
**Assembling the Weather:
Expertise, Authority and the Negotiation of trans-Tasman Aviation Forecasts**

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Abstract

The tyranny of distance has always figured significantly in accounts of New Zealand's place in the world. In these accounts the emergence of new technologies: steam ships, telegraph cables, refrigeration, satellite connections, and aircraft have all transformed New Zealand's geographies of connection. Aviation in particular has been celebrated the technology par excellence in drawing New Zealand closer to the rest of the world. Yet these celebratory tales of technological success gloss over the practical work of technoscientific assemblage that has made possible new, and enduring forms of connection. This paper focuses on the assemblage of aviation routes across the Tasman Sea between New Zealand and Australia in the late 1930s. Central to the making of this airspace was the concomitant development of specific meteorological networks that would transform the Tasman into a forecastable weatherspace. The paper identifies the layers of sociotechnical practice involved in assembling an oceanic weatherspace between national jurisdictions and observational networks. Within this new assemblage the paper focuses on the developing relationship between meteorologists and pilots, and argues that emerging tensions between these actors centred on the negotiation of the novel relationships of expertise and authority that had developed within the forecasting assemblage supporting trans-Tasman aviation.

Introduction

On the 2nd May 1940 the Tasman Airways Limited (TEAL) flying boat *Aotearoa* completed a roundtrip between Auckland and Sydney. Carrying mail and passengers the *Aotearoa*'s flight inaugurated a regular trans-Tasman air service, and ended over a decade of survey flights, political discussion, and commercial negotiation. The Sydney Morning Herald's (SMH) Aviation Correspondent, whose by-line proudly announced the correspondent's presence on the return

flight to Auckland, heaped praise on the flying boat facilities at Auckland's Mechanics Bay. In particular he praised the meteorological organisation supporting the flights observing that, "I watched aviation and meteorological experts prepare daily maps of Tasman weather developments and another covering a huge surface of the globe bounded by latitudes 25 degrees north and 50 degrees south and longitude 100 degrees east and 130 degrees west."¹ The weather maps being plotted in the New Zealand Meteorological Service's (NZMS) Auckland Aviation Weather Office (AAWO) were being pieced together from wireless reports of weather observations being made by New Zealand, Australian, British and Pan American Airways meteorological stations dotted throughout the Australia, New Zealand and the Pacific. Assembled together these observations, he marvelled, had just enabled the AAWO meteorologists to track and calculate the risk of the storm that the *Aotearoa* had flown through on its Auckland flight for over a week prior to the flight. These reports were not only coming from terrestrial weather stations. In a subsequent newspaper article the SMH's correspondent made special mention of the work of a dedicated meteorologist who was criss-crossing the Tasman Sea on the Union Steam Ship Company (USSCo) *Awatea* making regular reports on upper atmosphere conditions at sea.² Despite the efforts of this panoply of workers, the SMH nonetheless warned that much still needed to be done to perfect the trans-Tasman forecasts that would make regular, safe trans-Tasman crossings by the *Aotearoa* and its sister ship the *Awarua* a reality.

¹ Aviation Correspondent, 'Cooperation at Auckland', (4 May 1940), *Sydney Morning Herald*: 16.

² Aviation Correspondent, 'Flight over Gale', (7 May 1940), *Sydney Morning Herald*: 9.



Fig. 1. *Aotearoa* Survey Flight Across New Zealand, 1938.

Upper left: Coffee while travelling at 160 miles an hour and thousands of feet above sea-level-Mr. B. A. Blythe takes refreshments while at the controls. Upper right: Group-Captain T. M. Wilkes, Mr. A. Hardcastle, Mr. E. H. R. Green and Mr. L. Mangham view the landscape. Lower: Captain J. W. Burgess (left) and Mr. C. F. Elder (right), first officer, at the controls, with Mr. Blythe. Source: Sir George Grey Special Collections, Auckland Libraries, AWNS-19380106-42-2

The inauguration of a regular, commercial aviation route across the Tasman Sea was one of a series of changes that profoundly changed New Zealand's and Australia's geographies of connection with themselves and the rest of the world. Aviation in particular was celebrated as the technology *par excellence* in drawing both countries closer to the rest of the world.³ Alongside technologies such as the steam ship, the telegraph and refrigeration, the advent of trans-Oceanic aviation after World War One chipped away at the absolute tyranny of distance that defined the Australasian world's political, cultural and economic relationships to the rest of the globe. The

³ Ross Ewing and Ross MacPherson, *The History of New Zealand Aviation*, (Heinemann, 1986); Maurice McGreal, *A History of Civil Aviation in New Zealand* (David Bateman, 2003). For a wider cultural history of aviation see: Robert Wohl, *A Passion for Wings: Aviation and the Western Imagination, 1908-1918*, (Yale University Press, 1995); Robert Wohl, *The Spectacle of Flight: Aviation and the Western Imagination, 1920-1950*, (Yale University Press, 2005).

effect of these changing geographies was profound as the transformative energies of colonial societies were framed, and amplified, by the development of intricate links to global networks of intellectual and material commerce.⁴ The new networks that transformed these geographies were intimately technopolitical, blending together technological expertise with a keen sensitivity for the geopolitical and geoeconomic power of global connections.⁵

This paper takes the close entanglement that developed between aviation and meteorology in this context and focuses on the emerging relationship between two actors: pilots and meteorologists. Our tendency when thinking about the impact of new globalising technologies has been to focus on their impacts on wider societies and to pass over the work of the building and maintenance of the infrastructures whose ubiquity, accessibility, reliability and transparency make globalising connections possible.⁶ However, as Edwards et al argue the work of making infrastructures involves the simultaneous orchestration of technical systems, organisational practices and social norms; a point extended by Starosielski who argues that the fashioning of infrastructural networks leads to the concomitant development of new professional relationships amongst those making emergent networks function.⁷ In this context the complexity of meteorology's emergent professional cultures and the tensions involved in the stabilisation of the discipline's intersecting ontological and epistemological claims to expertise and credibility have been widely documented.⁸ However, what has been largely missing from debates about the development of meteorology as a globalised, 'infrastructural science' has been the development of situated understandings of how meteorologists engaged with other professional groups, such as pilots, with their own emergent and separate claims to expertise and authority, in order to act in the world.⁹ In one of the few studies addressing the specific relationship between meteorologists and pilots, Turner argues that this relationship was very important to the establishment of meteorology as a crucial support for aviation. This paper draws attention to the negotiation of forecasting authority between meteorologists and pilots as an important, but largely ignored, body of organisational innovation and practice in enabling the development of

⁴ Philippa Mein Smith, Peter Hempenstall and Shaun Goldfinch (eds.), *Remaking the Tasman World*. (Canterbury University Press, 2008); Eric Pawson and Tom Brooking (eds.), *Making a New Land: Environmental Histories of New Zealand, New Edition*, (Oxford University Press, 2013).

⁵ Robert Boyce, 'Imperial dreams and national realities: Britain, Canada and the struggle for a Pacific Telegraph Cable, 1879-1902', *The English Historical Review*, 115 (2000): 39-70; David Butler, 'Technogeopolitics and the struggle for control of world air routes, 1910-1928', *Political Geography*, 20 (2001): 635-658; Peter Hugill, *Global Communications since 1844: Geopolitics and Technology*, (The Johns Hopkins University Press, 1999); Alasdair Pinkerton and Klaus Dodds, 'Radio geopolitics: broadcasting, listening and the struggle for acoustic spaces', *Progress in Human Geography*, 33 (2009): 10-27; Gordon Pirie, *Air Empire: British Imperial Aviation, 1919-39*, Manchester University Press (2009).

