

# **THE LAST OF THE GREAT EARTHQUAKES OF 1906 – FINISTERRE RANGES NEW GUINEA**

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## **Abstract**

This great shallow magnitude 8.1 tsunamigenic earthquake on 14 September 1906 attracted little world attention following as it did the destructive earthquakes of Ecuador, San Francisco, Aleutians and Chile, all in the same year 1906. Hundreds of people died, there were extensive landslides and a tsunami. The published ISC location is poor and surprisingly, used no Australian data. We extracted arrival times from 5 seismographs not used by the ISC originally including Sydney, Melbourne, Christchurch (New Zealand), Victoria (Canada) and Colombo (Ceylon) and, at our request, ISC relocated the epicentre using current travel times. Perth seismograph station was not operational on the day of the mainshock but did record the main aftershock, magnitude 7.7 on 2 October. Surprisingly the ISC relocation was barely changed and is therefore preferred over the Sieberg location. The epicentre is not on the supposed plate boundary along the Ramu Markham fault zone.

The relatively small tsunami indicates that fault rupture propagated from the Finisterre ranges into Vitiaz Strait.

We have examined local reports of effects on people and the landscape to support this location from Australian media and local German sources. New Guinea was then under German administration. On the basis of the damage and felt reports we have set the main aftershock location at that of the mainshock, the two earthquakes constituting a doublet.

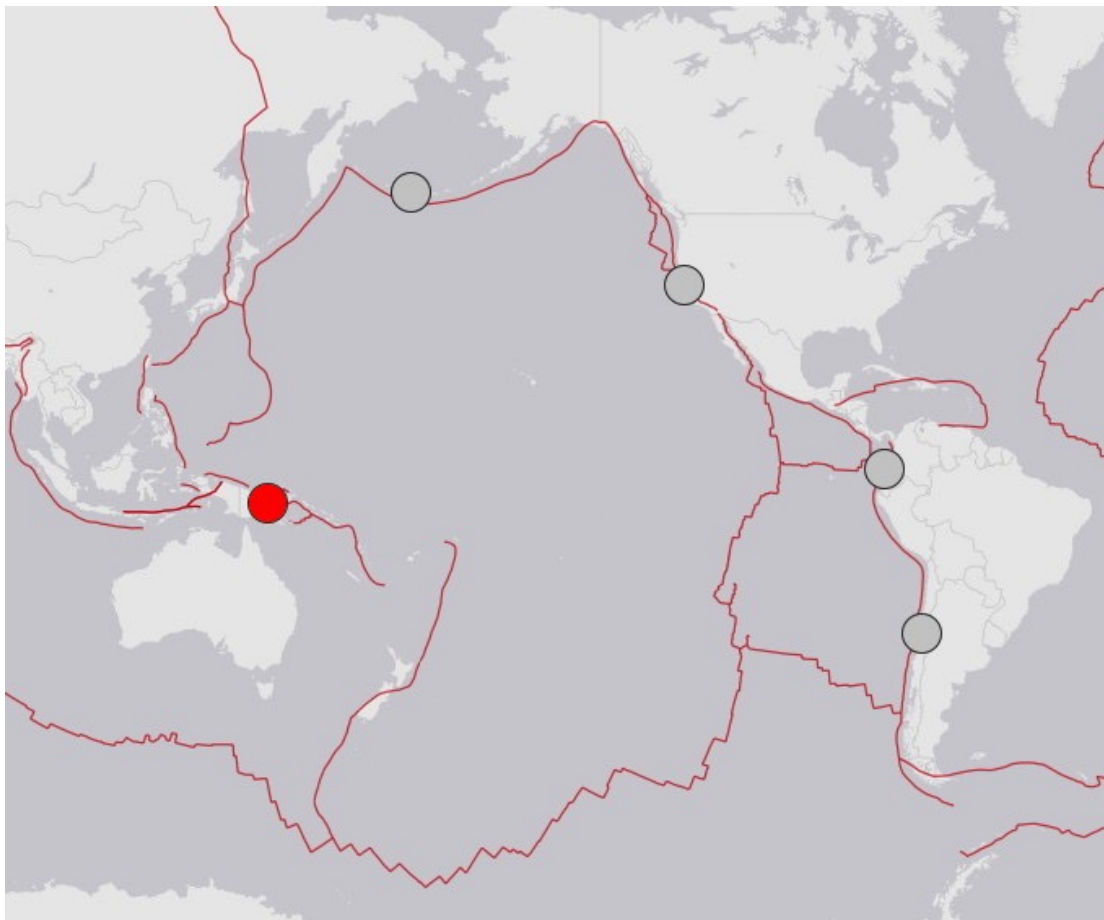
Information about this earthquake sequence and its impact on people in the epicentral region needs to be communicated to the current population of Lae and the Finisterre Ranges and national emergency services personnel who seem to have no inherited knowledge of the high probability of another great earthquake in the region, nor of the extent and severity of its effects.

