

THE PRINCIPAL TIME BALLS OF NEW ZEALAND

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Abstract: Accurate time signals in New Zealand were important for navigation in the Pacific. Time balls at Wellington and Lyttelton were noted in the 1880 Admiralty list of time signals, with later addition of Otago. The time ball service at Wellington started in March 1864 using the first official observatory in New Zealand, but there was no Wellington time ball service during a long period of waterfront redevelopment during the 1880s. The time ball service restarted in November 1888 at a different harbour location. The original mechanical apparatus was used with a new ball, but the system was destroyed by fire in March 1909 and was never replaced. Instead, a time light service was inaugurated in 1912.

The service at Lyttelton, near Christchurch, began in December 1876 after construction of the signal station there. It used telegraph signals from Wellington to regulate the time ball. By the end of 1909, it was the only official time ball in New Zealand, providing a service that lasted until 1934. The Lyttelton time ball tower was an iconic landmark in New Zealand that had been carefully restored. Tragically, the tower collapsed in the 2011 earthquakes and aftershocks that devastated Christchurch.

An Otago daily time ball service at Port Chalmers, near Dunedin, started in June 1867, initially using local observatory facilities. The service appears to have been discontinued in October 1877, but was re-established in April 1882 as a weekly service, with control by telegraph from Wellington. The service had been withdrawn altogether by the end of 1909.

Auckland never established a reliable time ball service, despite provision of a weekly service for mariners by a public-spirited citizen between August 1864 and June 1866. A time ball was finally installed on the Harbour Board building in 1901, but the signal was unreliable and it ceased in 1902. Complaints from ships' masters led to various proposals to re-establish a service. These concluded with erection of a time ball on the new Ferry Building in 1912. The service was finally announced in April 1915, but it was again unreliable and the time ball had been replaced by time lights before the end of that year.

The provision of time balls at Wellington, Lyttelton, Port Chalmers and Auckland is described in this paper with particular reference to newspaper announcements.

Keywords: Time ball, New Zealand

1 INTRODUCTION

Accurate determination of longitude by a ship at sea was one of the great technical challenges of the eighteenth century. All too often, errors in navigation and inaccuracies on charts had resulted in loss of life from shipwrecks on rocks. The Longitude Prize, established in 1714 during the reign of Queen Anne, was designed to encourage development of solutions. The observatory at Greenwich had been founded in 1688 specifically to improve accuracy in navigation via provision of precise astronomical observations. The key was that the Earth rotated at an almost exactly constant rate, so that remote stars appeared to rotate about the axis of the Earth's rotation while the Moon revolved about the Earth and changed position relative to the stellar background. In principle, a navigator could measure the time when the Sun was at its zenith, measure the relative positions of the Moon and a chosen set of stars, and then use a nautical almanac to compute longitude, with Greenwich as the reference meridian.

An alternative approach was to use measurement of the time at Greenwich in place of stellar observations, but clocks and watches in the eighteenth century generally had poor accuracy,

made even poorer by the effects of seaway motion and temperature changes. The achievement of John Harrison, in constructing a time-keeper that would be accurate to a few seconds over many weeks in those conditions, is almost incredible. It took him many decades and it required reluctant recognition by the great intellects of the day that a skilled artisan could possibly win the Longitude Prize. It was not until the 1830s that chronometers, as they were by then called, became available in sufficient numbers at sufficiently low cost to be carried by all major ocean-going vessels (Rooney, 2009).

1.1 The Need for Time Signals in Harbour

Although chronometers were much more accurate than ordinary clocks and watches, there could be significant cumulative errors after a long period at sea. The method of lunar distances, for example, was still needed to verify the location of land-based signals that could be used to check chronometers. These land-based signals took many different forms, including guns and flags, but the option preferred by the Admiralty was a time ball, dropped at a prominent position at the same time each day within sight of ships in harbour. It had been invented by Robert Wauchope, a distinguished RN officer,

with a first trial implementation at Portsmouth in 1829, followed by the first public time ball at Greenwich in 1833 (Bartky and Dick, 1981). The ball would usually be raised to cross-trees in two stages, so that an observer would know that a signal was imminent. The time to be recorded was the moment a gap first appeared between the top of the ball and the cross-trees, as the ball was released by triggers to descend in initial free fall.

To be of value to navigators, the time had to be precise and the signal had to be repeated at regular intervals. Then, the rate at which a chronometer was gaining or losing time, as well as the absolute error on a particular day, could be determined. That calibration would be repeated at other ports. Any adjustment was deferred until return to a chronometer maker.



Figure 1: New Zealand localities mentioned in the text; those with time balls are shown in red (Map: Wayne Orchiston).

New Zealand is almost as far away from Greenwich on the Earth's surface as it is possible to be, so it was particularly difficult to establish the exact longitudes of time signal locations and associated drop times for Pacific navigators. That was a particular challenge for the observatory at Wellington in North Island. The time ball at Lyttelton was the principal sig-

nal in South Island and was controlled by telegraph from Wellington, so did not require a nearby observatory. For New Zealand localities mentioned in the text see Figure 1.

The basic problems of chronometer calibration are well-described in a letter to an Auckland newspaper in 1911, when there was no time-ball service in Auckland. Extracts from that letter are transcribed below.

For instance, a captain is loading here and leaving in a few days for 'Frisco or Europe, via Cape Horn, and is not sure of his chronometer error or daily rate. He has to go and make arrangements with the Post Office for a signal at a certain time from the Wellington Observatory, and take this on a watch previously compared with the chronometer, then go back on board and compare with chronometer again. Only by doing this can he obtain the error of his chronometer on Greenwich mean time, and this error compared with that of his last error either here or in Wellington gives the daily rate, that is, the amount the chronometer is gaining or losing per day. The error shown will be used to keep the chronometer correct until the next check is taken.

Sometimes, in fact very often, the chronometer itself is taken up to the P.O. so as to get a direct check and not trust to a watch. This is a very bad plan, as the movement of the chronometer in transit, no matter how careful one may be, as well as the difference of temperature, all combine to upset the daily rate sometimes for days afterwards.

On the other hand with a time ball the chronometer is not touched an officer watches the ball, sings out 'stop' when it drops, and another officer watching the chronometer records the time and obtains the error, etc., and the whole performance is finished in a few moments, and without disturbing the instrument. (Chudley, 1911)

Similar arguments had been used in 1853 to support erection of a time ball in Edinburgh (Kinns, 2011).

2 ADMIRALTY LISTS OF TIME SIGNALS

The Admiralty in London published five editions of time signals for mariners between 1880 and 1898. The first and last of these show the growth of time signal provision worldwide towards the end of the nineteenth century (*Lists of Time Signals*, 1880 and 1898). The number of distinct entries increased from 71 to 154 during that period, some having more than one type of signal. The number of listed time balls had increased from 52 to 94 while the number of listed time guns had grown from 9 to 30. Many others are known to have existed worldwide. There were no time gun entries for New Zealand, so the time gun at Nelson, for example, was not regarded by the Admiralty as an official signal. The 1898 list formed the basis of a study by the

New Zealand Historic Places Trust to show the recent status of time signals and to provide additional information about their origin (Wright, 2007).

2.1 The Entries for New Zealand

Tables 1 and 2 show the entries for New Zealand in the 1880 and 1898 Admiralty lists. Dimensions are given in the original Imperial units. Time balls at Wellington and Lyttelton are included in both lists, but details change between them. Some are incorrect, although stated latitudes

and longitudes were subject to adjustment when more accurate astronomical data became available.

The Otago time ball at Port Chalmers, near Dunedin, had been established in 1867, initially as a daily signal using local astronomical observations, but appears to have been discontinued in 1877 for some years. That explains its omission from the 1880 list. The signal was re-established and controlled by telegraph from Wellington, but was downgraded in April 1882 to the weekly signal shown in the 1898 list.

Table 1: The entries for New Zealand in the 1880 Admiralty list

Signal Station Latitude and Longitude	Place	Signal adopted	Situation of Time Signal	Time of Signal being made		Additional Details
				Greenwich Mean Time	Local Mean Time	
41° 17' 15" S. 174° 47' 45" E.	Wellington	Red and White Ball	The Custom house – 60 feet above high water. 50 feet above ground. (Drop 12 feet.)	h.m.s. 12 30 0	h. m. s. 0 0 0	Ball two thirds up at 11 ^h 50 ^m . Ball hoisted close up as at 11 ^h 55 ^m . Ball dropped by electricity from Wellington Observatory clock at noon, New Zealand mean time* [Note: The days on which the signal may be relied on to one-tenth of a second are advertised in the daily newspaper. Ordinarily, the signal is never more than one second out.]
43° 36' 40" S. 172° 44' 17" E.	Lyttelton	Ball	Custom House 247 feet above high water. 56 feet above ground (Drop 16 feet.)	13 30 0	1 0 0	Ball hoisted close up as preparatory signal at 12 ^h 55 ^m p.m. Ball dropped at 1 p.m. New Zealand mean time.

* Throughout the Colony of New Zealand one uniform time is kept, called 'New Zealand Mean Time', computed for 172° 30' E. long., or 11h 30m 00s from the meridian of Greenwich.

Table 2: The entries for New Zealand in the 1898 Admiralty list

Signal Station Latitude and Longitude	Place	Signal adopted	Situation of Time Signal	Time of Signal being made		Additional Details
				Greenwich Mean Time	Local Mean Time	
41° 16' 50" S. 174° 46' 55" E.	Wellington	Ball	Staff on square tower at inner end of Railway Wharf	h.m.s. 12 30 00	h. m. s. 0 09 7.6	Ball dropped automatically at noon New Zealand standard mean time. (See page 2.) Signal only made when satisfactory observations have been obtained. The days the ball will drop are advertised in the local morning newspaper. Masters of vessels are also informed that in the public room of the Telegraph Office, near the Queen's Wharf, is a galvanometer which is deflected every hour.
43° 36' 42" S. 172° 44' 50" E.	Lyttelton	Ball	The Observatory	13 30 00	1 00 59.2	Ball hoisted up as preparatory signal at 0 ^h 55 ^m 00 ^s p.m. Ball dropped at 1 ^h 00 ^m 00 ^s p.m. New Zealand standard mean time (See page 2.)
45° 49' 0" S. 170° 39' 0" E.	Otago	Ball	Signal Staff at Port Chalmers	12 30 00	11 52 36	Ball dropped about once a week at noon, New Zealand standard mean time. (See page 2.) When ball is to be dropped a blue flag is hoisted on the flagstaff at 10h 00m 00s a.m. New Zealand mean time.

2.2 Errors in New Zealand Entries

The time ball extant at Wellington in 1880 had a drop of 18, not 12, feet. It had been procured from England in 1863. The ball colour is described as red and white, but available photographs suggest that it was a dark colour. A red ball with a white central band had been supplied for the Strand, London by the same manufacturer (The electric time ball ..., 1852, see Kinns, 2014). The colours may have been changed after arrival in New Zealand, to suit the ball location. The Wellington apparatus was relocated in 1888, so the locations in 1880 and 1898 were different. The changes at Wellington are due partly to a change in time signal location and partly to correction of co-ordinates. The later ball colour was not stated in the 1898 list, but it appears from photographic evidence to have been black with a central band, probably painted red.

There was never an observatory at Lyttelton; the time ball was actually located at the signal station and the same apparatus was used from 1876 onwards. The time signal was communicated by telegraph from Wellington. The Lyttelton apparatus had been shipped from England in 1874. It was a replica of that built for Sydney in 1855 and first used there in 1858. The drop was 10, not 16, ft. It is noteworthy that the stated longitude at Lyttelton changed by 33 seconds of arc between the 1880 and 1898 lists, with a much smaller 2 second adjustment in latitude. The signal location remained the same. The ball colour was not stated in the Admiralty lists; the present colour of the 5 ft. diameter ball is black with a central red band.