⁶ Paul Edwards, Steven Jackson, Geoffrey Bowker and Cory Knobel, *Understanding Infrastructure: Dynamics, Tensions, and Design: 'Report of a Workshop on 'History & Theory of Infrastructure: Lessons for New Scientific Cyberinfrastructures'*, (University of Michigan, 2007).

⁷ Nicole Starosielski, *The Undersea Network*, (Duke University Press, 2015).

⁸ Matthew Henry, 'Inspired divination': mapping the boundaries of meteorological credibility in New Zealand, 1920-1939', *Journal of Historical Geography*, 50 (2015): 66-75.

⁹ See: Roger Turner, *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science*, (PhD Thesis), (University of Pennsylvania, 2010).

regular trans-Tasman flights between Auckland in New Zealand and Sydney in Australia. In looking at the development of this specific relationship in this context of this route making the paper both extends our understanding of the multiple strands of situated technical, organisational and social work required to make meteorology an embedded infrastructural science, and of the ways in which its development as infrastructural science required meteorological knowledge and practices to move beyond meteorology and meteorologists.

Purifying the Weather

Meteorologists' desires to better understand and predict atmospheric processes have driven meteorology to fashion increasingly more extensive and uniform observational networks.¹⁰ The result has been, as Edwards shows us, the making of the 'vast machine' that characterises contemporary, global meteorology, and which comprises a complex, evolving assemblage of observers, instruments, models, data flows, and centres of calculation. Neither creating, or maintaining this assemblage has been an easy task, requiring as it does both the ongoing inscription of the atmosphere, the continual enrolment of those actors that constitute meteorological systems, and the connection of those systems together into infrastructural networks.¹¹ While the 'vast machine' has become extensive, as with assemblages of such scale and complexity, it is fragile insofar as its ability to render weather legible relies upon intricate coordination across time, space, instruments, observational practices, and weather cultures. Edwards talks persuasively of the friction that accompanies the inscription and circulation of meteorological data, and of the ways in which this continually disrupts the smooth functioning of meteorological networks. However, friction is more than a technical problem, insofar as it involves both organisational and social dimensions. In this vein, Hulme has pointed out that meteorology's global assemblages are constituted in, and through, a multiplicity of weather cultures which exist at multiple scales, situated in different organisations and in different places.¹² Some of these cultures, insofar as they advocate alternative understandings of weather and how it can be forecasted, have been engaged with by meteorologists in order to dissolve them. Traditions of lay forecasting, for example, have long been a target of meteorologists seeking to bolster the unstable credibility of meteorology.¹³ In other situations the different cultures are within meteorology itself which, despite its standardising dynamic, is always confronted by the particularities of local circumstances, and the tension of transforming local

¹⁰ Paul Edwards, 'Meteorology as infrastructural globalism', *Osiris*, 21 (2006): 229-250.

¹¹ Paul Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*, (The MIT Press, 2010).

¹² Mike Hulme, 'Geographical work at the boundaries of climate change', *Transactions, Institute of British Geographers*, NS 33 (2008): 5-11; Benjamin Orlove and Sarah Strauss, *Weather, Climate, Culture*, (Berg, 2003); Tim Sherratt, Tom Griffiths and Libby Robin, (eds.), *A Change in the Weather: Climate and Culture in Australia*, (National Museum of Australia Press, 2005).

¹³ Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology*, (University of Chicago Press, 2005); Henry, 'Inspired divination'.

weather into global data and vice versa.¹⁴ Such circumstances are shaped by unique combinations of weather, instrumental assemblages, and the variable priorities of technopolitical actors, and almost inevitably lead to the evolution of situated meteorological cultures within and between different agencies and the users they connect with. Consequently, while the friction of data is in part related to its particular material and informational characteristics, it can also be seen as a result of the relational, professional practices required to create, circulate and use atmospheric knowledges between different user groups.¹⁵

As with many field-based disciplines the relationships within which meteorology has established its onto-epistemological project have been characterised by the uneasy dynamic of what Latour describes as purification.¹⁶ Taking form in processes such as professionalization, instrumentation, automation and so on, this has involved sustained work to redraw the epistemological boundaries around meteorology that has necessitated the exclusion of a wide range of weather and climate knowledges, and associated interpretative communities.¹⁷ In turn this epistemological work has contributed to the ontological project of creating meteorology as a properly scientific discipline defined by its focus on a stable object of inquiry. Yet, meteorology has never been able to operate as a hermetically insulated discipline because of the need to use increasingly dispersed observational networks to collect the weather data that is the lifeblood of meteorology, and the consequent requirement to enrol a myriad of ostensibly scientific actors to voluntarily or otherwise to perform those networks.¹⁸ Meteorology throughout the nineteenth century and into the twentieth century relied upon amateurs to produce much of its basic data, and each of these actors had their own motivations, capacities and relationships that did not necessarily align with those of meteorology's own onto-epistemological atmospheric projects.¹⁹ As a consequence, meteorology's always-incomplete purification involved intense work focusing on orchestrating diverse actors around aspirations to create an infrastructural science that could produce increasingly fine-grained, globalised weather understandings, and which would position meteorologists as the 'obligatory points of passage' for other users seeking information about the weather.²⁰

¹⁴ Simon Naylor, 'Nationalizing provincial weather: meteorology in nineteenth-century Cornwall', *British Journal for the History of Science*, 39 (2006): 407-432; Simon Naylor, *Regionalizing Science: Placing Knowledge in Victorian England*, (Pickering and Chatto, 2010).

¹⁵ Gary Fine, *Authors of the Storm: Meteorologists and the Culture of Prediction*, (University of Chicago Press, 2009).

¹⁶ Bruno Latour, *We Have Never Been Modern*, (Harvard University Press, 1993). For a discussion of the inevitable impurity of science as practiced see: Simon Shapin, *Never Pure*, (The Johns Hopkins University Press, 2010).

¹⁷ For a wider discussion on this theme in science see: Thomas Gieryn, *Cultural Boundaries of Science: Credibility on the Line*, (The University of Chicago Press, 1999).

¹⁸ Jeremy Vetter, 'Lay observers, telegraph lines, and Kansas weather: the field network as a mode of knowledge production', *Science in Context*, 24 (2011): 259-280.

¹⁹ Georgina Endfield and Carol Morris, 'Exploring the role of the amateur in the production and circulation of meteorological knowledge', *Climatic Change*, 113 (2012): 69-89.

²⁰ This phrase comes from Michael Callon, 'Some elements of a sociology of translation: domestication of the scallops and the fisherman of St Briec Bay', in John Law (ed.), *Power, Action and Belief: A New Sociology of Knowledge?* (Routledge & Kegan Paul, 1984): 196-233.

One specific target of this work was on reconstituting informational networks to improve their speed, standardisation, and conceptual reach in order that meteorology could be established as an essential infrastructure support for aviation. In the United States, for example, Turner points out that meteorologists prior to Second World War began to produce atmospheric models and observational assemblages that reflected the upper atmosphere needs of aviation rather than other users such as agriculturalists.²¹ This was a pattern that was also reflected in meteorological services developing in places such as New Zealand where despite repeated calls for services such as frost warnings and seasonal forecasting from farmers, the NZMS increasingly focused on developing observational and forecasting networks concerned with the needs of the developing aviation industry.²² The result can be seen as mutually constitutive, insofar as while meteorology enabled aviation the obverse was also true, and that moreover meteorology increasingly came to conceptualise the atmosphere as an ensemble of processes in ways framed by the concerns of aviation.

