Time and the Making of New Zealand: A Theme in the Development of a Settler Society, 1840 to 1868

A Thesis Submitted in Fulfilment of the Requirements
for the Degree of Master of Arts in History

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Dedication

I dedicate this thesis to two special people:

Sir Tim Wallis – 'Hurricane Tim'

His "yes" in 1992 to my Warbirds over Wanaka book

proposal set in motion the flight plan to this thesis.

And

George Lee

My former Audit Manager,

Audit Office, Invercargill, in the 1980s.

You helped lay the foundations for my careful research.

Acknowledgements

This thesis could not have been written or completed without the help and support of some important people. I would like to express my gratitude to the staff of the History department. In particular, the enduring leadership and support of my primary supervisor Dr. Chris Connolly who, in spite of his ill-health and retirement duties, and the huge disruption to study caused by Canterbury's 10,000 plus earthquakes and aftershocks, kept regular vigilance of my progress. Writing a thesis is similar to climbing a demanding mountain, unattainable without an excellent Sherpa. Chris was an excellent Sherpa. His sense of humour, when dealing with my affliction to 'comma-itis' and other grammatical issues, will remain as a fond memory for years to come. Thanks must also go the Dr. Jane Buckingham who was my secondary supervisor. A thank you also goes Dr. Karen Pollard, in the Department of Astronomy, who read an early version of chapter two. Any errors or omissions remain my responsibility. A special thank you goes to Mrs Judy Robertson, the History Department's most able administrator, who with the strength of Atlas stepped in and carried our department through a most challenging 2011.

I would also like to acknowledge the assistance of *Papers Past*. I can honestly say that the depth of detail I was able to achieve would not have been possible without the vast collection of digitised New Zealand newspapers. Thanks also go to Allie Stedman, Gary Vogel and the rest of the post grads for their good humour, helpful advice and friendship. The team spirit was important during the earth shattering, life changing moments we shared. Kia Kaha! I also offer a special thank you to my family and friends. Thanks for listening. I love you all.

The most important thank you goes to my wife Mami. You provided unconditional love and support, picnics, wine and pizzas when needed most. Domo Arigato Gozaimashita!

Abstract

The thesis seeks to reveal, through the use of numerous case studies, the timekeeping processes that helped to make New Zealand. Whilst the period under review covers primarily the period 1840 to 1868 there is also a discussion of the emergence of clock time in thirteenth century Britain and Europe and its development through to the late nineteenth century. This is because the settlers' apprehension of time and their use of clocks and watches had evolved over the preceding centuries. The importance of reliable time was recognised by the Church from the medieval period but as ownership of public and private clocks proliferated the decentralisation of clock time commenced. Clock time commanded the lives of people and imprinted itself through the inculcation of such notions as punctuality and productivity. Better clocks brought a new emphasis to workplace efficiency underpinning the belief that time was money and facilitated the efficient coordination of Land, Labour and Capital. The discovery of New Zealand required timekeeping at sea. The achievements of James Cook, underpinned by improved chronometers, facilitated the large-scale British colonisation of New Zealand and seldom brought respite from the rule of time. Once on land, the settlers looked to establish a temporal order similar to Britain. The challenge to establish and disseminate the 'true' local time within communities led to the setting up of observatories and the use of public clocks, time ball stations, bells and guns to signal clock time. The myriad of local times was not a problem at first but once the telegraph began to link communities they hindered its optimal efficiency. This led to the introduction of 'telegraph time' in early 1868, dual time systems in communities using the telegraph, and public debate. Whilst most provinces accepted the new clock time, Otago saw it as an affront to their community's autonomy and identity. The province challenged the imposition of telegraph time, instigated a Parliamentary debate, and argued for the introduction of a common New Zealand time. Parliament's 1868 decision was a triumph for convenience and economic rationality over tradition and local identity. New Zealand was the first country entirely to abandon local times and regulate its time in relation to Greenwich mean time.

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Abbreviations

Newspapers

BH = Bruce Herald, CA = Cromwell Argus, DCS = Daily Southern Cross, EP = Evening Post, GRA = Grey River Argus, H&NS = Hawera & Normanby Star, HBH = Hawke's Bay Herald, HBWT = Hawke's Bay Weekly Times, LWM = Lake Wakatipu Mail, LT = Lyttelton Times, NEM = Nelson Evening Mail, NEandNZC = Nelson Examiner and New Zealand Chronicle, NZAandBofIG = New Zealand Advertiser and Bay of Islands Gazette, ME = Marlborough Express, NZCandPNA = New Zealand Colonist and Port Nicholson Advertiser, NZer = New Zealander, NZG (1839-40) = New Zealand Gazette, NZG&WS (1840-44) = New Zealand Gazette and Wellington Spectator, NZHandAG = New Zealand Herald and Auckland Gazette, NZSandCSG = New Zealand Spectator and Cook Strait Guardian, NZT = New Zealand Tablet, NOT = North Otago Times, ODT = Otago Daily Times, OW = Otago Witness, ST = Southland Times, TaraH = Taranaki Herald, TC = The Colonist, TDT = The Dunstan Times, TP = The Press, TimH = Timaru Herald, TT = Tuapeka Times, WC = Wanganui Chronicle, WH = Wanganui Herald, WI = Wellington Independent and WCT = West Coast Times.

Other Sources

CEAJ = The Civil Engineer and Architects Journal
HN = History Now
JBAA = Journal of the British Astronomical Association
JHG = Journal of Historical Geography
JMH = The Journal of Modern History
NMNC = Nautical Magazine and Naval Chronicle
NZJH = New Zealand Journal of History
NZG = New Zealand Geographic
NZPD = New Zealand Parliamentary Debates
RSNZ = Royal Society of New Zealand
SS = Southern Stars
TPNZI = Transactions and Proceedings of the New Zealand Institute
TPRSNZ = Transactions and Proceedings of the Royal Society of New Zealand

Introduction

We'll strive to emulate her fame
And seek to win, like her, a noble name,
To grander heights by patient toil to climb
And shape our destiny to ends sublime;
To found a nation, wise and good and great,
Grace, Mercy, Truth, the pillars of our state![1]

I want to introduce this thesis with a task to you the reader. Look at your clock, watch, cell phone, or IPad. What is the Time? What you may think is a fairly innocuous question, is not. I first asked that question in July 2006, but instead of getting a simple answer I found that additional questions followed. Why is that the time? How is it calculated? Who made the decision to adopt such a time? Where is the meridian from which it is calculated? Why was the decision made by the New Zealand Government to align our country with Greenwich mean time (GMT)?

I asked family and friends the above questions and no one could answer them, although some believed that New Zealand's clock time was Wellington's mean time. Initial research revealed a 1962 Department of Scientific and Industrial Research survey said that the meridian used to fix New Zealand time was 172° 50′ whilst the *New Zealand Encyclopaedia* of 2005 indicated that it was 172° 30′. It is also general knowledge that, during the non-daylight saving period, New Zealand is 12 hours ahead of GMT, which equates to 180°. So… which is correct?

In 2009, I commenced study for a BA (Hons.) in History at the University of Canterbury and one paper, 'Public and Applied History' under the supervision of Professor Geoff Rice, allowed me the opportunity to formalise my research in an academic environment within the parameters of a historical essay.[2] I also prepared a poster outlining my findings for my classroom presentation. In November 2009, I received University funding to attend the inaugural post-graduate students'

[1] William Jukes Steward, 'The Britain of the South', in O.T.J. Alpers, *The Jubilee Book of Canterbury Rhymes* (Wellington, 1900), pp. 45-6. The poem was written in 1868. The last verse of the poem portrays an image of a young New Zealand looking to its Home Country for guidance along the long path to modernisation. The year of publication was, co-incidentally, the same year that New Zealand adopted Greenwich mean time.
[2] University of Canterbury, History Paper 436.

conference at University of Victoria where I presented an A1-sized version of my poster. From the success of my essay and poster presentation, this thesis was born.

Until comparatively recently historians have neglected the topic of clock time. The works generally fall into two categories. Firstly, there are narratives of the horologists who go into painstaking detail explaining the principles of the technology, its development and the people responsible. These highly detailed accounts are best suited to readers who can bring prior technical knowledge to the pages being read, for in their minutiae lies the element of boredom to all but the most ardent fan. Secondly, there is the other type of book, the one that seeks to explain timekeeping and clock time within the context of its societal role as a determinant to order and discipline, its connection to people's lives and its influence on other technologies. Into this category falls the excellent work of David Landes. His book *Revolution of Time: Clocks and the Making of the Modern World* argues that a life without clocks would be much more complicated and disorganised. In order for society to function it must have fairly accurate and time-honoured standards of measuring time. Other studies, such as the works by Dava Sobel and Clark Blaise have won appeal for their portrayal of the struggle of individuals against the odds and have appeared on best seller lists.[3]

New Zealand historians have also overlooked the topic of clock time in New Zealand. Texts, such as Keith Sinclair's *A History of New Zealand* and Michael King's bestseller *The Penguin History of New Zealand*, when examining the path New Zealand followed towards modernity have tended to only focus on the conceptions of time that interacted with the introduction of transportation systems, the farming industries, electricity, radio and television, to name just a few.[4] And, whilst thousands of words have been devoted to the Government's 1893 decision to give women the vote, and New Zealand children are taught from a young age that the decision held international significance, scant regard has been paid to New Zealand's much earlier 1868 decision to elevate Greenwich to the position of prime meridian. Two reasons for this curriculum imbalance possibly lay in the spirit of both events. The first is that the 1868 decision came as a result of debate amongst only a small group of bureaucrats and scientists, and concluded with a simple adjustment to the

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[3] Dava Sobel, Longitude (London, 2005). Clark Blaise, *Time Lord* (London, 2000)

[4] K. Sinclair, *A History of New Zealand*, 1st ed. 1959 (Auckland, 2000) and M. King, *The Penguin History of New Zealand* (Auckland, 2003). I also examined G.W. Rice, *The Oxford History of New Zealand*, 1st ed. 1981 (Auckland, 1992) and P. Mein Smith, *A Concise History of New Zealand*, 1st ed. 2005 (Cambridge, 2011), and found no references.

inanimate hands of clocks and watches, a common enough occurrence already. Women's suffrage, in contrast, engaged the New Zealand public in a much more emotional and physical struggle for what was considered a human right. The second reason is noted by David Landes who asserts that the mechanical clock is considered a "banality, so commonplace that we take it for granted."[5] The choice of which clock time was best suited to regulate New Zealand's towns and cities was, for most people, equally banal.

This thesis takes up the challenge implicit in Landes' observation. It attempts to show that developments in the measurement and regulation of time have not only made an important contribution to the modern world, but that they can also be made interesting. It deals with the role of clock time in the European discovery and settlement of New Zealand. New Zealand's discovery and settlement, however, depended upon developments in Britain and Europe, so that is where the thesis begins. Chapter One discusses the development of timekeeping technology and the growing role of the clock in organising and disciplining society from the thirteenth to the eighteenth century. It draws extensively on the existing secondary literature, including technically oriented works by horologists and works by historians who have explored timekeeping as a social phenomenon. The latter, of course, includes E.P. Thompson's famous essay on time and social discipline.[6]

Advances in timekeeping played a crucial role in the European discovery of New Zealand, and Chapter two considers the role that these advances played in the voyages of Tasman and Cook. The literature on this subject is vast. On the topic of Tasman the National Library of New Zealand has at least 64 listings.[7] The thesis examines the very good works of Andrew Sharp, B.J. Slot, Anne Salmond, and Grahame Anderson.[8] In contrast, Cook's exploration of the South Pacific has been the subject of an even greater number of books. The National Library of New Zealand catalogue has holdings for 727 titles with contents wholly, or partly, devoted to

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[5] D.S. Landes, *The Wealth and Poverty of Nations: Why Some Nations Are so Rich and Some so Poor*, (London, 1999), pp. 47-8.

[6] E.P. Thompson, 'Time, Work-Discipline and Industrial Capitalism', in *Past and Present*, 38 (London, 1967).

[7] http://nlnzcat.natlib.govt.nz/cgi-bin/Pwebrecon.cgi?Search_Arg=abel+janszoon+tasman&Search_Code
The search date was 22 March 2011.

[8] A. Sharp, *The Voyages of Abel Janszoon Tasman* (Oxford, 1968). B.J. Slot, *Abel Tasman and the Discovery of New Zealand* (Amsterdam, 1992). A. Salmond, *Two Worlds: First Meetings between Maori and Europeans 1642-1772*, 1st ed. 1991 (Auckland, 1993). G. Anderson, *The Merchant of the Zeehaen* (Wellington, 2001).

Captain James Cook.[9] The specificity of theme for this thesis, however, ensures that only a small number were of value. Included in the list are the works of William Wharton, John C. Beaglehole, Derek Howse and Beresford Hutchinson, Andrew David (ed.), Anne Salmond, William J.H., Andrewes (ed.), Wayne Orchiston, Dava Sobel, and Paul Glennie and Nigel Thrift.[10]

The chapter examines the importance of clock time to Abel Tasman and James Cook. Both trusted the technology they used on their voyages, and the latitude and longitude points on their charts indicate the relative success or otherwise of their observations. Fully 127 years separated their voyages and the technology available to both men. Tasman's discovery of New Zealand illustrated what was achievable when existing technology was pushed to its limits. And, any discussion concerning Tasman's voyage, within the grand history of seafaring, should acknowledge it as a testament to the skills possessed, and the challenges faced, by seafarers of that age. Lastly, and most importantly, Tasman's legacy was crucial to the *Endeavour's* plans for exploration of the south west Pacific – it gave Cook something to aim for. In contrast, Cook's three voyages represented a significant horological episode – the trial of new experimental technology – that underpinned the remarkable charts that made it possible for subsequent voyagers to find New Zealand without difficulty.

Chapter three looks at the revolutionary impact the introduction of chronometers had on life aboard the ships that brought emigrants to New Zealand. Chronometers ruled the lives of not only the crew but also the passengers. They heralded in the mechanised era of navigation through safer and more efficient sea travel and set the nineteenth century apart from its predecessors as the century of mass movement of people across oceans. The emigrant ships embodied the rule of time that had been established in British society. Ship-board life was the very epitome of an existence ruled by the clock, and the rule of time was so well established in British

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9 http://nlnzcat.natlib.govt.nz/cgi-bin/Pwebrecon.cgi?Search_Arg=Captain+James+Cook&Search_Code. The search date was 17 March 2011.

10 Captain W.J.L. Wharton, *Captain Cook's Journal* (London, 1893). J.C. Beaglehole, *The Voyage of the Resolution and Adventure 1772-1775* (Cambridge, 1961). D. Howse and B. Hutchinson, *The Clocks and Watches of Captain James Cook: 1769-1969* (London, 1969). A. David (ed.) et al, *The Charts and Coastal Views: Volume One, The Voyage of the Endeavour 1768-1771* (London, 1988). A. David, (ed.), *The Charts and Coastal Views of Captain Cook's Voyages: Volume Two, The Voyage of the Resolution and Adventure 1772-1775* (London, 1992). A. Salmond, *Two Worlds*. W. Orchiston, *Nautical Astronomy in New Zealand, The Voyages of James Cook* (Wellington, 1998). W.J.H., Andrewes, (ed.), *The Quest for Longitude: The Proceedings of the Longitude Symposium, Harvard University, Cambridge Mass., Nov. 4-6, 1993,* 1st ed. 1996 (Cambridge, Mass., 1998). D. Sobel, *Longitude* (London, 2005). P. Glennie & N. Thrift, *Shaping the Day* (Oxford, 2009).

society in general that the passengers did not resent the regimen at all. On the contrary a good many took an active interest in the temporal procedures that were used in navigation and shipboard life. The literature examined on the subject falls into three categories. Firstly, evidence of specific temporal practices was sought in the diary narratives of husband and wife Dr. Alfred Barker and Mrs Emma Barker, Charlotte Godley and Dr. Henry Weekes.[11] Secondly, the thesis examined the more comprehensive narratives of Amodeo and Atkinson to get a broader view of shipboard life.[12] And thirdly, there was a study of two academic texts. The first was Daniel Montello's study of "psychologists in various sub-fields, geographers, linguists, anthropologists [and] neuroscientists" which explains the multi-disciplinary scope of the topic.[13] The second was the recently published work of Glennie and Thrift that is also referenced in chapter one. Although this volume concentrates on the period 1300 to 1800, a number of the authors' discussions remain relevant to nineteenth century timekeeping on ships.

Chapter four expands the thesis to involve the timekeeping practices of the first settlers and argues that clock time, regardless of small local differences, continued an unabated tyrannical reign over New Zealand's rough frontier society. The chapter examines the important role that clockmakers played in keeping their communities on time and the limited public clock time service in operation. It also examines the important role that leaders in business, science and politics played in the 1860s to replace the numerous local times with a uniform national time.

Chapter five continues the theme of the previous chapter and argues that the introduction of the telegraph from the early 1860s was the catalyst for the major change to how New Zealand kept time.[14] The adoption of telegraph time and New Zealand standard time were imposed because of development and rationalisation. The old system of myriad local times could not be changed without a battle because a town's 'local time' was often part of its identity. However, local times were becoming

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[11] C.C. Burdon, *Dr. A.C. Barker: 1819-1873* (Dunedin, 1972). Charlotte Godley, *Letters From New Zealand* (Plymouth, 1936), p. 7. J. Rutherford and W.H. Skinner, *The Establishment of the New Plymouth Settlement in New Zealand 1841-1843* (New Plymouth, 1940) and J. Hale, *Settlers* (London, 1950).

[12] Two examples are Colin Amodeo, *The Summer Ships* (Christchurch, 2000), and Neill Atkinson, *Crew Culture: New Zealand Seafarers under Sail and Steam* (Wellington, 2001).

[13] Daniel R. Montello, 'Navigation', in Priti Shah & Akira Miyake (eds.), *The Cambridge Handbook of Visuospatial Thinking* (Cambridge, 2005), p. 258, for quote.

[14] D. Rosenberg and A. Grafton, *Cartographies of Time: A History of the Timeline* (New York, 2010), p. 180 argue that the introduction of new communication technologies, such as the telegraph, made decisions, like John Hall's, for new "timekeeping conventions unavoidable."

unsustainable because the country was 'shrinking' and becoming more interdependent as a result of improved communications, especially after the introduction of the telegraph. Moreover, when a standard time was introduced, it was calculated according to the time difference from the Greenwich meridian, so that New Zealand pioneered what eventually became a world-wide system of Greenwich-based mean times.

This thesis provides a new historical perspective to the international topic of timekeeping and in doing so uses as a case study the history of timekeeping in New Zealand, and the deeds of some exceptional individuals, to draw attention to the role of clock time in shaping our society.

Chapter One:

The Rationalisation of Timekeeping in Europe

Hickere, Dickere Dock
A Mouse ran up the Clock,
The Clock Struck One,
The Mouse fell down,
And Hickere, Dickere Dock.[1]

The emergence of clock time in thirteenth century Britain and Europe and its development through to the late eighteenth century played a significant role in displacing the rule of event time. Event time is explained as the reckoning of time by how long it takes to complete an event, activity or chore that were principally derived from agricultural cycles and church ceremonial duties. Clock time did not influence the event, but the event's commencement, sequencing and conclusion were influenced or interrupted where there was the necessity for daylight and periods for rest, nourishment, spiritual reflection or social activities. The invention of the mechanical clock was directly influenced by nature, in particular the passing seasons, the movement of the Sun and human perceptions of the universe. The very movement of the hour and minute hands around the dial emulated that of the sun. These notions shape the substance of this chapter which traces the development of clock time from two approaches; firstly as a technology and secondly as a social discipline. The first, taken "as though it were simple common sense" considers it from the perspective of "technological advances."[2] The second argues that timekeeping devices, such as clocks, are no more than "social inventions," that is "mechanical movements of a particular type, employed by people for their own specific ends."[3]

[1] *Tommy Thumbs Pretty Song Book*, vol. II (London, c.1744). This traditional rhyme is one example amongst many that show how people – young and old – became aware of clock time.
[2] Glennie and Thrift, p. 28, for quote.
[3] Ibid., p. 43, for quotes, citing N. Elias, *Time: an Essay* (Oxford, 1984/1992), p. 118.

The Development of Clock Time as a Technology

The earliest known clocks, whether they were sun dials, clepsydra (water or mercury clocks), and fire clocks, were known collectively as *Horologia*.[4] Although two countries, England and Italy, are closely linked to the invention of mechanical clocks, knowledge of the technology spread quickly throughout Europe and subsequent development and improvements to accuracy were only achieved through the collaboration of an international pool of talented individuals who shared their theories and practices. The names of Galileo, Huygens, Newton, Harrison, Arnold and others are synonymous with the development of timekeeping devices.

Medieval clocks bore little resemblance to those in use today.[5] The first clocks told the time using bells or chimes and possessed neither an hour nor a minute hand, as the dial was not regarded as an intrinsic feature.[6] The development of dials inspired intricately crafted astronomical displays of the Earth at the centre around which revolved the Sun, moon and stars.[7] This was due to the popular belief that success in life required "a correct knowledge of the relative positions of the heavenly bodies and their motion."[8] The high construction costs usually spread over many years, dictated that only wealthy institutions, such as the Church, could afford to commission the design and construction of clocks.[9]

Figure 1.1. Astronomical Clock, c. 1540.[10]

The Catholic Church, in particular, lays claim to the development of the clock. In 1898, New Zealand's Catholics were informed that "The first clock with wheels was invented by a Catholic, Gerbert, abbot of Bobbio (tutor of the Emperor Otho III.), who afterwards became Pope [Sylvester II]. This great Pope and scientist was one of the most talented men of

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[4] From the Greek word Horology meaning the study of time.

[5] C.F.C. Beeson, *English Church Clocks, 1280 to 1850* (London, 1971), pp. 13-4. The first known mechanical clock is dated 1283, and was at Dunstable Priory in Bedfordshire, England.

[6] Glennie and Thrift, p. 158, indicates the hour hand was also known as "a finger, an index, or a point."

[7] Ibid., p. 39. The authors note that "several did not indicate the time of day at all."

[8] Whitrow, *What is Time?* p. 73, for quote. G.J. Whitrow, *Time in History: The evolution of our general awareness of time and temporal perspective* (Oxford, 1988), pp. 120-1.

[9] John D. North, *Stars, Minds and Fate: Essays in Ancient Medieval Cosmology* (London, 1989), p. 172.

[10] This clock is displayed at Hampton Court Palace in Middlesex, England. It was made by Nicholas Oursian. Sourced from http://www.ssplprints.com/lowres/43/main/4/83448.jpg

his age."[11] John North acknowledges Gerbert's inventiveness but refers to his achievement as a water clock and not a mechanical clock.[12] Horologists generally agree that it was not until the late thirteenth century that the clocks being referred to in documents were in fact mechanical clocks.[13] North also notes that

> The Church was rich and powerful. It controlled almost all academic education. It could afford to employ the best available craftsmen, and … some of the most skilful artisans of the time. The monastic orders had played an important part in the development of many mills and contrivances which could be powered by a waterwheel … The administrative machinery for such a vast enterprise as the construction of a large mechanical clock was available nowhere outside the Church and the courts of princes … The mathematics of the gear-trains – and this is especially true of astronomical trains – were the province of the well educated alone. And education of the appropriate sort was the monopoly of the Church.[14]

The high cost of clocks, due to a lengthy manufacturing time and their tendency to break down regularly, dictated that their owners should "buy a clockmaker along with the clock."[15] The clocks "were hopelessly inaccurate" and "needed continual care, frequent overhauls, and substantial replacement every ten or twenty years," which demanded "significant expenditure" by the churches and parishes.[16] Until timekeeping conventions were established there was no agreement nationally, let alone between countries, for such issues as sun dial or clock design, when a day began and ended, the definition of 'an hour', the split of day and night into equal hours, how hours should be numbered, or the times that sunrise and noon occurred.[17] Timekeeping was, in general, performed by a large machine sited on public buildings, such as a churches, market halls, or town halls. Sun dials were required to supply apparent local solar time.

Across Europe, in the fourteenth century, "the communal tower and bell … were legally important and symbolically significant municipal attributes, each of which could stand

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[11] Rev. T. Le Menant Des Chesnais, S.M., 'The Church and Commerce, Industry, Sciences, and Arts. Art. III, - Clocks, Watches, Thermometers and Barometers, I. – Clocks and Watches," *NZT*, vol. XXV, no. 45 (11 Mar. 1898), p. 3. Gerbert died in 1003.
[12] J.D. North, *Stars, Minds and Fates*: *Essays in Ancient and Medieval Cosmology* (London, 1989), p. 179. See also David Brewster (ed.), 'Horology', *The Edinburgh Encyclopaedia*, vol. 10 (Philadelphia, 1832), p. 472.
[13] G.J. Whitrow, *What is Time?* (London, 1972), p. 71, notes that "the English word 'clock' is etymologically related to the French word *cloche*, meaning a bell." See also North, pp. 176-178, for detail.
[14] Ibid., p. 172, for quote.
[15] Landes, *Wealth*, p. 48.
[16] Glennie and Thrift, p. 250, for the first quote, David S. Landes, *Revolution in Time: Clocks and the Making of the Modern World*, 1st ed. 1983 (England, 2000), p. 51, for the second quote, and, Glennie and Thrift, p. 41, for the third quote.
[17] Ibid., pp. 25- 27 and p. 139 for discussion. Sunrise was said to occur at the same time daily, but noon did not.

for the city as a whole."[18] The "city tower and bell were bearers of communal identity … and … marked a city as a relatively autonomous legal entity."[19] The commonly cited reason for and justification of a public clock was its role for the betterment of "the common welfare and the general utility of public time indication … [as] … the entire city was always treated as the intended audience of the time signal."[20] From the fifteenth century the clock tower's responsibility in the urban environment was recognised in the greater frequency it was depicted by artists.[21] Clock towers officially represented a city and in that respect functioned as iconography.

The choice of location of the communal clock towers was important. Towers were typically constructed at a central site that played a prominent role in the daily activities of the community's citizens. The weight of the clock and bells dictated that the tower was constructed in stone or brick adding further prominence and permanency to its role as a focus for the community. As the frequency of transportation between communities increased and linking roads were constructed, "city towers also became the zero points in the grid of highways."[22] The measurement of distances, namely miles, was calculated from one community's tower to another community's tower. The church tower in smaller communities performed the role of the communal tower.[23]

The greater reliability of clocks from late medieval times led to their use in regulating previously tedious human activities. One activity was their use as 'alarm clocks'. Time signalling in medieval times marked "particular moments during the day" that were not necessarily clock times.[24] The signals were "for both general purposes … or for specific groups of people."[25] Subsequent improvements in the technology meant that limited human input was required – "winding only every eight days, monthly or even less often" – making them more attractive to prospective owners.[26] People set the time at which the alarm went off, so it was people who used the clocks to regulate their lives. Clock time reduced the potential

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[18] Gerhard Dohrn-van Rossum, Trans. by Thomas Dunlap, *History of the Hour: Clocks and Temporal Orders* (Chicago, 1996), p. 197, for quote. See pp. 197-202 for discussion. The author compares their authority to that of the keys of the city, the seal, town hall, and the pillory.

[19] Ibid., p. 197, for quote.

[20] Ibid., p. 143, for quote.

[21] Ibid., pp. 146-7.

[22] Ibid., p. 201, for quote.

[23] Ibid., p. 202.

[24] Glennie and Thrift, p. 37, for quote.

[25] Ibid., p. 37, for quote. "General purposes" included the opening time of a city's market, and "specific purposes" included council meetings.

[26] Ibid., p. 36, for quote.

for conflict between interest groups, such as employers and employees, as it introduced an independent arbiter of time.[27]

The earliest documented clocks with minute hands appeared in the late fifteenth century when improved accuracy justified their attachment to tower and chamber clock dials.[28] By the late sixteenth century minute hands were promoted and sold as displays of the manufacturers' skill, but "minute indication remained unusual."[29] The next significant developments in clock technology occurred in the latter half of the seventeenth century. Until this time domestic clocks were derived from large public clocks and uncommon.[30] The inaccuracy of clocks resulted in their function being "to impress and impose, not to tell the time."[31] The high cost of the clocks restricted ownership to "princes, courtiers and the richest of the bourgeois," who considered them "more as a sign of affluence than a social necessity."[32] However, all this changed with the invention of the pendulum clock which brought a hitherto unknown level of accuracy to timekeeping.[33] What also emerged from this period were improvements in the smelting process of the various metals – iron, brass and steel – and the development of close cutting. The miniaturisation and mass-production of cheaper clocks and watches which followed was fuelled by a less wealthy consumer who demanded better accuracy.[34] This led to a division of labour that established a new class of craftsmen recognised for a precision unknown amongst the blacksmiths and cannon founders who constructed the much bigger tower clocks.[35] Clocks, in the decades immediately before and after 1700, signalled the time in the role of an alarm clock that used bells in one hour blocks. Improved technology meant that they struck eight times per hour, i.e. every seven and a half minutes.[36]

The passage of time through to the eighteenth Century saw the decline of the communal bell, but the communal clock retained its importance as a visual aid to telling the time. The moving hour hand on the clock dial presented a continuous visual image and

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[27] Ibid., p. 38, citing Dohrn-van Rossum, p. 198, and Humphrey, 2001.
[28] Landes, *Revolution in Time*, p. 118, also footnote 1, p. 452.
[29] Glennie and Thrift, p. 253, for quote and detail.
[30] Ibid., pp. 24-5.
[31] Landes, p. 91, for quote.
[32] Ibid., p. 89, for first quote, and Whitrow, *Time in History*, p. 112, for second quote.
[33] Landes, p. 133. See also pp. 128-30, for discussion on its conception by Galileo in 1637, the claims that Huygens, in 1656, plagiarized the design and the latter's successful defence against the claimants. Glennie and Thrift, p. 253, note that consensus on the part of clockmakers as to how they should display the precision achieved by the pendulum was not achieved until after 1700.
[34] Ibid., pp. 89 and 92 for discussion. Sundials were built into many watches to allow the owner to correct inaccuracies.
[35] E.P. Thompson, pp. 65-6 for discussion.
[36] Glennie and Thrift, p. 254. This led to the recognition of the practical limits to the frequency of aural signals and the eventual restriction of signalling to blocks of fifteen minutes.

challenged the earlier dominance of the chime, which signalled only a moment in time. Glennie and Thrift note that there was no "once-and-for-all transformation between 'aural' and exclusively 'visual' timekeeping."[37] As an aural exercise, the telling of time was arguably simpler, in that it only required of the listener an awareness of the numbering sequence and an ability to count the number of bells. In contrast, the visual exercise of telling the time contained a greater abstract element and was considered "an intrinsically more taxing task," but not beyond someone who applied themself.[38]

At the beginning of the eighteenth century the popular concept of a clock included a dial and an hour hand. Engraving showed time not only on the hour, but also on the half- and quarter-hour marks and some clocks also showed half-quarters.[39] If the crafting was precise then the hand's point allowed clock dials to show the time to within a few minutes. Accuracy was achieved to a loss or gain of about ten seconds per day. There were by then more domestically owned clocks than sun dials and the former, once a proxy for the latter on cloudy days, became the source of time. However, although the sun dial was precise only to five minutes it was still required to correct clock time.[40] Clocks were adjusted to keep time with the sun and were, as a consequence, accurate to about five minutes of apparent local solar time.[41]

A brief flurry of development early in the eighteenth century reduced the sun dial's inaccuracy to one minute.[42] Regardless of this achievement, the increasing reliability and convenience of mechanical clocks had the effect of demoting the sun dial and elevating the clock to the position of primary timekeeper. The Sun lost further authority as a timekeeper with the discovery of the Equation of Time. This came from the realisation that the Earth's orbit around the Sun is an ellipse and did not keep to a twenty-four clock.[43] Clocks were no longer set by the Sun, and now "people corrected the Sun."[44]

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[37] Ibid., p. 42. The chimes and bells of domestic clocks remained necessary in dimly lit buildings until the introduction of electricity from about the second decade of the twentieth century.

[38] Ibid., p. 42 for quote, and p. 142 for discussion. Whilst the hour hand points at, for example the two, the minute hand on the two must be read as ten minutes past the hour. Telling the time requires another level of thought when the minute hand is on, for example the seven, as it can be read as thirty-five minutes past the hour, or twenty-five minutes to the next hour.

[39] Ibid., p. 41 and pp. 140-1.

[40] Ibid., p. 26 and pp. 140-1.

[41] Ibid., pp. 41 and 141.

[42] Landes, pp. 132-3, for discussion. He cites Charles Bellair's 1659 letter to Christiaan Huygens with reasons for the need to improve sun dial accuracy. See also Glennie and Thrift, p. 140-1 for efforts to improve sun dials.

[43] It was found the Sun ran as much as sixteen minutes ahead of mean time and up to fourteen minutes behind. There are only four days per year when the day is twenty-fours in length.

[44] Ibid., p. 134, for quote.

The mechanical clock is now so common place that it is taken for granted, but its conquests should not be trivialised. The oft-quoted Lewis Mumford wrote that

> The clock is not merely a means of keeping track of the hours, but of synchronizing the actions of men. The clock, not the steam engine, is the key-machine of the modern industrial age … at the very beginning of modern technics appeared prophetically the accurate automatic machine. …. In its relationship to determinable quantities of energy, to standardization, to automatic action, and finally to its own special product, accurate timing, the clock has been the foremost machine in modern technics; and at each period it has remained in the lead; it marks a perfection toward which other machines aspire.[45]

Landes has added that "The clock was the greatest achievement of medieval mechanical ingenuity," and that "[e]very town wanted one; conquerors seized them as specially precious spoils of war; tourists came to see and hear these machines the way they made pilgrimages to sacred relics."[46] The clocks' creators are rightly considered "the pioneers of mechanical engineering."[47]

The Development of Clock Time as a Social Discipline

The second approach to the history of time is complementary to the first. It focuses on the role of clock time in regulating and co-ordinating a society's numerous recurring rituals. Clock time, it argues, should be regarded as "a social custom."[48] This argument had broader philosophical implications for society and culture on two levels. First, the ready access to clocks and watches, either at home or in one's pocket, led to the "privatisation (personalisation) of time."[49] This gave the individual the means to take command of his/her life at home or work, demoting the role of the public clock and helping to define Western civilisation's individualism.[50] Second, clock time challenged the astronomical and astrological influences on medicine, affecting philosophical thought on the conception of the

[45] L. Mumford, *Technics and Civilization* (London, 1934), pp. 14-5. This is cited by Landes, *Wealth*, p. 48, endnote 6, p. 529.
[46] Landes, *Wealth*, p. 49.
[47] Ibid.
[48] Glennie and Thrift, p. 43, for quote.
[49] Landes, *Revolution*, p. 92, for quote.
[50] Ibid.

universe, and bringing valuable precision to science and technology. On these two levels the proliferation of clock and watches changed forever humanity's perception of time.[51]

From medieval times, clocks kept better time than humans and were given the responsibility of ordering not only the lives of monks, but increasingly also those of the labouring and business communities. In Salisbury, for example, a tower bell struck eight times daily, day and night, to summon monks to prayer.[52] "The monastic emphasis on time implied, indeed imposed punctuality."[53] Daily schedules were created that recorded clock time much like an accountant's Profit and Loss Account that sought "to profit from the precious gift of time by ordering and using it."[54] The clock regulated the recitation of prayers and promoted the religious community, just as clock time promoted a civil community.[55] The Salisbury bell's elevation meant that it was heard beyond the church grounds, and over a period of time the surrounding communities used it in the role of an alarm that signalled the commencement and conclusion of activities, such as market business.[56] The clock's bells became the regulator of the community's practices.

The Catholic Church, and Protestant Church from the early sixteenth century, recognised that the possession of the clock's time reckoning allowed them to control time as never before. Landes notes that the Protestant Church attached the greatest value to

> the making and buying of clocks and watches. Even in Catholic areas such as France and Bavaria, most clockmakers were Protestant; and the use of these instruments of time measurement and their diffusion to rural areas was far more advanced in Britain and Holland than in Catholic countries.[57]

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[51] Horoscopes had been used to determine the time that a patient had become ill, and to indicate the best time for treatment. See Whitrow, *Time in History*, pp. 121-2 for further discussion, p. 127 for rejection of Aristotle's views and pp. 128-31 for Newton's concept of time in relation to the theory of gravitation. See also p. 129 for Leibniz's views and the argument that time should be derived from events and not vice-versa. See also, p. 130, for views of St. Thomas Aquinas.

