

Beyond Rainmaking: Climate Engineering on the Nineteenth Century Great Plains

The year was 1871, and the weather in New York City bordered on apocalyptic: a forecast of ashfalls. Falling clouds of cinders reminded commuters that somewhere to the west, the world was ending. In the waning days of a dry autumn, millions of acres of the North Woods had caught alight all at once, wildfires raging across four separate states and the province of Ontario, claiming well over a thousand lives.¹ Today, these fires have been largely forgotten—the Great Chicago Fire being the lone exception—but contemporaries found them deeply unsettling. It was not just the flames they feared. “Are we to have in the very centre of our Continent, and in the very midst of the magnificent granary of the Northwest, an artificial desert, rivalling... the famous deserts of the Old World? A few more such fires” would bring the region “to a state of desolation beyond the power of human labor and human skill to recuperate it.” Without quick intervention, “we may have, in our country, a doomed district, in which the tragedy which befell the ancient Cities of the Plain is to be re-enacted.”²

Though seemingly hyperbolic, the *New York Herald's* worries were echoed in the scientific headlines. A few months later, the most influential advocate for scientific weather observation in the United States, Increase Lapham, declared that without action, “Gradually, but surely, the whole country will be reduced (as have been the once fertile plains of the East) to the condition of a desert. To do this will require more than individual effort; only [...] governmental effort can afford hope of success.”³ The Great Wisconsin Desert? A wasteland in the Midwest? How did Americans come to view climate change as an imminent threat—in 1871? And what “governmental effort”

¹ “The Weather,” *Washington Evening Star* (Washington, D.C.), Oct. 12, 1871, p. 1. Quotes from “The Western Forest Fires,” *Washington Evening Star*, Oct. 10, 1871, 1, 6.

² “The Fire Storm of the Northwest – Are We to Have an American Desert?” *New York Herald* (New York City), Oct. 18, 1871.

³ Increase Lapham, “The Great Fires of 1871,” in *Report of the Chief Signal Officer to the Secretary of War, 1871-2* (Washington, D.C.: GPO, 1872), 187-8.

could possibly reverse this catastrophe?

In this article, I argue that nineteenth-century Americans believed that climate changed—and *could be engineered*—largely because theories of climatic malleability mimicked the language and appearance of science. The reclamation of arid lands through arboriculture, rainmaking, and “rain follows the plow” lost credibility among emerging elite academic meteorologists over the late nineteenth century; classic environmental histories often characterized such theories as anti-expert or anti-intellectual.⁴ It is my contention that they are better characterized as *counter-expert*—gaining legitimacy outside traditional knowledge hierarchies, either from their advocates’ seeming scientific fluency or their experience in farm labor and military service.⁵ This is a capacious category—counter-experts could be (self-aware) frauds or well-intentioned experimentalists lacking formal training in emerging climate science, and it did not simply overlap with being incorrect—both experts and counter-experts argued at various points that the Great Plains climate was changing (though major droughts eventually made that an exclusively counter-expert opinion). Ultimately, to those without training, the writing of both groups appeared scientific.

That appearance hinged on numeracy. Both experts and counter-experts cited an unprecedented public knowledge-production infrastructure that churned out many libraries’ worth of statistics, making climate change seem real and comprehensible to American settlers and governments. These same statistics, removed from their context, made any claim credible. No one

⁴ Donald Worster, *An Unsettled Country: Changing Landscapes of the American West* (Albuquerque: University of New Mexico Press), 1994. See also the overview in Richard White, *The Republic for which It Stands: The United States During Reconstruction and the Gilded Age, 1865-1896* (Oxford UP, 2017), 425.

⁵ Similar to constructions of “counter-expertise” in: Kim Fortun and Todd Cherkasky, “Strategizing Counter-expertise,” *Science as Culture*, 7, Iss. 2 (1998): 141–144. See also Logan Williams and Sharlissa Moore, “Conceptualizing Justice and Counter-Expertise,” *Science as Culture* 28, Iss. 3 (2019): 251-76; Michelle Nickerson, *Mothers of Conservatism: Women and the Postwar Right* (Princeton UP, 2012); and Michael Barkun, “Conspiracy Theories as Stigmatized Knowledge,” *Diogenes* (10/25/2016).

even needed to quote them—rather, simply by mimicking a culture of techno-optimism and alluding to evidence, those arguing the climate was changing had armored themselves with the weight of presumed scientific authority. In short, science became a cultural performance rather than a practice. Using the very same data, advertisers encouraged immigrants to follow an increase in rainfall; jingoists justified indigenous dispossession by arguing they were responsible for the region’s desertification; public servants secured government support for a project of ecological remaking; and rainmaking enthusiasts bamboozled the public into accepting spectacular technological fixes for droughts. All claimed to champion science.

American climate history often centers on the West, stressing how human behavior exacerbated environmental problems, how aridity shaped the region, and how “greening” the arid West became a quasi-religious endeavor.⁶ Jamie Pietruska has shown how turn of the century American society grappled with the uncertainty and risk inherent in weather forecasts, and how the government attempted to keep a tight lid on weather forecasting for fears of misleading the public.⁷ But Americans sought not just to predict but to *prevent* troubled skies—a topic recently the subject of much scholarly curiosity. Kristine Harper and Alan MacEachern explore how agents of the state controlled and challenged rainmaking efforts, advancing those aligning with their own agendas and rejecting those that challenged their authority, while James Fleming connects them to

⁶ Donald Worster, *Dust Bowl* (New York: Oxford UP, 2004, original publication 1979); Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle: UW Press, 1999), Pekka Hämäläinen, *The Comanche Empire* (New Haven: Yale UP, 2008), Worster, *An Unsettled Country*, Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin, 1993). Outside the West, see Anya Zilberstein, *A Temperate Empire: Making Climate Change in Early America* (Oxford UP, 2016), Conevery Valencius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002), and Sam White, *A Cold Welcome: The Little Ice Age and Europe’s Encounter with North America* (Cambridge, MA: Harvard UP, 2017).

⁷ Jamie Pietruska, *Looking Forward: Prediction and Uncertainty in Modern America* (Chicago: University of Chicago Press, 2017). See also Walter Friedman, *Fortune Tellers: The Story of America’s First Forecasters* (Princeton UP, 2013); see also Jon Levy, *Freaks of Fortune: The Emerging World of Capitalism and Risk in America* (Cambridge, MA: Harvard UP, 2012).

a longer history of failed human efforts to improve the sky.⁸ Julie Courtwright convincingly argues that Plains settlers' belief in rainmaking reflected their anxieties over the region's aridity.⁹ Beyond rainmaking, theories of continental-scale climate engineering like "rain follows the plow," have been taken as illustrative of an obsession with capitalist expansion.¹⁰ Joseph Giacomelli suggests skeptical scientists' ambivalence towards climate engineering reflected broader tensions in late nineteenth century settler societies.¹¹ These arguments dovetail neatly with broader literature on capitalism and boosterism, as historians have noted profit, advertisers, and promoters played vital roles in the explosive growth of Western cities.¹² Broadly, however, scholarly work on "rain follows the plow" and rainmaking leaves climate engineering as something that hoodwinked settlers but left no lasting material legacy—a quixotic sideshow in the midst of the otherwise successful commodification of a continent.

This article expands upon existing works by exploring the parallel courses of American climate engineering, experts and counter-experts, and environmental conditions on the Great Plains. Climate engineering did not begin as heterodoxy. Rather, as I detail below, it rose to prominence because it was a firmly scientific theory that slotted easily into the settler colonial project of American empire. Settlers thought changing the climate was their responsibility, and in

⁸ Kristine Harper, *Make it Rain: State Control of the Atmosphere in Twentieth-Century America* (Chicago: University of Chicago Press, 2017); Alan MacEachern, "The Rainmaker," *Canada's History* 101 (Aug./Sept. 2021): 28-34. James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control*, (New York: Columbia UP, 2012). See also Clark Spence, *The Rainmakers: American 'Pluviculture' to World War II* (University of Nebraska Press, 1980), arguing that, while most rainmakers were frauds, the scale of climate confounded even serious experimentalists, and Daniel Zizzamia, "Restoring the Paleo-West: Fossils, Coal, and Climate in Late Nineteenth-Century America," *Environmental History* 24, Iss. 1 (2019): 130-56, arguing that a combination of technological progress and geological discoveries of paleo-climates convinced Americans that Western climates were malleable.

