dino dei Luzzi written in 1316. The subject of "voluntary animal motion" interested physicians, scholars, and philosophers throughout history for a variety of purposes such as relating "voluntary motion" to the soul and understanding medical conditions through comparative anatomy. The research presented in this monograph includes not only a careful examination of different theories regarding animal motion, but also an analysis of how these theories developed within the context of changing medical and academic paradigms.

Another interesting and very useful feature of this work is its inclusion of extensive indexes and bibliography. The indexes include ones for Latin terms, Greek terms, book titles, names, and a general index. Due to the medical nature of its subject and the periods covered, the Latin and Greek indexes in particular prove invaluable to the book. Together, the bibliography of primary and secondary sources and the indexes comprise over 200 pages of reference material. This hefty, well-researched volume will be useful as both an analysis of early theories on voluntary animal motion and a reference source for this topic.

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GENERAL BIOLOGY

WHAT IS LIFE?: INVESTIGATING THE NATURE OF LIFE IN THE AGE OF SYNTHETIC BIOLOGY.

By Ed Regis. Published by Oxford University Press, New York, by arrangement with Farrar, Straus and Giroux, New York. $13.95 (paper). x + 198 p.; ill.; index. ISBN: 978-0-19-538341-6. 2008.

In this slim and engaging paperback volume, whose title echoes and explores Erwin Schrödinger's famous book from 1944, Regis brings his practiced hand to a description of scientists' attempts to agree on definitions of life and death, which naturally includes a survey of efforts to study and to duplicate the origin of life in terrestrial laboratories. Additional topics include metabolism and evolution, cellular automata and artificial life, and glimpses of the players and discussions at some key symposia that help mark the pace of research in this arena of science.

The author deftly presents an intriguing cast of characters—Schrödinger, Norman Packard, Steen Rasmussen, Stuart Kauffman, Stephen Wolfram, Marshall Nirenberg, James Watson, Francis Crick, Charles Darwin, Stephen Jay Gould, DNA, ATP, and a host of others—along with their contributions to the explanation of life as we know it and may create it. Most of these men (only Rosalind Franklin, I believe, makes a token appearance for the female half of humanity) appear in easily understood settings, often with pithy quotations: "nobody has a freakin' clue," Rasmussen remarks about the origin of life (p. 89); "The title was a piece of colossal nerve," Gunther Stent comments on Schrödinger's exposition (p. 63). Yet Regis never loses sight of the science, and makes it easily understandable. His book, clearly written and entirely accessible to those without any science background, offers a delightful and informative introduction to topics, which, understandably, do not yet cohere as well as they someday will.

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CRITICAL TRANSITIONS IN NATURE AND SOCIETY. *Princeton Studies in Complexity.*

By Marten Scheffer. Princeton (New Jersey): Princeton University Press. $99.50 (hardcover); $45.00 (paper). xiii + 384 p.; ill.; index. ISBN: 978-0-691-12203-8 (hc); 978-0-691-12204-5 (pb). 2009.

A traditional view of biological processes is that gradual changes in external stimuli generate gradual changes in system behavior. This may seem to hold in particular for large-scale systems consisting of many interacting components, such as ecosystems, in which many internal feedback loops should generate a gradual average response. This view has been fundamentally challenged by the advent of complex systems theory, but it still pervades much empirical thinking. The current book by Marten Scheffer is a passionate and eloquent plea to take the theory of complex dynamics seriously when it comes to understanding real biological systems. In particular, building on his extensive and pioneering research from the past two decades, Scheffer argues that many natural systems undergo critical transitions, during which system behavior abruptly and qualitatively changes as a response to gradual external changes. This appears to be a very important perspective for understanding many large-scale phenomena in a rapidly changing world.

The volume begins with a nice, nontechnical overview of some of the most important theoretical features of complex dynamical systems, such as alternative stable states, fold bifurcations, and hysteresis, which form the main theoretical underpinnings for the subsequent empirical examples. These examples represent an impressive array of intriguing large-scale systems and processes, ranging from deserts to oceans, and from mass extinctions to the world's fisheries and human society. In all of the examples, Scheffer describes large and abrupt shifts in dynamic regimes brought about by small and gradual environmental perturbations.

