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Rethinking Science, Religion and Nature in Environmental History: Drought in Early Twentieth-Century New Zealand

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Abstract: This article investigates popular and elite conceptions of science and religion in an early twentieth-century European settler society. It uses the case-study of rainmaking experiments and prayers in North Otago, New Zealand, in 1907, to challenge two dominant paradigms about New Zealand society: first, that scientific rationalism was automatically antipathetic to religion and, second, that by the early twentieth century scientific ideas were secularizing New Zealand society. North Otago's residents viewed prayer and experiment as complementary activities designed to meet the same ends; there was no distinctive, hermetically sealed division between the secular and the profane. Rainmaking also offers a fascinating way of exploring contested notions of science. While local residents enthusiastically embraced the use of explosives to bring rain, meteorologists decried these measures as unscientific and amateurish, thereby attempting to increase the legitimacy of their own profession. The reaction to North Otago's rainmaking prayers and experiments differed considerably from that of other societies such as in England and Australia in which similar prayers and experiments were undertaken. These differences reflected the special social and cultural characteristics of each country and, in New Zealand's case, its greater religious tolerance and social opportunities.¹

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Throughout history, natural events such as floods and fires, earthquakes and storms, comets and eclipses, have elicited a wide range of responses from different societies. Some people have viewed them as evidence of divine displeasure brought on by human transgressions, some as omens of bad things to come, and others as extreme natural phenomena. Environmental historians can use these events as occasions to learn about contemporary ideas of nature, science and religion.² So far, however, New Zealand's environmental historians have ignored such debates. Not only that, but most worldwide research on this topic focuses on the early modern period. By looking at the reaction of the residents of North Otago, New Zealand, to the drought of 1906-7, this article seeks to redress this imbalance. Investigating the rainmaking experiments and prayers that took place there in 1907 reveals a far more complex picture of religious and scientific ideas in New Zealand than many writers have so far recognized. In his two-volume history of New Zealand, James Belich, for instance, argues that the growth of scientific rationalism between the 1880s and 1920s meant a decline in religious belief.³ Belich's views form part of a general writing-off of religious history and religious views in early twentieth century New Zealand that is evident within the wider New Zealand historical profession.⁴ As this article shows, extending natural scientific explanations into new areas did not necessarily undermine people's religious readings of the same phenomena.⁵ Nor did increasing scientific understandings invariably bring about secularization in society. Many North Otago Protestants viewed prayer and experiment, religion and science as complementary activities designed to achieve the same ends. These findings complicate both the dominant historiographical picture of "modern society" in which science inevitably undermined faith, and the notion of hermetically-sealed divisions between the secular and the profane, science

knowledge of these events. I thank them for their hospitality. William Mooney, of the Geography Department, University of Otago, generously took time out of his busy schedule to draw the accompanying map.

² Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England* (New York, reprint, 1997), pp. 78-150; Simon Schama, *The Embarrassment of Riches: An Interpretation of Dutch Culture in the Golden Age* (London, 1991), pp. 127-220; Christian Rohr, "Man and Natural Disaster in the Late Middle Ages: The Earthquake in Carinthia and Northern Italy on 25 January 1348 and its Perception," *Environment and History* 9 (2003), pp. 127-149; Martin Stuber, "Divine Punishment or Object of Research? The Resonance of Earthquakes, Floods, Epidemics and Famine in the Correspondence Network of Albrecht von Haller," *Environment and History* 9 (2003), pp. 173-193; Michael Kempke, "Noah's Flood: The Genesis Story and Natural Disasters in Early Modern Times," *Environment and History* 9 (2003), pp. 151-171.

³ James Belich, *Paradise Reforged: A History of the New Zealanders from the 1880s to the Year 2000* (Auckland, 2001), p. 165.

⁴ John Stenhouse, "God's Own Silence. Secular Nationalism, Christianity and the Writing of New Zealand History," *New Zealand Journal of History* 38 (2004), pp. 52-71.

⁵ For some excellent research into these ideas see Ronald L. Numbers, "Science without God: Natural Laws and Christian Beliefs," in David C. Lindberg and Numbers, eds., *When Science and Christianity Meet* (Chicago and London, 2003), pp. 265-285.

and religion. These divisions, constructed by modern researchers, reveal more about the society in which they live than the one they study. Reactions to drought also demonstrate the fascinating process by which emerging scientific groups, such as meteorologists, sought to strengthen their own claims of professional legitimacy by criticizing the rainmaking experiments as scientifically unsound. Rainmaking prayers in North Otago received a different response to those in other countries. Controversy often attended rainmaking prayers in Australia and England for a variety of reasons. Liberal-minded clerics, scientists and professionals challenged the wealth and influence of other clergy by criticizing special prayers and the like. In England, some professionals attempted to undermine the church's status and authority, and thus create a niche for themselves, by challenging the dominance of the state church over educational institutions, politics and government. New Zealand professionals, in contrast, did not have to challenge an established church to gain power since none existed in the colony. New Zealand's greater social opportunities, similarly, enabled Catholics to enjoy greater educational and economic opportunities than in Australia, thereby minimizing the potential for religious grievances in the colony. For some, drought also fostered doubts about the suitability of existing European farming practices in Otago and evince that natural phenomena can sometimes change people's perception of the natural world.

Colonial New Zealand

Until Polynesian explorers ventured to New Zealand around 1200 A.D., the land's flora and fauna had been biologically and spatially isolated for eighty million years. The coming of humans, along with their introduction of animals and plants, would significantly alter New Zealand's landscape and avifauna. Extinction and vegetation change coincided with Polynesian settlement and from the mid-nineteenth century increased markedly with the commencement of planned British immigration. Before Europeans came to New Zealand some 100,000 Maaori lived throughout these islands. In the forty years after New Zealand became a British colony in 1840, New Zealand's European population rapidly surpassed its Maaori population, growing from 5,000 to well over 600,000 by 1881.⁶ Primary production became New Zealand's biggest export earner. Turning forestland to farmland, making "wastes" productive, became a

⁶ For New Zealand's environmental history, note the essays in Eric Pawson and Tom Brooking (eds.), *Environmental Histories of New Zealand* (Melbourne, 2002) as well as Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (New York, reprint 1994), pp. 217-268. Population figures from Jeanine Graham, "Settler Society," Geoffrey Rice (ed.), *The Oxford History of New Zealand* (Auckland, second edition, 1997), p. 112; note too the general history by Belich, *Making Peoples: A History of the New Zealanders* (Auckland, 1996).

catch-cry for Europeans, who rapidly began to develop New Zealand's resources, cut down forests, drain swamps, sow new grasses and extinguish most of the customary titles of Maaori.

The South Island's vast grassland plains on its eastern coast guaranteed the island's future as a pastoral and agricultural economy. In due course, the provinces of Otago and Canterbury developed into the economic powerhouses of the colonial economy. Extensive European settlement in Otago began in 1848 with the establishment of Dunedin as a Scottish Free Church settlement. Gold, discovered in Otago in the 1860s, attracted people from throughout the world, and rapidly diluted, but did not destroy, the Presbyterian influence in Otago. In the process, gold quickly made it one of New Zealand's wealthiest provinces in the nineteenth century. For the rest of the century, grain and grass would become the staples of the Otago economy. By the 1900s, a government-led program of land redistribution had prised open the land to closer settlement and smaller-scale farms. On many of these, farmers in North Otago ran sheep, grew grain, grazed cattle to supply the developing dairy industry or raised stock for the newly-emerging frozen meat export industry. By the early 1900s, the region's capital, Oamaru, bustled with commercial activity, evincing its recovery from the "Long Depression" of the 1890s, when both economic recession and drought in 1890-1891 had bitten deep into the pockets of many in the region.⁷ Drought, however, would soon return to haunt the region.