⁹ Julie Courtwright, "On the Edge of the Possible: Artificial Rainmaking and the Extension of Hope on the Great Plains," *Agricultural History* 89, no. 4 (Sept. 2015): 536.

¹⁰ See again Worster, *Dust Bowl*; Reisner, *Cadillac Desert*.

¹¹ Joseph Giacomelli, "The Meaning of Uncertainty: Debating Climate Change in the Gilded-Age United States," *Environment and History*, 24 No. 2 (May 2018): 237-264.

¹² William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton & Co., 1991), 23-54; see also David Wrobel, *Promised Lands: Promotion, Memory, and the Creation of the American West* (Lawrence: KU Press, 2002).

particular that arboriculture (widespread tree-planting) was a necessary component of the expansion of Euro-American agriculture, humid climate, and a healthy white society.¹³ Climate had long been seen as affecting human health, and suiting particular races more than others.¹⁴ But in the latter half of the nineteenth century, settler colonial ambitions amplified these beliefs. Climate engineering, rather than mere pursuit of profit or even the providential greening of the desert, became about the extirpation and replacement of wild ecologies, non-agricultural society, and indigenous peoples (all of which settlers largely saw as synonymous). I term this idea—that the expansion of Euro-American trees, crops, and people were inevitable and fundamentally inseparable—“manifest ecology.”¹⁵

But this project also waxed and waned with ecological conditions and the power of agricultural stakeholders. Before 1890, during wet years and capital expansion in the region, climate engineering enjoyed substantial and material government support. It exemplified a broader trend of settlers embracing, not rejecting, expert and government institutions which offered environmental solutions.¹⁶ Different sections of the government—sometimes even different parts of the weather service—disagreed about the efficacy of climate engineering. Even when

¹³ This is quite similar to the idea’s global ambit. See: Ruth Morgan, “Climate and Empire in the Nineteenth Century,” in Sam White, Christian Pfister, and Franz Mauelshagen, eds., *Palgrave Handbook of Climate History* (Palgrave Macmillan UK, 2018); Meredith McKittrick, “Talking About the Weather: Settler Vernaculars and Climate Anxieties in Early Twentieth-Century South Africa,” *Environmental History* 23, no. 1 (2018): 3–27; Phillip Lehmann, “Infinite Power to Change the World: Hydroelectricity and Engineered Climate Change in the Atlantropa Project,” *American Historical Review* 121 (2016): 70–100. For an American case: Joel J. Orth, “‘Directing nature’s creative forces’: climate change, afforestation, and the Nebraska National Forest,” *Western Historical Quarterly*, (Summer 2011).

¹⁴ Valencius, *The Health of the Country*; Zilberstein, *A Temperate Empire*.

¹⁵ This is a play on “Manifest Destiny”—one made with awareness of the misuse and overuse of that term (see White, *The Republic for which It Stands*, 103–4). “Manifest Destiny” was only a contemporary term in the antebellum period; here, I reference modern narratives of westward expansion—and argue that without recognizing contemporary beliefs that it was inextricable from ecological expansion, it is incomplete.

¹⁶ Deborah Fitzgerald, Lisa Onaga, Emily Pawley, Denise Phillips, and Jeremy Vetter, “Roundtable: Agricultural History and the History of Science,” *Agricultural History*, 92, No. 4 (Fall 2018): 569–604; David Hamilton, “Building the Associative State: The Department of Agriculture and American State-Building,” *Agricultural History* 64 (Spring 1990): 207–18; and Kathy Cooke, “Expertise, Book Farming, and Government Agriculture: The Origins of Agricultural Seed Certification in the United States,” *Agricultural History*, 76, No. 3 (Summer, 2002): 524–545; Charles Postel, *The Populist Vision* (Oxford UP, 2007).

distinguished meteorologists urged caution, other notables, touting their own expertise in forestry, agriculture, or simply lived experience of the Plains, used public data to legitimize contrary climatic theories and aggressively pursue afforestation. After 1890, however, government support weakened, as widespread droughts mostly disproved climate engineering's usefulness in greening the Great Plains, while popular counter-experts—denigrated by nascent institutions of climatology and meteorology but buoyed by manifest ecology thinking—embraced alternative hierarchies and institutions, using experience and identity as their credentials. Empiricism had opened a space in which anecdote could operate just as successfully as rigor—as long as it *looked* like science. Academic and government institution-building eventually excluded counter-experts from policymaking, but vitally, the government did not give up on the underlying dream of an interlinked transformation of the ecology and society of the West—there is a direct settler colonial throughline from Enlightenment-era theories of climate engineering to federal dam-building.

The story thus begins with arboricultural efforts up to 1890, continues with drought-spurred rainmaking experiments in the 1890s, and concludes with an expert skepticism of scalable climate solutions by the end of the drought in 1897. A belief that science and the state could remake the world endured throughout. For environmentalists, it is a story rife with irony, as the politics of settler colonialism stoked wishful thinking that climate could change—to our benefit. The result was a federal effort to engineer American climates, one so sweeping it forces us to ask where the idea came from in the first place.

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The answer has a surprisingly long history. Even in Enlightenment Europe, scholars had concluded that humans were climate engineers. Ancient and biblical texts described the Mediterranean as a verdant place: cedars in Lebanon, orchards in the Maghreb, a land of milk and

honey in Canaan. Juxtaposing ancient Edens with contemporary deserts, Europeans theorized Muslim mismanagement had ruined the region. Plants, they argued, emitted ambient moisture which would later fall again as rain; supposed land clearance and a lapse in cultivation after the fall of Rome meant less plant coverage; consequently, local rainfall over the years dwindled to nothing.¹⁷ American settlers brought this thinking with them across the Atlantic, blaming the cold and allegedly unhealthy climate came on the continent's supposed lack of cultivation.¹⁸

But there was an obvious corollary. If gross mismanagement could ruin the climate, proper caretaking could improve it. Meticulous forestry, conserving and planting to replenish or expand woodlands—what contemporaries called arboriculture—would humidify the atmosphere. The first efforts at arboricultural climate engineering began in colonial Indian Ocean empires, and spread from there.¹⁹ Austro-Hungarian scientists toyed with the idea as part of their pioneering climatological work.²⁰ Then, in the 1830s and 40s, French colonists in Algeria used the theory to advance a colonial agenda of dispossession.²¹ Russian surveys of the steppe in the 1850s claimed nomadic Turks and Altays had cleared its prehistoric forests in medieval times, rendering it a barren plain.²² France and Russia both subsequently launched tree-planting efforts to reverse these

¹⁷ Fredrik Albritton Jonsson, *Enlightenment's Frontier: The Scottish Highlands and the Origins of Environmentalism* (New Haven: Yale UP, 2013), 69-89. For the United States, James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford UP, 1998), 18-32. See also Jan Golinski, "Climate and Civilization," in Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: University of Chicago Press, 2007). See also Alfred Grove and Oliver Rackham, *The Nature of Mediterranean Europe: An Ecological History* (New Haven: Yale UP, 2003) for the idea's appearance in contemporary scholarship.

¹⁸ Zilberstein, *A Temperate Empire*; Valencius, *The Health of the Country*.

¹⁹ Gregory Barton, *Empire Forestry and the Origins of Environmentalism* (Cambridge: Cambridge University Press, 2002), Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860* (Cambridge UP, 1995), and Richard Grove, "The East India Company, the Australians, and the El Niño: Colonial Scientists and Ideas about Global Climatic Change and Teleconnections between 1770 and 1930," in Mahesh Rangarajan, ed., *India's Environmental History: A Reader*, Vol. 1 (Telengana, India: Orient Blackswan, 2013).

²⁰ Deborah Coen, *Climate in Motion: Science, Empire, and the Problem of Scale* (Chicago: University of Chicago Press, 2018).

²¹ Diane K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa* (Athens, Ohio: Ohio UP, 2007).

²² David Moon, *The Plough that Broke the Steppes: Agriculture and Environment on Russia's Grasslands, 1700-1914*, (Oxford: Oxford UP, 2013).

