BOOKS: THEORETICAL BIOLOGY

Structuring Nurture

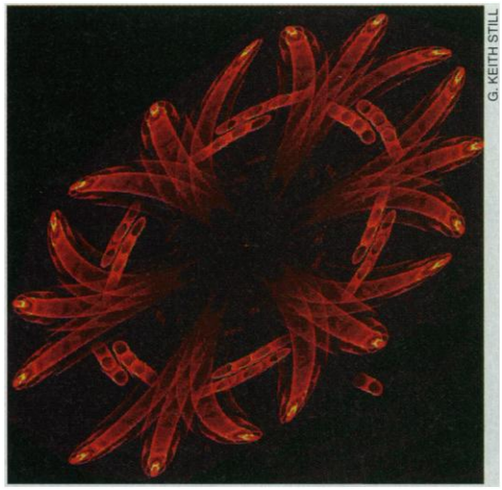
Sunetra Gupta

Life's Other Secret. The New Mathematics of the Living World. IAN STEWART. Wiley, New York, 1998. xiv, 285 pp., illus, + plates. $24.95 or C$34.95. ISBN 0-471-15845-3.

An apparent tug-of-war between "genetics" and "mathematics" forms the template for this fascinating exposition of how simple rules may suffice in generating many of the complex patterns of life as we know it. The spontaneous self-organization of physical material into a multitude of forms is as essential to life, Stewart argues, as the genetic code that underlies it. The author thus offers us an alternative to the notion that genes are engaged in a constant struggle to impose order on a relatively nonparticipatory (and generally unruly) physical universe—with the sole aim of ensuring that their copies survive through time. Instead, he contends, genes act in synergism with the fundamental laws of physical systems to create and maintain viable, flexible patterns. Nurture, in other words, is no less structured than nature, and Stewart steers us expertly through a series of beautiful examples from both the plant and animal kingdoms to prove his point.

Clues to this "second secret of life" are evident in everything from the startling geometry of viruses to the regularities of animal locomotion, and most obviously in the intriguing symmetries of the plant world. Stewart shows how mathematics plays a vital role not only in helping us to understand and catalog these patterns, but also by providing metaphors for the processes that govern them. For instance, drops of magnetic fluid, when allowed to fall at regular intervals into a dish of silicone oil in a magnetic field, will with a high probability arrange themselves into "sunflower seed patterns of interlaced spirals." By investigating the properties of this physical analog, insights can be gained into the fundamental rules of plant growth.

Stewart, a professor at Warwick University and the author of many popular books on mathematics and its applications, should have no problem convincing his readers that mathematics is the appropriate language for exploring how the spontaneous behavior of inert physical systems has been marshaled by genes into supporting vital processes. But he unnecessarily belabors the point that genetics is not the "only secret of life"—that DNA by itself in a test tube won't come to life." There is no real controversy here—it is not difficult to reconcile genetics with mathematics. Stewart does so himself, for example, in analyzing the mystery of collective behavior in animals: "There is—I strongly suspect—no genetic instruction to 'form a flock' in a bird. Instead, there are genetic and behavioral analogues of the rules that produce flocks."



G. KEITH STILL

Geometry of motion. An orchid fractal, produced by modeling crowd flow.

Rather than providing explicit instructions, DNA works by setting out the rules that, within the context of the laws embedded within material systems, can produce complex organisms with intriguing social behaviors. This does not mean, however, that we should stop holding genes responsible for these life processes and abandon our search for genetic associations with certain traits, as Stewart appears to suggest. What makes someone thin or homosexual may be neither straightforward nor particularly useful to know, but whether a gene confers resistance to a disease can be a critical piece of information in the design of drugs and vaccines.

The unnecessary polarization of genetics and mathematics as a framework for the book does little justice to its content. Mathematics is an important and exciting tool for unraveling the mysteries of life; genetics is, after all, just another of these mysteries.

The author is Wellcome Senior Fellow in Biodiversity, The Wellcome Trust Centre for the Epidemiology of Infectious Disease, Department of Zoology, University of Oxford, Oxford OX1 3PS, United Kingdom. E-mail: sunetra.gupta@zoology.oxford.ac.uk

MICROBES AND MINERALS

Rock and the Role of Microbiology

Derek R. Lovley

Geomicrobiology: Interactions Between Microbes and Minerals. JILLIAN F. BANFIELD and KENNETH H. NEALSON, Eds. Mineralogical Society of America, Washington, DC, 1997. xvi, 448 pp., illus. Paper, $32. ISBN 0-939950-45-6. Reviews in Mineralogy, vol. 35.

"These are good times to be a geomicrobiologist!" This exclamation in a chapter by W. W. Barker, S. A. Welch, and J. F. Banfield captures the spirited tone of this timely volume of *Reviews in Mineralogy*. *Geomicrobiology: Interactions Between Microbes and Minerals* is the product of a diverse group of internationally recognized geochemists and microbiologists that participated in an interdisciplinary Short Course on Geomicrobiology presented last year by the Mineralogical Society of America. Recent advances in microbiological and geochemical techniques make it likely that, as Barker *et al.* suggest, we are indeed entering "the golden age of geomicrobiology." This book provides enough introductory material to serve as a primer for novices interested in taking a first look at this rapidly emerging field, as well as sufficient detail and new insights to provide a handy reference for researchers already actively mining this area.

Decades of intense study have revealed many of the mechanisms by which microorganisms interact with organic compounds in the environment. In contrast, despite several hundred years of investigation in the fields of geology and microbiology, the role of microorganisms in the formation and dissolution of inorganic minerals is poorly understood. One reason for this lack of knowledge is that scientists trained in microbiology rarely have any significant training in geology and vice versa. Such cross-training is necessary if we are to

The author is in the Department of Microbiology, University of Massachusetts, Amherst, MA 01003, USA. E-mail: dlovley@microbio.umass.edu