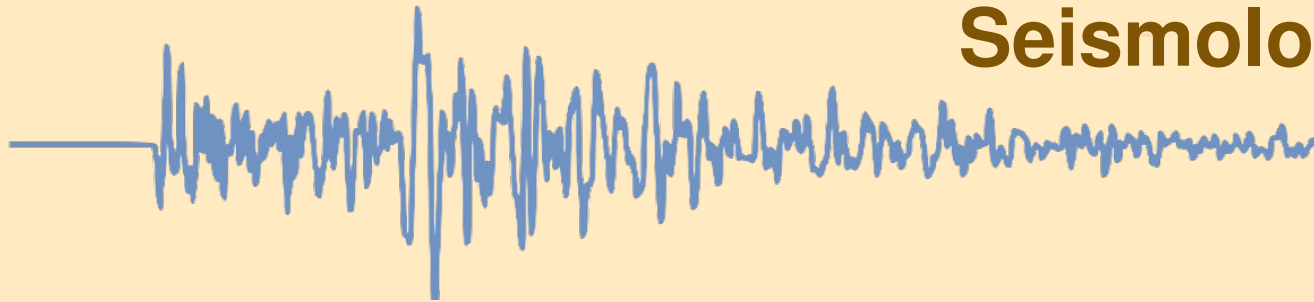


**Newsletter of the Seismological
Association of Australia Inc.
Sep-Oct 2020**





Seismological Association of Australia Inc.

Newsletter of the
Seismological Association of Australia Inc.
PO Box 682, Mylor SA 5153

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The SAA can be contacted by post to the
address above, or by email to any member of
Committee, as listed above

Membership of the SAA is open to all, with the
only prerequisite being an interest in seismology.
Membership applies for the calendar year
(January through to December)

Membership fees are:
Full member \$50

A Membership application form can be obtained
from the Treasurer by email or [download it here](#).

Member Submissions

Submissions for inclusion in the Newsletter are
welcome from all members; please note that
submissions may be held over for later editions.
Wherever possible, text submissions should be
sent via email in almost any word processing
format. Your name may be withheld only if
requested at the time of submitting. Images
should be high resolution and uncompressed,
although high resolution JPEGs are acceptable.

All enquiries and submissions should be
addressed to the Editor and preferably sent by
email to weaksignals@iinet.net.au

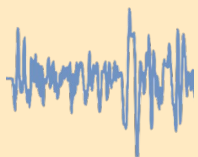
From the Editor

You can pretty much expect that the next
Seismological Association of Australia Inc.
Newsletter will not look like this one, or the
newsletters that preceeded it. The SAA will have a
new logo, a new year ahead of us and hopefully a
different newsletter editor.

In case it was thought that my last edition would be
a "phone it in", as the Americans say, I hope that
this one doesn't disappoint. It came close for a
while but some eleventh hour submissions
miraculously appeared to save it. My thanks to the
people concerned.

I look forward to supporting whomever takes up
this task and I hope that you all do too

Regards Peter



SAA News

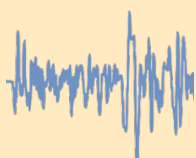
2020 SAA Annual General Meeting - Yes, it is that time of the year again, the AGM is almost upon us. Could all members please pencil in Monday, October 26th at 7:30pm ACDT for an online Zoom meeting. Details required to join into the Zoom meeting will be emailed out to all financial members of the association, this email should also serve as a reminder of the meeting date and start time. An agenda will also be prepared and sent prior to the meeting. At the top of the list will be voting for committee members. As a requirement of the constitution, all committee members must vacate their positions and a new committee elected. Should any member want to nominate for a position, nominations will be accepted prior to the vote. Please contact the Secretary, Joe Grida if you wish to nominate yourself (or someone else) to any of the committee positions.

State of the Network - As usual, there have been a few problems experienced at some of our seismic sites over the last couple of months. Torrens Island was shut down when the department hosting the seismometer were relocated and the building has been vacated for some time. David was able to get access recently to remove some heavy cabinet hardware that had left behind, it has since been relocated to Payneham. Willalooka (WKA) unexpectedly failed several weeks ago for reasons unknown. The fault is unlikely to have been caused by the solar panel shading problem which we identified at a visit last year. Perhaps the local drop bears launched an attack but until someone can get down to the station, identify the problem and be able to resolve it, we just won't know. Modbury Heights (THS) is dead and also proving to be a logistical problem, being located at the top of a hill, accessible only via 4WD. Sadly, the association can't really afford a 4WD and apparently the closest one available is about 100km away. The wet weather experienced this winter hasn't really helped and neither has the schedules of those involved. Hopefully the planets will align some time soon and progress may be made. Sunnydale (SUND) continues to experience WinSDR/A/D card reset problems which are usually identifiable by short breaks in the datastream followed by unlocked GPS indications. We've changed the A/D card, re-installed WinSDR, rewired and calibrated the Willmore, there's not much left that hasn't been changed, sworn at or kicked.

New Magnetometer at TPSO - Regarding installation of the Magson MFG-1S magnetometer, while we're not quite there yet, things should be finalised within the next couple of weeks. Hopefully this new capability will be up and running by the end of the month. There are some technical issues that still need to be resolved prior to installation and no doubt a couple more will present themselves once it's onsite - they usually do.

A new Logo for the SAA? - It's a bit late to make it into this edition of the Newsletter but by the time the AGM comes around in three weeks, we will have a new logo for the SAA. Our thanks go to Kevin McCue for his initiative and persistence with this matter.

On the Cover - SAA Chairperson, Blair Lade has just returned from participating in the Southern Launch sub-orbital tests at the Koonibba Test Range in western SA. This image comes courtesy of The Guardian newspaper, original image from Sean Jorgensen-Day/DEWC Systems.



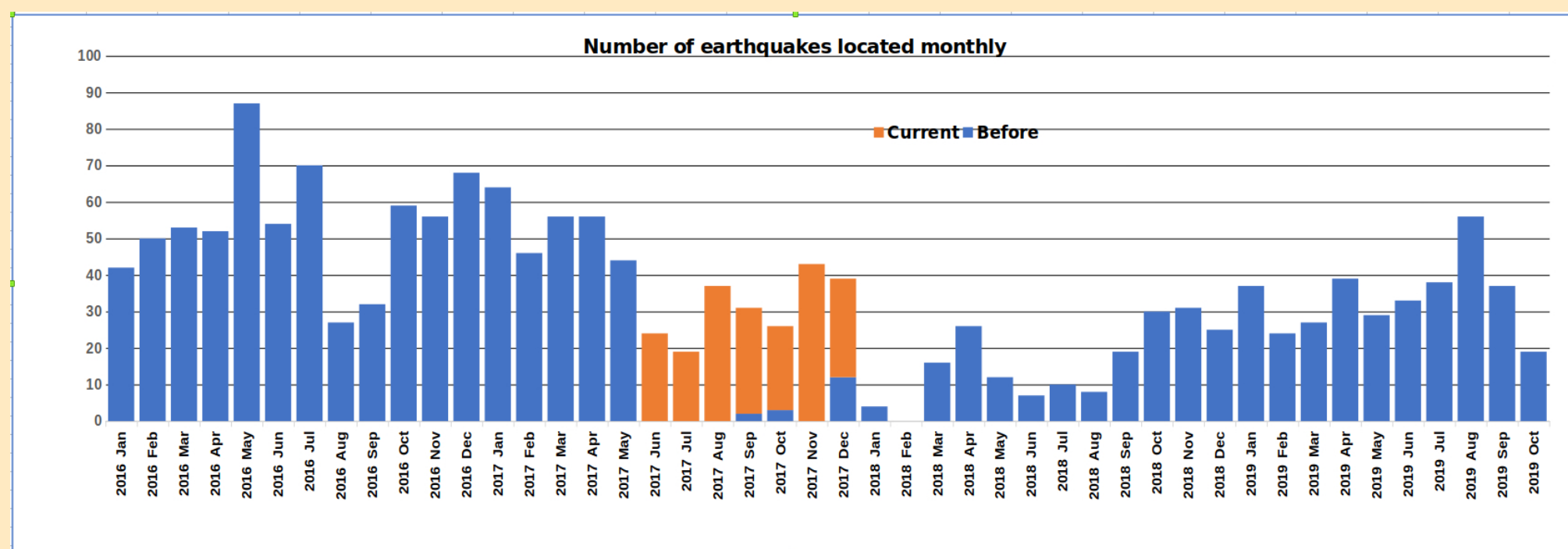
EARTHQUAKE WEBSITE UPDATE

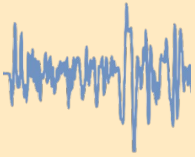
Kindly submitted by
Alison Wallace and David Love