2.3 Mean Time and Apparent Time

Mean time establishes noon at regular 24-hour intervals. This eliminates any daily variations caused by the Earth's elliptical path around the Sun. Local mean time changes by one hour for each 15° change in longitude. A single mean time for the whole of New Zealand had been established on 2 November 1868. This time (*New Zealand Mean Time*, n.d.) was exactly 11½ hours in advance of Greenwich Mean Time.

A notable difference between the 1880 and 1898 lists is definition of "Local Mean Time" in New Zealand. Confusingly in the 1880 list, the Local Mean Time is specified as New Zealand Standard Mean Time. In the 1898 list, the Local Mean Time shows the expected variation with longitude.

2.4 Drop Times in New Zealand

The time balls at Wellington and Port Chalmers were dropped at noon, while the time ball at Lyttelton was dropped at 1 p.m. The delay of one hour was common at many locations, in-

cluding Greenwich; it allowed astronomers to concentrate on solar observations at noon, rather than signal transmission.

2.5 The Lack of an Entry for Auckland

Perhaps surprisingly, there is no entry for Auckland in either the 1880 or 1898 lists. Many newspaper articles chronicle the various attempts to establish an official service, with frequent letters from ships' masters about the lack of a time ball service in such an important port. The underlying problem was lack of budgetary commitment over an extended period. There was great reluctance to buy the high quality, reliable apparatus and instruments that had allowed Wellington and Lyttelton to establish a credible service, and to provide the funds for maintenance and operation by skilled staff. An accuracy of a few seconds might be satisfactory for railway operation and workplace signals, but it was certainly not adequate for calibrating marine chronometers.

3 NEW ZEALAND NAUTICAL ALMANACS

The later history of time balls and other time signals can be traced through successive editions of the *New Zealand Nautical Almanac and Tide Tables*, which was first published in November 1902 for the following year. It was then published annually, but copies tend to be elusive, because the usual policy was to destroy the preceding edition when a new one was issued. The first edition has an introduction that included the following statements:

The want of an authoritative publication containing tide-tables and up-to-date information about the principal ports of New Zealand made use of by large foreign-going steamers has long been felt, and the Hon. Mr. Hall-Jones, Minister of Marine, has authorized the publication of this book, which will supply the want ... The various Harbour Boards supplied the latest information concerning their ports; but in most cases such information has been supplemented by particulars taken from the "New Zealand Pilot" and the latest New Zealand Yearbook, &c.

The various Notices to Mariners regarding the colony issued since the publication of the last edition of the "New Zealand Pilot" have been collated and published herein, and the General Notices to Mariners and special warnings which are issued monthly by the Board of Trade also appear.

Each *Almanac* includes statements about time signals that were expected to be available during the year. The only entries concerning time balls are for Wellington, Auckland, Lyttelton and Otago, many indicating that the signal had been withdrawn either temporarily or permanently. Extracts from almanacs for particular years will be given for each time signal location.

By 1928, the entries in the *Almanac* had changed to include a section entitled "Dominion Time-service Arrangements for Chronometer-rating Purposes", as well as entries for individual ports. This included a list of the different types of signal that were then available throughout New Zealand and the means available for rating chronometers. The following sub-headings were used.

1. Day wireless time-signals;
2. Night wireless time-signals;
3. Chronometer-rating time-signals by lights;
4. Chronometer-rating time-signals by time-ball;
5. Charging for telegraphing time-signals;
6. Rating chronometers at Wellington;
7. Dominion Standard Mean Time.

The following note in the 1928 *Almanac* indicates that no manual intervention was required for signal transmission:

Transmission of the time-signals is free of manual interference. The lights are extinguished, galvanometer deflected, wireless signals transmitted, and time-ball dropped automatically by direct communication from the Observatory clock at Wellington.

The complete entry under "Chronometer-rating time-signals by time-ball" (1928 *Almanac*: 132) was

Lyttelton. – From the signal-station. A time-ball is dropped at 3.30 pm N.Z.T. (04 00 00 G.M.T.) Supplied every Tuesday and Friday evening. (This time-signal is considered unreliable.)

The reason for the last statement is unclear, but it may stem from the need for manual intervention. The time ball had to be raised manually, so that triggers could be set prior to the drop. Thus, the process was not fully automatic and relied on the availability and skill of the operator. The specific entry for Lyttelton (1928 *Almanac*: 254) was "Time-ball for chronometer-rating purposes is directly connected with the Dominion Time Observatory at Wellington." The drop time of 0400 GMT reflects the re-basing of GMT from noon to midnight on 1 January 1925.

4 THE WELLINGTON TIME BALL

The first time ball in New Zealand was at Wellington and became operational on 9 March 1864. Its origin is known from correspondence relating to a time ball at the Cape of Good Hope.

4.1 The First Wellington Time Ball

A new time ball apparatus was described in a notice published by Sir Thomas Maclear, Astronomer Royal at the Cape (New time-ball at the Royal Observatory ..., 1863; reproduced in Kinns, 2014: 171). It featured in two letters to

George Airy, the Astronomer Royal at Greenwich, which show that a similar apparatus had been ordered for New Zealand (Maclear, 1863a; 1863b). The mechanism was provided by Sandys & Co. of 158 Aldersgate Street, London.

Maclear was told by Sandys that they been awarded a contract for a New Zealand time ball. Maclear wanted Airy to check its design and operation before it was shipped, having found defects in the machinery delivered to the Cape. The letters were uncertain about the precise destination in New Zealand, but it must have been Wellington. Maclear wrote in the first letter:

I suspect that our late excellent Governor – Sir Geo^e Grey, now Governor of New Zealand, originated the order, & am exceedingly anxious both on private & public grounds, that the machine should be sent out complete – in a state as perfect as the construction will admit of. My reasons for caution will appear presently ...

My reason for the precaution is the fact that he sent out the Cape machine unfinished. Because of the great fall (18 feet) & the danger of the wood of the upper or slotted shaft twisting in this climate, it is covered outside with plate iron, & inside knee bent plate iron in the corners ...

As the New Zealand Machine is to be on the plan of the Cape one, it will be found a heavy concern to manage. The weight of the Time Ball, gun metal rack rod & wood behind it, & metallic piston, come to about 350 or 360 pounds. 160 turns of the windlass are required to raise the ball, which on the average occupies 3 minutes. But the fault if any is my own. I wanted a great fall because of the low position & distance from the Anchorage. (Maclear, 1863a).

The second letter (Maclear, 1863b), written two days later, was concerned with the lack of telegraph and observatory facilities in New Zealand. Although Airy was willing to inspect the apparatus and Sandys would have agreed, the Maclear letters arrived too late; the apparatus had already been shipped to New Zealand by the time Airy made contact with the manufacturer (Sandys & Co., 1863). If the Wellington apparatus was indeed identical to that at the Cape, the ball would have had a diameter of 1.65m and a drop of 5.5m.

4.2 Announcement in Wellington

The time ball apparatus had arrived in Wellington by January 1864. The following brief account was published soon afterwards:

Many improvements have of late been made in the way of buildings, &c. and one of the chief objects that catches the eye from the wharf, is a time ball erected on the top of the Custom House, the pole passing through the centre of the building. It is on the same prin-

ciple as the Greenwich time ball, and will fall every day at 12 o'clock. The clocks in connection with the works will be under the management of S. Carkeek, Esq., Collector of Customs ... (*The Nelson Examiner and New Zealand Chronicle*, 1864)

The location of the new time ball is shown in Figure 2. The large drop of the ball is consistent with Maclear's description of the apparatus at the Cape. A fulsome description of the new time ball apparatus was published in the *New Zealand Spectator and Cook's Strait Guardian* (The time ball, 1864). Extracts from that notice are reproduced below. The article gives due credit to Stephen Carkeek, the leading astronomer in New Zealand. Orchiston (2016: Chapter 8) has described Carkeek's work in depth.

Saturday last ought to be marked as a red letter day in all future editions of New Zealand almanacks, for at 3 o'clock the Wellington Time Ball was dropped by electricity ...

To Mr. Carkeek belongs the chief credit of this work; as most certainly it would never have been thought of had we not possessed one so thoroughly capable of directing the setting up of the somewhat complicated gear which carries and works the ball. Saturday's experiment proved that all the machinery was in working order, but the ball will not, we understand, be dropped regularly each day for at least a month. The observatory has yet to be built at the side of the Custom house; the

transit instrument to be set up; the two clocks to be fixed and rated; all this done, each day at 12 o'clock the ball will drop, shewing with perfect accuracy true time ...

The necessity of thus checking the chronometers of ships is so well known in England, that a ball is dropped at Greenwich, at Deal, and at another point of the Channel. All three balls are dropped by the same current of electricity, and all at the same instant precisely, although so far distant from one another ...

The time ball is of zinc, weighing about two hundredweight. It is carried by an iron rod, which rod at its lower end is attached to a piston. The rod and piston are fitted into an iron cylinder resting on a foundation built up carefully from the rock below the Custom-house. The cylinder is packed at the bottom with India-rubber, forming an elastic cushion to deaden the blow of the piston when the ball is dropped ...

When the ball is wound up by the rack work the bottom of the piston is caught by a small piece of steel, which locks it securely. This trigger forms part of a most beautiful and delicate system of levers, which work one upon the other. The last of these, when the whole are set, needs but the slightest touch to release the trigger supporting the piston, and to drop the ball. Each day, when the ball is wound up to the top of the mast, these levers must be set by the assistant ...



Figure 2: View of the Wellington waterfront showing the Customs House and time ball (courtesy: Alexander Turnbull Library, H.N. Murray Collection, Ref: PAColl-0824-1).

The second clock is the Astronomical clock, required to give true time, in order to set, and to occasionally correct the going of the clock attached to the battery. The rate of this clock is ascertained by observations of the stars. When the observatory is fixed we purpose to give a description of the telescope and of the method of using it. We hope that the Provincial Council will supplement the work of the ball, by voting funds for powder, &c, for a cannon, which, when fired, will carry the tidings, it is 12 o'clock, to the Hutt and to those parts of the town where the fall of the Time Ball is not visible.

The time ball dropped for the first time as an official signal on 9 March 1864, as indicated by the following notice in the *New Zealand Spectator and Cook's Strait Guardian*:

Notice is hereby given, that on and after Wednesday next, the 9th instant, the Time-ball at the Custom House will be dropped on each and every day, Sunday's excepted. The Ball will be hoisted half-mast high at ten minutes before 12, to the mast head at five minutes before 12, and will fall precisely at 12 o'clock at noon, Wellington mean time. (Monthly Summary, 1864).

Notices about the time ball location and drop time were published regularly in newspapers. The following notice is typical:

The Time Ball at Wellington is situated in latitude 41 17' 01" S., and longitude 174 49' 15" E. It is dropped at noon every day (Sunday's excepted), or at 12h. 20m. 43s. past noon at Greenwich of the previous day. (*Wellington Independent*, 1864).