“historical” desertifications—and both claimed success.²³ Experimental verification arrived from Germany, where controlled trials of arboriculture showed gradually increased rainfall by the 1870s—efforts American climatologists followed with keen interest, and soon, sought to emulate.²⁴

Embracing this theory, settlers planted trees on the Plains from the beginning. But Americans were unique in employing a massive new state knowledge-production apparatus—a national weather service—to determine whether the practice really could change Western climates. Founded in 1870, the service expanded quickly, establishing stations in every territory by 1875.²⁵ It was immediately the most extensive of any national weather service in the world.²⁶ Manned by military officers who only made for amateur meteorologists, its stations nevertheless safeguarded ships, helped farmers avoid catastrophic crop losses, and even reported on events like labor strikes and native resistance as well as locust movements, and (of course) weather phenomena.²⁷ Weather forecasting remained contested: the weather service struggled to maintain sole authority in a crowd of almanacs and prognosticators.²⁸ But they were unrivalled in their collection of statistics: thrice-daily readings of temperature, precipitation, and cloud types. Courts often consulted these records in disputes over unfulfilled futures contracts, insurance, and spoiled crops; many weather observers reported subpoenas.²⁹ They also gave scientists, advertisers, financiers, and migrants

²³ Davis, pp. 131-76; Moon, 173-241.

²⁴ “Meteorological Notes,” *Nature* 19, No. 488 (March 6, 1879): 419, originally found in *Report of the Chief Signal Officer to the Secretary of War, 1878-1879*, (Washington, D.C.: GPO, 1879), 220.

²⁵ See list of stations, *Report of the Chief Signal Officer to the Secretary of War 1873-1874*, pp. 9-78. See also James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore: Johns Hopkins University Press, 1990) and James Rodger Fleming, “Storms, Strikes, and Surveillance: The U. S. Army Signal Office, 1861-1891,” *Historical Studies in the Physical and Biological Sciences* 30, No. 2 (2000): 315-332.

²⁶ Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005), p. 236, Fleming, *Meteorology in America*, 166.

²⁷ Erik Craft, The Value of Weather Information Services for Nineteenth Century Great Lakes Shipping, *American Economic Review* (1998): 1059-76; Fleming, “Storms, Strikes, and Surveillance.”

²⁸ Pietruska, *Looking Forward*. See also Anderson, *Predicting the Weather*, 42-70.

²⁹ *Report of the Chief Signal Officer to the Secretary of War 1873-1874*, 9-78.

tantalizing hints of increasing Western rainfall.

Contemporary experts interpreting these reports never agreed on whether arboriculture really worked: perhaps it varied cyclically or randomly. The sky had always been an easy topic of argument—visible to everyone, it defied controlled experiments and encouraged inexpert opinions.³⁰ But in America, new debates were fueled by a particularly vast body of records. These records made climate *tangible*, not only helping readers to interpret the climate but convincing them climatic change was easy to grasp, and offered legitimacy to the experiences of counter-experts. As shown below, proponents and detractors of climate engineering would cite these statistics for decades, scrutinizing them in hopes of uncovering annual, decadal, or even larger cycles—or change.³¹

For most settlers, the new statistics confirmed the long-held belief that cultivation changed the climate, as the advance of white settlement coincided with a wetter turn of the climate.³² For example, boosters cited Nebraska’s average annual rainfall, increasing from 29.82 to 35.74 inches from 1865-1875—readily publicized by the Signal Service: “The steady increase and reliability of the amount of rain-fall, as shown by Signal Service reports, has been the cause of an immense number of homesteads,” boasted an 1879 government report.³³ Financiers apparently agreed, giving ample credit to farmers in marginal lands.³⁴

³⁰ Vladimir Janković, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (Manchester: Manchester University Press, 2001), and Anderson, *Predicting the Weather*.

³¹ H. Helm Clayton, Jr., “A Lately Discovered Meteorological Cycle.: No. II,” *American Meteorological Journal, A Monthly Review of Meteorology and Allied Branches of Study* (April 18, 1885): 1, 12; *American Periodicals*: 528; Loren A. Sherman, “Weather Areas and Their Movements,” *American Meteorological Journal: A Monthly Review of Meteorology and Allied Branches of Study* (November 18, 1884): 1, 7; *American Periodicals*: 248, Cleveland Abbe, “Is Our Climate Changing? *Forum* (February 1889); *American Periodicals*: 678.

³² Climate records from: National Oceanic and Atmospheric Administration, “National Centers for Environmental Information: Climatological Data,” https://www.ncdc.noaa.gov/EdadsV2/library/CLIMATOLOGICAL_DATA, Accessed 3/12/2016.

³³ Cited in Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha: Daily Republican Print, 1881), 58. Quote in *Report of the Chief Signal Officer to the Secretary of War, 1878-79*, 80.

³⁴ Larry McFarlane, “British Investment in Midwestern Farm Mortgages and Land, 1875-1900: A Comparison of Iowa and Kansas,” *Agricultural History* 48, No. 1 (1974), Farming in the Midwest, 179-198, 196.

To most observers, this arboricultural victory was also clearly a victory for state power. Individual settlers planted trees, but state action massively scaled these efforts up. Nebraska enacted the first “Arbor Day” in 1872, and other states rapidly followed suit; participating men, women, and children planted millions of trees across the Plains.³⁵ A year later, the Timber-Culture Act doubled homesteads for farmers planting trees on 40 of their 160 acre claims—though successfully planting was difficult and fraud was rampant.³⁶ Writers extolled the virtues of forest-culture: shade, protection, future lumber, and even aesthetics.³⁷ Above all, however, these states emphasized the forests’ relationship with agriculture and perceived “civilization”—by humidifying the atmosphere, a representative newspaper article claimed, trees caused “an ameliorated climate, surer crops, and greater healthfulness.”³⁸ Plains states offered cash prizes to the counties or persons planting the most trees on Arbor Day, and local papers celebrated extraordinary feats of arboriculture—with some claiming to have planted over 5,000 trees in a day—singlehandedly.³⁹ In the same breath, Westerners lamented forest clearance in Eastern states, which had seemingly wasted their timber, and converted their once-fertile fields into treeless wastes—much like the Biblical precedents above.⁴⁰ One North Dakota paper claimed: “Evidence is accumulating that God never made a desert... and that the many barren spots on each continent are standing monuments of man’s stupendous ignorance and violation of nature’s laws.”⁴¹ Enthusiasts rarely cited such “evidence” directly; it was simply assumed.

³⁵ “Untitled,” *The New York Sun* (New York City), Feb. 26, 1872, 2, for the announcement. Articles in the following footnotes give estimates for trees reaching well into the millions.

³⁶ Gilbert Fite, *The Farmers’ Frontier, 1865-1900*, (New York: Holt, Rinehart and Winston, 1966), 15-33; White, *The Republic for which It Stands*, 121.

³⁷ Untitled, *The New York Sun*, Apr. 16, 1875, 2.

³⁸ “Forestry in Minnesota and Iowa,” *The Northern Pacific Farmer*, Dec. 1, 1881, 3.

³⁹ “Tree Items,” *The Worthington Advance* (Worthington, MN), May 18, 1876, 3.

⁴⁰ Steven Stoll, *Larding the Lean Earth: Soil and Society in Nineteenth-Century America* (New York: Hill and Wang, 2002).

⁴¹ “Forest Associations,” *Jamestown Weekly Alert* (Jamestown, ND), Mar. 24, 1882, 2.

State power was essential for a task whose economic benefits would take a long time to manifest. “Years must elapse before the general aspect of a country can be changed by cultivation;” one report to the Secretary of Agriculture read.⁴² A time horizon of *generations* simply required government. Farmers’ increasing professionalization, coupled with rising demands of debts and mortgages, made them increasingly ill-suited to the task of planning for their children or grandchildren.⁴³ “[N]ot one man in a hundred thousand ever thinks of these matters,” lamented one farmer in the *American Agriculturist* in 1871, who begged the federal government to directly administer arboriculture. If trees caused rain, he wrote, neglecting their planting would be “criminal.”⁴⁴

The government’s efforts might have satisfied him: in 1875 the Department of Agriculture declared there was an “already perceptible... modification of [Nebraska’s] climate.”⁴⁵ The Department collaborated with Plains states and corporations, citing trees’ role as “reservoirs and distributors of moisture” and the way they “attracted” clouds “so that there is a greater rainfall... than upon that which is not covered with trees.”⁴⁶ Indeed, investigating the climatic effects of forests was one of Congress’s three founding goals for the Department of Agriculture’s Division of Forestry.⁴⁷ State-supported universities studied which trees grew fastest or best, and often suggested specific species to plant in different parts of shelterbelts; one 1875 report specified individual species for windward and leeward sides.⁴⁸ The Department also supplied railroad companies with seeds, hoping they might cultivate them along the rails.⁴⁹ This had very material

⁴² *Report of the Secretary of Agriculture* (Washington D.C.: GPO, 1875), 342.

⁴³ Levy, *Freaks of Fortune*, 150-190.

