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0521436125 - Morphogenesis: The Cellular and Molecular Processes of Developmental Anatomy

Jonathan Bard

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Morphogenesis, the generation of tissue organisation in embryos, is becoming an increasingly important subject. This is partly because the techniques for investigating many morphogenetic mechanisms have only recently become available and partly because studying the genomic basis of embryogenesis requires an understanding of the developmental phenotype.

This timely book provides a comprehensive and contemporary analysis of morphogenetic processes in vertebrate and invertebrate embryos. After an introduction covering case studies and historical and technical approaches, it reviews the mechanistic roles of extracellular matrices, cell membranes and the cytoskeleton in morphogenesis. There is then a detailed discussion of how mesenchymal and epithelial cells cooperate to build a wide range of tissues; the book ends by considering the dynamical basis of the subject.

With its extensive literature review (more than 500 titles), this book will interest most developmental biologists and can also be used as an advanced textbook for postgraduate and final-year students.

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MORPHOGENESIS

**THE CELLULAR AND MOLECULAR
PROCESSES
OF DEVELOPMENTAL ANATOMY**

JONATHAN BARD
MRC Human Genetics Unit
Western General Hospital
Edinburgh



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CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press

The Edinburgh Building, Cambridge CB2 2RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9780521361965

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First published 1990

First paperback edition 1992

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data

Bard, Jonathan B.L.

Morphogenesis : the cellular and molecular processes of developmental
anatomy / Jonathan B.L. Bard.

p. cm. – (Developmental and cell biology series)

ISBN 0 521 36196 6 (hb) ISBN 0 521 43612 5 (pb)

1. Morphogenesis. I. Title. II. Series.

QH491.B37 1990, 1992

574.3'32–dc20 89-17415 CIP

ISBN-13 978-0-521-36196-5 hardback

ISBN-10 0-521-36196-6 hardback

ISBN-13 978-0-521-43612-0 paperback

ISBN-10 0-521-43612-5 paperback

Transferred to digital printing 2006

Cambridge University Press

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Preface to the paperback edition

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
December 1991

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Preface to the hardback edition

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

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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.

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Acknowledgements

I thank Duncan Davidson for our many interesting and enjoyable discussions about the wide range of topics discussed here, for pointing to several important papers that I might otherwise have missed and for being prepared to criticise early drafts at any time. I also thank Carol Erickson, Dianne Fristrom, Gillian Morriss-Kay, Eero Lehtonen, Ros Orkin and Lauri Saxen for commenting on specific parts of the draft manuscript and the many embryologists who were kind enough to allow me to use their drawings and photographs; they are acknowledged in the appropriate captions. Vernon French, Steven Isard, and Adam Wilkins, my editor at CUP, read the whole text and each made many helpful suggestions; I am very grateful to them, although I, of course, remain responsible for any errors and lacunae that remain. I also wish to acknowledge here the great debt that I owe to Tom Elsdale: he introduced me to the subject of morphogenesis and showed me the pleasures to be had in its study. Finally, I thank my family for their tolerance while I was writing the book.

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For Adam and Benjamin