The South Australian Earthquake Catalogue produced by the Geological Survey was only complete to the end of May 2017. The SAA catalogue began slowly in late 2017 as Eric Love developed the website. It can be seen at <https://earthquakes.mappage.net.au/q.php>

Alison has recently thrown herself into filling in the gaps (as well as keeping up with current ones). She has now finished 2017, and is about to progress onto 2018. The improvement can be seen as the orange bars on the chart. Alison has actually recalculated all events, so for those who investigate, they will find two versions of some events. The first step before locating any events is to scan each hour of each day to find the events. This is quite time consuming.

Recently Kevin McCue has begun the difficult catchup task of producing Australian Seismological Reports for 2016 to 2019. So 2017 data is ready just in time, and hopefully 2018 will likewise be. Eric and David are in the process of merging and checking all past SA digital data. It will hopefully be available on the website in two months.





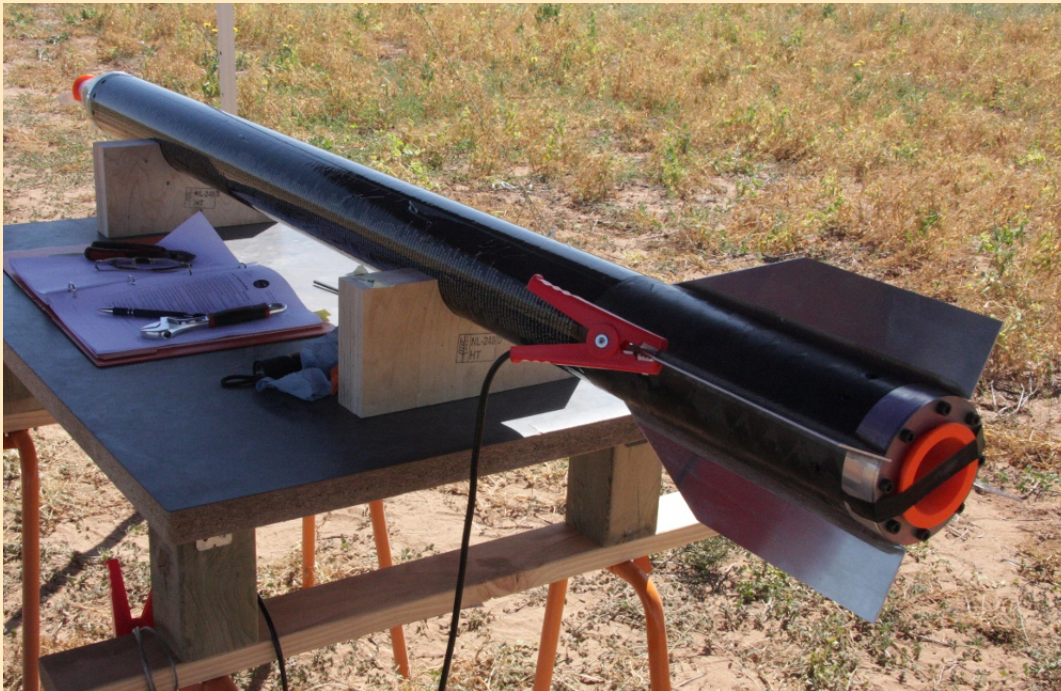
Seismic signals from Southern Launch's Koonibba launch site

Kindly submitted by Blair Lade

South Australian start-up company [Southern Launch](#) recently facilitated the launching of 2 sounding rockets from their [Koonibba Test Range](#), located 25 km NW of Ceduna in South Australia during September 2020.

Having worked in the 'rocket industry' for the last 20 years, I couldn't pass the opportunity to take a week's leave and join in the fun. I offered to deploy some seismometers to see if I could detect the spent booster rocket motors impacting the ground and assist in finding them.

The rocket motors for these launches were supplied by [T-minus Engineering \(TME\)](#) in the Netherlands and are 118mm in diameter, 2.3m long, weigh 29kg before launch and have 22kg of ammonium perchlorate (AP) based solid propellant. The rocket motors produce a thrust of 8kN for about 6 seconds and achieve a velocity of close to Mach 5 at burnout at an altitude of 7,000m and boost the 'dart' payload to an altitude between 50km and 120km depending on the angle of the rocket launcher and the mass of the dart.

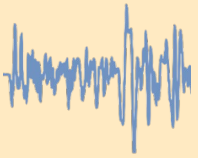


The rocket booster on the field preparation table

The [dart](#) is 35mm in diameter, 1.2m long and has a maximum weight of 3.5kg. It can withstand velocities exceeding Mach 5 and accelerations of up to 60G.

The proposed deployment of the seismic sensors would consist of four Echo recorders with L4C vertical seismometers and one [Gecko](#) tri-axial self-contained recorder. Planned sample rate was 500 samples per second.

The L4C seismometers would be put in plastic bags and buried in a hand dug hole about 600mm deep in the red sand. At two of the sites selected we struck underlying limestone rock 300mm down, so with the seismometer resting on the limestone, sand was heaped to cover the instrument. The recorders were inside my new field boxes with a 22Ahr 12 volt sealed lead acid battery, a solar charger and an external solar panel, with the GPS antenna taped to the top of the recorder inside the box.



Seismic signals from Southern Launch's Koonibba launch site

Everything was configured and tested in Adelaide prior to leaving for Ceduna and retested on site during Sunday, the day before deploying to get the latest GPS almanac as there would not be enough time to test each site as we put them in. It took about 3 hours for two of us to deploy all 5 instruments on the Monday morning and the rest of Monday was spent putting the rocket launcher together, setting up a safe explosives work area, rolling out the cabling, testing firing systems, communications, cameras and of course making sure the gas stove and coffee pot was working as expected. It was quickly becoming evident that this 'holiday' was going to be a lot of long hours and hard work.



A typical deployment (seismometer is buried under the loose sand)

Tuesday was the initial launch day and we finally attempted a launch just before the launch window closed at 2pm. Unfortunately, the initiator (Ignitor) for the rocket didn't work as expected and while we 'lit' the initiator, it didn't light up the rocket. We had what we call in the industry 'a misfire' which was pretty embarrassing considering all of the media being in attendance. After a 30 minute wait, the rocket was made safe and later removed from the launcher for another attempt on the Saturday.

Considerable effort was put in by the rocket provider TME and the launch ground team to resolve the issue and a fix (which was basically to wrap the ignitor in gaffa tape to hold it together a little longer) was put in place for the proposed Saturday launch attempt(s).

On Wednesday I had a chance to visit all 5 of the seismometers, connect up a laptop and make sure everything was working and indeed, the previous preparation work had paid off and all 5 instruments were working with 48 hours of background data being recorded with no reboots or errors and all the solar / battery systems behaving as expected.



Seismic signals from Southern Launch's Koonibba launch site

Saturday was the next launch attempt and after a 5:30am start, we successfully prepared 2 rockets, 2 payloads and launched 2 rockets.