⁴⁴ *The American Agriculturist*, Vol. 30, 1871, 7-8.

⁴⁵ *Report of the Secretary of Agriculture*, 1875, 325.

⁴⁶ *Report of the Secretary of Agriculture*, 1883, 453. See similar quotes in many, many other years, 1875 on.

⁴⁷ *Report of the Secretary of Agriculture*, 1885, 183.

⁴⁸ *Report of the Secretary of Agriculture*, 1875, 340-1.

⁴⁹ Illinois Central Railroad Company Archives, The Newberry Library, Chicago, Box 9, Folder 2, doc. 7. This letter, from the Secretary of Agriculture to the Illinois Central Railroad, contained *Catalpa speciosa* seeds, and requested

effects, radically overhauling the Plains' species profile. Forests in the region are still today mostly composed of imported Eurasian species, quite unlike their overwhelmingly-indigenous coastal counterparts.⁵⁰ In planting trees, governments were quite successful.

Still, their efforts paled beside the ideas of Charles Dana Wilber, a well-known booster who speculated that plowing released soil moisture into the air without any cultivation (or oversight) at all—famously declaring “rain follows the plow.”⁵¹ Wilber made the humble plowman the greatest conqueror of them all; he and even more fringe theorists argued that individual action on a national scale could do more than any government arboriculturist.⁵² Wilber cited the same numbers as arboriculture enthusiasts; Plains settlers saw agriculture and arboriculture as going hand in hand; and the same statistical apparatus legitimized both ideas, giving them the cover of scientific and statistical validity.

Both narratives relied on forgetting—white hands were hardly the first to try agriculture on the prairie.⁵³ Like other declensionist narratives globally, climatologists speculated native fires had desiccated the Plains and ignored native horticulture.⁵⁴ Where natives saw their fires as redirecting bison and replenishing the grass, settlers saw them destroying timber, exacerbating

the railroad plant them alongside their routes. “The subject of tree-culture along the lines of railroads... as it is also of public benefit, I am ready to give it all the attention and assistance that the appropriations made for the Department of Agriculture will warrant, until the companies see the importance of doing all they can...” *Catalpa speciosa* trees naturally grew near the Mississippi; today they are more abundant further west through arboriculture. See “Current Range and Importance Value and Little's Maps: northern catalpa,” USDA, accessed 3/11/2017, https://www.nrs.fs.fed.us/atlas/tree/curr_ivlittle_452.html

⁵⁰ Other examples can be found in the *Reports of the Secretary of Agriculture*, 1875-1890. See also Craig Miner, *West of Wichita: Settling the High Plains of Kansas, 1865-1890* (Lawrence, Kansas: UK Press, 1986), 8, 46. For Eurasian tree percentages, see Bill Rankin, “Trees Trees Trees,” on Radical Cartography, copyright 2016, accessed 3/12/2017, <http://www.radicalcartography.net/index.html?trees>

⁵¹ Wilber, *Nebraska and the Northwest*, 63-8.

⁵² Others suggested metallic conductors affected atmospheric electricity to somehow cause rainfall. See, for example, Wilber, *Nebraska and the Northwest*, 73. But they were dismissed by Lapham, “The Great Fires of 1871 in the Northwest,” 189, who calls it an “absurdity,” and Cleveland Abbe, “Is Our Climate Changing?” *Forum* (Feb. 1889): 678.

⁵³ Elizabeth Fenn, *Encounters at the Heart of the World: A History of the Mandan People* (New York: Hill and Wang, 2014).

⁵⁴ Lapham, “The Great Fires of 1871 in the Northwest,” p. 187-188, Powell, *Report on the Arid Lands*, 17-18, Wilber, *Nebraska and the Northwest*, 70-1, “The Fire Storm of the Northwest,” *New York Herald*,

drought-causing winds, and desertifying the West.⁵⁵ In the last third of the nineteenth century, the Bureau of Indian Affairs forced reservation natives to abandon their mixed-use economy and take up a sedentary existence on some of the region's least arable lands.⁵⁶ Genocide, white supremacy, and ecology became interlinked in Euro-American rhetoric; Wilber celebrated the extension of non-native weedy grasses as indicative of the success of climate modification—and the civilization of the frontier.⁵⁷ These earliest roots of conservation were dark, indeed.

Some scientists questioned both theories, most notably John Wesley Powell. His famed 1879 *Report on the Arid Lands* argued the changes would only be temporary: “we shall have to expect a speedy return to extreme aridity, in which case a large portion of the agricultural industries of the country... would be destroyed.”⁵⁸ Another dissenter, noted meteorologist Cleveland Abbe, argued that any “change in climate” would take decades to distinguish itself from statistical variation.⁵⁹ Historians have lionized these voices.⁶⁰ But both men endorsed forest extension and native dispossession.⁶¹ Moreover, neither one convinced very many people. With their own expertise carrying limited cachet, the weather service's copious data could be turned to either side of the argument; facts could be cherry-picked at will.⁶² In statistically rich but analytically poor environments, the more compelling narrative usually wins. Climatology was tailor-made for counter-expertise.

⁵⁵ Julie Courtwright, *Prairie Fire: A Great Plains History* (Lawrence: UK Press, 2011).

⁵⁶ Powell, *Report on the Arid Lands*, p. 18, as well as letters in the *Report to the Commissioner of Indian Affairs*, Washington, D.C.: Government Printing Office, between 1870-1900.

⁵⁷ Wilber, *Nebraska and the Northwest*, 80-86.

⁵⁸ Powell, *Report on the Arid Lands*, 90-91.

⁵⁹ Abbe, "Is Our Climate Changing?" as well as Cleveland Abbe, "Popular Errors in Meteorology," *American Meteorological Journal: A Monthly Review of Meteorology and Allied Branches of Study*, 4, No. 3 (Jul. 1887), 119 and "Our Climate Is Not Changing," *The Phrenological Journal and Science of Health* 89, No. 5 (May 1890), 242. Note Abbe never denied change—he advocated agnosticism.

⁶⁰ For this see Worster, *An Unsettled Country*.

⁶¹ Powell, *Report on the Arid Lands*, 14-18.

⁶² More rigorous analysis would have to wait for computer modeling. See Paul Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).

Taken together, theories of climate change painted a comprehensive portrait of the evolving West. They seemed well-supported by the data, and delivered a popular, optimistic verdict; it is of no surprise that settlers embraced them. But even they looked tame next to dreams of some not-too-distant future. In one 1881 piece on the subject that is worth quoting at length, the *New York Times* speculated:

In the present age we are coming to a point where the assurance of weather prophets begins to look less ridiculous. [...] **Men are no longer sure that they cannot, in some future time, control the elements to such an extent that uninhabitable regions will become habitable, arid districts become arable, frozen islands unlock their ice-bound coasts.** The attention to tree-planting points one way, namely, to a modification of climate through the attraction and retention of moisture and the formation and retention of soil. [...] But lately, thanks to the labors of geologists like Dr. Croll, and of naturalists on the largest mental scale like Alfred Russel Wallace, a great stride forward has been made in our knowledge of the action of the sea upon the climate of contiguous lands. [emphasis mine]

Wallace, the *Times* explained, had shown how in the geological past, even the North Pole had enjoyed tropical climes. Ocean currents bathed its Arctic shores with gentle warmth, not unlike the Gulf Stream. The editorial speculated that if a waterway could be created following “the track of the old sea that geologists have long laid down between Asia and Europe, the northern shores of both continents would support rich vegetation, birds and beasts, communities of civilized men.” Noting proposals for flood control on the Mississippi and a canal through Panama, the editorial went on to ask: “what will we not be capable of in the year 2000? Is it madness to imagine that bodies of warm tropical water can be led to cold shores...?”⁶³

Even if the Arctic would have to wait, the enthusiasm the *Times* displayed for climate engineering reflects the staggering ambitions Americans had for their science. Of course, the inevitability of “progress” was everywhere in the late nineteenth century. But this is precisely the point—Americans imagined they could unlock changes in the Earth as significant as those of ice

⁶³ "The Control of Climates," *New York Times*, Sept. 4, 1881.

ages. Indeed, they believed they already *had*, weaving themselves into a grand geohistorical narrative.

