
'THE WAY OF THE RAIN': TOWARDS A CONCEPTUAL FRAMEWORK FOR THE RETROSPECTIVE EXAMINATION OF HISTORICAL AMERICAN AND AUSTRALIAN 'RAIN FOLLOWS THE PLOW/PLOUGH' MESSAGES

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Abstract

History establishes that even before the advent of modern media, erroneous climate messages were disseminated to the public. A folk belief captured by the phrase 'rain follows the plow' (RFTP) is a prime example of such misinformation. This belief, popular in the late nineteenth century, maintained that cultivation of arid lands in the United States beyond the 100th meridian west would boost precipitation, creating a climate more favourable for farming. Encouraged by this narrative, homesteaders cultivated arid lands west of the meridian. Rain did not follow the plough and many farms in the Great Plains failed. RFTP was also invoked in South Australia in support of agricultural settlement north of Goyder's Line, a geographical boundary delineating the limits of reliable rainfall in the colony. This article revisits the origins of the doctrine and places RFTP messaging in its historical context by examining articles and poetry published in American and Australian settlement-era newspapers. The results of two newspaper database surveys reveal that a number of historical RFTP stories and an environmental poem with religious overtones appeared first in US newspapers and were later republished in newspapers throughout Australia. One of the surveys also reveals that, from 1876 to 1898, reports of parliamentary discussions or debates referencing the slogan were published in South Australia. The dissemination of inaccurate climate information in settlement-era America and Australia is discussed in relation to a proposed conceptual framework based upon contemporary theories of science communication that might provide a basis for the analysis of historical science messaging.

Keywords: climate, rain follows the plow/plough, 100th meridian, Great Plains, Goyder's Line, Charles Dana Wilber, Samuel Aughey, science communication, United States, South Australia

Introduction

Messages conveying erroneous scientific information have been disseminated to the public throughout history, often influencing public policy and human behaviour. A prime example of such misinformation is a folk belief captured by the phrase ‘rain follows the plow’ (RFTP).¹ This belief, popular in the late nineteenth century, maintained that cultivation of arid lands in the United States beyond the 100th meridian west would boost precipitation, creating a climate more favourable for farming. Encouraged by this narrative, homesteaders cultivated arid lands west of the meridian. Rain did not follow the plough and many farms in the Great Plains failed. The same belief was disseminated throughout settlement-era Australia and invoked in the colony of South Australia in support of agricultural settlement north of Goyder’s Line, a geographical boundary delineating the limits of reliable rainfall in the colony.

This article revisits the origins of the doctrine and places RFTP messaging in its historical context by examining articles and poetry published in US and Australian settlement-era newspapers. The results of a database survey reveal that a number of historical RFTP stories appeared first in US newspapers and were republished in newspapers throughout Australia. The survey also reveals that, from 1876 to 1898, reports of parliamentary discussions or debates referencing the slogan were published in South Australian newspapers. In addition, ‘The Way of the Rain’, an American poem celebrating the RFTP doctrine, was published in American newspapers then republished in Australian newspapers.

The dissemination of inaccurate climate information about rainfall in the nineteenth century (the RFTP belief) is discussed here in relation to a proposed conceptual framework based upon contemporary theories of science communication. This framework, which provides a basis for the analysis of historical science communications, is drawn from twentieth- and twenty-first-century science communication models, including those described by Dan Kahan, Gordon

1 ‘Plow’ is used when discussing the American experience, while the spelling ‘plough’ is used when discussing the Australian experience. Database searches will not be productive unless the proper spelling is used. Although the term ‘pseudoscience’ was used in the nineteenth century, this article does not define the folk belief RFTP as pseudoscientific. The term ‘pseudoscience’ invokes a complex philosophical debate about the boundaries among science, non-science, pseudoscience and other human activities. A thorough discussion of the Demarcation Problem is beyond the scope of this essay. Those interested in historical use of the term ‘pseudoscience’ or a discussion of the Demarcation Problem can consult the following references: George M. Sternberg, ‘Science and Pseudo-science in Medicine’, *Science* 5, no. 110 (1897): 199–206, doi.org/10.1126/science.5.110.199; Alex Wellerstein, ‘Heterodoxy and Its Discontents’, *Science* 338, no. 6104 (2012): 194–5, doi.org/10.1126/science.1227959; Massimo Pigliucci and Maarten Boudry, eds, *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem* (Chicago: University of Chicago Press, 2013), doi.org/10.7208/chicago/9780226051826.001.0001; David B. Resnik, ‘A Pragmatic Approach to the Demarcation Problem’, *Studies in History and Philosophy of Science Part A* 31, no. 2 (2000): 249–67, doi.org/10.1016/S0039-3681(00)00004-2; Thomas F. Gieryn, ‘Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Science’, *American Sociological Review* 48, no. 6 (1983): 781–95, doi.org/10.2307/2095325.

Pennycook and their research associates, and includes seven primary mechanisms that might explain how and why people adopted science misinformation in Great Plains and South Australian agricultural settlements. Also included in the framework is a consideration titled 'reality check' with which scholars can factor in conflicts between scientific misinformation and real-world events such as drought. The tools provided by this framework can be used to propose hypotheses and conduct analyses of historical science-related messages.²

Evidence derived from the data examined herein suggests that an array of factors likely influenced Great Plains and South Australian settlers' reception of and reaction to nineteenth-century RFTP messaging, which in turn influenced their decisions to establish farms, ranches and sheep runs on lands with less than optimal rainfall for agriculture. Graphical representations of this messaging suggest that it might have taken the harsh reality of drought for the American public to fully accept the fact that rain did not follow the plough.

This essay surveys historical newspaper coverage of the RFTP doctrine and lays the groundwork for the application of the proposed framework to critically assess processes by which RFTP beliefs evolved and were disseminated, debated and adopted (see Table 1). Application of this framework to a wide range of historical science or environmentally related messaging is possible.

Literature review: Models of science communication

In 'Why Do People Fall for Fake News?', the researchers Gordon Pennycook and David Rand make note of recent theories that might illuminate 'the human weakness for misinformation'.³ In years past, the 'deficit model' of science communication, suggesting that top-down methods of communicating science resulted in public ignorance and hostility, was a serious contender as an explanation for the poor public understanding of science.⁴ The deficit model was followed by the 'dialog

2 In a similar manner, Mike Conway, Maria Elizabeth Grabe and Kevin Grieves, 'Villains, Victims and the Virtuous in Bill O'Reilly's "No-Spin Zone"', *Journalism Studies* 8, no. 2 (2007): 197–223, doi.org/10.1080/14616700601148820, repurposed seven propaganda devices developed by the Institute for Propaganda Analysis to develop hypotheses about and conduct content analyses of O'Reilly's 'Talking Points Memo' editorials; also see Brian Trench, 'Towards an Analytical Framework of Science Communication Models', in *Communicating Science in Social Contexts: New Models, New Practices*, ed. Donghong Cheng et al. (New York: Springer, 2008), 119–35, doi.org/10.1007/978-1-4020-8598-7_7.

3 Gordon Pennycook and David Rand, 'Why Do People Fall for Fake News?', *New York Times*, 19 January 2019.

4 For a description of the deficit model of science communication see Patrick Sturgis and Nick Allum, 'Science in Society: Re-evaluating the Deficit Model of Public Attitudes', *Public Understanding of Science* 13, no. 1 (2004): 55–74, doi.org/10.1177/0963662504042690; Dan M. Kahan, Kathleen H. Jamieson and Dietram A. Scheufele, eds, *The Oxford Handbook of the Science of Science Communication* (New York: Oxford University Press, 2017), 219, 269, 293, 297.

model' where citizens were encouraged to engage in two-way communication with disseminators of science.⁵ According to Pennycook and Rand, however, there are two current models that do a better job of explaining why people fall for misinformation or propaganda. Much simplified, the first model (the Kahan model) hypothesises that we are 'hijacked by our partisan beliefs' and the second model (Pennycook and Rand's model) hypothesises that, for various reasons, we fail to exercise critical thinking in our decision-making processes—in other words, the authors say 'we're mentally lazy'.⁶

Kahan, a Yale Law School professor, conducts empirical research on human decision-making, frequently focusing on decisions requiring valid scientific evidence.⁷ He calls 'the failure of valid scientific evidence to quiet disputes over policy-relevant facts' the *science communication problem*. Kahan rejects as inadequate what he calls four 'false starts'—four popular and plausible explanations for the failure of science communication to eliminate public disagreement over policy-relevant scientific facts.⁸

These 'false starts'—theories Kahan says can explain only a few, isolated instances of science communication failure—include the 'irrational public' explanation (a variation of the deficit model); the 'obscure and partisan scientists' explanation; the 'age of denial' explanation; and the 'manipulated public' explanation, which suggests that some failures of rational evidence-based scientific decision-making are the result of orchestrated campaigns of scientific misinformation.⁹

Kahan offers four alternative explanations for why he believes the public has difficulty accepting what he calls 'decision-relevant' science (DRS). First, there is more decision-relevant science than members of the public can possibly understand, so they must accept as known more DRS than they can verify for themselves. Second, the public must be able to reliably recognise DRS in order to use DRS in decision-making. Third, public conflict over how to identify DRS is a recognition problem, not a comprehension problem. Finally, the recognition problem arises as a result of the tendency for people to align philosophically with the values of those with whom they share a cultural commitment. As a result, people tend to use biased

5 For additional science communication models see Trench, 'Towards an Analytical Framework of Science Communication Models', 119–20.

6 Pennycook and Rand, 'Why Do People Fall for Fake News?.'

7 Dan M. Kahan, 'What is the "Science of Science Communication"?' *Journal of Science Communication* 14, no. 3 (2015): 1, doi.org/10.22323/2.14030404; Dan M. Kahan, 'Fixing the Communications Failure', *Nature* 463, no. 7279 (2010): 296–7, doi.org/10.1038/463296a; Dan M. Kahan, 'Why Are We Poles Apart on Climate Change?' *Nature* 488, no. 7411 (2012): 255, doi.org/10.1038/488255a; Dan M. Kahan, 'On the Sources of Ordinary Science Knowledge and Extraordinary Science Ignorance', in *The Oxford Handbook of the Science of Science Communication*, ed. Jamieson, Kahan and Scheufele, 35–41, doi.org/10.1093/oxfordhb/9780190497620.013.4.

