Révolté (The Rebel), his long essay on the nature of revolution. He was introduced to Monod and, as Carroll puts it, they "hit it off right away". Monod helped Camus with a chapter on how communism had perverted science in the Soviet Union, exemplified by Lysenko. (The cruel Soviet suppression of Hungary's 1956 uprising put the seal on their mutual rejection of communism.)

Camus's influence on Monod is clear in Le Hasard et La Necessité (Chance and Necessity; Seuil, 1970), the international best-seller in which Monod drew on the new science of molecular biology. Biology, for instance, had demonstrated that Homo sapiens arose through a series of chance events and that there is no grand design to the Universe. In a reference to Camus's world view, Monod wrote that man "lives on the boundary of an alien world; a world that is deaf to his music, and as indifferent to his hopes as it is to his suffering or his crimes". In the late 1950s, Monod carried out experiments with François Jacob and biochemist Arthur Pardee that hinted at the existence of an unstable intermediate between DNA and ribosomes. Further work by Monod and Jacob led to the operon model of how gene expression is regulated, described in a classic paper in 1961. The same year Jacob, with biologists Sydney Brenner and Matt Meselson, provided the experimental confirmation by demonstrating the existence of messenger RNA. The Nobel prize for Monod, Jacob and Lwoff followed.

The journalist Jean Daniel observed of the comradeship between Monod and Camus that there was "a complicity so intense ... that only a shared kindness of heart allowed them not to find unwelcome those who interfered in their privacy". I am not sure that Carroll has conveyed that intensity — perhaps no one can. But although *Brave Genius* is a long and complex book, Carroll does a masterful job of keeping the many elements together and the story moving. I learned much about France at the time of the Second World War, and was prompted to reread Camus's great novel *La Peste (The Plague)*.

In 1959, C. P. Snow wrote of the "two cultures" — that gulf between science and the humanities. *Brave Genius* provides an opportunity for those on both sides of the divide to sample a potent mix of genetics, philosophy and literature, forged in the twentieth-century tumult of war and cold war.

Jan Witkowski is executive director of the Banbury Center, Cold Spring Harbor Laboratory, Cold Spring Harbor, New York, USA. e-mail: witkowsk@cshl.edu

Winston Churchill on a voyage across the Atlantic in October 1941.

ATOMIC SCIENCE

Winston and the warheads

Richard Rhodes explores a history of Britain's littleknown role in the race to develop an atomic bomb.

Britain and the United States, which cooperated so effectively as military allies during the Second World War, collaborated only intermittently — and from the British point of view inadequately — in the development of the first atomic bombs. The US side of the story has been told more than once; the British side, not recently explored, is now tackled by Graham Farmelo in *Churchill's Bomb*.

The author, a physicist, ranges across Winston Churchill's long career — from 1901, when Churchill wrote to H. G. Wells to congratulate him on *Anticipations*, a work of predictive non-fiction, to his final turn as prime minister in the early 1950s, when he pushed for a British hydrogen bomb. Farmelo is especially good on the Second World War years, revealing much about the Anglo–American relationship that has been guarded or unclear.

British work on the bomb preceded that by the United States. Britain was at war for more than two years before the United States came in, and was inevitably more urgently concerned with German uranium research. Moreover, Britain's generous policy of taking in refugee Jewish scientists who were



Churchill's Bomb: A Hidden History of Science, War and Politics GRAHAM FARMELO Faber & Faber: 2013.

their US counterparts famously enlisted Albert Einstein to alert President Franklin Roosevelt.

On both sides of the Atlantic, however, gatekeeper scientific advisers delayed progress. In the US case, the culprit was a government scientist named Lyman Briggs. Briggs, the director of the National Bureau of Standards, so overemphasized secrecy that the meeting minutes he received from the MAUD committee — the group of British officials tasked with researching the feasibility of building an atomic bomb — languished undistributed in his safe. Eventually, Briggs was moved aside and his safe opened to reveal its treasures.

In Britain, Farmelo reports, the problem was more serious because the gatekeeper was Winston Churchill's personal scientific adviser, Frederick Lindemann. Lindemann did not quite believe in the bomb, and in any case thought it should be built in Britain or, if that proved impossible, Canada.

At a crucial point in Churchill's ongoing negotiations with Roosevelt, in October 1941, a message arrived from the US president offering to coordinate "or even jointly conduct" a bomb programme. British official opinion still favoured consultation between parallel projects, Farmelo notes, rather than full collaboration. Discouraged by Lindemann and other advisers, Churchill delayed his response. Almost two months passed before he answered the president's note, and even then he did so only tepidly.

Those two months were crucial: the US programme officially expanded to full industrial scale on 6 December 1941, and the following day the Japanese bombed Pearl Harbor, shocking the United States into joining the war. The atomic-bomb programme was soon assigned to the US Army Corps of Engineers and, a few months later, now renamed the Manhattan Project, put under the command of a big, dynamic, no-nonsense engineering general named Leslie Richard Groves, a combative Anglophobe.

