

NEUROSCIENCE

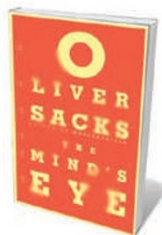
Learning to see

Steve Silberman is moved by Oliver Sacks's poignant account of losing his vision through cancer.

Eight days before Christmas Day 2005, neurologist Oliver Sacks — author of *Awakenings* (1973), *The Man Who Mistook His Wife for a Hat* (1985) and other popular collections of case histories — went to the movies. Sitting in the dark theatre, he noticed an incandescent flickering to his left, which he took to be the first signs of a migraine. But as a blind spot appeared and grew, the 77-year-old physician started to panic.

When the floor lights pointing to the exit abruptly vanished, he burst out of the cinema and phoned a colleague, who urged him to see an ophthalmologist. The diagnosis was sobering: Sacks had a melanoma in his left eye that would require prompt treatment. Thus the neurologist took his first steps on a harrowing course of transformation, mirroring those of his patients. *The Mind's Eye* is Sacks's frank and moving account of that journey.

Sacks has written about neurological disorders — such as autism, colour blindness



The Mind's Eye
OLIVER SACKS
*Alfred A. Knopf/
Picador*; 2010.
288 pp/272 pp.
\$25.95/£17.99

and synaesthesia — as a way of talking about the higher orders of the human mind since he published *Migraine* in 1970. At a time when the brain's plasticity was barely acknowledged in medicine, Sacks saw its reparative power in the lives of his patients, guiding them toward wholeness and vitality after a traumatic loss of ability. Defects, disorders and diseases, Sacks wrote in *An Anthropologist on Mars* (1995), can have a paradoxical role, “by bringing out latent powers, developments, evolutions, forms of life, that might never be seen, or even be imaginable, in their absence”.

In *The Mind's Eye*, Sacks probes visual

dysfunctions — including alexia (an inability to make sense of words), prosopagnosia (a failure to recognize faces) and his own ocular melanoma — to examine the complex roles of sight in human life and the constitution of personal identity.

He considers the case of Lilian Kallir, a concert pianist who became increasingly unable to make sense of her world visually. She lost the ability to read musical scores because of a rare degenerative condition called posterior cortical atrophy. Many elements of Kallir's story will be familiar to readers of Sacks's other books: her letter to the doctor seeking advice of last resort, the elusive diagnosis and the lofty cultural milieu of the patient. Also familiar are Sacks's attempts to comprehend the scope of Kallir's condition by visiting the vivacious 67-year-old musician at home.

Part of the appeal of Sacks's books is his depiction of an idealized world of thoroughly personalized medicine. Few physicians have the time or inclination to make house calls any more. Fewer still would say to a visually impaired patient, as Sacks does, “Let's go out, let's wander” — and then dress in red so that the patient can spot him in the bustling crowds of Manhattan.

This is not merely Sacks showing off. One of his role models, the late French neuropsychiatrist Jean Lhermitte, advised accompanying patients to a bistro to observe how they were coping with their illness. After Sacks visits the apartment that Kallir shares with her devoted husband, he writes about the ad hoc methods that the couple devised to make the pianist's illness less disabling. In the kitchen, for example: “Things were categorized not by meaning but by color, by size and shape, by position, by context, by association, somewhat as an illiterate person might arrange the books in a library. Everything had its place, and she had memorized this.”

Like most of Sacks's case studies, Kallir's story does not come to any satisfying therapeutic resolution. There is no breakthrough, no wonder drug and no hope of lasting recovery. But the ability of the pianist and her husband to maintain a shared sense of continuity in increasingly disordered circumstances is testimony to the resilience that is Sacks's

NATURE.COM
For a review of Oliver Sacks's *Musicophilia*:
go.nature.com/7iyzLQ

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The Art and Politics of Science

Harold Varmus (*W. W. Norton*, 2010; \$15.95)

In his memoir, Nobel prize-winner Harold Varmus reflects on his work in cancer biology, his directorship of the US National Institutes of Health and the many political battles that he has fought over science. His ability to connect basic research and medical application is evident. “Varmus reveals a sharp, analytical intelligence as well as great enthusiasm for his work and profession”, wrote reviewer Iain Mattaj (*Nature* **458**, 32; 2009).

overarching theme. Rather than being about disease, his tales are more about his patients' astonishing capacities to adapt — and even thrive — in radically transformed worlds. His books resonate because they reveal as much about the force of character as they do about neurology.

