

Preface

This is the second edition of *Mechanisms of Morphogenesis*, the first having appeared in 2005. The original text has been revised substantially to take account of the results of recent research. Two features of the original book remain unaltered. The first is the concentration on morphogenesis itself—the actual generation of form—with other aspects of development such as differentiation and pattern formation being taken for granted (the reasons for doing this are explained in Chapter 1). The second is an organization that progresses in scale from the sub-cellular systems critical for larger-scale morphogenesis, through mechanisms that take place at the cell level, to morphogenetic mechanisms that concern whole populations of cells.

The new edition of this book includes many new discoveries. Some of these add detail that appears throughout the text and updates mechanisms already featured in the first edition. Others represent such significant advances that they necessitated substantial re-writing of some chapters. Examples are our much-improved knowledge about how planar cell polarity controls epithelial morphogenesis (Chapter 16) and orientated mitosis (Chapter 22). Yet other new material represents areas of morphogenesis about which too little was known for them to feature in the first edition of the book, but which have advanced so much that they now merit complete chapters to themselves. Examples are collective cell migration (Chapter 13) and the formation and maintenance of boundaries (Chapter 20).

In addition to these changes, this edition includes an entirely new, three-chapter section on modelling. Morphogenesis is complicated—much more than the control of gene expression, for example—and some aspects are counter-intuitive. Modelling, in physical, computational, and engineered living systems, is therefore becoming important for connecting low-level cellular phenomena with organism-scale development. The new section outlines, with examples, how models of different types are constructed. It also presents case studies in which a well-constructed model has made a prediction that seems counter-intuitive but that has gone on to be verified experimentally. An example is the prediction that contact inhibition of cell locomotion *increases* the efficiency of invasive growth. My aim in writing this section is to help readers understand the purpose of modelling (which is frequently misunderstood) and to make the dialogue between biologists and mathematicians interested in morphogenesis a little easier.

As a reader of textbooks, I am frustrated by the tendency of authors to make successive editions longer and longer until what was originally a very helpful and concise work ends up being more useful as a step for reaching smaller volumes from high shelves. In an effort to avoid this problem, I have presented some material, particularly that concerning morphogenesis of sub-cellular structures (Section II), much more concisely than in the first edition.

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