students, such as making it dependent on the research question which behaviors to define, to avoid an observer bias, and to term a behavior pattern descriptively, avoiding terms that already imply function. However, it is not mentioned that behaviors should be separated between events (frequency is recorded) and states (recording of duration). The methods described for sampling behavior are correct but focused on "who to observe" without considering the important question of "how to observe." As such, the different recording rules (continuous recording, point recording, one/zero recording, and frequency recording) are not covered. The chapter on animal behavior provides a good and adequate introduction on which students can then build on in more specialized classes. From my reading, this is true for all of the chapters and when in the future I will have a student using a technique so far not used in my project, I will ask them to first read and apply the corresponding chapter in this book and then to move forward from there.

Are there any chapters missing? Not really. One important topic that I would urge everyone to address when teaching any of the topics is ethics and the necessity to apply for the necessary permits. Further, there are no chapters on how to collect blood or tissue samples. This is understandable as when teaching students how to collect blood samples, then these samples should also be used, for example, for hormone analyses, which is beyond the scope the book. Accordingly, how to collect samples is detailed in the chapter on karyotypes where the necessary laboratory techniques are also described. Thus, students interested in field techniques in mammalogy might want to visit courses in laboratory animal care, where one learns how to collect blood samples, and physiology courses to learn how to measure hormones and metabolic rate.

Although anyone teaching or learning field-based mammalogy will benefit from this volume, people like me conducting field work for 20 years will also enjoy reading it. This is because even though field biologists are specialized, they will encounter questions and opportunities that need techniques that they are so far not using. This book is now an important addition to the library in my research station in South Africa and I am sure the students working there will benefit from it.

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BOTANY

LEAF OPTICAL PROPERTIES.

By Stéphane Jacquemoud and Susan Ustin. Cambridge and New York: Cambridge University Press. $89.99. xiii + 555 p. + 16 pl.; ill.; index. ISBN: 978-1-108-48126-7. 2019.

If you are a plant ecologist, horticulturalist, plant anatomist, plant physiologist, plant developmental biologist, plant evolutionist, plant cell biologist, plant pathologist, biophysicist, biochemist, biosynthetic plant engineer, someone who does remote sensing, a historian of science, or someone interested in feeding the world, stop reading this review and buy this book. The authors write so that readers specialized in any one discipline will understand the material presented in all other disciplines.

Photosynthesis, which is the process that is fundamentally responsible for nearly all food on Earth, cannot be reduced to biochemical reactions alone, but also depends on the optical properties of leaves. Moreover, the natural history of plants cannot be understood fully without taking the optical properties of leaves into consideration. By providing observations, experiments, and theory that integrate form and function from the molecular scale to the ecosystem scale, and by analyzing the unity in terms of its diversity, *Leaf Optical Properties* quantitatively, qualitatively, creatively, and thoroughly makes this case.

This is a comprehensive, clear, and rigorous book, yet it is also a delight for those interested in plant trivia. It mentions John Ray's (1686) experiments on greening, Thomas Melvill's (1752) observations on the leaves of colewort, and Gavriil Tikhov's work on astrobotany. It mentions works of art and film that bring out properties of plant leaves. It discusses polarized light. It describes the effect the self-cleaning ultrahydrophobic epicuticular wax crystals of the sacred lotus, mimicry of eucalyptus leaves by *Tropidoderus* for camouflage, color matching of the leaves of the alpine plant *Corydalis* to the rocks in which it lives, the iridescent leaves of *Selaginella*, and the trichomes that give the white color to Edelweiss bracts, as well as research on many less well-known taxa, including *Salvinia*, *Gnetum*, and *Welwitschia*.

