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Book review:

Dynamics of Cell and Tissue Motion

by

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The keyword *dynamics* in the book's title emphasizes that most theories and models presented herein rely on dynamical systems in the broader mathematical sense. *Cells* and *tissues* are biological. The book, consisting of 33 contributions, written by some 50 scientists with specialities ranging from biology and medicine to physics and applied mathematics, encompasses most aspects of cell and tissue motion in the broad meaning of *biological motion* (intracellular motility, cell locomotion, chemotaxis, contact guidance, adhesion, shape formation, aggregation, cell divisions, cell-cell interactions in developing tissues, mechanical stresses and strains in cells and organs, plant organ growth). Specialized type of motions like mitotical movements of chromosomes, or in muscles, are not considered. The book helps in understanding the dynamics of self-organization in morphogenesis, and shows the applications of non-linear dynamical systems and simulation algorithms.

The book is of an interdisciplinary character (biology, biophysics, applied mathematics). In general, it may be classified as belonging to theoretical biology, nevertheless most contributions can be followed by experimental biologists and physicians. A characteristic feature of the book is that it considers mechanism of interactions within and between different organizational levels: molecular, cellular and organismal. There are striking analogies on different levels. Furthermore, universal principles appear in the models that rely on stresses. The integrated character of the book is formally strengthened by the common list of references.

There are four Chapters in the book: I. Motile Dynamics at the Cellular Level - Cytoplasmic Motion and Cell Shape (12 contributions); II. Dynamics of Cell Interaction with the Environment (8 contributions); III. Dynamics of Cell-Cell Interactions – Collective Motion and Aggregation (4 contributions) ; IV. Dynamics within Tissues – Morphogenesis and Plant Movement (9 contributions). A chapter starts with an Introduction that briefly reviews the background of the field, and ends with a Discussion that gives a survey of Open Problems. The contributions cover various theoretical tools and experimental techniques to reveal general principles and mechanisms in the motions they are

concerned with. At book's end there is a cumulative list of References, followed by a List of Addresses and an Index of Keywords. The book is carefully edited, well illustrated, mostly with line diagrams.

Consideration of cytoplasmic motion and cell shape dynamics is confined to cells with amoeboid type of motor system, i.e. distributed in the cytoplasm and mainly consisting of a filamentous meshwork with high dynamical instability (motions based on cilia or flagella or on highly specialized actin-myosin systems are not considered). Diffusing chemical messengers, mechanical stresses and hydrostatic pressure are considered as factors coordinating the system intracellularly and in interactions with environment, especially with the substratum and neighboring cells. Coordinated behavior of cells is modeled by means of various discrete or continuous simulation techniques, including cellular automaton. An interesting novelty of the book appears in the theme of global stress fields in morphogenetic dynamics on the level of tissue or organ. A unique article is the one written by L.V.Beloussov (embryology), J Bereitera-Hahn (cell biology) and P.B.Green (plant morphogenesis) on morphogenetical fields – an example of cooperation between different specialists. It presents a survey of morphogenetical field theories, and gives a critical insight into the concept of positional information based on diffusion gradients of morphogens. Further, it shows the principles of morphogenetical fields based on fields of mechanical stresses.

Formally, the book constitutes the proceedings of the second International Workshop on Cell and Tissue Motion which took place in Bonn-Röttgen in March 1995. For applied mathematicians it may be worth mentioning that the conference was organized whithin the framework of the research program "Nonlinear Partial Differential Equations", which means that the contributions of biologists were considered as ways to formulate mathematical problems. There can be no doubt that the book is a remarkable achievement for the Organizer who served also as the Senior Editor.

In summary, it must be asked whether or not there is a need for this type of books and whether or not the book is of interest for large enough group of scientists. I see the book not as a record of a conference which once came into existence, but as a coherent collection of interdisciplinary contributions to the problems indicated by the book's title, worth to be edited even if there were no conference. Yet, the conference resulted at least in adding the Open Problems and in the initiation of cooperative action of the authors during the preparation of the book. The book will long remain of value because it deals with principles rather than details.

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