Science, here, belonged to virtually anyone willing to parrot its language. In its guises as rainmaker, arboriculturist, and plowman, it stood poised to do more than the cowboy or the gunslinger ever had. As one forester wrote: “Those who have watched the effect of forests on rainfall say that, by commencing at the edge of any dry belt, the forests, and consequent rainfall, may gradually be extended,” making the Plains “as well watered as Iowa, Illinois, Wisconsin, or states further east.”⁶⁴ Extend it far enough, and, as the ever-jubilant Wilber wrote: “This bursts upon us in all the light of scientific truth—the fact that America can sustain a greater population than the entire old world.”⁶⁵ Millions of acres remained to be planted. Millions of lives could flourish in what was now a desert.

There was just one problem: it wasn’t true.

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One day, the rain just stopped falling. The summer of 1890 prefigured the Dust Bowl by forty years: scant showers in July, then nothing. The next two years brought some respite, but drought returned from 1893 until 1897.⁶⁶ The Dakotas and Nebraska became an agricultural graveyard: hundreds of thousands fled the region.⁶⁷ While charity kept settlers alive, no such luck awaited the region’s indigenous populations: thousands died of hunger or disease.⁶⁸ Compounding the problem, the droughts slammed the Great Plains in the midst of the global “Long Depression”

⁶⁴ James S. Brisbin, *Trees and Tree-Planting* (New York: Harper & Brothers, 1888), 11-12.

⁶⁵ Wilber, *Nebraska and the Northwest*, 165.

⁶⁶ National Oceanic and Atmospheric Administration, “National Centers for Environmental Information: Climatological Data.”

⁶⁷ Gilbert C. Fite, “Great Plains Farming: A Century of Change and Adjustment.” *Agricultural History* 51, No. 1 (Jan. 1977): 244-256.

⁶⁸ See Rani-Henrik Andersson, *The Lakota Ghost Dance of 1890* (Lincoln: University of Nebraska Press, 2008).

of 1873 to 1896.⁶⁹ They also hit during a boom in land speculation: much of the farming population now lived on mortgaged farms. The climate catastrophe was enough to ruin them, and their foreclosures helped lead to financial panic in 1893.⁷⁰ It was in this atmosphere that the Populist Party began its meteoric rise on a platform of economic relief.⁷¹

If ever there was a moment for innovative thinking, this was it. Everyone agreed if arboriculture worked at all, it required decades. That sufficed for problems like aridity. But during catastrophic drought, people sought *immediate* solutions. Instead of giving up, emigrating, or even just trying to wait out the drought, some farmers tried a new technology in the hopes of engineering one last Eden: artificial rain.

The first theoretical model for rainmaking came in 1840 from James Espy, the most accomplished atmospheric scientist of his day.⁷² Espy knew rainfall condensed out of clouds as pockets of air ascended and cooled.⁷³ He reasoned that if you could heat the air through artificial fires, it would rise, cool, and its water vapor would condense.⁷⁴ The theory earned some support, but never saw widespread testing—at least, not purposefully. But the 1871 wildfires (with which we began) put an end to the theory. Lapham’s report to the weather service examined the idea explicitly. He cited the records of dozens of nearby stations, each reporting no rain (Chicago likely would have done the same, had the station not been on fire). The *New York Herald* lambasted Espy, and even speculated that Espian rainmakers might have started the fire to begin with.⁷⁵

But 1871 was not all bad for rainmakers, for a new theorist—a popular counter-expert—

⁶⁹ Eric Hobsbawm, *The Age of Empire, 1875–1914* (New York: Vintage Books, 1989), 34-46.

⁷⁰ Levy, *Freaks of Fortune*, 150-190.

⁷¹ See Postel, *The Populist Vision* and Richard Hofstadter, *The Age of Reform: from Bryan to FDR* (New York: Alfred A. Knopf, 1955).

⁷² Fleming, *Fixing the Sky*, 53-58.

⁷³ Henry, “Meteorology in Its Connection with Agriculture (1856),” 48.

⁷⁴ James Pollard Espy, *The Philosophy of Storms* (New York: C.C. Little & J. Brown, 1841), 492-518.

⁷⁵ “The Espy Theory,” *New York Herald*.

emerged: Edward Powers.⁷⁶ Citing the rains after famous battles like Waterloo and Gettysburg, as well as the common experience of 4th of July fireworks cut short by showers, Powers argued explosions induced rain. Raindrop formation was (and is) poorly understood; Powers held that a sound wave forced droplets of moisture closer together until they collected into larger raindrops.⁷⁷ Meteorologists deemed it plausible (including Abbe and Powell), and combat veterans (most prominently, Daniel Ruggles, a former Confederate) testified to post-battle rain, petitioning Congress for experimental funds throughout the 1880s.⁷⁸ One group of Kansas Civil War veterans wrote in support, “knowing from experience that heavy rainfalls followed each battle or cannonading.”⁷⁹ Where arboriculture saw statistical arguments for and against longstanding scientific theories, concussion rainmaking advocates elevated common-sense and a different sort of expert: soldiers and citizens.

But skepticism abounded, as displayed by a particularly snarky *New York Times* writer:

Ruggles, unfortunately, declines to submit himself to the conditions which public Central African opinion imposes upon a native King who practices rain-making. In that primitive community, the rain-maker who fails to produce rain according to his promises is put to death. We should all have more confidence in Gen. Ruggles were he to adopt the rules governing members of his profession in Central Africa.⁸⁰

Regardless, there was little occasion to test such ideas in the 1870s, and still less in the soaking-wet 1880s. Why bother bombing the sky if the rain still falls?

The idea lingered in the public consciousness, though, and the fact that it remained a possibility—one entertained by so many experts, no less—astounded onlookers. Technological

⁷⁶ Edward Powers, *War and the Weather, or, The Artificial Production of Rain* (Chicago: S. C. Griggs, 1871).

⁷⁷ Fleming, *Fixing the Sky*, 61-4.

⁷⁸ Fleming, *Fixing the Sky*, 64-74. See also Untitled, *Alexandria Gazette* (Alexandria, VA), Feb. 27, 1880, 2, Untitled, *Alexandria Gazette*, Feb. 22, 1889, 2, and Untitled, *The Wahpeton Times* (Wahpeton, ND), Mar. 7, 1889, 2. An entry in a local Illinois paper describes minutes of a city council meeting: “Street Sprinkler Powe was given fifteen dollars and Nangls forty dollars for causing artificial rain during the summer.” No additional information was given. *The Ottawa Free Trader* (Ottawa, IL), Jul. 06, 1889, 5.

⁷⁹ Untitled, *The Wahpeton Times*, Mar. 7, 1889, p. 2.

⁸⁰ “Rain-Making,” *New York Times*, Feb. 14, 1880.

triumphalism was everywhere. “Great clouds!” said a character in one 1881 Ohio newspaper serial, “Another incomputable step in progress.”⁸¹ Another columnist reported on an 1872 petition for experimental funding: “What won’t American inventors do finally? [...] In case the experiment is successful, we suppose that every well-to-do farmer will invest in 300 cannon, and keep a large stock of powder always on hand. And, then, in dry times, the clerk of the weather will receive thundering salutes of artillery.”⁸² Powers himself claimed his invention belonged to an “age of progress.”⁸³ The theory rested on a mountain of circumstantial evidence and the lack of any proof to the contrary.

Then came the drought. 1890 would be a key turning point for rainmakers—if they could deliver on their promises. Powers released a second edition in 1890, and several new rainmaking companies were founded, some using Powers’ concussion method. Others mixed mysterious “chemicals,” a method (supposedly) imported from Australia.⁸⁴ Quite suddenly, people took notice, shifting attention from timber-culture and tree planting.⁸⁵