Carkeek carried out the appropriate astronomical observations to determine its latitude and longitude (Thomson and Jackson, 1871). Amateur astronomer and minister of religion, Archdeacon Arthur Henry Stock (Orchiston, 2016b), was responsible for the day-to-day operation of the time ball. He published a letter to the editor of the *Wellington Independent*, explaining the change that would occur on 2 November 1868 when New Zealand mean time was introduced:

Sir, The Time Ball will drop on Monday at 12 o'clock New Zealand mean time. This time is 9 minutes 17 seconds slower than Wellington mean time, as the longitude of the Time Ball is 174° 49' 15". This longitude differs from that generally given, but it was calculated by Mr Carkeek from several observations taken by the transit instrument of the Time Ball observatory. The master of H.M.S. Esk told me that he was aware of this error of the chart longitude. If true time is wanted for setting sundials, or for any other purpose, 9 minutes 17 seconds should be added to the Time Ball time. Clocks and watches should be put back 9½ minutes on Sunday night. (Stock, 1868).

The longitude quoted in the letter is precisely

that given in 1865 notices about time ball operation, which appears to have differed from contemporary Admiralty charts. The letter stated the need to readjust clocks and watches to take account of the introduction of New Zealand mean time. In the 1880 Admiralty list (see Table 1), the longitude was given as 174° 47' 45", a reduction of 1' 30" from the value determined by Carkeek.

The reliability of the time ball apparatus started to become a problem in the early 1870s. A notice in April 1871 stated that the time ball must not be used for rating chronometers until further notice (Stock, 1871). The problems had become more serious by November 1873:

Sir – The cause of the time ball's not falling is that some of the gear for raising it has from long use become worn. When application was made to the General Government for repairs, the answer was that, although the General Government had bought the needful apparatus for giving true time to the Telegraph Office, they had not bought the time ball. The Provincial Government were under the impression that they had sold everything. It is now settled that the time ball belongs to the Provincial Government. They have given orders for the needful repairs, and the time ball will drop as usual when these are completed. The same magnetic current that gives time to the Telegraph Office will drop the ball. (Stock, 1873).

The service was re-established about three weeks later (The time ball, 1873). There was still controversy about the longitude of the time ball and further calculations led to a time signal correction on 1 April 1874 (Longitude of Wellington, 1874). It was stated that the drop had previously been 6.15 seconds too early, corresponding to a longitude error of 1 minute, 33 seconds of arc too far east. The revised longitude was therefore estimated to be 174° 47' 42", almost exactly that appearing in the 1880 Admiralty list.

Problems with decay in the time ball mast had become significant by September 1874, and the ball had ceased to operate regularly (*Evening Post*, 1874). The winding mechanism was again faulty in the following year:

We are requested to give notice that in consequence of a defect in the winding-up gear of the Time Ball, it was not hoisted this morning. The ball will not fall until the defect is repaired. (*Evening Post*, 1875).

Controversy about the longitude of Wellington was further exposed in correspondence published on 16 December 1875 (Dr Hector ..., 1875). Newspaper announcements petered out in 1875, but the service may have continued until 1882, when major waterfront development required relocation of the time ball. Its appearance in the 1880 Admiralty list suggests that it was still operational in 1879.

4.3 Relocation of the Wellington Time Ball

The Harbour Master (1882) at Wellington offered his views about future time ball location to the Harbour Board. He referred to the poor visibility of the time ball against the background of houses and hills at its former location and argued that it should be positioned on Mount Victoria. His letter gives the impression that the first time ball had long since ceased to operate. Discussion continued for years afterwards. The Engineer concluded in a memorandum that the best location would be on the brow of Mount Wellington, next to an existing telegraph line. He noted:

... as the time ball is completely smashed, the question of size is not an element to be considered as the new ball could be made as large as might be deemed necessary ... (Engineer's memo ..., 1885).

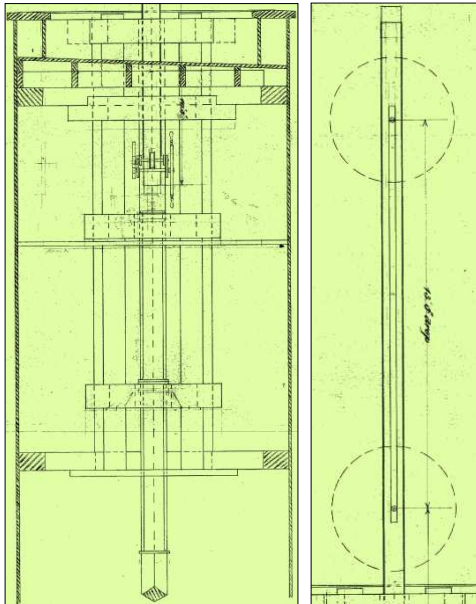


Figure 3: Extracts from 1888 installation drawing for the Wellington time ball apparatus (Wellington Harbour Board archive, Drawing Office No. 3511)

The matter was referred to Dr James Hector, Director of the Colonial Museum of New Zealand and the Colonial Observatory (Orchiston, 2016b), for his opinion. Hector (1886) indicated that he had received various papers about the time ball and that the favoured location was by then "... one of the tees of the wharf." He also noted that:

... I think it rather absurd that we should have the time observatory in Wellington and no time ball, nor any means by which the public can check the time that is distributed through the telegraph and railway clocks, while the time ball apparatus is lying idle.

It appears that the original time ball apparatus had been saved and that a new mast and ball would allow it to be re-used. It was to be

another two years before a Wellington time ball was again in operation.

4.4 The Second Wellington Time Ball

Notice of a new Wellington time ball service appeared in newspapers with the statement that "The time ball is to be erected once more for the benefit of shipping." (Wellington, 1888). The 1898 Admiralty list (Table 2) shows that the new ball was located on "Staff on square tower at inner end of Railway Wharf" whereas it had been located previously at "The Custom House" shown in Figure 2. The title of the drawing of a square tower issued to potential contractors by the Wellington Harbour Board was "Hydraulic Accumulator House at Waterloo Quay Woolshed (Wool Store J)". (Hydraulic Accumulator House ..., 1888).

A contract to erect the new building was signed by James Lockie (Wellington Harbour Board Contract No 43, 1888). The specification, signed by the Engineer to the Board on 18 January 1888, includes the statement "At the eastern corner provision is to be made as shown on Sheet No 2 and in detail on Sheet No 4 for the subsequent erection of a time ball mast and apparatus". Two elements of Sheet No 4 are shown in Figure 3 (Details for timeball, n.d.). The outline drawing for the time ball and mast indicate that the ball drop would be 13 ft. (4.0m), with a ball diameter of 4 ft (1.2m). Both dimensions had changed from the first Wellington time ball in Figure 2 and changed again in the final installation. An arrangement of gears and a capstan can be seen in the left-hand drawing. An offer to supply a new time ball for £5 10s was made on 31 August 1888, using a design supplied by the Harbour Board (Luke & Sons, 1888). A later report (*Wellington Harbour Board Report* ..., 1910) stated that the ball diameter was 5 ft. (1.5m). No evidence has been found that tenders were sought for a replacement apparatus, so it appears that the original 1863 apparatus was re-used with a new ball.

The photograph in Figure 4 shows the time ball at its new location on the tower next to 'J' shed. Figure 5 shows a close up of the ball and mast. Comparison of the photographs with the drawing of the building indicates that the ball diameter was 1.5m and that the drop height was about 5.2m, close to the original drop height. Figure 5 suggests that the second ball was painted black with a coloured central band, similar to the colour scheme used at Lyttelton (see later). A drawing of the Lyttelton ball, which had the same 1.5m diameter, was probably given to the ball manufacturer.

Captain Edwin was responsible for time ball operation and weather forecasts, but public announcements concerning the time ball drop time



Figure 4: The time ball at its second location in Wellington (courtesy: Wellington City Archives 2012/2:6725).

and longitude have not been found. The absence of these was noted:

That Mr Dacre wants the Harbour Board to advertise the hour at which the "time ball" will drop. Wouldn't it be better to get Captain Edwin to include the event in his daily prophecies? (They Say, 1902).

The Railway Wharf tower burnt down in March 1909 and the outline of the time ball apparatus can be seen in Figure 6. Subsequently, calibration had to be carried out by taking chronometers ashore:

In this week's Gazette it is notified that, owing to the destruction by fire of the "J" Shed, Waterloo Quay, the time ball which was situated on the tower of the said shed is no longer available for the information of masters of vessels frequenting the port. Correct mean time may be obtained in the public room of the telegraph office, close to the Queen's Wharf, where a galvanometer, controlled by the observatory clock, is deflected every hour. (Shipping News, 1909).

4.5 Possible Replacement in 1910

Enquiries about a replacement time ball apparatus were made in London:

I am directed by the High Commissioner to in-

form you that he has been requested by his Government to obtain quotations for the supply of a Time Ball Apparatus for Wellington, in place of one burnt by fire a short time ago. The Time Ball will be dropped by electric cur-

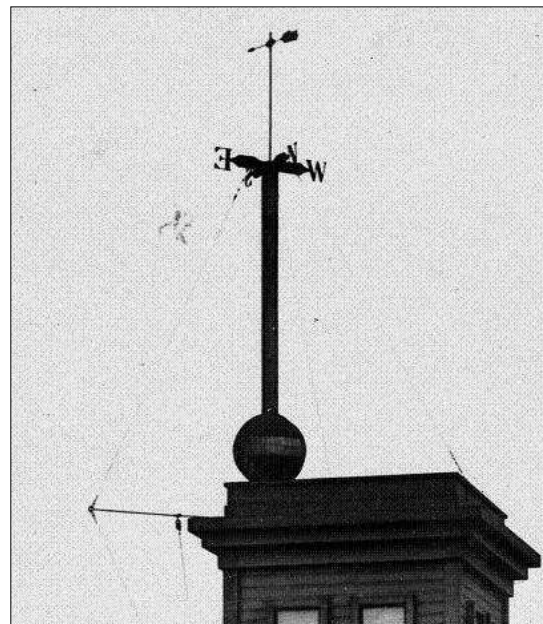


Figure 5: The ball and mast at their second location in Wellington (courtesy: Wellington City Archives 2012/2:6725).

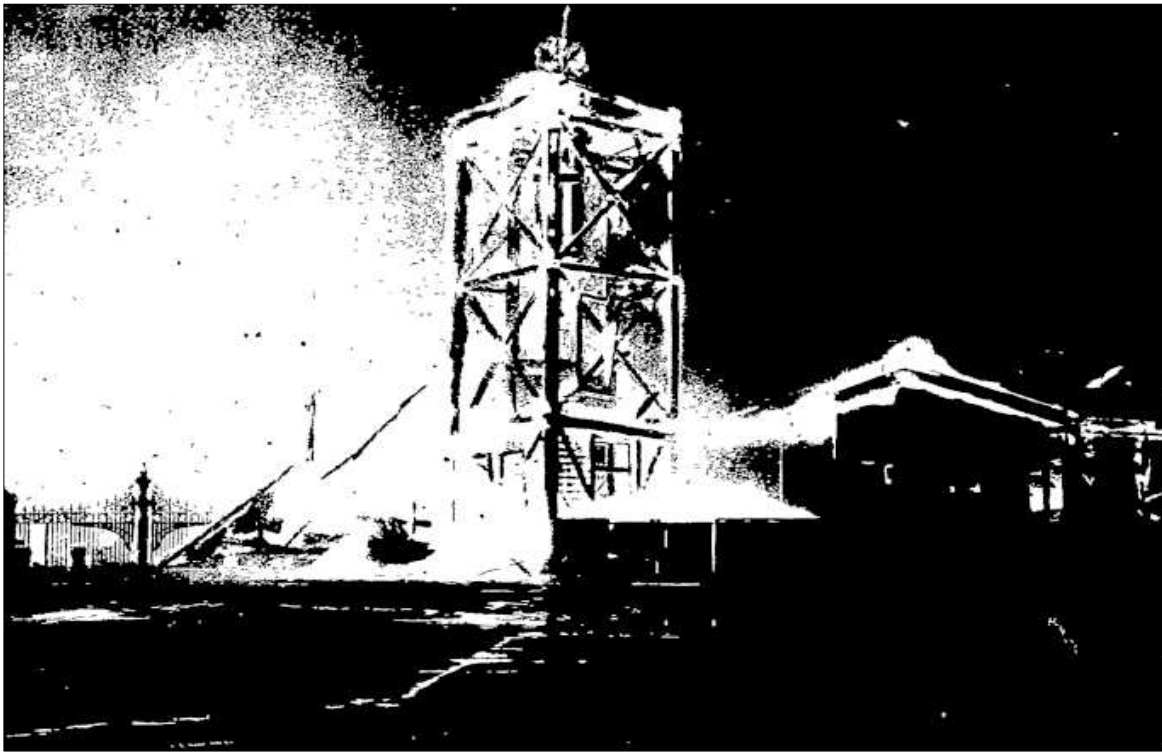


Figure 6: Wellington's Latest Conflagration – The Last of Capt. Edwin's Tower and Time Ball (*New Zealand Free Lance*, 13 March 1909).

rent from the Hector Observatory.

