

Historical earthquakes in Tasmania - Revised

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Abstract The earthquakes investigated here occurred between 1827 and 1954, well before the first modern seismograph commenced operation in Tasmania in late 1957. Three additional magnitude ~6 earthquakes have been identified, two in the 'large swarm' of 1883-1892 and another in 1907. The most destructive earthquake in Tasmania since European settlement and the most destructive in Australia between the 1903 Warrnambool and 1954 Adelaide earthquakes, occurred near Launceston, onshore, in 1929. The pattern of post-1965 instrumental earthquakes is quite different from that of the previous 120⁺ years showing that it can be quite misleading to use a short observation period for long-term hazard assessments. Several damaging earthquakes have been discovered that did not contribute to past earthquake hazard estimates so a new hazard study should be done. A brief review is presented of tsunamis that have impacted Tasmania.

INTRODUCTION

The high level of seismicity in Tasmania in the late 19th century, documented in contemporary newspapers (e.g. letter by J. Shortt to Editor *Launceston Examiner*, Monday 17 December 1883, Page 3), much of it in a 'large swarm' off the northeast coast, led to early seismicity maps showing the circum-Pacific belt extended to include Tasmania, in contrast with its apparent quiescence today. The dates of the start and end of the swarm are not clear, the *Launceston Examiner* (Monday 31 December 1883, page 2) suggests the first event of the swarm was on 26 May 1883 but we have found earthquakes there as early as 12 April 1883. Earthquakes continue to the present day east of Flinders Island, the last widely-felt event there in 1946.

There is also a marked apparent change in earthquake locations, 19th century events clustered off northeastern Tasmania, whereas late 20th and early 21st century earthquakes were predominantly in Western Tasmania as shown on the epicentre map (Figure 1). Two geologically-recent prehistoric fault scarps in the southwest of the state near Lake Pedder, are evidence of major earthquakes ($M \geq 7$) in the not-so-distant past.

Carey and Newstead (1960) established a modern 4 station, short-period seismograph network in Tasmania from 1957-1962 after Carey identified the Lake Edgar Fault Scarp as the result of a Recent earthquake and to monitor the large hydro-electric scheme being built. This network was perhaps the World's first telemetered seismograph network (Jensen, 2000), but the first recorded seismogram, on a seismoscope assembled by Captain Shortt, was recorded at St. Mary's much earlier on 7 December 1883 (*The Mercury* Saturday 15 December 1883, Page 2). The predominant direction of ground motion observed was north-south indicating the focus was to the east (not felt to the west), since the maximum deflection would have been caused by the 'S' wave.

The seismicity of Tasmania has been studied at intervals since Shortt and Biggs in the 1880s. Ripper (1963) documented the extraordinary swarm of strong earthquakes at the end of the 19th century, more than 2500 of them felt, the largest of which caused minor damage in Launceston and was felt as far as Kiandra NSW, south of Sydney, about 800km away.

Shirley (1980), Michael-Leiba (1989), Richardson (1989), and Gibson and others (2000) all contributed to our understanding of the seismicity of Tasmania.

A plot of earthquakes from 1827 to 1959 is shown in Figure 2, the epicentres from this report

and others, notably Michael-Leiba (1989).

Hogben (1912) mapped an earthquake off the northwest coast of Tasmania on 13 January 1910 which, if accurately located, should have been felt throughout Tasmania and in Victoria, which it wasn't, so McCue (2001), using phase arrivals from seismographs in New Zealand and at Riverview, re-located it. The revised epicenter was off the east coast at 44°S, 155°E and its magnitude was 6.0 from the Riverview amplitude and distance. This location satisfies the lack of felt reports from Tasmania and Victoria, and is in a known seismic zone.

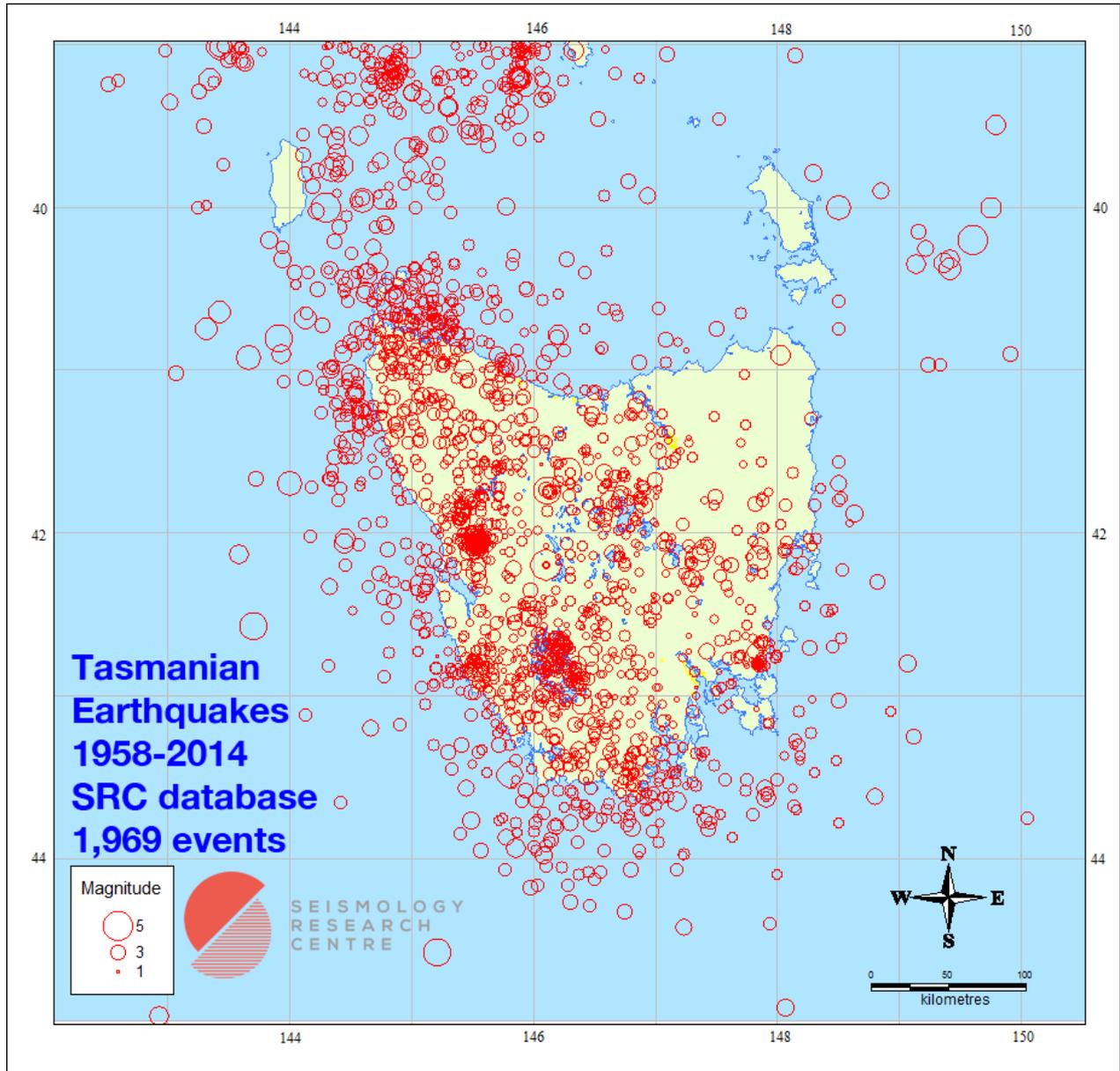


Figure 1 Seismicity of Tasmania, 1958–2014 (Adam Pascale, SRC). The 19th century earthquakes were off the NE coast, but the smaller post-1958 earthquakes are mostly in the western half of the island.

Underwood (1973) produced the first hazard map of Tasmania which was modified for the building code by McEwin & others (1976). Later hazard maps were published by McCue (1978) and Michael-Leiba & Gaull (1989). Michael-Leiba (1989) drew isoseismal maps for many of the larger earthquakes enabling her to assess their magnitude.

Isoseismal maps of Australian earthquakes are compiled in three atlases by Everingham & others (1982), Rynn & others (1987) and McCue (1996). Included in these volumes are isoseismal maps of 4, 0 and 15 Tasmanian earthquakes respectively.

Most of the post-1960 onshore foci are in the ancient Pre-Cambrian rocks of western Tasmania while the dramatic sequence of late 19th century events are northeast of the state. Perhaps the older crust is more highly fractured than the Paleozoic crust of eastern Tasmania, the two geological provinces separated by the Tamar Fracture System.

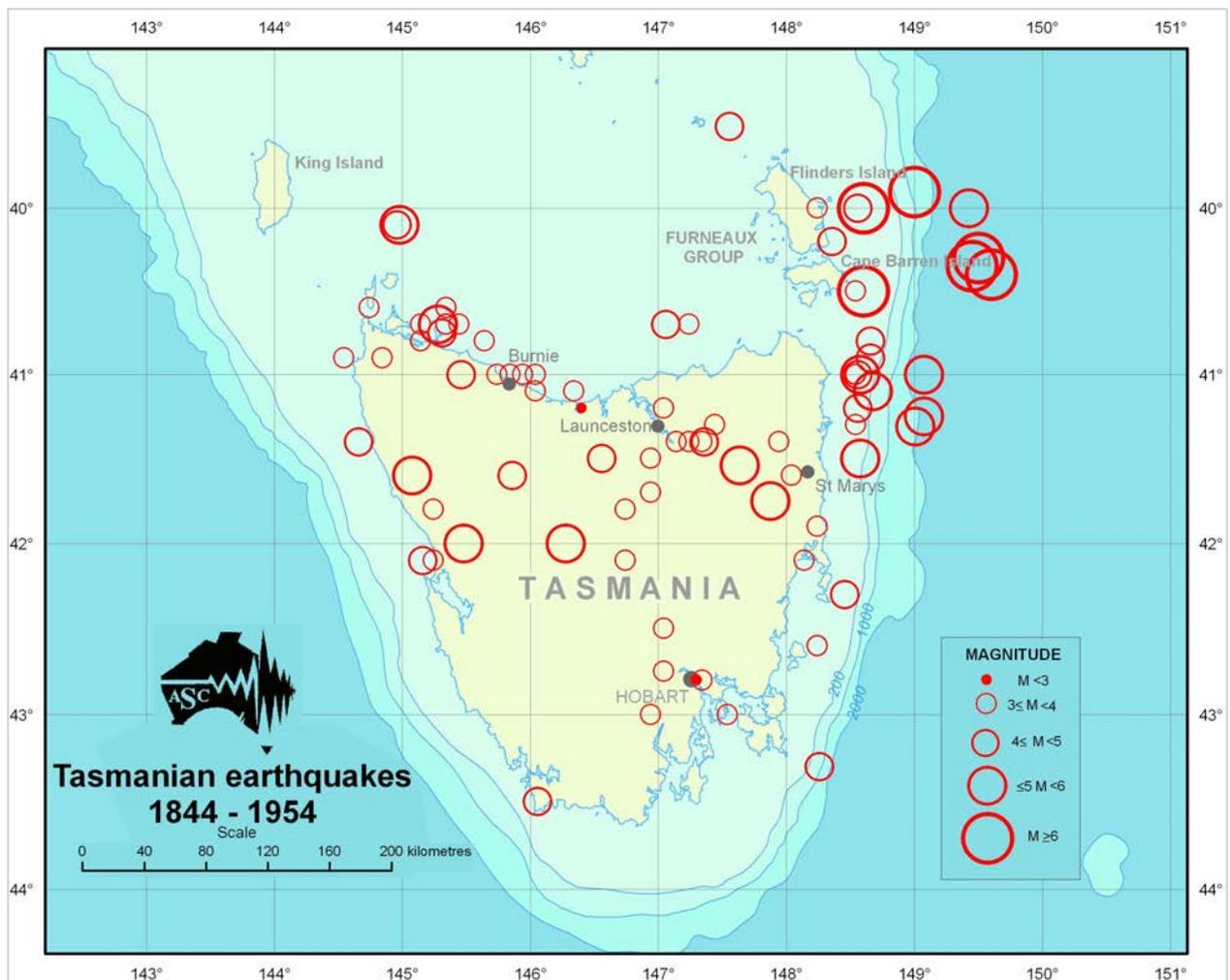


Figure 2 Seismicity of Tasmania, 1844–1954. The earthquake swarm that activated in the late 19th century was off the NE coast, ranging from about 41.5°S northward to 39.5°S. It was not a point source. The West coast was sparsely populated, especially the southwest quadrant of the island.

Carey and Newstead (1960) discovered a fault scarp, the Lake Edgar Fault in the southwest formed by a series of large earthquakes in prehistoric times and this discovery led to the establishment of the Tasmanian Seismograph network from 1957. Van Dissen and others (1997) mapped the fault scarps and assessed the magnitude of the causative earthquake(s) at about 7. Dating of the sequence has since been determined by Clark & others (2011).

Whilst these large early earthquakes have been noted worldwide, the current hazard map of Tasmania (AS1170.4 - 2007) suggests the state is relatively quiet compared with Victoria, South Australia or New South Wales because earthquake damage was minimal in Tasmania in these large historical earthquakes. Buildings in the eastern part of the state were seen to be much less at risk than those in the western half.

This author was most surprised then to come across an earthquake in the northeast in 1929 (McCue, 2013) that caused similar damage to those later earthquakes in Adelaide and Newcastle that put the latter cities on the engineers' radar and into hazard maps.

The recent on-line publishing of their scanned collection of some early Australian newspapers by the Australian National Library, made this discovery possible. The TROVE site allows users to correct the OCR of the scanned images which makes the collection even more valuable as this corrected text can be searched online by all. Examples of corrected text and scanned newspapers are documented below in the chronological list of earthquake reports.



Figure 3 Photo of part of the Lake Edgar Fault scarp (yellow arrows) from the lookout above Edgar Dam, looking south, the maximum vertical offset along this section is more than 4m. Were a major earthquake or series of earthquakes, sufficient to generate such a surface rupture, to occur today we would expect significant damage to buildings and infrastructure, the extent of damage depending on the location.

CHRONOLOGICAL EARTHQUAKE LISTING

1823 11 28 at 01:30 UTC, Launceston

Sydney Gazette, Thursday 25 December 1823, Page 2.

On Friday morning, the 28th ult. about half past 11 o'clock, an earthquake was felt at Launceston, in Van Diemen's Land, and its vicinity. The weather had been rather warmer than usual, the thermometer being at 74° of Fahrenheit. The shock was preceded by a very extraordinary rumbling noise in the air rather unlike thunder, and of not so deep or heavy a tone; it appeared to come from the S. W. The atmosphere was extremely clear and cloudless; but a warm and very gentle breeze passed over from that direction at the time. There was also a brighter appearance above the horizon in that direction than usual. The sound continued about a minute and a half, and it ceased with a concussion that very sensibly shook the houses in Launceston. It, however, appears to have been rather more violent in places of from 7 to 14 miles to the S. W. of Launceston, and some alarm was created, though we have not heard that it was sufficient to throw down any kind of building, nor was it even felt at George Town, 35 miles to the Northward.

1827 06 27, at 10:30am local time – Hobart

This earliest Tasmanian earthquake was felt in Hobart in 1827 and reported in the *Colonial*

Times and Tasmanian Advertiser, Friday 22 June 1827, page 3.

FRIDAY, JUNE 22, 1827.

EARTHQUAKE.—On Saturday morning last, at half-past ten o'clock, a slight shock of an earthquake was felt at Hobart Town, for a few seconds. The motion of the earth was tremulous, affecting the wine-glasses, doors, windows, &c. accompanied by a slight hollow rumbling noise, somewhat resembling distant thunder. It was sensibly felt in the Courthouse by several persons, while the Chief Justice was passing sentences; also, at the British Hotel, and in all directions about the town. At New Norfolk, and in the Macquarie District, it was likewise experienced exactly at the same time; and although we have not yet heard it for certain, we should imagine, all over the Island..... We never remember having heard of such an occurrence having happened in Tasmania before.

Wine glasses, the convicts lived well! If this earthquake was indeed felt 'all over the island' as suggested, it must have been at least magnitude 5 assuming a central Tasmania location, but one could only guess at its actual location.

No further earthquakes are reported until 11:30pm local time on 18 August 1844 when an earthquake was distinctly felt in every house on Flinders Island (*Launceston Advertiser*, Saturday 19 October 1844, page 4). There is insufficient information to draw an isoseismal map.

1844 08 18 at 13:30 UTC, Flinders Island

The Courier Tuesday 8 October 1844, Page 2.

SHOCK OF AN EARTHQUAKE AT FLINDER'S ISLAND.

We have been favoured with the following particulars of the shock of an earthquake sensibly experienced at Flinder's Island on the 18th of August last. We are informed that in 1827 the shock of an earthquake was felt in this colony, but we are not aware that anything of the kind has happened since that period:

"Flinder's Island, 19th August, 1844.

" It cannot be uninteresting to you to be informed that there was distinctly felt in every house on this settlement last night, about half-past 11 o'clock, a slight shock of an earthquake. I had gone to sleep upon a couch in the drawing-room in this house a few minutes after 11 o'clock, and could not have slept more than half-an-hour, when I was awakened by a deep loud rumbling sound, apparently very near, and by a tremulous motion of the couch on which I lay. The agitation was such as to shake a round table in the centre of the room and other loose furniture very audibly. There was no vibration of the panes of glass in the windows as there usually is during concussion of the atmosphere from electric explosions when close.

" There was not any lightning or thunder before or after in the course of the night, as I very satisfactorily ascertained. The sound which seemed to travel centrally, and if at all laterally in a S.E. direction, lasted for perhaps about two seconds, and the trepidation rather longer. " My cook told me this morning that the plates and dishes in my kitchen chattered quite loud, and the same it is said occurred in every cupboard and dresser on the settlement, though parties differ as to the direction which the accompanying sound took.....

" It may be worth while to compare these facts with observations made in Van Diemen's Land or elsewhere, should the same agency have been manifested anywhere in our vicinity."

It was not 'perceived' in Launceston but it was felt by the lighthouse keeper's wife on Goose

Island and by a ship's captain driven ashore by the weather on Cape Barren Islands (Ed. Tas. J. 1845).

1844 08 25 at 14:00 UTC, Flinders Island

Geelong Advertiser Monday 16 September 1844, Page 4.

On Saturday, the 25th August, and about twelve o'clock at night, the shock of an earthquake was felt by the inhabitants on Flinders Island; the effects were a powerful vibration and rumbling noise, which continued for some moments; the residence of Dr. Milligan, the superintendent, was shaken to the foundation.

Exactly one week apart and at the same time as the previous event, it is most likely that these are the same event, the tyranny of distance (at the time) intervening in the science of dating.

1853 09 17 at 07:50 UTC, Schouten Island (east of Hobart)

The Cornwall Chronicle Saturday 1 October 1853, Page 3 and *The Courier* Saturday 26 November 1853, Page 3.

Shock of an Earthquake at Spring Bay. — We have received the following from a correspondent: — At ten minutes before six last evening, we had a severe shock of an earthquake; the house, which is built of stone, shook severely. The tea things were on the table at the time; the furniture, cups, saucers, &c., all danced. Mrs. Hobbs was sitting leaning against the side of the fireplace, my son William was by her leaning on the mantelpiece, his head resting on his hand. The shock was so severe to them both, they felt the effects long after. One of my daughters was stooping at the time, and fell on her head. I can only compare it to the rolling of heavy waggons under an archway. All passed away to the N.E.— H.T. Advertiser, 21st inst.

THE EARTHQUAKE.—The shock of an earthquake was distinctly felt in the district of Great Swanport, both north and south of Swansea, on the 17th September. At Schouten Island the clocks, watches, and picture-frames attached to the walls of the rooms were much shaken by the earthquake, which was also felt at Spring Bay.

On the basis that these two reports refer to the same earthquake I have adopted the time from one and the date from the other. This sounds like a very close, local earthquake, but larger than the largest of the Bream Creek swarm events of the 1990's just to the south of Spring Bay.

1854 02 26 at 16:30 UTC, O'Brien's Bridge

The Argus Tuesday 28 February 1854, Page 5.

SHOCK OF AN EARTHQUAKE.—We understand that the shock of an earthquake was experienced yesterday morning at about half-past two o'clock, at O'Brien's Bridge. Mr. Hull, jun., states he was awakened at that time by a loud rumbling noise, which at first was thought to proceed from the roll of the drums in Hobart Town; but soon the tremulous motion of the earth, and the rocking of the house, told what was the real cause of the commotion.

It must have been a very small earthquake not to have been felt in Hobart.

1854 03 24 evening, Marlborough Central Tasmania – probably a landslide

Empire Friday 12 May 1854, Page 3.

The following letter had been received at Hobart Town:—" Marlborough, 21st April, 1854. I beg to inform you of a very strange occurrence on the evening of the 24th of March last. A shock like that of an earthquake was felt in almost every part of the Marlborough District. Two shepherds were gathering sheep the other day and discovered the cause of it. I went to the place yesterday; there has been some fearful volcanic eruption, rocks of

enormous size have been driven about, and the face of the earth appears to have been hoisted in the air and pitched surface downwards. I cannot describe to you the appearance, but if you will come up I am sure you will be highly gratified—the distance is about ten miles from this.

(Signed) THOMAS BELLINGER "

1857 09 09 at 15:45 UTC, Deloraine

The Age Thursday 17 September 1857, Page 6.

EARTHQUAKE AT DELORAINE. The Launceston Examiner publishes the following communication, dated from Deloraine, September 10th .

A shock of an earthquake was felt in this district about 1.45 a.m. this morning. On the township of Deloraine it was as if a tree had fallen, and then a lot of cannon balls rolled with great force, but up at the Red Hills it was much more severe. One farmer says himself and all in the house were much alarmed and got up, and all round about there also got up, The shock was like a heaving up of all sides of the house like a wave: in fact, the residents in that locality did not expect their houses to stand it, but expected to see them all fall; it came with a loud rumbling sound, very different to thunder. At Chudleigh it was even more severe; a resident there who was in New Zealand when an earthquake took place says the shock was very severe. At the Red Hills the inhabitants were affected by sickness, like sea-sickness, and a person from Chudleigh says it was as if a powerful man had taken hold of the bedstead and shaken it violently. Dr Rock, on this township, says it was as if the timbers of the house (a wooden one) were grating against each other. For the truth of this report numbers of persons can affirm. Mr Bennett, of the Red Gate says there was a severe shock about 4 a.m.

One paper described the shock as *so violent as to throw a man to the ground*. This description sounds like a moderate local earthquake.

1859 10 27 at 14:40 UTC Circular Head

The Hobart Town Daily Mercury Tuesday 1 November 1859, Page 2.

On Friday night about half-past twelve o'clock a shock of an earthquake was repeatedly felt by every person on Circular Head.

Launceston Examiner Thursday 10 November 1859, Page 2.

On Friday night, or, more strictly speaking, on Saturday morning, at twenty minutes or thereabouts to one o'clock, the solemn sound of an earthquake passed through the ground, shaking the houses violently, warning us all..... I was awakened from sleep by a loud noise, the house and bed shaking violently, and the whole building creaking with the disturbance. All my neighbours felt it at the same instant. I thought at first it might have been thunder, which requires some explanation.but I have ascertained that the shock was felt in the manner described all over the forest and township by people living 8 or 10 miles apart, proving beyond any doubt the true nature of the earthquake, which was certainly a very sharp shock. I am, Mr. Editor, yours, S. B. E. Circular Head, 29th Oct., 1859.

1859 11 21 at 18:50 UTC, Circular Head

Launceston Examiner Tuesday 22 November 1859, Page 2.

The following telegram was received this morning from Circular Head:— This morning, at ten minutes to five, a violent shock of an earthquake was felt here, frightening the inhabitants out of their beds, and even out of their houses ; many expected them to fail, the shock was so great. Women were running about in their night-dresses, not knowing

what was the matter. The shock was preceded by a low rumbling noise, which lasted for about a minute, then followed a tremendous shaking, upsetting bottles and crockery, and creating a great clutter.

Michael-Leiba (1989) gleaned enough information on this event to determine a location and magnitude, near the northwest tip of the island, its magnitude 5.4. This was the first earthquake database entrant for the island previously although an earlier slight earthquake was reported in the same area *less than a month passed the slight shock of an earthquake was felt at Circular Head* according to the *Cornwall Chronicle* of Wednesday 23 November 1859, page 4.

1860 03 28 at 19:50 UTC, Bothwell

South Australian Weekly Chronicle Saturday 7 April 1860, Page 1S.

SHOCK OF AN EARTHQUAKE —A correspondent of the Hobart Town Mercury, writing from Bothwell, on the 29th March, says —" I take up my pen to inform you that the shock of an earthquake was distinctly felt at this place a little before 6a.m. yesterday, the 28th inst. I was in bed at the time, when all of a sudden I was awoken by a loud rumbling noise, as though some very heavily laden cart were passing out of the yard close by my bedroom window (my room is on the ground floor and at the back of the house), and presently afterwards my bedstead distinctly vibrated backwards and forwards. My son and daughter, occupying rooms overhead, were both awoken from their sleep, the latter afterwards informing me that she felt her head move backwards and forwards on the pillow. My servant girl also felt it, and called out ' Is that you, master?' thinking I was making a noise to awake her. I subsequently ascertained that my neighbours on each side heard the noise, and felt the sensation, as also others on the township. About seven years ago the shock of an earthquake was felt at the Shannon, but the one yesterday is the first that has ever been experienced on this township."

Friday afternoon.

Two shocks of earthquake were felt at Green Ponds on Wednesday, but no harm done.

Green Ponds, 35km north of Hobart is now called Kempton, Bothwell is 55km NNW of Hobart. With no reports from Hobart the magnitude is limited to below 4.

1860 04 13 at 10:20 UTC, Hobart

Launceston Examiner Thursday 19 April 1860, Page 3.

HOBART TOWN (From the papers.) On Friday evening, at about 20 minutes past 8 o'clock, a shock of an earthquake was felt in the locality of Landsdowne Crescent, and from enquiry it appears to have been also felt on the hills adjoining the Cascade Factory.

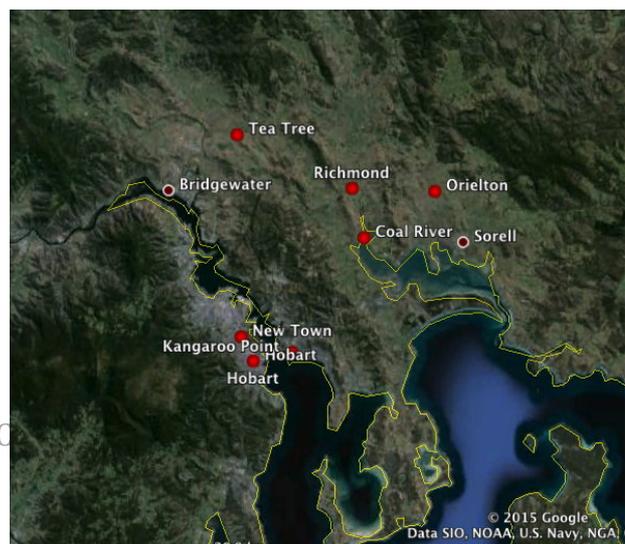
This sounds like a very small local earthquake.

1866 09 20 at 14:05 UTC, New Town Hobart

The Mercury Monday 24 September 1866, Page 2.

SHOCK OF AN EARTHQUAKE.

Sir,—I have been surprised to see no record in your columns of a phenomenon which is new to Tasmania. A very distinct shock of an earthquake was perceptible at New Town a few minutes after 12 o'clock on Thursday night. It lasted a few seconds, commencing with a heavy rumbling sound, and at its height was



sufficiently violent to shake the furniture of the house, and to awaken some of the sleepers. It would be interesting to know in what other portions of the island, and over what geological area its presence was felt.

I am, Sir,

Yours very truly,

C.H.T. Sept. 22nd, 1866.

Figure 4 Map showing the locations (solid red dots) from which the 1866 Hobart earthquake was reported felt.

Subsequent letters to the *Mercury* confirm it was felt by others in Hobart and at Glenorchy, that there was an earlier earthquake "little more than 40 years ago". Thursday's *Mercury* had the following letter:

TO THE EDITOR OF THE MERCURY

Sir,—I am induced by the communication of C.H.T., in yesterday's *Mercury*, to say that the shock of an earthquake was distinctly felt by many persons in and around this neighborhood, at about 12 o'clock on Thursday night last. The vibration, attended with a loud rumbling noise, is reported by various persons to have been felt on the Kangaroo Point Road; in Richmond; at the Tea Tree; Orielson; the Coal River; and Brushy Plains.

Yours truly,

D.R.D. Richmond,

September 25th, 1866.

1874 10 13 at 04:00 UTC, Port Davey

Advocate Saturday 7 November 1874, Page 16.

TASMANIA.

THE TIDAL WAVE.

Concerning the earthquake and tidal wave reported by telegraph, the *Hobart Town Mercury* of the 28th ult. writes:— " We are informed by Captain Carver, of the schooner *Kingston*, that arrived here yesterday, that at 2 p.m. on the 13th ult., and immediately after his arrival from Hobart Town, a shock of an earthquake was felt at Port Davey, the houses being severely shaken. The shock was also distinctly felt on board the schooner, which was lying a short distance from the shore. The inhabitants of the port informed Captain Carver, that on the morning of the 13th, and just before the arrival of the schooner; and the occurrence of the earthquake, a tidal wave ebbled and flowed."

There can be no connection between the supposed tidal wave and the later earthquake. The description sounds like a moderate, shallow local earthquake.

1876 05 03 at 15:15 UTC, Carrick

Launceston Examiner Tuesday 6 June 1876, Pages 2 and 3.

