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Book reviews

Genes and Embryos. Edited by D. M. GLOVER and B. D. HAMES. IRL at Oxford University Press, Oxford 1989. 228 pages, ill., index. Hardback £27.00. Paperback £18. ISBN 0 19 963028 3 and 0 19 963029 1.

This text is an up-to-date, multi-author survey of the developmental molecular genetics of *Drosophila*, *Caenorhabditis*, *Xenopus* and *Mus*. It is intended for advanced students and their teachers, and for post-graduates. However, since each chapter has a short, but generally adequate, introduction to the organism's normal development it should also allow embryologists, geneticists and molecular biologists not yet acquainted with it to get abreast of this exciting field. It is to be welcomed for that reason and for the quality of the presentations.

Drosophila, rightly, has pride of place with two chapters: one dealing with the maternally effective genes which block out the anterior/posterior and dorso/ventral territories of the pre-blastoderm embryo, and the other covering the zygotic genes which define its segmental form. Although it is generally said that the primacy of *Drosophila* as the model for development studies builds on the last 80 years of *Drosophila* genetics, only one of the mutants in Anderson's list of 38 maternal genes was known before the beginning of this last decade, and it had to be rediscovered! In short, *Drosophila* research had to be directed specifically towards identifying 'developmental genes' for progress to be made. Coincidentally, transposable P elements were found to be exploitable as mutagens, for tagging genes which could then be cloned and sequenced, and for introducing known genes into the germline. The results from this combination of genetic and molecular manipulation of specific genes are what are recorded here and, although there are many gaps, the *Drosophila* story is an impressive one. Progress with the other organisms during the same decade has been roughly proportional to our understanding of their developmental genetics.

Drosophila is peculiar in that the first divisions of the zygote are syncytial, and cells form at the blastoderm only at the 14th division. It is easy to imagine that gradients of morphogens will be established in this acellular space during ovogenesis, and that they will establish the primary axes of the embryo. Indeed, there is an anterior gradient of the *bicoid* gene product which is necessary for head–thorax development, but its location depends on three other genes. Similarly, abdomen development depends on the *nanos* gene, somehow regulated by half a dozen other genes, and the *torso* gene product is not localised, but is necessary for the development of the two terminal structures, the acron and the telson. Although Anderson's chapter on these maternal genes emphasises the case for an organising role for gradients, it is obvious that we have some way to go before we can claim this, or understand their functions in molecular terms. And the same is true for the dozen or so genes involved in establishing the dorso-ventral axis.

The three genes just mentioned regulate the activities of the zygotic gap genes (*hunchback*, *Krüppel*, *knirps* and *tailless*) whose products in turn define the sequence of anterior-posterior embryonic domains, first identified as morphological gaps by gene mutation and then confirmed by molecular probes. Pair rule genes, whose products are familiar as sets of stripes across the embryo with a 2-segment periodicity, are active just prior to cellularisation; and the next set of genes to be expressed (the segment polarity genes) are expressed in the now cellular blastoderm, where the stripes of their products define the parasegments and segments. Finally, the nine long-known genes of the homoeotic complexes define the specific segmental structures. Levine and Harding detail these regulatory hierarchies, the effects of mutations in one on the development of the others, what is known of the structure of such genes as have been cloned, and where we have got to in understanding such basic phenomena as, for example, the establishment of pair-rule stripes (which is not far). At this stage, the complexity of the subject seems to increase with each report of a newly cloned gene. This second chapter provides the essential framework for understanding this flow of new information as it comes along.

The *Drosophila* egg has usually been described as mosaic; that is, cell fates are determined at, or prior to, fertilization. If Foe's* 50 mitotic domains reflect this commitment as it is expressed at blastoderm, the data just discussed will have to take account of the very different patterns, not stripes, which her work discloses. There is no such problem with

* Foe, V. E. (1989). Mitotic domains reveal early commitment of cells in *Drosophila* embryos. *Development* **107**, 1–22.

Caenorhabditis whose embryonic lineages are essentially invariant. Although genetic mapping, transposon tagging and germ-line transformation can all be exploited in *Caenorhabditis*, identification of strict maternal effect mutants, which are the ones that matter most in a mosaic egg, has proved unrewarding. Kemphues therefore devotes considerable attention to the data accumulating on the cytoplasmic localization of identifiable molecules, e.g. the asymmetric distribution of microfilaments in the one-cell embryo, and the posterior localization of germ line-specific P granules. Laser ablation of single cells suggests that most embryonic mechanisms are cell autonomous, but not all: the germ-line proliferation (*glp*) gene and *lin 12* both affect the differentiation of other cells and their DNA sequence organization is now being studied; but that is about as far as it has got.