I am also directed to state that the High Commissioner will be very pleased if you could kindly furnish him with the names of the best Manufacturers from whom Tenders should be invited for the supply of this Apparatus. (NZ High Commission, 1910a).

W.H.M. Christie, the Astronomer Royal at Greenwich, arranged for a reply to be drafted by a member of his staff (Lewis, 1910a). His notes also included estimates of cost:

It is presumed that the Time-Ball installation is to be similar to those at Singapore, Portsmouth, Brisbane, Cairo, Port Said, Alexandria, &c. ...

The stays and hoisting gear for Singapore were made by Messrs Saxby and Farmer, 50 Victoria Street Westminster, who make Railway Signals. Capt. Lyons, when erecting the Egyptian Time balls, was unable to trace this firm.

The other portions were made by E. Dent & Co 61 Strand, W. C. who also make the whole apparatus complete. This firm supplied the whole apparatus for Genoa.

I would recommend that the High Commission communicates with these firms.

These notes were summarised in the official reply from the Astronomer Royal (1910a):

In reply to your letter of April 21, R. B 21/58, relative to the supply of a Time Ball and apparatus for Wellington, New Zealand, I have

to inform you that the Time Ball and hoisting apparatus can be supplied by Messrs Saxby and Farmer Ltd., Railway Signal Engineers, 53 Victoria Street, Westminster, and the Clock and Electrical appliances by Messrs E Dent & Co., Ltd., 61 Strand, W. C., or doubtless the latter firm would undertake the complete contract.

These firms have satisfactorily carried out the fitting up of Time Balls and apparatus in various parts of the world.

Tenders were sought by the NZ High Commission (1910a; 1910b) from the two firms. A subsequent report confirmed that offers were received from both, with additional offers from Messrs Smith & Sons and Messrs Gibett & Johnson, who stated that their time ball would be similar to those supplied for Port Said and Cape Town (*Wellington Harbour Board Reports ...*, 1910). Despite protests from shipping companies on 21 July 1911 (see *Wellington Harbour Board*, 1911), it appears that no order was ever placed for a new time ball apparatus.

4.6 Entries for Wellington in the *New Zealand Nautical Almanacs*

The entry for Wellington in the *New Zealand Nautical Almanac* for 1903 is particularly informative, including notification that the assumed longitude of the observatory was about to be changed and that the time ball would be dropped 3.8 seconds later than before. There

was also a clear distinction between days when the exact time could be confirmed by astronomical observations and other days where there had to be reliance on the astronomical clock for interpolation:

There is an astronomical observatory at Wellington, and approximately correct time may be obtained from daily signals which are given by a time ball situated on the tower of "J" Shed, Waterloo Quay, at the root of Railway Wharf. The time may be taken as absolutely correct for chronometer-rating purposes on the days when a flag is flown on the flagstaff close alongside the time ball; also, on these close-rating days a notice is inserted in the *New Zealand Times* to this effect. The ball falls at 12.30 Greenwich mean time, which is equivalent to noon in New Zealand, and this is the time which is kept throughout the colony. There is also a galvanometer, deflecting every hour, in the Public Room of the Telegraph-office, close to the Queen's Wharf, which is controlled by the same clock which drops the time ball.

[NOTE. – The longitude assumed for the Observatory in calculating time is 11h. 39m. 9.13s., which corresponds to that of the coastal charts. The accepted longitude of the Observatory is 11h. 39m. 5.31s., based on the longitude of Sydney. It is probable that this longitude will very shortly be adopted in giving Greenwich time by the time ball.]

The 1905 and 1906 entries confirmed the change in assumed longitude. The entry for 1907 contained an important announcement about relocation and development of the observatory at Wellington. A temporary observatory and a reduced time signal service, including suspension of the Wellington time ball service, would be available in that year:

The time ball has been temporarily discontinued owing to the observatory having been demolished. A new observatory is about to be erected on another site. Meanwhile the time for the colony is kept by chronometers which are checked by theodolite observations taken from a temporary observatory in the grounds of the Government Buildings by the Lands and Survey Department. Approximately correct time is given daily by galvanometer to the Telegraphic and Railway Offices, and once a week the correct time from observation is telegraphed to Auckland, Lyttelton and Dunedin. Any shipmaster in Wellington wishing to correct his chronometer should apply at the Museum to the Permanent Observer (Mr. King), who has charge of the chronometers, and gives the time to the colony.

The 1908 entry was the same as the 1906 edition, but there was a major change in the 1910 edition, owing to the fire which destroyed the time ball in March 1909. Apart from the note concerning longitude, the entry was reduced to:

There is an astronomical observatory at Well-

ington, and correct mean time may be obtained in the public room of the telegraph-office, close to the Queen's Wharf, where a galvanometer controlled by the observatory clock is deflected every hour.

The entry in the 1912 edition (the 1911 and 1913 editions have not been seen by the author) heralded the introduction of time lights at Wellington observatory, as well as final discontinuance of the time ball service in Wellington:

There is an astronomical observatory at Wellington on Battery Hill, in the Botanical Gardens, in latitude 41° 17' 3.76" S. and longitude 174° 46' 7.2" E. = 11h. 39m. 4.48s. From the tower of this observatory a time-signal by electric lights is being inaugurated (See further page 328.) The time-ball which was situated on the tower of J. Shed, Waterloo Quay, has been discontinued since the destruction of this shed by fire. Correct mean time may be obtained in the public room of the telegraph-office, close to the Queen's Wharf, where a galvanometer controlled by the observatory clock is deflected every hour.

Later editions include details of the telegraph, time light and eventually radio signals that were provided by Wellington. The sequence of time lights changed over the years, but a similar time light service was provided in Auckland after 1915.

5 THE LYTTTELTON TIME BALL

An informative booklet was published by the New Zealand Historic Places Trust (Bremner and Wood, 1979). According to that booklet, Siemens Brothers shipped the apparatus for Lyttelton from London in July 1874, following an order in March 1873. Siemens had become a principal supplier of telegraphic equipment, with heavy commitments to supply and installation of telegraph cables at the time. Lyttelton time ball operation had to await completion of the necessary tower and it became operational on 23 December 1876. It was restored faithfully during the 1970s and was a much-admired New Zealand landmark.

5.1 Design of the Lyttelton Apparatus

It has been demonstrated that the apparatus for Lyttelton is actually a replica of the 1855 design for Sydney, NSW, despite a long interval between their dates of supply (Kinns, 2009). Maudslay, Sons & Field of Lambeth, London built the time ball apparatus for Sydney in 1855, using a rack and pinion mechanism to hoist the ball that had been developed from the design for Edinburgh and Deal (Kinns and Abell, 2009). It became operational in 1858, following completion of Sydney Observatory and the time ball tower. Henry Russell, the NSW Government Astronomer, modified this apparatus during the 1870s, but most principal features were retained.

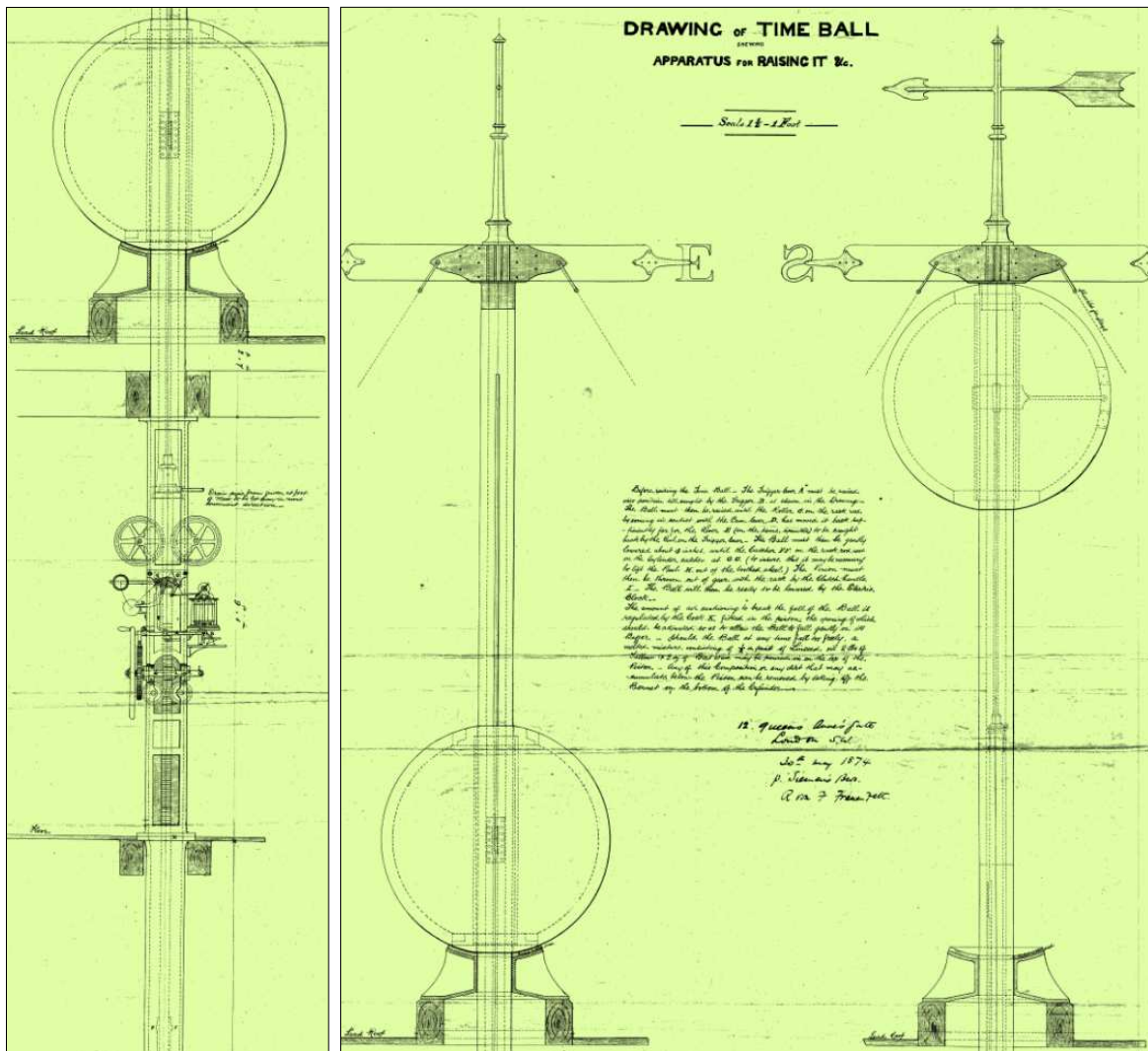


Figure 7: Extracts from Siemens 1874 drawing of the Lyttelton time ball apparatus (courtesy: Wellington Harbour Board archive, Drawing Office No. 3510)

He identified many of his changes in a letter to Sir Charles Todd in Adelaide. Detailed comparison of the two time ball systems in 2009 confirmed that Lyttelton used the unmodified 1855 design (Kinns, 2009). The only surviving note in Maudslay records about an 1873 order for a time ball indicates provision for the Cape of Good Hope and an association with Siemens (Sells, 1842–1883). No evidence has been found that an apparatus built by Maudslay, Sons & Field was ever delivered to Cape Colony. Also, no Siemens records showing supply of time ball apparatus to a location other than Lyttelton have been found. It was deduced that a single 1873 apparatus was built for Siemens Brothers who added electrical equipment and shipped the complete system to Lyttelton, not the Cape, in 1874.

