

Historical earthquakes in Victoria: A Revised List

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Abstract This paper lists felt-earthquakes in Victoria before 1954 with better-substantiated dates, magnitudes and locations. A significant earthquake and aftershock listed in 1868 actually occurred in 1869. Earthquakes felt throughout Melbourne in 1862 and 1892 and others have been re-discovered; surprising how often earthquakes have rattled Melbourne and suburbs. This and other new information has been mainly sourced from old Australian newspapers using TROVE the Australian National Library's on-line scans of early newspapers and other sources. A plot of the historical data shows a similar distribution but not frequency of epicentres to the post-1965 data which will lower uncertainties in hazard assessments by improving source zone definitions, activity rates and the magnitude threshold of completeness intervals.

The events described include poorly studied, moderate-sized earthquakes that shook Melbourne in 1885, 1922 and Benalla in 1946, let alone the two destructive Warrnambool earthquakes in 1903, each with one small felt aftershock. More damage was caused by these moderate earthquakes than is generally acknowledged.

VICTORIAN SEISMICITY

Various authors wrote about earthquakes in Victoria before short-period seismographs were introduced; Griffiths (1885), Baracchi (numerous newspaper reports), Gregory (1903), Burke-Gaffney (1951) who provided the first list upgraded by Underwood (1972) and Doyle and others (1968). Gibson and others (1980) extracted the larger events in Underwood's list and assigned them magnitudes (for $M \geq 4$) based on their felt areas and maximum intensity.

No large ($M \geq 6$) earthquakes have occurred in Victoria (or NSW) since European settlement in the early 1800s but geographers such as Hills (1963), Bowler and Harford (1966) and Twidale and Stehbens (1978) identified Recent fault scarps in the state left by large earthquakes in prehistoric times, some of which have subsequently been dated (McPherson and others, 2012). Several large earthquakes that occurred off northeast Tasmania and another in SE South Australia impacted Victoria and contribute to the earthquake hazard.

The most destructive Victorian earthquakes to date were the two near Warrnambool in April and July 1903 (McCue, 1978 & 1996). By good fortune no lives were lost nor were there serious injuries, despite the significant damage to many unreinforced masonry buildings. There was spectacular foundation failure (lateral spreading) and liquefaction (sandboils in two localities with disturbance of tombstones in the local cemetery). The two earthquakes were obviously shallow and very close to the city but relatively small at magnitudes 5.0 and 5.3 (McCue, 1978 & 1996). These events were a classic doublet with two possible foreshocks in 1900 and a single aftershock following each mainshock.

The Melbourne Observatory recorded both earthquakes on the Milne seismograph (installed the previous year), the July trace amplitude double that of the April earthquake (hence the 0.3 difference in magnitude).

Mr Baracchi's opinion (*Warrnambool Portland Guardian*, 20 July 1903) is: *that the earthquake originated a short distance south of the Merri River, two or three miles out to sea, at about 38deg. west of the Warrnambool town-hall, and about the same place as the earthquake on April 7. This present shock was more intense and deeper than the former one, and extended over a larger area The recent earthquake shock made a crack in the front wall of the Colonial Bank, a free stone building of two stories. The crack extends from the top of the front window of the public office to the roof, and though it is small outside, in the drawing-room, above the banking chamber, the wallpaper has been torn apart. At the residence of the railway station-master a chimney has been*

split.

The Warrnambool area is distinctive for its lack of earthquakes in the intervening 108 years; there was just one. The *Argus* of 11 December 1922 stated that a slight earthquake rattled doors and windows in and around Warrnambool on Saturday 9th December at about 3:20 pm local time. The Warrnambool Standard says it caused the windows to rattle loudly and it was felt by a great number of residents and woke many others. A check showed that it was not an aftershock of the 1897 Beachport SA and that it wasn't felt elsewhere in Victoria so, the 1903 doublet is not as isolated a region as previously thought.

During this study we did learn of two possible foreshocks to the April 1903 earthquake, in March and September 1900 small local earthquakes were reported felt in Warrnambool as detailed below.

The largest observed earthquakes in Victoria were at Mt Hotham in 1966 magnitude 5.5, Cape Otway 1960 and 1965 magnitude 5.3, and Gippsland in 1969 magnitude 5.3. In July 1885 a magnitude 5.7 earthquake occurred in Bass Strait, south-west of Wilson's Promontory; it was large enough to be felt from Seymour to Launceston.

It should be noted that a remarkable belt of approximately 500 volcanoes of Quaternary age extends across central Victoria from east of Melbourne to southeastern South Australia. Some of these such as Tower Hill near Warrnambool, or Mt Eccles further west, may have erupted as recently as 25,000 years or 8,000 years ago respectively. These volcanoes and the independent large prehistoric earthquakes are symptomatic of currently active tectonism in the local crust. The Monaro Volcanics near Cooma NSW are an ancient analogue of Victoria's Newer Volcanics.

Victoria boasts the highest density of seismographs of any state or territory in Australia and the Seismology Research Centre locates about one hundred small earthquakes per year, excluding aftershocks (~200 aftershocks were recorded in 2009 - see Payne and others, 2010). In Victoria the topics earthquakes and seismic hazard have been studied by Underwood (1972 & 1973), McCue (1978), Gibson and others (1981), Wilkie and others (1993, 1994), Gibson (1995), Brown and Gibson (1998 and 2004).

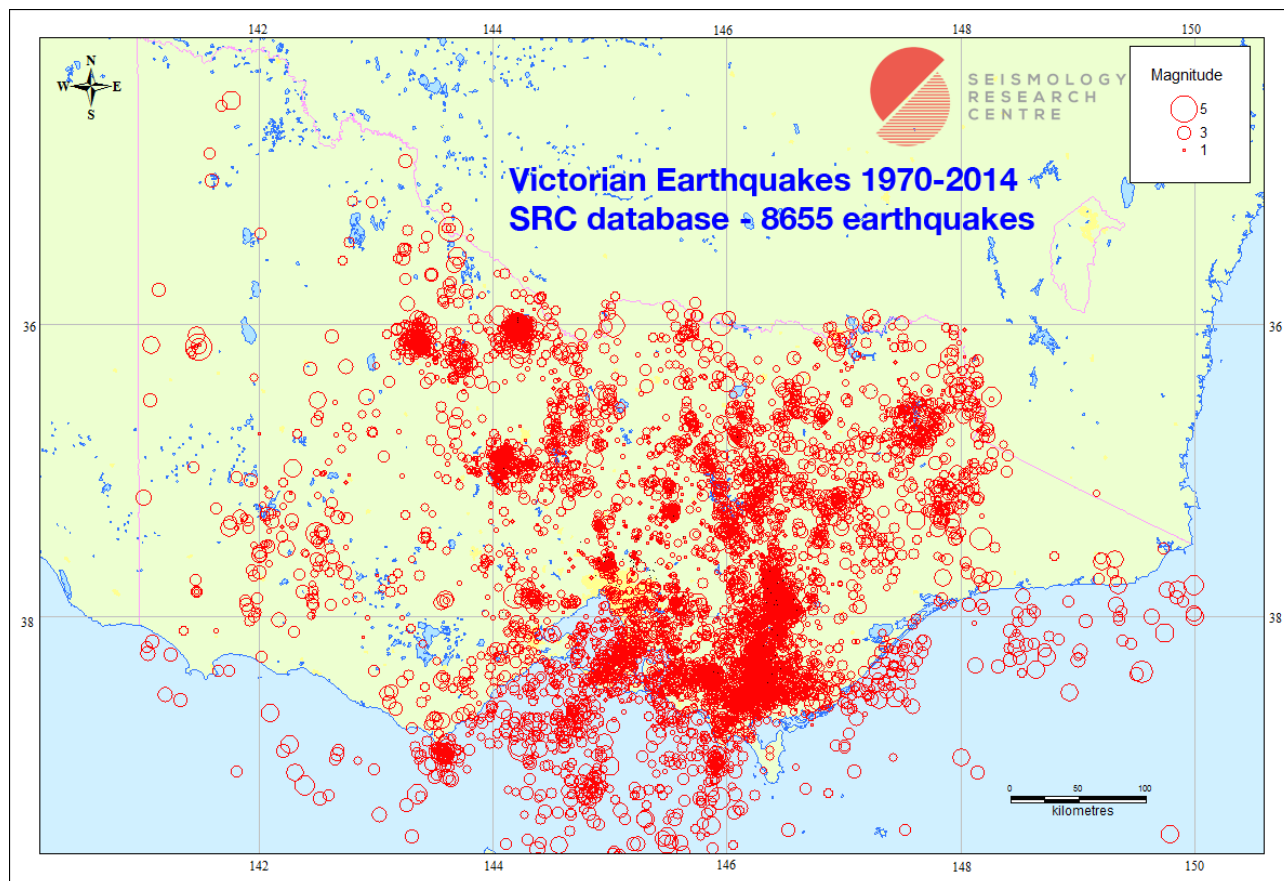


Figure 1a Seismicity of Victoria 1970 to 2014, (SRC's Adam Pascale and Elodie Borleis provided the map).

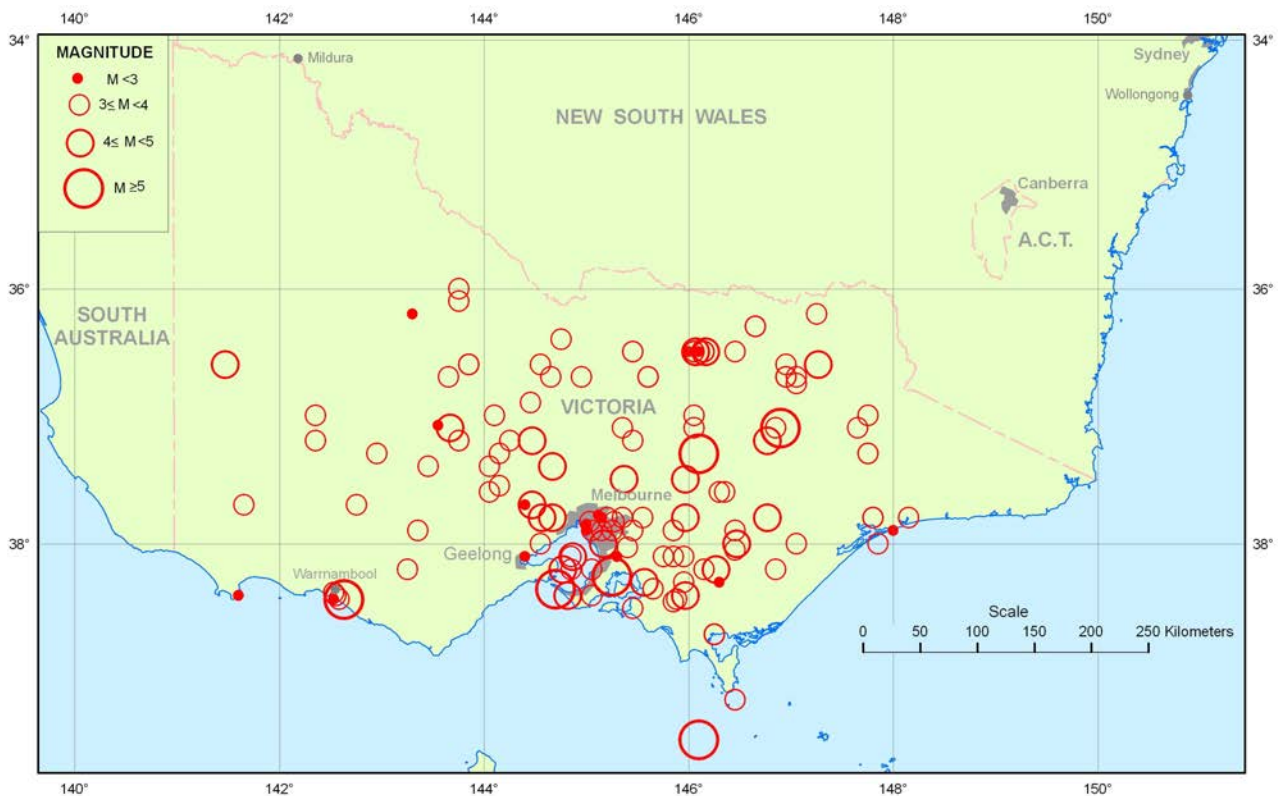


Figure 1b Seismicity of Victoria 1855 – 1954, epicentres of earthquakes assigned in this report.

Isoseismal Maps and Hazard

Isoseismal maps for Australian earthquakes are compiled in three atlases by Everingham and others (1982), Rynn and others (1987) and McCue (1997). Included are maps of 10, 1 and 8 Victorian earthquakes respectively.

Brown and Gibson (2004) and the current hazard map of Victoria (in AS1170.4 - 2007) suggest that the state has moderate levels of seismicity and earthquake hazard, sufficient for earthquake loading, like wind loading, to be taken into account in normal structural design, let alone special structures like the Animal Health Laboratory at Geelong.

This paper was possible because of the recent publishing on-line by the Australian National Library of their scanned collection of early Australian newspapers. The site TROVE allows users to correct the OCR of the scanned images which makes the collection even more valuable as this corrected text can be searched on-line by all. Examples of the scanned newspapers are documented below.

TIME

All events have been assigned UTC but that is not strictly true. The term Universal Coordinated Time (UTC) wasn't adopted until 1 January 1972, replacing Greenwich Mean Time that was introduced in Australia in February 1895. Before that, local time was measured from noon; when the sun was at its highest. Prior to 1895 reported times were assumed to be GMT + 10 hours, but whether the newspapers used Melbourne time or near-epicentre time is not known.

LIGHTHOUSE KEEPERS' REPORTS

Victorian lighthouse keepers' logbooks containing meteorological and other observations such as earthquakes were used with Newspaper reports to draw up the isoseismal maps of the 1903 earthquakes at Warrnambool (McCue, 1978). These important logbooks are kept in Melbourne and researchers must visit Melbourne to view them which limits their usefulness. They should be scanned and made available.

A CHRONOLOGICAL LIST OF EARTHQUAKES

1838 No date, time or location

An article in the *South Australian* (Tuesday 1st June 1847) about the 1847 earthquake in Melbourne (listed below), states that *this is not the first instance of such an occurrence in this Province, a shock, heavier than the one now recorded, having been felt in 1838.*

1841 04 28 at 18:00 UTC, Melbourne

The *Sydney Monitor and Commercial Advertiser* newspaper (Monday 10 May 1841 p2) selectively extracted stories from Port Phillip papers to 30th April including:

PORT PHILLIP

EARTHQUAKE.-Early in the morning of Wednesday last, a smart shock of an earthquake was felt in Melbourne and its neighbourhood, being the third similar irritation which has been experienced since the formation of the settlement. It is matter of congratulation, that these mysterious phenomena have hitherto been so slight as not to occasion the least danger or alarm to the inhabitants. Considering the evidently igneous formation of the province, it is singular that such convulsions do not more frequently occur.

The Adelaide newspaper *The Southern Australian* dated 22 June 1841 reports:

EARTHQUAKE.-The shock of an earthquake was generally felt in New Town and various parts of Melbourne, early yesterday morning. This is the second visitation of the same description which has been felt since the settlement of the province.

The first of these earlier events (two or three) was that in 1838. There was a subsequent one in 1841, the same source on Wednesday 23 June page 2 quoting from Port Phillip papers to 13th June 1841 says with no other details: *an earthquake caused a disagreeable sensation in the Church during Divine services.*

1841 06 13 hours of divine service, Geelong

Geelong Advertiser Saturday 19 June 1841, Page 2.

EARTHQUAKE.—On Sunday, during the hours of divine service, a rumbling noise was heard in the earth, supposed to be the forerunner of an earthquake, in the church it was distinctly heard, and in several parts of the town, giving rise to various speculations upon the subject.

1847 April 28 at 06:30 UTC, Melbourne

South Australian Tuesday 1 June 1847, Page 3.

All the papers agree in stating that a shock of an earthquake was experienced at Melbourne, of which we extract the following account: At half-past four o'clock, Melbourne was visited with one of those singular and at times dreadful phenomena. The shock was rather stiff and felt all over the town. In many of the streets some of the houses were severely shaken, and the inhabitants became very much alarmed, and ran into the streets. His Honor the resident Judge was presiding in the Supreme Court, in the cause of Boyd v. Wilson, when a noise like the rumbling of a carriage was heard, and the buildings appeared to rock. The proceedings were immediately suspended for a time, when the court was ultimately adjourned. The Flag-staff Hill was shaken to its centre, and also the other eminences in and about the town.

(Burnie Advocate Saturday 3rd May 1947, P4) ABOUT 4 p.m. on Wednesday, April 28, 1847, the 13,000 citizens of early Melbourne were conducting their ordinary daily business, attending to the wants of up-country pastoralists, loading and unloading the sailing vessels from "home" in the Yarra and at Sandridge, and engaging in the numerous other pursuits of a thriving colonial town.

SHORTLY after 4 p.m. the ground began to shake. People stopped in the street; those in buildings looked out of the windows, and then there was a mild panic. Someone shouted, "It's an earthquake," and those in the streets made for the buildings, while those inside started for the open air.

Actually it was not an earthquake; it was an earth tremor, of which Melbourne has had many, and of which, one, and perhaps two, had already occurred in the town on the Yarra in the time between its settlement in 1834 and 1847. But this was the most severe up to that time, and possibly there has not been a more severe one since.

Naturally such an event could not be ignored by the papers of the day, and on the following Saturday, May 1, the Port Phillip "Gazette" devoted three-quarters of a column to the occurrence.

"On Wednesday, between 4 and 5 p.m.," the "Gazette" recorded, "Melbourne was visited by an earthquake, which fortunately did no injury to the town. The sensation to those inside was that of a heavy body falling on the upper part of their houses. The panic was considerable in the Supreme Court, where the case of Taylor and M'Pherson versus Sutherland was being tried, and it was at once adjourned.

"The shock was felt most heavily in Elizabeth street, but it was also quite apparent to persons living some miles out of Melbourne.

"This is the second or third time that earthquakes have been felt in this town, the last having occurred in April or May, 1841, at 4 a.m. "

1848 11 24, Warrnambool - earthquake or storm?

Camperdown Chronicle, Thursday 20 July 1916, Page 4.

Old Time Warrnambool. NOTABLE EVENTS FROM 1853 TO 1885.

In September the shock of an earthquake was felt in Melbourne and other parts of Victoria, but it was not noticed in Warrnambool. Alluding to the circumstance, the "Examiner" says that, according to the diary of a lady who was residing in Warrnambool in 1848, an earthquake was felt there in the month of November of that year. The diary describes a fearful storm, which lasted from noon on the 24th November, 1848, until daylight of the 25th. The storm was described as most terrific, the sea trying as if to burst its bounds, and the house in which she lived visibly shook, the articles of crockery were displaced and broken. Those who have witnessed the violent storms sometimes experienced on the Western coast, and have resided there for a number of years, can quite understand the above statement, and yet believe there was no earthquake in reality.

1855 01 06 at 08:00 UTC, Buckland River

The Argus Saturday 13 January 1855, Page 5.

EARTHQUAKE AT THE BUCKLAND RIVER.

To the Editor of the Argus.

Sir,—A slight but distinct shock of an earthquake has been felt here to-day at about 6 p.m. The day has been exceedingly hot, but not close, there having been at intervals a strong breeze from the north. The sky, at the time of the shock, was quite clear. It would be interesting and perhaps scientifically useful, to know over what area the shock extended, in what direction it passed, and the point of its greatest severity; the latter particular may be difficult to ascertain from the reports of such unscientific correspondents as

Your obedient servant,

J.K.J.H.

Buckland River, 6th January, 1855.

1855 September 16 at 16:55 UTC, between Melbourne and Geelong

The next Victorian earthquake is described in *The Argus* on Page 5 later that Monday on 17 September:

EARTHQUAKE.—At five minutes to three o'clock this morning a severe shock of an earthquake was felt in Melbourne. It lasted about a minute. The rocking motion was very distinct, and caused the slates and windows to shake.

It was discussed in a letter dated Monday 17th September 1855, to the Editor of *The Argus* by one Ludwig Becker. The earthquake occurred at 2:50 a.m. that morning and reportedly lasted between 1 and 2.5 minutes.

He reported that in the Union Hotel the shaking was sufficiently intense to awaken nearly all sleepers. Strong shaking *creakings, clatterings and grindings of objects on the surface of the earth* was observed at Collingwood, St Kilda and Windsor. This shaking was preceded by a subterranean noise (P wave?) with the *same pitch or tone as a heavy omnibus or artillery wagon passing rapidly.*

The Geelong Advertiser notices the occurrence adverted to, by stating:—*A smart shock of an Earthquake was felt in Geelong, on Monday (yesterday) morning. The hour is variously stated at from 2h. 45m. to 3h. 10m. The vibration lasted about ten seconds, and appeared to oscillate from south-west to north-east. It was felt in the majority of homes in Geelong and suburbs, and from the surrounding country, during the whole of yesterday, persons called at our office to make enquiries and to communicate their impressions of the occurrence. One worthy farmer was under the impression that heavy drays were coming round his paddock, and got up to see if it was so. On the Barrabool Hills, the shock seems to have been more severe than in lower localities, and one professional gentleman hurried out of his bed on the supposed call for medical assistance by the ringing of the night bell. In a large ironmonger's store in Ryrie-street the storeman was aroused by the rattling of pots, pans, bullock bells, and the multifarious objects usually suspended from the roofs of such establishments.*

The earthquake was not felt in Warrnambool and there are no reports from elsewhere, so it is likely this earthquake occurred between Geelong and Melbourne, in which case the magnitude probably didn't much exceed magnitude 4.

1858 08 27 night time, Melbourne

Bendigo Advertiser Tuesday 31 August 1858, Page 3.

"Pons Ælij" in Monday's Age, says that he was sitting up on the night of the 27th and did not notice the unmistakable shock of an earthquake which the Argus mentioned.

This event was probably the electrical storm raging at the time, not an earthquake.

1861 07 03 02:15 UTC, Moora

Evening News Thursday 14 July 1881, Page 3.

SHOCK OF AN EARTHQUAKE. —The M'Ivor News of 5th instant says :—About a quarter to twelve a.m., on Wednesday last, the shock of an earthquake was distinctly felt in different parts of this district. It was experienced by every one in the Redcastle Police Court, and most places in the township. It was also felt on the Rushworth-road. A letter has been forwarded to our office from Mr. Tait, of the Halfway House, who states that the shock was very perceptible there. It is strange that, as far as we can discover, nothing of the shock was felt in Heathcote. Just on going to press we received a note from Mr. D. Mattheson, informing us that he felt the shock at his house on the Bendigo Road.—The Sandhurst Bee of same date says: —A gentleman, resident in Barkly-place east, informs us that on Thursday, about a quarter to one o'clock, several members of his family felt a peculiar tremulous movement under their feet, which continued for some time, and the description of the phenomenon was generally that of an earthquake. There was no appearance of thunder about at the time, and it was unlike the effect of a blast of powder.

There is some confusion in the media about the data and time.

Bendigo Advertiser Sunday 6 July 1861, Page 2.

SHOCK OF AN EARTHQUAKE.

(To the Editor of the Bendigo Advertiser.)

Sir,—I beg to inform you, for the information of your readers, that yesterday (Wednesday) we experienced a sharp shock of earthquake, at about 12.30 noon; it lasted for a short period only, and was accompanied with a noise like distant thunder. The effect was visible by the temporary shaking of all the buildings on our premises.

Believe me, dear Sir, yours most truly,

D. M. MATHESON. Matheson's Hotel, 4th July, 1861.

P.S.—I may mention that I am one of the oldest inhabitants in this part of the country, and I never remember to have experienced anything of the kind before.

The Star Tuesday 9 July 1861, Page 2 reports:

The shock of an earthquake which was felt at Bendigo appears to have extended to some distance. The Mclvor News of Friday says:—"About a quarter to twelve a.m. on Wednesday last, the shock of an earthquake was distinctly felt in different parts of this district. It was experienced by every one in the Redcastle Police Court, and most places in the township. It was also felt on the Rushworth road. A letter has been forwarded to our office from Mr Tait, of the Halfway House, who states that the shock was very perceptible there. It is strange that, as far as we can discover, nothing of the shock was felt in Heathcote. [Just on going to press we received a note from Mr D. Mattheson, informing us that he felt the shock at his house on the Bendigo road.]"

Redcastle is midway between Moora and Bendigo, and Rushworth is west of Moora, both of which are consistent with our adopted location and magnitude.

1862 07 03 at 06:43 UTC, Melbourne

Geelong Advertiser Saturday 5 July 1862, Page 2.

The shock of earthquake noticed in yesterday's issue, as having been felt at the Little River, was slightly felt in Geelong. The exact time is variously stated, but a quarter to five is about the mean. In some of the cases where the shock was distinctly felt, and mentioned at the time, the fact of its being an earthquake was not suspected, the noise and vibration being attributed to more ordinary causes. It was felt also in Melbourne. The Age says the shock occurred in Melbourne and the suburbs, about twenty minutes to five o'clock. We have received information of the shock having been felt at St. Kilda, Prahran, Emerald Hill (South Melbourne), and Richmond, but it appears to have been most distinctly experienced on the south side of Emerald Hill, where it lasted, for about thirty seconds. The vibration was very palpable, and was of sufficient force to cause articles of crockery placed on the shelves in some of the houses, to rattle against each other, alarming the inmates and causing them to run into the street. Upon instituting inquiries at the Observatory, we were informed by a gentleman there—Professor Neumeyer being absent—that he had felt the shock himself, and that at the time specified, the magnets were greatly disturbed, but that there were only very slight traces of electricity.

Figure 2 Felt area of the earthquake of 3 July 1862, felt throughout Melbourne and at the Astronomical Observatory.



The Argus Saturday 5 July 1862, Page 3.

The shock of an earthquake was distinctly felt and heard in Melbourne yesterday afternoon, between four and five o'clock. We have heard from several independent sources that in many widely separated parts of the city the sound was heard, and the shock felt, as if a heavy carriage had been rumbling by. A letter from Sandridge shows that there also the motion of the shock was felt.

The Age Saturday 5 July 1862, Page 5.

THE EARTHQUAKE.

We have been favored by Professor Neumayer with the following account of the earthquake which occurred on Thursday : — " The earthquake, which was reported as having occurred on Thursday, was also observed at the Flagstaff Observatory. A slight tremulous motion, apparently from a northerly towards a southerly direction, was felt at 4 hours 43 minutes. The vibrations were slight, but quite distinct, and lasted about (2) two seconds. The magnetic instruments, acting in such cases also as sismometers, oscillated rapidly; and it would rather appear, by a superficial examination of the observations, that one or two of the piers were slightly displaced by the effect of the shock, than that a striking change took place in the value of the magnetic elements. No noise was heard beyond that fully accounted for by the vibration. The weather immediately before the occurrence was dull and threatening, and a smart breeze blew the N.N.E., which by 7 hours shifted towards N., bringing heavy rain for the rest of the day..... At Queenscliff, Taradale, Creswick, and the vicinity of Melbourne the shocks were distinctly noticed. From the remainder of the stations within the colony of Victoria, intelligence was received that nothing was felt."

THE EARTHQUAKE.

TO THE EDITOR OF THE AGE.

Sir, — Last evening, on my return from Melbourne, the assistant astronomer reported to me that a peculiar tremor of the ground had been experienced at the Observatory, and that there was great reason to fear disturbance of the adjustments of our instruments in consequence. As unfortunately we are too liable to somewhat similar shocks, from our proximity to the railway and defence works, it did not at the time attract that attention which it would have done in any other locality. The assistant astronomer describes the shock as being of the nature of a terrestrial wave, travelling from north to south, extending over a period of two seconds. One of the workmen at the Observatory states that he experienced a very distinct vibratory movement about two minutes subsequent to the first shock, and in various parts of Williamstown the wave of the first shock was noticed. This, in conjunction with the fact that the shock was perceived simultaneously in Melbourne and in the suburbs, proves beyond a doubt that it was an earthquake. The adjustments of our instruments have been tested since, but no permanent disturbance appears to have taken place. — Your obedient servant,

ROBERT J. ELLERY, Government Astronomer. Observatory, Williamstown, 4th July, 1862.

The Age reports that it was strongly felt at Toorak, rattling the corrugated roof of the verandah while the Adelaide Observer says it was felt at St Kilda, slightly.

1862 09 03 at 10:30 UTC, Talbot

Empire Friday 12 September 1862, Page 2.

We have Melbourne papers to the 8th September. The following is from the Age:—

Another earthquake appears to have taken place in the colony. The Talbot Leader, of Friday last, says, "the shock of an earthquake was experienced in Talbot, on Wednesday evening, about half past eight o'clock. No underground noise was perceptible, but the windows of several shops and private houses were violently shaken, producing no small alarm among the occupants. The shock lasted for about ten seconds, and was followed by

a terrible flash of lightning, accompanied by a deep roll of thunder. The direction of the quake was N.W. There was a light rainfall, but no wind, at the time."

1862 10 21 at 14:00 UTC, Talbot

The Star Saturday 25 October 1862, Page 2.

ANOTHER EARTHQUAKE AT TALBOT.—The shock of an earthquake was experienced in Talbot on Monday night about 12 o'clock. Our informant, Mr Culley, of Scandinavian Crescent, says—" He was in bed and awake at the time, and that the bed was considerably shaken. This is the second shock of the kind we have had in this district during the last two months.—Leader 24th October.

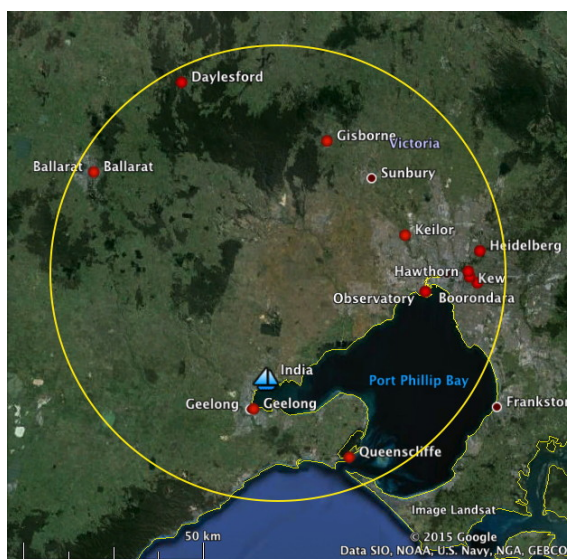
1867 August 09 at 19:31 UTC, W of Melbourne

Illustrated Australian News for Home Readers Tuesday 27 August 1867. Page 7.

The shock of an earthquake was experienced in and around Melbourne at half-past five a.m. on the 10th instant. So far as our inquiries extend, it was very generally felt in the city and suburbs. Information has reached us from Heidelberg, Boorondara, Hawthorn, Kew, South Yarra, Williamstown, and Queenscliff, which indicates that the vibration was more or less intensely experienced in those localities. All reports singularly agree as to the point of time at which the shock took place. The chronometer of Mr Crisp, jeweller, Queen-street, stopped at 5.30½ a.m., and a clock on the premises of Mr Katzenstein, similarly recorded the exact period of the shock. A resident on the Balaclava-road writes :— " A violent shock of an earthquake was felt, this morning, at half-past five. It commenced with a low rumbling noise, which gradually increased in violence. The house in which I was shook and trembled, the windows rattling, and the ornaments on the mantel-piece also shook. I was awake at the time, and having felt the last earthquake, knew the present one immediately, and therefore took particular notice. The shock lasted eight seconds, and seemed to come from a S.W. direction." At East Melbourne, a correspondent says the shock was so severe as to almost eject him from his bed, and its duration was nearly a minute. At Hawthorn, two distinct shocks are said to have been felt, accompanied by a muffled subterranean roll. Other persons residing at Kew testify to only one shock, the rattling of doors and windows, and giving the impression to those suddenly startled out of sleep that burglars were at work. The noise underground seems to have been generally heard. Some persons fancied that a report preceded it, but it would seem, from the testimony given, to have resembled the sound of distant thunder, not increasing in loudness with its continuance, but becoming fainter from its commencement. At Geelong, the course of the shock was said to be from east to west. At both Ballarat and Smythesdale, the motion of the earth was experienced. Mr Ellery, the Government Astronomer, favors us with the following notice of the phenomenon: — "A smart shock of earthquake was felt here this morning, and according to the notices I have received, it appears to have been general over the colony; but it seems to have been most severe at the coast stations. I was awake, at the time, and felt the shock, at 5 h. 31 min. 30 sec.; it was accompanied by a rumbling noise, like that of a passing carriage, and the direction of wave from about W.S.W. to E.N.E. As our magnetic instruments are now dismantled, pending the reconstruction of the magnetic house, I am not able to ascertain whether they were affected at the time. The shock was felt by Mr Wilhelmi, of the Botanical Museum, at his house, in South Yarra, who carefully noted the time, and having compared his watch with the Observatory clock this morning, he finds the times to be the same as that given above." From Queenscliff, the master of the telegraph station reports as follows: — "Earthquake occurred here at 5.30 a.m., lasting from five to seven seconds; vibration distinctly felt, and moveable articles seen to vibrate; noise like the rolling of heavy carriages. Spoke to Geelong station a few moments afterwards, and Geelong reports having felt the same sensation at 5.30. Direction appeared about east to west." Mr Foy, the keeper of the lighthouse, says that he felt the shock at 5.30. Both towers of the lighthouses vibrated considerably, but more especially the lower one.

The Melbourne Argus, 12 August 1867 (from the Empire of Thursday August 15, 1867, p5) reported that an earthquake was experienced in Melbourne at 5:30a.m. on Saturday 10th August 1867 EST. It lasted about 6 seconds in Melbourne and shaking extended from Queenscliffe to Gisborne.

Figure 3 Felt area of the earthquake of 10 August 1867 west of Melbourne. Shaking was strong throughout the city area but there are no reports from the epicentral region. Compare with Figure 2. The blue boat icon is the barque India (see text) in Corio Bay.



According to the article, the shaking was stronger in Melbourne than earlier ones including that of September 1855, mentioned above, perhaps because it was closer.

At South Geelong, the ceiling of one house is reported to have fallen down. At Corio Bay, the shock was felt aboard the barque India, awakening the Captain who thought another boat had run into them. Windows rattled in Hawthorn and St Kilda whilst at Keilor everyone was awakened.

The earthquake was felt very distinctly in Ballarat. A correspondent reports to *The Ballarat Star* on Tuesday 13 August 1867;—"Early on Saturday morning I was awakened by an extraordinary trembling of the house and bed on which I lay. The vibrations were very rapid—from twenty to thirty in a second—but were rather spasmodic than continuous and uniform. The movement, so far as I can judge, was from west to east, and the sensation experienced was that of shivering without feeling cold. It is difficult to state the exact time which the shock lasted, but I should estimate it at about twenty-five seconds—certainly not more." The earthquake was also distinctly felt in Daylesford.

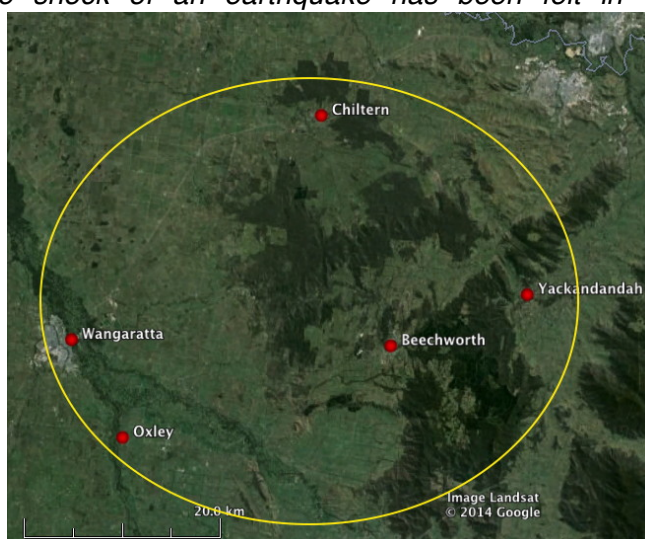
The location and felt area delineated in Figure 3 are very similar to those of the July 1862 earthquake in Figure 2.

