Cilia

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Preface

The basic outlines of cell biology have been clear since at least the invention of the electron microscope, and the basic catalog of organelles has long been a standard part of high school biology texts. One would think, therefore, that ongoing research in cell biology would have little to tell us about the "big picture" of organelle functions, and would instead focus on increasingly fine molecular details of mechanism. Cilia, however, represent an example of an organelle whose existence has been known for well over a hundred years, but whose ubiquitous roles in physiology, development, and disease have only become apparent in the past two decades. This is particularly true of nonmotile primary cilia, which while found in almost all cells of the body, were long thought to be vestigial structures with no important functions. The discovery that these organelles play key roles in many different signaling pathways, and that defects in primary cilia can cause a wide spectrum of human diseases, came as a complete surprise. One might assume that the motile functions of cilia and flagella, being visually obvious, would have been much clearer, but even here there have been tremendous surprises during the past 20 years, such as the finding that ciliary motility plays a key role in left–right symmetry breaking. The complex range of ciliary functions is reflected in a complex internal architecture and proteome, with the list of ciliary proteins continuing to grow even as this volume goes to print. In a very few cases, the functions of these proteins are known, but in most cases, we are left with a list of parts whose individual functions are still not clear. Putting these parts together into a mechanistic understanding of ciliary function is going to require a concerted effort drawing on a wide range of approaches, including genomics, proteomics, structural biology, biophysics, and computation. It is our hope that, by collecting many of the key aspects of ciliary biology into a single volume with chapters provided by leaders in the field, we can help launch future integrative efforts to understand cilia at a mechanistic level.

We have tried to represent the major areas of ciliary biology, including diverse levels of questions from the molecular to the organismal, and representing many different model systems and viewpoints. This would have been much easier to do 10 years ago, but with the explosion of research on cilia, the field has grown to the point that we can no longer promise comprehensive coverage, although we have done the best that we can. The editors apologize in advance to readers who will read this volume looking for answers to specific questions and not find them. At least we hope the chapters in this volume, taken together, will provide an entry point for students, postdocs, and faculty who become interested in cilia and would like to get a snapshot of the current state of knowledge in the field. It is the nature of such a collection that it represents a picture of what is known, without necessarily making explicit what is not yet known. We encourage the reader to approach the volume as a whole with a view to identifying gaps in knowledge. Such gaps would be fruitful areas for future study.

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their contributions. We applaud them for recognizing the value of promoting the development of our field as a whole. Finally, we want to thank our families for putting up with us as we added this task onto our already-overloaded schedules.

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