Plant Cells and Tissues: Structure–Function Relationships

William V. Dashek

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1. INTRODUCTION

This chapter is an introduction to methods-oriented microscopy. Because the contributing authors present methods in relation to their researches, plant cell structure–function relationships as revealed by light and electron microscopies are reviewed. Much of this conceptual and terminological information is summarized in tables that are augmented with references to either photomicrographs or electron micrographs of cells and tissues.

2. STRUCTURE OF CELLULAR MEMBRANES

Transmission electron microscopy, together with biochemical methods, have unveiled a copious number of functional organelles comprising most higher plant cells. In addition, the marriage of these disparate techniques has yielded significant information regarding the structure–function relationships of the diverse cellular organelles. Furthermore,
applications of these techniques as well as ancillary technologies such as freeze fracturing and freeze etching have resulted in a critical rethinking of the Davson–Danelli model of cellular membranes. Today, most students of the life sciences learn the fluid-mosaic model (1) of the membrane (Fig. 1). According to this widely accepted model, cellular membranes are composed of a lipid bilayer in which globular proteins are embedded. Integral proteins often traverse the bilayer and protrude on either side of the membrane. Whereas the embedded protein is hydrophobic (2), the exposed portion is hydrophilic. Short-chain carbohydrates attached to the protruding proteins are thought to function in cell-to-cell adhesion. Like most areas of contemporary life science research, both the structure and function of cellular membranes are continually being reexamined (3). Table 1 summarizes the composition of cellular membranes. In addition, the reader is referred to Packer and Douce (4), Leshem et al. (5), Yeagle (6), and Smallwood et al. (7) for in-depth recent reviews of membrane structure–function.

3. PLANT CELL ORGANELLES: STRUCTURE–FUNCTION RELATIONSHIPS

One striking advance in modern subcellular biology is a more complete understanding of the interrelationship of certain plant cell organelles (Fig. 2A–F). Rather than existing as discrete entities in physiological and biochemical isolation of one another, it is now generally accepted