8 Kahan does not define what he means by 'valid scientific evidence', which for purposes of this essay will be defined as scientific evidence that has been evaluated and accepted by one's scientific peers. See Kahan, 'On the Sources of Ordinary Science Knowledge and Extraordinary Science Ignorance', 36–41.

9 *ibid.*, 35–49.

decision-making processes (what Kahan calls 'identity-protective cognition'), thus placing more value on the beliefs of those with whom they have an affinity than on information vetted by experts.¹⁰

Pennycook and Rand's competing, but not necessarily incompatible, view suggests that failure to exercise critical faculties motivates some people to go with their gut rather than engaging in cognitive reflection during the decision-making process. In support of their view, Pennycook and Rand demonstrate experimentally a number of cognitive mechanisms they suggest explain people's tendencies to believe 'outlandish' information. One of these mechanisms is 'the illusory truth effect', the premise that prior exposure to a statement increases the likelihood participants will judge it to be accurate—in other words, that repetition increases the fluency with which a statement (whether true or false) is processed and accepted as true.¹¹

The works of Kahan, Pennycook, Rand and others are important steps forward in understanding the mechanisms involved in science-related decision-making. Their empirical work is impressive and illuminating. In addition to conducting empirical research, however, it is important to examine retrospectively those instances in history when the understanding or communication of scientific principles did not or could not facilitate effective decision-making in what were some of the most important science-related decisions of the era. Here a framework based on twentieth- and twenty-first-century models of science communication is proposed as a tool to examine historical instances of science miscommunication, including environmental and climate messaging in the nineteenth century.

Table 1: Factors considered in the analysis of historical scientific messages.*

<p>Factor 1: The public's capacity and/or willingness to comprehend and converge collectively on what constitutes valid (for the era) scientific evidence due to one or more of the following:</p> <ul style="list-style-type: none"> • willingness to accept more valid (for the era) scientific evidence as true than individuals can verify on their own • ability to recognise valid (for the era) scientific evidence • difficulty recognising valid (for the era) scientific evidence • ability and/or willingness to exclude external factors (such as politics) that obscure the science communication environment.
<p>Factor 2: Failure of scientists to explain valid scientific principles accurately or effectively due to one or more of the following:</p> <ul style="list-style-type: none"> • lack of expertise • failure of the scientific environment (lack of adequate scientific training, for example) • state of scientific knowledge • bias or partisanship on the part of scientists.
<p>Factor 3: Preference for or dominance of religious or other belief systems when deciding matters of science.</p>

10 *ibid.*

11 Gordon Pennycook, Tyrone D. Cannon and David G. Rand, 'Prior Exposure Increases Perceived Accuracy of Fake News', *Journal of Experimental Psychology: General* 147, no. 12 (2018): 1865–80, doi.org/10.1037/xge0000465.

Factor 4: The 'Illusory truth effect', i.e. the impact of repetitious messages.
Factor 5: Resistance to the authority of valid (for the era) scientific evidence [a form of science denialism].
Factor 6: The action of witting or unwitting transmission of misinformation due to one or both of the following: <ul style="list-style-type: none"> • orchestrated misinformation • misinformation conveyed, but not as an orchestrated effort.
Factor 7: The impact of public engagement on the public understanding of scientific issues. <ul style="list-style-type: none"> • Facilitated by top-down dissemination of scientific knowledge by scientists (a version of the deficit model). • Facilitated by public engagement in or observation of two-way dialogue with scientists or other disseminators of scientific messages (a version of the two-way dialogue model).
Reality check: The impact of harsh realities – What did it take for a science policy or belief course correction to occur (if one did occur)?

*Factors 1–7 were derived in part from references cited in notes 4–11.

Arid lands beyond America's 100th meridian

In the nineteenth century, a belief about the climate arose among those in favour of settling lands west of the 100th meridian, a line of longitude crossing North America that separates the arid west from the more humid east.¹² This belief, encapsulated by the phrase 'rain follows the plow', maintained that cultivation of arid or semi-arid lands beyond the 100th meridian would increase the evaporation of moisture, boost precipitation and effect a permanent change in the climate.¹³

Encouraged by a purported increase in the region's variable rainfall, promotion of the RFTP doctrine by railroad and real estate developers, and assertions by putative experts that the climate on the Great Plains was changing, homesteaders settled

12 J. A. Williamson, Commissioner of the Department of the Interior, 'Letter of Transmittal', in John Wesley Powell, *Report on the Lands of the Arid Region of the United States with a More Detailed Account of the Lands of Utah With Maps*, 2nd ed. (Washington, DC: Government Printing Office, 1879), iv–v, doi.org/10.3133/70039240. Available at pubs.usgs.gov/unnumbered/70039240/report.pdf.

13 Samuel Aughey, *Sketches of the Physical Geography and Geology of Nebraska* (Omaha, NE: Daily Republican Book and Job Office, 1880), 41–52, doi.org/10.5962/bhl.title.18267; Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), 69–92; Henry Nash Smith, 'Rain Follows the Plow: The Notion of Increased Rainfall for the Great Plains, 1844–1880', *Huntington Library Quarterly* 10, no. 2 (1947): 169–93, doi.org/10.2307/3815643; Walter Kollmorgen and Johanna Kollmorgen, 'Landscape Meteorology in the Plains Area', *Annals of the Association of American Geographers* 63, no. 4 (1973): 434–6, doi.org/10.1111/j.1467-8306.1973.tb00939.x; Cary J. Mock's modern interpretation of nineteenth-century evidence does not support the belief that rainfall was increasing on the Great Plains. See Mock's 'Rainfall in the Garden of the United States Great Plains, 1870–1889', *Climate Change* 44, no. 1–2 (2000):173–95, doi.org/10.1023/A:1005570827123. Also see Francis H. Snow, 'Letters to the Editor—Is the rainfall increasing on the Plains[?]', *Science* 11, no. 269 (1888): 158, doi.org/10.1126/science.ns-11.269.158; George E. Curtis, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 272 (1888): 194, doi.org/10.1126/science.ns-11.272.194; H. A. Hazen, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 274 (1888): 218, doi.org/10.1126/science.ns-11.274.218; H. Helm Clayton, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 275 (1888): 229, doi.org/10.1126/science.ns-11.275.229; Adolphus W. Greely, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 276 (1888): 240, doi.org/10.1126/science.ns-11.276.240-b.

and attempted to farm lands beyond the meridian. Unfortunately, drought ensued and many farms succumbed.¹⁴ 'Rain follows the plough' was similarly invoked in South Australia by supporters of agricultural settlement beyond Goyder's Line, a boundary that delineated the 10-inch isohyet (a line that joins all regions within a geographical area that experience an average annual rainfall of 10 inches) and the limits of reliable rainfall in the northern regions of the colony.¹⁵

Many historians have suggested that the phrase 'rain follows the plow' (if not the belief itself) originated in the nineteenth century among proponents of westward expansion across the North American continent. Harnessing a blend of idealism, religiosity and a sense of national exceptionalism, these boosters encouraged settlement of the American West, including the arid or semi-arid Great Plains region. Promoters of westward expansion often had their own agendas, but the overarching national agenda was distilled into a two-word slogan that would galvanise this migration to and settlement of the West. It was the country's 'manifest destiny', wrote the editor and columnist John L. O'Sullivan in 1845, 'to overspread the continent allotted by Providence for the free development of our yearly multiplying millions'.¹⁶ Through the efforts of homesteaders, the entire continent would soon become a 'garden in the grasslands', asserted RFTP believers.¹⁷

14 Peter Folger, *Drought in the United States: Causes and Current Understanding* (Washington, DC: Congressional Research Service, 2017), 2, 9. Available at fas.org/sgp/crs/misc/R43407.pdf; Gary D. Libecap and Zeynep Kocabiyyik Hansen, "Rain Follows the Plow" and Dryfarming Doctrine: The Climate Information Problem and Homestead Failure in the Upper Great Plains, 1890–1925', *Journal of Economic History* 62, no. 1 (2002): 86–120.

15 Janis Sheldrick, *Nature's Line: George Goyder Surveyor, Environmentalist, Visionary* (Mile End, SA: Wakefield Press, 2016), 272–5; Donald W. Meinig, *On the Margins of the Good Earth: The South Australian Wheat Frontier 1869–1884* (Chicago: Rand McNally & Company, 1962), 59–60; For an excellent comparison of Great Plains and South Australian settlement history and the role played by the 'RFTP' belief during colonisation of these two regions, see Kirsty Douglas' essay, "For the Sake of a Little Grass": A Comparative History of Settler Science and Environmental Limits in South Australia and the Great Plains', in *Climate, Science, and Colonization*, ed. James Beattie, Emily O'Gorman and Matthew Henry (New York: Palgrave Macmillan, 2014), 99–117, doi.org/10.1057/9781137333933_6.

16 John O'Sullivan, 'Annexation (1845)', *United States Magazine and Democratic Review* 17, no. 1 (1845): 5–10; Adam Gomez, 'Deus Vult: John L. O'Sullivan, Manifest Destiny, and American Democratic Messianism', *American Political Thought* 1, no. 2 (2012): 236–62, doi.org/10.1086/667616.

17 David M. Emmons, *Garden in the Grasslands: Boomer Literature of the Central Great Plains* (Lincoln, NE: University of Nebraska Press, 1971), 1–24; Bradley H. Baltensperger, 'Plains Promoters and Plain Folk: Pre-Migration and Post-Settlement Images of the Central Great Plains' (PhD diss., Clark University, 1974), 7–8.

By the early to mid-nineteenth century it had become apparent that the lands west of the 100th meridian were quite unlike the humid lands of the eastern United States where settlers had farmed successfully for more than a century.¹⁸ The inconsistent rainfall in the Great Plains region presented a challenge. Early explorers had, in fact, originally labelled much of the land west of the Mississippi a 'Great American Desert'.¹⁹ Although this concept eventually fell into disrepute, much of the land beyond the 100th meridian was in fact arid or semi-arid.²⁰ If these lands were to be settled and exploited successfully, extraordinary efforts (such as large-scale land reclamation and water management projects) would be required.²¹

In 1862 and 1864, Congress passed two acts that provided federal land grant and loan subsidies to finance a transcontinental railroad.²² Pursuant to these acts, the financial burden of constructing a railroad would be offset by granting to railroad companies lands adjacent to the lines under development. This immediately increased the value of the ceded lands, which in turn prompted a rush to sell these lands to homesteaders. In 1862, Congress passed the Homestead Act, which endorsed conveying parcels of up to 160 acres to homesteaders.²³

In order to encourage homesteading of land once declared a desert, a new mythos was required, and 'rain follows the plow' fitted the bill. In one of the most effective public relations schemes ever undertaken, boosters of westward expansion maintained that farming was transforming the desert into a lush region with sufficient rain to grow all manner of crops.²⁴ The philosophy underpinning this phrase had ancient beginnings and dubious supporters.

