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Book Review: *An Introduction to Percolation Theory*

An Introduction to Percolation Theory. D. Stauffer. Taylor and Francis, 1985, 124 pp.

Of all the nontrivial examples of continuous phase transitions, the percolation transition is perhaps the simplest to state. Although percolation has been actively studied for several decades, the student seeking an elementary introduction to the field has up to now had to turn to the review literature, including Stauffer's superb 1979 article (*Physics Reports* **54**: 1–79). Now Stauffer has given us an updated and less technical introduction to percolation theory. His selection of topics is similar to that in the *Physics Reports* article, mainly those aspects of the subject that can be approached using either numerical simulations or simple probabilistic arguments supplemented by scaling hypotheses.

Writing in an easily accessible and conversational style, Stauffer begins by defining the percolation problem and sketching its history. In Chapter 2 he takes up the distribution of cluster sizes and cluster perimeters, working out exact solutions for one dimension and Bethe lattices. These solutions are used as a springboard for introducing scaling ideas and exponent relations for two- and three-dimensional percolation. There is a good discussion of how Monte Carlo methods are used to test scaling hypotheses and obtain exponents. Chapter 3 is a quite brief discussion of the structure of percolation clusters, introducing the ideas of fractal dimension and the use of deterministic fractals and the nodes-links-blobs picture to describe the geometry of the incipient infinite cluster. In Chapter 4 real space renormalization group methods, both analytic and Monte Carlo, are discussed. Here the characteristically clear exposition falters and the small-cell real-space method is described in essentially a cookbook fashion with the unfortunate verb "renormalize" appearing without any definition. Chapter 5 addresses the question of transport properties on percolation clusters—resistor networks, ants on labyrinths, and kinetic clusters. Monte Carlo results are plotted and compared with conjectures for the conductivity exponent, including the famous but not quite right Alexander–Orbach conjecture. After some words to the wise in Chapter 6, the book

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closes with an appendix, which explains some of the niceties of extracting results from Monte Carlo data and of programming a computer to label clusters.

The book is written as if the author were sitting next to the reader with a pad of paper explaining the subject over a series of meetings in a coffee house. The explanations are generally clear, but the casual style belies the work required on the part of the reader. Although one goal of the book is to introduce percolation to students with essentially no knowledge of statistical physics, I doubt that any but the brightest of these students will actually follow the arguments beyond Chapter 1. A second criticism is that the book overlooks a number of important aspects of the field. There is only passing mention of series methods and rigorous results and there is no discussion of the field-theoretic ε-expansion or effective medium theory. On the other hand, there is much to be said for a book that occupies only a quarter inch of one's bookshelf. *Caveats* aside, I can heartily recommend Stauffer's book as a supplementary text for a statistical physics course and for anyone working in or contemplating entering the field.

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Book Review: *Fractals in Physics*

Fractals in Physics. L. Pietronero and E. Tosatti, eds. North-Holland, Amsterdam.

The book contains the Proceedings of the International Trieste Symposium on "Fractals in Physics" held on July 9–12, 1985, at ICTP, Trieste, Italy. It contains a very large collection of contributed papers, which in concert provide a broad overview of the concepts of self-similarity and scale invariance as found in several areas of physics.

The volume is divided into nine sections, though this subdivision is not strict and serves mainly as an indication of the topics covered. Part I, on general properties of fractals, deals mostly with specialized topics, such as self-affine fractals. A more complete account on general properties of fractals can be found in books such as *The Fractal Geometry of Nature* by B. B. Mandelbrot. Other parts of the book include an emphasis on experimental physics and fractals (part II); self-avoiding walks and polymer statistics (part III); branched polymers, gelation, and percolation (part IV); irreversible growth models (part V); kinetics of clustering (part VI); dynamical properties of fractal structures (part VII); hierarchical and fractal features of disordered systems (part VIII); and chaos and related topics (part IX). Dynamical systems and chaos are only partially covered. Better reviews of these topics can be found in proceedings of specialized meetings, as pointed out by the Editors.

The book conveys a rather full, updated picture of the role of fractals in contemporary physics, and this is in fact its greatest merit. It nicely emphasizes the theoretical and experimental work concerned with self-similarity and fractals, as studied in a wide variety of physical phenomena. The importance of the book as a review and reference guide has already been proved by the many citations of it in various recent research papers in the field.

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