Drought in North Otago, 1906-7

People define drought in different ways. A farmer may measure it primarily by the lack of crop or pasture growth, a meteorologist by the lack of rainfall or a deeply religious person by reference to God. Indeed, "the severity of a drought is controlled not just by the duration of the period without precipitation (meteorological drought), but by the effect of weather on plant growth, water supplies, and human activity."⁸ There is no doubt that North Otago in 1906-7 was stricken by drought: vegetation and stock died, water supplies dried up, and people widely referred to this phenomenon as a drought. The dry spell began in January 1906 and by the end of the year, the rainfall had averaged 45.2 per cent

⁷ K.C. McDonald, *White Stone Country: the Story of North Otago* (Christchurch, reprint 1977); McDonald, *History of North Otago for Centennial Period, 1840 to 1940* (Oamaru, 1940); Erik Olssen, *A History of Otago* (Dunedin, 1984).

⁸ Richard Ibbitt, Ross Woods and Alistair McKerchar, "Hydrological Processes of Extreme Events", M. Paul Mosley, Charles P. Pearson (eds.), *Floods and Drought: The New Zealand Experience* (Christchurch, 1997), p. 16. J. M. Salinger quoted in Mosley and Pearson, "Introduction: Hydrological Extremes and Climate in New Zealand," *Floods and Drought*, p. 10.

below the annual mean of the last thirty-nine years (1867-1906).⁹ For the first half of 1907, North Otago fared no better.¹⁰ “The absence of rain,” worried a journalist in 1906, “is beginning to tell on the district” since Ngapara’s soil was “as dry as dust” while late-sown grain was “not germinating at all.”¹¹ Another writer likened the area between Ngapara and Oamaru to the Sahara: dry, dusty and unproductive.¹²

Although some rain fell in May 1907, it was insufficient to end the drought since, by now, the ground was extremely dry.¹³ A little later, on July 15, 1907, heavy clouds raced across the sky, and it seemed that the drought might soon end, but hopes rapidly evaporated when by evening the skies cleared and once more the stars shone brightly.¹⁴ By mid-1907, the agricultural and domestic situation in the region had deteriorated further. Duntroon residents had to travel some distance to collect drinking water.¹⁵ North Otago pastoralists had to bring in truckloads of turnips as feed from over 200 kilometres away in distant Southland, out-pasture their stock or else slaughter them. Grain farmers had their lowest average annual harvest yield in the past decade and the dairy farmers also fared very badly.¹⁶ When the drought ended, and the cost counting began, estimates placed the financial impact of the drought at about £1 million. Butter producers alone lost £50,000, grain harvesters, £200,000.¹⁷ Ironically, while much of Central and North Otago as well as Canterbury were experiencing drought, many areas in Southland and most of the North Island enjoyed excellent weather. One paper described the North Island season as the “most bounteous” in living memory.¹⁸

Rainmaking Experiments

“Nothing less than a flood will serve us now,” urged one Kakanui agriculturist, unless farmers turn to rainmaking experiments. Detonating explosives in moisture-laden air had worked in Oamaru ten years ago and more recently in Queensland, continued the farmer.¹⁹ Support for the farmer’s suggestion gained

⁹ “Table 2. – Precipitation Data for Oamaru (Windsor Park), New Zealand” in D.C. Bates, “Report Upon the Dry Period and Rain-Making Experiments at Oamaru, New Zealand,” *Monthly Weather Review* 36 (July, 1908), p. 208.

¹⁰ Bates, “Report Upon,” p. 208.

¹¹ *Otago Witness* [henceforth *OW*], September 5, 1906, p. 40.

¹² *New Zealand Farmer* [henceforth *NZF*], 28 (March, 1907), p. 219.

¹³ *Oamaru Mail* [henceforth *OM*], May 25, 1907, p. 2.

¹⁴ *OM*, July 15, 1907, p. 2.

¹⁵ *OM*, July 5, 1907, p. 1.

¹⁶ Bates, “Report Upon,” p. 209. On the dairy industry see *OM*, June 1, 1907, p. 2.

¹⁷ *Evening Post* [henceforth *EP*], August 12, 1907, quoted in Bates, “Report Upon,” p. 209.

¹⁸ Department of Agriculture’s annual report, 1906, quoted in *OM*, 24 August 1907, p. 1.

¹⁹ *OM*, July 15, 1907, p. 3.

ground, and not just in North Otago. Two letters of support, for instance, appeared in the paper of a neighboring province, Canterbury.²⁰ A North Otago correspondent, T. M. Whither, urged that “no time should be lost in again repeating these experiments” while other letter-writers pledged support and money.²¹ Drought clearly generated a great deal of environmental anxiety in North Otago. Not all farmers, though, willingly championed rainmaking. Observing that his neighbor had contributed to the rainmaking fund, one canny Scots farmer declared, “If the rain falls in his [the neighbor’s] paddock it’ll no miss mine.”²²

Without explanation, Oamaru’s councilors declined the subscriptions that had been collected, so people began organizing the experiments themselves.²³ A Rain-Making Committee was formed on August 6, 1907 and soon, thanks to petitions and other fund-raising activities, a sizeable fund – £187 to be exact – had been collected for the experiments.²⁴ Both farmers and citizens attended the meeting, indicating that concern for the drought was widespread, as indeed did the quick raising of such a relatively large sum.²⁵ Although the local council declined to support the experiments, the New Zealand government did, eventually contributing to these £200, along with dynamite at cost, five Defense Force artillerymen, and three meteorologists.²⁶

The Principles of Rainmaking

In 1891, when the region had last experienced a severe drought, North Otago residents had decided to undertake rainmaking experiments. The return of rain, however, pre-empted their intentions.²⁷ Nevertheless, many letter writers believed that repeating these earlier planned experiments would bring the desired

²⁰ *OM*, July 19, 1907, p. 1. The Canterbury newspaper *The Press* [henceforth *TP*] also carried correspondence on rainmaking. *TP*, August 13, 1907, p. 9.

²¹ *OM*, July 23, 1907, p. 4; *OM*, July 24, 1907, p. 3.

²² *North Otago Times* [henceforth, *NOT*], August 12, 1907, p. 2.

²³ *OM*, July 24, 1907, p. 1.

²⁴ Chairman: H. Dovey; Secretary: Gibson; Duntroon: W. Sutherland, H. Dovey; Oamaru: Orbell, Muir; Enfield: C.W. Reid, J. Mahoney; Windsor: Livingstone, Mackay, J. Don; Tokarahi: W. Gardiner; Weston: G. Harvey; Ngapara: T. Little, Shand, J. McCulloch. The *NOT* supports the *OM*’s estimate of the people attending the meeting. *NOT*, August 6, 1907, p. 1. On petitions and fund-raising note, for instance, *OW*, August 14, 1907, p. 36.

²⁵ *OM*, August 6, 1907, p. 2.

²⁶ *OW*, August 14, 1907, p. 36. Earlier, Prime Minister Joseph Ward had promised a deputation of North Otago farmers aid and money. *OM*, August 3, 1907, p. 2.