Xenopus has essentially no genetics, so Sargent devotes his space to a thorough, critical review of what we know about the cytoplasmic determinants found in the egg, or more precisely to the postulated determinants. These, and the agents involved in induction of mesoderm, neural tube, etc. and all the events of classical amphibian embryology have not got much further than a descriptive phenomenology. It is true, of course, that some polypeptide growth factors are known to act as inducers, but proving their presence in the right place at the right times is another matter. Possibly more important has been the use of homoeobox sequences, first found as common parts of *Drosophila* homoeotic genes, to find equivalent nucleic acid binding proteins in vertebrate DNA libraries. The *Xenopus Xhox*-1A and *Xhox*-3 mRNAs have been so identified, are present at about the right time, and are found in antero-posterior gradients, the latter in the mesoderm. Injection of these mRNAs disrupts development.

This variety of surrogate genetics has been more successful for identifying homoeobox genes of the mouse: two dozen or so *Hox* genes have been fished out of DNA libraries. The *Drosophila* homoeobox genes are expressed in an anteroposterior sequence corresponding to their chromosomal order, and surprisingly their mouse analogues have the same organization and patterns of expression [Graham, A. *et al.* (1989), *Cell* **57**, 367–78]. This is the first clear evidence that genes of a very ancient lineage may have a developmental role in both arthropods and vertebrates. Not all genes are as accessible to molecular analysis and for these the experimental emphasis has moved to making transgenic mice, since it is relatively easy to microinject a cloned gene into a pronucleus of a fertilised egg. By using different promoters and reporter genes some of the many gaps in our knowledge of embryonic cell lineages may be filled; or alternatively cell specific ablation, using the cell lethal diphtheria toxin subunit A, may expose the importance of cell interactions. These molecular techniques can also be applied to embryonal carcinoma (EC) or embryonal stem (ES) cells grown in culture. These cells can be derived from mutants, including lethals, or made to carry known insertions, and then microinjected into the blastocoel where, usually, they will participate in normal development. As Jackson emphasizes in his very comprehensive review, all the methods of manipulating cells in culture can be applied to these embryonal cells, and in a proportion of cases the developing chimaeras will carry the transgene in the germline. The potential of these combined techniques is very great.

There are other organisms which might have been included in this text (slime moulds, sea urchins, leeches, etc.), but perhaps the four are enough for didactic purposes. As it is, the contrast between maternal determination in *Caenorhabditis* and its complete absence in the mouse – *pace* the curious phenomenon of imprinting – is enough to raise the question of how far the molecular mechanisms causing differentiation are similar in these cases. The implication of these surveys is that they are, but the problem is to prove it. Such different patterns of development and of experimental accessibility will give the reader pause for thought, something which the editors might have emphasised in their introduction. It is not just *Drosophila's* genetics, in the shape of balanced lethal techniques, etc. but also its particular pattern of development which has permitted the identification of developmental genes affecting embryo/larval morphogenesis, which are advantages not to be found among other organisms. Nevertheless, the empirical results described here, not theory, will continue to drive the subject forward; and that is quite a change in what has always been an over-philosophical subject.

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Cancer Cytogenetics. By SVERRE HEIM and FELIX MITELMAN. New York: Alan R. Liss, 1987; 2nd printing 1989. 309 pages. $35.00. ISBN 0 8451 4239 9.

Catalog of Chromosome Aberrations in Cancer. By FELIX MITELMAN. New York: Alan R. Liss. 3rd edition 1988. 1146 pages $165.00. ISBN 0 8451 4248 8.

Cancer Cytogenetics is a very readable, lucid and sensible book covering the entire field of chromosomes in neoplasia up to 1987. It is to be assumed from the need for a second printing in 1989 that many people already appreciate the vitality of this text, and it remains a classic despite some aspects, particularly in the area of molecular biology, being overtaken by the wealth of new research findings.

The book is divided into three parts, the first of which gives a brief history and overview of the subject together with descriptions of methodology and no-