Politics over Epistemology?

The reception of Robert Fitzroy's weather forecasts in Victorian Britain between 1860 and 1866

Elske de Waal
6626866

Master thesis History and Philosophy of Science
Supervisor: Dr. Lukas M. Verburgt
Second reader: Dr. David M. Baneke

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Foreword

This thesis has come about under strange circumstances. Having to change, or rather, improve a research question, or to alter the focus of the research, is of course natural to the process of (historical) research. Having to do so because of a world-wide pandemic, however, is not. By March this year (2020), I had drawn up a research proposal to investigate the use of weather maps by Robert Fitzroy and Francis Galton, in the early days of meteorology. I wanted to look at their epistemological assumptions, concerning these maps; what kind of knowledge was required for making them, and what did the makers expect to learn from their maps. To this end, I had planned to go to several archives in England. Two weeks before I was to go, however, the realisation that the Covid-19 pandemic had reached this part of the world set in, and traveling abroad to visit archives was no longer an option.

Because it was unclear when archives would open again, I decided to change my plans for my thesis. My original plan relied heavily on archival sources such as correspondence and (unpublished) weather maps, but working from home, I had to restrict my research to published, digitised source material. Staying with the topic of mid-nineteenth century meteorology and questions about the epistemological status of various methods within that field, I redirected my focus to Robert Fitzroy's weather forecasts (which had been my initial focus when starting this thesis project). Inspired by Ruth Barton's investigation into the language used by Victorians to distinguish between those who were considered part of the scientific community, and those who were not, I set out to analyse the public discussion of Fitzroy's weather forecasts. I wanted to find out what terms and arguments were used to in- or exclude the forecasts from scientific activity, but I discovered that the controversy over the forecasts as described in the existing literature, was not to be found in the sources I used. This lead to a new question: where is the controversy? This question then lead to this thesis.

The public nature of the sources has had consequences not only on the type of questions I have asked, but also on the scope of the answers I have been able to consider. Without reference to correspondence and other archival material, such as several reports, I have to limit my conclusions to what has been published. Therefore, I cannot

make claims about anyone's personal feelings or thoughts about either Fitzroy or his work. What I can do, and have done in this thesis, is to discuss the public discourse, and especially the changes in it. The public image of science and of those who work in science has always been very important, perhaps especially in mid-Victorian Britain. Focusing on the public discourse around Fitzroy's weather forecasts shows how the mid-Victorian scientific community navigated the complicated public debate about their scientific merit while also taking the social and political into consideration.

Introduction

The weather forecast as a phenomenon is surprisingly versatile. It is both a (seemingly) mundane part of every-day life, as well as a highly interesting object of inquiry for both historians and philosophers of science. Philosophical and social studies have investigated the role of uncertainty in modern weather prediction, and the epistemic nature of the knowledge used and produced in weather forecasting.[1] Most historical studies of weather forecasting have focused on the twentieth century, studying the revolutionary discovery by Vilhelm Bjerkness of 'fronts', or the influence and use of computers on the practice of forecasting.[2]

The first national weather services, however, were set up in the nineteenth century. From the end of the 1850s, systems of storm warnings and, a little later, forecasts, were initiated in several countries. Depending on the definition of 'forecast' one uses, several countries can be said to have been the first at attempting the feat.[3] The first to issue an 'official' general forecast of the weather was Robert Fitzroy, then the head of the Meteorological Department of the Board of Trade.[4] He issued a four-sentence statement about the probable general weather conditions for the following two days, along

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[1] Phaedra Daipha, *Masters of Uncertainty: Weather Forecasters and the Quest for Ground Truth* (Chicago: The University of Chicago Press, 2015); Charles A. Doswell, 'Weather Forecasting by Humans—Heuristics and Decision Making', *Weather and Forecasting*, *19,* 6 (2004): 1115-6, https://doi.org/10.1175/WAF-821.1; Gary Alan Fine, *Authors of the Storm: Meteorologists and the Culture of Prediction* (Chicago, Ill.: Univ. of Chicago Press, 2010).

[2] Robert Marc Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology* (Cornell University Press, 1993); Kristine C. Harper, *Weather by the Numbers: The Genesis of Modern Meteorology* (Cambridge, MA: MIT Press, 2012).

[3] In France and in the United States, warnings of existing storms were communicated through the telegraphic network in the mid-1850s. The Dutch meteorologist Christoforus Buys Ballot was, similar to Robert Fitzroy, more optimistic, and proposed in 1857 to communicate predictive warnings. Fitzroy, then, was the first, in 1861, to make a general forecast beyond the extremes of stroms. See Azadeh Achbari, *Rulers of the Winds: How Academics Came to Dominate the Science of the Weather, 1830-1870*, PhD diss. (Vrije Universiteit Amsterdam, 2017).

[4] Fitzroy is also written FitzRoy or Fitz Roy. All ways of writing occur in historical sources as well as secondary literature. In this thesis, I will use 'Fitzroy', except in quotes if the original used a different form.

with the usual report of meteorological observations printed daily in the *Times* and several other newspapers on 1 August 1861.

I deliberately use the word 'official', as the practice of foretelling the weather is probably as old as humans have depended on weather conditions. One only needs to refer to proverbs such as 'Red sky at night, Sailor's delight; Red sky in morning, Sailor's warning' and 'clear moon, frost soon', to know that people have been trying to predict the weather for ages. For a very long time, weather prediction, especially long-term, was the specialty of astrologers.

In the eighteenth and nineteenth centuries almanacs which included statements on the coming weather were widely popular. Astro-meteorology, the study of the influence of celestial bodies on the weather had become very popular with a wide audience through these almanacs. Therefore, when Fitzroy began his project of weather forecasting he had to distinguish his project from those of the 'weather prophets.[5] The historian of science Katharine Anderson has studied how meteorology, and specifically 'scientific' weather forecasting, developed in Britain in the second half of the nineteenth century.[6] Anderson focuses on the making of a science of meteorology, in contrast to, and in competition with, popular and astrological beliefs.

In this context, she argues that Fitzroy's forecasts, as weather predictions in general, were not welcomed by the scientific community. Weather prediction had too much connotation with astrology, and the predictions were not nearly as precise or successful as those of astronomy, the perhaps most reputable of the sciences. This narrative, of Fitzroy's forecasts being controversial, and not accepted by the scientific community, is the somewhat 'standard' narrative of Fitzroy's work. He is seen, by historians, sometimes as a tragic, misunderstood visionary, sometimes as a very skilful navigator and hydrographer, but overreaching when it came to the forecasts (and often he is mostly

[5] Katharine Anderson, 'The Weather Prophets: Science and Reputation in Victorian Meteorology', *History of Science*, *37*, no. 2 (1999): 179–216, https://doi.org/10.1177/007327539903700203.
[6] Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: Univ. of Chicago Press, 2005).

remembered for his role as 'Darwin's Captain').[7] What these narratives all have in common is the controversial status of his weather forecasts within the scientific community.

To corroborate that narrative, sources from after Fitzroy's death in 1865 are often quoted, most significantly the report resulting from an investigation of his work: the Galton Report. This report was very critical of Fitzroy's work, and concluded the forecasts lacked a scientific basis. On the basis of this report, the forecasts were discontinued in Britain for over a decade. The reception of the forecasts *before* Fitzroy's death, however, has not been studied systematically. In this thesis, I will show that the reception of Fitzroy's forecasts was more nuanced than has previously been described.

In this introduction I will provide a short overview of the history of meteorology up to the mid-nineteenth century; then I will describe how the Meteorological Department was established, and what its goals were; after that, I will discuss the public nature of both meteorology and the Meteorological Department; and finally I will offer a short biographical sketch of Fitzroy's life, before giving an overview of the chapters of this thesis.

History of meteorology

Meteorology, understood as the systematic study of the atmosphere, the causes of weather phenomena, and behaviour of weather systems, is a relatively young science. Before (roughly) 1800 the word 'meteorology' denoted the type of study Aristotle described in his *Meteorologica*. This classical meteorology pertained to the study of various kinds of rare phenomena, from earthquakes to meteors.[8] Only after 1800 did men of science focus their attention on the weather as object of systematic investigation. The 'general public', however, has been paying attention to the weather for centuries, as

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[7] John Gribbin and Mary Gribbin, *FitzRoy: The Remarkable Story of Darwin's Captain and the Invention of the Weather Forecast* (New Haven: Yale University Press, 2004); Patrick Hughes, 'Fitz-Roy the Forecaster: Prophet without Honor', *Weatherwise*, *41*, no. 4 (1988): 200–204, https://doi.org/10.1080/00431672.1988.9925262; H. E. L Mellersh, *FitzRoy of the Beagle* (New York: Mason & Lipscomb Pub., 1968); Peter Nicholas, *Evolution's Captain: The Story of the Kidnapping That Led to Charles Darwin's Voyage Aboard the 'Beagle'* (London: HarperCollins, 2008).

[8] Vladimir Jankovic, 'The End of Classical Meteorology, c.1800', in *The History of Meteoritics and Key Meteorite Collections: Fireballs, Falls and Finds*, (eds.) G.J.H. McCall, A.J. Bowden, and R.J. Howarth, vol. 256 (Geological Society, London, Special Publications, 2006), 91–99, http://sp.lyellcollection.org/lookup/doi/10.1144/GSL.SP.2006.256.01.04.

evidenced by the plethora of proverbs pertaining to, for instance, the colour of the sky and the related chances of rain the following day. Many people in most (or all) cultures and places had a vested interest in knowing the future stat of the weather, be it farmers who wanted to improve their crop returns, or sailors looking to enhance their chances of survival on the stormy seas. It is no wonder, therefore, that many took the opportunity to make a profit from the desire to know the future. Almanacs, in the eighteenth and nineteenth centuries often included predictions for the weather of the next weeks, months, or even years.

The systematic study of the weather and climate gained traction at the end of the 18th century, but was institutionalised in societies and national institutes over the course of the nineteenth century.[9] Earlier attempts had been made to collect weather measurements on a national, even trans-national scale.[10] The science of meteorology really started to gain track in the first half of the nineteenth century, with the systematic studies of wind patterns at sea. It was included in 'marine studies', or, in the Humboldtian sciences. Ships kept logs of several types of weather data, and in the 1810s and 1820s the first weather maps were developed.[11]

In the mid-nineteenth century, the discipline of meteorology was in rapid development. The electric telegraph enabled communication of the weather over great distances almost instantaneously. Furthermore, in the 'age of empire' seafaring nations attached great importance to any improvement of naval navigation. The historian Azadeh Achbari has illustrated how the institutionalization of meteorology first provided a

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[9] The distinction between climate and weather is a late-nineteenth century development. In the rest of my thesis, I will refer to meteorology as the study of weather and atmosphere, as those terms were mostly used by the sources I have studied. For a discussion of the history of the distinction between climate and weather, see Deborah R. Coen, *Climate in Motion: Science, Empire, and the Problem of Scale* (Chicago: The University of Chicago Press, 2018), 5–7.

[10] Keeping weather diaries became very popular in eighteenth century Britain. For a discussion of eighteenth century ideas about weather and climate in Britain, see Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: The University of Chicago Press, 2007); In the late-eighteenth century, a network of international meteorological observers was set up, but it had broken up by the turn of the century. See David C. Cassidy, 'Meterology in Mannheim: The Palatine Meterological Society, 1780-1795', *Sudhoffs Archiv*, *69*, no. 1 (1985): 8–25.

[11] Mark S. Monmonier, *Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather* (Chicago London: Univ. of Chicago Press, 1999), 24–26.

context for cooperation between men of science and naval officers, but later turned into grounds for conflict between these two groups. Achbari has argued that the collaboration provided the men of science with public legitimacy in their goal to establish official institutes. By working together with naval officers, they were able to emphasise the practical benefits of (marine) meteorology and other marine sciences. For the naval officers, Achbari claims, it was a chance 'to obtain scientific credentials and thereby advance socially'.[12] Moreover, the two groups had shared goals of establishing a science of meteorology, and agreed that international cooperation, and thus national funding, was necessary to this end. Once the institutions were established, however, their goals diverted, when the naval officers aimed for a practical focus at the institutes, while men of science saw 'higher', more theoretical goals. Achbari describes how the men of science 'won' the conflict, establishing hierarchies of 'theoretical' over 'practical', and 'genuinely scientific work' over the 'pursuit of utility'.[13] Achbari focuses in large part on the Dutch case, but argues that a similar situation took place in other countries, such as Britain.

The institutionalization of meteorology in western Europe and North America took shape, in most cases, in the third quarter of the nineteenth century. Many national institutions were the result of a conference held in 1853. This conference was initiated by the US lieutenant Matthew Fontaine Maury, who was the head of the United States Depot of Charts and Instruments.[14] In that position, he had begun a project of mapping the winds on the oceans, by gathering ships' logs and collecting their observations. International cooperation was needed, however, and Maury approached the British government and they came to a decision to hold the first International Maritime Conference. The attendees of this conference were all naval officers, except for two; the Belgian statistician Adolphe Quetelet, who presided over the meeting, and Henry James, from the British Royal Engineers.[15] The aim of the conference was to establish international agreement on meteorological observations aboard ships. They agreed upon a standard form

[12] Azadeh Achbari, 'Building Networks for Science: Conflict and Cooperation in Nineteenth-Century Global Marine Studies', *Isis, 106*, no. 2 (2015): 257-282, https://doi.org/10.1086/682020, 259.

[13] Ibid., 280.

[14] Achbari, *Rulers of the Winds*, 53–57.

[15] Ibid, 57.

to be issued to ships for the purpose of collecting weather data. Another outcome of this conference was the agreement that national meteorological institutes needed to be set up, to gather the data and to communicate internationally. Following the conference, national institutes were indeed set up in several countries in North-Western Europe. In 1854 both the Dutch (KNMI) and the British meteorological institutes were founded. In Britain, this institute was advocated for by the two attendees of the Brussels conference.

The establishment of the Meteorological Department

In 1854, following the Brussels conference, the British government established the Meteorological Department of the Board of Trade. The government had not been very enthusiastic about participating in the conference, but after a lobby by astronomer Lord John Wrottesley and sir Robert Inglis, two delegates were sent to Brussels with the explicit orders to not commit to any expenditure.[16] The conference was considered a success. Agreements were made related to uniform marine logs for meteorological measurements, and the intention to set up national institutes for the (international) coordination of meteorological measurements was expressed by everyone present.[17] The British government, delayed a few months because of the distraction of the Crimean War, voted on the establishment of the Meteorological Department. According to the historian Jim Burton, it was intended to institute the department within the Navy, but for reasons unclear it ended up under the Board of Trade's Marine Department.[18] The funding for the department came partly from the Board of Trade, and partly from the Admiralty.[19] The Board of Trade initially proposed a staff of seven for the department, but only four started it 1855. Fitzroy as head, and three clerks: senior clerk William Pattrickson, and junior clerks Thomas Henry Babington and F.R. Townsend.[20] The department was housed in a rather small premise at no. 2 Parliament street, and in 1862 the department expanded

[16] Jim Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', *The British Journal for the History of Science* 19, no. 2 (1986): 151.

[17] Achbari, *Rulers of the Winds*, 59.

[18] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 151.

[19] For an overview of the finances of the Meteorological Department between 1855 and 1866 see 'Table 1' in Ibid., 156.

[20] Ibid., 153.

into the adjoining building, no. 1 Parliament Street, in order to house the grown staff and the growing volume of records.[21]

The department did not have a clear, official assignment when it was set up. The Board of Trade had asked the Royal Society for their opinion on the 'great desiderata for meteorological science'.[22] The reply, written by Colonel Sabine, was sent in February 1855, when the department had been going for half a year. At later times, this letter was said to have been the 'directive' of the department, but it was never explicitly communicated as such.[23] The Royal Society's letter discerned several 'branches' of meteorology, which they divided their answer into: research pertaining to the 'Barometer', 'Dry Air and Aqueous Vapour', 'Temperature of the Air', 'Temperature of the Sea, and Investigations regarding Currents', 'Storms or Gales', 'Thunderstorms', 'Auroras and Falling Stars', and 'charts of the Magnetic Variation'. Of these sections, the first four were the longest.

In the letter, the Royal Society expressed a need for the collection of meteorological data, especially at sea. They saw a role for the Meteorological Department in the coordination of this collection, as well as the coordination of the standardization of the measurements, by ensuring that all ships use the same tables, and verified instruments. On 'Storms and Gales', the society just commented that it was important that captains were able to distinguish between a cyclonic storm or gale, and an 'ordinary' storm.[24] Not because that could inform their navigation through the storm, but because the facts filled out on the forms should be correct.

The society referred to both 'navigation' and 'general science' as the benefactors of the work they indicated for the Meteorological Department.[25] This speaks to the fact that the department had a kind of dual role, or function, from its beginning. From the scientific community, there was a desire to use the department for the development of meteorological science. They saw opportunities in a centralised, governmental institution for the collection of meteorological measurements. They also acknowledged, or

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[21] Jim Burton, *The History of the British Meteorological Office to 1905*, PhD diss. (The Open University, 1989), 46.

[22] 'Reply of the President and Council of the Royal Society to a Letter from the Board of Trade, dated January 15, 1854'. Reprinted as Appendix D in Fitzroy, *Weather Book, 932*.

[23] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 154.

[24] Fitzroy, *Weather Book*, 407.

[25] For instance, ibid., 396.

thought, that a governmental institution needed to be of practical value as well. Although this focus on practical, navigational purposes of the department may be 'for show', speaking to what the Royal Society thought the government would want to spend money on, this indicates that the scientific community, or at least the Royal Society, viewed the role of the department as somewhat ambivalent. Furthermore, they saw the function of the department mainly as collecting facts, not necessarily as producing theories from those facts.

Although the letter of the Royal Society came only half a year after the establishment of the department, the fact that it was in later years referred back to as the, perhaps, unofficial charter of the department, shows that the government was aware of the scientific character of their new department. Although this department was very small, with only four employees to begin with, its establishment speaks to a wider trend in this period. As Burton notes, it 'was evidence of a realization by government that the involvement of public money was necessary for undertakings that were, for one reason or another, unsuitable for development by private capital'. [26]

Public science in the Victorian era

Anderson has convincingly argued that the public nature of the Meteorological Department was an important factor in discussions about forecasts and meteorology. When the department was instituted, it was (one of the) first departments within the government that had not only a utilitarian objective, but also a scientific one. Because of this, Anderson argues, 'Fitzroy had the task of fostering collective science in a department that was relentlessly and often uncomfortably in the glare of politics and public life'. [27]

In the second half of the nineteenth century there were efforts to persuade the government to (structurally) finance science. There was little to no agreement, it seems, among the different groups in favour of this, except for that fact that they were in favour. The traditional centres of academia, such as Oxbridge and the Royal Society, argued for money given directly to these institutes, leaving them to figure out how to spend it. Their arguments revolved around the idea that science, or rather academia, did not produce

[26] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 153.

[27] Anderson, *Predicting the Weather*, 105

directly applicable knowledge, or products, therefore was not industrially viable, but worthy of funding because of the general lifting of society. They argued that science was 'pure'. On the other hand, there were those that argued the (seemingly) exact opposite; science had practical benefit for society and should therefore be funded by the state. This argument was heard mostly from those that wanted to reform British academia and to take the power away from the traditional institutions.[28] Even more confusingly, me of science often varied between arguments, depending on the audience they were addressing.[29] The Victorian Naturalist John Tyndall, for instance, used different ideas and ideologies about science when drawing the boundaries between science and religion or mechanics, respectively.[30] Thus, depending on what ideology a person of science adhered to, and on what kind of audience they were speaking to, 'practical' could be a very enthusiastic endorsement of a scientific idea/concept/theory in question, or a grave accusation.

Within this context, and with the collective goal of structurally funded science, publicly discussing the product coming from the first scientific governmental body was complicated. Looking solely at public discussions may distort the image of the 'real' perception of Fitzroy's forecasts, of course. Without personal, private communications, it is impossible to tell what someone like John Herschel or Edward Sabine really thought about them. For this thesis, therefore, I am expressly focussing on the *public* reception of the project. This can, I'll argue, show a light both on the efforts of the scientific community to draw boundaries (or consciously *not* draw them) for science, and the difficulty

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[28] Roy M. Macleod, 'The Support of Victorian Science: The Endowment of Research Movement in Great Britain, 1868-1900', *Minerva*, *9*, no. 2 (1971): 197–230, https://doi.org/10.1007/BF01553156.

[29] The denomination of those who participated in scientific activities in Victorian Britain is somewhat complicated. The term 'men of science' was most often used by people at the time, but it denies the reality that there were not just men involved in scientific work. The term 'scientist' would be more inclusive, but it is anachronistic. Although the word had been coined by William Whewell in 1834, it was barely used by Victorians. In this thesis, I will mostly use 'men of science' to refer to those involved in the public discussions about the nature of science and the merit of weather forecasts. Occasionally I will use the word 'scientist' to refer to someone involved in science generally, to avoid gendered connotations.