[52] North, pp. 172-3. See also Glennie and Thrift, pp. 25, 29, citing S.L. Macey (ed.), *Encyclopaedia of Time* (New York, 1994) and K. Lippincott (ed.), *The Story of Time* (London, 1999). The division of the day into units of hours dated back to "at least Assyrian and Babylonian times, several centuries BCE."

[53] Landes, p. 58, for quote.

[54] Ibid., p. 58, for quote with reference to endnote 30, p. 440, citing Eviator Zerubavel, *Hidden Rhythms* (Chicago, 1982), Ch. 2.

[55] Ibid., p. 59, for quote.

[56] Whitrow, *Time in History*, p. 112, citing Landes, *Revolution in Time*, p. 89, endnote 20, p. 202. North, pp. 172-3. He cites Beeson, p. 16, regarding the Salisbury clock's influence on the rules of the community's market, in the early fourteenth century. See also Glennie and Thrift, pp. 37-8, for discussion.

[57] Ibid., p. 178, for quote, footnote seven p. 539, citing D.S Landes, *Revolution in Time: Clocks and the Making of the Modern World* (London, 2000), pp. 92-3. "Cf. de Vries, *Dutch Rural Economy*, p. 219: on the basis of household inventories, possession of clocks in the Leewarderadeel district rose 2 percent in 1677-86 to 70.5 percent in 1711-50." He qualifies this though by stating, "Of course these were households sufficiently well off to make an inventory after death."

The setting of 'Church time', that is, the time "to wake, to go to work, to open the market, to close the market, leave work, and finally a time to put out the fires (*couvre-feu* gives us the word "curfew") and to go to sleep," had till then been determined using nature's time, which was 'God's time.'[58] The underlying canon made in clear that a person should not seek activities for leisure and enjoyment purposes as they will displease God's will. "Waste of time" as Max Weber wrote,

> is thus the first and in principle the deadliest of sins. The span of human life is infinitely short and precious to make sure of one's own election. Loss of time through sociability, idle talk, luxury, even more sleep than is necessary for health, six to eight hours, is worthy of absolute moral condemnation.[59]

However, it is reasonable to suggest that not everyone accepted the Church as the sole authority of clock time, or its self-ordained position as governor of discipline and order. In England, in the late fourteenth century, Geoffrey Chaucer, in the *Nun's Priest's Tale*, attested that the cock Chanticleer was actually a better time keeper than the Church:[60]

> And where he lived, his crowing told the hour
> Better than any clock in abbey-tour.
> He knew by instinct each revolution
> Of the equinoctial circle[61] of that town,
> For every fifteen degrees, on the hour[62]
> He crowed to perfection with all his power.[63]

The above lines also reveal a good understanding of time measurement, in particular longitude, with fifteen degrees being equivalent to one hour of clock time. Chaucer added a further reference to timekeeping:

> Having cast his eyes up to the brilliant sun,
> Which in the sign Taurus the Bull had run
> Twenty and one degrees, and somewhat more,
> Knew by no teaching other than nature
> That it was nine a.m. With merry note
> He crowed and said, 'The sun has now climbed up
> Forty-one degrees and a bit more, I'd guess.[64]

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[58] Ibid., for quote.
[59] Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, translated by Peter Baehr and Gordon C. Wells, (Penguin Books, 2002), p. 104, for quote.
[60] North, p. 173.
[61] It is an imaginary line round the equator.
[62] That is 360 degrees divided 24 hours (per day) equalling 15 degrees or one hour. This indicates a mathematical knowledge of longitude.
[63] David Wright, *The World's Classics, Geoffrey Chaucer – The Canterbury Tales,* modern English translation (Oxford, 1986), p. 203 for quote. Original work first composed circa 1387.
[64] Ibid., p. 211, for quote.

This passage also indicates that with some arithmetic people of Chaucer's day could estimate the time of day by the position of the sun and use this knowledge productively. Landes also argues that Max Weber's "'ideal type' of capitalist", of the sixteenth to eighteenth centuries, was just as likely to be a person with a faith as without a faith.[65] The latter person, he states, just as easily grew up to be "rational, diligent, orderly, productive, clean and humorless."[66] And neither did they have to be businessmen, but religion complemented with business acumen certainly helped.[67]

The 1967 essay of Edward Palmer Thompson becomes relevant at this point of the discussion.[68] Thompson acknowledges that there was a change in how people internalised their understanding of time at the end of the eighteenth century. He wants to know

> how far, and in what ways, did this shift in time-sense affect labour discipline, and how far did it influence the inward apprehension of time of working people? ... [He also asks] … If the transition to mature industrial society entailed a severe restructuring of working habits – new disciplines, new incentives, and new human nature upon which these incentives could bite effectively – how far is this related to changes in the inward notation of time?[69]

In order to find answers Thompson discusses the advantages and disadvantages of people's inward notation of time from the context of "task orientation."[70] He states that this concept of time recognises, firstly, that a person works on the tasks he/she considers necessary. Secondly, the length of the working day is determined by how long it takes to complete the task, and it is generally considered acceptable for the working day to be a blend of labour and social interaction. He cites examples where the availability of daylight and the requirements of the activity determined its commencement and duration, rather than clock time.[71] And thirdly, Thompson notes that this attitude to labour "appears to be wasteful and lacking in urgency," especially where labour was employed and wages paid. This meant that a "shift … to timed labour", was preferable from the perspective of capitalist employers.[72] He adds that "the timing of work can be done independently of any time-piece – and indeed precedes the

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[65] Landes, *Wealth*, p. 178, for quote.
[66] Ibid., for quote.
[67] Ibid., pp. 174-9, for detail.
[68] E.P. Thompson, pp. 56-97, cited by Glennie and Thrift, p. 43.
[69] Thompson, p. 57, for quote.
[70] Ibid., p. 60, for quote.
[71] Ibid., pp. 60-1 for detail. Glennie and Thrift refer to it as 'natural time,' pp. 23, 24, 25-6 for discussion.
[72] Ibid., p. 61, for quotes.

diffusion of the clock."[73] He maintains that since the eighteenth century time has acquired a monetary value, noting that "time is now currency; it is not passed but spent."[74]

Thompson, in order to affirm his thesis that timekeeping was a social discipline, considers the number of clocks manufactured, the cost of clocks and the people's consequent internalising of time. He believes that by the end of the sixteenth century "[t]he majority of English parishes must have possessed church clocks," and that by the 1790s there were "a lot of timepieces about" and by 1800 there were "plenty."[75] In the 1850s, however, the considerable cost of timepieces meant that "the gentry, the masters, the farmers and the tradesmen" still owned recorded time.[76] Thompson affirms that the middle and upper classes, through their possession of watches and clocks were able to set up a time-system that other people *had to conform to* whether they owned watches or not.[77] For examples, he notes the existence of external pressures that enforced time-discipline, such as the introduction of the timesheet and timekeeper by 1700, and the existence by the mid-1700s of "clocking-in" devices.[78] Thompson concludes that the industrial revolution could not have occurred without 'time-discipline' and that "a general diffusion of clocks and watches" was occurring "at the exact moment when the industrial revolution demanded a greater synchronisation of labour."[79]

Glennie and Thrift consider the essay a "pioneering paper" and "a powerful account of clock time as the vanguard of industrialism."[80] They argue that time discipline consists of a number of dimensions, with three of particular importance – standardisation, regularity and

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[73] Ibid., for quote.
[74] Ibid., for quote.
[75] Ibid., p. 63 for the first quote, p. 69, for the second quote, and p. 66, for the third quote. See Glennie and Thrift, pp. 108-133, pp. 145-175 and pp. 181-237. See also L. Weatherill, *Consumer Behaviour and Material Culture in Britain 1660-1760*, second edition (London, 1988), pp. 25-31, for ownership statistics. Also P. Borsay, *The English Renaissance: Culture and Society in the Provincial Town, 1660-1770* (Oxford, 1989), p. 36, for limited statistics. Gross, pp. 12-13, cites Weatherill and Borsay and claims that these authors state that Thompson underestimated the number of clocks and pocket watches in circulation. Neither author has a reference to Thompson therefore no such assertions exist.
[76] Ibid., p. 67, for quote. See also p. 68, and footnote 38 same page, for quotes and discussion of William Pitt's (Chancellor of the Exchequer, 1797-8) attempt to tax owners whose clocks and pocket watches were "articles of luxury," whilst exempting the lesser quality clocks owned "by the poorer classes." Also shows Pitt's estimates, in the hundreds of thousands, of taxable owners.
[77] Ibid., pp. 85-6, e.g. an 1857 textile mill, and an 1887 factory.
[78] Ibid., p. 82, for timesheet reference and p. 83, for timekeeper reference and quote.
[79] Ibid., p. 69, for quote. Cited by Glennie and Thrift, p. 44. See also pp. 44-5 and fig. 2.6, for "reconceptualising time-discipline" discussion involving the three dimensions of time-discipline: regularity, standardisation and coordination. Glennie and Thrift, p. 131 also state that Thompson asserts ""the availability of precise clock time" depended on "who owned … clocks and watches."" They do not cite the Thompson page reference. The use of speech marks, in two blocks, and an ellipsis (…) indicate an abbreviated quote that was supposedly lifted from three sources. A thorough examination, using a word search in a digitised copy of Thompson's essay reveals the existence of the word patterns on unrelated discussions spread throughout the essay. The combination of these words, by Glennie and Thrift, has produced an erroneous, non-existent Thompson quote.
[80] Glennie and Thrift, p. 43, for quotes.

coordination – occurring in "various permutations."[81] These authors, on the surface, have done nothing more than make explicit three dimensions of time that are not only consistent with Thompson's argument but implicit in it. The development of timekeeping technology, commercialisation and industrialisation had worked together to transform British concepts of time by the early nineteenth century. The result was the emergence of a society that was extensively and increasingly regulated by clock time – a society that created a technological and cultural inheritance that deeply affected the increasing numbers of British settlers who arrived in New Zealand after 1840.

[81] Ibid., p. 45, for quote. Also pp. 44-7 and Fig. 2.6, for discussion and definitions of the importance of reconceptualising time-disciplines, in three dimensions: standardisation, regularity and coordination.

Chapter Two:

The Importance of Clock Time to Tasman and Cook

Progress in timekeeping was not only helping to transform European society, but it was transforming the practice of navigation. In this chapter I will use two case studies to show the role that timekeeping played as European explorers followed the Māori in discovering New Zealand and then pioneered the charting of its coastline. The first case study concerns the time keeping practices that assisted Abel Tasman's voyage to New Zealand in 1642, and allowed him to chart the country's western coastline. In the second case study, the focus shifts to the inventions of better timekeeping technology that led to the rationalisation in navigation methods that took place on James Cook's three voyages. The first voyage featured painstaking astronomical observations and protracted arithmetical calculations, the second scrupulous testing of the 'new' chronometers alongside the 'old' method of calculation, and the third increased reliance on the chronometer. A revolutionary shift occurred between the second and third voyages and from that time improvements in the technology of timekeeping opened the navigation of the world's sea lanes as never been before.

"The essential task of a timekeeper", Glennie and Thrift write, "is to maintain a count of some regular event, laying down a 'grid' of divided time over everyday life."[1] The extension of this grid over the Earth's vast oceans eventually made it possible for seafarers to work from the same charts, as all shared a common measure of time. But this equality of information only became possible in the early nineteenth century. For a navigator to calculate his ship's position accurately at sea, he needs to know what the clock time is aboard his ship and also the clock time at the home port or another place of known longitude at exactly the same moment. With the help of complex, time-consuming mathematical calculations the hour difference can be converted into a geographical separation. This is because the Earth takes approximately 24 hours to complete a full revolution of 360 degrees. One clock hour is equal to 1/24th of a spin, or 360 degrees divided by twenty-four gives fifteen degrees for each hour. One degree equals the Earth's rotation in four minutes of clock time.

[1] Glennie and Thrift, p. 29, for quote.

Tasman

Figure 2.1, Abel Janszoon Tasman.[6]

In 1642, "Dutch cartographers were regarded as the best in Europe," and the technology, used by Tasman, which included a cross staff and astronomical tables, was considered the finest of its day.[2] Tasman's journal entries record the use of civil time that was measured from midnight to midnight.[3] Observations were taken at noon each day.[4] A watch system was in operation that used half-hour sand-glasses.[5]

Tasman used the common practice of "running down the latitude," and as a result of following the 44th parallel south of Australia he 'discovered' Tasmania.[7] Then following the 42nd parallel on 13 December 1642 the ships approached New Zealand and sighted the South Island's Southern Alps.[8] The 27 days spent in New Zealand waters resulted in a partial chart of its western coastline, shown below.

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[2] Salmond, p. 69, for quote.
[3] Sharp, p. 60, notes that occasionally entries after midnight were included in entries for previous day.
[4] Ibid.
[5] Ibid.
[6] http://www.nndbcom/people/442/000098148. Painting by J. McDonald.
[7] Alan Stimson, 'The Longitude Problem: The Navigator's Story', in Andrewes (ed.), p. 78, for quote.
[8] This section of the 42^{nd} parallel is now known as 'Tasman's Passage'.

A study is required of Tasman's chart. First, it was rotated 90º to the right in order to portray the more conventional north/south perspective. In Fig. 2.2, the vertical axis shows Tasman's latitude positioning of the coastline from about 43º south at its southernmost point, to about 34º south at the northernmost point. The horizontal axis displays Tasman's longitude positioning of the coastline which, from west to east, was thought to be in the approximate range of 188º east and 192º east of Teneriffe. The area to the west of the New Zealand coastline is the Tasman Sea. During the voyage a mountain was sighted and this was represented as a small 'triangle' in the centre of the chart. This is believed to be Mt. Karioi. Cook attempted to use this mountain as a navigational aid on the *Endeavour* voyage. The more prominent Mt. Taranaki/Egmont was not seen. Tasman was unaware that the coastline actually comprised two islands. The first European name given to the new land – Staten Land – expressed Tasman's belief that he had reached the western end of the Staten Land discovered by Le Maire near Cape Horn.[9] The most recognisable feature in the chart, when compared to later charts, is the area of the South Island coastline known as Farewell Spit and Golden Bay.

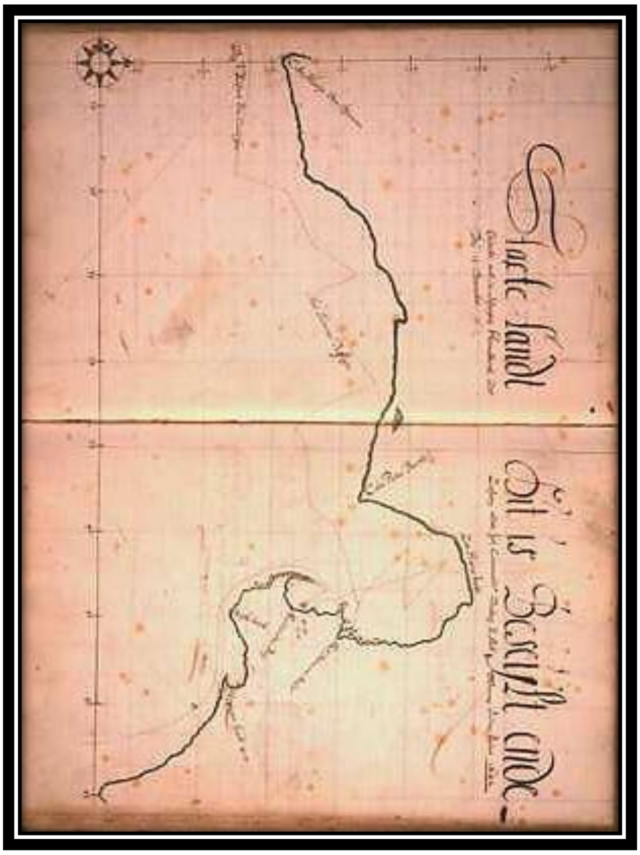

Figure 2.2, Tasman's partial chart of New Zealand's west coast.[10]

I examined Tasman's journals in conjunction with Fig. 2.2 for longitude and latitude points. From these sources, I constructed Table 2.1 in order to establish Tasman's location of New Zealand.

[9] Slot, p. 64.

[10] Source of chart: www.nhc.nz/.../abel%20tasman%20map%20.jpg. The chart is in the collection of the General State Archives, Eerste Afdeling, Acquisition 1867 AIII.

Table 2.1. Tasman's calculations of latitude and longitude as he charted New Zealand.[11]

Date	Longitude[12] (East of Teneriffe)	Longitude[13] (East of Greenwich)	Longitude[14] (West of Greenwich)	Latitude[15]
1642				
13 December	188º 28´	205º 7´	155º 7´	42º 10´
14 December	189 º 3´	205º 42´	155º 42´	42º 10´
15 December	189 º 40´	206 º 9´	154 º 9´	41º 40´
16 December	189º 54´	206º 33´	154º 33´	40º 58´
17 December	190º 47´	207º 26´	153º 26´	40º 32´
18 December	191º 41´	208º 20´	152º 20´	40º 49´
19 December	191º 30´	208º 9´	152º 9´	40º 50´
	191º 41´	208º 20´	152º 20´	40º 57´
20 December	192º 55´	209º 34´	151º 34´	40º 51´
21 December	192º 55´	209º 34´	151º 34´	40º 31´
22 December	192º 37´	209º 16´	151º 16´	40º 50´
23 December	Storm (no readings)	Storm (no readings)	Storm (no readings)	Storm (no readings)
24 December	ditto	ditto	ditto	ditto
25 December	ditto	ditto	ditto	ditto
26 December	192º 7´	208º 46´	152º 46´	40º 13´
27 December	190º 15´	206º 54´	154º 54´	38º 38´
28 December	192º 23´	209º 2´	151º 2´	38º 2´
29 December	191º 26´	208º 5´	152º 5´	37º 17´
30 December	191º 55´	208º 34´	152º 34´	37º
31 December	191º 46´	208º 25´	152º 25´	36º 45´
1643				
1 January	191º 7´	207º 46´	153º 46´	36º 12´
2 January	190º 47´	207º 26´	153º 26´	35º 55´
3 January	190º 17´	206º 56´	154º 56´	35º 20´
4 January	191º 9´	207º 48´	153º 48´	34º 35´
5 January	190º 40´	207º 19´	153º 19´	34º 25´
6 January	ditto (Anchored)	ditto (Anchored)	ditto (Anchored)	ditto (Anchored)
7 January	191º 9´	207º 48´	153º 48´	33º 25´
8 January	192º 20´	208º 59´	152º 59´	32º 25´

Tasman and his crews were ignorant of the deficiencies of their timekeeping and technology, and believed their navigating practices and charts to be correct. Just how good

[11] Sharp, p. 117, cites Meyjes, p. 232, who concludes the ships on 13/14 December were actually 170 degrees east of Greenwich. See also Anderson, pp. 82-87.
[12] Sharp, pp. 116-147, from translated daily log entries. See also Fig. 2.2.
[13] Slot, p. 59. See also Sharp, p. 61. Teneriffe is 16 degrees 39 minutes further west than Greenwich. This difference was added to the computations in Tasman's journal.
[14] See Figure 2.4 for overlay of Tasman's chart on the *Endeavour's* track to New Zealand.
[15] Sharp, pp. 116-147.

was their navigation and how accurate is Tasman's chart? In order to answer this question Fig. 2.2 and Table 2.1 need to be examined from two perspectives. First, we need to measure Tasman's position of New Zealand relative to other countries against present-day information and second, compare his segment of coastline to current charts. In order to do this I converted the Teneriffe meridian points to those of the Greenwich meridian and then compared them to the generally accepted points. This reveals Tasman's position for New Zealand to be about 35 degrees, or about 2,100 miles/3,500 kms, further east than is the country's actual position.[16] This supports Salmond's argument that Dutch navigators' co-ordinates were "often wildly wrong."[17] Second, I assessed the quality of Tasman's chart relative to the same areas of coastline as they are known today. I conclude that any similarity of Tasman's chart to modern charts was simply a result of the fact that the parts of New Zealand that he charted lie within a narrow band of longitude. The overall assessment is that Tasman's calculation of the relative position of points of coastal New Zealand was much more accurate than his calculation of New Zealand's position relative to South America or other distant points on the globe.

The navigational inaccuracies on Tasman's voyage were systemic to Dutch navigation and came about for a number of reasons.[18] First, the inaccurate calculation of the time when noon occurred meant imprecise latitude calculations.[19] Second, the Dutch incorrectly calculated the speed of their ships.[20] And third, the Dutch used Snellius's measurement of the German mile which was underestimated.[21] Coupled to these issues were practical difficulties associated with Tasman's two ships, the *Heemskerck* and *Zeehaen*. They could not sail into a head wind and were influenced by tides and currents.[22] Should Tasman have wanted to repeat the exercise of revisiting Perpendicular Point, Murderers' Bay or the Three Kings Islands, the task would have been very difficult. His expedition serves to illustrate the difficulties associated with navigation before accurate timekeeping was available on ships. However, the existence of New Zealand on nautical charts as a result of his expedition established a new

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16 This was based on one degree being about 60 miles (100 km). See also Table 2.1.
17 Salmond, pp. 69-70, for quote. See also footnote 70 of this chapter for reference to Cook's comments concerning inaccuracies he found in Tasman's journal.
18 Anderson, pp. 15-27 for an explanation of Dutch navigation practices.
19 Sharp, p. 60. Tasman's navigator could use trigonometry. If he knew the angle of his course when travelling from point A to point B and the difference in latitude between these two points then, using a formula the distance travelled could be calculated and the difference in longitude established. Slot, p. 60, cites Posthumus Meyes (1919) who concluded that latitude calculations were consistently "inaccurate by 8 minutes."
20 Anderson, p. 21, for details. See also Salmond, p. 73.
21 Sharp, pp. 60-61, citing R.P. Meyjes (ed.), *De Reizen van Abel Janszoon Tasman en Franchoys Jacobszoon Visscher in 1642-3 en 1644* (The Hague, 1919), pp. 199-204. The German mile was measured at 7158 metres instead of the more accurate 7408 metres. One German mile equalled four and a half English miles.
22 Salmond, p. 73, gives details of the poor condition of the *Zeehaen*.

frame of reference for South Pacific exploration that 127 years later would be better exploited.

Cook – The First Voyage

On 8 July 1714, the British passed an Act of Parliament – the Longitude Act[23] – to be administered by the Board of Longitude, with the power to award a monetary prize to the person or group of any nationality with the most efficient and practical means of calculating clock time at sea. The clock time could then be translated into a longitudinal location.[24] Three prizes were announced:

> £20,000 for a method accurate to half a degree,
> £15,000 for a method accurate to two-thirds of a degree, and
> £10,000 for a method accurate to one degree. [25]

Dava Sobel notes that the large prize money "eloquently expresses the nation's desperation over navigation's sorry state."[26]

Given that one degree, at the equator, equals about sixty-nine nautical miles and the distance becomes less the closer you are to the poles, a fraction of a degree equates to a great distance near the equator. In order to achieve the half degree accuracy, a clock could not gain or lose more than three seconds in twenty-four hours.[27] This was based on a forty-day voyage from England to the Caribbean. At the destination the error, compounded, equalled two minutes. To put this into a New Zealand context, a ship sailing from England directly to New Zealand for an estimated 120 days would have to deal with an error compounded to equal six minutes at the destination, or one and a half degrees.[28] At forty-five degrees south (the middle of the South Island) one degree equals forty-nine nautical miles.[29] The total discrepancy of

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[23] Signed by Queen Anne.
[24] David S. Landes, 'Finding the Point at Sea', in Andrewes (ed.), p. 25. See also Howse, pp. 10-13. The English prize was not the first. Other nations had over the previous century offered monetary awards.
[25] Peter Johnson, 'The Board of Longitude 1714-1828', *JBAA*, vol. 99, no. 2 (London, 1989), pp. 63-9. Half a degree was 30 nautical miles, 2/3 of a degree was 40 nautical miles and one degree was 60 nautical miles. Whitrow, *Time in History*, p. 141. Sobel, pp. 53-4. See also J. Betts, *Harrison*, 1st. ed. 1993 (London, 2007), p. 23, indicates that £20,000 equalled about £2,000,000 in 2007.
[26] Sobel, p. 54.
[27] Sobel, pp. 58-9.
[28] During the first emigrant wave from the 1840s, 120 days was the popularly quoted length of time for a sea voyage from England to New Zealand.
[29] http://www.nationalatlas.gov/articles/mapping/a_latlong.html. Last modified 26 January 2011.

the calculation is about seventy-three nautical miles. A huge margin of error therefore existed in longitude calculations.

So great was the effort applied to measuring longitude accurately that the quest for accurate measurement entered popular culture and "became a synonym for attempting the impossible."[30] Over the decades, several methods were submitted to the Board for trial by the Royal Navy. In 1769, when James Cook (1728-1779) prepared the *Endeavour* for its South Pacific voyage, the method for testing was the 'lunar distance method.'[31] This was based on lunar tables or 'lunars' in the *Nautical Almanac and Astronomical Ephemeris*.[32] Reverend Nevil Maskelyne, the Astronomer Royal at Greenwich, prepared Cook's copies of the tables, drawing on 250 years of research.[33]

The tables were based on Johannes Werner's discovery that the Moon's continuous motion round the Earth could be used as the clock's hand with the stars acting as the clock's dial.[34] He published his method in the 1514 edition of Ptolemy's *Geography*.[35] However, it was not until the invention of the octant in 1731 that the calculations became practical. The next crucial advance resulted from the work of Tobias Mayer,[36] whose use of advanced mathematics, without specialist instruments, led to the first publication of the lunars in 1755.[37] Four years later, in 1759, an improvement in technology resulted in the introduction of the sextant. The calculation of clock time to find longitude at sea was now possible provided timepieces were sufficiently accurate.[38]

The transit of Venus, at Tahiti, was essential to the subsequent circumnavigation and charting of New Zealand. The existence of Tahiti had only recently been established by

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30 Jonathan Swift, *Gulliver's Travels*, Part III, Ch. X, 'A Voyage to Laputa etc.' 1st edition 1726 (New York, 1999), p. 216. "The discovery of *longitude* … and many other great inventions brought to the utmost perfection." Cited by Whitrow, *Time in History*, p. 141, footnote three, p. 204, and also by Sobel, p. 56. See also David Wright, *Chaucer*, p. 203, for a much earlier reference to longitude.

31 Cook had practical experience in astronomy, surveying and navigation gained from 22 years at sea. Firstly, with John Walker's company shipping coal for nine years and then serving with the Royal Navy for 13 years.

32 This thesis refers to them as lunars.

33 Reverend Nevil Maskelyne (1732-1811), first produced the lunars in 1766. They contained calculations for every day of 1768 and 1769 at three-hour intervals. See also D.S. Landes, 'Finding the Point at Sea', in Andrewes (ed.), p. 28, who indicates the complexity of, and time required in using lunars "confined them to a small elite of trained specialists."

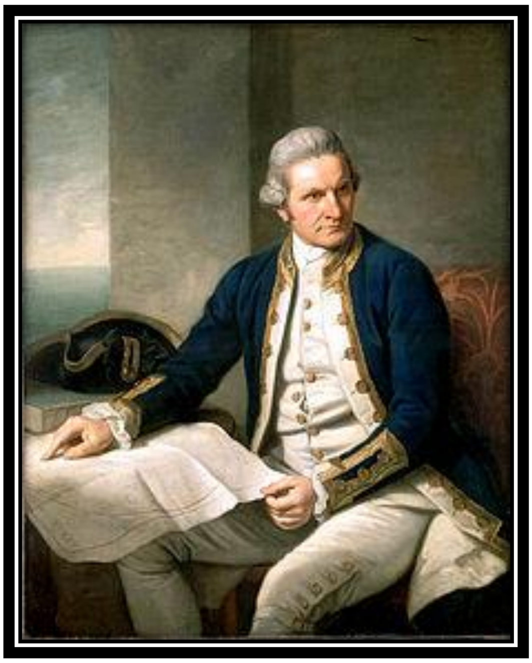
34 J. Betts, p. 21. Werner was a German astronomer (1468-1522).

35 Sharp, p. 24. Claudius Ptolemy was a Geographer from Alexandria.

36 Johnson, p. 66. See also Sobel, p. 97. Mayer (1723-1762) was a German mathematician. He used his observations, those of James Bradley, the Astronomer Royal from 1742 to 1762, as well as the equations of Leonhard Euler, a Swiss mathematician.

37 Glennie and Thrift, p. 345. Less than a year later the Royal Navy started using the lunars. The lunars were tested by Captain John Campbell in 1757 and 1758 and by Maskelyne in 1761.

38 David, *Charts of the Endeavour 1768-1771*, p. xxvii. See also Landes, pp. 27-8 and Howse, pp. 6-9, for more detail.



Captain Samuel Wallis of HMS *Dolphin*.[39] "Wallis was instructed to sail west from South America as far as possible, looking for Terra Australis until he reached [Tasman's] longitude for New Zealand."[40] But because Wallis took a northern track on his 1767 voyage he stumbled on a number of islands including Tahiti.[41] The *Dolphin* returned to England in 1768.

Figure 2.3, James Cook[42]

The following year, Cook with the aid of journals of the recent circumnavigations, such as Wallis's, sailed directly to Tahiti.[43] During the leg of the voyage from Cape Horn to Tahiti the emptiness of the ocean gave Cook and Joseph Banks doubts as to the existence of the Southern Continent.[44] Cook's primary instructions involved sailing the quickest route possible to Tahiti where he established a friendly relationship with the Tahitians, gained approval for the construction of Fort Venus and viewed the transit of Venus, on 3 June 1769.[45] The *Endeavour* then sailed south, per Cook's so called 'secret' instructions to search for the southern continent in the location that Tasman had indicated for New Zealand.[46] The instructions stated

> You are to proceed to the southward in order to make discovery of the Continent above-mentioned until you are arrive in the Latitude of 40º, unless you sooner fall in with it. But not having discover'd it or any Evident signs of it in that Run, you are to

[39] A. Salmond, *Aphrodite's Island: The European Discovery of Tahiti* (North Shore, 2009), p. 131.

[40] Ibid., p. 42. These instructions contradict Sir Peter Buck, *Explorers of the Pacific: European and American Discoveries in Polynesia* (Honolulu, Hawaii, 1953), p. 23, who indicates Wallis was instructed to sail at the latitude 20º south, which means that Wallis would never have located New Zealand.

[41] New Zealand western coastline, according to Tasman's chart, shared a similar longitude to Tahiti.

[42] http://www.google.co.nz/imgres?=james+cook...

[43] J.C. Beaglehole, *The Voyage of the Endeavour: 1768-1771*, (Cambridge, 1955), p. cxxxvii. See also Slot, p. 347. Banks had in his possession a copy of Tasman's report and chart, which he had translated. Cook refers to Tasman by name in his journal with references on 25 Dec. 1769 to Three King's Islands, 30 Dec. 1769 and 2 Jan. 1770 to Cape Maria Van Diemen, and 16 Jan. 1770 to Murderer's Bay.

[44] Salmond, pp. 133-4, for Banks's quote, in which he expressed his doubts.

[45] They stayed for three months.

[46] Beaglehole, p. cxxxvii, footnote 1, raises doubts as to secrecy of the instructions. The London *Gazetteer*, 18 Aug. 1768 stated that "The gentlemen … we are credibly informed, [are] to attempt some new discoveries in that vast unknown tract, above the latitude 40º." See Slot, p. 347. See also Beaglehole, p. 299, for publisher details. Banks had in his possession a translated copy of Tasman's journal. Cook refers to Tasman by name in the New Zealand section of his journal with references on 25 Dec. 1769 to Three King's Islands, 30 Dec. 1769 and 2 Jan. 1770 to Cape Maria Van Diemen, and 16 Jan. 1770 to Murderer's Bay.

> proceed in search of it to the Westward between the Latitude before mentioned and the latitude of 35º until you discover it, or fall in with Eastern side of the Land discover'd by Tasman and now called New Zealand.[47]

Of this leg of the voyage Captain Wharton wrote in the late nineteenth century that

> This long exercise to the south is a fine instance of Cook's thoroughness and determination in exploration. The belief in the southern continent was strong amongst most geographers; but it rested on nothing more than a false idea that dry lands in the two hemispheres should balance one another. Cook himself did not share the general belief; *and few others in his position would have struggled for 1500 miles out of his direct course into bad weather, simply to dispose of an idea*, when so much unexplored ocean lay before him to the westward, with a fair wind and fine weather.[48]

The section I have italicised is contentious. Cook, I argue, was in fact looking for the east coast of New Zealand in the position where Tasman's journal and chart indicated it was located. Tasman's chart of New Zealand's west coast was popularly believed to be the west coast of the supposed Southern Continent. When Tasman's chart is superimposed on the *Endeavour's* track, see Fig. 2.4, it reveals Cook's concerted effort to locate the eastern coastline. This is represented by the red line. Tasman's marked inferiority to Cook in his ability to calculate longitude was because he was unable to use the moon and the stars as a 'clock' as he had neither a sextant nor lunars.

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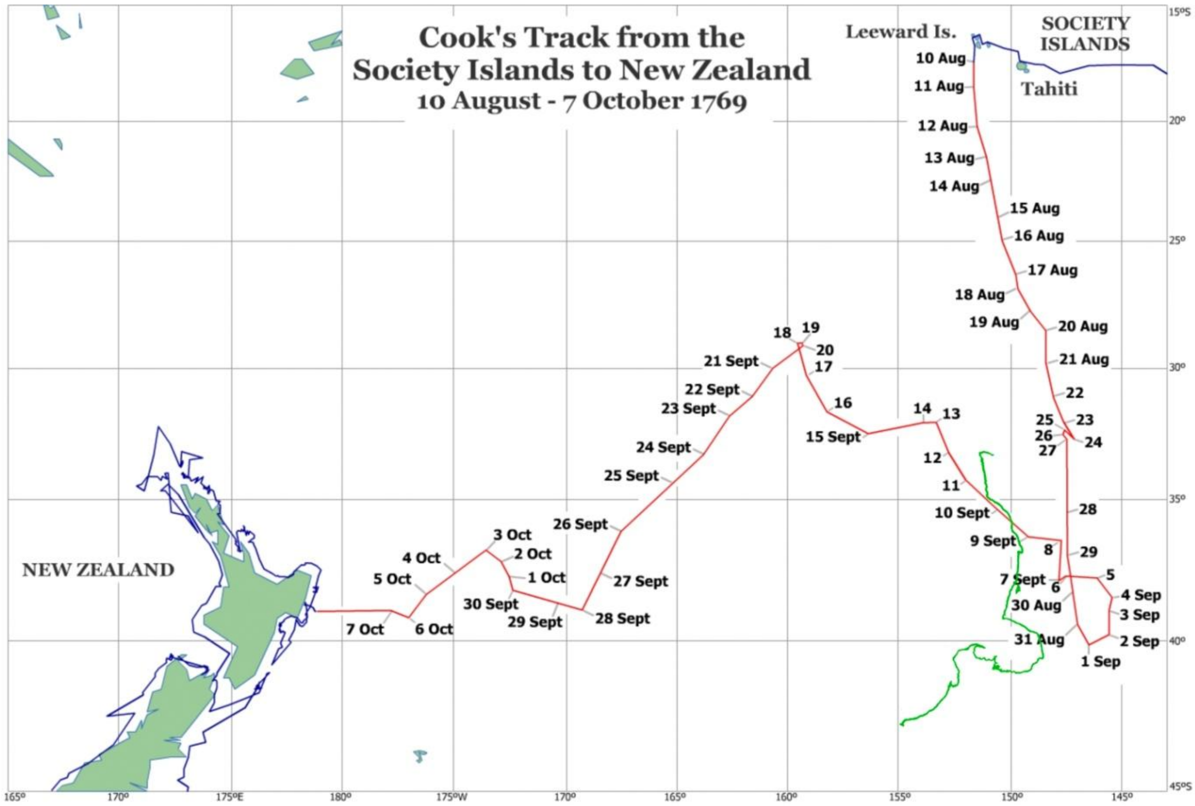
[47] Beaglehole, p. cclxxxii, for quote. See also pp. cix-cx. Cited by Salmond, pp. 128-9.
[48] W.J.L Wharton, p. 125, for quote in footnote.

