

A worker inspects equipment at the Large Interferometer Gravitational-Wave Observatory in Livingston, Louisiana.

PHYSICS

The wave catchers

Daide Castelvecchi applauds an inside story on the discovery of gravitational waves.

What constitutes a discovery? Is it the moment an instrument records a few blots of revealing data? Is it when the experimenters vet their statistics? Or is it when they persuade peer reviewers that their article is worth publishing? At what stage do discoverers know that they know?

Perhaps no case in recent memory has put these questions into starker relief than the historic first detection of gravitational waves by the Laser Interferometer Gravitational-Wave Observatory (LIGO), announced on 11 February 2016. In *Gravity's Kiss*, released on the first anniversary of the big reveal, sociologist of science Harry Collins dissects the singular process of discovery.

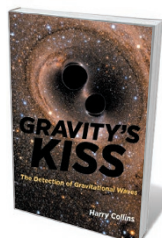
Collins, officially 'embedded' in LIGO for 43 years, has written three previous books about it (M. de Laet *Nature* 501, 164–165; 2013). *Gravity's Kiss* is structured as a week-by-week journal of the five months from detection to announcement, written in part as the events unfolded.

Collins was privy to all the experiment's internal discussions, starting with an e-mail sent on the morning

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of 14 September 2015 that flagged up a blip of data from LIGO's two giant detectors in Louisiana and Washington state. Many details — including an extraordinary trove of communications — have not been made public until now. Although there are several books on the development of LIGO, including Janna Levin's *Black Hole Blues and Other Songs from Outer Space* (Alfred Knopf, 2016; see S. Rowan *Nature* 532, 28–29; 2016), this is the first volume on the sensational discovery.

The gravity-wave collaboration comprises more than 1,000 researchers, including those at the LIGO observatories and the Virgo interferometer near Pisa, Italy. The two experiments pool their data and publish together. After the detection, the experiment was under incredible pressure. Almost exactly 100 years before, Albert Einstein had predicted the existence of gravitational



Gravity's Kiss: The Detection of Gravitational Waves
HARRY COLLINS
MIT Press: 2017.

waves. Two previous claims of detection had been false alarms — one starting in the late 1960s and one in 2014 (see *Nature* <http://doi.org/bxhn>; 2015). Furthermore, many had doubted that LIGO and Virgo, set up at a combined cost of nearly US\$1 billion, would be able to extract what should be remarkably feeble signals from the environmental noise. The team wanted its evidence to be rock solid before it came out with a claim, because a fiasco could have been disastrous — for the careers of those involved and for the field.

Other factors intensified the predicament. One was the timing. The signal had arrived during an 'engineering run'; LIGO, shut down for five years, was being tested and was due to reopen within days. Thus the signal — which seemed to reveal the final 0.2 seconds of the cataclysmic merger of two distant black holes — looked uncannily fortuitous.

Less than two weeks after the detection, another event cranked up the pressure yet further. The months-long work of vetting a result and preparing it for publication was meant to occur in secrecy. But on 25 September, cosmologist Lawrence Krauss, who was not part of the collaboration, tweeted: "Rumor of a gravitational wave detection at

LIGO

LIGO detector. Amazing if true. Will post details if it survives.” Soon, reporters started to call (see *Nature* <http://doi.org/bxhp>; 2015). The media and the public wanted to know whether the rumour was true. But this question had many possible interpretations, and at least as many answers. Were Krauss’s sources reliable? Perhaps. Even so, did that mean that the content of the claim was true? What does ‘they have discovered gravitational waves’ even mean, without context?

A leak, by definition, implies unreadiness to announce a result; rumours usually say nothing about error bars or Bayesian priors. Ultimately, the question was: did the researchers know whether the data blots were real? When Krauss tweeted, the answer was ‘it’s complicated’, as Collins reveals. The gravitational waves had emerged from the background noise so conspicuously that they could be ‘eyeballed’ — revealed without complicated analysis. Still, many in the collaboration urged caution: it is too easy to see what you want to see.

The closest thing to a eureka moment, Collins recounts, came on 5 October. By then, the interferometers had recorded enough noise for the team to properly quantify its confidence level. The researchers realized that they would not have to fight too hard to get the scientific community to accept their results. They had a slam dunk. Yet, until the announcement in February (after the paper had been peer reviewed; B. P. Abbott *et al.* *Phys. Rev. Lett.* **116**, 061102; 2016), their official response to the media was that they could not comment and were analysing data.