EARTHQUAKE AT WESTWARD. It would seem that a slight shock of earthquake was felt at Carrick and Westbury early on Sunday morning. Besides the reference to this occurrence made in the letter of our own correspondent, we have received the following from another resident:—A slight shock of earthquake was felt here at a quarter-past one o'clock a.m., to-day (Sunday). The night was very still and clear. The shock was accompanied by slight rumbling noise, and was distinctly perceptible for about a second—was of a tremulous nature, and caused doors and windows to rattle. Several inmates of my house were awakened by it—it also disturbed my horse in the stable, and caused a

commotion among the poultry and geese of the neighbourhood. Several persons to whom I have spoken during the day, felt the shock, but as may be expected in such matters, their experience of its duration and characteristics varies considerably. It will be interesting to know whether other localities were similarly visited. Another correspondent at Carrick writes : "I write to inform you that we I felt what might be a shock of earthquake yesterday (Sunday), about 1 or 2 a.m. I was asleep but it awakened me, and appeared as if the bed was lifted up and let down again, and causing the windows to shake. I spoke to an opposite neighbor, and she informed me that she was awakened at the same time under similar circumstances; perhaps some of your readers could throw some light upon the subject. There was no wind at the time, and although we listened attentively there was no repetition of the shock."

Westbury. A shock of earthquake was felt here about 1.20 a.m. on Sunday morning. Several people were awake from their sleep. It is the second shock that has been felt here. The houses completely shook. Some thought it was the result of a thunder clap, but it could not be mistaken by those who were up and about.

This was a small local earthquake southwest of Launceston where it apparently wasn't felt.

1880 02 03 at 06:30 UTC, Southern Tasmania

This earthquake was reportedly felt throughout Tasmania though there were no reports from the southwest quadrant (Iseismal map by Michael-Leiba, 1989) and it was not felt in the far northeast of the island. The magnitude is about right and the epicentre was surely in western Tasmania but where?

Launceston Examiner Wednesday 4, Monday 9 and Wednesday 11 February 1880, Pages 2 , 3 and 3.

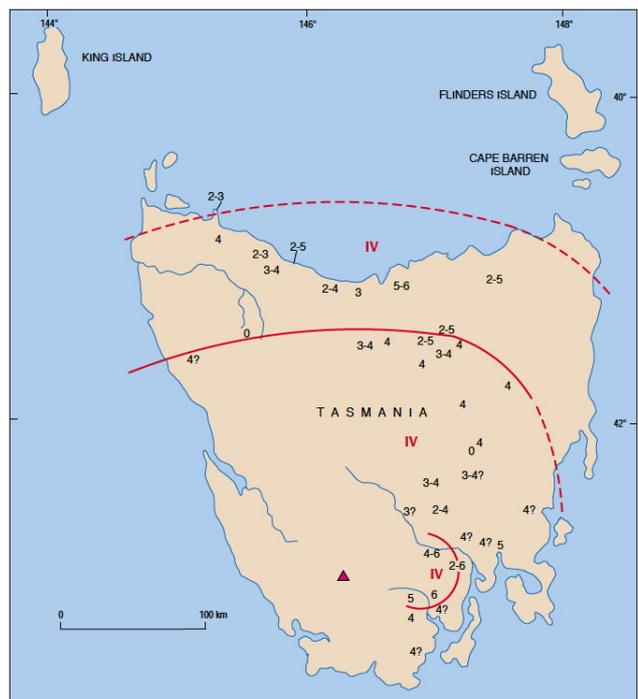
TASMANIA. HOBART TOWN, Feb. 3. A sharp shock of earthquake was felt in the city at half-past 4 this afternoon, shaking several buildings for three or four seconds, causing great excitement. The shock was severely felt in the Huon district.

Feb. 3. Two distinct shocks of earthquake were felt here this afternoon by a number of people at about half-past 4 o'clock. The vibration passed from south to north.

EMU BAY, Feb. 3. A shock of earthquake was felt here at half-past 4 this afternoon. Crockery was displaced in various houses, tables rocked, and clocks stopped during the shock, which lasted for several seconds, coming from the direction of north-west to south east. It was believed the disturbance was only local.

Figure 5 Top. Iseismal Map by Michael-Leiba (1989). Data are sparse, particularly in the southwest of the island, so the location is quite uncertainty. Bottom. Felt area this report, fewer reports (felt red dots, not felt blue dots). The small triangle near Lake St Clair is a possible alternative epicentre, and magnitude 5.3.

BOTHWELL, Feb. 3. Several distinct shocks of earthquake were felt here this afternoon, with a distinct rumbling sound. A large meteor was seen last



night steering a horizontal course at an altitude of about 45 degrees.

CARRICK, Feb. 3. A shock of earthquake was felt here about twenty minutes to five o'clock this afternoon. It lasted about a minute. My house, a wooden one, swayed to and fro, and the motion stopped the clock on the mantelpiece. It appeared to travel from north to south. The shock was felt by several on Carrick. The comet was visible here last night about nine o'clock. (FROM ANOTHER CORRESPONDENT.) A distinct shock of earthquake was observed by several residents to-day. It continued about a minute.

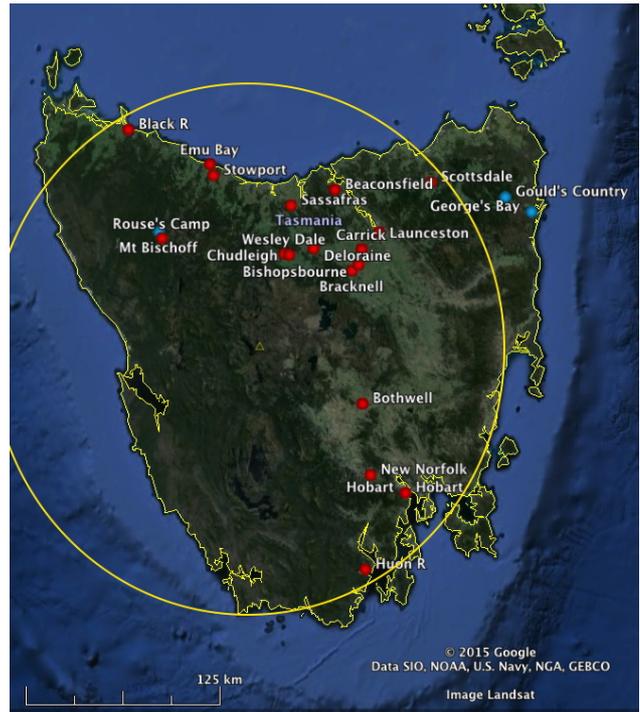
EMU BAY. The particulars of the earthquake are about sufficiently embodied in the telegram which has already appeared in your columns ; it is only necessary to add that the shock was distinctly felt by many, not only at Emu Bay, but also at the Cam, Stowport, and River Blyth.

BEACONSFIELD. (From our own Correspondent.) A slight shock of earthquake was experienced here on Tuesday last. Mr Sands distinctly felt the shock; he was writing at the time, and his pen was made to jump from one side of the paper to the other. Mrs Sands was standing in the centre of the room when the shock occurred, and she was compelled to grasp the handle of the door to steady herself. Mrs W. A. Sands was sitting on the sofa at the time, and was almost shaken from her seat. The cottage gave several distinct rocks. Mrs Sutcliffe, occupying a cottage a short distance from Mr Sands, also felt the shock, and there was a visible movement of the building. Mrs Williams, residing on the opposite side of the street, distinctly recognised the unusual motion. Some boys who were on the cricket ground, I am informed, felt the shock to such an extent that some of them almost fell down. I have been informed to-day that this slight shock of an earthquake was distinctly felt at Ilfracombe. The time at which this very unusual occurrence took place at Beaconsfield was about 2 o'clock p.m.

The earthquake was felt at Boyndie, Black River, at exactly ten minutes past four p.m. on Tuesday, 3rd instant. Three ladies were sitting at needlework, when suddenly they found all the furniture trembling, the house also shook, making a noise in doing so. This lasted about ten seconds, then ceased for about three seconds, commencing again more distinctly and louder than at first, ending in a low rumbling noise. The whole affair could not have lasted more than half a minute. The ladies ran outside, not being sure whether the house would come down. Feb. 6.

Maryborough Chronicle, Wide Bay and Burnett Advertiser Thursday 12 February 1880, Page 2. Hobartown, February 9.

On Tuesday last a succession of smart shocks of earthquake occurred, lasting several seconds. The chandeliers in both Houses of Parliament rattled, drowning the voices of members speaking. Much alarm was caused, and some damage done to the ceilings of private houses. Reports from all parts of the colony say that the shock was felt widely.



The people were running from their houses and crockery was smashed. The earthquake wave seemed to pass from south to north. The weather was very sultry at the time.

Launceston Examiner Monday 8 March 1880, Page 2.

REMARKS ON THE RECENT EARTHQUAKE SHOCK. BY S. H. WINTLE. Having received several communications respecting the recent earthquake shock, I will avail myself of the privilege offered by the columns of the press to reply to them in detail, as my leisure is limited, and the subject is one of public interest. It has been remarked by one of my correspondents, that "the force of the shock varied very much throughout the island," and suggests that "this may be due to certain geological conditions." In the first place the intensity of the momentum varied so much in different localities that throughout this district of George's Bay, it was not felt in the slightest degree. This also applies to Gould's Country and Thomas Plains..... On referring to the different reports of the various newspaper correspondents who have therein recorded their impressions of the shock, as well as those of other persons in the same district, it will be found that where the oscillatory movement was the strongest, there the stratified formations are well developed, and where it was feeblest, or not manifested at all, the crystalline granitoid formations preponderated. At Mount Bischoff, for instance, it is reported as not having been felt, while at the locality known as Rouse's Camp, distant 3 to 4 miles from the scene of mining operations, it was plainly experienced. That indefatigable and careful observer, the late Rev. W. B. Clarke, of New South Wales, has recorded between one and two hundred earthquake shocks in Australia during the period of his residence, embracing a period of thirty-nine years.

It is possible that the epicentre was in the Huon Valley area southwest of Hobart where a possible aftershock occurred 4 months later on 22 June (next listing). A more likely epicentre is further north of Michael-Leiba's epicentre in the central west of the island.

1880 06 22 at 18:00 UTC, Hobart

Launceston Examiner Friday 25 June 1880, Page 2, and Saturday 26 June 1880, Page 3.

HOBART TOWN, June 24. Several residents in the south and west portion of the city report having felt a shock of earthquake at about 4 o'clock on Wednesday morning.

SHOCKS OF EARTHQUAKE.—With reference to the shock of earthquake which was reported to have been felt in the south and south-west portions of Hobart Town on Wednesday morning, a correspondent of the Mercury states :—"I felt the shock of an earthquake distinctly shortly after 4 o'clock a.m. It was rather severe, and the noise that accompanied it very loud indeed. Though in bed at the time I was wide awake, and rather startled to find the bed and bedroom shaking inconveniently, for as I considered five or seven seconds. In the morning I had hoped to hear some one of the household mention something of an earthquake, but not a word did they say. However, as I went out I met an intelligent person, who asked me if I had felt the earthquake? Two or three others also informed me that they too felt it at the same time. Two visitations of this nature in the course of a few months are a little strange."

The Mercury Wednesday 7 July 1880, page 4.

A slight shock of earthquake, the second this year, was felt in Hobart Town and in some of the surrounding districts at an early hour on the morning of the 23rd ultimo.

The Launceston Examiner, Wednesday 30 June 1880, Page 2.

The shock of earthquake last week was severely felt in the New Norfolk district.

It is possible that these two earthquakes west of Hobart were co-located and closer to Hobart than envisioned by Michael-Leiba (1989) but the evidence is not strong.

1882 03 16 at 05:00 UTC, Burnie (Emu Bay)

LEVEN, March 16. A rather severe shock of earthquake was felt at Ulverstone at three o'clock this afternoon. The Post-office was shaken violently, and the vibration was succeeded by a loud noise. ...

EMU BAY, March 16. There was an earthquake shock here at three o'clock this afternoon. There was universal oscillation, which was severer than the last of the same kind.

CAM, March 16. A rather severe shock of earthquake occurred here to-day at about 2.40 p.m. A rumbling noise like that of thunder was heard, accompanied by a vibration of the earth, which caused the houses in some cases to rock visibly. Much alarm was felt at the occurrence.

TABLE CAPE, March 16. A severe shock of an earthquake was felt at Table Cape, at five minutes past three o'clock this afternoon.

These reports are taken to be of a close small local earthquake.

1883 04 12 and 13, Gould's Country – Earliest Found of Large Swarm off NE Coast

Launceston Examiner Monday 16 April 1883, Page 2.

Captain J. Shortt, R.N., Government Meteorological Observer, received the following telegram from Gould's Country: —"On the 12th inst., at 9 p.m., slight shock of earthquake ; on 13th, at 4 a.m., heavier ditto ; 12.15 p.m., slight ditto."

1883 05 17 – 29, Northeast Tasmania, Early Swarm Events

The Mercury Monday 25 June 1883, Page 3.

ROYAL SOCIETY OF TASMANIA.

The monthly evening meeting of the Society was held on Tuesday, 12th June, C. H. Grant, Esq., in the chair. From Captain Shortt, Government Observer.

Shocks of earthquake were felt at Gould's Country on the 17th, 18th, 28th, and 29th. They have also been felt at different places between the parallels of 41 and 42 S., and to the eastward of Longford. Some of the shocks have been reported as very severe.

1883 06 15? at 16:00 UTC, George's Bay East Coast

The Sydney Mail and New South Wales Advertiser Saturday 23 June 1883, Page 1167

HOBART, Sunday.

A very severe shock of earthquake was experienced at 2 o'clock on Saturday morning at George's Bay, accompanied with a loud rumbling sound. Another shock is reported to have been felt at St Mary's on the previous night, at 11 o'clock, with a similar sound.

1883 06 20 night-time, Deal Island, Kent Group, one injury

The Mercury Monday 10 September 1883, Page 2.

EARTHQUAKE AT KENT'S GROUP.—A resident at Kent's Group, writing to a friend in this city, gives the following details of earthquake shocks recently felt there :—"We have been terrified since the night of June 20. A very severe shock of earthquake was felt then, and three more since, the last on July 30. I was in my bedroom at the time the last occurred, and was completely lifted off my feet. The beds and the side of the house were all in motion, and it seemed as if the waves were rushing under the floor. The man on watch at the lighthouse was knocked down on the floor, and cut his arm."

Interesting that this event was well away from the swarm activity that seems to have been

centred off Flinders Island.

1883 07 30 at 10:00 UTC, NE Tasmania

Daily Telegraph (Launceston) Tuesday 31 July 1883, Page 2.

EARTHQUAKE SHOCKS.

The equanimity of a large number of residents in and around Launceston was disturbed about 8 o'clock last evening by another sharp shock of earthquake. A correspondent, who kindly noted the facts in writing soon after the shock was felt at the Sandhill, states:—"The windows rattled very much for about five or six seconds. I felt the vibration and heard a prolonged rumbling resembling a carriage at some distance. It acted like a galvanic shock in some degree to a lady in our house." A young man in a West's store on the Sandhill, noticed the shock very distinctly. He felt the counter move, as he leant on it. Others there noticed even the direction of the disturbing element, which seemed to be from north to south.

In the Phoenix Foundry a young man resting on a bench was nearly rolled off it by the heavy motion. In the Mission Hall, Wellington-street, the shock was so distinct that the very walls seemed to move. In Lower Brisbane-street a tradesman who was pressing a vest with an iron, could not hold the board steady, and a couple of door off a young married lady was so alarmed that she ran out to the street. Some of those most alarmed felt a sensation very like sea-sickness.....

Our Bridport and Branxholm correspondents have informed us by telegram of the effects of the shock down towards the north-east coast. Our intelligent and reliable correspondent at Bridport refers also to two distinct shocks of earthquake observed there between 3 and 5 o'clock yesterday morning, and states that the sound was very distinct with a rumbling noise like distant thunder. The description given of the shock at near 8 o'clock last evening is very minute and interesting thus:—"It seemed to shake everything in the houses, windows, glasses, crockery ; chairs and tables were moved and shaken by it till they rattled again. There is not the least doubt but it has been felt all along the coast. The frequency of those shocks of earthquake during the month, closing to-day, is causing some alarm throughout the North Eastern portion of the island. The fact that all the shocks recorded here have been noticed at the same time, at so great a distance off as the Straits islands, increases the feeling of uneasiness and doubt as to the stability of the foundations of our island home.....

We trust that whatever subterranean operations may be in progress in Northern Tasmania, they may be near a satisfactory close; and that the beautiful island may settle comfortably down on its broad basis to remain quite free from those mysterious shocks and heavings for the future.

To have been felt on the Straits islands and the northeast towns including Launceston, and with an epicentre off the northeast coast, the minimum magnitude has to be about 5.2.

1883 08 30 at 11:10 or 11:10 UTC, Northeast Coast

The Argus Monday 3 September 1883, Page 8.

HOBART, SATURDAY.

Repeated shocks of earthquake have been felt at various places on the east coast, no less than five or six having occurred in a day. On Thursday there was a most severe shock at George's Bay at 10 minutes past 9 o'clock last night. It was accompanied by very little noise. Several shocks were felt during the previous week, the residents being much alarmed.

1883 09 08 at 15:30, NE Tasmania

Launceston Examiner Tuesday 11 September 1883, Page 3.

SEVERE EARTHQUAKE SHOCK. TO THE EDITOR. Sir,— The frequency with which earthquake shocks of late occur, and their increasing intensity, is calculated, not without good reason, to awake a sense of uneasiness, if not of actual alarm in the minds of the public..... The severest earth shock that has visited Tasmania within the memory of man occurred this morning at 1.30. I was awakened from a sound sleep by the oscillation of the bedstead beneath me, and the rattling of the windows. The house where I live being of brick, and two storeys high, the vibration of the walls was alarmingly palpable. The shock consisted of three wavelike motions which lasted three or four seconds, and seemed to have a direction of from south to north. I experienced a very peculiar sensation of the flesh trembling on my frame, and also of the nervous system being intensely affected. I have not experienced one-fourth of the shocks felt and recorded by others in this island, but those which I have felt did not produce the physiological effect I have endeavoured to describe.

—Yours, etc, Sept. 9. S. H. Wintle

Without other reports I have located this near the source of the report, ie Launceston.

1883 09, throughout month, felt Launceston – short jerky motion

The Argus Thursday 20 September 1883, Page 11.

Earthquakes have been felt in several parts of the colony. The Launceston Examiner of the 17th inst. states:—" Another earth quake took place yesterday afternoon about 3 o'clock, and was felt by a large number of persons. As usual it was felt in elevated localities as the Windmill, Cataract, and Sand-hills. The motion was characterised as being of a sharp jerky nature and unaccompanied by any noise. Very little damage was done. Another slight shock took place about 1 a.m. on Sunday morning. It was accompanied by a noise like distant thunder."

The St Mary's correspondent of the Mercury, writing on the 13th inst., observes:—"Earthquakes still continue to cause some alarm not only by their frequency but also by their increasing severity. There was a very severe one on Sunday morning, 3rd inst., about 5; another on Tuesday morning, 5th inst., about 2; and another on Thursday morning, at half-past 5, which some here consider to have been the most severe that has yet been experienced in the district. On the afternoon of the same day other two were felt."

The Mathinna correspondent of the Launceston Examiner, writing on the 10th inst., states:—" For some time past the shocks of earthquake about here have diminished both in frequency and severity and we were laying the 'flattering unction' to our minds that for the present we had done with them but during the latter part of the last week we have had a recurrence of the phenomena, more often and much more severe than any one we have experienced previously. On Saturday evening last there was a smart shock at 10 minutes to 10 then at a quarter to 2 on the Sunday morning we had the most exciting shake of all, I believe that roused up nearly everyone on Matahinna. Another slight quake occurred at half past 7 a.m. on Sunday." Matahinna is 81 miles east from Launceston. Similar shocks were also felt about the same time in other localities in the north-eastern part of Tasmania.

This description of a 'sharp, jerky motion' indicates a closer focus to Launceston than most other earthquakes in the series.

1883 10 28 at 12:10 UTC, Launceston

The *Daily Telegraph* Monday 29 October 1883, Page 2.

Earthquake Shock.— Another smart shock of earthquake was felt in various parts of town at a quarter past 10 o'clock on Saturday (corrected in following day's paper to Sunday) night. It was noticed by Mr M'Dougall, draper, at his residence George-street. It is the first he has explained, and he paid more attention to the movement than persons do who have become accustomed to the shocks. The shaking motion of chairs and window sashes occupied about four seconds, and a sound like the rising of the wind accompanied this and died away with the cessation of the motion. Similar effects of the shock were felt by residents in other parts of George-street, St. John-street, and in other parts between that and the Cataract Hill, where by some it was felt more acutely.

1883 November, Approaching Storm - 77 felt earthquakes

The *Argus* Friday 7 December 1883, Page 6.

EARTHQUAKE SHOCKS IN TASMANIA.

HOBART, THURSDAY.

The reports from Gould's Country and St. Mary's received by the Government meteorologist from the 1st to the 30th November state that earthquake shocks were felt every day except on the 20th, 23rd, and 26th. On the 8th there was a continual rumbling all night, and on the 10th there was a severe shock, accompanied by a loud noise. The number of shocks during the month was 77. The direction of the wave is said to have been vertical. On the 20th there was a shock of long duration.

1883 11 14 at 05:00 UTC, NE Tasmania

Daily Telegraph Friday 14 and 15 December 1883, Page 3 and 2.

HOBART WEATHER REPORT FOR NOVEMBER, 1883.

From the reports of observers at Launceston and on the East Coast (North of latitude 42deg S.) earthquake shocks during the month are of less frequency, and also in force generally; excepting that of the 14th which is of most note, as it was felt nearly simultaneously, a little before and after 3p.m. in the disturbed districts, and at Hobart. Only two shocks have ever been felt at Swansea, East Coast, in lat. 42 deg 10min S.

J. Shortt, Meteorological Observer.

A REMARKABLE EARTHQUAKE SHOCK.

About 3 o'clock yesterday, an extraordinary shock of earthquake was felt, and noted in various localities in and about town, and also in the Scottsdale, Bridport, Ringarooma, and other districts. A gentleman from Launceston, on a business visit to Scottsdale, forwarded the following telegram to this office soon after 3 o'clock:—"Distinct shock of earthquake here, at 3 o'clock. It lasted quite 30sec. It was also felt as distinctly at Bridport and Upper Ringarooma." In town the shock and vibration were felt by ministers at the District Meeting in the vestry at the Wesleyan Church, Patterson-street; by the Rev. Canon Brownrigg, at the parsonage, St. John-street; by Mr A. B. Biggs, Patterson-street; Rev. C. Anthony, Wellington-street; at Galvin Town, at Canning, Frankland, Balfour, and other streets in that direction; at St. John-street, Cimitiere-street, Elphin road; Upper and Lower Brisbane-street. This earth tremor seemed to pass from west to east and its force was various in different localities, varying even in different rooms in the same residence. In one house the furniture was visibly agitated, and the window sash seemed to be twisted slightly out of plumb in one room, though not disturbed in another room. In some places the tremor passed rapidly, lasting only some few seconds; in others fully half a minute. We shall feel obliged by correspondents and others

forwarding to this office particulars of these earth tremors as soon after the occurrences as possible.

To have been felt in the northeast and at Swansea and Hobart as claimed, this earthquake had to be at least magnitude 5.5, especially at 3pm.

1883 12 13 at 08:58 UTC, NE Tasmania

Daily Telegraph Saturday 15 December 1883, Page 3.

EXTRAORDINARY EARTHQUAKE PHENOMENA

To the Editor.

SIR. — The earthquake that passed under the town of Launceston on Thursday evening last at 2 minutes to 7 o'clock, demands more than a passing notice, being by far the most severe shock experienced by the town. The first intimation I and my daughters had was the heavy shaking of the windows and the rocking motion of the building, which continued for a good many seconds followed by a very marked wave motion, which raised the chairs we were sitting upon apparently fully one inch. Our attention was at this moment directed particularly to the mud-flat extending from Ritchie's Mill to and beyond Soldier's Point, which was in a state of rapid agitation, moving apparently up and down in a most remarkable and alarming manner, the motion apparently coming from beneath, and from the N.W. to S.E. This rapid motion continued for fully 1 minute, and then gradually lessened, until it finally ceased. The wave motion was exceedingly severe. The tide being very low at the time, we had an unusually extended view of the remarkable phenomena, which, I can assure you, being once seen can never be forgotten. The motion of the earth being so singular and extraordinary can never be effaced.

Yours, etc., George P. Hudson. Ethel Cottage, Margaret-street North, December 14.

Interesting observations! This event may have been a small earthquake underneath the observer judging by the description, though other observers nearby did not notice such effects.

1884 03 18 ? time, Goose Island

Maryborough Chronicle, Wide Bay and Burnett Advertiser Friday 18 April 1884, Page 2.

Tasmania. Hobart, April 10.

Earthquake shocks continue to be felt at Goose Island, Bass Straits. A severe shock was experienced on March 18th.

1884 05 22, ?time, Cape Barren

The Mercury Saturday 31 May 1884, Page 4.

The captain of the barque Loongana, which arrived here on the 27th inst. from Newcastle, reports experiencing a shock of earthquake when off Cape Barren, on the 22nd inst. The sensation resembled that which would be produced by a vessel being dragged over a reef.

1884 08 29 at 01:00 UTC, NE Tasmania

This is apparently another significant event in the large swarm off NE Tasmania; in this case it was not only felt along the east coast from Launceston to Hobart but also out to sea on board the brigantine Helena, as shown in the map of felt reports. Underwood (1972) did not tabulate this event.

Daily Telegraph Saturday 30 August 1884, Page 2

SEVERE EARTHQUAKE SHOCK.

Yesterday morning a severe and prolonged earthquake shock was felt throughout Launceston, in the North-East and North-West districts, and in the Fingal and other districts down to Hobart. The time is variously given as 11 o'clock to 5 minutes past that hour. According to Launceston time the shock occurred at 11.5, and was remarkably strong in the offices at the Public Buildings. In the Chambers of His Honor the Commissioner in Bankruptcy where a case was being dealt with, business was partially suspended in consequence of the rattling of the windows and the swaying of the gas chandelier over the Commissioners' table. The tremor was so great as to cause some uneasiness, if not alarm. In force it was nearly divided into two parts, the second tremor being the most violent. Its duration was about 30sec. Its direction was as usual, from north-east to South-west. Throughout the town it was observable in many houses, while in others it was not noticed at all. The tremor was felt in various directions towards Scottsdale and beyond. At Latrobe the trembling sensation was accompanied by a distinct, rumbling noise. At Fingal it was accompanied by the usual rumbling, as if of distant thunder, and that more audible than usual. It was severely felt there, even by those out of doors, but it was not so marked as another one on Sunday last about 2 p.m. At Hobart the earth tremor was felt distinctly at about 11.5. Here in Launceston the rumbling sound referred to as noticeable at Latrobe and Fingal was not heard at all.

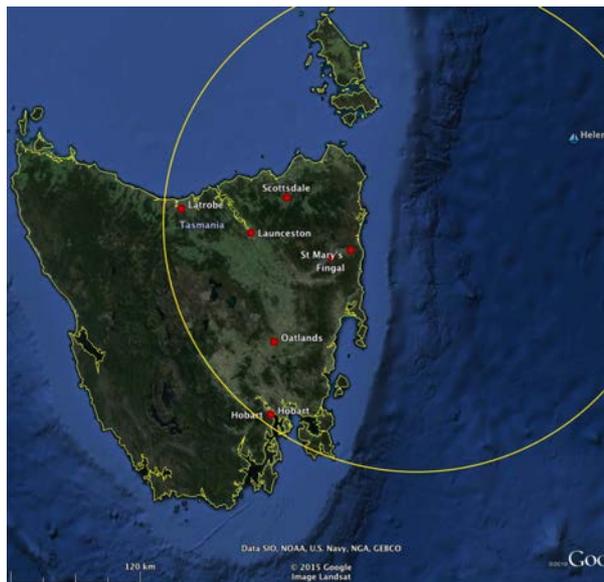


Figure 6 Felt area of the 29 August 1884 earthquake off northeast Tasmania. The brigantine Helena's position is shown. No reports from Flinders Is or Victoria have been found.

Launceston Examiner Saturday 30 August 1884, Page 3.

HOBART, August 29. A strong earth tremor was felt in the city this morning at five minutes past 11 o'clock. It was also felt in Sandy Bay and New Town.

LATROBE, August 29. ... A shock of earthquake was felt here at eleven o'clock this morning, lasting about twenty seconds. The trembling sensation was accompanied by a distinct rumbling noise. The direction was about from north-east to south-west.

The Mercury Wednesday 1 October 1884, Page 2.

The Meteorological Observer has received from Captain A. Hawkes the following account of the earthquake shock felt on board the brigantine Helena. The position of the vessel, 95 miles E. by S. of Cape Barren Island:—" On the 29th of August, at 11.25 a.m., in lat. 40deg. 42min. S., long. 150deg. 32min. E., experienced a severe earthquake shock, with a loud rumbling noise, which shook the vessel fore and aft; the sea being at the time in a very disturbed state, boiling and eddying all round the ship. We likewise noticed the long S.E. swell that had been running previous to the shock was at once smoothed.

1884 SEPTEMBER, MR ELLERY'S ADDRESS to the ROYAL SOCIETY

The Australasian Saturday 18 October 1884, Page 15.

At the conversazione of the Royal Society on the 3rd inst., (Ed. - October 1884) the president, Mr. R. L. J. Ellery, delivered his annual address to the members. We select the following

extracts:—

EARTHQUAKES AND EARTH TREMORS IN TASMANIA.

