THOREAU'S WILDFLOWERS: HENRY DAVID THOREAU.
Edited by Geoff Wisner; illustrated by Barry Moser. New Haven (Connecticut): Yale University Press. $30.00. xliii + 300 p.; ill.; index. ISBN: 978-0-300-21477-2. 2016.
THOREAU'S ANIMALS: HENRY DAVID THOREAU.
Edited by Geoff Wisner; illustrated by Debby Cotter Kaspari. New Haven (Connecticut): Yale University Press. $30.00. xxiv + 256 p.; ill.; index. ISBN: 978-0-300-22376-7. 2017.

During the 40-plus years he lived in Concord, Massachusetts, Henry David Thoreau kept journals that ultimately constituted over 2 million words. Wisner has combed through this intimidating material to produce a pair of volumes, *Thoreau's Wildflowers* and *Thoreau's Animals*, which concentrate on specific subjects of recurring interest to the author.

The two volumes share some features. Each one comprises dated selections from Thoreau's journals organized by the pattern of the meteorological season from spring through winter. In each book Wisner has done an impressive editorial job of presenting Thoreau's memorable prose, a scholarly challenge since available print versions of the journals are either incomplete or have been editorially altered. The volumes are well indexed, and an annotated map of the Concord environs is usefully appended to each. Both volumes feature handsome black-and-white artwork.

To some extent the illustrations convey different aspects of Thoreau's perception as a naturalist. *Wildflowers* contains meticulous pen-and-ink renderings of subject plants by famed artist Barry Moser. The precise ink images nicely match Thoreau's botanical accounts, which are typically lucid and exact. The Massachusetts author compulsively noted where and when hundreds of species came into bloom. In the 1850s he was determined to perfect his "Kalendar" to the point where he could specify the date of the year on the basis of plants that were then in a certain state of their growth cycle. As an entry from June 1857 claimed, he had made "acquaintance" with "each contemporary plant in my vicinity" (p. 84): "They are cohabitants with me of this part of the planet" (p. 84). Ultimately, of course, Thoreau's ambitious records have become a valuable reference tool for 21st-century researchers examining how a century-and-a-half of climate change has affected growing patterns in the Concord region.

The pencil drawings by Debby Cotter Kaspari in *Thoreau's Animals* are like finely elaborated field sketches, capturing the spontaneity of an encounter with living animals. They well suit Thoreau's prose, which likens a kingbird pursuing a crow to "a satellite revolving around a black planet" (p. 99), and for whom a croaking American bullfrog "swears by the power of mud" (p. 73). As with his botanical interests, Thoreau engaged the creatures around him with scientific curiosity. He employed his surveyor's skills, for instance, to calculate the length of a flying squirrel's glide from the top of a pine tree (he found that this mammal traveled almost exactly twice as far horizontally as it had plunged vertically). Indeed, Thoreau was so appreciated for his observational acuity that the eminent scientist Louis Agassiz made repeated use of his wildlife expertise to obtain hard-to-gather specimens. For a time Thoreau robbed birds' nests and gathered reptiles, birds, and small mammals whenever Agassiz needed certain fauna for laboratory study and dissection. Yet Thoreau confessed a "squeamishness" (p. xiv) about such activities: "I have just been through the process of killing the cistudo [Blanding's turtle] for the sake of science—but I cannot excuse myself for this murder" (p. 147), he records in one entry. "No reasoning whatever reconciles me to this act" (p. 147). Ultimately concluding "that this is not the means of acquiring true knowledge" (p. 90), Thoreau quit the collecting tasks that distressed his conscience. Rebuffing his own era's ideas of "science," Thoreau's impulse to make patient studies of living animals within their habitat would instead anticipate the practice of field biology today.

Thoreau lived long enough in a single area to realize that some plants and creatures had disappeared from his region, and in his writings he noted with concern the ominous diminishment of local chestnut forests and passenger pigeon flocks. "I should not like to think that some demigod had come before me and picked out some of the best of the stars," he wrote in plaintive warning. "I wish to know an entire heaven and an entire earth" (p. xviii). *Thoreau's Wildflowers* and *Thoreau's Animals* provide a keen glimpse into that ambition.

ED GILLIN, *English, State University of New York, Geneseo, New York*

GENERAL BIOLOGY

LIVING MACHINES: A HANDBOOK OF RESEARCH IN BIOMIMETICS AND BIOHYBRID SYSTEMS.
Edited by Tony J. Prescott, Nathan F. Lepora, and Paul F. M. J. Verschure; Assistant Editor: Michael Szollosy; Foreword by Terrence J. Sejnowski. Oxford and New York: Oxford University Press. $150.00. xx + 633 p.; ill.; index. ISBN: 978-0-19-967492-3. 2018.

