

with the tale of the agronomist and pseudoscientist Trofim Lysenko, whose theory of heredity, supported by Joseph Stalin, came close to destroying the science of genetics in the Soviet Union. One reason scientists so strongly opposed Velikovsky was the recent, chilling memory of Lysenkoism.

There are fascinating and alarming parallels between these outsider narratives and Christian creationists' use of pseudoscientific arguments to lend legitimacy to their cause. Henry Morris and John Whitcomb's 1961 publication *The Genesis Flood* (Presbyterian and Reformed Publishing) became the foundation of the 'creation science' movement. Like Velikovsky, these authors postulated a catastrophic history of Earth, reinterpreting all geology in terms of a single universal flood, as described in chapters 6–11 of Genesis. They based their conclusions solely on a literal interpretation of scripture, and rejected Velikovsky's naturalist explanations.

Pseudoscience that has the support of organized religion or economic interests tends to survive much longer than the work of a lone eccentric such as Velikovsky. In his final pages, Gordin touches on a new phase of pseudoscience, practised by a few rogue scientists themselves. Climate-change denialism is the prime example, in which a handful of researchers, allied with an effective public-relations machine, are publicly challenging the scientific consensus that global warming is real and is attributable mainly to human consumption of fossil fuels. Deniers' questioning of the climate data and their attacks on the integrity and motivations of the scientists involved was exemplified by the e-mail-hacking 'climate-gate' scandal of 2009. This is perhaps the greatest threat from pseudoscience today.

Velikovsky and Lysenko may be largely forgotten, but other forms of pseudoscience are flourishing — among both the public and many politicians. Gordin's historical analysis of pseudoscience remains disturbingly relevant. ■

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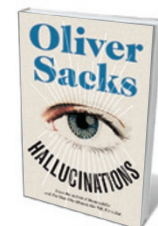
NEUROSCIENCE

Encounters with the nonexistent

Dominic ffytche contemplates Oliver Sacks' journey through the past and future science of hallucinations.

Oliver Sacks' *Hallucinations* opens with something of an apology. The neurologist explains that his book will not focus on cutting-edge brain-imaging studies of what happens during a hallucination or what predisposes individuals to having them; rather, it will concentrate on first-person accounts, with the aim of understanding what it is like to hallucinate. It is as if Sacks worries that such an approach is insufficiently scientific, in an era of functional and structural neuroimaging.

Such concerns are unfounded. Imaging studies have made significant contributions to the field, but it is still Sacks' clinical territory — where the listening, archiving



Hallucinations
OLIVER SACKS
Picador/Knopf
2012. 336/352 pp.
£18.99/\$26.95

and recognition of repeated patterns of symptoms takes place — that sets the research agenda.

By analogy to eighteenth-century catalogues of flora and fauna from different corners of the world, Sacks structures his book as a 'natural history' of hallucinations.

Chapter by chapter, he describes the various clinical and physiological settings in which people have hallucinations. They might ▶



The Collapse of Mechanism and the Rise of Sensibility

Stephen Gaukroger (Oxford Univ. Press, 2012; £25)
Historian of philosophy Stephen Gaukroger charts how a sensory view of nature coincided with the novel's rise in 1680–1760. (See George Rousseau's review: *Nature* **470**, 462–463; 2011.)



A Universe from Nothing: Why There Is Something Rather than Nothing

Lawrence M. Krauss (Simon & Schuster, 2012; £8.99)

The current thinking on multiverses, dark energy and what is meant by 'nothing' is unpicked by theoretical physicist Lawrence Krauss. (See Caleb Scharf's review: *Nature* **481**, 440; 2012.)

► see indecipherable writing, or miniature costumed figures (visual hallucinations); smell dill pickles (olfactory hallucinations); or hear incessant renditions of the song *White Christmas* (musical auditory hallucinations).

Using descriptions from his patients, correspondents and published accounts, Sacks covers areas as diverse as eye disease, stroke, drugs (in poignant revelations from his own past) and bereavement, as well as bizarre perceptual experiences that defy simple classification. Such classificatory dilemmas include the case of Sarah, who saw herself from the ceiling of an operating theatre (in an 'out of body' experience); and Ellen, whose brother's profile remained fixed in her vision for days (visual perseveration). What all such experiences share is that the perceived object either isn't there or differs in some way from how others would perceive it.

