



DRUGS

Gut response

Maryn McKenna finds much to digest in a warning about the demise of our bodily bacteria.

Last year, two public-health-agency chiefs chose dramatic language to alert their nations to a menacing health problem — a rise in the spread and severity of bacterial resistance to antibiotics. UK chief medical officer Sally Davies called it a “catastrophic threat”; Thomas Frieden, director of the US Centers for Disease Control and Prevention, spoke of a “nightmare”. They were flagging the emergence of an almost pan-resistant bacterium, carbapenem-resistant Enterobacteriaceae. This is the latest in a

series of tough-to-treat organisms — the result of overuse of antibiotics since the 1940s.

In *Missing Microbes*, Martin Blaser sounds a related alarm. He patiently and thoroughly builds a compelling case that the threat of antibiotic overuse goes far beyond resistant infections. Antibiotics, he warns, are destroying the benign bacteria that are crucial to the functioning of human bodies, and this trend is contributing to health problems from obesity to diabetes and bowel disease.

Antibiotic resistance can be devastating for

patients, but it has until recent years received scant attention from policy-makers, as Blaser knows. A physician and microbiologist, he has treated many people with resistant infections. And as past president of the Infectious Diseases Society of America, he pressed the US government to curb antibiotic overuse and encourage drug development.

Blaser, who is also director of New York University’s Human Microbiome Project, investigates the personal bacterial ecosystems that allow us to absorb nutrients and develop immunity. He has long studied *Helicobacter pylori*, a bacterium that thrives in the stomach and can cause ulcers and stomach cancers. Using mouse experiments and epidemiological data, he has shown that *H. pylori* may also be associated with a reduced incidence of asthma, allergies and severe reflux disease. That should concern us, he writes, because worldwide, the rate of *H. pylori* infection is going down.

The make-up of human microbiomes is shifting, with diversity declining and keystone species disappearing. Blaser blames these changes on innovations that impede bacterial attempts to set up shop inside us. Examples include germ-killing hand sanitizers, and Caesarean sections that rob newborns of the bacterial kick-start that they usually get by passing through the birth canal. In the United States alone, one-third of all births are now Caesareans.

Blaser is strongest, and most provocative, when he questions a practice that has become routine in much of the industrialized world: feeding small doses of antibiotics to meat animals as growth promoters. The early discovery that antibiotics work as fattening agents gave birth to the entire structure of modern concentrated meat-raising. By saturating the environment with antibiotic residues, Blaser argues, we have effectively recreated that weight-gain programme in humans — and the result has been the seemingly unstoppable increase in obesity, especially in children.

Can the trend of inadvertently destroying our microbiomes be reversed? Blaser is sceptical. The public has been indifferent to warnings about resistance since antibiotic use began: penicillin discoverer Alexander Fleming cautioned in his 1945 Nobel prize acceptance speech that using the drugs carelessly would undermine their power to treat

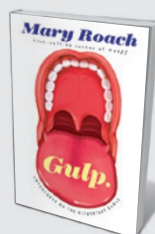
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An Appetite for Wonder: The Making of a Scientist

Richard Dawkins (Black Swan, 2014)

From childhood in Africa to enlightenment in Oxford, Richard Dawkins chronicles his life before *The Selfish Gene* (1976) and the nature and nurture of his science obsession. (See Eugenie Scott’s review: *Nature* **501**, 163; 2013.)



Gulp: Adventures on the Alimentary Canal

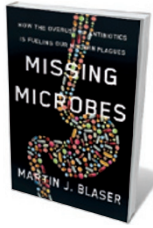
Mary Roach (W. W. Norton, 2014)

Journalist Mary Roach offers a consummate tour of the digestive system. Investigating dog-food-testing facilities, brain-munching Inuits and optimum mastication techniques, Roach maintains a balanced diet of wit and reliable gastro-wisdom. (See David Katz’s review: *Nature* **495**, 446; 2013.)

EDUCATION

Digital lessons learned

Robert Lue enjoys a deft study of online pedagogy.



Missing Microbes: How the Overuse of Antibiotics is Fueling Our Modern Plagues
MARTIN J. BLASER
Henry Holt: 2014.

lethal diseases. Antibiotics — like Caesarean sections and hand sanitizers — make modern life easier. Blaser would say that we have ignored Fleming’s warning: we have consistently chosen convenient over smart and safe.

The first step, Blaser says, is to roll back antibiotic overuse in agriculture and medicine. After that, he suggests, we should bend our appetite for innovation towards finding ways to repair the microbiome damage that the wonder drugs have done.