[30] Thomas F. Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists', *American Sociological Review* 48, no. 6 (1983): 781–95, https://doi.org/10.2307/2095325.

they faced confronted with someone claiming scientific authority in such a public way, and nuance the historical narrative about the acceptance of Fitzroy and his forecasts.

Robert Fitzroy (1805-1865)

Robert Fitzroy was born on 5 July 1805, to Lord Charles Fitzroy (1764-1829) and Lady Frances Anne Stewart (d. 1810). He was a direct descendant of King Charles II, and, according to his biographer H.E.L. Mellersh 'a conscious aristocrat'.[31] Fitzroy attended the Royal Naval College in Portsmouth in 1818 aged twelve.[32] Here he excelled, winning the first mathematical prize at the college, and in his lieutenant's exam he ranked first out of twenty-seven. Having been promoted to the rank of lieutenant in 1824 he gained employment on a ship in South America, and was appointed commander of the *Beagle* in 1828, after its former commander had committed suicide.[33]

After two expeditions with the *Beagle*, the second of which not only provided Darwin with the opportunity to study the natural history of South America, but also established Fitzroy's capabilities as a hydrographer, he earned the Royal Geological Society's Gold Medal.[34] Upon returning home, Fitzroy married Maria Henrietta O'Brien (1812-1852) in 1836. After writing his experiences on the *Beagle* down in his *Narrative of the Beagle Voyage*, Fitzroy became a member of Parliament for the county of Durham, for the Tories in 1841. After a little over two years, Fitzroy again switched occupations, as he was offered the position of governor of New Zealand. He did not endure very long in this position, however, as the country was disrupted by disputes between the natives and the Victorian colonists. When called upon to settle disputes, Fitzroy often decided in favour of the natives, angering the colonists.[35]

Fitzroy was called back to Britain after two years, in 1845. He returned to the Navy and oversaw the outfitting of a new ship, the steam-powered *Arrogant*. In 1850 Fitzroy retired from active service. For a short period he served as the personal secretary to his

[31] Mellersh, *FitzRoy of the Beagle*, 17.

[32] Ibid., 20.

[33] Ibid., 29.

[34] Ibid., 172.

[35] Anderson, *Predicting the Weather*, 106.

uncle, Lord Hardinge, and when he was called on by the Royal Society to become the head of the new Meteorological Department of the Board of Trade, he gladly accepted.[36]

Fitzroy set out to work at the department with the same zeal that characterised his naval expeditions. He was often referred to as 'zealous' by his peers, with differing connotations.[37] This enthusiasm for his work sometimes turned into overworking himself. His mental health started to deteriorate, and he took more and more breaks retreating to a house outside the city, to recover just enough to throw himself into his work again. By 1865 Fitzroy could no longer bear it, and he committed suicide on 30 April 1865. Fitzroy's suicide has been a source of speculation to his contemporaries as well as historians. Often, the criticism of his forecasts has been pointed to as the reason for his suicide. Other sources imply that he could not bear the role he, a devout Christian, had played such an important role in the development of the theory of evolution.[38] As Burton notes, however, these theories seem 'too simple an explanation, and it is more realistic to regard the motives for [Fitzroy's] action as complex and multi-causal'.[39]

Structure of this thesis

In this thesis, I will study Fitzroy's forecasts and their reception, first, by looking into Fitzroy's personal authority in the 'scientific community' and how he added to the collective attempt to define such a community. I will illustrate how Fitzroy's role as the head of a governmental body influenced the way in which both he, as a person, and his work were received. As I have already mentioned, the public status of the department combined with its (partly) scientific purpose, made the department an area of focus of attention, but also, as I will argue, seems to have muted the public criticism of it from the scientific community. I will illustrate this in chapter two, where I trace the reception of the forecasts from their first beginnings to end, after the report on them had judged them unscientific. In the third and final chapter, I will take a closer look at the report, and at its main

[36] Mellersh, *FitzRoy of the Beagle*, 260–62.

[37] E.g. Francis Galton (anonymously), '*The Weather Book: A Manual of Practical Meteorology.* By Rear-Admiral Fitzroy', *Athenaeum*, no. 1838 (1863): 80–81, 80.

[38] Jim Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', *The British Journal for the History of Science*, *19*, no. 2 (1986): 147-176, 168.

[39] Ibid., 169.

author, Francis Galton. Here, I will argue that the report was largely a reflection of Galton's personal opinion of Fitzroy and his forecasts.

By doing so, I will argue that the narrative of the great controversy over the first forecasts ought to be nuanced. It appears that, at least in public, men of science tentatively accepted Fitzroy's 'experiment', as some, including Fitzroy himself, called it. I show that Fitzroy was perhaps not a fringe figure in the scientific community in the 1850s and 1860s, but his Meteorological Department was unique. Its special status as a governmental body with a dual purpose, for both developing practical applications and supporting theoretical science, did indeed place it at the centre of attention for the British public. The attention from the public, as well as governmental involvement, made men of science cautious in their judgments of the work of the Meteorological Department. This, however, means that the later unequivocal criticism of Fitzroy's forecasts, including the narrative of the strong controversy, needs an explanation. Here, I argue that the Galton Report was not only successful in achieving the discontinuing of the forecasts, but it also gave men of science, who may have been apprehensive about the forecasts in private, a legitimate way to criticise them. So, taken together, this thesis shows how the political and social context of Britain in the 1860s influenced the discourse about and judgments of Fitzroy's weather forecasts.

1. Fitzroy and the Victorian Scientific Community

The Victorian era is characterised, in the history of science (and more broadly construed as well), by reform and change. The cultural authority held by the clergy and 'gentlemen of science' at the beginning of the century was challenged by those who believed in a higher authority of the laws of nature. The older centres of scientific power, such as the universities of Cambridge and Oxford were closely aligned with the Anglican Church and the pursuit of science was (mostly) restricted to the wealthy gentlemen elite. Science was considered a 'vocation' and was seen as the prerogative of the wealthy gentleman 'amateur', as there were very few paid positions in science. This changed over the course of the nineteenth century. New classes of men (and some women) started to redefine what it meant to be a 'man of science'.

This shift was accompanied by questions about the value of science, for whom it should, or could, be meaningful, and why. The historian Frank Turner argues that the values of science changed over the Victorian era. In the first half of the century science shifted from a vocation to a private enterprise, according to Turner. Then from about 1850 to 1870 science became seen as constitutive to the progress of civilization. It was linked to values such as self-improvement and peace. After 1870 to the early twentieth century, this association with civilization, and emphasis on the individual shifted to an emphasis on the practical values of science and science became related to the state. Accordingly, science was praised and promoted in terms of values such as collectivism and nationalism.[40] This transition of science from private enterprise to practical collective pursuit is also described by Richard Yeo, in his book on the life and work of William Whewell (1794-1866), an English polymath who was very influential in the early-Victorian debates about science. Yeo, however, argues that it was indeed a shift away from values as such. According to him, the relation of science to the state meant that science became free from individual judgment, and thereby free from value judgments.[41] The

[40] Frank M Turner, 'Public Science in Britain, 1880-1919', *Isis*, *71*, no. 259 (1980):589-608, 591–92.

[41] Richard Yeo, *Defining Science: William Whewell, Natural Knowledge and Public Debate in Early Victorian Britain* (Cambridge: Cambridge University Press, 1993), https://doi.org/10.1017/CBO9780511521515, 4.

question of the goal of science was no longer something individuals could or should debate, but rather something that was cultivated by the (government-reformed) universities.

The historian Roy MacLeod has also noted this shift in the place of science in society. He has described it in the context of the search for financial means. In the second half of the nineteenth century, the *endowment of research movement* (connected with the naturalists of the X-club) actively sought funding in the public context. In light of this goal, the movement argued for a revaluation in the way fundamental research was viewed by the government and universities.[42] This movement was not just concerned with honour and recognition, but for a change in how research was valued in society. MacLeod describes a change from privately funded science, where research was done as a 'hobby', to science as a profession, where professors and researchers could earn a living off their work. Moreover, in this context the shift away from the authority of the Oxbridge dons was important. The movement actively sought the recognition of the authority of science, as independent of religion.[43]

This 'traditional story' is limited mostly to the opposition between two groups; the Oxbridge clergymen and the new, London-based, middle-class 'professional' men of science. It has been nuanced more recently. The historians Ruth Barton and John Waller, among others, have shown that the divides were not so strict, that there were 'gentlemen' of science who joined the new class of professional men of science in the 1850s and 1860s. Waller has shown, for instance, that Francis Galton, who was, by background, a 'gentleman of science', saw an opportunity to gain cultural and scientific status by aligning himself with the rising elite: the famous X-Club.[44] Barton has shown that the distinction between 'professional' and 'amateur' does not reflect the reality of the members of this club. The club existed mostly of men who were trying to make a name for themselves and seeking a paid position in science to do so, but there were still also the

[42] MacLeod, 'The Support of Victorian Science', 230.

[43] The relation between science and religion in the Victorian era is another very important aspect of the status of science, but in this context of less importance.

[44] John C. Waller, 'Gentlemanly Men of Science: Sir Francis Galton and the Professionalization of the British Life-Sciences', *Journal of the History of Biology*, *34* (2001): 83–114.

traditional, 'amateur' gentlemen of science.[45] Moreover, Barton has shown that the terms 'amateur' and 'professional' do not quite reflect the categories of in- or exclusion for the scientific community of the late-nineteenth century.[46] By studying sources like the Presidential Addresses for the British Association for the Advancement of Science (BAAS) and Royal Society, correspondence of members of the X-Club and popular science literature, she has argued that 'amateur' and 'professional' were not the terms used by contemporaries to distinguish those who belonged in science and those who did not. The terms which were in use, differed in different contexts, with 'man of science' being the most frequently used.[47]

In the 1850s and 1860s, both what science was, and how it should be pursued was disputed. In this chapter, I first discuss how Fitzroy came to be an actor in the debate about the definition of a man of science. I show that while he identified as a 'practical man', he did actively seek to establish himself within the scientific community. To this end I show that his hydrographical work as a Captain in the British Navy both illustrates and informed his ideas about what scientific work was, or should be. Then, I discuss what Fitzroy considered to be epistemic virtues and vices, by showing what qualities he emphasised in himself, and what kind of behaviours he criticised in others. After this, I describe how others, who were part of this diffuse 'scientific community', judged Fitzroy's attempt at a definition of a man of science. Finally I will argue that this judgement of Fitzroy were influenced by the institutional context of the Meteorological Department. In this chapter my focus is on the person Fitzroy, and his place in Victorian science. In the next chapters, I will go into more detail about his work at the Meteorological Department.

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[45] Ruth Barton, ''Huxley, Lubbock, and Half a Dozen Others': Professionals and Gentlemen in the Formation of the X Club, 1851-1864', *Isis*, *89*, no. 3 (1998): 410–44, https://doi.org/10.1086/384072.

[46] Ruth Barton, ''Men of Science': Language, Identity and Professionalization in the Mid-Victorian Scientific Community', *History of Science*, *41*, no. 1 (2003): 73–119, https://doi.org/10.1177/007327530304100103.

[47] Ibid., 80.

From Captain to Meteorological Statist

Fitzroy did not receive an academic education, but was educated in the Royal Navy. When he joined the navy in 1818, there was a time of relative peace in Britain, with the Napoleonic Wars having come to an end in 1815. During this peaceful time, the expeditions of the Admiralty gained a stronger focus on surveying work. The historian David Miller argues that in this way, the naval officers played an important role in the development of the physical sciences in the first half of the nineteenth century.[48] The kind of scientific work done on the expeditions changed during this period. More importance was given to measuring physical variables, such as the earth's magnetic field, and its gravity.[49] According to Miller, the scientific servicemen were 'much more at ease' with these types of investigation, and 'assumed an increasing share of the scientific work rather than relying upon accompanying civilians'.[50]

In the navy, Fitzroy quickly rose up through the ranks and was given the command over the *HMS Beagle* in 1828, after its previous captain, Captain Pringle Stokes, had committed suicide. The ship was then part of a surveying mission along the South American coast, together with the *Adventure*, under the command of Philip Parker King. Fitzroy was an avid hydrographer, and for his work during the second expedition on the *Beagle*, the one on which he took Darwin as his 'gentleman companion', he earned the Royal Geographical Society's Gold Medal.

Fitzroy attached a lot of value to his surveying work. On that same voyage that earned him the Gold Medal, he found that the funds allotted by the Admiralty were insufficient for the exact measurements he wanted, and thus he invested a great sum of his own money.[51] He employed another ship, and supplied the expedition with more instruments, paying for them out of his own pocket. As a result, he produced 'eighty-two coastal sheets, eighty plans of harbours, and forty views covering the southern portions of the continent'.[52] Part of the *Beagle's* 1831 expedition also included the establishment

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[48] David Philip Miller, 'The Revival of the Physical Sciences in Britain, 1815-1840', *Osiris*, *2* (1986): 107–34, https://doi.org/10.1086/368654.

[49] Ibid., 113.

[50] Ibid.

[51] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 168.

[52]George Basalla, 'The Voyage Of The *Beagle* Without Darwin', *The Mariner's Mirror* 49, no. 1 (1963): 42-48, https://doi.org/10.1080/00253359.1963.10657714, 44.

of a series of meridian distances covering the oceans. Fitzroy had increased the number of chronometers, at his own expense, to twenty-two. The result of this endeavour again showed Fitzroy's capabilities and high standards, because over the period of five years, the measurements were only 33 seconds off of twenty-four hours. As Anderson states, this second voyage of the *Beagle* 'confirmed [Fitzroy's] own high standing as a hydrographer and announced him as one of the navy's most eminent scientific sailors'.[53] It is clear that Fitzroy held himself, and his staff, to high standards of accuracy in his hydrographical and navigational work.. Moreover, he employed these high standards for the purpose of producing valuable, practical material. In order to reach these results, no means were spared, as evidenced by the great sum of money he personally put into the expedition, with the aim to be able to measure as accurately as possible.

Given his training, it is not entirely clear where Fitzroy's high standards for his (scientific) work came from. For his ideas about scientific measurement one source of inspiration has probably been Francis Beaufort. In 1831, in preparation for the second *Beagle* expedition, Fitzroy received instructions from Beaufort on how to go about recording meteorological measurements. In 1829 Beaufort had been appointed Admiralty Hydrographer of the Navy, and from 1831 he headed the scientific branch of the Admiralty Board.[54] Historical geographer Simon Naylor has illustrated how the British navy was favourable to scientific work on their expeditions, but that the execution of this work on board the ships was not straightforward. Although naval officers received an education on subjects such as mathematics and astronomy, and used precision instruments for navigation, the use of such instruments for 'scientifically useful' observations was quite different. As the Admiralty Hydrographer Beaufort put a lot of effort into standardising observation practices on board navy ships, and instructing naval officers on the correct use of barometers and thermometers at sea.[55] According to Naylor, 'Beaufort ordered Fitzroy to keep a 'steadily and accurately kept' meteorological register',

[53] Anderson, *Predicting the Weather*, 105–6.

[54] Simon Naylor, 'Weather Instruments All at Sea: Meteorology and the Royal Navy in the Nineteenth Century', in *Geography, Technology and Instruments of Exploration*, Fraser MacDonald, and Charles W.J. Withers (Eds), Studies in Historical Geography (Surrey, UK England ; Burlington, VT: Ashgate, 2015): 77-96, 88.

[55] Ibid.

observing wind and weather conditions using Beaufort's own notations.[56] The register should include barometer and thermometer readings twice a day, along with the daily notation of the extremes of the self-registering thermometer. Lastly the surface temperature of the sea should be taken and compared to the temperature of the air.

Unfortunately there is no account of Fitzroy's ideas about these instructions, or whether he was able to meet them.[57] What is clear, is that Fitzroy developed a keen interest in meteorology, especially the use of barometers to help his navigation through stormy weather. In 1829, shortly after taking over the command of the *Beagle*, Fitzroy was caught in a storm. He later wrote that this was due to his inattention to the barometer on the ship, and that he should have seen the storm coming.[58] During his time in Parliament Fitzroy was a fervent advocate for more and better use of barometers to prevent shipwrecking. In 1843, in a statement for the 'committee on shipwrecks', Fitzroy emphasised the usefulness of barometers for the prevention of loss of ships due to stormy weather:

> '[I]f barometers were put in the charge of the coast guard at the principal stations round the coast […] they might be the means of preventing the great losses of life which take place every year owing to fishing vessels and boats going to sea when bad weather is impending; because no bad weather ever comes on our coasts without timely warning being given by the barometer'.[59]

When Fitzroy became the head of the Meteorological Department in 1854 his official title was 'Meteorological Statist', which reflected the emphasis on collection and coordination of measurements. His ambitions, however, were mainly informed by his practical experience, and his aims were to produce practical knowledge for the safer navigation of ships. In that way, Fitzroy promoted a practical view of science, as well as the view of

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[56] Naylor, 'Weather Instruments All at Sea', 89.

[57] One of Fitzroy's biographers, H.E.L. Mellersh noted that in 1968, Fitzroy's maps were still 'remembered as examples of their kind in the Royal Navy.' He does not, however, elaborate on what they were remembered for. Mellersh, *FitzRoy of the Beagle*, 172.

[58] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 158.

[59] 'First report from the select committee on shipwrecks', *Parliamentary Papers* 18 113, XI, pp. 19-311. Quoted in Burton, *The History of the British Meteorological Office to 1905*, 22.

a man of science in service of the general public. He promoted these ideas not only indirectly through his work at the department, but also directly in the popular press, in his reports of the work of the department, and in his *Weather Book* (1863). [60]

Fitzroy's ideals

In the previous section I have shown that Fitzroy's early career as a naval officer and hydrographer of renown earned him a place within the scientific community as a scientific sailor. His election into several academic societies, with the Royal Society in 1851 was certainly proof of the recognition of this status. His election into the Royal Society was supported by thirteen fellows, among them Beaufort and Darwin.[61] So when he participated in public debate, Fitzroy was certainly not an outsider. In this section I will discuss Fitzroy's self-image, that is, the way he presented himself to the scientific community and to the public. Part of his self-fashioning was done through criticising others. I will study Fitzroy's 'epistemic virtues', what characteristics he thought a man of science ought to have and how he should behave, through studying the ways in which Fitzroy criticised others, and described himself.[62]

Firstly, Fitzroy seemed very aware of hierarchical structures in science. He often referred to himself as a 'practical man' in deference to other 'true philosophers'.[63] He did not, however, shy away from discussing theories with these other 'true philosophers'. [64] Indeed, Fitzroy took part in discussions at the BAAS meetings, corresponded with men of science about theories of the atmosphere, and actively promoted his preferred theory, Dove's theory of polar currents. In 1860, for example, Fitzroy read a paper at the BAAS meeting, titled 'On British Storms'. Here, he claimed that theory had advanced in such a

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[60] Fitzroy, *Weather Book*.

[61] Mellersh, *FitzRoy of the Beagle*, 261.

[62] For more on epistemic virtues in the history of science, see Jeroen van Dongen and Herman Paul, eds., *Epistemic Virtues in the Sciences and the Humanities*, Boston Studies in the Philosophy and History of Science, volume 321 (Cham: Springer, 2017); Lorraine Daston and Peter Galison, *Objectivity* (New York, NY: Zone Books, 2010).

[63] Anonymous, 'Twenty-Fourth Meeting of the British Association for the Advancement of Science - Section A. - Mathematical and Physical Science', *Athenaeum*, no. 1408 (1854): 1270–71, 1271.

[64] Anderson, *Predicting the Weather*, 115.

way, that it was now possible to warn harbours of approaching (or developing) storms. He stated that it was 'recently proved' that most, if not all, storms on the British Isles were 'so much alike in character, and have been preceded by such similar warnings, as to warrant our reasoning inductively from the well-ascertained facts, and thence deducing laws'.[65] After describing several storms indicating their similarities, Fitzroy introduced Dove's theory of opposing currents. Fitzroy aligned himself with this theory, asserting that he 'can bear witness that his [Dove's] reasoning and particular views can be corroborated in every part of the world'.[66] Thus he used his practical experience as Captain to engage in the theoretical debate about the atmosphere.

As these and other examples suggest, in these theoretical debates Fitzroy continued to emphasise his practical experience and the practical value of his work. Fitzroy apparently had a different idea about what 'science' was than some of his peers. Many members of the scientific elite viewed practical skills and applicability of knowledge as subservient to theoretical, 'philosophical' knowledge. Fitzroy, however, not only appreciated the practical uses of knowledge, but also valued practical observers, workers with little theoretical knowledge who were nonetheless highly skilled. Anderson illustrates this with an episode where Fitzroy exchanged documents with his superior at the Hydrographic Office. In the documents, Fitzroy had replaced the adjectives 'simple', as in 'simple mariner', with 'practical'. According to Anderson this was 'a pointed refusal to denigrate the expertise of sailors in favor [*sic*.] of that of scientific men'.[67] It is clear that Fitzroy's idea of science was informed by his experience as a naval officer, and that it included the knowledge and skills that were gained through experience.