In the neurology clinic, hallucinations tend to be visual; in the psychiatric clinic, the overwhelming majority are auditory — specifically, voices. Sacks writes from a neurologist's perspective, so his catalogue of visual phenomena and other neurological symptoms is comprehensive and scholarly. Hallucinated voices and other manifestations of schizophrenia and bipolar disorder he mentions only in passing. They require, he suggests, a book of their own.

Hallucinations gives Sacks the opportunity to explore an area new to him: the paranormal. Before the twentieth century, hallucinations were often seen as belonging to the domain of spiritualism, ghost hunting, telepathy, crystal gazing and divination. The most detailed survey of hallucinations ever undertaken remains the International Census of Waking Hallucinations in the Sane, conducted in the 1890s for the Society for Psychical Research in London, to uncover evidence for communication from the dead.

Chapter titles such as 'Phantoms, Shadows, and Sensory Ghosts' and 'The Haunted Mind' remind us of these metaphysical probings. Hallucinations and

other anomalous brain experiences, Sacks suggests, lie behind psychical and paranormal phenomena, as well as fairy-tale and folklore descriptions of devils, witches, elves and leprechauns (or, more recently, alien encounters).

Sacks' book comes at a time of exciting developments in hallucination science. A key challenge to progress at present is the question of whether all types of hallucination are caused by the same brain mechanism, or by several distinct ones. In Sacks' natural-history terms, are hallucinations a single species of symptom or a family of species? It seems probable that the answer is a mixture of the two. Although they are

faulty efference signals. These signals come from the motor system and spread throughout the brain to inform it of impending movement or action. In current psychiatric accounts of hallucinations, faulty efference signals are thought to cause a failure to recognize thoughts, actions or inner speech as originating with oneself, so that they are perceived as spoken or controlled by others.

Other hallucination theories are based on knowledge stored in the brain that influences what we perceive through expectation or preoccupation. Sacks tells us of Marion, for example, who while grieving the loss of her husband, heard and saw him greeting her as she returned home — a 'top-down' influence that might be considered a third species of hallucination.

Current research is seeking to establish whether these apparently different species can be reconciled in a single overarching mechanism. Whatever the outcome, future classificatory schemes of hallucinations and related phenomena are likely to be very different from those we have now.

Hallucinations also take us to the edge of our understanding of perceptual consciousness by hinting at brain functions and processes that we did not even know were there. There is nothing in our models of object vision that explains Rosalie's descriptions, in *Hallucinations*, of silent multitudes in elaborate Eastern dress, or Marlon seeing his home, in reality ordered and tidy, as a world of chaotic dilapidation. It

is observations such as these, derived from the consulting room, that challenge the neuroscience of perception — and Sacks is leading the way. ■

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A KEY CHALLENGE IS WHETHER ALL TYPES OF HALLUCINATION ARE CAUSED BY THE SAME BRAIN MECHANISM.



very different, hallucinations originating in eye disease, hearing loss, amputation, sensory deprivation or stroke might be considered a single species because, for each, loss of input to the brain triggers a sequence of neurophysiological changes that results in spontaneous neural firing and hallucinations.

Another cause of hallucinations, which might be considered a second species, is



The Better Angels of Our Nature: Why Violence Has Decreased

Steven Pinker (Penguin, 2012; \$20)

We are becoming less violent thanks to societal evolution, avers psychologist Steven Pinker, citing significant evidence showing that warfare and murder rates are falling. (See Martin Daly's review: *Nature* **478**, 453–454; 2011.)



In Other Worlds: SF and the Human Imagination

Margaret Atwood (Virago, 2012; £9.99)

The creator of dystopian worlds in *Oryx and Crake* and *The Year of the Flood* looks to her own work and that of authors such as Kazuo Ishiguro and H. G. Wells in a collection of essays exploring science fiction. (See Q&A: *Nature* **478**, 35; 2011.)