Extracts from the drawing supplied by Siemens Brothers are shown in Figure 7 (Drawing of Timeball, 1874). The drawing of the Lyttelton

ball was probably used for the 1888 replacement ball at Wellington.

5.2 Entries for Lyttelton in the *New Zealand Nautical Almanacs*

The entry for Lyttelton in the *New Zealand Nautical Almanac* for 1903 continued to define the time ball location as “The Observatory”, perpetuating the anomalous description given in the 1898 Admiralty list:

At the Observatory, on the east side of Lyttelton, a ball is dropped at 1h. 0m. 0s. p.m., New Zealand standard mean time, or 13. 30m. 0s. Greenwich mean time. The ball is hoisted five minutes before the signal.

The entry for 1918 showed a change of drop time, but still referred to the Observatory. The time ball drop was delayed from 1330 to 1600 GMT, then still based by astronomers on noon at Greenwich, rather than midnight. GMT was rebased to midnight for all purposes on 1 January

1925:

At the Observatory, on the east side of Lyttelton, on days when accurate time signals are given a ball is dropped at 3h. 30m. p.m. New Zealand standard mean time, or 16h. 0m, Greenwich mean time. The ball is hoisted five minutes before the signal. The time signals will be sent on Tuesdays and Fridays, provided satisfactory observations have been obtained. If time signals are required on other days or at other exact hours of Greenwich mean time, application for them should be made to the Observatory, Wellington.

The service continued as the only official time ball in New Zealand until it was rendered obsolete by radio time signals and ceased at the end of 1934. At some time between 1918 and 1928, the location description given in almanacs had been changed to the 'signal-station'.

5.3 Damage in 2011

Tragically, the tower collapsed during the earthquakes and aftershocks in 2011 that devastated Christchurch. The extent of the damage is shown in Figures 8 and 9.

The photograph in Figure 8 was taken following an aftershock which had caused major structural damage to the tower, but had left the time ball apparatus largely intact. The tower was being dismantled and the photograph was taken from a crane only one hour before the second major aftershock that caused the tower to collapse completely.

The effect of that second after-shock is shown in Figure 9. The time ball itself can be seen in the lower left hand corner of Figure 9. The mechanism was badly damaged, but most key components have survived and it may be possible to restore it to working order.

5.4 Importance of the Lyttelton Ball

Although the Lyttelton ball was damaged in 2011, it is an important artefact, and is likely to be the only original time ball from the period before 1875 that is still in existence. The Maudslay time balls at Greenwich, Edinburgh, Deal and Sydney have all been replaced or modified since original supply. That at Edinburgh was restored in 2009, but its frame had been extensively reinforced during the nineteenth and twentieth centuries and the ball is now significantly heavier than the original. Time balls supplied by other manufacturers during the nineteenth century all appear to have been lost.

Figure 10 shows the Lyttelton ball in its present state. Figure 11 shows the internal framing of the top half of the ball, which escaped damage. This may be compared with photographs of the Edinburgh ball, before restoration, shown in Kinns (2014).



Figure 8: A photograph taken on 13 June 2011 just before the collapse of the Lyttelton Time Ball Tower (www.stuff.co.nz/the-press/news/8794428/Timeballs-last-known-photo).

6 THE OTAGO TIME BALL

The prospect of a time gun for Otago, in preference to a time ball, was introduced in March 1864 (Harbor Department, 1864). The report was published in the *Otago Daily Times* on 9 April. Extracts are transcribed below:

A flagstaff has been erected at Port Chalmers, and a signal master appointed, who will enter upon the duties of his office immediately ... I would now recommend that an astronomical clock be procured for this station, to assist in keeping accurate time, which will also be computed every clear day by observation; and that a small signal gun be got to be fired at eight p.m., to enable ship masters to correct their chronometers – an accommodation much prized by them. A gun would be much preferable to a time ball, as in the case of the latter



Figure 9: A photograph taken on 18 June 2011, five days after the collapse of the Lyttelton Time Ball Tower (www.stuff.co.nz/national/christchurch-earthquake/5145289/June-13-earthquakes-Morale-costs-get-a-shake-up).



Figure 10: The damaged Lyttelton ball (courtesy: Bruce Carr).

the time would necessarily have to be signalled at noon, an hour when ship masters are frequently on shore, and when the duties of the day would much prevent their giving attention to it. The gun would also indicate the time to the inhabitants of the town, many of whom are not within sight of the signal station, and to the river steamboat masters, who are desirous of keeping correct time with a view to secure punctuality in arriving and departing.

The idea of a time ball for Dunedin was raised again in a Letter to the Editor of the *Otago Daily Times*, with an emphasis on the need for improved clock accuracy in the City:

Sir – Now that the telegraph has been established throughout the Provinces, a very great addition, and one of much value to the public in Dunedin, would be the erection of a ball over the Telegraph Office, and some regular time adopted for the town ... (Time ball for Dunedin, 1865).

6.1 Introduction of a Daily Service

The imminent provision of a time ball for Port Chalmers, near Dunedin, was announced in the *Otago Daily Times*:

Active preparations are being made for the working of the long needed time ball at the Flagstaff, Port Chalmers. A conductor has been



Figure 11: Internal framing of the Lyttelton time ball (courtesy: Bruce Carr).

laid from the Observatory to the Flagstaff, which being attached to the haulyards by a simple arrangement, the ball is dropped instantaneously by the signal master. The whole of the arrangements are expected to be completed in a week, when the great want of a time ball to the shipping community will be numbered with the things of the past. (Shipping, 1867).

The service actually started on Saturday, 1 June 1867, two months later. This still preceded establishment of New Zealand Mean Time. The time ball was dropped every day, except Sundays:

The time ball at the Port was dropped, for the first time, on Saturday, and it will in future be dropped daily (Sundays excepted) at 1 p.m., Port Chalmers mean time or 1h 37m. 23.5s a.m., Greenwich mean time. (Customs entry, 1867).

Figure 12 is a photograph of the time ball, taken from a vessel that was anchored in Port Chalmers (cf. Hargreaves and Hearn, 1980: 47).

The following notice is typical of newspaper entries that appeared regularly in the *Otago Daily Times* until 5 October 1877

PORT CHALMERS OBSERVATORY.
Latitude, 45.48.55 south; longitude, 11h. 22m. 37s. east. Time ball drops daily (Sundays excepted) at 1 p.m. Port Chalmers mean time, or 1h. 37m. 23s. a.m., Greenwich mean time. (Port Chalmers Observatory, 1877).

Curiously, the stated drop time after 1868 continued to be 1 p.m. Port Chalmers mean time, not 1 p.m. New Zealand mean time.

The time ball service may have been discontinued from then until 1882. The need for vigilance concerning the accuracy of time signals and measurements of longitude is emphasised in the following letter from the Captain of *SS Zealandia* to the *Otago Daily Times*.

Captain Chevalier, of the Pacific Mail Company's S.S. *Zealandia*, publishes the following interesting notice to mariners: – The Union group, being in a direct line from Auckland to the Sandwich Islands, caution is necessary in passing them, they being low, dangerous islands, and have been found to be placed 11 miles to the east of their true position on Admiralty charts. The *Zealandia*'s chronometers were carefully rated by observations in San Francisco, assuming the Pacific Mail Company's wharf to be in latitude 37 deg. 40 min. 45 sec. N., and longitude 8 deg. 9 min. 32 sec. W [sic]. On arrival in Sydney on October 12th, after a lapse of 30 days, the chronometers by Observatory time ball were three seconds, or three-quarters of a mile to the east of true. The ship's position when off the Duke of Clarence Island, Union Group, was ascertained at time of observation by a series of angles. These islands have been sighted on two different voyages, and found each time to

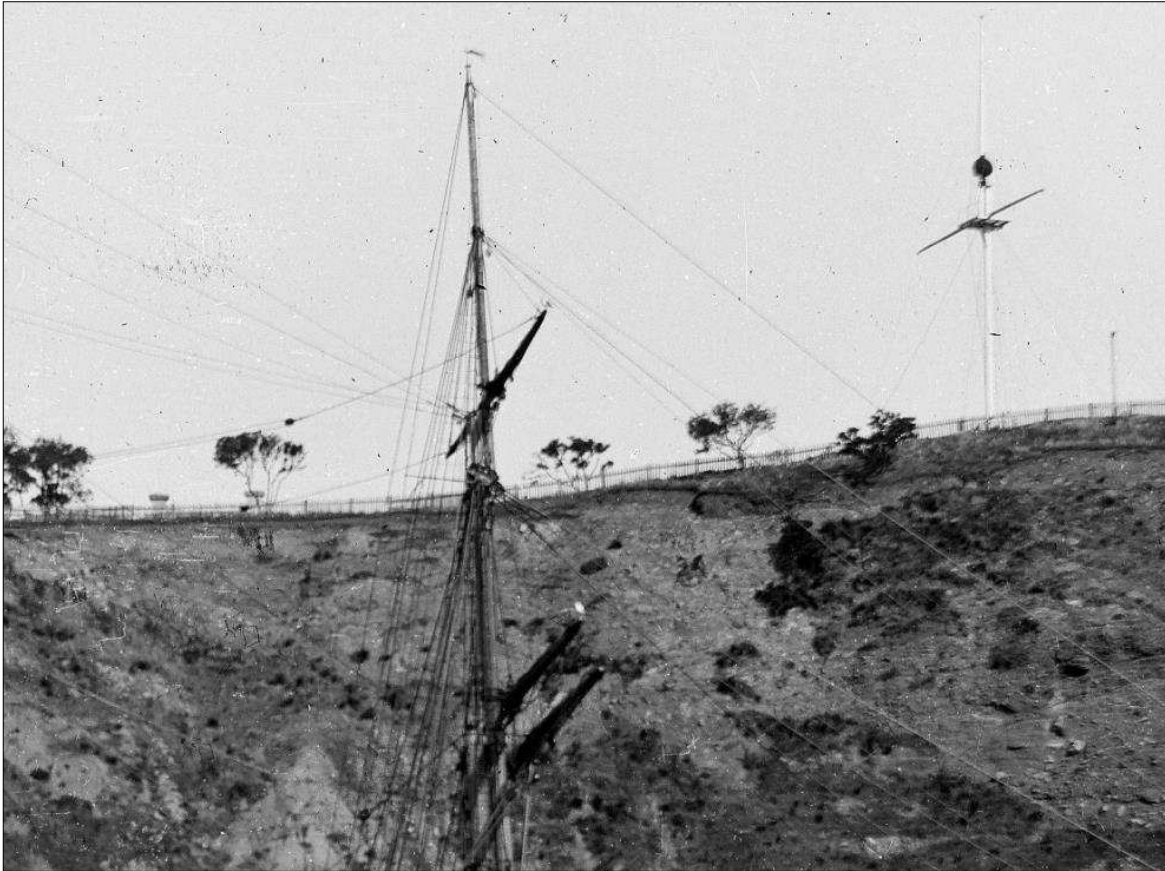


Figure 12: A close-up from a photograph of the sailing ship *Waipa* which shows the time ball at Port Chalmers some time prior to 1895 (courtesy: Alexander Turnbull Library, Ref: 1/1-002534-G).

be eleven miles out of position. (Shipping, 1877).

