From 1940, Blackett sat on the MAUD Committee, assessing the likelihood that research on nuclear chain reactions would lead to a practical atomic weapon within the timespan of the war. At first he was the lone British voice calling for the weapon to be developed only by the United States. After the war, and particularly after the 1946 McMahon Act broke with any pretence of joint UK–US responsibility for the bomb, Blackett argued vehemently against a British bomb project. He tried private routes of influence, but was rebuffed by the prime minister, Clement Attlee. So he went public, writing *The Military and Political Consequences of Atomic Energy*.

"Neither communist nor pacifist, Blackett had no argument with war," writes Nye, so why did Blackett take such "an outspoken and unpopular political position on matters of nuclear policy immediately following the Second World War?" Because his naval and operational-research experience taught him that policy decisions driven by inadequate knowledge were likely to be wrong. And because he was appalled by war-games theorizing, which he viewed as inhuman. ■

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Living with viruses

Viral Fitness: The Next SARS and West Nile in the Making
by Jaap Goudsmit
Oxford University Press: 2004. 202 pp. £18.50, $29.95

Steven Wolinsky

Breathing can kill you. So can eating and drinking. We live in a world where pathogenic microorganisms in air, food and water pose an omnipresent threat to human health and agriculture. Yet we continue to expand our global presence, engage in high-risk sexual behaviour, and produce more crops and domesticated animals bred for traits that restrict their diversity. As a result, we are exposing ourselves to dangerous viral pathogens that can cause epidemics on a scale seen only in apocalyptic novels. Viruses will inevitably help decimate our natural world and humans as well. So claims Jaap Goudsmit in his engaging new book, *Viral Fitness*.

Goudsmit, a professor of communicable diseases at the University of Amsterdam in the Netherlands, chooses several diseases of plants, animals and humans as case studies in the epidemiology and evolutionary biology of emerging viral pathogens. He highlights important ecological factors in the emergence of viruses, such as the role of waterfowl in the rise of the H5N1 influenza virus, which led to an outbreak of avian flu in Asia; the part the bushmeat trade played in the appearance of HIV in Africa; and the role of the consumption of palm civet in the spread of the coronavirus that causes severe acute respiratory syndrome (SARS).

Paying the price: the H5N1 influenza virus that caused avian flu was spread in Chinese markets.

M. HENLEY/PANOS

To become dangerous to humans, such viruses must cross the species barrier, which requires both genetic factors and incursions into new ecological niches. Antibodies against the SARS coronavirus from the Himalayan palm civet, the putative species of origin, have been found in other animals sold at local Chinese markets, implying that there are constraints to adaptation across species. Goudsmit points out that few transmission events are sustained. Monkeypox virus and the O and N groups of HIV type 1, for example, infected human hosts with limited subsequent transmission. This suggests that dead-end transfers of viruses with imperfect adaptation to the new host species may be common, and that transmission of a pathogen that spreads to epidemic proportions may be the exception rather than the rule.

Goudsmit deftly reconstructs epidemiological history and relates how climatic changes, population movements and trade have converged to help viruses emerge and spread. Many of these anecdotes are well known, but others are not. Goudsmit artfully unravels the threads that tie together the evolutionary selection processes working in the new host species. Because viruses have large population sizes, high mutation rates and short generation times, they are capable of rapid genetic evolution. Once inside the host, virus populations are shaped by forces of evolutionary change that include mutation, genetic recombination and natural selection. This complex interplay between the virus and its host — both in a single individual and in the population — can result in a variety of outcomes. For example, the introduction into Australia of a myxomavirus to reduce the rabbit population was highly successful, through an accidental experiment of nature. At first, rabbit numbers were drastically reduced. Over time, however, a milder strain emerged that was more effective at infecting rabbits. Through selection, the virus evolved to a less virulent form, illustrating the important difference between evolutionary fitness and virulence.

Despite the fascinating examples he cites, Goudsmit fails to address some critical topics, such as the contribution of host and virus genetic heterogeneity and coevolution, and the role of frequency-dependent selection in evolutionary change. Several of his suggestions are untenable, such as the idea that a new virus can emerge after an asexual *ménage à trois* among unrelated viruses in a single cell; not every virus can infect every cell. Viruses have anthropomorphic desires and a teleological end in view, according to Goudsmit. Other topics, such as the role of viruses in making possible our evolutionary development, and the use of phage therapy for clinical and agricultural applications, add another dimension to the host–pathogen relationship.

To bolster the claim that viruses are a threat to us now "more than ever before", Goudsmit considers epidemiological and evolutionary dynamics alongside the course of human events, but neglects to mention many public-health successes. Health officials are scrambling, so far with relative success, to contain the SARS coronavirus and prevent the spread of the influenza H5N1 and H7N7 viruses from waterfowl to humans. No mention is made of the important change to seasonal outbreaks of influenza achieved by simply moving pigs away from ducks on Chinese farms.

How can we avoid the dangers that nature presents? Wash your hands. Cover your mouth when you sneeze. Refrain from transplanting animal organs, Goudsmit would also add, and don't eat monkeys. Vaccines help to halt viruses that cause epidemics such as measles, which cause short infections

with strong cross-immunity, and influenza. For retroviruses such as HIV that lead to persistent infection, the prospects for a vaccine are dim; their diversity exists both in the individual and in the population as a whole. Until we have an effective AIDS vaccine, people will need the education and resources to modify their behaviour. Unless we change our way of life, Goudsmit warns, the emergence of viral threats to human health looms large. ■

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Video installation

Twin peaks

London Fieldworks artists Bruce Gilchrist and Jo Joelson have explored the work of two scientists who studied the weather from mountain-top observatories in the nineteenth century, and who went on to develop instruments that presaged the development of particle physics and space plasma physics.

