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Don't like the weather? Change it The weird science of weather modification makes a comeback

The Boston Globe

By Drake Bennett | July 3, 2005

In the summer of 1930, George Ambrosius Immanuel Morrison Sykes, a self-professed "minister of Zoroastrianism" and flat-earther (his calculations put the sun's distance from Earth at 3,300 miles), was hired by the Westchester Racing Association to ensure good weather for the horse races at Belmont Park. As described by historian Clark C. Spence in "The Rainmakers" (1980), the contract promised Sykes \$1,000 for every dry day during a week in early September, but required him to pay back twice that for every wet one.

For seven days Sykes's device--a jalopic pile of wire, antennae, jars of colored water, old radio sets, a vase, an electric heater and a toy propeller--was blessed by sun. But the following Saturday, after his contract was extended, the rains came. And when Sykes, looking to outwit fate, promised more rain two days later, the appointed day instead passed dry.

At press time, the National Weather Service was predicting a sunny July 4th in Boston, with temperatures in the low 80s. Still, it would be nice to be sure, wouldn't it? Seventy-five years after Doc Sykes's Belmont lucky streak ended in disgrace, the weather still resists our best efforts at prediction, much less control.

Not that this has stopped us from trying. Recent years have seen a growing interest not merely in forecasting, but in the seemingly fanciful prospect of customizing the weather. In 2003 the National Academy of Sciences recommended "a coordinated national program" to "conduct a sustained research effort" into weather modification. Politicians in Western and Southwestern states are funding attempts to tickle more moisture out of the clouds, and this March, Senator Kay Bailey Hutchison of Texas introduced a bill to create a national Weather Modification Operations and Research Board.

Last fall, a meteorologist named Ross Hoffman suggested in Scientific American that a network of microwave-beaming satellites could literally take the wind out of hurricanes. In some of the driest parts of Mexico, a Bedford-based company called Ionogenics is testing a rainmaking apparatus that uses an array of steel poles to ionize the air. China, a country with widespread cloud seeding, has announced plans to engineer clear weather in Beijing for the 2008 Olympics.

Meanwhile, deepening concern over the possibly cataclysmic effects of climate change has spurred a number of recent proposals, some sketched out in considerable detail, to engineer a measure of counteractive cooling. John Latham, an atmospheric physicist at the National Center for Atmospheric Research in Boulder, Colo., has proposed increasing the reflectivity of the cloud cover by stirring up water vapor from the ocean with a fleet of giant egg-beater-like turbines. A few years ago, a team led by the late Edward Teller suggested creating a similar effect by launching a million tons of tiny aluminum balloons into the atmosphere. The Teller team also revived a proposal, last explored in the early 1990s, to build an adjustable 2,000-kilometer-wide mirror in space to deflect some of the sun's energy before it reaches us.

To be sure, within the meteorological establishment the enthusiasm for weather modification is far from

universal. And climate engineering--the alteration of global, rather than local, weather systems--remains purely theoretical. Still, after decades of disfavor, such ideas are getting a second look. As our ability to comprehend the weather improves and as the threat of climate change looms larger, some scientists are ready to brave the uncertainty and tangled ethics of tinkering with the skies.

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In 1946, over Mount Greylock in western Massachusetts, a General Electric research chemist named Vincent Schaefer scattered three pounds of crushed dry ice out of an airplane into a cloud and set off a snow flurry. It was the world's first successful cloud seeding--later that year, the meteorologist Bernard Vonnegut (brother to the novelist) discovered that silver iodide smoke had a similar effect--and weather modification emerged from the realm of con men and eccentrics. Most meteorologists remained skeptical, but by 1951, 10 percent of the United States was under commercial cloud seeding. "Intervention in atmospheric and climatic matters on any desired scale" was only decades away, predicted John von Neumann, the mathematician who helped invent and began programming the first electronic computers to model the weather.

Over the next 30 years, the federal government spent hundreds of millions of dollars on projects all over the country to increase precipitation, to mitigate hailstorms (an age-old enemy of farmers), and, most successfully, to clear the fog from around airports. Perhaps the era's most ambitious endeavor was Project Stormfury, which sent up airplanes to seed the eye walls of hurricanes with silver iodide to weaken the winds before landfall.

The US military, unsurprisingly, was intrigued by the possibility of a godlike meteorological arsenal. According to Spencer Weart, a physicist and historian of science at the American Institute of Physics, the thinking in the Defense Department was "maybe we'll give the Russians a real Cold War, or maybe they'll give us one, so we should be ready." Pentagon money funded much of the era's climate research, helping to create the weather models we now use in forecasting. War gamers dreamed up climatological warfare scenarios like laying down a blanket of fog over an airfield or visiting drought upon an enemy's breadbasket.

One plan even made it off the drawing board. From 1966 to 1972, under the code name Project Popeye, the US Air Force flew thousands of cloud-seeding sorties over the Ho Chi Minh Trail, hoping to muddy it into impassability. (While there's some evidence that rain did increase, it's unclear what difference this made on the ground.) When the details of the plan surfaced in the press, the public outcry led to an international treaty banning "Military or any other hostile use of environmental modification techniques."