18 Powell, *Report on the Lands of the Arid Region*, 23–4.

19 Zebulon Pike, 'Appendix to Part III', *Account of Expeditions to the Sources of the Mississippi, and through the Western Parts of Louisiana* (Philadelphia, PA: C. & A. Conrad, 1810), 5; Richard H. Dillon, 'Stephen Long's Great American Desert', *Proceedings of the American Philosophical Society* 111, no. 2 (1967): 93; Bradley H. Baltensperger, 'Plains Boomers and the Creation of the Great American Desert Myth', *Journal of Historical Geography* 18, no.1 (1992): 59–73, doi.org/10.1016/0305-7488(92)90276-F.

20 Charles R. Kutzler, 'Rain Follows the Plow: The History of an Idea' (PhD diss., University of Colorado, 1968), 166–251; Andrew Menard, 'Striking a Line through the Great American Desert', *Journal of American Studies* 45, no. 2 (2011): 267–80, doi.org/10.1017/S0021875810000034; Powell, *Report on the Lands of the Arid Region*, 23–4.

21 Powell, *Report on the Lands of the Arid Region*, 23–4.

22 The Pacific Railroad Act of 1862, *An Act to Aid in the Construction of a Railroad and Telegraph Line from the Missouri River to the Pacific Ocean, and to Secure to the Government the Use of the Same for Postal, Military, and Other Purposes*, was passed on 1 July 1862 (12 Statutes at Large 489); The Pacific Railroad Act of 1864, passed on 2 July 1864, doubled the size of land grants and authorised railroads to sell bonds (13 Statutes at Large 356).

23 The 1862 Homestead Act (Public Law 37–64; 12 Statutes at Large 392) provided settlers the opportunity to obtain 160 acres of public land by paying a small filing fee and residing on the land for a minimum of five years. Another option was for settlers to reside on the land for six months and purchase the land from the government for \$1.25 per acre.

24 Emmons, *Garden in the Grasslands*, 1–24; Smith, 'Rain Follows the Plow', 175–6; Wilber, *Great Valleys*, 66–7, 69–78; Baltensperger, 'Plains Promoters and Plain Folk', 7–8; Baltensperger, 'Plains Boomers and the Creation of the Great American Desert Myth'.

Rain follows the plow/plough: Origins of the maxim

According to the scholar Kenneth Thompson, beliefs associating climate change with clearing and cultivating land arose as early as the third century BC, and continued to be advanced throughout history.²⁵ The twentieth-century American scholar Henry Nash Smith associated folk beliefs predating the phrase 'rain follows the plow' with the journal entries of Josiah Gregg, a merchant-explorer who travelled the Santa Fe Trail between 1831 and 1840.²⁶ In 1869, Cyrus Thomas, a member of the US Geologist F. V. Hayden's scientific team, drafted a preliminary field report on Colorado and New Mexico in which he also articulated the belief that a permanent increase in rainfall was connected to settlement of the American West.²⁷

One Great Plains sceptic was Major John Wesley Powell, a geologist in charge of the US Geographical and Geological Survey of the Rocky Mountains region. After extensive exploration and much thought, Powell transmitted a geographical and geological survey of the United States' arid region to the federal government.²⁸ Powell reported that some of the lands were good for pasturage only and others would require irrigation to be farmed. According to Powell, redemption of these arid lands was beyond the capability of poor individual farmers, therefore farming in the region would require extensive governmental engagement in reclamation and irrigation.²⁹ After recounting many of the suggested reasons for a purported increase in water in the arid regions of the American West (including laying of railroad tracks, construction of telegraph lines, cultivation of the soil and the interposition of divine providence), Powell wrote the following:

Of course such hypotheses obtain credence because of a lack of information relating the laws which govern aqueous precipitation ... But the operations of man on the surface of the earth are so trivial that the conditions which they produce are of minute effect, and in [the] presence of the grand effects of nature escape discernment. Thus the alleged causes for the increase of rainfall fail. The rain gauge records of the country have been made but for a brief period, and the stations have been widely scattered, so that no very definite conclusions can be drawn from them, but so far as they are of value they fail to show any increase. But if it be true that increase of the water supply

25 For an excellent discussion of the history of speculation about climate change, see Kenneth Thompson, 'The Question of Climatic Stability in America Before 1900', *Climatic Change* 3, no. 3 (1981): 227–41, doi.org/10.1007/BF00136669.

26 Smith, 'Rain Follows the Plow', 172, citing Josiah Gregg, *Commerce of the Prairies: Or the Journal of a Santa Fé Trader*, vol. 2 (New York: Henry G. Langley, 1844): 202–3.

27 Cyrus Thomas, 'Agriculture of Colorado', in F. V. Hayden, *Preliminary Field Report of the United States Geological Survey of Colorado and New Mexico Conducted Under the Authority of Hon. J. D. Cox, Secretary of the Interior by F. V. Hayden United States Geologist* (Washington, DC: Government Printing Office, 1869): 141. Available online at tinyurl.com/ya8fgas4.

28 Powell, *Report on the Lands of the Arid Region*.

29 *ibid.*

is due to increase in precipitation, as many have supposed, the fact is not cheering to the agriculturist of the Arid Region. The permanent changes of nature are secular; any great sudden change is ephemeral, and usually such changes go in cycles, and the opposite or compensating conditions may reasonably be anticipated.³⁰

The great nineteenth-century climate change debate

Science in mid to late nineteenth-century America was in a state of evolution.³¹ Early in the nineteenth century, a significant segment of American science involved acquiring the pelts of animals and birds as well as collecting stones, fossils, shells and plants.³² A gentleman educated as a theologian might become a ‘botanizer’, collect dried plants and herbs, conduct a few lectures, and call himself a professor. Honorary degrees were dispensed with alacrity and provided the itinerant or amateur scientist who was able to secure such a degree an aura of expertise.³³ Research science was not widely practised in the United States during this time, although the growth of professional organisations such as the American Association for the Advancement of Science did much to further interest in and recognition of scientific research as one of the roles of a ‘man of science’.³⁴ The 1859 publication of Darwin’s *The Origin of Species* prompted considerable debate and conflict about the relationship between science and religion, with some characterising the relationship as a ‘war’.³⁵

30 *ibid.*, 90–1.

31 Hamilton Cravens, ‘American Science Comes of Age: An Institutional Perspective, 1850–1930’, *American Studies* 17, no. 2 (1976): 49–70; Paul Lucier, ‘The Professional and the Scientist in Nineteenth-Century America’, *Isis* 100, no. 4 (2009): 699–732, doi.org/10.1086/652016; James Rodger Fleming, *Meteorology in America, 1800–1870* (Baltimore, MD: Johns Hopkins University Press, 1990), xix.

32 Matthew Laubacher, ‘Cultures of Collection in Late Nineteenth Century American Natural History’ (PhD diss., Arizona State University, 2011), available at repository.asu.edu/attachments/56624/content/Laubacher_asu_0010E_10662.pdf. For an excellent discussion of the role of collectors in relation to amateur and ‘professional’ scientists, see Steve Ruskin, ‘The Business of Natural History: Charles Aiken, Colorado Ornithology, and the Role of the Professional Collector’, *Historical Studies in the Natural Sciences* 45, no. 3 (2015): 357–96, doi.org/10.1525/hsns.2015.45.3.357; see also Elizabeth B. Keeney, ‘Introduction’, *The Botanizers: Amateur Scientists in Nineteenth-Century America* (Chapel Hill, NC, and London: University of North Carolina Press, 1992), 1–21.

33 C. S. M., ‘Abundant Honorary Degrees’, *Science* 17, no. 428 (1903): 432, doi.org/10.1126/science.17.428.432; ‘Comment and Criticism’, *Science* 4, no. 74 (1884), doi.org/10.1126/science.ns-4.74.1; Barbara Spector, ‘Honorary Degrees: Controversial for Centuries’, *The Scientist*, 24 June 1991, available at www.the-scientist.com/news/honorary-degrees-controversial-for-centuries-60529.

34 Cravens, ‘American Science Comes of Age’; Lucier, ‘The Professional and the Scientist’; Robert V. Bruce, *The Launching of Modern American Science 1846–1876* (Ithaca, NY: Cornell University Press, 1987), 7–28.

35 Andrew D. White, ‘The Warfare of Science’, *Friends’ Intelligencer* 33, no. 2 (1876): 17; Andrew D. White, *A History of the Warfare of Science with Theology in Christendom* (New York: D. Appleton, 1874); John William Draper, ‘History of the Conflict Between Religion and Science’, *The International Review* 2, no. 5 (1875): 711.

European science, on the other hand, was known for fostering the growth of experimental science.³⁶ Scientists such as Antoine Lavoisier, who declared that mass/matter could be neither created nor destroyed, possessed an understanding of chemistry that, had it been widely taught in the colleges and universities of America, might have made folk beliefs like RFTP less tenable.³⁷ All who called themselves 'men of science' would have done well to observe these words, written by Lavoisier in the preface to his famous treatise on chemistry:

We must trust to nothing but facts: These are presented to us by Nature, and cannot deceive. We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth but by the natural road of experiment and observation.³⁸

In 1888, a debate about the supposed increase in rainfall on the Great Plains took place in the pages of the journal *Science*—a scientific publication inaugurated in 1880 and, after several fits and starts, acquired in 1900 by the American Association for the Advancement of Science. The debate began when Henry Gannett published rainfall data from 'twenty-six stations at which rainfall records have been kept for periods ranging from six to twenty-eight years'.³⁹ Several writers responded, some supporting Gannett's position that rainfall was not increasing in the region, and others opposing his position. Some argued that there were too many errors in the collection and recording of the rainfall records for the data to be reliable.⁴⁰ In spite of Powell's arid lands report, many nineteenth-century 'men of science' continued to debate the rainfall issue. More than a century after the debate in *Science*, Cary J. Mock, author of 'Rainfall in the Garden of the United States Great Plains, 1870–1889', wrote that after reviewing precipitation records for the Great Plains region between 1870 and 1889, he found no evidence of persistently greater precipitation in the entire study area as compared to the late twentieth century.⁴¹

Increase or no increase, Powell rather forcefully insisted, much to the chagrin of Great Plains boosters, that successful settlement and rehabilitation of much of the public lands beyond the 100th meridian would require parcels larger than 160 acres, irrigation of some parcels, and relegation of other parcels to pasturage.⁴² Under

36 Cravens, 'American Science Comes of Age'; Lucier, 'The Professional and the Scientist'; Bruce, *The Launching of Modern American Science*.