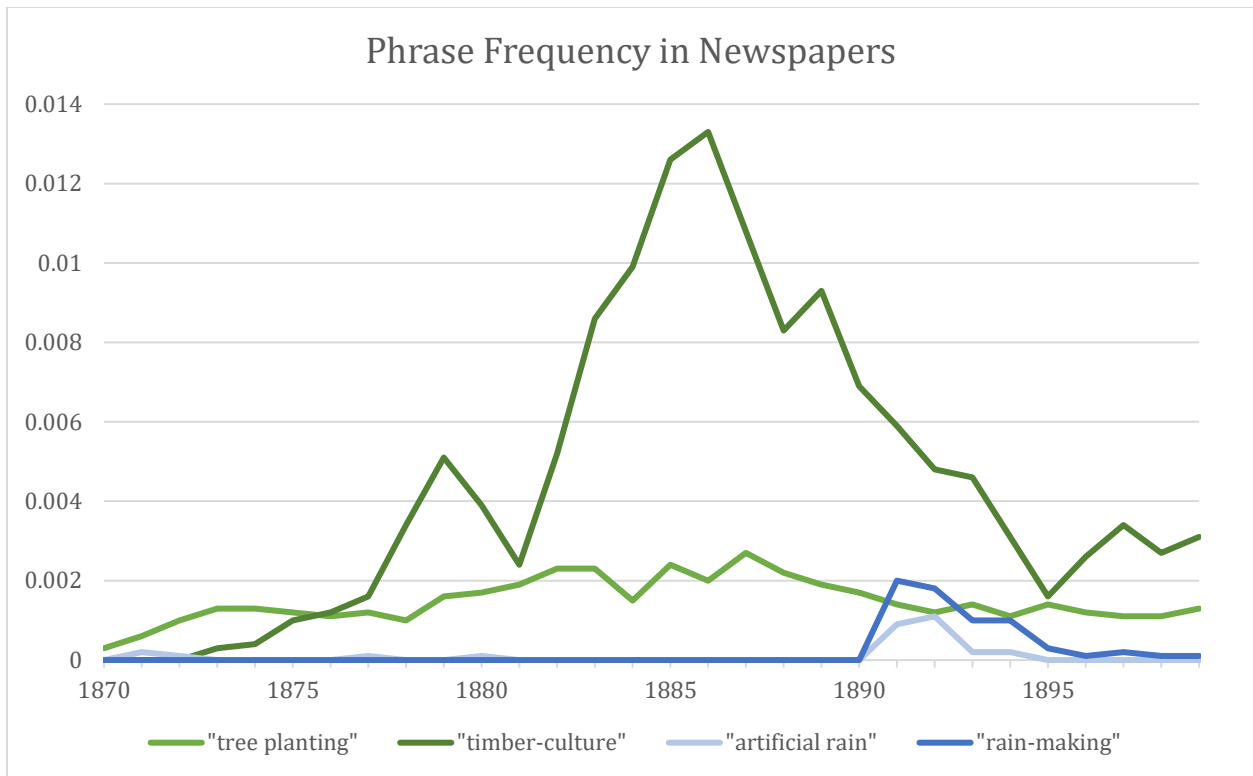
⁸¹ “Our Century of Progress,” *Democratic Northwest*, Napoleon, OH, Oct. 27, 1881, 6.

⁸² *The Semi-Weekly Republican* (St. Francisville, LA), Apr. 5, 1872, 1.

⁸³ Powers, *War and the Weather*, 3.

⁸⁴ Fleming, *Fixing the Sky*, 64-89.

⁸⁵ Chart adapted from Georgia Research Tech Institute, “US News Map,” accessed 2/12/2017, <http://usnewsmap.com/>.



To the majority of journalists, concussion experiments offered the most viable approach.⁸⁶ Quoting one rain-maker, the *Bismarck Weekly Tribune* wrote: “‘In many times of need the very feeblest assistance of nature by man is sufficient.’ It is a very different thing from claiming that rain can be produced by artificial means whenever or wherever it is desired.”⁸⁷ Comparatively, the Goodland Artificial Rain Company of Kansas might seem ridiculous: its operators trundled into town, apparatuses puffing smoke, and shrugged off questions. A local newspaper fretted that the owner, “Mr. Montgomery... wraps himself up in mystery when requested to tell something about the kind of a watering pot the concern [*n.b.* “company”] uses.”⁸⁸ But only three weeks later, they reported a resounding success: “It rained all Sunday night, and water was standing on the ground and running down the streets. We have seen seven winters in this locality and never knew it to rain this

⁸⁶ Popular sentiment was more mixed—see Courtwright, “On the Edge of the Possible.”

⁸⁷ “Artificial Rain,” *Bismarck Weekly Tribune*, Sept. 30, 1892, 4.

⁸⁸ “The Rain Industry,” *The Goodland Republic* (Goodland, KS), Nov. 27, 1891, 8.

time of year.” The only doubt lay in *whose* rain it was: multiple experimenters had been at it that weekend.⁸⁹ Attention, money, and rainmaking requests soon followed from the Dakotas, Kansas, Minnesota, and Nebraska.⁹⁰ Though dismissive of him, concussion rainmakers had inadvertently opened space for methods like Montgomery’s to operate. Any evidence could validate every theory. The slippery nature of “progress” again allowed anyone to claim the mantle of science.

Some talked of legal ramifications—whether, for example, rainmaking should be banned on Sunday under blue laws, or how courts might adjudicate the possession of atmospheric moisture—and speculated whether technology could be turned to other uses, like preventing frosts through artificial means.⁹¹ These widespread perceptions of success were probably helped by the sky itself—1891 and 1892 delivered steady showers to the Great Plains on the heels of the rainmaking rituals.⁹² But after a couple of good years—and even complaints that rainmaking was *too successful*—the droughts returned.⁹³

“What has become of the artificial rainmaker?” asked one Dakota paper in early 1893.⁹⁴ Others laughed at the “so-called rainmakers” and wondered “if there is any benefit to be derived from” their secrets.⁹⁵ Another blow came from Goodland, where the residents of the town released a statement declared their own rainmaking companies as a “fraud... gotten up as a money-making scheme.”⁹⁶ Skepticism and breathless hope had competed from the start over rainmaking—but a year and a half of drought was enough to swing the debate.

⁸⁹ “And Then It Rained,” *The Goodland Republic*, Dec. 18, 1891, 1.

⁹⁰ Untitled, *Turner County Herald* (Hurley, SD), Feb. 4, 1892, 2, “Contracts for Rain,” *St. Paul Daily Globe*, February 24, 1892, p. 5, and “Agreement,” *The Black Hills Union* (Rapid City, SD), Apr. 22, 1892, p. 4. See also David Wishart, *The Last Days of the Rainbelt* (Lincoln: University of Nebraska Press, 2013), 112-122.

⁹¹ *St. Paul Daily Globe* (St. Paul, MN), Jul. 31, 1891, 4.

⁹² For climatic conditions, NOAA, “Climatological Data.”

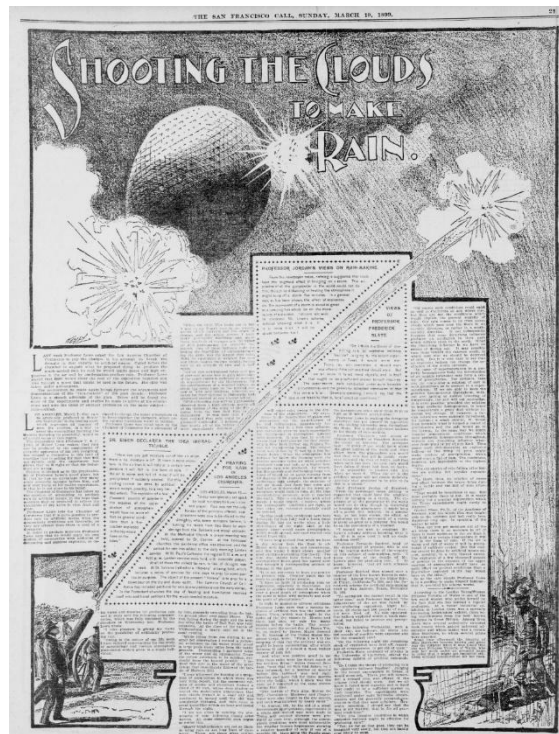
⁹³ See complaints, for example, in “Getting Too Much Water,” *St. Paul Daily Globe*, Apr. 09, 1892, 1.

⁹⁴ “Local Stories,” *Turner County Herald*, May 11, 1893, 1.

⁹⁵ “Rainmakers’ Convention,” *Hot Springs Weekly Star* (Hot Springs, SD), Apr. 06, 1894, 2.

⁹⁶ “Rainmakers,” *The Goodland Republic*, Jun. 22, 1894, 2.

Soon, even the concussion rainmakers began to wither. A highly publicized government test of the theory in Texas failed, and seemingly disproved scientific “artificial rain.”⁹⁷ Certainly, it soured government actors on the idea. Public patience evaporated by the mid-1890s. “It is astonishing what asses break into State Legislatures,” ran one article mocking a Nebraska appropriations bill for rainmaking corporations.⁹⁸ A contemporary farce centered on the efforts of its leading woman, Mrs. Casher, to “obtain a divorce from her husband, who is endeavoring to boom a town site, by offering a shower of artificial rain... instead of taking care of his family.”⁹⁹ When one railroad company announced its intention to outfit a car with rainmaking equipment, most were surprised that it “[had] not lost faith,” and one added that “people have no inclination to blow in any more money on artificial rain making.”¹⁰⁰



⁹⁷ Harper, *Make It Rain*, 19-58; Fleming, *Fixing the Sky*, 66-71.

