

# Modularity

Understanding the Development and Evolution of Natural Complex Systems

edited by **Werner Callebaut** and **Diego Rasskin-Gutman**

foreword by **Herbert A. Simon**

Modularity—the attempt to understand systems as integrations of partially independent and interacting units—is today a dominant theme in the life sciences, cognitive science, and computer science. The concept goes back at least implicitly to the Scientific (or Copernican) Revolution, and can be found behind later theories of phrenology, physiology, and genetics; moreover, art, engineering, and mathematics rely on modular design principles. This collection broadens the scientific discussion of modularity by bringing together experts from a variety of disciplines, including artificial life, cognitive science, economics, evolutionary computation, developmental and evolutionary biology, linguistics, mathematics, morphology, paleontology, physics, theoretical chemistry, philosophy, and the arts.

The contributors debate and compare the uses of modularity, discussing the different disciplinary contexts of “modular thinking” in general (including hierarchical organization, near-decomposability, quasi-independence, and recursion) or of more specialized concepts (including character complex, gene family, encapsulation, and mosaic evolution); what modules are, why and how they develop and evolve, and the implication for the research agenda in the disciplines involved; and how to bring about useful cross-disciplinary knowledge transfer on the topic. The book includes a foreword by the late Herbert A. Simon addressing the role of near-decomposability in understanding complex systems.

**WERNER CALLEBAUT** is Scientific Manager of the Konrad Lorenz Institute for Evolution and Cognition Research, Vienna, and Professor of Philosophy at Limburg University, Belgium.

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## Vienna Series in Theoretical Biology

“To have such an introduction to the many faces of modularity is wonderful, and this book is a welcome addition to the limited but hopefully growing body of literature on the subject. My feeling is that the book will become indispensable reading for anyone interested in modularity.”

—José B. Pereira-Leal, *Acta Biotheoretica*

“Presents interesting work in progress, inspiring both to academic students and researchers working in philosophy of science, biology and cognitive science, and to researchers willing to push the interdisciplinary challenge offered by complex systems further.”

—Linda Van Speybroeck, *Philosophica*

“The volume is a great read; the content of each chapter provides definitions, examples, and analysis so that the implications of ‘modular thinking’ are profound.”

—Marvalee H. Wake, *Quarterly Review of Biology*

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