37 Antoine Lavoisier, *Traité élémentaire de chimie, présenté dans un ordre nouveau et d'après les découvertes modernes* (Paris: Cuchet, 1789), doi.org/10.5962/bhl.title.67783. Translated into English by R. Kerr as *Elements of Chemistry, in a New Systematic Order, Containing All the Modern Discoveries* (Edinburgh: William Creech, 1790), as cited in George B. Kauffman, 'The Making of Modern Chemistry', *Nature* 338, no. 6218 (1989): 700, doi.org/10.1038/338699a0. Of course, Lavoisier's experiments were conducted in closed systems consisting of connected items of glassware, whereas rainfall occurred in an open system. Regardless, Lavoisier's work should have given promoters of RFTP pause.

38 *ibid.*

39 Henry Gannett, 'Is the Rainfall Increasing Upon the Plains?', *Science* 10, no. 265 (1888): 99–100, doi.org/10.1126/science.ns-11.265.99.

40 See note 13 above for references related to this rainfall debate in the journal *Science*.

41 Cary J. Mock, 'Rainfall in the Garden of the United States Great Plains', 173–95.

42 Powell, *Report on the Lands of the Arid Region*, 25–9.

pressure from policy makers, manifest destiny proponents and RFTP advocates, however, the US Government ignored Powell's recommendations and opened land west of the 100th meridian to homesteaders.⁴³

The messengers

Among the individuals who pressured the federal government of the United States to release the arid lands of the Great Plains for homesteading were two friends, boosters and self-promoters—Charles Dana Wilber and Samuel Aughey. Neither man had much, if any, formal education in science, but they both held strong negative opinions about Powell's proposed restrictions on Great Plains homesteading—opinions they disseminated widely.

The historian Jeremy Vetter, in the introduction to his fine book *Field Life: Science in the American West During the Railroad Era*, cautions against assuming that nineteenth-century scholars of natural history were professionals in the manner of twentieth-century scientists.⁴⁴ Many in this era without formal training often called themselves scientists. However, in the case of the dubious promoters of 'rain follows the plow', once the superficial patina of scholarship is scratched, one finds exaggerated credentials, sloppy science and even fraud or chicanery.⁴⁵

Samuel Aughey was trained as a theologian, claimed to be a scientist, and had a number of honorary degrees appended to his name.⁴⁶ In his 1880 book *Sketches of the Physical Geography and Geology of Nebraska*, Aughey wrote that he had collected

43 *Report of the Public Lands Commission, Created by the Act of March 3, 1879, Relating to Public Lands in the Western Portion of the United States and to the Operation of Existing Public Lands in the Western Portion of the United States and to the Operation of Existing Land Laws* (Washington, DC: Government Printing Office, 1880), available at tinyurl.com/yaqjsc5n; Karl Hess, Jr, 'John Wesley Powell and the Unmaking of the West', *Environmental History* 2, no. 1 (1997): 17, doi.org/10.2307/3985559; Wallace Stegner, *Beyond the 100th Meridian: John Wesley Powell and the Second Opening of the West* (New York: Penguin, 1953), 231–45.

44 Jeremy Vetter, *Field Life: Science in the American West During the Railroad Era* (Pittsburgh, PA: University of Pittsburgh Press, 2016), 14, doi.org/10.2307/1j.ctt1gxxqcp.

45 Dan Plazak, *A Hole in the Ground with a Liar at the Top* (Salt Lake City, UT: University of Utah Press, 2006), 117–123. Also see notes 65–8 below.

46 Aughey was awarded an AB (course unknown) from Gettysburg College in 1856, and completed a theological course at the Lutheran Theological Seminary, Gettysburg, in 1858. See Abdel Ross Wentz, *History of the Gettysburg Theological Seminary of the General Synod of the Evangelical Lutheran Church in the United States and the United Lutheran Church in America, Gettysburg, Pennsylvania* (Gettysburg, PA: Directors Gettysburg Theological Seminary, 1927), 192. See also 'Proceedings of the Lutheran Synod', *The Perry County Democrat* (Bloomfield, PA), 10 June 1858; an honorary PhD degree was awarded to Aughey by Pennsylvania College in 1873. See E. S. Bridenbaugh, ed., *The Pennsylvania College Book 1832–1882* (Philadelphia, PA: Lutheran Publication Society, 1882), 52. Other sources, including Aughey's obituary, suggest that he might have been awarded multiple honorary PhD degrees and an honorary LLD. See 'Prof. Samuel Aughey Lived a Useful Life: Was a Noted Scientist, an Able Teacher and Earnest Student of Theology', *Pullman Herald* (Pullman, WA), 23 February 1912, which stated: 'On the occasion of a certain commencement season (1874), the degree of Ph.D. was conferred upon him simultaneously by the Pennsylvania College, Wittenberg College, and the University of Ohio. In 1878 Wittenberg College honored him with the degree of L.L.D.'. Also see Wentz, *History of the Gettysburg Theological Seminary*, 414–15.

scientific evidence of 'increasing rainfall' in Nebraska including an increase in the number of springs, the appearance of water in old creek beds and changing vegetation. Of this anecdotal 'evidence' he wrote the following: '[t]he proofs ... that the rainfall of Nebraska is steadily increasing, are manifold. If space permitted, many more [proofs] could be given'.⁴⁷ The reason for this purported increase in rainfall, he opined, was 'the great increase in the absorptive power of the soil, wrought by cultivation, that has caused, and continues to cause an increasing rainfall in the State' of Nebraska.⁴⁸ In spite of the fact that he taught chemistry (and an array of other sciences he was not trained to teach) at the University of Nebraska, Aughey failed to consider Lavoisier's Conservation of Matter principle.⁴⁹ Aughey failed to ask: if rain is increasing on the Great Plains, where must rain be decreasing or water transforming into another physical state?

Aughey described an 'experiment' he had conducted in 1872 in support of his hypothesis that rain followed the plough. After a heavy rain, Aughey dug two six-by-six-inch squares of soil from the farm of a certain Mr Hawley. The first sample was taken from unbroken prairie and the second sample from cultivated land. Aughey dried and weighed the two samples and concluded from the difference that the soil of the cultivated field had absorbed more rain.⁵⁰

Many ascribe authorship of the phrase 'rain follows the plow' to Wilber, but the expression's provenance may be lost in the annals of history. Whether the speculator, railroad promoter, purported journalist and would-be scientist authored the phrase or not, Wilber certainly popularised it. Wilber's scientific background and credentials are obscure. He graduated from Williams College in 1856 (course of study not known).⁵¹ According to the Williams College general catalogue, Wilber was also awarded an MA (course of study also unknown) by the College and an honorary law degree (LLD) by the University of Nebraska in 1879 during his friend Aughey's tenure at the school.⁵² Wilber was often referred to as 'Prof. Wilber' in

47 *ibid.*, 42.

48 *ibid.*, 44.

49 Lavoisier, *Traité élémentaire de chimie*, as cited in Kauffman, 'The Making of Modern Chemistry', 700.

50 Aughey, *Sketches*, 41–52.

51 The *General Catalogue of the Officers and Graduates of Williams College*, (Williamstown, MA: Williams College, 1910), 261, contains an entry listing Charles Dana Wilber as an 1856 graduate of Williams College. No particular course of study is mentioned. The catalogue is available online at archive.org/details/generalcatalogue00willuoft/page/n4.

52 The *General Catalogue of the Officers and Graduates of Williams College*, 86, also contains an entry for Charles Dana Wilber, indicating that he was awarded an MA and an LLD by the University of Nebraska in 1879. The University of Nebraska's website, 'Honorary Degrees Recipients—Alphabetical', nebraska.edu/docs/awards/docs/HonoraryDegreesChrono.pdf, has an entry listing C. D. Wilber as the recipient of an honorary LLD degree in 1880. Aughey was appointed a faculty member at the University of Nebraska in 1871 (Robert N. Manley, *Centennial History of the University of Nebraska, I: Frontier University, 1869–1919*, (Lincoln, NE: University of Nebraska, 1969), 22–3), and resigned his position in 1883 ('The Lincoln Mystery: The Innocence of Professor Aughey Partially Established and His Resignation Accepted', *St Joseph Gazette-Herald* (St Joseph, MO), 10 November 1883).

the newspapers of his day.⁵³ Robert N. Manley, author of the first volume of the *Centennial History of the University of Nebraska*, referred to Wilber as ‘an itinerant scientist’.⁵⁴

Aughey and Wilber pushed back against Powell’s report in newspaper interviews, speeches, a published pamphlet, and their books.⁵⁵ On 1 March 1880, an article by special correspondent J. W. Robbins was published in the then prominent Chicago newspaper, *The Daily Inter Ocean*. The article recounted Robbins’ 26 February 1880 interview of Wilbur—an interview the reporter conducted in the Nebraska town Wilber platted and named after himself.⁵⁶ In the interview, Wilber invoked (for what appears to be the first time in American newsprint) the biblical-sounding slogan that would help inspire millions to risk life, limb and whatever fortune they might have to settle marginal lands west of the 100th meridian.⁵⁷

Much of the impetus behind Aughey and Wilber’s publicity campaign came from a letter sent to them by Robert W. Furnas, then president of the Nebraska State Horticultural Society, and Martin Dunham, then president of the State Agricultural Society of Nebraska, to ‘Profs. Samuel Aughey and C. D. Wilber’ urging them to respond to government proposals to shut down homesteading and designate as pasturage portions of the state of Nebraska west of the 100th meridian.⁵⁸

Headlined ‘The Desert Makers’, the Robbins article praised Wilber and Aughey for their intelligent and astute ‘research’ of the wonderful Nebraska soil and the state’s changing climate.⁵⁹ In a question-and-answer session with the correspondent, Wilber repudiated the existence of a Great American Desert, extolled the agricultural virtues of lands beyond the 100th meridian, and derided so-called government experts who he claimed falsely represented that the territory beyond the 100th meridian was ‘desert land’, ‘non-farming land’ and land ‘only fit for pastoral uses’.⁶⁰ These experts were the ‘desert makers’ of the headline, asserted Wilber, people who hung on to the obsolete concept of a Great American Desert. According to Wilber, the climatic challenges to farming Great Plains lands were ‘interposed by wiseacres, kid-gloved

53 ‘Western Mining Bureau’, *Fort Scott Daily Monitor* (Fort Scott, KS), 11 October 1871; ‘A Compliment to Kansas’, *Leavenworth Daily Commercial* (Leavenworth, KS), 12 April 1871; ‘State Board of Agriculture’, *The Nebraska State Journal* (Lincoln, NE), 30 January 1880.