The twentieth century was the century of experts in which the command of knowledge was central to the development of the modern nation-state, globalised commerce, and the networks that made these novel relationships possible.²³ Meteorology's internal processes of purification reflected the rise of scientific expertise as a particular source of authority, and involved a range of work to dissolve other forms of authority. However, concomitant with this project was the intensification of meteorology's relationships with other expert cultures that were also simultaneously seeking to build new social and material worlds.²⁴ Meteorology's entanglement with aviation is a paradigmatic example of these intensifying relationships, although one only lightly sketched in the broad context of the trans-Tasman histories of meteorology and aviation.²⁵ What distinguishes these intensifying entanglements from meteorology's internal projects to purify itself was the requirement for the negotiation of much more symmetrical relationships with other actors who had their own distinct logics, projects and claims to technoscientific authority. Here, then expertise in specific weather knowledges such as

²¹ Turner, *Weathering Heights*.

²² Henry, 'Inspired divination'.

²³ Mitchel Dean, *Governmentality: Power and Rule in Modern Society*, (Sage Publications, 1999); Rebecca Lave, 'The future of environmental expertise', *Annals of the Association of American Geographers*, 105 (2015): 244-252; Charles Maier, 'Consigning the twentieth century to history. Alternative narratives for the modern era', *American History Review*, 105 (2000): 807-831; Tim Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity*, (University of California Press, 2002).

²⁴ James Kneale and Samuel Randalls, 'Invisible atmospheric knowledges in British insurance companies, 1830-1914', *History of Meteorology*, 6 (2014): 35-52; Ruth Morgan, 'Farming on the fringe: agriculture and climate variability in the Western Australian wheat belt, 1890s to 1980s', in James Beattie, Emily O'Gorman and Matthew Henry (eds.), *Climate, Science, and Colonization: Histories from Australia and New Zealand*, (Palgrave Macmillan, 2014): 159-176; Meg Parsons, 'Destabilizing narratives of the "Triumph of the White Man over the Tropics": scientific knowledge and the management of race in Queensland 1900-1940', in James Beattie, Emily O'Gorman and Matthew Henry (eds.), *Climate, Science, and Colonization: Histories from Australia and New Zealand*, (Palgrave Macmillan, 2014) pp. 213-232; Mark Whitehead, *State, Science and the Skies: Governmentalities of the British Atmosphere*, (Wiley-Blackwell, 2009).

²⁵ Matthew Henry, 'Trans-Tasman meteorology and the production of a Tasman airspace, 1920-1940', *Environment and Nature in New Zealand*, 4 (2009): 14-36.

those related to the needs of aviation, and how these knowledges should be used to shape action, should be seen as the outcome of negotiated, contingent relationships between different domains of expertise rather than being the intrinsic feature of any one body of expertise. The development of relational, expert weather cultures is the product of complex technical, organisational and social process, and one whose exploration contains the potential to provide new insights into the development of meteorology as an infrastructural science and how it contributed to the world-building work of network makers.²⁶ Framing meteorology and its relationships in these terms raises questions about how these relationships are negotiated and practiced, what forms of novel assemblages arise out of them, and what are the implications for understanding how weather knowledges are put to work in the making of social and material worlds. It is to exploring these questions, in the context of the development of regular flights across the Tasman Sea between New Zealand and Australia, that the remainder of the paper turns.

Fashioning Trans-Tasman Weatherscapes

The weather has been a concern for potential aviators for as long as they have contemplated taking to the skies. The emergence and rapid development of powered flight following the Wright brothers' successful demonstration at Kitty Hawk in 1903 quickly led to requests for meteorological information to help prospective flights in the United States and elsewhere.²⁷ If aviators quickly realised the importance of meteorological forecasts, then meteorologists across the world also realised the opportunities that would accrue from reconstituting their discipline as an essential support to aviation. In New Zealand following the end of World War One (WW1) the Government Meteorologist, Reverent Daniel C Bates quickly grasped the intimate link between aviation, security and meteorology, arguing that, "though I am not very sanguine about the immediate prospects of commercial or civil aviation, yet I firmly believe that something will have to be done, and that it is necessary to encourage it and have it in the background as a support to the defence of this Dominion."²⁸ In this context, Bates concluded that, "For the development of aviation the prime necessity is the extension of the meteorological service."²⁹ However, in a refrain echoed by his successors, he feared that such extension would be beyond the capacity of a service that was understaffed and under equipped, and in this context he argued

²⁶ Kneale and Randalls, 'Invisible atmospheric knowledges'.

²⁷ Kristine Harper, 'Meteorology's struggle for professional recognition in the USA', *Annals of Science*, 63 (2006): 179-199; John de Lisle, *Sails to Satellites: A History of Meteorology in New Zealand*, (New Zealand Meteorological Service, 1986).

²⁸ Daniel Bates, 'International Meteorological Conference', (20 January 1920), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, MET 1 8/8 Pt1, p.5.

²⁹ Daniel Bates, 'International Meteorological Conference'.

that it would be dangerous to develop air services without attendant improvements in meteorological services.³⁰

Bates predicted that extending meteorology's ability to support aviation would require the expensive reorganisation of observational, reporting and forecasting networks as well as the development of specialist instruments and skills to inscribe and interpret aviation-centric weatherscapes.³¹ In New Zealand, the post-World War One work of assembling meteorological networks to support the nascent aviation industry crystallised in the provision of forecasts by Dr Edward Kidson, Bates' successor as director of the NZMS, for the successful flight of Charles Kingsford Smith and Charles Ulm's *Southern Cross* across the Tasman Sea in September 1928.³² This network required significant, novel work to fashion a new understanding of atmospheric processes in the Tasman Sea, and equally the orchestration of new socio-political relationships between New Zealand and Australian meteorologists. The result of this work was that knowing 'the weather' emerged as essential to securing national and imperial interests in the production of a successful, pioneering trans-Tasman flight.³³ The inherent uncertainties involved in the intersection of weather forecasting and trans-oceanic flights prompted Kidson and others to reflect on their own particular responsibilities in relation to how their advice could be used by pilots. A previous failed attempt to cross the Tasman, leading to the deaths of the aviators George Hood and Robert Moncreiff in early 1928, had led to the suggestion of an inquiry into trans-Tasman flights, and their possible suspension. Here Kidson, who had also supplied forecasts to Hood and Moncreiff, advised his colleagues in Australia's Commonwealth Bureau of Meteorology (CBM) that they should be prepared to answer questions, but that he felt, 'The aviators knowingly took a sporting risk and luck was against them.'³⁴ However, he also felt that progress was needed to be made in supplying better forecasts because, 'too great a responsibility is liable to be thrown upon the Meteorologists.'³⁵

The meteorological network fashioned to support the flight of the *Southern Cross* was an ad hoc assemblage that only enabled a very limited set of forecasts to be produced and disseminated for a single return flight.³⁶ While the *Southern Cross* flights demonstrated the potential for regular trans-Tasman air flights it also showed that a significant amount of

³⁰ Daniel Bates, 'Letter to Secretary, Marine Department', (13 February 1920), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, MET 1 8/8 Pt1.

³¹ de Lisle, *Sails to Satellites*. John Dubois, Robert Multhaus and Charles Ziegler, *The Invention and Development of the Radiosonde*, (Smithsonian Institution Press, 2002); Chihyung Jeon, 'Flying weather men and robot observers: instruments, inscriptions, and identities in US upper-air observation, 1920–1940', *History and Technology*, 26 (2010): 119–145.

³² Edward Kidson, 'Meteorological conditions during the first flight across the Tasman Sea', *Quarterly Journal of the Royal Meteorological Society*, 55 (1929): 53–54.

³³ Henry, 'Trans-Tasman meteorology'.

³⁴ Edward Kidson, 'Letter to Mares, Division Meteorologist, Commonwealth Meteorological Bureau, Sydney', (19 January 1928), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/1.

