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Book Review: *Random Walks and Their Applications in the Physical and Biological Sciences*

Random Walks and their Applications in the Physical and Biological Sciences edited by M. Schlesinger and B. West. American Institute of Physics, New York, 1984, 243 pp.

A diverse array of physical, technical, and biological phenomena can be modeled by various random walks. The recent review article by Weiss and Rubin Random walks: Theory and selected applications, *Advances in Chemical Physics* **52**:363 (1983), is a reasonably comprehensive and masterful summary of much of the literature with detailed discussions of applications such as polymer physics, solid state physics, motion of microorganisms in biology, etc. Another article which reviews random walks mainly with emphasis upon fractal random walks is by Montroll and Schlesinger, On the wonderful world of random walks, in *Nonequilibrium Phenomena II, From Stochastics to Hydrodynamics,* J. Lebowitz and E. Montroll, eds. (North-Holland, Amsterdam, 1984).

With these comments in mind, we come to the volume under review: a collection of 11 research papers on random walks of which ten are devoted solely to applications. The Kiefer and Weiss paper on the two-dimensional random walk recapitulates previous work, outlines their new approximations to exact solutions, and discusses some applications. Hioe discusses Weierstrassian and Levy random walks with applications to models of ferromagnetism. These random walks, are known in the mathematical literature as infinite Bernoulli convolutions have deep connections with algebraic number theory. Under certain conditions such random walks have singular probability distributions, i.e., the derivative of the probability distribution vanishes almost everywhere yet the corresponding random variable does not possess discrete components. Such Bernoulli convolutions arise in the theory of intersymbol interference in communication theory. It would be of interest to correlate these mathematical studies with the current studies on fractal stochastic processes. The remaining nine papers are specialized investigations on solid state problems; par-

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ticularly thought provoking is Family's article on the cluster renormalization for lattice models of polymers.

In addition to these research papers, the late Professor Elliott Montroll contributed an interesting historical article on the University of Vienna school of statistical thought. Note in particular Fig. 1 which traces fragments of the family tree. There are some puzzling omissions: Where is Fritz Zernike?

As with most of the AIP Conference Proceedings the articles are reproduced from the original manuscripts hence a variety of typefaces confront the eye. However this is a small price to pay for the pleasure of learning about the researches of these distinguished investigators.

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Book Review: *Quantum Statistics of Linear and Non-linear Optical Phenomena*

Quantum Statistics of Linear and Nonlinear Optical Phenomena J. Perina. D. Reidel Publishing Co., Boston, 1984, 310 pp.

The volume under review is a broad survey of the quantum statistical description of various optical phenomena that are of current interest. A particularly useful feature is the detailed bibliography of over 900 references! It is neither a text nor a monograph. The prospective reader should be forearmed to the extent of having read R. Loudon's now classic text: *The Quantum Theory of Light* (Oxford University Press, 1974) in addition to having a reasonable knowledge of stochastic processess including the Fokker–Planck equation and Karhunen–Loeve expansions.

Probably the most interesting chapters for the readers of this journal are Chapters 3–5 covering the quantum statistical theory of optical correlation, the coherent-state description (initiated by R. Glauber) of the electromagnetic field, and photocount statistics for various situations. There are a large number of problems involving stochastics in these areas. I hope that Perina's useful overview (in addition to serving its stated pedagogic purpose) will also call attention to these problems for the physically oriented applied mathematics community.

The remaining half of the book, aside from two terse chapters on nonlinear optical phenomena and on master equations, compromises two chapters. Chapter 8 covers aspects of the quantum theory of radiation in random media particularly with respect to photocount statistics, a subject to which the author has made important contributions. Finally Chapter 9 is devoted to the corresponding problem in nonlinear media with emphasis upon Brillouin and Raman scattering, multiphoton absorption and emmission, photon antibunching. Unlike the rest of the book, I found this chapter hard reading. For example, his discussion of sub-Poissonian radiation certainly needs some qualifications.

In summary Professor Perina's book is a very useful addition to the *adult* literature on quantum statistics of optical phenomena and should

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serve as a useful compendium. We note that Perina's previous book *Coherence of Light* (Van Nostrand Reinhold, 1972), of which the volume under review can be considered as a continuation, is also recommended.

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