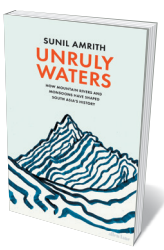
HYDROLOGY

India: a turbulent tale of rivers, floods and monsoons

Philip Ball plunges into an intermeshed human and environmental history.

The Indian novelist Amitav Ghosh remarked on a singular cultural gap in his 2016 book *The Great Derangement*. Environment and climate, he noted, are almost completely ignored in contemporary literary fiction — at precisely the moment they have become major agents of social and political transformation. The same might be said of much twentieth-century historical scholarship: the narratives tend to focus on issues such as urbanization, migration and identity. Now, in his stimulating, urgent *Unruly Waters*, historian Sunil Amrith strives to redress that imbalance.

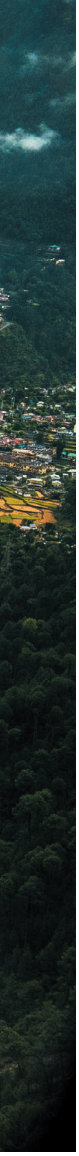
His focus is the Indian subcontinent, dominated by the monsoon, climate extremes and the great Himalayan rivers, such as the Indus, Ganges and Brahmaputra. It's a tale of drought, flooding, famine, water management and mismanagement — and, looming over all these today, the uncertain consequences of climate change. Water, Amrith shows, infuses Indian culture, influencing political and economic stability, creating inequality and hardship, and acquiring a symbolic charge. (This is evident, for instance, in both Mehboob Khan's 1957 cinematic epic *Mother India* and the environmental activism of writer Arundhati Roy.)



Unruly Waters: How Mountain Rivers and Monsoons Have Shaped South Asia's History
SUNIL AMRITH
Allen Lane (2018)

Much of India's recent history of water resources is a tale of how they were handled under British rule. During the drought-induced famine of 1873–74 in Bihar, in the northeast, the government imported rice from Burma (now Myanmar) and averted crisis. But in 1876–78, the British Raj's response to a drought on the Deccan Plateau and in northwest India was woeful in terms of both preparatory measures and famine relief. Amrith's judgement on this imperial legacy is strikingly relevant today. As he puts it, the Raj effectively undermined local

NATIONAL GEOGRAPHIC CREATIVE/ALAMY



The Tehri Dam on the Bhagirathi River, a headstream of the Ganges, in India.

resilience by allowing capitalistic and free-market practices such as taxes on land and produce, and insisting on open markets that drew food away from where it was most needed.

The British colonial governors were convinced that they could engineer Indian modernity. Between 1885 and 1940, the government built a network of irrigation canals in the Punjab to turn "waste" land into cropland, creating prosperous "canal colonies" such as the Chenab settlement. These hydro-engineering schemes altered India's economic landscape while producing a winner-takes-all scenario. "The control of water as well as control of credit concentrated land in fewer hands," further disenfranchising the rural poor, Amrith writes.

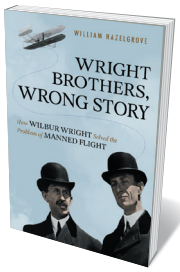
This is just one demonstration of how water management demands holistic thinking. Rivers and waterways do not abide by political borders. The 1947 partition, in which the subcontinent was summarily split into India and Pakistan by the withdrawing British, divided the waters as well as the land and the population. Disputes between the two nations about control of the Indus were among the earliest 'water wars' on the subcontinent, which persist today. Several stem from huge hydro-engineering projects planned for rivers in the Himalayan regions of India, Nepal, Bhutan and Pakistan, which would create 400 dams — roughly 1 every 32 kilometres. China, too, has a major stake in this game, with its plans to dam the Tibetan headwaters of the Brahmaputra.