²⁷ For more details of the 1891 rainmaking experiments see McDonald, *History of North Otago*, p. 154; *White Stone Country*, pp. 187-8; McDonald, “Rain-makers at Work: Experiments in North Otago in 1891,” *New Zealand Railways Magazine* 14 (July 1, 1939), p. 14.

result in 1907.²⁸ Many also drew confidence from overseas rainmaking efforts, since Oamaru's aborted plans in 1891 had been modeled on Wyoming and Texas rainmaking experiments.²⁹ In the 1890s, rainmaking experiments gripped the imagination of residents of the Great Plains states of the United States.³⁰ Texas rainmakers, funded by a United States Congress grant of US \$9,000, had exploded balloons containing hydrogen and oxygen a mile into the air, following these with charges of dynamite attached to kites. Torrential rain reportedly followed the blasts.³¹ In 1882 and 1902, Queensland (Australia) also conducted its own rainmaking experiments, albeit unsuccessfully.³² The importance residents placed on overseas experiments fully illustrates that environmental ideas were not played out in a vacuum, that networks of correspondence and newspapers, people and personnel distributed ideas and examples throughout the world.³³ This fact is borne out, too, by suggestions that new agricultural techniques that had worked in South Africa and the United States should be introduced into North Otago.

The hopes of rainmakers rested on the erroneous but popular notion that rain followed great battles.³⁴ Reverend D.C. Bates, the Government Meteorologist sent to observe the rainmaking, explained that in principle explosions expand moisture-laden air and create "a state of atmospheric instability. Condensation first takes place aloft, then possible drops fall, introducing a cooler current which might cause local showers."³⁵

²⁸ See *OM*, July 15, 1907, p. 3, July 19, 1907, p. 1, July 23, 1907, p. 4, July 24, 1907, p. 3.

²⁹ McDonald, *History of North Otago*, p. 154.

³⁰ Henry Nash Smith, "Rain Follows the Plow: The Notion of Increased Rainfall for the Great Plains, 1844-1880," *Huntington Library Quarterly* 10 (1947), p. 191.

³¹ McDonald, "Rain-makers at work," p. 14. W. J. Humphreys, *Rain Making and Other Weather Vagaries* (London and Baltimore, 1926), p. 32.

³² *The Australasian* [henceforth *TA*], February 4, 1882, p. 145; "The Weather Prophets: The Charleville Rainmaker," *Federation and Meteorology*, <http://www.austehc.unimelb.edu.au/fam/0007.html>

³³ On the general exchange of ideas, note Tony Ballantyne, "Empire, Knowledge and Culture: From Proto-Globalization to Modern Globalization," A. G. Hopkins (ed.), *Globalization in World History* (London, 2002), pp. 115-140. On the environmental exchange of ideas in New Zealand note James Beattie, "Environment Anxiety in New Zealand, 1841-1941: Climate Change, Soil Erosion, Sand Drift, Flooding and Forest Conservation," *Environment and History* 9 (2003), pp. 379-392; James Beattie, "W. L. Lindsay, Scottish Environmentalism, Webs of Information, and the 'Improvement' of Nineteenth-Century New Zealand," Tony Ballantyne, Judith A. Bennett (eds.), *Landscapes and Communities* (Dunedin, 2005 forthcoming).

³⁴ Bates, "Report Upon," p. 212. As Humphreys points out, it was purely coincidence that rainfall followed battles. Humphreys, *Rain Making and Other Weather Vagaries*, pp. 29-32.

³⁵ Bates, "Report Upon," p. 12.

Rainmaking Prayers

“It is impossible to consider” the matter of rainmaking, explained one correspondent to the *Oamaru Mail* in July 1907, “entirely apart from the religious belief of so many in our district.” This letter-writer held that rainmaking was not impious: “I solemnly believe that man, in the act of endeavoring [sic] to bring water down from the clouds above, can do so with just as much reverence towards Him as in the act of endeavoring to obtain water by digging and boring in the earth beneath.” Some people may object to the experiment, conjectured the writer, because they believe “the Creator is in the region of the clouds above” but, in fact, God is everywhere you look. The writer finished by enclosing a £1 donation with the hope that “others, [from] both farmers and citizens, will promptly follow.”³⁶ Another correspondent agreed. According to Scripture, rainmaking prayers and rainmaking experiments went hand-in-hand: “Let them ask for much-needed rain, and ‘Prove me now, herewith, said the Lord of Hosts, if I will not open you the windows of Heaven and pour you out a blessing that there shall not be room enough to receive it’ (Psalm XCV, from Malachi iii., 9 and 10),” wrote the correspondent.³⁷

At the second meeting of the Rain-Making Committee in August 1907, rainmakers acknowledged their “dependence upon the Almighty for the success of our efforts” by requesting “the co-operation of the various religious bodies in the district, and desir[ing] that the clergy and leaders of denominations offer up special prayers in relation to the matter.”³⁸ The next day, churches in Oamaru held special prayers for rain.³⁹ While Oamaru’s Presbyterian churches held indoor services, a group of Salvation Army faithful held a two-hour outdoor service in North Otago’s dry, droughty interior punctuated by music and quiet reflection. With the Salvation Army in Oamaru holding a similar service, it was popularly said at the time that the fall of rain in each area would indicate the faithfulness of the respective branches.⁴⁰

³⁶ *OM*, July 23, 1907, p. 4.

³⁷ *OM*, July 25, 1907, p. 3.

³⁸ *OM*, August 10, 1907, p. 2.

³⁹ *OM*, August 12, 1907, p. 2.

⁴⁰ Kathleen Stringer, North Otago Museum Curator, interview, May 2, 2001. For a brief history of the reception received by the Salvation Army when it came to Oamaru in September, 1883, see S. A. Muirhead, “The Turbulent Years: Early Days in the Salvation Army,” (unpublished manuscript, North Otago Museum [henceforth NOM], New Zealand, 97/25b.).

The Experiments

Meanwhile, on the afternoon of the third meeting of the Rain-Making Committee on August 13, a train conveyed Corporal Meikle and four men of the submarine miners to Oamaru.⁴¹ Rainmakers, perhaps buoyed by the impending arrival of the Defense Force members, were full of optimism. Rain following battles may be “coincidences,” wrote a reporter at the meeting, “but as coincidences they are remarkable.”⁴²

The first rainmaking experiment took place on 16 August atop Raki’s Table, a “flat-topped hill” almost 323 meters above sea level, 22 kilometers NNW from Oamaru.⁴³ At 5 p.m., with the “cool of the evening” approaching, Reverend Bates and the rainmakers, along with two journalists, made their way up to Raki’s Table. To Bates, an ordained Church of England clergyman, and future Director of the Meteorological Department, scattered rain in the distance, and 92 per cent humidity suggested that conditions did not favor rainmaking.⁴⁴ North Otago’s rainmakers disagreed, so, under Corporal Meikle’s direction, three detonations went ahead, starting at 5:15 p.m. and commencing every fifteen minutes thereafter.⁴⁵ The *Oamaru Mail* reported excitedly that a “great concussion” rent the air with the final explosion. Windows rattled in Mr. Shand’s home. It seemed that rain just might fall, but, as had earlier happened, the clouds lifted.⁴⁶ No rain fell near the site of the explosions, but at the completion of the last explosion Hilderthorpe, a small community north-east of Oamaru, did enjoy a half-hour drenching. Heartened by this “success,” rainmakers vowed to continue with the experiments. The *Oamaru Mail* felt that rainfall at Hilderthorpe following so close behind the last explosion was more than a mere coincidence.⁴⁷ Bates, in contrast, doubted that rainmaking could have caused the rain.⁴⁸

A day before the second experiment, morning drizzle began to fall on the coast. This time, Totara Station recorded 20 millimeters of precipitation. As in 1891, it seemed rain would pre-empt the experiments. Coastal rain continued

⁴¹ *OM*, August 13, 1907, p. 4.