Fitzroy seemed to have been acutely aware of the hierarchical structures of the scientific community. In the same paper quoted above, Fitzroy also commented on lieutenant Maury's wind maps. He criticised Maury for philosophizing 'when he has no facts for philosophy', but he did emphasise that 'as a practical man he has been guided by

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[65] Robert Fitzroy, 'On British Storms, Illustrated with Large Diagrams and Charts'.', *Athenaeum*, no. 1706 (1860): 22–24, 22.It is unclear to me to what 'proof' Fitzroy referred here.

[66] Ibid., 23.

[67] Anderson, *Predicting the Weather*, 118.

plain principles, intelligible to seamen generally'.[68] In this manner he showed an understanding of certain rules that pertained to philosophizing, and perhaps thought that a 'practical man' such as himself or Maury, could never be a 'true philosophers'. In another article, in the *Athenaeum* of that same year, 1860, Fitzroy expanded on his theory of winds and the possibility of foretelling storms and even the general weather, he ended this highly theoretical argument by assuring his readers that he was but 'a superficial follower, however devoted an admirer of real philosophers'.[69] To illustrate that his work was based on stronger authority he quoted the philosopher 'whose lead it is always delightful to follow', namely Herschel, commenting on the possibility and utility of storm warnings[70].

Fitzroy greatly valued the practical applicability of science, and had an explicit 'inclusive' idea of science, according to Anderson. He appreciated the more practical work, as well as the practical value of theories. She gives an example where Fitzroy changed all the descriptions of 'simple', as in 'simple observer' or 'simple sailor', to 'practical'.[71] However, he did not think that he, as a practical man, had enough credibility of his own. Therefore, he actively aligned himself with more 'theoretical' men. He often inferred the names of higher authorities, such has Herschel, or the German meteorologist Dove. It is unclear whether the two men had been in contact, but Fitzroy was greatly influenced by Dove's theory of winds. Dove's *Law of Storms* had been translated into English in 1860, and Dove was a highly regarded meteorologist at this time.[72] In many of his writings Fitzroy referred to Dove's theory as the basis for his rules for weather forecasting.

In an article in the *Athenaeum* in 1860 Fitzroy commented on two public developments in meteorology that had given rise to 'various questions'.[73] These were first, a suggestion to alter the words on the displays of barometers, and second the daily weather reports. The article is made up of thirty numbered paragraphs, in which Fitzroy

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[68] Fitzroy, 'On British Storms, illustrated with large Diagrams and Charts'. *Athenaeum*, No. 1706 (July 1860), 22-24: 23.

[69] Robert Fitzroy, 'The Weather', *Athenaeum*, no. 1726 (1860b): 710.

[70] Ibid.

[71] Anderson, *Predicting the Weather*, 118.

[72] Ibid., 89

[73] Robert Fitzroy, 'The Weather', *Athenaeum*, no. 1725 (1860a): 671–72, 671.

explains the choice for certain words on the face of the barometers, and how the weather tables can be used to foretell the weather, which I will return to in the next chapter. The arguments and explanations are mostly very 'practical', but Fitzroy ended by defending the theoretical basis of it all, Dove's theory of polar and tropical currents. He explained the theory, very crudely, and defended it from possible critics. He remarked that, as the currents comprise a global system, there may be many *local* phenomena that seem to contradict the general rule. These were 'so exceptional, however, that they may truly be said to prove the *generality* of those great laws so necessary to be studied by seamen'.[74] Fitzroy repeatedly showed how his ideas were based on Dove's scientific theory, and defended this theory as concerning the 'great laws' of nature.

Fitzroy's habit of invoking the names of greater authorities than himself was not just a way for him to establish his own credibility. He was also of the opinion that due credit should be given to those whose theories and ideas are at the basis of one's own work. This was, of course, not unique to Fitzroy, but the amount of times he invoked the names of others can be said to have been somewhat idiosyncratic. In his *Weather Book*, for instance, there are very frequent references to the work of others. On one occasion, in a historical sketch of meteorology, Fitzroy names Arago, Herschel, and Dove as having built on Humboldt's efforts in the early nineteenth century, together with 'a galaxy of distinguished names' which 'occur to mind as having largely contributed to the meteorlogic [sic.] knowledge'.[75] Subsequently he lists 58 names in a footnote, in alphabetical order.

Fitzroy was also very critical of those that did not give (enough) credit to those on whose ideas their work was built. One person who was at the receiving end of this criticism was lieutenant Maury. Fitzroy had a somewhat ambiguous relationship with Maury. He often criticised his work, believing that Maury did not give due priority to other (British) men of science, and reprimanded him for being too speculative. On the other hand, Fitzroy did care about Maury. Fitzroy was 'obsessed with anxieties' for Maury and his family, when they were involved in the American Civil War.[76] The sometimes very strong criticism Maury received from Fitzroy was, therefore, probably not meant as a

[74] Robert Fitzroy, 'The Weather' (a), 672.

[75] Fitzroy, *Weather Book*, 48.

[76] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 168.

personal attack, but as a genuine concern about the way in which science should be practiced.

Fitzroy and Maury were in a very similar position. Both were naval officers by training, both were hydrographers, and both were now heading departments that were collecting meteorological data in order to improve naval navigation. Perhaps Fitzroy was extra critical of Maury because he felt that if Maury could be accused of not being 'scientific', then he himself might be likewise accused, if only by association. If one naval officer in such a position was not deemed scientific, then it would be more difficult for the other to prove that he was. So Fitzroy actively and openly pointed out when Maury did not behave according to Fitzroy's own standards. In 1861 Fitzroy wrote an anonymous review of Maury's *The Physical Geography of the Sea, and its Meteorology* in the *Athenaeum*. The review was not very positive. After some general niceties about the value of the work as educating naval officers and merchant men, and thereby expanding the observers network, Fitzroy found numerous faults with the work. One returning point of criticism is the lack of reference made. In a comment on the chapters on Climate and Commerce, Atmosphere, and Rains and Rivers, Fitzroy stated that he 'could wish that more frequent reference had been made to authorities whose ideas, if not words, strike the mind in reading these well-filled pages'.[77]

Especially painful for Fitzroy, probably, was that he was himself misquoted in the book. On facts about rainfall in Patagonia, Maury refers to 'King and Fitzroy' for numbers of nearly 150 inches of rainfall in a year. Fitzroy, however, stated that 'on referring to 'The Voyages of the Adventure and Beagle', we can find no such statement'.[78] By making this mistake, Maury had 'proportionally weakened the force of the arguments based on those supposed facts'.[79] It is clear that Fitzroy attached great importance to the referencing of those whose ideas and facts were used, or on whose theories a work was based.

Fitzroy also made the comment that eminent men of science and great philosophers were not given their due. This concerned especially his fellow countrymen. One of these was John Hadley. Maury had apparently not given enough credit to the ideas of

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[77] Robert Fitzroy, ' *The Physical Geography of the Sea, and Its Meteorology* by M.F. Maury', *Athenaeum*, no. 1732 (1861): 14–17, 16.

[78] Ibid.

[79] Ibid.

Hadley. According to Fitzroy, it was Hadley to whom 'we owe the first theory of the trade winds, which has stood the test of time'.[80] One person who did pay homage to Hadley was Heinrich Dove, 'in whose last admirable work (translated into English) Hadley has his legitimate place'.[81] In this way Fitzroy both criticised Maury for not writing along the lines of proper science, and also placed himself in line with Dove and his work. In commenting on the lack of credit for Hadley, Fitzroy, as a kind of side-line, mentioned that he was the inventor of the first reflecting instrument for naval navigation, the octant. This is illustrative of a broader transatlantic rivalry Fitzroy felt towards Maury. Hadley had been superseded by an American Thomas Godfrey, who had invented the same instrument two years earlier. Fitzroy's concern with British priority in the area of studies of the ocean, winds, and atmosphere was evident in another case as well. Duncan Agnew has shown how this concern has probably led to the 'myth' that the English William Marsden invented the 'Marsden square', the grouping together in squares of ten degrees longitude and latitude of observations at sea.[82] Fitzroy was of the opinion that Maury had, at least, been inspired by earlier British work in the way that he grouped together the measurements in his work, without giving this work due credit. Fitzroy thereupon overemphasised the work of these Brits, among them Marsden, in an effort to establish British priority.

A last criticism that Fitzroy raised against Maury's work was that it was too speculative at times. Maury's ideas 'about the effects of polar condensation of vapour and liberation of latent heat', said Fitzroy, 'are very curious, and would be intensely interesting, had we only sufficient *facts* on which to base them'.[83] This accusation of being too speculative was one which Fitzroy used multiple times against Maury, and it shows that Fitzroy was actively promoting a certain idea of science, and by distancing himself from Maury in this way, promoting himself as a certain kind of man of science. One who collected facts and worked with theories built on facts. Here Fitzroy's predilection for

[80] Fitzroy, '*Physical Geography* ', 16.

[81] Ibid.

[82] D. C. Agnew, 'Robert Fitzroy and the Myth of the 'Marsden Square': Transatlantic Rivalries in Early Marine Meteorology', *Notes and Records of the Royal Society of London*, *58*, no. 1 (2004): 21–46, https://doi.org/10.1098/rsnr.2003.0223.

[83] Fitzroy, '*Physical Geography* ', 17.

references is important again. To refer to someone else's work, was to show that a theory or idea was not just speculation, but built on facts or theories stated by others.

Fitzroy's inability at diplomacy

Notwithstanding the diplomacy Fitzroy demonstrated in negotiating his own status within the scientific community, he did not show as much tact in other circumstances. According to Burton Fitzroy was 'a man of moods', who was not only hard on himself, but could also lash out at others. Darwin, for instance, said that he and Fitzroy had had 'several quarrels; for when out of temper he [Fitzroy] was utterly unreasonable'.[84] One example of this is an anecdote told by Darwin about a dispute he and Fitzroy had about the moral status of slavery. According to Darwin, Fitzroy had visited a plantation in Brazil where the he had been told by the enslaved people that they were happy to work there and did not rather want to be free. After Darwin had suggested that the presence of the slave-owner might have had anything to do with the positive answer, Fitzroy had become 'excessively angry, and he said that as I doubted his word, we could not live any longer together'.[85] That same evening, though, Fitzroy had turned around and had apologised. It is important to note that Darwin wrote down this story in his autobiography on which he worked in the late 1870s, over a decade after Fitzroy's death, and about forty years after it had happened, so it is questionable whether this was indeed the way it happened, but it gives an indication of what kind of man Darwin thought Fitzroy was.

There is more evidence for this notion that Fitzroy was quick to jump to his own defence. In the years that his weather forecasts were published in the *Times* and other newspapers, some critical readers sent in letters to the papers, sometimes openly criticizing Fitzroy, but often rather posing critical questions than outright criticism. Fitzroy, however, often responded almost hostile to these letters. In a letter printed in the *Times* of 21 January 1863 one George F. Burder wrote about storms which occurred in and around his place of residence, Clifton, which had not been forecasted in the reports printed in the *Times*. He did stress that it was possible there had been a storm warning

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[84] Darwin 1887, quoted in Diane B. Paul, John Stenhouse, and Hamish G. Spencer, 'The Two Faces of Robert FitzRoy, Captain of HMS *Beagle* and Governor of New Zealand', *The Quarterly Review of Biology*, *88*, no. 3 (2013): 219–25, https://doi.org/10.1086/671485, 220.

[85] Ibid.

for the area, of which he did not know, and suggested that Fitzroy may have a 'learned […] explanation' for the discrepancy, as he did for another recent incongruence of weather and forecast.[86] Burder emphasised that his criticisms were aimed solely at the forecasts and those who 'still believe that there issue from the 'meteorologic-office' [sic.] predictions which require no explanation'.[87]

Taking into account that Fitzroy often emphasised that the forecasts were probabilities, not predictions, his answer seems a bit unreasonable. He replied to the letter the next day, stating that telegraphic warnings had been sent out to (most of) the places that experienced the storms. Fitzroy's tone in the letter is almost disdainful, stating that he had 'helped' Burder to his post in Clifton, and, later on in the letter, dismissing Clifton as a good place for weather observation, because of its locality and surroundings.[88] Burder replied rather angrily, in a letter printed two days later, stating that he did not hold any post, but that Fitzroy was probably referring to his brother, who was part of an unpaid meteorological observers' network, but that he was not aware of any role of Fitzroy in this.[89]

Fitzroy's place within the scientific community

Apart from Fitzroy's own ideas of science and his place in the scientific community, it would be interesting to know how others viewed him and his work. In the next chapter I will take a further look at the reception of one of the most important, or at least most conspicuous, parts of his work, his weather forecasts. Here, however, I first want to take a look at how Fitzroy (the person) was perceived by his peers, whether he was seen as part of the scientific community, and in what form.

In the public sources, there are few instances of outright claims of Fitzroy belonging to the scientific community, or the opposite. Reading between the lines suggests that there were those who considered him as doing scientific work and doing it well, and those who thought he was acting outside his capabilities as a naval officer. Men of science defending Fitzroy's project and his position at the head of the Meteorological

[86] George F. Burder, 'Admiral Fitzroy and the Weather', *The Times*, 21 January 1863.
[87] Ibid.
[88] Robert Fitzroy, 'Letter to the Editor', *The Times*, 22 January 1863.
[89] George F. Burder, 'Admiral Fitzroy and the Late Gales', *The Times*, 24 January 1863.

Department would, for instance, explicitly oppose Fitzroy's work to that of the 'weather prophets'. John Herschel, in an article in the evangelical periodical *Good Words* defended Fitzroy's forecasting system, as being based on the investigation of causes, and from sound empirical observation. He contrasted this to the ideas of 'lunarists' about the influence of the moon on the weather. He noted the impossibility of long-term forecasting, and assured the reader that Fitzroy's forecasts, *because* they were merely 'indications' and only covered a short period, were to be trusted, as opposed to 'the 'weather-prophet', who ventures his predictions on the great scale, [and therefore] is altogether to be distrusted'.[90]

By explicitly denying that Fitzroy was a weather prophet, Herschel opposed those who associated Fitzroy's work with that of astrologers, 'lunarists', and other non-scientific persons who ventured into the business of foretelling the weather. Whether the notion that the forecasts were based on work that could be called scientific meant that, according to Herschel, Fitzroy himself was part of the scientific community remains to be not entirely clear. As noted above, Fitzroy and Herschel were in frequent correspondence, with Fitzroy seeking Herschel's advice on his own ideas. Perhaps in this correspondence there are some hints as to how Herschel viewed Fitzroy.

One indication that Fitzroy may have been seen, by some, as true part of the scientific community, can be found in an article in the *Athenaeum* in 1861. It is a reprint of a letter sent by Maury to Fitzroy, on 'American Affairs', namely on the issues concerning Secession and the Civil War. According to the anonymous introduction, 'readers will be glad to hear the opinion of a scientific man who is neither a partisan nor a politician'.[91] The 'scientific man' referred to was Maury, who, as was explained above, was in many ways in a similar position as Fitzroy. Thus, this is at least an indication that it was possible for a naval officer to be viewed as a man of science in British intellectual circles. One question which remains, however, is whether Fitzroy was indeed seen by his peers as an equal of Maury, and whether everyone shared the opinion that Maury was indeed a man of science.

[90] John F.W. Herschel, 'The Weather, and Weather Prophets', *Good Words* 5 (1864): 57–64, 58.

[91] Anonymous, 'Capt. Maury on American Affairs', *Athenaeum*, no. 1782 (1861): 846.

Public commentary on Fitzroy as a person, or on his status within the scientific community, is scarce. One type of source which gives an image of what was thought about Fitzroy, albeit somewhat polished, were the obituaries. When Fitzroy took his own life, many were shocked, and wrote (mostly) glowing eulogies. The *Athenaeum* regretted to announce the death of 'an eminent man of science, a useful public servant, and a valued contributor to the *Athenaeum*'.[92] The author suggested that Fitzroy was overworked, and worried much about the responsibility of producing the forecasts from often insufficient data. On his work in the science of meteorology the author noted that it was done in 'earnest', and of Fitzroy's *Weather Book* he said that 'the work shows much thought and study, yet indicates, from the want of connexion in parts, a mind overwrought'. Fitzroy's labours were praised, but his shortcomings were also pointed out.

Another obituary can be found in the *Proceedings of the Royal Geographical Society*, of which Fitzroy had been elected a fellow after his hydrographical work along the South American coast. The author lamented the loss of 'one of the most distinguished of our Geographers'.[93] He did not want to go into the entirety of Fitzroy's 'chequered career',[94] but focus on 'two brilliant and eventful periods of his life which connect him to this society'. By this he meant the surveying missions and his work as the head of the Meteorological Society. The author commended Fitzroy's method, his skill, and the safety he provided for many on sea. He was 'as truly esteemed by his former chief, the Prince of Naval Surveyors, Sir Francis Beaufort, as by his successors', according to this author.[95] It is clear that this author thought very highly of Fitzroy and his work.

Science, Government, and the Meteorological Department

An aspect that may have influenced the discussion of Fitzroy (the person) and his work by his peers, was the institutional context of the Meteorological Department. The nature of the department, as a governmental body with a dual task in aid of both public service and science, made it an exceptional institute in the mid-nineteenth

[92] Anonymous, 'Admiral Fitzroy', *Athenaeum*, no. 1958 (1865): 622.

[93] Anonymous, 'Obituaries', *Proceedings of the Royal Geographical Society* 9 (1865 1864): 215–18, 215.

[94] Ibid.

[95] Ibid., 217.

century. Earlier projects in which the government was involved, such as the Magnetic Survey, were not institutionalised in the same way as the Meteorological Department. Anderson has illustrated how the housing of the department under the Board of Trade emphasised the mercantile and utilitarian aspects of the work done there. She argued that this meant the work of the department was under extra scrutiny by the scientific community.[96] According to Anderson, the scientific community was weary of utilitarian concerns, as they 'destroyed the character of science'.[97] On the other hand, the department was also heralded as an achievement by members of the scientific community. When the department was established, the President of the BAAS complimented its own members for this achievement.[98] The celebration of the department's establishment can be understood in the context of the campaign in the second half of the nineteenth century to get government to finance science.

In the mid-nineteenth century men of science were advocating for structural government support for science. There was, however, little agreement on the form of which this support should take, with the traditional scientific elite arguing for a different form of support than, for instance, the new middle-class men of science. Although opinion was divided over what governmental support for science actually meant, the establishment of the meteorological department was seen as a successful example of this support. In this section I show that the department was explicitly understood in the context the debate for funding for science, and that actors in that debate used the department as an argument for more funding. This awareness also meant, however, that it was difficult for the scientific community to openly have criticism on the work of the department, as well as on Fitzroy, who was the public representation of the department, as they had a vested interest in convincing the government that it was a success.

Parallel to, or more appropriately, connected to the professionalisation of science over the nineteenth century, there was a debate about the financial support for science from the government. In the 1820s, the 'declinists' had warned that British science was in descent, and if no reform was put in place, Britain would soon fall behind the Continent. From this resulted some financial support for men of science through grants for the

[96] Anderson, *Predicting the Weather*, 118.

[97] Ibid., 119.

[98] George J.D. Campbell, 'Presidential Address', *Athenaeum*, no. 1455 (1855): 1060.

BAAS and Royal Society. These were not enough, however to support 'rising 'middle class' of science', men who were educated not at the elite universities, but at medical schools, or abroad.[99] MacLeod has argued that this development lead, eventually, to the 'endowment for research movement'. This movement, he argued,

> 'produced the first explicit signs of public acceptance of the proposition that research was moving from an occasional pursuit of individuals with private means to an organised activity, undertaken by individuals and groups working full-time in significant numbers within institutions where research occupied a specific and acknowledged place'.[100]

MacLeod placed this development between the late 1860s and 1900, when a group of members of the new scientific class explicitly argued for the endowment of research. The basis for this movement, however, was laid already in the 1850s. One group was particularly successful in the campaigns for funding for science: the X-Club. This was a club of men of science, including Herbert Spencer, John Tyndall, and Thomas Huxley. In the 1850s, most of the future members of the club were looking for a paid position, as they did not have the funds to support themselves. Barton has argued that these men already had outspoken agendas and made active efforts to reach those, before officially forming the X-Club.[101] In a similar vein, the institution of the Meteorological Department in 1854 should be understood in this climate of change in the context of government funding for science.