Figure 2.4. *Endeavour's* track to New Zealand in relation to Tasman's chart.[49]



From the period of approximately 20 August through to 7 October 1769, Cook was looking for the east coast of the land charted by Tasman. It can be seen that from the period 22-27 August, Cook was seeking evidence of land to the east of Cape Maria van Diemen. The *Endeavour's* 'loop' performed from about 30 August to 6 September conforms closely to where Tasman located a mountain at about 38º south. At the time Cook's track (at about 154º west of Greenwich) crossed Tasman's supposed track, between 11 and 12 September 1769, Cook had most likely concluded that Tasman's chart was inaccurate. In order to locate New Zealand Cook first had to refute Tasman's longitude and latitude points. The *Endeavour's* deliberate zigzag course during the period 13 September to 7 October was required in order for Cook to establish the degree of Tasman's error and it eventually led him to New Zealand.[50]

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[49] The source of chart was an Internet website, http://southseas.nla.gov.au/journals/maps/22_pacific.html. Tasman's chart was superimposed.

[50] Beaglehole, p. 500, for a section of Cook's letter, number 7, 23 Oct. 1770, to the Admiralty Secretary. In this he outlined the track the *Endeavour* followed, in accordance with instructions, after departing Tahiti. This track led to the eventual 'discovery' of New Zealand.

It is unsurprising that Cook decided to approach New Zealand on the latitude of about 38º S as it conformed closely to Tasman's journal estimate of the latitude of a mountain sighted by Tasman (Mt. Karioi) which is at 37º 50´S. Cook probably expected the landmark to be visible several miles out to sea and wanted to use it as a visual navigational aid. The mountain, however, was not visible. On 7 October 1769 Nick Young, the cabin boy, sighted the east coast of New Zealand's North Island, and landfall was made at the place later to be named Poverty Bay.[51] This coastline holds the distinction of being the first area of New Zealand to have its clock time calculated relative to Greenwich.

A six-month circumnavigation and charting of New Zealand commenced in which Cook, Charles Green, and Isaac Smith were the principal figures.[52] Andrew David notes

> The procedure for obtaining longitude by lunar distance required four observers and was as follows. While the principal observer measured with a sextant the angular distance between the sun and moon or between the moon and one of the selected stars, two of the other observers measured the altitudes of the moon and the sun or the selected star. At the same time, the fourth observer noted the precise time of the observation by deck watch, which he recorded together with the three observations. Next the local time of the observation was calculated, either directly from the watch, whose rate had been checked earlier in the day, or from the observation of the sun or star. The angles were then 'cleared' of the effects of lunar parallax and refraction to obtain their true values.[53] The *Nautical Almanac* was then consulted and by interpolation, the Greenwich time of the observation obtained. Then knowing the local time of the observation, the difference between the two gave the longitude of the ship east or west of Greenwich expressed as time. In practice, the method required precise observations, followed by lengthy and tedious calculation. An accuracy of less than 30 minutes of longitude was rarely achieved by this method.[54]

Beaglehole's observation that Maskelyne's lunar tables "had made possible the great triumphs of the *Endeavour* voyage" is an overstatement.[55] The published tables were only available for the first three months, October to December 1769, and each computation took thirty minutes. The tables for 1770 were not published at the time *Endeavour* sailed, and all subsequent computations took about four hours.[56] Cook wrote that, "The Method we have

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[51] E. Axford, *With Captain Cook in New Zealand* (Auckland, 1975), p.16.
[52] David, pp. xxvii, xxviii and xxxiii, for detail. Green was *Endeavour's* astronomer. He was a former assistant to Maskelyne, and was involved in the preparation of the lunars. Smith drafted many of the charts.
[53] Sobel, p. 98. The tables were drafted from the perspective of an observer standing on the surface of the Earth. Adjustments were therefore required for an observer's height above the horizon on a ship at sea level.
[54] David, pp. xxvii-xxviii. See also Howse and Hutchinson, p. 193 for similar instructions given to William Wales, the astronomer.
[55] J.C. Beaglehole, *Cook the Navigator* (London, 1969), p. 31, for quote. See also David, p. xxvii, states that the charting in 1770, without the lunar tables, was "a particularly tedious affair."
[56] D. Howse, *Greenwich Time* (London, 1980), pp. 66, 67. Sobel, p. 134. Landes, p. 28.

generally found may be depended upon within ½ a degree, which is a degree of Accuracy more than Sufficient for all Nautical purposes."[57] Observations taken using K1, the chronometer, on the second voyage indicated Cook was incorrect in his assessment of the lunars. Whilst some observations were within the ½ degree tolerance a number others were "measurably in error".[58] Had the *Endeavour* used the lunars to sail directly from England to a predetermined point in New Zealand the degree of discrepancy was likely have been greater, perhaps by as much as one and a half degrees. It would have missed the target by many miles as accuracy over longer distances, with the moon as a clock, was still a problem. Of Cook's survey, Captain William Wharton (1893) wrote that "The astonishing thing is, not that some longitudes are considerably in error, but that the majority of them are so near the truth."[59]

The popular belief of many historians was that James Cook was responsible for the observations necessary for the drafting of the first chart of New Zealand when the observations for the chart were chiefly the work of Charles Green.[60] As the ship's astronomer, he was responsible for the astronomical observations.[61] Cook in acknowledging the work of Green wrote:

> In justice to Mr. Green, I must say that he was indefatigable in making and calculating these observations, which otherwise must have taken up a great deal of my time, which I could not at all times very well spare.[62]

The *Endeavour's* voyage presented the opportunity for some on-the-job training as any person with aptitude and application could learn the skills. Cook wrote that

> By his [Green's] instructions several of the petty Officers can make and calculate these observations almost as well as himself. It is only by such Means that this method of finding the Longitude at Sea can be put into universal practice. Sea Officers … would not find them so very difficult as they first imagine, especially with the Assistance of the *Nautical Almanack and Astronomical Ephemeris* … Without it the Calculations are Laborious and discouraging to beginners, and such as are not well vers'd in these kind of Calculations.[63]

[57] David, p. xxxiv, for quote. See pp. xxxiv-xxxv, for details. See also Wharton, p. 316, for quote. Chronometer observations taken on the second voyage exposed some inaccurate calculations done using the lunars.
[58] Ibid., p. xxxv, for quote. This was a reference to the detailed observations taken at Queen Charlotte Sound.
[59] Wharton, p. xxviii. Cited by David, p. xxxvi, with footnote. Glennie and Thrift, p. 342
[60] For two examples of Cook's overstated role see Norman J.W. Turner, 'Cartography', in Andrewes (ed.), p. 60, Fig. 11, Green was omitted completely. And Glennie and Thrift, p. 342, Cook "had produced several new maps, including the first detailed coastal map of New Zealand." See also John Hearnshaw, 'The Development of Astronomy and Astrophysics in New Zealand,' in W. Orchiston, (ed.), *The Emergence of Modern Astronomy and Astrophysics in the Asian-Pacific Region* (2011?). Hearnshaw acknowledges Green as New Zealand's first professional astronomer.
[61] David, p. xxviii.
[62] Wharton, p. 316, for quote.
[63] Wharton, p. 317. My use of italics.

The officers tutored by Green became the teachers of future navigators. The *Endeavour's* voyage assisted in the adoption of a "universal practice", as predicted by Cook.[64] The *Endeavour's* voyage also brought the first occasions when mechanical timepieces were on New Zealand soil and clock time was calculated.[65] The George Graham watch, and most likely the astronomical clock, were taken ashore when detailed surveys were conducted at sites including Mercury Bay and Queen Charlotte Sound. The first completed chart of New Zealand revealed its position west of the prime meridian at Greenwich, with East Cape about 181° west and West Cape about 193° 15′ west.[66] In terms of clock time New Zealand fell between twelve hours four minutes behind Greenwich at the East Cape, and about twelve hours fifty-two minutes behind Greenwich at the West Cape.[67] This represented an approximate forty-eight minute time period from cape-to-cape.

In September 1770, Cook reflected on the technological developments his voyage possessed. He referred to them as "the helps" which assured his journal and charts a greater level of accuracy in contrast to those of earlier explorers, such as Tasman.[68] The "blame for the faultiness of the Charts", he stated, was shared by "Navigators", the "Compilers and Publishers" and the "Seaman" who drew various versions of the charts.[69] He concluded this day's entry (Friday, 7 Sep. 1770) lamenting that "between the one and the other we can hardly tell when we are possessed of a good Sea Chart untill we our selves have proved it."[70] Cook's observation exposes the long time widely held belief that earlier charts, including Tasman's, were correct for longitude and latitude, which was not the case. It was only from the 1750s that the technology used to navigate at sea achieved reliable results. The *Endeavour's* achievements underpinned the justification of the *Resolution's* later, technically more extensive and therefore more expensive, venture. It was a venture that had greater international implications.

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[64] Ibid.

[65] Howse and Hutchinson, p. 138. This book does not start at page one, but uses the original numbering of articles as first published in the journal *Antiquarian Horology*.

[66] The Admiralty did not publish the charts. Glennie and Thrift, p. 291, citing B. Lavery, *Nelson's Navy: the Ships, Men and Organisation, 1793-1815* (London, 1989), p. 182. Greenwich is the site of the Royal Observatory, near London. A Richard Pickersgill chart, I.170, of New Zealand interestingly shows New Zealand's position both east (upper border) and west (lower border) of Greenwich.

[67] 181 degrees: 180 degrees equals 12 hours plus 1 degree which equals four minutes.

[68] Beaglehole, *The Voyage of the Endeavour*, p. 413, for quote.

[69] Ibid., for quotes. Some previously charted coastlines Cook stated, from his own actual observations, came from the drawer's imagination rather than genuine observations.

[70] Ibid., for quote. Also footnote 4, pp. 413-4, for detail.

Cook – The Second Voyage

The timing of the second voyage coincided with the availability of new navigational technology – a chronometer to calculate clock time and longitude at sea. John Harrison (1693-1776) had offered his fourth timekeeping device, the H4, to the Admiralty for trials at the time Cook was planning his *Endeavour* voyage.[71] At this time, however, the chronometer was in the possession of Larcum Kendall who, with Harrison's supervision, was producing a duplicate.[72] The Board rejected the offer due to H4's uniqueness, and the anticipated hazardous nature of the voyage. H4 was also required for the construction of the Kendall duplicate. The duplicate, known simply as K1, was issued to Cook for the second voyage.[73] John Arnold (1736-1799), a London watchmaker, also supplied three of his self-designed watches for trial.

Figure 2.5, K1, the Chronometer.[74]

The second voyage was a much more elaborate venture with two ships, the HMS *Resolution* and HMS *Adventure*. The *Resolution* under the command of Cook included in its manifest three oversized pocket watches – the K1, the Arnold 3 and the Ellicott No. 4659. The *Adventure*, captained by Tobias Furneaux, was issued with the Arnold 1 and 2 and it also used the astronomer William Bayly's privately owned pocketwatch.[75] Prior to departing England, the watches were calibrated to Greenwich mean time.[76] Each ship was also allocated clocks for specific uses on land. These were two

[71] Whitrow, *Time in History*, pp. 142-145, Betts, pp. 29-95, Sobel, pp. 61-176, Anthony G. Randall, 'The Timekeeper that Won the Longitude Prize', in Andrewes (ed.), pp. 235-254, and Glennie and Thrift, pp. 359-406, for Harrison's background and achievements. H4 was completed in 1759.

[72] This was a stipulation of the Board. The chronometer had to be duplicable by another person.

[73] Cook had recently been promoted to the rank of Captain. Sobel, pp. 144, 150, states that K1 was completed in January 1770 following two and half years work and cost £450. However, p. 153 states £500. Howse and Hutchinson, p. 191 states £450, and p. 193 footnote indicates a £50 bonus was also paid.

[74] http://www.google.co.nz/imgres?q=k1+chronometer..., held by National Maritime Museum, London. Repro ID: C9303_1. K1 is 13 cm in diameter and weighs 1.45kgs.

[75] Howse and Hutchinson, p. 64. Beaglehole, *The Voyage of the Resolution and Adventure 1772-1775*, pp.16-7.

[76] David, *Charts of the Resolution and Adventure 1772-1775*, pp. xviii-xix. See also Howse and Hutchinson, p. 193, and Thomas, p. 164. These give more detailed footnoted accounts.

John Shelton[77] designed and built astronomical regulator clocks,[78] two Journeyman clocks and two Alarum clocks. They were used to time accurately the transit observations and were taken ashore in New Zealand during extended periods of stay. Examples of this were the detailed surveys conducted at Mercury Bay, Dusky Sound and Queen Charlotte Sound.[79] The ships were also well provided with surveying and navigational instruments supplied by the Board of Longitude or the Royal Society or purchased specifically for the voyage.[80]

Security surrounding the chronometers was quite strict with each housed in a purpose-built box that required three keys to open it. On the *Resolution,* the keys for K1 and Arnold No.3 were held by Cook, his First Lieutenant Robert Palliser Cooper and the astronomer William Wales. On the *Adventure,* the keys for Arnold No.1 and No.2 were entrusted to Captain Furneaux, First Lieutenant Joseph Shank and the astronomer William Bayly.[81] All were required to be present daily at noon when the boxes were opened, the watches wound and compared to each other.[82] The astronomers were responsible for the day-to-day guardianship of the chronometers.[83] One reason for the strict security that governed the use and movement of the chronometers was their cost: K1 was worth £500. A second and more prominent reason for the security of the chronometers laid in the specific function they had to serve. They were being formally tested for the British Government, so the risk of being tampered with had to be removed, and only those authorised to handle them were allowed to do so.

The Board of Longitude required the astronomers, Wales and Bayly, to undertake extensive trials of the chronometers to assess their performance. These involved the taking of observations for latitude and longitude.[84] Wales, for example, obtained the Resolution's longitude at sea by chronometer on over 1,000 days and by lunars on over 400 days. Sometimes multiple observations were made on a single day. The chronometers were

[77] A London clockmaker.
[78] David, p. xxiii. The *Resolution* clock was marked 'B' and the *Adventure* clock marked 'C'. "The purpose of these clocks was to provide accurate timekeeping on shore."
[79] Orchiston, pp. 61-92.
[80] David, p. xix. David quotes Wales (Wales and Bayly (1777)), p. vi, "every instrument necessary for the undertaking, of the best sort, and constructed by the most approved makers."
[81] Shank suffered from gout and was sent home. Arthur Kempe was promoted to first lieutenant and given the third key.
[82] If one person was unable to be present for any reason, then he had to be replaced by another officer. On one occasion, Wales, with his two observers, forgot to wind K1 and it stopped. However, Wales was able to reset it to GMT as he had been keeping accurate records.
[83] The chronometers were taken ashore for testing at Cape Town on 31 October 1772. Unfortunately, the longboat in which Wales was seated with Arnold No.1 and No.2 hit the wharf heavily, jolting one of the Arnolds. Wales examined it and even though it had stopped did not consider the damage to be serious. He restarted it but it kept time poorly. The second continued to keep good time.
[84] David, p. xvii and pp. xxv-xxix, for detail. See also Howse and Hutchinson, p. 193.

immune to the effects of cloud, and the position of the Sun relative to the moon and fixed stars.[85] However, in order to rate the chronometers astronomical observations were required to be taken on land on every possible occasion.[86] For the period of March/April 1773, K1 and Arnold 3 were tested in conjunction with the lunars during the *Resolution's* stay in Dusky Sound[87] and longitude was calculated with a high degree of accuracy. At the next anchorage, in Queen Charlotte Sound, the chronometers revealed that the January 1770 calculations were "measurably in error."[88] Further testing on 17 August 1773 at Fort Venus, in Tahiti, revealed K1 to be keeping excellent time.[89] In Tonga, on 2 October 1773, K1 was found to be accurate to within half a degree. On 22 April 1774, the *Resolution* was again in Tahiti and only a small error was found with K1. In October 1774, *Resolution* returned to Queen Charlotte Sound, when additional testing was done and Green's charts from the *Endeavour* voyage were amended. Only a small error was found with K1 when the *Resolution* arrived off the English Coast on 29 July 1775.[90] Cook's trust in K1 resonates in his journals. He attached a 'maternal' personality to the watch and referred to it in the third person singular as "she" and "her", and as "our faithful guide through all vicissitudes of climates."[91] K1 had presented a mechanical answer to the problem of finding clock time at sea, and its accuracy in helping to determine New Zealand's location and draft accurate charts proved it.

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[85] Ibid., p. xxv, for detail. The lunars could not be used in bad weather or when the Sun and moon were either too close to each other or too far apart. See also Betts, p. 21, for detail.

[86] David, pp. xxviii-xxix, for detailed explanation. See also Howse and Hutchinson, p. 194, Fig. 5, which shows the performance of K1 and Arnold No.1 from the Cape of Good Hope to New Zealand in 1772-3. K1's rate of gain increased from about two seconds to about seven seconds per day. Arnold 1's rate of loss increased from 20 to about 25 seconds per day over the same leg.

[87] It is on the southwest coast of the South Island.

[88] David, p. xxxv, for a detailed explanation. These errors occurred despite the calculations being made on land. The *Endeavour* voyage only had lunar tables published up to the end of December 1769.

[89] Fort Venus was chosen as the latitude and longitude were known with a high degree of certainty.

[90] Betts, p. 89. W.J.H. Andrewes, 'Even Newton Could Be Wrong: The Story of Harrison's First Three Sea Clocks', in Andrewes (ed.), p. 234. Harrison received just over £23,000. He died 24 March 1776.

[91] Howse and Hutchinson, p. 194, cite Cook's journal, June 1774, with endnote 12, p. 205. Cook used the personal pronoun 'she' three times, and "her" once, in the space of two sentences. And Ibid. which cites Cook's letter to Secretary of the Admiralty, April 1775, from Cape of Good Hope, and endnote 13, p. 205, for long quote.

Cook – The Third Voyage

Cook used K1 again on his third and fateful voyage to the South Pacific.[92] With many of his earlier crew returning, he sailed again in the *Resolution* and rather than merely being issued with K1, as he had been previously, he asked for it. Cook, Second Lieutenant James King, and the ship's Master, William Bligh, each held a key to open K1's box.[93] The chronometer's reliability brought a further rationalisation to the timekeeping aboard the vessel. No astronomer was appointed, the previously highly regarded lunars were relegated, and K1 was elevated to first choice. Captain Charles Clerke commanded the sister ship HMS *Discovery* on this voyage. William Bayly, his astronomer, was given the responsibility of safekeeping Kendall's newly manufactured K3.[94]

The third voyage brought home the tremendous responsibility the keepers of K1 were given and revealed that an immense inequality was now in existence. One ship enjoyed the reliability of K1, whilst its sailing companion and all other ships on the sea relied on the 'old' technology, the lunars. Until the mass-production of equally or more reliable marine chronometers the ship that used K1 had unique navigational capabilities.

The time for testing was over, and this voyage was primarily one of discovery.[95] On 14 February 1779, at about the time Cook died in a battle with warriors on a Hawaiian beach, K1 stopped ticking.[96] A coincidence only, but the sailors who later linked the two incidents did so to show Cook's bond with the watch. K1 had secured its link, for perpetuity, to the South Pacific. Britannia, it was now being said, "ruled the waves" with the help of watchmakers.[97]

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[92] They departed England on 12 July 1776.

[93] The Royal Navy rank of master indicated the officer was responsible for the ship's navigation. Bligh was the infamous captain of HMS *Bounty*, which suffered a mutiny in 1787. He was responsible for the security of K1.

[94] Howse and Hutchinson, p. 203, indicate that K3's performance was excellent. They note K1's performance was outstanding.

[95] W. Besant, *Captain Cook* (London, 1890), p. 116. Betts, p. 92. The growth of the British Empire was a real possibility.

[96] Sobel, p. 151.

[97] Sobel, p. 153 and Betts, p. 92. Originated from the poem "Rule, Britannia" by James Thomson and set to music by Thomas Arne in 1740. In contrast, visits by French ships to New Zealand - de Surville's (1769) and du Fresne's (1772) - relied on astronomical tables. It would be years before French navigators and their colleagues from other nations would be issued with reliable chronometers. Mercer, pp. 97-8, indicates the Spanish Navy from 1774 started testing chronometers manufactured by Ferdinand Berthoud. It appears that the Spanish Navy or individuals purchased at least eight, probably more, made by Arnold.

Cook, the Chronometers, and their Legacy

Despite the abortive and tragic nature of Cook's third voyage, Cook and the chronometers that he tested added a new chapter to the history of navigation. The chronometers represented an incredible advance in thought, development, testing, modification and retesting, which spanned several decades occupying tens of thousands of hours of work. John Arnold's "struggle" in constructing his timepieces, writes Anthony Randall, "would surely have proved too much for someone of a less resourceful and tenacious intellect."[98] This statement must surely apply also to John Harrison who solved what was arguably the greatest navigational problem of the age. The Harrison and Arnold chronometers were the result of ingenuity and originality of thought. Harrison created accuracy from "very great complexity of mechanism and perfection of execution," whereas Arnold's "machines were far simpler … [but still contained] the essential ingredients for accuracy if not for stability."[99] Both men proved that it was possible to construct accurate portable timekeepers.

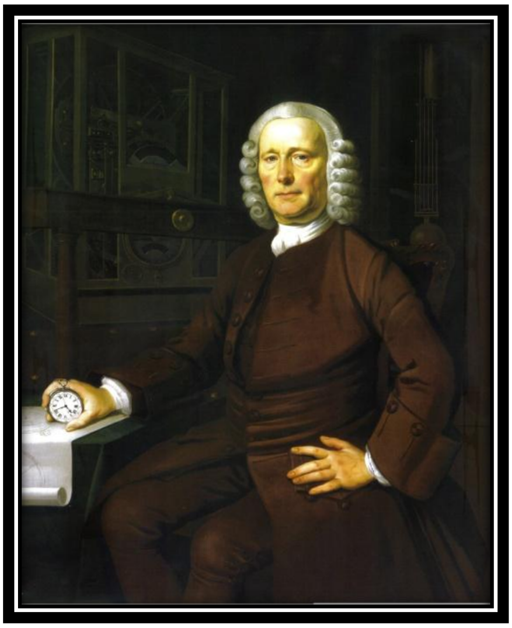

Figure 2.6, John Harrison with H4, the chronometer.[100]

John Harrison, with the help of his son William (1728-1815), produced a new chronometer H5 which was tested at King George III's private observatory at Richmond.[101] However, Harrison never enjoyed universal support for his work and suffered from the "bitter resentment" of some colleagues ignorant of his technology and jealous of his financial rewards.[102] Although he fully documented his work, it "was not understood by those engaged in the mainstream of horological science," and after his death the writings and drawings went unappreciated and were quickly forgotten.[103] This, Burgess

[98] A.G. Randall, in V. Mercer, p. vii.
[99] Ibid., for quotes.
[100] http://www.google.co.nz/imgres?q=john+harrison...
[101] Howse, p. 72. Also A.G. Randall, 'The Timekeeper that Won the Longitude Prize', in Andrewes (ed.), pp. 251-2. The observatory is known today as Kew Observatory. After ten weeks of testing it was found that H5 had lost only 4 ½ seconds.
[102] M. Burgess, "The Scandalous Neglect of Harrison's Regulator Science', in Andrewes (ed.), p. 277, for quote.
[103] Ibid., for quote.

argues, was due to a “gross failure of human relationships”, and not because of issues with complexity, long construction times or high costs.[104] No one took the time to learn directly from Harrison and this lack of cooperation with the master timepiece maker of the era delayed, by more than one hundred years, the construction of the R.A.S regulator at the Royal Observatory – a regulator that Harrison predicted would be accurate to within a second every 100 days. It has taken 200 years for Harrison’s regulator work to be appreciated.[105] In the 1990s, scientists in the fields of oscillator physics and mechanical engineering have found inspiration in Harrison’s work.[106]

Thomas Mudge (1715?-1794) was another watch maker noted for his complexity of design. He began his seven year apprenticeship to George Graham in 1730 and was aware of Harrison’s work through Harrison’s association with Graham. In 1738, he became a journeyman and was employed to assist other people, such as John Ellicott (1706-1772) making items until 1751.[107] He then set up his own business and supplied watches to the King of Spain and Johann Jakob Huber (1733-1798), Professor of Astronomy to Frederick the Great.[108] In 1779, he supplied two chronometers, known as Mudge ‘Blue’ and ‘Green’, for testing by the Board of Longitude. They performed well, and the Board rewarded him for his work. Subsequent watches made by his son Thomas Jr. were not as accurate, and the expensive, complex design made them unpopular with potential purchasers and the business failed.[109]

It fell to others to make the manufacture of accurate chronometers a profit-making enterprise. The simpler technology created by John Arnold and Thomas Earnshaw (1749-1829) was popular. Both men “provided the sort of practical machines that navigators wanted.”[110] Firstly, although the Arnold’s No.1, 2 and 3 “failed to live up to [Arnold’s] expectations,”[111] Arnold and his son, John Roger, went on to produce “several hundred” watches before the turn of the century.[112] Secondly, from the 1780s, Earnshaw produced

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[104] Ibid., p. 278, for quote.
[105] Ibid., for detail.
[106] Ibid, for detail.
[107] D. Penney, ‘Thomas Mudge and the Longitude: A Reason to Excel’, in Andrewes (ed.), p. 300, for detail. It is believed he helped produce Ellicott’s watch which had temperature compensation. Harrison claimed Ellicott stole the idea from him.
[108] Ibid., p. 303.
[109] Ibid., pp. 308-9, for detail.
[110] C. Cardinal, ‘Ferdinand Berthoud and Pierre Le Roy’, in Andrewes (ed.), p. 308.
[111] Mercer, p. 25.
[112] Sobel, p. 156.

chronometers and enjoyed "an excellent reputation within the trade as a watch-finisher."[113] He "reduced Harrison's complexity" with the invention of the spring-detent escapement.[114] Arnold disputed Earnshaw's claim to the invention and to this day the issue has not been resolved.[115]

The success of Harrison and Arnold enabled other clock and watch makers to follow. One in particular was Larcum Kendall (1719-90). Kendall was apprenticed, at various times, to both George Graham and John Jefferys for several years. He became a master "in making horizontal escapements, which at that time, was reckoned a difficult piece of business."[116] This led, in 1767, to his being commissioned by the Board to construct K1.[117] Sobel adds that William Harrison informed the Board of Longitude "that in some respects Kendall's workmanship [of K1] proved superior to his father's."[118] Kendall's later designs K2 (1772) and K3 (1774) were internally inferior to K1 and neither matched its accuracy.[119]

It would be wrong to assume that chronometer development occurred only in England. Two European watchmakers, Pierre Le Roy (1717-1785) and Ferdinand Berthoud (1727-1807) sought to bring practicality and commercial success to the construction of advanced timepieces.[120] Le Roy is credited with establishing the central tenets of the modern chronometer, namely "a detached escapement, temperature compensation in the balance, and an isochronous balance spring."[121] But he did not make a chronometer that could be copied easily or that was strong enough to survive the rigours of a sea voyage.[122] Berthoud's main concerns were "strength, simplicity in manufacture and manipulation, and convenience in repair."[123] He went on to produce 70 Chronometers of which 50 aided navigation on eighty

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[113] Jonathan Betts, 'Arnold and Earnshaw: The Practicable Solution', in Andrewes (ed.), p. 321, for quote. For detail see pp. 321-8.
[114] Sobel, p. 159.
[115] Sobel, pp. 160-1.
[116] David Penney, 'Thomas Mudge and the Longitude: A Reason to Excel', in Andrewes (ed.), p 299, footnote 32, for Kendall quote, which comes from *Gentlemen's Magazine*, vol. 60 (1790), part 2, p. 113. A Graham watch was on the *Endeavour* voyage.
[117] W.J.H. Andrewes, 'Even Newton Could Be Wrong: The Story of Harrison's First Three Sea Clocks', in Andrewes (ed.), p. 226.
[118] Sobel, p. 145, for quote. H4 and K1 were regarded as internally identical.
[119] Ibid., pp. 154-5. K2 was later used by Captain Bligh on the *Bounty*, and taken to Pitcairn Island by the mutineers. In 1808, they sold it the captain of an American whaling ship. K3 was on the *Discovery* during Cook's third voyage.
[120] C. Cardinal, pp. 282, 284. Le Roy was born in Paris, and Berthoud was from a little Swiss village near Neuchâtel.
[121] Ibid., p. 292, for quote.
[122] Ibid., for above and following quote. An extant chronometer is "of such fragility that it cannot be moved without difficulty."
[123] Ibid.

voyages.[124] In the world of clock makers Le Roy was considered the best, some argue even better than Harrison, but in the world of consumers Berthoud secured the financial rewards.[125]

When the time the Board of Longitude was established it announced three awards totalling £45,000. By 1828 when the Board disbanded it had disbursed over £100,000 in funds to about 60 individuals.[126] The awards included those to Harrison (£23,065), Arnold (£3,000), Earnshaw (£3,000), Mayer's widow (£3,000), Mudge (£3,000), Jesse Ramsden (£1,015), Kendall (£800), Euler (£300) and Captain Cook's widow.[127] John Harrison received the largest portion of the money paid out, and although "he was denied the satisfaction of having won the second half of the prize outright" he did receive an appropriate financial reward for 45 years of dedication to solving the longitude problem mechanically.[128]

What value did precision bring to navigation? Precise longitude was unnecessary during European voyages of exploration, such as Wallis's to Tahiti, but it became important when the explorers' sponsors wanted to exploit the discoveries by returning quickly and easily to particular parts with the aid of accurate charts and precise navigation. This explains Cook's voyage to Tahiti to observe the transit of Venus and his three voyages to New Zealand within the space of about seven years. Examples, such as these, not only indicated the European "drive … to discover but to control and command the world they encountered: to map it, to move freely over it, to know where everything is."[129] It also explains Cook's detailed chart of Queen Charlotte Sound; an excellent haven for ships and crews that he visited on all three voyages perhaps because he recognised that its command of the strait between New Zealand's two main islands gave it potential strategic importance.

About 50 years after Harrison's H4, increased supplies of Arnold, Earnshaw and Berthoud chronometers had reduced costs, and an increasing list of captains could afford the

[124] Ibid., see also footnote 39. It is likely that some of these chronometers helped in the navigation of ships to New Zealand.
[125] Ibid., pp. 282-292, for detail.
[126] The Board operated for 114 years.
[127] Johnson, pp. 67-8. Sobel, pp. 55, 98, 101, 122, 129, 132 and 149. Johnson states Maskelyne did not receive any payments, as the preparation of the tables was part of his duties; however Sobel indicates he was paid. See also Andrewes (ed.), pp. 46 and 155 for Mayer's widow, p. 155 for Euler, p. 234 for Harrison, p. 308 for Mudge, p. 315 for Kendall, p. 328 for Arnold and Earnshaw, and p. 404 for Ramsden. Ramsden (1735-1800) invented a machine which manufactured sextants that were consistently of high quality, more manageable in size and at a lower cost.
[128] A.G. Randall, 'The Timekeeper that Won the Longitude Prize', in Andrewes (ed.), p. 252, for quote.
[129] M.S. Mahoney, 'Longitude in the Context of the History of Science', in Andrewes (ed.), p. 68, for quote, citing M. Norton Wise, *The Value of Precision* (Princeton, New Jersey, 1994).

purchase price of the timekeepers.[130] Such was the growth in chronometer usage that in 1791 the East India Company, when considering the design of the logbook to be used by its commercial vessels, included a column for "longitude by Chronometer."[131] By the 1820s chronometers were in common use at sea, bringing a revolution in navigation.[132] Such a development had a huge impact on the growth and maintenance of the British Empire as clock time allowed for a repetition of voyages to single destinations using the quickest and the therefore most efficient routes. As a result, ship owners were able to minimise the costs of voyages, and captains were able to reduce the period of discomfort for passengers. Increasingly accurate charts and maps were published that gave people a new perspective of where they lived, and where their country was in relation to others. "The determination of longitude … presents one of the most solid links we have between technology and science" during the eighteenth Century.[133]

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[130] David S. Landes, 'Finding the Point at Sea', in Andrewes (ed.), p. 28. Cited by Jay Steven Gross, *Keeping Time: Clock Time in Nineteenth Century New Zealand*, MA History Thesis, (University of Auckland, 2003), p. 40. See also, N.A.M. Rodger, *The Command of the Ocean: A Naval History of Britain 1649-1815* (England, 2004), pp. 382-3, for details of chronometer availability in Royal Navy.

[131] Sobel, p. 162, for quote. On p. 163, she states that by 1815, approximately 5,000 chronometers existed. On p. 164, she notes that the Royal Navy had "nearly 800 chronometers" for its 200 ships in 1860.

[132] A. Sharp, (ed.), *Duperry's Visit to New Zealand in 1824* (Wellington, 1971), p. 28, for references to chronometers, in particular "Chronometer 26", which was used by French to navigate to New Zealand, and calculate longitude on land. Paris was used as the prime meridian.

[133] M.S. Mahoney, 'Longitude in the Context of the History of Science', in Andrewes (ed.), p. 67, for quotes.

Chapter Three:

The Emigrants, from 1840 onwards

Steer, helmsman, till you steer our way
By stars beyond the line
We go to found a realm – one day –
Like England's self to shine.[1]

By the 1840s chronometers were widely used on British ships and were able to play a major role in the transportation of emigrants to New Zealand. They not only assisted navigation but they were also used to regulate the lives of both passengers and crew. In this chapter I will attempt to answer three questions. What information about timekeeping was available to assist the emigrants' preparation? What timekeeping practices were in use on the ships? What impact did seafarers' timekeeping practices have on the emigrants' lives?

Information to Assist Emigrants' Preparation

Advice to prospective emigrants came from many quarters. Primary sources included the guide books by James Busby, Edward J. Wakefield, G.B. Earp, Robert Druitt, Frederick Tuckett, John H. Burton, and Reverend James Baird, to name but a few.[2] All drew on the experience of the authors who had spent time in New Zealand. Whilst their primary goal was the promotion of New Zealand as an ideal settlement destination, they also offered pragmatic advice on coping with the voyage and on what to expect on arrival.

Passengers required particular temporal information in order to prepare for the voyage. This was presented in the form of statistics, facts and advice. To understand the requirements is to appreciate how New Zealand was portrayed to prospective emigrants.

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[1] Thomas Campbell, verse one of 'Song of the Emigrants to New Zealand', *New Zealand Gazette*, vol. 1 (21 Aug. 1839), p. 4. Poem was dated 16 August 1839, London.

[2] For the purpose of this thesis the word emigrant includes both colonists, e.g. landowners, and emigrants, e.g. the skilled and semi-skilled working classes. James Busby, *Authentic Information Relative to New South Wales and New Zealand* (London, 1832). Edward Jerningham Wakefield, *The Hand-Book for New Zealand Consisting of the Most Recent Information for the Use of Intending Colonists* (London, 1848). G.B. Earp, *Hand-Book for Intending Emigrants to the Southern Settlements of New Zealand*, second edition (London, 1849). Robert Druitt, *Medical Hints for Emigrants* (London, 1850). Frederick Tuckett, *Do Not Emigrate Until You Can Possess That Portion Of The Land Which Should Be Your's*, London: Gilpin, 1850 (Bristol, England, 2005). John Hill Burton, *The Emigrant's Manual; Australia, New Zealand, America and South Africa* (Edinburgh, 1851). Rev. James Baird, *The Emigrant's Guide to Australasia* (London, 1871).

Literature identifying New Zealand's location measured its proximity to England in terms of the time required to travel there, rather than its physical distance by sea. A continuing reference to duration reveals a 120 day or four month voyage from England; however no information as to how this was calculated was given.[3] So, just how was the time calculated? In 1839, the London published *New Zealand Gazette*[4] stated that it took 120 days for a ship to sail the measured 13,200 miles from England "to Nicholson's Harbour, Cook's Straits" (Wellington).[5] The newspaper did not publish the source of this information. However, it possibly came from a British almanac and represented approximately an average time for previously recorded voyages.

The 120 day/four month voyage became the accepted 'temporal benchmark' for the journey to New Zealand, regardless of the port. Although the estimate was a rounded, inexact figure, it was adequate for passengers and as a guide easy to remember. As a consequence, a ship that did not arrive within this period was considered overdue and genuine concern was displayed until it arrived and accounted for its 'lateness'. The 'shorter voyages', such as those to the port of Bluff in Southland, Port Chalmers in Otago or Port Cooper/Victoria in Lyttelton were marketed in the media as being 'fast', in order to appeal to future emigrants. What must also be considered was that ships, by the 1850s, were better designed and were therefore faster than those of the 1830s, and the captains and crews had by the 1850s gained considerable experience sailing to New Zealand.

