

Preface

The life sciences have strong traditions as quantitative disciplines. In several fields quantitatively minded research was at a zenith in the 1960s and 1970s. Flick through, for example, chapters of the American Physiological Society's *Handbook of Physiology* that were published in this era (and even into the 1980s) and one will see physiology revealed as an engineering science, applying the tools of chemical, mechanical, and electrical engineering to measure, analyze, and simulate biological systems. A great deal of biochemical research in the 1960s and 1970s was focused on the kinetics, thermodynamics, and generally physical chemistry of biochemical systems. From this work emerged an interdisciplinary field sometimes called *biophysical chemistry*, which encompasses a collection of physical and mathematical methods for analyzing molecular structure and dynamics.

This great era of quantitative physiology and biochemistry was temporarily sidetracked by revolutions in molecular biology and molecular genetics, which, at risk of oversimplification, are focused on the question of what is there (inside a cell) rather than how it works. In the 1980s and 1990s much of the physically oriented quantitative research in biology was similarly focused on isolated molecules. In the 1990s the term *molecular biophysics* arose as a popular name of new departments combining experimental techniques with theory and simulation, emphasizing physicochemical approaches to studying biological macromolecules.

Nowadays, with several genomes sequenced and large amounts of data available on what molecules are present in what quantities and inside what sorts of cells, attention is shifted to the question of how it all works. The new focus is sometimes called *systems biology*. Whatever we call it, although a number of recent publications would have the reader believe that *systems biology* is an entirely new endeavor, the basic idea of pursuing quantitative mechanistic-based understanding of how biological systems function is a shift back to the philosophy of a previous era.

Of course we should not imply that progress in biological systems analysis ever ceased or that the current trend calls for a wholesale abandonment of reductionist approaches in favor of integrative systems analysis. Yet it is obvious to even the casual browser of the headlines of the science magazines that, in some form or another, systems analysis in biology is in the spotlight for now and at least the foreseeable future. At the heart of a systems approach to biology is a recognition of the importance of dynamic behavior (and function) of a system (a cell, an organ, or an organism) emerging from the interaction of its components. Moreover, computational modeling and simulation is centrally important to analysis of such systems.

While it is in the context of this newfound attention on quantitative and computational biology that we hope this book is useful, some readers may find some of the content old fashioned. A student planning a career in systems biology may wonder whether our emphasis on the physical chemical basis of natural phenomena looks backward or forward. This text represents an attempt to do both in synthesizing a basic foundation in *chemical biophysics* for analysis and simulation of cellular systems. The title of the book, yet another permutation of phys-, chem-, bio-, and related syllables, arises from this desire to continue the rigorous tradition while at the same time define something new.

We are fortunate to have been mentored by a number of leading scientists, including James Bassingthwaigthe, Elliot Elson, Carl Frieden, John Hopfield, James Murray, John Schellman, and Tamar Schlick. In particular we have both benefited a great deal from our long-time association with Jim Bassingthwaigthe. His advice and inspiration is at the root of much of what we have endeavored to do, including writing this book. In addition, we owe a particular debt to Athel Cornish-Bowden who gave us advice, both specific and general, and encouragement on the text. His book on enzyme kinetics sets the standard for clarity that we can only strive for. These two books, perhaps together with one that emphasizes molecular biophysics, could provide appropriate material for a year-long sequence on biophysical chemistry, from macromolecules to biochemical systems. On its own, this book has been used for a semester-long course on computational biology.

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