The members of the BAAS certainly considered it a success when the department was set up. They were not shy to tout this as their own success. In his Presidential Address to the BAAS meeting at Glasgow in 1855, George J.D. Campbell, the Duke of Argyll (F.R.S) told his audience about two recent developments that he thought very beneficial: the Kew Committee of the BAAS was tasked with the verification of scientific instruments, and the meteorological department of the Board of Trade had been set up with Capt. Fitzroy as superintendent. The President commented that he 'cannot help congratulating the Association on the position which has been secured by science in connexion

[99] Macleod, 'The Support of Victorian Science', 198.

[100] Ibid., 197.

[101] Barton, 'Huxley, Lubbock, and Half a Dozen Others'.

with both of these establishments. The thanks of the commercial as well as of the scientific world are due to Colonel Sabine and the other members of the Kew Committee, whose assistance is now highly appreciated by practical men, and eagerly sought for by the best instrument-maker; whilst Capt. FitzRoy's office and duties are in themselves an acknowledgment of no small importance of the public value of systematic observation'.[102]

Thus, the Meteorological Department was heralded as a public scientific body, and the role of the scientific community in its establishment was emphasised in public media. Another example of this, comes from an article in the *Athenaeum*, also in 1855, in which the author laments the state of financial support for science in Britain. That year, the government had decided to discontinue a 1000*l* grant to the Royal Society, which it had given out in the years 1850-4. According to the author, this was not only 'unjust', but also 'impolitic'.[103] Science had worked for the national interest in the form of economically useful experiments, such as investigations into materials for building purposes. 'Apart from the blow to science which this refusal strikes, is it wise policy to declare in the face of nations that England, with her vast resources, is yet so stricken by the [Crimean] war that she can no longer devote 1,000*l* a year to the promotion of science?' the author asked rhetorically.[104] The author drove his point, that the government *owed* science, home by recalling that the Government '[had] never been backward in requesting scientific aid from the Royal Society'.[105] The most recent example of this was the inquiry from the government to the Royal Society about the 'points of consideration' in meteorological science, in connection to the new Meteorological Department. The author stated that members of the Royal Society went out of their way to answer this enquiry, all for free. 'All this time and labour was, be it remembered, *given gratuitously*, by men who are not the best able to make a present of their time and valuable knowledge'.[106]

It is clear that the Meteorological Department was seen and used as both a success-story for the scientific communities' attempts at acquiring sustained funding for

[102] Campbell, 'Presidential Address', 1060.

[103] 'Science and the Government' *Athenaeum*, No. 1446 (July 1855), 814.

[104] Ibid.

[105] Ibid.

[106] Ibid.

science, and as an argument for more of that funding. Fitzroy apparently also saw the BAAS as an ally on this front. When he wanted to expand the work of the department, he asked the BAAS for their help, by commenting on his need for more staff and more resources at the BAAS meeting of 1857.[107] Subsequently, a year later the Parliamentary Committee reported that on the basis of their arguments put forward in Parliament, the Board of Trade had allotted more money to the meteorological department.[108]

Being a governmental institute, the Meteorological Department had to account for its expenses. Both Parliament and the Board of Trade were often sceptical about the amount of money allotted to the Meteorological Department, and about the ways in which that money was spent. Most of its expense was on the costs of telegraphic communication. Since this communication had grown considerably with the system of storm warnings and forecasts, the costs for the department had risen with it. In 1863 a Member of Parliament, Mr. Smith had questioned whether the activities of the department actually warranted the, according to him, excessive funds it was allotted. [109] As a result of the ensuing discussion in Parliament, the Board of Trade inquired with the Royal Society into their opinion on the status of the work at the Meteorological Department. The *Times* reported that the Board of Trade had expressed 'an anxiety to know whether the science of meteorology was now in such a state as to admit of permanent reliable system of storm signals and daily weather forecasts; and whether the progress and useful application of meteorological science would be more efficiently promoted by devoting the money voted by Parliament to the original objects contemplated', meaning the collection of meteorological data.[110]

The response of the Royal Society had been that 'they were assured by Admiral Fitzroy' that the tasks of collecting and tabulating etc., were still 'kept in view'.[111] Storm warnings were very useful, according to the society, and in certain type of storms there was quite a strong scientific basis for them. As the telegraphy network had been

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[107] Robert Fitzroy, 'Notice of Meteorological Observations Made at Sea', *Athenaeum*, no. 1559 (1857): 1151.

[108] Anonymous, 'Report of the Parliamentary Committee', *Athenaeum*, no. 1613 (1858): 394.

[109] *Hansard*, HC Deb 12 May 1864, vol 175, cols 399-405.

[110] Anonymous, 'Meteorological Observations', *The Times*, 20 June 1863.

[111] Ibid.

instrumental in establishing this basis, its cost was thus accounted for. As for the forecasts, because they required no extra finance, the society found the they 'scarcely fall […] within the questions submitted for reply; moreover, the President and Council have no data whereon to rest a conclusion in regard to the degree of reliance to which these last-named forecasts may be entitled'.[112] The Royal society refrained from passing judgment on the forecasts at this time. This could mean two things; either the society was indeed not yet sure of the scientific merit of the forecasts, and were interested in seeing what would happen, or they did not deem them scientific, but did not want to be responsible for the Meteorological Department's finances being cut. Anderson argues the latter, taking the later condemnation of the forecasts in the *Galton Report* after Fitzroy's death as evidence that the Royal Society was indeed of the opinion that the forecasts lacked scientific status.[113] We cannot be sure, however, what the reasoning behind not passing judgment on the forecasts was, without, perhaps, personal correspondence. In the proceedings of the Royal Meteorological Society, the letters exchanged between the secretaries to the Board of Trade and Royal Society were printed, but no report of the considerations on the part of the Royal Society.[114] Either way, no boundaries were drawn by the Royal Society in their answer to the inquiry of the Board of Trade, to either in- or exclude Fitzroy's weather forecasts. Interestingly, of the storm warnings it was said that certainly for some type of storms there was a scientific basis. By stating this the telegraphic network was justified, and thus may have functioned as a cautionary but supportive argument for letting Fitzroy continue his project.

An article in the Edinburgh paper the *Daily Review* reacted to these questions about the expenditure of public money by the Meteorological Department. The author was of the opinion that the department indeed spent too much money, as the amount of reports from the department were 'amply sufficient to meet the charge that the national money is wasted upon the Admiral's weather glasses and weather signals'. Then, making fun of people who defended the forecasts by stating that their value was not necessarily in their correctness, the author continued: 'We pointed out before that success in

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[112] Anonymous, 'Meteorological Observations'.

[113] Anderson, *Predicting the Weather*, 122–23.

[114] 'The Secretary of the Royal Society to the Secretary of the Board of Trade, 27 March, 1863', *Proceedings of the British Meteorological Society* 1 (1863 1861):391.

prognosticating such charges is not necessary to establish the utility [of them]'.[115] The reports the article refers to were annual reports on the practices and results of the Meteorological Department, written by Fitzroy.

Another consequence of being a governmental department, apart from being held accountable in Parliament, was having to make decisions based on budget cuts. Of course, not necessarily only in case of government, but maybe more obviously so in this case. An example of this can be found in the fact that in 1861 Fitzroy had to stop the communication of weather data via telegraph between his office and the Kew Observatory. The Kew Committee of the BAAS reported that this had happened 'on account of the Board of Trade having only a limited sum disposable for meteorological telegraphy, and Kew being too near London to prove a useful station'.[116] To make even clearer that this decision was made (almost) entirely based on financial considerations, it was reversed again two years later in 1863. In the report of the BAAS meeting of that year in the *Athenaeum*, correspondence between Fitzroy and the Kew Committee was printed. Fitzroy requested the reinstatement of the telegraphic communication between the Kew Observatory and the MD, acknowledging that previously 'on account of economical reasons solely, as you are aware, the Board of Trade asked for discontinuance of those Kew telegrams (which were then received as regularly as satisfactorily) but now, being able to add their expense (comparatively small to the current charges of this Office) it is my pleasing duty to make this application'.[117] From this, it seems reasonable to assume that members of the scientific community were well aware of the peculiar financial circumstances of the Meteorological Department, and the scrutiny it was under from not only the British public, but also from Parliament and the Government. I think the response of the Royal Society to the inquiry of the Board of Trade should be seen in this light, where they are treading carefully as not to upset the goal of acquiring further funding for science.

By 1866, although the meteorological department had been under investigation and was facing reorganisation, the idea of science informing government and

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[115] Anonymous, *Daily Review*, 22 April 1863.

[116] Anonymous, 'Report of the Kew Committee', *Athenaeum*, no. 1767 (1861): 318.

[117] Anonymous, 'Report of the Meeting of the British Association for the Advancement of Science', *Athenaeum*, no. 1870 (1866): 272.

government supporting science had not wavered. In the Presidential Address at the BAAS meeting in 1866 at Nottingham, William Grove commented on the lack of natural knowledge among 'educated men'. He was positive about the future, however, and continued: 'To assert that the great departments of Government should encourage physical science may appear a truism, and yet it is but of late that it has been seriously done; now, the habit of consulting men of science on important questions of national interest is becoming a recognised practice'.[118] In this context, Grove commented on the proposed reform of housing the duties of the meteorological department under the Kew Observatory, which could thereby 'possibly become an important national establishment'.[119]

In discussions about the governmental support for science, the meteorological department was never far from the scientific communities' mind, and in discussions about the (scientific) worth of the department, financial questions were never far from the Government's mind. This may have made it very difficult for the scientific community to navigate the debate around Fitzroy and his forecasts, as they did not want to give the Board of Trade any reasons to diminish funding for the department.

Conclusion

Fitzroy's work as a naval officer, charting the coast of South America, was highly prestigious and earned him recognition in the scientific community. His election into the Royal Society suggests that he was seen as a man of science, at least in relation to his work as hydrographer. It is questionable, however, whether his peers thought that this background granted him the knowledge and capability to theorise in the field of meteorology. Fitzroy, at least, was aware of a possible argument that he was not a man of science, and made up for this by establishing high standards for referencing others. He was, however, convinced of the fact that science should have practical value, and that practical men had something to offer to it. Thus while giving credit to 'true philosophers', Fitzroy actively promoted the idea that a 'practical man' belonged in science too.

Scientific discomfort with the practical objectives of Fitzroy's work at the department may have been present within the scientific community. In public, however, and

[118] William Grove, 'Presidential Address', *Athenaeum*, no. 2026 (1866): 240.
[119] Ibid.

especially when addressing government or the general public, the scientific community was also concerned with maintaining and promoting the idea of government funded science. In the next chapter, I will discuss the reception of Fitzroy's forecasting project. The public commentary on the forecasts by men of science was almost cautious, until the publication of the Galton Report. This caution can be explained by the institutional context of the department, as I have discussed in this chapter.

2. The Meteorological Department's Weather Forecasts

When Fitzroy was appointed in 1854, he set to work, and was actively pursuing what he saw as his greatest responsibility: using meteorological knowledge to protect the lives of British sailors. Over the course of his superintendence, he created a method of weather mapping known as 'synoptic charts,' he established a telegraphic observation network that spanned Britain and parts of north-western Europe, and he created a system of storm warnings and weather forecasts.[120] After Fitzroy's death, in 1865, however, the practice of forecasting the weather by the Meteorological Department was discontinued, and was not started again until 1879. Posthumously, Fitzroy's forecasts were deemed 'unscientific'. Anderson and Achbari, for instance, have cited the *Galton Report* that was issued after Fitzroy's death, which condemned his work as 'lacking scientific basis', and Burton has quoted Fitzroy himself who identified, among groups of his critics, those who attacked him for lacking an academic education.[121]

Despite this, some historians have pointed to evidence suggesting that there may have been more to Fitzroy's forecasts than he has been given credit for.[122] More impotently, the Galton report is used by most historians to illustrate the criticism on the forecasts from the scientific community. In this chapter, the discussion about the forecasts during Fitzroy's life will be traced, from their first appearance trough the eventual investigation and report issued after Fitzroy's death. This discussion shows that, at least in public, the scientific community appeared to withhold judgment on the scientific status of the forecasts. Some were explicitly positive, though cautious, others were enthusiastic about the practical benefit of storm warnings, but did not comment on the forecasts. The Royal Society even explicitly refrained from judgment about the scientific status of forecasts when asked about it in 1863.

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[120] Anderson, *Predicting the Weather*, 186–87.

[121] Ibid., 124; Achbari, *Rulers of the Winds*, 98–99; Burton, *The History of the British Meteorological Office to 1905*, 164–65.

[122] Burton has argued that the method used for calculating the success rate of Fitzroy's forecasts in the Galton Report was unfair. With an altered system, which is more similar to current systems of assessing the success of forecasts, Burton calculated a 76-90% success for the forecasts, instead of the report's 44-61%. Burton, *The History of the British Meteorological Office to 1905*, 60–61.

Thus, before the *Galton Report* had the final say about the scientific status of Fitzroy's forecasts, there was no clear, public, shared opinion within the scientific community. This apprehension about passing judgment should be considered in the context of the previous chapter. As I have shown there, the scientific community was very aware of the special status of the department as a governmental body that had an explicit scientific purpose. In a time when the scientific community was actively campaigning for structural funding for science, it can be understood that some care was taken to preserve this department and not outright attack its head.

Fitzroy's Forecasts

The scientific status of the work of the department was called into question several times, by the public, the Board of Trade and sometimes by men of science. There was, however, no straightforward condemnation of the work done by Fitzroy during his life. The questions arose when Fitzroy sought to expand the work of the Meteorological Department, beyond the collection and coordination of meteorological measurements. Fitzroy had spent the first few years at the department setting up the successful distribution of meteorological instruments and logbooks to naval and merchant ships, and collecting the measurements. He established a telegraphic observers' network in Britain, that communicated meteorological observations on land to London. Towards the end of the 1850s, however, he wanted to do more. He began advocating for the possibility of using the data he collected to provide ships and harbours with storm warnings. Fitzroy sent out the first storm warning in January 1861, and extended this program to general weather forecasts in the summer of 1861. These forecasts, and to a lesser extent the storm warnings, were eventually deemed 'unscientific' after Fitzroy's death, and discontinued until 1879.

Although the forecasts were judged 'unscientific' by the Galton committee, in this section I show that most of the early criticism, during Fitzroy's life, came not from the scientific community, but rather from Parliament and the Board of Trade, and from the general public. I argue that, publicly, the forecasts were not treated as obviously or clearly controversial by men of science. This, I argue, can be understood with reference to the institutional context of the Meteorological Department. Men of science who were not

convinced of the scientific merit of forecasts, may have been hesitant to exclude them from science outright out of fear of giving the government a reason to strip the department of (some of) its funds.

To properly contextualise the public debate about Fitzroy's forecasts, I will give a short overview of the change of the work of the Meteorological Department at the end of the 1850s. I describe how public and scientific opinion was favourable to such a project, and how this environment may have made Fitzroy confident that his forecasts would find a receptive audience, even though they were outside of the assignment by the Board of Trade. Then, I describe the public debate among men of science about Fitzroy's forecasts, showing that the criticism was actually not as vehement as even Fitzroy felt it was.

On 1 August 1861 Fitzroy sent his first weather forecast to *the Times* (figure 1) It consisted of a table of weather data, followed by 'prognostications', which read:

> '*General* weather probable during next two days in the –
> North – Moderate \westerly wind; fine,
> West – Moderate south-westerly; fine,
> South – Fresh westerly; fine'.[123]

This was an extension of the usual communication of weather data collected from a network of, originally, thirteen observatories in Britain and the exchange of observations between London and Paris, Fitzroy receiving six observations from the continent, while sending five observations the other way. Fitzroy had arranged the exchange with Le Verrier, who had put a similar observational network in place in France.[124]

The general forecast, an indication of the weather for the next 48 hours in Britain, can be seen as a result of the installation of a system of storm warnings, the year before. At the end of the 1850s, Fitzroy saw an opportunity to not only commercially help naval navigation, but to also make the passage safer. Over the preceding decades meteorologists had developed a theory of storms, which Fitzroy felt was mature enough to use to predict, not only where a storm would move once in existence, but also to predict whether a storm would occur independent of a knowledge of its existence somewhere else.

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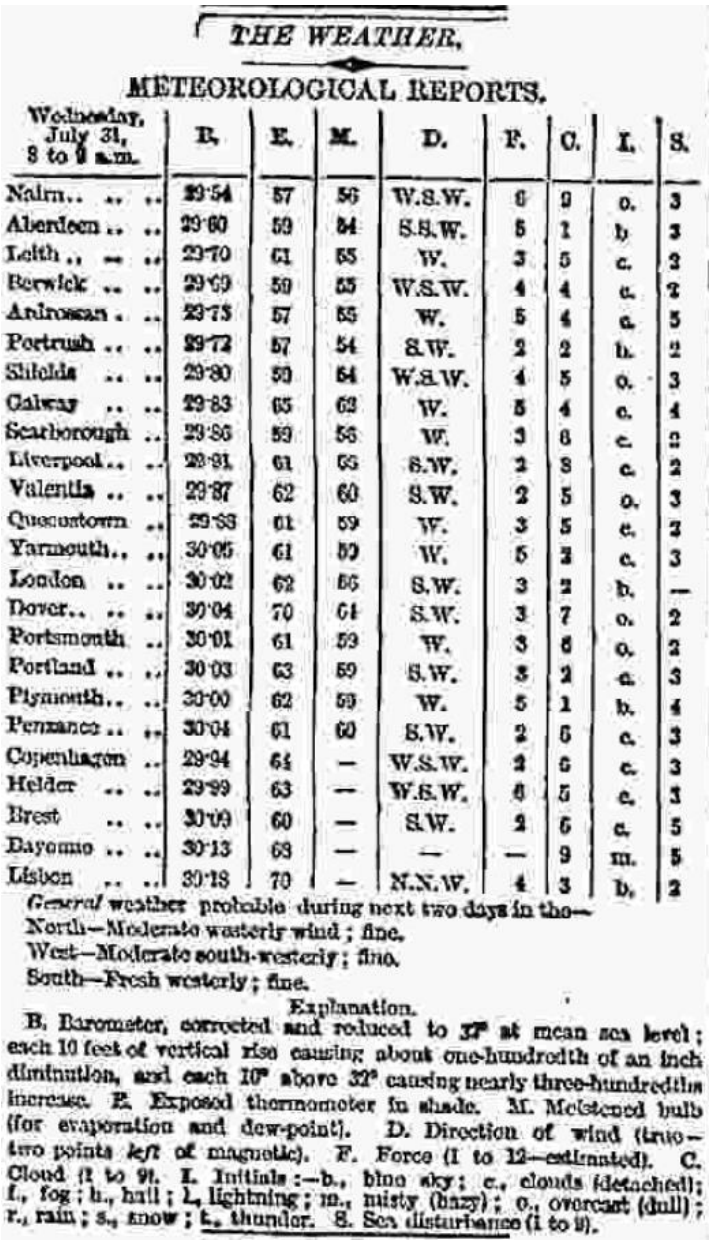
[123] Fitzroy, Robert, 'Weather', *The Times*, 1 August 1861. Within a few months, Britain was divided into four regions, instead of three: North, West, South, and East.

[124] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 161.



THE WEATHER.

METEOROLOGICAL REPORTS.

Wednesday, July 31, 8 to 9 a.m.	B.	E.	M.	D.	F.	C.	I.	S.
Nairn	29·54	57	56	W.S.W.	6	9	o.	3
Aberdeen	29·60	59	54	S.S.W.	5	1	b	3
Leith	29·70	61	55	W.	3	5	c.	2
Berwick	29·69	59	55	W.S.W.	4	4	c.	2
Anstruther	29·75	57	55	W.	5	4	c.	5
Portrush	29·72	57	54	S.W.	2	2	b.	2
Shields	29·80	59	54	W.S.W.	4	5	o.	3
Galway	29·83	65	63	W.	5	4	c.	4
Scarborough ..	29·86	59	56	W.	3	6	c.	2
Liverpool	29·91	61	55	S.W.	2	8	c.	2
Valentia	29·87	62	60	S.W.	2	5	o.	3
Queenstown ..	29·88	61	59	W.	3	5	c.	2
Yarmouth	30·05	61	59	W.	5	3	c.	3
London	30·02	62	56	S.W.	3	2	b.	—
Dover	30·04	70	64	S.W.	3	7	o.	2
Portsmouth ..	30·01	61	59	W.	3	6	o.	2
Portland	30·03	63	59	S.W.	3	2	c.	3
Plymouth	30·00	62	59	W.	5	1	b.	4
Penzance	30·04	61	60	S.W.	2	5	c.	3
Copenhagen ..	29·94	64	—	W.S.W.	2	6	c.	3
Helder	29·99	63	—	W.S.W.	6	5	c.	3
Brest	30·09	60	—	S.W.	2	6	c.	5
Bayonne	30·13	69	—	—	—	9	m.	5
Lisbon	30·18	70	—	N.N.W.	4	3	b.	2

General weather probable during next two days in the—
North—Moderate westerly wind; fine.
West—Moderate south-westerly; fine.
South—Fresh westerly; fine.