Curiously, Groves and his government superior, the science czar Vannevar Bush, worried as much about giving Britain a leg up on post-war nuclear-power development as they did about sharing the 'secrets' of the bomb. Early in 1943, Farmelo writes, Groves blocked British participation almost entirely after Imperial Chemicals' Wallace Akers was chosen to run the British programme. A secret Anglo-Russian agreement to share new and future weapons further soured Groves and Bush when they learned of it, although Farmelo argues that Churchill would have repudiated the agreement instantly had he thought it would quash collaborations with the United States. By the time all these misunderstandings had been sorted out, the British lead was buried in the dust of Groves' multi-pronged, multibillion-dollar race to an almost all-American bomb.

Farmelo's book sometimes falters on technical details. Breeding plutonium in large uranium–graphite reactors in eastern Washington state becomes "the production of chemicals containing weapons-grade plutonium". The bomb tested in the New Mexican desert in July 1945 was not, as he writes, "the first nuclear bomb" — that was the uranium gun bomb, Little Boy, already sailing towards Japan — but rather the first plutonium implosion assembly, the 'Gadget', its technology so radically new it needed ▶

Books in brief



Command and Control: Nuclear Weapons, the Damascus Accident, and the Illusion of Safety

Eric Schlosser PENGUIN (2013)

After dishing the dirt on junk food in *Fast Food Nation* (Houghton Mifflin Harcourt, 2001), Eric Schlosser tackles another weapon of mass destruction: the US nuclear arsenal. His propulsive narrative alternates between a history of nuclear arms and an account of a near miss: the explosion of a Titan II ballistic missile in Arkansas. Invoking sociologist Charles Perrow's finding that such "tightly coupled", interactive systems can be undone by trivialities, Schlosser calls for new thinking on this legacy — and soon.



Neurocomic Matteo Farinella and Hana Roš NOBROW (2013)

Illustrator Matteo Farinella and neuroscientist Hana Roš have crafted a graphic introduction to the human brain that seethes with many-layered invention. Boy meets girl, and is propelled into the *Alice in Wonderland* world of her brain — where, for example, Camillo Golgi and Santiago Ramón y Cajal grapple in a forest of neurons. Morphology and plasticity, for example, are distinct regions of 'Brainland', in which greats in each field are tour guides, and neural phenomena appear as anything from key-wielding superheroes (neurotransmitters) to a haunted castle (consciousness).



Oil and Honey: The Education of an Unlikely Activist *Bill McKibben* TIMES BOOKS (2013)

Environmental writer Bill McKibben set off shock waves in 1989 with *The End of Nature* (Anchor), the first popular treatment of climate change. Two years ago, with the impacts of oil-industry 'business as usual' biting, McKibben moved on to full-time climate activism. In this eloquent memoir, he interweaves reportage on deluges, heatwaves and melts with demonstrated solutions to "malfunctioning modernity". High-profile protest is only part of that, he argues. A revolution in local sustainability is also essential — and achievable, as the story of a Vermont bee-keeper reveals.



Life Beyond Earth: The Search for Habitable Worlds in the Universe

Athena Coustenis and Thérèse Encrenaz CAMBRIDGE UNIVERSITY PRESS (2013)

Is the biosphere that so astounds us one of thousands? In this packed primer on exoplanetary life, distinguished astrophysicists Athena Coustenis and Thérèse Encrenaz summarize the science and speculation. Kicking off with planet formation, life's origins on Earth and extreme environments, they boldly go into areas such as potential habitats in the outer Solar System and far-future ideas such as "terraforming" Mars for human habitation.



Disease-Proof: The Remarkable Truth About What Makes Us Well David L. Katz and Stacey Colino HUDSON STREET PRESS (2013) We are living longer, chronic disease rates are rising — and the

trade-off is a dubious one, argues medic David Katz. With writer Stacey Colino, Katz presents a research-based approach to increasing the chances of reaching a healthy old age that brims with intelligent suggestions for behavioural change. The discipline involved is workable, from eliminating 'stealth' sources of sugar to exercising in the 'nooks and crannies' of a busy day; and Katz's vision for wellness encompasses societal change. Barbara Kiser



to be tested at full yield. Nor did the scientists assembled in the desert to watch that first test apply suntan lotion to protect themselves from "the radiation blast". It was the high-intensity light from the nuclear fireball that concerned them.

More egregiously, Farmelo misses what is in my view a crucial part of the post-war negotiations between the United States and Britain over uranium supplies. The United States was at that time believed, for reasons I have never understood, to have only modest domestic sources of uranium ore. The two countries had agreed during wartime that they would share the rich ore resources of the Belgian Congo equally. By late 1947, Britain was approaching bankruptcy, a congressional debate neared on the Marshall Plan and several conservative US senators had been outraged to learn that Britain still had a veto over any US use of atomic bombs. The administration of President Harry Truman demanded changes: Britain would give up its veto as well as its share of the Belgian Congo ore; the United States, in return, would continue to aid its wartime ally economically. It was this ore grab — formalized in a *modus vivendi* of 7 January 1948 — not bureaucratic dithering, that delayed the British bomb.