⁴² *Ibid.*

⁴³ See map. Bates, “Report Upon,” p. 210.

⁴⁴ Bates had served as army chaplain in the Boer War before retiring on medical grounds and becoming. J. F. de Lisle, *Sails to Satellites: A History of Meteorology in New Zealand* (Wellington, 1986), pp. 31, 34-41. See also G. H. Scholfield, *Who’s Who in New Zealand and the Western Pacific* (Masterton, 1925), p. 15. Bates sat on the Zoological Gardens Committee at Wellington, and published several articles on meteorology. *NOT*, August 16 1907, p. 2. He also contributed two articles to the *New Zealand Journal of Science*, one, co-authored with L. Birks, on “Annual Rainfall Fluctuations,” 4 (1921), pp. 173-179; another on “Weather Research on the Kermadec Islands,” 5 (1922), pp. 265-274.

⁴⁵ Bates, “Report Upon,” p. 210.

⁴⁶ *OM*, August 17, 1907, p. 4.

⁴⁷ *Ibid.*

⁴⁸ Bates, “Report Upon,” p. 211.

on Monday (August 19), but it remained dry inland. Under skies threatening rain, then, excited artillerymen greeted Bates at Raki's Table with reports that a detonation at 12:30 p.m. had brought a brief shower. Bates remained skeptical. He could not see how explosions brought rain in a 40 kilometer per hour wind, in conditions of intermittent rainfall, nor at a point almost 20 kilometers away from the blast area. Rainmakers, however, Bates would write later, "were quite as decided in their opinions that the rain thickened heavily after each successive shot."⁴⁹

On the next day, sufficient rain fell for the *Oamaru Mail* gleefully to proclaim the end of the drought. On Sunday night, rain had begun to fall all over the district and still had not abated by Tuesday. Although the drought was breaking, the experiments continued because inland areas still required more rainfall to permit plowing.⁵⁰ In a grand finale to the experiments, the last of the detonations would be coordinated among three sites: Raki's Table, used in the previous experiments; Round Hill (almost 153 meters high); and Dalgety's Hill (247 meters high).⁵¹ Originally, rainmakers had intended to use four sites, but they thought better of using Big Hill (Papakaio) as it lay rather too close for comfort for coal miners working in a mine there.⁵² During the second experiments miners already had experienced, as one source put it, a "shock there so sharply that it resembled an earthquake."⁵³

Two groups of observers viewed the third and final set of experiments. Bates and his assistants went to Shand's Ngapara home laden with meteorological equipment and cameras, taking up the same position they had when viewing the experiments at Raki's Table. At 3:40 p.m. the first detonation of some 23 kilograms of explosives took place at Round Hill.⁵⁴ As Bates and his fellow observers sheltered from the light drizzle in a nearby haystack, they heard the day's third detonation. The clouds thickened. Then heavy rain fell for a short period. It was so heavy, in fact, that it wet the fuse, which could be lit only with the greatest of difficulty for the next detonation. During this blast, Reverend Bates saw no perceptible increase in rainfall after the explosion.⁵⁵ The three stations kept firing until, by 4:16 p.m., they had spent their explo-

⁴⁹ Ibid.

⁵⁰ *OM*, August 21, 1907, p. 2. The day before, the *OM* noted that water had percolated to a depth of 3 inches into land in the lee of the falling rain. Water percolated to a depth of 7 to 8 inches into unsheltered land. *OM*, August 20, 1907, p. 4. Other areas, such as South Canterbury, Waimate, Central Otago, and Kurow, also 'shared in the welcome rain', bringing an end to trying drought conditions. Some farmers seized the opportunity, and began to plough land. *OM*, August 20, 1907, p. 4. For details of the breaking drought in Timaru, Christchurch, Dunedin, and the West Coast see *OW*, August 21, 1907, p. 39. For the end of drought in Canterbury see *TP*, August 24, 1907, p. 11.

⁵¹ *NOT*, August 23, 1907, p. 4.

⁵² *OM*, August 23, 1907, p. 4.

⁵³ *NOT*, August 23, 1907, p. 4.

⁵⁴ *OM*, August 23, 1907, p. 4.

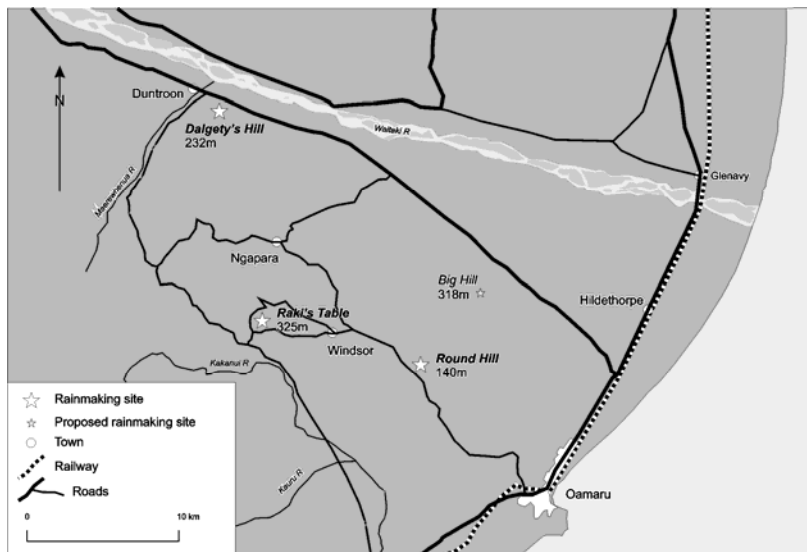
⁵⁵ *OM*, August 20, 1907, p. 4.

sives. By far the most spectacular explosion took place on Raki's Table which, according to *The Mail*, with over 90 kilograms of explosives lent "to the spectacle [of rainmaking] an element of grandeur" with detonations reverberating and re-echoing "amongst the hills like thunder."⁵⁶ Observers certainly felt this blast since its concussion threw them backwards.⁵⁷

Assessing the Rainmaking Experiments

What did observers make of the experiment? After the last blast, the *Oamaru Mail* was enthusiastic, but three days later its tone had dampened. "It has been demonstrated," observed its correspondent, "that rain cannot be induced to fall by air concussion created through the medium of high explosion," although it still gave the rainmakers hope. "Whether [rain fell] as a result of the committee's enterprise, or was the natural sequence of the incomprehensible working of the mightier forces in Nature, the district was experiencing such a downfall as had not been its lot for considerable over [sic] a year, and that the hearts of the farmers and business people would be materially gladdened thereby."⁵⁸

Map of the area where the rainmaking experiments took place.



⁵⁶ *OM*, August 23, 1907, p. 4.

⁵⁷ *OM*, August 20, 1907, p. 4.

⁵⁸ *OM*, August 23, 1907, p. 4.

