Life of Earth: Portrait of a Beautiful, Middle-Aged, Stressed-Out World

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Earth in Perspective

Life of Earth: Portrait of a Beautiful, Middle-Aged, Stressed-Out World. Stanley A. Rice. Prometheus Books, 2011. 255 pp., illus. $28.00 (ISBN 9781616142254 cloth).

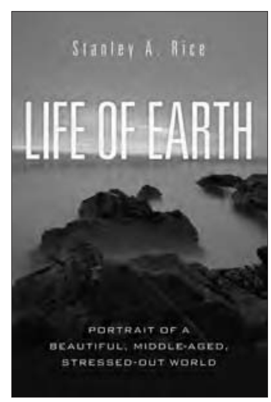
Biologist Stanley A. Rice, author of *The Encyclopedia of Evolution* and *Green Planet: How Plants Keep the Earth Alive*, gives readers a rudimentary sketch of the present state of life on Earth with his latest title, *Life of Earth: Portrait of a Beautiful, Middle-Aged, Stressed-Out World*. In his depictions, Earth appears at turns fascinating, thorny, obstreperous, and sympathetic, but Rice's characterization of the planet as a whole serves an explicit agenda: to present his subject as an environmental victim.

Over the past decade, the most popular overviews of life on Earth have appeared as screen documentaries such as Disney's *Earth* (2007) and the British Broadcasting Company's *Planet Earth* (2006) and *Life* (2009). In contrast, Rice's overview is broader in scope. *Life of Earth* opens immodestly with an account of the origin of the universe, describing the origins of the geological and atmospheric circumstances in which it was possible for both photosynthesis and respiration to emerge. This story leads to a presentation of how evolution produced organisms with adaptations like altruism and religiosity. Rice uses this history to contextualize the current state of life, which he presents as being deeply threatened by human activity and political policy. His portrait of the planet fuels the cause of environmentalism, and what heft his conclusion has depends on readers' opinion of the book's epic, panoramic narrative.

Life of Earth assumes a broad perspective, with particular details of biology presented at a basic level. The science does not become much more complicated than this: "When one DNA molecule becomes two, the new strands are almost identical to the old ones," Rice tells us. "Almost. Occasional mistakes occur during the copying process. These mistakes are called *mutations*" (p. 47). Clearly, the book is pitched to attract readers who have forgotten high school biology. Short segments of text, lasting no more than a few pages, are packed with intriguing facts written in the second person: "When animals began to live on land, they had to bring the ocean with them. To this day, the balance of salts in your cells is reminiscent of the saltiness of the ocean" (p. 83). Rice's natural-history observations are mixed with anecdotes about pop culture and the author's family. *Life of Earth* is not an academic book and is not particularly aimed at students, but it might be popular with those with no science background who want to be drawn in but not challenged by science. Rice aims to educate that audience with a heavy dose of light entertainment: "Dogs do this also. It's a wild and crazy time when the bitch is in heat" (p. 131), and "Back in the Stone Age, fat women were hot" (p. 123).

But a danger arises from this simple, jocular presentation of science: Ideas are occasionally simplified so much that they become misleading or confusing. For example, Rice defines evolution as natural selection (on p. 48): "The result is that the superior cells or organisms become more common than the inferior ones. This is natural selection: nature selects the superior mutations. That is what evolution is. That is all evolution is." The author should have clarified that superiority of alleles is not absolute, but relative to context, and that processes other than natural selection play a role in evolution. I would not fault a reader for being confused eight pages later when reading that natural selection is a stabilizing force—"the kind of selection that prevents evolution from occurring" (p. 56). I imagine the reader wondering, "How could evolution, being selection, prevent itself?"

Covering a lot of biology quickly, Rice also asserts scientific positions that are not universally agreed on. He embraces the view of human thought popularized by Richard Dawkins, Daniel Dennett, and evolutionary psychology in general. Although that is no fault, the sort of reader first learning how evolution works will not have the perspective to distinguish whether Rice is presenting scientific consensus or merely advancing an angle: "Literature is memes… Science is memes… Everywhere you look there are memes, memes, and more memes, all of them evolving," he writes, as though memes were a universally accepted part of standard biology (p. 70).