1868 02 27 at 22:05 UTC, Beechworth

The Argus Wednesday 4 March 1868, Page 5.

The shock of an earthquake was felt at Wangaratta, Oxley, Beechworth, Chiltern, Yackandandah, and the surrounding country, at about five minutes past eight on the morning of Thursday last, 27th ult. A writer at Beechworth says:—"For the first time within the memory of the oldest inhabitant, the shock of an earthquake has been felt in Beechworth. At a quarter to nine in the morning there was a dull, rushing, rumbling sound below the surface of the earth, and then for about three quarters of a minute the houses rocked. Several things were thrown to the ground from tables and broken."

Figure 4 Felt area of the Beechworth earthquake 27 February 1868. The magnitude based on the felt area shown is about 3.5.



The times are not consistent but we assume they refer to the same shock and have opted to accept the first time given.

1868 08 20 at 11:27, Woods Point Meteor

Illawarra Mercury Tuesday 8 September 1868, Page 2.

Singular Phenomenon. — A correspondent at Wood's Point writes to the Argus, under date the 26th August, as follows, mainly for the purpose of bringing the facts he mentions under the notice of scientific men : — " On the night of the 20th instant, at about twenty-seven minutes past nine, I noticed a splendid meteor fall, although it was raining heavily at the time. The light from it was most brilliant (of the hue of the lime light), and I saw it as it fell from behind a raincloud. Its course was from N.E. to S.W. It seemed to be formed of a chain of large stars or balls of fire, connected by various rods of light. I may add that a shock of earthquake and a tumbling noise were felt and heard about a minute afterwards at the hospital by all the patients, and also by two or three persons here; and on going to Jamieson I ascertained that it was felt and heard there also."

1868 08 29 at 18:50 UTC, Mt Hotham

No reports of this earthquake reported by Underwood (1972), and repeated by Gibson and others (1981) and McCue (1995), have been found in the scanned newspapers because the year was actually 1869, see below.

1868 11 01 at 15:00 UTC, Emerald Hill (suburb of South Melbourne) and Castlemain

The Sydney Morning Herald Saturday 7 November 1868, Page 8.

On Monday morning, at about 1 o'clock, something like the shock of an earthquake was experienced on the east side of Emerald-hill. A shock was felt as if the earth was rolling from one side to the other, and as if the house walls were falling. It only lasted for a moment, but was sufficiently marked to induce some of the Hillites to leave their beds in alarm.

It was also reported felt slightly at Castlemaine and Ballarat. The magnitude would have been about 4 even if the epicentre was equidistant from the towns. The following interesting memory 60 years later might be relevant to this event.

Kilmore Free Press Thursday 17 June 1837, Page 2.

Contribution by Mr. James Ochiltree, of Romsey. In my long life at Romsey I only heard one earth tremor. It was on a still night over sixty years ago that my father called out to me from his bedroom, "Did you hear that?" I heard it all right. The best description I can give of it is that it was like thousands of loads of large stones tumbling down a deep shaft, or like loud thunder near at hand. It is not known to the people of Romsey that they are living within two miles of an extinct crater which threw out the great red soil beds which make Romsey A1 as a great, potato, growing district. There must have been most terrific heat in the eruptions on the Rocky Range, as the blue stone there is as hard as any in the world. The lesser hardness of the red stone which is also there is due probably to not getting as much heat as the bluestone. A Hungarian visitor to my farm told me that if the bluestone were in Hungary it would be worth a fortune for use of running shafting instead of brass. In talking to an old Englishman about Melbourne skyscraper-buildings he said, "Yes, they are magnificent structures, all right, and earthquake feeders."

This is a relevant comment for any suggestion earthquakes don't happen in the midst of the Newer Volcanics.

1869 03 28 at 16:00 UTC, Daylesford

The Australasian Saturday 3 April 1869, Page 22.

DAYLESFORD.

About two o'clock on Monday morning, a shock, supposed to be of an earthquake, was experienced in Daylesford. It alarmed the printers of the local paper so much that they were on the point of running downstairs, to escape from the possible wreck of the building in which they were at work, when the case of their alarm subsided. It is reported that in Ballarat a similar shock was felt about the hour and on the day named.

1869 03 ??, Moorwatha near Albury

In the Albury district (says the Banner) we find that a very decided fissure in the earth has been left, in the neighbourhood of Moorwatha, by a slight shock of earthquake, felt at that place on the day of the great storm, about five weeks ago. Residents in the neighbourhood inform us that during the height of the storm a low and prolonged subterranean rumbling, quite unlike the sound of thunder, was heard, unaccompanied, however, by any noticeable movement of the ground.

Surely not!? Was it a shallow landslide?

1869 08 29 at 18:50 UTC, Eastern Highlands

This earthquake was incorrectly dated 1868 in (Underwood, 1972), the mistake then repeated in later publications. The local times by three different watches were 4:55am, 4:53am and 4:47am. Reports of jerky ground motion and cracked walls, diagonally from top to bottom, are evidence of quite strong shaking.

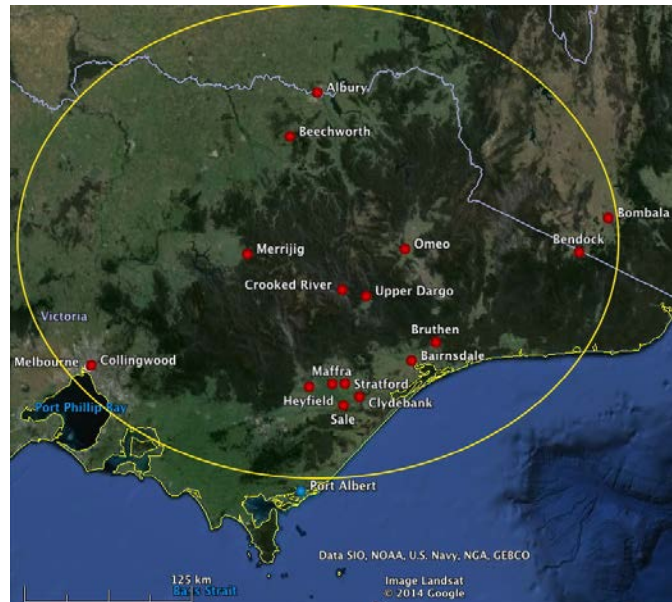
The Argus, Thursday 2 September 1869, Page 5.

THE EARTHQUAKE ON MONDAY LAST.

BEECHWORTH.—A smart shock of earthquake was felt in Beechworth between four and five o'clock on Monday morning. The wave appeared to pass from the south-west towards the north-east, and was accompanied by a dull rumbling noise, not unlike the sound of a train in motion. In several houses the occupants were awakened by the jingling of the glass and crockery on the shelves, whilst others were aroused from their slumbers by the shaking of the beds, and an unpleasant swaying motion given to the buildings. The shock, which is variously described to have lasted from three to fifteen seconds, seems to have been felt over a large extent of the hill country, but not, so far as we have heard, on the plains. A telegram from Bright informs us that a smart vibration was felt in that locality at a quarter to five o'clock, much about the same time it was experienced in Beechworth—Ovens and Murray Advertiser.

Figure 5a (top) Felt area of the August 1869 earthquake in Gippsland causing building damage and broken windows. The red dots are where the shaking was reported felt, the blue dot at Port Albert where, on enquiry, it wasn't. The equivalent magnitude is 5.4. **5b** (bottom) The map in the GA *Isoseismal Atlas*, same author of both maps.

GIPPS LAND.—A smart shock of earthquake was felt with more or less effect throughout North Gipps Land at an early hour on Monday morning.



From the number of accounts sent in to this office, and from inquiries instituted by ourselves in Sale and the vicinity, we glean the following particulars:—Time of occurrence, about 4.45 a.m.; direction of the wave, from east to west; time of duration, about twenty seconds. The vibrations were rapid, continuous, and distinctly marked, resembling the quick pace of heavy waggons over an uneven road.

The air at the time was only moderately cool, the whole of the previous period of the night having been unusually close and sultry, as was the greater part of the day preceding. A stiff north-westerly breeze had set in about half-past four o'clock in the afternoon, which gradually died away by sundown, after which time the night closed in hot and oppressive. Throughout the night and towards morning the atmosphere became almost painfully still, not a cloud being in motion. The first shock was that of a sudden and very distinct jerk, immediately followed by a low rumbling, apparently increasing in sound and effect as it came nearer. In this neighbourhood, the party walls of the most substantial building in the town were cracked diagonally from top to bottom. Windows were violently and visibly shaken, and the glass in some instances cracked, and a few small articles of furniture disturbed. A resident of Sale reports that the latch of his door was raised, and the door flung violently back on its hinges, and so severe was the shaking that he thought the house—a two-storied brick building—was coming to the ground. The effect on walls and windows generally is described as if very heavy ordnance had been discharged at about a half mile distance. The shocks were felt distinctly enough at the Heart, Clydebank, Nuntin, Maffra, Heyfield, the 42nd, Stratford, and Bairnsdale. At the latter place, our own correspondent reports the direction to have been north to south south-west; time, five a.m. Mr. Ferris, of Port Albert, says the disturbance was not felt in his neighbourhood, and we have not been able to discover that the occurrence was known at all fifteen miles south of the Hill-top. At that locality, in the neighbourhood of Glencoe station, the shock appears to have been very gentle, and not immediately recognisable as that of an earthquake.—Gipps Land Times.

The Ballarat Star Thursday 9 September 1869, Page 2.

THE EARTHQUAKE OF 30th AUGUST.

Wednesday's Argus contains two letters to the editor—one from Upper Dargo, and the other from East Collingwood—relating experiences of an earthquake, evidently identical with that reported in the Star of 3rd September as having occurred in Gipps Land and Beechworth on 30th August. It will be seen that in the case of the experience at Upper Dargo, the shock appears to have been more violent, and felt at ten minutes past five o'clock a.m., while those before reported and that at Collingwood all occurred at ten minutes before five o'clock. Mr Heckscher, however, may be mistaken as to the precise time—indeed, he implies that he is not certain. The following are the letters referred to:—

" Sir.—A tremendous shock from an earthquake was distinctly felt on the Upper Dargo on 30th August, at as near as possible ten minutes past five a.m. So severe was the shock that I thought the house was coming down. It lasted about ten or twelve seconds; in fact, it caused quite a consternation in this quiet hamlet. It was not only felt by the residents in Louisville, but, having occasion to go some eight miles from Louisville, made enquiries concerning the shock, and was told that it actually woke the children from nature's soft nurse. There was also a second shock, but not so violent as the first, which happened about twenty minutes past eight p.m. on the same day, which was also distinctly felt by the residents here, which lasted about three or four seconds, being the first shock to my knowledge that I have felt. I can only compare it to the noise caused by a heavy train of carriages passing under a bridge. If there had been any quartz reefs working close by I should have put it down to the explosion of powder caused by working reefs, but there are none working within some miles away from Louisville. On the following day I also had to go in another direction on business, and also made enquiries, but only found one person out of seven or eight that felt the same shock; but, of course, we are not all somnambulists. Since the above, we have had a very heavy fall of snow, with rain at intervals; in fact, impeding all

business. The Mongolians thought that the huge mountains were going to collapse; and the Dargo River is rising rapidly. "Philip Heckscher.

" Upper Dargo, Louisville, 1st September."

"Sir, —On Monday morning, 30th August, I was lying on my bed awake, when I became aware of a shaking motion, as if suspended in a cot, swinging either way six inches. The motion seemed to be from north to south, and lasted about six seconds. I got up immediately, and opening my bedroom door, was met by my son, who asked, 'Was that not an earthquake!' At the same time a third person opened his bedroom door, and said that he and his wife had both felt the same movement, and that 'the jug and basin on their washstand had been shaken.' The time by two watches was fifty-five minutes past four and fifty-three minutes past four, my own being forty-seven minutes past four. We all slept on the first story of a heavy stone building, viz., the Studley Arms hotel. Having experienced similar shocks in Collingwood on previous occasions—one about two years since, and another about twelve or fourteen years ago—I am thoroughly aware that what I now speak of was an earthquake. I have waited, day after day, expecting the fact would have been noticed in your columns, and mentioned it to several persons before your announcement of the Bairnsdale earthquake. You will see that the time in both cases, allowing for variation of watches, is exactly the same. Hoping some of your numerous readers who may have felt the shock will note the circumstances,

I remain, sir, yours respectfully,

" P. J. Petherick.

" East Collingwood, 7th September."

Gippsland Times Saturday 4 September 1869, Page 3.

THE EARTHQUAKE. We have received the following additional particulars about the shock of earthquake felt in North Gippsland on Monday, the 30th ultimo. Our Boggy Creek correspondent writes: " Monday, 30th August, 1869, 4.30 a.m. "An earthwave came from about N.E., giving a very decided oscillation, and slightly preceded by a sound wave, which came with a rushing noise, gradually becoming more and more rumbling until it died away like distant thunder. Duration of motion, about 30 seconds. The times are only approximate, but I think there cannot be much mistake about the direction, as my point of observation was about one and a half miles (horizontal) E.N.E. from the summit of Mount Halford, and the last reverberations of the sound wave certainly came from the south side of that mountain. "7.50 p.m. "An earthwave passed in the same direction as the former, accompanied by a sound wave not nearly so loud as in the morning. This one produced a decided vibration but the motion was not nearly so violent as the first. Duration about 10 seconds. I have met no one who noticed the sound wave as at all proceeding the earth wave in this case. Boggy Creek, 1st September, 1869." A gentleman at Omeo says: "Smart shock of earthquake at five minutes to five yesterday morning, local time. Apparent direction, south west to north east. Faint rumbling at 8 a.m. in the same direction. Slight shock at 8 20 p.m. Change of wind during the night, from north to south, with heavy snow storm. Omeo, 31st August, 1869." Our Bendock correspondent writes: " 30th August, 1869. " A few minutes before daylight this morning my wife and I were startled out of a sound sleep by an extraordinary rumbling sound, like the clanging, wavy sound of a heavy bell. My first sensation was thunder, but from four to five upheavals of the bed convinced me it was an earthquake, the wave of which passed from west to east. The peculiar sound lasted for about 20 seconds. The sky was clear and frosty. My next door neighbour heard it, and was equally startled." A correspondent at Merrijig, writing to a Bairnsdale firm says - "1st September, 1869. "I suppose you had the shock of the earthquake at Bairnsdale; it was very bad here. I thought my store would have been shaken down, and all the huts on the creek. I assure you it was very bad here, and I did not know what to think of it: I thought it was all up with us all. I hope nothing has happened to any of the building or to your store: had it shook like my store it must have come down, as it is brick. I hope we shall not hear

the like again. I was sick all the day after it, and every man on the creek, I think. Let me know whether it was bad at Bairnsdale or not, and whether any damage was done." Referring to the shock of earthquake reported in our last a friend sent us the following extract received from the Crooked River on Thursday. The writer says: "Judging from the state of affairs at Grant the world must be coming to an end. On Saturday the 29th of August it was as near summer in regard to climate as one could wish. On Sunday it snowed; on Monday morning at about five o'clock we had a shock of earthquake that nearly shook the house to pieces. On the same day at eight o'clock we had a hot wind, and this (Tuesday) morning the ground is covered with eighteen inches of snow and yet, as I write it is snowing hard." Our Bairnsdale correspondent writes :—A severe shock of an earthquake was felt at Bairnsdale about five a.m. on Monday, it was followed by one at eight a.m. and one at eight p.m., both being slight with a low rumbling sound resembling distant thunder. From reports I have heard it was felt very severely at Bruthen, Boggy Creek and towards Omeo. There are different opinions as to the course it took, several that I have spoken to on the subject are inclined to believe that it went to the westward. I felt the shock that occurred some fourteen years ago, and I can safely say this felt here was very severe in comparison. The swaying of the house to and fro for about thirty seconds caused such a sensation I never felt before. The night was oppressively hot and calm with a curious appearance in the sky; as far as I am aware there has been no damage done.

The earthquake was also felt in Albury and Bombala NSW. In Albury the motion was described as distinct but gentle and regular, with about 7 or 8 oscillations. More reports have been unearthed using Trove to search newspapers than found by a manual search of newspapers so the felt area and magnitude are larger than in the previous estimate, 5.4 vs. 5.0.

1869 08 30 at 10:20 UTC, Gippsland aftershock

There was also a second shock, but not so violent as the first, which happened about twenty minutes past eight p.m. on the same day, which was also distinctly felt by the residents here, which lasted about three or four seconds, being the first shock to my knowledge that I have felt.

This report was from Upper Dargo, Crooked river and other places. It is possible there was an earlier aftershock at 8 am but it was reported by only one observer.

1869 11 29 at 02:00 UTC, SE Melbourne

The Argus Friday 3 December 1869, Page 5.

The earthquake of Monday noon, writes the Government astronomer, appears to have been very distinctly felt in the locality of Berwick. A gentleman residing at Hillsley, near that place, furnishes the following information to the Observatory :—" At about a quarter past 12 p.m., the weather being very calm and quiet, a loud rumbling noise, like the roar of an approaching storm or whirlwind, was heard, and lasted from 15 to 20 seconds, which was followed in a few seconds by a gentle vibration, accompanied with a sound like the galloping of horses, that quite deadened the rumbling noise first heard." The shock was felt at the Balaclava-road, and a gentleman residing there reports having distinctly felt the shock, which he likened to " a heavy explosion, which caused the windows to shake." A slight vibration was felt at the Observatory about the same time, but it was so slight as scarcely to attract attention at the time, or to leave the slightest trace on the records of the self-registering magnetic instruments. The shock was also distinctly felt in the lower part of Collingwood.

1870 01 20 at 10:45 UTC, near Wickliffe

The *Empire* of Monday 7 February 1870 page 2 has the following:

SHOCK OF EARTHQUAKE IN VICTORIA.—Quite a severe shock of an earthquake, writes a correspondent of the *Argus*, was felt at Bin Bin and Glenronald stations, near Wickliffe, at about a quarter to 9 o'clock on Thursday night, the 20th ultimo. So severe was the shock at Glenronald that

it caused the things in the kitchen to rattle, in the walls of the house (which is a stone one) there are several cracks, and the ceilings of the rooms are quite destroyed. At Bin Bin the men in the hut were playing cards at the time. They immediately dropped them, and looked at one another with astonishment: and the overseer, who was reading the newspaper in his house, not knowing at the time exactly what was the matter, ran down to the hut to know if the men had felt anything, and found them in a considerable state of consternation at the strange event that had just happened.

This might be the first earthquake damage reported in Victoria.

1871 02 28 at 11:44 UTC, Melbourne

The Mercury Monday 6 March 1871, Page 2.

By the Tamar's mails, delivered here on Saturday morning, we have one day's later news.

Thursday's Daily Telegraph says: —"An unmistakable shock of an earthquake was felt on Tuesday evening in Melbourne and the suburbs. The time is variously stated by our informants at from twenty minutes to ten minutes to ten o'clock; but Mr. Ellery, in a letter published below, says that sixteen minutes to the hour was the exact moment of the occurrence. The shock was much more perceptible than the one which occurred about eighteen months ago, and seems to have extended over a far wider area. It lasted four or five seconds, and the vibration was sufficient to disturb furniture, shake Venetian blinds, and clink the drops of chandeliers. The rumbling is described by one lady informant as reminding her of muffled thunder, and inducing her to ask whether it was actually a clap. The unnatural stillness which followed is mentioned by another lady, who also distinctly felt the shock from west to east, as confirmed by Mr. Ellery. As the hour at which the little convulsion occurred was favourable to its peculiarities being noted by most people we may expect fuller particulars will yet be published. The busy workers in newspaper offices were too much occupied to be disturbed by the shock themselves, and though Melbourne had an earthquake of its own on Tuesday night the fact has not been announced until to-day."

The Government Astronomer describes it is follows: —"A rather sharp shock of an earthquake took place last night at sixteen minutes to 10 o'clock, its direction being evidently from west to east. The shock, which was preceded and followed by a vibration, like that produced by a waggon passing over a rugged road, had the character of a concussion, producing a remarkable sharp twisting motion at my house. The shock was experienced both at Emerald Hill and at South Yarra by officers of the Observatory, and no doubt has been felt over a considerable area."

Other reports indicate it was felt in Collingwood, South Melbourne (Emerald Hill) and the city, but no further.

1871 06 13 at 18:00 UTC, Beaufort

The Argus Wednesday 21 June 1871, Page 7.

" A very distinct earthquake shock," says the Beaufort Chronicle, " was felt by residents in every part of the Beaufort district, about 4 o'clock on the morning of Wednesday, 14th instant. In the township a number of families were awakened from their slumbers by a rumbling sound, and an unmistakeable vibration of the earth, which was sufficient in several places to cause a rattling amongst the kitchen crockery, and a perceptible trembling of bedsteads. The shock lasted from 25 to 30 seconds, and its direction is generally described as from west to east. Numbers of people were so much alarmed by this unwelcome addition to their colonial experiences that they summarily dressed, and waited for daylight with considerable anxiety. At Waterloo, most of the inhabitants felt the shock and heard the peculiar noise, some of them describing the sound as resembling that of a heavily-laden waggon, with muffled wheels, being drawn sharply over a metalled road."

1871 06 15 at 04:00 UTC, Tumut NSW

This earthquake was felt strongly in Victoria, (Spennemann, 1998) and is most probably the source of the 1871 event in the report about the Kerang earthquake of March 1897.

The Mercury Friday 16 June 1871, Page 3.

VICTORIA.

BEECHWORTH, Thursday.

An earthquake was felt most severely in the centre of the town this afternoon about 2 o'clock. It created some alarm amongst the residents..... There were three distinct shocks.....

WODONGA, Thursday.

A severe shock of earthquake, lasting several seconds, was experienced here this afternoon at 10 minutes past 2 o'clock.

WAHGUNYAH, Thursday.

A sharp shock of earthquake was felt here about 2 p.m. to-day.....

NEW SOUTH WALES.

Friday.

A shock of earthquake was felt yesterday at Goulburn, Yass, and Grenfell. At the former place it lasted about a minute. A shock of earthquake was felt yesterday in the Southern and Western districts.

ALBURY, Thursday.

A shock of earthquake was felt here at two minutes past 2 o'clock, local time.

WAGGA WAGGA, Thursday.

A violent shock of earthquake was felt about 2 o'clock to-day. It lasted 10 seconds, and caused great alarm.

1872 01 03 at 13:12 UTC, Tumut NSW

Adelaide Observer Saturday 6 January 1872, Page 3. TELEGRAPHIC NEWS.

VICTORIA.

Melbourne, December 30. A severe shock of earthquake was felt at Beechworth last night. It lasted over 30 seconds.

The Cornwall Chronicle Monday 8 January 1872, Page 4.

TELEGRAPHIC DESPATCHES. (Australian Associated Press Telegrams.) Beechworth, Jan. 4. A shock of earthquake, very severe for Australia, was felt here last night at 12 minutes past 11 o'clock, from west of north. The vibrations lasted fully 12 seconds, and the rumbling noise was heard distinctly for more than 30 seconds over a large tract of the surrounding country.

Wodonga, Jan. 4. A smart shock of an earthquake was felt here at 10 minutes past 11 o'clock last night, followed by another severe shock a minute afterwards. It was preceded by a rumbling noise, lasting about 15 seconds. The shocks were very strong, and distinctly felt.

WANGARATTA, Jan. 4. A smart shock of earthquake was felt here about midnight yesterday.

This was another of the Tumut NSW earthquake series, felt strongly in north central Victoria, including Chiltern according to *The Age* of Wednesday 10 January 1872, Page 5.

1872 08 07 at 19:10 UTC, Maldon

Thursday A distinct shock of earthquake was felt here at 10 minutes past 5 this morning (The Argus, Friday 9th August 1872, P5).

Portland Guardian and Normanby General Advertiser Thursday 15 August 1872, Page3.

EARTHQUAKE On Thursday, at 5 a.m., two distinct shocks of earthquake, following each other in lightning-like succession were felt in Maldon and at Baringhup by those whose avocations caused them to be early astir. Mr Crossly, the baker, and Mr A. M'Arthur in the same line of business, both thought at the time that the old Beehive mine had caved in. The patients at the hospital and several machine employees also many others, report having been startled by the subterranean disturbance, and Mr Hayes, junior, at Baringhup, who was in the act of feeding his horse, preparatory to riding to catch the first train to Melbourne, thought that the stable was coming about his ears. The concurrent testimony agrees that the motion was felt from the north, and that the rumbling echo died off to the south-west. All the old yarns as to Mount Tarrangower being still a slumbering volcano have been revived in a cheering mood with the wish expressed that the old mount may be riven sufficiently to disclose its presumed golden treasures.

1872 10 18 at 09:00 UTC, Beechworth

The Argus Saturday 19 October 1872, Page 5.

BEECHWORTH, Friday.

A slight shock of earthquake was felt here about seven o'clock this evening, with an oscillating motion.

Same day, different time as a moderate earthquake in Bathurst NSW. This may well be one of the Tumut series or a small local, more information needed.

1873 05 22 at 06:30 UTC, Berwick

Launceston Examiner Tuesday 6 May 1873, Page 1S.

VICTORIA. A slight shock of earthquake was felt in several localities not far distant from Melbourne on Tuesday afternoon, April 22nd. According to accounts that have been received at the Melbourne Observatory, the shock appears to have been most severely felt about 28 miles south-east of Melbourne. A gentleman residing near Berwick reports its occurrence at half-past 4 in the afternoon; it lasted about 20 seconds, its direction appearing to be from N.W. or N.W. by W. It was accompanied by a loud rumbling noise. The shock itself caused glasses and crockery to rock about, but not sufficient to capsize them.

This was obviously a small earthquake in the vicinity of Berwick, we assign it magnitude 3.0.

1874 08 13 at 16:45 UTC, Rochester

The Argus Tuesday 18 August 1874, Page 5.

An earthquake is reported by the Rochester Express :—" On Friday morning about a quarter to 3 o'clock several persons in Rochester were alarmed by what must have been a rather smart shock of earthquake. We have been unable to obtain any particulars as to the direction in which it appeared to travel, but have been supplied by a gentleman who felt the shock with the following description :—" I was getting into bed yesterday morning, about 3 o'clock, and was alarmed by feeling the whole house tremble in such a manner as to make every article in it shake. The plates on a rack were shaken violently, and the whole was accompanied by a rumbling sound, like the report of a distant gun. The nearest approach to the sensation I can imagine would be caused by a heavy hammer striking the whole building at once, if such a thing were possible. I may say that my wife also felt the shock, and was so terrified that she could not go to sleep afterwards.' Two other gentlemen have told us that they felt the shock, and noticed much the same effects as those related above."

1874 08 30 at 09:02 UTC, Melbourne

The Argus Monday 7 September 1874, Page 1S.

A slight shock of an earthquake occurred on Sunday evening, August 30, about one or two minutes past 7, accompanied by a noise like the roll of a heavy vehicle on a metalled road. It was felt in several places about Melbourne and Richmond, at St. Kilda, Brighton, and in the Harkaway Ranges, near Berwick.

1874 11 29 at 15:08 UTC, Stockyard Creek (Foster from 1879) foreshocks and aftershocks

The Mercury Saturday 5 December 1874, Page 3.

Stockyard Creek, Monday.

Several shocks of earthquake, with a loud rumbling noise, were felt here this morning at eight minutes past 1. Three of them were unusually severe, lasting fully thirty seconds each. Many things in the stores were shaken down and broken. The timber in underground workings was displaced, and steam machinery stopped. Four slighter shocks were afterwards felt. The shocks were also felt at Wilson's Promontory, Yanakie station, and Turton's Creek, causing great alarm, being the fourth shock in about six months, viz., 14th and 21st June, 11th November, and this morning. The shock travelled seemingly from S.W. to N.E.

The weather was calm and dull.

With reference to the above, Mr. Ellery of the Government Observatory, forwarded the following:—"The following telegrams have been received at the Observatory, reporting shocks of an earthquake experienced early this morning in the Gippsland district. — Memo, from Mr. J. G. Brent; manager electric telegraph, Wilson's Promontory : Sharp shock of an earthquake distinctly felt here this morning at eight minutes past 1 o'clock ; lasted about twelve seconds.— Memo, from Mr. S. Hodder, manager electric telegraph, Stockyard Creek: Several shocks of earthquake felt here this morning between 1 and half-past 3 o'clock. These were unusually severe ; many things shaken from shelves in stores ; timber in underground workings displaced ; steam machinery stopped ; seemed to come from S.W., going N.E. ; weather calm, fine, dry and overcast."

This sounds like a local earthquake near Foster rather than a larger event in Bass Strait, as tabled. The location and magnitude are uncertain.

1875 02 28 at 20:40 UTC, Maryborough

The Mercury Wednesday 5 March 1875 Page 3 and 10 March 1875, Page 3.

INTERCOLONIAL.

VICTORIA.

Maryborough, Monday.

A smart shock of an earthquake was felt here at Chinaman's, Timor, Majorca, Natta Yallock, Norwood, Rathscare, Mariner's Reef, and Adelaide Lead, this morning at about 20 minutes to 7 o'clock. The direction of the wave was from northwest to south-east. The shock was felt distinctly in the upper story of Mr M'Cullough's new building, High-street. Mr. M'Cullough himself at the time was at Natta Yallock, 15 miles distant. He was at breakfast, when a considerable tremor was felt, accompanied by a noise like the rumbling of a heavy waggon on a stone pitched street. The timbers began to creak, and Mr. M'Cullough and the members of the family jumped up and ran outside. The sky was perfectly cloudless, and the air calm at the time. At Rathscare, 11 miles from Maryborough, the shock was equally severe, and several persons were considerably frightened. In Maryborough, the shock was not so severe. Mr. William Fraser, M.L.A., felt his house tremble, and heard a noise which he describes as like the noise of a chimney on fire, raging fiercely. There also the weather was quite calm, and the sky cloudless. The shock was generally felt in High-street, but not severely. The noise, however, was loud and was heard by numbers of people. At Mariner's

Reef the shock was rather more severe. At Timor many supposed the noise to be thunder, and went out to look at the sky, which was cloudless there also. The iron on some of the roofs here and at Chinaman's shook greatly. At Alma the shock was distinctly felt.

St. Arnaud, Monday.

Figure 6 The felt area of the 28th February 1875 earthquake between Avoca and Maryborough. It was felt in the large towns Castlemain and Ballarat but not apparently in Bendigo. This is the minimum felt area, the magnitude at least 4.2.

A shock of earthquake was felt here this morning at about half-past 6. At Bell and Stewarts' store the crockeryware was thrown from the shelves and broken.

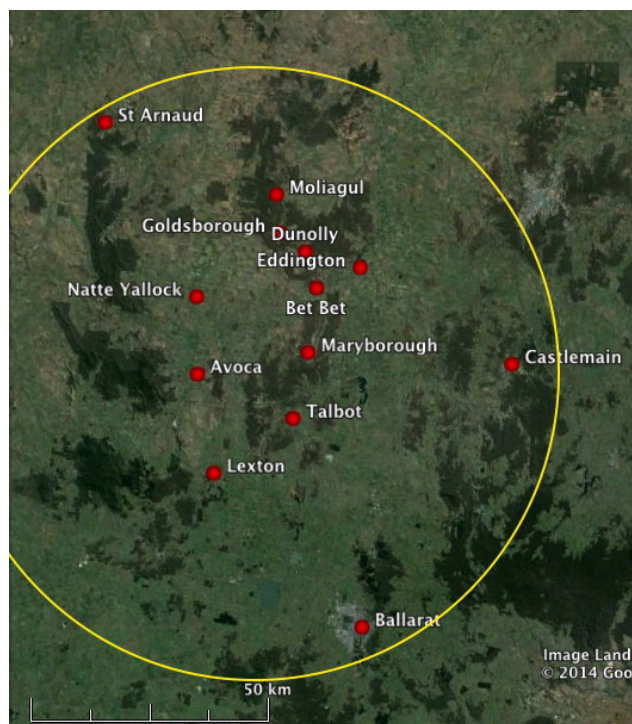
Avoca, Monday.

A little before 7 o'clock this morning, most of the inhabitants were awake with the shock of an earthquake, which lasted about one minute. The noise was like a very strong gust of wind coming from the Pyrenees, and directly following it the houses trembled and the windows rattled, frightening the occupants that were up, and causing them to run into the street.

THE EARTHQUAKE IN VICTORIA.

The Maryborough Standard writes :— " At 48 minutes past 6 o'clock on Monday morning a smart shock of earthquake was felt in Maryborough. The direction of the shock is not very clearly known, but it appears to have been from south to north. It was heard and felt over the whole of Maryborough, the noise and shaking being noticed from opposite points of the town east and west, vis., the vicinity of the gaol and the railway station. Some persons describe the noise as similar to that of the rumble of thunder, and others refer to it as such a noise as would be caused by heavy ordnance drawn along the road. Scores of persons, on having the matter mentioned to them, stated they had heard a noise of the kind in the morning, some awakening from sleep at the time but they attached no particular importance to it. Windows rattled, and articles were disturbed in houses in the township. The earthquake was felt at Chinaman's Flat, five miles away, and Mariner's Reef, a mile and a half in a different direction. Probably, also, it was felt in other localities from which we have had no tidings. We are informed that the shock was also felt at Talbot, and our correspondent at Dunolly states it was also felt there. Father Delaney, who was sleeping at Lexton described the Phenomenon as severe in that quarter. The rev. gentleman was shaken in his bed, and inhabitants of the township who were outside of their dwellings ran in alarm at the unusual occurrence. At Avoca it was pretty severe, and also at Natte Yallock."

The Dunolly Express says.—" Early yesterday morning many of the residents were aroused from their sleep by the passing of a loud rumbling noise as of distant thunder. Those fully expected a speedy downpour of rain, but on reaching the open air not a cloud was to be seen. Others, who were already astir, not only observed the noise, but articles in their houses were visibly shaken and in one instance we have heard of the doors banged to and fro, and the windows rattled in a terrible manner. The shock of earthquake, for such it was, appears to have passed from north to south throughout this district, as we learn it was felt at Jones's Creek, the reservoir, Burnt Creek, Bet Bet, Moliagul, Goldsbrough, Eddington, and Mount Hooghly, the duration in most instances being estimated at from ten to fifteen



seconds, and between half-past six and a quarter to seven o'clock. At Eddington and Bet Bet, sometime after midnight, a noise such as described was heard, but it was thought to proceed from a night train on the railway, and no further notice was taken of it until the shock as above was distinctly felt, and led the mind to revert to the former noise."

The Ballarat Star states that the shock was distinctly felt in Ballarat, at about 20 minutes to 7 o'clock a.m. The shock is described as being sufficient to shake a solidly built brick house, and to have lasted somewhere about two seconds. The direction of the wave here is stated to have been from north to south. The shock was sufficient to awaken a light sleeper, and caused more than one person to jump out of bed.

A correspondent of the Castlemaine Representative states that he felt the shock in that town, and that there was a noise as if a stone had struck the house, which trembled, and the windows rattled. This morning, adds the Representative of last night, between 4 and 5, a similar disturbance occurred here, but in a slighter degree.

The felt area corresponds to a magnitude 4.0.

1875 08 05 at 11:00 UTC, Naval guns - not earthquakes in Melbourne

The Argus Friday 6 August 1875, Page 5 and 7 August Page 7.

EARTHQUAKE IN MELBOURNE.

