Preface

For many years after the discovery of sperm in males and eggs in females it was thought by "spermists" and "ovists" that either sperm alone or eggs alone, respectively, gave rise to offspring (Cobb, 2012; Farley, 1982). However, in the late 18th century Lazzaro Spallanzani (1729-1799) proposed that fertilization requires both male sperm and female ova and in the following century Eduard Strasburger (1844-1912) described fertilization in flowering plants, Oskar Hertwig (1849-1922) and Hermann Fol (1845-1892) observed penetration of sea urchin sperm into eggs, and Jacques Loeb (1859-1924) proposed that fertilization led to activation of eggs by altering the egg's ooplasm. These and other advances led to a burst of research in the 20th century on the biochemical/molecular basis of fertilization and egg activation in a variety of plants and animals.

Fertilization, the fusion of a single sperm (haploid) with an unfertilized egg (haploid), triggers *activation* of the egg and transforms it into a developing embryo (diploid) that in time gives rise to a new individual of the species. Today, several gamete components that participate in species-restricted sperm-egg recognition (e.g., zona pellucida proteins ZP2 and ZP3) and sperm-egg fusion (e.g., proteins Izumo1, Juno, CD9, and Spaca6) and several changes in the egg's ooplasm (e.g., changes in Ca^{2+}, Zn^{2+}, and phospholipase C) and the egg's proteome and cellular state (e.g., cortical reaction, zona reaction, inactivation MPF, activation APC, and changes in mRNA content, translation, and transcription) following gamete fusion are known (Elofsson, Han, Bianchi, Wright, & Jovine, 2024; Krauchunas & Wolfner, 2013; Machaty, 2024; Wassarman & Litscher, 2022). Collectively, the changes at fertilization and activation result in conversion of unfertilized eggs, paused in a late stage of meiosis, into mitotic zygotes (fertilized eggs) that are totipotent and capable of giving rise to new individuals that consist of tens-of-trillions of cells, hundreds of differentiated cell-types, and several tissue-types.

This volume of *Current Topics in Developmental Biology*, titled "Fertilization and Activation of Development", includes a dozen chapters that address many aspects of egg and sperm biology, fertilization, and egg activation in both plants and animals. Chapters 1 and 2 deal with flowering plants, Chapters 3 and 4 with ascidians and nematodes, Chapter 5 with amphibians, Chapter 6 with flies, sea urchins, etc., and Chapters 7–12 with

mammals. We are grateful to all the contributors for their scholarly chapters submitted to the publisher on-time and thank Hua Zhang for providing a relevant image for the cover of the volume.

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References

Cobb, M. (2012). An amazing 10 years: The discovery of egg and sperm in the 17th century. *Reproduction in Domestic Animals, 47*(4), 2–6.

Elofsson, A., Han, L., Bianchi, E., Wright, G. J., & Jovine, L. (2024). Deep learning insights into the architecture of the mammalian egg-sperm fusion synapse. *Elife, 13*, RP93131.

Farley, J. (1982). *Gametes and Spores: Ideas about Sexual Reproduction, 1750–1914*. Baltimore, MD: Johns Hopkins University Press 312.

Krauchunas, A. R., & Wolfner, M. F. (2013). Molecular changes during egg activation. *Current Topics in Developmental Biology, 102*, 267–292.

Machaty, Z. (2024). The signal that stimulates mammalian embryo development. *Frontiers in Cell and Developmental Biology, 12*, 1474009.

Wassarman, P. M., & Litscher, E. S. (2022). Zona pellucida proteins as receptors for binding of mouse sperm to eggs. *Trends in Developmental Biology, 15*, 1–13.