⁹⁸ “Enough to Disgust People with Lawmakers,” *The Evening Bulletin* (Nebraska City, NE), Feb. 9, 1895, 2.

⁹⁹ “In Local Theaters,” *The Scranton Tribune* (Scranton, PA), Apr. 04, 1895, 3. No script has survived; the play was panned.

¹⁰⁰ *Potosi Journal* (Potosi, MO), May 1, 1895, 2, and “South Dakota News,” *Pierre Weekly Free Press* (Pierre, SD), May 2, 1895, 2.

Special on Rain-Making, San Francisco Call, 1899

After its failure on the Great Plains, rainmaking had a brief revival during a California drought at the end of the century, but the above full-page spread in the *San Francisco Call* ultimately concluded that concussion theory was “really nothing but a popular superstition which the Texas experiments ought surely to disprove.”¹⁰¹ “Thus these three men relegate us back to the same old state of affairs that the world has faced for so many thousand years;—no way of getting rain except to pray for it.”¹⁰²

If rainmaking had died a well-deserved (and incomplete) death, though, what of arboriculture?¹⁰³ Looking back, the droughts seem to have confirmed the upward trajectory of precipitation statistics over the last two decades had been nothing more than what Cleveland Abbe had suggested: a statistical artifact. It would be a neat and tidy narrative: failure killed the rainmakers and cemented scientific authority in institutions run by a sober-minded few. But the curious thing is that the dream hadn’t died, even for its most scientifically literate of dreamers.

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In 1890, Congress transferred the Division that would become the Weather Bureau from the Department of War to the Department of Agriculture. It would seem an apt metaphor: the Bureau ceased fighting the sky. But it also coincides with another trend, as the government put its stock into a new, experienced cohort of experts. Near the center of this group stood John P. Finley, one of the most prolific meteorological writers of the nineteenth century, the foremost authority on tornado formation and forecasting, and longtime member of the United States Signal Service.¹⁰⁴

¹⁰¹ “Shooting the Clouds to Make Rain,” *The San Francisco Call* (San Francisco, CA), Mar. 19, 1899, 22.

¹⁰² Rain-Making Again,” *Los Angeles Times* (Los Angeles, CA), Aug 27, 1891, 4.

¹⁰³ Rainmaking would be revived during later Great Plains droughts. See again Courtwright, “On the Edge of the Possible.”

¹⁰⁴ Joseph G. Galway, “J. P. Finley: The First Severe Storms Forecaster,” Storm Prediction Center, NOAA/Weather Service, Accessed 2/22/2017, <http://www.spc.noaa.gov/publications/galway/finley1.pdf>

He had corresponded with Powers, and personally witnessed the 1890s droughts.¹⁰⁵ By 1893, when Congress asked him to study the climate of the northern Plains, he had every reason to despair. And yet, what emerges from his *Certain Climatic Features of the Two Dakotas* is a hopeful portrait, though not in the same ways as before.¹⁰⁶

The problem of drought, Finley asserted, wasn't too little rainfall, but rather too much evaporation. "So strong is the agency of evaporation in this respect that we might conceive of a region... [in which] the occurrence of drought [was] entirely independent of rainfall."¹⁰⁷ Quoting a variety of experts, including skeptic John Wesley Powell, Finley noted that evaporation was exacerbated by "dry, hot southerly winds of the Dakotas," resulting "from peculiarities in the distribution of atmospheric pressure, modified to a certain extent by both general and local topography."¹⁰⁸ He showed little patience for beliefs in changing rainfall: "The universal popular belief that the climate is changing can only be explained by the short and defective memories of people who recall a few seasons only..." Climate change, he wrote, "would require some catastrophic change in the atmosphere itself rather than in the surface of the country."¹⁰⁹

But even this did not mean that government should give up on technological solutions to the climate. Finley concluded with 21 "lessons," ranging from the prosaic to the breathtaking. "The Dakotas must resort to an extensive system of irrigation. Forests must be preserved and extensive reforestation adopted. [...] Increase the area covered with vegetation."¹¹⁰ The reader will by now recognize these as classic climate strategies—irrigation to generate moisture and vegetation to prevent evaporation. Other provisions were not: "Every feasible means of checking evaporation

¹⁰⁵ Fleming, *Fixing the Sky*, 64.

¹⁰⁶ John P. Finley, *Certain Climatic Features of the Two Dakotas, Illustrated with One Hundred and Sixty-Three Tables, Charts, and Diagrams* (Washington: GPO, 1893).

¹⁰⁷ Finley, *Certain Climatic Features*, 20.

¹⁰⁸ Finley, *Certain Climatic Features*, 21.

¹⁰⁹ Finley, *Certain Climatic Features*, 25.

¹¹⁰ Finley, *Certain Climatic Features*, 34.

must be adopted. Wind-breaks of trees or hedges may be employed to... offer protection from the drying effect of winds.”¹¹¹ Even more remarkably, Finley claimed that cultivation actually *exacerbated* drought through increasing evaporation. Without irrigation, “as the population of the two States increases the deleterious effect from deficiency in precipitation and high evaporation must become more severe.”¹¹² Reproducing two hundred fifty pages of weather service data, Finley made it clear that after the drought, the government trusted its own meteorological experts above all. It was a monumental shift from decades of rhetoric around “amelioration.”

Perhaps most revealing, however, were two of Finley’s stranger lessons: “Both Dakotas need a greater variety of wind currents. [...] The occurrence of drought in the Dakotas bears such a close relation to the distribution of atmospheric pressure over the north-central portion of the United States that it becomes an inevitable result unless obviated through the intervention of artificial influences.”¹¹³ Finley did not seem optimistic that artificial wind and pressure systems would be available anytime soon, but their mere mention is astounding. Techno-optimism was alive and well. What had become apparent to Finley was the *scale* of the problem. If they were going to prevent drought—*truly* prevent it, not just mitigate it with irrigation, they would need to break up high pressure systems the size of continents. *How* that could possibly happen was immaterial, because until it could be done, nothing could be done.

After Finley, state arboriculture waned—but its animating principles remained intact in the first proposals for massive state irrigation projects. “No doubt,” ran a Weather Bureau report published in 1891, “a general introduction of irrigation and the consequent growth of vegetation... would very largely ameliorate the unfortunate meteorological conditions which at times result in

¹¹¹ Finley, *Certain Climatic Features*, 35.

¹¹² Finley, *Certain Climatic Features*, 35.

¹¹³ Finley, *Certain Climatic Features*, 35.

the destruction of crops in Kansas by extremely hot winds.”¹¹⁴ Similar proposals came in from Signal Service staff in Oregon.¹¹⁵ Certainly, these proposals chiefly concerned watering crops, but it is striking that they still cited theories of considerable “increase of the absolute humidity of the atmosphere” around reservoirs.¹¹⁶

On the one hand, then, there is a clear line between late climate engineering ambitions and the idea of massive dam-building projects. Likewise, manifest ecology drove these dam-builders: they pursued the greening of the desert as a continuing settler colonial endeavor.¹¹⁷ On the other hand, the ambitions of these latter-day climate engineers paled in comparison to that of their predecessors—and their focus had shifted. Once at the heart of American ambitions, by 1900, the Great Plains had become a backwater in a global world with multiple interchangeable agricultural hinterlands. No different from global grasslands like the Outback, Pampas, or Steppes, for the moment, the Plains had lost their chance to grasp the levers of capital and government.¹¹⁸ In short, what had faded was not a belief in arboriculture, but state investment in the Great Plains: dam-building, famously, concentrated in the Southwest. The expansion of the state in the New Deal Era would in fact revive arboriculture as “Project Shelterbelt.”¹¹⁹

Why did these settlers fight so tenaciously and so long? The answer likely has several elements to it: lucky climatic fluctuations, the cultural importance of the frontier, the mythic power

¹¹⁴ A. W. Greely, *Irrigation and Water Storage in the Arid Regions*, (Washington: GPO), 1891, 9-10.

¹¹⁵ H. E. Hayes and B. S. Pague, *Biennial Report of the Oregon Weather Bureau, Cooperating with U. S. Signal Service* (Salem, Oregon: Frank C. Baker, 1891), xxxvi.

¹¹⁶ Hayes and Pague, *Biennial Report*, 12.