According to the editors of this volume, the age of robotics is upon us. Reading this book makes me want to believe them. Their volume is a rich compilation of essays on nature-inspired robotic systems. Several of the featured authors are excellent, such as biologist Julian Vincent or roboticist Mark Cutkosky. Others are generally very good. Collectively, the authors surprised me with new areas, even though I have worked in this field for nearly two decades.

The most interesting chapters discussed how robots grasp: focus of their attention, communicate, and sense (see, hear, taste, and smell). The book's strength is its weaving together robotics and biology, with numbers used to compare the accuracy and capability of these systems. Although the authors add caveats about the limits of robotic systems, one cannot but marvel at the clear progress and prospects for the future of robotics.

Many of the authors wrote in fields outside their own training: for example, engineers wrote entire essays on biology. As a result, the volume does a fairly good job of being an introduction to this area. Any new terms are generally defined in the beginning of each chapter. One exception is the use of equations, which seemed to come abruptly, and without derivation. Authors were encouraged to give their expert opinion as well as fact. Consequently, each essay ends with two paragraphs, a frank discussion of the future of their field, and opinions on further reading. The narrative format of the text makes it generally readable. I will be passing my own copy to graduate students, the audience for which this book is best suited.

The volume includes a beautiful series of figures, from the digestive duck (a robot that was purported to digest food) to a human infant learning to grasp with its fingers to an array of sensors mimicking a fly's eye. The figures, ranging from the 1800s to the present, truly spark the imagination.

Although the inclusion of over 70 authors has created an astounding breadth, it has also come at a cost. A fraction of the essays are too short to contribute to the book. Some of the most intriguing topics are regretfully the most difficult to understand, such as chapters on self-replication, evolution, and consciousness. There is redundancy throughout the volume, as the authors of each chapter reintroduce their subject matter. A mismatch in writing style among the authors generally makes continuous reading difficult. The result is that the publication has become a bit unwieldly: at over 600 pages, this handbook requires two hands. Indeed, the volume could have been more carefully edited. Nevertheless, I would still recommend this ambitious and useful work to anyone who is looking to be inspired by the future of biological robotics.

DAVID L. HU, *Mechanical Engineering & Biology, Georgia Institute of Technology, Atlanta, Georgia*

NATURAL COMPLEXITY: A MODELING HANDBOOK. *Primers in Complex Systems.*

By Paul Charbonneau. Princeton (New Jersey): Princeton University Press. $99.50 (hardcover); $49.50 (paper). xv + 355 p.; ill.; index. ISBN: 978-0-691-17684-0 (hc); 978-0-691-17035-0 (pb). 2017.

With the advance of interdisciplinarity, biologists increasingly turn to complexity theory to tackle important biological questions. Indeed, the concepts and techniques used to study complex systems can help understand how the amazing phenomenology observed in biological systems emerges from the underlying ecological and evolutionary mechanisms. Complexity theory, in turn, is rooted in statistical physics, in which concepts such as scale invariance, fractality, or criticality are formally defined and supported by robust mathematical formalisms. The book *Natural Complexity* introduces such concepts and tools to uninitiated readers, using to that end classic models from statistical physics.

As part of the Primers in Complex Systems series, the volume is clear, easy to read, and presents simple computational code to support and help explain each example/model. This hands-on approach allows readers to easily familiarize themselves with the basic terminology. The author aims at making the book instructive and entertaining for a broad audience, with special emphasis on younger readers (e.g., informal language and use of Python coding language). The examples are biased toward Self-Organized Criticality, and the reading list focuses mainly on each topic's seminal work. Charbonneau eludes a thorough review of more recent accomplishments, an unavoidable sacrifice that, on the other hand, invites readers to find an independent path to further explore a particular topic. The author's effort to keep the text simple sometimes leads to an understandable lack of precision (e.g., not explicitly differentiating between the different types of phase transitions), yet the depth of the explanations is enough for readers to understand the key concepts presented through the different examples. Moreover, Charbonneau utilizes the examples well, not as mere motivation but also as a way to connect conceptually new ideas and techniques across chapters. This interconnection is, however, what may deter biologists from choosing this book as their first incursion in complex systems. The example selection may be too abstract and too far from biology for uninitiated readers to easily extrapolate the concepts and techniques to biological systems. This is unfortunate because biology provides excellent examples for the topics chosen by the author. For instance, the chapter on cellular automata could have delved into the Game of Life and biological interpretations. For fractality, the example of diffusion-limited aggregation is a step away from simple models for bacterial growth. After introducing Self-Organized