Timekeeping Practices Used on Emigrant Ships

Two uses of clock time existed on emigrant ships.[6] The first used clock time to mark the ship's longitude at sea. This allowed the navigator to measure the ship's position on a chart, and calculate how far it had come and how far there was to go. Successful navigation, as Montello explains it, "requires that as we move, we maintain a sense of where we are relative

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3 Wakefield, p. 443. See also *Canterbury Papers*, no. 3, facsimile edition (Christchurch, 1995), pp. 66 and 109.

4 'Tables of Distances', *New Zealand Gazette*, vol. 1 (6 Sep. 1839), p. 4 It was reprinted two weeks later. The distance quoted, 13,200 nautical miles, was the reported distance between Port Nicholson (Wellington) and England. The name of the English port was not disclosed, and therefore considered irrelevant. Issue two onwards was published in New Zealand. This newspaper was renamed twice and more commonly known as the *New Zealand Gazette and Wellington Spectator*.

5 Ibid.

6 Godley, p. 14, cites the use of chronometers (plural) on the *Lady Nugent* although no number was given. Mass-production had seen costs decrease which allowed not only the companies, but also the masters the opportunity to purchase. See also Sobel, pp. 134-5. Although lunars remained in publication until 1907 they were less common aboard emigrant ships.

to our goal, where places and objects we should avoid are located, and so on. That is [a navigator at sea] must maintain [geographic] *orientation*."[7] A navigator's chart was, and still is, in effect an ad hoc clock dial, recording the passage of time using hours, minutes and seconds. Just as the visible movement of a clock's hands reveals the passage of time so too does the addition of a new plot on a chart. The progress of a ship can be likened to a 'moving clock's hand'; each new computation indicates the current clock time, which was then expressed as a point of longitude.

The second use of clock time on the ships was to regulate the watch system. Every half-hour the crew counted the number of times the ship's bell was struck and knew how much of their watch time had passed and how much was left. Crews could also obtain the approximate clock time from knowing which watch was in operation by counting the bells. In this way the use of chronometers from the early 1800s replaced the use of the half-hour sandglasses that had previously regulated the watches.[8] The two tables that follow illustrate how the watch system worked. Table 3.1 explains the seven watches that operated on a 24-hour clock in terms of a 12 hour clock.

Table 3.1. Table of watch times correlated to clock times.[9]

Watch (24 hr clock)	*12 hour clock*
Middle 0000-0400	Midnight to 4 a.m.
Morning 0400-0800	4 a.m. to 8 a.m.
Forenoon 0800-1200	8 a.m. to noon
Afternoon 1200-1600	Noon to 4 p.m.
First Dog 1600-1800	4 p.m. to 6 p.m.
Last Dog 1800-2000	6 p.m. to 8 p.m.
First 2000-2400	8 p.m. to midnight

The second table, Table 3.2, indicates the number of bells that were struck every half an hour during a typical four hour watch.

[7] Montello, p. 264, for quote. Italics in original.
[8] Glennie and Thrift, p. 2, and for following quote. On the topic of accuracy they note that it "has to be assessed in the context in which the work took place." All crew worked to the time kept by the glass and none received more advantages or disadvantages than another did. The same argument applies to the accuracy of chronometers.
[9] 'Telling the time at sea – ship watches.' http://www.twogreens.co.uk/wakeup/lifeatsea/watches.htm. Glennie and Thrift, p. 307. Atkinson, pp. 3-5 for a more detailed explanation.

Table 3.2. The duration of each watch and the number of bells struck.[10]

Duration of Watch	*Number of Bells*
First half hour	One bell
First hour	Two bells
First hour and a half	Three bells
Second hour	Four bells
Second hour and a half	Five bells
Third hour	Six bells
Third hour and a half	Seven bells
Fourth hour	Eight bells

The sequence of bells was repeated for each watch as shown above in Table 3.1, except for the last dog-watch, which were one, two, three and then eight bells.[11] As a rule the ship's bell was only struck to mark the progress of each watch, and to indicate the ship's "position when at anchor, in fog or bad visibility, or to sound the general alarm in the event of fire or other emergency."[12]

Whilst nature, in the form of tides, at first determined when ships sailed, the clock served to express the moment in hours and minutes. Almanacs supplied the high and low tide clock times the captain needed, which allowed for the efficient use of time readying a ship for departure. By 1849, however, steam tugs had removed nature from the equation and clocks wholly determined sailing times.[13]

When a ship was in port or in sight of land it used civil time which reckoned the day from midnight to midnight. Once the ship was out of sight of land, however, nautical time took effect and measured the day from noon to noon.[14] Meanwhile, the search continued for improved methods of calculating the 'ship's time' time that corresponded to each ship's longitude. In the late 1840s, for example, a new practice offered a method of calculating time accurately not just at noon but on two other occasions – sunrise and sunset. It was discovered by Captain H.B. Weston of the East India Company and known as 'Weston's Method'.[15] It required a sextant and a calculation at the moment the centre of sun was observed in the horizon. The time on the ship's chronometer was recorded and Weston's tables were then

[10] Ibid.
[11] Atkinson, p. 5 indicates the bells were usually rung "by a boy or apprentice."
[12] Ibid., for quote.
[13] Burdon, p. 16, citing Dr. Barker's diary, of 20 Sep. 1850, recalling events of 5 Sep. The tug was called the *Black Eagle*.
[14] Glennie & Thrift, p. 304.
[15] *NZer*, vol.5, no. 341 (14 Aug. 1849), p. 2.

consulted to give a local time from which longitude was calculated. The *Nautical Magazine* wrote that "The observation is at once simple, easy, and within tolerable limits – certain of a result which may be depended on."[16] The Admiralty published Weston's tables and awarded him £100.[17]

The Impact of Seafarers' Timekeeping Practices on Emigrants' Lives

By the 1840s the rule of clocks and calendars was well established in British society, and embarkation instructions insisted on punctuality. A "Memorandum for Passengers" noted that

> The ships will sail on the day appointed; and as the comfort of individuals during the voyage very much depends upon the arrangements made by themselves before embarkation, exactness and punctuality are earnestly recommended … All Baggage must be alongside, and cleared, previous to the day fixed for leaving the Dock.[18]

Emigrants were compelled to closet their previous time keeping rituals and practices and adapt quickly to the two forms of ship time.[19] The first was imposed through the ship's bell, which regulated the timetables of daily, weekly and monthly activities.[20]

These fell into three categories:

1. Daily: bathing, roll-call,[21] eating, cleaning, washing, and collecting food, water and medicine.
2. Weekly: church services, lectures, children's classes, and entertainment (singing / dancing / games).
3. Monthly (approximately): collection of 'new' clothing from ship's hold.

All were regulated by the ship's clock time and through the sound of the ship's bell, which was the most efficient means of imposing a common time on a small, enclosed community.[22]

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[16] Ibid., the article cited *NMNC* (Glasgow, Nov. 1848). No page number for quotes.

[17] 'Rewards, &c, for Scientific Purposes,' *CEAJ*, Vol. XIII (London, 1850), p. 208.

[18] 'Memorandum for Passengers,' *Canterbury Papers*, p. 109. Cited by Colin Amodeo, *The Summer Ships*, (Christchurch, 2000), p. 46.

[19] G.J. Whitrow, *What is Time?* (London, 1972), p. 27, cites Immanuil Kant, *Universal Natural History and Theory of the Heavens* (1755).

[20] Atkinson, p. 5.

[21] The need for roll-calls was not stated in regulations, and depended on the strictness of the doctor so they may not have been common. They were used on the *Charlotte Jane* to Lyttelton (1850) and the *Philip Laing* to Port Chalmers (1847). See A.H. Reed, *The Story of Otago: Age of Adventure* (Wellington, 1947), p. 171, for the daily routine aboard the *Philip Laing*.

The emigrants came to realise that they had entered a community of seafarers with timekeeping practices quite different from any they had experienced before. The major was that time was packaged into half-hour blocks: other times, such as five minutes past the hour, or ten minutes to the hour, were not used. William Webster's diary indicates a good understanding of the bells as none of his entries were equated back to clock times. He refers to the ringing of the bell on Sunday 10 November 1839 to indicate the start of a sermon on deck "at five bells forenoon."[23] And on 25 December 1839 he wrote of "eight bells," which signalled the commencement of a wedding service.[24]

All passengers were expected to follow the daily routine established for them. Ensuring this was typically the role of the surgeon-superintendent (doctor), whose job it was to maintain the passengers' well-being. It was therefore in the interests of each doctor to control the clock time of the passengers. Aside from each doctor's natural desire to maintain his passengers' health, a pecuniary interest was attached to each: for every person who arrived alive, including births on board, he received a financial reward. The opposite applied also, as a fine was imposed for every death.[25] For the doctors, at least, the use of clock time to discipline and organise passengers' lives really did mean that 'time was money.' As a result doctors imposed rules and created physical and mental activities that they believed would promote their passengers' health. The rules were to be obeyed by all. The commencement, duration and finishing time of activities was tied to the ringing of the bell. The emigrants were required to listen for the bell, and given the relatively small size of the vessels, it was likely to have been heard, no matter where they were. Dr. Henry Weekes noted that "The people soon became acquainted with the intricacies of the vessel and already were very punctual in their attendance at the serving out of provisions."[26] Dr. Alfred Barker's diary reveals his use of clock time and food to maintain strict procedures and promote self-discipline. He required all passengers to be on deck, every morning, for a roll call. He wrote

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[22] Glennie & Thrift, p. 82. See also p. 83 for discussion. Pendulum clocks did not operate well on ships and were therefore stowed. Pocket watches were useful but humidity and temperature fluctuations hindered their accuracy and they required regular winding and resetting.

[23] Hector Bolitho and John Mulgan, 'Diary of William Webster,' *The Emigrants: Early Travellers to the Antipodes* (London, 1939), p. 73, for quote. Webster came to New Zealand in 1839-40 aboard the *Bengal Merchant*.

[24] Ibid., p. 87, for quote.

[25] These differed depending on which company was the employer. 'Emoluments to Surgeons', *Canterbury Papers* (1995), p. 138. Doctors on the ships chartered by the Canterbury Association (1850) received "ten shillings a-head for each passenger, whether adult or child, landed at Canterbury in New Zealand." Whereas, a fine of "twenty shillings [was deducted] for every death." J. Hale, p. 308, citing Dr. Weekes' employment conditions indicated, for each death, he was deducted 20 shillings from his fee, whilst a birth would profit him by 20 shillings.

[26] J. Rutherford and W.H. Skinner, p. 12, for quote. Weekes came to New Zealand in 1840-41 aboard the *William Bryan*.

that "Any who are not present and cannot give a good account of themselves are stopped in their rations."[27]

Mrs. Emma Barker's use of clock time took on a new dimension on 29 November 1850, when she wrote that "Both our watches have stopped; this is a great loss to us."[28] But why should the loss of the pocket watches, when the ship had excellent time keeping devices, so concern the Barkers? The answer is likely to have laid in the couple's use of the pocket watches as a sensory temporal frame of reference; they were visual 'aids to navigation,' for their day-to-day activities.[29] The Barker's loss of their visual record was very real, as they had learned to tell the time using their eyes rather than their ears. The visual sense of time was part of who they were. This visual need for a clock time only became apparent when their watches stopped and Mrs Barker chose to write about it. Had the watches continued to operate then the need would not have been placed on record.[30]

The second form of ship time illustrates the rational adaptation of a society to technological development. Passengers saw the application of this on a daily basis, in the careful use of chronometers, sextants, lunars, and charts. Charlotte Godley's voyage to New Zealand on the *Lady Nugent*, in 1849/50, is a good example. She wrote that "Our great excitement of the day is always at noon, when the Captain, if possible, takes an observation of the Sun, and then marks down our place on the chart."[31] The arrival of noon on Godley's ship did not occur every twenty-four hours as she had experienced on land. The ship entered different time zones along the route and for the duration of the voyage its passengers and crew lived in their own "completely enclosed temporal bubble".[32] The *Lady Nugent* had a unique clock time that reflected the changes to longitude as it left the English Channel on a south westerly course. A newspaper explained the issue:

> Steaming west, a passenger's watch keeping exact Greenwich time would seem to be fast when "eight bells" is struck at noon; and steaming east it would appear to be slow … Going east, the ship meets the sun, and thus apparently gains time each day … The connection between time and longitude is well expressed by the rhyming couplet: "Longitude east, Greenwich time least; Longitude west, Greenwich time best." … The disagreement between a passenger's watch and ship time is perplexing, but the reason is simple.[33]

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[27] Burdon p. 18, for quote. See also A.H. Reed, p. 171, which indicates that the "delinquents" of the "ordered life" aboard the *Philip Laing* had penalties imposed on them.
[28] Burdon, p. 40, for quote. The tone of Barker's writing perhaps indicates that the watches could not be restarted and reset using the ship's chronometer.
[29] Glennie and Thrift, p. 82, for detail.
[30] Although her pocket watch was important, few references to clock time appear in her letters.
[31] Godley, p. 11, for 6 Mar. 1850 quote.
[32] Glennie & Thrift, p. 307, for quote.
[33] *H&NS*, vol. LVII (7 Jul. 1910), p. 2, for quote.

Emigrant ships entered the South Atlantic, rounded the Cape of Good Hope and crossed the prime meridian on an easterly track across the southern ocean. On arrival in New Zealand waters well-known ‘seamarks’ such as The Traps and ‘landmarks’ like The Snares, Cascades Point, and D’Urville Islands aided the calculation of longitude as the ships headed to their destination ports.[34] These examples indicate the importance of seamarks and landmarks that could be identified readily because they corresponded with known points of clock time expressed as longitudes, relative to the Greenwich meridian.[35] The degree of daily changes in longitude meant that upon arrival at the port, such as Port Chalmers, local clocks indicated that the town was eleven hours twenty minutes ahead of Greenwich. Not only the time zone was different but so were the seasons and the stars, and when once the sun crossed the southern sky from east to west, it now crossed the northern sky, and caused one emigrant to write that the “moon’s face is upsidedown.”[36]

A Society Ruled by Time

Any enquiry into time-discipline demands careful research concerning temporal practices that actually existed.[37] In 1840, when the first wave of European immigration commenced to New Zealand the three dimensions of time discipline distinguished by Glennie and Thrift were all on display. The ships’ bells promoted standardisation, regularity and coordination amongst crew and passengers. Ships’ time advanced the integration of people of different economic backgrounds into new community identities.

The whole ship-board experience manifested in an extreme form the regimentation of a society ruled by time – or more precisely, the regimentation of a society in which the clock was used as an instrument of social coordination and social control. And for at least one ship at the conclusion of its voyage the regimentation resulted in the adult passengers’ reluctance to leave. Disembarking required some innovative management on the part of the ship’s

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[34] David, *Charts of the Endeavour; 1768-1771,* p. xxxiii. The Traps are a group of rocks off the south east coast of Stewart Island which the *Endeavour* nearly ran onto on the night of 9 March 1770. See Godley, p. 13, for detail about The Snares group of islands about 40 miles south west of Stewart Island. See also Bolitho and Mulgan, p. 92, for reference to the waterfalls at Cascades Point and D’Urville Islands.
[35] Rutherford and Skinner, pp.15-36. Dr. Weekes recorded latitude and longitude regularly. See also Godley, pp. 5, 6 and 9, for three of numerous references to latitudes and longitudes.
[36] Rutherford and Skinner, p. 24, quoting Dr. Weekes’ diary of 4 Jan. 1841.
[37] Glennie and Thrift, p. 47.

doctor. Dr. Weekes wrote that “Strange as it may appear, many of them had become so attached to the ship which displeased them so much at the early part of our voyage, that we had great difficulty in inducing them to make a proper despatch.”[38] He used “his slight knowledge of human nature” and placed the children in the boats first and the parents quickly followed.[39]

Calculating accurate longitude at sea was still a challenge for navigators. When Dr. William Weekes first sighted New Zealand in March 1841 he wrote that “It appears that the chronometers are right to one mile! So much for watchwork!”[40] Weekes’s scorn was unjustified as this degree of accuracy after a journey halfway around the world was pretty good. In December 1850, Emma Barker indicated that she expected at least another thirty days at sea, when in fact the ship was only half that number of days from Lyttelton.[41] Charlotte Godley near the end of the voyage recorded that her ship had made a navigational error. The captain informed her that he was “obliged for two days to take the observations by guess work and without much faith in the accuracy of the chronometers which indeed proved wrong by about three miles, which was enough to make a serious difference.”[42] This showed that a certain inability still existed on the part of some captains to read the seamarks and landmarks and calculate accurately the ship’s longitude in relation to its destination. These three examples indicate that a problem with the quality of chronometers still existed in 1850. The reliability of Captain Cook’s K1, from eighty years earlier, had not become universal.

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[38] Hale, p. 309, for quote.

[39] Ibid., for quote. This was an inordinately long voyage of 140 days and Weekes was proud that there were no deaths. He attributed this success “to a strict and constant observance of cleanliness, ventilation, and order.” ‘Order’ is taken to include the efficient use of time. See also Rutherford and Skinner, p. 41.

[40] Rutherford and Skinner, pp. 37 and 41. It is not known whether this was only the doctor’s opinion or that of the captain. It possibly indicated a feeling of relief that the ship had arrived after a prolonged 140-day voyage.

[41] Burdon, p. 40. The *Charlotte Jane* arrived 16 December 1850 after 99 days at sea.

[42] Godley, p. 14, for quote.

Chapter Four:

The Settlement of Clock Time

> Nothing testifies so much as time sensibility to the "urbanisation" of rural society, with all that that implies for rapid diffusion of values and tastes.[1]

In the last thirty-five years a good many writers have examined aspects of the history of time in New Zealand. They include George Eiby, Eric Pawson, Wayne Orchiston, Jay Gross, John Hearnshaw, Biswell and Nester, Jock Phillips and Ron Palenski.[2] None of the works can be considered comprehensive. This is because the period of early European settlement prior to 1868 has gone largely unexplored. This chapter will attempt to provide a fuller picture, using a wide range of primary sources, especially newspaper articles, advertisements, letters to the editor and other official sources. It will seek answers to the following questions. What timekeeping expectations were placed on the first settlers? What methods of timekeeping did the settlers use? Who were the first providers of clock time in New Zealand? How accurate was timekeeping in New Zealand? What contribution did Cobb & Co., make to clock time orderliness by establishing the first regular timetabled transportation service? What events conspired in the late 1860s to bring to an end the myriad of local times? Answers to these questions will hopefully bring a clearer image of what life was like in frontier New Zealand.

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[1] Landes, *Wealth*, p. 178.

[2] G.A. Eiby, 'The New Zealand Government Time-Service: An Informal History', in *SS*, vol. 27, no. 2 (Wellington, Jun. 1977), pp. 15-34. E. Pawson, 'Local Time and Standard Time in New Zealand', in *JHG*, vol.18, no.3 (1992), pp. 278-287. This work is the most commonly cited by other authors. W. Orchiston, *Nautical Astronomy in New Zealand: The Voyages of James Cook* (Wellington, 1998). J.S. Gross, 'Keeping Time in Nineteenth Century New Zealand', MA Thesis (Auckland, University of Auckland, 2003). J. Hearnshaw, 'New Zealand Astronomy: the Past, the Present and the Future' in *RSNZ* (2004). Biswell & R. Nester, 'Time', in *NZG*, no. 88 (Nov./Dec. 2007), pp. 60-69. J.O.C. Phillips, 'Forecasting the Weather and Telling the Time', in S. Nathan and M. Varnham, (eds.), *The Amazing World of James Hector*, (Wellington, 2008), pp. 87-93. R. Palenski, 'The Making of New Zealanders: The Evolution of National Identity', PhD Thesis (Dunedin, University of Otago, 2010), pp. 37-47.

Early Attempts at Finding Clock Time: Problems and Solutions

Living in a pioneering settlement in New Zealand brought little or no relaxation to the rule of clock time. At the time of European settlement clocks and watches had achieved a level of accuracy sufficient for everyday living. However, they needed to be wound and reset regularly. The question then arose – what was the time? In the absence of public clocks the immediate solution was to consult some other means of timekeeping, such as sun dials. Records of sun dials in the early New Zealand towns are sparse and it is unknown just how many were brought to New Zealand from the 1820s. Those that did come to New Zealand were expensive and likely to be owned by the wealthy, such as farmers, who sited them on a specially constructed stone plinth in a garden free from unwanted shadows.

Sun dials were an indicator of a desire to create settlements. Their installation also required some planning and use of geometry. It was not a matter of acquiring a sun dial from somewhere. It would not have 'told' the local apparent solar time accurately. This was because of an important technical consideration – the latitude of the site where the sundial was to be placed. This determined the angle, and therefore shapes, of the gnomon (rod).[3] Invercargill's latitude for example, is approximately 46º 24´ south, whereas Auckland's is approximately 36º 52´ south, which equates to about a 10º difference.

For those communities, such as goldfields, which had neither sun dials nor an accurate clock from which to check whether a clock or watch was running fast or slow, an alternative method was available. The *Cromwell Argus* (1870) offered a solution:

> Get two pieces of copper, tin, or brass, about six inches long, and an inch wide. In the middle of these cut a slit about three inches long (the slit to be as narrow as possible to see through). Fix these pieces opposite one another, about six inches apart, so as to be enabled to see through both slits, facing the north or south, in a position not to be readily moved. Watch when any fixed star passes the slits, and note the time by the clock. Next night, watch the same star pass the slits, and if the time is four minutes earlier the clock is right; if more than four minutes, the clock is going slow; and if less than four minutes the clock is going fast.[4]

[3] Pronounced as 'noh-mon'.
[4] *CA* (19 Jan. 1870). This is because the length of a sidereal day is about 23 hours and 56 minutes.

From the late 1840s, in England, the principle supplier of the correct clock time was a government official – the Crown appointed Astronomer Royal based at Greenwich – although a standard time was not in universal practice. New Zealand in the first half of the nineteenth Century had no government appointed astronomer, let alone a central observatory from which to make observations. The mantle of responsibility therefore fell to visiting ships' captains to advise local residents of GMT as registered by their chronometers, enabling them to calculate the correct local time. And, from the 1840s, there was a small number of clock and watch makers with astronomy skills scattered around New Zealand. New Zealand's first timekeepers were therefore not public servants and they did not draw a government salary; they served their communities without remuneration because there was a need. The knowledge and skill they applied to their job rather than their ability to secure an influential sponsor and compete for the position secured them the unofficial title of timekeepers in their community.[5] This was because the watches and clocks they had for sale had to be as accurate as possible. The necessary accuracy was attained because each business had a reliable, accurate, reference clock, known as a 'regulator', against which the performance of all other clocks and watches was checked before they left the workshop.[6]

Who were New Zealand's first regulators of time, how many were there, and what other forms of timekeeping operated during the first twenty-eight years of organised settlement, 1840 to 1868? The following tables, Table 4.1 and 4.2**,** read in conjunction with Appendix Three, are an attempt to answer these questions. Appendix Three supplies the names of the clockmakers, the dates they commenced business, some business details and footnoted sources.[7] The tables are a first attempt to look at the organisation of timekeeping in frontier New Zealand and quantify the dogged effort to bring accurate clock time to every New Zealand town and city. The first column in the tables indicates the number of regulator clocks (RC) that were in each community, for example, Auckland which had 29. Each number represents a clock/watchmaker, as each had a regulator clock in his shop from which his shop

[5] J. Garner, *By His Own Merits, Sir John Hall – Pioneer, Pastoralist and Premier* (Hororata, NZ, 1995), p. 25, for following quote, "the harsh reality was that a sponsor often counted for more than ability when it came to obtaining a worthwhile position with future prospects."
[6] Glennie and Thrift, p. 335.
[7] The Appendix 3a, list of clockmakers' names, pp. 132-7, is believed to be substantially complete, but further research will likely uncover additional methods of timekeeping employed by each community. See Appendices 3b-d, pp. 138-40.

clocks and those of the surrounding community could be set. This should not be read as if there were 29 in Auckland for the full period, as businesses came and went: it means only that these businesses operated in Auckland for at least some part of the period 1840-1868. This applies also to the other services listed, such as observatories: they did not function for the full twenty-eight years, but only part of that time.

Table 4.1. Timekeeping methods in the North Island 1840-1868. [8]

Location:	**Methods of Timekeeping:**								
North Island	**RC**	**Obs**	**TB**	**PC**	**SD**	**B**	**Go**	**Gu**	**TO**
Russell	1								
Auckland	29		*3*		1				1*
Alexandra									1*
Mercer									1*
Newcastle									1*
Onehunga				1					1*
Cambridge									1*
Hamilton									1*
Cambridge									1*
New Plymouth								1	
Wanganui							1		
Napier	1								1
Hastings	1								1
Taranaki	2								
Spit (Hawke's Bay)									1
Castle Point	1								1
Masterton									1
Featherston	1								1
Wellington	16	2	1	1, *2*					2

Abbreviations Used: RC – Regulator Clocks, Obs – Observatories, TB – Time Balls, PC – Public Clocks, SD – Sun Dials, B – Bells, Go – Gongs, Gu – Guns, TO – Telegraph Offices.

Notes: Italics indicates privately funded and operated services. The list of regulator clocks indicates that during the period under review there was at some stage the given number of clockmakers who each had such a clock.
For example, in Wellington, 16 did not continuously operate. The list excludes clocks inside government departments, trade businesses and other institutions.

*These telegraph offices were not connected to Wellington. All offices had a fairly similar longitude and probably kept to Auckland mean time.

[8] These were drawn from newspapers listed on *Papers Past* as at 29 February 2012. The key search words were 'watchmaker' and 'clockmaker'. See also Winsome Shepherd, *Gold & Silversmithing in Nineteenth & Twentieth Century New Zealand*, (Wellington, 1995). This author used trade directories as her primary source. Table 4.1 and 4.2 are believed to be substantially complete.

Table 4.2. Timekeeping methods in the South Island 1840-1868.

Location:	**Methods of Timekeeping:**								
South Island	**RC**	**Obs**	**TB**	**PC**	**SD**	**B**	**Go**	**Gu**	**TO**
Nelson	7			*1*					1
Havelock									1
Picton				1	1				1
White's Bay									1
Blenheim				1					1
Westport									1
Charleston									1
Brighton (West Coast)									1
Kaikoura									1
Greymouth	2								1
Hokitika	3								1
Cheviot									1
Kaiapoi				1					1
Bealey (nr. Arthur's Pass)									1
Christchurch	14	1		2		2		1	1
Lyttelton	1			1					1
Selwyn									1
Ashburton									1
Temuka									1
Timaru	2								1
Dunstan	1								
Naseby	2			*1*					
Oamaru									1
Queenstown				*1*					1
Cromwell	4								1
Clyde									1
Teviot									1
Waikouaiti									1
Port Chalmers			1						1
Dunedin	35	3		4, *2*		1		1	1
Lawrence									1
Milton									1
Gore	1								1
Mataura									1
Clinton									1
Balclutha									1
Invercargill	7			2, *1*					1
Bluff									1

Abbreviations Used: RC – Regulator Clocks, Obs – Observatories, TB – Time Balls, PC – Public Clocks, SD – Sun Dials, B – Bells, Go – Gongs, Gu – Guns, TO – Telegraph Offices.

Notes: Italics indicates privately funded and operated. The list of regulator clocks indicates that during the period under review there was at some stage the given number of clockmakers who each had such a clock. For example, in Dunedin, 35 did not continuously operate. The list excludes clocks inside government departments, trade businesses and other institutions.

A study of Tables 4.1 and 4.2, in conjunction with Table 5.1 and Fig. 5.3 raises the issue of continuity of service. We know from a variety of sources that a number of the businesses listed above operated for only a few years because some were sold, some shifted to another town looking for better prospects, and others went bankrupt. A study of the last column reveals the central government's concerted effort to have a telegraph office, with a clock regulated to a standard time, in as many communities as possible by 2 November 1868, when New Zealand mean time was enforced. Fig. 5.3 indicates that about 75 percent of New Zealand's population, excluding Auckland and Taranaki, lived in a community which had access to a telegraph office clock on 2 November 1868. This provided most people with the continuity of service that was often lacking in earlier times.

Whose Clock Time was Correct?

Newspaper advertisements, from 1840, indicate there that was a ready supply of new and second hand clocks and pocket watches available in settlements like Port Nicholson (Wellington), Nelson and the Bay of Islands.[9] Once a clock or pocket watch was purchased, however, its future accuracy was left to the owner, and therefore could not be guaranteed. Members of the public knew they could obtain the correct time from the clockmakers and telegraph offices. This however required effort on the part of enquirer who had to trek to the nearest reliable clock. For the sake of convenience many clockmakers and telegraph offices put a clock on display in their shop window, above their shop's doorway, or affixed to the side of their building. This was a free service to the community and generated goodwill for the business, but it did not ensure that the citizens kept the same clock time.

Despite the best efforts, the maintenance of accurate clock time around New Zealand was an ongoing problem. However, churches, businesses and other community groups were still required to turn up on time. For example, the Wesleyan Mission in 1842 expected parishioners to attend a "public tea meeting … at 6 o'clock

[9] *NZG&WS*, vol. I, no. 35 (12 Dec. 1840), p. 4. Ibid., vol. II, no. 68 (31 Jul. 1841), p. 1. *NEandNZC*, vol. IV, no. 197 (13 Dec. 1845), p. 1. *NZG&WS*, vol. I, no. 7 (23 May 1840), p. 2, lists an eight-day clock up for auction. *NZAandBofIG*, vol. 1, no. XIX (15 Oct. 1840), p. 4, for details of American clocks.

p.m."[10] The public were reminded of a similar requirement for auctions or sales with the use of the words, 'sharp' or 'prompt', such as in an advertisement placed by Richard Reeves & Co., whose Hokitika auction was to start at "12 o'clock sharp."[11]

At least three churches in New Zealand wanted to provide a service to parishioners and the wider community through the use of a clock mounted high in the church's steeple. Firstly, a clock was purchased, in 1849, by Reverend R. Cole of St. Peter's Church in Te Aro, Wellington. Cole opened a subscription to cover the £75.00 cost. Three years later only £35.00 had been received and a new subscription list was opened. Mr. Alexander Mackay, a local watch maker, installed the clock and maintained it weekly free of charge.[12] It is unknown whether the second subscription was successful. The second church was Christ Church Cathedral in Nelson, in 1860.[13] The third was St. Paul's, in 1863, and was in Thorndon, Wellington.[14]

In 1862, the Provincial Chambers in Picton acquired a clock in the front window. Soon afterwards the clock stopped and was not restarted for 12 months. Less than two months later it stopped again and no real effort was made to restart it. When Picton lost the political power struggle in November 1865 and Blenheim became the new provincial capital the non-working clock, furniture and records went to Blenheim. A storm of protest blew up around the much-loved clock that did not work![15] Even clocks that worked often disagreed about the correct time. Pawson cites the public and private offices on Lyttelton's Norwich Quay in 1865 as an example of "every one with a different time."[16] In Christchurch, the problem was noted by Dean Jacobs of College House who wrote:

> Nor must it be forgotten that progress was greatly hindered by the irregularity and unpunctuality of attendance, caused by the eccentricities of clocks and

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[10] *NZG&WS*, vol. III, no. 144 (25 May 1842), p. 1.
[11] *WCT*, no. 34, (22 August 1865), p. 3.
[12] *NZSandCSG*, vol. V, no. 372 (24 Feb. 1849), p. 2. Ibid., vol. V, no. 411 (11 Jul. 1849), p. 2. Ibid., vol. VIII, no. 769 (15 Dec. 1852), p. 2. Also Ibid., vol. V, no. 424 (25 Aug. 1849), p. 2, for name of church. The clock was made in Liverpool and arrived on the *Duke of Portland*. It was located at 211 Willis Street, Te Aro 6011, Wellington.
[13] *NEandNZC*: vol. XIX, no. 83 (10 Oct. 1860), p. 8. Ibid., vol. XIX, no. 85 (17 Oct. 1860), p. 2.
[14] *ST*, vol. III, no. 13 (7 Dec. 1863), p. 2. It was unreliable.
[15] *ME*, vol. XLVII, no. 109 (9 May 1913), p. 4.
[16] E. Pawson, p. 281. He cites other examples, all from *TP* (5 Jul. 1865), p. 2 and (11 Jul. 1865), p. 2. The accuracy of public clocks was and remains an ongoing issue in New Zealand. In 2010, pre-earthquake Christchurch, I conducted a survey of clocks in Cathedral Square, Hereford St., Worcester Blvd., Manchester St., Gloucester St., Madras St and Moorhouse Ave., and found discrepancies still existed. The difference was no more than about two minutes, a variance that many people probably consider tolerable. Christchurch's clocks are not unique in this matter. In November 2011, I gave a presentation at the University of Queensland, Australia, and noted their campus clocks ran similarly. The accuracy of the electronic clocks remains dependent on the accuracy with which they are set.

> watches, when there was no public clock, and no watchmakers, or none very accessible.[17]

As just one example of these 'eccentricities', the towns of Christchurch and Lyttelton had a longitude difference of less than a clock minute, but the time between the clocks of the two towns varied by as much as plus or minus fifteen minutes.[18] It is probable that there was almost the same amount of variation between clocks within Christchurch and within Lyttelton. Auckland's *Daily Southern Cross* also reported that "No two timekeepers in the town can ever be found to correspond as to the hour of day, and all the clocks visible from the streets appear to be at 'sixes and sevens,' or some other numbers."[19] The lack of an accurate clock time led an Arrow Court (Arrowtown) judge to dismiss a case against a public house which had been charged with being open after 12 p.m., as the constable "could obtain no witnesses who agreed in their statements as to the actual time of the alleged offence." The *Southland Times* suggested that if the government supplied every mining community with a clock which was regulated to a standard time then "the officious interference by the police" might end.[20] And lastly in 1868, an unnamed Otago town created its own time zone and kept a clock time that was one hour ahead of another town which was only three miles away.[21]

The 1860s were noteworthy for the efforts of three clock makers to establish a standard time in their communities. They were Joseph McGregor in Wellington, Alfred Bartlett in Auckland and Arthur Beverly in Dunedin. Joseph McGregor placed a chronometer in the window of his business premises, which were known as the "Wellington Observatory."[22] The public trusted 'McGregor's mean time' which unfortunately conflicted with the business hours Walter B.D. Mantell, the local post-master, chose to keep. This was the source of frustration for many when the latter, in 1842, opened 'late' and closed 'early'. On one occasion a customer was forced to wait forty minutes for the post office to open. No amount of door knocking induced Mantell to open for business. When asked why he opened late Mantell stated that

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[17] Maurice Knight, *A History of College House: The Collegiate Department of Christ's College, Christchurch, Canterbury, New Zealand* (Christchurch, 1933), p. 107, citing Dean Jacob's memoirs.
[18] Pawson, p. 281, cites *The Press* (25 Nov. 1864), p. 4.
[19] *DSC*, vol. XXIV, no. 3607 (9 Feb. 1869), p. 3, for quote. See Chapter Five of this thesis, pp. 106-8, for further discussion of Auckland's problem.
[20] *ST*, vol. I, no. 11 (25 Jun. 1864), p. 3, for quotes, citing *LWM*, 17 Jun. 1864.
[21] *BH*, vol. IV, no. 203 (18 Mar. 1868), p. 6.
[22] *NZG&WS*, Vol. II, No. 88 (10 Nov. 1841), p. 1.

"'He did not know the time. I have no means of ascertaining the proper time except by the sun, my watch having been in the hands of the watchmaker for nine months.'"[23] Mantell's indolence continued into February 1843 when further conflict resulted in a letter to the editor of the *New Zealand Gazette & Wellington Spectator*. The newspaper noted that the service "should not be curtailed for Mr. Mantell's convenience … and when [he] sees that public notice will be taken of such misconduct he will perhaps be a little more accommodating in future."[24] Mantell could not have got away with this in Britain, where he would have been part of a centralised structure with traditions of service, and would have had his employment terminated. However in a small New Zealand town – not yet the colony's capital – Mantell had enough independence and power to disregard clock time to some extent – at least till the newspaper organised public opinion against him.[25]

The second person who attempted to establish a local mean time was Alfred Bartlett of Auckland. In 1865, he established a time ball service at the rear of his premises situated at the top of Shortland Crescent.[26] The ball was dropped at 1 p.m. daily and this little area of Auckland was quickly given the nick-name "Time Ball Corner."[27] In June 1866, he advertised that he had moved his residence and observatory to Coburg Street, Barrack Hill, Auckland.[28] The privately funded service was discontinued in 1869 when he moved his premises to Queen Street.[29] He re-established the timekeeping service through the provision of a clock in his shop window. The public accepted his displayed time as the official time in Auckland. (See Chapter Six for further discussion.)