³⁵ Edward Kidson, 'Letter to Mares, Division Meteorologist, Commonwealth Meteorological Bureau, Sydney', (30 January 1928), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/1.

³⁶ See Edwards et al, *Understanding Infrastructure*, for a useful discussion of the difference between such ad hoc assemblages and infrastructure.

connection work between meteorologists in New Zealand and Australia would be required in order to consistently produce reliable, and timely, weather forecasts over the Tasman Sea.³⁷

Throughout the 1930s the growing geopolitical and geoeconomic significance of aviation was becoming increasingly evident in the Pacific. During the mid-1930s Pan American Airway (PAA) began negotiating with the New Zealand government about the establishment of a Pacific route between San Francisco and Auckland that could be eventually connected to the Imperial Airways (IA) route linking London and Sydney.³⁸ At the heart of these negotiations was a growing realisation of the geopolitical significance of meteorology's forecasting networks. Notwithstanding rapid developments in the capabilities of aircraft, without reliable weather forecasts the Pacific remained a vast and dangerous place in which to fly. Consequently, control over forecasting networks offered in a degree of control over the air routes themselves, and the United States and United Kingdom (plus New Zealand and Australia) actively engaged in meteorological network making as part of their wider geopolitical manoeuvring in the Pacific.

While the Tasman Sea was dominated by Australia and New Zealand the imminent arrival of PAA into New Zealand in the late 1930s meant the possibility of both commercial and geopolitical disruption as the United States extended its power into the Pacific. As with PAA's developing route between San Francisco and Auckland the technopolitical issues of meteorological forecasting represented a key dimension in the creation of an exclusive, imperial air route across the Tasman Sea.

To this end the interrelated issues of the meteorological information and radio networks needed to support regular trans-Tasman flights was the focus of a conference held at Melbourne's Victoria Barracks in mid-December 1938 that brought together civil aviation and meteorological representatives from the New Zealand and Australian governments.³⁹ At this conference the meteorological representatives from both the NZMS and the CBM proposed a scheme based on the arrangements that had already been thrashed out in relation to trans-Atlantic flights, and which in turn derived from recommendations developed by the International Commission for Aviation Meteorology. Collectively they argued that the core basis for the creation of effective trans-Tasman weather forecasting lay in the further development of cooperation between the services in New Zealand and Australia. In other words, beginning to integrate the meteorological systems that had largely developed independently in each country in order to produce a shared network to support an air route across the Tasman.

³⁷ Henry, 'Trans-Tasman meteorology'.

³⁸ Matthew Henry, 'Australasian airspace: Meteorology and the practical geopolitics of Australasian airspace, 1935-1940', in James Beattie, Emily O'Gorman and Matthew Henry (eds.), *Climate, Science, and Colonization: Histories from Australia and New Zealand*, (Palgrave Macmillan, 2014): 233-249.

³⁹ New Zealand Meteorological Service, 'Conference of Representatives of the Commonwealth and New Zealand Governments, (12 December, 1939), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, (ABLO 8 9/5/3 1935-1939).

The NZMS and CBW both agreed that closer cooperation required further work in developing what Egyedi has termed gateways, between their different systems.⁴⁰ There needed to be the constant interchange of the synoptic weather reports that both agencies had been gradually extending in geographical scope over the previous decades.⁴¹ While it was recognised that these synoptic reports were not specially prepared for aviation, it was nonetheless felt that they would provide a basis for specialised interpretative work by dedicated aviation meteorologists based in offices in Sydney and Auckland. In this scheme, once a report had been prepared it would then be sent to the other office for information and review. This procedure represented a novel departure for forecasting in New Zealand since previously all forecasts had been prepared centrally at the NZMS head office in Wellington, and this proposal offered a redistribution and partial decentralisation of interpretative authority, a key element of what Edwards has argued is the evolution of discrete systems into infrastructures.⁴² The rationale for the exchange of analysis lay in the desire to produce a uniform forecast across the route, and a recognition of the unavoidable, but potentially ambiguous, component of interpretation in the preparation of forecasts. On this point New Zealand's representative, Dr Miles Barnett, maintained that "the meteorologist at either end requires to know what the other man thinks about the situation, so that there may be uniformity, and you have the advantage then of the concerted opinion of the two men."⁴³ Following agreement on a forecast for the Tasman route it would be given to pilots for them to use. Here Barnett argued that the pilot needed to have an identical copy of the map prepared by two meteorologists in order to facilitate any changes to the flight that might have to be made because of the developing weather situation during a flight. In discussing this procedure, however, there was no explicit reference made to the potential interpretative role of the pilot in either route planning or responding to changing weather in the air. Rather, it was assumed that the forecasters at either end of the route would remain the point of passage for understanding and interpreting changing weather conditions over the Tasman.

The trans-Tasman weatherscape that the meteorologists proposed fashioning was to be comprised of three interrelated facets: the creation and circulation of synoptic reports; the

⁴⁰ Tineke Egyedi, 'Infrastructure flexibility created by standardized gateways: the cases of XML and the ISO container', *Knowledge, Technology & Policy*, 14 (2001): 41-54. Gateways are points of standardised connection through which things such as information can flow.

⁴¹ For accounts of the gradual extension of synoptic reporting in New Zealand and Australia see: John de Lisle, 'The New Zealand Meteorological Service -the beginnings 1861-1927', in Michael Hoare and Linda Bell (eds.), *In Search of New Zealand's Scientific Heritage*, (Royal Society of New Zealand in conjunction with the Alexander Turnbull Library, 1984): 17-23; Kirsty Douglas, 'Under Such Sunny Skies': *Understanding Weather in Colonial Australia, 1860-1901*, (Australian Government Bureau of Meteorology, 2007); Roderick Home and Kevin Livingstone, 'Science and technology in the Story of Australian Federation: The case of meteorology, 1876-1908', *Historical Records of Australian Science*, 10 (1994): 109-127; Eric Webb (ed.), *Windows on Meteorology: Australian Perspective*, (CSIRO Publishing, 1997).

⁴² Edwards et al, *Understanding Infrastructure*.

⁴³ Barnett was a physicist working at the Department of Scientific and Industrial Research (DSIR) who had been selected by Edward Kidson to develop meteorological services in the Pacific. Part of his meteorological training also involved him qualifying as a pilot. He had recently returned from completing his meteorological training in Britain, see: McGreal, *A History of Civil Aviation in New Zealand*.

fashioning and circulation of forecasts specific to the trans-Tasman flights between the forecasting meteorologists; and the circulation of those forecasts between the meteorologists and pilots. This proposed system put new relationships into play. In the first instance, it created a new geography of forecasting. Previously forecasting by meteorologists in either country had largely been confined to forecasts defined by their own national borders, but in developing Tasman forecasts the meteorologists were creating new forecasting spaces that did not neatly fit into previous, largely national scale reporting, interpretation and dissemination practices. Second, what the conference left partially unanswered, but which nonetheless would be a crucial question, was the nature of the relationships between the various actors being enrolled in this new network. The conference was clear that the logic of uniformity would drive the relationship between Australian and New Zealand meteorological practice where it came together in the Tasman, but left assumed that it would be the meteorologists who would have overriding interpretative authority in respect to the decisions made by pilots about developing weather situations.



Fig. 2. Mechanics Bay Meteorological Station, c.1950. Source: Sir George Grey Special Collections, Auckland Libraries, 1370-35-23.

