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Book Review: *Physics and Fractal Structures*

Physics and Fractal Structures. Jean-Francois Gouyet, Springer-Verlag, Berlin, and Masson, Paris, 1996.

Why are there so many fractal-like structures in nature? How do we quantify these structures? This short but comprehensive book is a good place to start looking for the answers to these questions. First, a warning: this is not a popular science book. Gouyet has assumed that the reader has at least an advanced undergraduate background in physics. Also, knowledge of the basic ideas of renormalization theory will help in understanding the text. But the book is not turgid either; its greatest strength is its very readable style, which is a testament to both Gouyet and the translator, David Corfield. Especially well written is the introductory chapter about fractal geometry. The concept of the dimension of a geometric object is discussed in a very comprehensible but rigorous manner. Other concepts introduced in this chapter are the connectivity, lacunarity, scale invariance, and randomness in fractal scaling, which are all important concepts in quantifying real-life fractal structures and the natural processes that form them.

The five remaining chapters deal with these processes. The number of topics covered is large, but the depth of coverage is sometimes thin. However, that is not a drawback, as plenty of references are provided. Particularly pleasing is Gouyet's concern with physical evidence: for each topic he briefly describes relevant experiments, and there are citations to many experimental papers. Diffusive processes are strongly emphasized, and an important "take home" message from this book is that there is more to diffusion than simple white-noise Brownian motion. Persistence and antipersistence effects can play a role in forming fractal patterns from a diffusive process. Among other topics covered are turbulence, aggregation, percolation, and modes of vibration in a fractal object.

This reviewer does have some "sore points" with this book. One is the surprising lack of any references to the work of Celso Grebogi, James Yorke, and Edward Ott, who have made important contributions both to the theory of fractal geometry and to the theory of dynamics on strange

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attractors. Also surprising is that aside from the Eden model of tumor growth, there is almost no discussion of fractal structures in biological systems. But the most serious criticism is not technical at all, but concerns a cultural misunderstanding. In the discussion of percolation, Gouyet compares a porous medium with blocked pores to an American city with poorly trained police who set up carelessly placed roadblocks to apprehend a criminal. Why is this city an *American* one? Do Paris or Marseilles really have better trained police? Despite this blemish on an otherwise fine work, Gouyet's book would be a good supplementary text for either a mechanics or a thermodynamics course. It also would be a good text for a one semester course on fractals in nature. The lack of exercises might bother some instructors but with so many topics covered in a short space, a serious student will be forced to use Gouyet's lists of citations and start reading the scientific literature on the field.

The exercises are there: they are just embedded in the text, and this reviewer often found himself eager to work out for himself the equations in this engaging text.

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