The remarkable prevalence of earthquakes and earth tremors in Tasmania, Bass's Straits, and the S.E. portion of Australia during the last 12 or 15 months afford a subject of considerable scientific interest. Fortunately none of the disturbances, so far, have been of sufficient intensity to do much damage, although a few, and notably one of July 13, were sufficiently severe to cause considerable alarm. The tremors and shakes have been experienced chiefly in the N.E. districts, but to some extent generally over Tasmania, since July 1883. It was not until February 1884, that they were noticed on this side of the Straits, when a severe shake was felt by the lighthouse people on Gabo Island. Since this date, however, no less than 12 shocks of small or moderate intensity have been reported from this and other places in Gipps Land, the last occurring on the evening of the 19th of this month, when the tremor was sufficiently intense to cause the lighthouse at Gabo to tremble, and things on the tables to dance about. This shake was also felt at Port Albert, Wilson's Promontory (where it "shook windows and furniture violently"), Cape Schanck, Omeo, and other localities in Gipps Land. The vibration lasted over a minute and a half, and appeared to have a direction from S. to N. There are one or two remarkable facts noticed in Tasmania in connexion with these seismic disturbances. The first is the tremulous character of most of them, producing a sensation of a distinct tremor of the earth's surface, frequently continuous for a considerable period—in some cases for hours, and very frequently for over an hour. Many observers state as their experience that the tremors appeared to be on the surface, and not extending to deeper strata. This is somewhat supported by reports I have received from Mr. Grant, mining manager at Branxholme, on the Ringarooma River, North-east Tasmania, who has kindly furnished me with his observations of over 100 earthquakes and tremors which have been experienced in his locality since January of this year. This gentleman called my attention a year ago to the fact that most of the tremors and rumblings, while startlingly manifest on the surface, were not noticed 12ft. or more below it, except sometimes in the open timbered shaft of the mines. Even in deep cuttings they were often unnoticeable. Another remarkable point is that in some of the stronger tremors, while ferns and low bushes were seen to tremble and wave about rapidly, no movement whatever was noticed in taller trees. When it is low water in the Tamar at Launceston a long range of mud-flats are seen from the town, extending some distance down the river, and on one occasion during a strong tremor the surface of these flats was seen to be agitated as by a series of very short waves passing over it. I extract the following from notes furnished me by Mr. Grant:— July, 25—Bar., 30.05. Fine and clear. 4.40 a.m. a shock, and 10.34 a.m. a moderate shock. This shock caused a peculiar vibration of small ferns and underscrub. They commenced to tremble quickly at first, but increasing in intensity till the maximum of the shock; when the vibration died away as the wave passed over. It did not appear to affect the large trees or moderate sized saplings, only the herbage close to the ground. This was the first time I observed the phenomena. Again, on August 11, at 2.41 p.m., during a slight shock, preceded by a loud rumbling, no vibration of the ground was felt, but the smaller or ground herbage was seen to tremble, the motion proceeding from N.E. to S. W.; the loftier scrub and trees showed no motion." Another gentleman, who is strongly of opinion these disturbances are superficial, and not subterranean, states that he has spent much of his time below ground during the last 12 months at Mount Victoria (Northeast Tasmania), but during all the tremors and earthquakes he never felt the slightest indication of a tremor under the surface. He has heard the rumbling noise near the surface in the shaft, but felt no vibration. He says that his companions on the surface have frequently hailed him to tell him an earthquake was

passing, but failed on every occasion to discover any vibration or tremor underground, although sufficiently near the surface to hear the rambling noises. Commander Shortt, of Hobart, informs me that the ship Helena felt the shock of July 13, 150 miles to the eastward of Cape Barren Island, and that the water around her appeared convulsed. The collected observations of July 13, and of the severer shakes since, make it pretty certain, the direction of the seismic waves have been always from N.N.E. to S.W. in Tasmania, and from S. to N. on the Australian coast. This seems as if the waves radiated from a centre either in or about Bass Straits, or from some point at sea to the eastward of these places and very probably about the locality the Helena felt the shock. I regret I have got no intelligence from the islands yet concerning the disturbances; for any precise observation from there would greatly help in giving a locus for the seismic centre. The evidence available, however, strongly supports the foregoing assumption. While there is ample evidence of extensive old volcanic action in the Australian group, we have always regarded these regions (of course including Tasmania) as far removed from any centres or line of seismic activity, and during my 33 or 34 years' experience in this country, earthquake shocks have been of considerable rarity and always of very small intensity.

These repeated and continued tremblings therefore, constitute a new order of things and a problem for the geologist and physicist, but let us hope they will not become sufficiently severe to present a problem also to the architect, as they do in Japan.

Mr. Ellery can rest in peace – Australian architects anticipate no problems from earthquakes.

1884 09 19 at 10:35 UTC, NE Tasmania, east of Flinders Island

There were four, not three, large ($M \geq 6$) earthquakes off northeastern Tasmanian in the decade-long sequence from 1883 to 1892 and this was the second, acknowledged as such by Underwood (1972) and the newspapers. It was felt at least 350 km away from the indicated epicentre off the east coast of Flinders Island. The epicentral region is far enough from the mainland and Tasmania that no damage would be expected but no reports have yet been unearthed from villages on Flinders Island, the closest populated area.

Daily Telegraph Tuesday 23 September 1884, Page 3.

A smart shock of earthquake was felt about 8.35 on Friday evening. Many people are of opinion that it was quite as severe as the shock felt on 13th July last. The direction appeared to be from N.E. to S.W. Mr Biggs professes, to be anxious for all information bearing on the subjects, therefore it may be of interest for him to know that Friday's shock was distinctly felt underground. The men in No. 2 tunnel of the Tasmania had just finished 'crib,' and were about to resume work, when many of them noticed the shock. They would be then quite 100 feet below the surface.

Launceston Examiner Monday 20 and 22 September 1884, Pages 2 and 3.

Earthquake Shock. — About 8.37 last night another rather alarming shock of earthquake passed along in the usual direction— north-east to south-west. It was the strongest we have had here since the 13th July last, and was accompanied by a peculiar hollow rumbling sound.

The walls of buildings trembled and appeared to rock; ceilings seemed to vibrate, and windows, gas fittings, ornaments, crockeryware, and furniture shook and rattled in a really alarming way. The cases of the compositors and even portions of the machinery in the Daily Telegraph office were shaken about. The congregation in the Mission Church, and the members of the choir practising anniversary hymns in the Wesleyan Church, were seriously alarmed, and an assemblage in the Fire Brigade Assembly Room dispersed without standing on the order of their going, as the commotion reminded them of the close vicinity of the Firebell Tower. As soon as

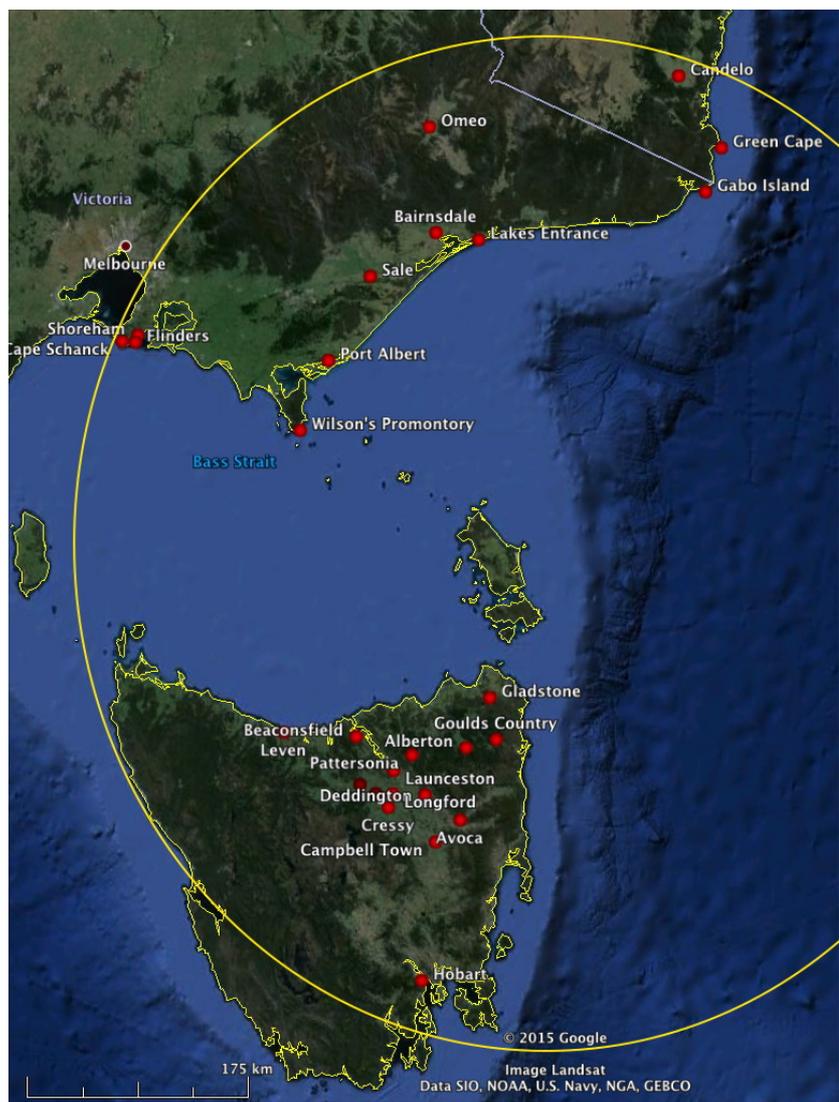
the hint was given a stampede for the open street commenced and the Assembly Room was vacated without a thought of passing a vote of thanks to the chairman. The fancy goods in Mr Pond's shop in Charles-street were so seriously affected that he did not attempt to save any of them from falling, but made track for the open street. Brisbane and Charles streets were soon filled with eager enquirers comparing notes in the expectation of hearing of some anxious catastrophe. The shock was felt in all parts of the town. It continued for upwards of 30 seconds. Our correspondent at "The Corners" (Hobart and Fingal roads), telegraphed before 9 o'clock that the most severe shock of earth tremor ever felt there had occurred at 8.38 p.m. We have no doubt the shock was general along a wide extent, from north-east to south-west.

THE LATE EARTH TREMOR. The severe earth wave with which we were visited on Friday last seems to have been generally felt throughout the island. So far as we have heard the most serious disturbance occurred at Gould's Country, our correspondent alleging the duration to have been nearly two minutes. Additional particulars are to hand showing that in town the shock was felt severely by passengers in the streets. Mr. Acres, standing in front of his residence, was thrown to the ground, causing an abrasion. Mr. Waldron, solicitor, who was in the street, felt no motion, but he heard a noise like a number of cars or carriages coming in opposite directions, and saw the shutters of shops moving and heard, windows rattling. Another resident was thrown out of his chair. At the Roman Catholic Church a large piece of plaster fell from the ceiling. In nearly all the poultry yards, the fowls left their roosting places, while sparrows and swallows flew out of their nests.

Figure 7 Felt reports following the large earthquake off Flinders Island on 19 September 1884. No damage has been noted but only on Flinders island might damage have been expected. No reports from there.

No doubt persons in different parts of the country have had some experience of the various tremors felt in the island lately, and it would be interesting if those resident, more especially on the coast, would record as briefly as possible and forward to the Press any unusual disturbance or wave, at sea, as it would form a valuable link in the elucidation of the causes of the disturbing influences now at work. A police constable informs us that on Friday night while the earth tremor was going on, he felt the West Tamar bridge, upon which he was standing at the time, oscillate violently, while looking below he noticed the river agitated, and the mud in a disturbed condition.

Captain Hall, of the s.s. Warrentinna, reports that at 8.35 on Friday evening, when the steamer



was lying off the George's Bay Wharf, a very severe shock of earth tremor was experienced. Captain Hawkes, of the schooner Helena, has also reported that on August 29th, when 150 miles to the east of Cape Barren, a severe, earth tremor shook the vessel.

The Mercury, of Saturday, states that a somewhat severe tremor, accompanied with a slight rumbling noise was noticed on Friday evening at about 8.40, the direction being, N.W. to S.E., and there being three distinct shocks in close succession. Buildings were shaken, bells tinkled and windows rattled, and a momentary scare was caused throughout the city, the tremor being equally severe both in high and low levels. In the Mercury office one of the dividing walls was thrown a little out of perpendicular, and a crack in another portion of the building perceptibly widened. Our correspondent states that at Austin's Ferry the shock and rumbling sound was perceptibly felt, and at the railway station, New Norfolk-road, the doors, windows, and various moveables were noticed shaking very perceptibly. Dr. James Hector, F.R.S., of Wellington, New Zealand, writes that earth tremors have been very rare in New Zealand for the last 18 months.....

Our country correspondents forward the following particulars :—

MUDDY CREEK (West Tamar), Sept. 20. On Friday, at about 8.30 p.m., we had the most severe shock of earthquake that was ever felt down the West Tamar. It came on with a very loud rumbling noise, which could be heard coming quite a minute before the shock, and lasted about the same time. The house cracked all over, and was lifted up and down like a railway train going over heavy stones. Rain set in at 12 o'clock, and has continued, with heavy rain, ever since.

OAKS, Sept. 20. A very severe tremor was felt here last night at 8.40. It shook the house and windows very severely, and was felt by all in the house, turning some quite ill for the time. The shock lasted fully a minute, and the wave seemed to travel north-east. We were holding a members' class meeting at the time in our room. A gentleman who was in bed in the house was rocked to and fro as if in a ship at sea.

LONGFORD Sept. 20. A very severe earth tremor was experienced here last night at 8.37, causing the greatest alarm to numbers of the inhabitants, some of whom rushed out of their houses terrified upon realising what was really happening. The tremor was accompanied by a rumbling sound, and was considered by those who felt the full force of it far more severe than that of Sunday, July 13th. Several gentlemen who were quietly reading at the public library at the time at once ran out into the street in alarm. Christ Church, bell was sounded twice, and one resident who retired to rest early was rolled out of his bed on to the floor. At the Temperance Hall entertainment the attention of the audience was taken up with refreshments, at the interval, the tremor consequently was not as noticeable in the bustle and excitement as it would otherwise have been; the swinging of the lamps, however, for some time gave unmistakable signs of the occurrence. Up to the present I have not heard of any damage being done in this district. A gentleman informs me that a second, but very much less severe, tremor was felt here at midnight.

WESTBURY, Sept. 20. The earth tremor of which I have already advised you by wire seems to have been one of the strongest ever felt here, and also to have been more generally felt than any preceding tremor. Many people who up to the time were somewhat sceptical in the matter had all their doubts removed by the violent oscillation of articles of furniture and pictures and other wall hangings, the rattling of glassware, etc. So violent was the shock that children awoke out of sleep, and rushed from their room in alarm. The tremor is variously stated to have lasted from 30 to 60 seconds; the time of the shock given by the majority of the residents seems, however, to be 8.40. The direction of the wave is also a matter on which there is a great difference of opinion.

Some persons contend that the course was from S.E. to N.W., while others feel equally sure that the vibrations passed from east to west. The bulk of opinion seems to favour the latter mentioned points. Whatever difference there may be on other points, all agree that the tremor of Friday night was the strongest yet felt here. The weather yesterday was very fine and warm, but to-day rain has fallen at intervals, and seems to have set in for the day. Fine warm weather is very much needed for both corn and grass.

PATTERSONIA, Sept. 20. A severe earth tremor was felt here at 8.30 p.m. yesterday, accompanied by a rumbling sound, and causing houses to creak.

CRESSY, Sept. 19. Cressy was again visited with a very severe shock of earth tremor about 9 o'clock this evening, lasting fully half a minute, shaking the windows with a loud noise, swinging the lamp and rocking the seat I was on distinctly from east to west, with an apparent motion of two or three inches backward and forward.

ALBERTON, Sept. 20. Last evening, about forty-five minutes past eight o'clock, we had an earth tremor which caused great excitement here. Many persons rushed outside their houses. Children also jumped out of their beds in terror. The vibration of the earth's surface was felt fully a minute. A loud rumbling noise accompanied the tremor, and a perfect calm at the time. Another correspondent wires:—An extremely heavy shock of earthquake was experienced last night at a quarter to 9. The shock came remarkably suddenly, and instead of being preceded by the usual rumbling, it was on the contrary, followed by it for about 90 seconds.

LEVEN, Sept. 21. A pretty severe earth tremor occurred here at about thirty-three minutes past eight on Friday night. The motion was a strong vibration, without coming apparently from any direction. Since the disturbance the weather has been very unsettled, with much rain. violent earthquake that has been felt here yet. The trembling lasted fully 80 seconds, and the vibrations were longer than usual. The people were terrified.

AVOCA, Sept. 20. A severe shock of earthquake occurred on Friday night at 8.44. The direction was from west to east. The shock was the most violent that has been felt here.

LOWER JUNCTION (Gould's Country), Sept. 20. A very severe shock of earthquake occurred here at 8.35 p.m. yesterday, its course being from S.E. to N.W., with a duration of nearly two minutes.

Tasmanian News Saturday 20 September 1884, Page 2.

Shock of Earthquake.—A severe shock of earthquake was experienced last night in several parts of the city, with a motion from east to west, at about twenty two minutes to nine o'clock. On enquiry at the Observatory, Captain Shortt reports that no shock was observed there, but it was felt by several of the audience attending Professor Andersons entertainment at the Town Hall. A correspondent writes:—" A shock of earthquake was felt in Church street last evening at 8.35 which lasted about 25 seconds, causing a vibration of the door knocker and windows. The atmosphere was quite calm at the time." It will be seen from our telegrams that the shock was very severe at Launceston, and the heaviest ever felt at Gould's Country.

In the Tasmanian News of Thursday 2 October 1884, Page 2 it was reported: Yesterday afternoon the Hon. the Premier, in company with Mr W. T.H. Brown, member for Campbell Town, Mr W. Moore, Mr F. Hart, Warden of Campbell Town, and Councillors C. H. Leake, E. Dowling, M. Fletcher, junr., James Gray, and M r T. H. Power, police clerk, visited the Campbell Town gaol and public buildings. It was seen that the buildings were in a very dilapidated condition, and totally unfit for the purposes for which they were used..... They next visited the Council Chambers, which are also in very bad order, a large amount of plaster having fallen

down with the last earthquake.

The earthquake was felt in Victoria and NSW.

The Argus Monday 22 September 1884, Page 6.

FLINDERS, Saturday.

A very distinct earth tremor was felt at Shoreham, soon after 8 o'clock last evening. Windows were shaken and tables and lamps agitated. There was only one shock, and the impulse appeared to have travelled from N.E. to S.W., or vice versa. A similar vibration was experienced at Cape Schanck, at half-past 8 p.m. Although Flinders lies between these two places, it does not appear that the shock was remarked by the residents here.

SALE, Saturday.

On Friday evening last, at half-past 8 o'clock, there was a shock of earthquake, which extended from Bairnsdale to Port Albert. It was felt slightly at Sale and in the neighbourhood. At Port Albert it lasted 50sec, causing some alarm.

A severe shock of earthquake, running from N. to S., which lasted a minute and 35sec., was felt on Gabo Island at ten minutes to 9 o'clock on Friday night, causing the lighthouse to tremble, and shaking the windows and furniture. The same shock was felt at Cape Schanck, Wilson's Promontory, Port Albert, Lakes' Entrance, and Omeo, and indeed throughout the southeastern portion of Victoria. At Wilson's Promontory the shock was accompanied by a loud rumbling noise and violent vibration.

The Sydney Morning Herald Monday 22 September 1884, Page 9.

Very severe shocks of earthquake at Gabo Island 8.50 p.m. 19th instant, lasting 1 minute 35 seconds, felt at Cape Green at 8.53 p.m., direction from S. to N.

1885 01 01 at 04:00 UTC, East of Flinders Island

Daily Telegraph Thursday 8 January 1885, Page 2.

Captain G. R. M 'Arthur, of the barque Free Trader, reports having experienced a severe shock of earthquake, lasting about 10sec, at 2 p.m. on the 1st inst., the vessel then being 80 miles to the eastward of Flinders Island. — Mercury.

For any magnitude, how far from the epicentre can one feel the shaking at sea? There are no reports that this earthquake was felt onshore, none that the author has found anyway.

1885 01 30 at 14:54 UTC, NE Tasmania

Launceston Examiner Monday 2 February 1885, Page 2.

THE RECENT EARTH TREMOR. The earth tremor which occurred shortly before one o'clock on Saturday morning appears to have been felt over a very wide area. Mr. A. B. Biggs informs us that his family and himself were awakened by it, and he noted the time as 12.54 a.m. The tremor was recorded by his apparatus, but the pillar indicator was not thrown down, though both the horizontal and vertical electric alarms rang out. No measurements were, however, recorded by the seismometers. In many parts of the town residents became so alarmed when they felt the shock that they ran out of their houses in alarm. So far no report has been made of any damage done to any buildings. Mr. John M'Mahon, of Longford, writes to Mr. Biggs, giving the time as 12.56 a.m., and states the tremor "was preceded by a loud rushing sound, as of a high wind coming; then came a gentle tremor, almost dying away, and then a jerk followed by a prolonged tremor." Mrs. M'Mahon heard a low rumbling sound as well as the rushing one, and as far as could be judged the direction was from N.W. to N.N.W. A correspondent at

Glenore writes: "A rather severe earth tremor was felt here this (Saturday) morning a little before 1 o'clock. I think the direction of the wave was from east to west." Our Hobart correspondent telegraphed on Saturday, as follows:—A number of persons residing in various parts of Hobart state that they experienced a sharp earth tremor this morning about 5 minutes to 1. The motion seemed to be from east to west, lasting about 10 seconds." Our Latrobe correspondent telegraphs:— " At 1 o'clock this morning a severe shock of earthquake was felt in the centre and east end of Latrobe, shaking crockery, etc. There appeared to be two or three waves." Our correspondent at Avoca telegraphs: —" A sharp earth tremor was experienced at 18 minutes to 1 o'clock this morning. Some persons say that they felt two distinct shocks."

The shaking was distinct at Sandy Bay, sharp at Ross, pretty severe at Winkleigh, rather severe at Forth, very severe at Coppington, Fingal, Pioneer and Pattersonia, nearly everyone violently awakened at Mangana, and felt in the Hobart Hospital by nurses and patients. Some Devonport residents said the shaking was as strong and lasted as long as that of Sunday last year. This was yet another notable earthquake in the swarm sequence, a minimal magnitude of 5.7 with an epicentre offshore St. Helens. No reports could be found of the intensity on Flinders Island.

1885 03 20 at 23:10 UTC, NE Tasmania

Launceston Examiner Saturday 18 April 1885, Page 1S.

Weather Report

Sharp shock of earthquake morning of 21st; felt at Swansea, 9.5 a.m.; Moorina, 9.7; Campbell Town, 9.10; Launceston, 9.11; Hobart, 9.13; it was also felt at Gabo Island at 9.25 a.m.

The quoted times are probably a fair approximation to the uncertainty in time estimates. That it was felt as far as Hobart and Gabo Is. indicates this aftershock was approaching magnitude 6.

1885 05 12 at 23:37 UTC, NE Tasmania – a Large Earthquake

This was very similar in size to the subsequent 26 January 1892 earthquake, the largest of the swarm sequence and largest known earthquake in historical time in Tasmania, both felt as far as Melbourne Victoria and Bega NSW (Michael-Leiba, 1989).

The aftershock sequence continued through to 1892 with events like the following.

1885 09 11 at 09:19 UTC, NE Tasmania

Launceston Examiner Saturday 12 September 1885, Page 2.

EARTH TREMOR.—Last evening a distinct earth shock was felt in town. The tremor was first experienced at 7.19 o'clock, when a slight vibratory motion commenced. This oscillation increased, and a low rumbling sound was perceptible; doors and windows rattled for about thirty seconds, at the end of which time the wave passed. Mr. A. B. Biggs informs us that the electric bells attached to his apparatus rang, indicating both a horizontal and vertical wave. The weather was sultry and calm at the time, not a breath of wind being perceptible, so that the low rumbling accompaniment could be heard with distinctness. Our Lefroy correspondent telegraphed last night that a strong earth tremor was felt there last evening about 7.20 o'clock.

Daily Telegraph Saturday 12 September 1885, Page 2.

EARTH TREMOR. — Another very forcible earth tremor was felt in Launceston, at 7.20 p.m. yesterday. The usual shaking of windows, and the lighter articles in furnished rooms, gave notice of its approach, and this continued for about 20 seconds, towards the close, a heavy lurch, which seemed to affect the most substantial brick wall, was perceptible. Our Hobart correspondent telegraphed, that the tremor was felt there at

7.15, and that its duration was 35 seconds.

The Mercury Saturday 12 September 1885, Page 2

EARTH TREMOR.- A very perceptible shake was experienced at 7.15 last evening in Hobart, lasting about 35 sec. Readers at the Public Library felt it plainly, and so also did residents in other parts of the city.

Figure 8 Felt area of the moderate but widely felt aftershock on 11 September 1885.

Reports scattered through the newspapers indicate that it was felt slightly in Coppington, Beaconsfield, Forcett, Lisle and Perth. It was felt at Turner's Marsh but at St Mary's it was described as a heavy shake. No report for Flinders Island.

1886 11 28 Bass Strait

Advocate Saturday 18 December 1886, Page 19.

Captain Smith, of the barque Jean Pierre, reports that when off Wilson's Promontory, on 28th November, he experienced a severe earthquake. It was quite calm just before, but the shocks were so severe that it appeared as if the ship was striking the ground. No damage was done to her.

The Mercury Friday 10 December 1886, Page 4.

We have had two or three slight shocks of earthquake here lately, but not sufficiently severe to cause any apprehension for the safety of property.

These two reports may or may not connect with the same event.

1887 11 09 at 15:53 UTC, NE Tasmania

The Mercury Friday 11 November 1887, Page 3.

EARTH TREMOR.

The following telegrams were received by Captain Shortt, meteorological observer, yesterday, conveying intimation of a shock of earthquake felt shortly after midnight.

BOOBYALLA.—Very strong earth tremor felt here at 1.53 a.m. from S.W. to N.

SWAN ISLAND. —Earth tremor felt here at 1.53 a.m. from S.W. to N.E., strong.

EAGLE HAWK NECK. Thursday. — At 2.8 a.m. a very violent earth shock.

CAMPBELL TOWN, Thursday. — Was awakened by sharp shock earthquake at one minute past 2. There appeared to be three separate shakings.

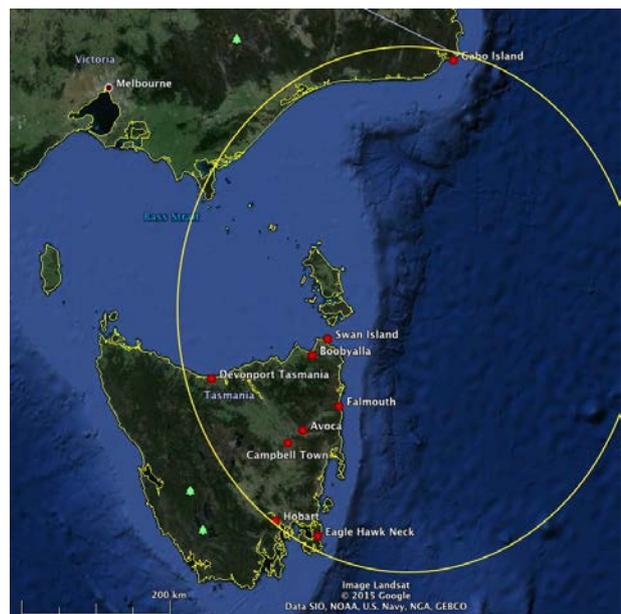
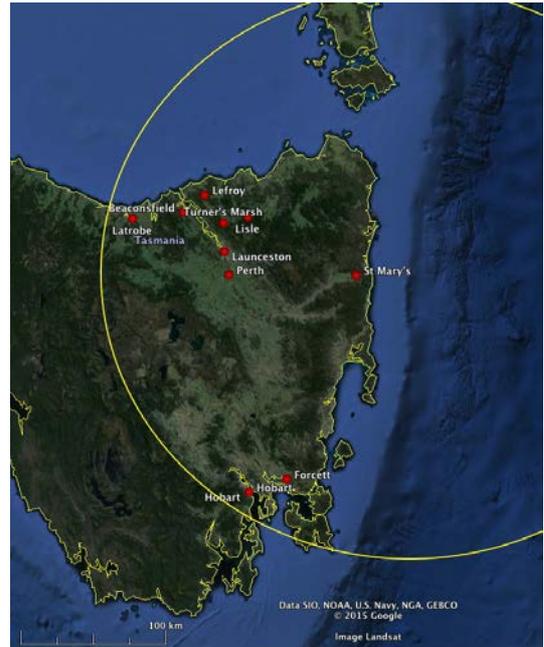


Figure 9 Felt area of the North East Tasmania earthquake of November 1887. No report of its effects at Gabo Island have been found in contemporary newspapers but Underwood (1972) mentions that it was felt there.

FALMOUTH, Thursday.—A severe earth tremor, accompanied by loud rumbling noise, was felt about 2 o'clock this morning, lasting 20sec.

We have received, the following telegrams from our own correspondents:—

AVOCA, Thursday.—After a long interval earth tremors have again paid us a visit, a severe one occurring at 2 o'clock this morning. A rumbling noise was heard for about 1min. before, and plates and dishes rattled loudly.

TORQUAY (Ed. Devonport), Thursday.—Very strong shock of earthquake at 1.55 this morning.

Mr. Wright, of Glenorchy, informs us that two distinct pulsations were felt there at 2 a.m., sufficiently strong to shake bedsteads, and other articles of furniture. Several residents in Hobart also state that they felt the tremors distinctly.

The earthquake was reported felt distinctly in St Mary's (George's Bay), and Underwood (1972) lists it felt at Gabo Island which indicates that it was close to magnitude 6.

1889 05 24 at 11:00 UTC, Hobart

Evening News Saturday 25 May 1889, Page 5.

Earthquake in Tasmania.

Hobart, Saturday. — About 9 o'clock on Friday night a distinct shock of earthquake was felt at Hobart. The walls of various buildings were shaken, causing the crockery on the shelves to rattle.

The Mercury Monday 27 May 1889, Page 3.

PORT ESPERANCE, SATURDAY.

A smart shock of earthquake was felt here on Friday evening at a quarter to 9. The shock was severe enough to shake houses, and was about 10secs. in duration. It was accompanied by a rumbling, and appeared to be travelling north.

The captain of the North Star reports feeling it while at anchor at Three Hut Point.

It was reportedly more severe at Hastings and Port Esperance than in Hobart.

1889 12 07 at 10:15 UTC, George's Bay

The Mercury Monday 9 December 1889, Page 2.

Smart earth tremor felt at George's Bay on Saturday evening.

Launceston Examiner Monday 9 December 1889, Page 2.

Our Wynford River correspondent telegraphed last night that at 8.15 on Saturday evening an earth tremor, accompanied by a loud rumbling, was experienced.

1890 07 14 at 07:50 UTC, George's Bay,

The Mercury Tuesday 15 July 1890, Page 3.

EARTHQUAKE ON EAST COAST.

GEORGE'S BAY, Monday.

A severe shock of earthquake was experienced here at 5 p.m. to-day.

MOORINA, Monday.

A very distinct shock of earthquake occurred here this evening at 5.51, accompanied by a loud rumbling noise, which lasted for about half a minute.

