

WATERBORNE PATHOGENS: DETECTION METHODS AND APPLICATIONS.

Edited by Helen Bridle. Academic Press. Amsterdam (The Netherlands) and Boston (Massachusetts): Elsevier. \$149.95. xi + 401 p.; ill.; index. ISBN: 978-0-444-59543-0. 2014.

ENVIRONMENTAL MICROBIOLOGY. *Third Edition.*

Edited by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry. Academic Press. Amsterdam and Boston (Massachusetts): Elsevier. \$99.95. xxii + 705 p.; ill.; index. ISBN: 978-0-12-394626-3. 2014.

This is the third edition of a successful textbook on environmental microbiology, geared to senior-level undergraduates or graduate students. One of the techniques used to make this a successful text is that chapters are written by experts in conjunction with one of the editors, thus presenting authoritative material at a similar complexity and style across chapters. Of the 31 chapters in this edition, five are new and eight are revised. One of the new chapters discusses the Omic approach.

FOUND IN TRANSLATION: COLLECTION OF ORIGINAL ARTICLES ON SINGLE-PARTICLE RECONSTRUCTION AND THE STRUCTURAL BASIS OF PROTEIN SYNTHESIS. *Series in Structural Biology, Volume 2.*

Edited by Joachim Frank. Hackensack (New Jersey): World Scientific. \$148.00. ix + 458 p.; ill.; no index. ISBN: 978-981-4522-80-9. 2014.



BOTANY

PLANT BEHAVIOUR AND INTELLIGENCE.

By Anthony Trewavas. Oxford and New York: Oxford University Press. \$94.95. xii + 291 p.; ill.; index. ISBN: 978-0-19-953954-3. 2014.

This aptly titled book is about plant behavior and intelligence. Behavior is defined as “what plants do” and intelligence is defined as “a capacity for problem solving” (p. 1). Trewavas begins by assuming that “to many, the notion that plants do anything at all is faintly ludicrous—are they not prime examples of still life or sculpture?” (p. 1). He then assures us of what Charles and Francis Darwin and Jagadish Chandra Bose knew over a century ago—that plants do many things and “to the extent that we come to understand the behaviour of all plants better, we will place a greater value on them and, in turn, on ourselves” (p. 1). Given that we live on a planet whose green color comes from the great number of plants, the precept that underlies this

book, according to Trewavas, is the Navaho saying, “Respect yourself first and then all that surrounds you” (p. 1). I wonder if at one time there were plants climbing up the columns of the Temple of Apollo in Delphi where it was inscribed “Know Thyself.”

The author begins the book describing the behavior and thinking of a plant biologist—himself. He started out interested in the whole organism but became more molecular as whole plant studies were no longer research priorities (meaning fundable?). However, he never lost sight of the whole organism and courageously fought the academic prejudices and dogma of the time. In this volume, Trewavas shares his lifelong knowledge of plants, gives us insights into their behavior and intelligence, and underscores his and our own ignorance of the green world.

He then takes a historical approach by describing the first published discoveries of plant behavior by Charles and Francis Darwin in *The Power of Movement in Plants* (1880. London (United Kingdom): John Murray). The Darwins found that plants sense the environment and respond in a manner appropriate for survival by transmitting a message from the sensory tissue to the motor tissue. The rest of the book provides examples of the “purposeful” or “goal-directed behavior” of plants responding to different environmental stimuli such as light, temperature, gravity, mechanical support, water, and nutrients, and then delves into the many levels of integration from the sensory events to the response.

Trewavas tells us that in describing the tropistic movements of plants in 1937, Frits Went and Kenneth Thimann wrote that “plants appear to exhibit a sort of intelligence” (p. 14). But what is intelligence? The author spills a fair amount of ink defining intelligence. Although there are many types of intelligence, is it not unreasonable to describe intelligence as the ability to analyze a situation and then act in a way to ensure one’s survival, or should we assume that intelligence can only be described by the ability to answer trivial problems on IQ tests?