The third and arguably the most important amateur in New Zealand's early horological history was Arthur Beverly, in Dunedin. He is believed to have led the charge for a common time for the whole country. A letter to the editor of the *Otago Witness* in 1858 revealed Dunedin's problem. "Sir – Though we have not attained to

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[23] Robinson, p. 36-7. Robinson indicates the complaint was laid by a Mr. Ridgway of Wellington, but author does not cite source of the Mantell quote.
[24] James Smith, 'Letter to Editor', *NZG&WS*, Vol. III, No. 217 (4 Feb. 1843), p. 3. See also Robinson, p. 37.
[25] *EP*, vol. CIX, no. 38 (14 Feb. 1930), p. 7.
[26] *DSC,* vol. XXI, no. 2455 (2 Jun. 1865), p. 4. *DSC,* vol. XXI, no. 2462 (10 Jun. 1865), p. 4. Also *DSC*, vol. XXI, no. 2463 (12 Jun. 1865), p. 4. *DSC*, vol. XXI, no. 2479 (30 Jun. 1865), p. 8. The service commenced on 10 June 1865 using a Tornaghi patent instrument from Sydney.
[27] *DSC*, vol. XXI, no. 2503 (28 Jul. 1865), p. 3.
[28] *DSC*, vol. XXII, no. 2777 (10 Jun. 1866), p. 1.
[29] *DSC*, vol. XXIV, no. 3607 (9 Feb. 1869), p. 3. See also,'Miscellaneous', *DSC,* vol. XXV, no. 3684 (10 May 1869), p. 7.

that commercial greatness in which 'time is considered money,' still there are occasions, even in our obscure community, when serious inconvenience arises from the variation of time-pieces."[30] The writer (believed to be Beverly) had sought a clock time solution in a sun dial and looked to the Otago and Canterbury Almanacks for advice on how to adjust for the equation of time. The explanations offered by both, he argued, were confusing. For some clarity he consulted "the *Cyclopedia*" and the "*Carpenter's Mechanical Philosophy*." The latter two sources were "at variance" with both Almanacks. The writer therefore supplied an 'Equation of Time' Table and explained how to calculate the correct clock time.[31] In February 1860, not for the first time, the Dunedin Town Board discussed the subject of a town clock. The cost was estimated at the hefty sum of £400, exclusive of a clock tower, and the proposal was abandoned. Beverly, however, took the initiative and on 12 October 1860 the *Colonist* reported that he had "erected a capital clock" over the front door of his Princes Street shop for the relatively cheap sum of £30. "The dial," the newspaper reported "was about two feet in diameter, and the figures visible at a considerable distance." The newspaper also stated that "It is somewhat disgraceful that the Town Board should turn a deaf ear to the reported remonstrances made to it on the subject."[32]

New Zealand's early legal profession also had issues with the application of a strict clock time. At the Dunedin Supreme Court on Wednesday 27 July 1859, Mr. Justice Gresson fined both the prosecuting lawyer William John Dyer and his witness, Dunedin's Resident Magistrate Justice John Hyde Harris, £50.00 each for arriving late for a court case. Gresson's decision "excited a very strong feeling among the members of the profession who were present, who consider his Honor's observations to have been in bad taste and quite uncalled for."[33] A.H. Reed notes that Judge Gresson later "manifested a conciliatory spirit by remitting the stiff fines he had imposed."[34] The Court purchased a clock from Beverly and asked him to service it. A bell was also purchased and rung to signal the commencement of court sessions.[35] McGregor, Bartlett and Beverly volunteered their services for only a short time unlike

[30] *OW*, no. 232 (10 Apr. 1858), p. 5, quote. Letter written by 'Tempus.'
[31] Ibid., all quotes.
[32] A.H. Reed, *The Story of Early Dunedin* (Wellington, 1956) p. 142, cites the *Colonist* (12 Oct. 1860).
[33] *OW*, no. 400 (30 Jul. 1859), p. 5. *OW*, no. 401 (6 Aug. 1859), p. 3. Case: Regina v Edward Ashley Tucker Steward. The newspaper suggested that the fines be used for the purchase of a town clock.
[34] Reed, p. 235-6, for detail and p. 236, for the following quote. Reed speculated that "the watches of Gresson and the magistrate were not in agreement, which, in view of the conditions prevailing, would not be at all surprising."
[35] Ibid. Also *OW*, no. 400 (30 Jul. 1859), p. 5.

England, where the appointment, remuneration and retirement of the Astronomer Royal were controlled. The responsibility for maintaining clock time required a more assured footing.

Despite the efforts of clock makers to provide agreed local times in different centres, confusion about the 'correct' time continued to cause some difficulty. Demands for a more secure time service were therefore placed on the provincial and central governments. A writer to *Daily Southern Cross*, in 1844, asked, "Could not the Government, or the Military invent some means of fixing the true time at twelve, or some convenient hour of the day, by tolling a bell, or beating a drum? There ought to be something to regulate by."[36] But sun dials continued to be manufactured and sold to individual Auckland consumers who wanted a convenient means of regulating their clocks.[37] Bells and guns were used to broadcast the correct local time and from the mid-1850s the use of time balls became a consideration.

In 1863, the Wellington Provincial Government established the first 'official' observatory – the Provincial Observatory – with a transit-house on reclaimed land overlooking Wellington's Queens Wharf. Stephen Carkeek, the Collector of Customs, was instrumental in setting up the time ball mechanism.[38] The time ball began operating from 9 March 1864 and was dropped at noon each day (except Sundays), so ships' navigators could set their chronometers.

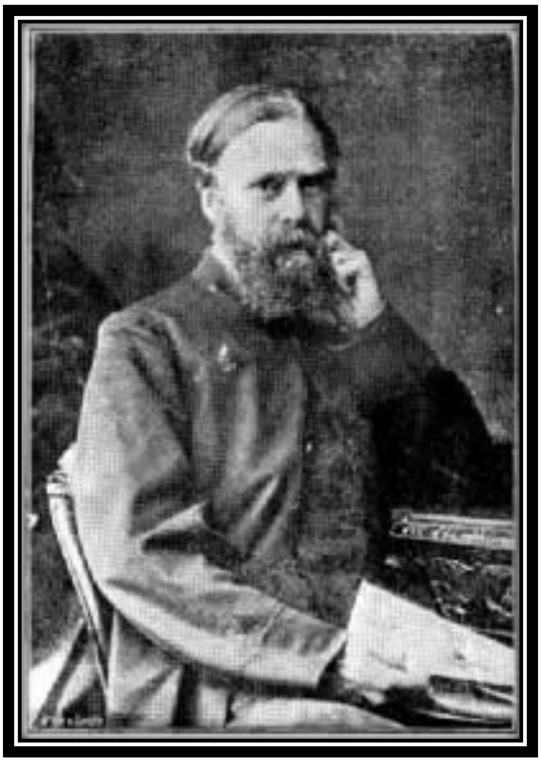

Figure 4.1, Archdeacon Arthur Stock.[39]

The *New Zealand Gazette* reported that "The ball will be hoisted halfmast high at ten minutes before 12, to the mast head at

[36] *DSC*, vol. 2, no. 68 (3 Aug. 1844), p. 2.
[37] *DSC*, vol. VI, no. 300 (14 Jun. 1850), p. 2. *DSC*, vol. VI, no. 300 (14 Jun. 1850), p. 2, made by Mr Florance. *DSC*, vol. XXI, no. 2447 (24 May 1865), p. 6, made by T. Peacock. *DSC*, vol. XXIV, no. 3559 (12 Dec. 1868), p. 1, sold by P.A. Phillips.
[38] *NEandNZC*, vol. XXIII, no. 6 (14 Jan. 1864), p. 3. *NZSandCSG*, vol. XIX, no. 1933 (10 Feb. 1864), p. 2, for detail of how it operated. See also *WI*, vol. XIX, no. 2104 (15 Sep. 1864), p. 2, for Carkeek's invitation to a visiting ship's captain to test the time ball's accuracy. It was found to be "right."
[39] Image source: www.nzetc.org/tm/scholarly/name-131446.html/.

five minutes before 12, and will fall precisely at 12 o'clock at noon, Wellington mean time."[40] Archdeacon Arthur Stock was in charge of the observations, at the Provincial Observatory on Grey Street and later at the Colonial Observatory on Bolton Street, until his retirement in 1887.[41] He regularly informed the public of time ball happenings in the local newspapers.

Figure 4.2. The Custom House time ball in Wellington.[42]

The Provincial Observatory was in a two-storeyed building that was split into three sections. To the left was the General Post Office, which used half of the ground floor. Its entrance was from Grey Street on the left. Custom House occupied the rest of the ground floor. The transit-house and the Observatory occupied the remainder of the building. It was from here that Stock provided the time ball service to the Wellington area.

[40] *NZ Gazette* (7 Mar. 1864).
[41] Eiby, p. 17. Stock was born in 1823 and died in 1901.
[42] http://www.teara.govt.nz/en/astronomy-overview/1/2, Alexander Turnbull Library, H.W. Murray Collection (PAColl-0824), Reference PAColl-0824-1. Last updated 24 Sep. 2011.

The time balls were not complicated devices.[43] They were designed to provide the exact time to ships whose chronometers required it. The mechanism of the time ball built at Lyttelton time ball in 1876, for example, was 15 metres high. The time ball was a hollow sphere made from a wooden frame covered with thin sheets of painted zinc. It was 1.5 metres in width and weighed over 100 kilograms. An Oregon pine mast was threaded through a hole in the centre. The ball was hoisted by means of a handwheel to the top of the mast where it rested on a catch. The release of the catch was controlled by an electromagnet, which was in turn operated by an electric current controlled by the astronomical clock. At a predetermined time, the circuit for the current was completed working a number of levers that released the catch holding the time ball. A piston controlled the speed of the fall. Navigators took their reading at the instant that the time ball left the top of the mast. The ball took eight seconds to drop the three metres and was accurate to within half a second a day. This error was not cumulative as astronomical observations were conducted at the Colonial (later Dominion) Observatory in Wellington and sent daily signals by telegraph to the post offices in the towns which had the time balls, such as Lyttelton.[44]

Not all time balls operated using this method. Table 4.3 shows a list of publicly funded time balls which operated in New Zealand. The Wellington, Lyttelton, Timaru and Auckland time balls operated from buildings but, the Port Chalmers and Wanganui time balls were attached by a wire or rope to a flagstaff and were probably dropped manually.[45] During the First World War the Government Astronomer, Dr. Charles E. Adams decided that in the interests of better accuracy and economy time balls should be dropped twice a week using a telegraph signal sent directly from the Observatory in Wellington to the time ball mechanism. An electric impulse from one of the Observatory’s clocks activated the mechanism which dropped the time ball at 3.30 p.m.[46] The introduction of radio in the 1920s ended the need for time ball stations and time signals to ships were broadcast across the airwaves on Monday and Thursday nights. On 31 December 1934, New Zealand’s last operational time ball, at Lyttelton, ended its service to ships.

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[43] Julie Bremner, *The Lyttelton Time-Ball Station: An account of its history, operation and restoration* (Wellington, 1979), p. 21, quoting George Eiby, Superintendent of the Seismological Observatory of the D.S.I.R., in 1978.
[44] Ibid., pp. 15-27, for detail.
[45] This is an area of study that requires further research as very little technical information was found concerning the time ball stations other than Lyttelton’s.
[46] It is unknown why the change was made from the traditional 1 p.m.

Table 4.3. New Zealand time ball stations.

Location	**Brief Notes**
Wellington (1864-1911?)	The service commenced on 9 March 1864 and overlooked Queens Wharf. The ball was dropped daily at noon, except Sundays. It was moved in 1882 to the Railway Wharf on Waterloo Quay. It was destroyed by fire in September 1911.[47]
Port Chalmers (1867-1909)	The time ball was on a flagstaff high on the hill overlooking the harbour. It was constructed in 1867 and dropped daily at noon. Control passed to the Otago Harbour Board in 1885, but it was only dropped twice a week, then fell into disrepair and by 1909 was considered derelict.[48]
Lyttelton (1876-1934)	The time ball was restored several times, most recently by a three-year effort concluding in 2007. It reopened on Friday 16 November 2007. But it was badly damaged in the 2010 and 2011 Canterbury earthquakes and at the time of writing is being demolished with a plan to rebuild.[49]
Wanganui (1877-1932)	It was operated by the Wanganui Harbour Board from the Signal Station at Castlecliff. The time ball was hoisted up the flagstaff daily (wind permitting) at 12.55pm and dropped at 1.00 pm. On 16 February 1886 the flagstaff was moved to Durie Hill.[50]
Timaru (1880-1913)	Timaru's time ball was part of the post office, which was formally opened on 8 September 1880. It was not actually on the waterfront like the others. It was dropped at noon each day. It was possibly removed from the tower in 1913.[51]
Auckland (1901-1920s?)	In 1901 it was erected on the roof of the Harbour Board Building, overlooking the Queen Street wharf. It was dropped daily from this building until 1912 when it was moved to the Ferry Building.[52]

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[47] *NZSandCSG*, vol. XIX, no. 1933 (10 Feb. 1864), p. 2. *WI*, vol. XVIII, no. 2032 (8 Mar. 1864), p. 2. *EP*, vol. LXXXII, no. 56 (4 Sept. 1911), p. 4.
[48] G. McLean, *Otago Harbour: Currents of Controversy* (Dunedin, 1985), p. 96 and endnote 19, p. 336.
[49] Bremner, for detailed history.
[50] Athol Kirk, 'Days of the Signalmen', in *HN* (Wanganui, 1994), p. 37. See also A. Kirk, 'Picture of Durie Hill Signal Station Found', in *WC* (late 1980s/early 1990s).
[51] *TH* (12 Aug. 1880), p. 5.
[52] *Observer*, vol. XXI, no. 1185 (14 Sep. 1901), p. 2.

The First Regular Transport Timetable: Cobb & Co.

New Zealand's coastline had been charted by Tasman and Cook but when the first published maps went on sale in Port Nicholson in 1842 they revealed little of the interior and vast areas were left blank.[53] These were quite possibly the first maps of New Zealand published for public consumption. However, over the next two decades the work of explorers and surveyors, with the assistance of Cobb & Co., added extensively to future maps.

Inland travel was common in Britain but it was not until the arrival of passenger coach services in New Zealand that many settlers were able to travel and settle inland. Prior to 1861, there was no regular transport service between New Zealand towns and travel outside the main settlements was difficult and dangerous. The common mode of transport was the horse and if there was substantial freight to be carried then a small covered wagon and driver could be hired. The occasional passenger was also transported. Howard Robinson notes that the first mail to Central Otago was carried by packhorse, but this was considered a "clumsy method."[54] These were the years when the 'roads' were no more than clay or rocky tracks, bridges did not exist, and river crossings were treacherous at the best of times. However, rivers swollen after rain storms threatened loss of life. Horses panicked, and drivers and passengers clung on fearfully as wagons slipped sideways or wheels jammed between rocks during river crossings. Fast flowing currents sometimes swept man and beast to their deaths. There was no timetable, and people rarely expected to arrive at their destinations at predetermined times.[55]

The introduction of a public transportation service offering a regular timetable brought a new attitude to travelling times. The catalyst came in 1861 with the discovery of gold in Gabriel's Gully, Central Otago. Amongst the fortune seekers who arrived in Dunedin from Australia was Charles Carlos Cole, a proprietor of the *Cobb and Co. Telegraph Line* in Victoria. He arrived in Port Chalmers on 4 October 1861,

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[53] *NZG*, Vol. I, No. 32 (21 Nov. 1840), p. 3. *NZG&WS*, Vol. II, No. 122 (9 Mar. 1842), p. 1. They were published, 1 June 1840 by James Wyld, Charing Cross, London, and arrived on board the *Clifton*.

[54] H. Robinson, *A History of the Post Office in New Zealand* (Wellington, 1964), p. 119.

[55] J.O.P. Watt, *Southland's Pioneer Railways: 1864-1878* (Wellington, 1965), pp. 8-9 and pp. 60-62. See also A.N. Palmer, *New Zealand's First Railway: Dun Mountain Railway, Nelson 1862-1872* (Wellington, 1962), p. 3. Railway transportation up to 1868 was insignificant. The only public lines which existed were: Lyttelton – Christchurch (1863), Invercargill – Makarewa (1865), Christchurch – Rolleston (1866), Invercargill – Bluff (1867), Invercargill – Winton (1868?). See also Reed, pp. 262-4, for detail and excellent drawings.

on S.S. *India*, with "one coach, 5 wagons, a buggy, several carts and some fifty-four horses."[56] Cobb and Co. used coaches built by J. Abbott of Concord, New Hampshire, in the United States of America. They were constructed of hickory, which was noted for its strength, and were lighter than British coaches. This made them suited to New Zealand's more primitive conditions.[57] As many as fourteen passengers, plus driver, could be carried – five outside on the box and roof seats and between six and nine (depending on size) inside.[58]

Figure 4.3, Cobb and Co. coach at Palmerston, Otago.[59]

Newspapers played a crucial role in the success of Cobb and Co. The company was quick to inform the local newspapers of the new business venture and in doing so 'used' the newspaper companies for dual purposes.[60] For Cole (and later his competitors) the media not only published news reports involving the coaches, but provided free advertising noting the reliability and punctuality of their service. The

[56] E.M. Lovell-Smith, *Old Coaching Days in Otago and Southland* (Christchurch, 1931), pp. 5-6, for detail and quote. See also I. Veitch, *From Wells Fargo, California, to Cobb and Co., Otago* (Dunedin, 2003), pp. 11-12. My thesis refers to the company simply as Cobb and Co.
[57] Robinson, p. 121, for details.
[58] New Zealand did not have speed limits, or restrictions on how many passengers could be safely carried. It was left to the discretion of the drivers.
[59] The image is from http://www.collections.tepapa.govt.nz/objectdetails.aspx?oid=195224. The photographer was William P. Hart and image is dated c.1880-90.
[60] Cole used the name out of courtesy to Freeman Cobb. Cobb had no connection with Cole's company. The familiarity of the brand and its reputation in Victoria made good business sense for Cole who realised many of the Otago miners had earlier worked in that colony.

Otago Witness wrote, "[i]t was announced that a large five-horse coach will positively leave Cobb's [Dunedin] office at six o'clock this morning (Saturday) for the Dunstan, to accomplish the journey through in three days." In a separate paragraph the writer noted "that the indefatigable Cobb and Co. are about starting a coach to run weekly to the Dunstan."[61] To this the *Southland Times* added, "[t]he spirited coach proprietary known as Cobb and Co., have started a five-horse-coach, which will leave Dunedin every Saturday morning for the Dunstan."[62]

The betterment of existing travel times was at the forefront of most media releases. "The usual time to reach the diggings was two days on horseback from Dunedin. Cole 'guessed and calkilated' he could do it in approximately nine hours." An advertisement noted that the coach's departure for Gabriel's Gully would take place on 11 October 1861 at 5.30 am.[63] Although the nine hours was exceeded, the coach did arrive that evening and Cole could be justifiably proud of the achievement – he had cut the time by half. Travel times became a selling point and reinforced the concepts of efficiency and effectiveness which were the public image of the company. Quicker travel times resulted in less work time lost, which for the passengers meant increased opportunity to make money. The two-way connection of Dunedin and Gabriel's Gully, a distance of about 175km, was New Zealand's first daily land transport operation with a timetable. This was a modest achievement by the standards of Britain, which had been operating a "unified network of public transport based on strict timekeeping" since 1784, but it was an important milestone for the fledgling New Zealand.[64]

It is probable that Cobb and Co. used a standard time on the Dunedin to Gabriel's Gully run. Dunedin's longitude is about 170º 30′ and Gabriel's Gully's is about 169º 68′. This constitutes a geographical clock time difference of approximately four minutes. It was likely the coach drivers kept their pocket watches set to Dunedin time as the four minute difference was immaterial. The level of clock precision required by the driver and passengers for the return trip to Dunedin was not as exact as the departure from Dunedin. This was because event time survived at Gabriel's Gully and on other early goldfields, and Cobb and Co. had no choice but to adapt to it. With little artificial lighting available people usually rose at first light and

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[61] *OW*, No. 573 (22 Nov. 1862), p. 5, for both quotes. The coaches departed from the Provincial Hotel.
[62] *ST*, vol. 1, no. 6 (28 Nov. 1862), p. 2.
[63] Lovell-Smith, pp. 5-6. Veitch, pp. 11-12.
[64] G.J. Whitrow, *Time in History* (1988), pp. 158-9.

the coaches commonly departed from Gabriel's Gully at first daylight, plus about an hour. The extra hour was needed to collect the horses, groom them and harness them to the coach.[65] The coach departed when the task was completed. The gold rush at Gabriel's Gully ended after about eight months (mid-1862) and the next significant gold finds occurred in the area known as the Dunstan, in August 1862.[66] From then on, the settlements were no longer mining camps made up of ramshackle huts and tents. The original calico walled buildings were replaced with wood and corrugated iron hotels, shops, stables and telegraph offices (from 1866, see Table 4.2) on purpose-built streets.[67] From about the summer of 1863/64 onwards there was a determined effort to construct bridges and operate punts and ferries across rivers.[68] From this time there were at least two clockmakers operating in Central Otago – in Dunstan (1864) and in Naseby (1865). The Dunstan clockmaker, from 1866, took weekly observations and supplied the community with the local clock time. The Cobb and Co. timetable however, probably continued to set the departure time as first daylight plus about an hour. Then in 1868, Cobb and Co.'s timetable came under the influence of the Postmaster-General. The company received instructions to convey the mail according to Wellington mean time and as from 23 March 1868 the mail coaches were required to depart and arrive according to the new standard.[69] The time to prepare the horses was less likely to have been an influence on the departure times from Central Otago.

Travel time from the beginning was measured in blocks of hours and not minutes. Whilst departure times, from Dunedin, in the beginning were to the minute, the return leg from Central Otago was more difficult to achieve. Arrivals at a predetermined clock time were impossible to achieve, even under the best road conditions. This was due largely to the inability of the horses to keep a constant speed over the rough terrain, the absence of bridges, and the variety of weather patterns experienced. The spread of Cobb and Co. throughout the North and South Islands saw the establishment of timetables that used clocks to indicate departure times. The time

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[65] Food for the horses was in limited supply, so they were allowed to forage on a farmer's paddock a few miles from the settlement. First daylight was not a static time, but was affected by the changing seasons. This information is from a discussion with Lloyd Carpenter, a PhD student, University of Canterbury, 11 Jan. 2012. His thesis concerns the Central Otago goldfields, in particular Bendigo.

[66] Reed, pp. 236-9, for detail.

[67] Ibid., pp. 234 and 306.

[68] *OW*, no. 647 (23 Apr. 1864), p. 14, tenders for public works. *OW*, 653 (4 Jun. 1864), p. 14, bridge of Tokomairiro. *OW*, no. 655 (18 Jun. 1864), p. 13, punt at Dunstan.

[69] 'Conveyances: Public Notice', in *ODT*, no. 1943 (23 Mar. 1868), p. 1.

of arrival was less certain and therefore the advertising was less exact. For example, the "East Coast Wairarapa Line left four days a week at 7 am., going by way of 'The Hut' and Featherston to Masterton … [with the scheduled arrival] … in Greytown in time for tea."[70] A method of promoting the company's efficiency was through the boasting of records achieved in beating the clock, such as on the Wellington to Masterton road on 5 April 1866. Departure from the former in the morning and arrival at the latter "the same evening" drew a crowd of settlers taking "a lively interest." The article noted that "the journey home was accomplished in ten hours, [apparently a record] but the driver assures us he will do it in nine as soon as he gets used to the many turns in the far-famed Rimutaka."[71]

The reporting of expected times of arrival began from about 1870. A study of advertisements indicate the journeys were usually between communities that were measured in hours rather than days, such as from Christchurch to Rangiora Boys' School, a journey of three hours, which departed at 3 p.m. and was to said to arrive at 6 p.m.[72] Robinson notes that such was the "speed and regularity" of the coaches "that even watches could be set by their appearance at the stated time."[73] He does not cite the source of this information, or the time period, and it is believed he is writing more of romanticism for the past rather than clock time accuracy. Strict arrival times to the minute were difficult to achieve, even after the construction of the railroad from the 1870s and the establishment of air routes from the 1930s. For example, a head or tail wind for an aircraft could result in a flight arriving later or earlier than expected.

Two examples from the late 1880s indicate the company's decision to highlight its efficient use of clock time even in the event of mishaps, rather than its ability to keep to a timetable for the duration of a journey. The first indicated that two travellers, to whom Cobb and Co. supplied a waggonette and two horses, encountered problems when one of the horses "kicked out [and] broke a swing-bar. A new one being on hand, [the problem] was immediately fixed, and the journey was resumed with a delay of only about ten minutes."[74] The second told of an accident to a Cobb and Co. mail coach. The driver "made instant arrangements for the forwarding of the passengers and mails. No delay avoidable occurred. So promptly was everything

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[70] Robinson, p. 123.
[71] *WI*, vol. XXI, no. 2345 (7 Apr. 1866), p. 4, both quotes. H. Robinson, p. 123, stated date was 3 April.
[72] *Star*, no. 665 (11 Jul. 1870), p. 3.
[73] Robinson, pp. 122-3.
[74] *Star*, no. 5785 (25 Nov. 1886), p. 3.

managed".[75] These examples show how the company carefully controlled its public image in the desire to portray itself as an efficient user of clock time.

The need for fast clock times, unfortunately, came at a price to drivers who became victims of their own efficiency. They felt pressured to get the passengers and mail delivered, and one well-regarded driver, James McIntosh, risked losing his passengers' and horses' lives, as well as freight, by crossing the flooded Otepopo (Waianakarua) River near Hampden on 10 October 1864. Fortunately there were no deaths and the mail, though wet, got delivered. The service had to get through.[76] Three months earlier McIntosh had been given a reward for "his affability and obliging disposition" in the form of "a handsome testimonial, in the shape of a gold watch and chain … by friends in the Clutha district."[77] On 6 February 1892, McIntosh died from injuries sustained in a coach accident. He was 62 years old and had been driving for 31 years.

Risk taking was common with some drivers forcing on through the night (without lights) and in deep snow.[78] There was also the recorded instance, when at the conclusion of a journey at Clutha (Balclutha) the passengers were so incensed at the driver's recklessness that they knocked him to the ground.[79] This event shows that Cobb and Co. really tried to live up to its advertising about being reliable and on time. More generally, the evidence shows that the company was symptomatic of the emergence in New Zealand of a society where exact times and the maximally efficient use of time were increasingly important. It was also in the tradition of earlier and continuing attempts to improve the efficiency of maritime transport, with faster ships, attempts to set records, and eventually the introduction of steam ships and timetables for departures and arrivals.

The attempt to produce a faster service and stick to demanding timetables did not result in serious loss of human life, as shown by the list of deaths in Table 4.4.

[75] *Star*, no. 6441 (10 Jan. 1889), p. 4.
[76] Veitch, pp. 37-8.
[77] *OW*, no. 657 (2 Jul. 1864), p. 13. See also Veitch, pp. 41-2. On 6 February 1892, McIntosh died from injuries sustained in a coach accident. He was 62 years old and had been driving for 31 years.
[78] Veitch, pp. 44-6.
[79] Lovell-Smith, p. 47.

Table 4.4. Deaths as a result of accidents in the South Island (unless otherwise stated) 1861-1900.[80]

Date	Name	Owner/Other details
Spring 1866	Margaret Smith	Cobb and Co.[81]
9 Nov. 1870	Mr. Ryrie	Cobb and Co.
2 Oct. 1871	William H. Shepard (driver)	Cobb and Co. (nr. Wanganui)
20 Dec. 1872	Rev. Williams	Cobb and Co.
Apr. 1874	Unnamed boy	Cobb and Co.
Jul. 1874	Unnamed girl	Mr. Hughes's coach
7 Sep. 1875	Henry Steadman	Cobb and Co.
Mid-1870s	A Chinese Man	Iveson's coach
21 May 1878	Maitland (boy)	Swanson and Warburton, many others
	Mr. Nichols	had serious injuries[82]
6 Feb. 1892	James McIntosh (driver)	Cobb and Co.

Aside from the above documented fatalities, it would appear that the vast majority of trips passed incident free. Given that the coach services examined here spanned a period of about thirty years, 1861 to 1900, the number of deaths was surprisingly low. Efficiency, it would seem, was achieved with a low loss of life.

The introduction of a regular railway service from the mid-1870s brought stiff competition to the coach lines. News reports reminded readers that coaches were still as good as, if not better than the iron horse, such as that which appeared in the *Star*. It noted that the visiting Australian cricket team, in February 1878, travelled by train from Oamaru to Christchurch. The journey of 150 miles took ten hours and it

> will long be remembered by every member of the Eleven. The oscillation and jolting of this narrow-gauge line was awful, and, to make matters the more disagreeable, the train did not travel much faster than Cobb and Co. The

[80] Lovell-Smith, pp. 46-7, 56, 60, 61, 93, 96, 106-7 and 110. The list was cross-checked to various newspapers where possible.
[81] Two horses also drowned.
[82] The coach was overloaded.

> cricketers arrived at Christchurch at 7 o'clock on Friday evening, completely knocked up and well nigh shaken to death.[83]

Whilst the railway had taken over from the coach between the main coastal towns, the hinterland routes still needed coaches. A new form of timetable pressure was forced on coach drivers when the first railway services reached Lawrence in October 1875. The railroad's connecting service forced a stricter punctuality upon the coach lines, and when once drivers had some flexibility to wait for the occasional late passenger; this was no longer an option, as they had "to keep up with train times."[84] Further extensions of rail services in Otago in the first decade of the 1900s resulted in the coach lines becoming shorter. The horse of muscle and bone could not compete with the horse of iron and steam for speed and durability. The development of the internal combustion engine and the invention of motorised coaches was the final nail for Cobb and Co. which was wound up in about 1915. Journeys that were once measured in days now took hours.

Towards a Common Time

By the 1840s, 'clock time' was an important part of the Western way of life and even in rough pioneering societies it maintained its control over many aspects of people's lives. In societies so dependent on clock time, the absence of publicly displayed time created problems, and the emergence of a great demand for public signals of local time. These indications were supplied by watch and clock makers, by churches, by provincial and local authorities, and by others. By the late 1860s, the supply of accurate local clock times was significantly lessened. Most interactions involving clock time were within local areas, so 'local times' were initially not a problem. Indeed they often made sense. Local times were also a way in which settled communities expressed their uniqueness, their solidarity, and their identity – just as they still did in many British communities during the 1840s and even later. In the early 1860s, the discovery of gold brought greater demand for overland inter-regional transport. This demand was met by companies, such as Cobb and Co., which

[83] *Star*, no. 3078 (14 Feb. 1878), p. 3.
[84] Veitch, pp. 46-7.

personified the modern attitude to time: the obsession with speed – similar to that of the clipper ships, the introduction of timetables – firstly for departures and then arrivals, and the emphasis on a frequent and dependable freight and passenger service. By the late 1860s, improved communications conspired to expose the inadequacies of ‘local times’, forced people to look outside their local borders for a collective solution thus setting the scene for John Hall’s introduction of a common national time in 1868.

Chapter Five:

The Path to Greenwich

> [The] adoption of a standard time is in hindsight the most dramatic change in our relationship to time since the invention of the mechanical clock around A.D.1300.[1]

On 2 November 1868 New Zealand abolished its numerous local times by adopting a standard time for the whole country. The new time was not based on some arbitrarily chosen point of longitude in New Zealand, such as that of the central government's Wellington observatory. Instead, it was calculated in relation to the longitude and time at the Greenwich observatory in London, half a world away.[2] This gave New Zealand a path breaking role. It was not until 2 August 1880 that Greenwich time became officially the standard time in Britain itself, and it was not until much later that Greenwich became the point of reference for calculating standard times in most countries. So it was New Zealand that pioneered the use of Greenwich as the Earth's prime (zero) meridian.[3]

Whilst international study and publications on the adoption of Greenwich as the prime meridian are extensive, the New Zealand connection has been completely overlooked. And it has only been in recent years that New Zealand writers have revisited the topic. James Hector, the architect of New Zealand's link to Greenwich time, wrote a contemporary account in 1868 and Thomas King returned to the matter in 1902.[4] However, even New Zealand writers then forgot the topic. Three-quarters of a century were to pass before George Eiby (1977) rediscovered New Zealand's temporal history in a twenty page journal article for *Southern Stars*.[5] Since then other writers have added to the history. These include Eric Pawson, Wayne Orchiston, Jay

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[1] C.E. Stephens, *On Time: How America Has Learned to Live by the Clock* (Boston, 2002), p. 122.
[2] The name Greenwich Mean Time (GMT) was used from 1851 until 1927. From 1928 it has been known as Universal Time (UTC). The abbreviation UTC (is a compromise between the British (CUT: Co-ordinated Universal Time) and French (TUC: temps universel coordonné).
[3] Sweden was actually second in formally adopting Greenwich on 1 January 1879.
[4] J. Hector, 'On New Zealand Mean Time', in *Transactions and Proceedings of the New Zealand Institute, 1868*, vol. I (Wellington, 1869), pp. 48-50. T. King, Article LV, 'On New Zealand Mean Time and the Longitude of the Colonial Observatory', in *Transactions and Proceedings of the Royal Society of New Zealand, 1868-1961*, vol. 35 (Wellington, 1902), pp. 428-451. King, the Transit Observer at the Colonial Observatory read it to the Wellington Philosophical Society on 18 March 1903.
[5] G. Eiby, pp. 15-34.

Gross, John Hearnshaw, Biswell and Nester, Jock Phillips and Ron Palenski.[6] None of their accounts, though, can be classed as comprehensive. This chapter uses a large number of primary sources to examine the role the telegraph played in the establishment of a common time for New Zealand. It then discusses the four identifiable phases of the 'Battle of the Clocks' and concludes with an assessment of Hector's time-reckoning for New Zealand.

The Introduction of the Telegraph

> Sing a song of saving
> A pocketful of tin,
> Telegrams for sixpence
> A surplus will bring in.
> When the cover's opened
> We feel inclined to sing:
> "It's all abbreviations,
> We can't make out a thing."[7]

New Zealand's first newspaper editors relied heavily on English newspapers for their content, which in turn meant a reliance on ships. Content, was in general, at least four months 'old' at the time it was read by New Zealanders. Amongst regular stories published from 1840 were reports of the new electric telegraph. Curious readers marvelled at the phenomenal speed information flowed. An 1843 article claimed

> that the speed is about 120,000 miles per second; that, therefore, a message could go to Bristol or Birmingham in 1-1400th of a second, or round the globe, if wires could be laid for its travelling upon, in one-sixth of a second. The messages upon the Blackwall Railway, upon part of the Great Western Railway, and some other railways are carried at this extraordinary rate. The bells in the House of Commons are rung by it, and its uses are extending.[8]

In 1846, another article noted, "It is estimated that when the Electric Telegraph is fixed between London and Liverpool, a communication backwards and forwards, may

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[6] E. Pawson, pp. 278-287. W. Orchiston, *Nautical Astronomy*. J.S. Gross, 'Keeping Time in Nineteenth Century New Zealand', MA Thesis (Auckland, University of Auckland, 2003). S.F. Biswell & R. Nester, 'Time', in *NZG*, no. 88 (Nov./Dec. 2007), pp. 60-69. J. Hearnshaw, 'New Zealand Astronomy: the Past, the Present and the Future', in *RSNZ* (2004). J.O.C. Phillips, (S. Nathan and M. Varnham, eds.), 'Forecasting the Weather and Telling the Time', in *The Amazing World of James Hector* (Wellington, 2008), pp. 87-93. R. Palenski, pp. 37-47.
[7] 'Parodies of Nursery Rhymes', in *Star*, no. 5518 (16 Jan. 1886), p. 3.
[8] *DSC*, vol. 1, no. 33 (2 Dec. 1843), p. 4.

be made in three minutes."[9] By 1848, another article stated that transmission had increased to "the lightning-speed of 288,000 miles in a second of time!"[10] In April 1848, a further article reported that the creation of the telegraphic network in England made it possible for a "Common Time Throughout England" to be adopted from 1 December 1847:

> On this occasion, by order of the Directors of the London and North-Western, with the concurrence, it is understood, of the Railway Commissioners and the Post-office authorities, the clocks at every station on the London and North-Western, the Midland, Birmingham, and Gloucester, and other lines were set to Greenwich time… between 200 and 300 [stations, in] all the principal towns and cities between London, Carlisle and London and York.[11]

New Zealanders and people in the other Australasian colonies questioned why they couldn't have a similarly efficient system.