**Keywords:** great earthquake, tsunamigenic, Papua New Guinea, historical

## INTRODUCTION

A world map of felt earthquakes was published by Mallett in 1858, the first clue to plate tectonics, a theory that didn't mature for more than another 100 years, yet even then the island of New Guinea was embedded in a circum-Pacific earthquake belt.

The year 1906 is renowned in seismological circles for a remarkable series of great earthquakes around the Pacific now reduced to four from seven originally, after revision of magnitudes worldwide. The last of these occurred near the north coast of the island of New Guinea which, at the time was a colony of Germany (fortunately for us as they took excellent notes of local happenings such as this earthquake).



**Figure 1.** Four great earthquakes of 1906 (from the USGS), the New Guinea epicentre (red dot). Two others, not plotted, in Japan and Colombia, have had their magnitudes downgraded as did the famous Californian earthquake which is plotted here.

We set out to re-examine old observatory registers of arrival times to find more station phase arrival data for the earthquake. To supplement a computer relocation, we investigated earthquake felt observations in New Guinea; reports from news items in Australian newspapers via Trove, contemporary reports in German written during the period of German

colonisation (*Deutsch-Neuguinea 1884-1914*), and other references such as Sieberg (1910) and Lutheran missionary documents.

According to mission papers and German government reports the earthquake killed an unknown number of people, however, estimates ranged between 100-400. Places that suffered most were the mission stations Sattelberg and Wareo. Many newly and well build houses were destroyed and moved off their stilts, some up to 0.9m. Watertanks were shifted off their foundations and squashed. At Sattelberg mission houses were moved by 2m. Trees were virtually sheared off; coconut trees bending down to the ground. During the earthquake it was impossible for people to stand upright or walk. On the west coast of New Britain, gaping soil cracks and numerous extensive landslides were observed.

About 15 minutes after the initial shock a tsunami was observed. The water level at Finschhafen rose by 1.2-1.5m above normal. After 0.5 minute the water wave disappeared as quickly as it had come. This phenomenon was observed a few times (Letz, pers. comm.).

### SEISMICITY OF PAPUA NEW GUINEA

Much has been written about the seismicity and tectonics of the New Guinea region by resident Port Moresby Geophysical Observatory (PMGO) seismologists such as Brookes, Denham, Everingham, Ripper, McCue, Letz, Anton, Moihoi, and many other researchers.

A map of epicentres of just the great earthquakes (locations and magnitudes from the USGS), of magnitude 8 or more since 1901, is shown in Figure 2. Another map of recent shallow earthquakes is shown in Figure 3 (from Ghasemi and others, 2016).