Published records of a meeting of the Harbour Board in January 1881 indicate that the time ball had been discontinued for some time, but that action was required in response to protests from shipmasters:

The following petition, which was signed by eleven shipmasters, was received: Port Chalmers, January 26, 1881. To the Chairman and Members of the Otago Harbor Board. Gentlemen, We, the undersigned, masters of vessels at present in port of Otago, respectfully desire to draw your attention to the great disadvantages under which we labor in consequence of the disuse of the time-ball at Port Chalmers, and desire to urge upon you the great necessity which exists for the appointment of some competent person to work the ball and otherwise attend to the duties of the signal station at this port. We trust our application will meet your favorable consideration. (Time ball, 1881).

After considerable discussion concerning previous inaccuracies, location of the time ball and methods for its control, "... it was resolved to inform the memorialists that a time-ball would be erected shortly."

6.2 Control from Wellington

On 15 March 1881 it was announced that the time ball was to be regulated in future by telegraph signal from Wellington:

On receipt this morning of intimation from the Wellington Telegraph Office that the time ball at Port Chalmers would in future be worked in connection with the telegraph, notice thereof was sent round to the masters of vessels by the harbor authorities. The time ball was dropped at the instant the current moved the needle of the galvanometer. The time given is mean time at longitude 11h 30min 00.3 [sic] sec east. (*Evening Star*, 1881).

6.3 Change to a Weekly Service

The lack of announcements during the following year suggests that the new service was only introduced in April 1882, when the signal was offered once per week :

TIME BALL AT PORT CHALMERS. New Zealand mean time at noon, calculated for the meridian of longitude, in time 11 hours 30 minutes east of Greenwich, will be signalled once a week by the time-ball dropping at the instant of mean noon. A blue flag will be hoisted at the mast-head, Port Chalmers signal-station, on the forenoon of the day when the time-signal will be given. (Shipping, 1882).

Regular time ball announcements in the *Otago Daily Times* re-appeared in April 1882 after the change to a weekly service. The last newspaper notice appears to have been in 1906 (Time ball at Port Chalmers, 1906), although New Zealand nautical almanacs indicated that the service was operating in 1908 and 1909 after development of the new Wellington observatory during 1907.

The latitude and longitude of the time ball are given in the 1898 Admiralty list (see Table 2) as 45° 49' 0" S. and 170° 39' 0" E (corresponding to 11h. 22m 36s E), almost exactly those stated in early announcements. This confirms that the time ball was not relocated. Rounding to the nearest minute of arc is likely to indicate the perceived accuracy.

6.4 Entries for Otago in the *New Zealand Nautical Almanacs*

The entry in the 1903 *New Zealand Nautical Almanac* was similar to those published in the late nineteenth century:

A time ball is dropped about once a week from the flagstaff at Port Chalmers at noon New Zealand standard mean time, or 12. 30m. 0s. Greenwich time. When the ball is to be dropped a blue flag is hoisted on the signal-staff at about 10h. 0m. 0s. a.m. *New Zealand mean time.*

The same notice was repeated up to 1906, but the entry for 1907 was changed to "The time ball has been temporarily discontinued." This is likely to have been caused by construction of the new observatory at Wellington during 1907, when only a temporary observatory was available. The original notice reappeared in the 1908 and 1909 editions. That changed in 1910 to "The time-signal ball dropped from Port Chalmers Signal-station has been discontinued." The same notice appeared in editions up to at least 1918.

The Otago time ball service had long ceased by 1919, but the demand for an accurate signal was still present:

At the termination of the meeting of the Harbour Board yesterday the chairman (Mr H. L. Tapley) introduced Captain Sebourne, who has distinguished himself in connection with submarine Warfare ...

The second matter was that means for rating chronometers were not provided at the Port – there was no time ball to correct them. That could be done by going to Lyttelton, but he thought that there should be a time ball here. Mr Galbraith asked if wireless time would not supply the deficiency, and take the place of a time ball. Captain Sebourne replied in the affirmative. Mr Galbraith then remarked that the Government had that matter in hand. (*Otago Daily Times*, 1919).

The Port Chalmers time ball service was never re-established after 1909.

7 THE AUCKLAND TIME BALL

7.1 The First Auckland Time Ball in 1864

The first time ball at Auckland was established by Captain Williams at Smale's Point. He offered a Sunday service only at 9 am, Auckland time, with a newspaper notice on the following Monday to state the time of the drop. The new service started on Sunday, 7 August (*New Zealand Herald*, 1864). Its announcement was republished fifty years later:

To the Editor of the NEW ZEALAND HERALD. A time ball for the benefit of the city and shipping will be dropped every Sunday morning about 9 a.m., and will be hoisted at the mast head, Smale's Point, some five minutes before it is let fall. The corresponding Auckland, as also Greenwich mean time, at which the ball was dropped, will be published in this journal on the Monday morning.
S.J. WILLIAMS Smale's Point (*New Zealand Herald*, 1914).

A typical Monday notice is transcribed below:

The mean time when the Ball dropped yesterday morning
Auckland 8h. 59m. 48s.
Greenwich 9h. 20m. 37s.
S.J. WILLIAMS Smale's Point (*New Zealand Herald*, 1865).

The local mean time was estimated to be 11 hours, 39 minutes and 11 seconds ahead of Greenwich. The longitude may have been calculated using data obtained by Wellington observatory. There is no known photograph of the time ball at Smale's point, but Figure 13 shows the view in January 1864 from close to its probable location later that year.

The service appears to have ceased on Sunday 10 June 1866, less than two years after it started, with a final published notice on the following day (*New Zealand Herald*, 1866a).

In practice, this time service would have been of limited value to navigators, who really required a daily service for rating chronometers while in port. It is not known how Captain Williams determined mean time or how he designed and constructed a time ball apparatus. He may have possessed a high quality astronomical clock and chronometer which he could calibrate in the City. The Wellington time ball service started in March 1864, a few months before his, using a heavy-duty apparatus provided by Sandys and Co. in England (Kinns, 2014). Williams' apparatus was probably much simpler with a light wickerwork ball and manual release.



Figure 13: A photograph of Auckland Harbour taken from Smale's Point on 29 January 1864 (courtesy: Auckland Libraries, Sir George Grey Special Collections, 4-1166).

7.2 Bartlett's Time Ball in 1866

The apparent demise of Williams' time ball may have been associated with the provision of a time ball by Mr A.G. Bartlett. He described himself in advertisements as a "Chronometer, Watch and Clock Maker" with a business on the corner of Shortland-street and High-street. He gave his credentials as "23 years Examiner to Messrs. Crockland & Atkins of 7 Cowper's Court, Cornhill, London" (*New Zealand Herald*, 1866b). Cornhill was the location of many chronometer-makers in England.

The new service was announced in the *New Zealand Herald*:

Mr. Bartlett has caused his time ball to be erected at his residence, a high situation in Coburg-street. This cannot fail to be of great convenience, and the unfailing correctness with which, by the aid of the transit instrument, time is kept, is a boon to men of business. It is commendable to the enterprise of this scientific chronometer maker, that "Bartlett's time" has become familiar in our mouths as household words. (Bartlett's time ball, 1866).

Although Bartlett's time ball may have been useful to local businesses, it fell short of providing a viable service to mariners.

Published correspondence in 1874 showed further interest in erection of a new time ball for mariners.

7.3 Proposal for a Time Ball in 1874

The Telegraph and Post Office had burned down in 1874 and there were suggestions that it should be rebuilt with a time ball. Extracts from an editorial in the 6 October 1874 issue of the *Auckland Star* are shown below:

The renovation of the lately burnt down Post-cum-Telegraph office is approaching completion, and the freshened aspect of its facade is quite imposing ...

As the support for a time ball, which is surely a necessity in every commercial port, as a means of signalling any approaching gales to the shipping in harbour, in accordance with the new system inaugurated, and as an embellishment to a city that has but few objects of architectural pretension, the tower once intended and since neglected is deserving of an effort on the part of our citizens. (Editorial, 1874).

The response was ambivalent and no action appears to have been taken:

The Mayor wished first to direct the Commissioner of Customs' attention to the desirability of completing the Post-office building, which had been handed over to the General Government, by the erection of a tower with the addition of a time-ball, which was of very great use to an important shipping port like Auckland. The tower could be utilized for many purposes, and the clock would not only be useful but ornamental.

Mr Reynolds said that the matter was one which came within the Department of the Minister of Public Works ... He should certainly not be in favour of erecting a time-ball there, as it would not be of any use; it would be better to erect it in a position nearer the harbour ...

Captain Daldy said if the Government intended to carry out the system of storm signals the time-ball would be required in connection with the telegraph. It was desirable that the time-ball should be connected with the Telegraph Department, which he believed would occupy that building. (Public Works in Auckland, 1874).

No evidence of further activity has been found before 1883. Possible provision of a time ball was discussed on several occasions in the years up to 1900.

7.4 Public Discussion between 1883 and 1900

The possibility of progress was noted in 1883:

We have been favoured with a glance at the conditions for the guidance of architects sending in competitive designs for the new Harbour Board offices. The building is to be situated on the reserve bounded by Little Queen, Quay, and Albert-streets, and Mr Goldie's property, and is to be three stories high, and provision is to be made for a time ball tower. (*Auckland Star*, 1883).

Still nothing happened and a discouraging note appeared in 1885:

The Works and Tariffs Committee's recommendations were: – (1) That the Board decline to expend £700 or £800 in providing a reliable time ball apparatus. (Harbour Board, 1885).

Another editorial in support of time ball procurement and the required operational budget was published in 1886 (*New Zealand Herald*, 1886). It was in support of a correspondent and showed that the design of the Victoria Arcade building had made provision for a time ball apparatus:

When the Victoria Arcade was in course of erection, representations were made to the directors of the New Zealand Insurance Company of the suitability of the projected clock tower of their new building for the purposes of a time ball, and urging the importance of one being fixed on it. On these representations, the directors caused the plans of the building to be altered, and the tower strengthened in order to render it available for the proposed object. After this expense has been incurred, we learn that the Government refuses to sanction the very small expenditure that would be involved in placing and maintaining the tower in electric contact with the telegraph office, and thence with Wellington, in order to secure the desired end. This is, we think, a matter on which strong representations might be made by the Chamber of Commerce and the Harbour Board.

Again, nothing happened. Another attempt to establish a time ball was made in 1893:

... Mr Crowther will move (1) "That the next ordinary meeting of the Board be held on Tuesday the 9th January, 1894, at 2.30 p.m." Mr Porter will move (2) "That the Secretary be instructed to communicate with Sir J. Hector, Colonial Museum, Wellington, with the view of obtaining information as to time ball for harbour purposes, and estimated cost of fitting and erecting same on the offices of this Board; time ball to be of a similar description to those

in use at Lyttelton and Wellington." (*Auckland Star*, 1893).

