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Book Review

Fractals and Disordered Systems

Edited by A. Bunde and S. Havlin, Springer–Verlag, New York, 1996, 408 pp., $69.50

This is the second revised and enlarged edition of a book first published in 1991. It concerns the application of fractals across a broad spectrum of the sciences, primarily in physics, chemistry, and biology. The book comes very close to being a textbook on fractals for advanced students, and at the same time it is a very useful reference volume for researchers.

There are 10 main sections or chapters in the book, written by about a dozen authors. One might worry, therefore, that notation and terminology vary from section to section, but the editors seem to have managed to establish a rather consistent system of notation and conventions, and this greatly facilitates reading material contributed by different authors. The book covers much of the usual ground in this field: diffusion limited aggregation, percolation, and cellular automata (in Sections 1, 2 and 3, and 9 written by H. E. Stanley, the editors, and D. Stauffer, respectively) and multifractals (treated throughout the book and in the final section on "Exactly Self-Similar Left-Sided Multifractals" by B. B. Mandelbrot, C. J. G. Evertsz, and R. H. Riedi). Some sections are unique to this book, I believe, e.g., Section 5 on fracture (by H. J. Herrmann). The viewpoint adopted in most sections is an attractive blend of theory, numerical simulation, and experiment. Indeed, Section 8 (by J. K. Kjems) is entitled simply "Fractals and Experiments." There are several stunning photographs, such as a picture of fungus colonies just before Section 4 (on "Fractal Growth," written by A. Aharony), a photograph of a soft coral (on p. 232, leading in to the section on "Transport Across Irregular Interfaces" by B. Sapoval), a ramified electrode made of Wood's metal on p. 249, and a photograph of cauliflower (p. 302), in case the reader needs to be convinced or reminded that structures closely resembling fractals are quite common in the real world.

One can see the book as an exposition of the science of "fractology"—and one can, as usual, wonder how far such morphological considerations will ultimately take us in understanding the phenomena treated. However, it becomes quite clear as one goes through the various sections that there is, at least, a new, common language of inquiry that has been established across these disjoint disciplines, and there seems to be a certain set of growth rules, whether formulated for a discrete system or for a continuum, that leads to this kind of phenomenology. These rules or equations arise, of course, in several different contexts, from electrochemistry to viscous fingering to the growth of fungi. The book strikes a pleasing balance between phenomenology and theory and raises thought-provoking questions about the nature of the solutions to certain problems in fluid and solid mechanics, biological and chemical growth processes, pattern-forming instabilities, and the electrodynamics of continuous media.

The book seems eminently useful as an advanced introduction to the field of fractals and as a reference or "inspirational" volume for researchers in several fields. It probably can be used quite effectively in a topical graduate course (although one would then need to supplement it with some kind of exercises or projects). The price is not unreasonable for a book of this quality with the many illustrations that it contains, several of them in color. There is a detailed list of contents and a comprehensive subject index, which allows one to navigate with relative ease, even though some topics are treated by several authors across several sections. It is easy to recommend this volume and to express the conviction that it will repay careful study by the serious reader.

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