An earthquake, which seems to have been chiefly felt south of the Yarra, was experienced last night. Mr. White, the acting Government astronomer, writes:

" One of the severest earthquakes ever recorded in Melbourne was experienced this evening. The first shock occurred at the Observatory about a minute before 9h. 7m. 55s., when the second shock was observed; about a minute after this a third shock was noticed; at about 9h. 10m. 5s. a fourth shock happened, and the fifth shock was felt at 9h. 11m. The second shock appeared to be the strongest, the first and third were somewhat weaker, and the fourth and fifth were much weaker than the others.

THE SUPPOSED EARTHQUAKE.

The shocks referred to in yesterday's paper as those of an earthquake have proved to be due to the reverberation of sound from the guns of the Cerberus at Point Nepean. Four guns were fired at about the hour of the supposed earthquake viz., 9 o'clock on Thursday night and that those caused the supposed earthquake shocks is rendered certain by a correspondent who writes that while walking on the St Kilda Esplanade at that time he saw four distinct flashes like those from ordnance in the direction of Point Nepean followed immediately by as many muffled reports and shocks.

These extracts are included in case others stumble upon the first story.

1875 12 01 at 19:00 UTC, Wilson's Promontory

The Colac Herald, Friday 3 September 1875, Page 3.

It is reported that two earthquake shocks were felt at Wilson's Promontory at five o'clock this morning.

The Gippsland Times Saturday 4 December 1875, Page 3.

Melbourne Friday evening. Two shocks of earthquake were felt yesterday morning at Wilson's Promontory as well as at Stockyard Creek.

Coincidentally (?) these two earthquakes are almost a year-to-the-day of the last event reported from these same two places.

1876 04 21 at 14:00 UTC, Stockyard Creek

NEWS OF THE DAY. Earthquake in Victoria.

The Government astronomer of Victoria received the following telegram from Mr. W. Barry, postmaster at Stockyard Creek, dated April 22: — " A very severe shock of earthquake, lasting about 15 seconds, occurred here last night, at 12 o'clock. It shook the whole place very much."

For want of information, this event is assigned the same location as the previous one.

1877 06 24 at 17:25, 17:37 and 18:08 UTC, SE Melbourne and aftershocks

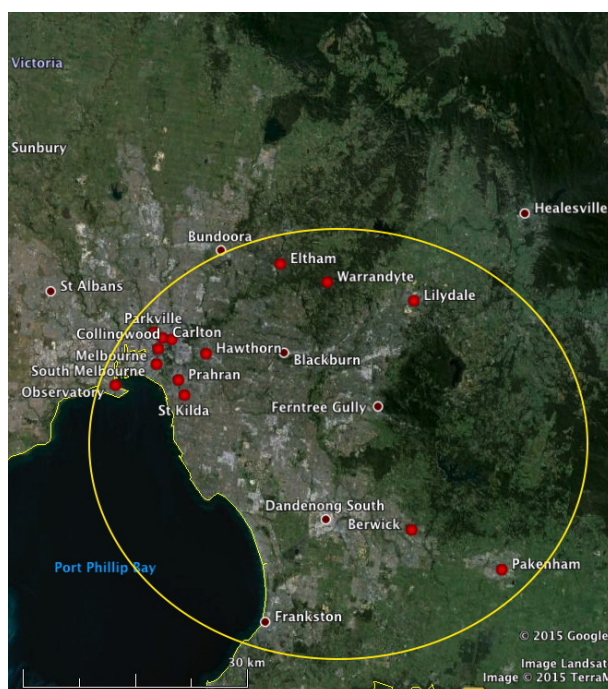
The Argus Tuesday 26 June 1877, Page 6.

THE EARTHQUAKE.

One of the severest shocks of earthquake which has occurred for a long number of years past in Victoria was experienced yesterday morning in Melbourne and the suburbs, as well as in localities more distant. At the Observatory the shock was very decidedly felt at 25 minutes past 3 a.m., and is described as sufficient to rattle windows and shake crockery. It lasted for about 10 seconds, but the direction of the wave could not be observed, the disturbance appearing to act vertically. At 22 minutes and a half to 4 a.m. a second but much gentler shock was felt, and again a similar shock at eight minutes past 4 a.m. The earthquake-shock was distinctly felt in most of the suburbs, and nearly all those who experienced it agree as to the time the shock took place. By residents of East St. Kilda it is described as being particularly heavy, one gentleman stating that it shook his bed quite visibly, and that afterwards there was the sound such as made by the rumbling of distant thunder. All the glass and crockery in the house, our informant states, rattled, and even heavy pieces of furniture seemed to share in the general disturbance. At Emerald-hill also the earthquake shock was very heavily felt, some of the frailer tenements shaking quite perceptibly. From nearly all the other suburbs accounts have reached us of the shock; but there is no reliable evidence as to the direction of the wave. By some it is stated as travelling from east to west, whilst others are of opinion that it went from south to north. No public alarm was occasioned by the unusual occurrence, although it formed the subject of general conversation yesterday, Happily, earthquakes are of rare occurrence on this continent, and as yet none of the shocks experienced have been attended with damage either to life or property.

Mr. Henry Westley, writing from Burnside, St. Kilda, says :—"This morning, at 25 minutes past 3, Mrs. W. and myself were both awoken by a shock of an earthquake, which seemed to last some 15 to 20 seconds. The noise resembled that of a full or heavy train pulling up—a continuous rolling noise (I fancied from south to north, but this I am not clear on). On looking out, the morning was bright and clear, and the water of the bay looked perfectly smooth. After a lapse of some 10 minutes there was a second shock, but the noise was not so loud or as long as the first."

Figure 7 Melbourne and suburbs where the earthquake was reported felt (solid red dots) on 24 June 1877 at 17:25 UTC.



Mr. E. Howitt states that he felt the earthquake very severely at East St. Kilda. The shock awoke him, and the house shook for some seconds. The shaking was almost severe enough to cause alarm. The lines of disturbance seemed at East St. Kilda nearly north and south, and the waves of oscillation E.N.E. by W.S.W.

"W. B." writes from Hawthorn:—"A lady lying awake during the night suddenly felt a sharp shake and quiver of the bedstead, and simultaneously heard a low rumble like distant thunder, comparable to a train passing over a railway bridge in the distance. The time was 21 minutes past 3 am. Everything was perfectly still before and after."

Our Eltham correspondent writes:—"A slight shock of an earthquake was felt at Eltham at about half-past 3 on Monday morning. It lasted for only a few seconds, but caused during that period considerable alarm to those who were suddenly aroused out of their sleep by the occurrence. It was accompanied by a low rumbling, as of distant thunder, which was repeated after an interval of about 10 minutes."

Several correspondents attach their names to the following communication from Lillydale:—" At 27 minutes past 3 this morning a severe shock of an earthquake was felt at the Black Springs Hotel, Lillydale. It resembled a very heavy peal of thunder, and shook the whole building, which vibrated for at least half a minute. The bedroom door shook, as though some person was shaking the handle, then it wound up with a severe crash, like the bursting of a bomb. One lodger in the house had his bed moved away from the wall. At four minutes to 5 o'clock a second shock took place, and at two minutes to 5 o'clock a third, but neither of the two last were as severe as the first. The direction of the shock appeared to be from south-west to north-east."

The Bendigo Advertiser of Tuesday 26 June 1877, Page 2 suggests that: *Altogether the earthquake of this morning appeared to have been by far the most severe hitherto recorded in the annals of this part of the colony.*

The Observatory mention that the shock appeared to be vertical is interesting, indicating near epicentre or a focal depth of about 15km. Observers agree there were at least two aftershocks though the time estimates vary – we have adopted the Observatory times. The time variation (surprisingly small) is a measure of the uncertainty in the reported times in this paper.

Table Local times (a.m.) at different locations for the mainshock and two aftershocks

Location	Mainshock	1 st aftershock	2 nd aftershock
Observatory	03:25	03:37	04:08
St Kilda	03:25	03:35	-
Hawthorn	03:21	03:31	-
Eltham	03:30	03:40	-
Lilydale	03:27	03:56	03:58

The Argus Friday 29 June 1877, Page 7.

The shock of the earthquake experienced in Melbourne was also felt in Buninyong at the time alluded to, more particularly by Mr. Charles Seal, and those residents near the Mount. The Ballarat Star states that the vibration aroused several persons, who could not account for the phenomena until they read the accounts recorded in the public press.

This report would make a significant difference to both the magnitude and location, provided it refers to this earthquake, but without the date and time specifically mentioned nor other reports west of the city, and contradictory evidence from Pakenham, I have not included it.

The Government Astronomer, Mr Ellery, discussed the earthquake at the July monthly meeting of the Royal Society and mentioned personal correspondence from other population centres. This included an observation from Pakenham that five events were felt between 3:30 and 5a.m., the first and fifth being the most severe.

1877 07 07 at 07:44 UTC, Rosedale

Evening News Monday 16 July 1877, Page 2.

A shock of earthquake appears also to have been experienced in Gippsland on Saturday last. The Rosedale correspondent of the GIPPSLAND TIMES writes:— " To be exact as to time, it was 5.44 p.m., when a sudden tremulous motion of the earth occurred, accompanied with a sound as of wind rushing past in a compressed compass. The direction of the shock was from south-west to north-east, and the duration, as near as can be judged, about two seconds. Although not strong enough to shake any loose articles in the houses, its passage was distinctly felt. Some thought from the rumbling, swaying sound and sudden stoppage that an accident had happened to some heavy vehicle; while one storekeeper was under the impression that a number of packing cases stowed under a neighbour's verandah had come down by the run. The strength of the shock appeared to pass under the Post Office.

1877 07 10 at 12:40 UTC, Inglewood

Evening News Monday 16 July 1877, Page 2.

Earthquake Shocks in Victoria.

The Inglewood correspondent of the BENDIGO ADVERTISER writes on Wednesday:— Last evening, shortly before 11 o'clock, we were treated to an unmistakable and what may perhaps be termed a rather heavy shock of earthquake, which shook houses and rattled windows in a perceptible manner. So far as can be judged the precise time of the visitation was somewhere between 25 minutes to 11 and a quarter to 11. The first notice received of anything unusual occurring was the hearing in the still night air of a heavy rumbling noise, coming rapidly from a southerly direction. When it reached the town houses trembled and shook in a violent manner, while in some instances crockery jingled about to such an extent as to make people believe they were about to fall on the floors. Wooden and iron houses were most affected, every board and sheet of iron rattling. One-story brick houses did not feel the shock so much, but those of two stories rocked considerably. At a house in Brooke-street several children were so frightened as to leave their beds, while a gentleman residing in Grant-street was awakened from a sound sleep, the shock coming on his house, he says, with a crash; and another says he was afraid his lamp would have been thrown off a chest of drawers upon which it was standing. Some persons describe the noise as resembling that caused by a heavy underground explosion, while others liken it to the sound of a train in motion, or a heavily loaded waggon jarring against a kerbing. The shock lasted about fifteen seconds; the air was perfectly still at the time, and the sky cloudless. At Dusty Town the residents were alarmed, and at five miles north of Inglewood the shock was distinctly felt, as also at Bulabul Creek, two miles to the south. Some curiosity was felt as to whether the earthquake was general through the colony, consequently, on arrival by mid-day train to-day, Sandhurst and Melbourne papers were eagerly scanned, and some surprise evinced at there being no mention of such a visitation. This is the second shock of earthquake felt in this town, the first occurring about two years and a half ago, it being, however, so slight as to be noticed only by two or three people, and lasting about five seconds. The Advertiser adds: The earthquake was felt with considerable severity at Wedderburn, the symptoms being similar to those here, but more violent. At a point on the Loddon, eight miles from Inglewood, the shock was heavy; but at Berlin, twelve miles south-west of Inglewood, and the direction from which the shock seemed to travel, it was most severe, several parties in a house there rushing out in great alarm, thinking a great explosion of some kind had taken place.

1878 03 23 evening, Avoca Lead

The Argus Wednesday 27 March 1878, Page 5.

AVOCA, TUESDAY.

The residents of Homebush and Avoca Lead state that they experienced a shock of earthquake on Saturday evening, but it was not observed at Avoca.

1880 11 09 at 18:30 UTC, Omeo

The Argus Monday 15 November 1880, Page 7.

NOTES FROM THE OBSERVATORY.

It has been reported that the shock of an earthquake was experienced at Omeo on Wednesday morning last, at about half-past 4. It lasted about three seconds, and appeared to proceed from a S.E. to a N.W. direction.

1881 05 06 at 07:45 UTC, Wood's Point

The Argus Monday 9 May 1881, Page 6.

NOTES FROM THE OBSERVATORY.

An earthquake occurred in the neighbourhood of Wood's Point on Friday evening at about a quarter to 6. Mr. Johnson, the telegraph manager reported :—" Smart shock of an earthquake felt here at a quarter to 6 p.m. Wave appeared to pass from N.W. to S.E. Shock lasted about 15 seconds, causing crockery, &c, to rattle in houses." Although this was only a slight earthquake and entirely local, on examination of the curves of the magnetograph at this time a slight undulation in the curve is apparent, of such a character as to suggest that there was a simultaneous disturbance of the earth's magnetism, rather than any mechanical disturbance of the suspended magnets.

1881 06 08 at 02:55 UTC, Merino

The Argus Monday 13 June 1881, Page 6.

TO THE EDITOR OF THE ARGUS. THE EARTHQUAKE AT MERINO.

Sir,—A distinct shock of earthquake was felt here at five minutes to 1 p.m to-day. It appeared to come from the N.E. and travelled to the S.W. with a lateral rocking and upheaving motion which lasted for about three seconds. It was accompanied by a loud rumbling noise resembling thunder. The sky at the time was tolerably clear, with light fleecy clouds. The weather during the past two days had been exceptionally stormy and wet, with considerable barometrical variableness but no thunder, though it was quite fine at the time of the shock. — Yours, &c.,

Merino, June 8.

OLD COLONIST.

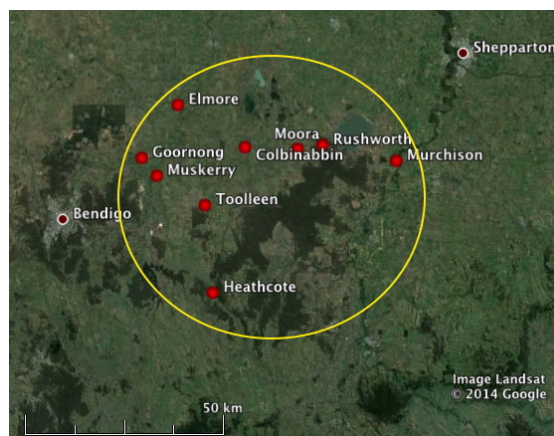
1881 07 08 at 23:07 UTC, Moora

The Riverine Grazier Wednesday 20 July 1881, Page 4.

EARTHQUAKE IN VICTORIA.

The shock of earthquake, (says the Bendigo Independent) reported in last Monday's issue as having been felt on Saturday morning about nine o'clock at Muskerry, and corroborated by our Colbinabbin correspondent in the same issue, had a rather extensive range. Its direction was due east and west, it having been felt at Muskerry, Colbinabbin, Moora, Rushworth at Murchison, on the Goulburn, and doubtless further east and west of Muskerry and Murchison, though the absence of telegraphic communication prevented reports coming to hand. Writing yesterday, our Toolleen correspondent gives a graphic description of the incident. — ' Saturday last will long be remembered by the inhabitants of Toolleen and surrounding district, in consequence of an earthquake shock of a very severe nature being felt. Rain fell in the early morning, the sky was cloudy, and subsequently an unusually thick mist overhung the ground. Just as the latter was clearing away, the shock was felt, causing the houses and fences to literally rock to and fro, while the earth reeled under the feet. The vibration commenced about five minutes past nine o'clock (as near as could be ascertained) and continued twelve seconds. The sound accompanying the shock was such as to convey the impression that a dray-load of stones had been tipped against the side of a weather board house.

Figure 8 Felt area of the Moora earthquake 8 July 1881. The equivalent magnitude is 3.7.



Several persons ran out of their houses, believing such was the case, while others went out expecting to find their large iron watertank upset, while the very cattle grazing in the paddocks stood trembling for a considerable time after the vibrations of the earth had ceased. A few casualties, but not of a serious nature, occurred. At the Mount Pleasant homestead, the residence of Messrs M'Roberts, the pictures were all violently thrown down from the walls, and also a great deal of plastering. At the house of a Mr Purves, of Colbinabbin, the door at the time was wide open, but the shock caused it to slam with the greatest force. Several of the largest logs composing fences rolled out of their places to the ground. In many houses the damage done to crockery, &c., was considerable. At Muskerry also the shock was felt to be of a terrible character. One farmer, who was ploughing in that locality, states that the earth completely reeled to and fro, and that the fence of the paddock continued rocking for some seconds. By making inquiries I have ascertained that the oldest inhabitants remember two shocks having occurred in this district like the one on Saturday last. The first was on 12th July, 1861 (twenty years ago), and the other about ten years ago. Each of these, however, was insignificant compared with that of Saturday last. The Goornong correspondent of the Bendigo Advertiser thus describes it: — " A smart shock of an earthquake was felt on Saturday, causing a general rattle and clatter among the dishes and iron roofs. One gentleman in this township was near being thrown out of his chair, and in Elmore the earthquake was felt still sharper. The centre of the shock would appear to have been at or along the Mounts Campbell and Pleasant range. Mr Wendel, my informant, a well known resident of the locality, says that he, in company with Mrs Wendel and Mr Wedner, was, at about twenty minutes past nine in the morning, standing on the range, when their attention was attracted to a low rumbling sound steadily approaching from the southward, and that when it reached them he felt three distinct upheavals, or, as he expressed it, it was just as though he were standing on a spring-board, and some one had caused it to spring upwards. The lift appeared to him to be about three inches; the sound continued on towards the north. Immediately afterwards there was a second sound running parallel with the first, but distant about half a mile down the valley; the continuance of the upheaval was about three seconds."

The Mclvor Times and Rodney Advertiser Thursday 14 July 1881, Page 2.

EARTHQUAKE—We have received accounts of a shock of an earthquake felt at Weston and Mount Pleasant and Wild Duck on Saturday morning last. We notice by the "Argus" that the shock was also felt in the Murchison and Rushworth districts. It appears, however, to have been most severe at Mount Pleasant. A correspondent writing from there states that on Saturday last at 9.45 a.m., a shock of an earthquake or violent electric current passed over the Mount Pleasant district, apparently travelling from north by west to south-east, accompanied by a noise resembling a heavy railway train passing over an iron bridge, and quite as loud, and also by a sound like a rush of air which generally precedes a thunder storm, though at the same time not a leaf or twig moved. The atmosphere was close and sultry. The sounds lasted about five seconds. The shock caused the ground to shake under one's feet, and gave a similar sensation to that experienced by contact with a powerful galvanic battery, and leaving a rather unpleasant feeling. At the Messrs, M'Robert's Mount Pleasant Station—the shingles and sheet iron clattered on the roof of the homestead, some plaster was displaced and shattered, and several pictures were knocked down from the walls.

These places Weston, Mt Pleasant and Wild Duck are presumed to be in the Heathcote region.

1881 07 28 time?, Drouin

Geelong Advertiser Saturday 30 July 1881, Page 2.

A slight shock of an earthquake was felt at Drouin on Thursday. It extended from the Bunyip to Drouin, and at the old Bunyip Hotel it was so severe that the windows in the house vibrated considerably. Its duration was nearly two minutes.

It is very improbable that this was the same event felt on Deal Island lighthouse in 1881 but without dates for the Deal Island event it is not possible to be certain.

1882 01 23 at 06:40 UTC, Omeo

Geelong Advertiser Wednesday 25 January 1882, Page 2.

A slight shock of earthquake was felt at Bairnsdale on Monday at seventeen minutes to five p.m. A severe shock of an earthquake was felt at Omeo, Gippsland, at 20 minutes to 5 p.m. on Monday. Its duration was upwards of 12 seconds. The whole town trembled violently. The occurrence caused much consternation amongst the inhabitants. The direction of the earthquake appeared to be from east to west.

The Maitland Mercury and Hunter River General Advertiser Saturday 4 February 1882, Page 7S.

A shock of earthquake was experienced at Jamieson at 18 minutes to 5 p.m., on Monday. The Court House and Post Office—both brick buildings—shook considerably, the occupants of each place feeling even the floor shake. The iron roof and windows of the buildings in the town rattled perceptibly, several of the residents going into the street to ascertain the cause. The shock was felt at Wood's Point and Alexandra, a distance of 35 miles. The vibration of the earth, which lasted some 3 seconds, was accompanied by a rumbling noise.

1882 05 21 at 01:27 UTC, Bright

Geelong Advertiser Wednesday 24 May 1882, Page 3.

EARTHQUAKE AT BRIGHT.

A telegram to last night's Herald states : —On Sunday morning, at twenty-seven minutes past eleven, a distinct shock of earthquake was experienced at Bright. A loud and distinct noise, resembling that of distant thunder, lasting for fully three quarters of a minute, was heard, the earth itself shaking tremendously and vibrating twice. Credence has been given to the above by all who felt the shock, and the day being exceedingly fine, not a cloud being visible in the clear blue sky, seems to make it less doubtful that the shock felt was none other than the shock of an earthquake.

1882 11 17 at 12:08 UTC, Near Jamieson Victoria

Geelong Advertiser Saturday 18 November 1882, Page 4.

THE EARTHQUAKE.

It is now some three or four month since one of those incidental disturbances of the earth's crust, which are, if not periodic, at least rather often recurrent, in the various parts of the Gippsland District, North and South, occurred, but the movement was a very slight one. Last night, however, a very severe shock of earthquake was felt throughout the eastern portion of this colony, concentrating its force on the distinctly volcanic locality of Woods Point and Gaffney's Creek. The activity of the geodetic wave was felt to a very marked degree at Mansfield and Jamieson, and in the adjacent districts of Matlock, and Jericho, and the populated centres along the valley of the Thompson were also disturbed to a corresponding extent. It appears, indeed, that this is the most violent earthquake that has been experienced for a number of years in any part of Australia, and as a portent of what might prove to be the revivification of a line of extinct volcanoes, or of a single crater, the visitation may not be looked upon as a welcome one. From intelligence received from other

parts of the interior it seems that the earthquake extended over a very wide area. It is not, of course, ascertained in which precise locality the disturbance took its rise, but, judging from its force, and the direction taken, it is probable that parts of the eastern portion of the sister colony of New South Wales felt the agitation. The extremest limits of its action have not been ascertained, but that it was very wide-spreading is attested by the fact that it was noticed—though to a slight degree only, in the city of Melbourne, and some of the suburbs. The disturbance occurred at 10 o'clock, its motions being registered a little after that hour. In St. Kilda and Richmond an uplifting and undulating movement was felt distinctly, and many were for some moments at a loss to account for the phenomenon. In the city the undulation, though gentle, was also felt. Mr R. L. J. Ellery, the Government Astronomer, relates that he, in company with other scientists, was engaged in discussion at the Royal Society's Hall, and that at the time named he distinctly noticed an uprising of the floor. He did not at the time feel confident of it being the consequent of an earthquake, but after taking incidental probabilities into account he came to the conclusion that it was so. He states that slight shocks have been felt in various parts of the colony at recent dates, but this is perhaps the severest that has been recorded as having extended over so wide a superficies. The only telegram received up till noon, however, at the Observatory was the following:—Cape Schanck.—A shock of earthquake felt at 10.5 last night, lasting few seconds only, accompanied by rumbling; direction of wave cannot be stated."

Figure 9 Felt area of the 17 November 1882 earthquake felt throughout Melbourne and widely in east-central Victoria. Melbourne Observatory suggested a location between Jamieson, Mansfield and Alexandra but our preference here is SW of Jamieson nearer Healesville. More felt reports would help.



A correspondent writes:—With reference to the shock of earthquake reported in this morning's papers, I may state that shortly after retiring to bed at the Lord Clyde Hotel, Flinders-street, last evening, about nine o'clock, I felt a sensation of trembling. My first thought was that some one was under my bed. Finding no person in that interesting spot, I next sounded the partition near my bed, thinking that parties in the next room were jumping on their bed. I then thought that, as music was going on downstairs, there must be some vibration caused thereby.

-Friday's Herald.

The Argus Monday 20 November 1882, Page 10.

NOTES FROM THE OBSERVATORY.

THE EARTHQUAKE

The earthquake which occurred about eight minutes past 10 on Thursday evening appears to have had its centre somewhere between Mansfield, Jamieson, and Alexandra, and its line of action in a S.W. direction from that locality, for it was most marked at places along that line, especially at Berwick and Cape Schanck. It was plainly, though faintly, felt all over the neighbourhood of Melbourne. Near Jamieson it appears to have been quite a strong shock, and more violent than usually experienced in this part of Australia.

It was felt distinctly at Hawthorn, but a report from Maryborough is of a different earthquake.

1884 05 31 at 19:20 UTC and 1884 06 01 at 12:25 UTC, Aftershocks East of Flinders Island Tasmania

Bairnsdale Advertiser and Tambo and Omeo Chronicle Thursday 4 June 1885, Page 2.

Shocks of earthquake have been reported as having occurred at Wilson's Promontory and Gabo Island on Monday morning. The keeper on watch at the Wilson's Promontory lighthouse states that a rather severe shock was experienced at 5.20 a.m., lasting about ten seconds; and at Gabo two sharp shocks were felt, the duration of each being about thirty seconds, and the direction from south to north. A third shock was felt at Gabo at 10.25 p.m. on Monday of nearly a minute's duration, and in the same direction as before.

1884 07 13 at 03:43 UTC, Tasmanian earthquake felt south-eastern Victoria

A shock of earthquake, corresponding as to time and description with the earth tremors reported from Tasmania, occurred on the Victorian side of Bass's Straits on Sunday afternoon. The earthquake was felt at Wilson's Promontory, Port Albert, Bairnsdale, and Omeo. At Port Albert, where the shock startled the residents, the earth tremour was accompanied by tidal disturbances. Earthquake shocks were also noticed at Eden, Pambula, and Carden on the New South Wales coast. Wm. Martin, keeper of the lighthouse at Wilson's Promontory, telegraphed as follows to the Minister of Trade and Customs:-"Wilson's Promontory, Sunday, July 13, 1884 – Felt clearly-defined shock of an earthquake at 1.43 p.m. to-day, with severe rocking motion, continuing about 12 seconds. No damage is reported."

1884 09 19 at 10:05 UTC, NE Tasmania

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.

1885 05 12 at 23:27 UTC, Large earthquake in north-east Tasmania, felt south-east Victoria

The Argus Thursday 14 May 1885, Page 6 and Friday 15 May 1885, Page 6.

THE SHOCK OF EARTHQUAKE.

We have received the following additional information regarding the shock of earthquake which was experienced on Wednesday morning in the neighbourhood of Melbourne, throughout a number of the country districts of Victoria, and in Tasmania :—

The lighthousekeeper at Wilson's Promontory reports as follows :—"A most violent shock of earthquake occurred here at 27 minutes past 9 a.m., on Wednesday, 13th May, lasting 45 seconds. The lighthouse men and I were engaged in cleaning the reflectors, and we thought that the lighthouse was coming down, for it swayed to and fro. All the quarters were shaken in like manner. The shock seemed to come from the south-east."

A correspondent telegraphs from Beechworth, stating that he noticed the earthquake distinctly on Wednesday at half-past 9 a.m.

(BY TELEGRAPH FROM OUR CORRESPONDENT.)

ALBURY, THURSDAY.

A shock of earthquake was felt here at five minutes to 10 o'clock yesterday morning. It was of a rocking character, and lasted for nearly half a minute.

TO THE EDITOR OF THE ARGUS.

Sir,— This morning at 20 minutes to 10 o'clock we felt a severe shock of earthquake, which lasted 40 seconds. It seemed to travel from W. to E., the air quite calm, sky grey and cloudy. The walls of our wooden house creaked and trembled, window frames shook violently. There were two distinct upheavals. Several of us rushed outside, fearing the worst consequences. Curtains swayed, iron bedsteads rocked, and there was a general feeling of

alarm and insecurity. This is the third (and most severe) earth-tremor we have felt during a residence of eight years in this neighbourhood.—I am., &c, X,Y,Z.

Warragul, May 13.

TO THE EDITOR OF THE ARGUS.

Sir,—As I imagined that the columns of this morning's paper would be teeming with the experiences of the various inhabitants of Melbourne and suburbs on the above subject, I did not deem it necessary to add my effusion to the rest, but as I found, much to my astonishment, on taking up the Argus of this morning that only one instance had been recorded of the shock having been felt here, and that only in a suburb, I felt it almost incumbent on me to relate what I experienced on Wednesday morning. I live at the Collingwood end of Victoria parade, and as far as I can conjecture at about half-past 9—for I had not a timepiece at hand—I was seated by a window of the upper story of our house, when the chair and myself suddenly began to sway gently from side to side. This lasted for about four or five seconds A table at my right hand also moved with sufficient force to agitate a mirror standing upon it. Had the weather been boisterous at the time or had there been a disturbance of any kind produced by the traffic in the street, I might have attributed this otherwise unaccountable commotion to natural causes but without, everything was calm, indeed unusually so. That, said I to a member of my family in the room at the time is an earthquake, for I had already had a similar unpleasant experience when visiting Tasmania about a year ago, and my first impression upon feeling this was that a terrible visitation had fallen on that tight little island, and this was but the reverberation of the terrific shock there. We both glanced at the chandelier. That also was swaying gently from side to side, proof positive in our minds of the genuineness of our unpleasant visitor.—

*I am,
A RESIDENT OF VICTORIA PARADE.
May 14.*

An isoseismal map was drawn by Michael-Leiba (in McCue, 1996).

1885 07 02 at ~14:05 UTC, Bass Strait earthquake

This earthquake was the final spur for Ellery to push for the installation of a Milne seismograph at Melbourne Observatory.

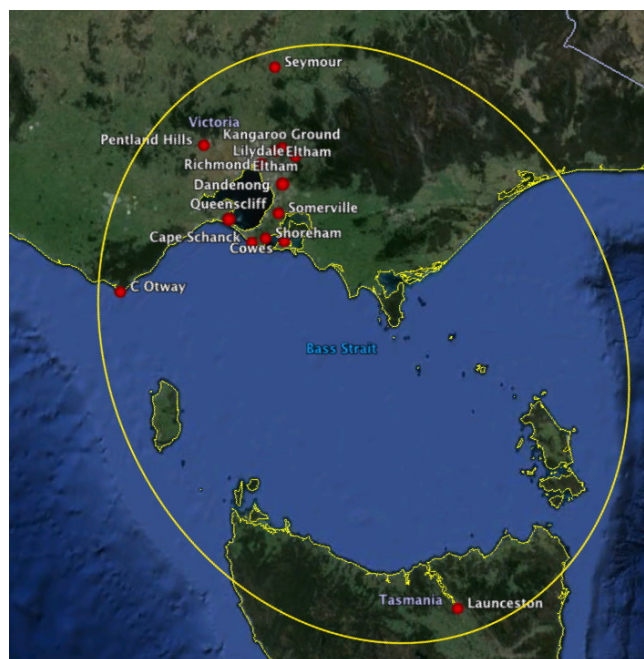
Figure 10 Felt area of the 2 July 1885 earthquake with spot intensities. The centre of the ellipse is southwest of Wilson's Promontory near (-39.5, 146.0) in Bass Strait.

The Australasian Saturday 4 July 1885, P 28.

THE EARTHQUAKE

The shock of earthquake which occurred in Melbourne yesterday morning, and to which reference was made in The Argus of yesterday, appears to have been more severely felt in the suburbs than it was in the city.

At 2 o'clock the wind fell to almost a calm, and at five minutes past that hour the tremor was felt. It seemed to travel in a northerly direction, and lasted for about eight or nine seconds. Its duration, however, was longer in some localities than in others. At Cape Schanck, for instance, the lighthouse-keepers declare that the shock lasted for about a minute and a half, while on the other hand, their compeers at Queenscliff assert that the time of its duration was about four



seconds. In Melbourne a similar variation occurred according to the statements of various persons. The telegraph operators at work at the General Post-office felt the tremor for about five seconds, while a number of people in the different suburbs, and particularly those south of the Yarra, stated that its duration was from 30 to 45 seconds. The shock was different from that which occurred a few weeks ago, which was of a gentle swaying or rocking motion, while on this occasion it partook of a severe shaking to and fro form, and was, like its recent predecessor, accompanied by a rumbling noise not unlike distant thunder. It awoke many persons from their slumbers, and those who had not previously experienced a similar shock, wondered for some moments what was the matter, and even those who had felt earth tremors before were considerably startled. Windows, crockeryware, and chandeliers rattled, while pictures hanging on walls could be heard swaying to and fro. Unfortunately there is no instrument at the Observatory to record the violence of the shock, or its length, but Mr. Ellery intends taking steps to procure one without delay. A general opinion, however prevails, that the tremor was the severest that has been felt in the colony for many years.

This earthquake was felt in Launceston and as far north as Seymour and Yackandandah. The shaking felt different in Melbourne to that of the May 1885 earthquake (recent predecessor); it was obviously much closer to Melbourne than that off NE Tasmania in May 1885, and smaller than the earlier event described above. The general opinion that the earthquake shaking was the most severe for many years is borne out by the magnitude of 5.7, computed from the felt area.

1885 10 07 at 23:36 UTC, Bright

Figure 11 Earthquake near Bright on 7 October 1885 at 23:36. It was reported felt at Albury and also at unnamed places in NSW on the Murray.

The Argus Friday 9 October 1885, Page 6.

EARTHQUAKE IN THE NORTH-EASTERN DISTRICT.

A shock of earthquake was very distinctly felt yesterday morning in many parts of the North-Eastern district of Victoria and one or two localities in New South Wales, bordering on the Murray. It is reported to have been experienced at the various places between half past 9 and 10, and in one or two localities the shock occasioned some damage. Several official reports with regard to it were forwarded to the Melbourne Observatory. A telegram from Bright stated that a sharp shock occurred there at 36 minutes past 9 travelling from south-west. The vibration, which caused several slates to fall from the roof of the state school, lasted about one minute. At Omeo the tremor was felt at a minute later than at Bright, and is stated to have lasted nearly a minute. In the Beechworth district a distinct shock was experienced at 20 minutes past 9, lasting about 20 seconds.

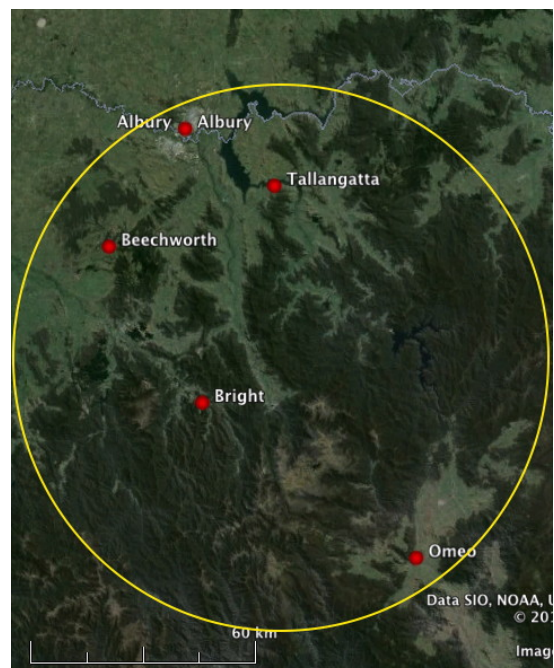
The following reports have been received from our correspondents:—

ALBURY, Thursday.

A shock of earthquake was felt here at 10 o'clock this morning.

BEECHWORTH, Thursday.

A distinct shock of earthquake, accompanied by a loud rumbling noise like distant thunder, was felt here to day, and caused some excitement. The wave passed from east to west, and the duration of it was about 20sec.



