Preface

Throughout the biosciences the rapidly growing number of experimental results and the increasing complexity of the investigated phenomena pose an unprecedented challenge for the interpretation of the accumulated data and the integration of this knowledge into the theoretical framework of biology. Therefore, abstract and conceptual models have become an indispensable tool for the analysis and interpretation of empirical results, for the organization of data, for theoretical integration, and for the formulation of new hypotheses. At the same time, bottom-up modeling elucidates properties of natural biological systems that can subsequently be explored empirically. Therefore, modeling represents a major component of scientific endeavors. Any advancement in the biological sciences thus depends on different kinds of modeling, whether they are used tacitly or strategically, and computation has become central to all these procedures. The present volume investigates the many ways in which new modeling strategies in the biosciences assist and influence our understanding of biological phenomena.

This book grew out of a workshop titled ''Biological Modeling: Structures, Behaviors, Evolution,'' which was organized by the KLI at Altenberg, Austria. The workshop brought together scientists from fields ranging across mathematics, physics, neurobiology, developmental biology, paleobotany, behavior, and theoretical biology. Three days of discussion reinforced the initial view that biological modeling will play an ever increasing role in the analysis and understanding of the properties and dynamics of biological systems, and therefore will be an important part of the resulting biological theories. Additional authors in fields of expertise that were not represented at the workshop kindly provided additional perspectives included in this volume.

The book is structured into parts according to the areas in which we feel the major advancements are taking place. We begin with the analysis of important conceptual issues regarding biological modeling in general, and then provide introductions to a number of specific approaches in the organismal domains of morphology, development, and behavior. We conclude with a part that addresses the modeling of these

properties in the context of evolution, with a particular emphasis on the emerging field of EvoDevo. While in both the workshop and the volume we had to be selective, and even to a degree idiosyncratic, the contributions nevertheless amply demonstrate how modeling mediates in an increasingly critical fashion between theory and empirical research in a wide range of biological fields.

We thank the workshop participants and the additional contributors to the volume for their enthusiasm for theoretical biology that appears throughout these chapters. We also thank the staff of the KLI for their continued efforts in organizing high-quality workshops that promote a creative exchange of ideas in the conducive environment of the Lorenz mansion in Altenberg, Austria. And, as before, we thank the motivated people at the MIT Press for their continued support of the Vienna Series.

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