Churchill's Bomb is colourful but incomplete, focused more on Churchill than on the bomb. It is a useful adjunct to what is still the best series on the British bomb, Margaret Gowing's official history *Britain and Atomic Energy 1939–1945* (Macmillan, 1964) and its successor volumes.

Richard Rhodes is the author of the Pulitzer-prizewinning The Making of the Atomic Bomb and three further volumes of nuclear history. e-mail: rhodes.today@comcast.net

satellites are usually reflective, so although no government admits to their existence, they are

trackable. Their orbits reveal where they are going and a little of what they are doing including when they fall out of the sky. The third set of essays covers interaction between the sky and ground. Bombers are

frightening because of their purpose, so their very presence in the sky is intimidating: one

aim of bombing runs has always been to

undermine morale. The 2003 campaign in

the US war with Iraq was explicitly called

MILITARY SCIENCE

Fight in flight

Ann Finkbeiner ponders a chronicle of airborne war.

To see farther, go higher: from horseback, hilltop and tower in the eighteenth century to balloons in the nineteenth, aeroplanes and satellites in the twentieth and robotic drones in the twenty-first. With each step up in height and technology comes a broader view of enemy territory and a greater personal distance from it. What to make of this?

In *From Above*, the view from higher up translates into a greater power to acquire and rule, to control and to kill. The 13 authors in this collection of essays, edited by Peter Adey, Mark Whitehead and Alison Williams, are academic humanists and social scientists linked by an interest in how human interaction with geography has shaped warfare.

The essays, which are divided into three categories, are often built around case studies and begin with the view from the sky. As captured in drawings, photographs and film for much of the past century, images taken from above tend to be visually confusing and must be interpreted and even manipulated. The imaging of large swathes of territory requires the formation of photomosaics, in which photographs taken at different times, heights and angles are stitched together. The slight sense of unreality inherent in the view from above, many of the authors argue, contributes to an emotional distance; the result is that conquering or killing becomes easier.

Meanwhile, warfare itself has changed: war is now fought not by vast, easily bombable armies but by small groups of insurgents who are hard to spot from the air. In the Vietnam War, for instance, seismic and acoustic sensors on the ground were used to locate insurgents. When triggered, the sensors signalled to distant computers that calculated, then sent, the enemy's coordinates to high-flying bombers. That war, writes geographer Derek Gregory (quoting from an article by Paul Dickson and John Rothchild), was a "lethal pinball machine" that - fastforward to the wars in Iraq and Afghanistan — became a network of surveillance and targeting drones run



From Above: War, Violence and Verticality EDITED BY PETER ADEY, MARK WHITEHEAD AND ALISON J. WILLIAMS Hurst: 2013.

by people who commute to work. The more distant the killing, the more impersonal, and the more the exercise resembles a video game.

The second group of essays focuses on the responses of those on the ground to being viewed from above — the immediate reaction being concealment. In the Second World War, for example, when the United Kingdom wanted to camouflage its industry and infrastructure from German bombers, people learned to think of the landscape as seen from the air. The Home Office even ran an unsuccessful experiment in which oil tanks were disguised with green and brown paints of differing reflectivity to harmonize with the British landscape. Another on-the-ground reaction is to spy on the sky. One international group of people practises a "peculiar version of amateur astronomy". Using little more than good binoculars, stopwatches, star charts and Kepler's laws of planetary motion, they track highly classified reconnaissance satellites. The

Shock and Awe because it aimed to sap the Iraqi will to fight. The interaction between air and ground is most easily seen in the use of unmanned surveillance drones. Each drone needs four people to guide it and to keep track of its technologies and communications — which they do from many miles away. Drones return vast amounts of information. If aerial views began with a person climbing a hill and then climbing back down to analyse what was seen, then drones almost seem to conflate person, view and action. *From Above* is written by academics for aca-

demics. The case studies are fascinating, but the sentences are often opaque. (In one example, an author discusses the 'weaponization' of the cinema, writing that it has "particular capacities for movement whose influences on specific ideas of global escalation make them into logistics of perception or the escalation of the modern technical beyond".) Thus, the ideas and connections between them are frustratingly hard to understand.

I think the book's main message is that the aerial view confers a remoteness that enables violence. Implicit throughout, as stated in the introduction, is the judgement that in spite of the "spectacle and beauty" of the aerial view, "we must be careful not to celebrate it". Since the first stone tools, technologies have had dual uses, both civilizing and military, and we should remember that duality.

Ann Finkbeiner *is a freelance writer in Baltimore, Maryland, and author of* The Jasons. *anniekf@gmail.com*