Explanation.

B. Barometer, corrected and reduced to 32° at mean sea level; each 10 feet of vertical rise causing about one-hundredth of an inch diminution, and each 10° above 32° causing nearly three-hundredths increase. E. Exposed thermometer in shade. M. Moistened bulb (for evaporation and dew-point). D. Direction of wind (true—two points *left* of magnetic). F. Force (1 to 12—estimated). C. Cloud (1 to 9). I. Initials:—b., blue sky; c., clouds (detached); f., fog; h., hail; l., lightning; m., misty (hazy); o., overcast (dull); r., rain; s., snow; t., thunder. S. Sea disturbance (1 to 9).

Figure 1: The weather report in the Times *for 1 August 1861. The forecast is wedged in between the, by then, standard meteorological report of measurements at several stations and the 'explanation' of the different columns of the chart.*

The first part of this idea, the possibility of telegraphic warnings for storms of which the department had information of its path through that same telegraphic network, was widely supported in the scientific community. John Herschel, a prominent mathematician and astronomer who was also an active participant in the debates around meteorology in the 1840s and 1850s, supported Fitzroy's plan for storm warnings.[125]

[125] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 160.

Furthermore, at the 1859 meeting of the BAAS in Aberdeen the project was discussed, and a resolution was passed to apply to the Board of Trade to extend the assignment of the department to this program.[126] Fitzroy, however, was of the opinion that both existing storms and storms that were to be expected on the basis of the weather data his department received should be communicated. This expectation of storms was based, for the most part, on barometric pressure reports, combined with temperature.

In connection to his advocacy for a system of storm warnings, Fitzroy promoted the possibility of making predictions, or 'forecasts' about probable weather conditions. In an article in the *Athenaeum* in 1860 Fitzroy defended and explained a suggestion for a change of the words on the scales of barometers, as well as his 'Tables', which were published daily, at this point still without the extension of the forecast. About these tables Fitzroy states that they show 'to all who are sufficiently interested to compare them day by day (aided perhaps by a map with wind markers), the present and recently past character of the weather *generally*, and in many specified places'.[127] Interestingly, the responsibility for doing part of the work is placed with the reader of the paper. Just looking at the weather report will not give the general reader enough information to draw any conclusions. The reader is thus not only expected to do some of the work, but also deemed capable of this, and to have access to a map with wind markers.

Fitzroy continued his remark, stating that the tables are not only of value regarding the present and recent past, 'but they enable one to foresee the probable nature of wind and weather, during the next day or two, even the next following days'.[128] For Fitzroy, the value and possibility of inferring the coming weather from its present state appears to be almost self-evident. From his years in the navy, and as captain of the *Beagle* and *Arrogant* he had gained the intuition and experience and possibly 'embodied knowledge' of sailors to foretell the probable weather, which was necessary to be able to sail well. It is clear that this experience was still close to his mind, as Fitzroy explicitly states, in the same article, that the general rules and laws connected to foretelling the weather were 'necessary to be studied by seamen'.[129] Not only did Fitzroy comment on the possibility

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[126] Anonymous, 'Our Weekly Gossip', *Athenaeum*, no. 1676 (1859): 777.

[127] Fitzroy, 'The Weather (b)', 1860a, 671.

[128] Ibid.

[129] Ibid., 672.

to foretell the weather, with access to the right information and instruments, he also explained how and why storm warnings of storms not yet 'existing' can be given. He explained the rule which is now known as Buys Ballot's law, after Dutch meteorologist Christophorus Buys Ballot, which 'establishes a connection between the connection between the direction of the wind and the location of areas of low and high pressure. With this rule, says Fitzroy, 'it immediately follows that telegraphic warnings may be sent […], and that, occasionally, on the occurrence of very ominous signs, barometric and other – including always those of the heavens – such cautions may be given *before* storms, as will tend to diminish the risks, and loss of life, so frequent on our exposed and tempestuous shores'.[130] In this way Fitzroy was simultaneously arguing for the possibility of predicting the weather, as well as its positive effect on the safety of sailors.

Most of the early commentary on this system, and on storm warnings in general, was positive, and most of it related to the practical use of them in saving lives and property. The early success of the warnings should also be seen in light of the recent storms, that were still on many people's minds. The Royal Charter Storm was still fresh in the collective memory, and the warnings were praised for preventing repetition of such disasters. A correspondent (J.C.G) of the *Athenaeum* remarks on the absence of Fitzroy's storm signals at his harbour Ramsgate. He argues that the harbour should do well to install the system there, in order to prevent 'loss both of life and property'.[131]

Fitzroy's advocacy, and the efforts of the BAAS resulted in the approval of the Board of Trade for a telegraphic network between London and observatories at the coast, for the purpose of sending warnings of storms. Historians have discussed whether Fitzroy was acting outside of his assignment when starting to issue his forecasts, as Galton had stated. Arguably the most nuanced conclusion is that of Burton. He argued that the storm warnings, although not included in the original letter by the Royal Society, should be seen as part of Fitzroy's assignment, as the Board of Trade authorised it in 1860. This authorisation did not include the authorisation for issuing predictions for the weather in general, making Fitzroy's forecasts indeed an 'unapproved' endeavour.[132] Fitzroy saw this very differently, and argued that the forecasts were merely an extension

[130] Fitzroy, 'The Weather (b)', 671. Emphasis added.

[131] J.C.G., 'Untitled', *Athenaeum*, no. 1775 (1861): 588.

[132] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 163.

of the practice of preparing and issuing storm warnings. As I have shown above, to him these two were always connected. When a few years later, in 1863, the Board of Trade inquired, via the Royal Society, into the practice and expense of the Department, Fitzroy had assured them that the general forecasts were merely an extension of the storm warnings, requiring no extra expenditure and barely any extra work.[133]

The new activity of the Meteorological Department in setting up the storm warnings was approved by government, and supported by prominent men of science. This support was mostly limited to the possibility of warnings for existing storms. Fitzroy, however, interpreted this approval to give him the authority to expand this work, into the general forecasts.

Initial reactions (1861-62)

The forecasts have been described as highly controversial, or at least problematic and questionable, in histories of meteorology. William Napier Shaw, for instance, briefly commented on Fitzroy's forecasts in a historical overview of the science in 1931. He stated that Fitzroy's forecasts had been thought 'premature' by 'some prominent scientific authorities'.[134] Shaw then continues, like most who briefly address Fitzroy's forecasts, to cite the Galton Report and the discontinuation of the forecasts as proof of the 'premature' nature of the forecasts. Interestingly, the *initial* public reactions to the forecasts do not underwrite the view that people within the scientific community were immediately opposed to them. In this section, I show that in the first months after Fitzroy started publishing his forecasts, there were rather few reactions in periodicals and newspapers.

A possible explanation for this could be that Fitzroy's forecasts were associated with those of the weather prophets and almanacs, that were part of Victorian culture. It might be that the general public indeed was used to predictions of the weather through these, and thus were (at first) not very moved by those of Fitzroy. The scientific community, however, was and had been explicitly opposed to those who claimed to know the weather in advance. In August 1861, when Fitzroy's forecasts had been published for a

[133] Letter from the Secretary of the Royal Society to the Secretary of the Board of Trade, printed in *Proceedings of the Royal Meteorological Society*, 391–92.

[134] Napier Shaw, 'A Century of Meteorology', *Nature* 128, no. 3240 (1931): 925, https://doi.org/10.1038/128925a0.

month, the mathematician Augustus De Morgan wrote an (anonymous) review of a book that treated on 'the theory of the dependence of the weather on planets and comets'.[135] De Morgan does not think very highly of this type of theory. He compares Shepherd, who also published a meteorological almanac, to Patrick Murphy. Murphy had published several works on astronomy and meteorology in the 1830s, but gained fame as a weather prophet. In 1838 he published a very successful weather almanac. Murphy had correctly predicted the coldest day of January of that year, resulting in his massive popularity. The rest of his predictions, however, turned out not very reliable, thus making him a much quoted example of an unreliable 'weather prophet'.[136]

De Morgan was an avid contester of astrological meteorology. In 1862, he wrote another review for the *Athenaeum*, one about a book titled *Foretelling Weather: a Newly-discovered Lunar Weather-System*, by S.M. Saxby. Although De Morgan asserts that parts of Saxby's theory are 'not borne out by facts', he does allow that there were still many open questions concerning the changes of the weather.[137] However, Saxby also gave some predictions for weather on certain dates, and De Morgan urged his readers to watch these dates and to compare the actual state of the weather with the prediction. 'Upon this theory, and all others, we make three very original remarks: First, by their fruits ye shall know them; secondly, the proof of the pudding is in the eating; thirdly, handsome is that handsome does'.[138] Clearly, De Morgan does not have high expectations for these predictions.

De Morgan's reviews should be understood in a wider effort of 'scientific' meteorologists to discredit astrological meteorology. Astrological meteorology was very popular and widespread in the nineteenth century. Meteorological astrologers and lunarists developed theories and made predictions about the weather on the basis of the influence of celestial bodies on the atmosphere. The almanacs in which they shared their theories and long-term weather predictions had a strong circulation in the mid-nineteenth

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[135] Augustus De Morgan (anon), 'Review of *The Climate of England* by G. Shepherd', *Athenaeum*, no. 1764 (1861): 217.

[136] Anderson, *Predicting the Weather*, 65.

[137] Augustus De Morgan (anon), 'Review of *Foretelling Weather: A Newly-Discovered Lunar Weather-System* by S.M. Saxby', *Athenaeum*, no. 1787 (1862): 115.

[138] Ibid.

century.[139] Therefore, in the public's eye, meteorology, and especially weather prediction, were closely related to astrology. Anderson has argued that the proponents of meteorology connected to the established institutions, such as the Royal Society and the BAAS, but also the relatively young British Meteorological Society (later Royal Meteorological Society), actively tried to distance their work from these weather prophets, and avoiding all association with weather prediction.[140]

Anderson argues that Fitzroy's forecasts were therefore controversial at the time. In a society where the general public associated weather prediction with astrology, and where men of science emphasised the importance of collecting measurements, building up a foundation of facts and not theorise too much, Fitzroy's forecasts would be problematic. It is interesting, then, that there were no comments like those of De Morgan about the forecasts in the periodicals, after Fitzroy's forecasts first appeared. In the first couple of years after the first forecast, there was barely any mention of them in the *Athenaeum*, and there was no mention at all of them in the *Westminster Review,* nor in the *Edinburgh Review*. Despite this lack of public criticism or endorsement from the scientific community, it does not necessarily mean that the forecasts were entirely uncontroversial, of course. In an article in the *Athenaeum* in 1862 titled 'The Meteorological Department of the Government', the (anonymous) author mentions 'objections' to the forecasts. However, it is not clear whether these objections came from the scientific community. The author did also explicitly make an effort to distinguish Fitzroy's work from lunar theories.[141]

The *Times* had published the forecasts daily, from their beginning in 1861. In a lead article in 1862 they commented on this for the first time. The article is of the 'don't shoot the messenger'-type, in which the author distances the paper from the content of the forecasts, claiming no credit for them, but explicitly also taking no responsibility for their possible failure. The author does, however, defend Fitzroy's project, stating that the recent failures of predicting the weather correctly 'do not in any degree detract from the importance of the labours in which [Fitzroy] is engaged, or from the probability of

[139] Anderson, 'The Weather Prophets', 185.

[140] Ibid., 193.

[141] Anonymous, 'The Meteorological Department of Government', *Athenaeum*, no. 1811 (1862): 49–50.

ultimate success'.[142] The forecasts are defended as being the first attempt at *scientifically* predicting the weather, thus explicitly drawing a boundary between Fitzroy's forecasts and the weather predictions in the almanacs. According to the author, mistakes were bound to happen, because 'first guesses must be but guesses'.[143] The continuation of the program is justified, the article argued, because by repeating it and improving upon it, the correct rules may be found. More importantly, the practical benefit of saving lives justified the continued printing of the forecasts.[144]

Fitzroy replied to the article in a letter to the editor the next day. In his letter, he first responded to the criticism that the forecasts were not always correct. Fitzroy's defence was that he did not pretend to know the future state of the weather for certain. Of the forecasts, he said:

> 'Prophecies or predictions they are not. The term forecast is strictly applicable to such an opinion as is the result of ta scientific combination and calculation, liable to be occasionally marred by an unexpected 'downrush' (Hershel) of southerly wind, or by a rapid electrical action not yet sufficiently indicated to our extremely limited sight and feeling'.[145]

Fitzroy had made this remark earlier in the Royal Institution, and repeated it in other places as well. Fitzroy clearly was aware of the stigma of weather prophets, and underscored the difference between their work and his. He coined the term 'weather forecasting', and explicitly avoided words like prediction and prophecy. After this remark Fitzroy continued that the knowledge of some the causes of changes of the weather was not complete. However, there were some causes that could be 'felt', through instruments', which allowed the forecaster to make statements about the *probable* nature of weather to come.

The author of the article in the *Times* that prompted Fitzroy's response, appears to respond to critical opinions about the forecasts, and possibly calls to end them. In the

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[142] Anonymous, 'Untitled', *The Times*, 11 April 1862.

[143] Ibid.

[144] It may be wondered, however, how many lives the *forecasts* really saved, or that the forecasts and storm warnings were taken together here.

[145] Robert Fitzroy, 'Letter to the Editor', *The Times*, 12 April 1862.

paper itself, however, as well as in the periodicals and local newspapers, there was next to no mention of the forecasts issued by the meteorological department. There was a continuing attack on astronomical meteorology in the reviews, but they did not refer to Fitzroy's forecasts (thus also not comparing them, in a way to show why those were acceptable). However, the comments in the articles in 1862, in both the *Athenaeum* and the *Times* do suggest there was discussion about and commentary on the forecasts. This suggests that the lack of discussion about the forecasts in the more public media needs an explanation. If there was debate about the merit and scientific status of Fitzroy's forecasts, like the two articles cites suggest, it took place in other forums than in the periodicals or papers that I have looked into. Anderson has shown that the debate about forecasts was explicitly public, and she argues that Fitzroy's forecasts were no exception to this. The periodicals formed a very public forum where men of science as well as the higher educated classes would defend or criticise scientific ideas and social developments. In that context, the lack of comment in these places about Fitzroy's forecasts is surprising. One possible explanation could be, that the scientific community was hesitant to draw boundaries in order to in- or exclude Fitzroy's forecasts. The fact that the Meteorological Department was one of the first government bodies with a strict scientific purpose, and thus one of the first structurally publicly funded scientific bodies, made the case of the forecasts more complicated than 'pure' scientific discussion on the scientific status of the forecasts.

A little more public discussion (1862-1865)

In the years that followed, Fitzroy's forecasts became a more prominent part of daily life for British public. They were the topic of discussion a bit more than in the first year, perhaps because people now began to rely on them and had expectations if them. A sign that the forecasts were indeed becoming a self-evident part of the British public debate is their use as comparison or metaphor in other discussions. Interestingly, they are used both in a positive and in a negative comparison. In October 1863 the *Caledonian Mercury*, an Edinburgh newspaper, suggested that parliamentary politics may be 'forecasts […] quite as accurately as Admiral Fitzroy foretells the character of the weather'.[146] Three

[146] Anonymous, 'Untitled', *Caledonian Mercury*, 23 October 1863.

days later, the *Newcastle Journal* also used Fitzroy's forecasts for a comparison, but this time in a very different way: 'Any forecast of the demand for cotton goods would be less reliable even than Capt. Fitzroy's forecasts of the weather'.[147]

Discussion among the scientific community in public forums does not really come to the fore, however. There are some comments about and articles on the forecasts, and a few on weather prediction in general. The President's Address by Sir William Armstrong at the BAAS meeting in 1863, printed in the *Athenaeum*, is illustrative of the way Fitzroy and his work were commented upon. Armstrong reflected on the practical value of meteorology, but also on the field being in very early stages, and the little knowledge that was available in this field. 'Nothing', he said, 'would contribute more to the saving of life and property, and to augmenting the general wealth of the world, than the ability to foresee with certainty the impending changes of the weather'. He emphasised the practical value of the ability to forecast the weather, the way in which many related the forecasts, and especially the storm warnings, to the saving of lives. He continues, however, that at that time, the 'means of doing so [foreseeing the weather] are exceedingly imperfect, but, such as they are, they have been employed with considerable effect by Admiral FitzRoy in warning mariners of the probable approach of storms'.[148] Thus Armstrong commended Fitzroy's project, and emphasised the practical value and promise of it. He did not, however, comment on the forecasts specifically, or give a straightforward endorsement of the scientific status of the warnings and forecasts. This is pattern is repeated in the periodicals and articles between 1862 and 1865. There are of course exceptions, but most of the commentary coming from the scientific community emphasised the practical value of Fitzroy's work, mostly commenting on the storm warnings, and left the scientific status of the weather forecasts (and also of the warnings) untouched.

The Royal Society's answer to the inquiry of the Board of Trade which was described above is of the same nature. The warnings were valuable, according to the Society, and thus their expense was justified. In their answer the Society refrained, however, from judging the scientific status of the forecasts, even though this was explicitly asked.

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[147] Anonymous, 'Untitled', *Newcastle Journal*, 26 October 1863.

[148] Sir William Armstrong, 'The President's Address', *Athenaeum*, no. 1870 (1863): 276.

By referring to Fitzroy's claim that the forecasts did not require any extra expense, the Society argued they were outside the question and thus they would not comment on them.[149] It is possible to interpret this answer in different ways. Burton has stated that this answer should be seen as a public endorsement of Fitzroy by the Royal Society.[150] The fact that the society explicitly expressed confidence in Fitzroy and that it emphasised the value and possibility of storm warnings shows 'support […] in scientific circles' according to Burton.[151] Another interpretation of the society's answer is given by Anderson. They argue that the society was, at least, hesitant about the scientific status of the forecasts, and therefore deliberately did not comment on it. Anderson argues for this by referring to the later condemnation of the forecasts by the society, after Fitzroy's death.[152] Whether the society was confident or positive about the forecasts in 1863 or not, the fact remains that they did not pass judgment (in public) about their scientific status then.

There were, however, commentaries that were more explicit as well, both positive and negative. One very positive article in the *Athenaeum* summarised and commented on a Report of the Meteorological Department written by Fitzroy in 1863. The article, titled 'The Weather', consisted in a large part of quotations from that report, and its aim seems to have been to justify the weather forecasts. The author disagreed with the forecasts and storm warnings as separate. Some commentators apparently had argued that the storm warnings were fine, and of value, but had criticised the forecasts. The author of this article in the *Athenaeum* argues that if the storm warnings were indeed found to be valuable and 'good', then the forecasts should get the same treatment, because they were part of the process of issuing storm warnings. To make this argument, the author of the article quoted the Report on the Department (which quoted Fitzroy's *Weather Book*), stating that 'it is only by closely forecasting the coming weather, and by keeping

[149] Secretary of the Royal Society to the Secretary of the Board of Trade, 27 March, 1863. Printed in the *Proceedings of the British Meteorological Society*, 1 (1861-1863) 390-392.
[150] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 165.
[151] Ibid.
[152] Anderson, *Predicting the Weather*, 122–23.

atmospheric condition continuously present to mind, that *judicious storm warnings can be given*. Forecasts grow out of statical [sic.] facts, and signals are their fruit'.[153]

In the report that was quoted in the *Athenaeum*, Fitzroy defended the weather forecasts made by the department, which he felt were unduly criticised. He identified three types of critics on his work; those that criticised him on his scientific method, those that hoped to gain financially from weather prediction (and thus saw their business ruined), and finally the ship-owners that saw their profit go down because their sailors did not want to go out to sea when a warning had been hoisted.[154] The first category is of the most interest in the context of this thesis. Fitzroy himself does not name any names, but to illustrate the 'scientific' category, historians often name Francis Galton, and especially his report, as evidence for this type of criticism. As I argue in this thesis, at least in public this type of criticism may have been less evident than assumed. Galton, however, is indeed a very good example of the existence of criticism from the scientific community, but his criticism is more of an outlier than an exemplary case.

Galton was very critical of Fitzroy's method in producing his forecasts, and he wrote an anonymous review of the *Weather Book* for the *Athenaeum*. About the only positive thing he wrote about the book, was that 'it conveys an undoubted testimony to the author's zeal and energy in pursuit of his favourite topic, and is a pleasing record of his scrupulous candour in acknowledging his indebtedness to authors whose theories he adopts and endeavours to put into practice'.[155] Fitzroy did indeed often emphasise the origins of his ideas, most often referring to Heinrich Dove and John Herschel. Perhaps he did so because he was very aware of his own non-scientific background. It was a way for him as well to distinguish his work from that of the US Capt. Maury, which I have shown in the previous chapter to have been very important for Fitzroy.

