A review of “Modularity: Understanding the Development and Evolution of Natural Complex Systems” edited by Werner Callebaut & Diego Rasskin-Gutman, published by The MIT Press ISBN 9780262033268 (2005)

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Vincent Vesterby, Vincent Vesterby

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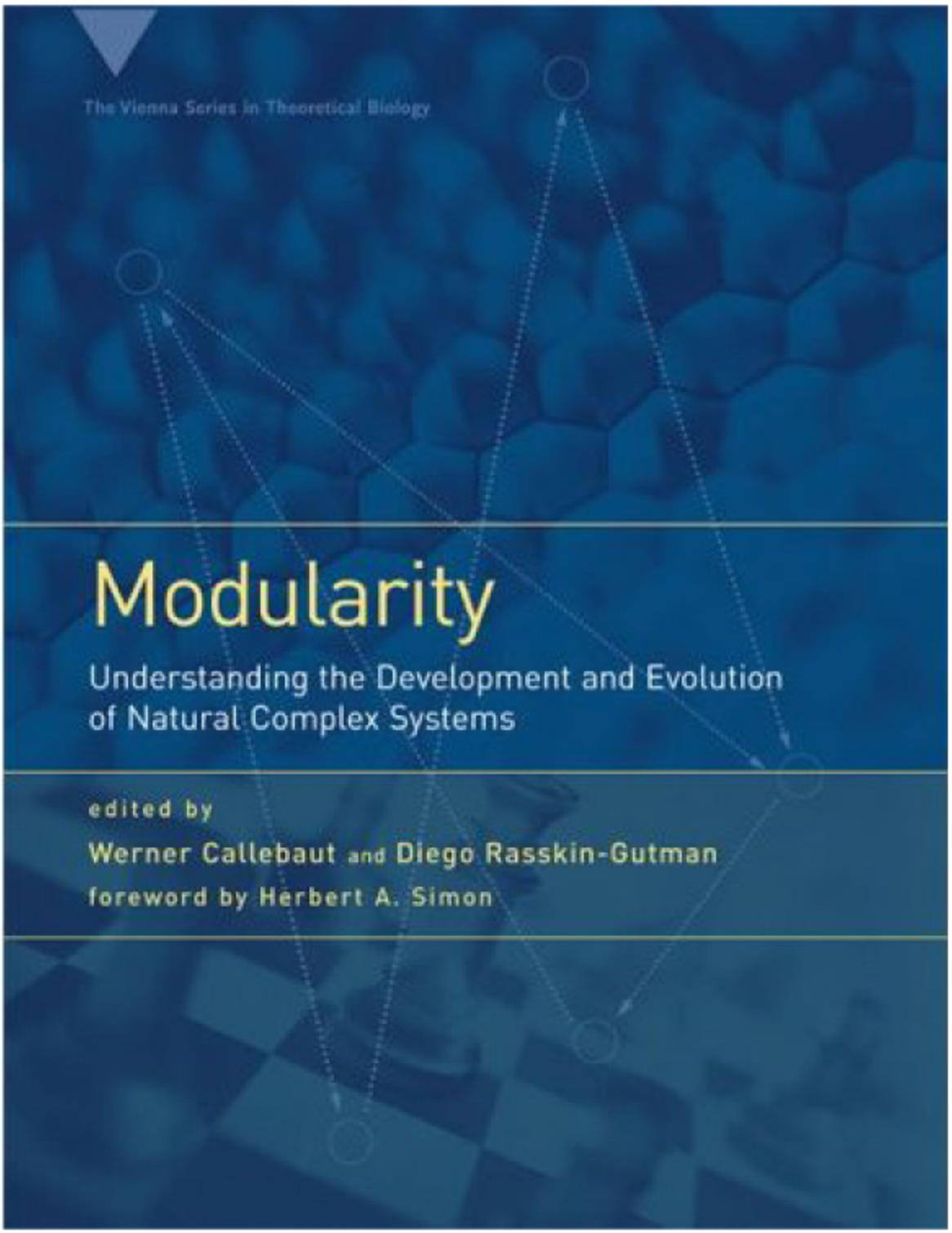
Abstract



Introduction

The Altenberg Workshops in Theoretical Biology are held yearly, near Vienna, at the Konrad Lorenz Institute for Evolution and Cognition Research (KLI). The books in the Vienna Series in Theoretical Biology result from these workshops. This book came from the workshop of the same name held in October, 2000.

