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Multi-author Review

Early amphibian development: genes and signals involved in embryonic induction and pattern formation

Introduction

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The last decade has been an extremely exciting time for developmental biologists because so much progress has been made in clarifying many very old questions, for example how the polarities in the embryo become established and how tissue interactions control the fates of cells in the embryo. Most of the progress in this discipline has occurred in studies of a small group of organisms, one of which is the amphibian *Xenopus laevis*. Of all of the organisms used for studying embryonic development, the amphibian offers the most opportunities for examination of early developmental events because of the relative ease with which one can manipulate it and because large numbers of embryos are readily available. Coupled with modern advances in molecular genetics, a very powerful arsenal of techniques has become available for untangling important developmental questions. Perhaps the most striking successes in work with *Xenopus* embryos concern how cell determination occurs. For example, work in recent years has shown that what had been termed 'growth factors' in the past (like FGF and FGFβ family members) control cell fate choices in embryos. A number of novel gene products (e.g. noggin) which are important in cell determination have been identified utilizing the advantages of the *Xenopus* system. Much of this progress has utilized molecular genetic approaches, but rests on discoveries from the past, for example the seminal work of Pieter Nieuwkoop on induction of the mesoderm. (Pieter Nieuwkoop passed away on 18 September 1996. With great respect for his person and scientific accomplishments, we dedicate this multi-author review to the memory of Pieter Nieuwkoop).

These and other striking achievements of the recent past are the subject of this special issue, which was initiated by Gaston-Denis Guex (Zurich). However, due to a serious illness Gaston was unfortunately unable to complete the work and the project has been taken up by us.

The articles in this issue are a mix of reviews of some of the current molecular successes mentioned above and of their classical foundations. In the latter category, there is an article by Pieter Nieuwkoop.

While Nieuwkoop's contributions served as a vital underpinning for very recent work on mesoderm induction, the article he wrote last and for the present issue also describes some of his recent work which concerns a hotly debated subject among developmental biologists: the route of signalling during the establishment of the anterior-posterior axis of the embryo.

An article by Rob Grainger provides an overview of early studies on how the anterior-posterior axis is formed, as well as the most recent, exciting progress in this field in defining the signalling gene products involved in this process. Other reviews by Tony Durston et al. and Harry Isaacs et al. concern the role of retinoic acid and FGF in early patterning events in the embryo; both of these molecules have been shown in recent years to have vital roles in axis formation in the embryo. Induction events are also considered from the perspective of the importance of particular transcription factors in developmental decisions by Walter Knöchel and Eric Kaufmann. Given the tremendous progress in our understanding of transcriptional control in eukaryotes in general, it has been an exciting development to see some of the mechanisms revealed in this work applied to development of amphibians. Going back to the very earliest events in axis formation, Geert Ubbels discusses classical and more recent data, suggesting that the provisional axial symmetry of the full-grown *Xenopus* oocyte is broken during maturation. Neither egg nor sperm nucleus is uniquely required for symmetrization of the mature egg, while experiments performed in near-weightlesness disprove the old hypothesis that gravity cues symmetrization. Finally, a most interesting finding in modern developmental biology has been

the conservation of determinative mechanisms among very different organisms. This issue is addressed in an article by George Malacinski et al. concerning the relatedness of inductive mechanisms among evolutionarily diverged amphibians where such comparative studies are far more feasible than with other vertebrates.

We believe that this group of articles comprises an exciting issue of CMLS, and we wish the journal a successful and exciting future.

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