The case for regime shifts due to positive feedback loops that cause runaway processes is very convincing for some of these systems (e.g., lacustrine and terrestrial ecosystems) and remains more speculative for others (e.g., long-term evolution). The author concludes by describing very useful starting points for detecting the onset of critical transitions in real systems, although I found the section about how to manage such systems overly optimistic. It seems good to avoid large catastrophes, but there is a caveat to utility managing: in the end, what we want as humans, and what we think is good or bad, is a moral and philosophical question, not a scientific one, and any approach based solely on scientific utility concepts seems incomplete.

I find Scheffer's arguments that complex dynamics, and in particular critical transitions, do in fact occur in many real biological systems very convincing. But I think it is also important to not get carried away. For example, the author repeatedly refers to a study claiming the existence of power laws in the fossil record as evidence for complex long-term evolutionary dynamics, but the observed pattern is most likely an artifact due to the methods of data analysis (J. W. Kirchner and A. Weil. 1998. *Nature* 395:337–338). Nevertheless, it seems clear that the possibility of critical transitions must be taken seriously in empirical studies, and judging from a number of proposals that I have seen as a member of one of the review panels of the Natural Sciences and Engineering Research Council of Canada, and that explicitly incorporate the study of regime shifts into their research agenda, this view is shared by an increasing number of empirical and applied researchers. For them, as well as for many others interested in large-scale thinking, Scheffer's volume will be a fascinating read.

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THE SIMPLE SCIENCE OF FLIGHT: FROM INSECTS TO JUMBO JETS. *Revised and Expanded Edition.*

By Henk Tennekes. Cambridge (Massachusetts): MIT Press. $21.95 (paper). xiv + 201 p.; ill.; index. ISBN: 978-0-262-51313-5. 2009.

This introduction to flight mechanics, a revised edition of a widely acclaimed treatment, provides conceptual background to and practical applications of the theory of flight. Through the use of simple equations, basic physical reasoning, and numerous biological and technological examples, the aeronauticist Henk Tennekes unifies themes of mechanical performance for flying machines as diverse as fruitflies and Boeing 747s. Size, speed, and air density are manipulated algebraically to yield the "great flight diagram" upon which cruising speeds and weights of all flying objects can be reasonably plotted and correlated with each other. This analysis then extends into discussions of power and flight energetics, the cost of transport, optimal strategies of migration, and the aerodynamics of flight control. Black-and-white drawings of diverse birds, insects, seeds, and airplanes are used to graphically indicate the kinds of morphologies relevant to flight performance, whereas data tables display the substantial range of relevant parameters as seen in both animal and mechanical systems. A healthy amount of both flight technology and basic biology (especially that relating to birds) is woven into the aerodynamic discussions. Given that a major theme of the book is the effect of body size, omission of the key concept of the Reynolds number is surprising. Similarly, the grand allometric curves exhibit sometimes shocking (i.e., ten-fold) deviation from mean values otherwise predicted by the overall linear regression and further discussion of those mechanical and biological factors underlying such variation would be helpful. Nonetheless, this serves as an excellent introduction to both the theory of flight aerodynamics as well as to its seemingly endless variants in both natural and technological domains. It would be excellent supplemental reading for undergraduates in biomechanics and engineering programs and, for general readers, it will serve as an informative and occasionally inspirational introduction to the marvels of flying machines.

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MATHEMATICAL METHODS IN BIOLOGY. *Pure and Applied Mathematics.*

By J. David Logan and William R. Wolesensky. Hoboken (New Jersey): Wiley. $84.95 (paper). xiii + 417 p.; ill.; index. ISBN: 978-0-470-52587-6. 2009.

Toward the end of his classic movie, *The Good, the Bad, and the Ugly* (1966), Sergio Leone taught us that there are two types of people in the world. For this review, they are mathematical scientists who want to learn about biology and biologists who want to acquire quantitative skills. I have taught such material to both groups for 30 years and written a number of books aimed toward the latter group. The former group is often looking toward biology as a source of problems in mathematics, but cannot find the problem. Biologists often have the problem in hand and get stuck on technical aspects. This volume, although aimed for both groups, is a much better fit for mathematicians who are trying to pick up some biology. The selection of topics is excellent, and the authors cover both deterministic and stochastic models, in what we might think of as the canon for quantitative methods in biology: foraging theory, diffusion, sin-