Parts of the network proposed in Melbourne existed already. Synoptic reporting had been the stock-in-trade for meteorological agencies from the mid-nineteenth century onwards following the expansion of national and international telegraph networks.⁴⁴ Both the NZMS and

⁴⁴ Deborah Coen, 'The storm lab: Meteorology in the Austrian Alps', *Science in Context*, 22 (2009): 463-486; Robert Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology*, (Cornell University Press, 2009); Hugill, *Global Communications*.

the CMB (and their precursor agencies) had expended significant efforts over the decades prior to 1938 in establishing and connecting observatories and weather observers into national weather forecasting systems.⁴⁵ However, as Home and Livingstone argue, while the use of the telegraph to transmit synoptic observations was simple and effective in theory, in practice it was dogged with difficulties that ranged from equipment malfunctions through to an indifference to the potential value of meteorological data.⁴⁶ From the mid-nineteenth century onwards the meteorological officials in the Australian and New Zealand colonies had been in regular correspondence to try and produce standardised meteorological data that could be circulated more easily between them.⁴⁷ However, despite agreements between meteorologists they were reliant upon access to telegraph networks, and while this access was of inestimable value to them, telegraph organisations tended to see otherwise. In an era of limited capacity and laborious data handling, telegraph companies needed ongoing persuasion to treat meteorological reports with priority. In New Zealand, for example, by the late 1927s the Reverend DC Bates, director of the NZMS, was still consistently complaining about delays in the transmission of weather cables caused by their low priority in the eyes of telegraph operators, and that the, “principle of the whole of the morning forecast being subject to the exigencies of the Pacific Company’s business is simply unthinkable”.⁴⁸ In this case the technological possibilities of networked weather reporting clashed with the friction of competing political and economic demands on overstretched lines.

Access to telegraph services, even begrudgingly offered ones, slowly knitted New Zealand and Australian meteorological systems together. But they did so only on a terrestrial basis. One problem in trying to fashion forecasts for the Tasman Sea was the Tasman Sea itself, and the difficulties associated with collecting and circulating weather observations from within it.⁴⁹ The synoptic reporting emerging at the cusp the post-WW1 development of aviation in New Zealand and Australia relied upon expanding networks of land-based, and ground-based, observers knitted together by growing networks of telegraph lines. While these networks gradually made weather processes over land legible, what was occurring at sea and in the upper atmosphere remained largely unknowable.⁵⁰ The growing use of wireless telegraphy prior to the First World War had prompted discussion amongst meteorologists about the possibilities of using it to enable ships to report weather observations as a way of extending synoptic reporting into places such as the Tasman. In New Zealand, Bates was an enthusiastic proponent of

⁴⁵ de Lisle, ‘*Sails to Satellites*’; William Gibbs, *Origins of Australian Meteorology*, (Bureau of Meteorology, 1988). Douglas, ‘*Under Such Sunny Skies*’.

⁴⁶ Home and Livingstone, ‘Science and technology’.

⁴⁷ Douglas, ‘*Under Such Sunny Skies*’.

⁴⁸ Daniel Bates, ‘Letter to Permanent Secretary, Department of Scientific and Industrial Research’, (22 January 1927), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ANZ MET 1 8/8/2, p.2.

⁴⁹ For a discussion of the difficulties of doing science at sea that mirrors the problems faced in the Tasman see: Katharine Anderson and Helel Rozwadowski (eds.), *Soundings and Crossings: Doing Science at Sea, 1800-1970*, (Science History Publications, 2016).

⁵⁰ Matthew Henry, ‘Assembling meteorology: balloons, leaking gas, and colonial relations in the making of new atmospheres’, *Journal of the Royal Society of New Zealand*, 47 (2017): 162-168.

extended marine reporting, lobbying the government for more resources to improve the quantity and quality of such reports. Likewise, in Australia, Bates' colleague AG Ackroyd at the CBM regarded the adequate provision of marine reporting as being very important.⁵¹ However, while ship based reporting provided a means of peering into the Tasman, its reliability and hence usefulness was ambiguous. This was because of the same sets of problems confronting meteorologists in gauging the reliability of data from land-based observers including: the variable quality and calibration of instruments, and the equally variable quality and diligence of observers. It was also not helped by the generally low priority given to the taking and timely transmission of meteorological observations by ships' officers. Despite the enthusiasm of people such as Bates and Ackroyd, the compromises of ship based weather reporting meant for others, such as Bates's successor at the NZMS, Kidson, a dedication to developing better land-based networks at the expense of ship-based networks.

Nonetheless part of the scheme to create a trans-Tasman weatherscape involved the more systematic attention to collecting meteorological information from ships crossing the Tasman. Upon the return of Dr Barnett to New Zealand following the Melbourne conference, the head of the New Zealand's Department of Scientific and Industrial Research (DSIR) Dr Ernest Marsden announced a plan to equip the USSCo *Awatea* and Huddard Packer's *Wanganella* with observation stations. Described by Marsden as 'floating observatories' these streamers regularly plied the proposed trans-Tasman aviation route and could offer regular, up-to-date reports on weather conditions in the Tasman.⁵² Onboard the *Wanganella* the Australian meteorological authorities posted a balloon observer who would periodically release weather balloons to provide wind reports from the upper atmosphere. Mindful of criticism of past efforts at ship-based reporting Marsden maintained that the equipment supplied and calibrated by the NZMS, "would be far superior to that which had been utilised for Tasman observations in the past" and that on the basis of this fact alone, "it was expected that observations would enable a greatly improved general observational and forecasting service for the Dominion itself."⁵³ What this system sought to establish in distinction to ad hoc observations being carried out grudgingly by ships' officers was a different set of relationships in which ship-based observations would be much more tightly controlled by meteorological authorities, and more closely framed by the epistemological expectations of uniformity and accuracy the framed general synoptic reporting. In these developments, we can see a further situated illustration of the ongoing purification of meteorology as its data generation practices and reporting networks were progressively made to revolve around the organisational and epistemological authority of meteorologists rather than other actors such as ships' officers.

⁵¹ Daniel Bates, 'Letter to Secretary, Department of Scientific and Industrial Research, (2 November 1926), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, MET 1 8/8/3; Ackroyd, 'Letter to Commonwealth Meteorologist, Commonwealth Weather Bureau, Melbourne, (22 November 1926), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, MET 1 8/8/3.

⁵² Weather Data, *New Zealand Herald*, (10 January 1939), p.10.

⁵³ Miles Barnett, 'Letter to the General Manager, Union Steam Ship Company re: Weather Reports from Ships', (21 July 1939), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/3 1935-1939.

The extent to which ship-based weather observations had become integral to the general system of aviation forecasting can be seen in complaints following the start of the trans-Tasman service. The service started in April 1940, but with the outbreak of war in the Pacific in December 1941 meteorological communications suddenly became strategically significant. Consequently, radio broadcasts became subject to censorship and encoding, and broadcasts from ships were curtailed.⁵⁴ With a proposal to extend the nascent trans-Tasman service to include night flights, the Officer-in-Charge of Auckland's Meteorological Section reported that the lack of reports from shipping in the Tasman, "leave the present network short of vital information essential if adequate meteorological safeguards are to be maintained."⁵⁵ A similar point was articulated by Barnett who observed that the absence of ships' reports left forecasters in Auckland seriously handicapped. Helping to plug the gap left by the absence of ships' reports were weather observations radioed to the forecasters in Auckland and Sydney by pilots over the Tasman, and he hoped that there would be no effort to reduce this radio traffic because of the exigencies of war.⁵⁶

The telegraph, and then radio, enabled meteorologists to more than transcend their locality and enable action at a distance, it also permitted the weather to be inscribed into new forms of visual representation that profoundly changed how the weather could come to be known. Kirsty Douglas suggests that the weather is illegible, and that to render it legible, and usable, required the fabrication of new forms of visibility characterised by the attenuation of complexity in the pursuit of predictable, representable order.⁵⁷ Thus, the generalised isobaric patterns and meteorological codes that enabled the telegraphic circulation of meteorological information relied upon the heroic abstraction of weather phenomena. In this way the weather map became a quintessentially modern artefact that both reflected and supported meteorology's ontological status as a modern project and its position as part of the necessary infrastructure of the modern world.⁵⁸ Yet this quintessentially modern project involving the inscription and circulation of the weather was constantly being challenged by equipment (unstandardized instruments) and circumstances (lax observational procedures at sea) that continued to defeat the goals of uniformity.

