

The Northern Lights — seen over Iceland — are caused by charged particles in the solar wind hitting Earth's magnetosphere.



## GEOPHYSICS

# Flip side of geomagnetism

Peter Olson savours a study of Earth's protective force and those who discovered it.

The year 1906 was a momentous one for physics and Earth science. Physicist J. J. Thompson was awarded a Nobel prize for his discovery of the electron; Albert Einstein's two papers on special relativity were being read across the globe; the geologist Richard Oldham discovered Earth's metallic core using seismic waves. And, in a remote location in central France, an obscure physicist called Bernard Brunhes discovered that about 780,000 years ago, Earth's magnetic field had flipped its polarity. The north magnetic pole replaced the south, and vice versa, an event recorded in volcanic rocks across the globe.

In *The Spinning Magnet*, science journalist Alanna Mitchell weaves together the story of Earth's magnetism. She covers its intellectual roots in ancient Greek natural philosophy: Thales of Miletus and Aristotle both speculated on the origins of magnetism. She then follows the hints of it that emerged through the era of classical physics in the nineteenth and early twentieth centuries, and into the



**The Spinning Magnet: The Electromagnetic Force That Created the Modern World — and Could Destroy It**  
ALANNA MITCHELL  
Dutton: 2018.

polarity reversals of the geomagnetic field have happened thousands of times in the geological past. We are overdue another. Indeed, Earth's dipole has decreased in strength by nearly 10% since it was first measured by Carl Friedrich Gauss in 1840.

present day, using Brunhes's startling discovery as the subplot. Mitchell adds a generous helping of tension to the mix, thanks to the social implications of that discovery: the potential loss of Earth's dipole, the 'magnetic shield' that deflects harmful particles from the solar wind.

Throughout *The Spinning Magnet*, Mitchell constantly reminds us that

That continues: we are on course to lose our magnetic shield within a couple of millennia. Mitchell even pinpoints where this might already be happening, notably beneath the South Atlantic Ocean. There, on the surface of Earth's liquid outer core, geoscientists are finding evidence that the magnetic field is reversing its direction over several million square kilometres, an area that grows with each passing decade.

So, will the north magnetic pole soon become the south, or is this just a transient episode to be followed by a rebound in magnetic-field strength? Meanwhile, what about our vulnerable infrastructure? How, for instance, will the patchwork US electrical grid respond to extreme solar storms when the magnetic shield goes down? To address these questions, Mitchell has interviewed dozens of geoscientists, space scientists and biologists, offering a readable account of what is probably in store for us, magnetically speaking, and how we got to this point.

ARCTIC-IMAGES/GETTY

More intriguing, however, are the historical players Mitchell describes in this scientific saga. The earliest to get prime billing is Petrus Peregrinus de Maricourt, a medieval French scholar and crusader whose 1269 *Epistle on the Magnet* launched the inquiry into Earth's magnetism in the West. (The subject was already known in the East, especially China, from around 200 BC onwards.) Then comes a trio of Englishmen, from the sixteenth to the eighteenth centuries. These were William Gilbert, astronomer, physician to Elizabeth I and author of the 1600 treatise *De Magnete*; Henry Gellibrand, who showed that Earth's magnetic field varies with time; and Edmond Halley of comet fame, whose representation of the geomagnetic variation became the familiar contour map.

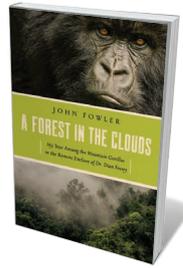
Next are the pioneers of electromagnetism from the eighteenth to the nineteenth centuries: Benjamin Franklin, André-Marie Ampère, Hans Christian Ørsted, Michael Faraday and James Clerk Maxwell. The most prominent woman on the marquee is geophysicist Inge Lehmann, who in 1936 discovered Earth's solid inner core. Finally, there is the large group of other twentieth-century geoscientists who quantified the theory of plate tectonics by using magnetic reversals recorded in igneous and sedimentary rocks. Through this, they demonstrated that the age of the ocean crust increases systematically with distance from the mid-ocean ridges.