> *"The control of water as well as control of credit concentrated land in fewer hands."*

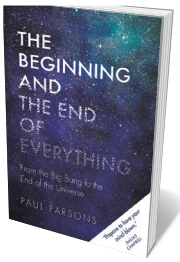
Unruly Waters is an interesting counterpart to studies of water's role in the history of China (my own included). There are as many contrasts as similarities. India does not have quite the stark wet south–dry north climatic division seen in China; nor are its rivers so strategic for trade and conquest. Rather, India's situation shaped its prospects: it is flanked by concave coasts and, after 1869, was accessible from Europe through the Suez Canal. China's climate is also less in thrall to monsoon conditions.

India lacks China's quasi-mythical narrative of civilizational continuity maintained by imperial dynasties. Nor does it have a long history of state-controlled hydro-engineering to exploit the major rivers and to build canals and reservoirs for trade, military transport, water storage and irrigation (A. Janku *Nature* **536**, 28–29; 2016). These two factors — the symbolic and practical value of waterways — are surely connected, even if not in the simplistic and eurocentric idea of "oriental despotism" founded on "hydraulic ▶

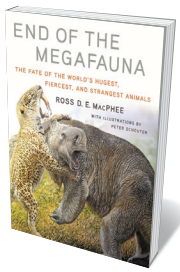
Books in brief



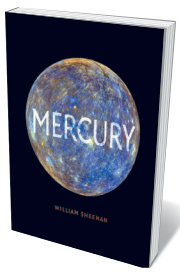
Wright Brothers, Wrong Story
William Hazelgrove PROMETHEUS *(2018)*
In December 1903, the first 12 seconds of controlled, human-powered flight took place near Kitty Hawk, North Carolina. That triumph is engraved in history; less so, the story of Wilbur and Orville Wright, the uber-geeks behind it. In this gripping dual biography, William Hazelgrove argues that theirs was no partnership of equals, as Orville claimed: it was Wilbur who rewrote the science of aeronautics. Hazelgrove delves into their experimental tinkering and family dynamics, but the real story here is that, as he eloquently puts it, one brother was a poet, and the other a scribe.



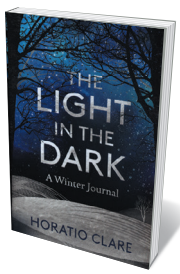
The Beginning and the End of Everything
Paul Parsons MICHAEL O'MARA *(2018)*
If a soup-to-nuts natural history of the Universe appeals, this one is a winner. Paul Parsons, a theoretical cosmologist turned science writer, delivers the oft-told tale with engaging lucidity, from the birth of the Universe 13.8 billion years ago to its putative end in a bang or a whimper aeons hence. As he traverses the phenomena, he interweaves stories of the researchers who discovered them, such as sixth-century Indian astronomer Varahamihira, who first conceptualized a force something like gravity, and the doughty researchers who found gravitational waves in 2015.



End of the Megafauna
Ross D. E. MacPhee W. W. NORTON *(2018)*
Just a few thousand years ago, gargantuan fauna roamed the planet, from the gorilla-sized sloth lemur *Archaeoindris fontoynontii* to the elephant bird *Aepyornis maximus*. What drove the extinction of these species "lost in near time"? Palaeomammalogist Ross MacPhee examines the theories, such as human over-hunting, climate change, emergent infections and food-web disruption; articulates the ongoing debate around them and what that might tell us about today's biodiversity crisis; and takes a look at de-extinction. Packed with evocative artwork by Peter Schouten.



Mercury
William Sheehan REAKTION *(2018)*
Mercury, the Solar System's innermost planet, was spotted in antiquity but remained an enigma until the 1960s. Science historian William Sheehan's portrait of the body (known in ancient Greece as the "scintillating one" for its flicker) reveals it as an airless iron world with an eccentric orbit. He interleaves discoveries, from Johannes Kepler's prediction of a transit of Mercury in the seventeenth century to NASA's MESSENGER probe, which relayed gorgeous images and data (such as the presence of a wealth of volatile compounds on the surface) before crashing on the planet in 2015.