BRIGHT, Thursday.

A severe shock of earthquake was felt here at 20 minutes to 10 o'clock this morning. The vibration lasted for upwards of half a minute.

TALLANGATTA, Thursday.

A shock of earthquake was distinctly felt at 35 minutes past 9 this morning. The duration of the rumbling was 20 seconds, and the course from N.N.E. to S.S.E.

1886 06 10 at 22:30 UTC, Glenluce

Globe Thursday 17 June 1886, Page 3.

EARTHQUAKES IN VICTORIA, (FROM OUR OWN CORRESPONDENT.) MELBOURNE, This DAY. A resident of Glenluce township, near Castlemaine, Victoria, states that he felt a distinct shock of earthquake last Friday morning about half-past 8, accompanied by a loud report, and followed by a subterranean rumbling which lasted 16 or 18 seconds. Similar phenomena was noticed at Green Gully, near Mount Franklyn which is supposed to be an extinct volcano.

1886 07 03 at 15:00 UTC, SE Ballan

The Argus Tuesday 6 July 1886, Page 6.

SHOCK OF EARTHQUAKE AT BALLAN.

BALLAN, MONDAY.

An unmistakable shock of earthquake was felt at the Yaloakvale station, about eight miles south-east of Ballan, on Sunday morning, at 1 o'clock. The assistant overseer, Mr. Wilson, was awakened by the rattling of the doors and windows, and the falling of articles about the room. He lit a candle, and so ascertained the exact hour. The shock, he says, lasted fully three minutes, and was accompanied by a loud rumbling noise, which died away as the shaking ceased. Mr. Wilson has had some experience of earthquakes in Tasmania, and is quite confident as to the nature of the disturbance on Sunday morning. The other inmates of the home station were greatly alarmed.

1887 08 16 at 01:05 UTC, Wood's Point

The Mclvor Times and Rodney Advertiser Friday 19 August 1887, Page 2.

EARTHQUAKE IN VICTORIA.—A telegram from Woods' Point, under date Tuesday, in Wednesday's Telegraph, states that the shock of an earthquake was felt there shortly after 11 that (Tuesday) morning. It seemed like two waves following in quick succession, and lasting for several seconds, travelling from east to west.

1889 01 10 at 05:45 UTC, Ballarat to Ballan and felt underground at Egerton

Earthquake in Victoria. SHOCK FROM BALLAN TO BUNINYONG.

At a quarter to 4 p.m, on Thursday a smart earthquake shock was experienced at Ballan, says "The Telegraph," the wave being from north-east to south-west. At Gordon the shock was distinctly felt, but most severely at Egerton, where the crockery was removed from shelves in dwelling-houses, and some consternation caused amongst the inhabitants. The men working at the 1,100 feet level of the Egerton Company were alarmed by a loud rumbling noise as if the rope on the shaft had been broken and the cage fallen down the shaft. The shock in the mine was also accompanied by the crackling of timber. At Yenon and Buninyong also the earthquake was sensibly experienced. A distinct shock of earthquake passed over Gordon, coming from the north-west and terminating in a north-easterly direction. No damage was done. Some nervous persons, however, got a fright. The shock lasted about two seconds. The Ballarat Star reports that a shock of earthquake was experienced on Thursday afternoon in the Gordon district. The vibration of earth was felt by a large number of persons, including Mr Yates, of Ballarat, and the Rev. Mr Barker, of

Gordon. The Buninyong correspondent of The Courier writes:—" A shock of earthquake was felt at 4 this afternoon. A distinct shaking of buildings was felt by a great many people for several seconds, accompanied by a sound like thunder."

1891 06 07 at 04:04 and 04:45 UTC, Port Phillip Bay Melbourne

Gregory (1903) and Underwood (1972) both mentioned this earthquake in their studies of Victorian seismicity. They in turn referred to the original records compiled by Melbourne Observatory, now held in Commonwealth Archives, and the Reports of the Australasian Association for the Advancement of Science (vol IV, 1893, pp. 208-212). I have also delved into contemporary newspapers (microfilm copies) from the Australian National Library including; *The AGE*, *ARGUS* and *Melbourne Herald* to draw up the isoseismal map.

In fact there were 2 earthquakes felt in Melbourne and suburbs, the first and strongest at 2.05 p.m. and the second at 2.45 p.m. The first lasted 4 or 5 seconds according to *The AGE* on 8 June 1891 and the second:

was of less duration than the previous one, while its results were also less marked. The tremors were so slight so as not to be observed by people out of doors, but those in their houses were aroused by the noise of the rattling windows and crockery.

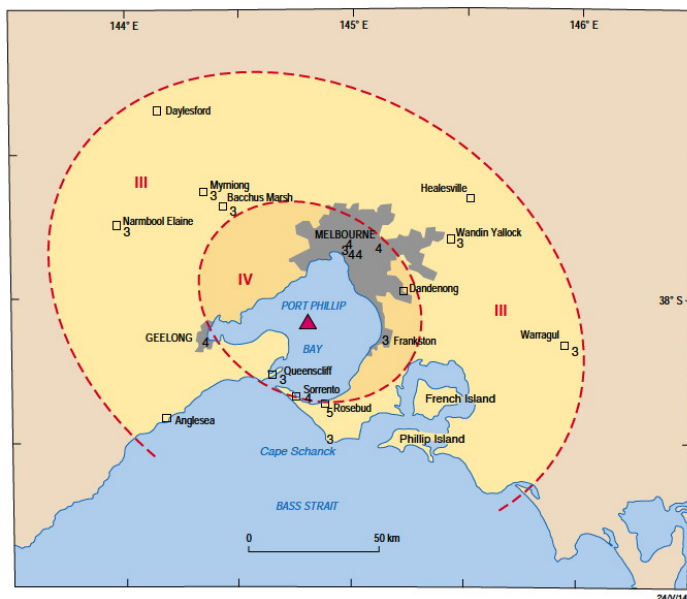
The article in the *AGE* of Monday 8 June 1891 noted that:

On many occasions Melbourne has experienced the milder symptoms of earthquakes, in the form of earth tremors, and these have frequently extended over a very wide area.

The front page of the *Melbourne Herald* of Monday 8 June 1891 reported that at Geelong:

The shock was severely felt, and at the hospital many of the inmates were preparing to leave their beds, thinking that the building was about to fall. One gentleman who was lying on his couch, informs me this morning that the glassware on the sideboard was nearly thrown to the ground, and several ornaments on the mantelpiece were disturbed. The house shook violently, and some minutes elapsed before the inmates of the house recovered from this fright caused by the shock.

Figure 12 The author's isoseismal map of the earthquake in Port Phillip Bay on 7 June 1891 (redrawn by Geoscience Australia), the magnitude about 4.8.



1891 07 03 at 11:30 UTC, Bright

The Argus Saturday 4 July 1891, Page 9.

EARTHQUAKE SHOCK IN THE NORTH-EASTERN DISTRICT.

At half past 9 o'clock last night there was a sharp shock of earthquake. The disturbance seemed to be travelling from west to east. It was felt over a large area, houses being shaken at Wandiligong and Bright.

1891 07 08 at 05:15 UTC, Walhalla

Goulburn Evening Penny Post Thursday 9 July 1891, Page 2.

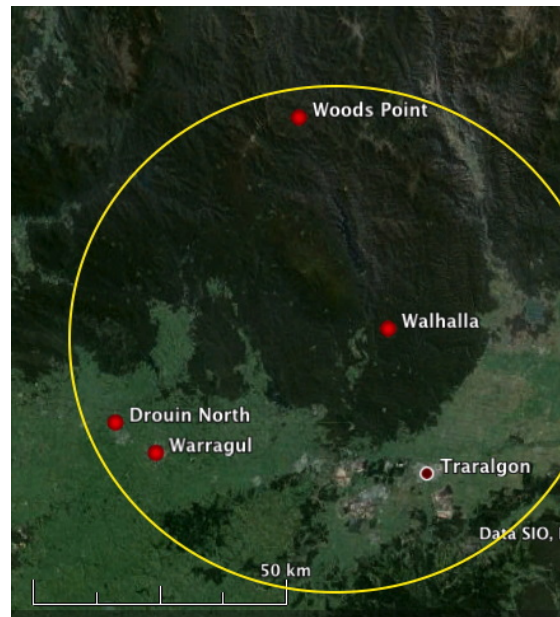
Shocks of Earthquake in Victoria. MELBOURNE, Wednesday.—A slight shock of earthquake was felt at a quarter-past 3 this afternoon, at Wood's Point, passing from west to east, and lasting about a minute. This afternoon a shock was also felt at Walhalla,

passing from N.W. to S.E. It was so severely felt that the monthly Police and Warden's Court was precipitately deserted for several minutes.

Figure 13 felt area of the 8 July 1891 Walhalla earthquake. The magnitude is about ML4.0 from the felt area.

Warragul Guardian and Buln Buln and Narracan Shire Advocate Friday 10 July 1891, Page 3.

The Walhalla correspondent of the "Argus" wires that a shock of earthquake was felt at that place on Wednesday afternoon. A similar report comes from Wood's Point, and Mr. Copeland of Drumlarney, also notifies of experiencing the shock, which was also apparent at Drouin North at Mr. Little's. This is the second shock within a short space of time which has been experienced at Mr. Copeland's. On the first occasion the pictures on the wall swayed, but this time there was a great vibration under the house.



The Argus Friday 10 July 1891, Page 6.

THE EARTHQUAKE SHOCK.

WARRAGUL, Thursday.

The earthquake shock which was felt in various parts of Victoria on Wednesday afternoon was also felt in certain localities outside Warragul. The effect lasted for nearly a minute and the earth tremors were very pronounced. The shock was also felt at Drouin North about seven miles from here. Mr. Little, farmer, noticed it whilst at work on the farm and when he returned home his daughters reported that the effect in the house was very marked. The occurrence does not appear to have been noticed in the township of Warragul itself, although on the last occasion several people heard a strange rumbling sound like distant thunder.

1892 01 26 at 16:30 UTC, Large north-eastern Tasmania earthquake felt in eastern Victoria

Bairnsdale Advertiser and Tambo and Omeo Chronicle Thursday 28 January 1892, Page 2.

EARTHQUAKE SHOCK. *A very distinct shock of earthquake was felt in Bairnsdale yesterday morning, shortly after half-past two o'clock. It was preceded by a low, rumbling noise. The first tremor felt was slight and barely perceptible. This was followed a few seconds later by a shock that made window panes rattle and aroused people from their slumbers. It appeared to be travelling in a south-easterly direction, and lasted about forty seconds.*

The isosismal map was drawn by Michael-Leiba (in McCue, 1996).

1892 04 01 at 23:00 UTC, Kinglake

The Mercury Friday 8 April 1892, Page 3.

Yea, April 4.

A shock of earthquake was experienced here at 9 o'clock on Saturday morning. Houses swayed, the water rose in waves in the river, and there was a sound as if trees had been uprooted and came down with a crash simultaneously. In all parts of the district it was felt, and nothing at all approaching to it in violence has been experienced before. The direction appeared to be north and south, and the shock must have lasted several seconds. At

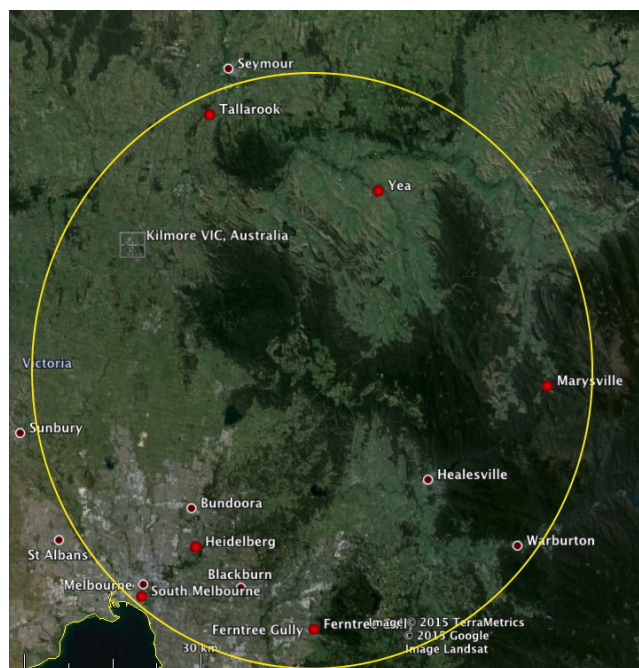
Tullarook it was felt with equal violence, but visitors from Kilmore and Seymour state that those towns were quite free from it.

Figure 14 Felt area of the earthquake of 1 April 1892 near Kinglake, shaking felt through Melbourne and suburbs. The estimated magnitude is 4.2. Solid red dots indicate places reporting the earthquake.

Newcastle Morning Herald and Miners' Advocate Tuesday 5 April 1892, Page 6.

SHOCK OF EARTHQUAKE. A severe earth tremor was felt at Marysville at 9 o'clock on Saturday morning. It lasted about a minute, and appeared to be travelling from west to east. The buildings were shaken.

The earthquake reported from the north-eastern part of the colony was felt on Saturday morning in Melbourne and suburbs. The tremor was not very severe, but was sufficiently pronounced to leave no doubt as to its nature. A gentleman residing in South Melbourne states that he felt a shock about 8.55 a.m. on Saturday and it was succeeded by several lesser shocks, at intervals of five or ten seconds, for nearly two minutes. A resident of Heidelberg states that he felt the quaking at 9 o'clock on Saturday morning, and the movement was so severe that he was rocked violently in his bed, and a number of pictures and other articles were thrown down.



Interesting comment about waves on the Yea river.

1892 07 18 at 07:55 UTC, Beechworth

The Argus Tuesday 19 July 1892, Page 6.

EARTHQUAKE SHOCK AT BEECHWORTH.

BEECHWORTH, MONDAY.

A shock of earthquake was distinctly felt here to-night at about five minutes to 6, apparently travelling from north to south, was also felt at Stanley, six miles distant. There was a noise like thunder, and a distinct earth tremor.

1893 July 22 at 15:00 UTC, Bendigo in-mine event

Bendigo Advertiser Friday 17 April 1914, Page 4.

Three shocks of earthquake were experienced in Bendigo and the surrounding districts at about 1 o'clock on the morning of the 23rd July, 1893. They were severe enough to wake people from their sleep and cause considerable consternation, and in some instances articles were thrown down from the shelves. The shocks were experienced as far north as Bridgewater, south as Taradale, east as Seymour, and west as Dunolly.

Bendigo was the supposed epicentre of an earthquake-like shock on Sunday morning according to the *Victorian Barrier Miner*. The story was headed *The Victorian Earthquake*, but subtitled *The effect on the mines. A fall of earth*. The newspaper reports that the area over which it was felt was nearly 2000 square miles (a circle of radius roughly 40 km corresponding to a magnitude of 3.9). The newspaper then highlights the damage underground in the Bendigo mines, particularly in the Confidence Mine.

We infer this was a mine-induced seismic event rather than a tectonic earthquake i.e. it wouldn't have happened without the change in differential stress caused by the mine opening.

1893 12 23 at 14:00 UTC, Mt Martha and Flinders

The Argus Tuesday 26 December 1893 Page 6.

EARTHQUAKE ON THE COAST.

FLINDERS, MONDAY.

A very distinct shock of earthquake was felt here just before midnight on Saturday. Windows rattled and houses shook. The vibration was also noticed at Cape Schanck and Dromana.

MOUNT MARTHA, MONDAY.

Just after midnight on Saturday three distinct shocks of earthquake were felt here, one of them being sufficiently strong to shake the houses. The wave appeared to be travelling in a direction from south to north.

The Sydney Morning Herald Wednesday 27 December 1893, Page 3 lists the times of aftershocks.

A sharp shock of earthquake at midnight on Saturday was felt at Mount Martha and Flinders, and at 12.6 there was a second severe shock, accompanied by a sharp cracking noise, shaking buildings perceptibly. Slight tremors followed at 12.9 and 12.45.

We assume these events are part of a small swarm on Mornington Peninsula, rather than larger Bass Strait events.

1894 11 13 at 14:00 UTC, Port Phillip Bay

The Australasian Saturday 17 November 1894.

The following memorandum has been supplied by the Government astronomer (Mr. R. L. J. Ellery):—"The earthquake shock experienced at Flinders, Cape Schanck, Little River, and other places about midnight on the 13th was coincident with the commencement of a magnetic storm, which continued through out the 14th....."

A pity the 'other places' weren't named. The centroid of felt reports is in Port Phillip Bay NE of Queenstown but there are no reports from Queenscliffe or Geelong that it was felt, none found yet. The location is similar to that of the previous earthquake and the magnitude at least 3.5.

1894 12 10 at 08:00 UTC, Omeo

Advocate Saturday 15 December 1894, Page 6.

A severe shock of earthquake was felt at Omeo at 6 o'clock on Monday evening, lasting fully 15sec., and causing considerable consternation to the inhabitants.

1896 02 09 at 16:02 UTC, Cranbourne

The Mercury 15 February 1896, Page 2S.

CRANBOURNE, February 10.

About half-past 2 this morning a heavy report was heard which shook the buildings, and was followed by rumblings and an earth vibration, continuing some 20 seconds. The shock was most pronounced, the first sensation being like the report of a big gun, followed by an earth tremor, dying away in a north-westerly direction.

1896 04 22, at ?, Yinnar

The Argus Friday 24 April 1896, Page 6.

MORWELL, Thursday. — Yesterday an earthquake shock was felt near Yinnar, which lasted for several seconds.

1896 05 08 at 22:30 UTC, Warragul

Gippsland Times Thursday 14 May 1896, page 3.

An earth tremor was felt on Saturday morning about half past eight o'clock in Warragul, Drouin, Longwarry, Neerim, and other places in a fairly wide district of which Warragul is the centre. At Drouin the clerk at the railway station said the shock felt as if a heavy waggon had run against the building. At Crossover Mr W. Little stated his house shook as if about to topple over.

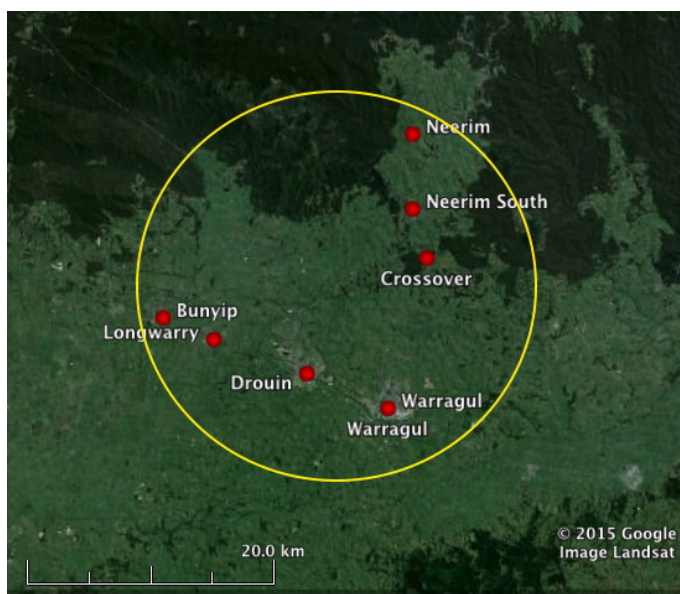


Figure 15 Minimal felt area, places where shaking was reported felt, of the 8 May 1896 earthquake near Warragul.

1896 08 13 at 11:00 UTC, North Gippsland

Barrier Miner Saturday 15 August 1896, Page 4.

MELBOURNE, Saturday.

At 9 o'clock on Thursday night an earthquake passed through North Gippsland. The houses were shaken by the tremor, which travelled northward.

1897 03 29 at 11:45 UTC, Kerang

Bendigo Advertiser Wednesday 31 March 1897, Page 3.

OUR COUNTRY SERVICE.

AN EARTHQUAKE SHOCK.

Kerang, Tuesday.

At about 9.45 last night Kerang was visited by a distinct but not very severe shock of earthquake, which caused some consternation among the inhabitants, many of whom were in their beds at the time. The seismic disturbance seems to have travelled from west to east, and was distinctly felt in many of the outlying districts. The earth undulation was accompanied by a rumbling noise resembling the sound of distant thunder, which lasted about two seconds. No serious damage was done by the earthquake, but furniture was shaken perceptibly, and crockery and glassware in all the houses in the town set rattling. The shock seems to have been most severe on Mount Kerang, where several people were so much alarmed as to leave their beds and hurriedly quit the houses. In some of the stores this morning it was found that goods had been shaken from the shelves, and a few bottles of sauce and other goods smashed in consequence. Many different statements are made as to the direction of the seismic wave, but the fact that it was felt by residents round Lake Wandella before it reached Kerang points to the fact that it must have travelled from west to east as stated above. Kerang was in 1871 visited by an earthquake, which is said by people then resident here to have been considerably more severe than that of yesterday. [Ed. One of the Tumut NSW sequence]

PYRAMID HILL, Tuesday.

A distinct shock of earthquake was felt here last night. The direction seemed to be east to west, and the shock was accompanied by a rumbling noise. The weather during the last three days has been very peculiar, being exceptionally sultry and inclined to rain.

It was also felt at Koondrook according to *The Horsham Times* of Friday 2 April 1897, Page 4.

1897 05 10 at 05:25 UTC, damage Western Victoria from Kingston-Beachport SA earthquake

The epicentre was in South Australia but damage was experienced in western Victoria, according to the *Geelong Advertiser* of Wednesday 12 May 1897, Page 4. At Stawell, vats of cyanide spilled and walls were cracked. Miners underground felt severe shaking and fearing an accident, rushed to the surface.

THE EARTHQUAKE.

The most severe shock of earthquake since the colonisation of Victoria took place on Monday afternoon, when the whole of the Western district was thrown into a state of consternation, which for a few instants bordered on panic. Though at a few of the townships the local meteorological authority had commented on the extraordinary appearance of the clouds, there was nothing to indicate the tremor which was to sweep across that portion of the colony during the afternoon. The first sign was a low rumbling noise, which is variously described as resembling a clap of thunder, the roar of a waterfall, and the patter of a hailstorm on a galvanised iron roof; and just as the rural population was awakening to ascertain why its placid existence had been so rudely interrupted the whole face of the landscape began to oscillate in an extraordinary manner. Public buildings were seen rolling like ships at sea, ceilings cracked, tanks were upset, and in a few instances windows were broken and chimneys crashed to the ground. Though no person is reported to have suffered injury by the earthquake, and the most serious damages are the cracking of walls and the falling of chimneys, a considerable loss must have taken place in stores and hotels, as in nearly every township the shock was sufficient to throw all bottles from the shelves to the ground. Barrels were also knocked over, and clocks and ornaments broken in hundreds. In the workings of the mines the shock was felt most severely. Fearing that some fearful accident had happened, the miners rushed to the shafts panic-stricken, and were completely at a loss to account for the supposed explosion when they reached the surface. In the State schools the children were thrown into a great state of trepidation, and in nearly all the towns business was suspended for the rest of the day. The most westerly point from which the news of the earthquake has been received is Adelaide, where two distinct shocks were felt.

Only one shock was noticed throughout all Victoria, with the exception of the town of Horsham, where the tremor was repeated three times. As far as can be ascertained at present, the earthquake was more severe here than in any other Victorian town. Each shock grew longer, and was more intense than that preceding, and was heralded by a loud rumbling noise. The wave appeared to come from north to south, and the earth remained in motion each time about half a minute. All the stone and brick buildings in the town rocked to and fro, inches out of plumb, and the streets were filled with people, who fled from their houses in terror.

The town hall, owing to a subsidence in the foundations, has been in a very insecure condition for a long time past, and immediately the shock came it rocked to such an extent that the borough officials expected it every moment to fall about their heads. After the earthquake passed the cracks in the town hall were seen to have visibly widened. At Stawell the shock seemed to be one continuous tremor of a minute and a half's duration, passing from north to south. Windows were broken, the ceiling of the Bank of Australasia fell in pieces, and bricks toppled from the chimney of the Union Bank. Several persons leaning against walls were thrown forward, and a large number were taken with fits of vomiting. The vats in the cyanide works overflowed, crockery was broken, and the cornice of the shire hall fell. At Nhill the shock was so intense that the patients in the local hospital were panic-stricken, and, despite all efforts to detain them, several left the building and refused to return.

1898 01 29 at 11:20 UTC, Yea

The Horsham Times Friday 4 February 1898, Page 2.

An earth tremor, preceded by a rumbling sound, was distinctly felt at Yea on Saturday night at 20 minutes past 9. It took the form of two successive shocks of rapid and short duration. The shock was felt in various outlying parts of the district, but no damage is reported.

1898 04 09 at 00:30 UTC, Charlton

The Argus Tuesday 12 April 1898, Page 6.

CHARLTON— A slight earthquake shock was experienced in Charlton on Saturday at about half past 10 a.m. The tremors were more pronounced at Clifton Hill, (West Charlton), and appeared to be travelling south-east. Unlike the shock felt last year, this visitation was accompanied by a dull rumbling report, such as that heard in blasting operations. The duration of the shock was brief, lasting only a few seconds and no damage was done.

1898 04 10 at 21:30 UTC, Minimay

The Horsham Times Friday 15 April 1898, Page 3.

THE EARTHQUAKE SHOCK.

HORSHAM, Thursday.

EARTHQUAKE SHOCK AT GOROKE. (FROM OUR CORRESPONDENT.) A slight shock of earthquake was experienced here early on the morning of Easter Monday; but as most of the inhabitants were wrapped in dreamless slumber, the unpleasant sensation was noted only by a few. At Minimay the shock was severe enough to cause the crockery to rattle. It was also felt at Edenhope, and appeared to be travelling in and from the same direction as the memorable "quake " of last year. An earth tremor occurred at Nhill at half past seven on Monday morning, lasting two or three seconds. A slight rumbling was heard and windows of houses rattled. No damage was done. A slight shock of earthquake was felt at Charlton on Saturday morning.

This earthquake was widely felt warranting a magnitude of 4.0, note the Charlton report is for a different event, Saturday not Monday, and 200 km away.

1898 11 21 at 01:40 UTC, Mansfield

The Argus Tuesday 22 November 1898, Page 6.

EARTHQUAKE SHOCK. MANSFIELD, Monday.

An earth tremour was experienced here at 11.40 this morning, when crockery and other articles on shelves were observed to shake. The shock was travelling from west to east.

1899 04 11 time?, Wartook

The Argus Friday 14 April 1899, Page 3.

A SHOCK OF EARTHQUAKE.

HORSHAM, Thursday.

EARTHQUAKE AT WARTOOK. (FROM OUR CORRESPONDENT.) A shock of earthquake was felt throughout the district on Tuesday, accompanied by a rumbling sound, which could be distinctly heard for about six seconds. Several houses received a shaking. The tremor seemed to be travelling in a north-easterly direction. The shock was not felt in Horsham, but was in Stawell.

1899 06 03 at 21:30 UTC, Gordon

Geelong Advertiser Thursday 8 June 1899, Page 2.

Two distinct shocks of earthquake are stated by the " Courier " to have been experienced at Gordons on Tuesday. The first disturbance was felt at about half-past seven a.m., and the other at about 25 minutes to four p.m. Considerable alarm was occasioned by the first shock, as it was preceded by a loud noise like the roar of a heavily-laden train travelling at

high speed. Houses were much shaken, crockery rattled, and pictures swung out from the walls. The people who were in bed at the time appear to have felt the tremors worse than those who were up. At Green Hill, about a mile away to the north, a lady who was taking a cup of tea in bed states that the cup was thrown from her hand, and that her children, who were dressing, were bumped against the wall, so violent was the tremor. The afternoon disturbance which was less severe, was heralded by a sharp sound like the discharge of light artillery. Both seismic waves appeared to travel from west to east. The residents of Lal Lal, and also the Gong Gong, were surprised between seven and eight a.m. on Tuesday by a heavy rolling rumbling sound like the report of a distant cannon, or blast in a mine accompanied by a slight vibration of the earth and the houses. When several came to compare notes they could come to no other conclusion than that there had been a slight shock of earthquake.

With an epicentre near Green Hill north of Gordon, the magnitude is about M3.0. There are no reports it was felt at nearby Ballarat, or anywhere else but not all the newspapers have yet been digitized.

1899 11 23 at 07:16 UTC, Portarlington

The Argus Friday 24 November 1899, Page 6.

AN EARTHQUAKE SHOCK. SEVERELY FELT AT PORTARLINGTON

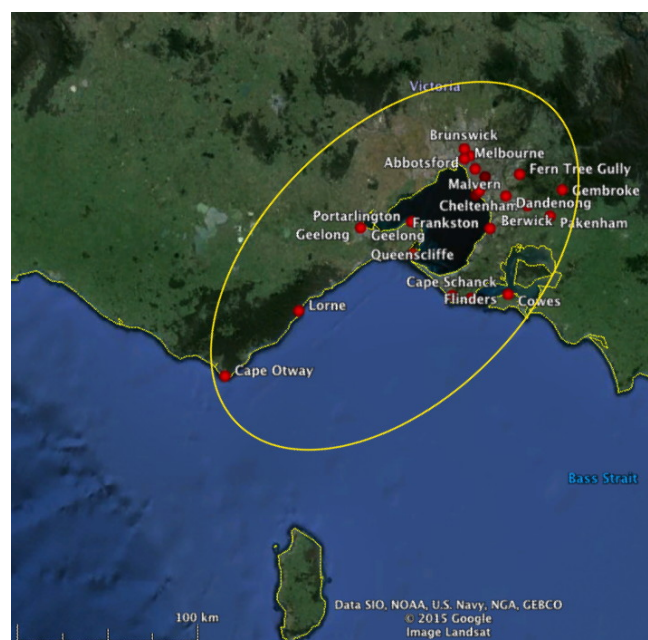
INHABITANTS MUCH ALARMED.

A distinct shock of earthquake occurred about 20 minutes past 5 o'clock yesterday afternoon, and lasted for several seconds. The tremor appears to have come from the south-east, and to have diminished in intensity as it proceeded, for the reports from the eastern shores of the bay show that the earth convulsion was of sufficiently serious character to cause the residents grave alarm. The township of Portarlington appears to have been the centre of the disturbance. The shock was of only two seconds duration there, but while it lasted it threatened to wreck some of the larger buildings and drove the more nervous of their occupants helter-skelter into the street. The Grand Hotel - the most imposing edifice in the township was shaken from top to bottom. The bottles in the bar were thrown from their shelves, crockery was overturned and smashed and the walls oscillated perceptibly during the most severe part of the shock. The occupants of the rooms on the second and third stories were greatly alarmed for at one time it appeared as if the building were about to collapse. Other houses in the locality were treated similarly but owing to their lesser height, the effects of the tremor were less noticeable.

Figure 16a Felt area of the Portarlington Victoria earthquake of November 1899. The reports of strong shaking at Portarlington, Belmont, Rosebud and Geelong are consistent with an epicentre southwest of Portarlington. The equivalent magnitude is about 4.7.

Figure 16b The GA Iseismal map of the same earthquake compiled by the same author but with more data results in a bigger earthquake; magnitude 5.0.

Apparently the shock travelled from Portarlington southwards through Lorne and Flinders, and north-easterly through Geelong to Melbourne. In the city more than one occupant of Collins street offices noticed the shock, and in the Malvern district it was remarkably distant. The tremor then travelled through Cheltenham,

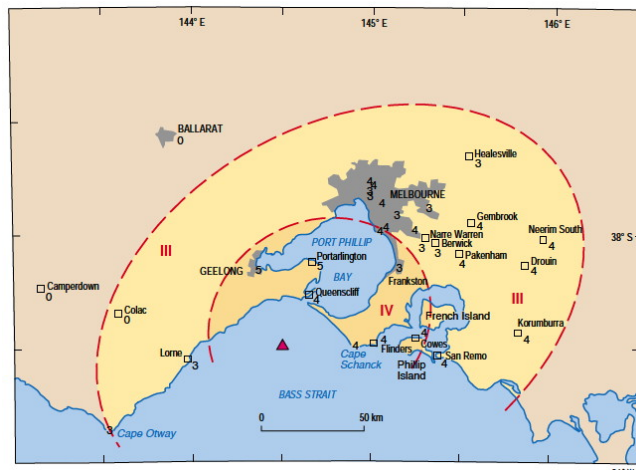


Oakleigh and Fern Tree Gully, and was last heard of at Berwick and Frankston. The seismograph at the Melbourne Observatory recorded a slight shock.

Geelong Advertiser Friday 24 November 1899, Page 3.

**AN EARTHQUAKE SHOCK.
EXPERIENCED IN GEELONG.**

An earthquake shock was sensibly felt in various parts of the Geelong district shortly after five o'clock yesterday afternoon, and telegrams from Portarlington and Queenscliff show that it was experienced at those places also. The course of the seismic disturbance appears to have been from west to east, and its duration, according to those by whom it was experienced, was about two seconds. In several instances the utmost consternation was caused by the disturbance, though, generally speaking, the phenomenon was severe enough to be noticeable. At Belmont the effects of the earth tremor appear to have been more perceptible than in Geelong. The Belmont Hotel vibrated to such an extent that Mrs M'Donald, the wife of the licensee, rushed downstairs in the expectation that the building would tumble. Mr M'Donald himself was sitting in a back parlor with a couple of friends at the time, and he ran outside to ascertain the cause of the alarm. The windows rattled, beds were bumped against the wall, several of the doors were violently slammed, and the bottles in the bar rattled together. The disturbance was also experienced at the Excelsior Woollen Mills, where some bales of blankets were toppled over. It was also felt to a very appreciable extent at Christ Church parsonage, the vibration of the walls and the rattle of crockery being the most distinguishing feature of the incident. The Rev. J. Nicholson, of the South Geelong Wesleyan parsonage, felt the tremor, and observed the lintel of one of the doors vibrate. In several of the business places of the town alarm was caused by the agitation of goods upon shelves, and the proprietor of a boot shop hurriedly retreated from his establishment in momentary panic. A number of people living chiefly below M'Killop-street have informed us that they were made aware of the disturbance by the displacement of articles of furniture, and the sensation is generally described as resembling the effect of a heavy train passing along close to a house. The exact time of the disturbance, according to general observation, was 5.15, and this tallies with that given by our Portarlington correspondent, who writes thus— "There was a distinct shock of earthquake at Portarlington at 5.10 this afternoon. The duration was about two seconds, and the buildings were greatly shaken."



The Horsham Times Friday 1 December 1899, Page 2 lists many other towns where the shaking was felt.

The earthquake last Thursday afternoon appears to have been felt most severely at Portarlington, whence it moved southerly and north-easterly. Cape Otway reported a heavy shock, while at Cape Schanck it distinctly shook the lighthouse keeper's quarters. The seismograph at the Melbourne Observatory showed the time of the shock to be at 5.16 p.m., but it was barely recorded there on the instrument, although the rattling of doors and trembling of tables was very perceptible. The following places reported having felt the tremor:—Abbotsford, Brunswick, Beaumaris, Cheltenham, Cowes, Dandenong, Fern Tree Gully, Gembroke, Lorne, Pakenham and Portarlington and Queenscliff. At Portarlington the Grand Hotel was shaken from top to bottom. The bottles in the bar were thrown from their shelves, crockery was overturned and smashed, and the walls oscillated perceptibly during the most severe part of the shock. The occupants of the rooms on the second and third stories were greatly alarmed, for at one time it appeared as if the building were about to collapse.

1899 11 30 night, Swan Hill, Hay and Balranald

The Argus Tuesday 5 December 1899, Page 7.

SWAN HILL —A slight shock of earthquake was experienced here on Saturday.

This event occurred in NSW.

1899 11 31 at 12:30 UTC, Goornong

Bendigo Advertiser Saturday 2 December 1899, Page 4.