The Mind's Eye also relates how an Australian psychologist named Zoltan Torey, rendered blind at 21 by a splash of acid, cultivates his photographic memory to the point that he shocks his neighbours by replacing the gutters of his house alone at night. In another chapter, Canadian novelist Howard Engel discovers that his morning *Globe and Mail* has been rendered into Cyrillic or Korean; it is his brain, of course, that has been translated by a stroke. After years of exhausting effort to engage language in new ways — composing by dictation, learning to scan words by linking adjacent letters — the novelist teaches himself to write books again.

For Sacks, disorders of vision, including his own, open a window on the brain's surprisingly active role in the authoring of experience. While under treatment for the ocular melanoma, the neurologist undertook a series of fascinating self-experiments. In one exercise, for example, he tested the limits of his brain's ability to fill in temporary gaps in his visual field caused by radiation treatment. Sacks found that repetitive patterns such as brickwork, and even clouds and trees, readily appeared to preserve the illusion of a seamless panorama around him. Faces, however, were beyond the conjuring ability of his visual cortex. "I've learned that the brain is always busy," he told me in an interview last summer.

Thankfully, Sacks's tumour has not returned, but he is still learning to cope with the aftermath, including a possibly permanent loss of three-dimensional vision — a poignant turn of events for a proud member of the New York Stereoscopic Society.

To maintain his own sense of continuity in the face of these challenges, Sacks will have to draw inspiration from the patients he has written about for 40 years. "The problems never went away," he quotes Engel as saying, "but I became cleverer at solving them." ■

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BOTANY

Hitchers, outcasts and wasteland beauties

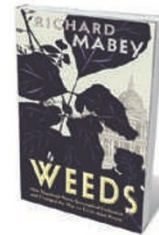
Sandra Knapp revels in a portrait of weeds as resilient rebels shaped by our meddling with the wild.

Like humans, weeds are pervasive, domineering and badly behaved. But they adopt these traits only in order to reproduce. As naturalist Richard Mabey explains in *Weeds*, they are an in-your-face example of evolution by natural selection: weeding benefits weeds by allowing those that evade the hoe to produce seeds that inherit the very characteristics that allowed escape; using herbicide causes weeds to become more resistant to such poisons.

Mabey weaves social history, psychology, literature and art into his clear rendering of plant biology. Explanations of evolution sit alongside explorations of flower symbolism in Shakespeare. This blend, familiar to fans of his earlier reflections on nature in the wild, broadens the book's scope to human attitudes to plants in general.

Indeed, the concept of a weed makes sense only in relation to people — they are plants that cause us trouble by growing where we don't want them. Most of the social connotations of weeds are negative: unruly, weak or aggressive. Yet these designations are fluid. Some plants, such as St John's wort (*Hypericum perforatum*) or hemp (*Cannabis sativa*), have passed from love to hate and back again. Others, such as autumn ladies' tresses (*Spiranthes spiralis*), are a rampant but admired invader of our lawns.

Some weeds considered ubiquitous today were once rare: rosebay willowherb (*Epilobium angustifolium*), depicted among the fine flora on the ceiling of the Natural History Museum in London, was described by some nineteenth-century botanists as a woodland plant 'not often met with in the wild state'. This magenta-flowered perennial carpeted the bombed areas of 1940s London, earning it the common name of fireweed. Its



Weeds: How Vagabond Plants Gatecrashed Civilisation and Changed the Way We Think About Nature

RICHARD MABEY
Profile Books: 2010.
288 pp. £15.99

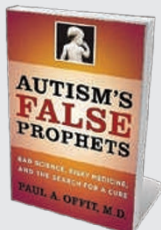
tiny seeds, carried on downy plumes, were dispersed by turbulence along railways; it now colonizes cities across Europe and North America. It is a good example of how weeds are a human construct, promoted by our tendency to disturb land.

Naturally invasive or easily transported species are also troublesome, particularly on islands with rare flora such as Hawaii,

the Galapagos and Australia. For example, the velvet tree (*Miconia calvescens*) has taken over rainforest areas in Tahiti and is spreading on Hawaii; it chokes off native vegetation, preventing natural forest regeneration in these fragile habitats. But these plants arrived with people. *Homo sapiens* is the ultimate invasive species — coming out of Africa to colonize the globe, altering the planet beyond recognition.

Weeds highlights our ambivalence about naturalness and artificiality. We often think of pristine nature as the landscape we, or our grandparents, grew up with. Yet nature changes all the time. In the Pleistocene, much of northern Europe was covered with ice: no plants grew. Our entire flora is invasive, but that hasn't stopped us loving it. ■

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Autism's False Prophets

Paul A. Offit (Columbia Univ. Press, 2010; \$16.95)
Vaccine expert Paul Offit digs beneath the unproven claims of links between autism and the measles-mumps-rubella vaccination, writing with "passion, authority, bluntness and literary skill", noted reviewer Jeff Thomas (*Nature* 455, 594–595; 2008).