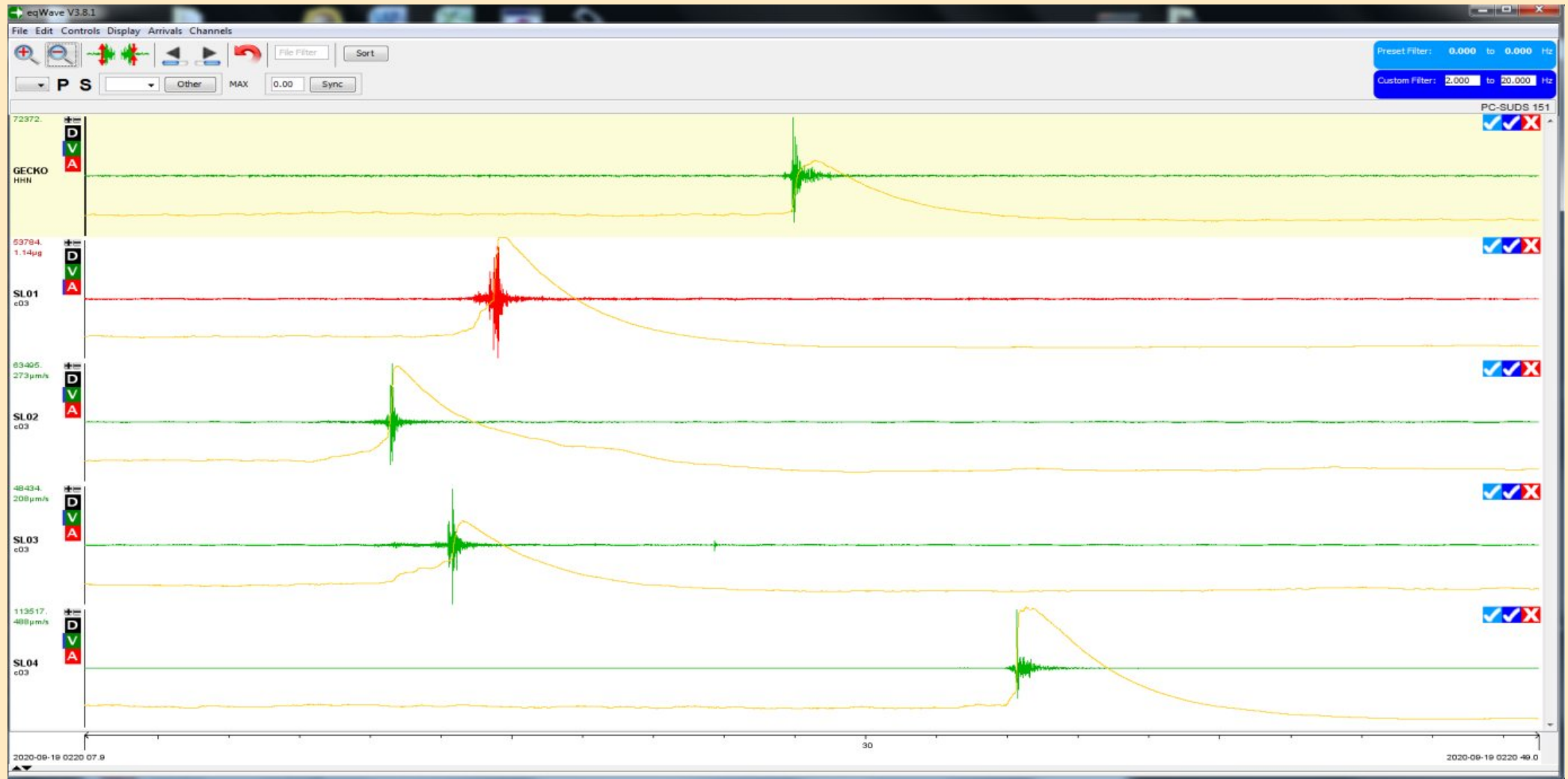
Successful ignition of TED01 at 10:09



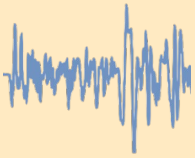
And away it goes



Seismic signals from Southern Launch's Koonibba launch site



Seismic signals from the TED02 launch



Seismic signals from Southern Launch's Koonibba launch site

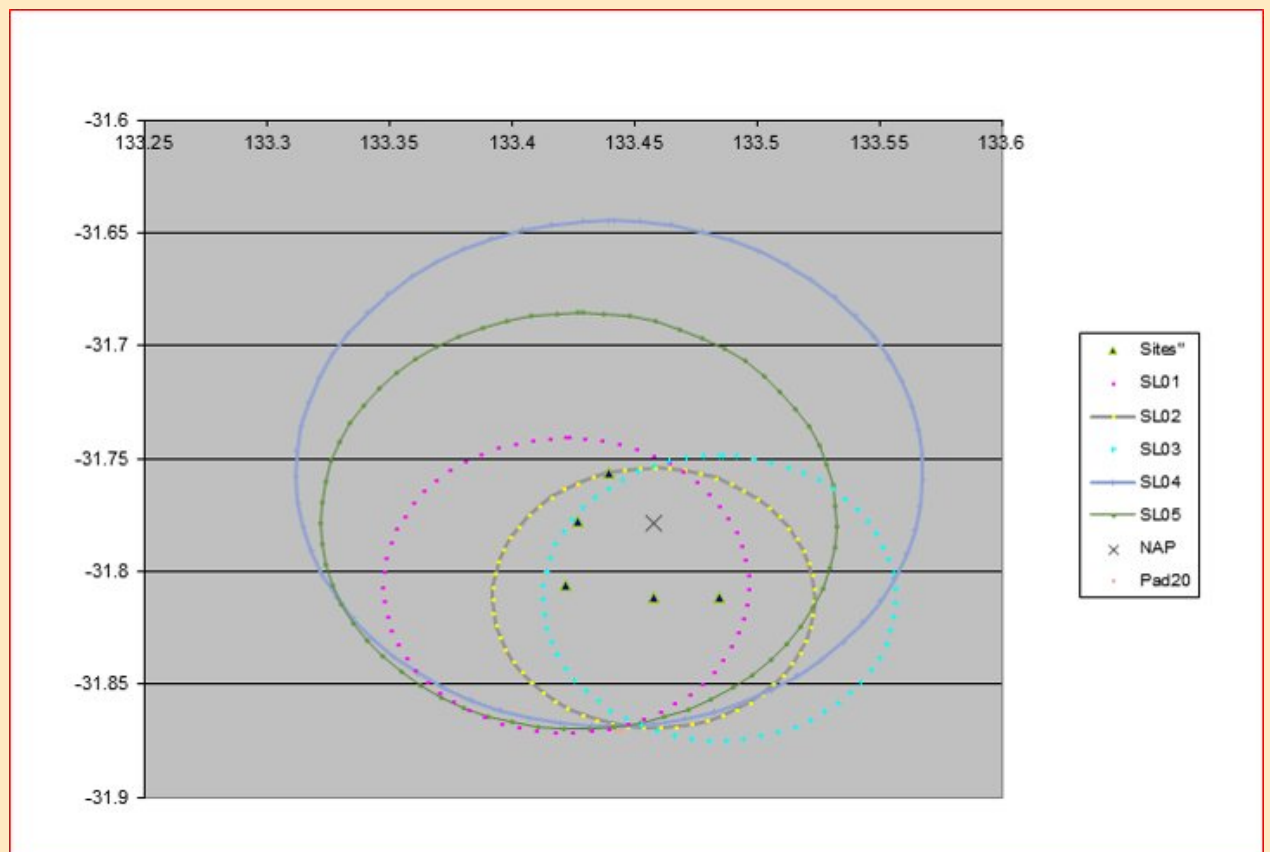
As soon as the 2nd launch (TED02) was over, the pack up started, rolling up cables, putting cameras, communications equipment and firing equipment into transport cases, taking down pergolas and the post launch briefing.

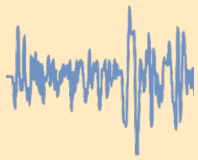
That all done, I then spent a couple of hours in the conservation park (the other side of the longest dog fence in the world) recovering the 5 instruments and finally we were all ready for the 'group photo' and to leave the site for a well-deserved rest and the mandatory celebration drink back at Ceduna. (well, actually it was lots of drinks if you must know!). It had been a long hard week.