54 Manley, *Centennial History of the University of Nebraska*, 43.

55 J. W. Robbins, ‘The Desert-Makers’, *Daily Inter-Ocean* (Chicago), 1 March 1880; Samuel Aughey and C. D. Wilber, *Agriculture Beyond the 100th Meridian, or a Review of the U.S. Public Lands Commission* (Lincoln, NE: Lincoln Journal Company, State Printers, 1880); Wilber, *Great Valleys*, 168–72; Aughey, *Sketches*, 41–52.

56 Robbins, ‘The Desert-Makers’.

57 *ibid.*

58 Wilber, *Great Valleys*, 41.

59 Robbins, ‘The Desert-Makers’.

60 *ibid.*

experts, and closet-philosophers'.⁶¹ The challenges of settling these lands were torn asunder, said Wilber, by the farmer with his plough 'leaving us to remember the experts only as charlatans or quacks'.⁶²

In his treatise *The Great Valleys and Prairies of Nebraska and the Northwest*, published the year after the *Inter Ocean* interview, Wilber repeated the phrase 'rain follows the plow':

Suppose now that a new army of frontier farmers ... could, acting in concert, turn over the prairie sod, and after deep plowing and receiving the rain and moisture, present a new surface of green, growing crops instead of the dry, hard-baked earth covered with sparse buffalo grass. No one can question or doubt the inevitable effect of this cool condensing surface upon the moisture in the atmosphere as it moves over by the Western winds. A reduction of temperature must at once occur, accompanied by the usual phenomena of showers. The chief agency in this transformation is agriculture. To be more concise. *Rain follows the plow.*⁶³

For years Wilber had toured the lecture circuit addressing topics as disparate as the coal fields of Illinois, agricultural chemistry, botany and fossils.⁶⁴ Later 'Prof. Wilber' acted as an 'advance man' for railroad companies.⁶⁵ Still later he became involved in mining as a mine inspector.⁶⁶ Aughey and Wilber were partners in crime, both figuratively and literally. The most startling of Aughey and Wilber's 'collaborations', which might more accurately be described as a 'corroboration', involved the scandal that led to Aughey's resignation from the University of Nebraska in 1883. According to newspaper reports, for several years prior to his departure from the university, Aughey had been negotiating promissory notes with forged endorsements at Nebraska banks. According to one newspaper article, among those whose signatures were forged were a railroad attorney and a 'brother professor'.⁶⁷

61 *ibid.*

62 *ibid.*

63 Wilber, *Great Valleys*, 68 (emphasis in original).

64 'The Coal Fields of Illinois', *The Pantagraph* (Bloomington, IN), 9 February 1859; 'Aurora Institute and Clark Seminary: Courses of Study', *Chicago Tribune*, 4 July 1859; 'The Illinois Natural History Society', *Chicago Tribune*, 28 June 1859; 'A Compliment to Kansas', *Leavenworth Daily Commercial* (Kansas), 12 April 1871; 'State News', *The Red Cloud Chief* (Nebraska), 14 April 1875.

65 'Death of an Eminent Geologist. Prof. C. D. Wilber of Aurora, Ill., Who Was a Classmate of President Garfield', *Chicago Tribune*, 22 December 1891; 'Wilber's Founder Namesake A Little-Known College Prof', *Sunday Journal and Star* (Lincoln, NE), 29 July 1956; 'Prof. Wilber, Inspector of Mineral Lands', *Chetopa Advance* (Kansas), 2 February 1870.

66 'Prof. Wilber, Inspector of Mineral Lands', *Chetopa Advance* (Kansas), 2 February 1870.

67 'A Mighty Fall: A Learned and Distinguished Professor—A Noted Scientist—Dishonors his Position, Disgraces the State, Sacrifices His Good Name, and Sinks the Nebraska State University in Deeper Shame', *Lincoln Journal Star* (Nebraska), 28 July 1883; 'A Professor's Crime', *Quad-City Times* (Omaha, NE), 30 July 1883; 'Charged with Forgery', *Chicago Tribune*, 30 July 1883; 'Considerable excitement was created at Lincoln, Neb., recently...', *The Fort Scott Weekly Tribune* (Kansas), 2 August 1883; 'Gone Wrong: More About the Downfall of the Nebraska Professor', *The Dayton Herald* (Ohio), 1 August 1883.

The University of Nebraska held a hearing on the matter, which is where Wilber entered the picture. Aughey's defence was that a man by the name of Vigenham was the procurer of the forged signatures and that Aughey knew nothing of the forgeries. When challenged as to the existence of Vigenham, Aughey introduced a letter from Wilber stating that he distinctly remembered having been introduced to Vigenham. While Aughey was eventually exonerated by the Board of Regents, newspaper accounts suggest that the evidence on which the exoneration was based was not necessarily convincing.⁶⁸ In spite of their spurious credentials and suspect activities, neither Wilber nor Aughey hesitated to portray himself as an expert in a variety of scientific endeavours. These two supposed men of science left an indelible mark on the Great Plains region. The theory they espoused regarding rainfall was disseminated as far away as Australia.

'Rain follows the plough': A brief description of the Australian experience

In *On the Margins of the Good Earth* (1962), Donald Meinig noted the complexity of South Australia's origins story, including the role of Edward Gibbon Wakefield early in its history.⁶⁹ Having himself barely avoided transportation to an Australian penal colony, Wakefield turned his attentions to developing principles that would provide a foundation for the orderly colonisation of South Australia, including the recommendation that settlers should be voluntary pioneers.⁷⁰ Wakefield became acquainted with the manner in which so-called 'waste' lands (public domain lands) of several European countries and the United States were sold, and testified as an expert witness on this topic before the Select Committee of the House of Commons on the Disposal of Lands in the British Colonies.⁷¹ Some but not all of Wakefield's concerns would be adopted in the form of land policy for the settlement of South Australia. Wakefield's policy required that all lands opened for settlement should be surveyed.

68 William J. Armstrong, 'The Case of Prof. Aughey', *Nebraska State Journal* (Lincoln, NE), 25 August 1883; 'At a Called Meeting of the Regents ...', *Nebraska State Journal* (Lincoln, NE), 10 November 1883; 'The Lincoln Mystery'.

69 Meinig left out the more salacious details concerning Wakefield's abduction of a wealthy child bride; see *The Trial in Full of Edw. Gibbon Wakefield, and Others for The Abduction of Miss Turner, by The Lancaster Assizes, March 23, 1827* (London, 1827).

70 Meinig, *On the Margins*, 9–10.

71 Robert J. Shultz, 'Edward Gibbon Wakefield and the Development of his Theory of 'Systematic Colonization'' (MA diss., University of Nebraska at Omaha, 1965), 75–80, available at tinyurl.com/yals8v4l.

George Goyder, appointed South Australia's Surveyor-General in 1861, would play an important role in South Australia's RFTP saga.⁷² Janis Sheldrick's definitive biography of Goyder describes his extensive field activities as a government surveyor.⁷³ As first assistant surveyor-general (an early rung in the ladder of his career), Goyder explored the Flinders Ranges and the area around Lake Blanche. Seeing that Lake Blanche was experiencing unusual flooding and believing that rainfall was regular and adequate in the northern regions of the South Australian colony, Goyder pronounced the level of the flooded lake a permanent condition, thus contributing to a land rush north. Goyder's conclusions about Lake Blanche were incorrect. The flooding he had observed did not occur on a regular basis. According to Sheldrick, Goyder sincerely regretted his mistake, which he freely admitted, and for which he apologised.⁷⁴

Controversy over settlement in South Australia was continuous during much of Goyder's time as a public servant, particularly during the years when he surveyed the northern lands (on horseback) in response to requests by squatters for financial drought relief.⁷⁵ Goyder returned from these inspections convinced that he could delineate, via changes in the nature of the vegetation he had observed, a line beyond which rainfall was too unreliable for the land to be farmed.⁷⁶ The government wanted an effective way to determine who deserved official drought relief, but Goyder used the opportunity to delineate a frontier beyond which he believed agriculture was too risky. This became known as Goyder's Line or, more accurately, Goyder's Line of Reliable Rainfall.⁷⁷

As prime agricultural land south of Goyder's Line was sold, settlers wanting to take a chance on lands to the north of it clamoured for the government to disregard Goyder's field studies and sell lands beyond the line.⁷⁸ Against Goyder's recommendations, the government of South Australia relented and lands north of Goyder's Line were surveyed and sold.⁷⁹ In 1880, the same year in which Samuel Aughey's book *Sketches of the Physical Geography and Geology of Nebraska* featured a discussion of the supposed relationship between cultivation and an increase in rainfall, a period of drought began in South Australia and agriculture, particularly wheat farms, started to fail.⁸⁰

72 Meinig, *On the Margins*, 11; Sheldrick, *Nature's Line*, 1–16.

73 Sheldrick, *Nature's Line*, 70.

74 *ibid.*

75 Meinig, *On the Margins*, 45; Sheldrick, *Nature's Line*, 141–61; 'The Northern Squatters', *South Australian Weekly Chronicle* (Adelaide, SA), 6 May 1865.

76 Meinig, *On the Margins*, 45–6; Sheldrick, *Nature's Line*, 141–61.

77 *ibid.*; Sheldrick, *Nature's Line*, 394.

78 Meinig, *On the Margins*, 51–6; Sheldrick, *Nature's Line*, 249–66.

79 Meinig, *On the Margins*, 64–6.

80 *ibid.*, 78–92.