Mitchell's portrait gallery is researched with a depth and breadth that make its protagonists' triumphs and failures compelling. She also gives entertaining accounts of today's working geoscientists. They include geologist Jacques Kornprobst, custodian of Bruhnes's legacy, and Daniel Baker, an authority on extreme space-weather events. Her interviews provide insights into their thoughts and actions that transcend the stereotypes of inscrutable nerd or heroic explorer.

The perceptive reader will notice a few disconnects. For one, Mitchell gives short shrift to the explanation of just how Earth generates and maintains its magnetic shield in the metallic core. The human drama behind recent developments, which featured innovative numerical experiments using massive computers, is also curiously omitted. And lastly, the subtitle's dire warnings of impending doom (*The Electromagnetic Force that Created the Modern World — and Could Destroy It*) is an unnecessary distraction, being no match for the real-life stories inside. ■

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## Books in brief



### A Forest in the Clouds

John Fowler PEGASUS (2018)

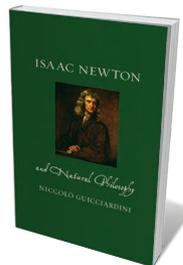
In the early 1980s, John Fowler — then a zoology undergraduate — worked with mountain gorillas at Karisoke, a research centre in Rwanda founded by primatologist Dian Fossey. His book, the only first-hand account of life inside the camp, is both a visceral ethological record and a disturbing portrait of an anguished and embittered Fossey. Framing her unsolved murder in 1985 as that of a scientist-soldier at the front, Fowler ultimately gives Fossey her due as the researcher who taught the world to love a kindred species, even as she became increasingly estranged from her own.



### The Joy of Sets

Chris Horrocks REAKTION (2018)

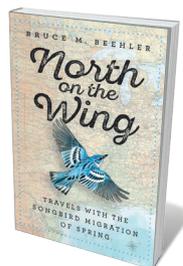
Television, reveals cultural historian Chris Horrocks in this compact chronicle, has tangled roots. The scientific advances of inventor John Logie Baird, broadcast pioneer Paul Nipkow and Karl Braun, inventor of the cathode-ray tube, are only part of the story. A slew of Victorian novels featured visual portals conquering time and space, such as the 'varzeo' in Ismar Thiusen's *The Diothas* (1883). Along with sets, from Baird's 1928 'Noah's Ark' televisor to today's ultra-thin screens, Horrocks examines the technology's military uses, the ethical furore over content, and its uses as a symbol in art, film and literature.



### Isaac Newton and Natural Philosophy

Niccolò Guicciardini REAKTION (2018)

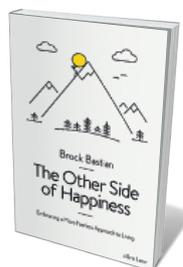
This pithy, nuanced biography of Isaac Newton examines the whole man, as a scientist born into the tumultuous seventeenth century and as an icon (and puzzle) through time. Science historian Niccolò Guicciardini reveals how Newton's theories first received a mixed reception, then became a kind of "cultural fashion" after his death. In the 1930s, his private archive of recondite and theological investigations muddied the picture further. Now, as Guicciardini shows, we are able to see Newton as a brilliant problem-solver eager to crack complexities — in mathematics, metaphysics and alchemy.



### North on the Wing: Travels with the Songbird Migration of Spring

Bruce M. Beehler SMITHSONIAN BOOKS (2018)

Many thrill to the spring arrival of avian migrants. Ornithologist Bruce Beehler decided not to wait. Inspired by Edwin Way Teale's 1951 US natural-history road trip, *North with the Spring*, Beehler set off in 2015 to follow, by car, canoe and bicycle, the migration of neotropical songbirds from Texas to Canada. Beehler's 100-day account is both deeply informed by conservation science and history, and lit by euphoric moments such as seeing roseate spoonbills duelling with "absurd spatulate bills", or a cerulean tide of blue jays in flight over Wisconsin wolf country.



### The Other Side of Happiness

Brock Bastian ALLEN LANE (2018)

Depressed by positive thinking? Psychologist Brock Bastian concurs. Many theories on the anatomy of happiness have got it wrong, he argues: real well-being involves embracing pain, from the social to the existential. His deft, evidence-based study reveals how avoiding pain backfires; over-protected children become less resilient; and adversity fosters community. If we take calculated risks, stop muffling our sorrow and eschew instant gratification, he avers, our lives will regain clarity of purpose. **Barbara Kiser**