On 24 July 1858, the General Telegraph Superintendent for Victoria, Australia S.B. McCowan wrote a report proposing the linking of Australia to New Zealand by 'electric cable.' His desire for a terminus to be located in the Cook's Strait area stimulated inter-provincial debate, but a location could not be agreed upon and the scheme collapsed.[12] Also in 1858, and within New Zealand, two early editors of the *Lyttelton Times*, William Reeves (father of William Pember Reeves) and Crosbie Ward, became strong advocates for the introduction of the telegraph. The *Lyttelton Times* was then Canterbury's leading provincial newspaper and it required a continuous flow of up-to-date information from Christchurch and other centres as well as passing on shipping and other local news back over the Port Hills. Petitions and badgering achieved success with the formal opening of the Lyttelton to Christchurch telegraph line over the Port Hills on 1 July 1862. Canterbury was the telegraph's pioneer in New Zealand.[13]

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[9] *NZSandCSG*, vol. III, no. 123 (3 Oct. 1846), p. 3.
[10] *NZer*, vol. 3, no. 179 (16 Feb. 1848), p. 3.
[11] *NZSandCSG*, vol. IV, no. 287 (29 April 1848), p. 3.
[12] A.C. Wilson, *Wire and Wireless: A History of Telecommunications in New Zealand, 1860-1987* (Palmerston North, 1994), p. 25.
[13] H. Robinson, *A History of the Post Office in New Zealand* (Wellington, 1964), pp. 142-153, for detail.

Canterbury's success was a catalyst for other provinces, particularly Auckland, which began construction of a line to Drury in February 1863. Then in January 1863 Alfred Sheath, for his part in the success of the Christchurch-Lyttelton line, was appointed Telegraphic Engineer for the central government. His task of advising provincial governments on the best locations for telegraph lines and supervising their construction proved most difficult. Administrative, financial and political problems as well as personality clashes all had to be overcome as telegraph lines were erected the length and breadth of the South Island. On 27 July 1866 an attempt was made to cross the telegraphic barrier represented by Cook Strait. The line was laid out from Lyall Bay in the north to Oyster Cove in White's Bay in the south. Unfortunately the cable fouled, machinery failed and the cable snapped. On 26 August 1866 a second and successful attempt was made. (See Fig. 5.1).[14] The thirty-two telegraph offices in the South Island, see Table 5.1, were now connected to the Lyall Bay telegraph office in the North Island. However, it was not until the following year that the three Wellington region telegraph offices were connected to the South Island.

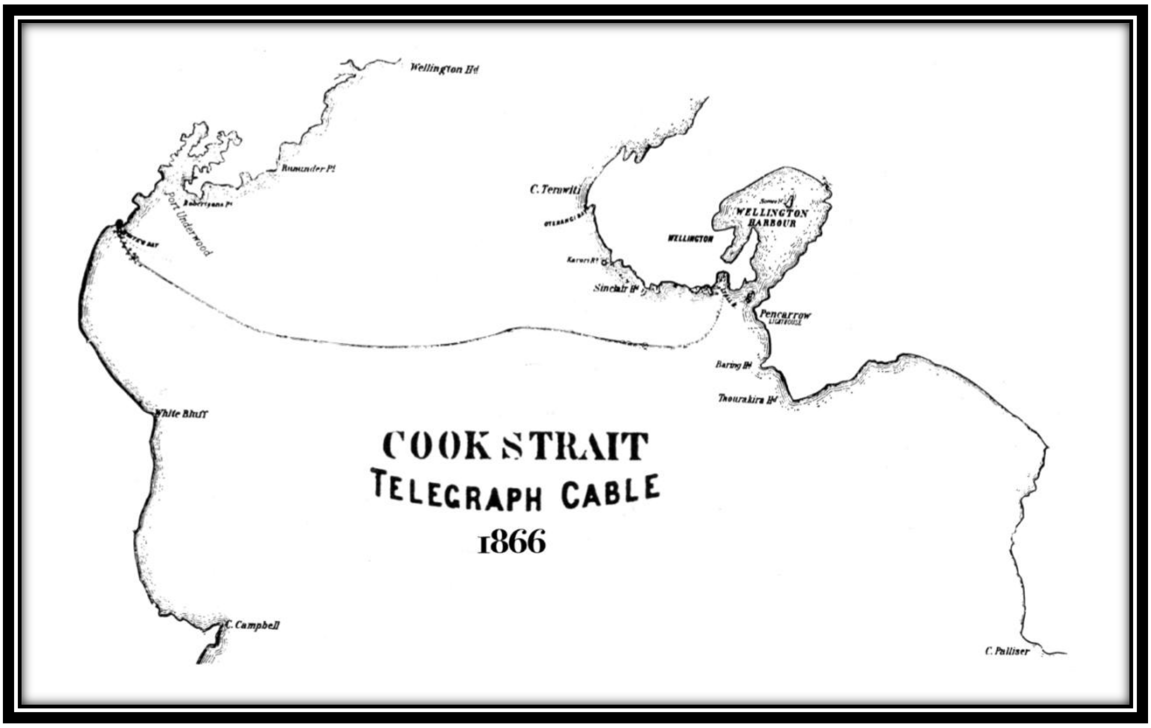
[14] Ibid., pp. 150-1.

Table 5.1. Telegraph Offices connected to Wellington, January 1868, listing year of foundation.[15]

Telegraph Offices connected to Wellington, January 1868			
Year	Location	Year	Location
1862	Christchurch Lyttelton Port Chalmers Dunedin Bluff	1866	Queenstown Lawrence Clyde White's Bay † Lyall Bay †*
1864	Invercargill Mataura ‡ Gore ‡ Clinton ‡	1867	Cromwell Cheviot Wellington * Govt. Buildings (Wellington) * Featherston *
1865	Balclutha Tokomairiro (Milton) Dunedin Waikouaiti Oamaru Timaru Ashburton ‡ Bealey (nr. Arthur's Pass) Temuka Selwyn Kaiapoi Kaikoura Blenheim Picton Havelock Nelson	1868	Teviot ‡ ‡ Omitted from *Gazette* list. † Telegraph stations for Cook Strait cable, not public offices. * In the North Island

[15] 'Telegraph Stations,' in *Star*, No. 571 (19 Mar. 1870), p. 4. Also, *New Zealand Gazette* (10 Dec. 1869), and Wilson, pp. 20-40. See also, *WI*, vol. XXII, no 2625 (21 Jan. 1868), p. 3, for Teviot detail.

Figure 5.1. The telegraphic link between the North Island and the South Island established on 26 August 1866.[16]



The Central Government recognised the financial gains to be earned from the new technology and in 1867 instructed Sheath to purchase all the South Island's private lines. Wellington was then linked directly to Bluff. However, the Central Government had overcommitted itself financially, and supply problems resulted. Sheath lost the support of his superiors, was judged as insubordinate and inefficient, and demoted.[17] In May 1867, Charles Lemon was appointed to the position of Director of Telegraphs.[18]

[16] Robinson, p. 151. Telecom NZ Archives for chart. Extraneous detail has been removed.
[17] Ibid., p. 150. In March 1868 he was transferred to Auckland as District Inspector. He married Stephen Carkeek's daughter.
[18] Wilson, pp. 20-40, for telegraphic history detail. See pp. 39-41 for Charles Lemon detail. See also *WCT*, no. 122 (7 Feb. 1866), p. 2, for details of early telegraph problems.

The Battle of the Clocks[19]

Phase One – The Enforcement of Wellington Mean Time

As the telegraph services stabilised and grew in popularity a number of operational problems became apparent. The inaccuracy of intra-provincial clocks was highlighted when inter-provincial communications increased. Only the handful of telegraph offices that had access to clocks regulated by an observatory were confident they had the correct time. An additional, and little understood, problem also became evident – the time zone difference between telegraph offices. Public perception of what the time should be was also an issue. An example of this occurred in Hokitika, in February 1866. Frustration resulted when the postmaster at the local telegraph office did not keep the opening and closing hours he was expected to maintain.[20] The 'Battle of the Clocks' was about to commence.

Figure 5.2. John Hall[22]

The beginning of the 'Battle' can be traced back to 26 August 1866 and the successful laying of a telegraphic cable across Cook Strait. This led to the enforcement from January 1868 of Wellington mean time in telegraph and post offices connected to Wellington.[21]

It might be argued that the Postmaster-General John Hall had not anticipated any negative response to his decision and simply expected each town/city to function with two clock times. If that were the case the choice of some business people in the South Island centres to adopt Wellington time must have surprised him. However, it makes

[19] *ODT*, no. 1943 (23 Mar. 1868), p. 5, expression used in letter by 'Time Ball'.
[20] *WCT*, no. 122, (7 February 1866), p. 2.
[21] N.H. Brayshaw, *Whites Bay Telegraph Station Centennial* (Whites Bay, N.Z., 1966), for detail.
[22] Image source: The Cyclopedia of New Zealand [Wellington Provincial District], Wellington, 1897, p. 64. http://www.nzetc.org/tm/scholarly/Cyc01Cycl-fig-Cyc01Cycl0064a.html.

more sense to place the decision in the context of Hall's well documented sense of vision and his ability to think strategically.[23] In that case we should see his decision as not just an attempt to solve problems of timekeeping within the postal and telegraphic services, but also as a step towards a much wider reform: the introduction of a standard time throughout the whole of New Zealand. This second interpretation seems entirely plausible, and it has the merit of explaining why Hall capitalised so quickly on the debate provoked by the introduction of 'telegraph time', using it to advance his case for the subsequent introduction of a standard time.[24]

As Hall probably intended, it was the imposition of Wellington mean time on the telegraph offices that were connected to Wellington that stimulated debate over the multiplicity of times in New Zealand and created demand for the imposition of a uniform time. In January 1868, the only cities and towns connected to Wellington, except for Featherston, were the 33 South Island communities that had a telegraph office. Table 5.2 when read in conjunction with Table 5.1, reveals that the service was available to a large percentage of the settler population.

[23] J. Garner, *By His Own Merits: Sir John Hall – Pioneer, Pastoralist and Premier* (Hororata, NZ, 1995).
[24] Ibid., p. 10. Garner notes that Hall was the principal architect of several far-seeing reforms, including the introduction of manhood suffrage and women's suffrage.

Table 5.2. European population of New Zealand in December 1867, (Excludes Maori).[25]

Location	*Population*	*%*
North Island		
Auckland	48,321	22.1
Taranaki	4,359	2.0
Hawke's Bay	5,283	2.4
Wellington	21,950	10.4

Sub-total		36.9
South Island		
Nelson	23,814	10.9
Marlborough	4,371	2.0
Canterbury	38,333	17.5
Westland	15,533	7.1
Otago	48,577	22.2
Southland	7,943	3.6

Sub-total		63.3
Chatham Islands	184	0.0
Total	218,668	100.0

New Zealand towns north of Wellington were not compelled to adopt Wellington time. In February 1868, one business in Napier attempted to disassociate itself from Wellington time. Under the headline "The Panama Mail Service, for Tauranga and Auckland," Routledge, Kennedy & Co., Agents advised that they "do not hold themselves responsible for any alteration in time of departure occasioned by the Honorable Postmaster-General."[26] A local watch and clock maker, Mr. Brewer, erected a public clock outside his shop which was most likely set to Napier mean time.[27] In Auckland the topic appeared not to have aroused public interest as the town and Wellington shared a similar longitude, and therefore the same clock time.[28]

Hall did not have the power to tell the autonomous provincial councils to adopt Wellington time, but he did have absolute control over the post and telegraph offices. The effect of his edict was to inject a new 'state' (principally one building)

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[25] Statistics of New Zealand (Cen: Ref. 3T5wsS).
[26] *HBWT*, vol. 2, no. 59 (17 Feb. 1868), p. 44.
[27] *HBH*, vol. 12, no. 927 (21 Mar. 1868), p. 2.
[28] I examined several months (using key words, e.g., 'time' and 'clock' in *Papers Past*) of the *Daily Southern Cross*, the only paper digitised that was operating then, for references and found nothing.

into each South Island community that had a telegraph office. Hall had lived in England in the late 1840s when a common time (Greenwich mean time) was introduced to railway timetables. From his post office management position he had seen the British postmaster-general's approval of a common time lead to its gradual acceptance by the surrounding communities and he believed this could be emulated in New Zealand.[29] Many settlers were also familiar with the use of Greenwich mean time prior to departing for New Zealand, while even those settlers who had left England prior to the adoption of Greenwich time were kept informed by letters and newspapers.[30] Many New Zealanders believed that Britain had universally adopted a common time, setting a precedent that they should follow.

How well was the New Zealand public informed of the introduction of a uniform telegraph time, in January 1868? Eric Pawson notes that the use of 'telegraph time' was "neither officially gazetted nor announced in the press. Only the Dunedin newspapers gave it space".[31] This statement is only partly correct. Whilst the change was not gazetted, newspapers outside of Dunedin were certainly aware of the proposal and encouraged public debate on their pages. One of the first warnings that the change was to take place appeared in an article in *The Colonist* (Nelson) on Friday 24 January 1868. Readers were informed that the Postmaster-General in Wellington had issued instructions to all his postmasters to adjust their office hours to Wellington mean time. The newspaper supported the decision stating that "The necessity has arisen for having one time for the whole of New Zealand, the same as in Great Britain, where Greenwich time regulates the clocks and watches of the entire country." Readers were instructed to adjust their clocks and pocket watches forward by "eight or nine minutes."[32] This indicates that no one knew for certain the exact time difference between the Wellington and Nelson. The reference to Greenwich also needs clarification. The statement that Greenwich time regulated the whole country was

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[29] The centuries old determination of time by clocks in church towers ended. See Chapter One for more information.

[30] *NZSandCSG*, vol. IV, no. 287, (29 April 1848), p. 3. See D. Howse, *Greenwich Time* (London, 1980), p. 113. In November 1840, the Great Western Railway was the first to adopt Greenwich Mean Time and Howse notes that "By 1855, 98 percent of the public clocks in Great Britain were set to GMT," but there was no Statute defining what the time was for legal purposes. This meant that all Acts of Parliament, deeds, contracts, Wills, births, deaths and marriages, for example, cited their local mean time. Howse, p. 114, indicates there were important legal issues which were not resolved until 2 Aug. 1880. Neither author credits the source of the percentage stated, nor how the 98 percent was calculated. See also Whitrow (1988), p.164.

[31] Pawson, pp. 282-3, for quote.

[32] *TC*, vol. XI, no. 1078 (24 Jan. 1868), p. 2.

misleading, too, as the legal profession and some communities (apart from the Post offices and railway stations) continued to ignore it.[33]

Other New Zealand newspapers published the Wellington edict. The *West Coast Times* (Hokitika) carried similar stories and added that the new time took effect in their town on Monday, 27 January. It told its readers (incorrectly) that they should adjust their timepieces forward by about 20 minutes.[34] The *Southland Times* was even more misleading telling its readers that they would need to advance their timepieces by forty minutes.[35] For users of Invercargill's Electric Telegraph Department the edict did not come as a surprise because from September 1867 the telegraph office had had its operating hours regulated to Wellington time.[36] In January 1868, the variety of times kept by the town's clocks resulted in some members of the Southland Provincial Council arriving late for a meeting. The speaker stated that from then on the correct time for the Council was that shown on the clock in the Council Chamber.[37] In Oamaru, on Friday 31 January, readers were instructed to advance timepieces by 14 minutes.[38] Within days, the Mayor of Hokitika and business leaders extended John Hall's ruling to cover all public offices and businesses from Monday, 3 February. Hokitika's newspaper corrected the earlier mistake indicating that the adjustment was not 20 minutes, but sixteen. This information appears to have come from someone with skills in astronomy as the paper also stated that Hokitika was 4 degrees west of

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[33] *The Law Reports: The Public General Statutes*, vol. XV (London, 1880), Chapter 9, p. 14, for detail and following quote. On 2 August 1880 the British Government passed an Act known as the Statutes (Definition of Time) Act, 1880. This stated that "Whenever any expression of time occurs in any Act of Parliament, deed, or other legal instrument, the time referred shall, unless it is otherwise specifically stated, be held in the case of Great Britain to be Greenwich mean time, and in the case of Ireland, Dublin mean time."

[34] *WCT*, no. 729 (24 Jan. 1868), p. 2. Ibid., no. 732 (28 Jan. 1868), p. 2. Ibid., no. 734 (30 Jan. 1868), p. 2. See also *GRA*, vol. V, no. 317 (25 Jan. 1868), p. 2.

[35] *ST*, no. 887 (24 Jan. 1868), p. 2. Ibid., no. 894 (5 Feb. 1868), p. 1, see 'Government Advertisements'. This indicated a new time observed for all government departments, especially Railways from 10 Feb. Readers were told to adjust by forty minutes. This error was still not recognised. See also ibid., no. 895 (7 Feb. 1868), p. 2, for article expressing support. Ibid., no. 897 (10 Feb. 1868), p. 1, see 'Government Advertisements'. Ibid., no. 892 (19 Feb. 1868), p. 3, for repeat of article expressing support. Those who used the post office must have realised that the stated forty minutes was a mistake. Cited by *TaraH*, vol. XVI, no. 813 (29 Feb. 1868), p. 2. This paper offered no opinion.

[36] *ST*, no. 729 (27 Sep. 1867), p. 2. The newspaper thought Wellington time was 40 minutes in advance of Invercargill time. It also doubted whether other clocks in the province would follow this standard.

[37] Ibid., no. 881 (13 Jan. 1868), p. 2.

[38] *NOT*, vol. IX, no. 281 (31 Jan. 1868), p. 2. The edict, received on 30 January was put into effect on 31 January.

Wellington.[39] Support for the new time spread to W.H. Ingram, a Hokitika watchmaker, who advertised that he had amended his clocks.[40]

Hall's decision divided some communities and united others. Some examples are noteworthy. Whilst Nelson's *The Colonist* (24 Jan.) supported the decision, the *Nelson Evening Mail* (1 Feb.) expressed annoyance at having to put forward local clocks by six minutes. The newspaper also attempted to garner support in order to incite some form of a revolt by stating that Invercargill would need to adjust its clocks by twenty-seven minutes.[41] Matters came to a head on 7 February when some business owners, who wanted letters posted in time for the *Gothenburg* sailing, missed the closing time.[42] The following day, at noon, Nelson's Christ Church clock was set to "Government time."[43] The adjustment to the 'government time' settled the issue and united the community behind the decision. Hokitika reaffirmed its use of Wellington time by immediately adopting it for a local body election and closed the voting according to the new time. Several businesses: drapery, grocery, ironmongery as well as boot and shoe shops indicated they had adjusted their clocks.[44] The paper indicated that other notables, Messrs T.R. Procter and J.P. Klein "the principal horologists of this town" supported the change.[45] Published misinformation and hearsay resulted in public confusion in Milton. The *Bruce Herald*, quoting the *Waikouaiti Herald*, noted that people who read that clocks were to be adjusted by twenty minutes "were under the impression the mail coaches would arrive so much earlier."[46] The coaches in fact did not arrive earlier, possibly due to incorrect clock details published, but perhaps due to the inability of the coach drivers to keep to an exact timetable, and perhaps because of the poor timekeeping of the public and private clocks.

Over the following weeks a clear pattern emerged across the South Island for support or objection to the Postmaster-General's edict. The Island which had shown signs of 'union by telegraph' was now divided. Communities known to be in favour

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[39] *WCT*, no. 735 (31 Jan. 1868), p. 2. Ibid., no. 736, (1 Feb. 1868), p. 2. Possibly W.H. Ingram.
[40] Ibid., no. 736 (1 Feb. 1868), p. 3, also in numerous subsequent issues.
[41] *NEM*, vol. III, no. 27 (1 Feb. 1868), p. 2.
[42] 'Postal Information', in *NEM*, vol. III, no. 260 (2 Nov. 1868), p. 4 reveals the solution to this problem. The Post Office introduced and enforced a closing time for mail. All mail had to be received at least one hour prior to the closing time.
[43] Ibid., vol. III, no. 32 (8 Feb. 1868), p. 2.
[44] *WCT*, no. 737 (3 Feb. 1868), p. 2.
[45] The astronomy skills of both men are unknown. Klein worked as a jeweller.
[46] *BH*, vol. IV, no. 198 (12 Feb. 1868), p. 5.

were: Canterbury, Hokitika, Invercargill, Lawrence, Nelson and Oamaru.[47] And against: Otago. This goes against Phillips, who illustrates provincial opposition to Hall's decision by saying that Christchurch "'people demanded, why should we be ruled by Wellington time?' Wasn't this an outrageous dictate from central government?" Phillips does not give the source of this quotation, but examination of the *Lyttelton Times* and *The Press* reveals that no public debate took place on their pages. In fact, the *Lyttelton* Times on Thursday, 12 March reported that "The time hitherto observed by the various departments of the Provincial Government will be altered this morning, and will afterwards be regulated by means of the telegraph."[48] Canterbury, it would appear, had resolved to adopt Wellington mean time. However, Phase Two of the 'Battle' had already commenced in Otago's newspapers.[49]

Phase Two – Public Debate in Otago Newspapers

Otago was New Zealand's most populous, richest and proudest province, and many of its citizens resented being subjected to Wellington time. Over a period of twelve days in March 1868 its newspapers were the forum for intense debate. The following is a day-to-day account of that debate as it occurred in the *Otago Daily Times (ODT)* and *Otago Witness (OW)*:

> 12 March, *ODT*: The paper argued that "in the absence of sufficient explanation" for the imposition of Wellington time the decision had to be regarded as "a fresh instance of the tyrannical caprice which actuates our rulers at Wellington." The decision "would lead to an infinite variety of confusion and inconvenience." Members of the public were told to adjust their clocks by 20 minutes [sic].[50]

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[47] 'Postal Notice,' in *TT*, no. 1 (15 Feb. 1868), p. 2. See Ibid., vol. I, no. 4 (7 Mar. 1868), p. 2. This expressed the confusion about which time should be kept. The article reveals that Lawrence was keeping Dunedin time. Lawrence wanted a uniform town, either Dunedin's or Wellington's.

[48] 'Government Time', in *LT*, vol. XXIX, no. 2254 (12 Mar. 1868), p. 2. It is unknown what stance the watchmakers took but, at least one, H. Thomson operating under the business name G. Coates did not mention it in his advertising. Several months of advertisements were examined.

[49] J.O.C. Phillips, p. 88. The source of the quote was not cited. Examination of the *Lyttelton Times* and *The Press* reveals no public debate took place on their pages. See also p. 88, Phillips is mistaken in illustrating time differences by saying that when Napier was "4.55pm" the time in Picton was "5.15pm." Picton is west of Napier, and actually about eight minutes behind, so its time would have been 4.47pm.

[50] *ODT*, no. 1934 (12 Mar. 1868), p. 4, for quotes. Pawson, p. 286, footnote 34, credits first quote to the *OW* (14 Mar. 1868), p. 9. A digital copy of this paper was examined and no reference found.

18 March, *ODT*: J. Hyman, a local watchmaker, in charge of the Provincial clocks, assured readers that the Superintendent had not instructed him to adjust the public clocks, and denied hearsay that local watchmakers were going to adjust their shops' clocks.[51]

19 March, *ODT*: The Supreme Court and Resident Magistrate's Courts adjusted their clocks to Wellington time. The banks and Custom House did not. The newspaper demanded uniformity.[52]

20 March, *ODT*: Mr. Justice Chapman of the Supreme Court reaffirmed the use of Dunedin mean time in his court. He stated that he had not approved the use of Wellington time the previous day.[53]

21 March, *OW*: The paper stated that watchmakers had adjusted their clocks, when they apparently had not.[54]

23 March, *ODT*: Cobb and Co., the holder of the Post Office's mail delivery tender, stated that it had been instructed by the Postmaster-General to adopt Wellington mean time.[55]

23 March, *ODT*: A letter by 'Time Ball' attacked the Provincial Government and banks "for making a mountain out of a mole hill." He argued that Wellington time should be kept as the Post Office was "the most important branch of the Public Service."[56]

23 March, *ODT*: A letter by 'Meridian' cautioned Otago authorities against making a quick, possibly ill-formed decision. He then assisted the decision-makers by supplying (for the first time) the correct clock time difference between Wellington and Dunedin, and noted the impact of clock time on other New Zealand cities/towns.[57] 'Meridian' argued that "before the meridian of any place is selected as the regulator for the whole Colony, it should be inquired into how such place is situated with respect to the chief towns of the Colony, so that as little difference as possible may be made in the real time of these centres of population."[58] The writer cautioned against formally adopting Wellington time and indicated that the Christchurch meridian would result in much less inconvenience in the principal towns throughout the Colony. (See Table 5.3 below.) Dunedin took his advice and continued to use two times.

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[51] Ibid., no. 1939 (18 Mar. 1868), p. 4.
[52] Ibid., no. 1940 (19 Mar. 1868), p. 4. It again incorrectly stated the time adjustment was 20 minutes.
[53] Ibid., no. 1941 (20 Mar. 1868), p. 5.
[54] *OW*, no. 851 (21 Mar. 1868), p. 11.
[55] *ODT*, no. 1943 (23 Mar. 1868), p. 1.
[56] Ibid., p. 5, both quotes.
[57] Ibid., for quote.
[58] Ibid., no. 1943 (23 Mar. 1868), p. 5, for quote. Although not stated, I believe this letter was penned by Dr. James Hector, due to the clarity and quality of the argument, and detail supplied.

Table 5.3. 'Meridian' on implications of choosing Wellington or Christchurch time.[59]

If Wellington meridian selected:		If Christchurch meridian selected:	
Location	Effect on Clock (Minutes)	Location	Effect on Clock (Minutes)
Auckland	right	Auckland	slow 8
Taranaki	fast 3	Taranaki	slow 5
Picton	fast 3	Picton	slow 5
Nelson	fast 6	Nelson	slow 2 ½
Christchurch	fast 8	Christchurch	right
Hokitika	fast 15	Hokitika	fast 7
Dunedin	fast 17	Dunedin	fast 9
Invercargill	fast 25	Invercargill	fast 17
Napier	slow 9	Napier	slow 17
Wellington	right	Wellington	slow 8

Table 5.3 helps us to understand why people in Dunedin and Invercargill were unhappy and why some people in Christchurch might have thought that their meridian should be chosen. It also shows that the citizens of Hokitika were remarkably cooperative, perhaps because they were relative newcomers who had arrived between 1864 and 1868 with the West Coast gold rushes. They had not made 'Hokitika time' part of their identity.

From this time onwards the public debate in Otago's newspapers disappeared. Newspaper reports after 23 March were confined to reports of comments made by editors of papers in other provinces, such as the *Grey River Argus* of 31 March, which listed the Dunedin clocks that continued to show Dunedin mean time: the Supreme Court, the banks, the watchmakers and the Provincial Superintendent administered public clocks.[60] The *Grey River Argus*, in support of Dunedin, argued that the telegraphic communication service was "irregular and frequently interrupted" and that in the absence of a railway network there was no justification for the imposition of

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[59] Ibid. See also Hector, *TPNZI*, pp. 48-50 and King, *TPRSNZ*, pp. 428-51.
[60] *GRA*, vol. V, no. 345 (31 March 1868), p. 2. *HBWT*, vol. 2 no. 64 (23 Mar. 1868), p. 73, repeated story from *ODT*, 12 March.

Wellington time.[61] Community leaders prepared for Phase Three of the 'Battle', which saw clock time on the agenda for discussion and voting at a meeting of the Otago Provincial Council.

Phase Three – The Otago Provincial Council Debate

On 27 May 1868, The Otago Provincial Council debated the matter. Councillor Sibbald moved the motion:

> That in the opinion of this Council, the adoption of Wellington time by the Post Offices throughout the Provinces is productive of much inconvenience. [Time should be] kept as it has been done heretofore. [It was unnecessary as] the country was not yet intersected by railways.[62]

An amendment was proposed that Wellington time "is productive of much convenience [and the opening] and [closing of] the Provincial Offices [should also be] by the same time."[63] The matter was discussed by the councillors, but agreement could be not reached.[64] The last to speak, William Hunter Reynolds, Speaker of the Otago Provincial Council, "hoped that the motions would be withdrawn." He acknowledged the very strong feeling in Dunedin and stated that "At the next meeting of the Assembly" he would propose that Dunedin's "time be taken from Canterbury instead of Wellington, and then it would be equalised throughout the Colony." He indicated that Southland and Westland opposed the adoption of Wellington time and "would do what they could to upset it when the Assembly met." Both the motion and amendment were withdrawn.[65]

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[61] Ibid., vol. V, no. 341 (21 March 1868), p. 2. Other newspapers, e.g. *The Press* carried similar reports. There were at least four occasions in June 1868 alone when telegraph lines were broken.

[62] Typed minutes for Province of Otago, New Zealand, *Votes and Proceedings of the Provincial Council*, Session XXIV – 1868, Dunedin, p. 89. The Motion was moved by Councillor Sibbald and seconded Councillor Taylor. Sibbald possibly considered the telegraph network insignificant.

[63] Moved by Councillor Mitchell, seconded by Councillor Main.

[64] In speaking order: Muir, Turnbull and Shepherd supported the amendment. M'Dermid supported the motion. Haughton wanted both the motion and amendment withdrawn, as did the Provincial Secretary. Duncan wanted Otago mean time kept. Mouat supported the amendment, as did Mosley. Hughes agreed with Wellington time at telegraph and post offices, but not for the Provincial Council.

[65] 'Provincial Council – Wellington Time', in *OW*, no. 861 (30 May 1868), p. 7, all other quotes. Typed minutes for Province of Otago, New Zealand, *Votes and Proceedings of the Provincial Council*, Session XXIV – 1868, Dunedin, p. 89. See, http://www.teara.govt.nz/en/1966/reynolds-william-hunter/1, and 'The Makers of Otago: Pioneers of the Province', in *ODT* (7 Mar. 1930), for biography.

Until the meeting of the Assembly in September, clock time confusion continued in Otago and spread to another province. In July 1868, Mr. Justice Chapman attended the Invercargill Supreme Court and was confused with the Court's sitting time. He arrived using Dunedin time, whereas the Invercargill court used Wellington time and realising his mistake apologised to the Court. The decision was made that future sittings in Invercargill would use Invercargill's mean time.[66] Chapman's authority covered the Supreme Courts in Otago and Southland. Invercargill's agreement to accept Wellington time was thwarted by Mr. Justice Chapman.

Figure 5.3. William Hunter Reynolds

Phase Four: The Central Government Debate

If the General Government insist[s] on Wellington time being observed in every department of the Service here, the battle of the clocks would cease.[67]

William Hunter Reynolds, the MP for Dunedin, looked for sound, pragmatic reasons to get rid of Wellington mean time as well as offer a workable alternative, and on 2 September 1868 he instigated a parliamentary debate during the Third Session of the Fourth Parliament.[68] He opened the debate by noting "that some months ago the Government had found it desirable to give instructions in various districts in the Colony that Wellington mean time be observed at the telegraph stations and also at the post offices." As a consequence, he said, Otago was observing two times – Wellington mean time in the post offices and telegraph offices, and Otago mean time

[66] *ST,* no. 986 (15 Jul. 1868), p. 3, Ibid., no. 987 (17 Jul. 1868), p. 2. Cited by *EP,* vol. IV, no. 149 (6 Aug. 1868), p. 2, and also in *NEM,* vol. III, no. 187 (10 Aug. 1868), p. 2.
[67] *ODT*, no. 1943 (23 Mar. 1868), p. 5, letter by 'Time Ball'.
[68] Image source: http://www.freepages.genealogy.rootsweb.ancestry.com/~nz...

in the other public departments. This created a number of difficulties.[69] Reynolds, with an obvious reference to 'Meridian's' letter, suggested that Christchurch time be observed as it "was nearly the centre … [of New Zealand. It] … would equalize the time in all districts throughout the Colony."[70] He referred to the use of Greenwich time "at home", and argued that New Zealand should also have its own mean time. He moved "that Christchurch mean time be observed throughout the Colony, and that the Government introduce a Bill legalizing the same."[71] This quote is worth some comment. Christchurch mean time was calculated from an arbitrarily chosen point of longitude that suited the Canterbury astronomer's placement of an observatory. It was not calculated from the centre of Christchurch, let alone the longitudinal centre of New Zealand. It was therefore a very inexact approximation of New Zealand mean time.

Major Charles Heaphy V.C., the MP for Parnell, added that he thought Reynolds was

> to a certain extent, in error in the arguments he advanced in favour of [the motion]. He didn't think it likely that the mean time of Wellington should be the mean time of Invercargill and Westland; the idea seemed out of the question. There would be a difference of thirty-four minutes between the Wellington time and the time in some parts of the West Coast.

He claimed that Reynolds in trying to correct an error

> had fallen into an error in degree of the same character, in desiring that the actual mean time at Christchurch should be that of the whole Colony. At Invercargill, for instance, there would be a difference of sixteen minutes: the sun would get to Invercargill sixteen minutes too late and to other places sixteen minutes too early. Wellington, Christchurch, or any other place should have no other time but their own. It would be simple enough to select some site where the best means of observation existed for determining the mean time and from that place regulate the whole time of the Colony. The mean time of that place should be taken as the basis for compilation of the mean time of every other place in the Colony where there were telegraph stations. [He argued that] In places possessing a tidal harbour, for instance Nelson, where the time of entry and leaving of vessels was regulated by the exact time of the tide – if they directed that place to observe any other mean time than its own they would throw out the arrangements of the harbourmasters and pilots

[69] 'Christchurch Mean Time', in *NZPD, vol.3* (1868), pp. 106-8, for detail, p.106 for quote. Reynolds explained to the other members of Parliament the problems experienced in Otago and gave examples (some exaggerated) to justify his proposal. He stated the time on the extreme west coast of Otago, the uninhabited West Cape, close to Dusky Sound, was 34 minutes behind Wellington time. In 1868, the township of any significant size that was the furthest west from Wellington, and connected by telegraph, was Invercargill, which had a time difference of about 25 minutes.
[70] Ibid., p. 106, for quote.
[71] Ibid., for quotes. The passing of a Bill did not eventuate, only a Resolution.

> of the place. [He added that] The time shown by the chronometers of different vessels entering the harbour from different ports [would be different and that] the time ball at twelve o'clock would not indicate the same time on board a man-of-war or merchant ships.

He concluded by saying,

> Let the principal authority of the place see that the proper computation was made, in accordance with the difference of the longitude between that place and locality where the time was determined. That was, he apprehended, the proper course to be adopted.[72]

The third person to speak was John Hall. It is probable that he was unprepared for the debate because he entered the debating chamber late and missed Reynolds's motion. Hall asserted

> That they [the Government] could not make the mean time of one place that of another. What they proposed was what existed in the mother country, where one uniform time was kept, namely Greenwhich [sic] time, which was kept by banks, railways, telegraph stations and various other departments throughout the country, and thereby the convenience of the public greatly promoted.[73]

He further added, "That he not only could not sympathise with [Heaphy's] opinions, but could not understand them."[74] Hall had finally revealed his true agenda.

In reply, Heaphy stated that "he assumed that what [Reynolds] had stated was correct – that Wellington mean time was directed to be followed throughout the Colony" by post and telegraph offices. Hall ignored Heaphy's reply and in giving an example of problems encountered made a verbal slip of the tongue:

> The telegraph station in Wellington closed, he would say, at eight o'clock, which was seventeen minutes earlier than in Dunedin. A person therefore in Wellington, assuming he could, up to eight o'clock, send a message to Dunedin, would be told that the office there was closed ten minutes ago. The same thing occurred at all the offices in the country.[75]

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[72] Ibid., p. 107, for quote. Heaphy's time ball reference was irrelevant. Wellington possessed the only time ball at this time.