After a drink (or two), I had a quick look at the data and found we had recorded an event about the time of each launch, with the data from the second launch shown on Page 8.

The arrival time of the first signal is about 20 seconds after the launch and fits nicely with an air propagation model. Several megawatts of energy are released during the rocket burn so it's not surprising that the sound can be heard 10km away. Looking back, I'll do it again!

Quick analysis of arrival times suggest they are coming from the launcher area. (where the circles intersect.)



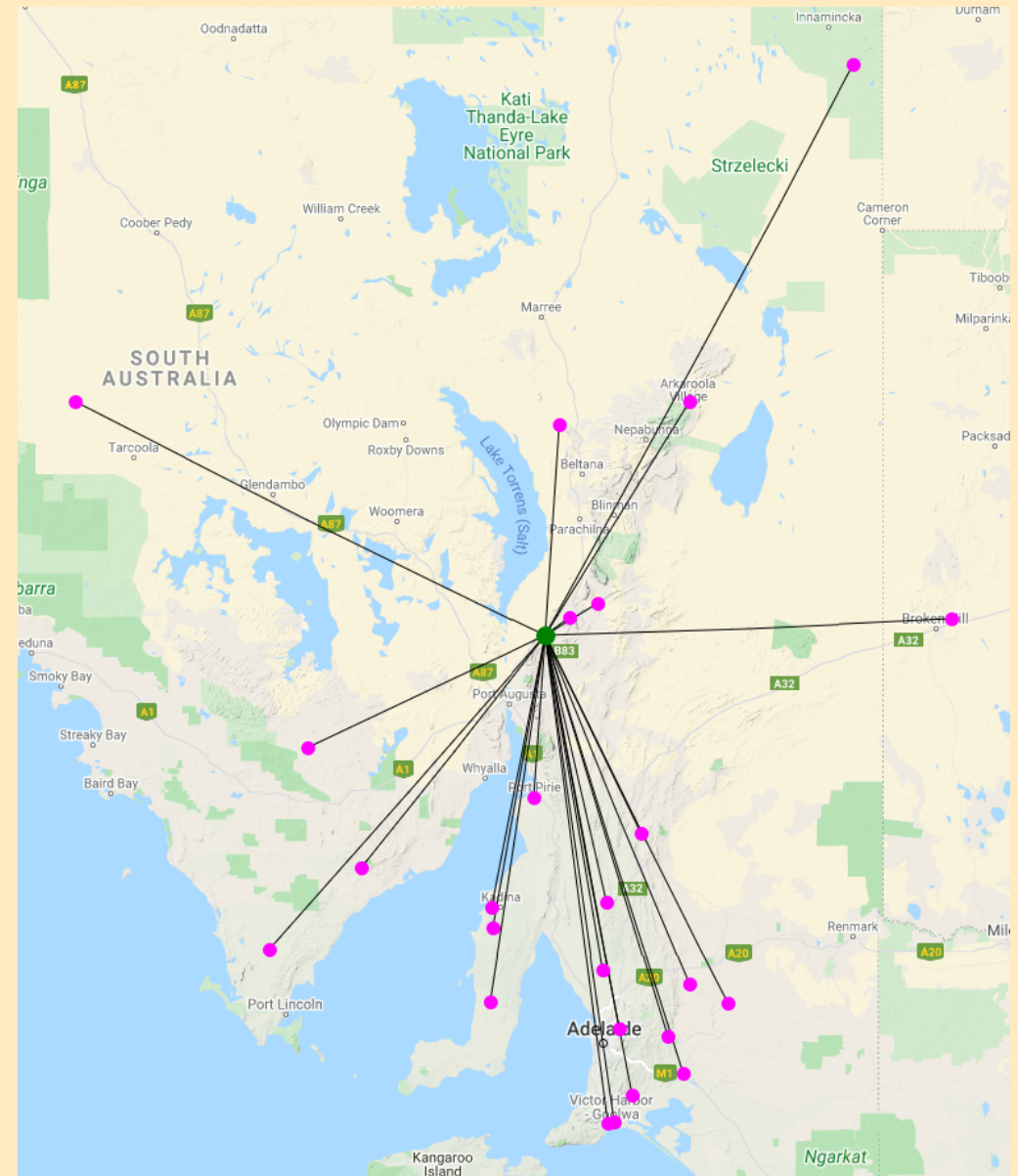


Recent Seismic Activity

HAWKER 2020-09-23 18:23 3.3MLv



Waveform arrivals at the two closest seismic stations, YAPP (Trillium Compact) & HKER (Mark Products L-4C3D)

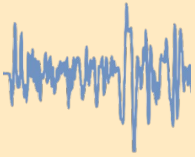




Recent Seismic Activity



GA's Yappala and SAA's Hawker seismic sites with 25km radii markers in green. The epicentre estimates are both located close to the northern end of the Wikatana-Depot Creek Fault (indicated in blue)



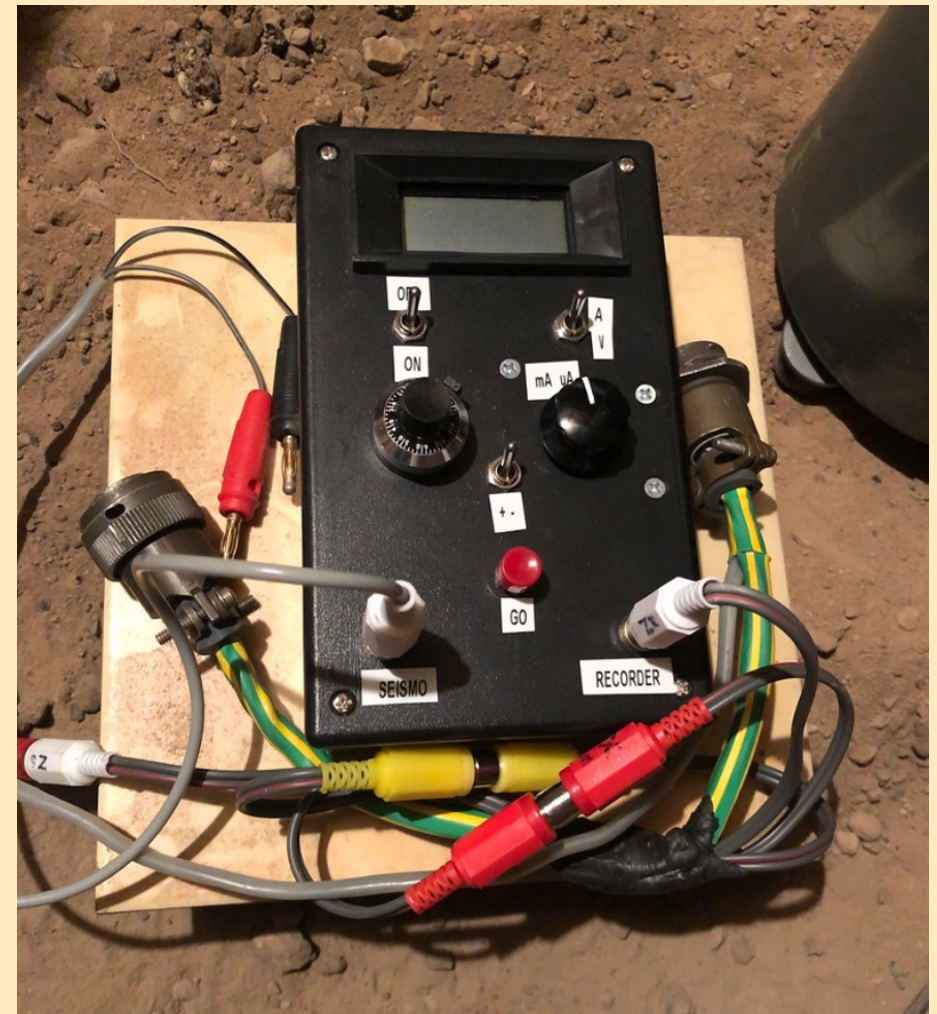
MAGNITUDE? STARTS WITH CALIBRATION!