A tension between consensus science and individual perspective is most notable with the author's treatment of Gaia—Rice's framing device for the book itself. In his depiction, it is a female being who is stressed out by human activities. Gaia is an idea that "many scientists" share, Rice asserts. Following the approach of the late Lynn Margulis, to whom the book is dedicated, Rice treats Gaia as analogous to a person, while emphasizing that she is not a person. Like a person,

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she regulates not only herself but also her environment, within limits. She is depicted as having had an infancy and as expecting an old age—one that may not include us. We human beings depend on her; we are Gaia's children and also a part of her.

I suspect that some readers who are encountering the concept of Gaia for the first time will be drawn to how it frames a relationship between humans and a motherly nature. For those who find the Gaia imagery appealing, this book may be persuasive, but it will not suit everyone's taste. The Gaia concept aptly serves Rice's purpose for writing *Life of Earth*, however, by presenting the history of Earth on a human scale. Rice helps us to care for Earth's systems of photosynthesis and respiration and temperature regulation by treating them as analogous to human bodily functions. Yet Gaia's value lies in accomplishing what people cannot seem to do naturally: establishing and maintaining the conditions of life for our species and every other one. This is wondrous and also superhuman. But is it more impressive when anthropomorphized?

Although it is not a book for biologists or for classroom use, *Life of Earth* can be persuasive in its message. In helping readers comprehend the history of life on Earth, it reveals the indispensability of Earth's living systems, and through the central figure of Gaia, encourages us to care about them.

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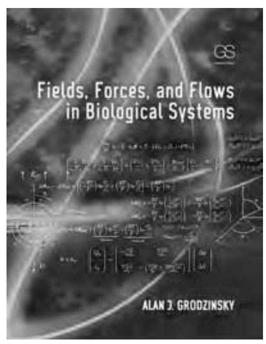
ELECTROMECHANICS FOR THE TWENTY-FIRST CENTURY

Fields, Forces, and Flows in Biological Systems. Alan J. Grodzinsky. Garland Science, 2011. 308 pp., illus. $120.00 (ISBN 9780815342120 cloth).

> "If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is."
> John Louis von Neumann

In 1974, Alan Grodzinsky wrote his doctoral thesis at the Massachusetts Institute of Technology (MIT) on membrane electromechanics at a time when computers were scarce and interest in biophysics was just starting to explode. In the following decades, biology saw the invention of fantastic new tools like magnetic resonance imaging, the scanning tunneling microscope, and the atomic force microscope, made possible by



the application of physics to biology. Today, mathematical methods for studying biology are more important than ever. *Fields, Forces, and Flows in Biological Systems*, Grodzinsky's well-illustrated mathematical primer on bioengineering, will stand as a guide for the next generation of electrical engineers interested in biology.

Grodzinsky is well qualified to write a textbook on the principles of bioengineering. He directs the MIT Center for Bioengineering and teaches in the three departments that together span the intended breadth of this book—mechanical, electrical, and biological engineering. Through his research, he has made contributions to cartilage-tissue engineering—particularly its mechanical, chemical, and electrical properties, which have helped researchers to understand and cure bone diseases such as osteoarthritis. Moreover, Grodzinsky is a member of the first generation of scientists and engineers, which includes Leroy Hood and Robert Nerem, to work in the area of bioengineering. His presence during the development of bioengineering into its own discipline gives Grodzinsky a historical perspective, which is evident in the text.

Electromechanics, which is the subject of this book, is composed of the interplay between three subjects—electromagnetism, electrical engineering, and mechanics. The primary contribution of the book is the unified presentation of all the laws of electromechanics within the context of bioengineering systems. Professors and graduate students previously had to gather this material from lecture notes or from articles in *Biophysical Journal* or *Journal of Biophysics*. This book provides all this information in a single place.

In *Fields, Forces, and Flows*, successive chapters present the governing laws of magnetism, electricity, and fluid flow, with numerous examples and a few end-of-chapter problems added to demonstrate their application in biological systems. The author approaches each topic from the perspective of an electrical engineer, starting from first principles, introducing the balance of forces and conservation of energy and momentum, and then proceeding to derive the governing equations. The most important governing equations are derived from scratch, including those of Maxwell and Navier-Stokes, which are presented in the form of vectorial differential equations. Next, he presents the rare analytical solutions to these equations, with initial and boundary conditions given in the context of previously solved bioengineering problems. One oversight is the neglect of computational approaches. However, the most important part of the problem-solving process—a discussion of the physical interpretation of the mathematical solution—is usually given.

Fields, Forces, and Flows is a wonderfully thin stand-alone reference. The author's concise prose allows him to

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