Book Review

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Self-Organization and Emergence in Life Sciences. Bernard Feltz, Marc Crommelinck, and Philippe Goujon (Eds.). (2006, Synthese Library Vol. 331, Springer.) Hardcover, €139, $179, 360 pages.

Self-organization and emergence have received much attention in biology and artificial life [1, 2, 4, 5], even though these pervasive concepts have eluded strict definition [3]. This makes the contributions contained in this interdisciplinary volume relevant to many aspects of artificial life.

Self-Organization and Emergence in Life Sciences was first published in 1999 in French, but the contents are not outdated. Moreover, it provides a window to Francophone approaches to self-organization, mainly represented by researchers based in France and Belgium. Though there is a certain geographical prevalence, the areas from which the different authors approach different topics are quite varied: from physics to philosophy, immunology to psychiatry, and history to biology.

It is difficult to organize such a heterogeneity of contributions, but the editors have managed to present them here as a coherent whole. The book consists of three parts, dedicated to the *scientific approach*, the *historical approach*, and the *epistemological and conceptual approaches*, each with two sections. While the quality of the contributions is varied, many are worth reading. Together they present a good overview of the concepts, problems, and open questions related to self-organization and emergence and their relationship with the life sciences.

The scientific approach starts with "Self-Organization and Biology: General Standpoints." Gérard Weisbuch gives a good introductory review of the complex adaptive systems approach to biology, covering complex systems, random Boolean networks, and immune networks. Vincent Bauchau uses Conway's game of life to provide an interesting discussion on emergence and reductionism, arguing for both of them in science. Hugues Bersini studies chaos in Hopfield neural networks and immune idiotypic networks, showing how frustration emerges from the network connectivity. The second section is "Self-Organization and Biology: Thematic Standpoints." René Thomas presents a summary of his work on regulatory network analysis and feedback circuits. Lefèvre et al. discuss the interaction between experimentation and modeling in neurosciences, focusing on ocular saccades. A posthumous chapter by Francisco Varela proposes the idea of synchrony of neurons as "neural glue." This is not the best introduction to Varela's ideas, but it is certainly worthwhile. In his contribution, Philippe Meire discusses dualism in psychiatry. The chapter by Atlan and Cohen is one of the most interesting in the book. They discuss how the nervous system self-organizes to process information, acquire meanings, and determine individuality. Then they extend this description to the immune system, which performs the same tasks.

The historical approach provides a good account of the development of the concepts of self-organization and emergence. The section on early philosophical conceptualizations starts with a chapter by Gertrudis Van de Vijver, who reviews Kant's approach to organization, that is, the notion of purposiveness in nature. Laurence Bouquiaux reviews Leibniz' ideas, arguing that variety is not explainable through Cartesian mechanism. François Duchesneau discusses different models of epigenesis in the eighteenth century, confronting "essential force" and "formative force." Philippe Goujon gives a good historical overview, reviewing logic, cybernetics, and self-organization. The chapter notes the role of randomness in simulating intelligence and adaptation. Paul Mengal gives a brief history of the concept of emergence. Originally arising from theology—framed by G. H. Lewes

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in the early nineteenth century—it has been discussed in changed language by scientists. The concept of "immanent action" has been replaced by that of "self-organization," and the "immanent vital impulses" have been replaced by "emergence." "Contemporary Origins" are presented in the second section of this part. An early history of artificial life and complexity (up to 1995) is given by Jean-Claude Heudin. In his article, Pierre Livet reviews the concept of self-organization in second-order cybernetics.

The third part of the book deals with epistemological and conceptual approaches. In the first section, teleology and intentionality are discussed. Robert Brandon analyzes the relationship between self-organization and selection, exploring the question of purpose in self-generated biological order. Marc Maesschalck and Valérie Kokoszka present a discussion of phenomenology in the cognitive sciences, reviewing different trends. Paul Thompson argues in favor of nonlinear models as opposed to those reducible to first-order predicate logic. In other words, he defends the primacy of semantics over syntax in modeling. Robert Richardson confronts two approaches of scientific explanation: causal or mechanical (e.g., Newton), and explanatory unification (e.g., Kauffman). The latter is argued to be more appropriate for studying self-organizing systems. In the final chapter, Bernard Feltz reviews the role of self-organization, selection, and emergence in theories of evolution.

The study of self-organization and emergence is still in development, and although this volume is worthwhile for those familiar with the field, a definitive introduction has yet to be written. This volume is not recommended as a first reading on the topic, as the articles are at the discussion level. It is certainly recommended for people doing active research related to emergence and self-organization. It contains important perspectives sometimes ignored in the Anglophone community.

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