

Preface

The first century of cell biology belonged to cytologists, whose painstaking observations with microscopes revealed that all living things are composed of fundamental units called cells, that all cells arise by the division of preexisting cells, and that each daughter cell contains a set of chromosomes like that of the mother cell. At the turn of the 20th century, the collision of cytology and the newly minted field of genetics led to the discovery that chromosomes are the physical determinants of heredity. Later in that century came the next great convergence, when the disparate fields of cytology, genetics and biochemistry together gave rise to the realization that all eukaryotic cells use similar molecular machines and regulatory mechanisms to perform and guide the events of chromosome duplication and cell division. We can now look back on twenty years of astonishing expansion in our knowledge of these mechanisms. But a new problem has arisen: the flood of information has not been accompanied by a clear understanding of how the pieces fit together into a coherent whole.

This book is an attempt to help solve this problem. My goal is to provide a clear and concise guidebook that organizes our vast knowledge on a coherent framework that emphasizes the key problems in cell division and the molecular mechanisms that have evolved to solve those problems. Although organized around key principles, the book does not avoid the so-called details: on the contrary, it includes a glimpse of every layer in our knowledge of cell division, ranging from the cytologist's descriptions of major events to the biochemist's atomic-level analysis of the protein structures and chemical reactions underlying those events. All of these layers are important—and fascinating. The architect Le Corbusier, writing in 1935 of the stunning confluence of form and function in modern aircraft, was more eloquent: "There are no 'details'. Everything is an essential part of a whole. In nature microcosm and macrocosm are one."

I owe a major debt of gratitude to the many colleagues who provided thoughtful and constructive suggestions during the writing of this book (see Acknowledgements). The information contained herein remains the full responsibility of the author, however. It is well known that the teaching of principles requires exaggeration of some facts and omission of others. My apologies to those scientists whose discoveries I have over- or under-emphasized.

The writing of this book began, in a state of wilful ignorance about the effort involved, during an eight-month sabbatical leave at the University of Uppsala in Sweden. In the six years since then, I have returned to Uppsala every summer to do much of the writing in the calm confines of the Biomedical Center library. I am grateful to my hosts on those wonderful visits: Carl-Hendrik Heldin and his colleagues at the Uppsala branch of the Ludwig Institute for Cancer Research, with whom I enjoyed countless discussions—and lunches—between paragraphs.

Every step in the synthesis of this book was catalyzed by the inspirational guidance of Miranda Robertson and her team at New Science Press. I am immensely grateful for the brilliant editing of Eleanor Lawrence and the beautiful illustrations of Matthew McClements. And thanks also to Karen Freeland, who skillfully and enthusiastically piloted the project with the help of Kerry Gardiner and Joanna Miles. Lore Leighton provided valuable assistance with protein structural figures and Bruce Goatly did a masterful job of copy-editing.

And finally, my apologies and heartfelt thanks to my family, who stood by me with patient understanding and unwavering support.

David O Morgan