The purpose of the conference was to bring together experts from various fields to try to:

1. *Survey the variety of disciplinary contexts 1. in which "modular thinking" in general … or more specialized concepts … play a role;*

2. *Clarify, against this background, what mod2. ules are, why and how they originate and change …, and what this implies for the respective research agendas in the disciplines involved;*

3. *Bring about a useful knowledge transfer be3. tween diverse field regarding the broad topic of modularity wherever this appears useful and feasible* (p. xv).

"KLI fosters research … on all aspects of theoretical biology, with an emphasis on the developmental, evolutionary, and cognitive sciences." "The workshops … concentrate on new conceptual advances originating in these disciplines, and are meant to facilitate the formulation of integrative, cross-disciplinary models" (p. vii). This, then, is what to look for in the twenty contributions that comprise the book. The authors focused primarily on the developmental, evolutionary, and cognitive sciences, with some additions from art and economics, and they presented conceptual advances in these disciplines. Even though at the end of the meeting the general feeling was that there had been a useful knowledge transfer between the fields of the attendees, they were not as successful at formulating integrative, cross-disciplinary models.

"In our world, modular systems, both natural and artificial …, abound" (p. 3). This is Werner Callebaut's first sentence in the first chapter, and it leads into the primary utility of the book, that it is a good source for starting points for further exploration of modularity. In several cases the authors are working on the leading edge of identifying modularity in complex dynamic systems. There is a great variation of approaches to modularity that are in the book, and an equal variation in style and quality.

Callebaut's chapter, mentions many significant points concerning modularity, and even though the discussion is brief, this chapter is itself a source for starting points to look into interesting aspects of modularity. The chapter by Robert N. Brandon is just the opposite. This essay gives the impression that the author is trying to correct some previous disagreement or misinterpretation of his point that conceptual analysis and empirical hypotheses are distinct but complementary. As he says in the last paragraph, "I hope to have shown conclusively that my conceptual analysis of evolutionary modularity is different from, and potentially complementary to, the work of Wagner and Altenberg" (p. 59). Because this is the aim of paper, there is little if anything about modularity that is in addition to what has already been said in the previous chapters.

The chapter by Lee Altenberg concerns modularity in evolution, but it also has some problems. While Lee Altenberg is a recognized expert on evolutionary computation and related fields, his research approach to evolution, and modularity, are so strongly orientated to computational and mathematical methodologies that his chapter is difficult to understand by someone not well versed in those specialty disciplines. There is too much jargon that is not adequately explained, and when the author does provide an explanation or definition, the reader is often left wondering what the definition means. Reading this essay leaves one with the impression that it is possible to be an expert in evolutionary computation without being equally expert in natural biological evolution. For example, Altenberg several times refers to phenotypic optima such as optimal values of traits. Natural biological evolution does not generally optimize phenotypes. It only progresses to what is sufficiently fit, to what is fit enough, to what works in any particular situation. The optima has nothing to do with what evolutionary change a biological system is currently undergoing.

Gerhard Schlosser wrote about modules in mosaic evolution in a very interesting chapter. Here the terms and concepts are clearly defined and explained. A rather advanced form of modularity is identified. It is then related to evolution, development, and function, and finally pointed out in natural occurrence at three levels of hierarchic organization using amphibian examples.

This book contains a wide diversity of types of modularity, in a variety of fields. This is definitely a multidisciplinary read.