

Deutsch, A., Howard, J., Falcke, M., Zimmermann, W. (ed.): **Function and Regulation of Cellular Systems**. – Birkhäuser Verlag, Basel 2004. ISBN 3-7643-6925-6. € 88.00, CHF 136.00.

This highly-interdisciplinary book is based on selected peer-reviewed contributions presented at the “First International Modelling and Theory in the Biosciences Workshop on the Function and Regulation of Cellular Systems: Experiments and Models” held in Dresden, June 24-30, 2001. The book can be considered as an introduction for biologists, mathematicians, and physicists dealing with cellular systems that can be better studied with an aid of mathematical models. Unique character of this publication resides in the effort to demonstrate possibilities of mathematical modelling of complex life processes in several different areas of biological research.

The book is divided into seven parts according to selected cellular processes of different level of complexity. The first part deals with modelling of metabolic networks. The papers cover various topics of metabolic modelling: presenting model of yeast glycolysis with special emphasis on dynamics of the process, steady state analysis, and glycolytic oscillation; study of the occurrence of temperature-compensation that is essential for cellular oscillation, acting as biological clocks; application of metabolic control analysis to the ATP free energy metabolism of skeletal muscle with special attention to rate control exerted by ATPases and calcium ions. The other sphere of research suitable for application of modelling is presented in the second part that deals with intracellular signal transduction. This branch of research is convenient for modelling due to much larger level of complexity of components involved in signal transduction than in biochemical systems of metabolism. This part presents modelling papers from different areas of signal transduction in different tissues. There is a paper modelling the dynamics of the second messenger calcium in the long-term modulation of synaptic transmission in neurons. Another one focuses on protein phosphorylation and introduces a mathematical model of the EGF-induced MAP kinase pathway. Three papers are devoted to intercellular signalling, e.g. the study of regulation of gap-junction channels that are responsible for the coordination of cellular activities in many tissues and modelling of the propagation of hormone-elicited calcium waves in the liver. The next part introduces another field of living cell research,

e.g. the internal architecture of cell, cytoskeletal organization, cell motility, and force generation by molecular motors. Reviews in this part cover the wide range from molecular approaches focusing on the mechanical and dynamical properties of individual proteins to a more complex system-based view of whole cells or even cell complexes. One of final parts of the book focuses on cell-cell and cell-substrate interactions. Important example of cell-cell interactions is cell sorting, where cells from different origin, after mixing in culture, reaggregate according to their origin. Besides short-range attraction, different ways of long-range attraction are possible between cells. These involve, e.g. chemotaxis, haptotaxis, galvanotaxis, contact guidance, and tensio-taxis. Authors demonstrate on embryonic tissues how the specific microscopic binding energies of adhesion molecules may be linked with the macroscopic surface tension of multicellular aggregates. The last but one part is devoted to the organisation of tissues. Embryonic tissue development and definition of the body axes is studied on a model organism, freshwater polyp *Hydra*. Its “organizer” tissues are specified to instruct and recruit the surrounding tissue to contribute to the formation of a particular structure. Comparative experiments showed that organizer tissues are not restricted to vertebrates only, and it is unclear when and how they arise during animal evolution. The last chapter is dealing with complex diseases and the immune system. Cancer growth as well as the corresponding immune response requires detailed analysis of the interplay between different physiological regulation processes. There are also articles focused on mathematical models of progressive tumour growth, followed by an article on aspects of the immune system.

Despite the first look that this book is a collection of very heterogeneous papers, a closer look shows that due to wealth of experimental data and complexity of life processes, biological research in very different areas increasingly relies on mathematical methods or formulation of ideas in terms of mathematical models. This is the genuine reason to recommend this book to all those working in interdisciplinary biological research fields.

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