attracted considerable research funding. Although 'prediction' is an enticing word, how it will be done is vaguely described at best. In Wolfe's research programme, prediction seems to involve fine-scale surveillance — for instance, through increasingly high-tech surveys of viral biodiversity in potential reservoir species, the monitoring of unusual animal die-offs, and the minute-by-minute screening of Google trends, Twitter and mobile-phone data.

Gathering such data is laudable, but still more reactive than predictive. In reality, accurate prediction faces challenges that could prove insurmountable. A novel virus discovered in a potential reservoir species may not replicate in human cells; a virus that replicates in human cells may not transmit between humans; and a variety of epidemiological processes dictate that even if such a virus is able to transmit between hosts, it may not spread through a population. Predicting viral emergence therefore requires a difficult, and perhaps unattainable, synthesis of genetics and epidemiology.

I believe that this fad for prediction presents a greater danger: that we establish expectations so unrealistic that they are met with inevitable failure, in turn undermining public confidence. Another unwelcome consequence, in my view, is the diversion of research funds from basic biological studies of viral emergence — such as defining the relationship between a virus and its host-cell receptor — to more speculative programmes, such as predicting future viral evolution.

Wolfe has become the public face of emerging disease. This enjoyable, well researched and thought-provoking book shows that he has a clear vision of how pandemics occur in human populations and the part he might play in their prevention and control. Although it is not clear what the coming years will hold, one safe prediction is that Wolfe will have a lot more to say. On the evidence of this book, he is worth listening to. ■

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TECHNOLOGY

The inspiration exchange

Chris Lintott assesses an idea that unites individual scientific expertise with collective intelligence.

Imagine sitting down at your computer each morning and choosing what to work on from a list of problems submitted by scientists from around the world. The requests cut across academic boundaries, yet have been selected with you in mind as the person best qualified to solve them. What would such a system achieve? What would your career be like as a consequence?

This scenario is the vision of writer and quantum-computation expert Michael Nielsen. In 2007, he announced on his blog that he felt he could have more impact by developing new scientific tools than by pursuing his physics research. *Reinventing Discovery*, his thought-provoking call to arms, suggests he was right.

Nielsen is convinced that, as a result of our growing ability to share information and ideas, we are living through a revolution

The Arsenic Century: How Victorian Britain was Poisoned at Home, Work, and Play
James C. Whorton (Oxford Univ. Press, 2011; £9.99)
Arsenic in the nineteenth century was ubiquitous — stored in kitchens as a rat killer, or used to dye sweets, candles and gloves. Historian James Whorton shows how its deadly past resonates with the environmental poisonings of today.

Where Good Ideas Come from: The Seven Patterns of Innovation
Steven Johnson (Penguin, 2011; £9.99)
Good ideas, says writer Steven Johnson, are rarely produced by lone geniuses. Innovation more often grows out of a network of minds, he argues. Universities offer the best chance for breakthroughs as they lack market pressures.

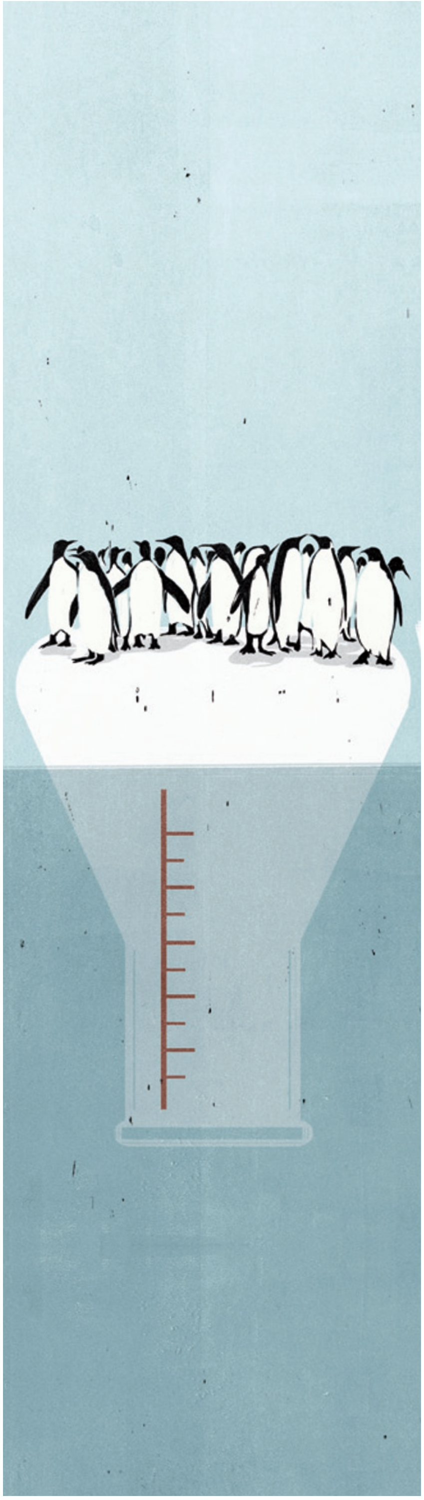
Reinventing Discovery: The New Era of Networked Science
MICHAEL NIELSEN
Princeton University Press: 2011. 280 pp. $24.95, £17.95