[73] Ibid., p.107, for quote. See also Garner, p.148. Hall was at this time the MP for Heathcote and the Acting Colonial Treasurer. He appears to have believed the use of GMT in the "Mother Country" had been legally adopted, which was not the case.

[74] Ibid., p.107, for quote.

[75] Ibid., Eight o'clock in Wellington could not be both 17 minutes and 10 minutes earlier than Otago. Dunedin mean time was officially set at 17 minutes behind Wellington mean time, so 8pm in Wellington would equate to 7.43 p.m. in Dunedin and the office was still open. See also Pawson, p. 283.

Hall clearly intended to use the example of a person in Dunedin frustrated in his desire to send a message to Wellington. To remedy this inconvenience, Hall stated that

> [A]n order [had been issued] that at all telegraph stations one mean time should be kept. They then found that at a great many places where the telegraph station and the post office were in the same building, the telegraph station was closed at one time and the post office at another. This was found very inconvenient. The result was that the post offices were ordered to keep the same time as the telegraph stations. That had been done, and in a good many parts of the Colony the inhabitants, knowing that this time was kept with great punctuality at those offices, regulated their own clocks by those at the telegraph stations and the post offices. The best plan would be to ascertain what the New Zealand mean time was, and when they knew the difference between that time and Wellington, they could then fix the telegraph time to be kept in Wellington. They would keep the New Zealand mean time [NZMT] and telegraph it to the various stations and post offices every day. With reference to the other objection as to the masters of vessels, they could easily ascertain what was the difference between the time kept by the local clocks and the real mean time.[76]

Hall offered an amendment to Reynolds's original resolution, proposing that "'Christchurch' be struck out for the purpose of inserting the words, 'New Zealand.'"[77] He wanted to seize back the initiative from Reynolds by making the Resolution a government measure. He was also anxious, as the representative of a Canterbury electorate to avoid any suggestion of a parochialism that might antagonise members from Otago and the North Island. Reynolds had no objection to the amendment.

The fourth speaker, James Macandrew, MP for Clutha, "thought it was a very great waste of time to continue discussion on that question. He did not see any necessity for debating the propriety or otherwise of adopting one uniform time throughout the Colony." He understood the need in the telegraph stations but a uniform time for the whole country would "only lead to a great deal of inconvenience."[78] Macandrew did not explain this last assertion.

Reynolds was surprised by the comments of Heaphy and Macandrew, and gave a further example of the problems that resulted from a dual time system by referring to the Cobb & Co. mail coaches which operated according to Wellington time. He also argued that "One good observatory at the seat of Government, where the

[76] Ibid., pp. 107-8, for quote.
[77] Ibid., for quote.
[78] Ibid., for quotes. He was also the Superintendent of the Otago Provincial Council.

mean time was correctly taken and telegraphed to the various ports, would be to the advantage of the shipping interests as a whole, and a considerable saving would be effected." The debate concluded and "[The] Motion, as amended, [was] agreed to."[79]

Parliament's decision resulted in a Resolution.[80] It did not impose NZMT on the New Zealand public, only the public sector. The private sector adopted it out of convenience. The *Evening Post* reporter, taking advantage of the fact that the details of the calculation were as then undecided, noted disparagingly that

> The march of centralisation goes on … Mr Hall having stated in answer to Mr. Reynolds's motion against the adoption of Christchurch time being introduced throughout New Zealand, that the "New Zealand mean time" – whatever that may mean – would in future regulate the business of Government offices.[81]

The *Otago Witness* was equally vague, but it did explain two weeks later that Reynolds' word 'Christchurch' had been removed in favour of Hall's word 'New Zealand'.[82]

From Clock Time Confusion to Clarity: "The 'Hector' time-reckoning for New Zealand"[83]

The person Hall turned to for the calculation of New Zealand mean time was Dr. James Hector, the Government scientist, who was asked to report on the different clock time options and make a recommendation. Hector was a respected expert on most scientific matters and was able to bring previously gained knowledge to the task

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[79] Ibid., for quotes.

[80] S.C. Hawtrey and H.M. Barclay, *Abraham and Hawtrey's Parliamentary Dictionary*, third edition (London, 1970), pp. 185-6, for definition. Specifically a Resolution is "An expression of the opinion of the House with reference to some subject or a declaration of its intention to do something." See D. McGee, *Parliamentary Practice in New Zealand*, third edition (Wellington, 2005), p. 214. See also following E-mail from Dr. John E. Martin, Parliamentary Historian (15 Nov. 2009). He notes that "Whilst legislation was referred to in the Resolution of the House of Representatives of September 1868 this was not forthcoming. Instead there was just the simple notice by the Government in the *Gazette.*" The Resolution was only binding on Government Offices and it was left to the discretion of the private sector and members of the public whether or not to accept it. The Resolution of course placed great pressure on local authorities and the public to avoid complications by falling into line.

[81] *EP*, vol. IV, no. 173 (3 Sep. 1868), p. 2. Hall was not against the adoption of "Christchurch time", just the use of the word 'Christchurch'.

[82] 'Wellington, Sept. 3rd.', *OW*, no. 876 (12 Sep. 1868), p. 9. Also, 'News of the Week', in *OW*, no. 878 (26 Sep. 1868), p. 13. See, *WI*, vol. XXIII, no. 2727 (3 Sep. 1868), p. 5, for a fuller but still heavily edited report.

[83] T. King, pp. 428-451.

that lay ahead.[84] As the deputy-leader of the Palliser Expedition in Canada from 1857 to 1860 he had co-written a 64-page Report of its work down to the end of 1858. In 1860 the expedition issued a second Report in which Hector recommended that the large size of the country required a new system of time measurement – "zone times".[85] Clocks, he suggested, should change at equal intervals of an hour for a person journeying east or west across the North American continent. The minutes and seconds would remain unchanged.[86] He applied this thinking to the New Zealand problem. Hector, with the likely assistance of his colleagues John Buchanan (a surveyor) and Richard B. Gore (a clerk), carried out meteorological observations and recording then prepared a report to the central government which concluded with a recommendation for a New Zealand meridian. Table 5.4 indicates the options considered by Hector.

Figure 5.4. Dr. James Hector[87]

[84] See Appendix One for Hector biography, pp. 128-9.
[85] http://www.teara.govt.nz/en/biographies/1b42/1, for Buchanan's DNZB biography. Gore (no biography) was skilled in carrying out meteorological observations and recording. He worked with Hector since the 1863 geological survey of Otago.
[86] Hector, p. 48-9, for quote. See also, I.M. Spry, *The Palliser Expedition: The Dramatic Story of Western Canadian Exploration 1857 – 1860*, 1st ed. 1963 (Toronto, 1995), pp. 296-7.
[87] Image source: http://www.nzetc.org/etexts/WarEarl/WarEarl349a.jpg.

Table 5.4. Options considered by Hector.[88]

Options (East of Greenwich)	**Average Meridian**	**Clock Time difference with Greenwich (plus)**
165° East		11 h.
172° 30′ East		11 h. 30 min.
178° 36′ 5″ East, 166° 26′ 30″ East[89]	172° 31′ 17.5″ east	11 h. 30 min. 5.2 sec.
A meridian which had an equal area of land lying to the east and west (within N.Z.)	172° 48′ 57″ east	11 h. 30 min. 34.7 sec.
Average longitude of ten ports[90]	173° 14′ 12.5″ east	11 h. 32 min. 56.9 sec.
180° East		12 h.

Hector dismissed the idea of using Christchurch mean time as proposed by Reynolds because "the absolute longitude of any place in the colony has not yet been determined; and it is better for a Statute to adopt a meridian, than an approximate longitude, for a place, which might hereafter require rectification." Hector followed Hall's suggestion that a NZMT time be established and proposed that the meridian 172° 30′ east be adopted for three reasons. First, the meridian "would cause the least inconvenience". Second, the meridian was "a close approximation to the average longitude for the colony", which was 11 hours 30 minutes 5.2 seconds east of Greenwich. And third, because the proposed meridian was an even number it was "most suitable for the purpose of enabling mariners to compare the errors of their chronometers, on mean Greenwich time; while the adoption of the mean time of place, for any town or port in the colony, will have no practical advantages."[91] Hector also noted that

> The time could, as at present, be determined at Wellington by the meridian transit, as it will be most convenient that the time balls at the different ports should be dropped at 1 p.m. of the adopted statute time, which for Wellington would be at 1 h. 9 m. 11.5 sec. mean time of place. [That is 9 minutes and 11.5 seconds after 1 p.m. apparent Wellington solar time.] By providing the

[88] J. Hector, pp. 48-50. See also T. King, pp. 428-432, for additional detail.
[89] This included small islands which formed New Zealand's dependencies.
[90] Hector, p. 48, for detail and following quote, "to which telegraphic communication exists".
[91] Ibid., p. 49, for quotes.

telegraph office clocks with two minute hands, indicating the instant required for the difference between the longitude of the place east or west of 172° 30′ with the true time, telegraph time can be shown if desired.[92]

Hector submitted his report to the central government within a month of the parliamentary debate and on 5 October 1868 the *Evening Press* published an abridged version of it. The newspaper noted that the decision to adopt NZMT "trifling as it may appear, is one which marks the progress made by the colony, and the extension of the many settlements towards what they will one day become – one harmonious and great country."[93] It informed the New Zealand public that the new time would take effect from 2 November. Over the following weeks other newspapers reproduced this article in various forms.[94]

How many communities were immediately affected by the Resolution? Fig. 5.5 shows the extent of Wellington's telegraphic connection to New Zealand communities at the time NZMT was introduced. It includes the extension to the telegraphic line – Wellington to Napier – which occurred after the February 1868 imposition of Wellington mean time.

Figure 5.5. New Zealand communities connected to Wellington by the telegraph.[95]

[92] Ibid.
[93] *EP*, vol. IV, no. 200 (5 Oct. 1868), p. 2, for quote.
[94] *TaraH*, vol. IX, no. 354 (17 Oct. 1868), p. 3. *Star*, no. 138 (21 Oct. 1868), p. 2. *NEM*, vol. III, no. 257 (29 Oct. 1868), p. 2.
[95] Original map source: teara.govt.nz website. The sextant and meridian are superimposed on the map.

The Adoption of a New Zealand Meridian

The Government approved the recommendations and laid them before the House of Representatives. On 31 October 1868 it was formally announced in the *New Zealand Gazette* that New Zealand time was to be exactly 11½ hours ahead of Greenwich mean time.[96] Newspapers reported the Government's decision. In the *Evening Post*, Archdeacon Arthur Stock published a letter informing readers that "The Time Ball will drop on Monday at 12 o'clock NZMT. This time is 9min 17sec slower than Wellington mean time. All clocks and watches should be put back 9½min on Monday morning."[97] At noon on 2 November 1868, all well regulated clocks throughout the South Island, connected by the telegraph to Wellington, struck twelve at the same moment Wellington's clock did. It can be seen in fig. 5.5 that some communities, such as Auckland and Stewart Island, were not connected to Wellington by the telegraph and felt less pressure to fall in line.[98] Having a telegraphic connection to Wellington did not mean the automatic adoption of NZMT. For example, not everyone in Napier agreed to a uniform time. In January 1869, the *Hawke's Bay Herald* noted that only the offices of the General Government, banks and the local watchmaker Mr. Brewer used NZMT and "much inconvenience [was being] experienced."[99] In addition, the central North Island was a war zone; much of it was controlled by tribes aligned with the King Movement, who thought Pakeha clock time was irrelevant and therefore ignored it.

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[96] *The New Zealand Gazette* (31 Oct. 1868), p. 507. Neither a Resolution of the House of Representatives nor a notice in the Government Gazette constitutes 'legislation' – a law passed by Acts of Parliament. It was only an order for all government departments to adopt Greenwich mean time.

[97] For example, 'New Zealand Mean Time', in *EP*, vol. IV, no. 224 (31 Oct. 1868), p. 2, for quote and also the *Star*, no. 148 (2 Nov. 1868), p. 2. See *TP*, vol. XIII, no. 1747, (3 Nov. 1868), p. 3. See 'New Zealand Gazettes', in *DSC*, vol. XXIV, no. 3531 (9 Nov. 1868), p. 3. See also *WCT*, no. 973 (4 Nov. 1868), p. 2, for following quote. The paper advised readers that "New Zealand mean time is transmitted regularly to the Telegraph Office, Hokitika, every morning at nine o'clock, and those persons who are desirous of preserving uniformity of time, and keeping engagements to the minute would do well to visit the Telegraph Office, in order to set their watches by the clock of that establishment." See also J.D. Atkinson, *DSIR's First Fifty Years*, (Wellington, 1976) p. 143. And Eiby, pp.17-9. Archdeacon Arthur Stock (1823-1901) carried out the observations until his retirement in 1887. Eiby, p.18, states that Stock was unable to supply the time until a new observatory was built in June 1869.

[98] Auckland city was not connected by telegraph link to Wellington until 1872. Stewart Island was connected on 11 June 1902. The undersea cable crossed Foveaux Strait from Ocean Beach, near Bluff, to Stewart Island's Lee Bay.

[99] *HBH*, vol. 13, no. 1016 (23 Jan. 1869), p. 2, for quote.

Auckland's Battle for a Standard Clock Time

John Hall's January 1868 decision for New Zealand to adopt Wellington time left Auckland, by virtue of its sharing a common longitude with Wellington, immune to any need to change its clock time. But the Central Government's Resolution in September 1868 that New Zealand should adopt Greenwich mean time was another matter. And whilst the rest of the country had argued, debated or discussed the imposition of Wellington mean time and then the Resolution for a NZMT, Auckland had not. Before, and immediately after the introduction of NZMT on 2 November there was no reaction from Auckland. It was almost as if nothing had occurred, that Auckland was perhaps another colony, and not a part of New Zealand.[100]

Auckland's slow reaction to the government's ruling is worth examining. It would appear the first occasion for Aucklanders to be made aware of *The New Zealand Gazette* notice was on 9 November, seven days after NZMT was enforced. From this day, the *Daily Southern Cross* decided to take some action. The newspaper applied pressure on the Auckland Provincial Government, the city board and other community groups to get NZMT introduced into the city and have it displayed on a public clock. The following is a sample of the newspaper's reports over a six month period from November 1868 to April 1869:

> 9 November: the newspaper informed readers of the *New Zealand Gazette* notice that NZMT had been adopted from 2 November. It wrote, "We in the city have hitherto been exceedingly careless in the matter of time – no two timekeepers in the town agreeing, except by chance. We daresay that, for a small payment, one of our clock and watchmakers might be got to ascertain the mean time, and have a reliable clock exhibited in some conspicuous position, say, at the front of the Post-office. The matter ought not to be beneath the notice of the Provincial Government or the City Board; but, as we have not much hope from either of these bodies, we may suggest that the Council of the Auckland Institute might move in the matter."[101]
>
> 3 December: the paper included amongst the several defects existing at the Supreme Court that "the clock is simply noticeable by its absence."[102]
>
> 9 February: the paper noted that "no two timekeepers in the town can ever be found to correspond as to the hour of the day, all the clocks visible from the

[100] The population of Auckland was just over 48,300 representing about 22 percent of the New Zealand total. See Figure 6.3.
[101] *DSC*, vol. XXIV, no. 3531 (9 Nov. 1868), p. 3, for quote. See also ibid., for 'New Zealand Gazettes'.
[102] Ibid., vol. XXIV, no. 3551, (3 Dec. 1868), p. 3, for quote.

streets appear to be at "sixes and sevens," or some other numbers." It informed readers of timekeeping methods across the Tasman Sea in Sydney, Fort Macquarie, Melbourne and Brisbane and reiterated that "as time is money in commercial transactions, and as our Provincial Government is in too impoverished a state to provide a clock for the Post-office, or other central position, our mercantile men ought to lay their heads together and contrive some means of establishing a standard time." The paper suggested a time ball.[103]

11 February: the paper affirmed "the grievous necessity existing for a public clock to set all matters right, thus placing us something on par with the Southern provinces of the colony." It made reference to "the old-fashioned piece of horology in the police Court" which played "all manner of vagaries with Time itself". It noted that whilst the Resident Magistrate T. Beckham did not rely on it other court officials may have done so "under the misplaced confidence that the clock indicated the right moment." The paper asked for the clock to be made "a trustier chronicler of the noiseless foot of Time."[104]

9 April: Mr Mason at an Auckland Chamber of Commerce meeting gave notice that at the next meeting he would move that the central government be asked to supply a public clock.[105]

13 April: A.G. Bartlett, a clockmaker on Queen Street, advertised that he had set his shop window clock to NZMT.[106]

14 April: the paper reported that a new Post-office clock was installed, albeit "in a corner under the porch" but that it was only visible from close proximity. The paper asked for it to be given a more prominent site. In a separate article it was noted that A.G. Bartlett displayed a chronometer in his shop window that was set to NZMT. The paper regarded Bartlett's clock as the "generally recognised standard by which most Auckland clocks are set." It briefly explained NZMT and hoped "that the standard fixed upon will be generally adopted in Auckland."[107]

16 April: the paper noted that Mr. MacCormick (a barrister) asked the Court what time was used by the resident magistrate's court – NZMT or Auckland real time? Mr. T. Beckham, the resident magistrate, "observed that he had only been made aware the previous day that an alteration had been made in the standard of time." He stated that in future all the courts would use NZMT.[108]

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[103] Ibid., vol. XXV, no. 3607 (9 Feb. 1869), p. 3, for quotes.
[104] Ibid., vol. XXV, no. 3609 (11 Feb. 1869), p. 3, for quotes.
[105] Ibid., vol. XXV, no. 3658 (9 Apr. 1868), p. 4.
[106] Ibid., vol. XXV, no. 3661 (13 Apr. 1869), p. 1. Ibid, p. 4 for brief Bartlett report.
[107] Ibid. vol. XXV, no. 3662 (14 Apr. 1869), p. 3, for quotes. Ibid., vol. XXV, no. 3684 (10 May 1869), p. 7.
[108] Ibid., vol. XXV, no. 3664 (16 Apr. 1869), p. 5, for quote. I have underlined the word "previous".

> 10 May: the paper reaffirmed Bartlett's chronometer as the regulator of clock time for most of Auckland.[109]

Despite the best endeavours of Alfred Bartlett to supply accurate clock time to Auckland problems with clock time accuracy continued in 1869. The *Daily Southern Cross* reported the Courts ongoing issues with inaccurate clocks and pocket watches.[110] The solo effort of Bartlett exposed Auckland's central problem. Although he could make astronomical observations, calculate accurate clock time and set his regulator clock he did not have an efficient means of communicating it to the burgeoning city. The situation also exposes a pre-existing attitude amongst the populace to clock time that clock and pocket watches inaccurate by two or three minutes were tolerable. It was only when officialdom questioned the clock time of day, for example at the Court that it became an issue. Auckland was set apart from its southern counterparts who enjoyed the accuracy of a clock time that was regulated from Wellington's observatory and communicated daily by telegraph.

The thesis returns to the comments at the start of this section concerning Auckland's slow fall into line with the rest of New Zealand. The campaign to get NZMT introduced into Auckland was apparently not motivated by the desire to get the city to 'fit in with the rest of New Zealand', because in the absence of a telegraphic connection south of Cambridge it had no reason to fit in. It could not coordinate its time with the rest of New Zealand. This would account for the disinterest exhibited by the Auckland Provincial Government and the Auckland City Board. The reason for adopting NZMT grew from two concerns. Firstly, the campaigners wanted everyone in Auckland to use the same time system. NZMT was the most practical option because some people, such as Bartlett, had already created confusion by adopting it independently and because the extension of the telegraph made its eventual introduction inevitable. Secondly, the campaigners used the issue of NZMT as a springboard for a crusade for better provision of public timekeeping in Auckland. The *Daily Southern Cross* and the business community were motivated by the need for more timely and efficient management of local, government and private enterprise.

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[109] Ibid., vol. XXV, no. 3684 (10 May 1869), p. 7.

[110] Ibid., vol. XXV, no. 3717 (17 Jun. 1869), p. 4. See also Ibid., vol. XXV, no. 3829 (26 Nov. 1869), p. 4. H.H. Turton, J.P., set his watch to 'Parnell Time' and arrived three minutes late according to the court clock.

Attempts to Gain International Recognition

Poor information flow appears to have robbed New Zealand and Hector of the international recognition and prestige that was, and still is, deserved. Nearly 40 years passed before the publication of a mistake in a 1901 issue of *The Observatory* allowed Hector to bring some of his achievements back into the light.[111] The article stated that time in New Zealand was 11 hours fast of Greenwich. Hector, then 67, wrote a letter of correction, the speed of which is noteworthy, as barely five months later it was published. Given that the Journal travelled by sea mail to New Zealand and Hector replied by sea mail, it indicates a great deal of pride on his part in his achievement and an urgent need to see it correctly recorded internationally. Hector sent the journal's editor a copy of the *Transactions and Proceedings of the New Zealand Institute*, and the journal in turn published an ambivalent acknowledgment.[112] "This time was adopted by the New Zealand Government as far back as the year 1868, when the present Time-Ball Observatory was established [the date was actually 1864], so that New Zealand may be considered as possibly the first country to take up the zone-time system, if we consider zones differing from Greenwich by an odd number of half-hours to properly come within that scheme."[113] Hector's letter to *The Observatory* reminded readers of another internationally significant contribution he had made. The article ended, "He also tells us that in 1860 he pointed out the modification of time reckoning that would be necessary on the long route of the Canadian Pacific Railway."[114] Thomas King, probably motivated by *The Observatory's* mistake, wrote a comprehensive report for the *Transactions and Proceedings of the New Zealand Institute* in 1902.[115]

In 1876, Sanford Fleming engineer-in-chief of the Canadian Pacific Railway published a memoir titled *Terrestrial Time* which advocated the use of a 24 hour

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[111] 'Universal Time', in *Observatory*, vol. 24 (Feb.1901), p. 90.
[112] Hector, pp. 48-9.
[113] 'The Time of New Zealand,' in *Observatory*, vol. 24 (Jul. 1901) p. 291. There are 29 time zones in the world.
[114] Ibid. This contradicts other authors, in particular Derek Howse, pp. 121-7, who credits Professor Charles Ferdinand Dowd, in 1870, with creating the system and explaining it in a 107-page pamphlet he published. R. Burnett, 'The Life and Work of Sir James Hector', MA Thesis (Otago, University of New Zealand, 1936), p. 5, states a possible reason for the mistake. "The Palliser Expedition was in Western Canada, while all those who publish researches on such topics in Canada live in the east, where the bulk of the population is located. Hence this expedition has never received the publicity it deserves." In 1922, the problem was further compounded when Palliser's own journals were destroyed by fire when rebels attacked his home in Ireland.
[115] T. King, pp. 428-451.

clock system and a uniform system of time zones for the whole world. Irene Spry notes that Fleming "always took Palliser's report with him on his survey trips; he found it of great use." Fleming was aware of Hector's time zone proposal.[116] Fleming in his book did not name Hector as the originator of the idea and as a result he himself gained the international recognition. A recent biography (2002), by Clark Blaise, *Time Lord: Sir Sandford Fleming and the Creation of a Standard Time*, has no reference to Spry's book on the Palliser expedition, the Palliser/Hector report, or the institution of a standard, Greenwich-based mean time under Hector's influence in New Zealand in 1868.[117]

It is not surprising that internationally the achievement of Hector and his team in 1868 appears to have remained largely unknown to the outside world as most New Zealanders were ignorant of it too. A writer to the *Wanganui Herald* in 1898 thought that the meridian passed through Wellington and was surprised to read that it did not.[118] Another 1898 reference appeared in the *Timaru Herald*, which quoted a *Southland Daily News* correspondent who also believed that the meridian was the longitude of Wellington.[119] Interestingly *The Observatory's* 1901 error reared its head again a decade later in an issue of *Nature* (1911).[120] The article quoted *Hazell's Annual*, which stated that New Zealand was 11 hours ahead of Greenwich, when it was in fact 11½ hours ahead. G. Hogben of the Seismological Observatory in Wellington wrote to *Nature,* which published a correction in the October 1911 issue.[121] Even in the late 1990s, Howse incorrectly stated that New Zealand adopted the Greenwich meridian in 1895, whilst Sobel and Andrewes omit New Zealand's historic link to Greenwich.[122] The omission of New Zealand's achievements from British history does not surprise Pocock (1975). He argues that histories of subordinate nations are regarded as less authoritative than those of great powers

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[116] Spry, p. 288. See also Howse, pp. 121-125 and 129. It is unknown whether Hector indicated Canada could be linked to GMT.
[117] C. Blaise, *Time Lord: Sir Sandford Fleming and the Creation of a Standard Time* (New York, 2002).
[118] *WH*, vol. XXXII, no. 9424 (29 Apr. 1898), p. 2.
[119] *TH*, vol. LX, no. 2705 (16 May 1898), p. 5.
[120] 'Standard Time in France', in *Nature*, vol. 87 (Mar. 1911), page unknown.
[121] Ibid., vol. 87 (Oct. 1911), p. 516.
[122] D. Howse, Table III, pp. 154-155. Australia adopted GMT in 1895 and Howse possibly linked New Zealand mistakenly with Australia. See also D. Sobel and W.J.H. Andrewes, *The Illustrated Longitude* (London, 1998), for no reference to New Zealand.

because New Zealand "society is less centrally and bureaucratically organised."[123] New Zealand therefore lacked the power to exert influence over England's record of history.

The Reynolds, Hall and Hector Legacy

In the early years of British settlement in New Zealand the calculation of exact clock time was difficult, each community kept its own clock time, and clocks and watches were usually inaccurate. The desire for faster communication led to the creation of New Zealand's telegraphic network. The Postmaster-General, John Hall, superintended the spread of telegraphic communications and it was he who removed the task of calculating clock time from clockmakers and made it the responsibility of Central Government. The enforcement of telegraph time (Wellington mean time) in January 1868 was a response to the progressive unification of the country by telegraphic communication and the desirability of coordinating the hours of telegraph stations in different centres. The adoption of telegraph time by the public, community organisations and businesses was entirely voluntary. Otago's debate over telegraph time resulted in the formalising of a standard time for all New Zealand.

New Zealand politicians debated, at provincial and central government levels, the best course of action and employed a world leader to head the scientific team that determined the best way of implementing their decision to adopt a standard time. Two politicians and a scientist deserve acknowledgement: Sir John Hall, William Hunter Reynolds and Sir James Hector. Without their combined efforts the events discussed in this chapter would not have occurred as they did. Hector's reasoning stood the test of transnational debate sixteen years later, in 1884, when world leaders met in Washington DC for the International Meridian Conference and voted overwhelming to accept Greenwich as the Earth's prime meridian. The Conference, in effect, endorsed Hector's decision without ever being aware of it.[124]

Stephens argues that the "adoption of a standard time is in hindsight the most dramatic change in our relationship to time since the invention of the mechanical

[123] J.G.A. Pocock, 'British History: A Plea for a New Subject', in *JMH*, vol. 47, no. 4 (Chicago, Dec. 1975), pp. 601-621. See p. 612, for quote.
[124] See Appendix Two, pp. 130-1, for Conference details.

clock around A.D.1300"[125] Hector elevated the Royal Observatory at Greenwich, located at an arbitrarily chosen point of longitude that was used for navigation on most ships and for calculating time in Britain, to the status of the prime meridian. His scientific reasoning was impeccable and it gives the Christchurch (New Zealand) meridian at least a small place alongside the Greenwich meridian a point of significant international horological importance. The decision in New Zealand, in 1868, was a 'world first' even if did remain largely unknown. The 'Hector Meridian' is a gift to New Zealand for perpetuity.[126]

[125] C.E. Stephens, p. 122.
[126] This is my name for the Meridian, and not official.

Conclusion

The thesis has shown the journey European New Zealanders travelled in the first decades of settlement in order to find a uniform clock time. It would be wrong, however, to observe the period reviewed from 1840 to 1868 in isolation. This is because the settlers' apprehension of time and their use of clocks and watches had evolved over the preceding five centuries. This was a period when clock time transformed people's lives. The importance of reliable time was recognised by the Church from the medieval period. Clock time played a significant role in the patterning of daily chores and social time into natural and comprehensible sequences that met the seasonal demands of agricultural land. It also influenced all levels and divisions of labour within the industrial occupations. In subsequent centuries clockmakers broke new ground in the search for greater accuracy. Their success with miniaturisation, the detection and correction of errors and the search for innovative and improved ideas inspired spin-off technologies. The ownership of public and private clocks proliferated and with it came a decentralisation of clock time as people acquired their own timepieces. Paradoxically, however, the increasing ability of ordinary people to 'tell the time' made it possible for employers and others in authority to demand a compliance with a more exacting temporal order. Clock time commanded the lives of people and imprinted itself through the inculcation of such notions as punctuality and productivity. Better clocks brought a new emphasis to workplace efficiency underpinning the belief that time was money and facilitated the efficient coordination of Land, Labour and Capital. Clocks therefore eased the transition to industrial capitalism and in the longer term increased national wealth.

The discovery of New Zealand required timekeeping at sea. However, the country's geographical position on charts remained incorrect until in the eighteenth century better timekeeping devices and other advances in navigational technology enabled James Cook to expose Tasman's errors. Cook's voyages were a testing platform for technology that brought increased assurance to the calculation of longitude at sea. The chronometer in conjunction with the sextant brought a vastly improved level of accuracy to navigation and cartography. The achievements of Cook, underpinned by improved chronometers, facilitated the expansion of the British Empire and the large-scale British colonisation of New Zealand.

It is in the chapters three, four and five that the real heart of this thesis beats. These chapters have relied heavily on primary resources and reveal a previously under-recorded period of New Zealand history. Emigration to New Zealand seldom brought respite from the rule of time. Indeed, the ships that brought the emigrants to New Zealand were regulated by the chronometer, and their passengers were subjected to a temporal order more rigid than they had experienced in Britain. Once on land, the settlers set about trying to set up a temporal order similar to the one they had experienced in Britain. Both the private and public sector accepted the challenge to establish and disseminate the 'true' local time within their communities. Clockmakers with astronomy skills established observatories and placed clocks on public view, whilst the central and provincial governments constructed observatories, time ball stations, funded public clocks, rang bells and fired guns. However, in more remote and transient communities, like the early goldfields, there was less success and even Cobb & Co. had to revert to 'event time'. The reason for all this effort lay in the main function timekeeping served - it enabled local residents to coordinate their activities. However, it resulted in each community having a different local time. This at first was not a problem but once the telegraph began to link communities together the myriad of local times hindered its optimal efficiency. Telegraph stations could only achieve this goal if they coordinated their activities through operating on a common time. This led to Hall's introduction of 'telegraph time' in early 1868.

Hall, in effect, had introduced a dual time system in communities linked to the telegraph, and this caused confusion. It also caused debate. Some people were committed to their local time, seeing telegraph time as 'Wellington time'—an affront to their own community's autonomy and identity. They consequently attacked the imposition of telegraph time, and if they could not get it abolished they were prepared to live with the inconvenience of a dual time system. Other people demanded a tidier, more convenient and more economically rational solution through the introduction of a common New Zealand time. When Parliament sided with them in late 1868, it was a triumph for convenience and economic rationality over tradition and local identity.

Parliament's decision and the government's subsequent implementation of a New Zealand standard time were events of some significance. First, they contributed to the development of the more efficient communications and transport networks that from the 1870s were a significant factor in New Zealand's economic development. Second, they contributed to the forces that were promoting growing identification with New Zealand as a whole, rather than with local communities and the individual provinces. In this respect, they contributed to the development of a more united colony and eventually to incipient forms of national consciousness. This affirms Palenski's thesis that arguments and debates over issues, such as how communities expressed their identity gave way to an insight that a common time for New Zealand was a step towards a better synchronization of the country's provincial councils and a benefit to all New Zealand.[1] Third, in an international context, the decisions have some significance. New Zealand was the first country entirely to abandon local times, achieving that distinction even before England. It was also the first country to regulate its time in relation to Greenwich mean time – that is, it was the first country to take a step towards an international order of time by setting its clock time with reference to the clock time of another country. This prefigured, but did not influence, the important decision at the 1884 conference in Washington to make Greenwich the prime meridian and institute national time systems that were keyed to that meridian and to Greenwich mean time. Fourth, for historians, the study of the role of time in the European discovery, settlement and development of New Zealand has a different sort of significance. It is a case study that reveals the underlying importance of technological development and economic imperatives in the development of the modern temporal order. It also shows how, as technology and economic development increased the size and complexity of communities and brought them into closer contact, the rule of clock time became increasingly important in regulating and coordinating the activities of individuals, groups, local communities, and entire countries.

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[1] Palenski, p. 47.

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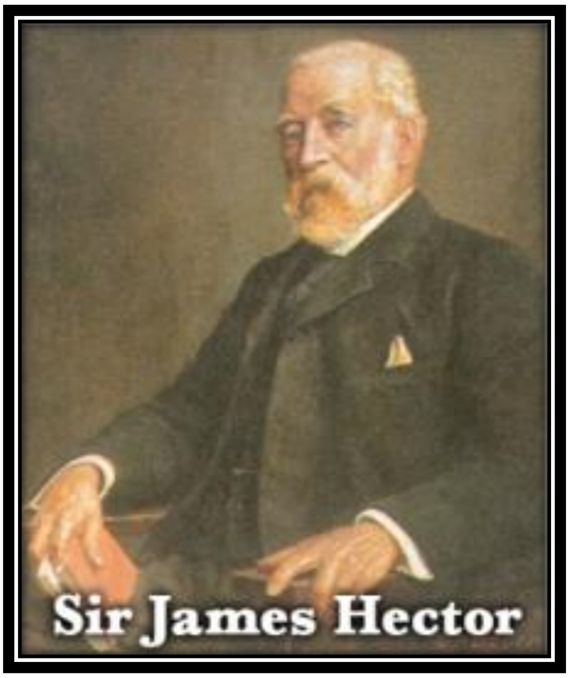
Appendix One:

Biography:



Sir James Hector, KCMG, Order of Golden Crown (Germany), FRS, FRS (Edinburgh) FRGS, Lyell Medal (Geological Society), and MD, 1834 – 1907. Hector was born in Edinburgh, Scotland. In 1856, he graduated in medicine from the University of Edinburgh. He studied botany and zoology and probably had training in geology. Geologists commemorate annually his birthday on 16 March 1834 – Hector Day – with field trips to many areas of New Zealand.[1]

In 1857, Sir Roderick Murchison recommended Hector for the appointment as Deputy-leader, surgeon, geologist and naturalist on John Palliser's expedition to western Canada. During this expedition (1858-1860), which was in rugged conditions and required a huge amount of personal resourcefulness, he established himself as a field geologist, natural historian and explorer. Hector named several geographic features including 'Kicking Horse Pass' in the Rockies, where he was kicked in the chest by his horse and thought to be dead. As his colleagues prepared him for burial he recovered consciousness and winked at them.

Hector stated, in his 1860 report to the Canadian Government, that given the large size of the country, a new system of time measurement – zone times – was necessary. Clocks, he recommended, should change at equal intervals of an hour for a person journeying east or west across the North American continent. The minutes and seconds would remain unchanged. However, it wasn't until a 107 page pamphlet, titled *A System of National Time for Railroads* was published in 1870 by Professor Charles Dowd (1825-1904), of Saratoga Springs, New York that the idea gained momentum in the United States. The United States, using Washington as the prime

[1] R.K. Dell, 'Hector, James 1834-1907', *DNZB*, Vol. One, 1769-1869 (Wellington, 1990), pp.183-4. See also William Gisborne, *New Zealand Rulers and Statesmen: From 1840 to 1897* (London, 1897), pp. 307-8. The painting is by Leonard Booth and sourced from, http://www.collections.tepapa.govt.nz.

meridian, introduced time zones before Canada. In 1876 Sanford Fleming (1827-1915) engineer-in-chief of the Canadian Pacific Railway published a memoir titled *Terrestrial Time* which advocated the use of a 24 hour clock system and a uniform system of time for the whole world.[2]

Hector's life in New Zealand began in 1861 when as a 27-year-old he was recommended again by Murchison for the appointment as Director of the Geological Survey of Otago, New Zealand. Hector established around him a team of very competent staff: William Skey to analyse rocks and minerals, John Buchanan as draughtsman, with botanical work and artistic abilities, and Richard B. Gore as clerk and meteorological observer.

