

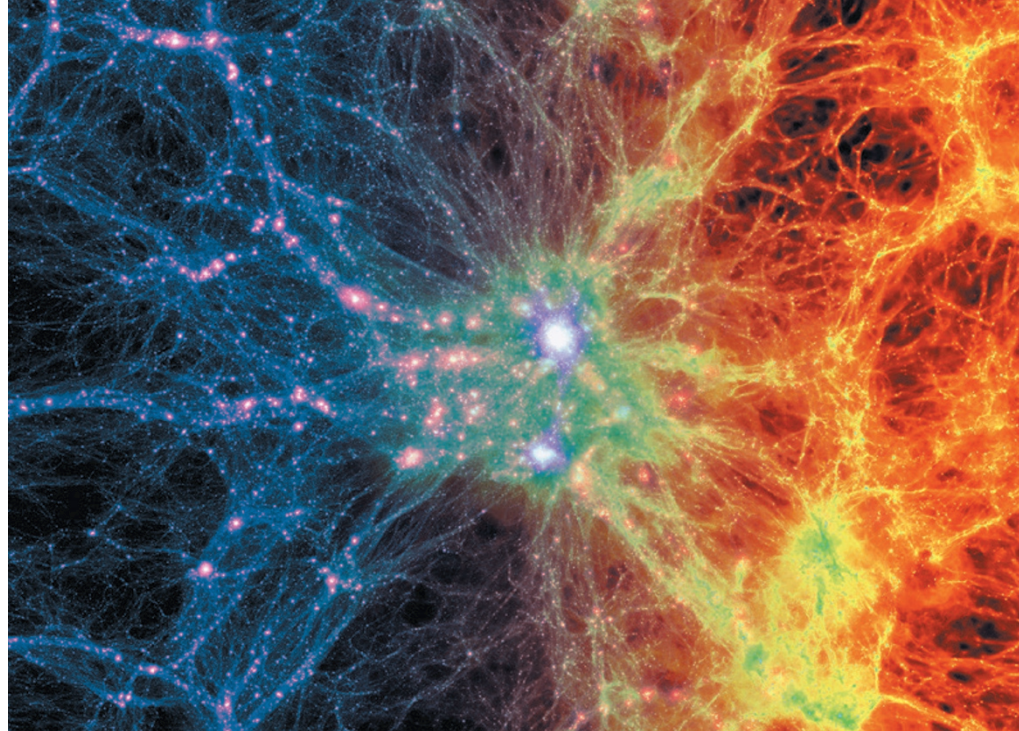
▶ official documents, they were waved across the border from Austria to West Germany — a scene rendered poignant in light of the current European refugee crisis. The ease with which Vilcek procured job offers from US colleagues is also hard to imagine now. He joined New York University as an assistant professor with no interview, a beneficiary of the US government's competitive research investments during the cold war.

The final section of the book I found the most original. Here, Vilcek reverts to the story of Remicade's success, and his unexpected wealth. His first quarterly royalty payment in 1999 was just less than his annual salary as a professor; by 2005, the portion of his future royalties pledged to New York University was projected to eventually reach more than US\$105 million. At first, Jan and Marica ate at restaurants and caught taxis more often; they helped family and friends, and replaced their second-hand furniture with European art-deco pieces. But they had no interest in luxury living, so as the royalties grew, they established what would become the Vilcek Foundation in 2000.

They began by supporting their workplaces, the New York University School of Medicine and the Metropolitan Museum of Art. They endowed professorships, lab space, scholarships and curatorships, earning a place among the top 15 US philanthropists of 2005. After the terrorist attacks of 11 September 2001, they began to see chinks in the US welcome for foreigners. Accordingly, in 2006 they launched annual Vilcek Prizes to recognize extraordinary achievements by immigrants to the United States in biomedical science and the arts and humanities. Aware that many of their prizewinners, from cancer biologist Joan Massagué to cellist Yo-Yo Ma, were already lauded, the Vilceks established annual prizes "for creative promise" in 2009 to honour up-and-coming talent. Prizewinners so far have included the Iranian-American scientist Pardis Sabeti, for her work on pathogen evolution (see N. L. Yozwiak *Nature* **518**, 477–479; 2015).