The Light in the Dark
Horatio Clare ELLIOTT & THOMPSON *(2018)*
The leafless gloom of British winters can evoke powerful emotions. Beset by depression during one, nature writer Horatio Clare vowed to track his psychological shifts during the next. His lyrical memoir mines dark realities, from rural crime to seasonal affective disorder and the rising incidence of anxiety among university students. Yet running through all is the understanding that immersion in nature — the "turbulent, colloquial cries of geese", silvered fields and sunlit birches — can help in overcoming the condition, as a growing body of Western and Japanese research suggests. **Barbara Kiser**

civilizations" that Marxist historian Karl Wittfogel proposed in the 1950s. The extensive canal building in India occurred mainly under British rule in the nineteenth century, when the use of canals for transport and trade already faced competition from the expanding railway network.

So although Amrith makes a persuasive case that rains, rivers, coasts and seas shaped the history of India as much as they did that of China, they did so in different ways. That is reflected in the fact that mastery of water in India has never been closely linked to a 'heavenly mandate' of state authority, as it has in China. Understanding those distinctions — and perhaps the equally marked differences in water's role in the Middle East — might offer a broader understanding of how history and environment entwine.

Lurking behind these questions is the issue of how far science and technology can help us to understand and manage nature. Modern meteorology can be said to have begun with the British colonial government's efforts to predict the monsoon, although that particular goal is still challenging. (The sensitivity of the monsoon to patterns of global climate such as the El Niño–Southern Oscillation are only now becoming understood.) It's ironic that, just as weather science has started to yield dividends, the impacts of technological advance itself have made it urgent that we develop a longer-term forecast.

In India and China in particular, climate change is complicating the centuries-old struggle with water. Global warming is expected to intensify monsoons, increase weather variability, raise sea levels and melt glacial reservoirs. At the same time, the precipitous modernization and socio-economic development of both countries has exacerbated pollution, over-use and inequalities of access — as potently symbolized in the despoliation of the Ganges.

That's why histories of this kind are needed more than ever. Political, economic and historical discourse cannot just linger on statecraft and strategy, alliances and migrations, trade and war. Increasingly, the environment is central — and its role needs to be understood not through sweeping, Wittfogel-style theses, but with the kind of attention to local detail and nuance that Amrith exhibits.

He is right to assert one general lesson about water management. He writes that it has never been solely a question of technology or science that can be solved within political borders. The unruliness of water means that the business of working with it is "deeply inflected with cultural values, with notions of justice, with ideas and fears about nature and climate". ■

Philip Ball *is a writer based in London, and the author of* The Water Kingdom: A Secret History of China.
e-mail: p.ball@btinternet.com

LAB LIFE

Science in hand: how craft informs lab work

Artists and performers can enrich the physical act of experimentation, explain **Roger Kneebone**, **Claudia Schlegel** and **Alan Spivey**.

Even shaking a sample, rather than stirring it, can change results. Why then, among the many reasons discussed for the reproducibility crisis, does lab practice not get more attention (see *Nature* **533**, 452–454; 2016)?

Most science students enter university with years of screen time under their belts, but very little experimental experience. Indeed, many early-stage PhD students struggle with the transition from predetermined practicals to independent experimentation and design, where the ability to notice tiny departures from the expected might be crucial to discovery.

Some might not have 'good hands'. Moreover, written accounts are notoriously open to interpretation: 'add reagent X dropwise until the solution changes from red to yellow' seethes with potential ambiguity. Laboratory knowing takes place at the intersection between materials, tools and a researcher's body. Its rhythms differ from those of simply absorbing facts.

We — a surgeon, a research nurse and a synthetic chemist — looked beyond science to discover how people steeped in artistic skills might help to close this 'haptic gap', the deficit in skills of touch and object manipulation. We have found that craftspeople and performers can work fruitfully alongside scientists to address some of the challenges. We have also discovered striking similarities between the observational skills of an entomologist and an analytical chemist; the dexterity of a jeweller and a microsurgeon; the bodily awareness of a dancer and a space scientist; and the creative skills of a scientific glassblower, a reconstructive surgeon, a potter and a chef.

For more than 20 years, R.K. has explored this landscape, building a network of experts from apparently unconnected domains to share insights for the lab or operating theatre. In October last year, that multidimensional collaboration led to the Art of Performing Science, a symposium at Imperial College