Fractal Growth Phenomena
Tamás Vicsek
World Scientific Publishers, 1989, 355 pp., $28 (paper), $67 (cloth).

Reviewed by Harvey Gould

Except for one simple program in an Appendix, there is little discussion of programs in this book. So what is a book like this doing in *Computers in Physics*? The answer can be seen from the many pictures of fractals generated by computer simulations shown in the text. Many of the properties of fractals would not even have been imagined without computers. Fractals are an example of the development of a "computer culture" and the changing way we think about physics. Other universal features represented by the text are that much of the research discussed has been done in a *collaborative* mode and, although the text was written by a single individual, the developments represent the work of scientists from all over the world. Imagine how our present collaborative research modes will evolve when computer networks become even more interactive and international.

One of the more fascinating aspects of fractal growth phenomena is that rules of random growth that might seem trivial, generate non-trivial geometrical shapes, many of which appear to be tantalizingly close to physical structures. Among the most significant of these fractals are diffusion limited aggregates and cluster-cluster aggregation. The author, who has made important contributions in both areas, emphasizes the fascinating relation between such fractal growth models and aspects of pattern formation based on the Laplace equation. The text is divided into three parts. Part I is devoted to the basic definitions and concepts related to fractal geometry, Part II introduces a variety of cluster growth models, and Part III discusses fractal pattern formation due to the motion of unstable interfaces dominated by surface tension. Throughout the text the results of computer simulations, scaling arguments, mean field theories are compared and discussed. Most importantly the author makes a real attempt to discuss the results of laboratory experiments and to compare them with appropriate models. The relation between theory, simulation and experiment is particularly important, since in my opinion there exists too many models that are relatively easy to implement on a computer but whose relevance is limited.

The text can be used as a textbook for a graduate course on fractals, as a reference text for workers in the field, and is suitable for advanced undergraduates doing a research project on random fractals. Although the text presents a good introduction to the field and an excellent overview, it is impossible for the text to be complete and the reader will find it necessary to refer to the research literature to learn the details of a particular simulation, theoretical argument, or experiment. The extensive list of references discussed in the text will assist the reader in determining what is important and where to look for more discussion. I would have enjoyed a bit more explanation on the more abstract properties of fractals, e.g., self-affine fractals, and multifractality, discussed in the introductory chapters. But much of the remaining chapters are accessible even to first-year graduate students.

My remaining comments are quibbles. For example, the quality of the paper used in the text is poor and many of the photographs of fractals suffer. In my hard cover copy several pages are difficult to read since the ink on one side of the paper can be seen on the other side. Also since I frequently refer to the text for access to the research literature, I would prefer that the references be at the end of the text rather than at the end of each part.

Overall the author has been very successful in fulfilling his goal of summarizing the basic concepts of fractal growth phenomena, in conveying the excitement and unanswered questions in the field. ■

Harvey Gould is Professor of Physics at Clark University and regular co-author of CIP's *Computer Simulations column.*