Intelligence requires consciousness, and consciousness, defined as an awareness of the external environment, is the first step in responding appropriately to the environment. Consciousness is a characteristic of life and may have begun with the first cell. Consciousness differs from conscience, which means a knowledge within oneself, including an inner sense of right and wrong, intention. It is a knowledge of the moral “invironment.” Plants may be sentient, as Trewavas argues, in terms of their internal hormone levels, but I do not think that plants have a well-developed conscience. The

origin of conscience is a pregnant question with evidence provided by levels lesser than and greater than the level of human biology. Plants are, however, truly conscious in that they sense the external environment, assess the balance between cost and benefit, and then respond appropriately to the sensations. Through the study of plants we see the unity of life and what Raoul Francé described as “mankind in the making” (1905. *Germs of Mind in Plants*. Chicago (IL): Charles H. Kerr and Company. Page 147.). However, there is also a diversity in life and a difference between plants and humans in that humans, living up to our specific epithet, *Homo sapiens*, have a well-developed conscience that gives rise to integrity and a greater consciousness that allows us to strive to understand the external world and our place in that world.

I recommend this volume to any student at any level, and any amateur or professional clinician or bench scientist who is interested in what living organisms do (and perhaps think about) to survive in the natural world. As an encouragement to “open-minded, imaginative individuals” (p. 278) to do something with that interest, I will end with the quote from Barbara McClintock with which Trewavas begins his book: “A goal for the future would be to determine the extent of knowledge the cell has of itself and how it used that knowledge in a thoughtful manner when challenged” (p. 1).

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PLANT-THINKING: A PHILOSOPHY OF VEGETAL LIFE.

By Michael Marder; Foreword by Gianni Vattimo and Santiago Zabala. New York: Columbia University Press. \$90.00 (hardcover); \$29.50 (paper). xix + 223 p.; index. ISBN: 978-0-231-16124-4 (hc); 978-0-231-16125-1 (pb); 978-0-231-53325-6 (eb). 2013.

My earliest memories include walking through the woods with my family and gardening in our backyard. Doing so, I learned to love plants and when I grew up I became a botany major at the University of Massachusetts where I was cultivated by teachers who loved both plants and the souls of their students. My teachers nurtured the relationship between the two. Things are different today. Describing the modern relationship between plants and the soul, Marder writes that

it would appear that just as the invocations of “the soul” are superfluous, if not misleading, seeing that they are redolent of an outdated *Weltanschauung*, so the philosophical treatment of flora in the age of positivist science is

unnecessary and is best left to the practitioners of the specialized (ontic) discipline of botany. Both verdicts have a common root in the reductively rationalized approach to reality, which has culminated in what Max Weber has called the “disenchantment of the world,” where the unquestioned priority of science goes hand in hand with a delegitimization of empirically unverifiable notions. What unites the soul and plants, the most ethereal and the most earthly, is their exclusion from the purview of respectable philosophical discourses in late modernity (p. 18).

To my mind, the real problem is that the “respectable philosophical discourses” tolerable in present-day academia, which is better described as not-for-prophet than not-for-profit, have the depth of a tumbleweed root and the breadth of a horse-tail shoot. We academics, who have bound one hand behind our back with technical and philosophical reductionism and put the other hand out in a quest for funding, have become the vegetables, forgetting the roots of our words as easily as we forget the roots of the plants. Marder tells us that the word vegetable comes from the Middle Latin *vegetare*, which means “to enliven.”

“What is in question then,” according to Marder, “in any retrieval of ‘plant soul,’ is the very meaning of life handed over to extreme objectification and treated as though it were a plastic image of death” (p. 19). *Plant-Thinking* reminds us that there is something more to the world—and specifically that plants are more than just food and fuel. According to Marder,

the plant confirms the “truth” of the soul as something, in large part, non-ideal, embodied, mortal, and this-worldly, while the soul, shared with other living entities and construed as the very figure for sharing, corroborates the vivacity of the plant in excess of a reductively conceptual grasp. Within the confines of this commerce, the elusive life of the ensouled plant cannot become a scientific object without getting irretrievably lost, transformed into dead matter, dissipated in cellular activity and in the larger anatomical (or phytotomical) units, prepared in advance for vivisection (p. 19).

Including the natural world around us into ethical thinking is not unknown to Western naturalists. Henry David Thoreau taught us that “in Wildness is the preservation of the World” (1862. *Atlantic Monthly* 9:224), Aldo Leopold realized the importance of “Thinking Like a Mountain” (1949. *A Sand County Almanac: With Essays on Conservation From Round River*. Oxford (United Kingdom): Ox-