An Orchard Invisible: A Natural History of Seeds

Jonathan Silvertown (Univ. Chicago Press, 2010; \$17)
Seeds harbour essential aspects of the story of evolution, reveals ecologist Jonathan Silvertown. Looking beyond the familiar seeds and grains cultivated over centuries by humans for food, the book notes the unusual solutions taken by seeds to overcome survival challenges.

HISTORY

A polymath rediscovered

George Rousseau uncovers the physiological side of Hermann von Helmholtz.

When the Harvard University psychologist Edwin Boring dedicated his classic 1942 monograph *Sensation and Perception in the History of Experimental Psychology* to Hermann von Helmholtz, many American readers wondered why. Helmholtz was a German, the Allies were rallying against the Nazi menace, and the United States had just entered the war. Few beyond professional historians of science knew about Helmholtz's work.

Boring justified his choice: "There is no one else to whom one can owe so completely the capacity to write a book about sensation and perception." Sixty years on, Helmholtz's major contributions to physiology and medicine, including his theories of visual and aural perception, have been largely eclipsed by his work in physics. In *Helmholtz*, neuroscientist Michel Meulders redresses the balance, showing that this towering figure was as influential as philosopher Immanuel Kant and as visionary as polymath Johann Wolfgang von Goethe.

Part of the reason for Helmholtz's partial invisibility today is that he wrote in German. It took decades for his work to reach the English-speaking world; his *Popular Lectures on Scientific Subjects*, delivered in the 1850s, were translated in the 1870s and 1880s, and his acoustical masterpiece, *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (1863), in 1885. After this flurry of works — distributed during Helmholtz's last two decades — came tributes on his death in 1894. His Jewish student Leo Koenigsberger published a classic biography, again in German, in 1902, which was translated into English in 1906.

An extensive obituary in the 1896 *Proceedings of the Royal Society of London* portrayed Helmholtz as the most important physicist of the epoch. His work on the conservation of



Helmholtz: From Enlightenment to Neuroscience

MICHEL MEULDERS
(TRANSLATED BY
LAURENCE GAREY)
The MIT Press: 2010.
264 pp. \$27.95,
£20.95

Helmholtz's legacy by placing him within the history of science and by locating him as an aesthetic thinker as well as a scientist.

A welcome and surprising inclusion in the book is Helmholtz's role within the aesthetics of music. Meulders is right to retrieve this overlooked aspect — only a handful of specialized monographs have touched on it before. Helmholtz tackled the aesthetics of pitch and tone in 1857, after a century of neglect. "Music has hitherto withdrawn

energy that led him to formulate the first law of thermodynamics in 1847 was widely cited — electromagnetism was cutting-edge science. But interest in his physiology and medicine was lost. Helmholtz himself pursued physics more than physiology after the 1870s, and his theories of sight and sound were bitterly contested well into the twentieth century. Meulders restores

colour. His view was that music depends on human experience and on the physiology of the senses for its effects. Helmholtz's physiological theory of music had a lasting impact on the composers Alexander Scriabin and Nikolai Rimsky-Korsakov, and on many twentieth-century academic musicologists.

Meulders brings in other German intellectuals on whose work Helmholtz built. For example, he analyses the theory of physics and physiology of colours published by Goethe as *Zur Farbenlehre* (Colour Theory) in 1810. Yet Goethe does not come to life in the book in the same way as Helmholtz's teacher Johannes Müller, portrayed as a genius who overcame insomnia and depression to hew a science of physiology.

Müller demonstrated in his famous Berlin laboratory that "the results of all physiological research must be, in the end, psychological in nature". Small wonder, then, that he assigned to his protégé Helmholtz a doctoral thesis topic in the 1830s based on invertebrates in Müller's own collection, which was eventually published as *Nerve Fibres Arising from the Ganglion Cells Discovered in 1836*. In this, Helmholtz built on the ideas of his teacher to bring together physiology and psychology.

Yet curiously, Meulders writes, Helmholtz never referred to the brain. My main reservation is that the book does not unpack this statement. Helmholtz consistently ignored anatomical data on the nervous system, and probably mistrusted the concept, popular at the time, that anatomical and psycho-

logical processes were identical. Thus he did not link the psychology of perception with the physical brain, and bought into an older theory of mind, with the soul as the arbiter of the senses. Helmholtz's defiance of nineteenth-century natural philosophy through his enduring omission of the brain is strange, and I hope another author will pursue it.