But the grandest climate engineering schemes came from the Soviet Union. The most Promethean among them was a late 1950s proposal to dam the Bering Strait and, by pumping water from the Arctic Ocean into the Pacific, draw warm water northward from the Atlantic to melt the polar ice pack, making the Arctic Ocean navigable and warming Siberia. The leading Soviet climatologist, Mikhail I. Budyko, cautioned against it, arguing that the ultimate effects were too difficult to predict (though he himself had played with the idea of warming the Arctic by covering it in soot to decrease its reflectivity). John F. Kennedy, as a presidential candidate, suggested the United States look into collaborating on the project.

While the two countries continued desultory discussions of the Bering Strait plan into the 1970s, the American government was by then losing interest in the whole field of weather modification. After years of increases, federal research money was cut sharply in 1973. Commercial cloud seeding continued, and a few states maintained their own cloud seeding programs, but over the next decade federal research funding effectively dropped to zero.

The problem, in part, was that there was no consensus on the efficacy of cloud seeding, the focus of almost all research up to that point. Study after study had been inconclusive. "The government had put a lot of money into it and they hadn't been able to prove a damn thing," says Weart.

The change in the political climate, however, wasn't simply the result of scientific failures. Chunglin Kwa, a historian of science at the University of Amsterdam and one of the few scholars to study the history of weather modification in depth, writes that, when it fell out of public favor, the field had "existed for most of its history with little clear evidence that rainmaking and hurricane abatement worked, but there was equally little clear evidence that it did not." Many meteorologists, he notes, argued that research deserved further funding.

What had changed, Kwa argues, were attitudes, especially American ones, about technology, risk, and nature. "There was the development of an attitude to not mess with Mother Nature," he said in an interview. With the growth of the environmental movement in the 1970s and 1980s came a conviction that human beings were foolishly tempting fate by trying to impose their will on nature, whether by damming up rivers or tapping the clouds. Environmentalists enlisted mounting signs of our unintentional weather modification--clear-cutting forests, for example, decreases rainfall, while smokestacks increase it--to argue that humanity was already disrupting the balance of nature.

The threat, in other words, wasn't that weather modification would fail but that it would work--a concern that still shapes the debate. "There's a real sense that the climate system is complicated enough that if you start messing around with it you're likely to get an outcome you didn't expect," says Edward Boyle, a professor of ocean geochemistry at MIT.

Critics point to our inability to understand even local cloud systems. In 1972, a government cloud-seeding run in South Dakota was followed by a violent deluge, and more than 200 people were killed in the ensuing flood. Meteorologists disagreed over whether seeding was to blame, but the incident became an ominous symbol for those who saw weather modifiers as latter-day Pandoras.

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Boyle's caution may be merited, but scientists are better equipped today to understand and manipulate the weather than they were 30 years ago. Roelof Bruintjes of the National Center for Atmospheric Research, a leading cloud seeding researcher, says that new radar and sensor technologies, better satellite imaging, and ever-increasing computer power have greatly aided his work. Today, he says, "We have new tools to get the basic answers that we couldn't get in the '70s, '80s and '90s."

Some scientists and engineers, such as Daniel Schrag, director of Harvard's Laboratory for Geochemical Oceanography, point out that, in light of the planet's growing thirst and rising temperature, even Soviet-scale climate modification is attracting real consideration. Boyle, who spoke at a joint MIT-Cambridge University conference on the topic last year, readily concedes, "There are very prominent, serious scientists who are considering these things."

Such projects are inevitably presented as last-ditch protections against an existential threat, but they nevertheless raise the issue of what it would mean to take a more active role in shaping the weather--not merely in the face of catastrophe but as a means of lengthening the growing season, making rainfall more regular, or blunting heat waves.

But controlling the weather, like controlling our genes, creates a thicket of ethical thorns. For one thing, despite the international ban, reliable weather modification could end up being weaponized. A 1996 Air Force report entitled "Weather as a Force Multiplier: Owning the Weather in 2025," argued that "the tremendous military capabilities that could result from this field are ignored at our own peril."

Even purely peaceful aims would lead to a cascade of seemingly zero-sum conflicts. In the US, cloud seeding has set off several lawsuits in which, for example, downwind farmers have accused a cloud-seeding neighbor of "stealing" their rain. Such issues only grow in complexity along with the scale. Ideal weather for a farm isn't necessarily ideal for a resort. (In 1950, the owner of an upstate country club unsuccessfully sued New York City over its attempt to alleviate a drought through cloud-seeding.) What once was, in insurance parlance, an "act of God" becomes something for which one can assign blame.

For climate modification's more eager supporters, such worries are premature. According to Joe Kaplinsky, a technology analyst in London, "To raise these things before the technology has really gotten off the ground is to deprive us of the potential benefits of any technology, because any technology can be misused."

"Of course some people will benefit and some people will lose," Kaplinsky says, "but there are social mechanisms for solving disagreements, either through compensation or through democratic debate." If a new technology provides a "net gain," he says, "the losers can be compensated. And it's very clear that there's a tremendous potential here for managing weather systems in a way that would create tremendous net gain."

Some of the calculations, though, would verge on the Solomonic. Suppose we could control hurricanes, posits Harvard's Schrag, "but stopping one requires an incredibly hot day in Africa that would burn up all the crops. You've got one hell of a moral dilemma there."

"Let's say you have a mirror in space," he goes on. "Think of two summers ago when we were having this awful cold summer and Europe was having this awful heat wave. Who gets to adjust the mirror?"

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