In contrast, right from the beginning of rainmaking discussions the *Mail's* rival, the country-focused *North Otago Times*, had poured cold water on the experiments.⁵⁹ At their conclusion, the *Times* wrote that the rainmakers went ahead “in spite of [what] all the newspapers have written, in spite of scientific reasonings [sic] on the subject, and in spite of the failure of all the experiments made by the various governments of the world.”⁶⁰ Other newspapers such as the *Auckland Weekly News* and *The Press* reported on the failure of the experiments.⁶¹ “ANTIFAKE,” a correspondent, even likened their effectiveness to “shooting boiled peas at Gibraltar.”⁶² Meteorologists also criticized the experiments. Measured criticism followed in Reverend Bates’ report on the rainmaking.⁶³ “Until it can be shown,” he wrote, “that the temperature of the air can be controlled by gigantic cooling operations we may look in vain for any alteration in the natural order of events by way of the production of artificial rain.”⁶⁴ Another meteorologist, probably Cleveland Abbe of the United States Weather Bureau, who edited the journal in which Bates published his report on the experiments, regarded the North Otago rainmaking “as misguided and vain by all scientific meteorologists.”⁶⁵ Bates, unlike Abbe, at least found room to praise the worthy efforts of Oamaru’s “progressive, enlightened, and experienced farmers and business people” who had “the best interests of the community at heart” in promoting the experiments.⁶⁶

In contrast, many people in North Otago poured their money and enthusiasm into the experiments, sincerely believing that these had ended the drought. Since rain had fallen almost immediately after the first explosion, many Ngāpara residents, for instance, attributed it to the experiment.⁶⁷ Indeed, one George White of Hilderthorpe felt sure that the experiment had caused rain in his area.⁶⁸

These contrasting opinions reveal a division between popular and elite conceptions of science. On the one hand, many local residents had placed their faith in rainmaking experiments. On the other, meteorologists such as Abbe and Bates regarded rainmaking as science in name only. By criticizing the experiments, Abbe and Bates were trying to establish boundaries between

⁵⁹ *NOT*, August 12, 1907, p. 2. For its earlier criticism see *NOT*, August 9, 1907, p. 4.

⁶⁰ *NOT*, August 23, 1907, p. 2.

⁶¹ *Auckland Weekly News* [henceforth *AWN*], August 27, 1907, p. 49; *TP*, August 23, 1907, p. 10. See also *NZF* 28 (December, 1907), p. 1068.

⁶² Letter, *OM*, August 10, 1907, p. 1.

⁶³ Bates, “Report Upon,” p. 212. For instance, noted Bates, “the condensation from vapour to water for an inch of rain to the square mile is estimated as equivalent to the work done by 100, 000, 000 horse-power for half an hour.” (Bates, “Report Upon,” p. 213.)

⁶⁴ Bates, “Report Upon,” p. 213.

⁶⁵ *Ibid.*, p. 212.

⁶⁶ C.A. [Clement Abbe], “Rain-Making in New Zealand,” *Monthly Weather Review* 36 (July, 1908), p. 208.

⁶⁷ *OM*, August 20, 1907, p. 4.

⁶⁸ *NOT*, August 19, 1907, p. 2.

legitimate and illegitimate science.⁶⁹ They were trying to “make their claims and practices credible ... by distinguishing them from unworthy claims and practices of some nether region of *non-science*.”⁷⁰ In essence, the meteorologists thought that the rainmaking experiments were not based on sound scientific principles. Around the turn of the twentieth century, New Zealand meteorologists, like other scientists and professionals, were attempting to bring increased legitimacy and status to their work.⁷¹ Perhaps this was because the Meteorological Department had suffered chronically low levels of government funding and therefore its staff wished to demonstrate its professionalism and usefulness and thus justify its status. Perhaps, too, because he did not have any formal training in meteorology, Bates wanted to establish his professional credentials.⁷² These attempts show that only from the 1890s were professionally trained scientists beginning to change the largely amateur-dominated New Zealand science scene. This process would take a quarter of a century or more to achieve. Instrumental in this was the establishment, in 1926, of the government organization, the Department of Science and Industrial Research.⁷³ For meteorologists, the Oamaru experiments offered an excellent chance to demonstrate the professionalism and superior scientific training of their department against the amateurism of the North Otago practitioners.

Assessing the Rainmaking Prayers

When the drought finally broke in late August, M. E. Davey of Hull Street, Oamaru, noted delightedly that the prayers for rain “have been abundantly answered.” “The lovely rain which is falling in such abundance as I write,” continued Davey, “ought to fill the heart of every man, women, and child with

⁶⁹ Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago and London, 1999). On this, note also Frank M. Turner, *Contesting Cultural Authority: Essays in Victorian Intellectual Life* (Cambridge, 1993), pp. 171-200 [chapter originally published as “The Victorian Conflict Between Science and Religion: A Professional Dimension,” *Isis* 69 (1978), pp. 356-376.].

⁷⁰ Gieryn, *Cultural Boundaries*, p. xii.

⁷¹ Michael Belgrave, “Medicine and the Rise of the Health Professions in New Zealand, 1860-1939,” Linda Bryder (ed.), *A Healthy Country: Essays on the Social History of Medicine in New Zealand* (Wellington, 1991), pp. 7-24; Brooking, *A History of Dentistry in New Zealand* (Dunedin, 1980), especially chapters 1-3. See also Jennifer M. Gray, “Potions, Pills and Poisons: Quackery in New Zealand, circa 1900-1915,” (unpublished Honors dissertation, University of Otago, Dunedin, 1980).

⁷² For details of the lack of funds of the department and Bates’ informal training see de Lisle, *Sails to Satellites*, pp. 30-42.

⁷³ On the development of New Zealand science, note Ross Galbreath, *DSIR: Making Science Work for New Zealand. Themes from the History of the Department of Scientific and Industrial Research, 1926-1992* (Wellington, 1998); C.A. Fleming, *Science, Settlers and Scholars: The Centennial History of the Royal Society in New Zealand* (Wellington, 1987).

gratitude to Our Heavenly Father who has so abundantly supplied our need.” Davey ended by imploring the Committee “in conjunction with the various ministers, [to] arrange for some plan whereby all may join in public thanks for His loving kindness.”⁷⁴

Oamaru’s churches, indeed, recognized His loving kindness. At St Luke’s (Anglican) Church, Reverend Hubert Jones led “a special thanksgiving for the plentiful rain.”⁷⁵ At Wesley Church, Reverend T. N. Griffin mentioned “the need for gratitude to God for His bounties,” as did the Baptist Church, and the Church of Christ. Meanwhile, St Paul’s (Presbyterian) morning service began with the congregation singing the Doxology. And Columba Church gave thanks for the ending of the drought.⁷⁶ Unfortunately, no details of these services survive.⁷⁷ The silence of Roman Catholics on rainmaking prayers is interesting. Previously, as when civil authorities proclaimed special fast days in 1868, they complained about the interference of secular powers in religious matters and had refused to observe them.⁷⁸ Perhaps their silence in North Otago indicates the desire to maintain social and religious coherence.

The rainmaking prayers and thanksgivings of 1907 demonstrate that in North Otago many people strongly believed that God remained actively involved in the natural world. The prayers also reflect changing religious beliefs. Had these prayers occurred in the middle of the nineteenth century, it is likely that a great deal of humiliation and much soul-searching among Protestant denominations would have taken place. Thanksgiving, not humiliation, greeted the end of the drought in North Otago because, by the 1900s, belief had moved away from a judgmental God towards a more beneficent Creator.⁷⁹ From the beginning of the nineteenth century, the practice of calling special prayers like those for rain in North Otago enjoyed popularity in England and Scotland

⁷⁴ *OM*, August 24, 1907, p. 1.

⁷⁵ *Ibid.*, p. 2.

⁷⁶ *NOT*, August 26, 1907, p. 2.

⁷⁷ “Oamaru Baptist Church: Minutes of the Oamaru Baptist Church,” uncatalogued, NOM; “Minutes of Managers’ Meetings of St. Paul’s Church, Oamaru, from November 11 1891 to October 14 1907”, NOM, Box 2623, Shelf 27b; “Session Record, St. Paul’s Church, Oamaru,” Box 2619, Shelf 27b, NOM.

⁷⁸ Alison Jane Clarke, “Feasts and Fasts: Holidays, Religion and Ethnicity in Nineteenth-Century Otago” (Ph.D. thesis, University of Otago, Dunedin, 2003), pp. 217-218.