It was at least recognised that the apparatus would have to be of similar quality to those at Wellington and Lyttelton, to be of value to mariners. Progress was still snail-like and there was no time ball during the last twenty years of the nineteenth century. That certainly explains the lack of an entry for Auckland in the 1880 and 1898 Admiralty lists.

Another strongly worded petition for a time ball was published in 1900:

Time Ball: A petition signed by over 60 ship-owners, agents, and shipmasters, was read, drawing attention to the great inconvenience caused by the absence of a time ball at the port. Auckland, said the petition, was the only port in Australasia where such a necessary adjunct to navigation was absent. The petition was referred to the Works and Tariff Committee. (*Auckland Harbour Board*, 1900).

The lack of a time ball was an embarrassment to such an important port.

7.5 The Time Ball on The Harbour Board Building

A time ball for Auckland was finally under detailed discussion in 1900, with support from the Admiralty:

Machinery, Time Balls, etc. – Messrs. W. and A. McArthur wrote that the Admiralty considered it better that shop tools and iron ladders should be made in Auckland, and enclosing sketch thereof. Information with regard to the time ball, core former, sheer legs, etc., was also forwarded. – Referred to the Works and Tariff Committee to report. – The Acting-Chairman said the work could be done here for a small sum of money. It was at first thought it would cost a lot. (*Harbour Board*, 1900).

Tenders for construction of the time ball were invited with a closing date of 30 April (Tenders, 1901). Meanwhile, the possibility of a time gun also was debated:

TIME BALL: Sir, – I see by your paper that, we have got a time ball for Auckland, by which to regulate our clocks and watches, but like many others I have no opportunity of seeing such a thing from my point of view, and without undervaluing the time ball I think that (if practicable) the electric wire might be extended to the Albert Park and connected with one of the guns there, and at the same moment that the current frees the ball it will also discharge the gun, which could be heard all over the city, and so greatly extend its usefulness, a plan adopted in Edinburgh. (*Auld Reekie*, 1901).

The proposed system would be like that used in Edinburgh since 1861, when the gun was introduced to complement the time ball that had become operational in 1854 (Kinns, 2011). Bart-

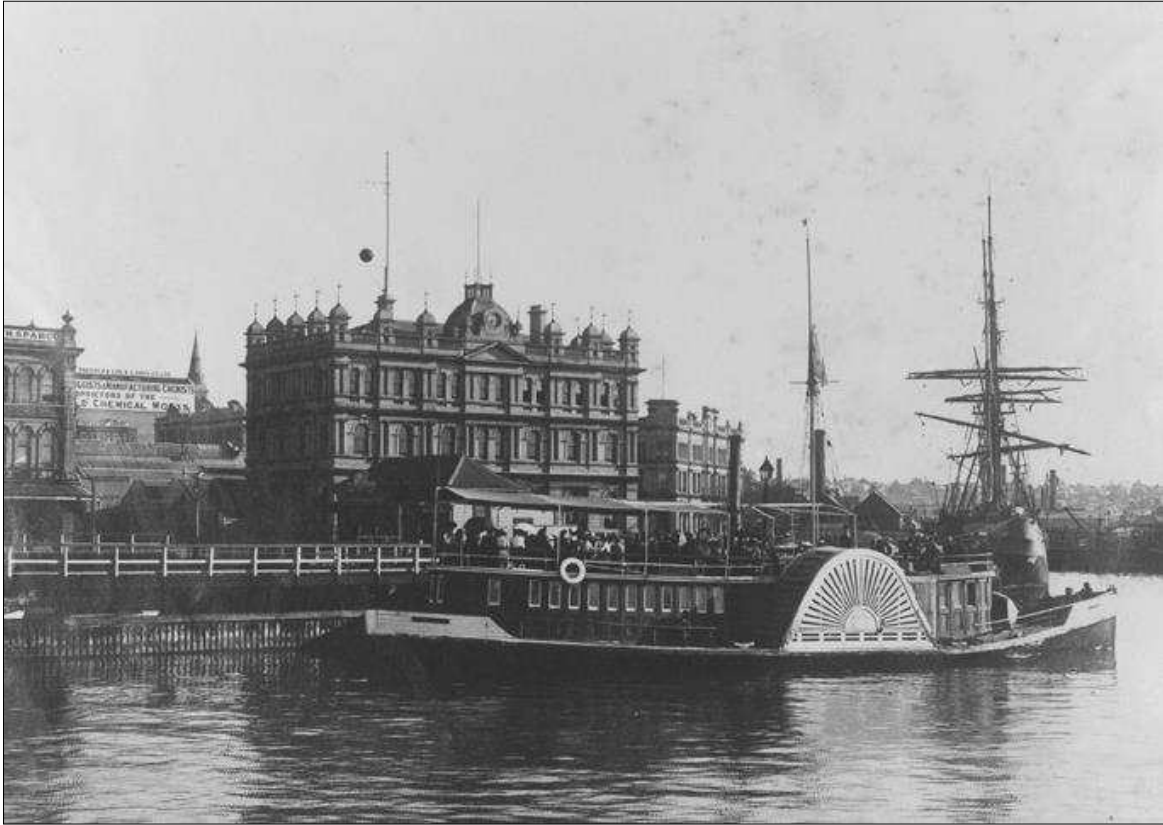


Figure 14: Harbour Board Building, pre-1911 (courtesy: Auckland Libraries, Sir George Grey Special Collections, 4-2938).

lett was given a budget of only £30 per annum to operate the time ball:

Works and Tariff Committee. – The report of this committee was adopted ... that Mr A. Bartlett be requested to take the necessary steps to cause the time ball to be dropped at 12 noon every day, excepting Sundays and holidays, payment not to exceed £30 per annum ... (*Auckland Star*, 1901).

It was 35 years since he had operated a time ball at his own premises.

7.6 Design of the Auckland Apparatus

The time ball can be seen on top of the Harbour Board Building in Figure 14. The photograph has uncertain date. As shown in the Figure 15 close-up, the time ball is clearly off-set from a tall mast. This suggests that the apparatus was dissimilar to those used at Lyttelton or Wellington and may have used the 'Devonport Principle'. This type of design was outlined in correspondence relating to a new time ball for Portsmouth:

In the more recent form of apparatus, there are two vertical guides (wire) and when once the ball is hoisted it is held by a small rope. Everything else being loose, the ball drops about a foot before the thick rope used in hoisting comes into real action. (Astronomer Royal, 1910c).



Figure 15: A close-up of the time ball shown in Figure 14 (courtesy: Auckland Libraries, Sir George Grey Special Collections, 4-2938).

The design had been developed by William Wharton, Hydrographer of the Navy, and was first used at Devonport, England. It was much cheaper than the designs using rack and pinion mechanisms for hoisting the ball, gave a larger drop distance and was used almost universally for installations after 1885:

The principle of our Time Ball [at Greenwich] is not so suitable as the later pattern which was adopted at Devonport about 1884-5 and has been so successful that it has been copied at Ports all over the world. Moreover it is doubtful whether the firms that originally installed our apparatus are now in existence. (Astronomer Royal, 1910b).

The dominance of the design was emphasised in an internal note to the Astronomer Royal:

90% of recent Time-Balls are on the Devonport Principle. This gives a drop of 18 to 20 ft. The Greenwich type [supplied by Maudslay, Sons & Field] can scarcely be expected to give anything like this – Ours is 10 ft. (Lewis, 1910b).

The Auckland time ball finally became operational in September 1901:

Harbour Board Offices, September 6th, 1901. Notice is hereby given that the Time Ball erected at the Offices of the Board, Quay-street, will be Hoisted every day (Sundays and holidays excepted) at 11.50 a.m. and Dropped at 12 Noon, Colonial Mean Time (same time as observed in the town). By order of the Board. J. M. BRIGHAM, Secretary. (Time ball, 1901).

So far, so good, but other expenditure was needed:

Mr A.G. Bartlett wrote asking for a clock, cost £50, to assist in keeping the time ball correct – The letter was referred to the Works and Tariff Committee. (Harbour Board ..., 1901).

Regular notices about the time ball drop appeared in the *Auckland Star* and continued up to August 1902 in one of two forms:

TIME BALL: The time ball drops at the Harbour Board Buildings at noon daily. New Zealand mean time, equivalent to 12 hours 30 minutes Greenwich mean time. (*Auckland Star*, 1902a).

TIME BALL: Harbour Board Offices, August 2nd, 1902. Notice is hereby given that the TIME BALL erected at the Offices of the Board will be hoisted every day (Sundays and Holidays excepted) at 11.50 a.m., and dropped at 12 noon, Colonial mean time (same time as observed in the town). By order of the Board. M. H. LAIRD, Acting Secretary. (*Auckland Star*, 1902b).

The service did not last long and appeared to have stopped on 5 August 1902. Not long afterwards, it appears to have been abandoned altogether:

The Harbour Board, at its meeting yesterday,

decided on the recommendation of the Works and Finance Committee to incur no further expenditure in regard to the time ball over the Board's buildings. The chairman (Mr. J.T. Julian) said the time-ball had become the laughing stock of the port on account of its unreliableness, and Mr. J.A. Walker said that the visiting naval officers, as well as shipping masters, had ceased to take any notice of the thing for the reason stated by the chairman. Mr. W.J. Philson said he thought a correct timeball was essential for any sub-naval station, but other members regarded the matter of adjusting the present instrument as apparently hopeless, and adopted the committee's report. (Local and General News, 1903).

The following letter was published in the *New Zealand Herald*:

Sir, – A few years ago the Harbour Board, at some considerable expense, imported and erected a time ball for the benefit of vessels frequenting this port, but, as the antics of the said ball became very erratic, further expense was incurred by an additional pole. An astronomical clock was next to arrive, followed by an individual with electrical knowledge: still the ball remains a fixture ...

– I am, etc. Correct Time. (Time ball, 1904).

There were further attempts to re-establish the service, still involving Mr. Bartlett, and the following statement was published in 1905:

Time Ball Wanted. – Mr Dacre moved. "That it is in the interest of the port that a correct, time ball be kept in use." He found there was a great need of this, and it was a necessity for any up-to-date port. – Mr Napier, seconding, asked why it was not gone on with. – The Chairman said it was because of complaints that it was inaccurate. It cost £50 a year to maintain, and he thought it was unnecessary expense. When the matter was gone into two years ago Mr Bartlett told them that to ensure correct time it would be necessary to erect an observatory in the Albert Park – The matter was referred to the Works and Tariff Committee. (Harbour Board, 1905).

This was followed by another announcement:

The Harbour Board has instructed its engineer to submit an estimate of the cost of putting an observatory into the Albert Park, and requested Mr A. G. Bartlett to quote the cost of maintaining the time ball at accurate time. (Advertisement, 1905).

Yet another plan was published in the following year, whereby electro-magnetic triggering was to be used, with control from Wellington:

Mr. J. Hamilton, director of the Colonial Museum, Wellington, has written to the Harbour Board stating that the Superintendent of Telegraphs is willing to arrange for the Auckland Harbour Board's time ball to be dropped by the Wellington standard signalling clock each weekly rating day provided that the ball has an electro-magnetic trigger. Mr. Logan was will-

ing to lay on a special wire from the Auckland Telegraph Office to the ball tower. The Wellington clock would then be connected with the main line to Auckland and the ball, being properly set, could be made to drop exactly when the clock makes contact with its chronograph. That referred to the weekly signal, but if desired any other day, that could also be arranged. The balls at Port Chalmers and Lyttelton are similarly dropped at one p.m. (Advertisement, 1906).

Progress appeared to have been made with a decision by the Harbour Board to erect a new time ball:

The fortnightly committee meeting of the Auckland Harbour Board was held yesterday afternoon. In reply to requests from Captain McNellar, of the SS Kaikoura, it was decided to state that a time ball would be erected on top of the proposed offices in the corner of Queen-street as soon as convenient. (*Auckland Star*, 1907).

