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Book Review: *Random Fluctuations and Pattern Growth: Experiments and Models*

Random Fluctuations and Pattern Growth: Experiments and Models. H. Eugene Stanley and Nicole Ostrowsky, eds., Kluwer Academic Publishers, Dordrecht, 1988.

This book is the proceedings of a NATO Advanced Study Institute, organized by the two editors, and held in Corsica in July 1988. The stated intent of the meeting was to investigate the very wide range of random patterns formed in a diverse array of physical phenomena, and to seek similarities in the underlying physics describing the patterns and their formation. The phenomena considered ranged from fluid displacement to fracture, from dendritic growth to dense radial morphologies, from surface films to surface membranes, and from convection to complex systems. This is an ambitious undertaking! To their credit, the editors have organized an interesting and informative book. The commonality of the themes sometimes appears weak, as one might expect with such a wide range of topics. However, taken as a whole, this book does give a good introduction to a vast range of phenomena which produce fascinating patterns and interesting physics.

The book consists of nine chapters, each dealing with a different general topic, and each representing one "course" in the schol format under which the meeting was organized. The first chapter has two purposes: to introduce the themes of the book and to discuss several dynamic and transport properties of random materials. Both theoretical and experimental contributions are included. One highlight of this chapter is the discussion of experimental studies of fractons by Courtens and Vacher. The second chapter is a brief discussion of aggregation, highlighted by the imaginative studies of microparticle growth patterns on surfaces by Skjeltorp and Helgesen. There is additional discussion of aggregation included in articles in other chapters.

The third chapter deals with flow in porous media and the patterns that result. It includes an excellent summary paper by Lenormand and

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822/56/5-6-27

Daccord about micromodel work. Chapter four consists of three papers on patterns formed by solidification of liquid crystals and by lipid monolayers at an air/water interface. The following chapter deals with patterns formed by solids, and includes several papers discussing the dense branching morphology seen in thin films. Chapter six deals with fracture, and consists of several papers discussing probabilistic modeling of breakdown, as well as an experimental study of fracture of drying arrays of polystyrene spheres on a surface.

Chapter seven is a discussion of the properties of disordered membranes and the description of their shapes. The papers in this chapter are well written and extensive, making this chapter particularly valuable. The following chapter is something of a mixture, containing papers about patterns in hydrodynamic convection, multifractal analysis, and diffusion-limited aggregation. The book closes with a chapter on "complex systems" and includes papers on $1/f$ noise along with discussions of models that claim to account for its origin. Also included are discussions of several other systems that seem to be collected here primarily because they do not fit naturally into any other chapter.

The articles in the book are of varying quality, as one might expect for a conference proceedings. The majority of them are reasonably well written, and provide sufficient references to allow the interested reader to pursue points that are not fully discussed. Several of the papers are outstanding, while a few others are nothing more than one-page abstracts. As a whole, however, the book forms a timely collection of work in several areas of physics concerning pattern formation in random systems. It would make a useful reference volume for workers in the field, serving as an introduction to related areas. For this, the broad range of topics covered is a strength of the book. However, this book is particularly well suited for students or researchers about to start work in any of these areas. Since the meeting was organized as a school, this is presumably the goal the editors were striving to achieve. In this, they have done an admirable job.

David Weitz
Exxon Research and Engineering Co.
Annandale, New Jersey 08801

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Book Reviews: *Measures of Complexity* and *Chaos and Complexity*

Measures of Complexity, L. Peliti and A. Vulpiani, eds., Springer, Berlin, 1988.
Chaos and Complexity, R. Livi, S. Ruffo, S. Ciliberto, and M. Buiatti, eds., World Scientific, Singapore, 1988.

These proceedings provide a useful contribution to the current debate about the emergence of a "science of complexity." The question is whether or not a common meaning underlies the word "complexity" in the different disciplines and whether or not there exists a convergence of techniques for the investigation of complex systems.

The volume edited by Peliti and Vulpiani (the proceedings of a 1987 Rome conference) attempts to answer this question by taking the "physicist's" attitude that a common meaning may be identified if complexity is measured in comparable ways in various contexts. The measures of complexity appearing in this volume share a common attempt to overcome the Shannon information measure, but leave the issue quite open. Several interesting proposals arise, but do not appear to command a consensus. The largest choice appears in the theory of dynamical systems, whereas the deepest debate—around a "measure of meaning"—is probably the one going on in the biological sciences. Also interesting is the attempt to measure the complexity of a task by the effort needed to learn it by an artificial learning device.

The volume edited by Livi *et al.* (based on a workshop in Turin, October 1987) is more ambitious. In particular, it attempts to bridge the gap between the community of investigators of dynamical chaos and the ones interested in the statistical behavior of highly interconnected systems. Instead of asking generic questions, such as, What is a complex system? What is the relation between chaotic and complex behavior?, it prefers to follow a more operative approach, asking, for example, Has the transition to chaos something to do with phase transitions in statistical mechanics? What is the role of disorder in a large system of interconnected objects with

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respect to its dynamical behavior? What are the implications of ergodicity breaking for the validity of the predictions of statistical mechanics?

The Turin proceedings are arranged in five sections: Theory of Dynamical Systems, Experiments on Spatio-Temporal Chaos, Networks, Cellular Automata, and Biology, Evolution Theory and Biological Networks. The diversity of subjects is reflected in a comparable diversity in investigation techniques. The discussion of experimental research in the dynamics of chaotic systems and of neural networks adds to the interest of the volume. A link between the two communities mentioned above seems to have been established, although a common language has not yet arisen.

The concreteness of the discussion contained in these volumes makes their reading useful and thought-provoking, in contrast with many other contributions which attempt a unification at all costs.

Antonio Coniglio
Universita di Napoli
Dipartimento di Scienze Fisiche
80125 Napoli, Italy