BOOKS: BOTANY

Voluminous, Varied, and Vital

Natasha V. Raikhel

Vacuoles of plant cells are often compared to mammalian lysosomes and yeast vacuoles. To some extent, these comparisons are justified: like their counterparts, plant vacuoles are acidic organelles with a lytic function and are the home of hydrolytic enzymes. However, it is less well recognized by nonplant biologists that vacuoles are essential for plant life. Unlike yeast, plants cannot survive without vacuoles, and every plant cell has at least one vacuole. Plant vacuoles are dynamic, multifunctional organelles that are crucial for the regulation and maintenance of plant growth and development.

Plant Cell Vacuoles
An Introduction
by Deepesh N. De

CSIRO, Collingwood, Victoria, Australia, 2000. 304 pp. Paper, $60, £58.95, A$85. ISBN 0-643-06254-8.

Vacuoles exhibit a considerable diversity in composition and morphology, their abundance per cell varies widely among plant tissues and developmental stages, and they are vital for numerous specific cell functions. Vacuoles play a crucial role in the maintenance and regulation of cell turgor. They are important for the opening of stomates and movements of leaflets, as in the "sensitive plant" (*Mimosa pudica*). They act as storage compartments for ions, sugars, amino acids, and the enormous variety of secondary metabolites that plants synthesize to defend themselves against pests. In seeds, leaves, bark, and other storage organs, vacuoles store reserve proteins and defense proteins. Vacuoles are often responsible for the beautiful colors of fruits and flowers. They serve as repositories for various biosynthetic alkaloids that are invaluable as medicinal compounds, as well as for a large group of antimicrobial substances called phytoalexins. Specialized vacuoles store numerous proteins that are a major source of nutrition for humans. Other vacuoles sequester xenobiotics and heavy metals taken up from the environment. This long but still incomplete list of functions shows some of the ways in which plant vacuoles are unique and indispensable.

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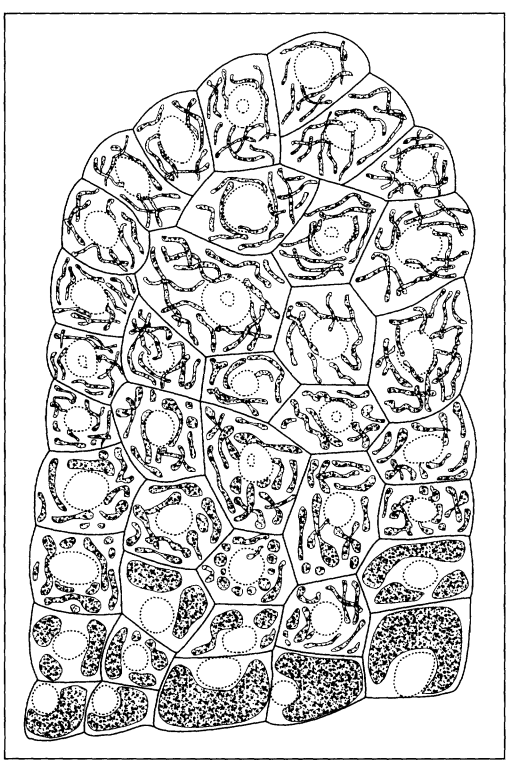
Deepesh N. De's book is a comprehensive—indeed, encyclopedic—tour through the past quarter century of literature on plant vacuoles. It supersedes the last comparable analysis of the field, which was provided by Philippe Matile in *The Lytic Compartment of Plant Cells* (Springer-Verlag, New York, 1975).

Since 1975, many review articles and book chapters have described our broadened understanding of plant vacuoles. These have focused on such topics as protein targeting to the vacuole, the discovery and function of aquaporins and ion channels in the vacuolar membrane (the tonoplast), and the role of vacuoles in detoxification and phytoremediation. The attraction of De's book lies in his success at combining the earlier information on vacuoles with what we have learned in recent years, which provides a useful reference tool for a diverse group of plant biologists. The author's thoroughly researched and well-illustrated account covers topics ranging from methodology, vacuolar diversity, and structure to biochemistry and molecular biogenesis.



Rose reds. As young rose leaflets develop, the filamentous vacuoles filled with red anthocyanin pigments (stippling) swell, anastomose, and fuse to form one large vacuole per cell.

The book will be of use to the increasing number of plant scientists who are finding, often to their surprise, that regardless of their initial research questions, the proteins that interest them are somehow connected to the cell's secretory system. As a crucial part of this system, vacuoles often become the center of their attention. This tendency is increasingly clear as we gain a better understanding of molecular genetics in plant development. Vacuoles also play important roles in cell senescence and the formation of vessels and tracheids that compose the xylem. Furthermore, vacuolar dynamics are essential to a plant's ability to cope with stress such as drought, cold, or pathogen invasion.

Although *Plant Cell Vacuoles* could be used as part of a plant cell biology course, its main value is as a repository of data depicting specific features of vacuoles under various conditions, in particular tissues, and in a variety of plants. The book is so rich in details that it is difficult to discern the research questions that are currently shaping the field. Nonetheless, plant scientists searching for specific information about plant vacuoles will find De's compilation very useful.

BROWSINGS

Light Science. Physics and the Visual Arts. *Thomas D. Rossing and Christopher J. Chiaverina.* Springer, New York, 1999. 458 pp. $79.95, £61. ISBN 0-387-98827-0. Undergraduate Texts in Contemporary Physics.

Writing for students in the visual arts and for readers whose interest in art is not accompanied by any prior knowledge of physics, Rossing and Chiaverina emphasize phenomena rather than mathematical theories. Their "light-hearted" discussions cover a wide range of topics including the nature of light, holography, symmetry, and computer imaging.

Mitochondria. *Immo E. Scheffler.* Wiley-Liss, New York, 1999. 381 pp. $99.95, £64.50. ISBN 0-471-19422-0.

Scheffler provides a single-author overview of the biochemistry, cell biology, and molecular genetics of mitochondria. Often emphasizing the historical progression of our understanding, he uses insights from model systems and comparative studies to discuss the roles of mitochondria in health, disease, and evolution and as the powerhouse of the cell.

Zero. The Biography of a Dangerous Idea. *Charles Seife.* Viking, New York, 2000. 254 pp. $24.95, £46.50. ISBN 0-670-88457-X.

In this informative and entertaining account, Seife (a mathematician now writing for *Science*) follows zero from its appearance as a placeholder in Babylonian numbering to its current role in cosmology. He includes scenes from philosophy, mathematics, religion, science, and even art. The Greeks feared zero's implications of the void and infinity, and the repeated efforts to banish zero form a central theme of Seife's story.