One of the most contentious targets of activist philanthropy is education. Among others, the Walton family — heirs to the Walmart fortune — Zuckerberg and hedge-fund maestro Bill Ackman have given enormous sums to charter schools, facilities that are publicly funded, privately administered and sometimes for-profit. Illustrating how fraught this philanthropic involvement is, in Newark, New Jersey, a top-down school-reform strategy disregarded community priorities, generated wide resentment, exacerbated inequity and defunded public schools.

Despite his lament that increasingly powerful philanthropy engenders civic inequality, Callahan pays inadequate attention to philanthrocapitalism. This model, which infuses business principles into philanthropy (proffering handsome investment returns), essentially justifies wealth accumulation on the backs of ordinary people. He mentions various structural enablers of gargantuan fortunes, from tax shelters to weak securities laws and corporate pressure to cut taxes and shrink regulation. Yet he retreats to mild critique, calling for a "balancing act" of middling reforms around philanthropic accountability, transparency, partnerships and political lobbying.

If philanthropy indeed poses a grave threat to egalitarian values, Callahan's prescription may amount to tinkering at the margins. Why should self-anointed philanthropic elites, who already exercise inordinate power, have carte blanche to steer public policy? As former US labour secretary Robert Reich has noted, governments once collected billions from tycoons, then democratically redistributed these revenues. Many would argue that it is high time to rein in the megabillionaires, whether they are wielding influence from the boardroom, the White House or philanthropic perches. ■

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METEOROLOGY

Weather makers

Jim Fleming assesses a history of US governmental intervention in the atmosphere.

"Make it rain," commanded choleric US bureaucrats who sought to control the weather in the nineteenth and twentieth centuries. Yet their decrees carried little weight in the aerial realm: the atmosphere does not respond to state control.

In *Make It Rain*, historian Kristine Harper treats weather control as a political agent in the hands of the American state. Politicians at local, state and national levels issued edicts in pursuit of their political ends to bring enhanced 'sky water' to their thirsty districts, or to mobilize the clouds for diplomatic or military ends; "entrepreneurial scientists" took their money and produced technical reports. But in the long run, the weather did what the weather does.

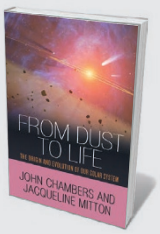
In an overextended metaphor belying the complexity of her narrative, Harper asks us to imagine the state as "a shadowy male figure" lurking at the edges of technical and environmental histories: "Do we invite him in, take his money, let him 'meet the parents', acknowledge that he is calling the shots, and then continue checking in with him to make sure he hasn't trotted off with a more attractive partner…?" Her work is informed by political scientist James C. Scott's *Seeing like a State* (Yale Univ. Press, 1998), which criticizes the administrative ordering of nature and society by the state. It also echoes sociologist Theda Skocpol's admonishment to "bring the state back in" — in the book of the same name, co-edited with Peter B. Evans and Dietrich Rueschemeyer (Cambridge Univ. Press, 1985) — when describing efforts to control nature.

The strongest sections of *Make It Rain* include an account of GROMET, the code name for a secret agricultural rainmaking project run by the United States in India during the administration of US president Lyndon Johnson, in 1967. GROMET provided a diversion and a cover story for the testing of silver iodide cloud seeding, slated to be used in the Vietnam War. Here, an interesting cast of characters from the 1960s appears, made up of big government figures not typically included in histories of science: Bureau of Reclamation director Floyd Dominy, US ambassador to India Chester Bowles, secretary of state Dean Rusk, agriculture secretary Orville Freeman, national-security adviser Walt Rostow and CIA director Allen Dulles.

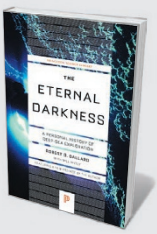
Make It Rain: State Control of the Atmosphere in Twentieth-Century America
KRISTINE C. HARPER
University of Chicago Press: 2017.

Yet Harper includes no parallel analysis of earlier bureaucrats and no mention of president Richard Nixon's continuation of weather-modification programmes over Vietnam. She provides a helpful list of weather-control bills passed by Congress in the period 1947–53, and a list of weather-control research projects conducted in more than a dozen countries in the 1950s — but these lack detailed analysis.

