

SELF-ORGANIZATION AND EMERGENCE IN LIFE SCIENCES

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SELF-ORGANIZATION AND EMERGENCE IN LIFE SCIENCES

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INTRODUCTION

The concept of self-organization takes a growing place in the evolution of contemporary sciences. Coming from the second cybernetics, which developed in USA at the end of the 1950th, this concept had first implications in biological sciences in the context of the Biological Computer Laboratory founded by Von Foerster and in the works of three symposia on the Self-Organizing systems from 1960 to 1962. During the 1970th, this approach was developed especially by the chilian school of biology. Since the 1980th, the Santa Fe Institute gives a new impulse to these perspectives. These works go on linked with the progress in the algorithm's theories, in artificial intelligence and in the analysis of non linear systems, in particular by the Brussels school. They lead, on the beginning of the 1990th, to books whose explicit purpose is a fundamental new approach of the living.

The concept of emergence refers to the coming out of new properties linked to the complexity of an organization. In scientific context, self-organization models have an important place in the formalization of emergence. The order from chaos, presented by Self-Organizing models, is often interpreted in terms of emergence, *id est* the advent of a higher level of organization.

These two concepts can be analysed according to different perspectives. This explains the structure of this book in three parts: scientific, historic and epistemologic. It will be first analysed in what extent the concepts of self-organization and emergence have some impact in experimentations in the different fields of contemporary life sciences. Second, historical origins, distant or more recent, will be envisaged. This concerns remote intuitions of antiquity, the first approach in philosophy of life in the modern period, as the more recent developments of the first and second cybernetics. Finally, in a third part, emergence and self-organization will be epistemologically analysed in relation with the questions of teleology and explanation.

* * *

The scientific approach presents two parts. The first one is an introduction to different formalisms of self-organization and emergence. Physicist G. Weisbuch introduces to the dynamic complex systems. V. Bauchau analyses boolean automata networks in biology and H. Bersini presents the problematic of artificial life. The second part analyses experimental biology and medical practice. R. Thomas shows the importance of positive feed back in the cellular differentiation process. Ph. Lefevre and his colleagues develop an example of emergent properties of neuronal networks and F. Varela studies neuronal synchronization in cognitive functions. Ph. Meire analyses the relevance of self-organization concept in psychiatric practice. Finally, H. Atlan shows the fecundity of self-organization perspective in immunology. The dominant image is one of great potentialities with already actual results but specially a great hope of promise.

For historicist, such a fecundity is not surprising. Self-organization and emergence problematic indeed concerns fundamental debate on specificity of living since antiquity to contemporary period. G. Van De Vijver shows that precisely in a detailed analysis of kantian position. More linked to the history of science, the contribution of F. Duchesneau studies the concepts of “formative force” and “essential force” in the epigenesis theories in the 18th century, while P. Mengal shows how, in the 19th century, the concept of emergence oscillates between biology and theology. This historical survey shows that self-organization and emergence, in their philosophical intuitions, lead to a concept of scientific approach of living which takes distance with mechanistic project. On the contrary, analysis of more recent origin of these concepts places us in a radically mechanistic perspective. The first cybernetics is the starting point of a more complex elaboration which tends to integrate the problematic of self-programmation. J.C. Heudin develops such perspectives in relation with artificial life, while P. Livet studies the relations between self-organization and the logic of deconstruction. Historical approach exhibits clearly ambiguities of self-organization and emergence. Distant origin refers to concepts which lead to vitalism, while proximate context places these concepts in a deliberate mechanistic research programme.

This ambiguity is precisely in the core of epistemological analysis of the third part. All the scientists and philosophers of this book keep away from vitalism without renouncing to the question of the specificity of living which presents new formulations. R. Brandon analyses the relation between self-organization and teleology, which is at the core of living, while

M. Maesschalck and V. Kokoszka envisage the relation between self-organization and the phenomenological intentionality. Moreover, epistemological analysis of emergence is linked to the question of explanation which focalises the last contributions. P. Thompson studies the concept of model in Self-Organizing systems. R. Richardson analyses the relation between explanation and causality in these systems. Finally, B. Feltz proposes an articulation between self-organisation and selection in evolutionary theory and analyses the implication of these concepts in the question of emergence.

* * *

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