some experimental facts and points to new experimental expectations; and, in turn, experiment verifies and challenges some of the consequences of theory: first it is the old quantum theory with relativity of motion in the Bohr orbits; then the new quantum theory of matrix and wave mechanics; and finally the quantum electrodynamics in which accord between theory and experiment is apparently achieved.

Chapter 11 is devoted to the hyperfine structure of the hydrogen energy levels which arises from the interaction between the magnetic fields of the electron and nucleus of the hydrogen atom. The effect of this is to split the ground state into two sublevels separated by 1420.4 Mc/sec. It is regretted that the author did not add just one more paragraph to this chapter telling the great importance of this effect; for in the hands of the astrophysicists it has opened up new insights into the structure and evolution of the universe. In the final chapter is set up the theoretical framework for the short-lived 2-particle atom consisting of a proton and an electron. Some evidence for its brief existence is found in certain radioactive processes.

This book will not appeal, perhaps, to the general reader. Owing to its brevity it will serve best as a topical guide to further reading by the more advanced student. To read it with understanding and profit one must have sufficient knowledge of mathematics and access to a library where the ample literature citations may be found.

An Introduction to Probability Theory and Its Applications, Vol. 1 (2nd Edition). By William Feller. 461 pp. John Wiley and Sons, Inc., New York, 1957. $10.75. *Reviewed by Philip M. Morse, Massachusetts Institute of Technology.*

Whether he wishes or not, the physicist today must know his probability theory. Its basic concepts underlie our interpretation of quantum mechanics and statistical mechanics, are fundamental to our formulation of aerodynamics, of gaseous discharge, and of galactic structure, among other subjects. Classical probability had its deceptive simplicity, which on closer examination revealed the computational drudgeries of combinatorial analysis and the conceptual difficulties inherent in the very definition of probability. But modern probability, which deals with stochastic processes, such as the theory of random walk and of Markov chains, is not even superficially simple, resorting to Laplace transforms or to Jordan canonical matrices at the drop of a hat. Probability theory has not the solid logicality of classical analysis or even of group theory but, alas, it is a branch of mathematics we must understand and use.

Since its first appearance, in 1950, Feller's *Probability*, Vol. 1, has become pretty much the standard text on the subject in this country. One could watch the spread of references to it in more articles and more journals each year. The new edition is welcome, though this reviewer must confess a regret that Vol. 2 did not appear before Vol. 1 had to be revised. Vol. 1 deals with discrete sample spaces, Vol. 2 is to take up continuous spaces.

The new edition contains quite a bit of new material, as well as some reordering of previous material. The first two chapters, one on definitions of probability and the concepts of sample space, the other on the elements of combinatorial analysis, are not much changed. The third chapter, however, on fluctuations in simple random events, is new. It is an interesting discussion, using elementary mathematical techniques, of the tendency of many random variables to "drift" away from their mean values, a tendency perhaps less surprising to physicists than to mathematicians—or to gamblers—or to parapsychologists.

The next four chapters dealing with the "standard" probability distributions, are not much changed, nor are the next three, which lead up to the "laws of large numbers". The last seven chapters are somewhat rearranged and have some new theorems and examples. These provide a clear, well-organized introduction to the basic theories of random walk, Markov chains, and other aspects of stochastic processes, at least to those aspects which can be dealt with by using a discrete sample space. The first edition brought unity and clarity to these rather "messy" subjects. The second edition displays some further improvements in exposition and in choice of illustrative examples.

As the reader might guess by now, this reviewer recommends the book.