EARTHQUAKE SHOCK AT GOORNONG.

Goornong, 1st December.

A very distinct earth tremor was felt here at 10.30 o'clock last night, and consisted of about seven vibrations, lasting for fully 10 seconds. The wave of motion appeared to be moving in a north-easterly direction. The door and windows of brick buildings, and the verandahs oscillated in a most decided manner. A slight shower of rain fell immediately afterwards, but there was no wind blowing.

Coincidentally, *The Riverine Grazier* of Friday 1 December 1899, Page 2 reports a 'slight but distinct' earthquake at Hay NSW (235 km away), at the same time.

1900 03 11 at 17:45 UTC, Warrnambool

The Argus Wednesday 14 March 1900, Page 8.

WARRNAMBOOL.

On Monday morning between half-past 3 and 4 o'clock, a slight earthquake was felt in Warrnambool.

1900 05 26 at 14:30 UTC, Neerim North

The Argus Monday 28 May 1900, Page 5.

WARRAGUL, Sunday.

One of the strongest earthquake shocks ever experienced in this district was felt at half past 12 p.m. today. The tremor appeared to travel from east to west and lasted for 35 seconds. A peculiar feature of the experience was the fact that the motion appeared to be perpendicular, producing sensation of being bumped up and down. This was especially noticed by persons lying or sitting down. Another peculiarity of the shock was that while it was severe in certain localities the intervening ground, was but little affected.

Figure 17 Felt area of the earthquake on 26 May 1900. It was clearly felt in the city and eastern suburbs of Melbourne.

FELT IN MELBOURNE

The shock referred to in the above message from Warragul was experienced in Melbourne and suburbs. It was plainly felt in the residence of a gentleman in South Yarra, and the time was noted as 33 minutes past 12; while an inmate of an office in Collins-street and residents of East Melbourne also felt it distinctly. Mr. Baracchi, the Government astronomer, heard of a second shock which was



experienced in South Yarra and St. Kilda, at about half past 5 in the afternoon. At the Observatory, however, there was no knowledge of either shock.

The Argus Tuesday 29 May 1900, Page 7.

THE EARTHQUAKE SHOCK. STATEMENT BY MR. BARACCHI.

Mr. Baracchi states that a slight shock of earthquake has been reported to him from many quarters as having occurred at about half past 12 on Sunday morning and another shock at about 5 in the afternoon. He has not been able to consult the recording instrument at the Observatory yet, but the instrument will be available for inspection today when he presumes that the magnetic needles will be found to have registered the disturbance. He observes that the centre of the disturbance seems to have been near Warragul, and that it was probably due to an "earth fault" of local situation, rather than to an earthquake in the ordinary acceptance of the term.

The shock was also felt at Ferntree Gully, Grantville, Jeetho, Korumburra, Leongatha, Mansfield, Neerim South, Pakenham, Poowong and San Remo.

DROUIN, Monday

The earthquake shock reported in "The Argus" this morning was distinctly felt in Drouin and the district. Buildings shook and rattled audibly, and people sitting at dinner were rocked in their chairs. Windows and crockery rattled, and many people were greatly alarmed. At Poowong North, as the worshippers were leaving the church after the morning service, they felt the building shake, and the lamps swayed to and fro.

The Coburg Leader Saturday 2 June 1900, Page 1 reports it was felt by several residents in Brunswick.

1900 09 16 at 15:00 UTC, Warrnambool

The Argus Friday 21 September 1900, Page 3.

WARRNAMBOOL.

A slight earth tremor was felt in Warrnambool on Monday morning at about 1 o'clock. This is the second disturbance within the space of a few months.

The previous one occurred on 11 March (see above).

1902 10 22 at 21:00 UTC, Walhalla

The Argus Friday 24 October 1902, Page 6 and 25 October Page 16.

AN EARTHQUAKE SHOCK.

WALHALLA, Thursday.

A severe earthquake shock was felt here at 7 o'clock this morning. The disturbance, which was travelling in a northerly direction, greatly alarmed householders, and caused much anxiety to the men working in the mines.

THE EARTHQUAKE SHOCK.

MOE, Friday.

A shock of earthquake was experienced at Moondarra, on the road to Walhalla, 10 miles from Moe, yesterday morning, at about half past 7 o'clock, and lasted about three minutes. In the settlers' houses the crockery shelves swayed, and at one homestead a bucket of milk standing on the stump of a tree, cut for such a purpose, was capsized.

With no other reports we assign this a magnitude of 4 based on the alarm and that it was felt underground.

1902 12 22 at 12:50 UTC, Mornington

The Argus Friday 26 December 1902, Page 3.

EARTH TREMOR AT MORNINGTON.

MORNINGTON. Tuesday. —An earth quake occurred here last night at 10 minutes to 11. A loud rubling noise accompanied it, and lasted about 7sec.

Figure 18 Felt area of the Mornington earthquake, 22 December 1902.

Underwood (1972) mentions that it felt also at Flinders, Queenscliffe, Cape Schank, Hawthorn; and Sunbury and Ballarat! – must be two separate earthquakes the other near Sunbury and Ballarat or it would surely have shaken Melbourne quite strongly.

1903 04 06 at 23:52 UTC, Warrnambool and aftershock

Border Watch Sunday 11 April 1903, Page 4.

SEVERE EARTHQUAKE. WARRNAMBOOL VISITED.

A telegram from Warrnambool states that the most severe earthquake ever felt there was experienced on Tuesday morning. It occurred at 9.52, and created intense consternation among the residents. The disturbance seems to have travelled from the south-west to the north-east, and lasted about 10 seconds. It was accompanied by loud rumbling sounds, and was so pronounced in its effects that people rushed from shops and houses into the streets in alarm. A woman in Timor - street fainted, and even horses and dogs were possessed of a sense of abject fear. Houses were seen to perceptibly sway to and fro, and water tanks oscillated on their stands in an extraordinary fashion. At the state school a hollow brass rod extending across the room from wall to wall was bent in the form of an arc. While the shock lasted everything appeared to be in motion, and many people experienced a giddy sensation followed by acute headaches. At St. John's Presbyterian church the massive cement cross which surmounted one of the turrets on the top was shaken from its base, and hurled through the roof. The ceilings of the post-office are cracked in various directions, while at the shire hall much plaster is down, and the building is otherwise damaged.

The chief damage, however, was to the town hall, and, judging by the results, the building would appear to have been in a direct line with the course of the disturbance. The mischief was worked in the upper apartments, used as cloak-rooms. The floors were bestrewn with plaster, and at the point where the walls connect with the ceiling it looks as though the roof had been lifted up and had then come down again. A plaster of paris ventilator was wrenched away from the wall and came down with a crash, and one of the globes on the chandelier was smashed. The gas pipe was broken asunder, and when the caretaker entered the building he found the stench over-powering, and immediately opened the windows and turned the gas off at the meter. One of the walls of the room affected is also cracked right through. At the police station ink was spilled from the bottles, and the building literally rocked to and fro. Several chimneys of private houses were thrown down, but fortunately the inmates escaped with nothing worse than a severe fright. Considerable destruction was wrought among crockery in stores and in private houses, and things fell to the ground in an alarming way.

The greatest panic occurred in the state school, where hundreds of children were seated in the various classrooms, when they were terrified by the shock and the noises, which were intensified by the rattling of slates on the roof. The senior scholars rose in a body, and some boys and girls jumped through the windows, while others made a rush for the doors. The smaller children were panic-stricken. The teachers strove to allay their alarm, and by their presence of mind prevented serious accidents. A terrible catastrophe was threatened



in the upstairs part of the school, where there were about 70 scholars who made a wild rush for the door. A lady teacher, who saw the danger of so many scrambling on the staircase at one time, succeeded in shutting the door, and thus keeping the little ones together, but when the strain was over she broke down. All the children got safely out of the building, but on re-assembling shortly afterwards many were crying piteously, and as several teachers were also unnerved by their experiences the head teacher decided to dismiss the school for the day.

The shock appears to have been most severe in the low-lying part of the town, in an easterly direction, and also along the banks of the Hopkins River. The Brian Boruimhe (Ed. Boru) Hotel, on Raglan parade, was badly shaken, and its repairs will cost a considerable amount. The chimneys and walls of several houses in that locality were broken. The Anglers' Hotel, and the Hopkins Hotel, on the banks of the river, suffered severely, the former having three chimneys destroyed, while in the bar of the Hopkins Hotel numerous bottles of liquor fell from the shelves. At the Warrnambool Cemetery, in the same neighbourhood, several tombstones were moved out of their positions, and it is estimated that an outlay of at least £600 will be necessary to effect repairs. The ornaments from several monuments are to be seen on the ground, while many stones are partially overturned, and almost toppling over.

The steamer Flinders was alongside the breakwater pier at the time, and the officers state that they felt two distinct vibrations, and also observed the breakwater wall tumbling.

The shock was severely felt at Port Fairy.... Reports to hand from Framlingham, Grassmere, and other out lying places report that the earthquake was very alarming, and that in some instances kerosene lamps were thrown down and household crockery broken. Nothing approaching to such a severe shock has ever been known before, and the whole population is excitedly discussing the disconcerting experience.

There can be no doubting the high intensity in Warrnambool, at least MMVII but the shaking was reported felt over a very limited area, not even at Melbourne just 225km away. It was a very close, shallow, small earthquake, high frequency, short duration, strong acceleration. Liquefaction was clearly described. Certainly this earthquake was smaller than the follow-up earthquake in July, just as Barrachi said.

Interestingly, an hour later, an earthquake was felt in the mid-north of South Australia. No connection surely.

1903 04 08 at 09:30 UTC, Warrnambool aftershock

Geelong Advertiser, Saturday 11 April 1903, Page 8.

ANOTHER SHOCK AT WARRNAMBOOL.

WARRNAMBOOL, Wednesday.

Another shock of earthquake was experienced to-night at half-past 7 o'clock, but it was only a slight tremor. It was felt in various parts of the town, windows rattling and buildings vibrating.

This small aftershock has gone unnoticed previously, the unusual pattern repeated in December 1989 in Newcastle.

1903 07 14 at 10:29 UTC, 2nd damaging earthquake Warrnambool, no deaths by good luck

It would be difficult to find a better description of liquefaction than that in the following story.

Adelaide Observer Saturday 18 July 1903, Page 29.

EARTHQUAKE AT WARRNAMBOOL.

MELBOURNE. July 15.

The earthquake last night in the Warrnambool district was attended by more serious results than was at first thought. Reports now to hand show that the damage to property runs into several thousands of pounds, and that many women have been seriously injured in health by shock to the system. The stone buildings in the low lying parts of the town, and in the vicinity of the Hopkins River, sustained most damage, but for miles around chimneys were either thrown down or seriously cracked, and work has been provided for glaziers by the wholesale cracking of window glass. Had the shock occurred later, when the people had retired to bed, loss of life would probably have taken place, for in several cases heavy masses of plaster and brickwork fell on bedsteads.

A remarkable phenomena was observed at the mouth of the Hopkins River. Within 200 yards of the sea shore there were at least 12 peculiar looking holes, circular in form, each having a mound of about a foot to 18 in. high surrounding it, composed for the most part of slate coloured material, resembling mud such as would come from the bottom of the river. As the surface of that locality is composed solely of sand, this discoloured substance has a striking effect, especially as it is scattered for yards around the hole, appearing as though it had been forced out of the ground in the form of spray, and had come down in showers on the surface. The holes are a considerable depth, poles 7 ft. long having been put down without touching bottom.

Hundreds of cracks were made in the sand, and at one point there is a subsidence in the ground, varying from 1 ft. to 2 ft. deep, about four chains long by one chain wide. The result of this subsidence on the rising ground was the formation of a series of terraces, one rising above the other, along the side of the sand hummock. A quarter of a mile distant from the mouth of the river is the Anglers' Hotel, and the metalled road leading to Warrnambool, with a bridge over the stream. The road and the country through which it runs is cracked in many places, and though the cracks are not wide, they appear to be a considerable depth.

The Anglers' Hotel was badly shaken. A chimney crashed through the roof into a room where a young woman was seated. Every bottle in the hotel bar was thrown down, and a barrel of beer was jerked off a stand, and rolled along the floor. A house in the vicinity, occupied by Mr. W. Haberfield, was partially wrecked. The chimneys, which had just been repaired from the effects of previous earthquakes, were again shattered, and large apertures were made in the walls. Other houses fared similarly.

There were two landslips, one on each bank of the river. A huge block of stone and earth fell near Hyde's boathouse, and caused slight damage.

The cemetery sustained greater damage than on the occasion of the previous shock, and now presents an irregular appearance. Almost every tombstone is out of position, and many have been wholly or partially destroyed. Monuments weighing from four to seven tons were moved in various directions. The damage in the cemetery is estimated at £800. The sexton's residence had the walls cracked and plaster displaced.

At Russell's Creek, one mile distant from the town, a resident, Mr. Samuel McDonald, an auctioneer, had his walls cracked, the pictures thrown down, and the tremor was so violent that it shook the milk out of a jug standing on a sideboard. The residence of Mr. H. R. Warrington, solicitor, was partially wrecked. A portion of one wall was knocked out, and the other walls so cracked that they may fall at any moment. Some of the inmates had a narrow escape from being struck by falling debris. The town hall escaped with comparatively little damage, though fears are entertained that the wall fronting Liebig street will have to be rebuilt. The cornices and much of the plaster in the upstairs rooms were broken, but the main hall was not interfered with to any extent.

Two churches were damaged to an extent which will necessitate extensive repairs. At St. John's, the Presbyterian Church, no fewer than seven crosses, each weighing from 1 cwt. to 2 cwt., were displaced, while the walls appear to have been shaken. It is estimated that quite £250 will be required to effect repairs. The spire of St. Joseph's Roman Catholic

Church, which towers to a considerable height, was twisted near the top, and is said to be fully 2 in. out of position.

One strange feature of the shock was the large number of tanks which burst. Reports from townships surrounding Warrnambool, including Allanford, Panmure, Garhoy, Woodford, Pernim, Farnham, and Cassidy's Bridge, show that the earthquake was severely felt, though the damage was confined mainly to broken chimneys and crockery.

The earthquake in the western district last night does not appear to have been noticed by residents of Melbourne, but the seismograph at the observatory indicates that a short, sharp shock took place at 29½ minutes past 8 on Tuesday night.

1903 07 14 at 11:50 UTC, Warrnambool aftershock

The North Western Advocate and the Emu Bay Times Saturday 18 July 1903, Page 4.

A second shock of a mild character was felt at 9.50 o'clock.

1904 04 09 at 22:00 UTC, Bright

Figure 19 Small earthquake near Bright on 9 April 1904, minor non-structural damage reported.

The Argus Tuesday 12 April 1904, Page 6

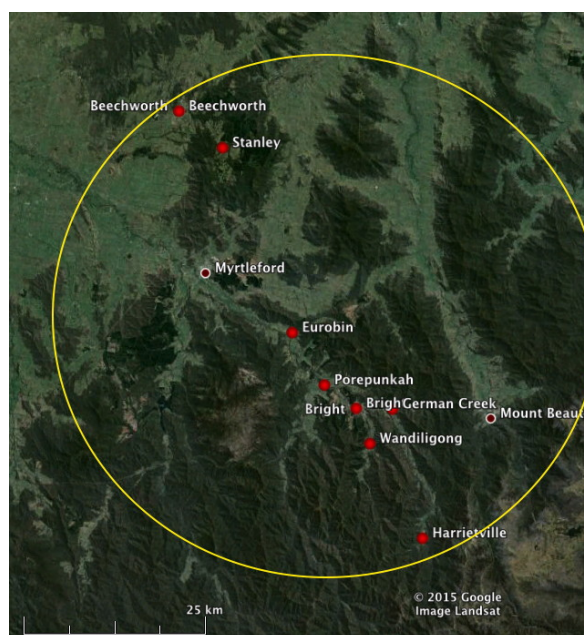
EARTHQUAKE SHOCK. NORTH-EASTERN DISTRICT AFFECTED.

BRIGHT, Monday.

At 8 o'clock yesterday morning a distinct shock of earthquake was felt at Wandiligong, Porepunkah, Eurobin, Harrietville, and Bright. The duration of the shock was half a minute, and the vibration was felt most severely at German Creek and Bright, where crockery fell from the shelves. The direction of the wave was along the Ovens Valley from west to east. It was accompanied by a noise resembling a heavy load being drawn along a road.

BEECHWORTH, Monday.

Between 8 and 9 o'clock yesterday morning a dull, rumbling noise, with a strong vibration, as if caused by the passage of a heavily loaded vehicle, was distinctly noticed by the residents of Beechworth and Stanley. It caused a rattling of windows and crockery.

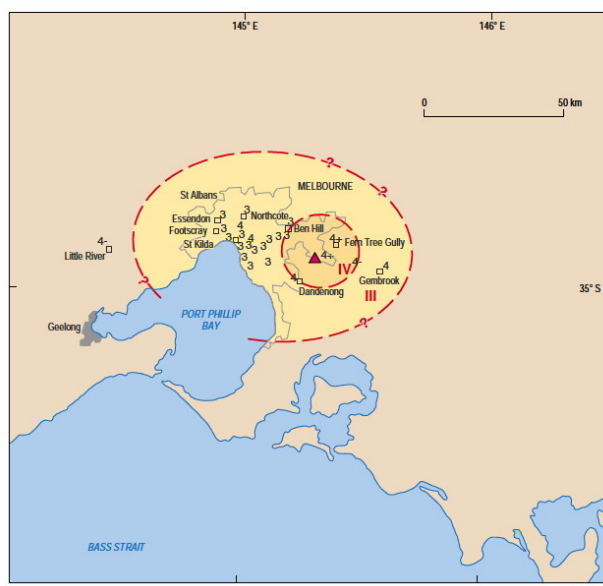


1904 07 09 at 09:27 UTC, W of Lilydale

North Brighton was the only place to report minor damage following the earthquake at 7:27 pm on Saturday 9th July 1904. According to the Observatory, it lasted about 20 seconds.

Figure 20 Felt area of the earthquake of 9 July 1904 east of Melbourne. The radius of perceptibility is at the very least equivalent to that of a magnitude 4 earthquake (the felt reports to draw this isoseismal map from McCue (1996) "had been entered into the Melbourne Observatory's 'Earthquake Book' by Miss Watt on 20 August 1904").

The earthquake was felt widely throughout the



eastern portion of the metropolitan area and at Lilydale, Narre Warren and Springvale according to the *Argus*, Monday 11 July 1904. Clocks were stopped at Berwick. *The Healesville and Yarra Glen Guardian* of 16 July 1904 mention that Healesville and Lilydale were thrown into a state of consternation.

1904 09 22 at 11:58 UTC, Korumburra

Korumburra was the likely epicentre of a small earthquake felt by town residents just before 10pm on Thursday night (*The Argus*, Saturday 24 September 1904, P16).

This earthquake heralded later shakes for the residents of Korumburra. On 20 June 1969 the whole of Gippsland was strongly shaken by a magnitude ML 5.3 earthquake. Again on several occasions in 2011, earthquakes shook Korumburra, one of them thrilling thousands of delegates attending the IUGG meeting in Melbourne in early July.

1904 11 24 at 12:30 UTC, Beechworth explosion

Albury Banner and Wodonga Express Friday 2 December 1904, Page 28.

A Scare in Beechworth.

The peaceable citizens of Beechworth, many of whom had retired to their well-earned rest, were startled between the hours of 10 and 11 o'clock on Thursday night week by a sudden and violent reverberation which astonished those awake, and roused the sleepers from their slumbers. Some thought it was an explosion of thunder, but the calm moonlight sky dispelled that idea; others who were awakened from their sleep declared that they felt a distinct tremor of the earth, and attributed it to the premonitory warning of an earthquake ; whilst others supposed it must be an explosion of some kind. Next morning there was a general curiosity as to the origin of the phenomenon, which was ultimately solved in a very simple manner. It appears that by some means, probably by human agency, a massive boulder had been dislodged from its site on the side of the gorge below the Newtown bridge, and had lodged in the cutting leading to the outlet of the Rocky Mountain Company's tunnel underneath the town. This occurred a day or two ago, and as the mass of rock had destroyed part of the sluice-boxes, and was blocking the overflow of water, Mr. J. Chappell, mining manager to the company, reported the matter to the directors, and was authorised to remove the obstruction without delay. To do this it was found necessary to use a heavy charge of dynamite to break up the mass before it could be removed in fragments, and it was the explosion of this which caused the excitement. The incident was startling, but it is well that it was not of a serious nature.

1905 01 27 at 16:00 UTC, Moe

The Maffra Spectator Thursday 2 February 1905, Page 3.

A slight shock of earthquake was experienced in Moe about 2 a.m. on Saturday. It was also felt at Tanjil South, about five miles away. It travelled in a northerly direction. The same shock was noticed at Traralgon. At Mr C. Christensen's residence at Tyers everything in the house shook. Mr and Mrs J. Galbraith, who live over a mile away from Mr Christensen's, also felt the shock and heard a rumbling noise. An earth tremor was felt at Walhalla at 2.30 on Saturday morning. It was accompanied by a loud rushing noise like a large tree falling. The direction of the tremor was nearly north and south. It lasted for a few seconds.

1905 08 21 at 18:35 UTC, Riverton SA

Underwood (1972) queries whether this earthquake was in Western Victoria or South Australia – it occurred near Riverton SA and was felt at Hamilton SA, not Hamilton Vic. It was not felt in Victoria at all although perhaps there was another earthquake in Victoria at a similar time.

1905 09 20 at 18:00 UTC, San Remo

Australian Town and Country Journal Wednesday 27 September 1905, Page 9.

A severe shock of earthquake occurred at San Remo, 65 miles from Melbourne, shortly after 4 o'clock on Wednesday morning. Nearly all the residents were awakened, and many got up and dressed. The vibration and the noise were terrifying. No damage was done.

1906 07 17 at 15:30 UTC, Daylesford

Bendigo Advertiser Tuesday 24 July 1906, Page 5.

EARTHQUAKE AT DAYLESFORD.

RECORDED AT THE OBSERVATORY.

Melbourne, 23rd July.

The earthquake shock which was reported to have been felt at Porcupine Ridge, six miles north-east of Daylesford, last Wednesday, was recorded at the Melbourne Observatory.

On the seismograph being opened by Mr. Baracchi yesterday, it showed a definite shock, but of short duration, as having been recorded at 1.30 a.m. on Wednesday.

1907 03 31 at 14:30 UTC, Western Port Bay

Portland Guardian Wednesday 3 April 1907, Page 2.

EARTHQUAKE SHOCK.—Whilst most of Melbourne slept early on Monday morning a sufficiently marked earth tremor was felt to cause temporary alarm to those who were aware of it. It passed unnoticed at the observatory. Apparently it was of very short duration - one gentleman, residing in the city, asserts it was over in a "second." Other accounts say that it lasted from 6 to 10 seconds. It occurred at about half-past 12 o'clock, the time varying somewhat with the localities whence it was reported. Some persons who felt the shock attributed it to shooting at the Heads. At Cape Schanck the lighthousekeeper is a meteorological observer, and he reported that a "rather sharp shock " was felt at 12.33 a.m. A St. Kilda resident, who remarked that the beds were agitated and the crockery rattled, gave the time as 12.35 a.m., while in other reports received at the Observatory the time was stated to be 12.25 and 12.35 a.m.

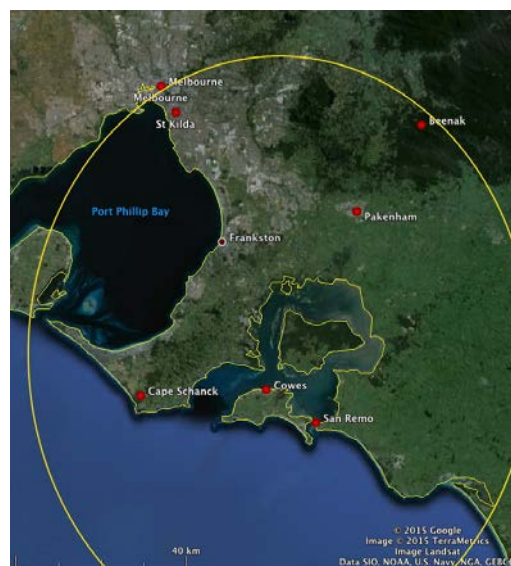


Figure 21 Felt area of the Westernport Bay earthquake of 31 March 1907, the reports are quite sparse so the epicentre is not well defined.

Underwood (1972) notes that the earthquake was felt at Beenak, east of Melbourne and it was reportedly felt at San Remo, Pakenham and at Cowes (*Two shocks of earthquake were felt. The first took place at 12.30. It lasted about 10 seconds, and caused buildings to oscillate violently, though no damage was done. The shocks were accompanied by loud rumbling noises.*

1907 04 03 at 22:25 UTC, Wartook

The Argus Monday 8 April 1907, Page 7.

EARTHQUAKE SHOCK.

COUNTRY EXPERIENCES.

HORSHAM. Saturday. — A local resident who returned from Wartook, to-day states that the residents of Wartook and Brimpaen distinctly felt two shocks of earthquake on Thursday morning. Mr. M'Donald of Wartook, was leaning against a verandah post at his residence when the structure was violently shaken. The tremor lasted a few seconds, and was

followed by another shock of less duration. The residents of Brimpaen, eight miles from Wartook, also felt the earthquake.

SEYMOUR, Sunday. — A perceptible shock of earthquake was experienced here during the week. At Mr. F. Pearce's slaughter yard a crack nearly an inch wide has been made in a cement floor. Some people living in the vicinity state they felt a tremor on Friday morning. The crack referred to runs north and south.

There were obviously two separate earthquakes, one near Wartook (time from Underwood's table, not given in scanned newspapers) and felt Stawell, the other near Seymour, the latter possibly related to the earthquake listed below near Tallarook in October.

1907 05 05 at 02:45 UTC, Ararat

The Argus Tuesday 7 May 1907, Page 6.

AN EARTHQUAKE SHOCK.

ARARAT, Monday. An earthquake shock was felt here on Sunday at a quarter to 1. The shock was accompanied by a low rumbling sound, travelling from south to north. Some people on the Moyston-road ran out of their houses. The shock was felt at Mount William, Garnim, Jackson's Creek and other places.

Geelong Advertiser Wednesday 8 May 1907, Page 1.

A shock of earthquake was experienced here yesterday. The shock occurred at about a quarter to one, when a low rumbling sound was heard travelling from south to north. On the Mapean road the windows of the houses were broken and some people ran out of doors. At Gorrinn and Jackson's Creek, and also at Mount William the effects of the shock were also distinctly felt.

The newspapers details aren't identical and they aren't clear about the time, though Underwood (1972) has it in the early afternoon rather than early morning.

1907 05 16 at 10:00 UTC, Geelong naval guns

The Mercury Monday 20 May 1907, Page 3.

EARTHQUAKE AT GEELONG.

GEELONG, May 17.

About 8 p.m. on Thursday there were a couple of shocks of earthquake in the northern part of the town. They were preceded by rumbling noises like distant cannon, but the centre of the disturbance seemed to be under Corio Bay. The shocks were distinctly felt in all houses along the western shore of the bay, known as North Geelong. Crockery and glassware rattled, and windows shook for some time. People on Moorabool-street pier heard noises so distinctly that they imagined they emanated from the steamer Barwon, berthed at the railway pier, but, as a matter of fact, all was quiet there. There was a slight rumbling noticed at North Geelong.

Geelong Advertiser Saturday 18 May 1907, Page 2.

THE ALLEGED EARTHQUAKE.

Inquiries regarding the alleged earthquake in Geelong on Thursday evening indicate that the rumbling noises, which were the origin of the scarewere caused by nothing more alarming than the booming of the guns of the cruiser Psyche, which was maneuvering in the bay. This vessel was seen by people on board the Courier, who heard the guns being fired from the warship..... It is fortunate the real cause of the "earth tremor" has been ascertained, otherwise the incident might have served as an argument against the sewerage proposals or the electric tram project.

1907 05 30 at 20:30 to 23:00 UTC, SE South Australia felt Western Victoria

Border Watch Wednesday 5 June 1907, Page 2.

THURSDAY'S EARTH-SHAKE.—The seismograph at the Melbourne Observatory was opened on Saturday, and the film on being developed showed that a succession of tremors had been experienced locally. On Thursday morning, between half-past 6 and 9 o'clock, these shocks, which were not severe, corresponded with the earth tremors felt at Narracoorte, Mount Gambier, Casterton, and elsewhere. People at Yahl and O.B. Flat assert that they felt a sharp shock about 1 o'clock on Friday morning.

1907 08 06 at 00:54 UTC, Warragul

The Argus Wednesday 7 August 1907, Page 7.

EARTHQUAKE SHOCK. COURT BUSINESS SUSPENDED.

WARRAGUL, Tuesday. A sharp earthquake shock was experienced this morning just before 11 o'clock. The contents of the houses and stores were greatly shaken. The shock was most violent in the lower portion of the town, and the disturbance appeared to travel in a westerly direction. At the court-house business was temporarily suspended as the building, which is a two-storeyed brick structure, was violently agitated. Several people in the town experienced a sensation of sickness.

BAIRNSDALE, Tuesday. — Shortly before 1 o'clock this afternoon an earthquake shock was felt in Bairnsdale but it was so slight that few people noticed it.

WARBURTON, Tuesday. — A sharp shock of earthquake was experienced through the Warburton district at 5 minutes to 11 o'clock this morning. It was generally noticeable at Mrs. Ryan's Hotel, West Warburton, where a rumbling noise was heard and the vibrations lasted for several seconds.

Other newspapers say it was felt at Gembrook and Neerim North. Underwood (1972) notes that it was also felt at Drouin, Yarragon and Bairnsdale but *The Argus* report indicates that rather than one large earthquake, there were two smaller earthquakes nearly 2 hours apart, the earlier one near Warragul, the second about 150 km to the east near Bairnsdale.

1907 08 10 at 06:55, Camperdown

Daily Telegraph Tuesday 13 August 1907, Page 5.

CAMPERDOWN, Monday.

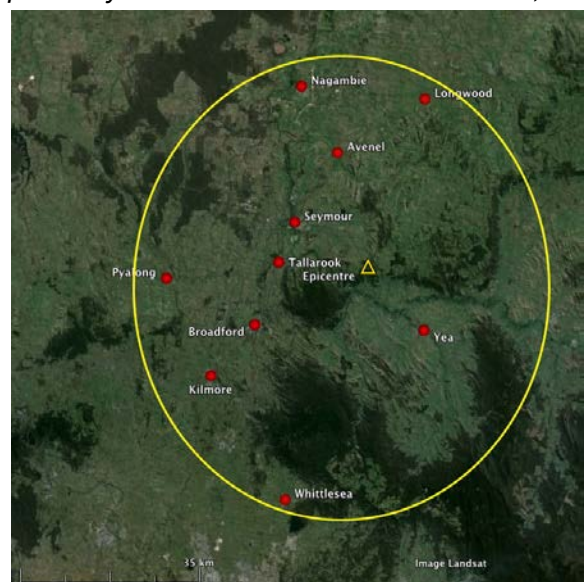
An unmistakable shock of earthquake was experienced here on Saturday afternoon, a little before five o'clock. The shock was accompanied by all the usual signs of seismic disturbance, crockery rattling violently on the shelves, etc. In the shops in the main street, which were filled with customers, the hour being probably the busiest of the whole week, much alarm was caused by the sudden oscillation of all the hanging goods. The shock appears to have been quite an isolated one. It lasted for some seconds, and fears were expressed that it would recur, but there was no further disturbance.

1907 10 04 at 09:30 UTC, Tallarook

According to the *Kilmore Free Press* of Thursday 10 October 1907, page 3 an earthquake was widely felt about Broadford and Seymour.

Figure 22 Felt area of the 1907 earthquake near Seymour, the magnitude estimated at 3.9.

Earthquake On Friday evening about 7:30 a shock of earthquake was felt at Tallarook, Seymour, Nagambie, Yea, Pyalong, Kilmore and



Broadford. At Broadford the tremor was distinctly felt, and a number of people rushed out of their dwellings. In Kilmore, however, the shock was only slightly felt by a few people. Messers Lincoln, O'Connor and Rees were camping at the head of the Kilmore Water Works. They state they felt the shock distinctly, and heard the wombats and bears cry out as soon as the tremor occurred.

The Argus of Monday 7 October 1907, page 7 mentions that it was felt at Kilmore, Whittlesea, Longwood and Avenel. Note the April foreshock mentioned above in the discussion of the Wartook event.

1908 06 09 at 19:35 UTC, Korumburra

The Argus Friday 12 June 1908, Page 6.

EARTHQUAKE SHOCK.

KORUMBURRA, Thursday.—A distinct earth tremor was felt by some residents in this district at 25 minutes to 6 yesterday morning. The shock was not severe.

1908 10 23 at 17:45 UTC, Wedderburn

Riverine Herald Tuesday 27 October 1908, Page 3.

Earthquake Shocks.

TWO FELT AT WEDDERBURN.

EARLY ON SATURDAY MORNING.

Wedderburn, Saturday.

This morning between 3 and 4 o'clock the residents of this district were startled by an alarming thunderclap kind of noise, accompanied by a slight earth tremor, which proved to be an earthquake shock. This was followed an hour later by a milder shock. Many people got up and examined their premises, but apart from a rent in Mr George Norcroft's underground tank no damage was done.

SIMILAR EXPERIENCE AT INGLEWOOD.

Inglewood, Saturday.

A distinct earth tremor passed over the town at about a quarter to 4 o'clock this morning. The shock was accompanied by a rumbling noise like distant thunder. During the passing of the tremor a loud noise as of an explosion occurred, causing houses in some places to vibrate. The course appeared to be from an easterly to a westerly direction.

1909 11 14 at 03:55 UTC, Bairnsdale

Bendigo Advertiser Tuesday 16 November 1909, Page 3.

EARTHQUAKE SHOCKS. FELT IN GIPPSLAND.

Bairnsdale, 15th November.

Reports received to-day from Cunninghame, Bruthen and Metung indicate that the earth tremors experienced here early yesterday afternoon were generally felt in the Lakes district.

At the places mentioned the shocks were distinctly felt by the inhabitants. Windows rattled, and some crockery was shaken off shelves.

Bairnsdale Advertiser and Tambo and Omeo Chronicle Tuesday 16 November 1909, Page 2.

EARTH TREMOR. On Sunday afternoon, at five minutes to 2 o'clock, a distinct earth tremor was felt in a number of households in Bairnsdale. In the higher buildings, particularly those of brick, the effects of the shock were more noticeable than in one storey premises. The crockery in many households rattled, articles in an upright position on shelves and tables swayed perceptibly and creaking noises were heard in a few instances. No damage was

done, fortunately. Although the shock only lasted a few seconds, it was strong enough to cause some consternation and scare some of the more timid householders. It is the fourth similar visitation the town has experienced during the past 31 years. The shock was felt also at Bruthen and Orbost. At the latter place it left its mark by making two small openings over the back entrance to the Club Hotel.

We have placed the epicentre onshore, but it could equally have been further south offshore.

1910 03 18 at 21:15 UTC, Warragul

Evening News Saturday 19 March 1910, Page 7.

MELBOURNE. Saturday.— Earthquake shocks have been reported from the Gippsland district—Morwell, Moe, Traralgon, and Warragul — apparently travelling eastward.

Portland Guardian Wednesday 23 March 1910, Page 2.

EARTHQUAKE SHOCK.—A distinct shock of earthquake was felt at Bunyip on Saturday morning at a quarter past 7 o'clock. A rumbling noise was followed by the moving of houses. Residents north of Bunyip, four miles away, also felt the shock. At Drouin and Trafalgar it was also plainly felt. Warragul and Yarragon report a similar occurrence.