During the 1880s in particular, newspapers reported parliamentary debates that included brief but spirited discussions about the settlement of South Australia's northern lands, the reliability of rainfall to the north, the geographical limits of agricultural versus pastoral pursuits, and the truth or falsity of RFTP.⁸¹ In 1888, a major drought year in much of Australia, the Commission of Land Laws in the hard-hit colony of South Australia considered the issue of failed wheat farming beyond Goyder's Line. According to Sheldrick, the findings of the commission vindicated Goyder's position on the unreliability of rainfall beyond the line.⁸²

'Rain follows the plow/plough': Newspaper coverage in the United States and Australia

During the last quarter of the nineteenth century, American articles referencing the RFTP doctrine appeared in newspapers from Lewisburg, Pennsylvania, westward. A search for the phrase 'rain follows the plow' in the newspapers.com database originally identified 264 American newspaper articles published between 1877 and 2017.⁸³ Articles using the words 'rain follows the plow' in a context unrelated to the folk doctrine were eliminated and the range examined was narrowed to include only those articles published between 1877 (the last year of a seven-year drought in the United States) and 1949 (approximately 10 years after the end of the Dust Bowl). The remaining 143 articles were published in newspapers across the country—with a significant number of articles published in Kansas (54) and Nebraska (14). All 143 articles were examined for references to 'rain follows the plow' that expressed either a positive/hopeful or a negative/sceptical attitude toward the folk belief. Articles containing keywords or phrases that referenced the topic in terms other than the popular maxim were not used in this portion of the survey as it was Wilber's famous phrase that was the focus.

Duplicate stories or articles were not eliminated as the volume of coverage of the phrase was deemed more important for the purpose of this survey than the singularity of particular stories. Many stories were published multiple times, primarily in separate newspapers but occasionally in multiple issues of the same publication. Figure 1 illustrates the distribution of negative/sceptical and positive/hopeful 'rain follows the plow' messages in the United States in five-year intervals between 1870 and 1949.

81 'Proceedings in Parliament', *South Australian Advertiser* (Adelaide, SA), 30 June 1882; 'The Parliament, House of Assembly', *Adelaide Observer*, 9 June 1883; 'Parliamentary, Disposal of Public Lands', *Express and Telegraph* (Adelaide, SA), 2 July 1890.

82 Sheldrick, *Nature's Line*, 347–8.

83 'Newspapers.com is the largest online newspaper archive with 300+ million pages of historical newspapers from 11,100+ newspapers from around the United States and beyond.'

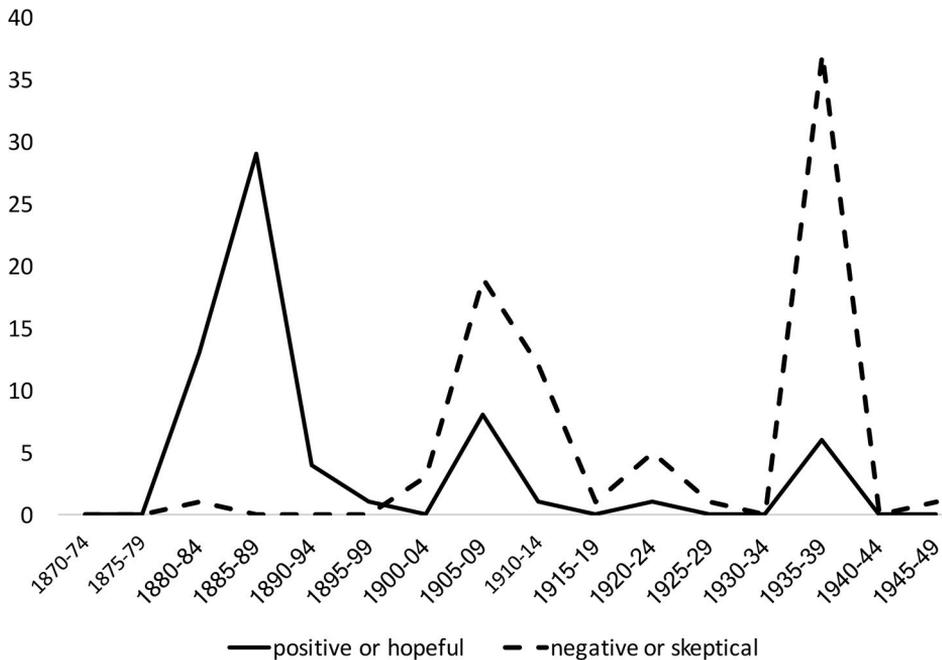


Figure 1: Positive and negative 'rain follows the plow' articles in US newspapers. Source: The author.

An examination of Australian newspapers was conducted using the database Trove.⁸⁴ A keyword search for the phrase 'rain follows the plough' identified 250 articles published in Australian newspapers from 1870 through 1949. Seventeen false positive messages were eliminated and the remaining texts including the phrase 'rain follows the plough' were scored according to whether the phrase was used in a positive/hopeful context, a negative/sceptical context, or in the course of a news article covering a parliamentary debate or discussion (which often included both positive and negative references). A majority (190) of the remaining articles appeared in South Australian newspapers. Of those 190, 161 were Adelaide newspapers.

Figure 2 illustrates the distribution of these Australian RFTP messages in five-year intervals from 1870 through 1949. Table 2 lists relevant drought periods in the United States and Australia, and Figure 3 compares overall coverage of RFTP messaging (in five-year intervals from 1870 through 1949) in US and Australian newspapers.

⁸⁴ Trove is a database curated by the National Library of Australia and can be accessed at trove.nla.gov.au.

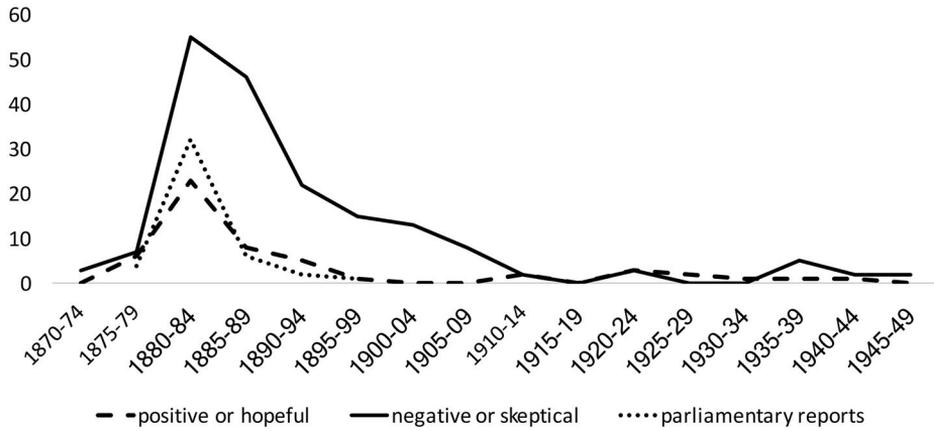


Figure 2: Positive and negative ‘rain follows the plough’ articles in Australian newspapers (and a subset of articles containing parliamentary reports).

Source: The author.

Table 2: Relevant US and Australian drought history.

American droughts ^a	Australian droughts ^b
1856–1865 (‘Civil War drought’)	1864–1866 & 1868
1870–1877	1880–1886
1890–1896	1888
1930–1936 (the Dust Bowl)	1895–1903
	1911–1916
	1918–1920
	1939–1945

^a Peter Folger (2017) *Drought in the United States: Causes and Current Understanding*

^b Yearbook Australia, 1988

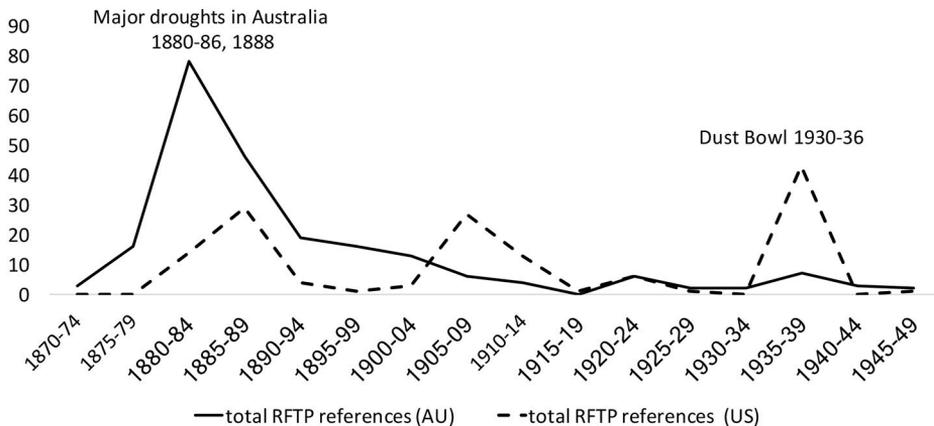


Figure 3: ‘Rain follows the plow/plough’ articles in US and Australian newspapers.

Source: The author.

Unexpectedly, a group of RFTP-related articles that used the phrase 'cultivation induces rainfall' rather than 'rain follows the plow/plough' were discovered in the American and Australian databases. These articles, first published in US newspapers or papers covering the Great Plains settlements then republished in whole or in part in several Australian newspapers, were identified during a search for Australian references to Aughey and Wilber. For example, on 24 December 1880, the *Saint John Weekly News*, a Kansas newspaper, published a review of Aughey's book *Sketches of the Physical Geography and Geology of Nebraska*, including an extensive discussion of Aughey's 'cultivation induces rainfall' theory.⁸⁵ On 6 July 1882, a substantial excerpt from the *Saint John Weekly News* review was reprinted in the New South Wales newspaper *The Shoalhaven Telegraph*.⁸⁶

On 24 October 1887, the Kansas newspaper the *Omaha Daily Bee* published a speech delivered by US General Henry A. Morrow at the Cheyenne County Fair held at Sidney, Nebraska.⁸⁷ Although Aughey was long gone from the University of Nebraska by that date and the general did not use Prof. Wilber's phrase 'rain follows the plow', Morrow's speech drew heavily on the concept behind the doctrine, including Aughey and Wilber's ideas about rainfall in the Great Plains. 'It is the history of every new country,' noted Morrow, 'that the rainfall increases in proportion as the land comes under cultivation. This is an undoubted fact, though the reasons assigned for it are not fully agreed upon by scientists.'⁸⁸

In 1888, a major drought year, newspapers throughout Australia reprinted the Kansas article recounting Morrow's speech. Similar excerpts from the speech, under the headline 'Why Cultivation Increases Rainfall', appeared in at least 16 Australian newspapers (at least one article published in every Australian colony) between 6 April and 7 July 1888. The article appeared again in Victoria's *Great Southern Advocate* on 5 January 1893 (see Table 3).

