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Book Review: *Diffusion and Reaction in Fractals and Disordered Systems*

Diffusion and Reaction in Fractals and Disordered Systems. Daniel ben-Avraham and Shlomo Havlin. Cambridge University Press, Cambridge England, 2000.

A perennially favored and widely quoted review of theoretical approaches to the physics of disordered systems is one published by the authors of this book (S. Havlin and D. ben-Avraham, *Adv. Phys.* **36**, 695 (1987)). I've always had the impression that the number of words per critical exponent was far too small in that venue. This book updates the article and, I'm pleased to report, takes a considerably less telegramatic approach to the subject. Many, but not all topics relevant to the general subject area, are covered, and the exposition is supplemented by exercises for the student, an excellent bibliography up to 1999 as well as a list of open problems to challenge the more adventurous reader.

Some of the topics discussed include the characterization of diffusion in random and deterministic fractals, percolation theory, and various aspects of diffusion-limited reactions. As might be expected, the discussion of these topics tends to be best when they represent either of the authors' field of interest, and more superficial when they leave those domains. For example, in their discussion of the trapping of random walks they give the standard Balagurov–Vaks, or Donsker–Varadhan formula for the asymptotic form of the survival probability of a random walker moving through a field of traps. They fail to mention the corresponding result for the mean-squared displacement, which can be found by essentially the same method as the survival probability. Only cursory attention is paid to results relating to the approximations useful at early-times for the survival probability. The early times deserve some attention as they are probably the ones most relevant for physical applications. There is no mention of the very interesting phase transitions in trapping models which include a bias field.

There is a nice discussion of some of the work of the first author on coalescence models in one dimension. Too little is said about research on

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reactions in condensed media requiring consideration of many-body properties, and which is the focus of intense research by chemical physicists. No mention is made of approximations based on the notion of an effective medium, or of transport theory modeling of the scattering of particles in a turbid medium.

Having pointed out some of the lacunae in this book, I would nevertheless recommend it as an introduction to the general area of transport in disordered media. It is a very readable account of at least several general topics in a research area of wide interest. In particular, it presents clear definitions of parameters used to describe diffusion in disordered media. It would make a fine introductory text at the graduate level; but the instructor would also have to supply considerable supplementary material related to both theory and experiment.

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