Figure 23 The earthquake of 18 March 1910 was either a small one centred near Trafalgar (as depicted here) or a larger one offshore south of Wilson's Promontory.

1910 05 27 at 15:45 UTC, Myrtle Creek

Riverine Herald Tuesday 31 May 1910, Page 4.

Earthquake Shock.

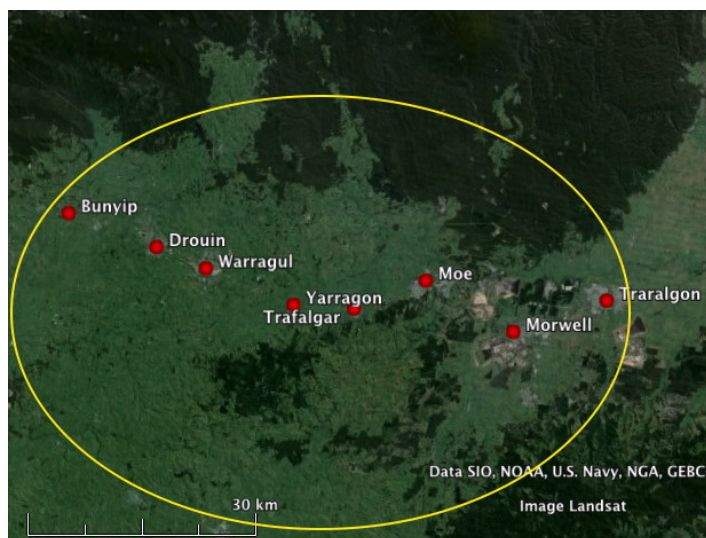
FELT IN BENDIGO. SATURDAY MORNING SENSATION.

Bendigo, Monday.

A heavy rumbling noise accompanied by a sudden, though comparatively slight, earth tremor, rudely awakened a great number of the residents of the Bendigo district at 1.45 o'clock on Saturday morning, and convinced them that an earthquake shock had been experienced. The shock was distinctly felt by a large number of citizens residing considerable distances apart. It resembled the rumbling of distant thunder, and the houses and buildings vibrated considerably. Of course the majority of citizens were asleep and were unaware of any seismic disturbance, and even when told of it on Saturday ridiculed the statement. The shock was felt by the men working in the Victoria Proprietary mine. The tremor appears to have travelled from north to south, and those citizens residing on the higher levels of the city felt it more distinctly. Bendigo is not the only district in which the shock was felt, for many residents in the Castlemaine and Sedgwick districts also felt its effects.

Although of only a few seconds duration, the tremor was quite sufficient to cause considerable alarm and consternation, and the phenomenon formed the subject of much discussion in the city on Saturday and yesterday. The disturbance at Mandurang and Sedgwick especially, was sufficient to disturb even heavy slumberers.

In some cases locally much anxiety was felt. The rattling of ceilings, walls, windows and crockery, is reported having been heard distinctly by those residents on the higher portions of the city. Those with thoughts far away from earthquakes attributed the rumbling to thunder, heavy wind or strange noises in other portions of their homes, the cause of which investigations failed to reveal.



Mr. J. Beebe, who is in charge of the local observatory, and who resides with his family at East Bendigo, was not disturbed in his night's rest by any unusual noise or vibration. In fact not one of the occupants of his home heard anything of a strange nature, and consequently Mr. Beebe was considerably surprised to learn that an earthquake shock had been experienced in the city. He stated that there is no seismograph at the local observatory, so that there was no means of recording an earth tremor. Mr. Beebe pointed out that while he did not doubt there had been a shock, on many occasions it had been found that a long roll of thunder was sufficient to shake loose doors and windows, and even a whole building. In connection with this, Mr. Beebe added that it was more often a peal of thunder which appeared to be a long way off that had this effect.

FELT AT CASTLEMAINE.

A shock of earthquake which travelled from north to south with a low rumbling sound for several seconds was experienced at Castlemaine on Saturday morning at 10 minutes to 2 o'clock. Houses were shaken, and a number of people became so alarmed that they ran out into the streets to ascertain what was the matter. The majority of people being fast asleep, did not hear the disturbance, and beyond the shock to a number of those who did feel the disturbance, no harm was done.

Hopefully enough reports like this will convince people that miners underground do feel the shaking.

1910 10 24 at 17:00 UTC, Bunyip

The Argus Thursday 27 October 1910, Page 4.

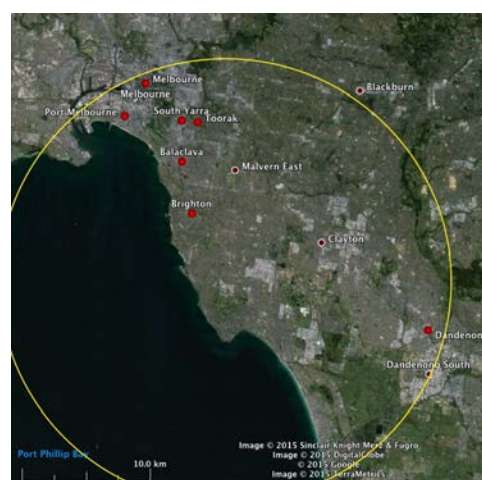
BUNYIP, Wednesday.—At about 3 o'clock on Tuesday morning, a distinct earth tremor was felt. Some people were awakened by the rattling of crockery, windows, and doors.

1911 01 06 at 17:55 UTC, SE Melbourne

SMH 7 January 2011, P14: *Melbourne, Friday. A slight earthquake shock was experienced in Melbourne at 5 minutes to 4 o'clock this morning and alarmed a great many people in the southern suburbs. In some cases nervous folk were awakened by the disturbance which lasted only a few*

Figure 24 Felt area of the small earthquake near Melbourne on 7th January 1911 at 3:55a.m. EST. The magnitude converted from felt radius is about 3.0.

seconds. They rushed out of doors in their night clothes but by a great majority the shock was not noticed. Along the bay front from Port Melbourne to Brighton the effect seems to have been most pronounced. The shocks were said to have been accompanied by a muffled rumbling noise resembling a distant explosion.



The Argus, Saturday 7 January 1911, P19 noted that there was a distinct vibration of buildings and rattling of windows in East Melbourne, South Yarra and Toorak. A following article in the same paper noted that a distinct earthquake was felt at Dandenong at 5 minutes past 4 a.m., and it was felt at Balaclava.

This information is consistent with an earthquake of about magnitude 3.5 located some 10km southeast of the city of Melbourne.

1912 07 05 at 06:54 UTC, Little River

Geelong Advertiser Saturday 6 July 1912, Page 11.

EARTHQUAKE.

We have been informed that a shock of an earthquake was felt at the Little River yesterday afternoon at about six minutes to 5. It was preceded by a rumbling noise like distant

thunder. The slates of the Catholic schoolhouse rattled as if the whole roof had been shaken. The oscillation was very perceptible, and appeared to come from the north-west. The shock was slightly felt in Geelong. The exact time is variously stated, but a quarter to 5 is about the mean.

1912 08 11 at 07:20 UTC, Bealiba

EARTHQUAKE SHOCK. FELT AT TARNAGULLA.

Tarnagulla, 12th August.

At 5.25 o'clock yesterday evening a distinct earthquake shock was felt, accompanied by a rumbling sound, which lasted ... seconds, causing doors to shake and windows to rattle. The disturbance appeared to travel from a north-north west to south-south-east direction.

The Australasian Saturday 17 August 1912, Page 40.

A loud rumbling noise, lasting for a minute, and followed by a slight earth tremor occurred in the Bealiba district of Victoria, at a quarter past 5 o'clock on Sunday evening, and tremors were felt at Dunolly, St.Arnaud and Tarnagulla.

1913 01 11 at 00:30 UTC, Portland

Border Watch Saturday 18 January 1913, Page 1.

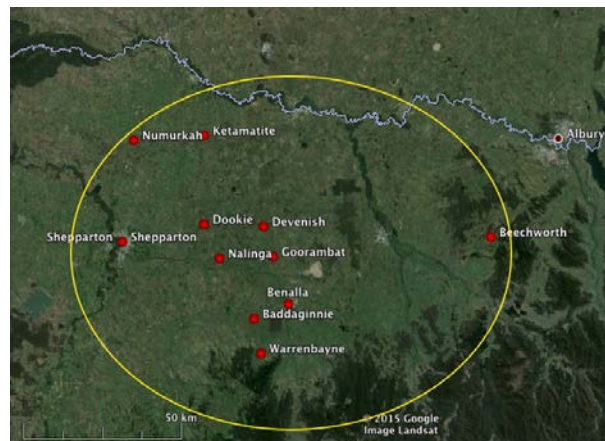
The wife of the Portland lighthouse keeper reported a slight shock of earthquake occurring about 10.30 on Saturday morning, it being stated that the floor of the kitchen, which is of asphalt, was distinctly felt to move.

1913 03 02 at 17:45 UTC, West of Benalla

Figure 25 Felt area of the 2nd March 1913 Benalla earthquake. The inferred epicentre is about 20km west of Benalla; there was no report it was felt at Wangaratta. The estimated magnitude is 4.2.

Chronicle Saturday 8 March 2013, Page 45.

EARTH TREMOR IN VICTORIA. Melbourne, March 3. At Shepparton to-day a distinct shock of earthquake was experienced. The inmates of the Mooroopna Hospital, over two miles away, were roused from their slumbers by an unusual noise. A nurse, who was in the kitchen, was alarmed by a violent rattling of crockery and ran quickly out of the room. Mr. Maher, a farmer from near Dookie, 50 miles from Shepparton, confirmed the report as to the shock, which, he says, was very distinct in his neighborhood. A distinct earth tremor was felt at Benalla at 3.45 a.m. to day in a number of houses. Walls trembled and windows rattled. This is the severest shock of the kind yet experienced in Benalla. One occurred three years ago but on that occasion only a few people felt it.



Benalla Standard Tuesday 4 March 1913, Page 3.

Earthquake Shock. — At a quarter to four yesterday morning a distinct shock of earthquake was felt by a very large number of people in Benalla. In a number of houses the walls shook and the windows rattled. The sound was like distant thunder, and was travelling from west to east. In some places the beds were felt to be moved, while glasses were knocked over. At Messrs. Hearn Bros., Mount Ada, some plaster was knocked off the walls. The shock was also felt at Warrenbayne, Nalinga, Devenish, and Goorambat. Some twelve years ago a shock was felt in the town, but was not nearly so distinct as that of yesterday. Our Baddaginnie correspondent reports that the shock was also distinctly felt there. It was accompanied by a loud report and a slow undulation of the earth. Sleepers were awakened by the vibratory motion, and many were alarmed at the oscillation of the bedsteads. So far

as can be ascertained no serious damage resulted. A sensational report gained currency in Benalla that the shock was felt in Melbourne, and that damage had been done to a number of buildings in Flinders-street, but this, like Mark Twain's reported death on one occasion, was " very much exaggerated."

1913 10 15 at 19:00 UTC, Cunninghame (Lakes Entrance)

The Argus Friday 17 October 1913, Page 7.

CUNNINGHAME, Thursday. - A slight earth tremor was felt here at about 5 o'clock this morning.

1913 11 26 at 09:52 UTC, Dandenong

The Argus Friday 28 November 1913, Page 9.

EARTHQUAKE SHOCKS.

RUMBLINGS ALONG BAY FRONT. TREMORS IN DANDENONG RANGES

Distinct earthquake shocks were felt along the Bay front, from Port Melbourne to Cheltenham, at about 2 o'clock yesterday afternoon, and the tremors and rumbling were of sufficient severity to suggest that changes were taking place either in the bed of the bay or the ocean at no great distance from Melbourne. The disturbances evidently began on the previous evening as earth tremors were felt at Lilydale, Warburton, Gembrook, and other places between 7.50 p.m. and 7.55 p.m. on Wednesday. The postmasters at the three towns mentioned forwarded telegrams to the Observatory yesterday, reporting slight shocks, lasting about 10 seconds, in their districts. The tremors were accompanied by rumblings like the boom of artillery far away.

Similar shocks were felt at Port Melbourne, Mentone, Black Rock, and Cheltenham, between a quarter to 2 and 2 o'clock yesterday afternoon. Windows rattled and there were other signs that the earth's crust within a limited area was trembling, but the shocks were not of sufficient severity to cause alarm. In the city nothing was felt, but in a telegram which he forwarded to the Observatory, the Rev. G. Kelly said that at Cheltenham the shock caused buildings to shake.

The extent of the shocks recorded on the seismograph at the Observatory will not be known until this afternoon, as the film in the instrument is only examined at half past 12 o'clock every Friday. Almost weekly slight tremors are recorded by the sensitive instrument, but no serious earthquake disturbance has occurred in Victoria for many years.

Picnickers Surprised.

LILYDALE, Thursday. —The Port Melbourne Citizens and State Schools Committee held their 23rd annual picnic at Lilydale yesterday, when about 1,000 persons attended. While the picnickers were assembled on the railway station waiting for the train a distinct shock of earthquake was felt. The tremor apparently passed from south-west to north-east, and caused some consternation among the intending passengers.

DURATION OF 8 SECONDS

WARBURTON, Thursday. —A distinct shock of earthquake was felt here at seven minutes to 8 p.m. yesterday lasting about eight seconds and causing windows and crockery to rattle.

TWO DISTINCT TREMORS

BEACONSFIELD UPPER, Thursday. — Two very distinct earthquake tremors were felt here on Tuesday night at 8 o'clock, the earlier shock being much stronger than the latter one. Many people heard the rumbling sound.

1913 11 27 04:00 UTC, Melbourne

Geelong Advertiser Saturday 29 November 1913, Page 4.

EARTHQUAKE IN MELBOURNE ?

On Thursday several residents of Port Melbourne experienced earth tremors.

In the Graham-street State School the doors moved perceptibly, and the walls seemed to shake. One resident declared that the shock lasted ten seconds, and that she rushed into the street for safety. The porters at the Port Melbourne railway station all felt the shock, which appeared to travel from towards the sea. Yet the seismograph at the Observatory, which is a very delicate instrument, shows no records of the shock. Mr. P. Baracchi, Government Astronomer, expressed the opinion yesterday that as the seismograph was not affected, the tremor must have been a purely local and superficial one. The movement must have been very close to the surface.

Examiner Friday 28 November 1913, page 5.

EARTHQUAKE SHOCKS. MELBOURNE, Thursday. Distinct earthquake shocks were felt along the bay front from Port Melbourne to Cheltenham at about 2 o'clock this afternoon. The disturbance evidently began on the previous evening, as earth tremors were felt at Lilydale, Warburton, and Gembrook between 7.50 p.m. and 7.55 p.m. yesterday. Similar shocks were felt at Port Melbourne, Mentone, Black Rock, and Cheltenham between a quarter to 2 and 2 o'clock this afternoon. Windows rattled, and there were other signs that the earth's crust within a limited area was trembling, but the shocks were not of sufficient severity to cause alarm.

1914 08 17 at 23:31 UTC, Drouin

The Ballarat Courier Wednesday 19 August 1914, page 8.

EARTH TREMOR AT DROUIN, Tuesday. At 9.31 to-day a distinct shock of earthquake was felt here. Buildings shook, and horses attached to vehicles were prevented with difficulty from bolting. No damage is reported.

Stratford Sentinel and Briagolong Express Friday 21 August 1914, Page 2.

BUILDINGS SHAKEN.

Warragul, Tuesday.

A severe shock of earthquake occurred here at 9.35 a.m. to-day, which appeared to travel from a westerly to an easterly direction. Buildings shook, windows rattled, and business people rushed out into the streets. Old residents considered the shock to be the most severe ever experienced in the district.

Bunyip, Tuesday.

Residents of Bunyip were startled this morning at about 9.30, when a severe earth tremor occurred. People rushed from their dwellings in alarm. Every house in Bunyip felt the shock distinctly.

Great Southern Star Friday 21 August 1914, Page 2.

An earthquake shock was felt at Korumburra on Tuesday, but was not noticeable in Leongatha. In the Nerrena hills at about 10.40 a.m. the earth tremor was very pronounced. At Mr Tom Carmody's the crockery in the kitchen was seen to sway. A correspondent at Mount Eccles states — " this district was subject to rather a severe earth tremor on Tuesday at 9.41 a.m. The movement was preceded by a loud rumbling noise lasting for at least two seconds, which was followed by three severe bumping noises. Everything in the State school shook; windows rattled, and the movement of the floor was quite noticeable. The whole movement lasted some four or five seconds, and was weird and uncanny in the extreme."

1914 08 18 at 15:30 UTC, Gippsland

The Argus Thursday 20 August 1914, Page 10.

MIRBOO NORTH. Wednesday. — An earth tremor was distinctly felt yesterday morning. In many houses crockeryware rattled loudly.

TOOLANGI, Wednesday. —A slight shock of earthquake was experienced here at half past 1 o'clock yesterday morning. The tremor was of about five seconds duration and seemed to run from south to north.

Bruthen and Tambo Times Wednesday 19 August 1914, Page 3.

An earth tremor was felt in Bruthen about 2 a.m. this morning. It was more severely felt in some parts than in others. In one instance it was reported that it shook the pictures from the wall and the tumbler's from a sideboard on to the floor.

There were two distinct earthquakes reported, one in East Gippsland, another near Bendigo.

1915 05 24 at 08:00 UTC, Walhalla

An earth tremor was distinctly felt by a number of people in Walhalla on Monday evening close upon 6 o'clock. The shock was also felt at Rosedale. It is worthy of remark that a few months ago both towns had a similar experience.

1916 06 29 at 22:00 and 22:45 UTC, Bright

The Age Saturday 1 July 1916, Page 10.

EARTHQUAKE SHOCKS.

BRIGHT. — The residents of Bright and district experienced two distinct earthquake shocks on Friday. The first occurred at about 8 a.m., and was accompanied by a noise like a fast-travelling motor car. It rattled the windows and crockery on the shelves, and shook the beds. Some alarm, was felt at Harrierville, and Wandiligong. At Porepunkah tins were rattled from their benches to the floor. The second tremor occurred at about 8.45. It was not so severe as the first.

MYRTLEFORD. — A pronounced earthquake shock was experienced here at 8 a. m. on Friday.

1917 04 02 at 19:55 UTC, Holbrook NSW

This earthquake was widely felt in Victoria but the epicentre was near Holbrook NSW.

The Argus reported severe shaking in NE Victoria.

SEVERE EARTH TREMORS.

In North-Eastern Victoria.

At or about five minutes to 6 o'clock yesterday morning severe earth tremors occurred in the north-east of the State, at a number of places between Albury, Wagga, and Rutherglen. Sleepers were aroused by the shaking of beds and the rattling of windows, and in some cases by the breaking of crockery. No serious result is reported.

CORRYONG. Tuesday. —A severe earth tremor was felt in this district between half-past 5 and 6 o'clock this morning. It was also felt on the Murray, at Bringenbrong. The tremor shook the houses and broke crockery.

BEECHWORTH, Tuesday. —A very distinct earth tremor was felt here this morning at 6 o'clock. There was a long, rumbling noise, and people were awakened by the severe shaking of beds and rattling of windows and crockery. Both the tremor and the rumbling lasted for several seconds.

1917 06 07 at 11:05 UTC, Lismore

Daily Advertiser Monday 11 June 1917, Page 2.

Mr. Hunt, the Commonwealth meteorologist, was advised on Friday afternoon that at Lismore, in the Western District, two sharp earthquake shocks were recorded at five minutes past 9 on Thursday night. Furniture and pictures in dwellings were displaced.

1921 05 30 at 15:00 UTC, Swan Hill

The epicentre of this magnitude 5.5 earthquake, felt strongly at Boort, was east of Swan Hill, in NSW (McCue (2015) and was widely felt in Victoria. Underwood (1972) lists 4 small earthquakes felt at Boort between 9th and 18th October 1932.

EARTH TREMOR.

Boort to Balranald Affected.

BOORT Tuesday.—A sharp, earth tremour was felt at 1 o'clock this morning. It lasted about two minutes, and appeared to travel, from east to west. Beds were bumped against walls, crockery rattled, and furniture rocked. Many people were considerably alarmed by the swaying motion. When the tremor passed, heavy rain fell for nearly an hour. The tremor was felt in many parts of the district.

KYABRAM, Tuesday. — A slight earth tremor was felt this morning at 20 minutes to 1 o'clock.

MURCHISON, Tuesday.—An earth tremor was felt here early this morning. A number of people got out of bed to find out what had happened, as their doors and windows were shaking.

SWAN HILL, Tuesday.—At seven minutes to 1 o'clock this morning, a violent earth tremor shook the houses. The roofs rattled, plaster walls cracked, and water tanks were thrown off their stands. A red glow was observed in the northern sky while the shock lasted.

YARRAWONGA, Tuesday.—A distinct earth tremor was felt in the town early this morning. It lasted only a few seconds, but houses shook. No damage was done.

1921 06 08 at 19:30 UTC, Foster

The Argus Friday 10 June 1921, Page 6.

FOSTER, Thursday.—A sharp earthquake shock was felt here at half-past 5 o'clock this morning. There was a loud rumbling noise, followed by a sharp bump. Persons in bed felt the shock, and doors were swung open.

1922 02 28 at 15:00 UTC, Ocean Grove

The year 1922 was quite an active one, felt earthquakes are headlined in newspaper articles right across southern Australia. One of these earthquakes early on 1st March (EST) shook the city of Melbourne frightening many of the residents. Interest in this event seems to have been eclipsed by a magnitude Ms 5.2 earthquake in Bass Strait (Everingham and others, 1987) five weeks later on 10th April which also shook the city, but more strongly. In neither case was damage substantiated.

Figure 26 Extract from *The Argus*, 2 March 1922.

Surprisingly no isoseismal map had ever been prepared for either earthquake; the March earthquake is not in the Geoscience Australia database though it is in Underwood's (1972) extensive listing of Victorian earthquakes. The



epicentre of the April event in Table 1 below (e.g. Underwood, 1972; Everingham and others, 1987) is quite uncertain – which one to choose for hazard studies?

The Victorian earthquake at 1am on the 1st March 1922 local time was felt throughout Melbourne and widely reported from southern Victoria, despite the early hour. Most reports were that the tremor was short and sharp, mainly the vibration of furniture and rattling of doors and windows. At Cowes some picture frames propped against a wall fell down, breaking the glass – the only reported damage. It was recounted during the April earthquake that this March event had also been felt on King Island (as mentioned by Underwood, 1972) the only point south of the interpreted epicentre off Cape Otway.

Figure 27 Isoseismal Map Ocean Grove earthquake, 28 February 1922.

The Argus says it wasn't 'recorded' at the Mt Pleasant Observatory at Ballarat, an astronomical, not a seismological, observatory and the logbook of the day makes no mention that it was felt there. The



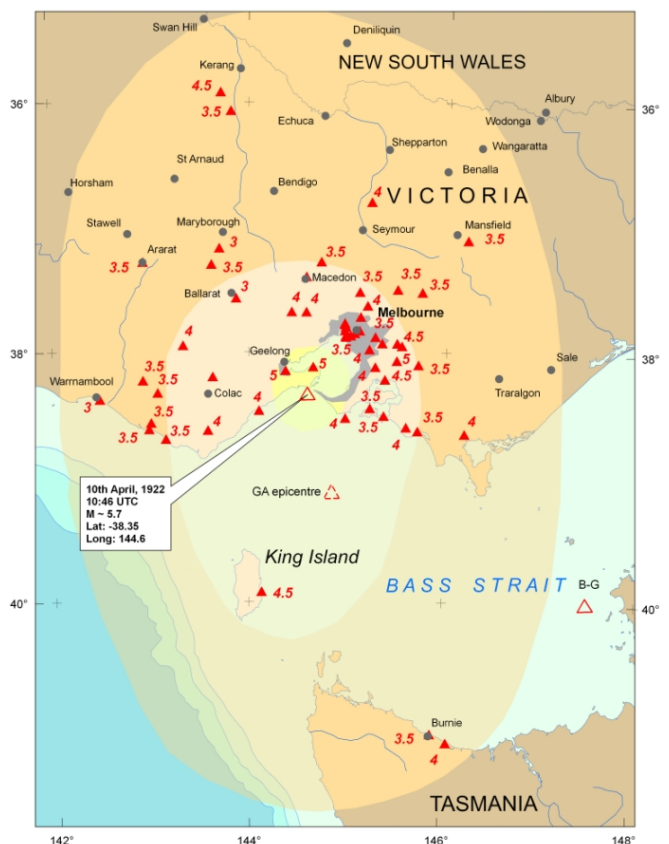
later earthquake on 10th April was however noted by the astronomer John Brittain in the logbook: *9pm Earth tremor*.

This earthquake was recorded at Melbourne Observatory, the P wave at 15:00:42, the duration about one minute, the maximum amplitude only 0.3mm. The epicentre was interpreted by staff (correctly!) to have been within 100 miles of the observatory.

1922 04 10 at 10:46 UTC, Ocean Grove

It was hard to ignore the 10th April earthquake, so many reports were extracted by TROVE in a search of 1922 newspapers and many of them were at odds with an epicentre in eastern Bass Strait (Everingham and others, 1987). Ground shaking was felt at Burnie on the northwest coast of Tasmania, felt strongly on King Island, and as far west as Warrnambool and north to Ivanhoe in Victoria.

Figure 28 Isoseismal Map Ocean Grove earthquake, 10 April 1922. The GA and Burke-Gaffney (B-G) epicentres are marked by the open red triangles.



There were more reports of damage than in the earlier earthquake, both of which were felt throughout Melbourne; a chimney reportedly collapsed in Glen Iris and several places reported that crockery had vibrated off shelves and broken: in Pakenham, Portarlington, Cranbourne and East Malvern. A Perth newspaper reported it felt as far as Portland.

The isoseismal map shown here supports an epicentre off Ocean Grove in Victoria, not far from the February earthquake discussed above.

Table 1 Earthquake details reported by different sources

<i>Date</i>	<i>Time UTC</i>	<i>Lat °S</i>	<i>Long °E</i>	<i>Mag</i>	<i>Approx Location</i>	<i>Source</i>
28 02 1922	15:00	39	145		NE King Is Tas	Melbourne Observatory
	15:00:30	38.4	144.75	4.9	Off Lorne Vic	This paper
10 04 1922	10:45	39.3	144.3		N King Is Tas	Melbourne Observatory
	10:47:39	40	147.5	4.8 ML	Flinders Is Tas	B-G
		40	147.5	5.2 Ms	Flinders Is Tas	EDG
		38.35	144.60	5.7 ML	Off Lorne Vic	This paper

Geelong Advertiser Wednesday 12 April 1922, Page 6.

SEISMOGRAPH RECORD (Ed. Milne Seismograph 1902-1927)

SHOWS ORIGIN IN BASS STRAIT MELBOURNE, April 11.

When the seismograph record of last night's earth tremor was developed to-day at the Observatory, the officials were able to say that the centre of the disturbance was within 150 miles of Melbourne, and roughly, in a south-easterly direction — in Bass Strait, where a previous disturbance originated. The record also indicated that the tremor was of a more violent nature than the one which occurred at the beginning of March. The first disturbance of the boom of the seismograph occurred at 8hr. 46min. 24sec. p.m., and was followed by the second, part of the disturbance at 8hr. 46min. 48sec. p.m. It was this second phase that was felt as the beginning of the tremor, the first being too small to be noticed except by the instrument. The maximum disturbance occurred at 8hr. 47min, 6sec., when the boom was vibrating over an amplitude of 1.7 millimetres. The total duration of the tremor was about one minute, but it was only sensible for 35sec. "A good sharp shock"— that is how Observatory officials described the disturbance. They deprecated the use of the word "earthquake." "These disturbances are not earthquakes," said Mr. C. J. Merfield, the Acting Government Astronomer, "they are merely tremors. An earthquake implies buildings toppling and the earth opening. Such a thing has never occurred in Australia, and I hope it never will. The centre of last night's shock was local— that is, within a few hundred miles of Melbourne— hence its severity and short duration." Asked to explain the cause of these disturbances, Mr. Merfield said that running through the continent, below the surface, was what geologists called a "fault" line— a huge crack. Another fault line passed through Bass Strait, and along these fault lines tremors were constantly occurring.

Many of them were so slight that they were not noticed. "When a disturbance such as occurred last night takes place," he went on, "it means that a strain is taking place, and the earth is adjusting itself into position." Reports which are still coming in indicate that considerable anxiety was caused by the disturbance. In many cases people rushed out of their houses, feeling safer in the open. A Hampton housewife thought a gang of urchins was operating when her front door knocker hammered and she found no one there; but it was only the earth tremor. In the centre of the city the shock was particularly acute.

Members of the United States Consulate staff, in the Equitable Building in Collins-street, who were working late, stated that the buildings seemed to sway noticeably. One with experience of earthquakes in Japan declared that it was "quite a respectable shock." Although the reports indicate that the effects of the shock were widespread little damage was done.

The relative amplitudes of the February and April virtually co-located earthquakes off Ocean Grove on the MEL Milne seismograph of 1.7/0.3 indicates a magnitude difference of 0.75 which is very close to the difference computed from their felt areas.

The year was not finished with earthquakes, a slight but very distinct earthquake was experienced along the Tallangatta Valley on Friday 17th November at 8:30pm local time (*The Argus*, Monday 20 November 1922, P7). There was also a very local earthquake near Warrnambool on 9th December mentioned in the introduction above.

1925 07 11 late at night, Foster

News Monday 13 July 1925, Page 1.

The distinct earth tremors were felt at Foster (107 miles from Melbourne, on the South Gippsland railway line) late on Saturday night. The shocks were sharp and distinct. They were accompanied by rumbling noises and caused houses to rock.

The Argus Tuesday 14 July 1925, Page 12, says the earthquake occurred on Sunday night.

Foster Earthquake.

No records of the earthquake shock which was reported to have occurred at Foster on Sunday night have yet been obtained at the Melbourne Observatory. The Government astronomer (Dr. J. M. Baldwin) said yesterday that he did not think that the tremor would be recorded on the seismograph at the Observatory, and for this reason he had not had the instrument opened for the film record to be developed. Normally the instrument was only opened once a week, but if he had thought that there was any possibility of a record having been made he would have had the film developed immediately. Experience had shown that shocks reported from country districts were generally purely local in character, and the earth waves never reached the recording apparatus at the Observatory, though this apparatus was influenced, by the more deeply seated waves coming from earth movements at much greater distances. The record on the seismograph would be developed on Thursday morning.

1925 09 05 at 19:05 UTC, Castlemain

The Argus Monday 7 September 1925, Page 17

VIOLENT EARTH TREMOR.

Castlemaine Residents Alarmed.

CASTLEMAINE, Sunday — Residents of Castlemaine and district were awakened this morning shortly after 5 o'clock by a violent earth tremor. A loud crash was followed by the swaying and creaking of houses and the rattling of windows and crockery. Many persons left their beds in fear but the shock was of short duration. In a number of houses crockery was shaken from kitchen dressers and broken. Otherwise no damage was done. Residents recall a similar shock about 10 years ago.

Shock Felt at Bendigo

BENDIGO Sunday. — Many persons were awakened at about 5 o'clock this morning by an earth tremor which caused buildings to vibrate for a few seconds. The tremor was felt throughout the district, but it did not cause any damage to property.

It was also reported felt on good authority in East Malvern:

The Corowa Chronicle Wednesday 9 September 1925, Page 2.

AN EARTH TREMOR.

A pronounced earth tremor, which lasted several seconds, was felt in various parts of Victoria shortly before daybreak on Sunday. As most people were asleep at the time, and as the shock was not sufficiently violent to wake heavy sleepers, the tremor passed unnoticed in many places. Some people, however, were awakened by the rattling of windows and creaking of the wood work of their homes. At East Malvern the tremor was felt distinctly by a number of residents a few minutes before 5 o'clock. At the Sacred Heart Convent, Burke-road, some of the nuns, who had already risen, said the whole building seemed to shake for about ten seconds.

With an epicentre southeast of Castlemain, the minimum magnitude is about 4.7.

1927 03 22 at 12:30 UTC, Benambra

The Yackandandah Times Friday 25 March 1927, Page 1.

Benambra Earth Tremor. On Tuesday, about 10.30 p.m., a most pronounced earth tremor was felt throughout the district. Buildings shook and crockery rattled. Persons sitting in chairs felt the shock distinctly, causing quite a scare to many.

The next earthquakes triggered a small swarm in the Euroa region of north central Victoria that seems to have ended with a bang; unusually the largest earthquake was the last perceptible event of the sequence. Undoubtedly there were hundreds more smaller unreported/unfelt ones.

1927 05 14 at 19:00 UTC, and 1927 05 15 at 14:00 UTC, Seven Creeks near Euroa

The North Eastern Ensign Friday 20 May 1927, Page 3.

'Quake at Euroa. EARLY MORNING EXPLOSIONS EUROA RESIDENTS ALARMED

Loud explosions immediately followed by several severe earth tremors have alarmed the residents of Seven Creeks, Kelvia, Kithbrook and other small country places near Euroa on Sunday and Monday. Seven Creeks seems to have fared the worst. At 5 on Sunday morning and at 2 on Monday morning, members of Mr Ian Currie's homestead were aroused by loud explosions similar to those caused by blasting. A rumbling sound followed, house furniture shook, the crockery rattled and the dogs howled as if in fear. On each occasion the earth tremors were of several minutes' duration, and residents experienced a wierd feelings. At Kithbrook prolonged rumblings were experienced on Sunday morning, and were immediately followed by the shaking of houses. Similar occurrence took place at Kelvin, and Mr N. Mackrell's house. Here again the dogs endeavored to seek shelter indoors.

1927 05 17 at 09:00 UTC, at least 7 shocks felt Euroa

Riverine Herald Thursday 19 May 1927, Page 2.

EARTH TREMORS AT EUROA RESIDENTS ALARMED

EUROA, Wednesday

There has been a recurrence of earth tremors in the Seven Creeks district, which have extended to Castle Creek, Kelvin View, and other places in the hilly districts around.

At 2 p.m. yesterday there was a tremor, and about 7 o'clock last night one of the most severe there has been took place. Five slighter 'quakes were noted during the night.

The explosion, rumbling and vibration alarmed the residents, and gave them a most uncanny feeling. At Mr. F. Elgin's, at Castle Creek, a Gloria light bulb was shattered. Domestic animals showed great uneasiness and alarm.

Last night's tremor extended to Euroa township, the earth movements being felt, in the brick residences of Messrs. E. Stribling and Jas. Elgin. The crockery in the latter's house rattled.

The area over which the disturbances are occurring is a volcanic belt of country extending from Bald Hill, near Mr Chomley's Killeen Homestead, to Shean's Creek. Great speculation is rife as to the cause of these alarming happenings. When they occur in the night the beds of the residents rock.

1927 07 10 at 08:30 UTC, Euroa

The Northern Ensign Friday 15 July 1927, Page 3

FURTHER SHOCKS AT EUROA. After an absence of tremors for some weeks a severe earthquake shock was experienced at Seven Creeks, Gooram, and Euroa at about 6.15 p.m. on Sunday. There was the usual explosion and continued rumbling, with the rattling of crockery and the howling of terrified dogs. The centre of the disturbance seemed to be in the granite country of Seven Creeks and Gooram. Previous disturbances were felt only in brick residences in Euroa, but this shock was much more pronounced. At one home the family were having tea at the time, and were considerably alarmed by the tremor. The occupants of wooden buildings all became alarmed by a noise as of a collision and the vibration of the building.

1930 06 17 at 21:05 and 06 18 at 01:30 UTC, Omeo

The Argus Thursday 19 June 1930, Page 14.

EARTH TREMOR AT OMEO.