1892 01 26 at 16:48, NE Tasmania - a large earthquake

Launceston Examiner Friday January 29 January 1892, Page 3.

JAN. 27. STRAHAN.—Two sharp shocks of earthquake were felt at 2.35 this morning; crockery rattled on the shelves. This being the first felt on the coast, some people were slightly alarmed.

The *Zeehan and Dundas Herald* Friday 29 January 1892, Page 3 reports it as severe and the time as 3.15am. The shaking was caused by the fourth large earthquake off the northeast coast of Tasmania since July 1884 so the comment about this being the first earthquake felt on the west coast is surely incorrect. Michael-Leiba (1989) published isoseismal maps for three of the large earthquakes off the NE coast of Tasmania to assess their location and approximate magnitude.

1894

Two earthquakes are briefly documented, one at 6:33 pm on Tuesday 29 May around Stanley in the northwest, the other at 17 minutes past noon on Tuesday 20 November, probably a late swarm aftershock in the northeast.

1897 05 25 at 07:30 UTC, Eddystone

South Australian Register Wednesday 26 May 1897, Page 6.

TASMANIA. HOBART, Tuesday.

An earthquake shock was severely felt at Eddystone, on the east coast, at 5.30 this afternoon.

1897 08 11 at 10:10 UTC, Eddystone

The Mercury, Friday 13 and 16 August 1897, P 3 and 2.

EARTHQUAKE.

GOULD'S COUNTRY, THURSDAY.

At 10 minutes past 8 last night there passed over this district a heavy shock of earthquake, with a very loud rumbling noise. It lasted several seconds.

EDDYSTONE, THURSDAY.

About 8 p.m. yesterday a severe earthquake shock was felt here, travelling south, and lasting eight seconds.

THE RECENT EARTHQUAKE.—The recent earthquake felt in Launceston was also experienced in Hobart, although many have not reported it. One of those who felt the shock, however, was Mr. Alfred J. Taylor, the Public Librarian, who at a quarter to 8 o'clock that evening, while sitting in his office at the Library, heard the gas reflector over his head rattle. The motion lasted five or six seconds, and was sufficiently marked to arrest Mr. Taylor's attention. When he heard of the shock at Launceston he at once remembered the incident, Mr. Swalwell, grocer, of Hampden-road, Battery Point, who was in bed at the time, also distinctly felt, the bed shake.

This earthquake may have been considerably larger than 4.4 if, as the last report indicates, it was felt at Launceston and marginally in Hobart.

1899 01 12 at 18:00 UTC, Scottsdale

The *Launceston Examiner* reported very briefly that: Scottsdale 13th, an earth tremor was felt plainly at 4 a.m.

It was also felt 'sharp' at Launceston.

1899 06 18 at 21:00 UTC, Stanley

The *Launceston Examiner* Tuesday 20 June 1899 Page 3.

STANLEY.

A SEVERE EARTHQUAKE SHOCK.

STANLEY, Monday.— At 7 o'clock this morning the sleeping portion of the community were scared from their beds by the severest earthquake shock experienced for many years. The windows rattled, and the houses trembled, causing much excitement, but no actual damage resulted. The shock lasted for several seconds, and was followed by the rumbling noise peculiar to such disturbances. The shock was felt throughout the district.

Two shocks were reported felt at Smithton that morning at 6:27 and 6:50: *the first severe for Tasmania causing the windows and crockery to rattle violently.*

1902 06 20 at 19:15 UTC, NE Tasmania

An earthquake in northeast Tasmania in 1902 was mentioned in a few newspapers and widely enough felt to estimate its magnitude and location. No mention could be found in newspapers of it being felt on Flinders Island or at Devonport but the lighthouse logbooks have not been examined.

Daily Telegraph Monday 23 June 1902, Page 2.

During last week sharp earthquakes were reported in South Australia and New Zealand, and on Saturday morning Tasmania had a visitation, a shock of more or less severity being felt. From reports the tremor appears to have been experienced on different occasions, between the hours of 4.30 and 5.30, and lasted about 30 seconds. In the city, however, numerous residents put the hour as 5.15. The shock in Launceston was not severe. At several houses windows rattled, and in one or two instances minor pieces of crockery fell on the floor and were shattered. Mr Goddard, one of the guests at the Brisbane Hotel, was aroused by the erratic behavior of the jug on the washstand in his room, and several others staying at the hotel were also awakened by the oscillation of the beds. There were but few in the city who were not aroused by the shock. The effects were perhaps most severe at a brick house in Balfour-street, one of the walls being thrown out of plumb. At Evandale the tremor was distinctly felt, it lasting some seconds. Our Moorina correspondent wired last night: A most decided earth tremor, with the usual rumbling noise, happened here at about half-past 5 yesterday morning. Doors and windows rattled, and the earth shook enough to be distinctly felt.

Examiner (Launceston) Monday 23 June 1902, Page 5.

AN EARTHQUAKE. At 5.15 a.m. on Saturday many people were rudely awakened by a seismic disturbance that for Tasmania was perhaps a severe one. The unusual rattling of doors and windows proved too much for the nerves of some imaginative citizens learned in the cabled details of the Martinique disasters, and at least one spontaneous meeting of lightly-clad alarmists was held in the dark and frosty street. There not being a seismograph in Launceston, it was impossible, except by mental comparison with the "quakes" of nine or ten years ago, to arrive at any judgment as to the measurements of this latest occult visitation, but it was certainly of many seconds' duration. A number of people seem to have felt a preliminary tremor at 5.10 a.m.

GOULD'S COUNTRY, Saturday. This morning there was a severe earthquake shock at 5.15.

MOORINA, Saturday. An earth tremor occurred here this morning at half-past five, accompanied by the usual rumbling noise, making windows and doors rattle. It appeared to be passing to the west.

ULVERSTONE, Saturday. About 5.15 a.m. to-day a distinct rumbling announced the approach of an earth tremour, which shortly afterwards made its presence felt in an unmistakable manner, the shock being the most severe felt here for years.

VIEWPOINT (River Isis), Saturday. A sharp earth tremor was felt here at 5.15 this morning, lasting some seconds.

An approximate location and magnitude are determined here, at 40.7°S, 147.0°E and magnitude 4.8.

1902 07 28 at 14:00, La Trobe

Examiner Friday 1 August 1902, Page 7.

A shock of earthquake was felt at Latrobe on Monday night, lasting about 10sec.

The Mercury Monday 4 August 1902, Page 2, adds:

A slight shock of earthquake was felt at Latrobe about midnight on Monday, 28th July.

1903 12 31 at 11:00 UTC, St Mary's

Examiner Tuesday 5 January 1904, Page 6.

ST. MARY'S. On New Year's Eve a distinct earth shock was felt travelling from the north-east to the south-west. The tremor was fairly severe, and was felt by a large number of the inhabitants. The shock took place at 9 p.m.

ALBERTON. An earth tremor was severely felt at the Hinemoa mine about 9 p.m. on Thursday. It came with a sudden shock, and lasted for several seconds.

1905 03 25 at 12:48 UTC, West Coast

The Broadford Courier and Reedy Creek Times Friday 31 March 1905, Page 5.

Earthquake in Tasmania A distinct earthquake shock has been felt in Tasmania, but fortunately not of sufficient violence to cause any damage. The earth tremor was felt at Zeehan, Strahan, Queenstown and Lyell. At Kelly's Basin the shock was severe, and it is reported to have been much felt on the ranges back of Lyell.

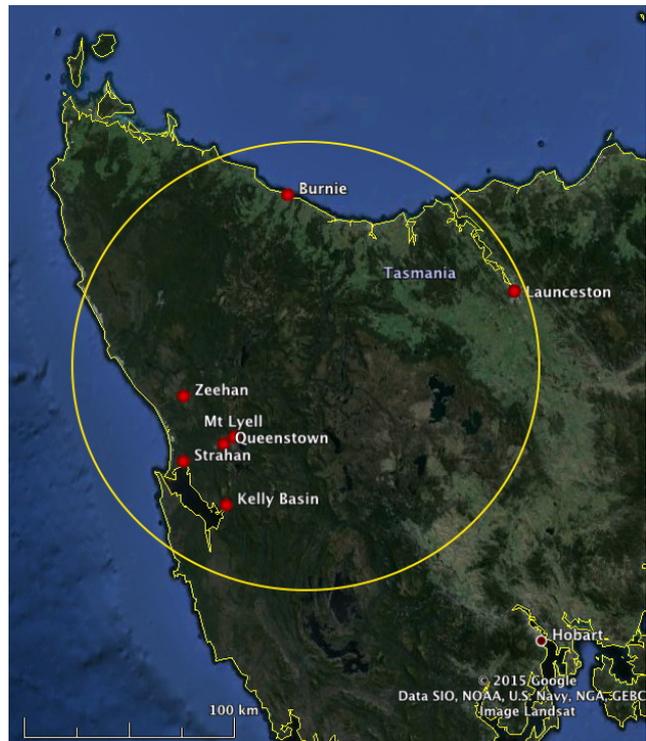
Figure 10 Felt area of the March 1905 earthquake on the northwest coast.

Daily Telegraph Monday 27 March 1905, Page 2.

AN EARTHQUAKE SHOCK ON SATURDAY NIGHT.

An earthquake tremor was felt in Launceston at about 12 minutes to 11 o'clock on Saturday night. The shock was only a slight one, and lasted for a few seconds. Owing to the local observatory not being equipped with the necessary instruments, no observations were recorded. The shock was also felt at Devonport, Burnie, Zeehan, and Queenstown.

BURNIE, Friday. At about 11 o'clock last night a slight shock of earthquake was felt at



Burnie. Reports of the occurrence have come from the surrounding districts, as well as from town. It only lasted for two or three seconds.

1907 01 31 at 07:45 UTC, NE Tasmania

Daily Telegraph Friday 1 February 1907, Page 5.

SEVERE EARTH TREMOR

EXPERIENCED IN TASMANIA. SHOCK LASTS FIFTEEN SECONDS.

At nine minutes to six last evening a severe earth tremor was felt in Launceston. It lasted exactly 15 seconds, and caused a great deal of excitement. The shock was not so much noticeable in the basements of buildings, but those working in the upper storeys felt it distinctly. In some workrooms something approaching a panic was engendered, and girls left their work and hurried from the rooms. The severity of the shock can be gauged by the fact that in some places very heavy articles swayed about in a most uncanny manner. At Messrs. Munnew and Findlay's warehouse all the pianos shifted, whilst in all the shops around Brisbane-street mirrors were swung violently from walls, and gas and other fixtures moved about in an alarming manner. No damage has been reported, but the tremor has left such an impression that those who felt it are not by any means desirous of going through such an experience again. Mr H. H. Scott, the curator of the Museum, when seen regarding the tremor, said that he felt it distinctly, and timed its duration at 15 seconds. He judged it to be travelling in a north-westerly direction and considered that if the disturbance were a local one it would be due to some submarine change having taken place in the Straits. The shock was distinctly felt also in the country districts, as the following reports will show:

ST. MARY'S, Thursday. — A very severe earth tremor was felt here this evening at 5.50. The disturbance was heard fully one minute before its full effect was experienced. Houses were shaken, and windows rattled severely, causing quite a sensational stir amongst the residents.

GLADSTONE, Thursday. — A sharp shock of earthquake was felt here at 5.55 this afternoon. It was accompanied by loud rumbling, which lasted some seconds.

DERBY Thursday. — A heavy earthquake shock occurred at about a quarter to six this afternoon. It caused much excitement.

RINGAROOMA, Thursday. — A severe shock of earthquake occurred at 6.55 this afternoon, and lasted two minutes.

ALBERTON, Thursday. — Thunder, accompanied by heavy rain, was experienced on Monday, Tuesday, and Wednesday. A very distinct earth tremor was felt at 6 o'clock this evening. It travelled from north to south.

MATHINNA, Thursday. — Mathinna has been shaken up at last. A severe earthquake tremor was felt at 5.50 this evening.

LOTTAH Thursday. — An unusually severe earth shock occurred at eleven minutes to six to-night. It lasted exactly 15 seconds, much to the surprise of the inhabitants, who ran out into the street.

The Mercury Friday 1 February 1907, Page 5 carried some additional information.

About 6 p.m. yesterday earth tremors were felt in different parts of Hobart, but not all over the city. Some guests in the upper rooms of the Orient Hotel were quite startled by the disturbance.

Mr. Kingsmill, the Government Meteorologist, states that he felt nothing at the Observatory, but had received a telegram from Eddystone Lighthouse, stating that at

5.55 p.m. there was felt a severe earth tremor with a rumbling noise. The Rev. F. Sharland also reported having felt the tremor at Rokeby about the same time.

On being informed that telegrams had been received at "The Mercury" office notifying that the tremors had been felt at different places on the East Coast, Mr. Kingsmill attributed this to the granite formations there, seismic disturbances being always more pronounced in a granite country. This might also account, in some measure, for the tremors being felt in some parts of Hobart and not in other portions of the city.

Mr. Kingsmill has no seismograph among his scientific instruments, though the Science Conference, which met in Hobart some few years ago, strongly advised that such an instrument should be supplied for recording shakings, tremors, and tiltings of the earth when occurring here, the records being of importance for comparison with results obtained elsewhere.

TELEGRAMS FROM THE COUNTRY.

AVOCA, January 31.

This afternoon, at about 5.45, a sharp earth tremor was felt here. Course, west to east.

GOULD'S COUNTRY. January 31.

A severe earth tremor was felt here at ten minutes to 6 this afternoon. It came with a loud noise, like thunder, and made dishes rattle in the houses, and lasted several seconds. It travelled from west to east. Weather calm at time.

Figure 11 Felt area of the January 1907 earthquake east of Flinders Island, felt from Hobart to Eden NSW. It was felt onboard the Largo Bay when at the position shown. The epicentre, about the 's' of C Barren Is, is 100km east of the marked settlement there.

REPORT FROM LAUNCESTON.

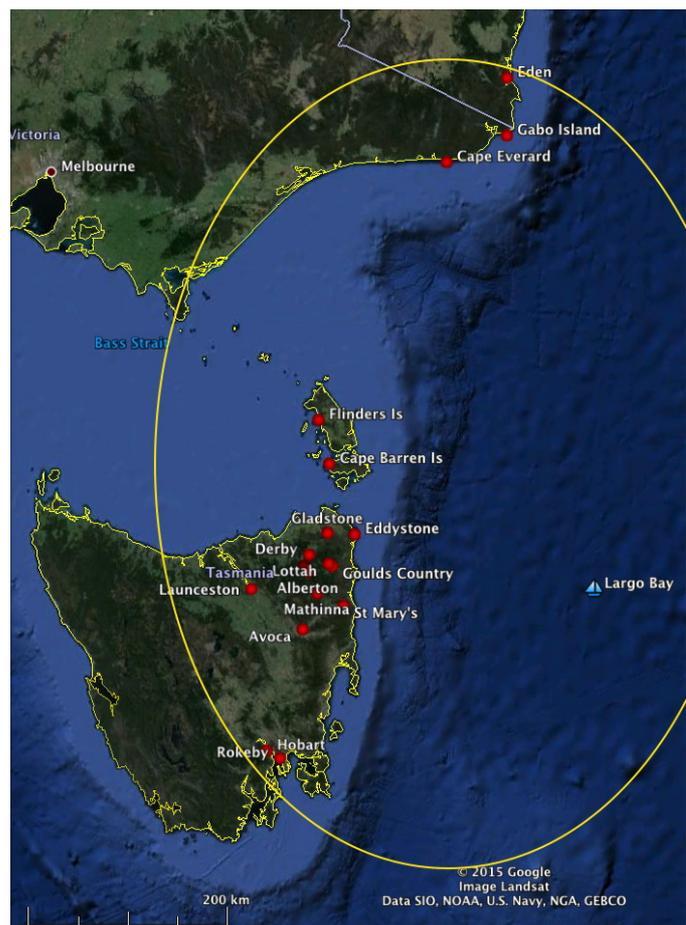
(By Electric Telegraph.)

LAUNCESTON, January 31.

An earth tremor was felt in the city at 5.49 this evening. Mr. H. H. Scott, Curator of the Victoria Museum and Art Gallery, was examining some talking machines when he saw the instrument vibrate, and called the attention of a gentleman present to the incident. Mr. Scott pulled out his watch, noted the time, and found that the tremor, which he described as "rather severe," lasted 15 seconds. He had no instruments to determine what direction the shock travelled, but he believed it was from north-west to south-east.

Twelve years ago a like occurrence took place in Launceston.

While a great number of persons in the city noticed the tremor this evening, quite as many were utterly unconscious of it. The descriptions of the duration of the tremor are all



widely different, ranging from three to thirty seconds; but, of course, the testimony of Mr. Scott, who is a scientific man, is entirely reliable. He says the museum sensibly shook.

Many persons relate that their windows rattled, and their pictures moved on the walls.

At the Presentation Convent the tremor was distinctly felt, and a number of the nuns, becoming alarmed, hastened into the convent ground.

Daily Telegraph Monday 11 February 1907, Page 4.

EARTHQUAKE AT FLINDERS ISLAND.

Our Flinders correspondent reports that the earth tremor which occurred on January 31 was felt on the island. Writing at 6 o'clock on the evening of that day he says: We have just experienced a sharp earth tremor, or rather I should say shock, as it was the heaviest for many years, and tremors as they are termed occur with frequency amongst the islands. Though many ladies and children were very frightened, no damage is reported yet. The rumble was travelling from a northerly direction.

Examiner Monday 18 February 1907, Page 7.

CAPE BARREN ISLAND, Feb. 4. Residents on this island were much startled last week by an earthquake, which lasted about half a minute, and gave us all a good shaking. A good rumbling sound, like thunder, accompanied the shock, which added to the alarm felt.

The Sydney Morning Herald Friday 1 February 1907, Page 6.

SHOCKS AT EDEN AND GABO ISLAND.

A slight shock of earthquake was felt at Eden and Gabo Island at 5.54 p.m. yesterday.

THE LARGO BAY FROM GLASGOW.

During the voyage of the British barque Largo Bay from Glasgow to Sydney she experienced what was evidently an earthquake at sea. On January 31, at 4 p.m., when in lat. 41.49 S, and long. 150.10 E, a peculiar rumbling sound was heard under the surface of the ocean, and a few moments later the vessel vibrated as though she had struck a sunken rock.

The times don't agree but it is likely the latter report refers to the same event. The only reports found that it was felt in Victoria were at Gabo Island and Cape Everard. Other stories that Somerville and Berwick felt earthquakes on Wednesday afternoon were at different times or ambivalent dates.

1907 05 21 at 09:55 UTC, Stanley

Examiner Thursday 23 May 1907, Page 5.

EARTH TREMOR. STANLEY, Wednesday. An earth tremor was felt shortly before 8 o'clock last evening. There were three slight but distinct vibrations. A portion of an old stone wall was shaken down on the premises of one resident.

The report of damage is tempered by the descriptive *slight* and the lack of other reports. There was even a hint of black humour about their earthquake: *Stanley took a pardonable pride in the earth tremor of the 21st inst., and feels justly indignant at other localities claiming a participation. The mild little earthquake was a shock of distinctly local origin; and recognition of claims only advanced after publication of Stanley's reports is hereby emphatically declined (Examiner Tuesday 28 May 1907, Page 8).*

The Daily Telegraph Thursday 23 May 1907, Page 5 elaborates:

Earth Tremor at Stanley:

A wire received from Stanley last night stated that the residents had experienced the sensation of another earth tremor similar to that recorded in almost every part of the State a few months ago. Several vibrations were experienced, and in different parts of the district small stone walls were knocked down. Crockery and other material were shaken off the shelves and broken. No word has been received of the shock being experienced in any other part of the State.

1907 05 21 at 17:00 UTC (early morning local time on Tuesday), Launceston area

Examiner Thursday 24 May 1907, Page 4.

An Earth Tremor :

Early on Tuesday morning an earth tremor, similar to that experienced at Stanley, referred to in yesterday's 'Daily Telegraph,' but perhaps of not such violence, was felt in the city. Heavy rain was falling, but distant rumbling sounds were heard, succeeded by the rattling of crockery. The unusual occurrence might have escaped unnoticed but for the fact that similar experiences were reported from various districts.

Until further information is available we will assign the time to 3am i.e. 17:00 UTC.

1907 06 14 at 07:30 UTC, Wynyard

Daily Telegraph Saturday 15 June 1907, Page 9.

WYNYARD

A slight earth tremor was felt here yesterday evening about 5.30, it was accompanied by a rumbling noise resembling thunder.

The weather report for June mentions an earthquake southwest of Launceston: *Creekton*. A slight earth tremor 10.30 p.m. on the 14th (*Examiner Friday 21 June 1907, Page 8*). This is probably a separate event, the times are so different.

1907 09 08 at 06:42 UTC, Burnie

The North Western Advocate and the Emu Bay Times Monday 9 September 1907, Page 2.

AN EARTH TREMOR,

Many residents of Burnie and the surrounding districts were startled last evening by an earthquake shock which occurred at 6.42 o'clock. The tremor was accompanied by a loud rumbling, which had the sound of heavy rocks rolling down a distant mountain side. The disturbance was travelling north-west and passed very quickly. Windows were rattled violently and many homes shook distinctly. Several persons were alarmed by the shock, and were for a time altogether at a loss to assign a cause for the commotion. More than one "ran outside," which appears to be the natural thing to do in an "earthquake". The shock was the principal topic of conversation last evening.

1908 05 04 at 09:50 UTC, Strahan

Daily Telegraph Wednesday 6 May 1908, Page 2.

EARTHQUAKE SHOCK ON THE WEST COAST.

STRAHAN, Tuesday. — At about 8 o'clock last evening a rather severe earth-tremor was felt here, which caused considerable excitement and alarm. The disturbance appeared to be travelling from north-west to south-east, and lasted for some few seconds, causing houses to rock and, sway, the windows and all small objects shaking in a very distinct manner. It was accompanied by a loud roaring noise, which added very much to the alarm of many. The brick buildings appeared to feel the effects more than the wooden structures.

THE SHOCK AT CHUDLEIGH.

DELORAINÉ, Tuesday. — A fairly severe earth tremor was felt at the Needles between 7.30 and 8 o'clock last evening.

CHUDLEIGH, Tuesday. — A severe earth tremor was felt last evening at 8 o'clock. Windows and crockeryware rattled, and residents were considerably alarmed.

THE EFFECT AT QUEENSTOWN.

QUEENSTOWN, Tuesday. — No additional damage beyond that already reported seems to have been done by the earth tremor of Monday night. The Mount Lyell Company's reduction works where there are two huge smoke stack, escaped unharmed. The men underground at the North Lyell mine distinctly felt the tremor, but attributed it to heavy firing, or simultaneous explosion of two shots. At Gormanston and Linda the same alarm, as at Queenstown was created, and some of the women have not yet recovered from nervous shock. The walls of two or three buildings have been cracked, but the fractures are very slight.

Michael-Leiba (1989) used newspaper reports to draw an isoseismal map for this earthquake from which she estimated the magnitude as 4.5 to 4.8.

1910 01 13 at 00:16 UTC, Tasman Sea

Hogben (1912) located an earthquake off the northwest coast of Tasmania on 13 January 1910 which, if accurately located, should have been felt throughout Tasmania and in Victoria, which it wasn't. McCue (2001), using phase arrivals from seismographs in New Zealand and at Riverview to re-locate it. The revised epicenter was off the east coast at 44°S, 155°E and its magnitude was 6.0 from the Riverview amplitude and distance. This is an active zone of submarine volcanoes marking a now-inactive spreading ridge. A large earthquake occurred on this ridge on 25 November 1983 and wasn't felt in Tasmania or SE Australia.

1910 06 22 at 05:00 and 08:15 UTC, Mathinna

Daily Telegraph Monday 27 June 1910, Page 4.

Earth Tremor at Lottah : A rather severe earth tremor occurred at Lottah during the week (writes our correspondent), accompanied by a loud rumbling noise. Some years ago they were of daily, nay hourly, occurrence, and old residents nowadays pay little heed to an occasional 'shock.'

Our Mathinna correspondent writes: On Wednesday many residents felt, some several, earth tremors — one about 3 o'clock, and a more severe one about a quarter past six in the evening. The latter shook the houses and rattled the crockery, and was heard coming.

No mention at St Mary's so we assume they were north of and nearer Mathinna than Lottah.

1910 06 30 at 09:00, Cape Barren Island

Examiner Tuesday 5 July 1910, Page 8

Cape Barren Island

An earth tremor occurred here about 7 o'clock last Thursday night, and was accompanied by a loud rumbling noise. It caused some little excitement among the inhabitants while it lasted, which, fortunately, was not very long.

1910 07 24 at 12:50 UTC, Launceston

Daily Telegraph Tuesday 26 July 1910, Page 4.

An Earth Tremor

On Sunday night many families were thrown into a state of mild excitement by a slight earth tremor, which is said to have occurred at about 10.50, and wild rumors were afloat yesterday regarding the effect of the shock. Many people affirmed that a distinct rumbling sound was heard, a slight tremor of the earth being felt at the same time. Residents of the hills appear to have noticed the shock more than those on the flats, but no reports of damage to or disturbance of property have come from a reliable source. Unfortunately, a seismograph is not included among the instruments at the Launceston observatory, so that the extent and course of the tremor has not been recorded.

The Mercury Tuesday 26 July 1910, Page 3.

About a couple of years ago the residence of Mr. J. A. Jensen, on Beauty Point-road, near Beaconsfield, was in danger of being wrecked, owing to a landslip which occurred close by. This morning he was alarmed to find that the foundations of the house had suddenly opened out. Whether this can be attributed to the earth tremor felt last night is not known, but the task of making the residence secure will prove a costly undertaking.

1910 08 08 at 13:20 UTC, Strahan

Daily Telegraph Wednesday 10 August 1910, Page 3.

STRAHAN, Tuesday. —A slight earth tremor was felt last night at about 11.20, and lasted about half a minute.

1911 02 27 at 09:40 UTC, Smithton

The North Western Advocate and the Emu Bay Times Friday 3 March 1911, Page 2.

SMITHTON. On Monday evening, between 7.30 and 8 o'clock, a distinct earth tremor was experienced. At first there was a rumbling noise like thunder, and then the houses shook as if some large object had fallen against the buildings. A slight thunderstorm passed over the town on Monday, and rain followed.

Daily Telegraph Tuesday 28 February 1911, Page 4.

A distinct earth tremor was experienced at Stanley at 7.40 last evening, and startled the residents.

1911 11 04 at 01:27 UTC, Zeehan

Chronicle Saturday 11 November 1911, Page 37.

EARTHQUAKE IN TASMANIA.

Zeehan. November 5.

A strong earthquake shock was experienced throughout western Tasmania at 11.30 o'clock on Saturday morning. It passed along from north to south, and in some places proved severe. A low rumbling sound was heard. The earthquake shook the buildings, especially the wooden structures, considerably, and alarmed many people. Underground in the mines the effect was pronounced. In a private house crockery rolled off the dressers. Between three and four years ago a somewhat similar shock occurred, and it was noticed that both shocks appeared to follow the contact rock line of country. Saturday's shock lasted about 15 sec.

Michael-Leiba (1989) used newspaper reports to draw an isoseismal map for this earthquake from which she estimated the magnitude as 4.8 ± 0.3 .

1915 03 27 at 12:15 UTC, Rosedale

Every Week Thursday 4 March 1915, Page 4.

A severe earth tremor was felt at Rosedale on Saturday night about 10.15 o'clock.

Several houses were severely shaken, and the occupants very much startled. The tremor lasted several seconds.

1915 04 04 at 07:50 UTC, Stanley

Circular Head Chronicle Wednesday 7 April 1915, Page 2.

Earth Tremor. At about ten minutes to six on Sunday evening a rather severe earth tremor was felt in Stanley. The tremor was accompanied by a noise like thunder and was travelling in a south-westerly direction.

1917 12 21 at 17:00 UTC, Stanley

Circular Head Chronicle Wednesday 2 January 1918, Page 2.

Earth Tremor.

Residents of Stanley were startled by a severe earthquake shock which occurred at three o'clock on Saturday morning, 22nd ult. It was accompanied by a rumbling noise, and it only lasted a few seconds. Reports from Smithton and Irishtown state that it was distinctly felt in both places.

1918 03 22 at 11:20 UTC, Launceston

Daily Telegraph Saturday 23 March 1918, Page 7.

Earth Tremor: Last night in the interval between 9.15 and 9.30 o'clock residents in York-street, and at any rate in the centre of the city, heard a rumbling noise resembling that of thunder. It was followed immediately, however, by a violent shaking of the furniture and fixings, with the rattling of crockery, etc., and recognised it as an earth tremor. Those who experienced the shock describe it as severe. Launceston of late years has not had frequent manifestations of this sort, though many years ago earth tremors here were numerous, and sometimes quite alarming.

1918 04 22 at 17:45 UTC, NE Tasmania

Daily Telegraph Wednesday 24 April 1918, Page 4.

Earth Tremor.

*After comparative freedom for a number of years Tasmania is again experiencing earth tremors. A slight shock was felt about a month ago in the north of the State, and yesterday morning there was another visitation, this time rather sharp. The time of the shock varied, some people saying they felt it at about 2 a.m., while others gave the time at 4 o'clock. There may, however, have been more than the one tremor. At Eddystone Point, on the East Coast, a sharp tremor was felt, and was reported to have lasted for two minutes. It appeared to be travelling from the south-west. At Mount Nicholas (reports our correspondent) a sharp earth tremor was felt at 3.50 a.m. yesterday. Our Ringarooma correspondent reported that a tremor was felt at about 3.45, and lasted for about 15 seconds, windows and doors rattled. *Unfortunately there is no seismograph in the State by which the time and force of these shocks can be recorded.**

The call for a seismograph fell on deaf ears for many decades!

1918 10 04 at 10:00 UTC, Marrawah

Circular Head Chronicle Wednesday 9 October 1918, Page 5.

Marrawah.

Earthquake Shock. —On Friday evening at about 8 o'clock, a distinct earth tremor was noticed.

1919 04 19 at 10:00 UTC, Woolnough : 1919 04 20 at 21:00 UTC, Stanley

Advocate Thursday 24 April 1919, Page 2.