MEULDERS DOESN'T SURRENDER HIS ADMIRATION — AT TIMES VERGING ON HERO WORSHIP.

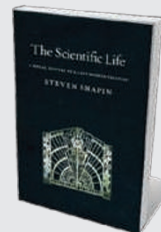
itself from scientific treatment, more than any other art," he wrote. Poetry, painting and sculpture borrow from the world of experience, he explained, but music seems to "reject all anatomization of pleasurable sensations".

Helmholtz developed a 'resonator' device, a pierced sphere of glass or brass with a narrow neck, to demonstrate musical pitch and tonal



Imperial Nature: Joseph Hooker and the Practices of Victorian Science

Jim Endersby (Univ. Chicago Press, 2010; \$25)
Botanist Joseph Hooker became one of the first professional scientists when research began to be funded by governments. "A refreshing record of how scientists worked during this transition," wrote Sandra Knapp (*Nature* 453, 721; 2008).



The Scientific Life

Steven Shapin (Univ. Chicago Press, 2010; \$20)
Historian Steven Shapin shatters myths about the divide between pure and commercial science by arguing that moral values are as abundant in industry as in academia. Reviewer Jerome Ravetz described it as "required reading for all scientists" (*Nature* 457, 662–663; 2009).

Meulders concludes his book with three incisive chapters on the aesthetics of music. In one he deals with the Pythagorean legacy, especially the idea that mathematical relationships were the basis of harmony and tone. In the second he considers 'the musical ear', demonstrating that findings in auricular physiology, particularly Italian anatomist Alfonso Corti's discovery in 1851 of fibres that function as acoustical sensor cells in the cochlea, had complicated the aesthetics of sound.

This chapter is a triumph of compression of a vast province of physiology and aesthetics into a few pages. Surveying the musico-logical terrain from the argument between Jean-Philippe Rameau and Jean le Rond d'Alembert to Johann Sebastian Bach and Andreas Werckmeister, and on to Mozart and Mendelssohn, Meulders pauses to explain how Helmholtz the empiricist understood

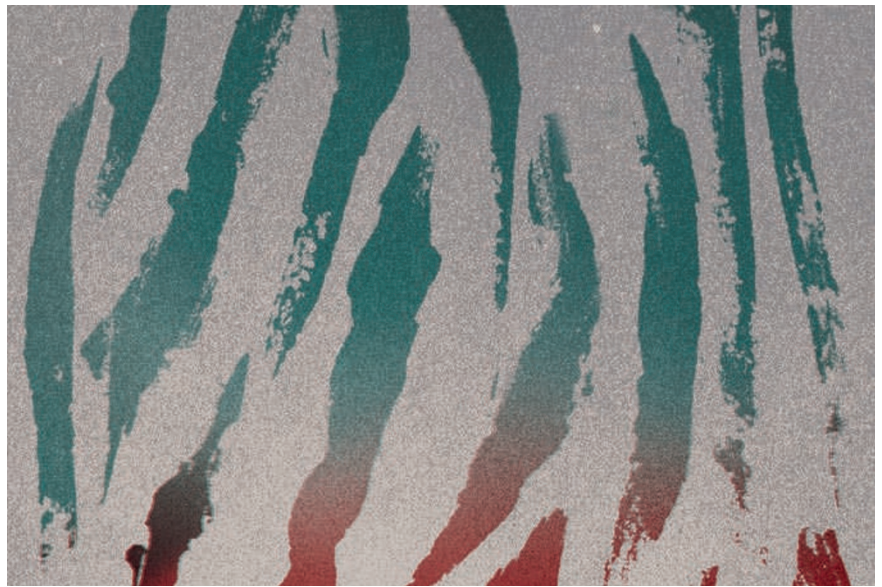
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For more on German science history, see: go.nature.com/R5K7Qw

music theory and aesthetics as a grand unifier. Musical sounds, he thought, can only be understood as great art by combining anatomy, physiology, philosophy and psychology. The third of these chapters meditates on Helmholtz's nostalgia, intuition and memory — an odd amalgam, the breadth of which adds to Meulders's claim for Helmholtz's genius.

Meulders stitches together the thoughts of a lifetime into his slim book. He doesn't surrender his admiration — at times verging on hero worship — despite the occasional critique. The approach is hit-and-miss and does not amount to the much-desired extended interpretation unifying Helmholtz's physiology and aesthetics, but it is a brave start.