Blaser foresees the development of microbial supplements — a more sophisticated version of the faecal transplants already being used in some quarters to combat *Clostridium difficile* infections — that could restore microbial communities devastated by antibiotics. The regulation of faecal transplants has confounded the US Food and Drug Administration (M. B. Smith *et al. Nature* 506, 290–291; 2014), but many patients — along with academic researchers in Europe and Australia — have taken to them intuitively and enthusiastically. It seems likely that Blaser’s concept of personal, protective microbial cocktails would also find support.

It is urgent that we take these steps soon. *Missing Microbes* explains that our ancient microbiome is akin to an essential organ; we unthinkingly excised it, and only now are waking up to the implications. Changes to it come with costs, Blaser warns, “but we are only just beginning to recognize them. They will escalate.” ■

Maryn McKenna is the author of *Superbug* and *Beating Back the Devil*, and a senior fellow at the Schuster Institute for Investigative Journalism at Brandeis University. She lives in Atlanta, Georgia.
e-mail: mmckenna@mindspring.com

Massive open online courses, or MOOCs, have generated unprecedented debate over their educational value and impact on the university ecosystem in the past three years. Deploying videos, online assessments and discussion forums to teach potentially 100,000 students at a time, MOOCs have taken off with the advent of for-profit companies such as Coursera in Mountain View, California, and non-profit efforts including edX, founded by Harvard University and the Massachusetts Institute of Technology (MIT) in Cambridge. As the faculty director of HarvardX, the Harvard initiative involved with edX, I have observed the pendulum of media opinion swing between extremes.

Initially MOOCs were lauded as the ultimate way to deliver educational content: they could reach the farthest corners of the globe and cut costs to promote sustainability. Now, views have reversed: the schemes seem to be reaching mainly those who already have a degree, and concerns are emerging that they will threaten faculty jobs in some institutions. The reality will almost certainly lie between.

In her provocative book *The War on Learning*, Elizabeth Losh fires several warning shots across the bows of online education. Along with MOOCs, she takes on active learning methods such as real-time online polling. She provides welcome context on both the recent history of distance education, covering efforts such as the OpenCourseWare movement launched by MIT in 2002, and the surprising contribution of applications such as iTunes. Her book is a timely exploration of the sometimes daunting but often rewarding faculty

and institutional experience of teaching with technology; it touches on students’ experience more lightly.

Losh is critical of both irrational exuberance over the reach of technology, and panic that it has destroyed the classroom. She presents anecdotes documenting instructors’ successes and failures, including her own misadventures using Twitter to engage a large lecture class in the Culture, Art and Technology programme at the University of California, San Diego. It became a platform for humorous expressions of student inattention and class-wide pranks. Indeed, not all modes of digital engagement are suited to education: anonymous mass action can result solely in mischief. Losh seeks a pedagogical silver lining by connecting classroom Twitter with new ways for students to engage with both content and the learning experience.

Losh’s rich selection of anecdotes swerves between triumphs and tragedies — so much so that real success becomes difficult to recognize. She seems to revel in this ambiguity, perhaps seeking to underscore just how much remains unproven and unsettled in a field still find-

ing its way. Is the compelling but carefully scripted drama of a TED Talk a model for engaging students online — or an opportunity for mutual narcissism, whereby the speaker tells the audience exactly what they want to hear? Does the professor lauded for his or her classroom oration promote self-interest above learning when their online reach goes global?

Healthy scepticism is Losh’s dominant tone, especially in her discussion of ‘gamification’ — the use of video-game ▶

NOT ALL MODES OF DIGITAL ENGAGEMENT ARE SUITED TO EDUCATION.



To Save Everything, Click Here: The Folly of Technological Solutionism

Evgeny Morozov (*PublicAffairs*, 2014)
Can a toolbox of techno-fixes really solve climate change, disease and crime? Social theorist Evgeny Morozov rebels against a technocratic Utopia and critiques the ideology of computerized cure-alls. (See Nicholas Carr’s review: *Nature* 495, 45; 2013.)



Brilliant Blunders: From Darwin to Einstein

Mario Livio (*Simon & Schuster*, 2014)
Astrophysicist Mario Livio reveals the epic errors of famous scientists that yielded glorious breakthroughs. When Einstein misconstrued universal equilibrium, his equations led to the discovery of the expanding cosmos. (See Mario Livio’s Comment: *Nature* 497, 309–310; 2013.)