Book Reviews

Given the complexity of the issues, it seems likely that this will not be the last book on this interesting subject.

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Intracellular Structures

Microtubules. JEREMY S. HYAMS and CLIVE W. LLOYD, Eds. Wiley-Liss, New York, 1994. xii, 439 pp., illus. $89.95 or £74. Modern Cell Biology, vol. 13.

First described with the aid of electron microscopy about 30 years ago, microtubules play critical roles in intracellular organization, organelle transport, ciliary and flagellar motility, and chromosome motion during mitosis. The book on the subject edited by Hyams and Lloyd—not the first with its title—covers the most recent advances in what is now a rapidly expanding field.

Though some contributions will be of interest primarily to researchers concerned specifically with microtubules, most of the volume will be of interest to a larger audience of cellular, molecular, and developmental biologists. For example, a contribution by Elizabeth Raff describes the results of experiments designed to elucidate the role of multiple genes for the subunit protein of microtubules, tubulin. The results reveal that not all tubulin genes are functionally interchangeable. Although the research clearly deals with the particulars of tubulin, it has implications for the larger questions of protein structure-function relationships and the evolution of multigene families. Several chapters address the topic of microtubule-associated proteins, in particular those found in neuronal tissue (contributions by Matus, Muller *et al.*, and Goedert *et al.*). Here again basic cellular questions are addressed: targeting of proteins to specific subcellular locations as well as the regulation of gene expression and the role of the cytoskeleton during neuronal development.

Several contributions are devoted to "molecular motors," enzymes that utilize the energy of adenosine triphosphate hydrolysis to move various cargoes along microtubule tracks. Analysis of the mechanism of force generation has itself made many advances of late, and the book is already out-of-date on this important topic. The contributions address the cellular regulation of motor molecules and the identity of the various cargoes that are transported. These topics should be of interest to those concerned with the general problem of organelle transport and membrane trafficking in eukaryotic cells.

The last chapter of the book deals with perhaps the most enticing aspect of microtubule biology, mitosis. Many are familiar with the general features of mitosis—the alignment of the chromosomes into the characteristic metaphase plate and the dramatic motion of the chromosomes to the spindle poles at anaphase. Movies of the process of mitosis never fail to enthrall viewers, seasoned veterans and newcomers alike. This chapter makes clear that many of the topics examined in previous chapters contribute to various aspects of mitosis as well. For example, cytoplasmic dynein and kinesin-like proteins are now known by genetic and immunological evidence to contribute to mitosis. Microtubule-associated proteins, gamma tubulin, and microtubule dynamic behavior, each discussed in earlier chapters, must also be accounted for in a complete description of mitosis. But despite many advances mitosis still remains incompletely understood, perhaps because it does involve so many interrelated processes. For example, McIntosh presents several models for spindle formation and notes that they are "slightly bewildering, not because one cannot see how spindle poles could separate or what enzyme could do the job, but because these are so many legitimate scenarios involving different motors." Later, in the context of anaphase motion, the complexity issue again surfaces: "Anaphase A is . . . a multicomponent process that probably involves minus motor activity at the kinetochores, plus motor activity at the poles, and tubulin depolymerization at both kinetochores and poles." In mitosis research it is difficult to eliminate any process, and, as McIntosh puts it, "We are faced with an embarrassment of possibilities with which to account for the observed movements." Perhaps analysis of the function of microtubules in simpler motility phenomena will help to shed some light on the more complex process of mitosis.

From among the vast quantity of interesting data available, the editors have made reasonable choices of what to include, bringing together information touching on central aspects of microtubules and their behavior in cells. The book will be especially useful for graduate and postdoctoral students who desire a readable overview of many topics pertaining to microtubules.

Other Books of Interest

Mechanisms of Protein Folding. ROGER H. PAIN, Ed. IRL (Oxford University Press), New York, 1994. xviii, 265 pp., illus. $68 or £40; paper, $43 or £25. Frontiers in Molecular Biology.

"To be biologically active, proteins must adopt specific folded three-dimensional, tertiary structures. Yet the genetic information for the protein specifies only the primary structure, the linear sequence of amino acids in the polypeptide backbone. Many purified proteins can spontaneously refold *in vitro* after being completely unfolded, so the three-dimensional structure must be determined by the primary structure. How this occurs has come to be known as 'the protein folding problem.'" Thomas Creighton thus states the theme of this book intended to make the subject more accessible to a broad scientific audience. According to the editor, who points out that understanding protein folding is now not only "one of the most intriguing intellectual challenges in molecular biology" but an industrial necessity, "the main emphasis has been on surveying the concepts and experimental approaches that have led to our present knowledge of how proteins fold." Creighton's opening chapter analyzes the problem in a way intended to set the stage for the eight following contributions on more specific aspects of the subject. In chapter 2 Heinrich Roder and Gülnur Elöve describe the early stages of protein folding. Henriette Christensen and Pain then discuss the molten globule model, Barry Nall discusses proline isomerization as a rate-limiting step, and H. F. Gilbert discusses the formation of native disulfide bonds. The protein engineering approach (in which denatured proteins are induced to refold) to the analysis of folding is expounded by Andreas Matouschek *et al.* and Nicholas Price discusses the assembly of multi-subunit structures. Protein folding in vivo is described by Roman Hlodan and F. Ulrich Hartl, who consider the process in relation to biosynthesis, enzyme catalysis, and molecular chaperone proteins, and the final chapter, by David Thatcher and Antony Hitchcock, discusses "refolding science"