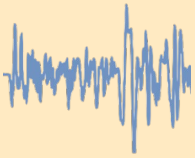
Kindly submitted by
David Love : SAA Chief Seismologist

Magnitude has always been a problem in Australia, as in many other countries. Gary Gibson says he attended his first workshop on magnitudes in 1968, and it hasn't got much better since. I attended my first workshop on magnitudes in about 1989, and things have progressed in fits and starts, but not always forwards. As a seismologist who was more interested in locations than magnitudes, this whole area was not first on my radar, but that is changing.

The first step in getting reliable magnitudes is instrument calibration. When I started seismology in 1986 we inherited a whole-system calibration method from the University of Adelaide, which we continued to use. However in about 1995 I came across an article in BSSA that demonstrated putting a step pulse into the signal coil of a seismometer, and matching the output waveform with a theoretical curve. This method was suitable for any passive, coil type seismometers. (Most new ones are of the electronic feedback variety.) This method really impressed me. It sounded straightforward, and only required knowledge of the input current and the seismometer mass. It did not require a calibrate coil, and could easily be done on site.

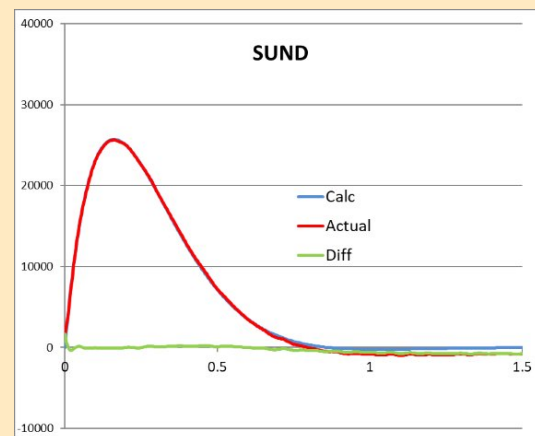
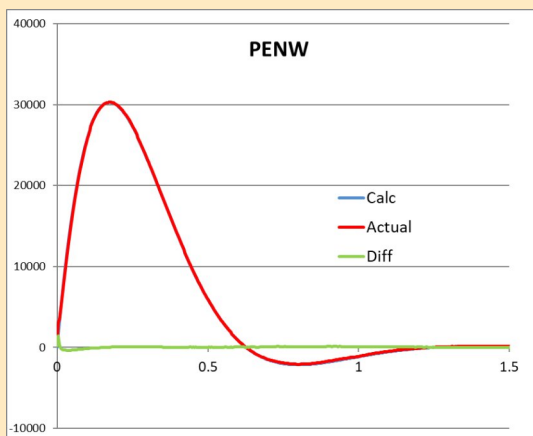
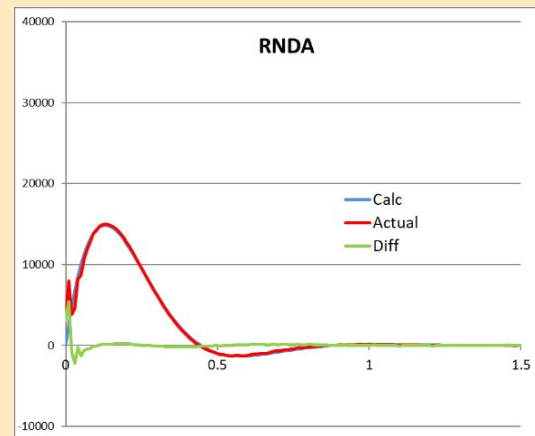
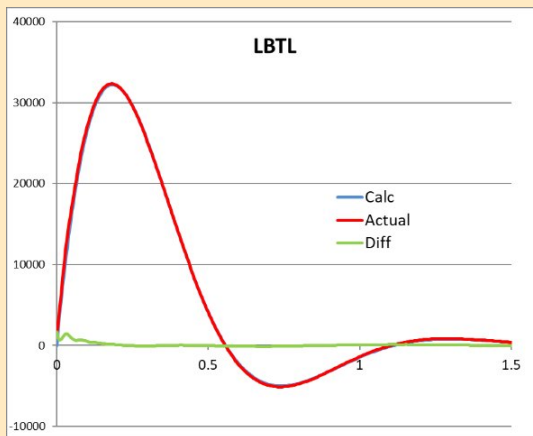
It was only in about 2015 that the late John Harris built me a calibrator to do the task. It is simply a small box of electronics with connectors to use in-line with the PSN or Echo recorder. Being for passive seismometers, it can be plugged in without turning anything off. In recent months it has been used by Blair Lade, Jim Deer, Jack Pappin and Kevin McCue. I think they will all attest that it was fairly quick and not difficult. There is a short document to explain how to run the calibrate; alternatively it is not difficult to explain it over the phone. The calculation of the seismometer properties is presently done through a spreadsheet. This does require a fair amount of familiarity with the process, and I prefer to do a number in a short space of time, to avoid having to relearn. The spreadsheet could be improved by an Excel expert, or by a programmer.





MAGNITUDE? STARTS WITH CALIBRATION!

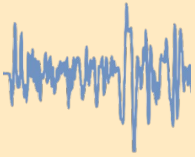
The first step is to get a text file of the seismometer output. This is straightforward for a PSN recorder (using WinSDR set to trigger and output in MiniSEED), or an Echo or EchoPro recorder. The waveform can be viewed in Waves, and output to text. The text is then put into the Excel worksheet. After time and baseline corrections the output gain, natural frequency and damping can be adjusted until the actual and theoretical curves match. The output waveform is best captured by an EchoPro at 250 sps with no filter. If there is 50Hz noise, then 100Hz filtered is required, but this leads to a noisy start to the pulse, as is visible on the RNDA calibration below. With PSN filtering is hard to properly match the beginning of the pulse also, but is not a major problem, and is not obvious on these plots.



Site	Code	V/m/s	Natural frequency	damping Hz
Sunnydale (PSN)	SUND		1.04	0.83
Lobethal (PSN)	LBTL		1.04	0.51
Aranda (EchoPro)	RNDA	293	1.42	0.61
Bredbo (Echo)	BDBO	294	1.50	0.58
Penwortham (EchoPro)	PENW	363	1.04	0.64

Table. Results of the curve matching

Reference: Rodgers, PW et al:
Signal Coil Calibration of Electromagnetic
Seismometers, Bull. Seism. Soc. Am. 85, no3,
pp845-850



"ONE NEVER KNOWS." (By our Special Reporter)

Kindly submitted by
Kevin McCue

EARTHQUAKES AND ARCHITECTURE. SOUTH AUSTRALIANS REFUSE TO BE FRIGHTENED.

**Advertiser (Adelaide, SA : 1889 - 1931),
Saturday 30 May 1914, page 21**

Thursday night's earth tremor startled many people, and the thoughts uppermost in the minds of many property-holders centred round their possessions. The question of earthshock resisting buildings is probably one that seldom troubles the average Australian, so immune is the country from earthquakes of a serious and destructive nature. Less fortunate countries, however, consider the subject in a more serious light. Japan probably worries over the matter more than any nation, and can it be said in that country's favor that their interest does not end there? Realising their perilous position in the danger zone, they have availed themselves of the seismological calculations of Professor P. Omori of the University of Tokio, and have adopted safeguarding methods of building construction. They have profited by the disastrous earthquakes and sea-quakes in Sicily and Calabria, and are using more foresight than in the past. The question naturally arises, "Should not South Australia be equally on its guard? The solution of the problem is not, however so readily forthcoming. A representative of The Advertiser, fully seized of the importance of the subject, endeavored on Friday to gain expressions of opinion from different authoritative sources. Some were sceptical, others apathetic, others satirical, and, alas, very few serious. The reporter quoted such important treatises on the question as the work of Alfredo Montel; he recapitulated the warnings of a dozen authorities, and finally placed before his subjects the main points of an inter-view with South Australia's Government Astronomer. Mr. G. F. Dodwell, B.A.