After this remark about Fitzroy's zeal in referring to other men of science, Galton's review of the *Weather Book* continued with several criticisms. First of all, he condemned Fitzroy for theorizing and being too speculative. For Galton, this meant that Fitzroy did not present the empirical facts on which he grounded his ideas. According to Galton Fitzroy

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[153] Anonymous, 'The Weather', *Athenaeum*, no. 1852 (1863): 556–57, 556.

[154] Burton, *The History of the British Meteorological Office to 1905*, 49.

[155] Galton (anonymously), 'Review of *The Weather Book*', 80.

> 'omits to supply the facts which meteorologists most need. It is a fault in a book intended to lay the foundation of a new experimental science, that it should be mainly occupied with deductions from unproven hypotheses, instead of the careful establishment of axioms by rigorous induction from observed facts'.[156]

Furthermore, Galton refers to Fitzroy's theory and practice as 'weather-wisdom', which was usually used to refer to colloquial knowledge, proverbs, and sometimes the work of so-called weather prophets. In the early 1860s Galton was himself working on meteorology, but in a very different manner. He was mainly interested in collecting weather observations and summarizing those into graphical displays. In 1863 Galton also published a book, *Meteorographica*, in which he mapped the weather for the month of December of 1861. The differences between the two works, the *Weather Book* and *Meteographica* were illustrative of the differences between the two authors and their ideas about the goal for meteorology, which I will return to in the next chapter as well.

In the review of the *Weather Book*, Galton did draw a distinction between Fitzroy's forecasts and his storm warnings, going against Fitzroy's argumentation. 'While we doubt the value of forecasts in our ordinary English weather in the present state of the theory', Galton wrote, 'we gladly testify to our belief in their value, when any extraordinary storm is approaching […]. In addition to this, we are convinced that a mere statement of existing dangerous weather telegraphed to the ports is of great advantage'.[157] This is the same conclusion he would come to in the *Galton Report* in 1866 evaluating the Meteorological Department after Fitzroy's death. In that report, the general forecasts were condemned as lacking any scientific basis and should be discontinued, but the storm warnings were considered of such value that that practice should be upheld.

This sentiment can also be found in a review of another book, *A Treatise on Meteorological Instruments* by Negretti and Zambra. Henry Negretti and Joseph Zambra were London-based instrument makers and were highly regarded. They both began as glass blowers and thermometer makers, and founded their business in 1850. At the London 'Exhibition of the Works of Industry of All Nations' they had one the only prize medal

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[156] Galton (anonymously), 'Review of *The Weather Book',* 80.

[157] Ibid., 81.

for meteorological instruments.[158] The anonymous reviewer (chemist, geologist and photographer Robert Hunt[159]) was overall very enthusiastic about the book, but took issue with a comment in the preface. There, the authors commented on the 'utilization of meteorology' in the form of storm warnings, and on the use of 'instruments as weather indicators'.[160] This did not go over well with Hunt. According to him, Negretti and Zambra claimed 'for meteorology far more than that science will be answerable for – far more than any of it true students will admit to be possible'.[161] Hunt allowed that the development of existing storms can be foretold a few hours ahead, and thus warnings may be given. With the help of the telegraph and widely dispersed observatories, it would be possible to ''forecast' to-day the weather which may be expected to-morrow'. However, 'beyond this, meteorology cannot venture in the prophetic groove'.[162] Thus Hunt was very cautious about the ability of the public to be able to foretell the weather with the use of instruments such as the barometer and thermometer.

Hunt did nuance this view, however, in favour of Fitzroy's work at the department. He remarked that the meteorological instruments were of no use as 'prophetic weather-glasses' for individual observers, but due to the department being able to collect and compare the observations from many stations dispersed over a wide area, these instruments did indeed have utility in foretelling the weather, according to Hunt. In this way, the review illustrates the difficult situation the scientific community was in with respect to weather prediction. They were avidly protecting the science of meteorology from associations with weather prophecy, while simultaneously defending the project of the Meteorological Department.

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[158] William J. Read, 'The Development of Scientific Instruments Relating to Negretti & Zambra, Instrument Makers, England, 1850 – 1985.', in John T. Stock and Mary Virginia Orna (eds.) *The History and Preservation of Chemical Instrumentation* (Dordrecht: Springer Netherlands, 1986), 211–16, https://doi.org/10.1007/978-94-009-4690-3_16.

[159] 'Hunt, Robert (1807–1887), Chemist and Photographer', Oxford Dictionary of National Biography, accessed 24 July 2020, https://doi.org/10.1093/ref:odnb/14203.

[160] Robert Hunt (anonymously), '*A Treatise on Meteorological Instruments.* By Messrs. Negretti & Zambra', *Athenaeum*, no. 1897 (1864): 336.

[161] Ibid.

[162] Ibid.

Fitzroy's suicide, an investigation, and the Galton Report

Although the results above suggest that the controversy over Fitzroy's forecasts was not as intense as often suggested by historians and by some of Fitzroy's contemporaries alike, Fitzroy himself was acutely aware of any criticism he received. He perhaps also made more of comments than there actually was to them. It seems that any time someone wrote (somewhat) critical letter or article in the *Times*, Fitzroy sent a reply defending his work and explaining himself. In response to the 1862 *Times* article cited above, in which the paper distanced itself from the forecasts, and emphasised that they were the first attempt at scientific weather prediction and therefore must contain some mistakes, Fitzroy replied in a 'Letter to the Editor' the next day. He defended himself and his forecasts, explaining why forecasting the weather was so complicated, and stressed that he did not pretend to know the future, but merely presented 'probability', an opinion based on 'scientific combination and calculation'.[163] From the tone of the reply it seems that Fitzroy felt harshly criticised by the piece from the previous day.

Fitzroy was known for his heavy-heartedness and sensitivity. Burton notes that Fitzroy was 'liable to fits of depression' and that in 1865 his wife had deep concerns about his health.[164] He took some time off work to spend time away from London and he apparently at times seemed to improve, but on the morning of April 30, 1865 Fitzroy took his own life.[165] Some accounts ascribed Fitzroy's suicide to the criticism on his forecasts and his work at the department, others connected it to his worries over his role, as a devout Christian, in the development of Darwin's theory of evolution. As Burton notes, however, these theories are probably too simplistic, and the reasons for Fitzroy to take his own life were complex.[166]

Whatever the reason, the Meteorological Department now found itself without a director. The work of producing the daily forecasts had mostly been taken over by Thomas Babington, the Junior Clerk at the department, and he took over from Fitzroy as the director. Meanwhile, the Board of Trade started an investigation into the work that had been done at the department. The reason why they did this is not entirely clear. As

[163] Fitzroy, 'Letter to the Editor', 1862.

[164] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 168.

[165] Ibid.

[166] Ibid., 168–69.

indicated by the questions put to the Royal Society in 1863 the government had had its doubts about the forecasts. These doubts were probably not purely on scientific grounds. The expense of the department had risen steadily through the costs of the telegraphic communication necessary for the storm warnings and forecasts. The inquiry from the Board of Trade to the Royal Society happened in response to comments made in the House of Commons by Mr. Augustus Smith, on the greatly increased expense of the Board of Trade.[167] A committee was formed, with Francis Galton as chairman, put forward by the Royal Society, Thomas Henry Farrer, representing the Board of Trade, and Frederick John Evans from the Admiralty.[168] Both Galton and Farrer had been sceptical of Fitzroy's work, the first on the basis of his conception of 'good science', the latter was primarily concerned with the justification of the expense of the work.[169] It has been noted that it is likely that the report was (mostly) written by Galton, as he was the only one without any other professional obligations in 1866.[170] The report was presented in April 1866. It consisted of three parts and a conclusion. The first part dealt with the collection of meteorological statistics of the ocean, the second with weather telegraphy, including (or mostly focussing on) Fitzroy's forecasts and storm warnings, and the final part was on the costs of the current situation and estimated costs of the proposed reforms.

The report was a scathing condemnation of Fitzroy's work at the department. It criticised the decision to all but stop the collection of ocean statistics by the department, and emphasised that this had been the purpose of the department as described in the letter by the President of the Royal Society, which Fitzroy had seen as 'suggestions', more than a straightforward directive. According to the report, the collection of meteorological statistics was and should be the primary task of the department, if any progress was to be made in that science.[171] Thus, it should be no surprise that the shifted attention towards weather telegraphy in the previous years was severely criticised. The report made a distinction between the storm warnings and the forecasts, for their investigation. Both were assessed for their accuracy, and were found to be inadequate. The storm warnings,

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[167] *Hansard*, HC Deb 12 May 1864, vol 175, cols 399-405.

[168] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 169.

[169] Anderson, *Predicting the Weather*, 124.

[170] Ibid.

[171] Burton, *The History of the British Meteorological Office to 1905*, 56.

however, were very popular, as was shown in the reactions from harbours to questions the committee had sent them. Due to this public popularity and practical value of the warnings, the committee recommended that they should be continued. The forecasts, however, were not treated in the same way.

The committee's opinion about Fitzroy's forecasts can be found in the heading of chapters in the second part of the report. After describing the practice of weather telegraphy and the establishments of telegraphic system for storm warnings and forecasts, chapters on the 'Practice of the Department in foretelling the Weather', 'The practice not carried on according to any definite Rules', 'The Maxims on which the Department acts not founded on any sufficient induction from facts', and 'Experience of the Office not utilised in reducing this Practice to a System' follow.[172] The criticism in the report focused mostly on the (conceived) empirical nature of the forecasts, making them unscientific. Especially the fact that they were mostly the work of one person, and depended not on strict systematic rules which were laid down in writing, was a great offense according to the committee. 'No notes or calculations are made. The operation takes about half an hour and is conducted mentally'.[173] Anderson describes how the criticism in the report is a reflection of the committee's idea of 'proper science'. 'It required unvarying rules, preferably left evidence of tis logical processes in the tangible form of notes or calculations, and lent itself to command of observers and observations'.[174] Anderson concludes that the forecasts, due to their 'empiricism and imprecision […] undermined the processes of legitimate scientific work'.[175] At least, what the committee (Galton) viewed as legitimate scientific work.

The report left no doubt about the status of the weather forecasts. The committee concluded the section on the forecasts by stating that 'there is as yet no scientific basis for [them]'. As they had found that the forecasts were not 'generally correct in point of fact', nor was there 'evidence of their utility', the committee recommended their complete discontinuation. The Board of Trade welcomed this suggestion, as it would mean

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[172] *Report of a Committee Appointed to Consider Certain Questions Relating to the Meteorological Department of the Board of Trade* [hereafter 'Galton Report'], 3.

[173] Ibid., 20.

[174] Anderson, *Predicting the Weather*, 124.

[175] Ibid., 124.

a significant reduction of the expense of the department. It went even further, however, and decided to discontinue the storm warnings as well. After strong campaigning from the public these were reinstated after a year.

Subsequently, reactions to the report, both in favour of it and defending Fitzroy and his project, appeared in the periodicals and newspapers. In the *Edinburgh Review*, the Galton Report was discussed at length. This was actually the first time the periodical published anything about Fitzroy and his work at the Meteorological Department. The author this essay on 'Weather Forecasts and Storm Warnings' was very explicit about their opinion of Fitzroy's forecasts. Fitzroy was referred to as 'weather prophet', and the forecasts were said to be 'purely empirical'.[176] The author does not deny that in principle it may be possible that scientific forecasting could be done, 'that we may ultimately arrive at this knowledge [of the weather for the next two days is possible', he says. He questions, however, whether Fitzroy had the expertise to reach this knowledge. According to the author Fitzroy showed 'continual inexactitude and confusion' in his work.[177] The author drew a very clear boundary, excluding Fitzroy's forecasts, by stating that 'the very first step and aim of official action should be to take weather forecasts out of the domain of *loose conjecture and personal guesswork* and to elevate it into a science of induction. This alone will distinguish it from *vulgar prophecy*'.[178] Here Fitzroy's forecasts were put in the same category as the almanacs of the weather prophets. There is no question what the author of the essay thought about the scientific status of those.

Another author, writing article on the Galton Report in the *Athenaeum*, was a little less outspoken in their opinion. The author was positive about the contents of the report and they lamented the popular outcry for forecasts, in favour of descriptive (statistical) meteorology.[179] Fitzroy's focus on foretelling the weather was, the author agreed with the report, the reason that the department had not collected the necessary amount of meteorological data to meet the desiderata of the Royal Society. Then, on the report's conclusions about the forecasts the author commented that the report dealt 'in a manner

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[176] Anonymous, 'Weather Forecasts and Storm Warnings', *Edinburgh Review* 124 (1866): 52–83, 52.

[177] Ibid., 71.

[178] Ibid., 62.

[179] Anonymous, 'The Meteorological Report', *Athenaeum*, no. 2015 (1866): 770–71, 770.

entirely in accordance with the Committee's instructions', but that not all who read the report would sympathise with it.[180] The author seems to agree with the conclusions of the report, stating that the forecasts did not meet 'a fair measure of success', but they were also aware that the forecasts were very popular with the general public, and perhaps with some in the scientific community.

Conclusion

As has become clear in the discussion above, the general opinion within the scientific community about Fitzroy's forecasts was not unanimous or straightforward until after Fitzroy's death in 1865, at least publicly. In the public fora of newspapers and periodicals, the scientific community mostly kept quiet about the scientific status of the forecasts. It could be that this indicates that there was no great controversy over them, in their earliest stages. Perhaps they were seen as an interesting experiment, or as unthreatening to the scientific community and their status. In this case, however, it seems strange that this changed as quickly as it did, after Fitzroy's death. I suggest that there is a possibility that the scientific community did not discuss the forecasts in public due to the complex institutional status of the Meteorological Department. By criticising the department, they risked having the department's funds cut, or worse. Most men of science seemed to have been favourable of the department's existence, regardless of their opinion of the forecasts.

Gieryn has conceptualised the work done by Victorian men of science in this period as 'boundary work'.[181] He has shown that in the effort to establish a cultural authority for science, boundaries were drawn, often explicitly, on ideological bases to distinguish science from non-science. Here, I would like to propose that men of science were actively *not* drawing boundaries to define forecasts as science, or non-science. Only after the publication of the Galton Report were clear boundaries drawn, to exclude the forecasts from science. At this time, when the government intended to reorganise, and had asked the Royal Society, again, for their advice on the matter, the scientific community may have felt it was now safe to pass strict judgments on the forecasts. Furthermore,

[180] Anonymous, 'The Meteorological Report', 771.

[181] Gieryn, 'Boundary-Work'.

Galton was becoming a highly regarded man of science, and had prominent supporters in men such as Darwin (his half-cousin) and colonel Sabine. In the next chapter, I will further illustrate the background of this report, and its main author.

3. Galton and the Report

In the previous chapters I have shown that in the early 1860s Fitzroy was part of a community involved in science, which consisted of people with varying backgrounds attempting to define what it meant to be a 'man of science'. Fitzroy's work as the head of the Meteorological Department was (cautiously) accepted by most in this community, at least in public. At this time, the boundaries between who could claim scientific authority (and who could not) were being negotiated, both explicitly and implicitly. In this chapter I will show how Fitzroy's work and his reputation were subject to this process, and argue that the notion of 'hotly debated forecasts' is a notion that resulted from the eventual 'winning' of the professional scientists. It was a very direct result of the nature of the Galton Report, and the social and scientific position of its (main) author.

As shown in chapter two, Fitzroy's forecasts were neither widely and openly condemned nor widely endorsed among the members of the scientific community. In 1863 the Royal Society, after explicit inquiry into the scientific status of the forecasts, found a way in their answer to the inquiry not to formulate an opinion on the scientific merit of the forecasts.[182] After Fitzroy's death, however, and even more so after the scathing conclusions of the Galton Report, Fitzroy and his forecasts were openly criticised because they were deemed to lack a scientific basis. In December 1866, half a year after the appearance of the Galton Report, an editor of the *Athenaeum* wrote about the Board of Trade's decision to discontinue the storm warnings. According to the author, the decision had 'excited much discussion' among the British public, and appeals to reconsider the decision were made.[183] The author criticised the appeals. 'It appears', they stated, 'to be already forgotten that last spring […] the Report of a committee [the Galton Report] [was published], in which, […], it was shown that the warnings were no more trustworthy than if they had been derived from the tossing up of a halfpenny'.[184] The author of this

[182] Secretary of the Royal Society to the Secretary of the Board of Trade, 27 March, 1863. Printed in the *Proceedings of the British Meteorological Society*, Vol. I (1861 to 1863) 390-392. The exchange between the Board of Trade and the Royal Society is discussed in more length in chapter 1.

[183] Anonymous, 'Weekly Gossip', *Athenaeum*, no. 2042 (1866): 798.

[184] Ibid.

piece takes a very different view than others had done, in the same periodical, up until Fitzroy's death. As shown in the previous chapter, the *Athenaeum* had often published quite positive commentaries, especially on the merit of storm warnings. Now, with the Galton Report in hand, these warnings were condemned, and the people who called for their continuance reprimanded.

The main criticism the author of this piece had against the warnings were their lack of scientific certainty. In the previous years, the certainty of the warnings had also been questioned, but mostly just incidentally. Now this author in the *Athenaeum* could quote the Galton Report as a definitive ruling on the lack of scientific certainty of the warnings. The possibility of a system of storm warnings that did achieve such certainty was not excluded, as the author expressed the hope that 'in a few years such a knowledge of meteorological laws will be obtained as will enable the Board to resume their system of storm-warnings with some approach to scientific certainty'.[185] Thus in principle storm warnings (and, possibly, by extension forecasts) could be considered to be scientific, but Fitzroy's certainly did not meet the requirements. One point of criticism from the Galton Report, which the author in the *Athenaeum* repeated, was the insufficient focus on collecting meteorological observations. In his enthusiasm for the warnings and forecasts, Fitzroy had been distracted from what others saw as the main purpose of the Meteorological Department: collecting and coordinating meteorological observations.

This criticism was also raised against Fitzroy by Galton, in the latter's review of the former's *Weather Book*. In this chapter, I will argue that Fitzroy and Galton were both trying to establish their own personal authority in the scientific community, along their attempt to define the way forward for meteorology. In order to do so, they tried to discredit the other, on the basis of the value of their work. The Galton Report can be construed as a way for Galton to establish his ideas about the correct approach to meteorology. In that way, it is an example of the boundary work being done by Galton, to exclude Fitzroy and his work from 'science'. This struggle for personal and scientific authority, as I will show, was exemplary of the wider attempt of the 'scientific community' to establish boundaries in the third quarter of the nineteenth century.

[185] Anonymous, 'Weekly Gossip'.

In order to illustrate the differences and similarities between Fitzroy and Galton in their ideas about meteorology, I will take a closer look at each of their books which were both published in 1863. First, I will discuss Fitzroy's *Weather Book*, its message, intended audience, and what we can learn from it about Fitzroy's general ideas on the way forward for meteorology. Then I will take a look at Galton's *Meteorographica*, and compare his objectives and ideas about what constitutes 'science' with those of Fitzroy. Lastly, I will return to the investigation of Fitzroy's work after his death, and Galton's role in this. Here I will show that Galton's position on the investigatory committee, and his subsequent role in the reorganisation of the Meteorological Department were instrumental in the later view of Fitzroy's forecasts as 'premature', or 'controversial'.

Fitzroy's *Weather Book* and his ideas about meteorology

The *Weather Book* was published in 1863. It has been argued that Fitzroy wrote the book to justify his methods, in response to criticism of his forecasts and storm warnings.[186] This could indeed be the case. As I have shown in previous chapters, Fitzroy was very aware of any criticism directed towards him. In the book, Fitzroy does mention the fact that some objections had been made to his forecasts.[187] It is not entirely obvious, however, that this book was solely a reaction to this criticism. In the introduction of the book, Fitzroy made clear that this book, in line with his views of the work of the meteorological department, focused on the practical use of meteorology. It was aimed at a broad audience, 'intended for many, rather than for few'.[188] Part of the reason for writing this book could indeed have been a desire to instruct as many people as possible, so that Fitzroy's forecasts could be utilised as best as possible. He expressly aimed his work at 'the unpractised and […] the young, rather than to the experienced and skilful, who do not need such information'.[189] This does not necessarily go against the narrative that Fitzroy felt the urge to write the book to appease his critics, but I want to offer up the possibility that this was indeed his honest intention.

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[186] Anderson, *Predicting the Weather*, 119; Achbari, *Rulers of the Winds*, 95.

[187] Fitzroy, *Weather Book*, 190.

[188] Ibid., 1.

[189] Ibid., 2.