⁷⁹ Special days of humiliation were called, for example, in Wellington in 1848 following a fearful earthquake and throughout New Zealand in 1854 with the outbreak of the Crimean War. Ali Clarke, “Humiliating Holidays: Public Fast Days in Colonial Otago,” unpublished paper presented at *Passions of the Past II: History Post-Graduate Symposium*, Dunedin, November 4, 2000. Clarke, “Feasts and Fasts,” pp. 212-220; James Beattie and John Stenhouse, “God and the Natural World in Nineteenth Century New Zealand,” John Stenhouse, Antony Wood (eds.), *The Contribution of Christianity to the Shaping of New Zealand Society* (forthcoming, 2005).

among Anglicans and Presbyterians alike.⁸⁰ Special prayers addressed many important national issues, from drought and cattle plagues, and cholera outbreaks to the health of the Prince of Wales.⁸¹ Increasingly from the mid-nineteenth century, however, rainmaking prayers in England and Australia were generating a great deal of criticism from among the liberal Protestant intellectual elite and other social groups. In England, growing understandings of the natural world – the discovery of what would be termed “natural laws” – were helping change notions of Providence, and in turn were leading some liberal Protestant elite and agnostics to question the efficacy of special prayers. To them, “solutions to human problems lay with human effort rather than through the protection of the Church.”⁸² Another important reason behind the increasing criticism of special prayers is to be found in social changes taking place in England. Liberal-minded clerics, scientists and professionals challenged the wealth and influence of other clergy by criticizing special prayers and the like. Where often some professionals attempted to undermine the church’s status and authority, and thus create a niche for themselves, some liberal clergy wanted to broaden the appeal of the church.⁸³ One consequence of these changes came in 1853, when Lord Palmerston, the British Home Secretary, limited the use of prayers to cure cholera because he believed poor sanitary conditions, not divine displeasure, explained its spread.⁸⁴ Controversy raged over the next decades on the efficacy of special prayers, and not just in England.

In Australia in 1882, the Anglican Bishop of Melbourne, Dr Moorhouse, became embroiled in scandal when he refused to endorse prayers for rain. Moorhouse argued that “God indicated by His providential arrangements that it was His will that we should conserve the water sent to us in winter.” *The Australasian’s* editor drew comparisons between Moorhouse’s reply and that of Lord Palmerston.⁸⁵ Later the editor praised Moorhouse for his “logic,” “eloquence” and “freedom of thought” in supporting science against theology. The editor presented Moorhouse as expressing views that formed “a well-defined milestone on the road to intellectual progress.” The editor implied that Moorhouse’s action would abolish “that large part of church ritual which is directed to enlist

⁸⁰ Turner, *Contesting Cultural Authority*, pp. 151-170 [chapter originally published as “Rainfall, Plagues, and the Prince of Wales,” *Journal of British Studies* 13 (1974), pp. 46-65]. Quote from p. 154.

⁸¹ Turner, *Contesting Cultural Authority*, p. 153.

⁸² John Hedley Brooke, “Science and Secularization,” Linda Woodhead (ed.), *Reinventing Christianity: Nineteenth-Century Contexts* (Aldershot (Hampshire), 2001), pp. 229-238, quote from p. 155. See, for instance, Gilbert White, *The Natural History of Selbourne* (Oxford, reprint 1993).

⁸³ Turner, *Contesting Cultural Authority*, p. 158.

⁸⁴ *Ibid.*, pp. 154-155.

⁸⁵ *TA*, March 4, 1882, p. 273.

the aid of heavenly agencies on our behalf.”⁸⁶ Moorhouse’s views scandalized others. One resident of Victoria described the Bishop’s standpoint as “impious,” another as “hopelessly antagonistic to the doctrine of his own, and all other Protestant Churches.” Indeed, “his respected lieutenant in command, Dean Macartney” and several other clergymen took it upon themselves to hold their own rainmaking prayers in defiance of the Bishop’s view.⁸⁷

Although religious beliefs changed over the period of the nineteenth century, I do not imply that it substantially declined.⁸⁸ To some theists and some Christians, God was the Divine Clockmaker, and nature a mechanized entity, but except for a small but growing minority of agnostics and atheists, these changes scarcely undermined the sovereignty of God. Science could reveal the marvelous adaptation and organization of the natural world God created.⁸⁹ Many ordinary folk, similarly, retained their faith in Providence, their belief unaffected by the intellectual controversies swirling above them in some elite circles.

The Reaction to Rainmaking Prayers in North Otago and New Zealand

Why did similar controversy not attend the rainmaking prayers in New Zealand? Most settlers consciously wanted to avoid bringing to New Zealand the class and religious conflict that was inherent in the British society they came from. Sectarian tensions certainly did exist in New Zealand, but few incidents in the colony “spilled over into direct and violent confrontation.”⁹⁰ Unlike both England and Scotland, New Zealand had no state religion and therefore “no powerful church, supported by the state, able to dictate to and discriminate against non-adherents.”⁹¹ The dominance of the state church in England over educational institutions, politics and government meant that many of the newly emerging classes in England such as lawyers and doctors had to fight against

⁸⁶ *TA*, April 8, 1882, p. 433.

⁸⁷ See *TA*, March 25, 1882, p. 3, April 1, 1882, p. 402, March 4, 1882, p. 273.

⁸⁸ See Callum G. Brown, *The Death of Christian Britain: Understanding Secularisation, 1800-2000* (London and New York, 2001) for the debate on this issue in Britain.

⁸⁹ Brooke, *Science and Religion: Some Historical Perspectives* (New York, reprint 1993), pp. 117-191.

⁹⁰ On sectarian tensions in New Zealand see Allan K. Davidson, *Christianity in Aotearoa: A History of Church and Society in New Zealand* (Wellington, 1991), pp. 64-73, 85-94; R.P. Davis, *Irish Issues in New Zealand Politics, 1868-1922* (Dunedin, 1974). Quote from John Stenhouse, “Sectarian Conflict in New Zealand to 1914,” unpublished research essay History 405, p. 4.

⁹¹ Stenhouse, “Sectarian Conflict”, p. 13. See John Stenhouse, “Darwinism in New Zealand,” Ronald L. Numbers, John Stenhouse (eds.), *Disseminating Darwinism: The Role of Place, Race, Religion, and Gender* (New York, 1999), pp. 62-64.

this body for power and prestige. New Zealand professionals, in contrast, did not have to challenge an established church to gain power. New Zealand's greater social opportunities enabled Catholics in nineteenth-century New Zealand to enjoy greater educational and economic opportunities than in Australia, and probably Ireland, thus minimizing the potential for religious grievances in the colony.⁹² A measure of its greater religious tolerance is that in the 1880s the Stout-Vogel Government was led by a freethinker, Sir Robert Stout, and a non-observing Jew, Sir Julius Vogel. Later, in 1889, John Ballance, an energetic and likeable Irish freethinker, became New Zealand's Prime Minister.⁹³ Rainmaking prayers did generate some discussion in New Zealand, but it is important to note that most came from an overseas source. The American meteorologist Clement Abbe mocked the rainmakers' belief in the efficacy of their experiments and prayers, chiding that the Oamaru people "now stood ready to denounce both religion and science if rain did not follow the cannonading." Rainmaking, Abbe fulminated, provided yet "another illustration of the waste of public money consequent upon popular ignorance and superstition."⁹⁴

According to historian James Belich, scientific rationalism formed "a strong secular element in New Zealand's moral ideology."⁹⁵ Yet, this secularizing aspect of science may be overstated. One way to avert the inflammation of religious tensions was to avoid religious language in scientific papers. Avoidance of religious language did not mean that most scientists had suddenly renounced religion, but rather that they now practiced their faith in private.⁹⁶ The government meteorologist sent to observe the rainmaking experiments, Reverend Bates, is an interesting exception. Bates was an ordained Anglican cleric and a government meteorologist, who later served as Director of the Meteorological Department (1908-1927). On August 18, 1907, Bates preached at St Luke's Anglican Church's morning and evening services, choosing for his evening service: "Thy mercy O Lord is in the heavens and Thy faithfulness reacheth unto the clouds" (Psalm 36:5). Bates presented a theistic interpretation of clouds. As objects of beauty, clouds glorified the Divine, he observed, and reminded mankind of the wonder of the Resurrection. Clouds underlined God's "wise design" of the firmament, continued Bates, illustrating that God had "fitted the earth to be the home of organic life." Indeed, said Bates, "Nature" was "a book written in cypher by the finger of God," which imparts,

"All the lore its scholars need
Pure eyes and Christian hearts."

