

Fate of the lineage

Cell Lineage and Fate Determination Edited by Sally A. Moody

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Cell lineage and determination are terms heavy with significance for developmental biologists because they are the central concepts underpinning the process of regional specification—the mechanism by which different parts of an early embryo become programmed to form different cell types or bodily structures. Above all other topics in development, regional specification has been the central theme of research for the past two decades and is—for many systems—well understood at the molecular level. *Cell Lineage and Fate Determination*, edited by Sally A. Moody, comprises more or less this molecular account of the development of a number of standard experimental organisms.

The book deals with sea urchins, *Caenorhabditis elegans*, leech, *Drosophila melanogaster*, *Xenopus laevis*, zebrafish, chicken, mouse and—seeming a little out of place in this familiar zoo—the stripe-faced dunnart, a mouse-like marsupial. Most of the work concentrates on early development, with a limited section at the end on topics such as clonal analysis of the central nervous system, haematopoiesis, myogenesis and development of the pancreas. There is also a chapter on the use of green fluorescent protein, that remarkable reagent for which the applications seem never-ending.

I was disappointed by the lack of critical discussion of the central concepts. Cell lineage and determination are terms that have several distinct meanings, and it is important to establish which is intended in a particular situation. For instance, 'lineage' can refer to the family tree of cells in an

embryo, or to the acquisition of a state of commitment through the action of a cytoplasmic determinant, or to the clonal heritability of a state of commitment regardless of how it was originally acquired. Among developmental biologists, such distinctions are not always made explicit or even recog-

nized, so it is often necessary to enquire further if someone says that a particular cell type develops by a 'lineage' mechanism. Likewise, determination refers to what will happen to an embryonic region during normal development, as depicted on a fate map, but it is also used synonymously with state of commitment, such as when a treatment is said to change the fate of a group of cells. These issues are not addressed in *Cell Lineage and Fate Determination*, which

plunges without hesitation into the molecular and cell biology of each system.

The relevance of a little reflection may be shown by the story of *C. elegans*, which has an invariant cell lineage—meaning that every individual has the same number of cells located in the same relative positions and arising from the same genealogy. This fact dominated the thinking of the *C. elegans* community for many years: they assumed the invariance of the lineage meant that regional specification of the worm must be controlled mainly by cytoplasmic determinants, that is, regulatory molecules segregated to parts of each blastomere before its division. The compilation of the complete lineage was seen as the central research goal and was accomplished by 1983. Although this has been a useful tool for subsequent investigations, it did not, in itself, reveal anything of the

underlying developmental mechanisms. It has subsequently transpired that there are some cytoplasmic determinants, but there are also many inductive interactions in *C. elegans*, and an understanding of them requires knowledge of the spatial relationships of cells at different stages as well as their genealogy. The lineage diagram was of limited help for this purpose, as it does not show the spatial relationships, or other any aspects of three-dimensional morphology. So, despite its considerable level of detail, the *C. elegans* cell lineage falls short of being a complete fate map. Had the work been carried out today, with the benefit of hindsight, it might have been done so a different way.

Despite this caveat about philosophical issues, the book is well produced with good illustrations. The authors are distinguished developmental biologists, and the chapters they have written will be useful to graduate students, or advanced undergraduates, in any developmental biology course. Regrettably, the price of *Cell Lineage and Fate Determination* will confine its purchase to the wealthier academic library. And as with any multi-author work, there is the problem of how to guarantee coverage and how to harmonize standards. There are some inconsistencies: for example, *Hox* genes are discussed in the context of *C. elegans* and zebrafish, but not other organisms. Major areas are left untouched, such as cell movements, the *Drosophila* gene hierarchy, and growth and regeneration, but this may be because these particular topics were not felt to be sufficiently related to cell lineage.

To some extent, the work suffers because it is neither flesh nor fowl, notwithstanding the fact that its major characters are all animals. The subject matter of cell lineage and fate determination covers most of modern developmental biology. But this is not a general textbook to be compared with those by Lewis Wolpert or Scott Gilbert. *Cell Lineage and Fate Determination* omits various topics, and is deficient when dealing with the later stages of development such as organogenesis. At the same time, it is more coherent than a collection of review articles such as might be found in the annual patterning issue of *Current Topics in Genetics and Development*. In the end, I am left a little puzzled about the purpose of the book, but nonetheless feel that it should have a place in any university library used by developmental biologists. □