Meulders sums up his subject thus: "With his will to unify so many different scientific disciplines in a coherent entity, he proved once again his veritable gluttony for science and knowledge." Some may find Meulders equally gluttonous, but his book demonstrates that Helmholtz was indeed a polymath *par excellence*. ■

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ECOLOGY

Conservation thriller earns its stripes

A travelogue about tiger poaching in Russia's far east opens up a new genre, discovers **Geoff Marsh**.

Yuri Trush steadily points his camera at the stubs of bone protruding from a pair of thin rubber boots lying in the blood-speckled snow. As the leader of an Inspection Tiger anti-poaching unit, his job now is to piece together the details of Vladimir Markov's run-in with the tiger. Judging by the whimpering of Trush's dog, the big cat in question remains close by, among the trees.

Inspection Tiger is a government agency that was set up to combat poaching in Primorskiy Krai (or Primorye) — an area the size of Washington state in the far east of Russia, bordered by China and North Korea. Trush's team travels in a decommissioned army truck, armed with knives, pistols and semiautomatic rifles. Their mission is to intercept poachers and to resolve



The Tiger: A True Story of Vengeance and Survival

JOHN VAILLANT
Sceptre/Alfred Knopf:
2010. 352 pp.
£18.99/\$26.95

the locals' conflicts with the largest cats in the world.

In *The Tiger*, author John Vaillant relates his travels across the region while investigating the pressures on tiger conservation. His vivid portrayal of Primorye reveals a unique ecosystem at the crossroads of four distinct biomes: the Siberian taiga forest, the steppes of Mongolia, the subtropics of Manchuria and the boreal forest of the far north. A peculiar mix of hardy alpine



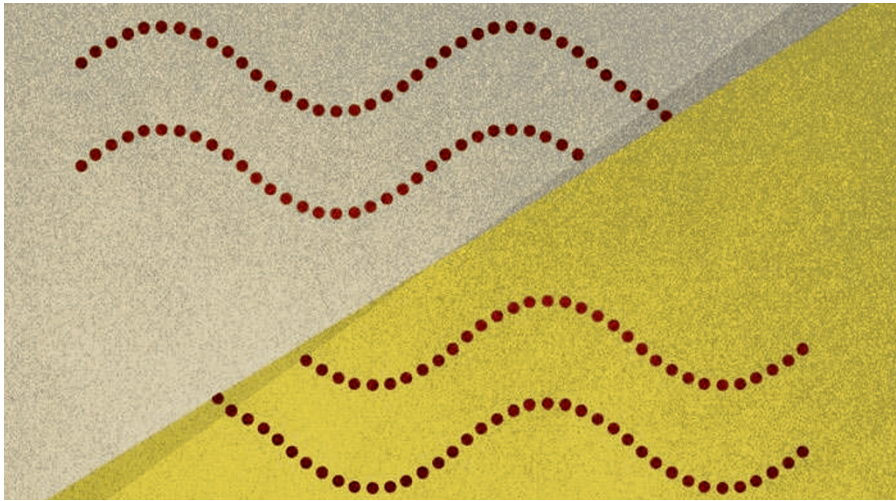
The Art Instinct

Denis Dutton (Oxford Univ. Press, 2010; £9.99)
Art appreciation has an evolutionary basis, according to philosopher Denis Dutton. The basic elements of aesthetic taste are similar across cultures and are part of our evolutionary heritage rather than being socially constructed, he claims provocatively.



Pink Brain, Blue Brain

Lise Eliot (OneWorld, 2010; £12.99)
Neuroscientist Lise Eliot marshals the latest evidence to show that social pressures are the main cause of behaviour differences between boys and girls. Although small gender variations are apparent at birth, they grow as our plastic brains quickly become modified by experiences.



QUANTUM PHYSICS

Tripping the light fantastic

Geoff Pryde on the weird world of quantum entanglement.

The only way to understand the quantum world is to measure it. This empirical view is dear to the heart of Anton Zeilinger, now at the University of Vienna, a leading figure in quantum physics through his work on correlated photons. In *Dance of the Photons*, he explores the phenomenon of quantum entanglement, the quantum correlations in the properties of particles.

When two photons are made to interact, they share their quantum information and become 'entangled'. If one travels off, it retains knowledge about its counterpart. So measuring one can determine the state of the other, even if they are far apart. Albert Einstein was worried by such reasoning: instant messaging between entangled particles contradicted his theory of relativity, which stated that signals cannot travel faster than the speed of light, unless you allow the crazy idea that particles do not have real properties independent of measurement. Quantum mechanics, he

decided, was not up to explaining the world.