⁹² Stenhouse, "Sectarian Conflict," pp. 8-12.

⁹³ Thanks to John Stenhouse for the information on Ballance.

⁹⁴ Abbe, "Rain-Making," p. 208.

⁹⁵ Belich, *Making Peoples*, p. 165. On further examples of the assumption that science and rationalism brought about secularisation in New Zealand, note Stenhouse, "God's Own Silence." On this topic in a wider context, see Numbers, "Science without God"; Brooke, "Science and Secularization," pp. 229-238.

⁹⁶ Stenhouse, "Battle".

God had created clouds so as “to give pleasure to man.” According to Bates, they “spoke of the Divine mercy and faithfulness ... [and] were also types of sorrow, sin, and forgiveness.” Just as clouds rose “from various places ... in glory and purity: so might humanity be glorified in the resurrection, and, though poor and weak and sinful now, be numbered amongst those who stand around the throne of God.”⁹⁷ A theistic sermon about clouds preached by the future head of the country’s meteorology branch, indeed, does indicate that historians have underplayed the role of religion in early twentieth century New Zealand science. Equally, the assumption that rationalism automatically precludes religious sensibility must be questioned.

Environmental Learning and Agricultural Change

The North Otago drought of 1906-7 brought changes to farming practices. Dairy farming, which suffered severely during the drought, virtually disappeared from the region and only recently has re-emerged.⁹⁸ Irrigation networks and fertilizer use also increased.⁹⁹ Other suggested changes, including tree planting to encourage rainfall and the adoption of dry farming techniques failed to gain popularity and indicate the popular limitations of environmental learning. Earlier extreme climatic events in New Zealand also had caused land use changes. The 1895 snowstorm, which swept through the South Island, for instance, highlighted the problem of overstocking.¹⁰⁰ Extensive periods of drought, likewise, often heightened fears of human-induced climate change caused by deforestation.¹⁰¹

Bates believed that deforestation had caused climate change in North Otago, and thus “may be combatted [sic] on scientific lines” through tree planting.¹⁰² Bates drew attention to archaeological evidence from the region that indicated North Otago’s wetter climate, since, he wrote, “in ancient times ... long before European settlement, trees seem to have flourished in the Oamaru district.” He recommended planting “larger and more varied plantations,” especially “in

⁹⁷ *OM*, August 19, 1907, p. 2.

⁹⁸ Dairying began in North Otago in November 1883 with the opening of a cheese factory at Weston by the Waiareka Dairy Factory Company. In the 1890s and 1900s a succession of local and outside companies variously established creameries or went out of business. For instance, in 1892 the New Zealand Dairy Supply Company of Dunedin established a co-operative butter factory at Oamaru and Hampden, quickly followed in 1894 by proprietary ones at Enfield and Reidston. McDonald, *Whitestone*, pp. 185, 214-215.

⁹⁹ McDonald, *Whitestone*, pp. 210, 217.

¹⁰⁰ Julian Kuzma, “The 1895 Snowstorm,” (Honors Dissertation, University of Otago, 1999), p. 1.

¹⁰¹ James Beattie, “Environmental Anxiety in New Zealand, 1830-1920: settlers, health, environment, conservation,” (Ph.D. thesis draft, University of Otago, 2004).

¹⁰² Bates, “Report Upon,” p. 212.

belts intercepting the northwest and southwest winds,” to “act as shelters and windbreaks,” and to “conserve the rainfall which now runs off in floods or evaporates in hot, dry weather.” Although Bates avoided the question of “whether forest trees increase the rainfall or are themselves the result of an abundant precipitation,” he nevertheless upheld their influence on climate. Deep-rooted trees, he explained, “prevent surface evaporation by the winds, but also, as they transpire freely in the summer, create a beneficial humidity in their neighborhood [sic]. The excessive heat of a bare, sun-baked soil drives away the rain from a drought-stricken district and thus diminishes the ‘probability of rain.’”¹⁰³ Bates’ confidence that tree planting brought rainfall appears curious, given his strong view that farming techniques should be adjusted to the climate of a region. However, as he indicated in a public lecture on meteorology given in Oamaru, he felt that tree planting could only bring about local climatic changes rather than significant changes in a region’s climate.¹⁰⁴

The forests-rainfall link enjoyed a great deal of popularity among foresters and the public alike and led to the establishment of climatic reserves and forestry departments throughout the world.¹⁰⁵ By the early twentieth century, however, increasing doubt was being thrown on this theory both overseas and in New Zealand.¹⁰⁶ In the United States, engineers and meteorologists, including Clement Abbe, were vocal critics of the forests-rainfall link as well as the idea that forests controlled flooding and soil erosion.¹⁰⁷ In New Zealand, by the 1910s, most professionally trained scientists had dismissed the forests-rainfall theory outright, although they supported the influence of forests on erosion and flooding.¹⁰⁸ Yet, two prominent New Zealand meteorologists, Bates and Meeson, continued to promote this idea, perhaps a reflection of their non-professional training in meteorology.¹⁰⁹

Bates also advocated environmental learning, for, he noted, although “our seasons are usually so temperate, regular, and fruitful,” drought showed that

¹⁰³ Ibid., p. 213.

¹⁰⁴ ‘Except where local changes in physical conditions had taken place, as in the case of tree planting on the Canterbury plains ... there could be no real change in the climate.’ *NOT*, August 21, 1907, p. 4. Bates’ other publications do not mention the forests-rainfall link. *Bulletin No. 9: Meteorology in Relation to Farming*, [put out by New Zealand Department of Agriculture, Divisions of Biology and Horticulture] (Wellington, 1905); *Meteorology of New Zealand: Supplied to Schools for School Purposes by the Education Department* [pamphlet taken from *New Zealand Year-Book*] (Wellington, 1912).

¹⁰⁵ Cf. Richard H. Grove, *Ecology, Climate and Empire: Colonialism and Global Environmental History, 1400-1940* (Cambridge, 1997).

¹⁰⁶ Beattie, “Environment Anxiety,” pp. 379-392.

¹⁰⁷ Ashley L. Schiff, *Fire and Water: Scientific Heresy in the Forest Service* (Cambridge, 1962).

¹⁰⁸ Beattie, “Environment Anxiety,” pp. 379-392.

¹⁰⁹ John T. Meeson, “The Rainfall of New Zealand,” *Transactions and Proceedings of the New Zealand Institute* 23 (1890), p. 553.

