PREFACE

Since the early years of experimental embryology, it has been known that maternal factors loaded into the egg are capable of directing early embryogenesis. The most definitive experiments involved enucleation of amphibian or echinoderm embryos, which were shown to be capable of undergoing cleavage divisions and even forming partial blastulae (Briggs, Green, & King, 1951; Fankhauser, 1934; Harvey, 1936). These experiments complemented earlier ones on interspecific hybrid sea urchins that led to the conclusion that the embryo's own nuclei were essential for subsequent development (Boveri, 1893; Tennent, 1914).

The 125 years since those initial experiments have seen the advent of developmental genetics, molecular biology, recombinant DNA, high-resolution imaging methods, and, most recently, techniques that permit global analyses of the genome, transcriptome, proteome, and many other "-omes." Thus, for almost any plant or animal, it is now possible to define almost all of the changes in cellular components and behavior that occur from the production of the gametes, through fertilization and early embryogenesis, into later developmental stages. When combined with genetic, reverse-genetic, or surrogate-genetic strategies, it has been possible not only to define the changes in "-omes" but to identify key regulatory processes and the factors that control them.

Studies on a wide range of plants and animals have revealed shared and distinct features during the crucial, early developmental stages. Perhaps most striking has been the discovery that all plants and animals undergo a maternal-to-zygotic transition, during which two temporally overlapping processes occur: phased elimination of a subset of the maternal gene products that had been loaded into the female gamete and phased activation of the embryo's own genome. The deep conservation of the two components of the maternal-to-zygotic transition reflects the fact that sexually reproducing, multicellular organisms evolved similar overall strategies to hand developmental control from the female parent to its offspring.

Given the enormous advances in elucidating the content, scale, dynamics, regulation, and functions of the maternal-to-zygotic transition, it seemed timely to assemble a book that describes our current understanding of this process. While there have been review articles that have covered animals (Tadros & Lipshitz, 2009) or both animals and plants

(Baroux, Autran, Gillmor, Grimanelli, & Grossniklaus, 2008), many exciting discoveries have been made since these were published. Furthermore, a single review article cannot capture a field with the same depth and breadth as a multichapter book. I was therefore delighted with but not at all surprised by the enthusiasm with which this project was received by the contributors to this volume of *Current Topics in Developmental Biology*.

How does the maternal-to-zygotic transition relate to other developmental events, such as the mid-blastula transition? We previously defined the maternal-to-zygotic transition as "the period that begins with the elimination of maternal transcripts, continues through the production of zygotic transcripts and ends with the first major morphological requirement for zygotic transcripts in embryonic development" (Tadros & Lipshitz, 2009). Importantly, this defines the maternal-to-zygotic transition as spanning a period of development rather than a specific time point, thus distinguishing it from the mid-blastula transition, which is the first developmental event that depends upon the embryo's own genome rather than that of its female parent. Several of the chapters in this book take an even broader view by considering the oocyte-to-embryo transition, which includes events that occur well before fertilization (e.g., oocyte maturation), during which there are also global changes in RNA and protein populations that are crucial for egg activation and early embryogenesis. Furthermore, it is now clear that regulated and large-scale clearance of maternal mRNAs continues after the mid-blastula transition, at least in *Xenopus* and *Drosophila*. Thus, large-scale changes to the transcriptome and proteome brought about by posttranscriptional and posttranslational processes occur well before fertilization and extend well beyond the mid-blastula transition *per se*. While the biological role of several specific transcripts and proteins during the maternal-to-zygotic transition is understood, the role of global changes in the transcriptome and proteome remains to be determined.

The contributors were given flexibility in their choice of topic. Several chose to consider the MZT in both soma and germline, while others focused on only one of these. In addition, while some chose to review mechanistic aspects of maternal product clearance and/or zygotic genome activation, others focused more on the timing and function of these processes. I encouraged the contributors to provide personal perspectives and to speculate. Some chapters are more philosophical than others, reflecting I suspect more the personality of the author(s) than the state of understanding in their particular developmental model.

Together, the chapters in this volume provide a diversity of perspectives written by top researchers on essentially all of the animals and plants in which we now have a deep understanding of the maternal-to-zygotic transition. No doubt a decade from now we will have even deeper functional and mechanistic insights, but I hope that readers will view the current volume as both timely and interesting.

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