Earth Tremors.—Residents of Woolnorth report an earth tremor felt there about 8 o'clock last Saturday evening travelling from N.E. to S.W. Another tremor was experienced at Stanley about 7 o'clock Easter Monday morning.

1919 08 01 at 14:25 UTC, Cressy

Examiner Thursday 7 August 1919, Page 3.

Blackwood Creek. A very severe earth tremor was felt here on Friday night at a little after 12 o'clock. It started with a low rumbling noise, and ended like a loud clap of thunder, rattling the crockery and shaking the houses.

Zeehan and Dundas Herald Wednesday 6 August 1919, Page 2.

Tremor at Cressy: An earth tremor was felt at Cressy (Tas.), at 25 past 12 on Friday night. It was preceded by a noise like an approaching motor car which increased in volume, and was followed by a trembling, which lasted a few seconds. The direction of the tremor was S.W. to N.E.

1921 02 07 at 14:30 UTC, Stanley

Circular Head Chronicle Wednesday 9 February 1921, Page 2.

Earth Tremor.

A distinct earth tremor was felt in Stanley on Monday night, at 12.30 o'clock. It was preceded by a rumbling noise, and windows rattled, in some of the houses. The disturbance appeared to be running in a north-south direction.

1921 07 16 at 10:30 UTC, Zeehan

Zeehan and Dundas Herald Monday 18 July 1921, Page 2.

SLIGHT EARTH TREMOR EXPERIENCED SATURDAY EVENING. Several persons report having noticed a slight shock of earthquake on Saturday evening, at 8.30 o'clock. They state that a rumbling, grating sound occurred, which caused in several instances the floors of houses to shake slightly. The tremor was not of long duration, and it passed in two or three seconds. According to those who noticed it, the direction, of the earth tremor would be approximately north-east by south-west, or down the Great Fault line of the West Coast. Several years ago an earth tremor passed down the same line, but it was strong, and felt by all. The children of one local family declared that there was a "storm under their house," and others experienced a similar sensation.

1922 04 10 at 10:50, Bass Strait

The Mercury Tuesday 11 April 1922, page 5.

AN EARTHQUAKE SHOCK. TREMOR ON NORTH-WEST COAST.

FELT ALL OVER MELBOURNE.

BURNIE, April 10.

A slight earth tremor was experienced on the North-West Coast to-night at 8.50. There were half a dozen distinct shocks.

MELBOURNE, April 10.

Throughout the metropolitan area alarm was caused shortly before 9 o'clock to-night by a distinct earthquake shock, the second within a few weeks. Reports from practically every suburb stated that the tremor was felt. Houses shook, and in some cases the plaster of the walls and ceilings was displaced. The disturbance lasted for several

The State Meteorologist (Mr. J. C. Foley) told a "Mercury" representative yesterday that the tremor had been reported from several districts. *The observatory is not equipped with a seismograph, which is an instrument designed for detecting and recording earth tremors.* The barograph sheet showed that the needle, had jumped slightly at 5.37a.m.

Huon Times Friday 28 April 1922, Page 2.

EARTH TREMOR IN THE HUON

Yesterday morning shortly before 6 o'clock an earth tremor was distinctly noticed by a considerable number of persons in the Huon, especially at Franklin. The disturbance was accompanied by a rumbling sound which, lasted for several seconds and caused the walls of buildings to tremble. Several disturbances have been recorded lately by the seismograph at Melbourne, the origin of which is said to be in Bass Straits.

1924 03 01 at 12:00 UTC, Zeehan

Examiner Monday 3 March 1924, page 6.

SHOCKS AT ZEEHAN, MANY RESIDENTS ALARMED. HOUSES AND CONTENTS SHAKEN. ZEEHAN, Sunday. About 10 o'clock last night a seismic disturbance of some magnitude was felt in Zeehan by people who were both inside and out of doors. Amongst many others, the brick premises of the E.S. and A. Bank were badly shaken, the windows rattling violently, and pedestrians gave the building a wide berth. It was noticed by residents all over the town. Numbers who were in bed arose to ascertain what had happened, while others vacated their premises for the street to learn if any damage had resulted.

Daily Telegraph Monday 3 March 1924, Page 5.

PANIC AT ZEEHAN.

ZEEHAN, Sunday.— An earth tremor was experienced at 10.15 last night. Zeehan residents rushed out of their houses and places of entertainment on to the roads panic stricken. Picture frames and ornaments fell off the walls of houses and were smashed. Two small huts collapsed but no other damage was done. It is sixteen years since the occurrence of the last earth tremor on the West Coast. It was not so severe at Queenstown. The miniature quake was followed some hours after by extraordinarily heavy thunder, and brilliant lightning which continued throughout the night.

Contrasting stories of the same event, same place, where the shaking was undeniably strong. This is another of the early earthquakes studied by Michael-Leiba (1989) who drew up an isoseismal map indicating a magnitude of 5 to 5.1.

1925 04 25 at 13:35 UTC, Burnie

Advocate Monday 27 April 1925, Page 4.

AN EARTH TREMOR FELT ON COAST.

An earth tremor was experienced on the North-West Coast on Saturday night. It appeared to be travelling from east to west and was felt at Burnie at about 11.30 o'clock.

A Stanley report says, the 'quake was felt in that district at about 11.40 p.m. and lasted for two or three seconds.

FOREST.

Earth Tremor— An earth tremor was felt with some severity last Saturday night in different parts of the district; being so violent as to cause the timbers in houses to creak and rattle as well as crockery and glassware.

1926 01 27 at 17:45 UTC, Several shocks at Stanley

Examiner Friday 29 April 1926, P4.

EARTH TREMOR AT STANLEY. Between 3 o'clock and 4 o'clock yesterday morning an earth tremor at Stanley shook furniture and woke people up. There were three slight tremors between 8 o'clock and 10 o'clock on the previous night.

1927 09 20 at 09:00 UTC, Port Arthur. No damage, felt reports and isoseismal map

Figure 13 Isoseismal map of the 20 September 1927 earthquake. The strongest shaking was reported from Port Arthur.

This earthquake rated page 7 of the *Hobart Mercury*, the journalist reporting that it was felt in *The Mercury* office a few minutes after 7pm, following which staff were kept busy answering phone calls from residents enquiring whether the staff too had felt the shaking. Some people hastily vacated their house fearing another stronger quake. At Port Arthur the shaking was rated severe, small articles on shelves being displaced but there was no damage.

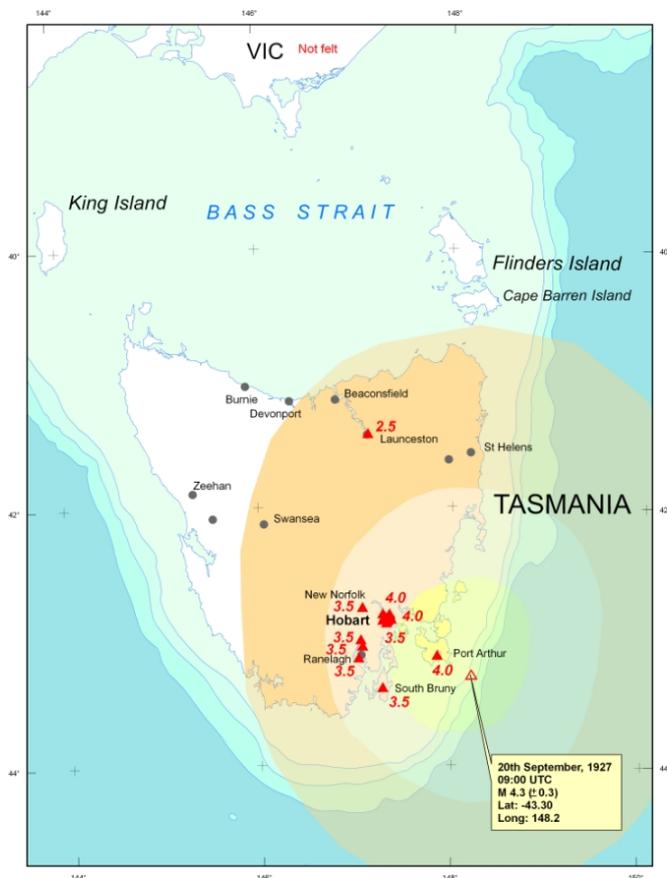
Mr A. N. Lewis, lecturer in Geology at the University of Tasmania, commented to a reporter from the *Examiner* newspaper that *the noise and shock were unusual for Tasmania and even the oldest of the old inhabitants cannot recall a tremor accompanied by so much noise.*

The reports were compiled and an isoseismal map drawn up to determine an approximate epicentre and magnitude.

1928 01 18 at 01:20 UTC, Damage at Fingal, AAAS Congress in Hobart Shaken

The Mercury Hobart Thursday 19 January 1928, Page 9 gave a big spread to the earth tremor: plaster was cracked and dislodged in the Bank of Australasia in Fingal; the shaking rated severe at Ross and Campbell Town, books and crockery fell from shelves, the tremor lasting about 5 seconds. It was particularly noticeable in the Midlands, water tanks swayed on their stands along the Macquarie River where the shaking rated 'severe', but it was only slightly felt in Hobart, Launceston and along the northwest coast.

The Australasian Association for the Advancement of Science Congress opened in Hobart on 17th January so delegates must have felt the earthquake. Edgeworth-David implies, as mentioned in his light-hearted comment reported in the following day's newspapers, that some felt it, did he?



The Mercury Friday 20 January 1928, Page 8.

"Splendid" Earthquakes.

"You have had an earthquake in Tasmania—splendid!" said Sir Edgeworth David in the course of a lecture on "Do Continents Float?" in the Town Hall last evening. "It is interesting to have earthquake shocks in Tasmania, so long as they are not too serious. One of your photographers (Mr. Beattie), who has done so much to bring Tasmania's beauty spots under notice, did not think it was splendid, though. He thought that his studio, where he was sitting at the time, was going to fall to pieces. But there is no fear of anything like that." In reply to the laughter of the audience, some of whom were doubtless recalling the qualms they felt when the shock occurred. Sir Edgeworth added: "Oh, it is just as well to feel you are alive. A shaking up is good now and again." He showed that Tasmania was situated in a mild earthquake zone, and in illustrating his point that the earth's crust moves, he said that part of the coast line of an island in the New Hebrides had "jumped up" 20 feet as a result of an earthquake, and a further shock raised it another 12 feet, leaving sunken ships high and dry.

Figure 14 Isoseismal map of the 18 January 1928 earthquake near Fingal.

One of the comments in the newspaper was that the shaking in Hobart as measured on the Weather Bureau barometer was *not nearly as much as during the tremor on September 20 last.*

Daily Telegraph Saturday 21 January 1928, Page 16

ST. MARY'S EARTH TREMOR

A mild sensation was caused here on Wednesday about mid-day. A distinct earth tremor was felt. It lasted a few seconds only.

North-Eastern Advertiser Friday 20 January 1928, Page 3.

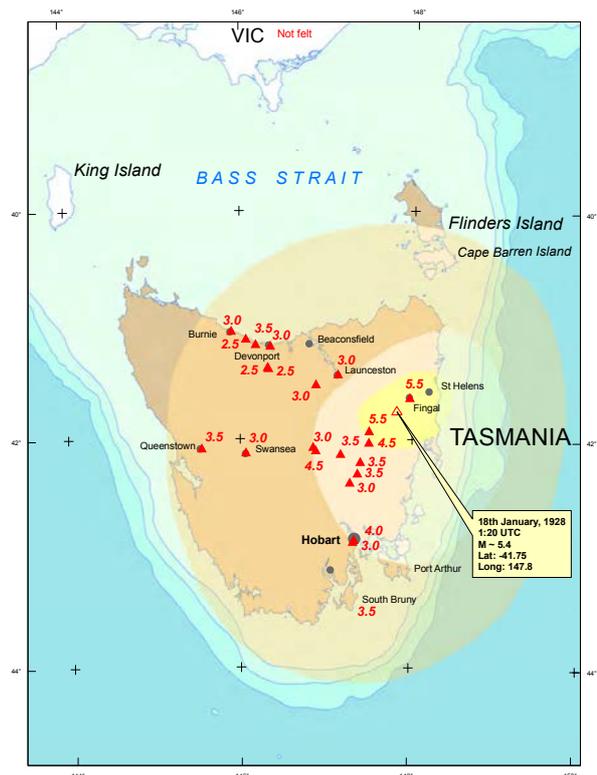
At about 11.30 on Wednesday morning a slight earth tremor was experienced at Derby. The vibration was sufficient to rattle windows and doors and in some cases crockery was dislodged from shelves.

The Mercury Saturday 21 January 1928, Page 10.

The earth tremor which occurred on Wednesday, was fairly severe at Merton Vale, the home of Colonel Henry Foster (Ed. Campbell Town). The vibration dislodged books from the shelves, and mortar was shaken from the ceilings of a new building. The tremor was also felt at Railton.

North-Eastern Advertiser Friday 20 January 1928, Page 3.

Pioneer



About 11 o'clock on Wednesday morning an earth tremor was felt here. The roar could be heard in the distance, but seemed to be well under the earth. When the shock arrived, it was just as if a large motor lorry had struck the writer's house. The house swayed and then settled down again. The chair in which the writer was sitting was distinctly felt to tilt and then resume its usual position. The tremor appeared to be travelling from south to north.

1928 05 12 at 05:00 UTC, Circular Head

Circular Head Chronicle Wednesday 16 May 1928, Page 3.

An Earth Tremor. On Saturday about 3 p.m. several townsmen experienced an earth tremor, which shook houses and caused crockery to rattle ominously. Articles hung from walls swung pendulum fashion for some time after the tremor.

1929 07 11 at 05:30 UTC, Stanley

The Mercury Friday 12 July 1929, Page 4.

A slight earth tremor was felt at Smithton at 3.30 p.m. yesterday.

Advocate Friday 12 July 1929, Page 4.

EARTH TREMOR. Felt on N.W. Coast.

Burnie residents who were in Wilson street early yesterday afternoon report having experienced what they believe to have been an earth tremor. The district forester (Mr. M. R. Garrett) told an "Advocate" reporter that shortly after 3 o'clock the building in which his office is situated shook. The inspector of machinery (Mr. Dan Clark), whose office adjoins that of Mr. Garrett's, had a similar experience. Strangely enough, those occupying other buildings nearby, notably the Burnie institute, felt no tremor, although pedestrians in Wilson street and the occupants of several shops did so.

The tremor was felt by many Stanley resident at 3.25 o'clock yesterday afternoon. The tremor was heralded by thunder, which appeared to be travelling from north to south. The tremor lasted for three seconds, and caused windows and doors to rattle.

1929 12 28 at 01:22 UTC, Launceston

Damage, felt reports and isoseismal map

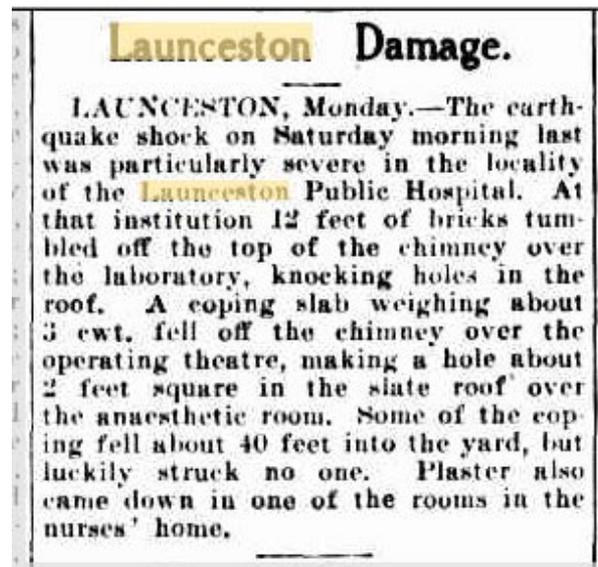
Figure 15 Extract from the Burnie Advocate of Tuesday 31 December 1929.

Various newspapers reported the 1929 earthquake and the story titled *Launceston Damage* in the north coast-based Burnie Advocate is shown in Figure 2.

Significant damage was done, luckily no one was killed or injured. The earthquake was felt in the State capital: the Hobart Mercury of Monday 30 December 1929 page 5 reports the following story: *Shortly before half-past eleven on Saturday morning a very noticeable earth tremor was experienced in Hobart and its surroundings. The pronounced vibration was felt in all parts of "The Mercury" building, the rattling of windows accompanying the earth movement.*

In city offices and establishments generally the same disturbance was noted. In domestic

Advocate (Burnie, Tas. : 1890 - 1954) (about) ◀ Tuesd



residences bells rang of their own accord, crockery danced, and clotheslines heaved. No actual damage to property is reported.

The disturbance registered itself at the Hobart observatory at Anglesea Barracks by a sudden violent movement on the part of the sensitive instrument (Ed. a barometer), indicating that it was centred in a distant earthquake of more than ordinary severity.

The earth tremor was felt very clearly throughout the Huon about 11.25 on Saturday morning. Windows rattled, and crockery and pictures shook perceptibly. It was very noticeable at Cygnet among the yachts at anchor in the bay, the boats tossing about as if in the wash of a large steamer (Ed. this seems to be a description of a seiche in the bay).

Figure 16 Burnie Advocate, Tuesday 31 December 1929. The earthquake was strongly felt on board the collier *Kiwitea* (approximate position at the time is where the ship icon is plotted on the isoseismal map southeast of Cape Barren Island).

A number of chimneys partially collapsed or cracked, the most severe being in a private house in Paterson Street, and the old Launceston Public Hospital, where a kitchen chimney gave way. At St. Andrew's Church, Paterson Street, a stone ornament at the top of the spire was dislodged, and fell into the street.

Lighthouse reports

A search was undertaken to locate Tasmanian and Victorian lighthouse records in Australian Archives, Canberra. Lighthouse keepers kept meticulous logbooks of meteorological and other observations such as earthquakes but the logbooks are kept in the States. The author arranged to visit the Melbourne Office of Australian Archives and found no mention in the logbooks of the four nearest Victorian lighthouses, the closest on Wilson's Promontory (shown as '0' on the map). Ian Ripper examined the Tasmanian lighthouse keepers' records at the archives office in Hobart during his visit there in early 2012 and was well rewarded with four keepers noting the shaking.

From these and many other reports in Tasmanian newspapers an isoseismal map was constructed (Figure 4). No photos of the damage were discovered which is disappointing. There are a number of intensity reports that seem to be inconsistent with the contoured rating but such outliers are often observed and may reflect shallow geological features, like the sediment-filled Tamar Graben under Launceston, which are known to amplify shaking at some frequencies. Alternatively, such outliers may simply reflect a lack of factual reporting.

The high intensities on Flinders Island are surprising, probably the reason for the Geoscience Australia (GA) epicentre being where it is. At Lady Barren a party reported: *At 11.20 a.m. an earthquake occurred, with considerable noise and the shaking of chimneys. On the boat it sounded as if the winch was in operation.* This is consistent with our map. One could play a bit with the contours but that would not change the interpretation that this was a moderate shallow earthquake under northeastern Tasmania rather than an offshore earthquake like the large ones in the 1880s and 1890s (Ripper, 1963; Michael-Leiba, 1989).

The report about the shock being felt at sea on board the *Kiwitea* is interesting but doesn't exclude either epicentre. Another observation, by Mr E. J. Gillian from Devonport, that there



were two shocks with an interval of only a few seconds in between would support an epicentre within 20 to 40 km or so, if what he felt were the separate P and S waves.

Earthquake location and magnitude

A search of the GA database restricted to Tasmania in 1929 returned zero events but changing the selection criteria to Australia gave the top row in the following table. The bottom line is the epicentre shown on the isoseismal map at the centre of the high intensity contour (Figure 4).

There were few regional seismograph stations operating in 1929; Melbourne, Riverview, Adelaide, Perth and Christchurch and of these only Riverview was equipped to record local earthquakes. The uncertainty in the GA database location by Everingham, Denham and Greenhalgh (EDG 1987) is much larger than the 2nd decimal place of the reported epicentre would indicate, perhaps $\pm 1.0^\circ$ at best. The GA database epicentre is 200km from the centre of the MM6 isoseismal contour shown in Figure 4, the point adopted as our epicentre. Burke-Gaffney's (B-G 1951) solution is closer to our epicentre.

Table 1 1929 earthquake details reported by different sources

Date	Time UTC	Lat °S	Long °E	Mag	Approx Location	Source
28 12 1929	01:22	40.0	148.5	5.0 ML	W of Flinders Is	B-G 1951
		39.69	149.45	5.2 Ms	E of Flinders Is	EDG 1987
		41.54	147.56	5.6 ML	NW Tasmania	This paper

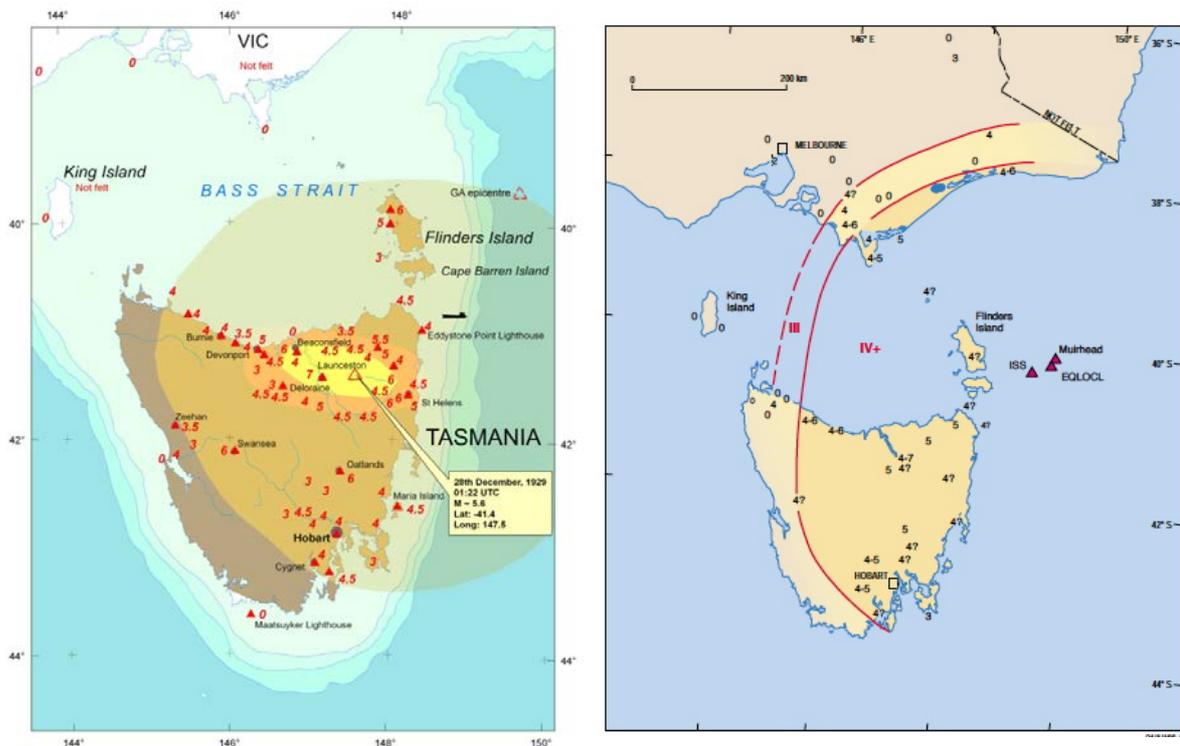


Figure 17 Isoseismal maps, Modified Mercalli intensities based on newspaper reports and lighthouse keepers logs; December 1929 on left, September 1946 (from Michael-Leiba and Jensen, 1992) on right.

The surface-wave magnitude M_s 5.2 was measured on the Riverview seismogram by Everingham & others (EDG, 1987) and independently at Pasadena M_s 5.6 (from the ISC on-line Bulletin).

Using the method relating magnitude to radius of perceptibility (McCue, 1980) and allowing for a reasonable MM 3 contour yields an ML equivalent of 5.6 which is compatible with the damage observed, and similar to M_s , though it would be expected to be larger than the M_s value.

At 200 km distance from the epicentre of the Newcastle earthquake, the intensity was 3 to 4 so if the GA epicentre of the 1929 earthquake is correct, the earthquake should have been felt in Victoria and the intensity in NE Tasmania should not have exceeded 4 except at sites like Launceston renowned for its site amplification effects. The shaking would have been all but imperceptible in Hobart. It is interesting to compare this epicentre and isoseismal map with that of the similar-sized earthquake on 14 September 1946 located east of Flinders Island (Everingham & others, 1987). The 1946 event caused no damage other than breakage of crockery and ornaments and was felt almost as strongly in Victoria as Tasmania (Michael-Leiba and Jensen, 1992). The Burnie Advocate of 16 September 1946 reports: *Mr. A. Kirkcaldy, F.R.A.S. of Upton street, who said that earthquakes were uncommon in Tasmania, added that the tremor yesterday morning was not as severe as that felt about the time of the 1929 flood.*

On these grounds we suggest an onshore epicentre for the 1929 earthquake as indicated on the map. There is no information to assess focal depth except for the high intensities in the mezoseismal area so we presume the earthquake was shallow and in the upper crust.

1931 02 25 at 00 UTC, Maria Island

EARTH TREMOR

FELT AT MARIA ISLAND.

A slight earth tremor was felt at Maria Island at 10 o'clock on Wednesday morning, February 25, rattling the windows in the houses for about 20 seconds. The atmosphere was very calm but sultry and oppressive.

1931 03 14 at 21:10 UTC, Bass Strait NW Tasmania

The Argus Monday 16 March 1931, Page 10 and Friday 20 March 1931, Page 11.

EARTH TREMOR AT GEELONG.

GEELONG, Sunday.—About 7 o'clock yesterday morning an earth tremor was felt in Newtown, Belmont and east Geelong. Houses rattled and furniture(?) rocked.

No damage was reported.

KING ISLAND NEWS.

KING ISLAND, March 16. — Two earth tremors were experienced on Saturday. The first, at 2 o'clock in the morning, was very slight, but the second, just after 7 o'clock, was of several seconds' duration.

Examiner Tuesday 17 March 1931, Page 6.

Tremor at King Island An earth tremor was felt at King Island between 7 and 7.30 a.m. on Saturday. The vibration was uniform throughout. The previous tremor, which occurred about seven years ago, was considered by a leading authority to have been caused by the subterranean landslide north-east of the island. Water of great depth is said to be close to the west coast of King Island. The soundings taken for the cable route between the meridians of Adelaide and Cape Leeuwin revealed a depth of about three miles.

The Mercury Monday 16 March 1931, Page 5.

SEVERE EARTH TREMOR FELT AT BURNIE.

RESIDENTS ALARMED.

A severe earth tremor was experienced in the Emu Bay district early on Saturday morning. In some cases people fearing a collapse of their dwellings ran outside, and children were frightened by the phenomenon. About 7.12 a.m. there was a violent trembling of the earth and beds shook, crockery rattled, and buildings vibrated. The shake lasted for some seconds, and was continuous.

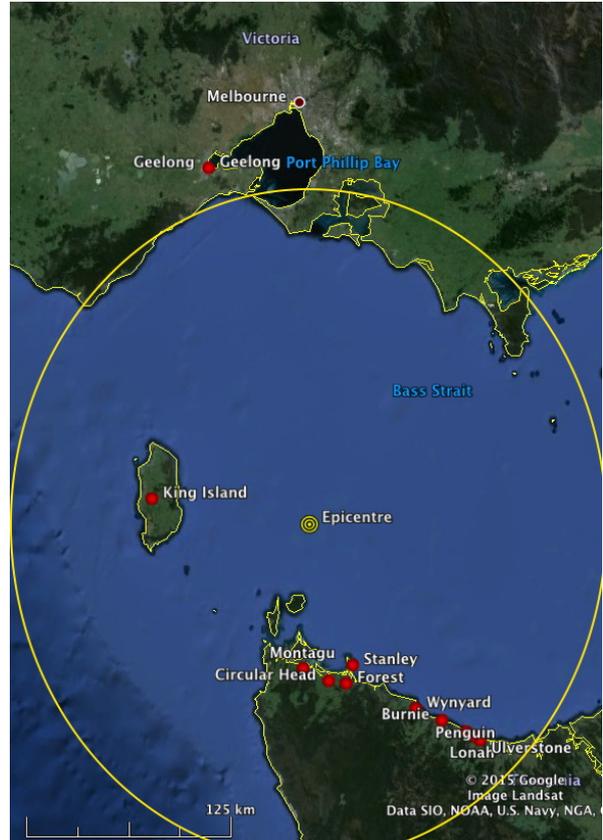
The tremor was also felt in the Circular Head district and at Penguin.

EARTH TREMOR,

People Alarmed at Burnie. Rare Phenomenon.

A severe earth tremor was felt in the Emu Bay district early on Saturday morning. In some cases it is reported that people, fearing the collapse of their dwellings, ran outside, and children were frightened by the phenomenon. At about 7.12 a.m. many residents were awakened by the violent trembling of their homes. Beds shook and crockery rattled to an alarming extent. The shake, which lasted for several seconds, was continuous, and did not recur.

Figure 18 Felt area and approximate epicentre of the earthquake of 14 March 1931 in Bass Strait.



The tremor felt in West Burnie was more severe than in other parts of the town, especially in the vicinity of the big hill on the western side. One resident in a large house in that locality said that the building creaked and groaned as if under a big strain, causing intense alarm. In other quarters of the town the shake was felt to an extent sufficient to waken sleepers.

One man who was sitting at breakfast at the time, said he felt the chair shake under him and picked it up to see if it had a faulty leg, but the rattling crockery on the shelves indicated that the house was shaking. In another case several children rushed into the street screaming with fright.

It is a very rare occurrence to experience an earth tremor in this part, and many old residents declare that Saturday's shake was the most severe they had ever known.

No damage was reported. A distinct shock was felt throughout the Circular Head districts about 7.12 a.m. and it was reported from Stanley, Smithton and Forest that crockery was rattled, while many stated they were shaken in their beds. No damage was done.

Two slight shocks were felt at Ulverstone. They followed in quick succession, but neither was of sufficient force to cause alarm. The shocks were felt in several parts of the town, and also at "Lonah," midway between Ulverstone and Penguin.

Advocate Tuesday 17 March 1931, Page 4.

