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Book Review: *Instabilities, Bifurcations, and Fluctuations in Chemical Systems*

Instabilities, Bifurcations, and Fluctuations in Chemical Systems, Edited by L. E. Reichl and W. C. Schieve, University of Texas, Austin

This book is the product of a workshop held in Austin, Texas, March 10–13, 1980. It simultaneously provides chapters for the technically adept practitioner, already working in this broad area of research, and chapters for those others who would like an introduction to the field. Four major divisions are delineated: A, Theory of bifurcation phenomena in chemical systems; B, Experimental properties of chemical systems; C, Biochemistry; and D, Fluctuation phenomena and stochastic theory. This mixture of theory and experiment gives the book balance. A great deal can be learned from this book about the maturity of this rapidly growing discipline.

The strength of this book lies in a subset of its chapters which are really very good accounts of their particular contents. These chapters will be discussed below. Its weakness is that several chapters address topics which have been treated better, elsewhere, by others; in some instances the better treatment can be found in the references to the chapter. Overall, the experimental chapters are of higher quality than are the theoretical chapters, and of greater intrinsic interest, as well.

Bifurcation phenomena in chemical systems is the subject of Section A. The chapters of this section provide an introduction to the subject, but not much depth or detail. If one explores the references to these chapters, the needed depth and detail may be found, but most readers probably won't go to the trouble. Bunow and Kernevez have presented numerical results for reaction-diffusion processes involving immobilized enzyme arrays. The interplay of chemistry and geometry is exhibited in a very readable essay.

Two chapters comprise Section B: Experimental properties of chemical systems. Smoes has written a detailed account of the Zhabotinskii reaction, the redox reaction which propagates colored wave fronts in real space and time. While this chapter is primarily experimental, the interface with theory is clearly adumbrated. I found the section on "center ignition" especially intriguing. The chapter includes a very complete set of references.

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The other chapter of Section B, by Ortoleva *et al.*, concerns mechanisms of bio- and geo-pattern formation. This is one of the highlights of the entire book and provides a thorough exposure to the very ambitious research program of Ortoleva and his associates. The chapter contains a refreshing mixture of observation, theory, and experiment. The treatment of bioelectric self-organization in the rockweed, *Fucus*, epitomizes the underlying approach of the group and exhibits their successes to date. There is a playfulness to the approach that one cannot fault, which is manifested in the section about "Dimplons."

Section C is simply called: Biochemistry. Unfortunately, it is a misnomer. The chapter on morphogenesis, while of great interest in itself, is hardly "biochemistry." Similarly, the chapter on multicellular arrays and membranes, is hardly "biochemistry." Only Darden's very nice chapter on enzyme kinetics qualifies, and it serves the Section C heading very well, indeed. One, however, wonders what the editors were thinking when they assembled these chapters under a single heading.

Darden's chapter might well have been in Section D for that matter. It discusses the differences between stochastic and deterministic treatments of enzyme kinetics equations. It is a scholarly and useful account, directed at the small numbers of molecules of any particular species to be found in an *E. coli* cell, for example.

As regards morphogenesis, I believe one can do no better than to study the paper by S. A. Kauffman *et al.*, *Science* **199**:259 (1978) to get a taste of modern progress in this venerable field.

Section D is about fluctuations and stochastic equations. The outstanding chapter is by Englund *et al.* on optical bistability. Recent work with lasers will provide very stringent experimental tests of theory. The methods of stochastic analysis used in this chapter are closely related to the methods used in the other chapters of this section, although the context is rather far removed from "chemical systems" per se. I found the other chapters in this section too topical. They were not appropriate as introductions for general interest readers and they were of little informative value for the specialist reader, such as myself.

Overall, this book provides a useful introduction to the literature on stochasticity and stability in chemical systems. While it is a bit uneven in level, this is a result of some chapters being merely competent, while others are of a noticeably high level.

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