strategies of nuclear defence. By retracing an impressive web of connections, Steingart shows how the authors, the US mathematician John von Neumann and the German economist Oskar Morgenstern, not only helped to define the relationship between science and politics during the cold war, but also provided a model for further attempts at mathematization in the social sciences.

Taken to excess

Ironically, even as some mathematicians argued that abstract thinking was the key to applying maths to other disciplines — and suggested that even the most abstract maths was worthy of public funding — most mathematicians in academia seemed singularly uninterested in getting involved. For decades, much of the progress in applied mathematics ended up taking place not in universities, but in think tanks and industry laboratories, or in newly established departments devoted to fields such as computer science or statistics.

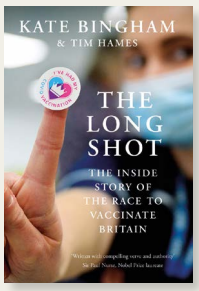
Eventually, an excess of abstraction caught up with mathematicians. Steingart sketches how the latter parts of the twentieth century saw a turning of the tide: she picks the example of William Thurston, an enormously influential topologist who delighted in making his complex geometric constructions feel physically real.

One major development she does not touch on is a renewed cross-fertilization with theoretical physics in the late twentieth century. This includes the application of topology to innovations such as 'topological' materials — which could even form a basis for super-powerful quantum computers — and the development of string theory, which might not have given physicists their long-sought theory of everything, but has inspired many a maths PhD thesis. And there is some anecdotal evidence that in the past decade or so, the barriers between pure and applied mathematics have started to drop: it is not uncommon now to see researchers from the most abstract reaches of the field 'getting their hands dirty' with applications such as data analysis.

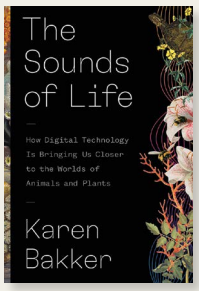
Meanwhile, Eilenberg and Steenrod's approach to pedagogy came to be seen as a cautionary tale, with their techniques, although still widely used, affectionately being called 'abstract nonsense'. But in another of the twists of fate often seen in the history of maths and physics, some physicists now consider abstract-nonsense techniques a promising approach to devising a quantum theory of gravity — perhaps delivering another route to the very real, if abstract, goal of a theory of everything.

Davide Castelvecchi is a senior reporter for *Nature* in London.

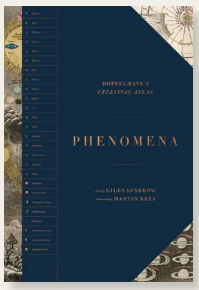
Books in brief



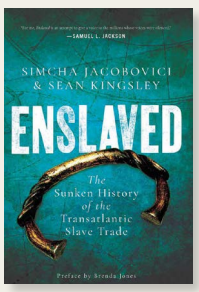
The Long Shot
Kate Bingham and Tim Hames *Oneworld* (2022)
In April 2020, the UK government decided to expedite the introduction and deployment of a COVID-19 vaccine. Eight months later, the first recipient was jabbed. Credit goes to the Vaccine Taskforce led by Kate Bingham, a biochemistry graduate and health venture capitalist, working from home during lockdown. She was acutely aware of most vaccines' failure, the risk of viral mutation and her lack of government training. Her frank and fascinating book, written with journalist Tim Hames, details the inside story of this "longest of all long shots".



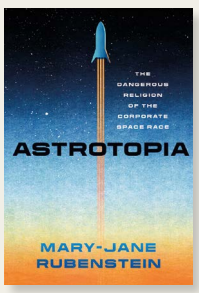
The Sounds of Life
Karen Bakker *Princeton Univ. Press* (2022)
Nature is full of sounds that humans cannot hear. The raised-tail mating display of male peacocks involves powerful infrasound; bats and toothed whales emit beams of ultrasound and navigate using the echoes that come back. In this beautifully written study, Karen Bakker, a tech entrepreneur and academic, compares digital technology that can reveal these sounds with the microscope's effect on vision. By extending our hearing, the technology allows us to encounter "new soundscapes around the world and across the Tree of Life".



Phaenomena
Giles Sparrow *Thames & Hudson* (2022)
Mathematician, astronomer and cartographer Johann Doppelmayr created his largely forgotten celestial atlas in Germany in 1742. This magnificent book showcases its illustrations, with formidable explanatory text by astronomer Giles Sparrow and foreword by UK astronomer royal Martin Rees. The frontispiece depicted astronomers Ptolemy, Nicolaus Copernicus, Johannes Kepler and Tycho Brahe. Isaac Newton is absent; his 1687 concept of gravity was, Sparrow notes, too close to "occult forces" for many natural philosophers of the time.



Enslaved
Simcha Jacobovici and Sean Kingsley *Pegasus* (2022)
During the 400-year transatlantic slave trade, 12 million Africans were forcibly shipped to the Americas, and almost 2 million died en route. Using mixed-gas diving and remotely operated vehicles, divers have investigated seven surviving deep-sea wrecks of ships used in the trade and two 'freedom ships' carrying fugitives from slavery, as described in a six-part series by film-maker Simcha Jacobovici. His book, written with marine archaeologist Sean Kingsley, vividly explores these disturbing sunken archaeological archives.



Astrotopia
Mary-Jane Rubenstein *Univ. Chicago Press* (2022)
In the cold war, space exploration's wonders served a race between political systems. Today, argues religion and science scholar Mary-Jane Rubenstein, they are subject to commercial rivalry, notably between billionaires Jeff Bezos and Elon Musk, who are littering space and advocating it as a refuge from Earth's destruction. She argues that we must eschew such myopic, colonialist "astrotopia", and listen instead to a sort of "pantheistic mysticism" — valuing and learning from the cosmic environment — scorned by past imperialists. **Andrew Robinson**