

## Weather as a Weapon

The troubling history of geoengineering so far.

By James Rodger Fleming

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Is there a technological fix for global warming? Where would we put a "planetary thermostat," and who would control the settings? The long and tragicomic history of fixing the sky—of rainmakers, rain fakers, weather warriors, and climate engineers—indicates that such ideas are far-fetched. Dosing the stratosphere with sulfuric acid to turn the blue sky milky-white does not sound like a good idea. Neither does dumping an iron slurry into the oceans to fill them with algae and turn them soupy-green. A global forest of artificial trees? Storing massive amounts of carbon dioxide under our feet forever? A flotilla of ships pumping seawater into the clouds? Unlikely, unlikely, unlikely.

Global climate engineering is untested

and untestable, and dangerous beyond belief. The famous mathematician and computer pioneer John von Neumann warned against it in 1955. Responding to U.S. fantasies about weaponizing the weather and Soviet proposals to modify the Arctic and rehydrate Siberia, he expressed concern over "rather fantastic effects" on a scale difficult to imagine and impossible to predict. Tinkering with the Earth's heat budget or the atmosphere's general circulation, he claimed, "will merge each nation's affairs with those of every other more thoroughly than the threat of a nuclear or any other war may already have done." In his opinion, attempts at weather and climate control could disrupt natural and social relations and produce forms of warfare as yet unimagined. It could alter the entire globe and shatter the existing political order.

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Indeed, the history of these schemes provides a valuable perspective on what might otherwise seem to be a completely unprecedented challenge. Geoengineering has been proposed before, many times. In the 1950s Nobel laureate Irving Langmuir wanted to seed the entire Pacific basin to control storms. In the 1960s the Russians declared war on permafrost and sought to engineer an ice-free Arctic Ocean. About a decade before the ozone concerns of the 1970s, Weather Bureau scientist Harry Wexler identified catalytic chemical reactions that could devastate the stratosphere—a potential "bromine bomb." In the 1990s a committee of the National Academy of Sciences suggested using naval guns to shoot sulfates into the high atmosphere, since it was cheaper than reducing carbon emissions.

The editors of the venerable *Oxford English Dictionary* err when they propose to define geoengineering (*noun*) as "the modification of the global environment or the climate in order to counter or ameliorate climate change." To assign a specific goal to geoengineering does not make sense, since, first of all, the discipline does not yet exist; it is at best "geoscientific speculation." Second, an engineering practice defined by its scale (geo) need not be constrained by the good that might result from it, such as the counteraction or amelioration of climate change. Nuclear engineers, for example,

are capable of building both power plants and bombs; mechanical engineers can design components for both ambulances and tanks. So to constrain the essence of something that does not exist by its stated purpose, techniques, or goals is misleading at best. Large-scale planetary manipulation techniques, like any engineering practice, can be used for both good and ill. In fact, a type of military geoengineering was actually practiced by both the United States and the Soviet Union half a century ago, and it had nothing to do with staving off climate change.

On May 1, 1958, at the National Academy of Sciences, University of Iowa physicist James A. Van Allen announced that Geiger counters aboard the *JPL Explorer 1* and *Explorer 3* satellites had picked up high readings at certain points in their orbits, indicating that powerful radiation belts (later known as the Van Allen belts)

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surround Earth. This was the first major scientific discovery of the space age. Ironically, and on that very same day, Van Allen joined Operation Argus—the U.S. military's top-secret project to detonate atomic bombs in space, with the goal of generating an artificial radiation belt and disrupting the ionosphere. This was planetary-scale engineering—or "geoengineering."

"Space is radioactive," noted Van Allen's colleague Erie Ray. The military wanted to make space even more radioactive by nuclear and, later, thermonuclear detonations that in times of war could disrupt enemy radio communications from half a world away and damage or destroy enemy satellites and intercontinental ballistic missiles. In late August and early September 1958, a specially equipped naval convoy launched and detonated three 1.7-kiloton atomic bombs in near space above the South Atlantic Ocean to "seed" the ionosphere with high energy nuclear particles and radioactive debris. Van Allen's *Explorer 4* satellite, launched a month earlier, carried lead-shielded Geiger counters designed to withstand the blasts and document the tests.

The Soviet Union went on to detonate four small space-bombs in 1961 and then three larger ones during the height of the Cuban Missile Crisis the following year.

One of the tests, conducted over Kazakhstan and Kyrgyzstan, started a fire that burned down a power plant and destroyed electrical and telephone lines. The largest and highest U.S. test was the 1.4-megaton Starfish Prime H-bomb detonation at an altitude of 400 kilometers over Johnston Island, which disrupted the natural Van Allen belts, destroyed several communication satellites, and damaged about 300 streetlights in Hawaii, almost 1,500 kilometers away. This led British radio astronomer Bernard Lovell, along with the International Astronomical Union, to protest, "No government has the right to change the environment in any significant way without prior international study and agreement." Van Allen, who had eagerly participated in the tests, later regretted his involvement.

But despite these precedents, today's leading proponents of geoengineering are

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acting as though their field were brand-new. At the recent Asilomar International Conference on Climate Intervention Technologies, I heard any number of a-historical statements regarding climate intervention. Most of the group, and certainly many of its spotlight speakers, seemed to have a collective blind spot regarding the importance or the relevance of the past; or perhaps they wished to distance themselves from the checkered history of weather and climate control. According to one speaker, "We don't have a history of geoengineering to fall back on." (*Yes we do.*) Another rose to claim, "We are the first generation to think about these things." (*History says otherwise.*) And a third, "Things are moving quickly, so we don't have the luxury of looking at history." (*Yet we must take the time.*)

In November 2009 the U.S. House Committee on Science and Technology held hearings on the implications of large-scale climate intervention. I was the only historian on a panel of five, which included three strong advocates for geoengineering and a climate modeler who warned of unintended consequences. In my testimony I reviewed the checkered history of weather and climate control and recommended that the first steps toward effective collaboration on geoengineering research and governance should not be technically oriented, but

should involve study of the historical, ethical, legal, political, and societal aspects of geoengineering. I was making the claim that climate change is not quintessentially a technical issue; it is a socio-cultural and technical hybrid, and our effective response to it must be historically and technically informed, *interdisciplinary* in nature, *international* in scope, and *intergenerational* in its inclusiveness.

Geoengineering is in fact untested and dangerous. We don't understand it, we can't test it on smaller than planetary scales, and we don't have the political capital, wisdom, or will to govern it. Planetary tinkering is not "cheap," as some economists claim, since the side effects are unknown. It poses a moral hazard by possibly reducing incentives to mitigate. It could be attempted unilaterally, or worse, proliferate among rogue states, and it could be militarized.

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(Learning from history, it likely *would* be militarized.) Geoengineering could violate a number of existing treaties such as ENMOD, which, as von Neumann warned so long ago, would add to international stresses. Most poignantly, by turning the blue sky milky white or the blue oceans soupy green, by attenuating starlight, and by putting bureaucrats and technocrats in charge of a global thermostat, geoengineering will indeed alter fundamental human relationships to nature.

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