

made before, but West brings it home with particular clarity.

He notes that although thermodynamic flows — rates of fossil-fuel consumption, say, and consequent entropy production — are central to socio-economic progress, discussion of that hardly figures in economics textbooks: “Remarkably, concepts like energy and entropy, metabolism and carrying capacity have not found their way into mainstream economics.” If these are acknowledged at all, it tends to be by economists such as Julian Simon and Paul Romer, who have argued that human ingenuity will solve any problems. Ideas, however, are themselves the product of complex social systems — vitally dependent on institutions, opportunities, equality, liberty and the spiritual health of societies.

This blind belief in innovation as a panacea is, as West points out, often coupled to misapprehension or even denial of the costs of open-ended growth, such as climate change. At best, such issues are swept under the carpet as “externalities”, market failures that pose a nuisance for economic accounting. An economics afflicted by such attitudes is not even a dismal science; it’s a pseudoscience.

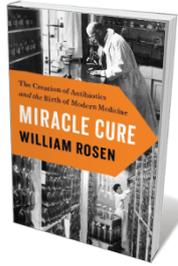
Likewise, cities have often been regarded as if they are mechanical entities that can be arbitrarily redesigned, rather than, as urban theorist Lewis Mumford argued, being more like living organisms, constantly adapting and evolving. West particularly highlights the pioneering ideas of another urban theorist, Jane Jacobs. Her advocacy of the organic approach to urbanism in the 1950s and 1960s invoked the idea of self-organization, now so central to the science of complex systems, before that language even existed (see A. Williams *Nature* 537, 614–615; 2016).

West is too canny to imagine that universal laws of size and growth say all that needs saying about such systems. But *Scale*, a grand synthesis of topics he has studied for several decades, makes an important and eloquent case for their significance in an ecology of the natural and human world — and in understanding whether the two can fit together. He calls this “a grand unified theory of sustainability”, allowing “quantitative, predictive, mechanistic” parsing of that relationship. West has no prescription for what such a theory might look like. It surely won’t be built bottom-up from an Aristotelian assemblage of details; neither will it reduce simply to a series of scaling laws.

Much of what *Scale* contains has been popularized before, but West manages to reveal the deeper principles on which these regularities rest. These are inevitable aspects of complex systems. You can ignore them, but you can’t escape them. ■

Philip Ball is a writer based in London. His latest book is *The Water Kingdom*. e-mail: p.ball@btinternet.com

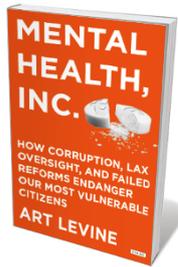
Books in brief



Miracle Cure

William Rosen VIKING (2017)

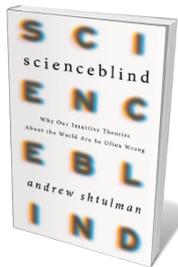
In this assured chronicle of the twentieth-century antibiotics revolution, William Rosen delivers reams of science at a thrilleresque pace. The experimentalists — Gerhard Domagk and Howard Florey among them — are vividly portrayed, as are the patients cured, the pharmaceutical corporations created and the moment in 1943 when bacteriologist Mary Hunt found the ancestor of all penicillin used today, on a mouldy melon. Antibiotic resistance and putative solutions are given their due, including Michael Fischbach’s work on microbial-gene clusters in the human microbiome.



Mental Health, Inc.

Art Levine OVERLOOK (2017)

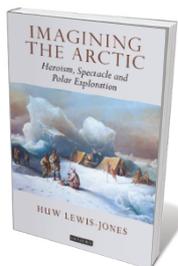
Some 18% of US citizens grapple with mental illnesses, but the country’s mental-health-care system is struggling too. In this trenchant exposé, investigative journalist Art Levine examines challenges such as US\$4-billion cuts to state mental-health budgets, as well as case studies of casualties, from prison inmates to teenagers in residential ‘boot camps’. While lauding judicious medication, Levine takes aim at endemic “drug-and-sedate” practices. He sees hope in institutional reform, peer-to-peer counselling and innovations in de-stigmatizing therapies for post-traumatic stress disorder.



Scienceblind

Andrew Shtulman BASIC (2017)

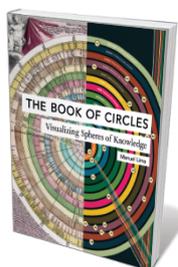
Many people misconstrue basic physical or biological phenomena, from the nature of gravity to the transmission of disease. At a time of widespread science denialism and potential pandemics, intuitive theories can have a pernicious impact, argues Andrew Shtulman. In his lucid and methodical corrective, the psychologist reveals how such stabs in the dark arise, drawing on developmental research and snippets of history, such as chemist Joseph Black’s discovery in 1761 that heat and temperature are distinct. A reminder that scientific literacy is the backbone of functional, democratic societies.



Imagining the Arctic: Heroism, Spectacle and Polar Exploration

Huw Lewis-Jones I. B. TAURIS (2017)

To Victorian Britain, Earth’s poles were an icy terra incognita, ostensibly ripe for exploration. Yet as historian and polar guide Huw Lewis-Jones reveals in this monumental cultural and political chronicle, the public was much less obsessed with that heroic narrative than many histories claim, despite relentless boosterism by the likes of geographer Clements Markham. Lewis-Jones shows how exploration was itself explored in art, literature and the media — an Arctic of the imagination in which the triumphalism of John Ross and broken dreams of Robert Falcon Scott commingled.



The Book of Circles: Visualizing Spheres of Knowledge

Manuel Lima PRINCETON ARCHITECTURAL PRESS (2017)

The human iris, a full Moon, volcanic calderas: natural circles have inspired culture for millennia. Information visualizer Manuel Lima gathered centuries’ worth of circular charts, graphics and illustrations for this volume, organized in a ‘taxonomy’ spanning everything from spirals to pies. It’s a ravishing tour, from the spangled glory of globular star cluster M13, imaged by the Hubble Space Telescope, to Martin Krzywinski’s bold 2007 radial genomics diagram *Human–Dog Homology*. Puts circular thinking in a whole new light. **Barbara Kiser**