

► level, there is Reykjavik's success in using new technology to extend the reach of its municipal lawmaking institutions by enabling citizens to suggest, and vote on, initiatives. Surprisingly, Mulgan devotes an optimistic chapter to ways of improving how we run meetings. He calls for smaller meetings that promote a shared understanding of their purpose through clearer agendas, allocation of defined tasks, well-stated goals, and better use of space, moderation and gadgets.

Equally surprising is his ultimately dour and dispiriting assessment of the limits of collective intelligence for improving parliaments and legislatures at scale. He overestimates the success of new platforms for generating ideas, which, over time, have not led to much in the way of outcomes and have only increased frustration with democratic institutions. At the same time, he potentially underestimates emerging models for “crowdlaw” — that is, those online processes for engaging broader publics in making decisions and evaluating their impact.

Mulgan points to examples of complex and large-scale political collaborations, such as the Paris Climate Accord and the 2015 ratification, by 193 countries, of the 17 global Sustainable Development Goals. And he rightly concludes that the jury is still out on the question of which processes or technologies could sustain new forms of collective public governing.

Inspired by this question, the fifth annual Collective Intelligence Conference, held in June in New York City, focused on democracy. Experts from computer science to the social sciences came together to examine what democratic institutions need to do to better tap the intelligence and expertise of those they govern. As Mulgan concludes, answering this question is hampered by a stark fact. Although parliaments fund and universities conduct research, neither invest much in ways to improve how institutions actually mobilize collective intelligence. Despite the advent of the Internet, these bodies look the same as they did a generation ago. The trenchant questions and thoughtful discussion in *Big Mind*, however, will help us to reimagine our institutions and convince us of the urgency of doing so. ■

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Researchers collaborate at the ATLAS experiment at CERN.

RESEARCH MANAGEMENT

What makes teams tick

Kara L. Hall examines a study of current research on scientific collaboration.

Tackling global challenges such as food insecurity, or advancing complex technologies like quantum computers, requires collaboration. ‘Team science’ may involve two researchers in the same department, or thousands across the globe: teams of teams, such as those at the Large Hadron Collider at CERN, Europe’s particle-physics laboratory near Geneva, Switzerland. To develop techniques for 3D printing of human tissues, say, researchers must integrate life science and material science with electrical and mechanical engineering; transcending such disparate disciplines complicates collaboration.

As the complexity of team science increases, so does demand for sophisticated skills, strategies and resources. Yet currently, although it is relatively common to find scientific structures and norms suited to small, single-discipline research teams, support for more-complex teams remains inadequate.

In 2006, a new cross-disciplinary field was launched: the ‘science of team science’ (SciTS). Its aim is to build an evidence base to help administrators, funders, researchers and others determine the best ways to structure and support scientific teams and improve their effectiveness. The field examines the impacts of, for example, science policies, organizational structures, technological tools, team management and individual competencies on the success of science teams. In *The Strength in Numbers*, science-policy specialists Barry Bozeman and Jan Youtie delve into one aspect of SciTS: managing teams.

Drawing heavily from a survey of 641 researchers, interviews with 60 faculty members and web posts from 93 anonymous contributors, the authors focus on conflicts in relatively small teams and co-author

relationships. They classify collaborations into four types — dream, routinely good, routinely bad and nightmare — and offer advice for addressing factors such as working style, career stage and trust.

The Strength in Numbers: The New Science of Team Science
BARRY BOZEMAN &
JAN YOUTIE
Princeton University
Press: 2017.

For many, *The Strength in Numbers* might come across as a missed opportunity. Bozeman and Youtie state that research on collaborative teams has become fragmented, or “balkanized”, yet they risk fuelling such divisions by citing literature from leading SciTS scholars in just a handful of paragraphs. The authors intermittently mischaracterize and dismiss existing SciTS research and resources such as the Team Science Toolkit, instead of considering how those might bolster their “prescriptions”. Much of their advice is either overly specific or vague. To one researcher, they recommend: “Get through the project the best you can, and then do not work with the senior colleague again.”

Meanwhile, they tout their newly developed “Consultative Collaboration” strategy as the primary answer to the complexities of team science. All team members, they argue, should be consulted at key points in a collaboration to pin down values and choose the next steps. Yet fewer than a dozen pages are devoted to discussing the approach, and only a handful include explanations of how to use it. This leaves the reader to ponder what strategies such as “effective communication, not constant communication” actually mean. Consulting the decades of existing literature on the science of management, leadership or teams would have provided detail and depth.

And detail and depth are sorely needed. As I talk to researchers, science administrators and leaders, I hear frustration ('We tried getting faculty members to collaborate across boundaries, but it didn't work'). I also hear resistance to changing rewards and incentives ('Language about team science in our policies would lower our bar for promotion') and confusion about how to support team science ('Why fund large centres, instead of having lots of small grants?'). Leaders often want to maintain tradition ('We value team scientists, they just shouldn't get tenure', or 'It's unethical to encourage junior investigators to do interdisciplinary research'). Researchers may have difficulty adjusting to multidisciplinary ('The more transdisciplinary I become, the less I seem to fit in at my institution').