in how knowledge is constructed. He argues that, just as the widespread adoption of the scientific method in the seventeenth century made discovery a realistic aim for anyone who could devise the right experiment, so the rise of data-driven discovery will transform the ability of the average scientist to contribute. Although there is room for the lone genius, the rest of us need all the help we can get.

Researchers should take advantage of the emergence of this collective intelligence to tackle more difficult problems, Nielsen suggests. In one chapter (on which I gave feedback), he describes a variety of web-based 'citizen science' and other case studies to marshal his points. Some have research as their goal, such as my Galaxy Zoo project (www.galaxyzoo.org), which enlists the public's help in classifying galaxies, and the collaborative mathematics carried out by participants in the Polymath projects (www.polymathprojects.org). But a strength of Nielsen's book is that many more of the examples come from beyond academia.

For instance, a virtual game of chess in 1999 pitted the then world champion Garry Kasparov against 'the world', as represented by the votes of some 50,000 online participants. It was more keenly fought than expected. The game hinged on a critical move by 'the world' that was proposed by US women's champion Irina Krush. Moving the black queen to fork two pawns, Krush exploited her knowledge of a previous situation she'd studied to open up a novel position. She wasn't in Kasparov's league, but she had the ability and knowledge to exploit the situation in which her team found itself.

This idea of micro-expertise underlies Nielsen's vision of networked discovery. If enough people are exposed to a problem, he explains, the odds of one of them having the special insight or analytical ability needed to solve it increases, and so does the speed of discovery.



The key is that, as with Krush, the right person is faced with the right problem at the right time. What links the successful case studies in the book is that each has a system for directing the attention of the multitude of participants. Posts on the Polymath blog, for example, are structured so that each contains only one insight, making it easier to direct your contributions. It is this sort of systematic focusing of attention that moves us beyond the traditional 'wisdom of crowds' to a more powerful and subtle collective intelligence, capable of solving even complex problems.

It is tempting to rail against the lack of romance in Nielsen's collective vision, but a division of labour has been under way in science for decades. Many scientists are happy to leave the creation of large data sets to those who specialize in it: modern astronomers, for example, are more likely to write a database query than to visit a telescope. Last year saw the launch of ScienceExchange.com, which allows professional labs to sell their spare experimental capacity in a market tailored to that commodity. An exchange for inspiration, or at least for mental capacity, may not be far behind.

In a plea for an "open science imperative", Nielsen argues that scientists need to do more than swap data and code. They need to share speculative thoughts — including half-finished ideas and open questions. Some are already doing this: take Rosie Redfield's open-resource blog chronicling her microbiology experiments and bench-based musings from her lab at the University of British Columbia, Canada (see go.nature.com/ae82wp). But it is still a lonely endeavour, and until a substantial number of leading researchers take the plunge, it is likely to remain so.

Nielsen ends simply, with the suggestion that we all try openness. The lack of a step-by-step programme for the revolution comes as a disappointment, but it is to his credit that he convinces us that radical change is a real possibility. *Reinventing Discovery* will frame serious discussion and inspire wild, disruptive ideas for the next decade. ■

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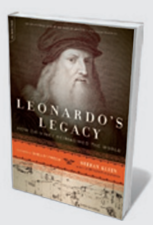
Internet Alley: High Technology in Tysons Corner, 1945–2005
Paul E. Ceruzzi (MIT Press, 2011; $14.95)
Historian Paul Ceruzzi uncovers the story of the hub in Virginia from where much of the Internet is managed and governed. "Ceruzzi chronicles the evolution of Internet Alley astutely and accurately," wrote Joel Shurkin (*Nature* **452,** 533; 2008).



Leonardo's Legacy: How Da Vinci Reimagined the World
Stefan Klein (Da Capo Press, 2011; $16)
Leonardo da Vinci designed a working robot, a heart valve and weapons. Science writer Stefan Klein analyses aspects of the artist's scientific genius, from well-known projects such as his flying machine to other, more obscure inventions.