Preface

Cells in Evolutionary Biology: *Translating Genotypes into Phenotypes – Past, Present, Future*, is the first in a series of books on *Evolutionary Cell Biology*. This book lays out and evaluates how cells have been viewed and have influenced biology, especially evolutionary biology, since 1840 when the Cell Theory was proposed, and how evolutionary theory has influenced the development of cell biology since 1859. All the authors are active researchers and scholars in one or more aspects of cell biology. They represent the best thinking on the topic from the disciplines of philosophy, history of science, developmental and evolutionary biology, and microbiology. An historical approach has been used, spanning 178 years, from the Cell Theory to the present day; no other book has such a wide ambit.

This book begins with how cells were viewed from when the Cell Theory was proposed in 1840 to around 1870 and Darwin's theory of evolution by natural selection and its application to determining relationships between animals and plants. Recognition of the differences between germ, somatic, and stem cells, discussed in Chapter 2 and of cell lineages in ontogeny and phylogeny, discussed in Chapter 3, both had enormous influences on the direction taken by evolutionary biology in the late nineteenth century.

Identification of cells as organisms (protists) led to the recognition of multiple evolutionary routes to multicellularity (Chapter 4), knowledge that is foundational to how we classify life today. Discovery that cells exchanged organelles via symbiosis (the topic of Chapter 5) undercut our organization of life into prokaryotes and eukaryotes, resulted in recognition of multiple (3–6) domains of life, and was fundamental to ongoing re-evaluations of the nature of the Tree of Life. The origination and diversification of cellular signaling centers, discussed in Chapter 6, using vertebrates as the model organisms, facilitated the diversification of tissues, organs, and divergent patterns of morphological evolution.

With increased understanding of cell reproduction, cellular mechanisms were recognized as underpinning tissue and organismal growth that was facilitated by differential mechanisms of growth, tissue-specific patterns of growth, and the evolution of altered timing in ontogeny as important mechanisms of evolutionary change (Chapter 7). Importantly, but still underappreciated, cells form the units that modulate genotype–phenotype interactions, a topic discussed in Chapter 8 in the context of cell behavior as mediating the plasticity that enables change in the phenotype during evolution. The last topic, discussed in Chapter 9, places the behavior of animal and plant cells into the context of developing patterning modules, demonstrating the fundamental evolutionary mechanisms provided by cells in mediating the interactions between genotype, environment, and phenotype in morphological evolution.

By using knowledge from fields as disparate as philosophy, history of science, developmental and evolutionary biology, molecular biology and genetics, *Cells in Evolutionary Biology* evaluates the evolution of cells themselves and

the role played by cells as mechanisms of biological change at other levels. Cells provide the link between the genotype and the phenotype in development and in evolution. *Cells in Evolutionary Biology* establish the central role of cellular mechanisms in translating genotypes into phenotypes in all forms of life. To resurrect an old term from development and cytology, there is a *cenotype* between the genotype and the phenotype.

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