Whatever the actual intention for writing the book, it probably was not very accessible for the public he had had in mind. The book is nearly 500 pages long, and very densely packed with theory and information. Fitzroy gives a detailed overview of theories of the atmosphere, the movement of weather systems, as well as an illustration of the work of the Meteorological Department. Throughout the book, and especially in the sections on the work of the meteorological department, Fitzroy's convictions about the most appropriate ways to pursue meteorology are clearly established. Firstly, although any theory or practical work in meteorology should be based on empirical facts, Fitzroy warns against the hazards of unguided, limitless fact gathering. 'Loading the mind, as well as shelves, with overwhelming accumulations of facts, only causes distaste, if not oppression, even among the most zealous', he wrote.[190] Measuring minute local differences was unhelpful, even harmful, for the purpose of general forecasts and storm warnings. The unbounded accumulation of observation could halt the progress of science, according to Fitzroy. Thus, a careful selection in what kind of observations were collected, and how frequently, was necessary.

Secondly, this apprehension of vast amounts of unselected data also played a role in Fitzroy's ideas about the publication of weather observations. He was against the publishing of any and all weather logs. Only the '*combined data* from many sources are wanted by the majority of those who are interested in such matters, not isolated diaries or extracts, except in special cases'[191] Rather, Fitzroy argued that the observations collected by the Meteorological Department should first be summarised into charts. Fitzroy discussed two types, the naval charts divided into squares of 10 degrees longitude and latitude, and so-called 'synoptic charts'. The first were used by lieutenant Maury as well, in his collection of maps of the winds on the oceans. The second kind, the synoptic charts, were first made by the Meteorological Department in 1857. Observations were collected from Britain, the Us, Norway, Denmark, the Netherlands, Germany, France, Spain, Portugal, and Italy, according to Fitzroy, with which maps were produced representing simultaneous observations over a very large area of the world.[192] Fitzroy emphasised the importance of such maps, in showing the progress of the weather over a period

[190] Fitzroy, *Weather Book*, 32.

[191] Ibid., 33.

[192] Ibid., 102.

of time. Of these maps, of which the department produced over one hundred, according to Fitzroy, only a few were published. These were the maps that showed two severe storms in 1859, and were published 'as an atlas, with the Tenth number of the Board of Trade Meteorolog [sic.] Papers'.[193]

A third noticeable feature of the *Weather Book*, is the continuous reference to Fitzroy's naval background, and the benefits of his work at the department for those at sea. He seemed genuinely concerned with the safety of seamen. He recognised that the department was set up, at least in part, to enable swifter navigation of the oceans, in order to increase commercial benefit, but with shorter travel times, he remarked, there is also 'a great diminution of the risk from fatal maladies; as instead of losing time, if not lives, in unhealthy localities, heavy rains, or calms with oppressive heat, a ship properly navigated may be speeding on her way under favourable circumstances'.[194]

Fitzroy's ideals, then can be summarised as guided and goal-related gathering of observations, communication of these observations in 'usable' form, and the main aim for these observations, for him, was to ensure safe passage for seamen. Fitzroy did mention the fact that the purpose of the work of the meteorological department was twofold, namely the betterment of naval navigation, but also collecting observations for the use of men of science. He did not, however, reflect on the way in which the department worked towards this second goal. In the next sections, I show that although there are similarities between Fitzroy's and Galton's ideas about the way meteorology should be done, they differed on some key issues. Galton did not think there was such a thing as 'too many observations', and his ideas about 'useful communication' also differed from those of Fitzroy.

Galton's early career in geography and meteorology

Francis Galton (1822-1911) is now primarily known for his work in statistics, heredity, and eugenics, but he began his career in geography and meteorology. Galton, at the strong suggestion from his father, had begun studying medicine at King's College, but had transferred to studying mathematics at Cambridge. He had obtained a mere 'pass'

[193] Fitzroy, *Weather Book*, 32.

[194] Ibid., 53–54.

for his mathematics exam, when his father died in 1844, leaving a considerable inheritance.[195] Galton had never been much of a studious person despite apparently discussing the *Iliad* at the age of six, and he seized the opportunity to quit his studies.[196] He gained notability in the (scientific) world with his travels in West-Africa, and the two books he wrote about them. The first, *Tropical South Africa*, was a popular account of his travels and the second, *Art of Travel*, a 'how-to' book for the Victorian traveller. The first of these earned Galton the Founder's Medal of the Geological Society in 1854.[197] He wrote several other papers on his African travels, and he became the honorary secretary of the Royal Geographical Society in 1857.

By the late 1850s Galton had been elected a fellow of the Royal Society and was a member of the Kew Committee of the BAAS. There he became acquainted with and interested in the science of meteorology. Though he did not have any educational background in meteorology, he set out to work in that direction. By 1863 he had written two highly regarded papers and a book, *Meteorographica*, on the subject.[198] According to Waller, this decision to go in the direction of meteorology was largely strategical, for Galton. 'For an individual', Waller states, 'who shunned competition, disliked fields requiring extensive preparatory learning, and was keen to make an early impression, meteorology had much to commend it'.[199] As meteorology was a relatively young science, compared to the more traditional disciplines of chemistry or physics, this field was tempting for Galton who had a wide interest, but did not really follow through on most subjects. Consequently, there was some animosity between Galton and Fitzroy, which Waller ascribes to their shared ambition of making a name as a man of science and their conviction that meteorological science was at that time very well suited for a man to make a name for himself.[200] Both men criticised each other's work through reviews in the *Athenaeum*.

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[195] Nicholas Wright Gillham, *A Life of Sir Francis Galton: From African Exploration to the Birth of Eugenics* (Oxford University Press, 2001).

[196] Ibid., 24.

[197] Milo Keynes, *Sir Francis Galton, FRS: The Legacy of His Ideas* (Springer, 1993), 10.

[198] John C. Waller, 'Becoming a Darwinian: The Micro-politics of Sir Francis Galton's Scientific Career 1859–65', *Annals of Science* 61, no. 2 (April 2004): 145, https://doi.org/10.1080/00033790110117467.

[199] Ibid., 145–46.

[200] Ibid., 145.

Galton ultimately had the best platform to attack Fitzroy's work, as the chairman of the committee investigating the Meteorological Department after Fitzroy's death.

Galton's criticism of Fitzroy's work often addressed fundamental ideas about the way in which scientific work should be undertaken. In the review of Fitzroy's *Weather Book* that Galton wrote for the *Athenaeum*, he not only criticised Fitzroy for speculating, as described in the previous chapter. He also found fault with the work on a more fundamental level, relating to his own ideas about the best foundation of the developing science of meteorology. According to Galton, Fitzroy was being too rash in his conclusions, applied rules and laws, such as the rule that weather systems generally moved eastward due to the earth's rotation, in a field where, in Galton's view, a strong foundation of empirical facts was lacking. Fitzroy's work failed to do what it set out to do, namely to give a foundation for the practical use of meteorology, according to Galton. He argued that 'it is a fault in a book intended to lay the foundation of a new experimental science, that it should be mainly occupied with deductions from unproven hypotheses, instead of the careful establishment of axioms by rigorous induction from observed facts'.[201] Around the early 1860s, Galton and Fitzroy clearly differed in their opinion about what could, or should, be done in the science of meteorology, and to what end.

Galton's meteorology: data collection and visual representation

Galton took a different approach to meteorology than Fitzroy. While Fitzroy was primarily concerned with obtaining useful knowledge about the development of storms and weather, in order to use this knowledge for the benefit of the public, Galton was focused on collecting as many measurements as possible, without which he thought there was no sound foundation for the science. Galton put much emphasis on the need for collecting these measurements, and on the need for their easy communication. Fitzroy agreed with this notion that observations should be easily communicated, but the two men differed in their opinion on how this was done best, and in their intended audiences. For Fitzroy, communication was aimed at sailors and the general public. This meant that the observations should be summarised in such a way that the general reader could gain some intelligence of the weather from them. Galton's intended audience were other men

[201] Galton (anonymously), 'Review of *The Weather Book*', 80.

of science. Therefore, he wanted to communicate much more 'raw' data, in a less reduced form. This was done best, he thought, by visually representing the data on maps and in diagrams. In the *Weather Book*, Fitzroy had commented on the usefulness of maps and charts for the communication of weather observations, and he had described the efforts of the Meteorological Department to produce them, but they were not widely published, and they contained only reduced and summarised data. Galton lamented this fact that the department produced apparently 'hundreds of wind-charts', without publishing them.[202]

In order to promote his ideas about the best method of collecting and representing meteorological measurements, Galton set out to produce a collection of maps and charts of the weather in Europe for the month of December in 1861. This work, the *Meteorographica* was published in 1863.[203] In the introduction to this work, he made clear what deficiency in meteorology he aimed to rectify. He wrote that 'a scientific study of the weather on a worthy scale, [was] an impossibility at the present time from want of accessible data. We need meteorographic representation of large areas, as facts to reason upon'.[204] In 1861, he had sent a request to 'most of the leading meteorologists of the continent',[205] including Quetelet in Belgium, Buys Ballot in the Netherlands, and Karl Kreil in Austria, to send him meteorological measurements, of the barometric pressure, temperature, force and direction of wind, and state of the sky (degree of cloudiness), for each day of the month of December.[206] These measurements were to be taken three times a day. Before being sent, they should be corrected for altitude and converted into the appropriate (English) scales. Galton also enclosed blank schedules with the circular, on which the measurements were to be filled out. 'The result', Galton wrote, 'will be the accomplishment of a valuable piece of scientific work, that will also help to afford an answer to the question whether synchronous charts may hereafter be printed regularly, with success'.[207] This project clearly showed his intentions for the future of meteorology.

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[202] Galton (anonymously), 'Review of *The Weather Book*', 81.

[203] Francis Galton, *Meteorographica; or, Methods of Mapping the Weather of a Large Part of Europe, During the Month of December 1861*, 1863.

[204] Ibid., 3.

[205] Ibid., 4.

[206] Francis Galton, 'Circular Letter to Meteorological Observers' (Privately printed, 1863).

[207] Ibid.

From the measurements Galton received from about 80 stations, mostly located in Belgium, Holland, Prussia and Austria, he produced 93 maps showing the weather three times a day for each day of December. He used a set of symbols he had devised for the purpose, indicating cloudiness with a range of stripes, and wind direction with an arrow-like figure (*figure 2*). He also included charts with a geographical representation of barometer measurements, using symbols and colours to visually indicate the value of the reading (*figure 3*). Although his main objective in preparing the book was to propose a new way of gathering and communicating meteorological data, he added some 'meteorological results' as well.[208] The most important of these was that Galton proved the existence of not only cyclones, but also anti-cyclones. The cyclonic nature of storms, where the air moved in anti-clockwise direction around an area of low barometric pressure, had been assumed for some years, and in the *Meteorographica* Galton showed definitively that there were indeed such storms. He also observed the exact opposite, in his maps. There appeared to be weather systems where the air moved in clockwise direction around an area of high barometric pressure. These he termed 'anti-cyclones'. Galton prefaced his conclusions with a caution that they were not definitive, as his data was not exhaustive, but he is now credited with the discovery of these anti-cyclones. The *Meteorographica* is further credited by historians with proving the effect of mountain ranges, such as the Alps, on weather systems.[209]

The *Meteorographica* did not only function as an argument for his own agenda for the science of meteorology, but also simultaneously as a criticism of Fitzroy's work at the Meteorological Department. In the introduction to the book, Galton commented on the lack of organised collection and distribution of weather data. He remarked that in Europe over 300 observers sent daily observations to meteorological institutes of some kind, but that there was no central point of collection of all these observations.[210] The department had not done enough to attain this goal, according to Galton. The

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[208] Galton, *Meteorographica*, 7.

[209] Crispin Tickell, 'Meteorographica and Weather', in *Sir Francis Galton, FRS: The Legacy of His Ideas: Proceedings of the Twenty-Eighth Annual Symposium of the Galton Institute, London, 1991*, ed. Milo Keynes, Studies in Biology, Economy and Society (London: Palgrave Macmillan UK, 1993),54-61: 55–56, https://doi.org/10.1007/978-1-349-12206-6_4.

[210] Galton, *Meteorographica*, 3.

observations the department received were made only once daily, which was insufficient according to Galton. Furthermore, the department did not publish enough extended meteorological records. This was, at least in part, the reason for the lack of substantial progress in the science, according to Galton. Thus, he proposed better and more efficient data collection was needed for the future of meteorology. The labour of collecting the meteorological measurements for his book was too much, according to Galton, for anyone to do every time they wanted to study the weather. This work, he felt, was exactly the kind of work that central institutes should take on. Here, he made reference to Fitzroy's work at the Meteorological Department. Galton expressed gratitude for Fitzroy's daily reports, but he 'believed them to be insufficiently numerous, extended, or frequent'.[211]

Thus one important difference between Galton and Fitzroy was their opinion about the value of vast amounts of data. Fitzroy, as shown above, valued the collection of observations for a specific purpose. Limitless or indeed purposeless amassing of data only hindered the utility of them. Galton, on the other hand, did not think there was such a thing as too much data. With the *Meteorographica*, he had shown that using and visualising large amounts of data could lead to new, previously unexpected knowledge, such as the existence of anti-cyclones.

[211] Galton, *Meteorographica*, 3.

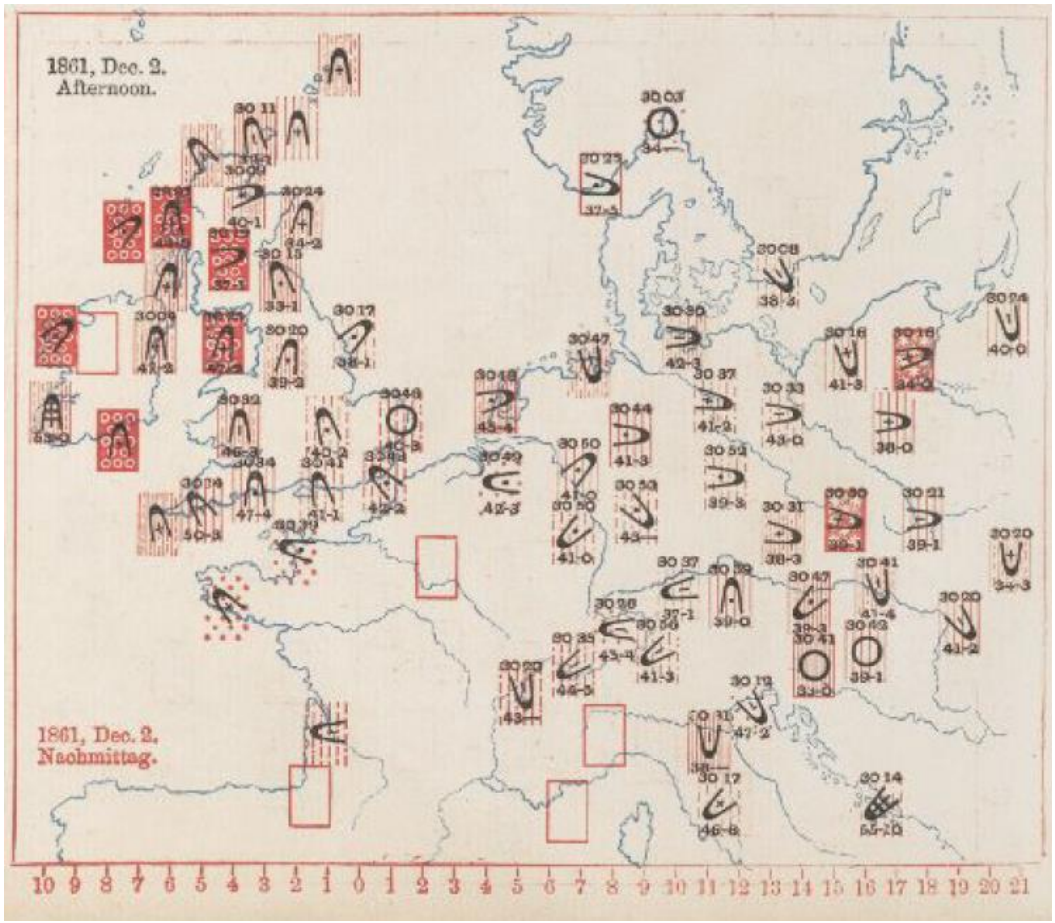

Figure 2 Weather map for afternoon December 2 1861. The amount of stripes in one square indicates cloudiness, with the more dense the stripes, the cloudier the sky. The arrow-like figures in the squares indicate wind direction, with dots indicating the force.

Having established the importance of widely shared, vast amounts of data, Galton proceeded to explain his proposed way of communicating the observations. He found fault with the usual communication of measurements listed in large tables. 'When lists of observations', he said, 'are printed in line and column, they are in too crude a state for the employment in weather investigations; after their contents have been sorted into Charts, it becomes possible to comprehend them; but it requires meteorographic Maps to make their meaning apparent at a glance'.[212] As a first step, he argued for the measurements of one place to be printed 'compactly in squares', as opposed to on one line. This meant that in a rectangular box of about 1 by 1.5 cm would contain the name of the place the measurement was taken, reading of the barometer, direction of wind, force of the wind, a measure of how cloudy the sky was, and the correction to thermometer related to the height above sea level of the station (*figure 4*). This way the meteorological data for one place could be perceived at once, according to Galton.

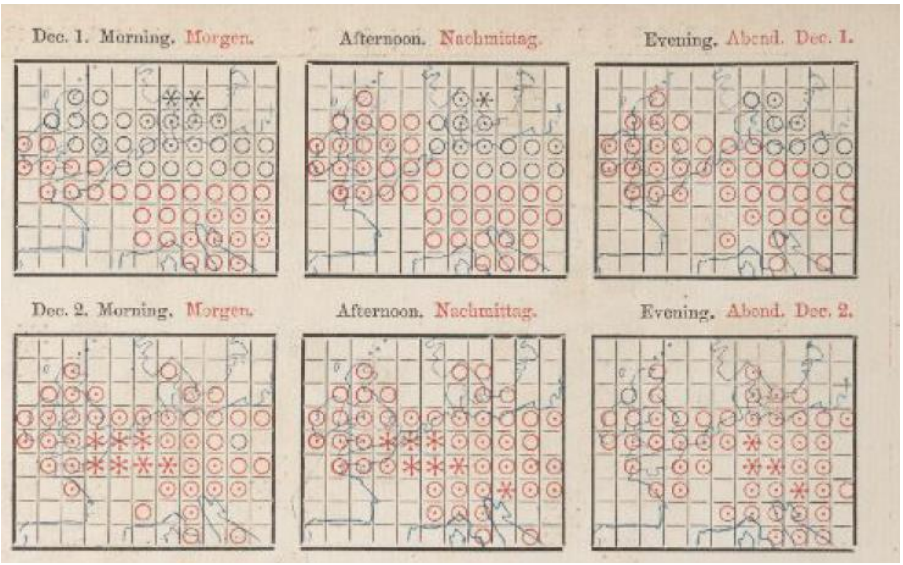

Figure 3 Galton's Barometrical charts. The circles are drawn in on a diagram of north-western Europe. The color of the circle indicates weather the measurement is higher (red) or lower (black) than the average barometric height. The symbols each indicate a range of barometric readings.

[212] Galton, *Meteorographica*, 3.

The tables with these squares were to be complemented by 'a series of small meteorographic Maps' like the ones Galton made.[213] He asserted that a series of the maps he provided for one month, extending over two or three years, would give meteorology 'an extraordinary impetus'.[214] Not only would such a series generate and supply a great source of material for the study of meteorological science, it would also, according to Galton, provide a way to test 'the extant theory of 'forecasts' with a rigour impossible at the present time, and they would necessarily improve it'.[215] Galton was of the opinion that weather maps would, by visualizing the state of the weather for a vast area of land simultaneously, provide a better way to assess the correctness of Fitzroy's forecasts. He did not, however, expand on this point and explain how maps would aid the practice of forecasting. As the forecasts were made for large areas of land, Galton may have thought that the visualisation of the weather over these areas provided better means for assessing them, than records of the state of the weather at specific places.

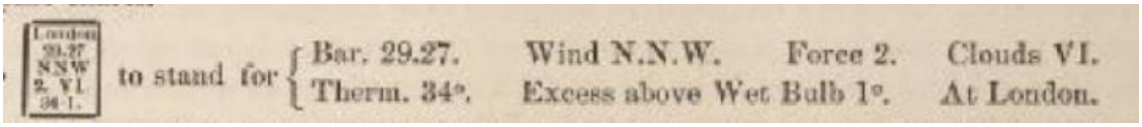

Figure 4: Galton's proposed 'squares' for communicating meteorological measurements. From top to bottom it reads 'London, 29.27, NNW, 2 VI, 34, 1'.

Although Galton scholars nowadays emphasise the discoveries Galton made in the *Meteorographica*, such as the anti-cyclone, and the revolutionary character of his weather maps,[216] at the time it was not an undisputed success.[217] Critics lamented the unintelligibility of Galton's symbols, and the over-crowdedness of the maps with their red and black diagrams. Anderson points out that instead of the direct communication of weather data that Galton claimed his maps provided, they actually 'were just as likely to raise problems of interpretation and call attention to a hierarchy of technological and analytical expertise'.[218]

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[213] Galton, *Meteorographica,* 3.