¹¹⁷ Erika Bsumek, “Reclamation, Redemption, and Political Maneuvering in Dine Bikeyah, 1947-1980,” in Brenden Rensink and Jane Hafen, *Essays on American Indian and Mormon History* (University of Utah Press, 2019), 137-160.

¹¹⁸ Such mobilization waited for dedicated interest groups; see Elizabeth Sanders, *Roots of Reform: Farmers, Workers, and the American State, 1877-1917* (Chicago: University of Chicago Press, 1999), and Elisabeth Clemens, *The People's Lobby: Organizational Innovation and the Rise of Interest Group Politics in the United States, 1890-1925* (Chicago: University of Chicago Press, 1997).

¹¹⁹ Worster, *Dust Bowl*, p. 39; “Fighting the Drouth,” *Popular Mechanics Magazine* 62, No. 4 (Oct. 1934): 483-485; C. G. Bates, “The Plains Shelterbelt Project,” *Journal of Forestry* 32, No. 9, (Dec. 1 1934): 978-991. See also Wilmon H. Droze, *Trees, Prairies, and People: A History of Tree Planting in the Plains States* (Denton, TX: Texas Woman's University, 1977).

of cornucopianism and agrarianism, the providential project of greening the desert, and, of course, profit. But profit alone was not enough—the lands of the High Plains were marginal at best, and there were better avenues for capital. Together, an epistemological slippage between the language of science and its actual practice and a drive to change North American environments repackaged Manifest Destiny for a new era. Americans believed this manifest ecology could be infinitely reproduced across the continent. Any environment could be conquered, not just by the action of humans, but by their plants and animals as well. All of North America could be made not just fertile, but *American*, home to farmers, farms, and cities.

Climate engineers' track record is not encouraging. But where science failed, science fiction dreamed on. Through 1880, a feminist utopian author, Mary Bradley, regaled her readers with a serial story of a strange, faraway land called Mizora—a land which “[obtained] rain artificially when needed, by discharging vast quantities of electricity in the air.”¹²⁰ Unlike in our land, where climate “produced scarcity, and sometimes famine,” in Mizora, “the daintiest morsels came from the chemist’s laboratory, cheap as the earth under her feet.”¹²¹ In the perfect future, the sky cannot touch us. Indeed, that utopia has seemingly become ever more realistic.

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Our world faces a foe as apocalyptic as those of 1871, but on a global scale. Ironically, our current predicament did not go completely unanticipated. In 1856, the American scientist Eunice Foote predicted that carbon dioxide warmed the atmosphere.¹²² Forty years later, Svante Arrhenius would connect this hypothesis with industrialization to suggest human civilization was changing

¹²⁰ Mary E. Bradley, *Mizora, A Prophecy* (New York: G. W. Dillingham, 1889, orig. pub., *Cincinnati Commercial*, 1880-1881), 11. Note the similarity to the concept of telegraphs bringing rain (footnote 52).

¹²¹ Bradley, *Mizora*, 14.

¹²² Leila McNeill, “This Lady Scientist Defined the Greenhouse Effect But Didn’t Get the Credit, Because Sexism,” *Smithsonian.com*, 12/5/2016, Accessed 12/1/2018, <https://www.smithsonianmag.com/science-nature/lady-scientist-helped-revolutionize-climate-science-didnt-get-credit-180961291/>

the Earth's climate.¹²³ What neither Foote nor Arrhenius could know was that emissions from agricultural land use changes—particularly in the Americas—had already begun to warm the planet.¹²⁴ In a roundabout way, farmers *had* been changing the climate, and given that overall rainfall will rise in a warmer world—quite a lot in the American Midwest—rain *will* follow the plow.¹²⁵

With the rise of a new apocalypse, something quite like climate engineering has risen to meet it: “geoengineering” ideas ranging from aerosols, to solar shades, to far-fetched schemes of carbon sequestration, all of which promise to fix stubborn skies once again. Climate engineering is alive and well, promoted by scientists as well as policymakers.¹²⁶ The nineteenth century might appear to be a relevant cautionary tale, then—a story of scientists, dreamers, and a climate that failed to change.¹²⁷ But it is not terribly insightful to note that climate engineering remains popular—its decline was never about popularity, and modern proposals are far more feasible than historical ones.

More revealing instead is how specific assumptions are still baked into climate engineering proposals. First: a manifest ecology, though modified, continues to propel American thinking, binding settler colonialism and climate politics. An American ecology remains paramount, capitalist expansion necessary—the fossil fuel era and American ways of life must be preserved, even if geoengineering is costly or deadly. As the most effective latitudes to deploy sulfur aerosols

¹²³ Svante Arrhenius, “On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground,” *Philosophical Magazine and Journal of Science* 5, Vol. 41 (Apr. 1896): 237-276, and Francis Molena, “Remarkable Weather of 1911: The Effect of the Combustion of Coal on the Climate—What Scientists Predict for the Future,” *Popular Mechanics* (Mar. 1912): 339-342.

¹²⁴ John Brooke, *Climate Change and the Course of Global History* (Cambridge: University of Cambridge Press, 2014), 402, 478-9.

¹²⁵ David Archer, *Global Warming: Understanding the Forecast* (New York: Wiley-Blackwell, 2009), 70-3.

¹²⁶ Edward Parson, “Opinion: Climate policymakers and assessments must get serious about climate engineering,” *Proceedings of the National Academy of Sciences* (Aug. 29, 2017), DOI: <https://doi.org/10.1073/pnas.1713456114>.

¹²⁷ See Fleming, *Fixing the Sky*.

are equatorial, so it is the rainfall, sunlight, and ultimately agriculture of the Global South that will be most affected by these schemes. Geoengineering schemes do not require international cooperation, but instead only enough planes to put sulfur into the sky; a single government can effectively govern the atmosphere of billions who fall outside its sovereignty. Here, as in so many cases, environmental conditions defy legal boundaries and amplify existing power, permeating both nations and bodies.¹²⁸

Second: the statistical richness of climate data means narratives that mimic scientific language remain popular—but quite changed. The nineteenth century climate debate was characterized by an explosion of statistics and claims of legibility—recall that Wilber, Powers, and even authority figures like Finley claimed the evidence was clear. The twentieth century, on the other hand, transformed analysis through computerization, big data, and credentialing—and modern climate denialists like the fossil fuel lobby instead emphasize the illegibility of climate data and models.¹²⁹ The demise of the rainmakers during the 1890s drought likewise suggests that these counter-narratives will only die when undermined by our collective *experience* of climate—perhaps beginning with the wildfires, storms, and flooding in the twenty-first century.¹³⁰

Third: the history of climate engineering hints that collective action is quite possible. After all, nineteenth century Western governments were effective at coordinating local efforts to achieve common goals. Public (particularly layperson) enthusiasm and participation in science were key

¹²⁸ Jane Flegal, Anna-Maria Hubert, David Morrow, and Juan Moreno-Cruz, “Solar Geoengineering: Social Science, Legal, Ethical, and Economic Frameworks,” *Annual Review of Environment and Resources* 44 (Oct. 2019): 399-423 <https://doi.org/10.1146/annurev-environ-102017-030032>. Troy Vettese, “To Freeze the Thames: Natural Geo-Engineering and Biodiversity,” *New Left Review* 111, (May/Jun. 2018), <https://newleftreview.org/issues/III111/articles/troy-vettese-to-freeze-the-thames>. See also Paul J. Crutzen, “Geology of Mankind,” *Nature* 415, No. 23 (3 January 2002), doi:10.1038/415023a.

¹²⁹ Edwards, *A Vast Machine*. On denialism, see Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury, 2011), and Leah Aronowsky, “Gas Guzzling Gaia, or: A Prehistory of Climate Change Denialism,” *Critical Inquiry* 47, No. 2 (2021), <https://doi.org/10.1086/712129>.

¹³⁰ Naomi Klein, *On Fire: The Burning Case for a Green New Deal* (New York: Penguin, 2019).

to sparking a public climate response that spanned the West. This history, then, has quite promising implications for proponents of bold policy proposals built on broader visions of the future, like the Green New Deal, even or perhaps especially if ill-defined.¹³¹

Fourth, and perhaps the most vital lesson from climate engineering: scale. Western governments had not given up—they simply recognized the problem of scale. Climate is not a matter of acres and years, but of continents and decades. Again, Americans confront apocalyptic atmospheres—indeed, ash from western wildfires again drifts eastward in the jet stream. This time, however, it seems unlikely that expanding capitalism can find a substitute as it once did for the Great Plains.

¹³¹ See again Klein, *On Fire*.