

as a key factor in the health of economies. Hidalgo's particular contribution here is to weave these ideas into a theory that provides a conceptual picture of a society's collective accumulation of productive information "in firms and networks of firms". He argues that these entities are not so much the result of that accumulation as the means by which our societies have evolved to make it possible.

What emerges is a new measure of economic complexity that acknowledges not just gross domestic product, but also diversity in the types of product that a nation produces. This index, Hidalgo says, offers a metric that predicts long-term economic growth. His thesis here is dense and not always lucidly explained, but it contains some innovative thinking about what drives growth that could help us to navigate the turbulence of the ever more interconnected global economy.

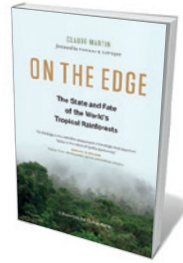
Hidalgo wants to take his ideas about information and its productive exploitation beyond economics, especially into biology and ecology. In a nutshell, the task is to restore notions of meaning to information theory. The seminal text *The Mathematical Theory of Communication* (Univ. Illinois Press, 1949) by Claude Shannon and Warren Weaver explicitly expunged the idea that information in itself has meaning, as Hidalgo reminds us. But we often persist in thinking otherwise, not least in the delusions that we can do science by mining big data without a guiding theory, or that genomes contain 'instructions' for making an organism.

The distinction between knowledge and know-how, which seems evident enough in economics, can be profitably made in the natural sciences too. A gene sequence is information; know-how refers to the ability to make something from it, and this cannot reside in the information itself. "DNA has no knowhow and cannot unpack itself; it is a slave to the machinery needed to unpack it," says Hidalgo. This seems obvious, but it is worth restating, if only to remind us that this unpacking process (and not further sequencing per se) is now the most important unanswered question in genomics.

Whether all this really justifies Hidalgo's claim to explain "what information is, where it comes from, and why it grows" is another matter. For one thing, with quantum mechanics being reframed as an information theory, it is unclear whether any classical arguments can give the whole picture. But that does not detract from the stimulating new perspectives on offer. Hidalgo has identified a fertile seam, and all his book really needs (apart from some prose-tightening) is for the title to be turned into a question. ■

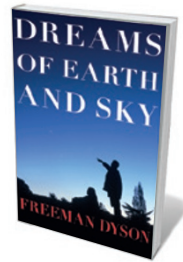
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## Books in brief



### **On the Edge: The State and Fate of the World's Tropical Rainforests** *Claude Martin* GREYSTONE (2015)

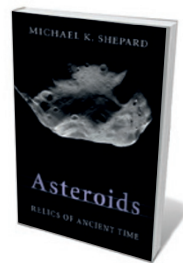
However crucial in terms of biodiversity, climate moderation and the carbon cycle, rainforests are at bay. Almost one-fifth of the Amazon, for instance, has been lost over 50 years. In this definitive report to think tank the Club of Rome, conservation veteran Claude Martin and contributors cover the territory from the bad old days of error-ridden global forest monitoring to today's smart mapping and strategies for sustainable management. Martin predicts a further 100-million-hectare loss of primary forest by 2050 — but delivers 17 steps for averting the worst. Key reading for environmental policy-makers.



### **Dreams of Earth and Sky**

*Freeman Dyson* NEW YORK REVIEW BOOKS (2015)

"The big blunders in this book are not accidental but intentional." So physicist Freeman Dyson proclaims of the maverick ideas percolating through this collection of his *New York Review of Books* essays and book reviews from 2006 to 2014. Dyson delivers his iconoclasm with humour, honesty and off-the-cuff brilliance, whether riffing off microbiologist Carl Woese's concept of living systems by seeing both thunderstorms and butterflies as "patterns of organization", imagining ecology enriched by genome designers, or mulling over how Mary Shelley's *Frankenstein* cast science as "an agent of doom".



### **Asteroids: Relics of Ancient Time**

*Michael K. Shepard* CAMBRIDGE UNIVERSITY PRESS (2015)

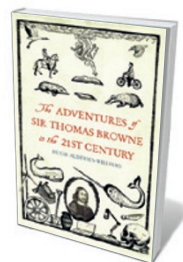
The chunks of broken protoplanet we call asteroids are potential killers as well as scientific gold mines. Both thrills are explored in this comprehensive study of these "little worlds". Planetary geoscientist Michael Shepard recounts the history of asteroid spotting, from pioneers such as Giuseppe Piazzi — who detected the first, Ceres, in 1801 — to today's Catalina Sky Survey, run by the University of Arizona. Interweaving anecdotes from his own work with copious technical detail, Shepard leads us on an expert tour of a fecund branch of astronomy and its lessons for planetary science.



### **Breathing Space: The Natural and Unnatural History of Air**

*Mark Everard* ZED (2015)

The air — all 51 quadrillion cubic kilometres of it — is the biggest ecosystem on Earth, an atmospheric ocean connecting all life. Yet as science writer Mark Everard shows in his original study, the importance of this layered envelope of gases and aerosols is hardly reflected in policy. He argues for reassessment, looking in turn at the nexus of atmosphere, biosphere and human culture, and abuses such as air pollution and climate change. To secure "breathing space", Everard calls for an approach integrating management of the atmosphere with that of other Earth systems.



### **The Adventures of Sir Thomas Browne in the 21st Century**

*Hugh Aldersey-Williams* GRANTA (2015)

A playful erudition permeates this biography of Thomas Browne, the seventeenth-century English polymath who wrote the debunking classic *Pseudodoxia Epidemica*, coined 784 new words and had an eye for patterns in nature. Hugh Aldersey-Williams zips between our time and Browne's, and through the East Anglian landscapes Browne knew, to reveal the man and his work. Browne emerges as an exemplar of synthesized knowledge — and as such, curiously at home in today's cultural remix of science and humanities. **Barbara Kiser**