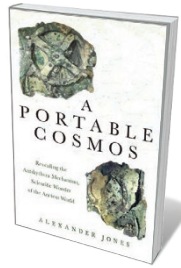
For Collins, that line was misleading to the point of unethical. His thesis is that science must serve as a model of honesty and integrity for society, and so must avoid secrecy as much as possible. I find this too harsh. As a reporter on the gravitational-wave beat (who often pestered Collins, as he notes in the book), I knew that there were things that team members were better off not telling me. Besides, covering the rumours was just too much fun.

Furthermore, the secrecy that shrouded the discovery will lead to greater transparency in the long run. LIGO opened a new window on the cosmos. The gravitational-wave community is gearing up to share data and reveal its findings almost immediately. Detection of black-hole mergers will become routine, and a host of other phenomena may show themselves through gravity ripples.

In an age of strongman politicians and outright despotism, this impassioned call for a “beacon of values” is more important than ever. “We desperately need science to rescue democracy from greed,” Collins writes. “We need that even more than we need gravitational wave astronomy.” ■

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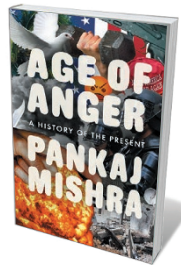
Books in brief



A Portable Cosmos

Alexander Jones OXFORD UNIVERSITY PRESS (2017)

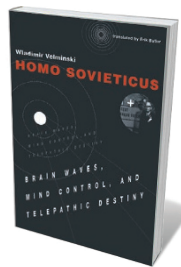
It was once a conundrum in corroded bronze. Now, the Antikythera mechanism has emerged a complex teaching tool for parsing astronomical phenomena. In this scholarly treatise, science historian Alexander Jones argues that its parts plausibly extend functions of known inventions. Touring decades of study using ever more sophisticated imaging technologies (see T. Freeth *et al.* *Nature* **444**, 587–591; 2006), he pieces together its structure and scientific and cultural context. A nimble, comprehensive survey of a wondrous machine that “brought the stars down to the Greco-Roman world”.



Age of Anger: A History of the Present

Pankaj Mishra ALLEN LANE (2017)

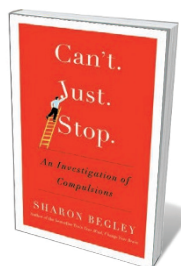
In an era shaping up to be one of the most politically tumultuous in memory, political thinker Pankaj Mishra traces the roots of the crisis to patterns of cognitive behaviour born with the Enlightenment. “*Ressentiment*” looms large: an existential envy arising where high-flown theories of freedom, equality and rationality mask grim realities, from racism to socio-economic inequity stoked by neoliberal economics. What is urgently needed, Mishra argues, are grounded governance and public policies that embrace cooperation, reciprocity and a nuanced understanding of human psychology.



Homo Sovieticus: Brain Waves, Mind Control, and Telepathic Destiny

Wladimir Velminski (translated by Erik Butler) MIT PRESS (2017)

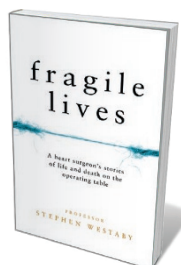
This slim treatise by media scholar Wladimir Velminski wafts us to the wilder shores of Soviet experimentation: cybernetics and telepathy research aimed at controlling society by ‘implanting’ thoughts. The pseudoscience is extreme, not least in the work of electrical engineer Bernard Kazhinsky, who posited that humans are radio stations, and thoughts electromagnetic waves. Perhaps oddest were the 1989 mass-hypnosis sessions on Moscow television, in which clinical psychotherapist Anatoly Mikhailovich Kashpirovsky attempted to shape public response to the fall of the Berlin Wall.



Can't Just Stop: An Investigation of Compulsions

Sharon Begley SIMON & SCHUSTER (2017)

We live in an era of “dreads both existential and trivial, societal and personal”, notes science writer Sharon Begley — anxieties that drive compulsive behaviours affecting millions. In this accessible treatment, Begley distinguishes between compulsion (hinging on the avoidance of negative consequences) and addiction (characterized by a hedonic hit, tolerance and withdrawal). In her explication of conditions from hoarding to trichotillomania (hair-pulling), she interweaves compelling historical case studies with the long march of medical and neuroscientific understanding.



Fragile Lives

Stephen Westaby HARPERCOLLINS (2017)

Cardiac surgeon Stephen Westaby’s memoir is a window on the gore-spattered drama of the surgical theatre and the lives of people driven to the operating table by heart disease, medical anomalies or devastating accidents. As the narrative ricochets from diagnosis to the visceral details of surgery and aftercare, we meet a handful of patients — including Peter Houghton, who survived for 7.5 years with a Jarvik 2000 artificial heart. As for Westaby, he has finally hung up the rib retractors and moved on to stem-cell research. [Barbara Kiser](#)