OMEO, Wednesday. —A severe earth tremor was felt at Omeo this morning shortly after 7 o'clock. Buildings trembled and crockery rattled in many dwellings. Residents at Ensay and Swift's Creek also report similar experiences. The shock was accompanied by a loud rumbling noise. Another tremor occurred at half-past 11 o'clock.

Gippsland Times Monday 23 June 1930, Page 4.

EAST GIPPSLAND SHAKEN BY EARTH TREMOR

Houses Tremble and Crockery Rattled

What in the opinion of old residents was one of the worst earth tremors felt for a great number of years shook East Gippsland early on Wednesday morning last. Shortly after seven o'clock many residents, who were still in bed were awakened by loud intermittent rumblings like distant thunder which which caused dwellings to tremble and the crockery to rattle eerily on the shelves. Reports to hand seemed to indicate that the shock was the best pronounced in the mountain areas. At Omeo the low rumbling was distinctly audible and the echoes as they died away among the hills and the gorges produced a decidedly uncanny effect. In the township the rattling of household crockery and the trembling of buildings was most pronounced. Old residents at Bindi and Tongio at the foot of the Dividing Range stated it was one of the severest shocks ever experienced in those parts. At Ensay South, it was reported that the noise misled inmates of the hotel in the belief that some person was perpetrating a practical joke rolling barrels along the front verandah of the building. Getting up to investigate they were surprised to find nothing amiss. The shock was also felt on the foothills around Bruthen. The windows and crockery at Mr. R. Duke's residence were rattled and similar experiences were reported from homes of Mr. J. Heard, Mrs. Forsyth and from the Bruthen Inn. A lad milking the cows in the hotel yard was reported to have noticed the cow bail shaking. Another shock was experienced at Omeo at about 11:30 a.m. on the same day.

1931 03 14 at 21:00 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.

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.

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

1931 04 17 at 03:51 UTC, Benalla

Benalla Victoria seems to have been close to the epicentre of this earthquake that was reported felt from Rutherglen in the north to Mansfield in the south.

The Argus (18 April 1931) reports that a chimney collapsed in Mr McLean's house in Benalla.

The North Eastern Ensign (Benalla, VIC.) Friday 24 April 1931 Page 3:

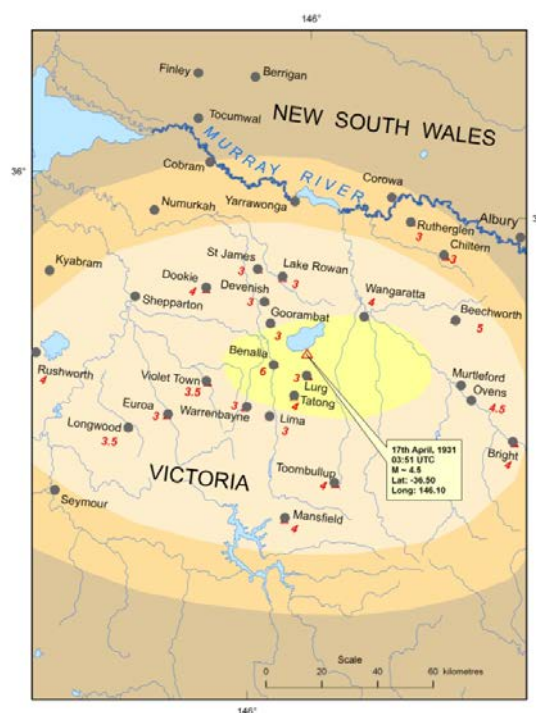
EARTH TREMOR AT BENALLA CONSTERNATION AMONG RESIDENTS. SHORTLY before 2 o'clock on Friday last Benalla suffered from a severe earth tremor which caused much consternation among the residents. The tremor was accompanied by a rumbling like thunder, and business people rushed from their shops while residents left their homes to ascertain the cause. The earth shook, and in many instances some weird experiences were felt.

The Governor, Lord Somers, was being entertained by local returned soldiers at the Benalla Hotel at the time and those in the dining room felt the tremor. Members of the staff of the State Electricity Commission who were busy at their work got a rude awakening when the desks began to move and Mr. Bob Rennle was hurled to the floor. They apparently thought that they would be safer downstairs, and lost no time in gaining the ground floor.

Several cracks were noticed in the building, particularly on the ground floor. A large crack was also noticed in the wall of one of the rooms at the High School, and several openings were also observed at the Convent. A rack of furs at the shop of T. J. Davis and Co. were hurled to the ground and goods in other shops in the town left the racks.

Figure 29 Isoseismal Map, Benalla earthquake, 17 April 1931.

Mr T. Murrphy of the State Electricity Commission was effecting repairs at the top of an electric light pole when he felt the shocks and quickly returned to the ground. The feeling was uncanny, and his experience was an unenviable one. In the private houses crockery rattled on the shelves, furniture shook and generally



everything moved. A stack of motor tyres at the store of the State Electricity Commission in Bridge Street was knocked down.

The shock was felt around Warrenbayne, Lima, Lurg, St. James, Devenish, Lake Rowan, Goorambat and other parts. It was severely felt at Tatong and Toombullup where the tremor was preceded by a heavy rumbling noise that resounded through the gullies. Residents were terrified at the experience which 'they' declare they do not hope to feel again. An old prospector who was sitting on a box on the bed of a creek was terrified when the box swayed backwards, and forwards and he narrowly missed being hurled into the creek. Mr Ern Dickson who is also prospecting in that locality had an unenviable experience. He was down a 17 foot shaft, when the earth began to sway and he declared he never got out of anything quicker in his life. A table at the home of Mr Sims moved about six inches and the crockery in the kitchen of all the houses clinked on the shelves.

The Melbourne Observatory seismograph recorded a small earthquake disturbance from a comparatively near source on Friday. The first signs on the record occurred at 1h. 51m. 7s. p.m. This corresponds closely with the time of the tremor in the Benalla district.

1932 09 02 at 18:22 UTC, Mornington

Holmes (1933) was acting government astronomer at the time of this earthquake and he must have been thrilled receiving hundreds of phone calls from excited residents of southern Victoria reporting an earthquake. A good physicist, he sent out a questionnaire via *The Argus* newspaper and more than 200 people sent responses from which he compiled an isoseismal map. Unfortunately Holmes did not plot his assigned intensities nor did he bother to include the MM3 isoseismal contour and the questionnaire responses have not been unearthed, so I decided to redo a map just from the 46 newspaper reports I found, partly to check our method.

The two maps are published below. The epicentres agree very well. The magnitude computed from the radius of perceptibility is ML 5.1 which is rather larger than the 4.6 quoted in Everingham and others, 1982. The larger magnitude may be warranted considering the earthquake was recorded on the Sydney Observatory seismograph (and on the Riverview station as expected). The value of ML 5.1 is commensurate with Ms 4.6 from Riverview (Everingham and others, 1982).

Many reports claim there was little or no damage but then, like the *Frankston & Somerville Standard* of Saturday 10 September 1932 they itemise the damage.

EARTHQUAKE. Mt. Eliza was severely shaken by the earthquake last Saturday. Little serious damage was done. At Mt. Eliza store several bottles, tins and other goods were thrown from the shelves. At the public hall a large crack has appeared in the north wall, but as this is only a temporary wall the damage will not cause the committee serious concern. At the Church of St. James the Less the tremor cracked one of the arches. The damage is so serious that repairs will have to be effected.

A public appeal was mounted for funds to carry out the repairs on the church, one of the oldest in the State and this work was completed in December the same year.

The same paper reported that the earthquake was felt elsewhere:

SOMERVILLE - THE EARTH TREMOR. Although no serious damage was done at Somerville by the earth tremor which disturbed a large number of people of southern Victoria on Saturday morning last, a number of minor damage was reported. Walls of several brick buildings were cracked, plaster fell from walls and ceilings, pictures and mirrors fell from the walls and bottles and other articles were thrown from shelves. In one case a washhouse chimney was shattered. It is interesting to note that in quite a number of cases the first impression was that a large motor car or truck had crashed into the house, and in several cases it was thought that horses were either in the house or rubbing against or kicking at the walls. One man on springing out of bed grabbed a gun and cartridges in preparation for a supposed burglar. In comparing impressions most people admitted being more or less alarmed and even terrified. Young children were the least affected, some of them sleeping soundly throughout the disturbance.

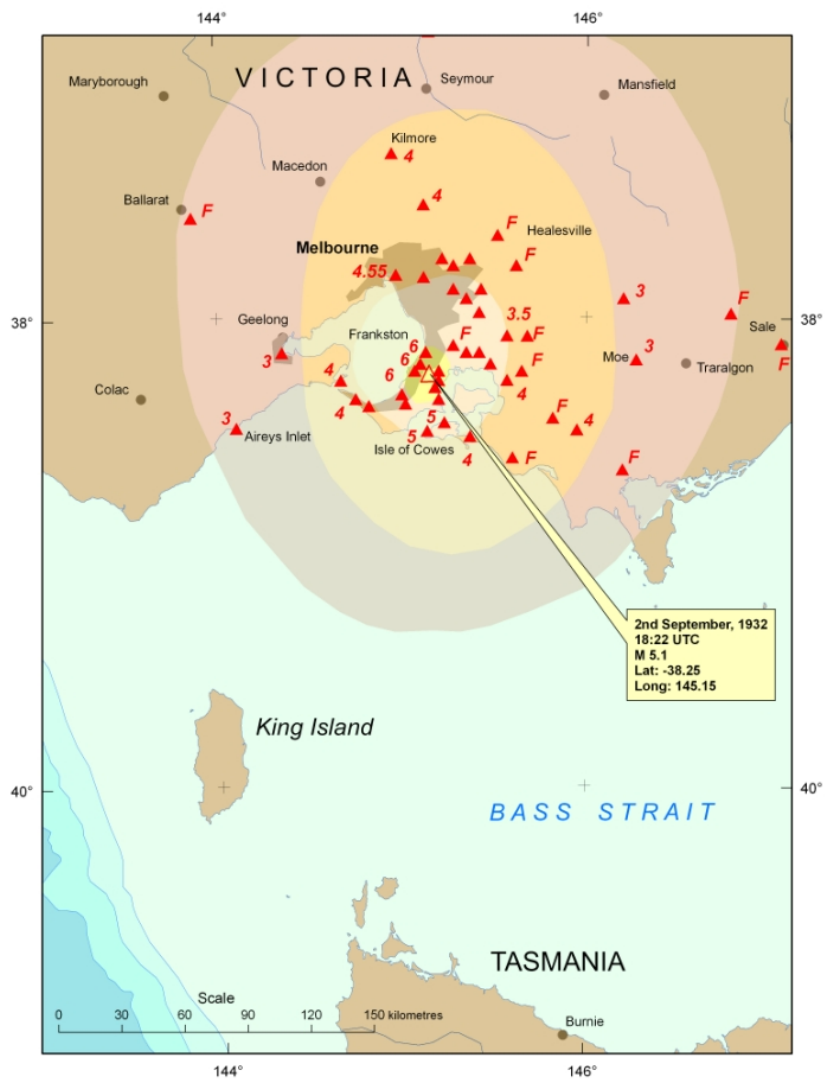
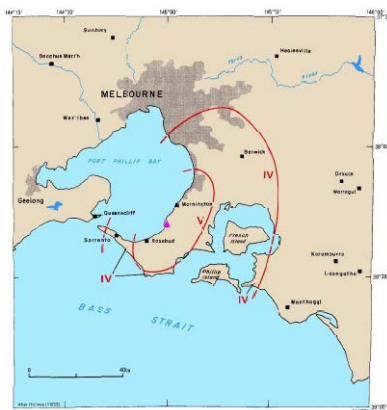


Figure 30 Comparison, at a similar scale, of isoseismal maps; (i) right, the Mornington earthquake of 2 September 1932 from Newspaper reports alone, and (ii) above, the original by Holmes (1933), from the newspaper reports and questionnaires. Holmes did not plot individual point assessments or an isoseismal delineating intensity 3, the felt area. The epicentres are virtually identical, as much as the intensities allow.

at Tyabb:

Many residents felt the severe earth tremor at 4.20 a.m. last Saturday. Old-time residents state that 40 years ago a similar tremor occurred. (Ed. this might refer to the 1892 earthquake off NE Tasmania).

Underwood (1972) lists 2 aftershocks the same day at 20:35 and 20:41, both recorded on the Milne Shaw seismograph at Melbourne Observatory MEL.

1932 09 19 at 15:00 UTC, Benalla

During this search for earthquakes in Victoria in 1932 I came across many reports of a series of earthquake near Benalla in September. *The Argus* of Wednesday 21 September 1932 reports:

EARTH TREMORS AT BENALLA. SLIGHT DAMAGE TO BUILDINGS,

BENALLA Tuesday. Benalla residents were startled shortly after 1 o'clock this morning by an earth tremor which shook the town. Most residents had retired and when the shock was felt many left their homes. Those living in Bridge street rushed into the street in their nightclothes to ascertain the cause of the disturbance. In some of the buildings crockery was displaced and articles fell from mantelpieces. The shock resembled a sharp gun report, and numbers of residents thought that a safe was being blown open. Two railway detectives were on duty, believing that a robbery was being perpetrated at the Broken River butter factory, hurried to the factory.

The principal buildings affected were the State Savings Bank and Noonan's Commercial Hotel, where large pieces of plaster were broken from the walls. At the Bank of Australasia the blinds in the banking chamber fell.

A second tremor was felt at about 3 o'clock, but it was much milder. It was felt also at Tatong, Devenish and Thoona. This is the second tremor which has occurred in Benalla in the last 18 months (see April 1931 earthquake above).

There are puzzling details in the *Riverine Herald* (Echuca) Wednesday 21 September 1932, page 2, specifically a list of places where this earthquake wasn't felt and the final observation that there were no cracks in the earth.

Figure 31 Limit of felt area of the early morning earthquake on 19 September 1932. The mauve dots indicate where it was reported not felt, the focus assumed to be under Benalla. This would indicate a maximum magnitude of 3.5.

EARTHQUAKE AT BENALLA

Houses Damaged MELBOURNE, Tuesday.

Earth tremors which shook plaster from ceilings, rattled windows, and cracked walls, awakened Benalla about 12.50 a.m. today.

Long-distance telephone inquiries showed that, the shock had not been noticed at Shepparton, Euroa, Beechworth, Wangaratta or Violet Town. This suggests that it was localised in the Benalla District.

Benalla people think the tremor might be allied with the earthquake in Gisborne, New Zealand, last Friday. About two days after the Napier (New Zealand) earthquake in February, Benalla experienced a tremor similar to that of today. "It is most unlikely that there is any connection between the New Zealand earthquake and this one" said the Government Astronomer (Dr Baldwin) today. "It is probably pure coincidence."

The Observatory has received no report of the Benalla tremor. The seismograph record will not be developed until Friday, but Dr Baldwin thinks it improbable that this instrument will have recorded the shock.

The shock was preceded by a rumbling noise which sounded like a distant explosion. Then came a distinct trembling which passed across the town evidently travelling from north to south.

In brick houses it seemed as though somebody were bumping against the walls. Plaster crashed from the ceilings in about 12 homes, and several walls were cracked. In weatherboard houses it seemed as though the walls were being twisted and there was a creaking of roof beams.

Nearly everyone in the town was awakened. Those who were in bed felt a distinct, lurch, and people who were sitting up felt themselves thrown forward. This was followed by a slight rocking movement.

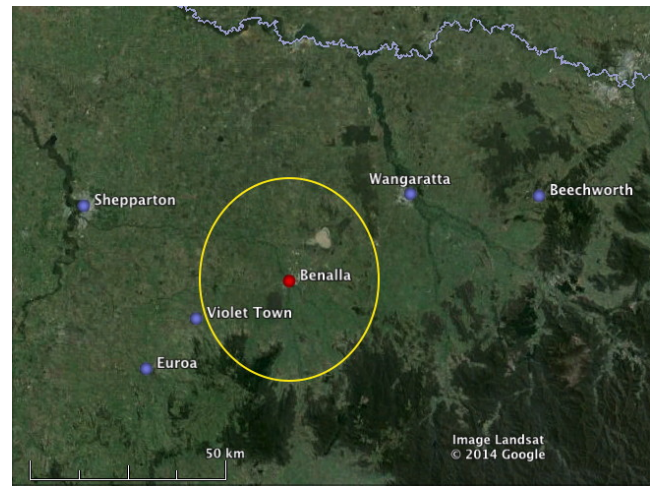
In one house a tall safe was thrown over, and a woman who was sitting at a table was jolted forward against her husband. Goods packed on the shelves of stores were moved out of position, but there were, no breakages.

The tremor lasted for about 10 or 12 seconds. Before it began, the atmosphere was heavy, and the conditions suggested the approach of a thunderstorm. After it had ceased, the air was tinged with a bluish haze. It was about 20 minutes before this dissolved.

No cracks were found in the earth.

1932 September 21 at 05:30 UTC, Benalla

The Argus of Thursday 22 September followed up with:



BENALLA SHAKEN AGAIN. RESIDENTS TERRIFIED. MUCH DAMAGE TO BUILDINGS.

BENALLA Wednesday - Residents of Benalla were terrified this afternoon by another earth tremor following a slight tremor which was felt this morning at half-past 3 o'clock. This was followed by a rumbling which lasted about five minutes.

At half past 3 o'clock this afternoon the second tremor came with terrific force, and it resulted in much damage to buildings while many persons were thrown with great force from their seats. Probably the worst damage was done at the offices of Mr. R. P. Lewers, solicitor. He was seated at his table and narrowly escaped being struck by falling plaster. Large bundles of files which were stacked away on racks were scattered about the room. A large crack occurred in the walls at the Bank of Australasia where some damage was done by the tremor on Monday morning. Pictures were scattered over the floor, and much plaster was broken from the walls. Large cracks were observed at the fire brigade station. Most damage occurred at the residential quarters where part of the wall shifted for at least two inches.

Plaster was broken in many places at the post-office and a large crack was noticed at the Lands office, which adjoins the offices of the Country Roads Board. A chimney fell at the residence of Mr. W Say, and a valuable chandelier was broken. Mr. J. Burns who was in a cafe at the time of the tremor fainted and was removed outside. Three of the main clocks in the town stopped at the moment of the tremor. They were the clocks outside the post-office, at the goods shed and at the railway station. The National Bank chambers were strewn with broken plaster. In private homes large cracks were noticed in the walls and a considerable amount of crockery was broken. At some homes many valuable ornaments fell and were broken to pieces.

The tremor came with more force than the one felt early on Monday morning. Occupants of shops in Bridge, Carrier and Nunn streets left the buildings hurriedly and rushed into the streets in an excited state.

These September 1932 events are probably part of a nested mainshock/aftershock sequence within the 1931 earthquake sequence and not an independent set of events. There were insufficient reports from other towns to compile an isoseismal map so the magnitude is estimated at ML 4.0 ± 0.3; it did damage so it was bigger than ML 3.5, on the other hand it was not widely felt like the April 1931 earthquake so was less than ML 4.5.

The 1930s was an active decade for Victoria, two further earthquakes have been 'discovered', one in 1937 and then another two years later which was widely felt.

1932 10 26 at 03:08 UTC, Boort

Advocate Thursday 27 October 1932, Page 7.

Earth Tremor in Victoria.

MELBOURNE, Wednesday. — An earth tremor — the most severe experienced in the area — occurred at Boort at 1.10 p.m. to-day. Many residents hurriedly vacated their homes. Houses momentarily rocked, plaster fell from walls, windows rattled, and clocks stopped.

1933 01 16 at 21:15 UTC, Benalla aftershock

Albury Banner and Wodonga Express Friday 20 January 1933, Page 8.

ANOTHER EARTH TREMOR AT BENALLA

Shortly after 7 a.m. on Tuesday, when many people were in bed, another earth tremor was felt in Benalla (Vic.) and district. Buildings shook, but as the tremor was not severe, and only lasted a few seconds, no damage was reported. This is the second tremor since Christmas, and the inhabitants are taking very little notice of them. Although six tremors have happened in the district during the last few years, the dairying district of Warrenbayne has only once been affected.

1933 05 19 at 20:00 UTC, Benalla aftershock

The Argus Monday 22 May 1933, Page 7.

EARTH TREMOR AT BENALLA.

BENALLA, Sunday. —An earth tremor was felt in the district about 6 o'clock yesterday morning. It lasted only a few seconds, and, as it was slight, it did not alarm residents. After a series of about four earth tremors last year, one being very severe, Professor Skeats, of the University of Melbourne, said that there was no cause for alarm, as he considered that they were due to a movement of earth along "fault planes" somewhere in the district.

1933 07 26 at 19:05 UTC, Bairnsdale

Gippsland Times Monday 31 July 1933, Page 5.

Shortly after 5 a.m. at Bairnsdale on Thursday an earth tremor occurred. The disturbance was felt in the centre portion of the town and it lasted for several seconds. It was accompanied by a rumbling resembling distant thunder. The tremor was also felt at Bruthen.

1933 11 30 at 06:50 and 07:10 UTC, Benalla aftershock

The North Eastern Ensign Friday 1 December 1933, Page 2.

EARTH TREMORS FELT IN BENALLA YESTERDAY. LAST year Benalla was subject to severe earth tremors, which did much damage, and to the surprise of many, two tremors were felt in Benalla yesterday afternoon. The first occurred about 4.50 with a loud rumble which shook crockery, rattled windows and a general disturbance could be felt in the main buildings of the town. This was followed by a second one about twenty minutes later which was not so severe. The residents are beginning to treat the tremors lightly owing, to their frequency. In the past it has been noticed that where there have been tremors one day that it is generally followed by another one within a few days.

1934 07 26 at 19:05 UTC, Bairnsdale and Bruthen

Gippsland Times Monday 31 July 1933, Page 5.

Shortly after 5 a.m. at Bairnsdale on Thursday an earth tremor occurred. The disturbance was felt in the centre portion of the town and it lasted for several seconds. It was accompanied by a rumbling resembling distant thunder. The tremor was also felt at Bruthen.

1934 08 01 at 21:05 UTC, Benalla aftershock

The North Eastern Ensign Friday 3 August 1934, Page 2.

ANOTHER EARTH TREMOR. Benalla was visited by another earth tremor on Thursday morning last shortly after 7 o'clock. It lasted only a few seconds, no damage being done to buildings.

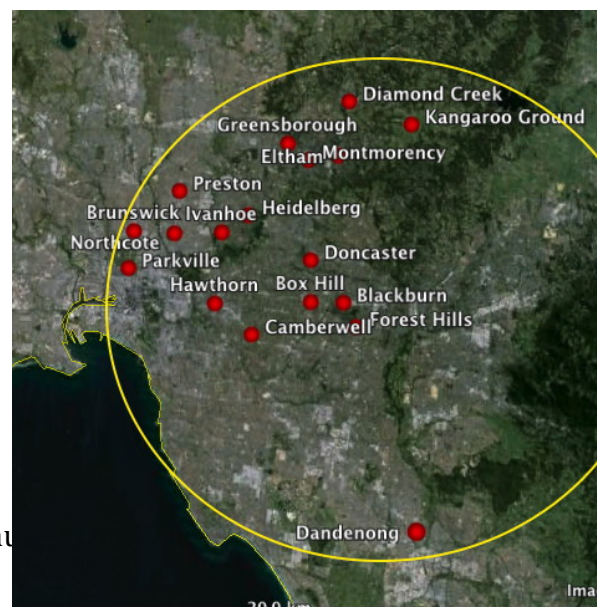
1935 06 18 at 17:50 UTC, Melbourne

The Argus Thursday 20 June 1935, Page 11.

Figure 32 Felt area of the 18 June 1935 earthquake under Melbourne's northeast suburbs. Only magnitude 3.2, the epicentre just east of Forest Hills has an implied mid-crustal focal depth.

EARTH TREMOR IN SUBURBS NOISE LIKE EXPLOSION REPORTS OVER WIDE AREA

Windows rattled, plaster was dislodged, and householders were awakened yesterday



morning by an earth tremor which shook the northern and north-eastern suburbs at 3.50 a.m. Although the barograph, which is used at the Meteorological Bureau to record atmospheric pressure, was affected by the vibration, the seismograph at the Melbourne, Observatory allowed no appreciable record of the shock.

Accompanied by a noise which many people mistook for an explosion, the tremor was felt at Hawthorn, Camberwell, Box Hill, Northcote, Preston, Parkville, Brunswick, Ivanhoe, Heidelberg, and along the Plenty River valley and Doncaster. At Seven Creeks, near Euroa, a slight tremor was felt.

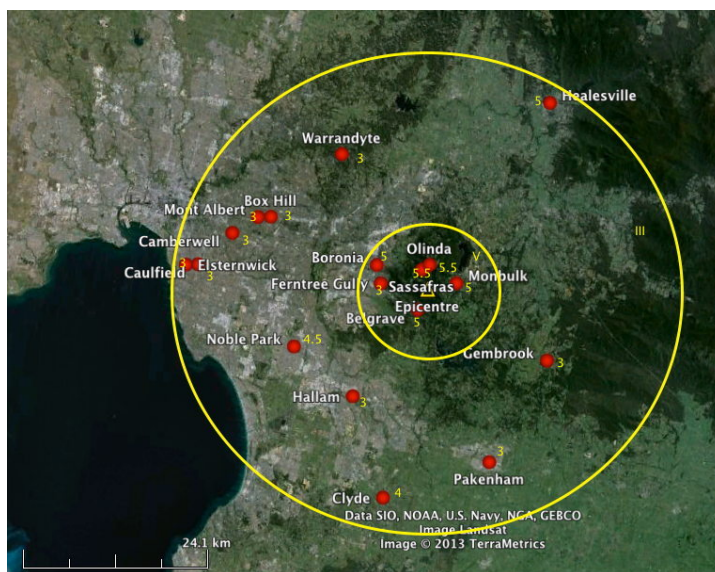
The same day's *Camperdown Chronicle* on page 2 had a more extensive list of places where the earthquake was reported.

Earth Tremor Shakes Suburbs. An earth tremor was felt by many people in the eastern and north-eastern suburbs between 3.30 and 4 a.m. yesterday. Residents were awakened by the rattling of furniture, and plaster was dislodged in some houses. The noise accompanying the tremor was described by some people as being like an explosion. Others said it sounded like a roll of thunder. At Preston the police wireless patrol rushed to the railway station, fearing that an attempt had been made to blow the office safe. The suburbs in which the tremor was felt included Hawthorn, Camberwell, Box Hill, Northcote, Preston, Ivanhoe, Heidelberg, Blackburn, Forest Hills, Greensborough, Eltham, Kangaroo Ground, Montmorency, Doncaster and Diamond Creek.

1937 June 17 at 19:55 UTC East of Melbourne – an earthquake related injury

This and the following earthquake were missed in the first draft of this report because the newspapers had not then been scanned, though both are mentioned by Underwood (1972). Both were felt in Melbourne suburbs so it was considered important to get a location and approximate magnitude. Assigning either of them to a particular fault would be imaginative given the uncertainty in the locations, but the June 1937 event was attributed at the time to Selwyn's Fault.

Figure 33 Isoseismal map of the June 17 1937 earthquake, showing just the MM3 and MM5 isoseismals.



The June 1937 earthquake was widely reported in the media though tracing the stories was problematic, mention made in the smaller rural newspapers. Many people were awakened by the shaking at 5:55 am local time and goods were shaken off shelves at Sassafra and Olinda. Most of the reports were brief noting that the earthquake was felt with no other details.

The magnitude is about 3.6 based on the felt area shown in the figure.

The Argus of Monday 21 June 1937, Page 10 reported an injury thought to be related to this earthquake.

Believed to have been loosened by the earth tremor which occurred on Friday morning, a small rock fell from the face of the municipal quarry at Moorooduc yesterday, and, after descending about 150ft., struck Thomas Evans, of Pearcedale, aged about 45 years. Evans received a fractured arm, and was removed to the Alfred Hospital.

1938 06 15 at 00:20 UTC, Bairnsdale

Gippsland Times Monday 20 June 1938, Page 2.

EARTH TREMOR In Bairnsdale District Shock Felt Most in Brick Buildings The most pronounced earth tremor felt at Bairnsdale for 50 years occurred on Wednesday morning about 10.20 a.m. It was felt throughout Bairnsdale, Wy Yung, Lucknow, and in Gippsland East. The counter at the Bairnsdale Post Office vibrated for several seconds, and at the Bairnsdale Court House the tremor was very pronounced. At the Prince Regent Theatre, Mr. Arnold Glover, stated the noise made by the tremor in the empty building, resembled that which would be made by a number of men walking on the roof. At other brick buildings, such as banks, the Bairnsdale District Hospital and various shops, the tremor was felt for several seconds. Out of the town, at Lucknow and in the Tambo Upper and Bruthen districts, residents stated that the tremor resembled that felt immediately after a loud explosion, such as when lightning strikes the earth. There was a mild tremor about two years ago, but the occurrence on Wednesday was the most pronounced since several severe tremors occurred about 50 years ago, which were accompanied by a rumbling noise. At Clydebank the tremor was felt by some farmers while having morning lunch.

1938 03 24 at 20:03 UTC, Riverina area NSW.

Advocate Saturday 26 March 1938, Page 7.

Country Towns Rocked

MELBOURNE, Friday.

A severe earth tremor alarmed residents of northern districts of Victoria and southern portions of New South Wales soon after 6 a.m. to-day. Buildings in many towns rocked for almost a minute, throwing crockery from pantry shelves to the floor. Reports from country centres stated that the tremor was preceded by a loud rumbling, similar to thunder or a heavy truck passing over an asphalt yard.

Seismograph recordings at the Melbourne Observatory and the Sydney Observatory showed that the 'quake was farther below the earth's surface than usual and was not severe.

After the first shock had subsided two smaller tremors, lasting only a few seconds, were felt in a number of districts.

This earthquake was widely felt in north-central Victoria. Note the interesting comments about the fact it was recorded at Sydney and Melbourne Observatories and its supposed unusual focal depth.

1938 04 15 at 05:45 UTC, Foster

Daily Advertiser Monday 18 April 1938, Page 3.

EARTH TREMOR IN VICTORIA MELBOURNE, Saturday.

An earth tremor, the most severe experienced in the district, shook houses and rattled windows violently at Foster, in Gippsland, about 3.45 on Friday afternoon. The tremor was accompanied by a low rumbling, which accentuated the eeriness of the occurrence and caused residents to rush from their homes in fear. No damage has been reported.

1939 April 05 at 13:00 UTC, East of Melbourne

Almost two years after the June 1937 earthquake east of Melbourne discussed above, a slightly larger earthquake in the same general area was felt throughout Melbourne, not just the eastern suburbs but as far afield as Ballarat, Lorne and Kilmore, according to Underwood (1972). These three places were not found listed in newspapers available at the time of this study.

The epicentres of the June 1937 and April 1939 events may well be the same, though not shown as such here.

The Argus, Thursday 6 April 1939, Page 1.

TREMOR IN EARTH AFFECTS WIDE AREA

Melbourne, its suburbs, the whole bayside and nearer country districts were shaken at 11 o'clock last night by the most severe earth tremor that has been recorded in Melbourne for about 20 years. The tremor, which lasted about 30 seconds, was felt over an area extending from Queenscliff to Ringwood and Bayswater. Brick houses shook, windows rattled, crockery was dislodged, and pictures were tilted or fell from walls.

Hundreds of persons were awakened by the shock, and the Melbourne Observatory and police stations were telephoned by many alarmed inquirers. Throughout the suburbs and hill country rumbling noises were heard at 11 p.m., and were followed by severe vibrations.

No Major Damage

No major damage was reported, although the shock was felt in the city, and at Surrey Hills, Ivanhoe, Camberwell, Hawthorn, Deepdene, East Malvern, Hampton, West Melbourne, Canterbury, Camberwell, Rosanna, Coburg, Blackburn, Mitcham, Bayswater, Ringwood, Kew, Murrumbeena, Bonbeach, Carrum, Seaford, Geelong, and Queenscliff.

At Carrum the Stationmaster (Mr. Gregson) hastily left the booking-office because it shook so severely that it seemed likely to collapse. In several suburbs the shock was felt as people were leaving the picture theatres, but in no instance was anything resembling panic reported. Several people who were awakened by the tremor described it as resembling a heavy motortruck being driven past their rooms. At Queenscliff the shaking was so severe and the rumbling so loud that some residents thought that the fort had unexpectedly gone into action. Early to-day the Railways Department had received no reports of stoppages, but at Seaford the shock rattled the levers in the signal-box.

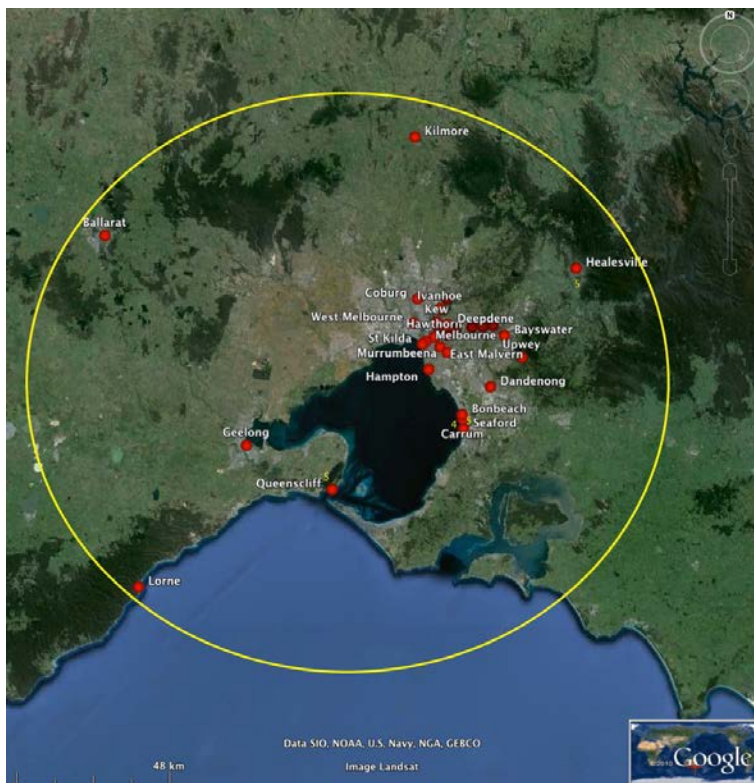
A report from Hampton said that after the first shock, which lasted only a few seconds, there was a second and much slighter tremor, which was not felt, but which caused vibrations in water for six minutes.

Expert's Theory

The seismograph record at the Observatory will be developed this morning when the scientific staff will endeavour to trace the course and origin of the tremor.

The seismologist (Mr. W. Holmes) said last night that from the wide area affected it appeared that the most probable explanation of the disturbance was an earth movement along one of the fault lines in the basic rock structure of the earth's surface. This would send out "waves" which would be felt generally.

Figure 34 The felt area of the 5 April 1939 earthquake outlined by the yellow ellipse, is commensurate with a magnitude of 4.1.



Earth tremors of this kind were not unusual in Victoria, but that which occurred last night was of much greater intensity than the average.

The epicentre is not well fixed; at Carrum, the station-master made a hasty retreat from the ticket office; at Hampton, water was disturbed for several minutes; and at Queenscliff people thought the nearby fort had gone into action. Between 11 and 11.30 more than 2000 'phone calls were handled by Central Exchange. Radio stations and newspapers were besieged for information about the

tremors by startled citizens. The Government Physicist (Mr. Holmes) was in a car at the time, and did not feel the shock (as usual for seismologists).

1940 01 31 at 19:00 UTC, Melbourne suburbs – activity cyclic

News Thursday 1 February 1940, Page 7.

Earth Tremor In Melbourne MELBOURNE, Thursday.—A slight earth tremor awoke some Melbourne people at 5 a.m. today. St. Kilda, South Yarra, and Armadale were among suburbs affected. The observatory had one report from St. Kilda, but will not develop its seismograph record until tomorrow. The tremor was accompanied by a short rumbling noise. An observatory official said that although several tremors had been reported in Victoria recently, no conclusions could be drawn or explanation offered by the observatory. It was possible that such things occurred in cycles.