Although *Leaf Optical Properties* is a comprehensive volume with reliable well-explained information, there are a few faux pas that could be corrected in the second edition. For example, the authors note, "*Hemicelluloses* are a family of polysaccharides that are more complex than sugars and less complex than cellulose" (p. 26). The untruth of this sentence is clearly shown in Figure 2.11 on page 27. Then they say, "Chlorophyll is a chlorine molecule" (p. 29) where they clearly mean chlorin molecule. There is no mention of Albert Szent-Györgyi (1937. Oxidation, energy transfer, and vitamins. https://www.nobelprize.org/prizes/medicine/1937/szent-gyorgyi/lecture/) in the section on brown pigments on page 35. The authors state, "electromagnetic radiation incident on a dielectric is given by the well-known Fresnel's equations, after the French physicist and engineer Augustin-Jean Fresnel (1788-1827), who was the first to establish them in 1918" (p. 444), but it should read 1818. Although the equations are well-known, they are not so clear since a contradiction exists in the various textbooks on optics and electromagnetism written over the past two centuries. I can find no rationale from the authors for the rejection of Fresnel's original equations. I have presented a rationale based on an argument from analogy for accepting the original formulations of the Fresnel equations (2019. *Light and Video Microscopy*. Third Edition. Amsterdam (The Netherlands): Elsevier). The original formulation for the reflection amplitude coefficient would change Equation E.40 on page 448 to $R_{\parallel} = \frac{1-n}{n+1}$, and consequently, $R_{||}$ would be equal to $R_{\perp}$.

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Plastid Genome Evolution. *Advances in Botanical Research, Volume 85.*

Edited by Shu-Miaw Chaw and Robert K. Jansen. Academic Press. Amsterdam (The Netherlands) and New York: Elsevier. $214.00. xiv + 382 p.; ill.; subject and author indexes. ISBN: 978-0-12-813457-3. 2018.

Evolutionary Dynamics of Plant-Pathogen Interactions.

By Jeremy J. Burdon and Anna-Liisa Laine. Cambridge and New York: Cambridge University Press. $130.00 (hardcover); $49.99 (paper). x + 383 p. + 12 pl.; ill.; index. ISBN: 978-1-108-47629-4 (hc); 978-1-108-70015-3 (pb). 2019.

In 1987 Jeremy J. Burdon published *Diseases and Plant Population Biology* (Cambridge (U.K.): Cambridge University Press), a seminal book that contributed much to help make plant pathologists aware of the relevance of evolutionary biology and ecology to understand pathology. Since then, studies on plant-pathogen interactions, and on the genetic and ecological factors that shape their dynamics and evolution, have progressed enormously. Knowledge on the population biology of plant-pathogen interactions has been often reviewed and summarized in at least one excellent book (M. M. Milgroom. 2015. *Population Biology of Plant Pathogens: Genetics, Ecology, and Evolution.* St. Paul (MN): APS Press). In this scenario, Burdon and Laine's book is an important contribution because of the variety of topics addressed, and their organization, which will be attractive to plant pathologists with an interest in both agricultural and wild systems.

This volume includes a detailed review of current knowledge on the evolutionary dynamics of plant-pathogen interactions, as attested by over 1000 references to original research papers and reviews. This wealth of information is, however, not presented as an exhaustive collection of cases. Rather, cases are introduced to illustrate hypotheses and test theoretical predictions on host-pathogen evolution and ecology. After an initial chapter introducing basic concepts in plant pathology, the book is organized into seven core chapters each covering a main subject in a logical sequence, and ends with a brief recapitulation of gaps to be addressed by future research. In each of these chapters, the topic is first delimited, and theory and concepts are introduced in a clear and didactic way. A good example is the excellent introduction to metapopulation theory in Chapter 6. Then, the empirical and experimental evidence relative to hypotheses or predictions is provided. The presentation of evidence may be occasionally overwhelming, as in parts of Chapter 2, which deals with environment as a determinant of pathogen incidence, abundance, and evolution. I prefer when evidence is presented as a detailed discussion of a few selected case studies, as in the sections on coevolutionary dynamics "in the real world" (Chapter 6) or the effects of introduced or native pathogens in plant community dynamics (Chapter 8). However, the large amount of information presented in each chapter, including Chapter 2, will be extremely useful to many scientists who want to first approach the different themes. Reference to empirical or experimental studies mostly focuses on systems involving fungi or oomycetes, to the exclusion of other pathogens. Including examples from the literature on bacteria and, particularly, virus genetic variability, population structure, host adaptation, tradeoffs among life-history traits, or emergence would undoubtedly have contributed to the book's larger view of its subject. This thematic bias reflects the unfortunate split between plant pathologists according to pathogen classes, which seems difficult to bridge. However, this bias does not decrease the overall interest of the volume. Its two-faced quality of an advanced textbook and a reference treatise will appeal to both junior and established plant pathologists. I am confident it will be as stimulating to any pathologist interested in population biology as it has been to me.

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