Book Review

Pollack GH: Cells, Gels, and the Engines of Life, 305 pp, Seattle, Ebner & Sons, 2001, ($27.95).

Robert Hooke (1635–1703), the English physician, naturalist, and philosopher, is credited with establishing the cellular nature of living tissues in his "Micrographia" of 1665. Introductory botany courses (in my day at least) were prone to open with remarks on Hooke's depiction of a cross-section through a cork that he had popped out of a wine bottle. Although the good doctor was aware of significant differences between living and dead cells, it is an incongruity that he actually drew a magnified image of a mass of cell walls. The protoplasms and the plasma membranes of those cells had long disappeared, even at the time the bark was harvested from the living oak tree. Hooke had invented the balance spring for watches 7 years earlier, and he went on to write on a wide range of scientific subjects, including earthquakes. Given this combination, I dare say he would have been attracted to the engaging title of the present volume, written three centuries later by a bioengineer who is devoted to exploring nature's way of converting chemical energy into mechanical work at the cellular level.

All living protoplasm is bounded by a limiting membrane, which is composed of phospholipids, sterols and proteins, of various and variable compositions that reflect both the function and the milieu of the intact cell. Much of the biochemistry, biophysics, and ultrastructure of plasma membranes has been elucidated during the past century. However, Gerald Pollack maintains that there has been far too much scientific shouting about the pivotal role of these membranes in health and disease. He wants to place more emphasis on the cytoplasm and, in particular, the manifest properties of aqueous gels containing concentrated proteins, nucleic acids, and polysaccharides.

Accordingly, this book aims to convince the reader that much more attention should be paid to the biophysics of the cytoplasm and that many of the cell's impressive functions still can be performed under conditions where the membrane is stressed, leaky, or even broken. The arguments are built on the work of a handful of pioneers in this field, Gilbert Ling and Albert Szent-Györgyi and more recently Ichiji Tasaki and Gen Matsumoto, which is extended by Pollack into an intriguing scientific story. He starts as if walking on eggs (probably fearing that his audience is more peeved than titillated by his audacious hypothesis) and then carries us persuasively from chapter to chapter. Along the way Professor Pollack introduces much physics and chemistry in a "user-friendly" manner, and the wide outside margins are more often than not filled with successful illustrations, charts, and cartoons. The art work was ably executed by David Olsen.

The book is assembled in five sections. The first sets the stage by debunking myths and sharpening organized skepticism, and the second establishes the groundwork on water, solutes, ions, and cell potentials. The third and central section advances the hypothesis that cell function resembles gel function and emphasizes phase transitions as driving forces for diverse biological mechanisms. Here the author pulls out all the stops and presents much that is worthy of contemplation. The fourth part deals with cell dynamics and discusses everything from secretion to muscle contraction. The fifth section is entitled "loose ends" and attempts an integration of the underlying themes.

Toward the end there is a discussion on water transport in tall trees, capillary action, and the role of gels within the water conduction vessels (xylem). In fact, a little more attention to walled cells (algae, bacteria, and fungi as well as higher plants) would have complemented this book. Notwithstanding the power of the present arguments, anyone who has had the pleasure of watching under the light microscope the reversible plasmolysis of purple beetroot protoplasts (in and out of sucrose solution and distilled water) will still maintain a healthy respect for the function of plant plasma membranes and their mechanical protection by cell walls.

Gerald Pollack is Professor of Bioengineering at the University of Washington, Seattle. He presents a fresh view of how cells function, hopes to reach a wide audience, and displays an intense commitment to his subject. The phenomenon is important, the working hypothesis is contentious, but modern pathologists will enjoy the presentation and benefit from the exercise of reading this book.

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