By September 1862, the team had explored the eastern districts of Otago, visited Central Otago and collected about 500 rock, fossil and mineral specimens. The following year it investigated the West Coast and made a double crossing between Milford Sound and Dunedin. John Sullivan (from the Palliser Expedition) came to New Zealand and joined Hector, recording his mountain journeys for the *Otago Times.*

In 1865, the New Zealand Exhibition, held in Dunedin, displayed the Survey's maps and collections. This brought Hector to the attention of the central government, which was looking to establish a colonial geological survey. Following extensive discussions he was, later that same year, appointed government scientist and director of both the Geological Survey and Colonial Museum in Wellington. At the time of Parliament's decision to adopt a common time for New Zealand Hector's staff of Skey, Buchanan and Gore had been increased to include other scientists: Alexander Mckay, T.W. Kirk, S.H. Cox, James Park[3] and F.W. Hutton.

[2] Spry, p. 288 notes that Fleming, "always took Palliser's report with him on his survey trips; he found it of great use." Fleming was aware of Hector's time zone proposal. See also Howse, pp. 121-125, 129.
[3] Later Professor James Park of the University of Otago and father of Air Chief Marshal Sir Keith Park.

Appendix Two:

The Adoption of a Common Time for the World

In September 1881 the agenda of the Third International Geographical Congress, which met in Venice, included discussion on "the establishment of a universal prime meridian and a uniform standard of time."[4] The astronomers, geodesists and mathematicians attending the Seventh International Geodesic Conference held in Rome in October 1883 laid an objective framework, free of national prejudices, for the 1884 Conference and went as far as stating that they "hoped" the whole world would accept Greenwich as the prime meridian.[5] They supported the United States Government's call (made in October 1882) for an international convention at the earliest possible time where the unification of longitude and time could be agreed upon.[6] On 13 October 1884 at the Prime Meridian Conference in Washington DC, USA, a meeting commenced to consider the need for a common prime meridian and a universal time.[7] The American president, Chester A. Arthur, instigated the conference.

Countries attending:[8]

Austria-Hungary	France	Italy	Paraguay	Switzerland
Brazil	Germany	Japan	Russia	Turkey
Chile	Great Britain[9]	Liberia	San Domingo	United States
Colombia	Guatemala	Mexico	Spain	Venezuela
Costa Rica	Hawaii	Netherlands	Sweden	Salvador

The 41 delegates from 25 nations met on eight occasions over a period of a month and subsequently voted 22 – 1 to adopt Greenwich. A report of over 200 pages was produced.[10] France argued it would only accept GMT if Great Britain adopted the

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[4] Howse, p. 136
[5] Ibid., p. 137, for quote.
[6] Ibid., pp. 131-138 for detail.
[7] Also known as the International Meridian Conference. Recommended websites: http://wwp.greenwichmeantime.com/info/conference.htm, http://wwp.greenwichmeantime.com/info/conference-delegates.htm and http://wwp.greenwichmeantime.com/info/time-zones-history.htm. My copies as at 26 Dec. 2006.
[8] The expected delegate from Denmark never arrived.
[9] Great Britain represented its Colonies and Dominions, which included New Zealand.
[10] Ibid., pp. 131-151, gives background information leading to 1884 conference, and a detailed account of the conference. San Domingo voted against, whilst France and Brazil abstained. It took several years, in some cases decades, before each country implemented the decision.

metric system. The French objections were overridden by the Conference. However, the French refused to accept GMT until 1911.

Why Greenwich?

The choice of Greenwich was for a number of reasons. One of the primary functions of the Royal Observatory after its establishment in 1675 was to tabulate the apparent movement of the stars across the night sky. Its charts, which had been published in the British *Nautical Almanac* since 1767, were used by seamen to calculate longitude. Since the observations upon which the charts were based were made using the transit telescope at the Royal Observatory in Greenwich they adopted the convenient convention that Greenwich lay on the prime meridian. For the same reason, when John Harrison developed the chronometric clock used to calculate longitude at sea he set the zero degree meridian at Greenwich's observatory. Sir Sandford Fleming, the British delegate representing Canada at the International Meridian Conference reported that the Greenwich meridian was being used by 65 percent of the world's ships, carrying 72 percent of the tonnage of the "'whole floating commerce of the world." The Paris meridian, the second most popular, was used by 10 percent of the ships carrying 8 percent of the tonnage. The remaining shipping used sundry miscellaneous meridians.[11]

[11] Howse, p. 141, for quote. Percentages are from table on same page.

Appendix Three:

Timekeepers and Methods of Timekeeping in New Zealand

The following appendices support Tables 4.1 and 4.2. The period of coverage is up to the time New Zealand adopted GMT in 1868. Appendix 3a is a list of New Zealand's first clockmakers from 1841 to 1868. The date shown was the first year of business.[12] Appendix 3b is a list of observatories. Appendix 3c is a list of time balls. Appendix 3d is a list other forms of timekeeping.[13]

Appendix 3a: Clock and Watchmakers

Location: North Island

Year	Clock/Watchmakers	Notes
Kororareka (Russell)[14]		
1841	William Robertson	
Auckland[15]		
1841	Thomas Gill	
1844	C. Doiron	From Wellington
c. 1844	William Cormack	
c. 1844	George Partington	
1847	Henry D. Ley	He joined Cormack at his Shortland Street premises
1857	G.B. Hair	
1862	James Howden	
1863	Y.C. Haymes	
1864	Richard Beck	
1864	Malcolm Bruce	

[12] The key search words were 'watchmaker' and 'clockmaker'. Another useful reference was Winsome Shepherd, *Gold & Silversmithing in Nineteenth & Twentieth Century New Zealand*, (Wellington, 1995). This author used trade directories as her primary source. Appendix 3a is believed to be substantially complete.

[13] Drawn from newspapers listed on *Papers Past* as at 29 February 2012.

[14] Robertson: *NZG&WS*, vol. II, no. 74 (11 Sep. 1841), p. 1. Also *NZG&WS*, vol. II, no. 89 (13 Nov. 1841), p. 4.

[15] Gill: *NZHandAG*, (18 Sep. 1841), p. 3, cited by Gross, p. 93-4. Gross indicates that Gill probably only worked in Auckland until 1843, and that Gill was not the first. Doiron: *DSC*, vol. 2, no. 73 (7 Sep. 1844), p. 1. See A. Mackay, Wellington. Cormack: *NZer*, vol. 2, no. 81 (19 Dec. 1846), p. 1. See also Gross for reference to *Moore's New Zealand Almanac for 1844*. Partington: Ibid., using Gross reference. Ley: *NZer*, vol. 3, no. 133 (8 Sep. 1847), p. 1. Ibid., vol. III, no. 143 (13 Oct. 1847), p. 1. Hair: *DSC*, vol. IV, no. 1041 (19 Jun. 1857), p. 2. See also Shepherd, p. 199, which states 1861. Howden: Shepherd, pp. 171-2 and p. 199. Haymes: *DSC*, vol. XIX, no. 1712 (14 Jan. 1863), p. 1. Beck: Shepherd, p. 199. Bruce: Shepherd, p. 199, Buchanan: Shepherd, p. 1999. Clarke: Shepherd, p. 199. Fournier: Shepherd, p. 199. Hicks: Shepherd, p. 199. Keetley, Shepherd, p. 199. King: *ST*, vol. III, no. 241 (13 Apr. 1866), p. 3. See also Shepherd, p. 199. Lynsar: Shepherd, p. 199. Macready, Shepherd, p. 199. Quartier: Shepherd, p. 199. Raven: Shepherd, p. 199. Wallace: Shepherd, p. 199. Bartlett: *DSC*, vol. XXI, no. 2455 (2 Jun. 1865), p. 4. See also Shepherd, p. 165. Dorrington: Shepherd, p. 199. Alexander: Shepherd, p. 199. Cleal: Shepherd, p. 199. Hautrive: Shepherd, p. 199. Lewisson: *DSC*, vol. XXII, no. 2780 (23 Jun. 1866), p. 1. Also *WI*, vol. XXIX, no. 4036 (25 Feb. 1874), p. 4. See also Shepherd, p. 199. Phillips: Shepherd, p. 199. Travil: Shepherd, p. 199

1864	W. Buchanan	
1864	J.T. Clarke	
1864	Louis Fournier	
1864	Thomas A. Hicks	
1864	Thomas Keetley	
1864	Thomas M. King	
1864	Charles Lynsar	
1864	Thomas Macready	
1864	Aurelle Quartier	
1864	William Raven	
1864	William Wallace	
1865	Alfred Gregory Bartlett	1865, established privately funded time ball service
1865	Nathanial Dorrington	
1866	Isidore Alexander	
1866	H. Cleal	
1866	M. Hautrive	
1866	Fredrick Harvey Lewisson & Co.	1866, purchased Bartlett's premises. 1874, to Wellington
1866	J. Phillips	
1866	Thomas Travil	

New Plymouth[16]

1857 W. Black

Wanganui[17]

1868 J.W. Robinson

Napier[18]

1862 Thomas Morrison
1868 Mr. Brewer

Hastings[19]

1861 Simon Aaronson

Taranaki[20]

1857 J. Knight

[16] Black: *TaraH*, vol. V, no. 259 (11 Jul. 1857), p. 2. He probably began business earlier.
[17] Robinson: *WH*, vol. II, no. 344 (9 Jul. 1868), p. 4. See also Shepherd, p. 201.
[18] Morrison: *HBH*, vol. 6, no. 337 (25 Nov. 1862), p. 2. Brewer: *HBH*, vol.12, no. 913 (1 Feb. 1868), p. 2
[19] Aaronson: Shepherd, p. 203.
[20] Knight: *TaraH*, vol. V, no. 259 (11 Jul. 1857), p. 1

Port Nicholson (Wellington)[21]

1841	William Neal	Brief partnership with Sturgeon
1841	Robert Sturgeon	Brief partnership with Neal
1841	Joseph McGregor	Premises known as the 'Wellington Observatory'
1842	Septimus Allen Puckridge	Late 1844, to Australia where he died
1844	Alexander Mackay	1845, acquired Puckridge's premises
1844	C. Doiron	Brief partnership with Mackay. 1844, to Auckland
c. 1848	John Hogg	
c. 1850	J. Phillips	
1856	Mr. Hanneke	
c. 1860	Henry and Samuel Drew	Father and son. 1870, Samuel to Wanganui
1865	Charles Campbell	
1866	George Denton	
1866	C. Golder	
1866	Henry James Freeman	Worked for Charles Campbell
1866	S.W. Harvey	
1866	B.A. Selig	

Location: South Island

Year	Clock/Watchmakers	Notes

Nelson[22]

1842	R. Boddington	
1842	A. Smith	
1844	Mr. Marsden	
1850	Giles Coates	Installed clock in first cathedral. 1860, to Christchurch
1858	Lewis Conway	
1860	Alexander Hunter	Serviced cathedral clock after departure of Coates.
1864	E. Murrell	

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[21] Neal: *NZG&WS*, vol. II, no. 47 (3 Mar. 1841), p. 4. Ibid., vol. II, no. 81 (16 Oct. 1841), p. 2. See also *NZG&CSG*, Vol. I, No. 18 (8 Feb. 1845), p. 1, indicates his son William Jnr., was in same profession. Sturgeon: *NZG&WS*, vol. I, no. 51 (3 Apr. 1841), p. 4. Ibid., vol. III, no. 134 (20 Apr. 1842), p. 2. McGregor: *NZG&WS*, vol. II, no. 52 (10 Apr. 1841), p. 2. Ibid., vol. II, no. 76 (25 May 1841), p. 2. Ibid., vol. II, no. 81, (16 Oct. 1841), p. 2. Ibid., vol. II, No. 88 (10 Nov. 1841), p. 1. Ibid., vol. III, no. 217 (4 Feb. 1843), p. 1. Puckridge: *NZG&WS*, Vol. II, No. 119 (26 Feb. 1840), p. 2. Also Freepages.genealogy.rootsweb.ancestry.com/~ourstuff/clifton/htm, compiled by Denise and Peter, 1999-2009, Ref. Archives New Zealand, NZC 34/2, p.181. Also used http://www.finda.net, then headstones.weebly.com/coulta-old.html, for listing in Coulta Old Cemetery Index, South Australia. Mackay: *NZG&WS*, Vol. IV, No. 332 (13 Mar. 1844), p. 2. Ibid., vol. IV, no. 337 (30 Mar. 1844), p. 2. *NZS&CSG*, Vol. I, No. 13 (4 Jan. 1845), p. 1. He advertised his departure in 1852 in *NZG&WS*, vol. VIII, no. 756 (30 Oct. 1852), p. 2. Returned later and worked with Sir J. Hector. Hogg: *NZSandCSG*, vol. IV, no. 320 (23 Aug. 1848), p. 2, advertisement giving notice of intention to cease trading. Phillips: NZSandCSG, vol. VIII, no. 364 (28 Dec. 1850), p. 2. Hanneke: *LT*, vol. VI, no. 360 (16 Apr. 1856), p. 11. Drew: Shepherd, p. 168. Campbell: Shepherd, p. 201. Denton: Shepherd, p. 202. Golder: *WI*, vol. XXI, no. 2339 (24 Mar. 1866), p. 4. Freeman: Shepherd, p. 169. Harvey: Shepherd, p. 202. Selig: Shepherd, p. 202.

[22] Boddington: *NEandNZC*, vol. I, no. 9 (9 Apr. 1842), p. 17. Smith: *NEandNZC*, vol. I, no. 37 (19 Nov. 1842), p. 145. Marsden: *NEandNZC*, vol. III, no. 116 (25 May 1844), p. 45. Coates: *NEandNZC*, vol.III, no. 710 (14 Feb. 1855), p. 2. *NEandNZC*, vol. XIX, no. 82 (6 Oct. 1860), p. 2. See also Shepherd, pp. 26-9. Conway: *NEandNZC*, vol. XVII, no. 54 (7 Jul. 1858), p. 1. Hunter: *NEandNZC*, vol. XIX, no. 86 (20 Oct. 1860), p. 2. *The Colonist*, vol. VII, no. 718 (13 Sep. 1864), p. 2. See also *ST*, no. 592 (16 Nov. 1866), p. 3, for first name. Murrell: *NEandNZC*: vol. XXIII, no. 39 (31 Mar. 1864), p. 2.

Greymouth[23]

1866	Peter Larson	
1863	Charles Broadbent	

Hokitika[24]

1865	Joseph Philip Klein	
1866	William Henry Ingram	Made first duplex watch in Australasia. 1877, to Wellington
c. 1869	Mr. Osborne	Possibly only a jeweller

Christchurch[25]

1852	Giles Coates	
1855	John McNab	
1856	Thomas Charles Barnard	Late 1871/early 1872, to Greytown
1859	Carl Asmussen	1860, sold business to Urquhart
1860	John Hurst	Premises were known as "Time Cottage"
1860	Alexander M. Urquhart	1860, bought business from Asmussen
1862	Marcus Sandstein	Three year partnership with Barnard
1863	Benjamin Petersen	
1866	D.C. Anderson	
1866	J. Cockroft	
1866	H. Smith	
1866	Stoddart & Co.	
1866	Joseph Swindell	Worked for Coates
1866	J. Woodford	

Lyttelton[26]

1856	J. Joyce	

Timaru[27]

1865	C. Jacobs	
1866	Stanley B. Seymour	

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[23] Larson: *GRA*, vol. IV, no. 271 (8 Oct. 1867), p. 4. See also Shepherd, p. 205, which lists Larson incorrectly (?) in Hokitika. Broadbent: *WCT*, no. 1208 (6 Aug. 1869), p. 3.

[24] Klein: *WCT*, no. 27 (2 Aug. 1865), p. 3. *WCT*, no. 781 (25 Mar. 1868), p. 3, for first names. See also Shepherd, p. 205, where it is spelt as Kleen. Ingram: *WCT*, no. 744 (11 Feb. 1868), p. 3. He received a first class certificate for the Melbourne Exhibition of 1857 for a duplex watch he constructed. See also Shepherd, p. 172 and p. 205. Osborne: *ST*, no. 1198 (23 Jul. 1869), p. 2. *WCT*, no. 1208 (2 Aug. 1869), p. 3. He possibly began business earlier.

[25] Coates: *ST*, no. 655 (10 Apr. 1867), p. 2. See also Shepherd, p. 167 and p. 200. McNab: Shepherd, p. 200. Barnard: *LT*, vol. VI, no. 342 (9 Feb. 1856), p. 2, Ibid., vol. IX, no. 550 (10 Feb. 1858), p. 9, for jury list and source of first name. Also *EP*, vol. VIII, no. 215 (10 Oct. 1872), p. 3. Business sold at Auction, *EP*, vol. XIX, no. 95 (26 Apr. 1880), p. 3. See also Shepherd, p. 79 and p. 200. Hurst: *LT*, vol. XIII, no. 758 (11 Feb. 1860), p. 5. Urquhart: Shepherd, pp. 79-80, p. 184 and p. 201. Sandstein: Shepherd, pp. 110-113, pp. 164-5, p. 182 and p. 200. Petersen: *TP*, vol. III, no. 35 (12 Dec. 1863), p. 1. See also Shepherd, pp. 50-62, pp. 180-1 and p. 200. Anderson: Shepherd, p. 200. Cockroft: Shepherd, p. 200. Smith: Shepherd, p. 201. Stoddart: Shepherd, p. 201. Swindell: Shepherd, p. 184. Woodford, Shepherd, p. 201.

[26] Joyce: *LT*, vol. VI, no. 342 (9 Feb. 1856), p. 2

[27] Jacobs: *TH*, vol. I, no. 47 (22 Apr. 1865), p. 3. Seymour: *TH*, vol. IV, no. 100 (14 Apr. 1866), p. 6

Dunstan, Central Otago[28]

1864	Irwin and Barlow	In 1865, known as Godwin & Barlow, They supplied "The Correct Time", which was "Ascertained by observation every week."

Naseby, Central Otago[29]

c. 1865	Robert Strong	
1867	Julius Hyman	Premises also in Dunedin

Oamaru[30]

1864	Alexander Beaver	Premises also in Dunedin
c. 1864	J. Clendinnen	Possibly earlier
c. 1867	George Young	Premises also in Dunedin
1868	Robert W. Adair	Manager of George Young's business.

Dunedin[31]

1852	James Reid	1868, to Invercargill.
1858	Henry Perring	
1858	Arthur Beverly	1860, erected city's first privately funded public clock. 1868, probable instigator of standard clock time for NZ.
1859	Robert Hogg	He purchased Perring's business.
1862	John Hislop	1867/68, purchased Young's business.
1862	Julius Hyman	Premises also at Mt. Ida.
1862	E. Nathan	
1862?	Mr. Robertson	He patented a lever movement, worked for Beverly.

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[28] Irwin and Barlow: *ODT*, no. 802 (14 Jul. 1864), p. 5. See also, *TDT*, (15 Jun. 1866), p. 2, for quotes. See also Shepherd, p. 169.

[29] Strong: John O'Neill, *The History of Naseby: 1863- 1976* (Naseby, 1976), p.12. The town had a variety of names: Hogburn (1863), Parkers, Mt. Ida, Vincent, and Naseby (1864). Ibid., pp. 7-8, for Strong details. It was later operated by William Strong (son) until his retirement in 1959. See also C. Finlayson, 'A Small Survivor', *Heritage New Zealand*, no. 123 (Wellington, Summer 2011), pp. 6-7, which indicates the business began in 1868. Hyman: *OW*, no. 836 (6 Dec. 1867), p. 11.

[30] Beaver: *NOT*, vol. II, no. 30 (15 Sep. 1864), p. 3. Ibid., vol. XI, no. 366 (24 Nov. 1866), p. 2. See also Shepherd, p. 165. Clendinnen: *NOT*, vol. I, no. 1 (25 Feb. 1864), p. 1. Young: *NOT*, vol. VIII, no. 200 (23 Apr. 1867), p. 1. Adair: *NOT*, vol. VIII, no. 187 (8 Mar. 1867), p. 3.

[31] Reid: *ST*, no. 965 (8 Jun. 1868), p. 1. He had previously worked in Dunedin for 16 years. See also Shepherd, p. 204, which has spelt as Reed. Perring: *OW*, no. 332 (10 Apr. 1858), p. 3. Beverly: *OW*, no. 335 (1 May 1858), p. 3. See also Shepherd, p. 165 and p. 203. Hogg: *OW*, no. 381 (19 Mar. 1859), p. 4. Ibid., no. 397 (9 Jul. 1859), p. 2. See also Shepherd, p. 204 which indicates 1863 partnership with Beaver. Hislop: *ODT*, no. 1997 (25 May 1866), p. 2. See also Shepherd, p. 63, p. 171 and p. 204. Myers: *ODT*, no. 36 (26 Dec. 1861), p. 5. Hyman: *ODT*, no. 70 (5 Feb. 1862), p. 3. See also Shepherd, p. 172 and p. 204. Nathan: *ODT*, no. 147 (6 May 1862), p. 1. Robertson: *ODT*, no. 321 (30 Dec. 1862), p. 5. Young: *ODT*, no. 1997 (25 May 1866), p. 2. See also Shepherd, pp. 63-67, p. 186 and p. 205. Broadbent: Shepherd, p. 166. Curne: Shepherd, p. 203. Chapman and Jacobs: *ODT*, no. 472 (25 Jun. 1863), p. 8. Feldheim: Shepherd, p. 203. Herman: Shepherd, p. 203. Ingram: Shepherd, p. 204. E. Jones: Shepherd, p. 204. T. Jones: Shepherd, p. 204. Legard: Shepherd, p. 204. Myers: Shepherd, p. 204. Nathan: Shepherd, p. 204. Proctor: Shepherd, p. 204. Shaw: Shepherd, p. 183. Tofield: *ST*, no. 653 (3 Apr. 1867), p. 2, spelt as Lofield. See also Shepherd, p. 205. Wood: Shepherd, p. 205. Beaver: *NOT*, vol. II, no. 30 (15 Sep. 1864), p. 3. Ibid., vol. XI, no. 366 (24 Nov. 1866), p. 2. See also Shepherd, p. 165, p. 203 and p. 204, which indicates 1863 partnership with Hogg. Baxter: Shepherd, p. 203. Humphrey: Shepherd, p. 204. Salomon: *ODT*, no. 1305 (5 Mar. 1866), p. 7. See also Shepherd, p. 182 and p. 204. Turner: Shepherd, p. 205. Woodhams: *BH*, vol. IV, no. 170 (24 Jul. 1867), p. 2. See also Shepherd, p. 205. Hayman: Shepherd, p. 203. Lachaume: Shepherd, p. 204. Mollison: Shepherd, p. 204. Neill: See Shepherd, pp. 179-80. Paton: ST, no. 991 (24 Jul. 1868), p. 2. He possibly began business earlier.

1862	George Young	1865, purchased Beverly's business.
1863	Charles Broadbent	Soon to West Coast, for 10 years. 1874, to Wellington.
1863	Robert Curne	
1863	Chapman and Jacobs	
1863	Feldheim Bros.	
1863	Isaac Herman & Co.	
1863	William Henry Ingram	1866, to Hokitika.
1863	Edwin Jones	
1863	Thomas Jones	
1863	Charles Legard	
1863	Abraham Myers	
1863	Ezekiel Nathan	
1863	T.R. Proctor	
1863	Arthur John Shaw	Served apprenticeship with Adair, then worked as assistant. 1880, bought the business.
1863	Fredrick Tofield	
1863	Alexander Wood	
1864	Alexander Beaver	Premises also in Oamaru.
1866	J.R. Baxter	
1866	George Humphrey	
1866	Nathan Salomon	
1866	James Turner	
1866	A. Woodhams	
1867	P. Hayman & Co.	
1867	Calixte Lachaume	
1867	James Mollison	
1867	Henry Neill	Worked for Young. 1868, in partnership with Elijah Harrop, a jeweller.
c. 1868	William Paton	

Clutha Ferry (Balclutha)[32]

1867	John Jamie	

Invercargill[33]

c. 1862	Isaac Broad	He had worked for Beverly in Dunedin
c. 1862	George Lumsden	Premises was known as 'Sign of the Clock'
1863	Charles Reese	
1863	Lewin Berrick	
1863	Myers Caselberg	
1865	Hyam & Co.	
1868	James Reid	He had previously worked in Dunedin for 16 years.

[32] Jamie: *BH*, vol. IV, no. 170 (24 Jul. 1867), p. 1.

[33] Broad: *ST*, vol. I, no. 4 (21 Nov. 1862), p. 1. He possibly began business earlier. Also *ST*, vol. I, no. 28 (13 Feb. 1863), p. 3, for first name. See also Shepherd, p. 205. Lumsden: *ST*, vol. I, no. 4 (21 Nov. 1862), p. 1. He possibly began business earlier. See also Shepherd, p. 205. Reese: *ST*, vol. 2, no. 65 (19 Jun. 1863), p. 3. Also *ST*, vol. 2, no. 104 (21 Oct. 1863), p. 3, for first name. See also Shepherd, p. 205, where spelt as Reece. Berrick: *ST*, vol. 2, no. 76 (28 Jul. 1863), p. 3. Also *ST*, vol. I, no. 19 (14 Jul. 1864), p. 2, for first name. Caselberg: *ST*, vol. 2, no. 107 (28 Oct. 1863), p. 1. See also Shepherd. P. 205. Hyam: Shepherd, p. 205. Reid: *ST*, no. 965 (8 Jun. 1868), p. 1.

Appendix 3b: Communities with Observatories.

Date	Name/Location	Operator
Publicly Funded		
1863	Provincial Observatory, Wellington	Wellington Provincial Council[34]
1863	Christchurch	Christchurch Provincial Council, Superintendent Dr. Haast[35]
1868	Colonial Observatory, Wellington	New Zealand Government, Manager Rev. Arthur Stock[36]
Private Funded		
1866	Port Chalmers, Otago	Captain John Robertson[37]
c. 1868/9	Caversham, Dunedin	John Turnbull Thompson[38]
c. 1868/9	Dunedin: Roslyn then to Leith Valley	Henry Skey[39]

Appendix 3c: Communities with Time Balls.

Date	Name/Location	Operator
Publicly Funded		
1864	Custom House, Grey Street, Wellington	Central Government[40]
1867	Port Chalmers, Otago	Otago Provincial Council[41]
Privately Funded		
1855	Auckland Harbour	HMS *Pandora*[42]
1865	Customs Office, Smale's Point, Auckland	Capt. Williams[43]
1865	Shortland Crescent, Auckland	A.G. Bartlett[44]
1866	Coburg Street, Barrack Hill, Auckland	A.G. Bartlett[45]
1866	Shortland Crescent, Auckland?	F.H. Lewisson?[46]

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[34] http:/www.aneyefordetail.co.nz/Portfolio/HistoryofCarterObservatoryof Wellington.aspx, by Briony Coote, 2010, gives the date 1863, whereas Eiby p. 15, indicates it was 1864.
[35] *ST*, vol. 2, no. 84 (25 Aug. 1863), p. 6
[36] http:/www.aneyefordetail.co.nz/Portfolio/HistoryofCarterObservatoryof Wellington.aspx, by Briony Coote, 2010. This was located in Wellington's Botanic Garden, on the edge of Bolton Street Cemetery.
[37] *ODT*, no. 1536 (29 Nov. 1866), p. 5
[38] *ODT*, no. 3052 (17 Nov. 1871), p. 2. The date is not known for certain, possibly earlier.
[39] *ODT*, no. 2434 (24 Nov. 1869), p. 1. The date is not known for certain, possibly earlier. His residence was known as 'Observatory Cottage', at top of Stuart St, near Kaikorai Toll Bar, Roslyn. See also *ODT*, no. 2630 (12 Jul. 1870), p. 1. The date of his move to Leith Valley is unknown.
[40] Eiby, p. 15
[41] *ODT*, no. 1692 (3 Jun. 1867), p. 4. It was first dropped Saturday on 1 June 1867.
[42] *DSC*, vol. XII, no. 844 (18 Dec. 1855), p. 2, citing the *NZer*. Captain Drury supplied the service on Wednesdays and Saturdays, at noon, for the duration of his vessel's visit.
[43] *DSC*, vol. XXI, no. 2455 (2 Jun. 1865), p. 4. Ibid, vol. XXI, no. 2462 (10 Jun. 1865), p. 4. Ibid., vol. XXI, no. 2479 (30 Jun. 1865), p. 8. The service operated from his residence. Ibid., vol. XXIV, no. 3607 (9 Feb. 1869), p. 3. Date of commencement of operations is unknown, possibly 1865. The service was possibly discontinued by 1869.
[44] Ibid., vol. XXI, no. 2455 (2 Jun. 1865), p. 4. Ibid., vol. XXI, no. 2462 (10 Jun. 1865), p. 4. Also Ibid., vol. XXI, no. 2463 (12 Jun. 1865), p. 4. Ibid., vol. XXI, no. 2479 (30 Jun. 1865), p. 8. Ibid., vol. XXI, no. 2503 (28 Jul. 1865), p. 3. Ibid., vol. XXII, no. 2777 (10 Jun. 1865), p. 1. Ibid., vol. XXIV, no. 3607 (9 Feb. 1869), p. 3. See also 'Miscellaneous', Ibid., vol. XXV, no. 3684 (10 May 1869), p. 7. This was a privately funded service.
[45] Ibid., vol. XXII, no. 2777 (10 Jun. 1866), p. 1

Appendix 3d: Communities with Other Methods of Timekeeping.[47]

Public Clocks – Publicly funded

1863	Custom House building, Dunedin[48]
1863	Government Buildings, Picton[49]
1864	Industrial Exhibition building, Great King Street, Dunedin[50]
1864	Government Buildings, Blenheim[51]
1864	Railway Station, Invercargill[52]
c. 1864	Wanganui[53]
1865	Dunedin Public Hospital, Great King Street, Dunedin[54]
c.1867	Telegraph Office, Christchurch[55]
1867	Telegraph Office, Lyttelton[56]
1867	Telegraph Office, Invercargill[57]
1868	Stock Exchange building, Princes Street, Dunedin[58]
1868	Central Post Office, Cathedral Square, Christchurch[59]
c. 1868	Kaiapoi Borough Council, Kaiapoi[60]

Public Clocks – Privately funded

1849	St. Peter's Anglican Church, Te Aro, Wellington[61]
1860	Above doorway, Arthur Beverly, clockmaker, Princes St., Dunedin[62]
1860	Christ Church Cathedral, Nelson.[63]
c. 1863	St. Paul's Church, Thorndon, Wellington[64]
c. 1863	Mounted high on corner of Provincial Hotel building, Dunedin[65]

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[46] Ibid., vol. XXII, no. 2780 (23 Jun. 1866), p. 1. Lewisson announced his intention to erect a time ball. This is unconfirmed and may not have occurred.

[47] *Papers Past* digitised up to 31 Jan. 2012.

[48] *ST*, vol. II, no. 2 (10 Jul. 1863), p. 2

[49] *ST*, vol. III, no. 13 (7 Dec. 1863), p. 2

[50] T.M. Hocken, *Contributions to the Early History of New Zealand [Settlement of Otago]* (London, 1898), pp. 310-1. The clock had four dials. It sat high in a specially constructed tower as part of a building on Great King Street for the 1865 New Zealand Industrial Exhibition. *ODT*, no. 832 (22 Aug. 1864), p. 4, noted it was installed by Julius Hyman.

[51] *ST*, vol. III, no. 45 (19 Feb. 1864), p. 5

[52] Ibid., vol. I, no. 58 (13 Oct. 1864), p. 2. The diameter of the dial was 30 inches. It was manufactured by Elder of Melbourne.

[53] *NZSandCSG*, vol. XIX, no. 2016 (26 Nov. 1864), p. 2, citing *WC*, 23 Nov. 1864.

[54] It was formerly the 1864/65 New Zealand Industrial Exhibition building. In 1868, the clock was moved to Stock Exchange Building in Princes Street. The four dials remained on the Hospital building and a new clock installed.

[55] *ST*, no. 692 (5 Jul. 1867), p. 2

[56] Ibid.

[57] Ibid, no. 729 (27 Sep. 1867), p. 2. It was above the outer door of the office.

[58] It was formerly the clock from Dunedin Hospital. New dials were manufactured.

[59] *Star*, no. 98 (5 Sep. 1868), p. 2

[60] *Star*, no. 180, (9 Dec. 1868), p. 2. "Councillor Dudley stated that he had heard a good many complaints lately about the management of the clock. He moved, and it was carried, "That Mr. Johnson get the key of the clock from Mr. Lezard, and that Mr. Johnson be entrusted with the care of the same."

[61] *NZSandCSG*, vol. V, no. 372 (24 Feb. 1849), p. 2.

[62] See footnote 33, of this chapter.

[63] *NEandNZC*: vol. XIX, no. 83 (10 Oct. 1860), p. 8. Ibid., vol. XIX, no. 85 (17 Oct. 1860), p. 2.

[64] *ST*, vol. III, no. 13 (7 Dec. 1863), p. 2. It was unreliable.

[65] Lovell-Smith, p. 5 for drawing of first (?) hotel. See also p. 36b, Plate VIII, for image of new or extended hotel with clock. Cobb and Co. occupied an office on the ground floor. The hotel was the departure point for Cobb and Co.'s service to Central Otago. *ST*, vol. 2, no. 2 (14 Jul. 1863), p. 3

1864	Stock Exchange Clock Tower, Wellington[66]
1864	Bank of Otago, Queenstown[67]
c. 1865	Above doorway, Robert Strong, clockmaker, Naseby, Central Otago[68]
1866	Exchange building, Invercargill[69]

Sun Dials

1844	Auckland Treasury Office[70]
1864	Holy Trinity Church, Wairau Road, Picton[71]

Bells

Mid-1850s/1860	Rung by policeman, Dunedin[72]
Sep. 1861	St. Michael's Church, Christchurch[73]
1862	Christchurch[74]

Gongs

1864	On Rutland Stockade hill. It was struck hourly (daylight hours) by members of Wanganui Garrison.[75]

Guns

Early-1840s	New Plymouth[76]
1850s	Dunedin[77]
1850s?	Lyttelton[78]

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[66] D. McGill and G. Sheehan, *Landmarks: Notable Historic Buildings of New Zealand*, (Wellington, 2005), p. 223

[67] *ST*, vol. III, no. 45 (19 Feb. 1864), p. 4

[68] See footnote 31, of this chapter.

[69] *ST*, vol. III, no. 272 (1 Jun. 1866), p. 2

[70] *DSC*, vol. 2, no. 68, (3 Aug. 1844), p. 2. From approximately June 1844.

[71] *ME*, vol. XLVII, no. 109 (9 May 1913), p. 4. The Mayor, Arthur Penrose Seymour purchased the sundial from Troughton & Simms makers of philosophical instruments in London and it was mounted in the Provincial Council grounds. Following the transfer of power to Blenheim its foundations were broken and it was transferred along with the rest of the Board's assets. However, instead of being put back on display in sat in the Survey Office at Blenheim until 1871. Pictonites rebelled at the loss of both their clock and sundial and argued successfully for sundial's return. Its sanctuary, the church's grounds, protected it from further politicians' requests to move it. Also J. MacDonald, *Picton Memories* (Picton, 2003), p. 112. Also H.D. Kelly, *As High As The Hills: The Centennial History of Picton* (Picton, 1976), p. 56, Extant with a Category II listing from the Historic Places Trust.

[72] *OW*, No. 224, 18 Jul. 1857, p. 4. Rung at noon on Saturdays.

[73] (Alfred) Selwyn Bruce, *The Early Days of Canterbury*, facsimile edition, (Christchurch, 1995), p. 42, notes that "it was arranged that as the town possessed no town clock, it should be tolled each day at certain hours for the information of the populace as the official time of day."

[74] Pawson, p. 281, endnote 24, p. 286, cites Christchurch Council Minute Book (8 Dec. 1862).

[75] *NZSandCSG*, vol. XIX, no. 2016 (26 Nov. 1864), p. 2, cites *WC*, 23 Nov. 1864.

[76] Hale, p. 314, cites Rutherford, and Skinner, "The morning gun is fired daily at seven a.m."

[77] Pawson, p. 281. See also Reed, *The Story of Otago*, p. 225.

[78] Ibid., p. 281, apparently on Saturdays at noon.