Wynyard Earth Tremor:

The earth tremor which was experienced in various parts of the North-West Coast on Saturday morning was distinctly felt here. Many persons were awakened from their sleep, while furniture-shook and ornaments and crockery on shelves rattled. People were alarmed by the manner in which their homes shook. It was considered to be the most severe shake experienced here for some time.

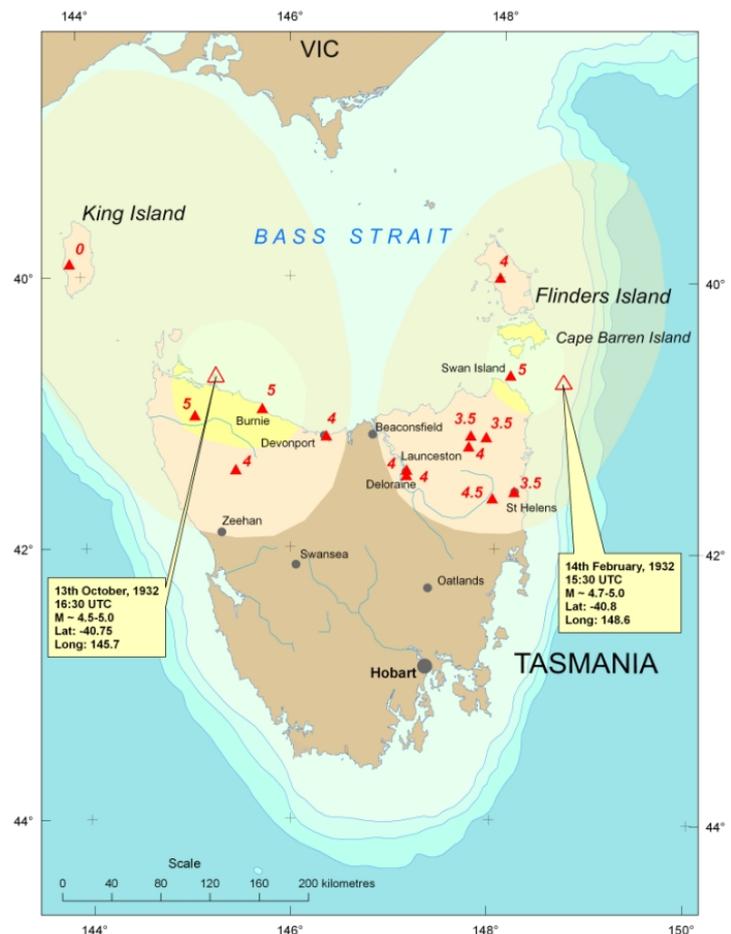
The epicentre was obviously near the NW coast of Tasmania at 40S, 145E, either way it was felt over a large area and warrants a magnitude of 5.5 or so.

1932 02 14 at 15:30 UTC, Northeast Tasmania

Whilst investigating earthquakes in Victoria in 1932 I came across references to two previously un-catalogued earthquakes in Tasmania the same year, one in the northeast of the state in February, the other in the northwest in October. These were both early morning earthquakes when most people were asleep so the magnitudes derived from the normal radius of perceptibility (MM3) are not well defined. The shaking either woke everyone as the newspaper reports suggest ie MM4 at least, or there are a lot of insomniacs in Tasmania.

Figure 19 The two 1932 isoseismal maps in NW and NE Tasmania.

No damage was reported in either earthquake but the description from the Swan Island lighthouse would suggest an intensity of MM 5: *the shock was severe while it lasted and the tower shook violently, but no damage was done.* The shaking was reported felt from Flinders Island in the north to Fingal in the south, more than 160 km, and in an eastwest direction from St. Marys to Launceston. From this we derive a minimum magnitude of 4.7.



1932 10 13 at 16:30 UTC, Northwest Tasmania

The felt reports were from Trowutta to the northwest and Devonport to the east, and Magnet and Wynyard. Large cracks were reported in the plaster of one house in Wynyard, windows and doors banging in Magnet and roused sleepers elsewhere. One person commented that it wasn't as strong as the earthquake 4 years ago, perhaps referring to the 1929 earthquake mentioned above, nearly 3 years earlier.

1934 01 20 at 05:15 UTC, Maria Island

The Mercury Saturday 27 January 1934, Page 7.

Maria Island Earth Tremor

An earth tremor was felt at Maria Island at 3.15 p.m. on Saturday last. The shock lasted about 20 seconds, and rattled the windows in the houses and was accompanied by a low rumbling sound travelling from a northerly direction.

1935 08 18 time?, Flinders Island

The Maitland Daily Mercury Wednesday 15 May 1935, Page 8.

VAN DIEMEN'S LAND

On the 18th of August a slight shock of an earthquake was felt at Flinders' Island. It only lasted a few seconds, and did no damage.

1936 10 02 at 22:00 UTC, Maria Island

The Mercury Thursday 8 October 1936, Page 2.

EARTH TREMOR Felt at Maria Island

An earth tremor was felt at Maria Island at 8 a.m. on Saturday. It lasted about 10s.

1937 09 04 at 13:15 UTC, NE Tasmania

The Mercury Monday 6 September 1937, Page 5.

EARTH TREMORS Disturbances on East Coast of Tasmania

Earth tremors of a varying degree of severity were felt along the East Coast of Tasmania and at Flinders Island on Saturday night. At Swansea and Cranbrook the tremors were slight. There was a loud rumbling noise, and houses shook for about 30s. The one at Swansea was not so severe as that experienced about seven years ago. A fairly severe tremor was felt in the St. Marys district at 11.15 p.m. It rocked crockery on shelves and shook houses.

A tremor was reported from the Eddystone Point Lighthouse at the same time, and there was a slight disturbance at Emita on Flinders Island. It lasted about a minute, and in this centre appeared to travel from north-east to south-west.

Monday's *Examiner* reports it was felt slightly in Launceston at 11:15pm local time.

1938 12 13 at 13:50, NW Tasmania

Advocate Thursday 15 December Page 8, and Friday 16 December 1938, Page 6.

Figure 20 Felt area of the 13 December 1938 earthquake off the northwest coast of Tasmania.

EARTH TREMOR SHAKES HOUSES An earth tremor which shook houses, rattled crockery in cupboards and awakened many from their sleep, occurred in some North-West and West Coast districts just before midnight on Tuesday. A feature of the disturbance was that it appeared to have affected portions only of the North-West, being felt at centres extending from Circular Head to Burnie. Its occurrence was fairly general on the West Coast, where it was



stated to be the first for twelve years. The severity of the tremor, which lasted for about a minute, differed at various centres.

Residents of some centres stated that only a slight vibration was felt, and others said the shock was very distinct. The disturbance appears to have been felt more severely towards the Far North-West. At Stanley residents said the shock was heralded by a noise like distant thunder. A resident living near The Nut said the sound suggested to her a large stone rolling down the face of The Nut. Many stated that crockery and windows rattled for several seconds. According to reports the tremor was scarcely noticed at Wynyard, but in other parts of the Table Cape district it was felt more. A resident of Sisters Creek, who resides near the beach, said the rocking of his house was most noticeable for some 10 or 15 seconds, and furniture and beds shook. In the Yolla district some people were wakened from their sleep. One resident said he was just going to bed when he felt it shake as though some one had grasped the end and "heaved on it." Mr. W. D. Jones said that his daughter was awakened by the rattling of the window and got out of bed to see if anyone was attempting to enter the room. Other residents stated that they left their rooms to investigate the occurrence. A resident of West Burnie said he had just entered his home when he felt a vibration, and the door rattled as though someone were about to follow him into the room. At Upper Burnie Mr. D. Jones said he was awakened by the noise of his window rattling. On the West Coast the disturbance awakened many, particularly those sleeping in top rooms of buildings. The upper storey of a Zeehan hotel shook alarmingly, and boarders were given a scare. At Rosebery, it was recalled that a similar shock was felt in the town some twelve years ago.

MARRAWAH Earth Tremor: The earth tremor, which appears to have been fairly general, was felt by several residents at a late hour on Tuesday night. It lasted for approximately 10 seconds.

Examiner Tuesday 20 December 1938, Page 9.

STRAHAN—The earth tremor on Tuesday was rather definitely experienced here. Several houses gave distinct shudders shortly after midnight. One resident thought a motor lorry had crashed into his house. A lady visitor from New Zealand had startling visions of what might happen, as she had experienced quakes in her homeland.

1939 03 29 at 06:20 UTC, Swansea

The Mercury Thursday 30 March 1939, Page 4.

Earth Tremor At Swansea

A slight earth tremor was felt at Swansea at 4.20 p.m. yesterday.

1942 08 11 at 22:30 UTC, Redpa

Circular Head Chronicle Wednesday 19 August 1942, Page 3.

REDPA.

A severe earth tremor of a few seconds duration was felt at Redpa last Wednesday morning at 8.30 a.m.

1944 05 25 at 19:20 UTC, Waddamana Penstock

The Mercury Monday 29 May 1944, Page 5

Earth Tremor Felt At Waddamana

Residents of Waddamana Penstock and Shannon were awakened at 5.20 am on Friday by a pronounced earth tremor which shook dwellings and buildings. It lasted a few seconds and was accompanied by a loud rumbling noise resembling a distant explosion.

1944 10 20 ? , Marrawah

Advocate Saturday 21 October 1944, Page 4.

MARRAWAH EARTH TREMOR—A number of local residents recently reported what appears to have been an earth tremor. The line of shock was from south-west to north-east, and the tremor was accompanied by sharp vibrations and a roaring noise.

This is the only report, no date or time, so we won't include it in the table.

1945 01 04 at 19:35 UTC, Breona

At Breona, an earth tremor was felt at 5.35 a.m. on January 5.

1946 09 14 at 19:50 UTC, NE Tasmania

The lead story on the front page of the *Launceston Examiner* on 16 September 1946 was titled: EARLY MORNING EARTH TREMOR SHAKES TASMANIA, GIPPSLAND

Slight Damage Caused in Startling Occurrence

People throughout Tasmania, and part of Victoria were startled by an earth tremor lasting about 45 seconds at 5.50 a.m. yesterday. The tremor shattered window panes, broke crockery and cracked plaster in some buildings in Launceston and seriously damaged the Rosevears Hotel. Flinders Island was affected by the tremor.....

Michael-Leiba and Jensen (1993) drew up an isoseismal map from newspaper reports and lighthouse logs. Gutenberg and Richter assigned it a magnitude of Ms 5.6 and a location more than 100km west of the preferred re-located epicentre from Michael-Leiba and Jensen (1993).

1947 05 20 10:30 UTC, Smithton

Circular Head Chronicle Wednesday 21 May 1947, Page 2.

A slight earth tremor was felt at Smithton about 8:30 last night.

1948 08 09 at 14:55 UTC, Flinders Island

Examiner Wednesday 11 August 1948, Page 3.

A MILD earth tremor was felt over most parts of Flinders Island at 12.55 yesterday morning. Although not as severe as the tremor experienced about two years ago, when chimneys fell, it was sufficient to awaken many of the residents. The tremor was accompanied by a low rumbling noise, which gradually increased in intensity. The rocking of houses and rumbling continued for 10 to 20 seconds. No damage was reported.

1948 09 11 at 03:59 UTC, NE Tasmania

The Argus Monday 13 September 1948, Page 1.

EARTH TREMOR IN TASMANIA

LAUNCESTON, Sun: An earth tremor that lasted only about four seconds was felt in parts of Northern Tasmania including Launceston and the East Coast, as far south as Orford, at 1.59pm yesterday. It was only noticed indoors. The last earth tremor felt in Tasmania was on September 15, 1946.

1950 05 28 at 18:05 UTC, Burnie

Advocate Tuesday 30 May 1950, Page 15.

EARTH TREMOR

Residents in many parts of Burnie and suburbs as well as several surrounding districts were awakened by an earth tremor at 4.5 a.m. yesterday. It was most noticeable at West

Burnie. Mrs. G. F. McDermott, of 15 Queen Street, said she was awakened by rattling doors and windows. Her husband, who was lying awake, said there had been a distinct tremor. Small picture stands and ornaments toppled in some rooms. Mrs. Harwood, also of Queen st., said she was awakened by the tremor and experienced the sensation of the bed sinking from under her. Penguin and Natone people had similar experiences.

1950 11 20 at 13:30 UTC, Fingal

Examiner Thursday 23 November 1950, Page 6S.

EARTH TREMOR AT FINGAL AN earth tremor of short duration was felt at Fingal on Monday at 11.30 p.m.

1952 03 09 at 10:05 UTC, Latrobe

Advocate Monday 10, Tuesday 11 and Wednesday 12 March 1952, Pages 4, 8 and 10.

SEVERE EARTH TREMOR

A severe earth tremor was felt in Latrobe shortly after 8 o'clock last evening. It shook buildings, and rattled windows. There was also a distant rumble. There were no reports from other towns of the disturbance.

EARTH TREMOR. — Reports from all parts of the town disclose the severity the earth tremor felt on Sunday evening. A sound resembling a loud explosion accompanied the tremor, in some homes, children left their beds and householders ran outside to ascertain the cause of the noise. The tremor was one of the severest ever felt in Latrobe.

ULVERSTONE EARTH TREMOR. — Local residents, Mr. and Mrs. S. Morgan, formerly of Hobart, mentioned yesterday having experienced on Sunday evening something of the earth tremor reported from Latrobe. They were reading in the lounge of an upstairs flat they occupy when the windows rattled and furniture about the room moved, slightly. Other residents have mentioned a similar happening.

WESLEYVALE EARTH TREMOR. — Last Sunday's earth tremor was recorded here at 8 p.m. It shook buildings, but lasted only a few seconds.

DEVONPORT. — The earth tremor reported from Latrobe was also felt, in Devonport on Sunday shortly after 8 p.m. Many accounts of the tremor have been received. When he heard an unusual rumble, one householder thought it was caused by a heavy lorry passing, but as he saw no lorry, he went round the house to ascertain the cause. One woman was so scared that, she waited outside the house till her husband came home. Others stated that they felt a distinct vibration.

These reports tell as much about the evolution of a story as about the earthquake.

1953 10 24 at 03:15 UTC, Somerset

Advocate Tuesday 27 October 1953, Page 10.

EARTH TREMOR— Somerset reports of an earth tremor early on Saturday afternoon were confirmed yesterday by Mrs. Hilda Lee, of South Burnie. Dozing and almost asleep while resting close to a window, Mrs. Lee said, she was suddenly awakened by the window rattling and the settee apparently moving. There was no wind at the time. Soon afterwards the same thing happened again, but the movement was not so strong. "I thought I had been dreaming," Mrs. Lee said, "but the Somerset reports explain what happened."

1954 12 11 at 11:30 UTC, Flinders island

North-Eastern Advertiser Tuesday 14 December 1954, Page 2.

EARTH TREMOR

During a slight break in the heavy rain and wind on Saturday night, a slight earth tremor was reported at Scottsdale and Legerwood. The tremor occurred a little after 9.30 and many residents of Scottsdale felt the sudden trembling of the earth which lasted only for a few seconds. The tremor was followed immediately by a particularly heavy gust of wind. A similar tremor was reported from Legerwood, but no word has been heard from other towns in the district.

The Mercury Wednesday 15 December 1954, Page 3.

Big Tank On Island Shatters

A CONCRETE water tank on the Happy Valley Estate, at Ranga, Flinders Island, burst with a noise like a cannon on Sunday night, and the 17,000 gallons of water from it dashed into the side of the homestead. The tank burst at 6 p.m. 16½ hours after the islanders had felt the first earth tremor on Flinders for five or six years.

The manager of the estate (Mr. H. C. Gavin) said last night that the tank burst into dozens of pieces, and some of them were flung up to 60 yards away. The tank had been reinforced with galvanised iron and wire.

It would cost upwards of £200 to replace the tank, and some £50 to repair damage to the house. A worse aspect of the incident, however, was that the loss of the tank will leave homestead and stock at that end of the estate short of water in the hottest part of the year.

A temporary tank of galvanised iron would be erected immediately.

But for the obscure report from Ranga, this earthquake would have been designated a small earthquake near Scottsdale. It is unusual for such a delay between the earthquake and tank damage, perhaps the earthquake exacerbated a foundation problem that led to the tank destruction. Obviously the earthquake was quite a lot bigger than first thought.

Results

The parameters of the earthquakes discussed here are summarized in the following table. The uncertainties are ill defined but are estimated to be about one minute in time, 20km in epicentre location (apart from the 1910 event), 10 km depth (ie upper crust) and 0.3 in Richter magnitude.

Table 2 Details of earthquakes discussed in this text

<i>Date</i>	<i>Time UTC</i>	<i>Latitude °S</i>	<i>Longitude °E</i>	<i>Magnitude</i>	<i>Place</i>
1844 08 18	13:30	40.0	148.5	4.0	Flinders Island
1853 09 17	07:50	42.3	148.4	4.0	Schouten Island
1854 02 26	16:30	42.8	147.3	2.5	O'Brien's Bridge
1857 09 09	15:45	41.5	146.5	4.0	Deloraine
1859 10 27	14:40	40.7	145.0	4.0	Circular Head
1859 11 21*	18:50	40.7	145.2	5.4	Circular Head
1860 03 28	19:50	42.5	147.0	3.5	Bothwell
1860 04 13	10:20	42.8	147.3	2.5	Hobart
1866 09 20	14:05	42.8	147.3	3.0	Hobart region
1874 10 13	04:00	43.5	146.0	4.0	Port Davey
1876 05 03	15:15	41.5	146.9	3.0	Carrick
1880 02 03*	06:30	42.0	146.2	5.3	West of Hobart
1880 06 22	18:00	42.75	147.0	3.0	West of Hobart
1882 03 16	05:00	41	146	3.6	Burnie
1883 04 12	11:00	41	148.5	3.0	Gould's Country
1883 04 12	18:00	41	148.5	3.5	Gould's Country
1883 04 13	02:15	41	148.5	3.0	Gould's Country
1883 06 20		39.5	147.5	4.0	Deal Island
1883 07 30	10:00	41	149	5.2	NE Tasmania
1883 08 30	11:10	41.3	148.5	3.5	NE Tasmania
1883 09 08	15:30	41.4	147.3	4.0	NE Tasmania
1883 10 28	12:10	41.4	147.3	3.5	NE Tasmania
1883 11 14	05:00	41	149	5.5	NE Tasmania
1883 12 13	08:58	41.4	147.3	4.0	NE Tasmania
1884 07 13*	03:55	40.5	148.5	6.2	NE Tasmania
1884 08 29	01:00	41.25	149.0	5.5	NE Tasmania
1884 09 19	10:35	40.0	148.5	6.0	NE Tasmania
1885 01 30	14:54	41.3	148.9	5.7	NE Tasmania
1885 05 12*	23:37	39.9	148.9	6.5	NE Tasmania
1885 09 11	09:19	41.5	148.9	5.5	Off St Mary's
1887 11 09	15:53	40.3	149.4	6.0	NE Tasmania
1889 05 24	11:00	43	147.5	3.0	Hobart
1889 12 07	10:15	41	148.5	3.5	NE Tasmania

1890 07 14	07:50	41	148.5	4.0	NE Tasmania
1892 01 26*	16:48	40.4	149.5	6.9	NE Tasmania
1897 08 11	10:10	40.9	148.6	4.4	NE Tasmania
1899 01 12	18:00	41.3	147.4	3.2	Launceston
1899 06 18	21:00	40.6	145.3	3.5	Stanley
1902 06 20	19:15	40.7	147.0	4.8	North Coast
1902 07 28	14:00	41.2	146.4	2.5	Latrobe
1903 12 31	11:00	41.2	148.5	4.0	St Mary's
1905 03 25	12:48	41.6	145.8	4.7	West Coast
1907 01 31	07:45	40.35	149.35	6.0	NE Tasmania
1907 05 21	09:55	40.7	145.3	3.8	Stanley
1907 05 21	17:00	41.2	147.0	3.0	Launceston
1907 06 14	07:30	41.0	145.7	3.0	Wynyard
1907 09 08	06:42	41.0	145.9	3.5	Burnie
1908 05 04*	09:50	42.0	145.4	5.0	West Coast
1910 01 13	00:16	44	155	6.0	Tasman Sea
1910 06 22	08:15	41.4	147.9	3.3	Mathinna
1910 06 30	09:00	40.5	148.5	3.0	Cape Barren Is
1910 07 24	12:50	41.4	147.1	3.0	Launceston
1910 08 08	13:20	42.1	145.2	3.0	Strahan
1911 02 27	09:40	40.7	145.1	3.0	Smithton
1911 11 04*	01:27	42.1	145.1	4.8	West Coast
1915 03 27	12:15	41.9	148.2	3.0	Rosedale
1915 04 04	07:50	40.7	145.3	3.0	Stanley
1917 12 21	17:00	40.7	147.2	3.0	Stanley
1918 03 22	11:20	41.4	147.2	3.0	Launceston
1918 04 22	17:45	41	148.5	5.0	NE Tasmania
1918 10 04	10:00	40.9	144.5	3.0	Marrawah
1919 04 19	10:00	40.6	144.7	3.0	Woolnough
1919 04 20	21:00	40.7	145.4	3.0	Stanley
1919 08 01	14:25	41.7	146.9	3.0	Cressy
1921 02 07	14:30	40.6	145.3	3.0	Stanley
1921 07 16	10:30	41.8	145.2	3.0	Zeehan
1922 04 26	19:37	43	146.9	3.5	Huon Valley
1924 03 01*	11:55	41.6	145.0	5.1	West Coast

1925 04 25	13:35	41.0	145.4	4.0	NW Tasmania
1926 01 27	17:45	40.7	145.3	3.2	Stanley
1927 09 20	09:00	43.3	148.2	4.3	Port Arthur
1928 01 18	01:20	41.75	147.8	5.4	Fingal
1928 05 12	05:00	40.8	145.1	3.0	Circular Head
1929 07 11	05:25	40.8	145.6	3.8	Stanley
1929 12 28	01:22:50	41.54	147.56	5.6	Launceston
1931 02 25	00:00	42.6	148.2	3.2	Maria Island
1931 03 14	16:00	40.1	144.9	4.5	Bass Strait
1931 03 14	21:10	40.1	144.9	5.5	East of King Is.
1932 02 14	15:30	40.8	148.6	4.7 – 5.0	East of Swan Is.
1932 10 13	16:30	40.75	145.25	4.5 – 5.0	Wynyard
1934 01 20	05:15	42.6	148.2	3.2	Maria Island
1935 08 18		40.0	148.5	3.5	Flinders Island
1936 10 02	22:00	42.6	148.2	3.0	Maria Island
1937 09 04	13:15	41.1	148.6	5.1	NE Tasmania
1938 12 13	13:50	41.4	144.6	4.8	NW Coast
1939 03 29	06:20	42.1	148.1	3.0	Swansea
1942 08 11	22:30	40.9	144.8	3.0	Redpa
1944 05 25	19:20	42.1	146.7	3.0	Waddamana Penstock
1944 10 20?		40.9	144.5	3.0	Marrawah
1945 01 04	19:35	41.8	146.7	3.0	Breona
1946 09 14	19:58 50	40.0	149.35	5.5	NE Tasmania
1947 05 20	10:30	40.8	145.1	3.0	Smithton
1948 08 09	14:55	40.0	148.2	3.5	Flinders Island
1948 09 11	03:59	41.5	148.5	5.0	NE Tasmania
1950 05 28	18:05	41.1	146.0	3.5	Burnie
1950 11 20	13:30	41.6	148.0	3.0	Fingal
1952 03 09	10:05	41.1	146.3	3.2	Latrobe
1953 10 24	03:15	41	145.8	3.0	Somerset
1954 12 11	11:30	40.2	148.3	4.5	Flinders Island

* from Micheal-Leiba (1989); # no attempt has been made here to document all 2500 felt earthquakes, only some of the earlier or larger ML 5 events which seem to be scattered across the northeast rather than focused in a small region. A listing of the 2500 earthquakes compiled by TasUni students from newspapers and other sources under the direction of Lesley Read (now Hodgson) for Professor Carey and thought to be long-lost, has been unearthed by June Pongratz and will be published separately.

The past record of seismicity in northeastern Tasmania indicates that this part of the state is highly stressed. The network of seismographs on the island is not sufficiently dense to undertake focal mechanisms using first-motions of the P wave so the earthquake mechanisms are unknown. However, for a short period in late 2009 a dense network of broad-band seismographs was deployed by the University of Tasmania's Anya Reading for Kuth Energy in the northeast of the state. During the deployment, a small earthquake (magnitude ML 3.8) fortuitously occurred near Swansea where it was felt. Using first motion data from this temporary deployment, the Tasmanian Hydro network and the jointly managed University of Tasmania and GA stations TAU and MOO, the author determined the focal mechanism in Figure 7. The diagram shows a typical thrust mechanism, the principal stress acting in an ESE direction.

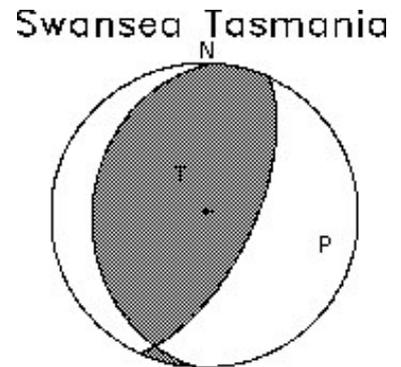


Figure 21 Focal mechanism of the 7 December 2009 Swansea Tasmania earthquake, magnitude 3.8.

A large Recent fault scarp at Lake Edgar was identified as such by Carey and Newstead (1960) and first trenched and investigated by van Dissen & others (1997). It too is indicative of compression with a near horizontal principal stress direction approximately east-west. The importance of such studies is that they indicate that the current stress field in Northeast and Central Tasmania is similar to that in the southeast of continental Australia, a single large stress domain.

EARTHQUAKE SWARM

Earthquake swarms are common in Australia but no other swarm has occurred in written memory on the scale of the Tasmanian swarm of 1883-1892.

An example of what it is like enduring such a swarm can be gleaned from the following letter to the *Launceston Examiner* published on 27 September 1883.

Mr. H.F Jarvis writing to the Launceston Examiner from Gladstone under date September 18 says:- "As there seems some uncertainty about the direction the earthquakes travel in this island, I beg to state that as far as I have noticed, they all appear to come from as near due east as possible, hardly varying a point north or south. They have been very frequent of late and the rumbling is getting more prolonged and louder. There have been three this afternoon, two within five minutes of each other, at half past 2 and the last at 4 o'clock. There was also a severe shock at a quarter to 3 p.m. on Saturday, and another about the same strength at exactly the same time on Sunday. I have noticed quite 200 within the last three months, and as many as 10 within the 24 hours."

The first large earthquake in the swarm had not yet occurred (July 1884) when the above quote was written, and one can only wonder what advice a seismologist today would give about the probability of a large earthquake to follow, let alone 6 of them.

The two staunch observers of this swarm in Tasmania, Alfred Biggs (Astronomer and inventor) and Captain J Shortt RN (Meteorological Observer), did not always agree as to the cause and location of the earthquakes, whether they originated at one spot or not and whether they were influenced by New Zealand activity or not. How could they with no seismographs, having to relying on human observations of direction and timing and having no knowledge of the actual velocity of seismic waves, their estimates were about a factor of 5 to 10 too slow. Biggs (*Launceston Examiner* Saturday 22 August 1885, Page 1S) thought: *An earth wave has been estimated to travel at from 1200 to 1800 miles per hour. But I think we have good reason for estimating the progress of the wave at a much slower rate, inasmuch as nearly all*

reports agree in describing the sound as preceding the shock, allowing that the earth wave was slower than the sound wave.

A summary of observations on earthquake phenomena made in Tasmania, during 1883 and 1884, by Commander Shortt of Hobart, records a great number of moderate shocks during these years, although they had been very rare before. Nearly one hundred disturbances were felt at St. Mary's In February, 1884 ; and over one thousand have been noted at Gould's Country since April 12, 1883, when the first shock was felt there. These small earthquakes are seldom felt outside of the north-eastern part of Tasmania; and their origin seems to be a hundred or more miles out to sea, near the border of the deep waters which separate Australia from New Zealand. (Science Vol 5, No 118, p392).

The possibility of an impact of this swarm on the topography of Tasmania was considered at the time; the navy was asked to redo a hydrographic survey in Bass Strait) but the discovery of the following figure (<http://www.john-daly.com/deadisle/part2.htm>) was rather surprising. The report by Daly (2003) comments:

It was the possible vertical movement of the land resulting from these tremors which prompted Shortt to carry out the benchmark measurement in the first place. He knew full well that tremors and earthquakes can and do displace the land vertically.

The question is, did it? We don't know for sure, but this comment at the end of Shortt's 1888 paper suggests it did. - "It is interesting to place on record, that Captain Miles has learnt from the half-casts in the Furneaux Group they have noticed within the last few years that there seems to be less depth of water over certain well-known rocks near the islands than formerly."

A few centimetres of mean sea level fall would normally go completely un-noticed due to the large variability of the tides, and changes in level due to weather. However, since the 'half-casts' of the Furneaux Group did notice it, the fall in level there must have been many centimetres, sufficient to account for a significant sea level fall 'within the last few years'. How significant? It was pointed out in Part 1 that the nearly 10 cm sea level rise claimed by Pugh et al. shows no visible evidence of its presence at all, not from photographs, not from paintings or sketches, not from the width measurements of Eaglehawk Neck. Therefore, for the 'half casts' to notice a sea level fall in the Furneaux Group suggests a fall greater than 10 cm.

Similar tremor activity in other parts of the world cause vertical movements of the land by much larger amounts than a mere 11 cm (4½ inches). In Tasmania's case, we are talking about an uplift in the land, not in one go as happens in earthquakes, but incrementally in tiny amounts, over a period of 4 years and over a thousand tremors. Even the comparison between the width of Eaglehawk Neck at 71 metres in 1854 and 106 metres today, as reported in [Part 1](#), further suggests a sea level fall there since 1854.

The spate of earth tremors in the 1880s puts the last piece of the jigsaw into place.

Ed. – Port Arthur is about 300km south of the supposed epicentral region of the large swarm of the 1880/90's east of Flinders Island, or 200km south of the southern end of the epicentral region off St Mary's as proposed here. That is several, ~ five, fault lengths away. Such a distant elevation change has not been observed in recent large earthquakes at Tennant Creek or Meckering although in neither case did anyone specifically look, the pre-earthquake data was not available, no LIDAR then.