Other relationships could also potentially disrupt the project of making the Tasman Sea's weather knowable. As Barnett had observed at the 1938 Melbourne conference a key part of the creation of a uniform Tasman forecast was the circulation of analysis as well as the circulation of observations and charts. Kidson, Barnett's predecessor as Director at the NZMS, had since the

⁵⁴ Miles Barnett, 'H-37 Report of the Director of the Meteorological Office for the year ended 31st March 1940', *Appendix to the Journal of the House of Representatives*, 3 (1940): 22-24.

⁵⁵ L.N. Larson, 'Report by L.N. Larson on Meteorological Conditions over the Tasman Sea as affecting possible regular night flying on the route between Auckland and Sydney', (Undated), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/3 1942-1945.

⁵⁶ Miles Barnett, 'Letter to the Acting-Controller of Civil Aviation, (27 March 1942), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/3 1942-1945.

⁵⁷ Douglas, 'Under Such Sunny Skies'; James Scott, *Seeing Like a State*, (Yale University Press, 1998).

⁵⁸ Edwards, 'Meteorology as infrastructural globalism'.

early 1930s been developing forecasting methods for aviation in New Zealand based on the Norwegian school of frontal analysis.⁵⁹ This work had been spurred by the unexpected visit of Jorgan Holmboe to New Zealand in 1933 as the meteorologist on the Lincoln Ellsworth Antarctic Expedition. However, like observational data the exercise of interpretative expertise required constant calibration between meteorological centres, particularly where it started to be based on new conceptual models of the atmosphere such as were starting to be used in New Zealand. Discussions at the intercolonial conferences in the late nineteenth century had thrown up tensions concerning the extent to which the colonial meteorologists felt the need to subordinate their situated expertise in relation to forecasting to the standardised protocols of the Royal Meteorological Society.⁶⁰ Uniformity of instrumental calibration and observational practices was one thing, but trying to do the same thing for forecasting was another insofar as forecasting was argued to depend upon the situated interpretative ability of experts operating in dispersed calculative centres.

This issue was highlighted by LN Larsen, an Assistant Meteorologist at the NZMS's AAWO based at Mechanic's Bay, who in mid-1939 asked for permission to accompany the *Aotearoa* on its next trans-Tasman survey flight between Auckland and Sydney.⁶¹ The genesis for his proposal had come from the *Aotearoa*'s Captain Jack Burgess who had expressed his belief that significant benefits would accrue from having a meteorologist accompany the survey flights so as to be able to directly compare the forecast conditions with the actual conditions experienced by pilots on the flight.⁶² Larson also argued that in addition, "it would be of great value to us to contact the Australian people and see just what they are doing."⁶³ Larson flew to Sydney with the *Aotearoa* on its next survey flight, and his report on return affirmed the value of the trip. The flights had enabled him to directly compare the forecast weather and the actual weather, and for the return journey he had been able to personally see how the CBM meteorologists went about analysing and preparing their weather charts and forecasts. Observing the work of his Australian colleagues, wrote Larson, "will be of great value in interpreting the statements from that Service at a later date and to assist in them in interpreting the situation as

⁵⁹ Edward Kidson and Jorgan Holmboe, *Frontal Methods of Weather Analysis Applied to the Australia-New Zealand Area: Part I Discussion*, (Department of Scientific and Industrial Research, 1933); Edward Kidson, 'The analysis of weather charts', *The Australian Geographer*, 2 (1935): 3-16.

⁶⁰ Home and Livingstone, 'Science and technology'.

⁶¹ L.N. Larson, 'Letter to Dr Barnett, (19 September 1939)', Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/4 1939. Prior to working at the Mechanics Bay office, Larsen had been in charge of the NZMS office at Christchurch's Wigram Aerodrome with a particular focus on instructing Royal New Zealand Air Force pilots and navigators, see: Evening Post, 'Weather Services', (23 August 1939): 11.

⁶² Captain Jack Burgess was a New Zealander who undergone pilot training in the United Kingdom and had subsequently served in the Royal Airforce and with Imperial Airways. A brief biography of Burgess was published on his arrival with the *Centaurus* from Sydney in December 1937, see: 'Proud Family', *Auckland Star*, (27 December 1937): 9.

⁶³ L.N. Larson, 'Letter to Dr Barnett', (19 September 1939), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/4 1939.

transmitted by one's own Service.”⁶⁴ However, while Larson praised the hospitality of his hosts he was critical of some of their methods. He noted for instance that in the CBM's Sydney Office standardised maps were not used for the preparation of synoptic weather charts, and that isobaric contours were sometimes plotted in millibars and sometimes in inches. In plotting these charts, the Sydney Office used cabled data from New Zealand, but Larson expressed his surprise that no formal system had been put in place to receive the NZMS's broadcasts. At the CBM office in Melbourne, Larson discussed arrangements for the trans-Tasman route with the Commonwealth Meteorologist William Watt. As with the practice he observed at the Sydney Office, Larson felt that improvements could be made in the plotting of synoptic charts. He inspected the system for collecting the Bureau's upper air soundings, reporting that in relation to air mass classification, “a local terminology based on broad geographical limits has been adopted for internal use.”⁶⁵ More importantly he observed that, “In the analysis again little attempt is made to analyse the Tasman Sea and New Zealand area. Copies of the various charts used in the synoptic section have been secured and it will be seen that some do not include New Zealand at all.”⁶⁶

Larson's comments are sharpened if they are placed alongside contemporaneous reflections by Kidson about the future development of the NZMS.⁶⁷ Kidson noted the rapid expansion of the NZMS and the difficulties associated with training large numbers of new officers. One specific problem that was being addressed was the need for uniformity in the making and coding of meteorological observations. Here he pointed to the essential art of the forecaster depends upon visual uniformity insofar as the “only way in which a meteorologist can understand the existing situation and so anticipate future changes is to plot the information on charts so that it can be taken in by the eye, and the relation of the different elements grasped.... If reports come in different codes, if different elements are reported, or different units used, the difficulty in charting is very much increased.”⁶⁸ In particular, he argued, the need for uniformity was especially acute for aviators since by the very nature of their activity they were constantly moving from system to system. Consequently, “The methods of plotting reports and drawing maps must, therefore, also be uniform. The charts themselves must [be?] on uniform and suitable projections and the number of different scales used reduced to a minimum.”⁶⁹ In order to achieve this desired level of uniformity Kidson advocated adhering as closely as possible to the voluntary standards established by the International Meteorological Organisation (IMO) because it enabled

⁶⁴ L.N. Larson, 'Survey Flight by Flying-Boat 'Aotearoa' to Australia, 24th. Sept. to 1st Oct. 1939. Report by L.N. Larson, Meteorologist, Auckland', (Undated), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/4 1939. p.1.

⁶⁵ Larson, 'Survey Flight by Flying-Boat 'Aotearoa' to Australia', p.5.

⁶⁶ Larson, 'Survey Flight by Flying-Boat 'Aotearoa' to Australia', p.5.

⁶⁷ Edward Kidson, 'H-34 Meteorological Branch: Report of the Director, 1938-39', *Appendix to the Journal of the House of Representatives*, 3 (1938): 96-102.

⁶⁸ Edward Kidson, 'H-34 Meteorological Branch', p.96.