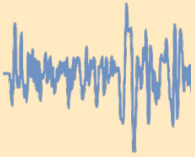
"One Never Knows."

When interviewed with reference to the question, the Government Astronomer (Mr. Dodwell) remarked:-"I have often thought it would be a wise precaution on the part of architects and builders to take into account the results of recent investigations on the question of earthquake proof

houses. Much attention is being given to the subject in Japan, and to-day, largely as the result of the work of the late Professor Milne and the Japanese scientists he trained, and who have followed him, the loss of property in Japan through earthquakes, which are a common occurrence there, has been wonderfully reduced. I do not wish to convey the impression to your readers that human skill can defy the elements. I am dealing with general cases. It would be possible for some extraordinarily severe shocks to wreck the most solid buildings that architectural and building skill could devise. The points demanding particular attention are:- (1) Selection of site: (2) quality of the foundations; (3) the structural proportions of buildings: (4) lightness of the structures, thus enabling the rocking of the building without endangering the integrity of the walls; (5) joists and joinings to be constructed on such lines as have been found by the experience of builders in earthquake countries to be the safest. In conclusion, I would like for a moment to dwell upon the advantages of buildings composed of such material as reinforced concrete and the strength-giving qualities of the iron rods used in the erection of such. "Do you really think South Australians need consider this question in so serious a manner? "One never knows," was Mr. Dodwell's smiling response.

"Life's Too Short to Worry."

The reporter took occasion to thunder out his message of warning in the ears of several leading architects and builders. He failed, however, to instil any great fear or dread into the souls of these cheerful home-designers and home-builders. There were no blanched faces or irregular heart beatings as the pressman delivered himself of Montel's great message. One contractor puffed placidly at his cigar, and smiled pitifully at his interviewer. "Don't worry, young man." was his initial injunction. "Life's too short. We are here for a span, and it takes us all our time to make the money we set our hearts upon. An elaborate system of building,



"ONE NEVER KNOWS."

such as you have explained to me this morning, would entail enormous, and, in my opinion, unnecessary expense. We could not do it. The public would not demand it, and therefore we would not supply it. I refer in that direction more particularly to residential houses. At the present time there is little wanting in skilful design and workmanship in the construction of the majority of any recently-erected big business houses. Of course, in a country like Japan there is need for such great precautions. Considering Adelaide's practical immunity from earthquake shocks of a severe nature, such far-reaching precautionary methods would be not only unnecessary, but ludicrous."

"Cause of Half the Trouble."

Another big contractor, who swears he has never erected a "jerry-built" house in his life, curtly remarked that "there is certainly need for greater supervision in the erection of most houses." "Why!" he continued, "a good hailstorm would crack up many of the houses one sees in Adelaide's suburbs." Yes, but many people demand cheap houses. "Quite correct. That is the cause of half the trouble. In my opinion, it would be a splendid thing to introduce more solidly built houses. Even if there were no fear of earthquakes occurring it would have its many apparent advantages."

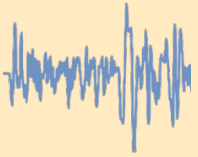
Editor's note:

In order to provide some additional perspective to this article, I have included other newspaper reports of this seismic event in the following pages, enjoy!

AN EARTHQUAKE SHOCK. ADELAIDE VISITED. SEVEREST FOR YEARS. CITIZENS ROUSED FROM THEIR BEDS. EXCITING EXPERIENCES.

**Advertiser (Adelaide, SA : 1889 - 1931),
Friday 29 May 1914, page 15**

At 9 minutes to 11 o'clock on Thursday night Adelaide was visited by the severest earthquake that has been felt here since the disastrous visitation in September, 1902, when the severity of the shock caused considerable damage to buildings throughout the State, and spread terror into all corners of the city. Last night's convulsion was felt in every quarter of Adelaide, and within a few moments of its occurrence the city that had been so silent and still before seethed with life and animation. Nearly every home emptied its quota of inhabitants into the streets to stand shivering, and discuss their experiences. Lights sprang up in dwellings that had but a moment before been in darkness, because the inmates had retired to rest for the night, and whole streets seemed to have undergone a transformation through the very suddenness of the shock. Coming at such an hour, and after such a long immunity from earthquakes, the visitation caused a feeling of alarm, and it was a long time before people could calm their nerves sufficiently to retire again. The night air was exceedingly keen, but sooner than trust themselves to the buildings that had rocked so insecurely over their heads, many spent an hour or so shivering outside. The shock seems to have travelled from west to east and to have attained a considerable velocity. It lasted only a few seconds, but it shook every building in the city and in the suburbs, where it was most severely felt, many people were actually terror-stricken. A woman who was walking down her garden towards her house, declared that she saw the whole building rock and sway before her, and so vivid was her terror that she declined positively to enter it. It was not until half an hour later that she had been sufficiently calmed to go to bed. At "The Advertiser" office the shock seemed to lift the building up



AN EARTHQUAKE SHOCK

as on the crest of a wave and let it dip gently down again as it passed; but it was sufficiently violent to be felt in the rooms where even the rattle of the linotypes and the rush of preparation for going to press did not drown the evidence of its approach. It seems to have been felt particularly clearly at North Adelaide, Glenelg, and the Reedbeds, although reports from all quarters affirm the fact that it was distinctly perceptible in every direction. Its approach was heralded by a dull subterranean rumbling that sounded to some like thunder, while others received the impression that a heavy traction engine was passing; but the tremor and the rise and fall of the earth that accompanied the sound quickly dispelled all illusions, and, in fear of the possibility of a recurrence, all who had experienced the shock lost no time in quitting the perilous shelter of their home. Nothing further occurred, however, and the telephones were soon set ringing with friends comparing notes and residents of all the suburbs describing their sensations. One who has not gone through an earthquake can have no idea of the weird and terrifying sensation of feeling the solid floor and walls about one rocking and swaying as though in a breeze. Many people communicated with "The Advertiser" within a few minutes after the shock occurred, and described their experiences. By making enquiries in other directions a fairly accurate idea was obtained of how the convulsion affected the various districts. There was no shock felt at Port Pirie, the only outside centre with which it was possible to communicate, while reports from the hills describe the visitation as being of short duration and no great violence. Apparently it was comparatively isolated and circumscribed in extent.

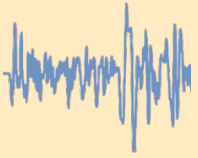
Chief Justice's Experience.

His Honor the Chief Justice (Sir Samuel Way) was one of the first to communicate with the Government Astronomer. He stated that he was in the act of retiring when the shock was first felt. His room was downstairs, and his first thought was that somebody was thumping on the floor above, but the rattling of the doors and windows and the subterranean rumbling

convinced him that Adelaide was again on the crest of an earthquake. Other inmates of the house thought something heavy had struck the walls. The shock seemed to go right through the house and then to fade away gradually. The sound was distinctly audible as the tremor passed into the distance.

Mr. Dodwell Interviewed.