Table 3: Publication of articles related to 'cultivation increases rainfall' references from the United States and Australia in the nineteenth century.

Date	Title of article	Newspaper	State or Colony	Source
12/24/1880	Does Cultivation Increase Rainfall?	<i>The St John Weekly News</i>	Kansas, USA	Samuel Aughey, PhD, LLD ^a
7/6/1882	Does Cultivation Increase Rainfall?	<i>The Shoalhaven Telegraph</i>	NSW	Samuel Aughey, PhD, LLD
10/24/1887	The Great American Desert	<i>Omaha Daily Bee</i>	Nebraska, USA	General Morrow's address ^b

85 'Does Cultivation Increase Rainfall?', *Saint John Weekly News* (Kansas), 24 December 1880.

86 'Does Cultivation Increase Rainfall?', *Shoalhaven Telegraph* (NSW), 6 July 1882; the scholar Stephen Legg noticed a similar sharing of American writings related to climate issues, although he focused on the role of forests in climate change beliefs, not RFTP. See his 'Debating the Climatological Role of Forests in Australia, 1827–1949: A Survey of the Popular Press', in *Climate, Science, and Colonization*, ed. Beattie, O'Gorman and Henry, 123, 126.

87 'The Great American Desert', *Omaha Daily Bee* (Nebraska), 24 October 1887.

88 *ibid.*

Date	Title of article	Newspaper	State or Colony	Source
4/6/1888	Why Cultivation Increases Rainfall	<i>Alexandra and Yea Standard, Bobur, Thornton and Acheron Express</i>	Vic.	Excerpt from General Morrow's address
4/6/1888	"	<i>Portland Guardian</i>	Vic.	"
4/6/1888	"	<i>Euroa Advertiser</i>	Vic.	"
4/6/1888	"	<i>Avoca Mail</i>	Vic.	"
4/7/1888	"	<i>Ovens and Murray Advertiser</i>	Vic.	"
5/12/1888	"	<i>Border Watch</i>	SA	"
5/19/1888	"	<i>Western Mail</i>	WA	"
5/26/1888	"	<i>Darling Downs Gazette</i>	Qld	"
6/5/1888	"	<i>Kerang Times and Swan Hill Gazette</i>	Vic.	"
6/9/1888	"	<i>Adelaide Observer</i>	SA	"
6/12/1888	"	<i>The Colac Herald</i>	Vic.	"
6/16/1888	"	<i>Molong Express and Western District Advertiser</i>	NSW	"
6/19/1888	"	<i>Glen Innes Examiner and General Advertiser</i>	NSW	"
6/23/1888	"	<i>Launceston Examiner</i>	Tas	"
6/29/1888	"	<i>The Richmond River Herald and Northern Districts Advertiser</i>	NSW	"
7/7/1888	"	<i>The Week</i>	Qld	"
1/5/1893	"	<i>Great Southern Advocate</i>	Vic.	"

^a Review and commentary on Aughey's *Sketches of the Physical Geography and Geology of Nebraska* (published in 1880), which features discussion of rainfall increasing with cultivation.

^b On 5 October 1887, General Morrow delivered an address praising the settlement of Nebraska at the opening of the Cheyenne County Fair in Sidney, Nebraska, USA. In this speech, Morrow asserted that the settlement and cultivation of Nebraska had increased the state's rainfall.

'The Way of the Rain'

As described above, references to the popular nineteenth-century rainfall belief appeared in newspaper articles and books of the era, but the biblical-sounding phrase also appeared in a few lines of verse by A. D. T. (Adeline Dutton Train) Whitney, an American poet and writer of books for girls.⁸⁹ Whitney's poem, published in the 22 March 1884 *Friends' Review* and 114 times in American

89 A. D. T. Whitney, *Zerub Throop's Experiment* (Boston: A. K. Loring, 1871); Adeline Dutton Train Whitney, *Selections From the Writings of Mrs. A. D. T. Whitney* (Boston and New York: Houghton, Mifflin & Co., 1887); A. D. T. Whitney, *We Girls: A Home Story* (New York: Yurita Press, 1906); A. D. T. Whitney, *Real Folks* (Milk Press, 1906) and A. D. T. Whitney, *Faith Gartney's Girlhood* (Milk Press, 1906). Ada Dutton Train Whitney was the cousin of George Francis Train, a founder and promoter of the Union Pacific Railroad. 'A Human Puzzle: Some of the Achievements of George Francis Train, Traits of an Iridescent Mind Strangely Balanced Between Lunacy and Superman "Psychosis"', *Indiana Herald*, 17 September 1884, 7; Rebecca Crowe, 'A Madman and a Visionary: George Francis Train, Speculation, and the Territorial Development of the Great Plains', *Great Plains Quarterly* 34, no. 1 (2014): 35–6, doi.org/10.1353/gpq.2014.0003.

newspapers between 1884 and 1887 (Figure 4), embodied many of the elements of the doctrine, including the suggestion that the proliferation of rain after ploughing the soil was a divinely ordained process. The same poem, cited below, also appeared in at least nine Australian newspapers between 1884 and 1895 (Table 4).

The Way of the Rain

I heard an old farmer talk one day,
Telling his listeners how
In the wide new country far away,
The rainfall follows the plow.

As fast as they break it up, you see,
And turn the heart to the sun,
As they open the furrows deep and free,
And the tillage is begun,

The earth grows mellow, and more and more
It holds and sends to the sky
A moisture it never had before,
When its face was hard and dry.

And so, wherever the plowshares run,
The clouds run overhead,
And the soil that works and lets in the sun
With water is always fed.

I wonder if that old farmer knew
The half of his simple word,
Or guessed the message that, heavenly true,
Within it was hidden and heard?

It fell on my ear by chance that day,
But the gladness lingers now,
To think it is always God's dear way
That the rainfall follows the plow.

A. D. T. Whitney⁹⁰

90 A. D. T. Whitney, 'The Way of the Rain', *Friends' Review* 37, no. 34 (1884): 542.

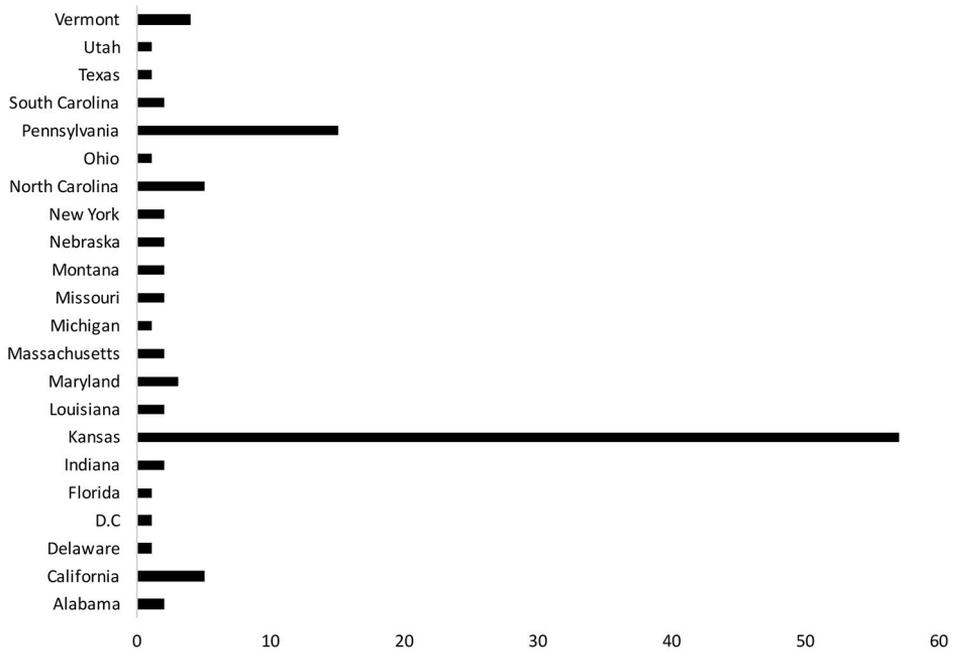


Figure 4: US states where 'The Way of the Rain' was published between 1884 and 1892.

Source: The author.

Table 4: 'The Way of the Rain' by A. D. T. Whitney appearing in Australian newspapers.

Date	Newspaper	Location
3 May 1884	<i>The Queenslander</i>	Brisbane, Qld
2 July 1884	<i>The Burrangon Argus</i>	NSW
1 Sept 1886	<i>Newcastle Morning Herald and Miners' Advocate</i>	NSW
15 June 1895	<i>Weekly Times</i>	Melbourne, Vic.
28 June 1895	<i>Warragul Guardian</i>	Warragul, Vic.
4 July 1895	<i>Cobram Courier</i>	Vic.
5 July 1895	<i>The Broadford Courier and Reedy Creek Times</i>	Broadford, Vic.
6 July 1895	<i>Ovens and Murray Advertiser</i>	Beechworth, Vic.
19 July 1895	<i>Quorn Mercury</i>	SA

Source: The author.

Dissemination of a myth

This essay examined an array of factors at play in the re-emergence and transformation of an ancient doctrine—that cultivation of the land could stimulate rainfall—into a belief system whose implications impacted the settlement of arid regions thousands of miles from each other, in a day when newspapers were a primary source of information. The maxim 'rain follows the plow/plough' represented a potent distillation of the religious and patriotic sentiment that helped drive settlement of the American West and Australia (particularly South Australia).

It could be said, regarding the settlement of the Great Plains of the United States, that a belief in American exceptionalism, the virtue of manifest destiny and the desirability of exploiting the natural resources of the West became entangled in a belief system that furthered settlement of the North American continent at the expense of homesteaders and the environment. Promotion of 'rain follows the plow' was, in its essence, a propaganda campaign that preyed upon those who wanted to believe that the West would become a personal Garden of Eden if they just ploughed hard enough. Similar dynamics were likely at work in Australia, particularly in South Australia.