This story is told humbly, with honest insight into the deliberations between the Vilceks and generous credit to the many people who have advised them. The couple clearly delights in following the careers of the awardees. Jan Vilcek is now in his early eighties, and he mentions in *Love and Science* how he and Marica have made provision for the foundation to continue when they can no longer administer it. One senses that he is happy with his legacy, both scientific and benevolent. ■

Marian Turner is senior News & Views editor for Nature.



Density fluctuations in the Universe (shown in a computer simulation) have a sponge-like topology.

ASTRONOMY

Topology quest

Michael Blanton enjoys a history of cosmology focused on large-scale structure in the 'spongy' Universe.

Over the past half-century, astrophysicists and cosmologists have revealed how structure formed in the Universe. This has vast importance: we exist only because tiny initial fluctuations in the density of matter grew through gravity to form galaxies, stars and planets. Key pieces of physics, astronomy and mathematics have only in recent decades been combined into a scientifically coherent and convincing origin story. In *The Cosmic Web*, astrophysicist Richard Gott, a compelling teller of cosmological stories, describes his part in this scientific quest.

He begins with a brisk primer on the early history of cosmology, starting with the discovery of the expansion of the Universe by US astronomer Edwin Hubble and others in the 1920s. The second half of the twentieth century, he shows, brought the detection by Arno Penzias and Robert Wilson of the cosmic microwave background radiation left over from the very early Universe (predicted by George Gamow and others), and the realization that fluctuations in this radiation would reveal the irregularities in density that seeded the growth of large-scale cosmic structure.

This is when Gott's work enters the picture. Beginning with his high-school obsession, topology — how geometric shapes can be connected — the book comes into focus. We start to follow Gott's fascinating path towards a better understanding of large-scale cosmic structure. Remarkably, his early discoveries

led to a paper in *American Mathematical Monthly* when Gott was just 20, on a new class of regular 'pseudopolyhedrons' with sponge-like topology (J. R. Gott *Am. Math. Mon.* **74**, 497–504; 1967). These polyhedrons are infinite, and their surfaces divide space into two identically shaped, interlocked regions. As in a sponge, each region (the 'sponge' and the 'holes' in it) is fully connected. If the Universe is separated into regions greater than and less than the mean density, it shows the same sponge-like topology, although with irregular patterns. Gott's enduring (and endearing) enthusiasm for this connection carries the reader through the more technical parts of the book.

The Cosmic Web is not a complete or representative intellectual history of twentieth- or twenty-first-century cosmology. Gott is rigorous in assigning credit for findings, but tells the history through the lens of his collaborations. This could leave a reader with the impression that a relatively small group of scientists is responsible for the discovery of dark matter, the development



The Cosmic Web: Mysterious Architecture of the Universe
J. RICHARD GOTT
Princeton University Press: 2016.

ILLUSTRIS SIMULATION

of structure-formation theory and progress on unravelling galaxy formation. Gott's major protagonists (including James Gunn, Jeremiah Ostriker and James Peebles) did make key discoveries, but in the context of a broader group than Gott describes. Gott also gives only a partial account of the creation and development of a key contemporary effort: work on large-scale structure and mapping of the cosmic web by the Sloan Digital Sky Survey (SDSS) — which uses the optical telescope at Apache Point Observatory, New Mexico — to create the most detailed 3D maps of the Universe yet, and continues to map further regions and earlier times.

Gott's is a personal view of cosmological developments, giving space and life to realities of research. This evokes the best of physicist and science historian Abraham Pais's more comprehensive books, such as *Inward Bound* (Clarendon/Oxford Univ. Press, 1988). Unafraid of spending a page explaining an idea that turns out to be wrong, Gott engagingly describes the blind alleys along the way to current views. He presents figures and equations stripped to their fundamental forms, but avoids the common temptation to water them down unrecognizably.

His work shines with this approach. As 3D maps of the Universe emerged from the 1980s onwards, revealed by surveys such as the SDSS and its forerunners, and as the theoretical picture of cosmology developed,

“Gott's is a personal view of cosmological developments, giving space and life to realities of research.”

it became clear that the pattern of density fluctuations in the Universe is a cosmic, topologically sponge-like web. Gott's youthful work had primed him to grasp this, and gave him the

mathematical tools to test it. This aspect of cosmology is now an essential facet of our knowledge, and our fullest understanding of the topology of large-scale structure is derived from techniques that Gott developed.