A reporter called upon Mr. G. F. Dodwell, B.A. (Government Astronomer) shortly after the tremor was felt. In the course of an interview Mr. Dodwell remarked:—"There is an indication of the shock on the barograph, an instrument used in recording atmospheric pressure. It occurred about nine minutes to 11, and in my opinion was of from five to ten seconds' duration. I was in bed in an upstairs room at the time, and was therefore unable to judge the direction in which the wave was travelling. There was a slight tremor and a rumbling noise, denoting a mild shock of earthquake, but it was not of sufficient intensity to move any of the pictures on the wall. The shock would be of intensity three to four on the Rossi-Forel scale (appearing below). If complete records are made available by the various observers of the intensity of the shock in the different localities we will be able to form an idea of the seat of the disturbance. It was probably some adjustment of the earth between the Gulf of St. Vincent and the Mount Lofty Ranges. A slight tremor of a similar description was experienced about three years ago, but only a few persons noticed it. Before that there was a fairly severe shock in September, 1902, and again previous to that in May, 1897. The 1897 earthquake originated below the sea off our south-east coast, and there were repeated and severe shocks felt at Kingston, Robe, and Beachport. On that occasion they were of sufficient intensity to cause the residents in those parts to leave their houses and live in tents for about a week. In Adelaide on that occasion the shock was of about equal intensity to that felt tonight." In amplification of a theory propounded by him in the course of a newspaper article several years ago, Mr. Dodwell continued:—"Fortunately earthquakes are not very common in South



AN EARTHQUAKE SHOCK

Australia, and they seem to be associated with a gradual uplift of some regions and a downthrust of others, which have, in the course of time, resulted in the formation of the gulfs St. Vincent and Spencer on one hand, and the Mount Lofty Ranges on the other. At the present time mild earthquakes or tremors in South Australia are more frequent in the hilly country north-east of Port Augusta." Questioned by the reporter as to the possibilities, of an immediate recurrence of the shock, Mr. Dodwell held that the chances were against a repetition. In his opinion it was an entirely local disturbance, and would not extend far into the State. Until he received the reports from the various stations he could not definitely state just how far removed they were from the origin.

The Earthquake Recorder.

Asked to explain the exact work of the seismograph and its relation to shocks generally. Mr. Dodwell remarked that that instrument was designed to record those earthquake waves which had travelled such a distance that, they became damped down and were unable to be perceived by senses. A shock of the description of last night's would not be recorded on the seismograph. "For earthquakes near at hand," continued Mr. Dodwell. "we have to depend upon personal observations in the most cases, although there are now instruments which will give useful and automatic records. Among these is the barograph, to which I referred earlier in our interview."

Rossi-Forel Scale of Intensity.

For the benefit of those who contemplate forwarding details of their observations to Mr. Dodwell we publish the following particulars of the Rossi-Forel scale of intensity:-

1. Recorded by a single seismograph, or by some seismographs of the same model, but not by several seismographs of different kinds: the shock felt by an experienced observer. 2. Recorded by seismographs of different kinds; felt by a small number of persons at rest. 3. Felt by several persons

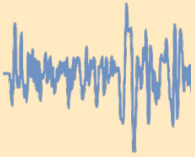
at rest: strong enough for the duration or the direction to be appreciable. 4. Felt by persons in motion: disturbance of movable objects, doors, windows, cracking of ceilings. 5. Felt generally by everyone: disturbance of furniture and beds, ringing of some bells. 6. General awakening of those asleep: general ringing of bells, oscillation of chandeliers, stopping of clocks; visible disturbance of trees and shrubs. Some startled persons leave their dwellings. 7. Overthrow of movable objects, fall of plaster, ringing of church bells, general panic, without damage to buildings. 8. Fall of chimneys, cracks in the walls of buildings. 9. Partial or total destruction, of some buildings. 10. Great disasters, ruins, disturbance of strata, fissures in the earth's crust, rock falls from mountains.

Sleeping Citizens Aroused.

The State meteorological officer (Mr. E. Bromley) was in bed at Rose Park at the time of the earthquake, but he felt it most distinctly. He stated, when communicated with, that it was the only shock he had felt since the big one in September, 1902, and that it made him feel a bit anxious at the time. His coolness, however, is instanced by the fact that his first act on jumping out of bed—for he was in bed when the first tremors were felt—was to examine his watch, and he was consequently able to state that it occurred at 9 minutes to 11. The shock, he said, shook the house quite appreciably, but not enough to knock down any pictures or upset any ornaments. The sound of the approaching earthquake was like thunder, he stated, but knowing there was no thunder about, he had jumped to the correct conclusion, even before the shock had advanced and shaken the whole house. Everybody in the neighbourhood was disturbed from bed by the visitation, and Mr. Bromley stated that in a few minutes the whole street was lit up.

At the Tramways Depot.

Mr. W. G. T. Goodman, the general manager of the Tramways Trust, who lives in Strangways-terrace, North Adelaide, stated that the shock was very



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severe in that part. To use his words, he thought his house was going to roll over. At the depot, he stated, the movement was so pronounced that the officials deemed it advisable to make a hasty exit from the buildings.

Telephone Exchange Busy.

The attendants at the Telephone Exchange had not much time to analyse their own feelings, for they were overwhelmed with an almost, unprecedented rush of calls. They stated, however, that the shock had been distinctly perceptible at the exchange. The walls had shaken to an unnerving degree, but apparently no trouble had been caused to any of the lines. The officer in charge of the telegraph operating-room reported that the shock had not been very strong up there, although most of the occupants of the room had heard the rumbling above the clicking of the transmitters.

Reports from Suburbs.

Mrs. Skinner, of East Adelaide, said the members of her household, who had not retired for the night, felt a distinct shock, and thought an explosion had occurred. The tremor passed away quickly. Mrs. Munro, a neighbor, rushed into her house, and said she felt the shock very badly. The Norwood police stated that all they had felt was a slight earth tremor, lasting about four seconds. "There was a rumbling noise," said the officer, "and we could feel the chairs moving under us." Mrs. T. R. Scatfe, of Marryatville, remarked that some visitors were preparing to leave her residence shortly before 11p.m., when they heard a noise, which they thought was caused by an explosion at a quarry. A little girl in an upstairs bedroom said that the windows shook loudly and the vibration was terrific. At Knightsbridge the residents were very much alarmed. Mr. F. C. Catt, who has a large house in that neighborhood, said that the building shook forcibly and the tiles on the roof rattled distinctly. The shock was very severe while it lasted. The report from the Goodwood police station was that they had heard a loud

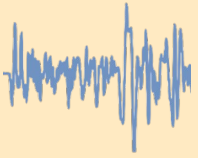
noise as though something had violently struck the window of the room, in which several occupants of the house were sitting. Chairs rocked and crockery, &c., rattled.

Ornaments displaced.

A resident at Malvern was under the impression that an explosion had occurred somewhere in the vicinity. There was a loud rumbling noise, and the windows rattled. The vibration lasted only about 5 seconds. Mr. H. R. Knowles, of Commercial-road, Hyde Park, stated that the noise seemed to come from the south-east. The occupants of his house rushed out into the yard, and on returning indoors found that several ornaments had fallen from the mantelpieces. It would seem that at the Reedbeds and Henley Beach the force of the shock was very intense. It was felt about 10.52p.m., and the rumbling, so far as could be judged, came from a north-westerly direction. "It was like the rumbling of a mighty waggon," remarked one resident. The iron on the roofs rattled, and the houses were shaken to their foundations. A hanging lamp at one place swung and shivered like a pendulum of a clock, and the vibration, which was very pronounced, lasted for about a quarter of a minute. The officer on duty at Henley Beach stated that he had heard a heavy and distinct rumbling noise resembling thunder and felt an earth tremor. The police officer at Glenelg reported that the shock was not felt to any great extent there, while similar information was received from the Port Adelaide police. The roof of the Nailsworth Police-station was reported to have been shaken, but the shock was not severe.

Slight Tremor at Mount Lofty.

In the bills the tremors were evidently of short duration, for according to reports received from various parts the shock was only momentary. There was a slight noise made by the shaking of the windows, and beyond that there was nothing to cause the residents any alarm.



THE EARTHQUAKE. REPORTS FROM THE COUNTRY

**Advertiser (Adelaide, SA : 1889 - 1931),
Saturday 30 May 1914, page 19**

Now that the excitement of the first alarm has worn off, the exaggeration which was natural in the first impressions formed of Thursday night's earthquake, has been displaced by a more ordered and more sober view of the occurrence, and those who felt an unwonted flutter in the region of the heart when the tremor was passing under them, now review their experiences with equanimity. The terror of the night before seemed unreal in the broad light of the day. The shock, it seems, was comparatively restricted in area, for reports from the country record it only as far north as Kapunda, and in most outside centres it was light in character and short in duration.