C. T. R. Wilson observed visual phenomena such as the 'Brocken spectre' in the skies above Ben Nevis in Scotland when working as a relief meteorologist. He went on to develop the cloud chamber, which enables the visualization of the tracks of subatomic particles, earning a Nobel prize for his efforts.

Kristian Birkeland's observations of the aurora borealis from the summit of Haldde in Norway inspired him to build the terrella, which models the aurora's relationship to solar activity.

Little Earth, a video installation that explores this move from lone observers of nature to an era of technological and abstract science, can be seen at the Wapping Project in London until 12 February, and then at the Fort William Mountain Film Festival in Scotland until 3 March.

www.londonfieldworks.com

Peering out of the box

Pioneering Research: A Risk Worth Taking
by Donald W. Braben
Wiley: 2004. 198 pp. £23.50, $39.95, €33.30

Nina Fedoroff

Donald Braben's book begins with the idea that the unique quality of *Homo sapiens* is not wisdom, but rather the capacity for dissent. By this he means not the transient dissatisfactions that spark violence at sports events, for instance, but the dissent that emerges from "an individual's overwhelming conviction that some aspect of life has become unbearable". Braben believes it is this characteristic of humans that gives rise to scientific discovery of the kind that changes our view of the world, be it Galileo's restructuring of the Universe or Barbara McClintock's transposons, which overthrew the notion that genomes are static. And because it is increasingly recognized that science and technology power contemporary economic growth, it follows that the freedom to challenge the prevailing thinking is essential not just to deepen our understanding of the world, but to sustain economic growth as well.

Suppressing dissent leads to both scientific sterility and economic stagnation, be it in Europe in the Dark Ages or in the Soviet Union not so very long ago. But, more ominously, Braben argues that what suppresses scientific invention today isn't religious dogma or a political regime (although some contemporary observers of US politics might argue otherwise). Rather, it is the well intentioned bureaucracy of the system for awarding grants and the way it operates in a resource-limited environment that is at once egalitarian and increasingly mindful of cost-effectiveness.

Braben argues that until the last few decades, scientists with unconventional ideas could afford to ignore the opinions of their colleagues. But not any more. This is because "selected groups of their fellow experts now have responsibility for setting priorities and allocating resources. Consensus opinion cannot be ignored." What he's talking about, of course, is the peer-review system: panels of experts who gather all over the planet to decide which research proposals are worth funding and which are not. But, Braben says: "An expert opinion is one thing; the consensus of experts is another." He goes on: "Unfortunately, science and democracy are poor bedfellows… No matter how many agree on the validity of a point of view, a single person with a more viable, accurate, or comprehensive alternative may overthrow it." Well said, and all too true.

One might question Braben's anthropology and history, but he certainly has the credentials to comment on contemporary scientific bureaucratization. After almost two decades as an academic nuclear and elementary particle physicist, he joined the ranks of scientific administrators, first in the UK Cabinet Office and later in the Science Research Council. There he had responsibility for the Marine Technology Directorate, which funded marine technology research, and the Teaching Company, whose objective was to bring academic engineers together with industry. He also worked as chief scientist at the Bank of England printing works.

Braben was then recruited by the energy company BP in 1980 to head its 'blue skies' research initiative, which came to be called the Venture Research Unit. The unit's mission was simply "to support the research that might lead to new types of industrial activity". Constrained by neither a specific mission nor an 80-page manual for the preparation of grant proposals, but only by a limited budget, he could make it up as he went along. Well, almost: he still had to convince the members of BP's Venture Research Advisory Council, all of whom were fellows of the Royal Society, and all of whom objected to his abolition of peer review as the mechanism for funding research, a system they didn't think needed fixing.

But instead of focusing on grant proposals, Braben insisted on choosing people, treating their selection "as if it were a scientific problem rather than an administrative one" and struggling "constantly to reduce the number of rules" imposed on applicants. In Braben's view, "the highest accolade one can give a new research proposal is that it could radically change the way we think about something important." That's why he sought researchers whose thinking was decidedly out of the box, working diligently to make sure that it wasn't merely out to lunch — not an easy task on which to score well.

I unreservedly recommend this book to anyone who has puzzled over the growing malaise of contemporary scientific research: we build virtual mountains of data, but where are the paradigm-busters? Braben says they're still there, but that the system is almost guaranteed to filter them out.

I think he has got the diagnosis right. Does he also have the cure? I leave it to others to judge Braben's personal success rate, but the prescription is certainly inviting: pick people and their ideas, not projects; trust them, they'll know when it's time to stop or change direction; provide freedom and sufficient money; expect radical ideas, and expect them to meet with resistance, at least initially. That seems a bit revolutionary to those of us who have grown accustomed to the proposal grind: specific objectives, preliminary data, experimental plan, deliverables and timeline. Small wonder then that there's no time to wander off the beaten path.

Oh, and did I say that this book is a surprisingly good read? Braben is literate, pithy and personable. ■

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