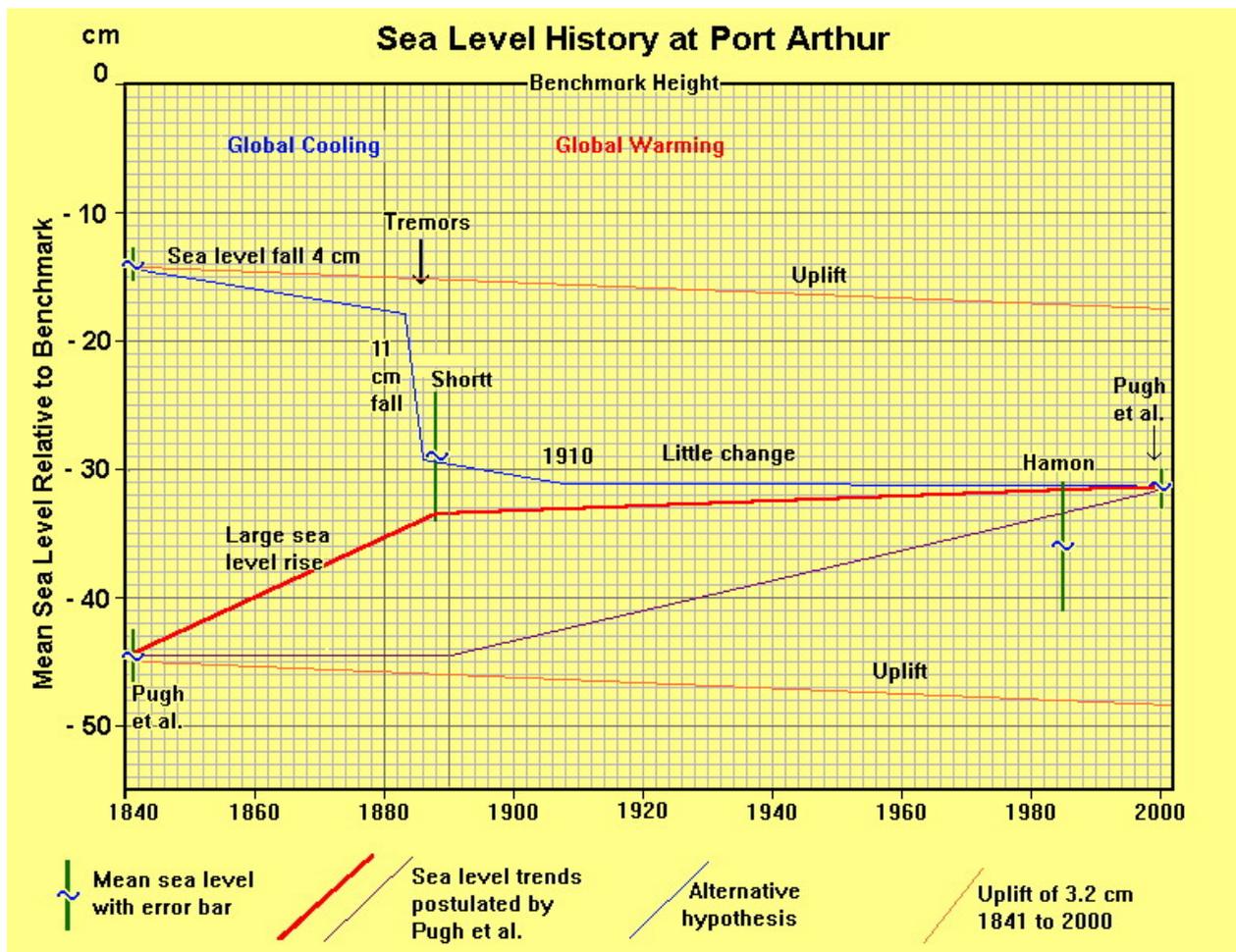


Figure 22 Changes in Tidal level at Port Arthur, two models depicted plus offset caused by earthquake swarm (from Daly, 2003).

This remarkable suggestion by Davy (2003) is reported here to make it more available to the community most interested - the Australian seismologists.

TSUNAMI

'Historical accounts of tsunamis in Tasmania' is the unlikely topic of a recent report by Morris & Mazengarb (2009). They identified 16 cases of unusual wave activity between 1852 and 2007, some of which were undoubtedly tsunamis caused by distant earthquakes. The Pacific Ocean sources were earthquakes along the SW Pacific Ridge from Macquarie Island to Tonga and also South America; but Indonesia, Sumatra and Krakatoa, generated world-wide tsunamis that impacted Tasmania.

Two seismic sources missing from their list were the tsunamis generated by the great earthquake in Chile in 1877 and the great earthquake on the Macquarie Ridge in 1924. Another inexplicable wave sequence was observed in 1931 that is not in their list. They made no reference to the GA tsunami database which is strange (McCue and Lenz, 1996). Some of the events are discussed below.

1855 01 23 at 09:32 UTC, Wairarapa Earthquake New Zealand

The Mercury Wednesday 25 November 1863, Page 2.

An interesting paper on " Volcanic action in New Zealand" was read by Captain Chesney, R.E., and illustrated by reference to a large map of the North Island.

On the conclusion of the paper Archdeacon Davies remarked in reference to the shock of earthquake recorded by Captain Chesney, as having been felt 150 miles off the West Coast of New Zealand, on the 23rd January, 1855, that on that exact day a very sudden rise (and fall) of the waters of the Derwent, as far up as New Town Bay, had taken place to such an extent as to wash up a log of wood on the road near Bishopstowe. This, no doubt, was due to a wave having its origin at the seat of volcanic disturbance.

1868 08 13 at 20:45 UTC, Chilean Earthquake - Tsunami Tasman Peninsula

The Pacific wide tsunami generated by a great earthquake in Chile on 13 August 1868 struck south-eastern Australia. It was observed in Hobart and Launceston, Tasmania then, but neither communication nor instrumental seismology was what it is today, the tsunami preceded knowledge about the earthquake:

Launceston Examiner, Saturday 29 August Page 5 and 5 September 1868, Page 4.

TIDAL WAVE AT CIRCULAR HEAD. [From a Correspondent.] On Saturday, the 15th instant, a very remarkable tidal wave was observed at Circular Head—the ebb and flow amounting to two or three feet, repeated at intervals. It appears a similar occurrence was noticed at Sydney and Hobart Town on the same day.

THE TIDAL WAVE.This tidal wave struck the eastern coast of New South Wales on the same day that it reached our shores, viz., the 15th August; but there it rose much higher, and also ebbled and flowed every hour, according to the newspapers, which, to say the least of it, is a very remarkable and perhaps unaccountable feature. Here in Tasmania it did not appear to ebb and flow in that manner; it struck the land and shortly subsided. About ten years ago a similar phenomenon was observed as in the present instance, but of a more striking character, at New Town Bay, where, owing to the configuration of the land, the wave becomes suddenly interrupted, and its waters consequently accumulate. On that occasion Dr. Milligan, who was then secretary and curator to the Royal Society, was appealed to through the press, as well as other scientific observers, for an explanation of the fact, but the appeal was in vain. It was about that time — shortly afterwards, if I mistake not — that a distinct shock of earthquake was felt in Tasmania, which, according to many, displaced furniture and broke crockery in many instances. But as the shock occurred in the dead of night the majority of the inhabitants were insensible to it. One other slight shock is said to have been felt about four years ago. About fifty years ago a most decided and alarming shock was experienced in Tasmania, and which is in the memory of many of our old colonists. It occurred on a Sunday morning during the hours of divine worship, and so alarmed the congregation in St. David's Cathedral that numbers rushed out in terror. I mention the instances of terrestrial disturbance to show that this part of the globe, at least, is not quite in accordance with the great poet's statement of — "Thou sure and firm set earth." Within fifty years, it will thus be seen, that no less than three earthquake shocks have been experienced in Tasmania, and two oceanic disturbances.....It is no wonder, then, that anything which tends to remind us of that central cauldron over which we dwell in fancied security — even though it be by a tidal wave, should bid some pause, and seriously reflect upon the uncertainty of human existence, and the transient nature of all things. — S. H. W.

Advocate Wednesday 24 June 1931, Page 4.

TIDAL WAVES

And Earth Tremors.

(By H. Stuart Dove.)

Among the papers left by Thomas Hainsworth is one describing that rare occurrence in these latitudes — a tidal wave. That which struck our Coast was, it is true, only a small one, but on the New South Wales coast it was much higher, and is said to have ebbed and flowed every hour—a remarkable feature. There is no doubt that it was due to submarine volcanic action, for as the writer says, the sea-bed, although veiled from our sight, is often the scene of greater volcanic disturbances than the dry land. Not long previously a great wave had struck the Pacific Islands, with much loss of life, and New Zealand had experienced several. About ten years before the one on this Coast there had been a similar visitation, but of a more striking character, at Newtown Bay, in the South. About the same time a distinct shock of earthquake was felt, which displaced furniture and broke crockery. The writer says that about 50 years previously a very alarming shock had been experienced one Sunday morning during church hours, which so alarmed the congregation in St. David's Cathedral that many, in terror, rushed out of the building.

Three Shocks in 50 Years.

These instances show that the surface of the globe is by no means in accordance with the poetical statement, "Thin sure and firm-set earth," for within 50 years three earth-shocks had been experienced in our island, and two oceanic disturbances.

Evidences of great volcanic activity occur in the nearest mainland State Victoria. Since the island-continent rose from the deep lava burst from numerous vents, overflowed her plains, and coursed down her valleys, as shown by the presence of numerous blocks of trachytic, vesicular stone. Here in Tasmania, too, evidence of former volcanic action is frequently met with by those who have eyes to remark these phenomena.

A fine instance of an old volcanic vent occurs at the disused quarry in Best street, Devonport, where can be seen the spokes of solidified lava radiating from the centre of discharge. Much the same is visible in the basalt quarry near the sea at Burnie.

[It would be interesting to know whether any old Coastal resident recollects the tidal wave described above. -H.S.D.]

In 1868 and 1877 great earthquakes in Peru/Chile generated Pacific-wide tsunamis that struck the eastern coast of southern Australia including Tasmania and New Zealand. Perhaps they are the ones referred to in this article – a reminder that tsunamis may be a concern for some east coast communities.

The Mercury Wednesday 16 September 1868, Page 2.

ROYAL SOCIETY.

The monthly meeting of the Fellows was held at the museum last evening, Hon. R. Officer, Esq., in the chair.

The SECRETARY read the following report forwarded by J. Boyd, Esq., on the remarkable effect produced by the tidal waves of the 15th August at Long Bay, Tasman's Peninsula:—

Port Arthur, Tasman's Peninsula,

17th August, 1868.

Sir,—A remarkable phenomenon of tide having visited the shores of this peninsula, the direct cause of which is at present unknown to your correspondent,without further speculating on what might probably be the cause, I take the liberty of furnishing you with a detail of the particulars as observed by several eye witnesses at Long Bay, and are as follows :—

On Saturday, the 15th instant, at about nine o'clock, a.m., the condition of the tide was low, the dry strand showing for 200 yards from the ordinary full tide mark on shore. Several of the prisoners who were employed in bringing shingles from the bush to the jetty, observed, what they mistook to be a heavy swell on at sea, a huge tidal wave coming down the strait from the Brown Mount, towards Long Bay. At the time of its being first observed, it was about three or four miles distant. Not apprehending any approach of danger, they continued their employment carrying the shingles they had brought, from the waggon, and placing them on board a launch moored to the jetty. While engaged in this operation, the shallow waters of the bay received an impetus, and were propelled towards the shore at a speed of between eleven and twelve miles per hour, the water in the bay then gradually and rapidly increased, spars were washed in, and several large gum logs, by no means a buoyant description of timber, one of which was ten feet long, diameter, four feet nine inches, and weighing at the lowest estimate three tons, were washed in, while only half the diameter of some was submerged, and the one of which I have given the dimensions, was driven in rapidly, while only three fifths of its diameter was covered. Logs that had become bedded in the sands, and remained there for years undisturbed, were forced up and drifted in. A launch of forty tons burden was anchored in the bay, and lying head to sea, was driven in, dragging chain, cable, anchor, &c., for a distance upwards of 100 yards. The men employed in unloading the waggon at the jetty, seeing the rapidity with which the tide continued rising became alarmed, and as any attempt to reach the shore by running up the jetty was futile, they were directed by their overseer, Mr. Hawkins, to jump into the launch, which was securely moored to the jetty by five-eighths cable chain, and had just complied with the order, when the small T on the north side of the jetty gave way, and was washed in.

In the meantime, the current or tide meeting with an abrupt interruption from the embankment of the shore, altered its course, and swept round from the south end of the beach to the north in a stream of about 50 yards broad with amazing velocity, carrying 45 yards of a substantially built jetty entirely away, bottom logs side plates, sleepers iron rails, &c., &c., were swept clean away and deposited 25 yards out of the direct line; and had that part of the jetty been built much stronger, it could not have resisted the force of that current. The water having speedily risen above the embankment, rushed on inundating the land for 60 yards beyond, and two feet above the level of the highest tide mark known to any of the longest residents on the peninsula. The water having reached this point and acquired a perpendicular height of seven feet from the low water mark, in the short space of four or five minutes, now receded instanter, with equal velocity, and the same rushing sound that characterized its coming in, sweeping with it logs, spars, launch, &c., &c., seaward, to a distance considerably beyond where they were removed from, and leaving the strand part 600 yards long from the shore, allowing a decline towards the bed of the sea, at the rate of nine inches to the 100 yards, would show a depression of three feet of water below the water mark of the previous low tide. The waters of the bay thus suddenly rose seven feet, and lowered ten feet. The time that elapsed from the first appearance of this tidal phenomenon until the waters of the bay were again settled, was no more than 15 minutes. The surface of the water was perfectly calm, presenting no appearance of commotion, beyond the protuberance of the wave. The morning was fine, and as far as the horizon was visible, no indication of any atmospheric agency likely to produce such a result was apparent. The coxswain, Mr. Chadwick, who has observed the tides which have visited these shores during the last 14 or 15 years, states that it is the most remarkable tide he has ever witnessed here, but he is unable to imagine the actual cause from which it originated. Several of these waves washed upon the shore at irregular intervals during the day, and up to a late hour on Saturday night, the last of which exceeded the height of the one I have described, but came in and went out more calmly leaving the one I have described the most remarkable of the whole.

*I have, sir, the honor to remain,
Your humble and obedient servant,
FREDERICK A. KEITH,
J. Boyd, Esq., J.P. Overseer.
Civil Commandant.*

1877 05 09 Chilean Earthquake - Tsunami observed Port Davey

The great Chilean earthquake of 1868 was followed by another great earthquake on 9 May 1877, the consequent Pacific-wide tsunami observed along the SE coast of Australia and even at places like Port Davey, note the duration of the wave train – 24 hours and the period, about an hour.

The Mercury 18 June 1877, Page 2.

On the 11th of May a tidal wave was experienced. The water receded so low that the anchors and chains were seen on the bottom, and half-an-hour afterwards it was up to the houses. This lasted for 24 hours.

1883 Late August, Krakatoa eruption

The incredible volcanic eruption and caldera collapse of Krakatoa in Sunda Strait generated a global tsunami, 2m waves along the northwest coast of Australia, significant along the southeast coast and noticeable for more than 24 hours at Franklin near Hobart.

Launceston Examiner Friday 31 August 1883, Page 2.

TIDAL DISTURBANCE. – From our southern contemporary we learn that a curious tidal disturbance occurred at Franklin, Huon, on Tuesday and Wednesday. An inrush of water occurred, five knots an hour faster than the usual rapid rise and fall, and there has been mud upheaved on the flat in Crowther's Bay. Several mounds of mud there are 3ft high.

1885 01 06, North Coast

Geelong Advertiser Thursday 15 January 1885, Page 3.

TIDAL WAVE ON THE TASMANIAN COAST.

*On Tuesday, the 6th of January, a rather remarkable tidal wave occurred on the north coast of Tasmania (reports the Launceston "Examiner"). On that day it was high tide about noon, and somewhere after that time a wave from 3ft to 4ft high, ran into the Leven, jostling the vessels that were lying at the wharf against each other, and in its reflux causing one to break adrift; it also knocked over several stacks of timber that had been placed along the edge of the river ready for shipment. The same action was observed at other ports on the coast, but on a modified scale; and Captain Burt, of the schooner *Trader*, which arrived at the Leven in the afternoon, said he felt the unusual wave out at sea. The time of the occurrence is given by several masters of vessels as half-past 2 p.m. It appears not to have been felt east of the Forth, as the master of the *Victory*, which was lying in the Don, states he did not notice anything unusual. At the Emu River, near Emu Bay, the wave rushed in with terrific force, completely covering the wharf to which the small vessels are moored, breaking two of them adrift. The schooner *Florence Elliott* was washed on a bank further up the river than the wharf, whilst the *Berean* broke adrift from the wharf, and as the water fell again she drifted out of the river. Besides this several pieces of timber were washed off the banks of the river. At the river Forth the water rushed in and carried away logs of about 10cwt. from off the bank of the river, but did not do any material damage.*

1936 04 12 Melbourne Heads – Rogue Wave?

Narandera Argus and Riverina Advertiser Friday 17 April 1936, Page 3.

TIDAL WAVE SWEEPS FOUR PERSONS FROM SHIP

A tremendous tidal wave broke over the interstate liner, the S.S. Nairana, as she was entering the Melbourne Heads from Tasmania on Sunday morning, resulting in the deaths of four persons— three being swept overboard and one crushed against the decking — and injuries to a large number of others including members of the crew. Almost indescribable panic and confusion reigned until it was realised that the vessel was not foundering, and it was only the calmness, of the crew that prevented many more being hurt in the mad rush to reach the decks.

1924 06 26 Macquarie Island Tsunami

The Horsham Times Friday 11 July 1924, Page 8.

TIDAL WAVE. Travelling at the rate of 464 miles an hour, a tidal wave, raised by an earthquake near Macquarie Island, reached Sydney in less than four hours on Tuesday. Macquarie Island is the seat of the recent big earthquake. It is 1740 miles from Sydney. The first wave from the Macquarie earthquake was noticed on 26th June, at 8.30 p.m., in Sydney, and a slow succession of these tiny waves went on till 4 a.m.

Trove is limited to pre-1955 newspapers so there is no easily found information on the effects of the 1960 Chilean earthquake in Tasmanian ports but we expect they were more profound than either of the earlier tsunamis mentioned.

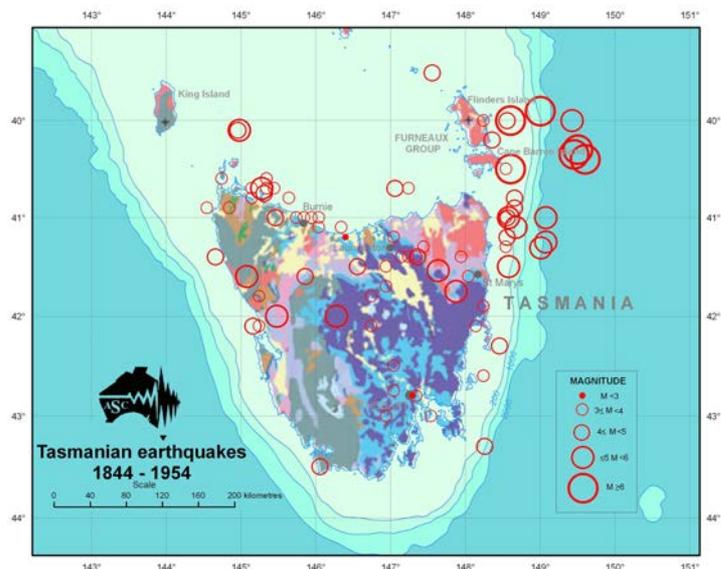
EARTHQUAKE HAZARD ASSESSMENT

One of the defining decisions made in hazard assessment is choosing the source zone map from the known distribution of past earthquakes, guided if possible by the geology. Moore and others (2015) recently published a geological map of the Tasmanian region on which we have superposed the historical seismicity (Figure below). The island is a conglomerate of blocks of different ages, Precambrian in the west and on King Island to Devonian in the northeast including Flinders Island, their boundaries reasonably clearly defined. There is no obvious correlation between seismicity and age of basement blocks, nor in most cases with the boundaries between them including the continental/oceanic crust boundary so clearly defined by the bathymetry. The earthquakes seem to have occurred principally across the northern half of the island, the large earthquakes ($M \geq 6$) all in the northeast. There are no known active faults in Tasmania. My conclusion is that it would be difficult to defend any zoning based on the geology.

Naturally a hazard map will reflect the choice of source zone configuration, highest in the middle of the sources, lowest at the points furthest from the sources. For any earthquake hazard zone, the computed hazard is a maximum at the centre of the zone, reduces to about half the maximum value at the source boundary and to the background value about 100 km outside the source.

Figure 23 Historical seismicity (red open circles) superposed on the geology (from Moore and others, 2015 – a slightly different projection).

In their most recent assessment of earthquake hazard in Tasmania (Leonard and others, 2014) the authors explained: *Using the*



spatial analysis we divided the Australian continent into 4000 square cells of 55 °— 55 km and counted the number of events in the declustered catalog (approximately 2400 earthquakes since 1 January 1965 with $M \geq 3.0$) in each cell.

Naturally if the seismicity is low in the chosen period of observation then the hazard will be low, and vice-versa. What the hazard map should reflect is the expected earthquake density over the next 450 years, a prediction, together with some measure of the confidence of the analyst in making that 'prediction'. Equally obvious is that the longer the observation period, the better the confidence in the prediction averaged over time - there are likely to be fewer nasty surprises.

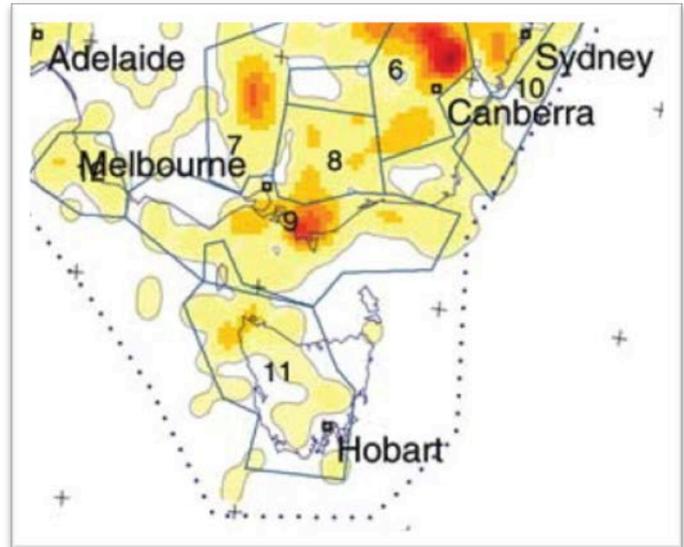
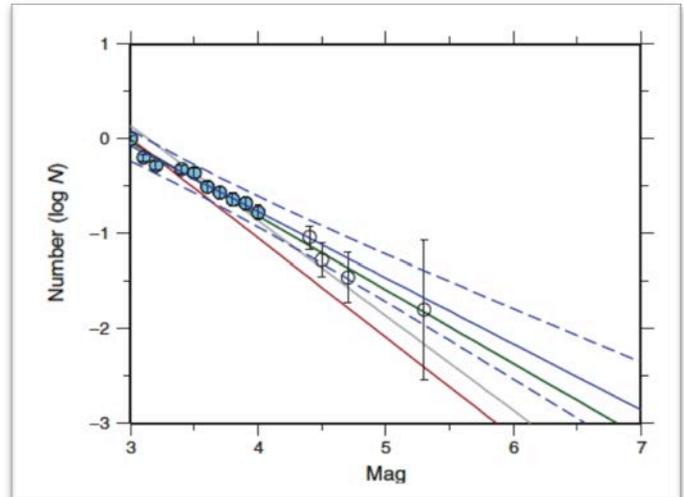


Figure 24 Part of the zone map published by Leonard and others, 2014 covering Tasmania for the 1965 - 2010 period). The colours indicate the smoothed spatial density of the declustered earthquake catalogue.

Figure 25 Magnitude–frequency statistics for zone 11 (from Leonard and others, 1914). The dashed blue lines are the ± 1 s.d. uncertainties in the modified least squares estimate. The b-value from maximum likelihood estimate (red), least squares (green), modified least squares (blue), $b=1$ (grey).



The largest earthquake considered by Leonard and others, 2014) in computing the 'b' value in the modified least squares method for zone 11, is about ML4.7, a magnitude unit lower than observed. It is surprising that by removing the largest earthquake, ML 5.3, results in a lower 'b' value (blue) than with it included (green). The very high seismicity in NE Tasmania, most of it pre-1965, has been all but been ignored which is reflected in the exceedingly low hazard computed by them in the northeast of Tasmania and Flinders Island.

The hazard at intraplate Vancouver Canada is dominated by a subduction zone earthquake that happened more than 300 years ago, pre-historic, whereas in the historic period the highest intensity is a bare MM6. Similarly, hazard at Christchurch NZ was dominated by interplate earthquakes in the last Loading code but the city was severely damaged by an intraplate earthquake, smaller than three of those off north-eastern Tasmania in 1883-1892.

The hazard map for Tasmania must be re-computed using all the data available.

DISCUSSION

Messrs. Biggs and Shortt endeavoured to locate large earthquakes of the swarm using time differences, and argued whether they originated at a point or were associated with New Zealand; without the benefit of knowing the velocity of seismic waves, and trying to work with timing which was manifestly inadequate for the purpose. In this paper we chose to use intensity rather than time difference and arrive at one answer to their dilemma: the swarm was distributed

over hundreds of square kilometres rather than just at a spot. Knowing what we now know about plate tectonics we can also discount any causal relationship with the tectonics of New Zealand.

Why some the earthquakes discussed here have been forgotten is hard to fathom although the economic depression and two world wars followed the 19th century sequence off the NE coast of Tasmania. This earlier sequence had drawn international interest, well before Tasmania finally acquired a seismograph network to systematically record such events, thanks to the energy and foresight of Professor Sam Carey at the University of Tasmania. Unfortunately, the current seismograph network is no longer supported by the Tasmanian government and data from it are not routinely published though available on request.

Hopefully, there are no more 'surprise past earthquakes' in Tasmania greater than magnitude 5.0, at least onshore, and the events listed here will fill the gap in the earthquake database between the late 19th century earthquake storm and the modern era of seismographic monitoring, bar the years 1955-1958. Another search when more newspapers have been digitized should lower the magnitude threshold further.

More thought will have to be given to the weighting of hazard between eastern and western Tasmania, tempered by the thought that future earthquakes in Tasmania will no doubt bring as many surprises as did the historical ones and the paleo-seismological evidence. Source zones based on regional or global models or different time periods will obviously give very different results but to do the regional model well, we need as long a database as possible. The latest published hazard map needs drastic revision.

Being prepared for disasters is an obvious lesson of this plunge into history; if we site, design and build to withstand earthquakes as we do routinely for rare floods and occasional strong winds and tsunamis then we will have fewer disaster to respond to, and a lower ultimate cost to society.

ACKNOWLEDGMENT

Friend and cartographer Gayle Young most generously gave her time to draw up the isoseismal maps and epicentral map of historical earthquakes in this report. Google Earth was used to draw up many of the other maps. Ian Ripper traded recreational time for discussion and to search through the lighthouse keepers' logs in Hobart. I would like to thank helpful staff in Commonwealth Archives in Canberra and Hobart and their State counterparts in Melbourne and Hobart. The National Library of Australia is commended for their initiative in scanning the early Australian newspapers and establishing TROVE thereby allowing the public free access as encouragement to correct the OCR. Steve Hutcheon revised many of the TROVE texts used here. David Palfreyman provided the excerpt from the Sydney Gazette of December 1823 from his extensive collection. Sonja Lenz reviewed the early manuscript, but any errors are mine. Kuth Energy sponsored a review of earthquake hazard in NE Tasmania, one outcome of which was the focal mechanism of the Swansea earthquake.

REFERENCES

- AS1170.4-2007. Minimum Design Loads on Structures Part 4: Earthquake Loads. Standards Australia. 64pp.
- Biggs A. B. The Tasmanian Earth Tremors, 1883-4-5. Papers and Proceedings of the Royal Soc., Tasmania pp, 325-334. By. (Read 9th June, 1885.) eprints.utas.edu.au/15569/1/1885-biggs-tas_earth_tremors.pdf
- Burke-Gaffney, T.N., 1951. Seismicity of Australia. J and Proc. Roy. Soc., NSW, Vol LXXXV, pp. 47-52.
- Carey, S.W., and Newstead, G., 1960. Tasmania University Seismic Net. Publication 84, Geology Department, University of Tasmania.