At the time of Great Plains settlement, American science was in flux. At the end of the nineteenth century and the beginning of the twentieth century, US science was in the process of professionalising. Science was moving slowly from being the province of amateurs to becoming a profession with distinct disciplines, professional organisations, journals and meaningful degrees—a profession rigorously taught by professors who themselves were highly educated professionals. Nineteenth-century science education was too much of a hotchpotch for the average citizen to have been able to discern confirmed knowledge and real expertise.

Dissemination patterns of the RFTP belief in American and Australian newspapers were similar in many respects: articles in favour and articles criticising the belief appeared in the newspapers of both countries. According to data examined in the course of this research, the belief appeared to diminish more quickly in Australia—or at least it disappeared more quickly from Australian than American newspapers. The highest peak of RFTP coverage was between about 1875 and 1894 in both countries. By 1894, RFTP coverage in Australia had diminished more than fivefold. Whether this was because of the drought years of 1880–86 and 1888, because of the publication in newspapers of informative parliamentary debates on RFTP, or for other reasons is unclear, but the suggestion that debates discussing the pros and cons of the belief impacted its viability is intriguing and worth examining further.

In the United States, newspaper references to RFTP declined more slowly than in Australia. RFTP references in the United States surged slightly between 1904 and 1914, by which time negative or sceptical newspaper references to the doctrine had

begun to dominate the coverage. By the time of the US Dust Bowl, negative/sceptical references to RFTP in American newspapers were at least sevenfold more abundant than positive/hopeful references. This pattern suggests that, although the belief was losing strength, it might have taken a disaster like the Dust Bowl to eliminate the belief entirely from the American psyche. Additional research is necessary before this hypothesis can be established with any degree of certainty.

Positive coverage of ‘rain follows the plow’ eventually disappeared from American newspapers. The final death knell for the doctrine in the United States might have been sounded by an article written in 1908 by the prominent reporter William E. Curtis, who wrote for *The Star* (Washington, DC). His article reported that an unnamed US agriculture agent had said: ‘to send poor, land-hungry people out on these lands as homesteaders and to sell the adjoining railroad lands at the [high] prices ... is cruelly heartless’.⁹¹ The tone of this article, which mirrored Powell’s earlier expressions of concern for poor farmers attempting to settle the Great Plains, was republished and widely circulated. Still later in the twentieth century, the prominent Washington, DC, columnist Paul Mallon dealt the RFTP philosophy a coup de grâce in his article describing the practice of dry farming, the use of certain techniques adapted to farming on arid lands, as ‘dry propaganda’.⁹²

Application of a science communication framework

Kahan and associates’ research suggests that the overwhelming amount of scientific knowledge in circulation and the concomitant difficulty distinguishing good scientific information from bad contributes to a poor public understanding of science. Kahan does not consider the intentional promulgation of misinformation to be a significant driver of decisions requiring scientific knowledge. Much RFTP messaging in the nineteenth century, however, appears to have involved propagandising by those who wished to profit from the settlement of the West. The research of Pennycook, Rand and associates regarding the impact of repetition on the acceptance of misinformation supports a conclusion that the repetition of RFTP doctrine in a multitude of newspapers played an important role in the promulgation and persistence of the message.

91 William E. Curtis, ‘Dry Farming Costly, Cruel to Tempt Poor Men, Big Farms and Much Money Needed to Make Them Pay, Stump Land in the Northwest Far Better, Farmers are Growing Wiser’, *Evening Star* (Washington, DC), 22 December 1908; The Department of Agriculture official ‘who shielded himself from criticism by anonymity’ is referenced in John L. Cowan, ‘Desert Farming Without Irrigation’, *Technical World Magazine*, 204, available at play.google.com/books/reader?id=27dMAAAAYAAJ&hl=en&pg=GBS.PA204.

92 Paul Mallon, ‘News Behind the News—Drought Delusions’, *Great Falls Tribune* (Cascade, MT), 6 August 1936.

The history noted herein suggests that the following factors (see Table 1) played a role in the persistence of and reliance upon RFTP beliefs:

- Factor 1: The public's capacity and/or willingness to comprehend and converge collectively on what constitutes valid (for the era) scientific evidence: During settlement of the Great Plains, American science was in a state of flux. Many scientists did not have an adequate understanding of the established scientific principles of their era. Without adequate knowledge themselves, they were incapable of instructing the public on known principles of science. Without adequate instruction, the public was not capable of comprehending valid scientific evidence and making decisions based upon that evidence rather than on belief. Also implicated were external factors, such as the political environment, the role of the railroads and the impetus of manifest destiny—all of which might have impaired the public's ability to evaluate evidence contradicting the RFTP doctrine.
- Factor 2: Failure of scientists to explain scientific principles accurately or effectively: In the early to mid-nineteenth century, American science was evolving. Scientific training, in many colleges and universities, was repetitious and rudimentary. Scientific knowledge was limited and many of the advances made in Europe had not been fully incorporated into the average American curriculum. Many scientists did not themselves have adequate scientific education or training. Therefore, their level of expertise was insufficient to convey an adequate understanding of science to the public.
- Factor 3: Preference for, or dominance of, religious or other belief systems when deciding scientific matters: During the years when RFTP was ascendant in the American and Australian press, evocations of religious beliefs and folk beliefs appeared to have more influence than science on the public understanding of Great Plains or South Australian climatology. It is possible, however, that due to a lack of exposure to reliable science, the ordinary individual had no basis to distinguish between science and belief.
- Factor 4: The 'illusory truth effect', the impact of repetitious messages: The frequent publication of articles criticising and diminishing the value of knowledgeable individuals like Powell, the relentless drumbeat in favour of the RFTP doctrine (found in articles and poetry published in American and Australian newspapers of the era), likely impacted all who read or heard about this newspaper coverage.
- Factor 5: Resistance to the authority of valid (for the era) scientific evidence: Aughey and Wilber (and others) actively resisted and attempted to diminish the value of Powell's knowledge and advice. In Australia, the fieldwork of the government surveyor Goyder was resisted and ignored in preference for a folk belief that favoured settling and cultivating the northern reaches of South Australia.
- Factor 6: The action of witting or unwitting transmission of misinformation due to orchestrated or unorchestrated misinformation: Whether what appeared to be a campaign to amplify the RFTP message was witting or unwitting is difficult to prove. However, a number of scholars have concluded that this campaign was witting and orchestrated, particularly by those who stood to profit from the hapless homesteaders who bought and attempted to settle lands in the Great Plains region and the northern reaches of South Australia.

- Factor 7: The impact of public engagement on the public understanding of scientific issues: The publication in South Australia of parliamentary debates on the pros and cons of RFTP might have increased the willingness of the public to question RFTP. Determining whether this might be true requires additional study.
- Reality check: In both the United States and Australia, it took a dose of reality, in the form of drought, for the RFTP belief to begin losing its cachet. In the United States, the belief persisted, to some degree, until the Dust Bowl.

The survey of American and Australian newspaper coverage (and selected writings by Aughey, Wilber and Whitney) included herein brought together in a new way both previously studied and more obscure information about the RFTP belief system, its promoters and its believers. While Aughey and Wilber have been referenced by other scholars, this essay explored their backgrounds more deeply, from the reality of their limited education and scant knowledge of science, to the ways in which they ‘branded’ themselves as men of science whose advice and counsel was believed in spite of their dubious credentials and limited knowledge.

Limitations

This essay did not claim to be a detailed study of the meteorological, geographical, environmental or climatological characteristics of the regions referenced. It presented a brief survey of historical American and Australian coverage of RFTP beliefs as well as a framework for the examination of historical scientific messages—including environmental messages.

Due to space limitations, a more detailed exposition of the Australian RFTP experience, including an exploration of the status of Australian science as well as the journalistic, commercial and scientific networks through which RFTP messages migrated to Australia, could not be included; nor could a discussion of the distribution of the RFTP doctrine in other regions (such as the grasslands of Canada) be included. The Australian newspaper data (much of which pertains to the colony of South Australia) was an unexpected discovery that illustrated how far scientific misrepresentations or misunderstandings were capable of spreading—even in the nineteenth century. This topic certainly merits further discussion in the future.

Another limitation of the study is that the analysis of the articles themselves was not granular. The articles were not categorised as to type (editorial, letters to the editor, reportage or other category of article) nor were characteristics such as the length or position of the article on the page examined. A more detailed analysis would have been possible—and interesting—but the focus here was on

a preliminary exploration of historical messages about science-related matters and the introduction of a proposed framework with which these messages could be examined in more detail.

Last, but not least, the database research was limited by the contents of the databases themselves. Neither newspapers.com nor Trove represent themselves as complete repositories of all newspapers published in the regions they cover. It should be noted that, because such databases are often updated, the newspapers.com and Trove searches were conducted anew during the revision process. As a result, there were some changes in the data—including the addition of data regarding the frequency with which 'The Way of the Rain' was published in American newspapers.

Future directions

Future directions include application of the framework proposed herein as a foundation for content analysis with which to examine the RFTP articles collected in connection with this essay. Coding sheets, the basis for content analysis, could easily be prepared based upon the framework provided herein. Further exploration of the history surrounding publication of Whitney's poem 'The Way of the Rain' might also be a productive topic. Was publication of this poem part of a concerted public relations effort by Union Pacific or other boosters of Great Plains settlement? A few, rather obscure texts mention the relationship between Whitney and her cousin, the Union Pacific official George Francis Train, but the significance of this connection vis-à-vis dissemination of the poem is not clear. In addition, the way in which news coverage personally and professionally demeaned the roles and expertise of Powell, Goyder and other knowledgeable scientists should be explored further. Compilation of circulation statistics for the relevant newspapers would assist in several of these analyses.

The framework or rubric proposed herein can be applied to historical instances where the public understanding—and application—of science was hindered by factors modern researchers study in their empirical work. It should be noted that, although Kahan maintained that 'orchestrated misinformation' is not one of the most significant factors contributing to 'the science communication problem', there have been critical junctures in history where witting or unwitting exploitation of inadequate scientific knowledge has been used to shape public policy—severely impacting individuals who relied on others for the expertise necessary to make important science-related decisions. These instances should be studied and the knowledge gained applied, as appropriate, to current studies of our science communication environment. The framework presented in this essay can be used in such studies and refined. Hopefully it will prove useful in other explorations of historical representations (or misrepresentations) of science.

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