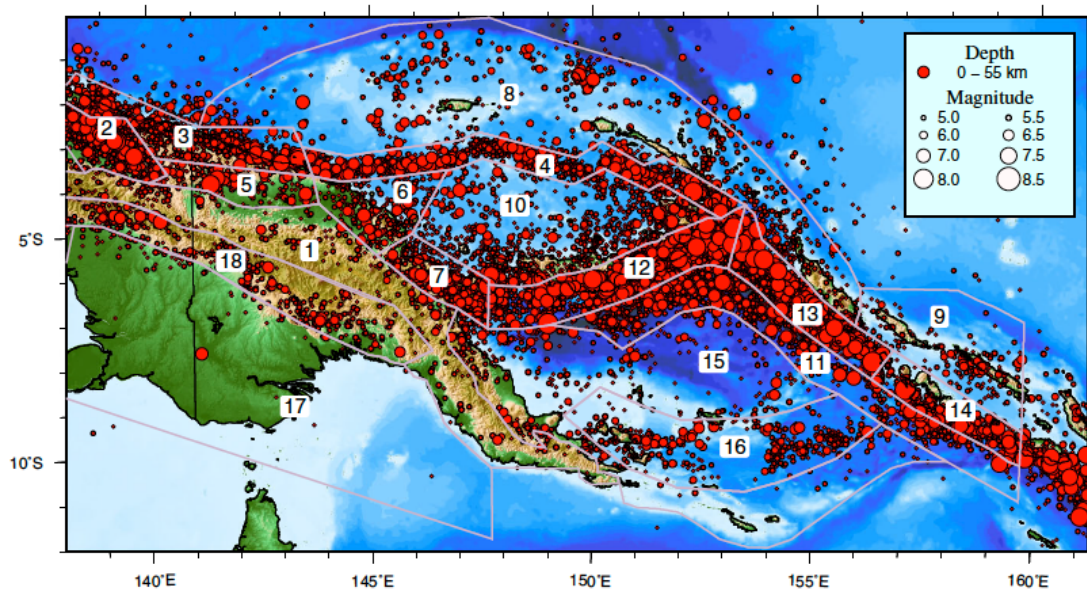


**Figure 2.** Great earthquakes in the New Guinea Region, 1901 - 2019, from the USGS.

The epicentres of great earthquakes highlight both the regions of rapid stress accumulation - in northeast and northwest Solomon Sea, and the most likely sites for the next great earthquakes - in the gaps between them allowing for finite sources, New Guinea north coast and southern coast of New Britain. The mid-Bismarck Sea plate boundary should not be discounted either but earthquake risk there is low.

The deep seismicity shows the forward edge geometry of the subjecting plates while the shallow seismicity (Figure 3) shows the surface extent of the plates whether on transform, subducting or normal faulting plate boundaries, all three mechanisms represented in the region. These shallow earthquakes also cause the highest earthquake hazard as rated by their relative collision velocity.

The New Guinea region has more small plates than most other parts of the globe, partly because of the high collision rates and partly because it is at an oblique continent/oceanic collision between the Pacific and Australian plates. The pattern of earthquakes is typical of the dislocation pattern within a major shear zone at many scales.



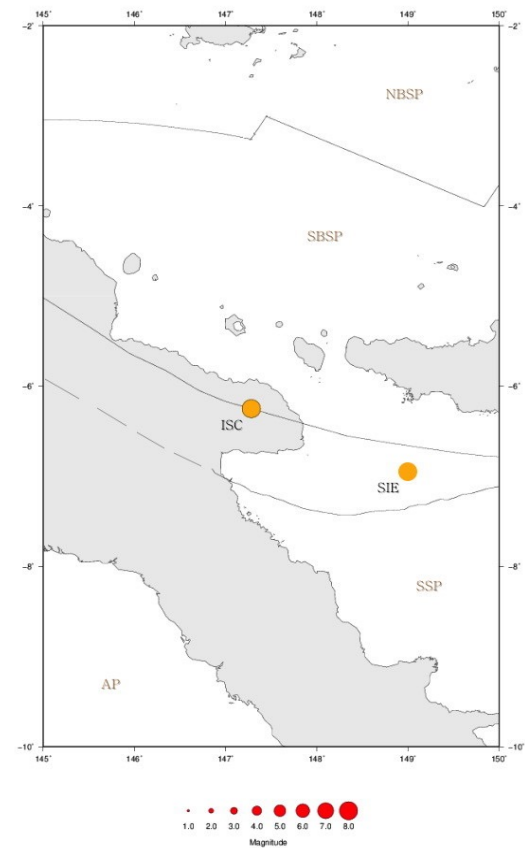
**Figure 3.** Shallow seismicity of the New Guinea Region with zones used for a Geoscience Australia PSHA. Zones 6 and 7 are 100km wide zones of deformation, the seismicity is not focussed on a narrow zone along the Ramu-Markham Fault zone. Drawn slightly differently, the Ramu-Markham Fault could have formed the boundary between zones 7 and 1.

## 1906 EARTHQUAKE LOCATION

The earthquake occurred just after 2am local time on Tuesday morning 15 September 1906 (EST). Sieberg (SIE, 1910) was the source for the Gutenberg and Richter (GUTE, 1954) and Everingham (IBE, 1974) epicentres as summarised in Table 1.

The implied precision of 100m in the ISC relocation is not to be taken at face value. The real uncertainty is at least 100km, just 11 arrival times were used (only 5 of them P phases and no S phases - the rest PP or diffracted P). The nearest seismograph was at Manila 3300km away, the station gap is 164° (between Apia and Jakarta) and the P arrival time residuals are large. 100km is about the difference between Sieberg's estimate and the ISC location (Figure 4). The focal depth of 35km was assigned, not computed, the shallow nature of the earthquake was recognised from the waveforms.