⁶⁹ Edward Kidson, 'H-34 Meteorological Branch', p.96. Given these comments one hesitates to think what Kidson would have made of Larson's report showing the variations in charts and plotting in the Australian meteorological offices.

the creation of a visual language for the weather that transcended either language or organisational differences.⁷⁰

PRELIMINARY FLIGHT FORECAST.

METEOROLOGICAL OFFICE, AUCKLAND.

AIR DEPARTMENT.

FROM . . . AUCKLAND TO . . . SYDNEY SERIAL NO. AW.133.

BASED ON 1200 G.M.T. CHART Tues. day June. 30th 1942
0200 G.M.T. Tues. day. Aerological Chart.

AIRCRAFT ZK-AM CAPTAIN J.W. Burgess

SCHEDULED DEPART. 1900. G.M.T. Tues. day June. 30th 1942.

	Zone	5	4	3	2	1
W	Surface	N 20	NNW 26	WNW 20	W 20	NW 22
I	2000 . . ft.	350 28	330 32	260 22	280 24	310 28
N	5000 . . ft.	350 28	330 30	300 28	300 28	290 28
D	10000 . . ft.	310 20	310 26	300 30	270 35	270 35
	WEATHER (Beaufort ltrs)	Overcast Intermittent rain.	Overcast Intermittent rain. Patchy Showery.	Partly Cloudy of fog.	Cloudy, odd showers	Cloudy
L	Type & Amt.	St 9/10	Ns 10/10	Cb 6/10	Cu 6/10	Cu 4/10
O	Base.	1500	800	1500	2000	2000
W	Tops	2500	10,000	12,000	8000	7000
C	Type & Amt.	Ps 3/10			Sc 4/10	Sc 4/10
L	Base	600			2000	2000
C	Tops	1000			3000	3500
U	Type & Amt.				Cb 3/10	
D	Base				1500	
	Tops				12,000	
	MEDIUM CLOUD	As 10/10	As	Ac	Ac	As & Ac
	HIGH CLOUD	-	-	-	Ci	Ci
VIS.	Surf. in miles.	2000 yds./ 8 miles	2000/4000 yds.	12 miles	12 miles	12 miles
ICE	Type Levels	Nil	Nil	Clear	Nil	Nil
SEA & SWELL		Moderate	Rough	Moderate	Moderate	Moderate
TERMINAL WEATHER		WNW 18 kts., Cloudy, Cu 4/10 at 3000 ft. Vis. 12 miles Sea slight.				

REMARKS: Because of the deep depression in the South Taranaki Sea, winds along the route are for the most part Westerly to Northwesterly and averaging 25/30 kts at 2000 ft. A wave on the cold front at 350S 1600E is not expected to develop into a major depression. It's position at 0000 hrs. on 1st July is expected to be about 410S 1610E. Anticipate slow moving cold front of moderate intensity towards end of Zone 5, giving a period of continuous rain, low ceiling and poor vis. A second cold front also of moderate intensity may be expected towards the end of Zone 4, accompanied by heavy showers & fair vis. E.C. 2/6

Zone No.	AK	2 5	2 4	2 3	2 2	2 1 SY
Long. E.	175	170	165	160	155	151

Fig. 3. Preliminary Flight Forecast, Auckland to Sydney, 30 June 1942. Source: Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/3 1935-39

⁷⁰ Edward Kidson, 'H-34 Meteorological Branch', p.96.

Larson's visit to Sydney and Melbourne, as well as Kidson's statements about uniformity in forecasting, highlighted the importance of Barnett's earlier assertion that regular Tasman forecasting required more than the circulation of uniform data. It also required the fashioning of uniform interpretative spaces. Larson's observations of the day-to-day plotting practices of his CBM colleagues illustrated subtle variations in analysis. Local variations that in themselves were not necessarily important when framed within the confines of a nationally organised meteorological system, but which could easily cause misunderstandings when locally coded analysis was circulated beyond the context of its production and interpretation. Larson's series of observations about the relative lack of use of New Zealand derived data, and the general deficit of attention to the analysis of the Tasman reflected the different environmental conditions and priorities that confronted each meteorological agency. Thus, in the case of the Australian meteorologists the analysis of the situation over New Zealand was of far less importance than air movements from the tropics downwards, while conversely New Zealand's prevailing westerly air movements meant that the Australian situation provided an important indication of future weather conditions over the Tasman and New Zealand. Thus, the creation of a trans-Tasman weatherscape was then not simply a case of connecting together two existing meteorological systems. Rather it required degrees of harmonisation between the priorities of two local networks that had orientated themselves in different ways towards different weather patterns

While Larson focused on the work of his Australian colleagues, he also briefly touched on the relationship between pilots and meteorologists. Based on his own flights and discussions with Captain Burgess and others he observed that, "the Captain of the aircraft feels more confidence in the forecaster if it is known that he has had actual flying experience over the route in question."⁷¹ Larson's point about the confidence needed by a pilot in forecasters, and how that confidence could be developed, reflected the growing importance of the relationship between pilots and meteorologists as flights grew longer and increasingly over water. A feature of the discussions that occurred during the 1938 Melbourne conference was the tension between meteorologists and aviation representatives on the relative authority of an aircraft's captain vis-à-vis a forecaster. The system that was being proposed at the Melbourne conference was predicated upon the routing of meteorological information through the meteorological offices in either Sydney or Auckland. In turn, these offices would act at centres of calculation for the interpretation of weather information and preparation of forecast charts. While pilots would have copies of these charts, once in the air further reports and analysis would continue to come through the two meteorological offices. A point affirmed by Dr Barnett, who under questioning from Squadron Leader CS Wiggins, stated that, "except in special emergencies, the whole thing should go through the terminals."⁷² However, Wiggins continued to press the point about a

⁷¹ L.N. Larson, 'Survey Flight by Flying-Boat 'Aotearoa' to Australia', A sentiment that perhaps explains Dr MAF Barnett's pilot training as part of his meteorological training in the United Kingdom.

⁷² New Zealand Meteorological Service. 'Conference of Representatives of the Commonwealth and New Zealand Governments', (12 December 1938), Archives New Zealand / Te Rua Mahara o te Kāwanatanga, ABLO 8 9/5/3

definite procedure arguing that, “in an emergency he might need to use facilities available from a ship and from an observer on that ship. Therefore it would seem advisable that during normal conditions that procedure should be practised.”⁷³ Barnett resisted, arguing that such a practice would be not be desirable, in part because he could not see a situation where a ship based observer could provide more information than what was coming from the forecasters located at the terminals. One of the CBM meteorological representatives HM Warren suggested that the issue of an aircraft captain contacting ships in the Tasman was an operational issue insofar as, “the ships will be putting in their reports to the terminal stations and the terminal stations will be using those for the preparation of its messages” and that this would constitute the normal circuit of meteorological information.⁷⁴ However, Warren also suggested that, “If there is any other message a ship desires, that would be an ordinary operational matter for the pilot.”⁷⁵ A distinction that Barnett continued to express his doubts about, but to which he reluctantly agreed. The result was that aircraft captains would have the authority to seek further weather information from sources outside the normal meteorological network if they felt they needed to do so.

