

## Preface to the paperback edition

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I have added two appendices to the book. The first considers briefly some 40 recent papers of particular morphogenetic interest, the references being grouped under the appropriate section number in the main text. Appendix 2 summarises the properties used by mesenchymal and epithelial cells to make structures in embryos. Together, these properties comprise a *morphogenetic toolkit* of abilities, with distinct subsets being employed for each tissue.

Jonathan Bard  
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The book is not one where a substantial gap remains in our understanding, as it is to some extent, in morphogenesis, the study of the processes by which cellular organisation emerges in embryos. Although we often have good qualitative pictures of how a particular organ forms and of the nature of the particular signalling molecules involved, it is not always clear how we achieve any insight into the details of the mechanisms that lead to the establishment of a particular tissue architecture. Indeed, I do not even believe that we have the appropriate language with which to describe the morphogenetic process. This book is an attempt to fill that gap, not least in terms of clarity, so that it is a little easier.

In writing about a book, I have had two other purposes in mind. The first was to clarify my own views of a field in which I have worked almost 20 years and it has been a pleasure to read and to think about the origins of mesoderm organisation, although I know that my pointed

## Preface to the hardback edition

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In 1895, Roux set out the problems confronting the new subject of experimental embryology and commented that, although he and his peers intended to simplify what was clearly a very complicated set of events, they knew so little about development that they would be unable to elucidate the underlying mechanisms without a great deal of work. Moreover, because they were so ignorant, they could not know which approaches would be the most helpful in their attempts to gain understanding. The initial result of any research in the area would therefore be to make the situation appear even more complicated than it already was and it would take some time for the simplicities to become apparent.

After a century of work, there are few in the field who would say that enough of those underlying simplicities have yet emerged. Much of development remains complex and, with the tools of molecular biology now being applied to the subject, it is, by Roux's conjecture, likely to become more so, in the short term at least. This is not to say that the results of 100 years of research have in any way been fruitless: we now know a great deal about what happens as development proceeds and are beginning to understand the molecular nature of the cell-cell and cell-genome interactions that underpin embryogenesis.

However, one area where a substantial gap remains in our understanding, or so it seems to me, is morphogenesis, the study of the processes by which cellular organisation emerges in embryos. Although we often have very good descriptions of how a particular organ forms and of the nature of the participating cells and molecular constituents, it is in relatively few cases that we have any insight into the details of the mechanisms that lead those cells to cooperate in forming tissue architecture. Indeed, I am not even certain that we have the appropriate language with which to discuss the morphogenetic enterprise. This book is an attempt to fill that gap or, more accurately, to make it a little smaller.

In writing such a book, I have had two other purposes in mind. The first was private: I wanted to clarify my own views of a field in which I have worked almost 20 years and it has been a pleasure to read and to think about the origins of tissue organisation, although I know that my printed

words do not always do justice to the richness of the subject. The second was public: I felt that many in the biological community needed reminding that, although morphogenesis is complex, it is not as intractable as it is sometimes made out to be.

The book is thus intended for those who enjoy looking at tissue organisation and thinking about the processes by which it is laid down, and here I have in mind not only developmental biologists, but also anatomists and pathologists. It might be thought that anatomy is a completed subject requiring little more research and that pathology does not need a mechanistic basis. However, our understanding of both subjects is still inadequate because we know so little about the processes responsible for generating the normal structures of the body and how these processes have gone awry when abnormal structures form.

I have also tried to make the book readily accessible to students near completing a degree in the biological or medical sciences because I believe that the subject of morphogenesis provides challenging problems with which to embark on a research career. I have not always succeeded in this aim because some tissues are hard to investigate and the data from their study seem contradictory and hard to explain in terms of current concepts. These difficulties derive, of course, from a subject which requires a great deal of further work and, in discussing what might be done, I hope that I will not only intrigue students but also highlight approaches that my peers may find helpful. However, given the large number of papers published in the area and my inability to read them all, I am chary of claiming that anything here is original.

Finally, I should add that I have enjoyed the freedom given to anyone writing a book and have sometimes discussed aspects of the subject that knowledge has yet to reach and suggested experiments that I will never do. I hope, however, that the distinction between truth and speculation has always been made clear. I also hope that, should readers be offended by any of my suggestions, they will set out to prove that I am wrong, and I would appreciate being told whether they succeed.

Jonathan Bard