Zeilinger explains that Einstein was wrong. Experiments in the 1980s and 1990s proved the weird predictions of quantum entanglement to be true. Putting the reader in the role of discoverer, he describes these tests through the eyes of fictional students Alice and Bob, namesakes of the characters regularly put to work in explaining quantum physics. Examining the philosophical and technological implications of spooky quantum phenomena, he points to big issues that demand further thought — the inherent randomness of quantum physics and the role of the observer in determining a quantum particle's reality.

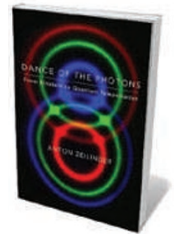
As well as giving an overview of other work, Zeilinger relates in detail his own group's research. For instance, he describes a 'delayed choice entanglement swapping' experiment he has carried out using four photons (1, 2, 3, 4). Two pairs share prior information: photons 1 and 2 are entangled, photons 3 and 4

are also entangled, but there is no correlation between those pairs. Making a particular type of quantum measurement — known as a Bell measurement — jointly on photons 2 and 3 entangles them and then destroys them. Through their prior links, this connection then entangles the states of photons 1 and 4, even though they have never interacted and may be very distant from one another. This remarkable property also has practical significance — the ability for two parties to share entanglement over long distances could have applications in secure communications and powerful distributed processing.

Even stranger things can happen. It is possible to delay the measurement on photons 2 and 3 until after photons 1 and 4 have been detected. One need not even decide whether to make that measurement until after 1 and 4 are detected. Yet the experiment seems to 'know' what you will do in advance: 1 and 4 appear entangled if a later measurement of 2 and 3 is made; they are not entangled if not.

It is as if photons 1 and 4 knew the future — whether or not the measurement would be made at a later time. The state of the photon not only seems to depend on the choice of measurement, but also on measurements that are yet to be made. This has implications for our ideas about reality and time, but Zeilinger reminds us that we must always make a careful accounting of the data. The reward for following Alice and Bob's reasoning as they teach us how to puzzle out these types of result is a rich understanding of entanglement beyond the simplified picture.

Zeilinger adds local colour throughout the book. In his tale, however, the real treasure of Vienna is not its opera, nor Ludwig Boltzmann's blackboard (which was used for the book's sketches), but a set of dark tunnels under the River Danube. These are home to a photon teleportation experiment, in which the quantum polarization state (which shows the orientation of the plane in which the light wave oscillates) of a photon on one side of



Dance of the Photons: From Einstein to Quantum Teleportation
ANTON ZEILINGER
FSG: 2010. 320 pp. \$26



Sand: A Journey through Science and the Imagination

Michael Welland (Oxford Univ. Press, 2010; £9.99)
The world is visible in a grain of sand in geologist Michael Welland's acclaimed book. From dunes to ancient glass to electronics, he opens doors to its mysteries. "Nothing like it has been published before," wrote Andrew Robinson in his review of the hardback edition (*Nature* **460**, 798–799; 2009).



Why Does E=mc²? (And Why Should We Care?)

Brian Cox and Jeff Forshaw (Da Capo, 2010; £8.99)
Physicists Brian Cox and Jeff Forshaw provide an accessible explanation of Einstein's iconic equation. They explain the equivalence of mass and energy and look ahead to investigations of the nature of mass at the Large Hadron Collider at CERN, the particle-physics lab in Switzerland.

the Danube is instantaneously transferred to a photon on the other side. Again, the author gives the science a human face: we meet Rupert, possibly a caricature of Zeilinger's postdoc, who is condemned to the tunnels to keep the equipment running. Fortunately, Zeilinger instils him with a sense of humour.

The Vienna group's latest entanglement experiments are performed on a far larger scale — between two of the Canary Islands. A telescope with a one-metre-diameter mirror is used to catch an entangled photon that has travelled 144 kilometres through the turbulent atmosphere. Optimizing the optics, stabilizing the pointing systems and synchronizing the electronics over picoseconds make these experiments challenging, but they have enabled even more careful tests of the counter-intuitive features of quantum entanglement. By using satellites to send the quantum signals, such techniques will one day allow us to distribute entangled information between far-distant locations on Earth.

The book concludes with an outlook of where entanglement will and won't take us. Teleporting humans may be out, as we can't entangle two atom-for-atom clones of a person. But the powerful way in which quantum states carry information opens the path to quantum computing and quantum cryptography. By sharing entanglement over optical fibres (as in the Danube experiment), secret keys can be distributed over short distances. Using entanglement swapping (as in the delayed choice experiment), we might build a quantum repeater — a device for extending key distribution over much longer ranges. Using satellites, secure worldwide communication networks between classical and quantum computers will become possible.

