

advertises a site for a few hours, even if she has found a dream home.

This stops the swarm jumping to a premature conclusion — a vital delay, as the best site is rarely found first. Eventually, the dynamics of dancing cause about 20–30 scouts to arrive at a single, high-quality nest site. Once this quorum is reached, the scouts stop the debate and communicate their decision to the swarm with high-pitched piping sounds and by running amid the other bees buzzing their wings, a preflight routine. The swarm then warms up and moves off, the scouts pointing the way.

This form of decision-making is extremely robust. Each bee's job is simple. Even if one makes a mistake, the rules that transform individual deeds into collective behaviour set the swarm back on course. Other systems have independently evolved the same tricks. A neuron, for example, carries little information. But by using similar rules to bees, cells combine to enable our brains to do clever things, such as tracking a moving object.

In the final chapter, Seeley lists his bee-derived rules for good human decision-making, and describes how he applied them as head of Cornell University's neurobiology and behaviour department in Ithaca, New York. He points out that groups make the best decisions when leaders interfere as little as possible. Individuals are then free to explore and debate options, and are most likely to arrive at the best decision. The wise leader, he advises, manages the process of decision-making and lets the product take care of itself.

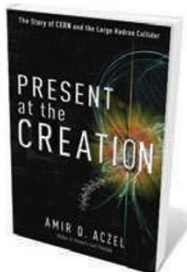
In his own community, Seeley ensured that all possibilities were considered and that everyone had his or her say. He then stepped back to let the group make up its own mind by secret ballot. Such a process (discovered by several human societies independently) ought to work well in situations where a group with a common interest chooses between many options, from friends choosing a holiday destination to a government poised to invest billions in a defence system.

However, this rule about leaders facilitating decisions rather than making them is also the one humans find hardest to apply. Why struggle to the top if you can't push your own agenda? Or why pick leaders if they don't make their presence felt? In a crowd-sourcing exercise this year by the new UK government, for example, the public was asked to propose policy ideas and money-saving tips. Thousands of suggestions came in. But people were not asked to choose between the proposals. The decisions remained with those at the top. Humans prize their power and expertise — and that, Seeley's splendid book suggests, may be a cause of many of our problems. ■

John Whitfield is a science writer based in London. His book about reputation will be published in 2011.

e-mail: j.a.whitfield@gmail.com

Books in brief



Present at the Creation: The Story of CERN and the Large Hadron Collider

Amir D. Aczel CROWN 288 pp. \$25.99 (2010)

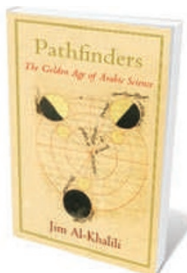
Mathematician and author Amir Aczel describes the origins and science of the Large Hadron Collider at CERN, Europe's particle-physics lab near Geneva. Conveying his excitement at visiting the game-changing machine, Aczel's odyssey includes the voices of key scientists. After explaining the history of the standard model of particle physics, he looks ahead to string theory, the identity of dark matter and tests of the Higgs mechanism for conferring mass. But the real gems, he believes, will be beyond our imagination.



Good Faith Collaboration: The Culture of Wikipedia

Joseph Michael Reagle Jr MIT PRESS 256 pp. £20.95 (2010)

Joseph Reagle, a computer-science historian, looks at the collaborative culture behind online encyclopaedia Wikipedia. He charts the technology-driven attempts in the 1930s to collect the world's knowledge and bypass elite publishers, such as Paul Otlet's information indexing system and H. G. Wells's proposal for a World Brain stored on microfilm. Wikipedia, Reagle argues, comes close to the goal of a universal encyclopaedia owing to the openness of its users in assessing knowledge. But there are downsides to inclusivity — for example, censorship, lawsuits and bureaucratization.



Pathfinders: The Golden Age of Arabic Science

Jim Al-Khalili ALLEN LANE 336 pp. £25 (2010)

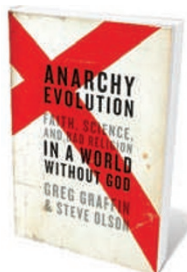
Physicist, author and broadcaster Jim Al-Khalili celebrates the forgotten pioneers of early Arabic science. His focus is the House of Wisdom, a great centre of learning established in the ninth century by the caliph of Baghdad, Abu Ja'far Abdullah al-Ma'mun. Among its wise alumni are Syrian astronomer Ibn al-Shatir, whose work inspired Nicolaus Copernicus's heliocentric model of the Solar System; Andalusian physician Ibn al-Nafees, who described blood circulation 400 years before William Harvey; and zoologist al-Jahith, who proposed natural selection 1,000 years before Charles Darwin.



The Planet in a Pebble: A Journey into Earth's Deep History

Jan Zalasiewicz OXFORD UNIVERSITY PRESS 256 pp. £16.99 (2010)

Every pebble holds the story of Earth, shows geologist Jan Zalasiewicz. He extracts from a humble stone evidence of the violent formation of the Solar System, in which our embryonic planet was dusted with the detritus of supernova explosions and the elemental litter of the Big Bang. Trapped, too, is the tale of Earth's evolution — the lives and deaths of disappeared plants and animals, volcanic eruptions and long-vanished oceans. Zalasiewicz explains how oil and minerals form and how geologists use clever chemistry to sniff out the resources on which we depend.



Anarchy Evolution: Faith, Science and Bad Religion in a World Without God

Greg Graffin and Steve Olson IT BOOKS 304 pp. \$22.99 (2010)

Greg Graffin's memoir, co-authored with science writer Steve Olson, offers an unusual perspective on evolution. As an evolutionary biologist and lead singer of punk band Bad Religion, Graffin argues that research and punk rock have much in common: both require an open mind and look to evidence and rationality. Bucking authority and the religious views of his family, Graffin explains how he has developed a personal philosophy that celebrates the power of nature.