

Preface

THE NUCLEUS IS ARGUABLY THE MOST eye-catching structure and characteristic feature in most eukaryotic cells. It houses the vast majority of an organism's hereditary material and is the cellular site where critical functions occur such as the execution of precisely regulated gene expression programs, the accurate duplication of the genome during replication, and the maintenance of genome integrity by highly efficient DNA repair mechanisms. Despite its prominence, our cell biological understanding of how the cell nucleus and the genome it contains are organized in space and time and how this organization contributes to faithful genome function has long lagged behind that of other cellular organelles. While early microscopy studies uncovered the presence of the most prominent intranuclear compartments, more detailed characterization of the architecture of the nucleus, particularly the 3D organization of chromatin, proved challenging. The past two decades have witnessed the development of remarkable technologies that now allow the high-precision mapping of genome organization and interactions at a global scale, the imaging of intranuclear structure at high resolution and in living cells and tissues, and the three-dimensional reconstruction and modeling of chromatin organization and its fundamental properties.

These dramatic advances in our understanding of how genomes are organized and how the cell nucleus functions are reflected in this second edition of *The Nucleus*, published 10 years after the inaugural publication. The progress captured in the 23 chapters, written by leaders in the field, is impressive. The chapters describe some of the basic principles that organize the nucleus and the genome, including the presence of prominent chromatin domains and the ubiquitous presence of chromatin loops, but also the importance of dynamics, biophysical properties, and the stochastic nature of genome organization and function. In separate sections, the properties of chromatin and its interactions with nuclear landmarks such as the nuclear envelope are described, and their relevance to nuclear processes, development, and disease are discussed. Our goal in the selection of these topics was to paint a broad, but representative, picture of where we are in our understanding of nuclear and genome cell biology, and to outline the challenges that lie ahead.

This book would not have been possible without the dedication and expertise of many. First and foremost, we thank our colleagues who authored their chapters with much care and who responded to our editorial requests with diligence and understanding. We were fortunate to be able to rely, as always, on the outstanding staff at Cold Spring Harbor Press. We thank our Managing Editor Maria Smit, our Production Editor Diane Schubach, and especially our Senior Project Manager Barbara Acosta, who kept us on track and solved all editorial problems large and small. We appreciate the opportunity to take this snapshot of the field given to us by our Publisher John Inglis and our Executive Editor Richard Sever.

The biology of the nucleus and of genomes has come a long way, yet many questions remain for those in the field and for the next generations of genome cell biologists. Our hope is that these chapters will inform and serve as a basis for future work and will also inspire many to continue the fearless exploration of the cell nucleus.

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