[214] Ibid.

[215] Ibid.

[216] Michael Friendly and Howard Wainer, 'Galton's Gleam Visual Thinking and Graphic Discoveries', *Significance* 17, no. 3 (2020): 28–33, https://doi.org/10.1111/1740-9713.01403.

[217] Anderson, *Predicting the Weather*, 201.

[218] Ibid.

Those that agreed with Galton that the meteorological tables published by the Meteorological Department were lacking in clarity tended to appreciate Galton's work. An anonymous reviewer in the *Westminster Review* commented that, with the *Meteorographica*, Galton had given 'a comparative summary of the meteorology of a great part of Europe […], such as we should in vain attempt to obtain from any inspection of weather tables'.[219] The author expressed the hope that the Meteorological Department would continue the work initiated by Galton, and would consider the production of meteorographical charts for the communication of their weather data. This was unlikely, however, as Fitzroy was not convinced by the publication. According to Waller, Fitzroy considered the book to be an example of 'un-Baconian theorizing'.[220] Fitzroy was of the opinion that Galton speculated on the basis of insufficient data, using the same argument that Galton used against him. Galton himself admitted, in the introduction to the book, that his data did not cover the entire region he mapped, and that it was very likely that measurements were incorrect, due to correction mistakes, or inaccurate readings by the local observers.[221] He did not describe any statistical dealing with the errors, except that he found about one in ten records to be 'obvious irregularities'.[222] Nevertheless, Galton proceeded to stake some strong claims upon the charts, such as the existence of anticyclones. Fitzroy believed that this claim was too premature, and wrote to Sir James D. Forbes that '[Galton's] views about anti-cyclones seem to myself – among many – quite unsupported by facts or any plausible theory'.[223]

The *Meteorographica* can be seen as an illustration of Galton's ideas of what science in general, and meteorology specifically, should look like. It is a testament to his emphasis on data collection, on statistical research, and on using visual representation of the data to communicate them. The book also illustrates very clearly the differences between Galton's work and that of Fitzroy. Weather maps were, for instance, made at the

[219] Anonymous, 'Science', *Westminster Review* 79–80 (1863): 261.

[220] Waller, 'Becoming a Darwinian', 154.

[221] Galton, *Meteorographica*, 6.

[222] Ibid.

[223] Robert Fitzroy to Sir J.D. Forbes, 4 January 1864, quoted in: Waller, 'Becoming a Darwinian', 154.

Meteorological Department as early as 1857, but they were not published, much to Galton's regret.

Galton *versus* Fitzroy: Victorian context

The greatest difference between Galton and Fitzroy's approach to meteorology was their intended audience. For Fitzroy the science of meteorology was a means to practical ends. His primary concern was to enhance the safety of those who set out to sea, and to aid individual observers by supplying them with the (summarised) meteorological reports and weather forecasts. The collection of observations for the aid of men of science was of secondary importance for Fitzroy. Galton, on the other hand, had the advancement of knowledge in mind as the most important goal, when he argued for better communication of weather observations. *Public* or general practical value was merely a secondary benefit. These differences between Fitzroy and Galton are exemplary of the developments in the societal context of science in the mid-Victorian era. Historians in the 1970s, particularly Frank M. Turner, described this period as a period of *professionalisation*, in which the pursuit of science changed from a personal vocation for the elite, into a paid profession.[224] More recently, however, historians have pointed at the teleological assumptions of this thesis and have nuanced it, taking into account actors' categories, the aims of the historical actors at the time, and focusing on the reception and emergence of different audiences for science.[225]

Although these more recent studies have shown that the professionalisation thesis as explanation of every dispute and action within the Victorian scientific community ignores important aspects of the historical debate. Barton has shown, for instance , that 'amateur' and 'professional' were not necessarily the boundaries of in- or exclusion. The notion, however, that in the mid-nineteenth century, men of science were engaged in a what can be termed a 'fight for authority', along several social and scientific divides, still holds. Barton summarises what Jack Morell and Jan Golinski had identified in the 1990s as the several changes that were collected together in the notion of professionalisation:

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[224] Frank M Turner, 'The Victonan Conflict between Science and Religion: A Professional Dimension', *Isis* 69 (1978): 356–76.

[225] Barton, '"Men of Science"'; Aileen Fyfe and Bernard Lightman, *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (University of Chicago Press, 2007).

'an increase in the number of full-time paid positions; the establishment of specialist qualifications; the development of formal training procedures; specialization in publication; growing group solidarity and self-consciousness; new internal reward systems; [and] a firmer boundary between amateurs and professional specialists which set up a new barrier against women's participation'.[226] Although she agrees that these were trends in nineteenth century science, she argues in her paper that the division between 'amateur' and 'professional' was not an actors' category. She shows that in the mid-nineteenth century, language of in- and exclusion was much richer, and that amateurs could be both included and excluded. This is particularly interesting in the context of the case of Galton and Fitzroy, as both men do not neatly fall in either the older elite, Oxbridge men of science, nor in the new professional category. As shown in chapter one, Fitzroy's place in the scientific community was ambiguous. Fitzroy was an aristocrat, but not with an Oxbridge education or other scientific background. He did have a paid position which might place him in the 'professional' category, but this was not an unequivocal 'scientific' position.

Galton, on the other hand, did study mathematics at Cambridge, and came from an intellectual family, but he only 'passed' his exam and did not continue his studies there. He spent one or two years at medical school, but did not finish this. His background could qualify him perhaps as part of the Oxbridge elite, but in the late 1850s and early 1860s he was very much looking to make a place for himself in the scientific community. In the late-1860s he actively aligned himself with Huxley and the naturalists, who were part of the 'professionalisation' movement against the older elite, in terms of Turner's notion of professionalisation. Waller has argued that Galton's association with the X-Club is not anomalous, however. Galton understood, correctly, that in the 1860s (and later) he could enhance his own authority in science as well as in broader culture, by aligning himself with these men.[227]

[226] Barton, ''Men of Science'', 76–77.

[227] Waller, 'Gentlemanly Men of Science'.

Success of the Galton Report

After Fitzroy's death, the government appealed to the Royal Society and it was decided that a committee would be installed to evaluate the work of the Meteorological Department under Fitzroy. Galton was asked to take place in this committee on behalf of the Royal Society, together with representatives from the Admiralty and the Board of Trade. The report of the committee was presented in April 1866 and, in the words of Burton, 'it virtually demolished everything [Fitzroy] had accomplished'.[228] The report was definitive in its conclusions, the work of the department, for which Fitzroy was responsible, did not meet Galton's standards. One of the strongest criticisms, perhaps, or at least the most indicative of the differences between Galton and Fitzroy, was directed at Fitzroy's decision to all but cease collecting meteorological measurements from ship logs.[229] As shown above, Fitzroy did not see much merit in the aimless assimilation of data, just for the sake of collection. By 1862 he had found himself and his clerks overwhelmed by the amount of observations they had collected, and unable to process everything. He had judged that they had collected enough measurements for their immediate purposes.[230] This went against everything Galton believed in.

Furthermore, the forecasts were strongly criticised as well. According to the report, they lacked any basis in science. They came about without any calculations written down on paper, and there were no straightforward rules to base the forecasts on. In fact, the whole endeavour depended on the knowledge of one man.[231] Fitzroy had anticipated this criticism, in his *Weather Book*, where he stated that, in fact, the work did *not* depend on just him, that it was a collective process.[232] The focus on the individuality or collectivity of the process of forecasting was related to the association of the practice with weather prophets. These were seen as individuals, their work as highly individualistic. In

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[228] Burton, *The History of the British Meteorological Office to 1905*, 56. Burton is very critical of the Galton Report. According to him, 'Galton was preoccupied with the power of statistics, his judgment was erratic and he lacked the imagination necessary to look upon FitzRoy's work as more than an academic exercise being attempted by someone lacking in scientific expertise'. 62.

[229] Burton, 'Robert FitzRoy and the Early History of the Meteorological Office', 169.

[230] Burton, History of the British Meteorological Office to 1905, 47, 56.

[231] Achbari, *Rulers of the Winds*, 98.

[232] Fitzroy, *Weather Book*, 171.

contrast, meteorology as a scientific discipline was developed in a collective context, with observation networks and central institutions. According to Anderson, 'Meteorology thus became a science in which the nature of collaboration, institutional authority, and public responsibility could be debated'. [233] In that way, the criticism that the forecasts relied too much on one person associated Fitzroy's forecasts with the popular weather prophecies, thus undermining their scientific value.

The report proposed to discontinue the forecasts, as they were unscientific and were not deemed very valuable. The storm warnings, however, were recommended to continue. The committee had sent out a question to the ports who received the warnings, asking them about their experienced value. They received many glowing reviews, and judged that, despite their basis being the same as the forecasts, their practical value justified the warnings. The report was warmly received by the government, as they now had legitimate reasons to cut the budget of the Meteorological Department. After having raised questions about the work of the department in connection to their funds several times over the previous decade, they now had the answer they had been looking for. Both the storm warnings and the forecasts were discontinued, despite the recommendation to keep the warnings in place.

A last recommendation of the report, was to reorganise the Meteorological Department. It was suggested to bring the work under the Kew Committee's supervision, because a scientific body would be more suited to direct the work than a governmental body.[234] The government took this recommendation to heart as well. The Kew Committee was discussed, but eventually it was decided that the department, renamed as the Meteorological Office and housed under the Board of Trade, would be supervised by a committee of the Royal Society, the Meteorological Committee. The committee was established on 13 December 1866 when the Council of the Royal Society met, and it existed of seven men: John Peter Gassiot, Dr William Alan Miller, Warren De La Rue, Francis

[233] Anderson, *Predicting the Weather*, 82.

[234] Burton quotes a letter from Galton to Sabine, in which Galton explains that several options were considered, but that he preferred that Kew was given the task. He had a 'branch office' in London in mind, which would be run by a superintendent 'of sufficient character and intelligence', but he 'would act entirely under the orders of Kew'. It is worth wondering whether Galton saw an opportunity for himself here. Burton, *The History of the British Meteorological Office to 1905*, 58–59.

Galton, William Spottiswoode, the Hydrographer, and colonel William James Smythe.[235] All of these men were at that moment members of the Council, or had been the year before. The committee was thus comprised of some of the highest scientific authorities in Britain at the time. The committee appointed Robert Henry Scott as the new director of the Meteorological Office. Scott had little prior experience in meteorology. His only work in that context was his translation of Dove's work on the theory of storms into English.[236] According to Burton, Scott owed the position to his close connection to general Sabine, then president of the Royal Society. Scott's appointment was illustrative of the intentions the Meteorological Committee had for the new Meteorological Office. They had, most likely, chosen him for his reputation as a reliable administrator, not because of his scientific authority. In Burton's words, they were 'not looking for an innovative scientist – the scientific thinking under the new regime was to be done by the Committee'.[237] In that way, Fitzroy's legacy was almost completely wiped out. His project of forecasting the weather was stopped, harbours no longer received life-saving storm warnings, and the department was reorganised into a mere institute of collection, with barely any public purpose in view.

In 1879, when the practice of forecasting was reinstated by the Meteorological Office, several articles on forecasting, and its history were printed in the periodicals. One such article was 'Weather Forecasting' by Sir John Knox Laughton, a naval historian at the Royal Navy College at Greenwich, in the literary journal *Fraser's Magazine*.[238] Laughton acknowledged Fitzroy's role in the history of forecasting in Britain. The warnings and forecasts were the consequence of Fitzroy's 'devoted industry', according to the author.[239] The attempt, however, 'was rather premature, and [the forecasts'] correctness was very doubtful'.[240] Laughton stated this as a given, with the discontinuation of the forecasts as proof of the consensus about the lack of scientific value of the forecasts.

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[235] Burton, *The History of the British Meteorological Office to 1905*, 69.

[236] Ibid., 71.

[237] Ibid., 72..

[238] J.K. Laughton, 'Weather Forecasting', *Fraser's Magazine* 20, no. 1879 (n.d.): 242–54.

[239] Ibid., 246.

[240] Ibid.

Another, similar, article in the same year in the *Quarterly Review*, titled 'The Weather and its Prediction' discussed several publications on meteorology, weather charts and weather prediction.[241] It traced the development of 'existing systems' of weather services in several countries, such as (then) Germany, France, the USA and Britain.[242] It is notable, however, that the first director of the British weather service, Robert Fitzroy of the Meteorological Department, was not part of the history of forecasts in Britain, in this piece. The only mention of Fitzroy, in the article, was, ironically, in reference to Galton's *Meteorographica*. The author noted that the *Meteorographica* was far ahead of its time, and 'had Admiral FitzRoy recognised in all their fullness the pregnant ideas sketched out in *Meteorographica*, he would have anticipated almost all the so-called discoveries of the last fifteen years'.[243] Not only was Fitzroy's own work not worth discussing, to this author, he was even to be blamed for the lack of attention he paid to Galton's *Meteorographica*.

These 1879 articles read very differently from the discussion in the 1860s around Fitzroy's forecasts. An obvious difference is that in the 1860s there was little doubt that Fitzroy was pioneering the practice of forecasting, whether people condoned that practice or not. By 1879, however, his role in the development of meteorological weather prediction was seen as negligible. Over the course of a little over a decade, and a reorganization of the Meteorological Department, Fitzroy's ideas and methods of running the Department had been all but forgotten

Conclusion

As described in this chapter, the eventual 'victory' of Galton's ideas about science, and the posthumous eviction of Fitzroy from the scientific community should not be taken as self-evident. They were both equally fighting for their visions of a 'man of science', and of meteorology. Galton can be said to have been the most successful, as he would become a very influential man of science. As such, his ideas have been disseminated

[241] Anonymous, 'The Weather and Its Prediction', *Quarterly Review* 149 (1879): 489–500.
[242] Ibid., 490.
[243] Ibid., 494.

through his widely read and used work, and his legacy as a prominent man of Victorian science lives on today.

In the 1860s, however, this was all still to come. Galton's success in advocating his version of meteorology, had depended on several factors. First, Galton's position on the investigating committee after Fitzroy's death, was undeniably beneficial for the promotion of his own ideas, and his criticism of Fitzroy's work. Second, the government was very welcoming to Galton's suggestions, including the discontinuation of the forecasts, as they had been apprehensive about the costs of this practice for some years.

Conclusion

Under the direction of the Meteorological Committee, the Meteorological Office continued its work of collecting and combining meteorological measurements. Daily weather reports were still sent to the *Times* and other newspapers, but without the notice of the 'probable weather'. The system of storm warnings was taken up again shortly after it was stopped, in 1867, after public protests to reinstall the warnings. The warnings were only given out, however, for storms which were already in existence, not for those which were to be expected on the basis of other weather signs.

Galton continued to serve on the Meteorological Committee (later Meteorological Council) until 1900.[244] In this role, he further developed his meteorological charts, and in 1875 the first daily weather maps, based on his work, were printed in the *Times*. In 1879, Galton was behind the proposal to reinstate the weather forecasts.[245] In order to be able to argue that now the forecasts were, in fact, scientific, the men behind them had to justify the new scientific basis of the forecasts. Achbari and van Lunteren have argued that to this end, the British turned what was known as the empirical 'Buys Ballot's rule' into 'Buys Ballot's law'.[246] The rapidity with which the rule was empirically verified, and the fact that Fitzroy also made use of this rule, suggest that there was not necessarily a better scientific basis for the forecasts in 1879, but that other factors played a role in their resumption.

This reinforces the proposition of this thesis, that social and political factors played an important role in the public discussion about Fitzroy's weather forecasts by men of science. A little over a decade after Fitzroy's forecasts had been deemed unscientific by Galton in his report, there had been very little progress in the theory that was at the basis of these forecasts. Therefore, an internal explanation based on theoretical progress within meteorology does not sufficiently account for the initial discontinuance and consequent reinstatement of the forecasts.

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[244] Burton, *The History of the British Meteorological Office to 1905*, 185.

[245] Ibid., 159.

[246] A. Achbari and F. van Lunteren, 'Dutch Skies, Global Laws: The British Creation of 'Buys Ballot's Law'', *Historical Studies in the Natural Sciences* 46, no. 1 (February 2016): 1–43, https://doi.org/10.1525/hsns.2016.46.1.1.

The social and cultural context of the Victorian men of science informed their public reactions to the work of the Meteorological Department. I have shown how the department's institutional context as a governmental body with both practical and strictly theoretical aims, functioned as a factor in public debates about the work done at the department. The scientific community saw the institution as a success of their campaign to get the government to fund science more structurally. This meant, however, that they were probably cautious in criticising Fitzroy's forecasts. In order to be able to use the department as a success story, to help their campaign for funding, they had an interest in not outright attacking it's head, Robert Fitzroy.

Before his death, Fitzroy was not (yet) seen as a fringe figure in the scientific community. He was a fellow of the Royal Society, and corresponded with the likes of John Herschel and Edward Sabine. The more popular image of Fitzroy, that of a literalist Anglican who criticised Darwin's evolutionary theory with a Bible in hand, or that of an overzealous naval officer trying to be a meteorologist, has been based, mostly, on posthumous accounts.[247] Although Fitzroy was not a very diplomatic person, at times, he was well-respected within the scientific community. After Fitzroy's death, however, accounts from Darwin, for instance, reshaped the public image of Fitzroy.

The reshaping of the image the public had of Fitzroy probably helped to affirm the idea that his forecasts had been unscientific and problematic. As I have shown, the public discussion about the forecasts was rather subdued until 1865. There were critics of Fitzroy's work, most notably, and perhaps most vocally, Francis Galton. There was, however, not a clear consensus among the scientific community that the forecasts were problematic. Men of science handled the forecasts with caution, aware of the connotations with weather prophecy, but did not outright condemn them. Only after Fitzroy's death, and especially after the Galton Report was published, did the forecasts become the object of strong and ample criticism. This change in the discourse may perhaps be explained by the fact that the Royal Society was actively involved by the Government to evaluate the work of the Meteorological Department. This may have assured them that in any further decision about the department, they would be involved, thus enabling them

[247] Paul, Stenhouse, and Spencer, 'The Two Faces of Robert FitzRoy, Captain of HMS *Beagle* and Governor of New Zealand'.

to have a say in the future work of the department. Perhaps this certainty lacked in the years before, making them careful in criticism of Fitzroy and his work.

The Galton Report was very clear about its judgement of the weather forecasts, and its author had much influence in the scientific community in the late 1860s. Galton was a member of the Council of the Royal Society at the time, giving his report much authority. The report was, as I have illustrated, a reflection of Galton's ideas about meteorology, and science in general. Due to the fact that Galton and his allies, such as the members of the X-Club, were able to establish their view of science with significant authority, Fitzroy's forecasts had retrospectively become straightforwardly unscientific. This narrative, however, has to be nuanced according to my findings.

One very important missing piece in this story, however, is the personal correspondence of the people discussed here. It would be interesting to investigate whether the public expressions matched those made in private correspondence. This would enable us to draw some conclusions about the awareness of Victorian scientists about their public image, and the importance of upholding the Meteorological Department as a successful scientific institution. Archival material with references to either Fitzroy or his forecasts could give an insight into the opinions of Fitzroy's peers about them.

Another area where further research would be interesting, is the local reception of Fitzroy's forecasts. I have focused mainly on the London elite, but locally, opinions may have differed. It could be expected that in, for instance, harbour towns the forecasts were much more and more openly discussed, because they had a greater effect on life there. Not only would this add to a fuller, localised history of weather forecasting, it would also give further insight into the role of local and national politics in discussions about science.

With this thesis, I have shown that in the case of the London elite, who were often close to the Government, both geographically and metaphorically, political considerations were of great importance to their reception of Fitzroy's forecasts. Early comments on the forecasts were cautious. Only when the political and social context had changed after Fitzroy's death, and there was a (near) certainty that the Royal Society would have influence over the work of the new Meteorological Office, did the discourse change radically. This illustrates that the history of new types of knowledge(making) should be

studied as embedded in their cultural and political context. Scientists are not, and have never been, outside of their society. This history of Fitzroy's forecasts reiterates that fact.

Acknowledgments

The past months have been a great learning experience. I enjoyed reading about Fitzroy and his peers, and my conversations about the weather have been less boring because of it. Another way in which it has been a learning experience is through being forced to work from home, thus having to find the self-discipline in order to finish this thesis. I want to thank Lukas Verburgt, for helping me, not only with finding my way in the history of Victorian science, but also with staying motivated and optimistic about the project. Second, I want to thank David Baneke for directing me towards this topic. About a year ago, he told me about the controversy about Fitzroy's forecasts. I am glad I ignored my initial feelings of 'weather, seems boring', and went along with the idea. Lastly, I want to thank Katharine Anderson and Jim Fleming for answering some of my questions.

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