Inclusion of an observatory was suggested after another year had elapsed:

Time Ball. – In answer to a letter from J. Hamilton, of Wellington, re a time ball, it was decided on the motion of the Chairman to inform the writer that the Board contemplated erecting a building on the water front, which would be fitted with an observatory. (Harbour Board Committee, 1908).

A photograph of new breastwork shows that the ball was still in place on the Harbour Board building in 1909 (Improvements ..., 1909). It was probably removed at some time before 1913, when a time ball should have become operational on the new Ferry Building.

7.7 The Time Ball on the Ferry Building

There was still no time ball in 1911 (A time ball for Auckland, 1911). A time ball on the new Ferry Building should have been operational in the following year, but the excuse was that there had been a problem in connecting the time ball to the Post Office (The time ball, 1912). The unfortunate saga was exposed in the *Auckland Star*:

The Harbour Board engineer reported to the Board this afternoon that although the time-ball had been ready for many months and connection with the post office had been promised in April last, nothing whatever had been done by the Department, and the gear was simply rusting from inaction. In connection with this matter a "Star" reporter, who made inquiries in official circles, was informed that the Department had never been made aware that the time-ball was ready for connection. The Department would fix it up at once when the Board was ready, but no intimation of any kind had been received, nor any suggestion of a conference made. When the connection is made it is understood that the exact

mean time will be made available from Wellington at certain defined periods, possibly twice a week. (Time ball: a Department's inaction, 1913).

Figure 16 shows a photograph of the Ferry Building in April 1913, taken before the clock had been installed. A small diameter ball can be seen on the mast above the tower. A notice published two years later suggested that a new time ball service was at last imminent:

The time ball on the Ferry Buildings will in future be dropped daily at 1 p.m., while on the day of the week on which a time signal is flashed from Wellington a red flag will be displayed from the building. (*Auckland Star*, 1915a).

The plan was changed in August 1915 to the use of night-time signals (*Auckland Star*, 1915b), the time ball having proved to be unreliable yet again:

Another attempt probably will be made by the Auckland Harbour Board to provide time signals for the harbour. At to-day's meeting of the Board a letter was received from the acting Government astronomer approving of the proposal for two time signals per week at 9 p.m. Usually signals of guaranteed accuracy were provided on three nights a week at Wellington, and he felt fairly safe in promising two for Auckland.

The harbourmaster (Captain Sergeant) recommended that the signals should be given only on those nights when the observatory could guarantee them. The Government Astronomer should notify the Board by telegram at 2 p.m. on the days when he could guarantee the signals. When such telegram was received a red flag should be hoisted on the tower of the Ferry Buildings from 4 p.m. to 4.30 p.m., notifying shipping that a guaranteed time signal would be given that night. At least two guaranteed signals per week should be given at 9 p.m. and the following lights shown from the flagstaff of the Ferry Buildings. – Green light switched on at 8.10 p.m., red light at 8.50 p.m., white light at 8.55 p.m. All lights switched off at 9 p.m.

The Harbourmaster further recommended, that the present time ball-signals should be discontinued at once owing to their irregularity, and the night signals commenced as soon as the mechanism had been installed. (Time signals: a new proposal, 1915).

The Auckland time lights were operating by the end of 1915.

7.8 Entries for Auckland in the *New Zealand Nautical Almanacs*

There was no mention of an Auckland time ball in the first (1903) edition of the *New Zealand Nautical Almanac*, but the statement "The time ball has been temporarily discontinued ..." app-



Figure 16: The Auckland Ferry Building on 8 April 1913 showing the time ball on the mast (courtesy: Auckland Libraries, Sir George Grey Special Collections, 1-W1555).

eared in the editions for 1905 to 1910 (the 1904 and 1911 editions have not been seen by the author). In the 1912 edition, this was expanded to

The time ball has been temporarily discontinued. When the Ferry Buildings, now in the course of erection, are completed the time-ball will be placed at the summit of the tower.

The statement in the 1914 edition was

The time ball has been erected on the tower of the Ferry Building and will shortly be ready for use. It will be dropped at noon each day, except Sundays.

That was changed again in the 1915 edition to

The time ball has been erected on the tower of the Ferry Building, and is now awaiting satisfactory connections with the Government Observatory at Wellington.

The 1916 edition confirmed the final demise of the Auckland time ball:

The time ball has been discontinued and a system of night signals has been adopted. Not less than two guaranteed time signals per week will be given at 9 p.m.

8 OTHER NEW ZEALAND TIME SIGNALS

8.1 Time Balls

Time balls existed at various other places in New Zealand, but they appear to have been used mainly to provide time signals for local inhabitants, rather than a calibration service for chronometers on ocean-going vessels. Wright (2007) noted those at Wanganui and Timaru.

8.2 The Wanganui Time Ball

A Wanganui newspaper editorial on 16 October 1874 expressed the frustration that occurred when a local time ball was not maintained or operated properly:

The irregular manner in which the time ball has been attended to of late has been the cause of great complaints being made by the public, especially the working men. On Wednesday it was not put up until 0.55 p.m., and dropped at 1 p.m. Yesterday (Thursday) it went up about noon and fell at 0.45, going up again a little before 1 p.m. and dropping at the full hour. If Wanganui has a time ball, we do not see why it should not be attended to properly, and if anything goes wrong, the cause should be ascertained and remedied. As at present

attended to, it is quite useless, as it misleads some, while others take no notice whatever of it. (*Wanganui Herald*, 1874).

Most references to a time ball at Wanganui are in 1886 or later, when a time ball was located on a mast at the Harbour Board's signal station on Durie Hill. There appear to have been persistent difficulties in operating the station with limited staff and budgets (The signal station, 1899). It was reported that the ball had once blown down in a gale:

A heavy nor'-westerly gale was experienced to-day, and a big sea was running, in the roadstead. The gale blew with great force on Durie Hill, and about 12.5 o'clock brought down the time ball from the flagstaff, a passer-by having a very narrow escape, as the ball fell with a crash within a couple of feet of him. (*Local and General*, 1914).

The Wanganui time ball was not mentioned in any edition of the *New Zealand Nautical Almanac* from the first in 1903, so it was not regarded as an official signal for mariners.

8.3 Time Guns

A time gun at Nelson fired for the first time on 11 September 1858 (Nelson town improvements, 1858), almost three years earlier than the time gun in Edinburgh (Kinns, 2011). It was fired at noon on Saturdays, but did not feature in the Admiralty lists as an official signal for mariners. There were occasional minor incidents concerning safety (*New Zealand Herald*, 1878).

Time guns were used at other locations, including Dunedin and Auckland, but were often controversial because of disturbance, concerns about safety and the cost of maintaining the service. A gun was installed on Mount Victoria in Wellington at the end of 1877, but ceased to operate in 1880 when the supply of cartridges was discontinued on grounds of cost (News and Notes, 1880). No time gun in New Zealand was included as an official signal in either Admiralty lists or *Nautical Almanacs*.

9 CONCLUDING REMARKS

Accurate time signals in New Zealand were important for navigation in the Pacific. The provision of time balls at Wellington, Lyttelton, Port Chalmers and Auckland has been described. Time balls at Wellington and Lyttelton were noted in the 1880 Admiralty list of time signals, with the addition of the Port Chalmers (Otago) time ball in the 1898 edition. Time balls were operated in Auckland for short periods during 1901–1902 and 1915, but failed to provide a reliable service and were soon abandoned. The later history of time balls has been traced through successive editions of the *New Zealand Nautical Almanac* from 1903 onwards.

9.1 Wellington

The time ball service at Wellington started in March 1864 using the first official observatory in New Zealand. The apparatus was supplied by Sandys & Co of London and used a rack and pinion system for hoisting. The ball diameter was 1.65 metres with an unusually large drop height of 5.5 metres. It was installed at the Customs House on the Wellington waterfront. Accurate determination of longitude at the time ball location was a particular challenge; the drop time was adjusted when improved estimates of longitude became available. Newspaper notices about the time ball petered out in 1875. It is likely that the time ball service was still operating in 1879, but it had ceased in 1882 at the start of long period of waterfront redevelopment. After prolonged discussion that included the possibility of a time ball on Mount Victoria, a second time ball service started in November 1888 at a different harbour-side location. The original time ball had been destroyed, but the mechanical apparatus had been saved. A new ball was manufactured, apparently using the design for Lyttelton, and had a diameter of 1.5 metres. The ball drop was over 5 metres. The system was destroyed by fire in March 1909 and was never replaced. Instead, a sequence of time lights was inaugurated in 1912.

9.2 Lyttelton

The service at Lyttelton, near Christchurch, began in December 1876 after construction of the signal station there. It used telegraph signals from Wellington to regulate the time ball. By the end of 1909, Lyttelton had the only official time ball in New Zealand, those at Wellington, Auckland and Port Chalmers having been discontinued. The Lyttelton time ball service continued until it was finally rendered obsolete in 1934 by the wide-spread availability of radio time signals.

The Lyttelton time ball apparatus was shipped by Siemens Brothers of London in 1874, but the mechanical apparatus replicated the original 1855 design for Sydney, New South Wales, which had been supplied by Maudslay, Sons & Field. It is known that Maudslays received an order for another apparatus in 1873 and that there was an association with Siemens. The ball had a drop of 3 metres and a diameter of 1.5 metres. The differences between the Sydney and Lyttelton systems in 2009 reflected the changes made in Sydney since original manufacture.

The Lyttelton time ball tower was an iconic landmark in New Zealand that had been carefully restored. Tragically, the tower collapsed during the 2011 earthquakes and aftershocks that devastated Christchurch.

9.3 Port Chalmers

A daily time ball service at Port Chalmers, near Dunedin, started in June 1867, initially using local observatory facilities. It appears to have been discontinued in 1877 and therefore was excluded from the 1880 Admiralty List. The intention to use telegraph signals from Wellington for future time ball operation was announced in March 1881, but the service was reduced to weekly in April 1882. It was suspended in 1907 and terminated by the end of 1909.

9.4 Auckland

Auckland never established a reliable time ball service, despite provision of a weekly service for mariners by a public-spirited citizen between August 1864 and June 1866. A time ball was finally installed on the Harbour Board building in 1901, but the signal had poor accuracy and the service was soon withdrawn. Complaints from ships' masters led to various attempts to re-establish a service. These concluded with erection of another time ball on the new Ferry Building in 1912, but the service only started in April 1915, proved to be unreliable and was soon discontinued. It had been replaced by time lights before the end of 1915.

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The work was based initially on notices, articles and correspondence that appeared in New Zealand newspapers from the 1860s onwards. This material was accessed on-line using 'Papers Past', a free service provided by the National Library of New Zealand. This was complemented by research in Cambridge and I thank the Science and Technology Facilities Council and the Syndics of Cambridge University Library for permission to use material from the Royal Greenwich Observatory archives in this paper.

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10.1 Dedication

This paper is dedicated to the memory of Alice McElroy (1917–2014), a family friend in Christchurch who inspired the first of many visits to New Zealand from my home in Scotland. The first visit in February 2000 included a demonstration of the Lyttelton time ball by Bruce Carr of the NZ Historic Places Trust, which led to my enduring interest in the history of time signals worldwide.

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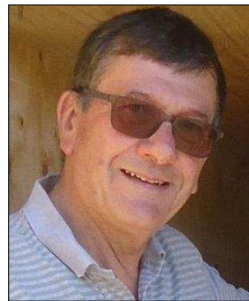
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