

it — a sign of addiction (Z. M. Aghajan *Nature Neurosci.* **18**, 121–128; 2015). In a 2014 study by Frank Steinicke and Gerd Bruder at the University of Hamburg in Germany, a participant started blurring the distinctions between real and virtual objects after immersion in a virtual environment many times in a single day (F. Steinicke and G. Bruder *Proc. 2nd ACM Symp. on Spatial User Interaction* 66–69; 2014).

Bailenson mentions escapist, excessive use of VR as a major risk. Because of “simulator sickness” and eye strain, which can develop after just 20 minutes, this has not yet been studied in humans. It is as yet a speculative concern, explored more in film and fiction. In addition, there are concerns that violent programs, such as VR versions of first-person-shooter video games, might encourage antisocial or aggressive behaviour in the real world. But Bailenson gives such concerns short shrift. Nor does he call for transparency or oversight of VR companies, or for regulations to ensure consumers’ safety. He seems confident that developers and users will know how to use the technology responsibly.

Indeed, Bailenson is, by his own admission, “bullish” about VR; he recognizes that he might have “drunk the Silicon Valley Kool-Aid”. That relentless positivity means that the book can lack nuance, as if VR can

**“Virtual reality lends itself to social, ethical and environmental education.”**

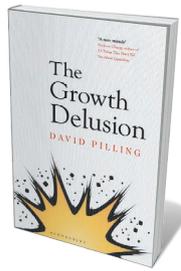
solve the world’s problems. Bailenson, for instance, wants to combat climate change by using the technology to encourage people to change their behaviour, for example by taking shorter showers and making fewer long-distance flights. He also wants to see it used in schools for virtual field trips — although the cost of the equipment would make access unequal.

Social-media trolls pose another problem. Platforms such as Facebook — which acquired the VR company Oculus in 2014 — could one day incorporate virtual interactions, raising the chilling spectre of increasingly realistic goading and abuse.

Bailenson often writes like a scientist. His prose can be verbose, peppered with jargon such as “boundary conditions”. He verges on the grandiose, calling VR a “movement” or a “revolution”. Nevertheless, his enthusiasm is contagious, and he explains complex issues to an audience broader than fellow scientists, providing a real vision of our possibly VR-infused future. ■

**Ramin Skibba** is an astrophysicist turned science writer based in San Diego, California.  
e-mail: [raminskibba@gmail.com](mailto:raminskibba@gmail.com)

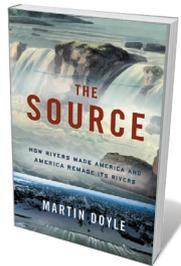
## Books in brief



### The Growth Delusion

David Pilling BLOOMSBURY (2018)

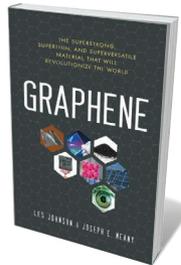
“Only in economics is endless expansion seen as a virtue. In biology it is called cancer.” Rarely does a study of gross domestic product (GDP) and growth sizzle with such wit and acuity, but *Financial Times* editor David Pilling manages the feat. He skewers the linked concepts as a statistical neverland that factors in crime and ignores housework. He pulls out absurdities such as the stratospheric US health-care costs that prop up the nation’s economic well-being, yet destroy uninsured families. And he presents a cogent argument for the multi-index ‘dashboard’ superseding mere GDP. Masterful.



### The Source

Martin Doyle W. W. NORTON (2018)

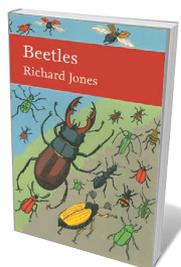
Rivers have shaped the United States geologically, economically and demographically — there are, after all, 250,000 in the country. This history by water-policy expert Martin Doyle nimbly explores that process in tandem with the heroic era of US construction that saw the rise of projects such as the Grand Coulee Dam. In his telling, rivers become a lens on federalism, energy and conservation — a rolling narrative taking us from George Washington’s quest to find a passage from the Atlantic Ocean to the Ohio River, through decades of levee-building, flood control, water wars and much more.



### Graphene

Les Johnson and Joseph E. Meany PROMETHEUS (2018)

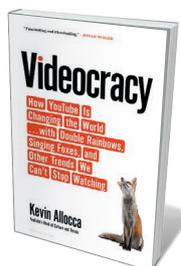
How can a material one atom thick conduct electricity or filter filthy water? Physicist Les Johnson and chemist Joseph Meany tell all about graphene, that wispy “tessellation of carbon atoms” finally coming into its own. Their primer is fittingly slim, but covers an impressive swathe of the science and its applications. Along with a lucid history of earlier carbon “miracle materials”, they follow the path from lab to production. The potential is vast, from making the material using waste carbon dioxide harvested from astronauts’ breath, to creating graphene-based transistors that detect harmful genes.



### Beetles

Richard Jones WILLIAM COLLINS (2018)

It’s no surprise that Alfred Russel Wallace and Charles Darwin were both avid fans of the beetle. The nearly half a million described species of Coleoptera are like animated jewels, from their gaudy wing-casings to their shiny, scateur-like mandibles. Entomologist Richard Jones’s illustrated tome (part of the Collins New Naturalist Library) ranges over their anatomy, natural history and behaviour. Things get really wild with the defensive ‘chemical cannon’ of the bombardier beetle, and the biscuit beetle’s reduction of noodles to “ticker tape and dust”. Watch out — there are wonders underfoot.



### Videocracy

Kevin Allocca BLOOMSBURY (2018)

YouTube can seem like a parallel universe — a trove of cultural data so huge it would take years to watch the content posted in a day. This ‘biography’ of the web-video behemoth by its trends director, Kevin Allocca, tours the technology and the clips that have trended or gone viral, from astronaut Chris Hadfield singing David Bowie’s ‘Space Oddity’ on board the International Space Station, to Egyptian protests during the Arab Spring. Allocca examines, too, the darker side of mass cultural participation, such as the raising of troll armies. [Barbara Kiser](#)