Gott's journey shows how scientists can be so motivated by their earliest obsessions that they persist in pursuing them — and how unique obsessions can let them bring something new to the crowded table of ideas. For working scientists, this book is a reminder of what drives us, the value of chasing down questions that only we would ask, and how circuitous that chase can be. *The Cosmic Web* is not just a well-told story about the frontiers of cosmological knowledge. It is also an inspiration to explore them further. ■

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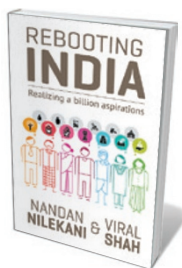
Books in brief



In a Different Key: The Story of Autism

John Donovan and Caren Zucker CROWN (2016)

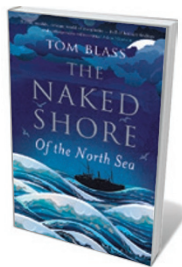
Hot on the heels of Steve Silberman's *Neurotribes* (Avery, 2015; see *Nature* **524**, 288–289; 2015) comes another monumental history of autism. Journalists John Donovan and Caren Zucker (whose television series *Echoes of Autism* broke ground in the 2000s) trace the halting progress in understanding the condition, weaving in stories of, among others, Donald Triplett, the first person diagnosed as autistic; US medic Leo Kanner; and UK psychiatrist Lorna Wing. The scoop is historian Herwig Czech's claim that key player Hans Asperger contributed to Nazi 'social cleansing' of children deemed mentally ill.



Rebooting India: Realizing a Billion Aspirations

Nandan Nilekani and Viral Shah ALLEN LANE (2016)

India's telecoms network is the world's second largest, yet the country's rural poor often effectively run marathons in accessing services. In this audacious technological manifesto — now in a UK edition — entrepreneur Nandan Nilekani and software specialist Viral Shah argue that India's vast challenges in banking, health care and other systems are solvable, if approached like government start-ups run by handpicked entrepreneurs. Nilekani and Shah cite the e-Aadhaar biometrics identification card, open to all Indians, as a first step on the road to digitally streamlined governance and society.



The Naked Shore: Of the North Sea

Tom Blass BLOOMSBURY (2016)

Compared to the charismatic Mediterranean, Europe's North Sea can seem a workaday tract of "mists, miasmas and surliness", notes journalist Tom Blass. But in trawling its depths for this vivid travelogue, Blass dredges up nuggets from an eventful cultural, military, industrial, economic and ancient history. Launching from the estuarine murk of the Thames, he takes in Dutch polders (tracts of land dubbed 'waking', 'sleeping' or 'dreaming', depending on distance from the sea), Frisian dialects, fishing fracas, puffins, porpoises and a future of warming waters and giant wind farms.



Six Steps Back to the Land: Why We Need Small Mixed Farms and Millions More Farmers

Colin Tudge GREEN (2016)

The much-chewed-over conundrum of how to feed a projected global population of 10 billion demands an agrarian renaissance led by scientifically run, small, mixed farms, avers biologist Colin Tudge. Using principles such as agro-ecology and a focus on "lots of plants, not much meat, and maximum variety", Tudge's transformative prescription is fresh, pragmatic and packed with cutting-edge science. It is impressive, too, for its sound circular-economy thinking, not least an emphasis on an informed food culture.



The Wheel: Inventions and Reinventions

Richard W. Bulliet COLUMBIA UNIVERSITY PRESS (2016)

As innovations go, the wheel might seem the ubiquitous driver of cultural evolution. But Richard Bulliet's technological history reveals complexities. The wheel was invented 3 times (with fixed and moving wheels on axles both emerging 5,000 years ago, and casters a mere 300); defined differently by the rail and automobile industries; and eschewed by civilizations such as the pre-Columbian Olmecs. Hitched in turn to rickshaws, ox carts, Mongolian mobile homes, barouches and bicycles, this is a deft narrative. **Barbara Kiser**