“climatic variations are of the greatest concern to the colony.”¹¹⁰ “We are only a young country,” he had declared to the *Mail*, “and have perhaps tried to follow the Old Country too closely with regard to our productions. We have many things to learn with regard to plants most suitable to the soil and the climate.” Bates recommended that North Otago farmers cultivate “species of crop best suited [to] a dry climate.” They could learn much from South African and North American farmers, he noted, who cultivated land in arid areas.¹¹¹ Use of South African and North American examples reinforces the environmental links connecting New Zealand to the rest of the world. The tenor of Bates’ message, that its farmers struggled to maintain agricultural productivity because their farming practices did not suit a semi-arid region, challenged more than the popular image of New Zealand as a well-watered and temperate land.¹¹² Bates threatened the very ideological taproot upon which the prosperity of New Zealand was founded: its agricultural potential as a neo-Europe. Bates feared that farming practices still had not adapted to the soil and climate of a new country. Others shared his views. In June, 1907, for instance, *The Oamaru Mail* reproduced a two-column story on dry farming in the Rocky Mountain West, indicating that this technique should be considered in North Otago.¹¹³ Climatic extremes thus forced some to reevaluate existing agricultural practices and to recognize the need to adopt methods better suited to the region’s environment.

Most North Otago farmers did not follow Bates’ advice about dry farming, and it is difficult to find out whether tree planting resulted from his suggestion. Instead, they turned to irrigation and artificial fertilizers to maintain agricultural productivity.¹¹⁴ These were popular choices because, unlike dry farming methods, irrigation and fertilizer use did not force farmers to significantly change their agricultural practices, which would have resulted had they adopted dry farming techniques. These changes in agricultural methods originated in settlers’ views that a productive, farmed landscape, fertilized by plentiful rainfall, was the norm. Anything else, particularly a droughty, unproductive environment, exemplified its antithesis and, more than that, moral failure, since cultivation stood for the apogee of a civilized, Christian society.¹¹⁵ For settlers,

¹¹⁰ Bates, “Report Upon,” p. 213.

¹¹¹ Bates quoted in *OM*, August 13, 1907, p. 4.

¹¹² On this note, for instance, Judith Anne Johnston, “Images and Appraisals of New Zealand, 1839-1855: A Cognitive-Behavioral Approach to Historical Geography” (Ph.D. thesis, University of Auckland, 1975); Miles Fairburn, *The Ideal Society and its Enemies: The Foundation of Modern New Zealand Society 1850-1900* (Auckland, reprint, 1990).

¹¹³ *Supplement to the Oamaru Mail*, June 19, 1907, p. 2. For other suggestions for the adoption of dry farming techniques note: “Dry Farming,” *New Zealand Farmer* 28 (April, 1907), p. 261; “Dry Farming or Good Farming,” *New Zealand Farmer* 28 (June, 1907), pp. 445-446.

¹¹⁴ Brooking, Hodge, Vaughan Wood, “The Grasslands Revolution Reconsidered,” in *Environmental Histories of New Zealand*, pp. 169-182.

¹¹⁵ On the importance of cultivation to western society, note, for instance, Richard Harry Drayton, *Nature’s Government: Science, Imperial Britain and the “Improvement” of the*

expecting a productive and well-watered landscape, the drought of 1906-7 seemed an aberration, but it was one that they later would realize actually formed a regular part of this region's climate.

Conclusion

Reactions to drought offer the environmental historian an opportunity to investigate contemporary environmental ideas. In the nineteenth and twentieth centuries, drought gnawed away at the confidence of some farmers and public alike and none more so than in parts of the South Island provinces of Canterbury and Otago. These provinces, the powerhouses of the nineteenth century New Zealand economy, relied on abundant rainfall for the production of grain, meat and milk. When, in 1906-7, drought struck North Otago, severely curtailing agricultural production, residents turned to rainmaking prayers and rainmaking experiments. Special prayers thanking the Almighty for the end of the drought show that, for many North Otago Presbyterians, God remained directly involved in the natural world. Residents of North Otago viewed prayer and experiment, religion and science, as complementary activities designed to meet the same ends. D.C. Bates, meteorologist and clergyman, neatly illustrates that, to many in early twentieth-century New Zealand society, there was no distinctive, hermetically sealed division between the secular and the profane, or between science and religion. Science and religion were not mutually exclusive fields, locked in battle for the minds of modern Westerners.¹¹⁶ This evidence of the continuing strength of religion and science questions two dominant paradigms about New Zealand society: first, that scientific rationalism was automatically antipathetic to religion and, second, that by the early twentieth century scientific ideas were secularizing New Zealand society. Certainly, for some agnostics and a smaller number of atheists, scientific ideas allowed them to question religious belief, but for the vast majority, Christianity remained important and relevant to their lives. Rainmaking also reveals divisions within society over the meaning of science. Local residents enthusiastically embraced the bombarding. In contrast, meteorologists decried them as unscientific and amateurish, thereby attempting to increase the legitimacy of their own profession by criticizing the amateurism of non-professionals. Aside from revealing such tensions in New Zealand society, rainmaking has wider relevance. As this

World (New Haven and London, 2000); John Delumeau, *History of Paradise: the Garden of Eden in Myth and Tradition* (translated by Matthew O'Connell, New York, 1995).

¹¹⁶ For a history of the development of ideas of a conflict between science and religion see John Hedley Brooke, *Science and Religion*, pp. 33-42; David C. Lindberg, Ronald L. Numbers, "Introduction", David C. Lindberg, Ronald L. Numbers (eds.), *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Los Angeles and Berkeley, 1986), pp. 1-18.

article shows, other people, such as those in England and Australia, undertook similar prayers and experiments, yet responded to them in very different ways. Investigating these differences reveals the importance of the special social and cultural characteristics of each country which, in New Zealand's case, was its greater religious tolerance and social opportunities.

Drought also encouraged changes to existing farming techniques, including the use of dry farming methods, tree planting, fertilizers and irrigation. In suggesting dry farming methods, some settlers rejected the dominant image of New Zealand as a fecund and well-watered land ideally suited to European agricultural practices, an important step in environmental learning that was thwarted because improved fertilizers allowed agricultural techniques to remain unchanged. Tree planting offered another alternative to improving the droughty North Otago interior by encouraging rainfall to the region. Ultimately, however, expectations of a productive, well-watered land outweighed considerations that North Otago's environment might be anything different.

Investigating reactions to individual weather phenomena thus can reveal much about the societies affected by these events: about their organization, the solutions they sought to combat the problem and, in turn, the prevailing environmental beliefs underpinning these. Religious writings and documents stand out as a rich, and so far underused, source of enquiry into New Zealand's environmental history. Sermons offer fascinating perspectives on clerical views on the relationship between humans, the natural environment and God. Settlers' diaries and newspapers, likewise, reveal the importance of religion in determining the range of attitudes and actions that encompass the study of environmental history. Sometimes religious ideas justified turning forest to farm, subduing the wilderness and making lands productive. At others, they vindicated the preservation of areas of the natural world and the creation gardens, even the way people treated animals and their choice of what plants and animals to acclimatize. Many missionaries were talented and enthusiastic landscape artists whose religious views influenced their perception of the landscape and the natural world. Even such simple documents as church leases can show how religious ideas were transplanted into legalistic and natural terms.¹¹⁷ As with the episodes surrounding the North Otago drought of 1906-7, studying particular environmental events adds color and complexity to historical assumptions about religion and rationalism, secularism and science, humanity and environment.

¹¹⁷ On the use of religious documents and their importance to New Zealand's environmental history, note Beattie and Stenhouse, "God and the Natural World"; Beattie, "W. L. Lindsay, Scottish Environmentalism."