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Preface

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THE ROYAL SOCIETY

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Preface

Our understanding of the ways in which genes control embryonic development has made remarkable progress over the last 20 years, the identification of genes controlling development of the fruit fly *Drosophila* having made a key contribution. Most of these studies, however, have concerned pattern formation and cell differentiation; that is, the spatial organization of cell activities and the terminal differentiation of cell types. By contrast there has been much less progress in understanding how embryos undergo changes in shape: morphogenesis.

In the past, the term morphogenesis has been used to refer to development of the embryo in general, as in Joseph Needham's book *Biochemistry and morphogenesis* (1942). But as early as 1939, Paul Weiss in his *Principles of development* had defined morphogenesis as the morphological transformation accompanying organ formation.

The importance of changes of shape in embryonic development was first recognized in 1895 by Wilhelm Roux, who stated that it was the general purpose of what he called developmental physiology to discover the forces that generate shape. In the early 1900s a variety of mechanisms were put forward to explain the changes in shape of cell sheets, which are so common in developing systems: the neural tube, for example, starts off as a sheet and then 'rolls up'. The proposed mechanisms for such buckling include surface contraction, differential swelling and cell division (Gustafson & Wolpert 1967). A major advance was the work of Holtfreter in the 1930s on cell movements during gastrulation and the role of differential cell affinities in this process. The latter was based on the 'sorting out' of disaggregated and re-aggregated cells from different germ layers. It was this work that led to increasing interest in the importance of cell adhesion in morphogenesis. The work of Holtfreter also highlighted the importance of cell motility and migration (see Townes & Holtfreter 1955).

Much of the current interest in morphogenesis continues along these lines. The problem is to understand how genes control the changing shape of the embryo in molecular terms. In general, patterning precedes morphogenesis, so a central question is how the two are related.

However, there is more to morphogenesis than adhesion and motility. Single cells, like yeast, have a well-defined shape and plant morphogenesis involves neither adhesion nor motility but changes in cell shape and cell division. Much of the Discussion Meeting therefore focused on the molecular basis of change in cell shape, adhesion, motility, and the cell signals controlling these processes. This is well illustrated by how neurons find their targets.

We are grateful to The Royal Society for sponsoring a stimulating and exciting Discussion Meeting, to the staff of the Society for their hard work, to the audience for their many interesting contributions, and especially to the speakers for their excellent presentations. We also thank Judith De Maria, Commissioning Editor for *Philosophical Transactions*, series B, for persuading the editors to stick to a timetable.

The original idea for this Discussion Meeting was Nigel Holder's. Nigel died in December 1998 and is sadly missed by his many friends.

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