Dance of the Photons is an enjoyable introduction to the strange world of quantum phenomena and the technologies they empower. It gives a foundation from which to ponder the nature of randomness and reality — and whether, in Vienna, the photon dance is performed to a Strauss waltz. Maybe Rupert can tell us over a lager, if he's ever allowed out of the tunnels. ■

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MATHEMATICS

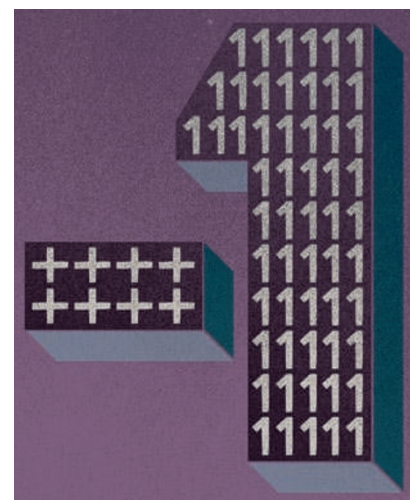
Deception by numbers

Jascha Hoffman reads about the rise of nonsense statistics in everything from adverts to voting.

The statement, published in a newspaper, that only 0.027% of US felony convictions are wrongful is false. Based on a back-of-the-envelope calculation, it was nevertheless quoted in a court case that ended with a prisoner being sent to his death. Such bad figures are “toxic to democracy”, argues science journalist and former mathematics student Charles Seife in his latest book *Proofiness*, a field guide for spotting the numeric impostors. Seife's polemic against the reporters, politicians, scientists, lawyers and bankers who spread tenacious and specious statistical claims is strident but sobering.

Seife coins the term “proofiness” to refer to the misuse of numbers, deliberate or otherwise. He dubs the simplest quantitative sins “fruit-packing”. These include: “cherry-picking” the data, as he says Al Gore did when describing climate change in *An Inconvenient Truth*; “comparing apples to oranges”, as economics pundits do when they neglect to adjust for price inflation; and “apple-polishing”, as when advertisers use graphics to mislead.

Seife finds bogus figures in every corner of public life — where there are numbers, they will be fudged. He does not spare his fellow hacks, citing the opinion poll as a method for journalists to manufacture their own stories. Surveys, no matter how large their



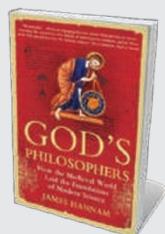
sample sizes and small their margins of random error, may be skewed by slanted questions, biased samples and lying respondents, he explains.

Even the simple act of counting ballots can be fraught with controversy, as in the contested Florida presidential recount in 2000. Claiming the margin of error to have been larger than the 537-vote difference between George W. Bush and Gore in that state, Seife suggests that the race should have been declared too close to call — and therefore, by Florida law, settled by the drawing of lots. He also describes economist Kenneth Arrow's impossibility theorem, which expresses how no voting system can fully capture the preferences of a group.

Seife faults some scientists, too, for over-interpreting their data and making extravagant causal inferences when the evidence is slim. This is particularly problematic in health and nutrition research, he argues,



Proofiness: The Dark Arts of Mathematical Deception
CHARLES SEIFE
Viking: 2010.
295 pp. \$25.95



God's Philosophers: How the Medieval World Laid the Foundations of Modern Science

James Hannam (Icon Books, 2010; £9.99)
Historian James Hannam debunks myths about the European 'dark ages', explaining that medieval people didn't think the world was flat. Rather, the many achievements during the period fed into the later works of Galileo and Newton.



The Pythagorean Theorem: A 4,000-Year History

Eli Maor (Princeton Univ. Press, 2010; \$17.95)
Pythagoras's famous geometric theorem is central to science. Mathematics historian Eli Maor describes its origins and explains how it features in every scientific field today, pointing out that the formula was known by the Babylonians 1,000 years before Pythagoras.

casting doubt on studies alleging, for example, that an artificial sweetener causes brain cancer and that debt causes illness. He criticizes a handful of peer-reviewed articles, including some published in *Nature*, for making claims that, in his eyes, go beyond common sense. For example, Seife thinks it unlikely that wearing red helps Olympic fighters to win, offering his own analysis of results from the 2008 Beijing Olympics as proof. He dismisses other assertions, such as that wide-hipped women give birth to more sons than daughters, as mixing up cause and effect. Seife highlights how scientists can sometimes be seduced by models whose curves fit their data, attributing misguided efforts to find causal relationships to a “misfiring of our pattern-seeking behavior”.

