observed differences in success — judged by popularity or sales, for example — follow from network effects. People rush to buy an early leader, swayed by the mistaken belief that others' choices tell them about standard.

This results in huge differences in outcome that have nothing at all to do with quality. That phenomenon is the subject of the second law: "Performance is bounded, but success is unbounded." Take the top 100 wines entered into a competition. Their true differences in quality, for example in clarity or varietal character, are generally small: they're all produced by top winemakers using similar technology. Yet one wine, because of the amplifying power of social networks, might enjoy orders of magnitude more sales than others.

Social scientists have known about such effects for decades, although research by many, including Barabási and his students, has brought them into much clearer focus. *The Formula* also covers nuanced studies showing how success can be predicted. So the third law that Barabási describes is: "Previous success × fitness = future success." Careful studies — for example, by network scientist Manuel Cebrian or complexity scholar Dashun Wang — have found that it's possible to identify how much of a product's popularity depends on its quality or fitness, and how much can be traced to random amplification by network effects. Detailed data on consumer ratings and sales over time gathered by a site such as Amazon.com can be used to disentangle herding effects (those tending to push the already popular towards further popularity) from real consumer preferences based on true perceived quality. This understanding can be used to forecast trends, but also to boost sales or consumer satisfaction.

And then there's the fourth law: "While team success requires diversity and balance, a single individual will receive credit for the group's achievements." Analyses of highly successful teams in science or business show that which individuals get the most credit has nothing to do with who actually did the work. Credit is based on perception, and is a collective social phenomenon. Effective teams absolutely require diversity, but society singles out lone individuals for the accolades.

Altogether, *The Formula* offers a rich tour of research on how relatively simple feedback forces channel our lives in surprising and counter-intuitive ways. We might think that success ought to be determined by a person's skill and hard work. Yet, more important is how other people respond, by interacting in complex social networks. Even individual success is a thoroughly social matter. ∎

Mark Buchanan *has written many books about network effects. He is based in Abergavenny, UK.*
*e-mail: buchanan.mark@gmail.com*

Books in brief
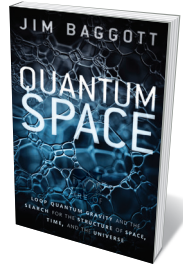
### Quantum Space
Jim Baggott OXFORD UNIV. PRESS *(2018)*
Prolific physics writer Jim Baggott is back with a terrific page-turner on loop quantum gravity (LQG) — the theory posited as a solution to that chasm in physics between quantum mechanics and the general theory of relativity. Baggott digs into the how and why of what LQG might reveal about "space, time and the universe", tracing its evolution through the work of Abhay Ashtekar, Lee Smolin, Carlo Rovelli and others, to its current implications for, say, the physics of black holes. Baggott masterfully tenderizes the scientific chewiness and is careful not to over-egg what is, after all, a work in progress.
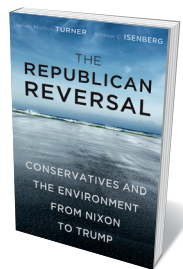
The Republican Reversal
*James Morton Turner and Andrew C. Isenberg* HARVARD UNIV. PRESS *(2018)*
In the 1960s and 1970s, the US Republican Party — pressured by the era's environmental movement — created the Environmental Protection Agency (EPA) and extended the Clean Air Act. Today, it busily eviscerates the EPA while denouncing climate change as a hoax. Environmental historians James Turner and Andrew Isenberg follow this reversal from Ronald Reagan's presidency on, revealing how conservative ideologues hostile to science and bent on deregulation have gradually bolted US exceptionalism to anti-environmentalism. Searingly timely and cautiously hopeful.
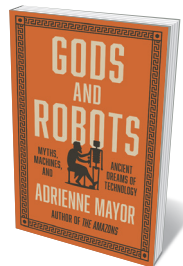
Gods and Robots
*Adrienne Mayor* PRINCETON UNIV. PRESS *(2018)*
More than two millennia before today's explosion in robot manufacture, bards and philosophers toyed with the concept of imitating life. Classics scholar Adrienne Mayor's astonishing chronicle harks back to mythic automata, such as "evil fembot" Pandora and bronze giant Talos. And she examines real mechanical devices — flying doves, bellowing statues and gliding Buddhas — devised by virtuosic technicians from the Mediterranean to China. A third-century BC colossus crafted for Egyptian monarch Ptolemy II Philadelphus, for instance, could stand up, sit down and pour milk.
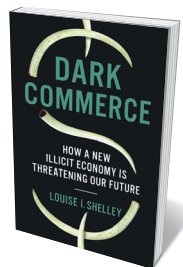
Dark Commerce
Louise I. Shelley PRINCETON UNIV. PRESS *(2018)*
Illicit trade in human organs, wildlife, arms and rare woods has vastly expanded over the past three decades as communications and digitization have improved apace. Here, Louise Shelley, a leading researcher in the field, examines organized crime over four millennia. She unpeels its disturbing dynamics today through case studies such as Silk Road, a vastly lucrative cybersupermarket, and the much-documented illegal market in rhino horn (currently priced at US$60,000 per kilo). And she lucidly lays out the dark economy's planetary costs, as it escalates biodiversity loss and deforestation.
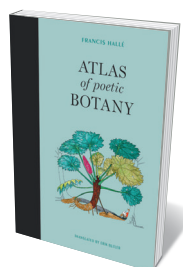
Atlas of Poetic Botany
Francis Hallé with Éliane Patriarca, transl. Erik Butler MIT PRESS *(2018)*
From the epiphytic 'hanging' plant *Guzmania lingulata* to the mushroom mimic *Helosis cayennensis,* compelling oddities crowd equatorial forests. Botanist Francis Hallé celebrates their spectacular weirdness in this sprightly homage, translated from French by Erik Butler. Alongside descriptions of clonal forests, underground trees and 'dancing' plants, Hallé sets playful stylized drawings explicating the strange behaviours, adaptations and coevolution of each species. It's a vegetal parade that reminds us, yet again, how some chunks of Earth's biosphere still smack of *terra incognita*. **Barbara Kiser**