Bozeman and Youtie present SciTS as one of several revolutionary trends in science, alongside commercialization of research, the drive for gender diversity and multiculturalism, and the rise of multidisciplinary. To propel SciTS forward, Bozeman and Youtie acknowledge the need for multilevel and systems approaches — yet state that the analytical and data requirements "are prohibitive".

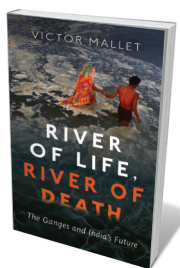
Probably the biggest barrier to conducting more systematic and complex SciTS research is the lack of established support for SciTS scholarship from designated federal funding programmes. With adequate funding, SciTS experts will be able to build cross-disciplinary teams of researchers and put their scholarship into practice.

The great mission of science is, directly or indirectly, bettering the world. Yet its structures and cultures are misaligned with key approaches, such as team science, that are crucial to advancing its mission. What changes should happen? Do we scale up bold ones, such as restructuring our universities, as Arizona State University in Tempe is doing? Do we continue to foster new roles, such as those of interdisciplinary executive scientists who broker knowledge connections across large initiatives? And will modest moves, such as creating new promotion policies for team scientists, make a difference?

Evidence generated by SciTS can inform such decisions. The 2015 US National Academies of Sciences, Engineering, and Medicine report *Enhancing the Effectiveness of Team Science* was the organization's third most downloaded publication that year. The report lays out the opportunity and promise of SciTS: to use science to transform the ways researchers do science. ■

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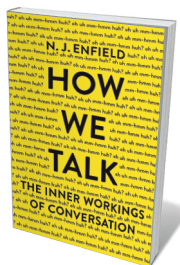
Books in brief



River of Life, River of Death: The Ganges and India's Future

Victor Mallet OXFORD UNIVERSITY PRESS (2017)

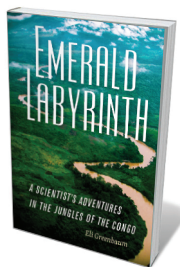
How has India's mighty Ganges river become a conduit for "the industrial effluents of Kanpur, the sewage of Varanasi, and the garbage of Patna and Calcutta"? Victor Mallet explores some ferociously muddied waters through lenses geographical, political and religious. He finds vast challenges, from the prevalence of the bacterial enzyme NDM-1, implicated in antibiotic resistance, to wild bureaucratic promises. But with many Indian policymakers concerned about the state of a waterway supporting 450 million people, Mallet is cautiously hopeful for more-synchronized political will.



How We Talk: The Inner Workings of Conversation

N. J. Enfield BASIC (2017)

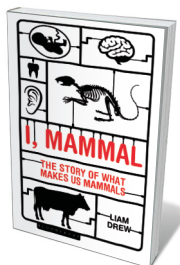
Out of every 60 words we speak, one will be 'um' or 'uh'. Such patterns of behaviour, argues linguist N. J. Enfield in this assured study on the science of dialogue, are predictable and cross-cultural — a "conversation machine" that drives verbal communication worldwide. Each exchange, he argues, is a demonstration of distributed cognition, a process of give, take and observation in which 'meaningless' words may regulate conversational traffic. From the universality of 'huh?' to the imperative of time, Enfield opens a window on linguistic dimensions far beyond grammar.



Emerald Labyrinth

Eli Greenbaum FOREEDGE (2017)

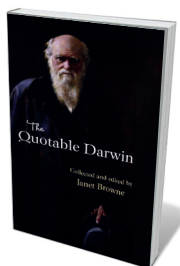
Over the past decade, herpetologist Eli Greenbaum has tracked shifts in biodiversity in the Democratic Republic of the Congo — a country haunted by Belgian colonial atrocities and riven by a recent war that claimed 5 million lives. Thus, Greenbaum's account of a 2008 expedition with Congolese colleague Chifundera Kusamba and a crack team of local rangers is much more than derring-do among prodigious natural riches: it is also a meditation on how colonial power seeds violence. A valuable record of conflict and conservation at a time of climate change and population pressures.



I, Mammal: The Story of What Makes Us Mammals

Liam Drew BLOOMSBURY SIGMA (2017)

As former neurobiologist Liam Drew reminds us in this splendid evolutionary study, humans belong to an exclusive club, along with aardvarks and bumblebee bats. Mammalia, a vertebrate class 210 million years old, boasts more than 5,000 species with intriguing traits such as mammary glands. Drew is a wry guide to wonders such as the evolution of the scrotum and the epic journey of marsupial newborns. But, at heart, his is an erudite analysis of organisms as "Russian dolls of biological identity", whose ancient, intricate lineages make any extinction all the grimmer.



The Quotable Darwin

Edited by Janet Browne PRINCETON UNIVERSITY PRESS (2017)

"At last gleams of light have come... I think I have found out (here's presumption!) the simple way by which species become exquisitely adapted to various ends." Thus, Charles Darwin to botanist Joseph Dalton Hooker in an 1844 letter — just one gem from Janet Browne's selected excerpts. Darwin vividly emerges as a crack shot with a tin ear for music, a loving father, a would-be anthropologist struggling to understand indigenous peoples and the consummate scientist, working "from a sort of instinct to try to make out truth". **Barbara Kiser**