- Clark, D., Cupper, M., Sandiford, M., and Kiernan, K., 2011. Style and timing of late Quaternary faulting on the Lake Edgar fault, southwest Tasmania, Australia: Implications for hazard assessment. *The Geological Society of America, Special Paper 479*, pp. 109-131.
- Daly J. 2003. – <http://www.john-daly.com/deadisle/part2.htm>
- Drake, L., 1974. The seismicity of New South Wales. *Royal Society of New South Wales. Journal and Proceedings*, v. 107(1-4). 35-40.
- Everingham, I B, and Tilbury, L., 1972. Information on Western Australian earthquakes 1849-1960. *Royal Society of Western Australia. Journal*, v. 55(3) November, 90-96.
- Everingham, I.B., McEwin, A.J., and Denham, D., 1982. Atlas of isoseismal maps of Australian earthquakes. *Bureau of Mineral Resources, Australia, Bulletin 214*.
- Everingham, I. B., Denham, D, Greenhalgh, S.A., 1987. Surface-wave magnitudes of some early Australian earthquakes. *BMR Journal of Australian Geology and Geophysics* 10(3) 253-259.
- Gibson, G., Jensen V., and McCue, K., 2000. The Seismicity of Tasmania – A Review *in Dams Fault Scarps and Earthquakes. Australian Earthquake Engineering Society Conference Proceedings*, Paper 4.
- Griffiths, G.S., 1885. On the Recent Earth Tremors, and the Conditions which they Indicate. Read at the Royal Society of Victoria, June 11, 1885. <http://trove.nla.gov.au/ndp/del/article/138099285?searchTerm=earthquake%20royal%20society&searchLimits=dateFrom=1884-01-01&dateTo=1885-12-31#pstart11301345>.
- Editor 1845. Shock of an Earthquake at Flinders Island. *Miscellanea. Tasmanian Journal of Natural Science, Agriculture and Statistics*, Vol 2(9), April 1845, pp. 309-310. <https://www.nla.gov.au/ferg/issn/14400642.html>
- Hogben George 1894. Earthquakes in Australasia.—III. *Science* Vol. 23, No. 577 (Feb. 23, 1894), pp. 106-107. Published by: [American Association for the Advancement of Science](http://www.jstor.org/stable/1767819)
Stable URL: <http://www.jstor.org/stable/1767819>.
- Hogben, George M.A., 1898. The Tasmanian Earthquake of the 27th January, 1892. *Transactions and Proceedings of the Royal Society of New Zealand*, V31, pp 594-601. [Read before the Philosophical Institute of Canterbury, 2nd November, 1898.]
- Hogben, G., 1912. Earthquake origins in the south-west Pacific in 1910. *Trans. of the New Zealand Institute*, Vol XLIV, 1911.
- International Seismological Centre, *On-line Bulletin*, <http://www.isc.ac.uk>, Internatl. Seis. Cent., Thatcham, United Kingdom, 2012.
- Jensen, V.H., 2000. The Tasmanian Seismic Net. *in Dams, Fault Scarps and Earthquakes. Proceedings of the AEES 2000 Conference*, Hobart, Tasmania.
- Leonard M., Burbidge D. R., Allen T. I., Robinson D. J., McPherson A., Clark D., and Collins C. D. N. 2014. The Challenges of Probabilistic Seismic-Hazard Assessment in Stable Continental Interiors: An Australian Example. *Bulletin of the Seismological Society of America*, Vol. 104, No. 6, 6pp., December 2014.
- McCue, K.F., 1978. Seismic Risk in Eastern Australia. *University of South Australia, Report ADP 153* (unpubl.)
- McCue, K.F., 1980. Magnitudes of some early earthquakes in south-eastern Australia. *Search*, 11(3), 78-80.
- McCue, K.F., 1996 (compiler) *Atlas of Isoseismal Maps of Australian Earthquakes Part 3*. AGSO Record 1996/19.
- McCue, K.F., 2001. Missing Australian earthquake? *Australian Earthquake Engineering Society Newsletter* No. 2/2001.
- McCue, K.F., 2013. Some Historical Earthquakes in Tasmania with implications for Seismic Hazard assessment. *Proceedings AEES Annual Conference*, Nov. 15-17, Hobart Tasmania. 13pp.
- McCue, K.F., 2015. Historical Earthquakes in Victoria - Revised. www.AEES.org.au

- McCue, K.F., & Lenz, S., 1996 - The AGSO Tsunami Database. *in* Tsunamis - A Hazard for the SW Pacific and SE Asia. AGU/IEAust Tsunami Workshop, Brisbane 24 July.
- McEwin, A.J., Underwood, R., Denham, D 1976. Earthquake risk in Australia. BMR Journal of Australian Geology and Geophysics 1(1), 15-21.
- Malpas, K 1993. Historical earthquakes in South Australia vols 1-5. Flinders University of South Australia, School of Earth Sciences, unpublished report.
- Michael-Leiba, M.O., 1989. Macroseismic effects, locations and magnitudes of some early Tasmanian earthquakes. BMR Journal of Australian Geology and Geophysics, 11, 89 - 99.
- Michael-Leiba, M.O., and Gaull, B.A., 1989. Probabilistic Earthquake Risk Maps of Tasmania. BMR Journal of Australian Geology and Geophysics, 11, 89 - 87.
- Michael-Leiba, M.O., and Jensen, V., 1993. The West Tasman Sea (Flinders Island) earthquake of 14 September 1946. BMR Journal of Australian Geology and Geophysics, 13, 369-372.
- Milne J. 1885. Earth Movement in Australia. (reproduced in part in the appendix below).
- Moore, D. H. Betts, P. G. & Hall, M. 2015. Fragmented Tasmania: the transition from Rodinia to Gondwana. Australian Journal of Earth Sciences, 62:1, 1-35, DOI: 10.1080/08120099.2014.966757
- Morris M. K. & Mazengarb C. 2009. Historical accounts of tsunamis in Tasmania. Tasmanian Geological Survey Record 2009/04.
http://www.mrt.tas.gov.au/mrtdoc/doinfo/download/ur2009_04/ur2009_04.pdf
- Payne, C., Adam Pascale, Wayne Peck and Craig Lowe, 2010 – ES&S Seismic Network Report, 2009. http://www.aees.org.au/Articles/Payne_ESS-SNR_2009.pdf
- Richardson, R.G., 1989. Tasmanian Seismicity. *in* Geology and Mineral Resources of Tasmania. Geol. Soc. Aust., Special Publication 15, 463-465.
- Ripper, I.D., 1963. Local and regional events recorded by the Tasmania seismic net. Honours Thesis, University of Tasmania, Hobart (Unpublished).
- Rynn, J.M.W., Denham, D., Grenhalgh, S., Jones, T., Gregson, P.J., McCue, K. and Smith, R.S., 1987. Atlas of isoseismal maps of Australian earthquakes. Bureau of Mineral Resources, Australia, Bulletin 222.
- Shirley, J.E., 1980. Tasmanian Seismicity – Natural and Reservoir-Induced. Bull. Seism. Soc. Amer., 70, 6, 2203-2220.
- Shortt, J. 1884. *Summary of observations on earthquake phenomena made in Tasmania during 1883 and 1884.* Papers & Proceedings of the Royal Society of Tasmania. pp. 263-270.
- Underwood, R., 1972. Studies of Victorian Seismicity, Proc Royal Soc Vic, 85, 27-48.
- Underwood, R., 1973. Progress Report on Seismic Zoning in Australia. BMR Bulletin 164, 61-66.
- Van Dissen, R., McCue, K.F., Gibson, G., Jensen, V., Somerville, M., Boreham, B., McKavanagh, B., and Goede, A., 1997. The Lake Edgar Fault: Evidence for Repeated Quaternary Displacement on an Active Fault in Southwest Tasmania. *in* Proceedings of the Seminar. Earthquakes in Australian Cities - can we ignore the risks? Australian Earthquake Engineering Society Conference Proceedings, Brisbane 2-3 October 1997.

APPENDIX 1 EARTHQUAKE SHOCKS IN TASMANIA DURING THE YEARS 1883-1884.

by Commander Shortt, R.N., Meteorological Observer

ROYAL SOCIETY OF TASMANIA. ABSTRACT OF PROCEEDINGS,

NOVEMBER 17, 1884. *The Mercury* Saturday 29 November 1884, Page 6.

The monthly meeting of the Royal Society of Tasmania, the last of the present session, was held on Monday, November 17, His Honor the Deputy Governor (Hon. W. L. Dobson, F.L.S.) in the chair.

This paper contained a list of the various shocks felt and noticed at the various stations throughout the island during the years 1883-1884. The object of the paper was to afford the

member's of the Royal Society an opportunity of learning the way in which the earthquake shocks were recorded at the meteorological office, and to furnish a summary of the information to be deduced from a study of the records as a whole. It was pointed out that a very large number of shocks (over 1,000) had been felt, but that none of them were severe, and that the reports are tabulated with the time, etc., of each shock, and an attempt was made to demonstrate the probable centre of disturbance. It was found that there were discrepancies in the reported times of various shocks, but, on consideration of a considerable number of shocks, it is shown that the slighter shocks were only felt in the N.E. part of Tasmania and adjacent islands, while the severer ones, which were felt over a wider area, affected St. Mary's, Gould's Country, Kent's Group, etc., before they did Launceston, Hobart later still, and South Victoria, with Gabo Island, afterwards. Various sources of error were pointed out as liable to cause discrepancies, and the various subjects for investigation in reference to the shocks were also alluded to. Finally, a short reference was made to the various theories in connection with earthquake phenomena, and it was strongly urged that further and more careful observation was required before any theory could be satisfactorily established.

A further explanatory paper on the same subject by Mr. J. C. Ross, B.Sc, F.G.S., illustrated by models and diagrams, showing various rough forms of seismometer, by the use of which the tremors or shocks might be more accurately recorded. The forms described were such as from simplicity of construction were suitable for use by untrained observers, such as blocks of wood of various sizes to be displaced by the shocks, basins containing treacle or other viscid liquids, etc.

Where did the earthquakes originate? – Mr Biggs view in 1886.

Launceston Examiner Saturday 19 June 1886, Page 2.

The eruption at Mount Tarawera commenced between 2 a.m. and 3 a.m on the 10th inst., and the fact that at 11.50 p.m. on the 9th inst. an earth tremor, accompanied by a low moaning sound from the east ward, was experienced in Sydney, while at 4.26 p.m. on the 10th four or five distinct though very slight vibrations were recorded at Launceston, by Mr. A. B. Biggs, naturally again directs attention to the possible connection between the earth tremors experienced in Tasmania during the last three years and known centres of volcanic activity. Two theories put forward and discussed at various times, through the Press and at meetings of the Royal Society at Hobart, attracted considerable attention. Capt. Shortt, the Government Meteorological Observer at Hobart, contended that the centre of seismic disturbance was about 90 miles to the eastward of the N.E. Coast of Tasmania, and that the depression in the sea bottom, which slopes to a depth of 2000 fathoms between this colony and New Zealand, presented an effectual barrier to vibrations from volcanic centres in the latter colony travelling to Tasmania. This theory was supported by Professor Milne, of Japan, who holds a premier position in seismology; and who coincided in the idea that the seat of the numerous earth tremors experienced in Tasmania in 1883-4-5, was near the edge of the 2000 fathom line off the N.E. Coast of Tasmania. Mr. A. B. Biggs, of Launceston, who has devoted much time and labour to recording and studying the remarkable series of earth tremors that, suddenly commencing in the end of May, 1883, were experienced at frequent intervals up to the beginning of 1885, when they gradually became both feeble and rare, put forward as early as July, 1884, a theory which met with much criticism and little support, but has been stoutly upheld by its author up to the present. A severe tremor that occurred on the 13th of July, 1884, which was widely felt in Australia, forced him to abandon a preconceived opinion of a local centre close at hand. His calculations upon the great distance and particular duration of the focus of all the severe tremors experienced up to that date forced him by the irresistible logic of a careful and mathematical investigation of the time curves to attribute the disturbance to more distant causes and his belief in the theory then put forward was strengthened by subsequent investigation. Nine days only after the shock of July 13, 1884, Mr. Biggs stated that the nearest focus he could find for the synchronous time curves was Mount Egmont, on the west coast of

New Zealand. The focus of a subsequent severe tremor on 10th September of the same year he located about 500 miles east of Cape Howe. In June of the following year he expressed his conviction that the tremors were due to, first, the vibrations from distant centres of volcanic activity, and secondly minor forces, comparatively local, excited into sympathetic activity by some distant or general disturbance. The theory of one fixed centre for all was not supported by his calculations and deductions, and the minor tremors at least seemed to proceed from different directions. Statistics showing the connection, in point of time, between earthquakes in Java, Italy, Asia Minor, Portugal, England, Syria, Spain, Persia, Algiers, etc., during 1883-4-5, were given in support of his theory, which Mr. Biggs put forward in a very modest manner for consideration, without presuming to dogmatise. The theory met with much adverse criticism, indeed for a time Mr. Biggs might be said to have stood alone. It must, however, be gratifying to him from a personal as well as a scientific point of view to find that his opinions are now being adopted, and that Mr. R. J. Ellery, Government Astronomer of Victoria, who at first opposed the theory, has now expressed his opinion that the various shocks and vibrations that have been experienced in Tasmania and the southern coast of Australia have only been premonitory symptoms of an outbreak which should have been expected at the nearest volcanic centre, viz., the scene of the recent outbreak in New Zealand. Mr. Ellery now states there is without doubt a line of "volcanic weakness" tending from East Bank Straits, north-east of Tasmania, to New Zealand, and the disturbances which have taken place indicated that an outbreak was pending. He also regards the volcanic action in the area referred to as being distinct from eruptions which have taken place in other parts of the globe further north. Additional support is given to Mr. Biggs's theory by the coincidence between the cessation in the early part of 1885, after nearly two years' duration, of the singular series of outbreaks of volcanic forces in Europe and Asia, and the gradual cessation of the earth tremors experienced in Tasmania during the whole of this period of disturbance. The attention, however, which the recent outburst in New Zealand will attract from scientific observers throughout the world will tend to throw further light upon the subject, and meantime it is satisfactory to note that Dr. Hector, the Government Geologist in New Zealand, considers that sufficient safety valves are now open in the North Island to prevent a recurrence of the disastrous explosion of last week.

APPENDIX 2 EARTH MOVEMENTS IN AUSTRALIA

By Professor John Milne, of Tokyo, Japan

THE ARGUS, Saturday, October 10, 1885

Now for a few words about the more violent movements which we call earthquakes. Since April 1883, hundreds of these disturbances have shaken the eastern portions of Tasmania. Many of these movements have made themselves felt in Victoria, whilst one or two have been propagated even as far as New South Wales. General accounts of these phenomena, accompanied with many details, have already been published by Commander Shortt, R.N., Mr. A.B. Biggs, and Mr G.S. Griffiths. The first named gentleman possesses a very complete list of these disturbances, which, so far as it has gone, shows that they commenced gently, gradually became more and more numerous, until at last their frequency reached a maximum. From this time they have been on the wane, both as to their numbers and their intensity. It is to be hoped that this list may shortly be published. In itself it tells us of the birth, the vigorous manhood, and the decline of a seismic area, and it would undoubtedly form a valuable addition to seismological chronology.

From the various investigations which have been made, it appears that there is a line of weakness in the earth's crust running parallel to the eastern coast of Tasmania. From time to time, whilst sinking to a state of equilibrium, this line gives way, first at one point and then at

another. Each of these movements is announced as a series of tremors which now and then may be accompanied by one or more violent lurches. If this is a correct view to take, then in a few years it is possible that actual stability may be reached, and the earthquakes of Tasmania and Victoria become tradition of the past.

A second view is that the disturbances are directly connected with the capillary intrusion of seawater to volcanic foci, consequent on which there are explosions and ruptures along the above mentioned line of weakness. Be it as it may, it is certainly remarkable that the greater number of earthquakes in the world occur in volcanic countries, but not actually at volcanoes. They usually originate on or near the foot of a slope beneath deep water. Eighty per cent of the earthquakes in Japan have such an origin. The great earthquakes of South America, which are sometimes propagated to the shores of this colony as a series of sea waves, originate beneath the deep water off the western coast of that continent. Many of the earthquakes of New Zealand have originated beneath the ocean at the entrance to Cook's Straits.

APPENDIX 3 REMARKS ON THE RECENT EARTHQUAKE SHOCK.

BY S. H. WINTLE.

Launceston Examiner Monday 8 March 1880, Page 2.

Having received several communications respecting the recent earthquake shock, I will avail myself of the privilege offered by the columns of the press to reply to them in detail, as my leisure is limited, and the subject is one of public interest. It has been remarked by one of my correspondents, that "the force of the shock varied very much throughout the island," and suggests that "this may be due to certain geological conditions." In the first place the intensity of the momentum varied so much in different localities that throughout this district of George's Bay, it was not felt in the slightest degree. This also applies to Gould's Country and Thomas Plains. In explanation of the exemption of this part of the island from the oscillatory movement, I venture to observe that the *vera causa* may be traceable to the fact of this district being occupied by granite. It is well known that certain substances convey force and sound much better than others. In a district where sedimentary rocks are extensively developed both in superficial area and depth—such for instance as slate, limestone, and sandstone—it is only reasonable to expect that motion, having its origin in telluric disturbance, would be more strongly felt than in one where a solid, compact, amorphous rock, like granite, solely obtains, and which is accepted as the normal solid matter of the globe, from which all stratified or sedimentary formations have sprung. On referring to the different reports of the various newspaper correspondents who have therein recorded their impressions of the shock, as well as those of other persons in the same district, it will be found that where the oscillatory movement was the strongest, there the stratified formations are well developed, and where it was feeblest, or not manifested at all, the crystalline granitoid formations preponderated. At Mount Bischoff, for instance, it is reported as not having been felt, while at the locality known as Rouse's Camp, distant 3 to 4 miles from the scene of mining operations, it was plainly experienced. Now Mount Bischoff is essentially a hill of eruptive granitoid rock; its sides being flanked here and there with vestiges of the lower members of Silurian strata. At the spot where the wave of disturbance is said to have been made manifest, these strata have an unknown thickness, and are overlain by crystalline prismatic basalt, having a pentahedral structure and which extends to the North West Coast. This crypt, or covering of basalt, would act a similar part to the crystal line slates and limestones as a conductor of force or motion, and hence it is found, where such geological conditions prevail, the oscillatory movement was felt the most. In the southern part of the island, where the sedimentary formations of the coal measures are extensively developed in conjunction with eruptive and intrusive trap rocks, the shock, it would appear, was felt at its maximum. So also in the midland districts, where like geological conditions prevail. At the West Coast were also stratified rocks of Silurian—or at any rate of Palaeozoic age abound, it is reported as having been

equally severe. The inference to be drawn from these data is, that certain geological conditions materially influence the transmission of an earthshock. In advancing this view of the question, I wish it to be put forth more as a theory than as an incontestible argument. Assuming the data to be correct, as based upon the reports of correspondents from different and widely separated localities, the conclusion that will inevitably be arrived at by logical inductive reasoning, will harmonise with what I have advanced. There is a growing belief among the more advanced natural philosophers of the day, that telluric activity is greatly on the increase. The geologist, in studying the history of the earth as recorded in its stony pages, learns how much of its present physical aspect is due to telluric catastrophism which occurred countless ages ago. He also knows that there is no actual stability in Nature, for change may be said to be the life of matter. But this change works in obedience to a fixed law, and has its times, or periodicity. Inductive philosophy, by which we reason from the known to the unknown, teaches the existence of what I may call the law of resumption—that which has been, will be again; and hence this increasing unrest of the surface of our planet is not devoid of meaning. That indefatigable and careful observer, the late Rev. W. B. Clarke, of New South Wales, has recorded between one and two hundred earthquake shocks in Australia during the period of his residence, embracing a period of thirty-nine years. The forces which produced by catastrophic convulsion the Andes, the Himalayas, the Apennines, the Australian Alps, and Tasmania's mountain system incalculable epochs ago, are still in existence in the womb of the earth, although in, it may be said, a latent form, and are ready at any given unknown time to assert their re-constructive agency. I cannot convey my meaning better, perhaps, than by quoting a passage from my contribution to the Australasian in May last, entitled the "Cosmical Forges of the Past." " We have seen what stupendous modifications of the physical aspect of the earth's surface have been effected by the former agent (water), and still more extensive alterations by the activity of pent-up subterranean fires. Hence the inference to be drawn is plain. The resumption of such activity is only a question of time, but who shall say when that time may come? The geologist sees how at different periods the earth has been inhabited by various and diverse forms of life under diverse fitting conditions—how whole races have, as it were, held dominion, fulfilled their destiny, and perished, and passed away, to prepare, possibly, by a wise preordination the way for the advent of man. He, too, in obedience to the immutable law of change, has his destiny to accomplish during an unknown period, while fitting conditions for his existence shall last, and in turns when another reconstructive telluric catastrophe occurs, make room, for aught that may be said to the contrary, for even a race of higher intelligences. " It may, as a set-off to this argument, be contended by some reasoners that although the number of recorded instances of volcanic or telluric disturbances of the present day strikes us with intense force, such disturbances may not actually be more numerous within a given period than they were during a like period of the past, when there were not the facilities that exist now for recording their force and occurrence. Such a view of the question is entitled to some weight. But at the same time it will be found by a careful study of the published records of this terrestrial unrest for the last ten years, that during the latter part of that term such records show a rapid increase." There is one other view of this question which claims consideration, and it is this, that the frequency of these earth-throes of late years would indicate less liability to serious, wide-spread catastrophe, such as characterised telluric activity in aforesaid time, than if such manifestations were fewer in number; thus acting much on the safety-valve of the steam engine. Be this as it may, they teach us the great fact that the remodelling element of the earth's crust is still active beneath our feet, and possesses, for aught we know to the contrary, the same force as of old.

APPENDIX 4

EARTHQUAKE SHOCKS IN TASMANIA. PART II.

Br S. H. Wintle, F.L.S., &c.

The Australasian Saturday 15 March 1884, Page 3S.

Not the least remarkable feature in connexion with these terrestrial movements is that they seem confined to such a limited area, along the east coast and north-east coast of the island, and the islands in Bass's Straits. For every shock that has been felt, or at least recorded, in the southern part of the island, there have been twenty felt in the northern and north-eastern parts, while the western districts seem to have been almost entirely free from them. Tasmania at best is only a small island, and this fact makes the phenomenon all the more remarkable.

Among the theories which have been propounded to account for these terrestrial disturbances is one that ascribes them to being the result of volcanic activity at Java. That this is untenable in the extreme I will endeavour to show. In the first place, it would be doing violence to the law of dynamics to contend that a movement, the result of an eruptive force, could travel in other than straight lines from the centre of such matter displacing force, and, therefore, were a straight line drawn from Java to the centre of the island of Tasmania, it would be found to pass through Dampier's Archipelago. West Australia, skirting the western part of South Australia, through Port Lincoln, the Great Australian Bight, and through the western boundary of Victoria and King's Island, in Bass's Straits. Consequently, a vast extent of intervening territory would be affected to even a greater extent than Tasmania, which is comparatively so remote from Java, for the reason that the disturbing force would decrease in intensity in the exact ratio of the squares of the distance. But the reverse is the fact; for, even Victoria, which is the nearest intervening territory to Tasmania, is exempted from earthquake shocks felt in Tasmania, and we never hear of them in West Australia occurring simultaneously, if they occur at all. And, again, what still further goes to show that there is no immediate connexion with the disturbed centre of volcanic activity in Java and the island of Tasmania is the fact of these earthquake shocks having been experienced in Tasmania a considerable time before the terrible explosion occurred in the former locality. Those persons who have promulgated this theory of connexion with Java seem to imagine that there is direct connexion existing between all known centres of volcanic activity in our planet. This idea is entirely opposed to the belief entertained by the foremost students of geologic science, which is, that there are certain belts or zones of volcanic action, some active, others latent or dormant, and independent of each other, scattered over the face of the globe.

What might tend to suggest this theory of intimate connexion between the seats of igneous activity is the fact of our planet being at the present time in a remarkably disturbed state. Never, perhaps from the dawn of the historic period was it shaken by these deep-seated forces to the extent that it is now; for, from nearly all civilised parts of the globe accounts reach us of these terrestrial throes. Much, however, may be said of the facilities of communication between remote countries which electrical science has conferred upon us, by the result of which, as soon as an earthshock is experienced in any part of the globe which boasts the blessing of telegraphic communication, it is flashed to the most remote countries with which it is connected by the metallic tie. If during former periods of human history, the earth laboured under these pent-up forces to the extent that it does at the present time, the means of recording and disseminating the fact were much more limited than now. However, we can only deal with what we know, and the knowledge of what is taking place at the present time is not calculated to inspire confidence in the stability of the crust of the earth on which we dwell.

Another theory which seems to have gained ground among some speculative minds is that these phenomena are due to disturbed terrestrial magnetism; but as my friend Mr. A. B. Biggs, of Launceston, to whom I referred in a former contribution, remarks, in the way of addenda to his meteorological report in the *Launceston Examiner*, of the 7th inst. — "If these terrestrial disturbances are due to electricity, i.e. disturbed equilibrium of terrestrial magnetism, they would imply extraordinary modes of departure from the ordinary mode in which the subtle force manifests itself. In connexion with such abnormal development we should look for thunderstorms, unusual displays of aurora, derangement of telegraphic communication, and

probably sad destruction among ship- ping. This statement has at least the merit of sound logical inference, for with the atmosphere, so with electricity. Let the balance of the air be destroyed, and the gale or the hurricane is the result of Nature's effort to restore that balance, and the same applies to electricity.

From the latest accounts it would seem that earthquake shocks have been increasing in severity, if not in number, during the last month in Tasmania. No data that can be considered as having a practical value has yet been obtained there to show the rate at which the seismic wave travels. The time of transit, there can be but little doubt, depends much upon the geological structure of the country. It is not unreasonable to suppose that a tract of country occupied by granite would be affected by a seismic wave to a greater extent than one where stratified formations obtained, especially when those stratified formations are not of a highly transmuted or crystalline character. This is borne out by the fact that in the more mountainous parts of Tasmania, where granite is the prevailing rock, alternating with patches of inclined metamorphic strata, the force of the seismic waves is felt more than where sedimentary formations abound. For instance, all along the east coast and north-east coast of the island, for a maximum distance of 60 miles inland from the coast westerly, granite is the prevailing rock, and the area so embraced constitutes the tin districts. In the midland districts, where the granite is overlain by probably thousands of feet of upper and lower coal-measure strata, consisting of shales, sandstone, clays, and the mudstone and limestone series, the shocks seem hardly to make themselves manifest. Up to the present time, fortunately, no fissures or dislocations of the earth's crust have resulted from these telluric disturbances in Tasmania as far as known. As a rule, fractures and dislocations always occur in directions more or less transverse to the wave path. Overthrow or projection, on the contrary, always takes place in the line of the wave path, or in the vertical plane passing through it.

By the latest advices from Tasmania it appears that the severest shocks yet felt there occurred on the morning of the 15th February, at half-past 9 a.m. and that the seismic wave had a direction from east to west, with a loud, prolonged noise. The account further states that a slight shock was experienced at Hobart at the same time. It would appear that it was most severely felt at St Mary's, on the east coast of the island, distant from Launceston about 65 miles. St. Mary's is bounded on three sides by lofty hills. This, then, is the first time within my knowledge that a shock has been recorded in Hobart occurring simultaneously, or nearly so, with one in the north of the island. We also learn that the course or direction of the seismic waves is changing from north and south to east and west, and, further, that they are approaching Victoria, for it is reported that Gabo Island has been shaken with one—indeed, that they are beginning to make themselves felt in this colony I can affirm, for on the evening of 18th of February, at 8.17 a.m., as I was sitting quietly in a room at Fitzroy-parade, I distinctly felt a slight seismic wave having three undulatory motions pass in a direction about north-west by west, yet I did not detect the usual rumbling sound, but that may have been drowned by the noise of passing vehicles.

Notwithstanding that so much has been written on the subject of earthquakes—not withstanding all the accumulated data—the result of long, patient observation and reasonings thereon, by the master-minds of physical science, to which the student of our earth has every means of access, the *vera causa* of these phenomena is still involved in much mystery, and therefore all theories thereon belong to speculative geology, which relates to the actual condition of the centre of our globe—a knowledge which it has not yet been given to man to acquire, and it is more than probable that it never will be given to him. That these too often destructive oscillations and movements in the crust of the earth which we inhabit are due to deep-seated forces striving to get vent, whether such forces consist of gas, or vapour, the effect is still the same. Reasoning by analogy, it must be one or the other of these permanently elastic fluids, but whether the heat necessary to their expansion to the extent of disrupting the crust of the globe is derived from a central cavity of igneous activity, as some theorists suppose, or from

local volcanicity nearer the surface, is a question that remains for the future to solve. Under circumstances such as these, which do not admit of contradiction, it is advisable to be simply content with describing the results of such terrestrial phenomena instead of propounding theories for which there is no positive data.

I took occasion to point out through the columns of *The Australasian* in May 1879, in some papers under the heading of "The Cosmical Forces of the Past," to what an extent Tasmania, and also Victoria, had been the theatres of volcanic catastrophism, the former colony viz., the paleozoic period and the latter part of the Cainozoic period or tertiary—how, during the first-mentioned epoch, mountain heights of granite which had disrupted the older sedimentary rocks and left them resting on their sides in acute anticlinals, had been in their turn disrupted by plutonic greenstone which had overflowed the granite, and frequently overflowed much of the sedimentary formations, and also how, during the miocene tertiary period, another terrible outburst of molten rock matter occurred, which converted valleys into plains by filling up the inequalities with basaltic lava—i.e., the bluestone of Victoria. The scale on which these volcanic outbursts took place—the terrible grandeur of these terrestrial eruptions of molten rock matter—overwhelms the mind of the geologist in contemplating the eloquent evidences which confront him on every hand. I contended that, that what had taken place in the remote past (remote only by human computation of time based on passing events) would be repeated in the future while the same grand natural law existed by the operation of which these great changes occurred, but I was scarcely prepared to find premonitions of this terrestrial unrest manifest themselves so soon.

By Chambers's *Journal* for December last it would seem that these earth-movements were felt some days prior to the terrible eruption at Java, but little or no importance was attached to them. At Anger, on the 29th August last, numerous shocks of a slight, harmless character were felt by the inhabitants, but as no damage was caused by them—not even to the extent of shaking down a chimney—they scarcely arrested attention.

We now know they were the heralds of a terrible catastrophe, and, therefore, they should have a value in the eyes of a people inhabiting the spot where they are felt.

When this calamity occurred we find that a seismic wave was felt to a severe extent at Gayundah, New South Wales, a few hours subsequently, when the courthouse and lock-up were destroyed, while at Goulburn several buildings were damaged. At the same time a large tidal wave struck the west coast of New Zealand, sweeping away several houses, and a few hours later a tidal wave left some boats high and dry at Franklin village, on the Huon River, Tasmania. The difference in time of the wave striking the west coast of New Zealand and the coast of Tasmania agrees with the average rate at which a tidal wave will travel. For instance, in the broad open ocean a tidal wave may travel at the rate of 550 miles per hour; but at the mouth of a channel, such, for instance, as the Irish Channel, that rate will be reduced to 200 miles per hour, and this reduction of the speed of the translating momentum will lessen in proportion as the width of the channel decreases. There is no account of any visible displacement of water sufficient to cause a tidal wave, on ever so small a scale, the result of the shocks felt in Tasmania and the islands in Bass's Straits. Up to the present time the observers of these phenomena who have taken the trouble to record their experiences are few. They are, however, daily increasing, I am pleased to learn, and by comparing notes from increasing records our knowledge of seismology will extend.