The sensation of a member of the audience at the Theatre Royal is worth recording. The performance of the pantomime "Aladdin" was approaching the end, when the tremor shook the theatre, and he thought the rumbling and shaking were caused by a few people leaving the gallery above him, before the play was over. He remembers thinking that, if a few people leaving the gallery, shook the building like that, a stampede would bring the whole house down. The suggestion that an earthquake was the cause of the disturbance did not occur to him. Nor, apparently, did anybody else suspect anything out of the ordinary, for he heard no whisper of it either there or in the crowded car, in which he travelled home.

Kapunda. May 29. A distinct earth shock was felt by residents at about a quarter to 11 o'clock on Thursday night. The tremor, which appeared to travel from east to west, was of some seconds' duration. Owing to the goods traffic at night time when a number of trains run through the town, many thought the vibration was caused by passing trains. It was also felt at Koonunga, about six miles out, on the Truro-road.

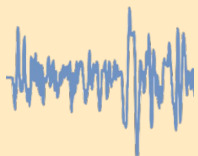
Bugle Ranges, May 29. A very severe earth shock was felt here a little before 11 o'clock last night. It was accompanied by a low rumbling noise, which could be heard for some seconds. The vibration was severe enough to cause buildings to shake and windows to rattle. It was the severest shock felt in this district for many years.

Meadows South, May 29. A slight earthquake shock was experienced in this locality on Thursday night shortly before 11 o'clock. It was of short duration, and appeared to be travelling from west to east. Although the tremor was very slight, it was sufficient to shake the walls and rattle dishes on shelves.

Gumeracha, May 29. A distinct shock of earthquake was felt here last night about nine minutes to 11 o'clock. It seemed to be travelling from west to east. There was a noise which resembled the sound of a heavy vehicle passing along. Windows rattled.

Lobethal, May 29. An earth tremor here at about nine minutes to eleven o'clock last night alarmed the residents. The shock lasted about three seconds, and seemed to travel from east to west.

Our Reedbeds correspondent writes:—The earthquake shock on Thursday night was exceptionally severe in the Reedbeds and Henley Beach districts, and residents state that it was the most pronounced shock since the severe shaking experienced in 1902. The shock was first noted about 9 minutes to 11 o'clock, and seemed to come from the direction of St. Vincent's Gulf, like a huge explosion, or series of muffled explosions. People rushed from their houses to see what was the matter, as the timber in the roofs of the dwelling creaked in an uncanny way, and the iron rattled as though someone was running over the top of the houses. Swinging lamps rocked to and fro like the pendulum of a clock. The shock lasted quite 14 or 15 seconds.



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REPORTS FROM THE COUNTRY

The reports received from country centres by the State Meteorological Officer (Mr. E. Bromley), are as follow:—

Clarendon—Slight earth shock felt at 10.52 p.m. last night.

Meadows—Severe earthshock felt, travelling north to south, lasting four seconds, rattling all windows and crockery, and shaking the beds.

Hahndorf—Shock felt at 10.53 last night.

Gawler—Earthshock at. 10.50 p.m..

Kapunda—Slight earthquake at 10.50 last night, travelling west to east. Nothing special to note.

Teatree Gully—Sharp shock of earthquake felt here about 11 last night.

Echunga—Earthshock about 11 p.m.

Stirling West—Sharp earth tremor 10.50p.m.; duration, 10 seconds.

SEISMOGRAPHICAL RECORDS.

INTERESTING EXPLANATION BY MR. DODWELL.

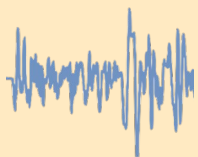
The record of the seismograph at the Observatory was developed on Friday morning and showed the graph of a distinct and severe earthquake at midnight on Tuesday. The preliminary tremor of this shock began at 1 minute 48 seconds past 12. The long waves followed at 5 minutes 42 seconds past 12, and then the amplitude of the vibration increased until, at 15 minutes 36 seconds past 12, the displacement from the mean position of the pendulum was 43.2 millimetres, or $1\frac{3}{4}$ inches. The boom continued to swing for 4 hours 20 minutes before it again assumed its normal position. So far as Thursday night's shock was concerned, the record was only just visibly affected. There was just a thickening of the line which is traced out by the instrument. It was not the true harmonic swing of the pendulum, but indicated rather a bodily displacement of the instrument. The records showed that the shock occurred at 50 minutes 36 seconds past 10.

When asked how it was that the instrument gave such a clear record of a shock that was felt by nobody, while it almost failed to record an earthquake

that disturbed the whole city, Mr. G. F. Dodwell, the Government Astronomer, gave a most interesting explanation of the machine and its purpose. He stated that the boom on the seismograph was timed to swing to and fro in a period of about 17 or 18 seconds. That was the rate at which the long waves came from distant earthquakes, counting from crest to crest, and, by adjusting the swing to harmonise with that wave length, a faithful record of the shock was obtained in the deviation of the pendulum from its normal course. To indicate the difference between recording near and distant earthquakes, Mr. Dodwell compared a convulsion of the earth to a storm at sea. The long waves, to record which the seismograph was adjusted, were like the swell of the ocean a long distance from the storm centre, while the violent tremors, such as were felt in Adelaide on Thursday night, were like the broken waves and short wavelengths in the storm centre itself. The seismograph was adjusted to pick up the "swell," and if they desired to have a record of the local tremors as well, then it would be necessary to have another instrument adjusted to show them. It was not essential, however, to have a complete record of local visitations, as they were able to secure sufficient information on those from personal observation.

In response to other questions, Mr. Dodwell stated that an earth movement lengthened out to about 17 or 18 seconds between each wave after it had travelled 400 or 500 miles, but that nothing closer than that, would be recorded on the instrument, unless, as seemed to be the case on Thursday night, it displaced the instrument bodily. The fact that the seismograph showed any record at all indicated that the direction of the tremor was either from east to west or from west to east, for no earthquake travelling from north to south or from south to north could have affected it.

Mr. Dodwell further stated that the record of Tuesday night's disturbance tallied with that taken at the Sydney Observatory, and it was believed the earthquake that had affected both instruments had had its origin in Java.



Resources & useful links

Description	URL / Webpage	Notes
SAA Membership Application	https://www.assa.org.au/media/74629/saa-membership-	Join up with the SAA using this form
SAA Flier	https://www.assa.org.au/media/74629/saa-membership-	Our current brochure - flier, saying what we do
SAA Newsletters	https://www.assa.org.au/resources/technical-special-	Download any SAA Newsletter from this site
SAA EqServer	http://ade-eqserver.dyndns.org:8080/eqserver/	South Australian miniseed seismometers
Melbourne University EqServer	http://meiproc.earthsci.unimelb.edu.au/eqserver/	Australian miniseed seismometers
Regional Seismic Network	http://www.regional-seismic.net/	PSN seismometers - Aust. Centre for Geomechanics
Australian Public Seismic Network	http://cqsrg.org/psn/stations/	Australian PSN seismometers
Recent SA Earthquakes	https://earthquakes.mappage.net.au/q.php	Data & summaries of recent SA quakes
Central QLD Seismology Research Group	http://www.cqsrg.org/	CQSRG - Kevin McCue
Astronomical Society of SA	https://www.assa.org.au/resources/technical-special-	ASSA - Seismology page
Geoscience Australia	http://www.ga.gov.au/earthquakes/initRecentQuakes.do	Our national authority on seismic events
Earthquake Services	https://www.researchgate.net/profile/Colin_Lynam	Citizen Science Consultant - Col Lynam
Seismic Research Centre	https://www.src.com.au/	OEM of seismic instruments & software
symCDC	http://symcdc.com/	OEM of seismic instruments & software
IRIS Seismic Monitor	http://ds.iris.edu/seismon/	Global seismic events
Joint Australian Tsunami Warning Centre	http://www.bom.gov.au/tsunami/	Bureau of Meteorology site
Australian Earthquake Engineers Society	https://aees.org.au/	An organisation with similar interests
Atlas of the Underworld	http://www.atlas-of-the-underworld.org/	Mapping the Earth's mantle
Atlas of Living Australia	https://www.ala.org.au/	A Citizen Science initiative