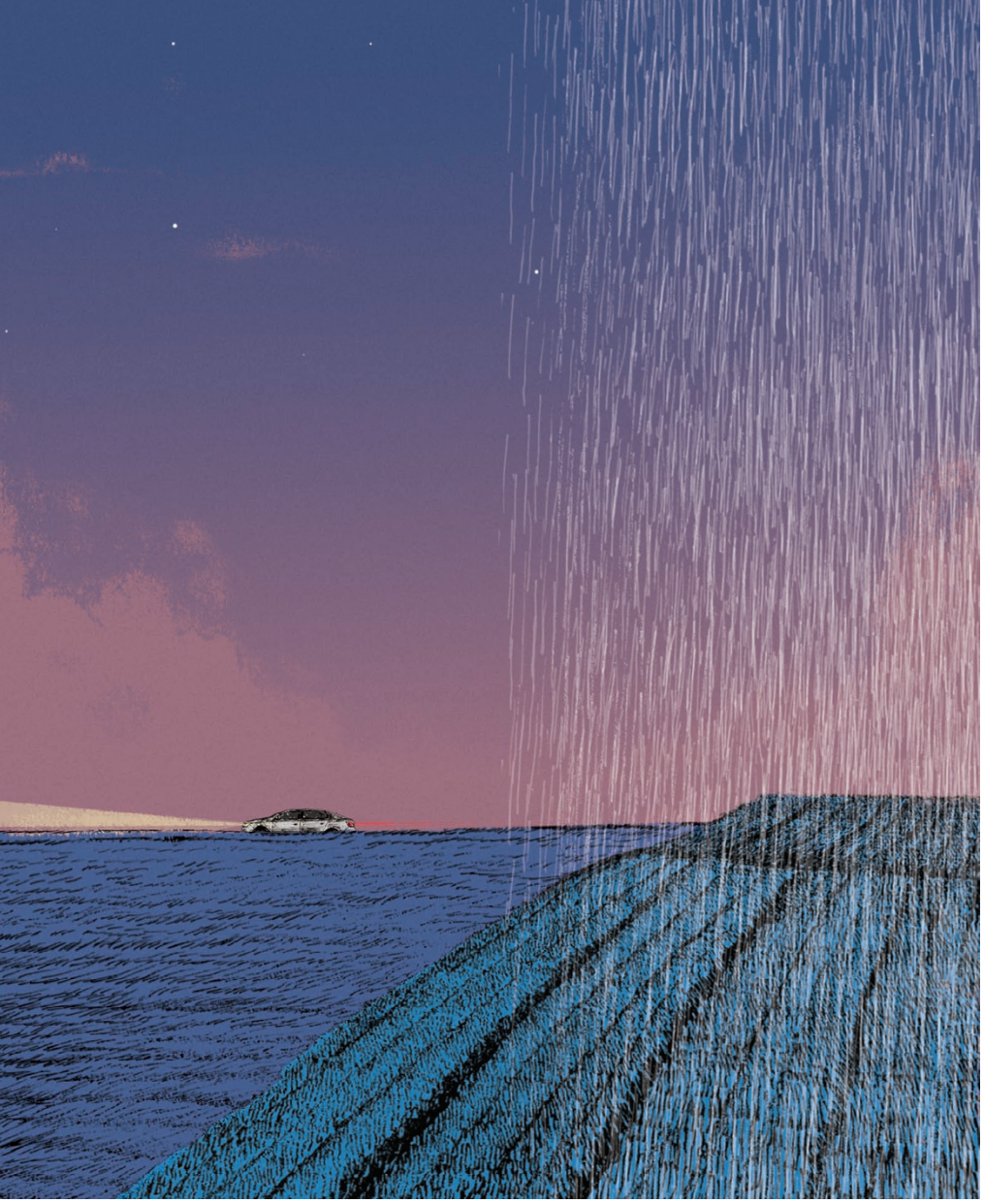
Harper indicates, in several places, that weather control is actually possible. Most meteorologists would disagree. She cites the "earliest success" as occurring in 1921, "when an airplane dispersing [electrically] charged sand into clouds triggered a snow flurry". This was an Army Air Corps-sponsored project in Dayton, Ohio, that produced no reliable scientific results. Later, she writes that "as a result" of silver iodide seeding in 1961, Hurricane Esther's barometric pressure "stopped deepening and maintained a relative constant pressure thereafter". She also cites



From Dust to Life
John Chambers & Jacqueline Mitton (Princeton Univ. Press, 2017)
In this grand chronicle of the science behind the origins of our 4.6-billion-year-old Solar System, John Chambers and Jacqueline Mitton peruse everything from the giant collision thought to have formed our Moon to the nature of meteorites.