At the heart of this dispute was the emerging relationship of authority and expertise between forecasters and pilots. Framed by the authority of action given to sea captains, pilots had been accorded very significant, albeit largely tacit, authority over the operation of their aircraft and flights. Such authority rested on the assumed expertise of the pilot as the ultimate point of operational decision-making in flying an aircraft. Moreover, meteorological instruction was, as Turner shows, an increasingly significant part of pilot training by the late 1930s and pilots could claim with some justification to have degrees of situated, interpretative expertise when it came to weather.⁷⁶ However, as aviation’s operational assemblages grew in complexity the singular authority of the captain also shifted. The meteorological system being put in place in Melbourne in 1938 did more than simply place a weather chart and forecast in the hands of the pilot. Rather via continual radio contact it placed the forecaster in the cockpit with the pilot as another potential centre of expertise and authority. Here then existed the conditions for tension between the meteorological expertise of the forecaster and the operational expertise of the pilot, particularly where pilot training was largely silent on how that relationship was to be negotiated. In New Zealand, for example, meteorological instruction codified in publications such as the Royal New Zealand Airforce’s *Elementary Meteorology* simply framed the relationship in terms of the supply of information to pilots, not how that information was to be used, and not what other information might also be used for decision-making in relation to weather conditions.⁷⁷

1935-1939. p.9.

⁷³ New Zealand Meteorological Service. ‘Conference of Representatives’, p.9.

⁷⁴ New Zealand Meteorological Service. ‘Conference of Representatives’, p.10.

⁷⁵ New Zealand Meteorological Service. ‘Conference of Representatives’, p.10.

⁷⁶ Turner, *Weathering Heights*.

⁷⁷ Royal New Zealand Airforce, *Elementary Meteorology*, (Whitcombe & Tombs, 1941). A later discussion of a lecture outline for pilot training talked about the point of meteorological instruction as being about providing pilots with enough understanding to have an intelligent conversation with a meteorologist about weather reports and

Given this context Squadron Leader Wiggins' pressing on the issue of the ability of pilots to seek information beyond the formal meteorological network illustrated a nervousness about the potential diminution of expertise, authority and status of pilots caused by the enmeshing of pilots and the operation of their aircraft within wider assemblages of command.

Conversely, Dr Barnett's continued belief in the sufficiency of the forecasts being provided from the terminals reflected the significance attributed to the production of a uniform Tasman weatherscape, and the potential disruption to that uniformity of information and analysis that might result from the ad hoc addition of weather information and analysis from ships in the Tasman Sea. Consequently, in what appears to be a minor debate there lurked quite significant questions about the relationship between two bodies of expertise and between the ideals of the situational authority of pilots vis-à-vis the search for consistency and uniformity that framed the work of the meteorologists. In this respect, the decision to allow pilots to contact ships for situational observations outside the normal circulation of meteorological analysis represented a continuing recognition of the overall authority of pilots in navigating trans-Tasman airspace in relation to the growing aspirations of meteorologists to become the singular point of interpretative authority.

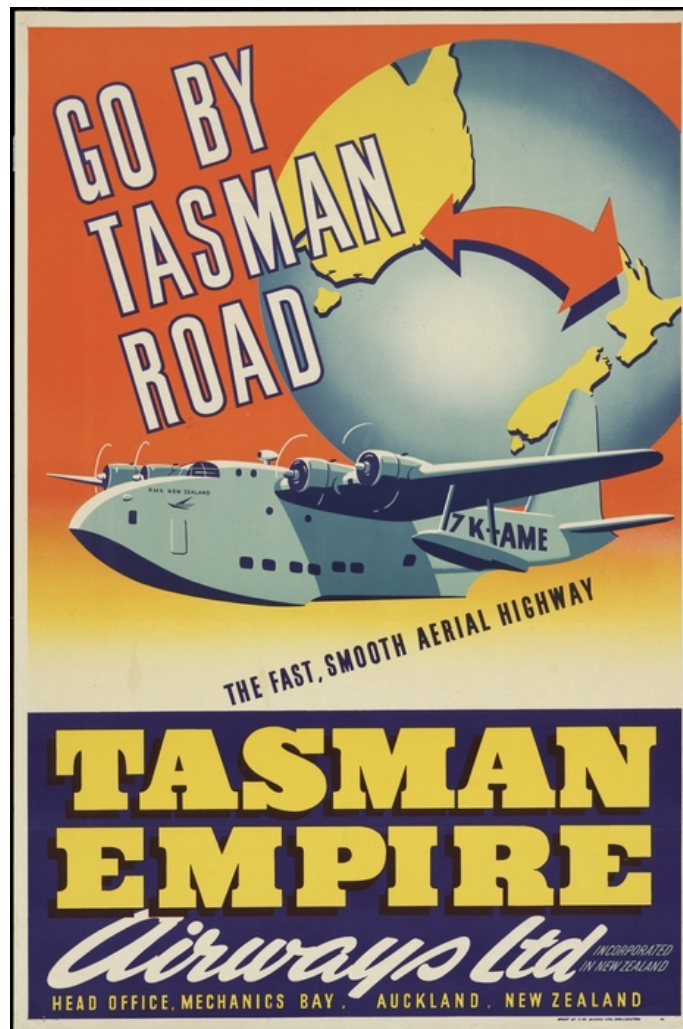


Fig. 4. Poster Advertising the New Trans-Tasman Air Route, c.1946. Source: National Library of New Zealand, Eph-D-AVIATION-1946-01

Conclusion

In late 1944 the New Zealand Herald boldly announced in relation to trans-Tasman flying that the weather had been mastered (see Figure 4).⁷⁸ With the combination of improved meteorological information and practices, plus four years of experience operating across the Tasman, flights were now running to within a few minutes of scheduled times. The emergence of regular flights was in no small part dependent upon the creation and ongoing maintenance of a trans-Tasman meteorological infrastructure that was producing regular weather reports and forecasts. This paper has traced the emergence of this network, its historical antecedents and the effort that it took to bring multiple strands of information and analysis into uniform alignment. A key dynamic in the fashioning of this new service was the gradual purification of meteorological

⁷⁸ New Zealand Herald, 'Tasman Flying', (28 October 1944): 8.

networks that saw meteorology's long and dispersed inscription systems becoming increasingly uniform and connected, albeit never completely so. At the centre of these developing networks rested the ideal, albeit never fully realised, of the interpretative authority of the meteorologist who alone had the expertise to transform the data of atmospheric tumult into usable guides for action. Meteorology's internal dynamics of purification existed in tension with the increasing intensity of its relationship as an infrastructural science with other fields of activity such as aviation. Such relationships were highly productive, spurring the generation of new theories, techniques and instruments in order to make legible the phenomena of novel spaces such as the upper atmosphere. However, as the paper has argued, by becoming increasingly entangled with aviation, meteorologists also confronted limits to their authority insofar as their developing relationships with pilots exposed alternative sources of authority in respect to decision-making about the weather. While meteorologists positioned themselves as key interpretative actors in confronting aviation's weather problems, it was a contingent authority that allowed room for the continuing exercise of pilots' situated decision making regarding their use of weather information.

Beyond the specific development of a trans-Tasman aviation route and the negotiation of the relationship between meteorologists and pilots on that route, what this paper is arguing is that emerging research into meteorology's history need to be more actively searching for the myriad traces of the relationships between meteorologists and the other actors, such as pilots, who have been involved in the making, circulation and use of meteorology as an infrastructural science in the fashioning of modern worlds. Meteorology's historiography has been dominated by the effort to uncover and understand how meteorology came to be global, and how meteorologists came to be the points of passage through which the weather became legible. What has been missed, as central objects of attention, are the ways in which the story of meteorology's purification and extension has a corresponding story in the intensification of its relationships to other networks and spheres of work. What this paper has shown is that in exploring the story of meteorology's intensifying relationships with other professional groups we can start to build a richer picture of how meteorology came to be able to act in the world at a distance through other actors. But in doing so we also begin to see how that ability to act has been intimately framed by the negotiation of the tension between contrasting sources of expertise and authority enacted by the variety of actors involved in the making of situated, relational weatherscapes such as was begun to be produced over the Tasman Sea in the late 1930s.

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