fossil stick insect discovered in coal deposits in France by another entomologist, Charles Brongniart. Its accompanying engraving (see page 25) effectively stitches together two pieces of observational data — the body and wings of the insect, separated in the coal bed.

Such simple line engravings had become a staple. The same year in *Nature*, Canadian botanist Grant Allen published a series depicting the shapes of leaves, arguing that their shapes reflect levels of competition with other plants for access to energy sources.

Between the 1880s and 1900, the old collaborations gave way to technological interlocutors: photographers. Science journals viewed photography as a way of seeing that enabled "mechanical objectivity". There was greater trust in the power of ground lenses and silver halides to capture the world in a way that the eye cannot. As with all visual technologies, however, it needed selection, organization and interpretation for data to be rendered into a comprehensible image.

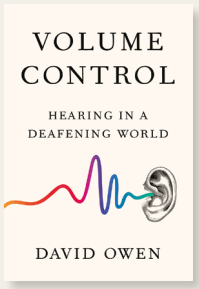
The work of French physiologist Étienne-Jules Marey is an iconic example. Following Eadweard Muybridge, who had captured animal locomotion through 'instantaneous photography' in the 1870s, Marey developed his own method: chronophotography. In an 1882 issue of *Nature*, he described his 'photographic gun', which used a rotating photographic plate to take sequential images of a flying bird[11], helping to pave the way to understanding powered flight. Meanwhile, the Carte du Ciel project at the Paris Observatory, which ran from 1887 to 1950, led to the creation of 22,000 glass-plate negatives of stars from more than 20 observatories[12].

Throughout the first half of the twentieth century, photography became crucial to science. Kathleen Lonsdale pioneered the form of crystallography in which X-rays are directed at a sample to measure diffraction and determine its atomic and molecular structure. Lonsdale published her 1928 findings on the benzene ring in the *Proceedings of the Royal Society*[13]. Her X-ray diffraction photographs — such as the 1941 series of eight, on diamonds — regularly appeared in *Nature*'s pages[14].

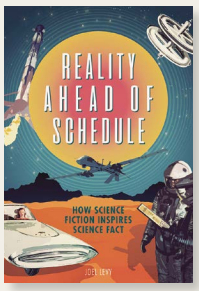
The technique became crucial to the explosive discovery[15] of DNA's structure by molecular biologists James Watson and Francis Crick, published in *Nature* in 1953. The key piece of evidence, 'Photograph 51', showed the diffraction pattern of DNA and was taken, under the supervision of crystallographer Rosalind Franklin, by then-graduate student Raymond Gosling[16].

Photography was also used to disprove one of the biggest twentieth-century scientific hoaxes. In 1912, amateur archaeologist Charles Dawson claimed to have discovered the missing link between humans and apes in what looked like an early human skull found in Piltdown, Sussex. In 1913, the anatomist David

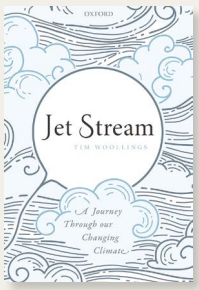
Books in brief



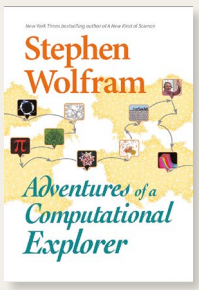
Volume Control
David Owen Riverhead (2019)
"For a deaf child, having hearing parents can be a serious handicap," notes *New Yorker* staff writer David Owen in this sensitive study of hearing. (He is personally involved, as someone with tinnitus who saw his grandmother struggle with deafness.) Meshing the science with individual auditory experiences, Owen discusses hearing aids, cochlear implants, genetically deafened mice, sign language, Thomas Edison and noise levels in US cities and towns — all in absorbing, anecdotal detail, although regrettably with no diagrams.



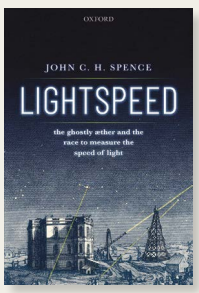
Reality Ahead of Schedule
Joel Levy Smithsonian (2019)
This picture-packed volume by science journalist Joel Levy tours scientific advances sparked by ideas in science fiction. The title comes from a definition of sci-fi by Syd Mead, an industrial designer behind the look of futuristic movies such as *Blade Runner* (1982). But how prescient is sci-fi? Levy shows how H. G. Wells's 1903 story 'The Land Ironclads' inspired Winston Churchill to promote the development of the military tank in 1915. But Wells did not envisage its key technical idea: caterpillar tracks, for added grip.



Jet Stream
Tim Woollings Oxford University Press (2019)
The jet stream — strong high-altitude air currents — was discovered in the 1920s. In this analysis of its complex impact on weather, physicist Tim Woollings relates how in 1944, the Japanese used the jet stream to launch trans-Pacific incendiary balloons. By strange chance, one hit the US plant that provided plutonium for the bomb that devastated Nagasaki in 1945. Today, argues Woollings, the jet stream is "very likely" to be threatened by another product of human activity: rising carbon dioxide emissions.



Adventures of a Computational Explorer
Stephen Wolfram Wolfram Media (2019)
Computer scientist and businessman Stephen Wolfram, designer of the technical-computing system Mathematica, proffers good stories in this collection of autobiographical essays. In 'Something I learned in kindergarten', he recalls himself as a six-year-old spotting a bite taken out of the Sun: a solar eclipse, something unknown to the other children. In 'My life in technology', he recalls rejecting the Latin word *mathematica*, learnt at school, as too long and ponderous. Silicon Valley luminary Steve Jobs convinced him otherwise.



Lightspeed
John C. H. Spence Oxford University Press (2019)
Starting with Albert Einstein, scientific consensus holds that the speed of light is a universal constant. So writes physicist John Spence in his history of attempts to measure the speed of light. Spence considers the implications of its constancy for modern physics and technology. For instance, the aether — a theoretical space-filling medium rejected in Einstein's relativity — is still "anything but empty". Despite its appealing vignettes of great physicists, this is a challenging read. **Andrew Robinson**