

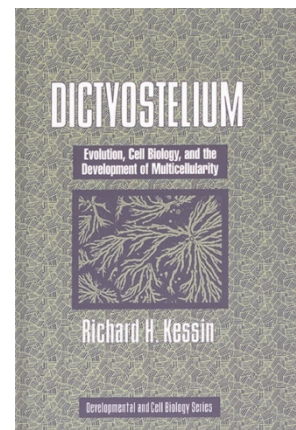
Dictyostelium in focus

Dictyostelium: Evolution, Cell Biology, and the Development of Multicellularity

by Richard H. Kessin

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What do we do — we cell and developmental biologists, and molecular geneticists — and why do we do it? Whatever our field of investigation is, we probably study fundamental cellular processes, possibly in a 'model organism' or system that lends itself uniquely well to such inquiry. Inevitably, though, the remarkable conservation of these processes between species, particularly between those of the animal kingdom, means that we frequently discover specializations of processes that have already been characterized elsewhere. No one would argue with the fact that we learn a great deal about biology by studying its conserved operation in a wide range of species. It is equally true that we can learn by studying the diversity of mechanisms that do not quite fit with this consensus. This knowledge often comes by studying niche organisms that do not fit the 'model organism' tag so well. What *Dictyostelium* offers is a conjunction of both the former conserved, and the latter diverse, mechanisms. What *Dictyostelium: Evolution, Cell Biology and the Development of Multicellularity* offers is a wonderful introduction to the field of *Dictyostelium* biology and research, aimed at the non-specialist with little or no prior knowledge. Richard Kessin, Professor of Anatomy and Cell Biology at Columbia University, is a renowned researcher in *Dictyostelium* and a marvellous teacher. These two facts explain why his book works so well in presenting this field in an extremely accessible manner.

Dictyostelium is a unicellular organism that exhibits many features of animal cell biology. The amoeba form has a highly organized actin-myosin cytoskeleton, which is a major area of research. *Dictyostelium* has consistently led the field of myosin research and cell motility in general. Such topics are dealt with in the first half of the book, which also includes an overview of cell and organelle organization. Kessin makes the important point that our current knowledge of *Dictyostelium* cell biology is soon to be greatly enriched by the completion of the genome project. To anticipate this, Kessin gives a useful outline of the genome project

itself and of current methods for genetic manipulation in *Dictyostelium*. This is just one reason why *Dictyostelium* research is so exciting right now: as Kessin says, 'the cell and structural biology of *Dictyostelium* is a nearly unlimited area of research'.

The hottest area of *Dictyostelium* research lately has been chemotaxis, with many seminal papers published in the top journals. This has placed the humble amoeba in an exalted position indeed. This recent work has discovered that the asymmetric activation of signalling pathways downstream of G-protein-coupled receptors is responsible for directional signalling. In line with much of the recent research, Kessin covers topics such as the recruitment of pleckstrin-homology-domain proteins to the leading edge of cells in response to stimulation. Less well described is the possible role of cyclic GMP (cGMP) in controlling chemotaxis via mobilization of the cytoskeleton. Kessin is emphatic in stating that cGMP is responsible for initiating events in cell motility. The biochemical evidence for this has seemed persuasive, but no genetic data directly support this at present (indeed, they suggest that it might be wrong). However, I believe that *Dictyostelium* is the system of choice for studying the enigma of cGMP in cytoskeletal regulation, and the genome project is already providing new directions for this research.

When *Dictyostelium* runs out of food it switches from its unicellular existence to a multicellular developmental programme. Kessin makes a similarly abrupt switch in his book, devoting the second half to this subject. This is the area that divides opinion on *Dictyostelium*: because the developmental mechanisms used seem to be so different from those of multicellular animals, critics see them as being irrelevant. In fact *Dictyostelium* development presents some themes that are familiar from animal development (such as the involvement of glycogen synthase kinase-3 in cell fate specification, and protein kinase A in cell differentiation) and some that are different (acquisition of multicellularity by cell aggregation, tissue organization through coordinated cell movements). One unique

aspect of *Dictyostelium* development is the species-specific morphogen DIF-1 (differentiation inducing factor). As with a few other examples in the book, timing was not on Kessin's side here, as significant advances in understanding the actions of DIF-1 have been made within the past year and are therefore largely absent. Within the context of development, Kessin also discusses many subjects of great interest in signal transduction, such as the activation and adaptation of G-protein-coupled receptors, the regulation of STAT transcription factors through these receptors, and the involvement of two-component signalling systems in controlling cAMP signalling. In an effort to be up to date, the author occasionally goes awry by relying on unpublished data and personal communications, so some of the models presented lack verification. This is most noticeable (to me) in the account of two-component signalling, but Kessin does give warning of this. Surprisingly, one area in which *Dictyostelium* has again been a leader of the field, that of G-protein-independent signalling through serpentine receptors, is hardly mentioned. This new paradigm in receptor signalling has truly benefited from work in *Dictyostelium*.

This book is well organized and superbly presented, with over a hundred diagrams, photographs or tables. It is easy to read and very accessible to the newcomer to the field. Those well versed in *Dictyostelium* or in a particular area of cell biology will not find much new within their own specialization but will get a good overview of areas they are less familiar with. Some parts of the book read as rather light, but I believe this is the best approach, and Kessin refers to more thorough reviews for further information on particular subjects. *Dictyostelium* is never given much focus in other cell biological or developmental texts, but the time is certainly right for a book to introduce this organism and its research to a wider audience. This is the ideal book.

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