The Eternal Darkness
Robert D. Ballard & Will Hively (Princeton Univ. Press, 2017)
Globally, just 1% of the sea floor has been explored in detail. Robert Ballard and Will Hively's exploration of that unforgiving environment reveals how divers reach it, and uncovers amazing beasts, such as blind white crabs and giant clams.



"qualitative data" reported by military pilots and observers that clouds seeded over Vietnam "grew six to ten times taller and wider within ten minutes of seeding and doubled the precipitation of unseeded clouds". None of these observations is verifiable, in my view.

Intervention is not control. In 1946, Kathleen Burr Blodgett, a physicist at the General Electric Corporation, advised chemist and weather-modification enthusiast Irving Langmuir that altering a cloud was a far cry from controlling its subsequent motion, growth or characteristics of precipitation. This is still true. The US National Research Council study *Critical Issues in Weather Modification Research* (National Academies Press, 2003) warned that "weather modification has largely been relegated to the realm of promises unfulfilled". It noted, too, that further research may reveal that the "intentional modification of a weather system is neither currently possible nor desirable".

Harper's book contains some errors. For instance, US government agent Robert Dyrenforth, who in 1892 sent explosives and balloons into the air to produce rain, used a hydrogen–oxygen mixture, not helium. (Helium was isolated on Earth only in 1895, by chemist William Ramsay.) The Bergeron–Findeisen ice-crystal process — a theoretical explanation of the growth of precipitation particles made of both ice and liquid water — is active in clouds in many seasons and latitudes, producing rain in mid-latitude summer and tropical convective systems, not, as Harper indicates, only in mid-latitude winter.

Harper's exclusive focus on state-run projects unfortunately prevents examination of the plethora of private rainmaking efforts in the United States and elsewhere during the twentieth century. And the book's US-centrism means no mention of the successful British fog-clearing project FIDO during the Second World War.

In my book *Fixing the Sky* (Columbia University Press, 2010; cited in Harper's first footnote), I covered rainmaking by concussion, electrified sand, chemical agents, dry ice and silver iodide; weather warfare; and climate engineering. Many of my protagonists (and even some of the cartoons) are the same: Dyrenforth, James Espy, Wilder Bancroft, Tor Bergeron, Henry Houghton, Vladimir Zworykin, John von Neumann, Langmuir, Vincent Schaefer, Bernard Vonnegut and Edward Teller. The two books are best read in parallel.

Near the end of *Make It Rain*, Harper lists the current challenges of climate change, wondering whether rainmaking will make a comeback to alleviate water shortages. But her claims that all weather-control efforts are local and pertaining to water prevent her from any meaningful follow-up on technological fixes for climate warming, such as carbon dioxide removal or albedo modification.

The state can indeed influence, and in many ways control, water resources. The hydrological and hydroelectric regimes controlled by the great Hoover Dam, for example, far exceed in capacity and reliability the puny results produced by any politician who commanded rain to fall from the sky. It is important, however, that historians of science begin to bring the state back into their stories, and this book is a start. ■

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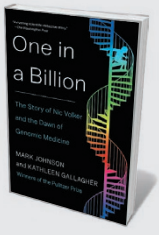
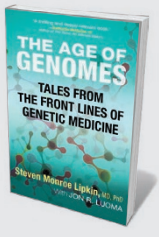


One in a Billion
Mark Johnson & Kathleen Gallagher (Simon & Schuster, 2017)
Journalists Mark Johnson and Kathleen Gallagher tell the story of Nic Volker, a boy with a baffling inflammatory condition. Volker's life was saved when scientists harnessed DNA sequencing to identify the genetic mutation responsible.



The Age of Genomes
Steven Monroe Lipkin & Jon Luoma (Beacon, 2017)
In his insightful tour of clinical genetics, Steven Lipkin shares the stories of his patients — some of whom have rare conditions. With science writer Jon Luoma, he also delves into the field's limitations, including the manipulation of DNA in high-profile murder cases.