Moving on to the legal system, Seife describes how probabilities may be taken out of context in court. Statistics showing that particular crimes or events are rare have wrongly been cited as proof of innocence and guilt — delivering what Seife calls “judicial nonsense”. In business, problems arise when numbers are used to under- or overstate potential dangers. Whereas the media tend to overplay risk, Seife reminds us that “underestimating risks, not exaggerating them, is where the money is”. He points to prominent company directors who hid their firms’ liabilities, and corporate banks that had to be bailed out by governments because of their reckless underestimation of credit risk.

Seife can overstate his case, as when he claims that proofiness is robbing us of “the democratic right to think for ourselves”, oiling the “machinery of death” and “crippling our economy”. He does little to explain why, given the onslaught of phony figures, many people remain susceptible to them, and he provides few practical suggestions for reducing their influence. Yet there is plenty of healthy scepticism and common sense in Seife’s taxonomy of statistical malfeasance. In a world of unreliable numbers, *Proofiness* is a helpful guide. ■

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FORENSICS

Crime-scene science in the dock

Two books chart the growth of forensic science from its birth to modern times, finds **Laura Spinney**.

Here are two books that span an era. Douglas Starr’s *The Killer of Little Shepherds* describes the birth of modern forensic science in France in the late nineteenth century, revealing how it led to the capture of a serial killer. Michael Capuzzo’s *The Murder Room* revisits cold cases from the past 50 years, just as the field of forensics is beginning to modernize and move in a new direction. Both accounts are riveting. But whereas Starr knows he is writing about a period of intellectual upheaval, Capuzzo seems impervious to the winds of change.

Starr’s hero is the French physician and criminologist Alexandre Lacassagne, who established the ground rules for many forensic disciplines, from autopsy and blood-spatter analysis to toxicology and psychology. He worked in exciting times for the field. Between 1885 and the First World War, when Lacassagne’s school of forensics in Lyons was influential, anthropologists Francis Galton in Britain and Juan Vucetich in Argentina were classifying fingerprint types for identification purposes, Austrian physician Karl Landsteiner discovered blood groups and, in 1897, a Parisian blaze provided the backdrop for the first identification of corpses by their teeth. The application of probability theory to the interpretation of forensic evidence in court was highlighted by the Dreyfus affair — the trial in France of artillery officer Alfred Dreyfus for treason, which hinged on the analysis of handwriting in an incriminating document.

Lacassagne brought such forensic advances to bear on the case of Joseph Vacher, a serial murderer whose

The Killer of Little Shepherds: A True Crime Story and the Birth of Forensic Science

DOUGLAS STARR

Knopf/Simon & Schuster: 2010/2011. 320 pp.
\$26.95/£16.99

The Murder Room: The Heirs of Sherlock Holmes Gather to Solve the World’s Most Perplexing Cold Cases

MICHAEL CAPUZZO

Gotham/Michael Joseph: 2010. 448 pp/384 pp.
\$26/£17.99

victims included young shepherd boys out watching their flocks in rural France. Through analyses of the crime scenes and victims’ bodies, the criminologist showed that Vacher’s crimes were premeditated and systematic, implying that the killer was not insane. Vacher was convicted in 1898, and executed by guillotine.

Similar forensic methods are still used more than a century later. Capuzzo’s heroes in *The Murder Room* are William Fleisher, a former special agent with the US Federal Bureau of Investigation, and forensic psychologist Richard Walter and forensic sculptor Frank Bender, who together founded the Vidocq Society in Philadelphia, Pennsylvania, in 1990. Taking its name from the nineteenth-century French crook-turned-crimefighter Eugène Vidocq, the non-profit, closed society brings together 150 volunteer experts to solve crimes that have gone cold. From forensic scientists to business leaders, the membership pools its knowledge once a month, over lunch, to home in on perpetrators

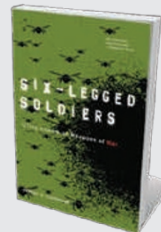
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Origins of Human Communication

Michael Tomasello (MIT Press, 2010; £13.95)
Developmental psychologist Michael Tomasello examines the evolutionary origins of human communication. Sharing information with and helping others, he suggests, is the main purpose of speech and gesture. Such goals require the development of complex linguistic grammars.



Six-Legged Soldiers: Using Insects as Weapons of War

Jeffrey A. Lockwood (Oxford Univ. Press, 2010; £9.99)
From scorpions used by Roman armies to beetle infestations spread in the cold war, entomologist Jeffrey Lockwood reveals insects’ military uses. Reviewer Kenneth J. Linthicum described it as “an excellent account” (*Nature* 456, 36–37; 2008).