1944 11 02 at 14:05 UTC, Marysville

The Argus Saturday 4 November 1944, Page 6.

EARTH TREMOR NOT EXPLAINED

Origin Probably In Bass Strait

Until recording plates at Melbourne Observatory are developed on Monday it is unlikely that a definite conclusion will be formed regarding the cause and extent of the earth tremor felt over the southern portion of Victoria early yesterday morning.

The tremor yesterday morning was felt over a wide area, extending from Mornington to Bunyip and many inland towns 50 miles from the sea front.

Professor E. S. Hills, of Melbourne University, said yesterday it was impossible at present to determine the cause and course of the tremor. Geological authorities would be helped in preparing a report if people who felt the tremor sent to the Observatory or University information recording the rattling of crockery, broken or rattling windows, movement of furniture, or cracked walls. This information would help in determining more accurately the nature, scope, and track of the tremor. It was undoubted that the earth movement which caused the tremor was of a minor nature in comparison with earth "shocks" felt in Victoria in the last 20 years.

The State Electricity Commission and Railways Department reported yesterday that no interruption to services had occurred because of the tremor.

The Sydney Morning Herald Friday 3 November 1944, Page 1.

Earth Tremor Near Melbourne

MELBOURNE, Friday.—A widespread earth tremor which shook buildings was felt in Melbourne, some suburbs, and hill centres within 50 miles of the city, shortly after midnight.

The shock appears to have been most severe through a belt of country running from Bayswater and Croydon to Healesville. No serious damage has been reported so far, but walls of houses were cracked at Thornbury and North Coburg.

The Argus story is devoid of details, not even that it was felt throughout Melbourne and Geelong, unlike newspaper accounts of earlier earthquakes. Gaskin (1947) published a paper about it, including an isoseismal map. The felt area of the map indicates a larger magnitude, 4.8, than the 4.0 assigned by Everingham and others (1982).

1946 03 08 – 13, three earthquakes at Benalla

Benalla Ensign Friday 15 March 1946. Page 5.

More Earth Tremors

Following slight tremors which were felt in the town on Friday last (7th March), a very severe one was experienced about mid-day on Wednesday last (13 March), when buildings rocked

for a few seconds. A few minutes later another slight tremor was felt. At the Benalla West School, the children in one classroom received such a shock, that within a second or two, all had disappeared outside.

1946 03 17 at 06:55 UTC, More than £2000 Damage in Benalla

Benalla Ensign Friday 22 March 1946, Page 1

OVER £2000 DAMAGE TO BUILDINGS - WORST IN BENALLA'S HISTORY - FURTHER SLIGHT TREMORS ON WEDNESDAY

Shortly before 5 p.m. on Sunday last, Benalla experienced the worst earth tremor in the town's history. Lasting only a few seconds, the tremor caused damage estimated at over £2000 to dwellings in the residential areas, while portions of the business sections also suffered. Although the tremor was felt over a large area in the Benalla district, the greatest damage was confined to a narrow strip on the north side of the railway line. A brick home in Gillies Street, was so badly damaged that it has to be rebuilt, while practically all the chimney tops of houses in Magennis Street were displaced. While slight tremors occurred on Wednesday, Sunday's unpleasant experience is still the topic of conversation.

DAMAGE IN MAIN SHOPPING AREA. It was strange that only portions of the north side of Bridge street suffered the most in the business section of the town. Mr Vin Hayes, who was the heaviest loser, had the unpleasant experience of finding broken bottles of wine, tomato sauce and honey stacked in shelves lying broken on the floor and the contents all mixed up together. It was a sight which Mr. Hayes and his staff will never forget. Three chemists Messrs. R. Deans, V. Say and G Say - also found many bottles removed from shelves, while damage was also reported by Mr R. Rumpff at Moran and Cato's. Some of the shop windows which had been decorated for the week-end trade, were a real medley, with articles strewn in all directions, and they were the centre of attraction the same night. **REBUILDING OF HOME NECESSARY.** The worst of all damage was viewed at the home of Mr and Mrs Farr, Gillies Street, where all the walls were so badly knocked about and the damage so extensive, that the building will have to be rebuilt, and arrangements have been made with a local building contractor to commence the work of rebuilding today. At the present time, Mr and Mrs Farr and their son, Dick, consider the building so unsafe that being unable to secure a temporary dwelling, have made temporary quarters in the sleep-out. A few doors down, Mr. H. Hardy found a chimney so badly affected that it will have to be re-built. The only house on the north side of Gillies Street, owned by the Railway Department, and occupied by Mr. and Mrs. O'Connell, was condemned following Sunday's damage. Further down the chimneys at Mr. Hossack's were turned almost at 45 degrees and will have to be completely rebuilt.

DAMAGE TO CHIMNEY TOPS. The new homes in Magennis street presented an unpleasant site, where practically every building had one or two chimney tops dislodged. At the three homes of Mr. Griffiths and his sons, Jack and Eddie, it has been found it necessary to have six chimney tops replaced, while damage was done internally to Mr. T. Howell's home. A crack in the bitumen on the roadway was also the result of the tremor. In other portion of the town, chimney tops were dislodged.

OTHER BUILDINGS SUFFER. While minor damage was done internally to many building by fallen plaster, broken mirrors, ornaments and bottles of jam, the tremor did considerable damage to others. At the Victoria Hotel large cracks were discovered in some of the rooms upstairs, the openings in some instances being very large. Cracks were also noticed in the High School, while the Arts and Crafts school showed signs of damage to the walls.

PATH OF TREMOR. The direction which the tremor travelled is still a debatable question among many of the residents. Although it is believed that it came in the direction of Coomalibee. It is remarkable that the portion of the town which suffered most was in the same path which the recent tornado travelled on reaching the town a few weeks ago. The cause of the tremor is unknown, but it is assumed that along that area is an underground

river. In 1932, the town was subjected to a severe tremor, and while it did much damage on that occasion, it had not the damaging effect as on Sunday, which was felt over a wide area in the Benalla district. In Melbourne, a slight tremor was recorded officially.

TREMOR FELT AT BADDAGINNIE While two very slight tremors occurred to Benalla on Wednesday, one of them was felt most severely at Baddaginnie (Ed. 10km WSW Benalla).

The *Riverine Herald* of 19 March 1946 claims the earthquake was not felt in Violet Town, only 25km away, nor are there reports from other centres, so the earthquake can't have been very large, but £2000 damage (~\$400,000 in 2015 dollars).

1946 09 09 at 19:50 UTC, East of Flinders Island Tasmania

Barrier Daily Truth Tuesday 17 September 1946, Page 1.

Severe Earth Tremor Felt In Gippsland

Melbourne, September 10. — Thousands of residents of Gippsland were awakened about 6 a.m. yesterday by a severe earth tremor. The tremor which was accompanied by a rumbling noise, shook houses for between 40 and 50 seconds before it ceased. It was felt from Orbost to Foster, on Islands in Bass Straight, and at Swansea, in Tasmania. First-Constable Fleischer, of Foster, said yesterday that the police station was rocking when he was awakened. A grandfather clock which was not going began to chime. He had made a tour of the area, but no serious damage had been reported. Most people had been awakened to find their homes rocking. Crockery had fallen off shelves in some houses. Some Foster residents said they had heard a deep, rumbling noise while the tremor lasted. A message from Orbost says the tremor was the severest felt there for many years. Houses shook, crockery rattled, and beds moved. The tremor approached from the sea, and appeared to pass inland. A few items of crockery and ornaments in houses in Orbost were damaged. The tremor was particularly severe on Wilson's Promontory, where all buildings rocked. It was also felt on Deal, Swan and Flinders islands. The officer in charge of the Harbour Trust 60ft. observation tower, which controls river traffic at the entrance to Victoria Dock, reported that the building twice shook violently shortly before 6 a.m. It felt as if a large ship had bumped the wharf heavily. Reports of the tremors were received at the Weather Bureau in Melbourne.

The epicentre of this earthquake was in Tasmania (Michael-Leiba and Jensen, 1992) but it shook Victorian towns strongly and such events need to be considered in any risk assessment for Victoria and Tasmania.

1947 04 13 at 16:55 UTC, Bendigo

Northern Star Tuesday 15 April 1947, Page 5.

EARTH TREMOR

IN VICTORIA

MELBOURNE, Monday. — Many Bendigo residents were awakened from sleep shortly before 3 o'clock this morning by a loud rumbling believed to have been caused by an earth tremor. Several people said they heard a sustained thunderous roaring noise for a few seconds. The noise was of shock. In a few instances rumbling was so severe that ornaments and crockery wobbled and fell on their sides. Many people rushed from the beds.

1947 06 09 at 07:00 UTC, Colac

Border Watch Tuesday 10 June 1947, Page 1

Earth Tremor at Colac.—Buildings were shaken and employees ran from business premises when an earth tremor was felt in Colac and the surrounding districts at 5 p.m. yesterday. The tremor lasted only a few seconds.

1948 05 26 (?) at 05:00 UTC, Doncaster

The Argus Thursday 27 May 1948, Page 3.

EARTH TREMOR

A slight earth tremor was felt in parts of Doncaster about 3pm. It lasted only a few seconds, and caused no damage.

1951 05 08 at 18:00 UTC, Wangaratta

The Argus Thursday 10 May 1951, Page 3.

TREMOR ROCKS HOUSES

Wangaratta, Wed.

Reports of an earth tremor came from outlying districts today. Residents of Edi, Meadow Creek, Carboor, and other King Valley townships, all reported having felt a slight shock between 3.30 and 4.15 a.m.

Some Wangaratta people also said they had felt it. Mrs. A. Brown, of Carboor, said that the house shook, crockery rattled, and furniture moved slightly. There was no wind or rain at the time, and no serious damage was done.

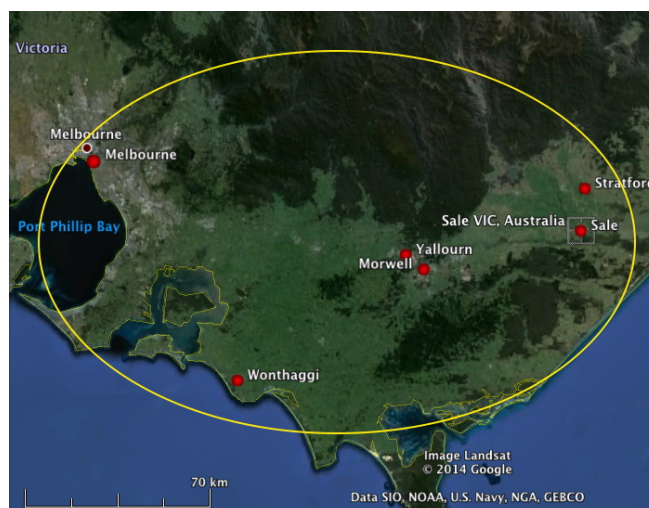
1951 05 28 at 15:45 UTC, Melbourne

Barrier Miner Tuesday 29 May 1951, Page 1.

Earth Tremor

Melbourne.—What was described as "a brief but violent" earth tremor shook Melbourne and towns of Morwell and Yallourn in the Gippsland area at 1.45 a.m. today. Beds shook, windows and crockery rattled, and night workers at the factory said the concrete floor rose visibly.

Figure 35 Felt area of the Gippsland earthquake on 28 May 1951.



It was also felt in Stratford, slightly in Sale, the worst in Yallourn and Wonthaggi. According to a Bathurst newspaper, the shock was recorded at Riverview Observatory, justifying our minimum magnitude of 4.6.

1951 06 04 at 16:23 UTC, Gippsland

The Argus Wednesday 6 June 1951, Page 3. Second tremor in week.

Tremors which shook Melbourne and some country areas early yesterday were probably shifting rock formations under the earth's crust in Gippsland, Mr. W. Baragwanath said last night. Mr. Baragwanath was, at the time, a geological consultant to the State Mines Department.

The tremor yesterday was the second felt in Melbourne in a week. It occurred between 1.45 a.m. and 2.33 a.m., and was felt in the metropolitan area, as well as at Leongatha and Erica, in Gippsland.

Mr. E. Newman, of Carween av., Mitcham, said he was awakened at 2.23a.m. by a creaking noise. His weatherboard house shook for about 10 seconds. Leongatha householders were awakened by heavy rumblings and the rattling of crockery and windows. Erica residents said the tremor was more like a gust of wind, followed by a slight movement of the earth's surface.

Could this event have been a meteorite like the following two events in November? If not the magnitude would have been about M 4.5 but there are few reports.

1951 11 04 at 15:30UTC, Melbourne meteorite?

Northern Star Tuesday 6 November 1951, Page 1

BLINDING FLASH, EXPLOSION IN VIC. TREMOR

MELBOURNE, Monday.—An earth tremor in the early hours of this morning rocked a 200-mile belt of Southern Victoria from Geelong through Melbourne to Gippsland. A blinding flash of blue-green light and a big explosion accompanied the earth tremors at 1.30 a.m.

The tremor was the heaviest in Victoria for many years, but no damage was reported. At Flinders Naval Base, a blinding light rose 1800 feet, flashed across Port Phillip Bay at terrific speed, then a loud explosion was heard. An able seaman said the floor of his room seemed to ripple.

One resident of a bayside suburb said the light was like an atomic explosion. A St. Kilda resident said his house shook like a leaf. Residents at Dandenong panicked and rushed into the streets as the tremor rocked their homes. A telephone exchange operator said the hills "seemed to wobble".

Professor L. H. Martin, of Melbourne University, said the disturbance was probably subterranean, but scientists were unable to explain the light.

Melbourne Weather Bureau has no seismograph to record tremors. In Sydney today, Father O'Connell, of Riverview Observatory, said his seismograph had recorded no activity in Victoria during the night.

This has all the hallmarks of a meteor, despite Prof Martin's assessment.

1951 11 14 at 15:25, Melbourne

News Thursday 15 November 1951, Page 7.

New Tremor in Melbourne

Melbourne, Thurs.: Melbourne and suburbs were shaken early to-day by another earth tremor. It was felt at 1.25 a.m. Some people reported a flash accompanying the tremor similar to that seen last Monday week. The tremor then was reported at 1.27 a.m. The Melbourne Harbor Trust building in the city shook as a "long-drawn-out rumble, like thunder, was heard by workers there, Mr. Harry Virtue said. "Windows rattled eerily, but we saw no flash," he said.

Mr. G. Carson, Hampton, said that his wife was awakened by what seemed to be a flash of light, followed by two tremors. Mystery rumblings in the Western District on Tuesday night and yesterday have puzzled officials. Although consistent, the noises—which sounded like heavy thunder—did not cause any damage. The disturbance was centred at Glen Ormiston, near Terang, but was felt to a lesser degree in surrounding townships.

Surely this too was a meteorite like that of 10 days ago, the area so large yet no damage, few felt reports and one of lights accompanying the shock.

1953 03 21 at 16:00 UTC, Tungamah meteorite

Wodonga and Towong Sentinel Friday 27 March 1953, page 3.

EARTH TREMOR AT TUNGAMAH As unusual phenomenon of an earth tremor combined with a vivid flash of light was seen and heard by people in the Tungamah district about 2 o'clock on Sunday morning. A car loaded with people was returning from Yarrawonga when suddenly the sky was lit up by a flash of light which then seemed to spread over the heavens in a couple of seconds. They heard no noise as the car was closed in. At the home of Mr. Andrew Mulquiney, "Glendalough," five miles from Tungamah and about

quarter of a mile from where the car was, all in the house were awakened by the dwelling trembling. Within seconds of the house trembling there was a terrific explosion followed by a flash of light. Frightened dogs in the backyard started barking. The first flash of light appeared to come from the north-east, but no reports of fire balls or meteors have been received so far.

1953 11 21 at 18:50 UTC, Benalla

The Benalla Ensign Thursday 26 November 1953, Page 1.

EARTH TREMORS ROCK BENALLA Residents Alarmed As Houses Swayed

Two earth tremors which rocked Benalla early last Sunday resulted in only minor damage, but caused residents over a wide area to rush from their beds in night attire. Many believed they were experiencing tremors which struck the town between 1938 and 1943, when considerable damage was done to many houses and buildings. The tremors were felt at 4.50 a.m. and at 5.45 a.m., the first being the most severe.

Few people were awake when the first struck, but those who were said the atmosphere was eerie before the rumblings commenced. Houses creaked, glassware and crockery rattled, and articles in many homes fell from shelves. Several reports of bricks being dislodged from chimneys and of walls cracking were notified over a wide area. The first lasted a couple of seconds, but the second was a sharp one, more like the resounding echo of a heavy gun being fired. As people rushed from their homes carrying children, some of whom were still asleep, they excitedly talked with neighbours, and recalled previous tremors. Many refused to go indoors again, fearing further shakings. One effect the tremors had was to alter alarm clocks.

Householders reported their clocks being an hour fast or slow after the tremors had passed. This caused some confusion as to the exact times of the tremors. The tremors, which were felt over a wide area, missed Winton Swamp. They were experienced at Chesney Vale and Swanpool. Police on duty reported the atmosphere being very still, and that a smell of sulphur was in the air. Although some elderly people suffered shock it was not sufficient to warrant medical attention. People in sleep-outs said it was frightening, as the walls appeared to swing in and buckle. The tremors were preceded by a hot, humid day on Saturday, followed by heavy thunder and rain in the evening.

The Argus Monday 23 November 1953, Page 2.

"Like a thunderclap"

SHARP EARTH TREMORS ROCK TOWN

A SHARP rumbling earth tremor woke and shook thousands of people in Benalla and district at 4.45 yesterday morning. Almost an hour later they were shaken by a second milder tremor.

The tremors rocked houses, dislodged bricks in chimneys, rattled windows, and brought down vases and pictures. In shops, articles were thrown from shelves. Both tremors lasted only a few seconds.

Mr. Stan Rogash, 36, of Byrne st., Benalla, said: "The house shook as though it had been hit by a truck, and there was a noise right overhead like a thunder-clap."

Mr. Len McQualter, of King st., said: "There was a rumbling sound, and the house shook. My bed bounced and moved, and a photograph fell from the wall." Mr. Les Frazer, of King st. said: "The rumbling noise took me back to the wartime battles." Mr. G. R. Craze, of Goorambat, said: "I felt as though somebody had got hold of the bed and pulled it. The timbers in the house creaked." Mr. F. Hernan, of Wenton said: "We had only one tremor, about 4.55 a.m. It was preceded by a loud clap like thunder, and a rumble."

It is most unlikely that this small M3.5 earthquake at Benalla was felt in Orbost as described.

Discussion

The period of this study ends on December 31, 1954 after which copyright prevents the ANL scanning newspapers. That is a great pity because there is a gap of about a decade until sufficient short period seismographs were established in Victoria; by BMR at Toolangi (1962) and Bellfield (1972), and by the ANU at Bogong (1963), Buchan (1964 and Mt Tassie (1964).

One of the drivers for this study was an attempt to recreate the Rev W.B. Clarke's lost catalogue of early Australian earthquakes. He used the newspapers, plus personal communications with colleagues in the states. The latter we cannot replicate but we can probably access more of the newspapers. A second driver was to establish a sufficiently long sample of earthquakes to compare the pre-instrumental period with the instrumental period and thirdly, in Gippsland, to enable a better comparison with other areas such as the long record of earthquakes in the Yass-Gunning-Goulburn area of NSW, rather than just the short post-1965 record.

This study has focused mainly on earthquakes discovered in a search of early scanned newspapers, supplemented by information in Underwood's (1972) extensive list, and some additions by Gibson and others (1981). Future research will be rewarded when more of the relevant newspapers have been digitized. More earthquakes were being edited even as we drew the line at the end of January 1915.

Comparison of Figures 1a and 1b is interesting for several reasons. Firstly, most of the epicentres in the two periods plot between 143° and 148° East. Secondly there is no obvious concentration of activity in Gippsland in the earlier period so the hazard, averaged over the whole period 1855 - 2014, is not any higher than the rest of the area of central Victoria including Melbourne. One of the surprising features of the historical seismicity map is the activity in the vicinity of Melbourne, resulting in a surprising number of earthquakes felt in the city, compared with Sydney for example.

The existence of the 1885 earthquake and relocation of the 1922 Bass Strait earthquakes should contribute to a re-assessment of earthquake risk in the Melbourne region, especially to the southwest of the city where there are special structures like the Animal Health Laboratory and a concentration of oil and gas storage facilities. Earthquakes in NSW, South Australia and Tasmania impact on earthquake hazard in Victoria and vice-versa.

As this study was nearing completion it was surprising to find the 1885 earthquake listed in the GA earthquake database with identical magnitude and similar location, the source AUST, but probably an extract from Gibson's unpublished catalogue (pers. comm.).

Improvements in the epicentres of historical earthquakes may be made when further local newspapers are scanned by the Australian National Library, or other sources such as diaries are made available to improve the isoseismal maps. There is always scope for improvement as Underwood (1972) pointed out 40 years ago.

Small earthquakes near the cities are as important as larger rural earthquakes to improve risk assessments to those cities, especially if the events can be associated with mapped faults.

Ground shaking attenuation is very rapid in Victoria so that unless a small to moderate earthquake occurs virtually under an urban area we should not expect significant damage. The 1903 Warrnambool earthquakes are a good example. The hazard calculation then can focus on relatively frequent small to moderate very close earthquakes or infrequent large earthquakes out to perhaps 50 km (given the recent Christchurch NZ experience). More focus should now be put on an exhaustive search for Recent fault scarps to develop more confidence in the apparent frequency of large earthquakes determined from extrapolation of the frequency of small to moderate earthquakes, now better known because of studies like this one.

Human activities are increasingly leading to earthquakes, whether pumping fluids underground for waste disposal or geothermal reservoir production, filling large reservoirs or mining. Historically, mining has shown a capacity to induce earthquakes, the hard rock mines of Victoria are no exception as the event near Bendigo in 1893 shows clearly. More recently fracking operations in

coal rich areas will no doubt provide many more examples. Such operations should be monitored closely with dense networks of seismographs, and the data made publicly available.

Appendix 1 List of earthquakes with a date and magnitude that affected Victoria and are discussed in this paper. The small earthquakes for which isoseismal maps were not produced have been assigned a magnitude of ML 2.5 to 3.5 being a reasonable balance between being felt only locally, but strongly enough to be noted in a newspaper, without causing damage.

Date UTC	Time UTC	Latitude °S	Longitude °E	Approx. Mag.	Comments
1855 01 06	08:00	36.7	146.9	3.0	Buckland River
1855 09 16	16:55	37.8	144.5	4.3	SE of Melbourne
1861 07 03	02:30	36.7	144.6	3.5	Bendigo region
1862 07 03	06:43	37.7	144.4	4.2	W Melbourne
1862 09 03	10:30	37.2	143.7	3.0	Talbot
1862 10 21	14:00	37.2	143.7	3.0	Talbot
1867 08 09	19:31	37.8	144.6	4.3	W Melbourne
1868 02 27	22:05	36.3	146.6	3.5	Beechworth
1868 11 01	15:00	37.4	144.6	4.0	Near Woodend - perhaps
1869 03 28	16:00	37.4	144.0	3.2	Daylesford
1869 08 29	18:50	37.1	146.8	5.4	Eastern Highlands
1869 08 30	10:20	37.1	146.8	3.0	Gippsland aftershock
1869 11 29	02:00	37.9	145.2	3.2	SE Melbourne
1870 01 20	10:45	37.7	142.7	3.5	Wickliffe
1871 02 28	11:44	37.83	144.98	3.0	Melbourne
1871 06 13	18:00	37.4	143.4	3.0	Beaufort
1872 08 07 *	19:10	37.0	144.05	3.0	Maldon, small close local event
1872 10 18	09:00	36.3	146.6	3.0	Beechworth
1873 05 22	06:30	38.03	145.35	3.0	Berwick
1874 08 13	16:45	36.4	144.7	3.0	Rochester
1874 08 30	09:02	37.9	145.1	3.3	SE Melbourne
1874 11 29	15:08	38.7	146.2	3.8	Foster
1875 02 28	20:40	37.1	143.6	4.2	Maryborough
1875 12 01	19:00	39.2	146.4	3.5	Wilson's Promontory
1876 04 21	14:00	39.2	146.4	3.0	Stockyard Creek
1877 06 24	17:25	37.9	145.2	3.6	SE Melbourne
1877 06 24	17:37	37.9	145.2	2.5	SE Melbourne
1877 06 24	18:08	37.9	145.2	2.5	SE Melbourne
1877 07 07	07:44	38.2	146.8	3.5	Rosedale
1877 07 10	12:40	36.6	143.8	3.8	Inglewood
1878 03 23	-	37.08	143.55	2.5	Avoca Lead
1880 11 09	18:30	37.1	147.6	3.0	Omeo

1881 05 06	07:45	37.6	146.25	3.0	Wood's Point
1881 06 08	02:55	37.7	141.6	3.0	Merino
1881 07 08	23:07	36.7	144.9	3.7	Moora
1881 07 28	-	38.1	145.8	3.0	Drouin
1882 01 23	06:40	37.2	146.7	4.9	Omeo
1882 05 21	01:27	36.7	147.0	3.0	Bright
1882 11 17	12:08	37.3	146.0	5.1	Jamieson
1884 05 31	19:20	40	149	5.6	NE Tasmania
1884 06 01	12:25	40	149	5.0	NE Tasmania
1884 07 13	03:43	40.5	148.5	6.2	NE Tasmania felt SE Victoria
1884 09 19	10:05	40.5	148.5	5	NE Tasmania
1885 05 12	23:37	39.9	148.9	6.5	NE Tasmania felt SE Victoria
1885 07 02	14:05	39.5	146.0	5.7	Bass Strait
1885 10 07	23:36	36.6	147.2	4.4	Bright
1886 06 10	22:30	37.2	144.2	3.0	Glenluce
1886 07 03	15:00	37.7	144.4	2.5	Yaloak Vale SE Ballan
1887 08 16	01:05	37.6	146.3	3.0	Wood's Point
1889 01 10	05:45	37.6	144.0	3.0	East of Ballarat
1891 06 07	04:04	38.1	144.8	4.8	SW of Melbourne
1891 06 07	05:45	38.1	144.8	3.5	SW of Melbourne
1891 07 03	11:30	36.75	147.0	3.0	Bright
1891 07 08	05:15	38.0	146.4	4.0	Walhalla
1892 01 26	16:48	40.4	159.5	6.9	NE Tasmania felt widely in Vic
1892 04 01	23:00	37.5	145.3	4.2	Kinglake SW Yea
1892 07 18	07:55	36.3	146.6	3.0	Beechworth
1893 12 23	14:00	38.4	145.0	3.0	South of Dromana
1893 12 23	14:06	38.4	145.0	3.2	South of Dromana
1893 12 23	14:09	38.4	145.0	2.5	South of Dromana
1893 12 23	14:45	38.4	145.0	2.5	South of Dromana
1894 11 13	11:00	38.2	144.8	3.5	Port Phillip Bay
1894 12 10	08:00	37.1	146.0	3.0	Omeo
1896 02 09	16:02	38.1	145.3	2.5	Cranbourne
1896 04 22	-	38.3	146.3	2.5	Yinnar
1896 05 08	22:30	38.1	145.9	3.0	Warragul
1896 08 13	11:00	38	147	3.0	North Gippsland
1897 03 29	11:45	36.0	143.7	3.5	Kerang

1898 01 29	11:20	37.2	145.4	3.0	Yea
1898 04 09	00:30	36.2	143.3	2.5	Charlton
1898 04 10	21:30	36.6	141.4	4.0	Minimay
1898 11 21	01:40	37.0	146.0	3.0	Mansfield
1899 04 11	-	37.2	142.3	3.5	Northern Grampians
1899 06 03	21:30	37.55	144.1	3.0	Gordon (east of Ballarat)
1899 11 23	07:20	38.2	144.7	4.7	Near Portarlington
1899 11 31	12:30	36.6	144.5	3.0	Goornong (north of Bendigo)
1900 03 11	17:45	38.4	142.5	3.0	Warrnambool
1900 05 26	14:30	37.8	145.9	4.6	Neerim North
1900 09 16	15:00	38.4	142.5	3.0	Warrnambool
1902 10 22	21:00	38.0	146.4	4.0	Walhalla
1902 12 22	12:50	38.2	145.0	3.7	Mornington
1903 04 06	23:52	38.43	142.53	5.0	Warrnambool 1 st mainshock
1903 04 08	09:30	38.43	142.53	3.0	Warrnambool aftershock
1903 07 14	10:29	38.43	142.53	5.3	Warrnambool 2 nd mainshock
1903 07 14	11:50	38.43	142.53	2.5	Warrnambool aftershock
1904 04 09	22:00	36.6	146.9	3.8	Bright
1904 07 09	09:27	37.8	145.3	3.8	Clocks were stopped at Berwick
1904 09 22	11:58	38.43	145.83	3.5	Korumburra
1905 01 27	16:00	38.05	146.4	3.2	Moe
1905 09 20	18:00	38.5	145.4	3.0	San Remo
1906 07 17	15:30	37.3	144.1	3.0	Daylesford
1907 03 31	14:30	38.3	145.5	4.3	Westernport Bay
1907 04 03	22:25	37.0	142.5	3.2	Wartook
1907 05 05	02:45	37.3	142.9	3.0	Ararat
1907 08 06	00:54	37.9	145.8	3.6	Warragul
1907 08 06	01:55	38.0	147.8	3.0	Bairnsdale
1907 08 10	06:55	38.2	143.2	3.0	Camperdown
1907 10 04	09:30	37.1	145.3	3.9	Tallarook
1908 06 09	19:35	38.45	145.8	3.0	Korumburra
1908 10 23	17:45	36.6	143.8	3.5	Wedderburn
1909 11 14	03:55	37.8	148.1	3.8	Bairnsdale
1910 03 18	21:15	38.2	146.1	3.8	Warragul
1910 05 27	15:45	36.9	144.4	3.4	Myrtle Creek
1910 10 24	17:00	38.1	145.7	3.0	Bunyip

1911 01 06	17:55	37.9	145.0	3.5	Melbourne
1912 07 05	06:54	38.0	144.5	3.0	Little River
1912 08 11	07:20	36.7	143.6	3.5	Bealiba
1913 01 11	00:30	38.4	141.6	2.5	Portland
1913 03 02	17:45	36.5	146.0	4.2	West of Benalla
1913 10 15	19:00	37.9	148.0	2.5	Cunninghame (Lakes Entrance)
1913 11 26	09:52	37.8	145.5	3.3	Macclesfield
1913 11 27	04:00	37.9	145.0	2.5	SE Melbourne
1914 08 17	23:31	38.3	145.9	3.2	Drouin
1914 08 18	15:30	37.8	146.7	4.9	Gippsland
1915 05 24	08:00	37.9	146.4	3.0	Walhalla
1916 06 29	22:00	36.7	146.9	3.5	Bright
1916 06 29	22:45	36.7	146.9	3.0	Bright
1917 06 07	11:05	37.9	143.3	3.0	Lismore
1921 06 08	19:30	38.7	146.2	3.0	Foster
1922 02 28	15:00	38.40	144.75	4.9	SE of Ocean Grove
1922 04 10	10:46	38.35	144.60	5.7	South of Ocean Grove
1922 11 17	10:30	36.2	147.2	3.5	Tallangatta Valley (Hume Reservoir)
1922 12 09	05:20	38.38	142.48	3.5	Warrnambool
1925 07 11	-	38.7	146.2	3.0	Foster
1925 09 05	19:05	37.2	144.4	4.7	Castlemaine
1927 03 22	12:30	37.0	147.7	3.0	Benambra
1927 05 14	19:00	36.5	145.4	3.0	Seven Creeks near Euroa
1927 05 15	14:00	36.5	145.4	3.0	Seven Creeks
1927 05 17	04:00	36.7	145.55	3.0	Euroa
1927 05 17	09:00	36.7	145.55	3.5	Euroa 7 earthquakes
1927 07 10	08:30	36.7	145.55	3.7	Euroa
1930 06 17	21:05	37.3	147.7	3.8	Omeo
1930 06 18	01:30	37.3	147.7	3.0	Omeo
1931 04 17	03:51	36.5	146.1	4.5	Benalla
1932 09 02	18:22	38.25	145.15	5.1	Mornington
1932 09 19	15:00	36.5	146.1	3.5	Benalla
1932 09 21	17:00	36.5	146.1	3.5	Benalla
1932 09 21	05:30	36.5	146.1	4.0	Benalla, the largest of five earthquakes mentioned.
1932 10 26	03:08	36.1	143.7	3.5	Boort

1933 01 16	21:15	36.5	146.1	3.0	Benalla aftershock
1933 05 19	20:00	36.5	146.1	3.0	Benalla aftershock
1933 07 26	19:05	37.8	147.75	3.0	Bairnsdale
1933 11 30	06:50	36.5	146.1	3.0	Benalla aftershock
1933 11 30	07:10	36.5	146.1	2.5	Benalla aftershock
1934 07 26	19:05	37.8	147.75	3.0	Bairnsdale
1934 08 01	21:05	36.5	146.1	3.0	Benalla aftershock
1935 06 18	17:50	37.83	145.22	3.2	Melbourne suburbs
1937 06 17	19:55	37.9	145.4	3.6	East of Melbourne
1938 04 15	05:45	38.7	146.2	3.0	Foster
1938 06 15	00:20	37.8	147.75	3.0	Bairnsdale
1939 04 05	13:00	38.0	145.1	4.1	SW of Melbourne
1940 01 31	19:00	37.85	145.0	2.5	Melbourne suburbs
1944 11 02	14:05	37.5	145.9	4.8	Marysville
1946 03 07	-	36.5	146.0	2.5	Benalla
1946 03 13	02:00	36.5	146.0	3.0	Benalla
1946 03 17	06:55	36.5	146.0	4.0	Benalla £2000 Damage
1946 09 09	19:50	40.0	149.35	5.7	East of Flinders Island Tas.
1947 04 13	16:55	36.6	143.8	3.0	Bendigo
1947 06 09	07:00	38.35	145.6	3.0	Colac
1948 05 26	05:00	37.78	145.12	2.5	Doncaster
1951 05 08	18:00	36.5	146.4	3.2	Wangaratta
1951 05 28	15:45	38.2	146.2	4.6	Gippsland felt Melbourne
1951 06 04	16:23	38.4	145.9	4.5	Gippsland
1953 11 21	18:50	36.5	146.0	3.5	Benalla
1953 11 21	19:45	36.5	146.0	3.0	Benalla

* Prior to the introduction of Eastern Standard Time in 1895, time was based on actual longitude. In Melbourne, at longitude 145°, local time would have been 9h 40m ahead of Greenwich (not 10 hours), at Horsham at 142°E, local time would have been 9h 28m ahead of GMT. Reports seem to have used Melbourne time.

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Appendix 2 Earthquake Poetry

"BASS STRAIT QUAKE."

by A. EVELYN LYNCH. Bonbeach. Published in the *Frankston & Somerville Standard* Saturday 24 September 1932, page 5 following the Mornington earthquake.

*There's a dawn I shall remember,
August had just said "How do to September".
Suddenly a loud rumbling like heavy thunder,
Startled Peninsula folk from their slumber.
Houses were quaking on their foundations,
And quivering beds gave queasy sensations.
Astronomers are seeking the cause of commotion,
Deeming the tremor began in the ocean.
Maybe Earth developed a pain in her "tummy,"
Her quivering and groaning made us all feel rummy.
If attacked there again and not stand the strain,
She may pop with a terrific explosion.
Then we'll be drying our tears in a new strathasphere,
Or fleeing from sharks in the ocean.*

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