Molecular Motors

Cell Movement. Liss, New York, 1989. In two volumes. Vol. 1, The Dynein ATPases. FRED D. WARNER, PETER SATIR, and IAN R. GIBBONS, Eds. xviii, 337 pp., illus. $88. Vol. 2, Kinesin, Dynein, and Microtubule Dynamics. FRED D. WARNER and J. RICHARD MCINTOSH, Eds. xvi, 478 pp., illus. $98.

In the past five years the study of intracellular movement has experienced a surge of major advances catalyzed by the development of electronically enhanced video images from light microscopes and a motility assay in which filaments are levitated and transported by molecular fingers attached to a coverslip. As a result of these developments, the diffraction image of a single microtubule, normally well below the resolution limit of a light microscope, can be visualized, and translocator molecules (the molecular machines that convert chemical energy in the form of ATP to kinetic energy in the form of moving organelles) can be detected in cytoplasmic extracts by imaging the motion of single microtubules. These new methods led to the discovery of kinesin, a microtubule-based translocator molecule, and of a previously unknown function for a well-characterized translocator molecule, dynein.

Cell Movement documents the resulting advances. The first volume, "The Dynein ATPases," is dedicated to the best-characterized microtubule translocator molecules, ciliary and flagellar dyneins (*dyne* = force). These molecules were discovered in 1965 by Gibbons and colleagues were later demonstrated to cause adjacent microtubules in axonemes to slide relative to each other, motion that is translated into the bending movements of cilia and flagella. Four groups of papers, dealing with the molecular biology, functional dynamics, ATPase mechanism, and regulation of the dyneins, provide a well-organized and detailed treatment of the nuts and bolts of dynein structure and function, concluding with one of the more dynamic areas of research in this field, the regulation of bend formation in cilia and flagella.

The eclectic selection of topics (including, for example, myosin I, nuclear division, and post-translational modification of tubulin) in volume 2, "Kinesin, Dynein, and Microtubule Dynamics," contrasts with the clear order of volume 1. Nevertheless, the broad range of topics covered makes for stimulating reading. At the core of the volume are three sections devoted to kinesin and cytoplasmic dynein, the two major microtubule translocator molecules active in the transport of intracellular organelles. In two of these sections, cytoplasmic dyneins identified in lower organisms and as microtubule-associated proteins are presented, and Pratt provides a perspective of research in this field. The other section documents the impressive progress in the understanding of the structure and function of kinesin that has been made since its discovery by Vale, Schnapp, Reese, and Sheetz in 1985. During this short period the molecule has been identified in a variety of organisms, its morphology well characterized, its biochemical activities identified, and important insights into its mechanism of action gained.

As a compilation of current research results from nearly all of the major investigators in this field, these volumes will serve investigators of cytoplasmic transport as a baseline source of information for years to come. In addition, the "Perspective" chapters that open each major section will help make the volmes accessible to a more general scientific audience. Of particular interest among these are Gibbons's detailing of the recent advances in microtubule-based translocator research and Brokaw and Johnson's informative treatment of dynein force generation in volume 1 and Sheetz's discussion of kinesin structure and function in volume 2. Many of the papers conclude with interesting questions yet to be addressed, giving the reader a look into the future of this fast-moving field.

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