**Figure 4.** 1906 earthquake location according to Sieberg (SIE) and the International Seismological Centre (ISC). Plate boundaries are from the ISC except that we have dashed in the rest of the truncated boundary along the Ramu-Markham Fault near Lae. The brown labels mark the North (NBSP) and South Bismarck Sea Plates (SBSP), the Solomon Sea Plate (SSP) and Australian Plate (AP).



**Table 1** Locations of the Great New Guinea Earthquake of 14 April 1906 (UTC)

Reference	Date	Time (UTC)	Lat °S	Long °E	Depth km
Sieberg	1906 09 14	160418	7	149	—
GUTE		160443	7	149	35
Everingham		160418	7.0	149.0	shallow
ISC		160443.9	6.249	147.281	35
ISC-GEM		160443.7	6.25	147.22	35

### Missing Seismological Data from the Pacific including Australia and New Zealand

Seismographs were operating at Australian Observatories in Perth, Melbourne and Sydney in 1906 yet none of this invaluable data has been listed by the ISS/ISC nor used in its location to dramatically close the gap (Table 2). Newspaper reports indicate that the earthquake was recorded at all three observatories in Australia yet, unusually, none of the times are given in the interviews with government astronomers (not trained seismologists unlike the Jesuits running the Manila MAN, Apia API or 3 years later the Riverview RIV Observatory seismographs).

- **PER** According to the *Bendigo Independent* (Vic. : 1891 - 1918), Monday 8 October 1906, page 2., the shock was recorded at Perth ... yet a copy of the Register from the Perth Observatory says *No record from 14 Sept. 14 1906, 7h 15m, to Sept 15, 2h 0m.*

- **SYD** The British Association for the Advancement of Science Register from Sydney Observatory does report P and L.W. times with a comment that *amplitude greater than width of paper for 14min.* and P 16h 9.9m L.W. 16h 17.1m.
- **MEL** The *Melbourne Register* reports *Disturbance commences suddenly* and P 16 11 02.3
- **CHR** The same paper has a time from Christchurch NZ (CHR) with a comment *A.T.'s obscured by night tremor* but they felt comfortable to report P 16h 12.1m. L.W. 16h 19.3m
- **VIC** The Register also has a time from Victoria Canada (VIC) P 16h 18.0m, and
- **COL** Colombo (COC), P 16h 15m 23s (note decimal minutes or minutes and seconds).

These data are appended to Table 2 with computed magnitudes in Table 3. ISC-GEM was in the process of relocating this earthquake when we sent them our data, all but the MEL data had been recovered by them independently however they incorporated MEL P time and redid the location (Table 1) which they will publish in time. The MEL P wave residual was 0s. Interestingly the relocation hardly moved the location despite the much smaller gap and greater number of stations, because the residuals and uncertainty are so large.

**Table 2** ISC Bulletin, [Event 16957920](#) (most columns removed) and angle of incidence inserted from Richter (1958). UPP was not used, some of the residual times are very large e.g. DJA the 2<sup>nd</sup> closest station, 18.6s, the gap 164 degrees. Additional readings not used in the ISC location are added at the end of the table.

Station	Distance	Azimuth	Phase	Arrival Time	Angle of incidence	Time Residual
MAN	33.27	308.8	P	16 11 15	29.5	-3.3
DJA	40.20	267.8	P	16 12 36.0	28	18.6
API	40.96	103.8	P	16 12 11	28	-12.7
API	40.96	103.8	S	16 18 33		-0.7
OSA	42.19	345.5	P	16 12 33.0	27.8	-0.4
OSA	42.19	345.5	S	16 18 50.0		-1.3
ZKW	44.68	327.9	P	16 12 51.0	26.6	-2.5
ZKW	44.68	327.9	S	16 18 31.0		-56.8
IRK	68.79	333.3	P	16 15 36.0	21	-8.5
IRK	68.79	333.3	S	16 24 48.0		2.3
TIF	103.45	311.3	Pdif	16 19 23.0	14.8	41.9
UPP	114.43	334.7	P	16 24 42		
UPP	114.43	334.7	S	16 33 48		
JEN	122.26	328.5	PKPdf	16 23 35		-0.2
JEN	122.26	328.5	PP	16 24 54		-16.5



JEN	122.26	328.5	smax	16 36 00		
JEN	122.26	328.5	SKKPbc	16 37 36		15.8
JEN	122.26	328.5	L	17 00 36		
JEN	122.26	328.5	L	17 04 06		
JEN	122.26	328.5	L	17 16 00		
GTT	122.74	329.8	PKPdf	16 23 39		2.8
GTT	122.74	329.8	PP	16 25 22		8.3
GTT	122.74	329.8	L	16 53 18		
GTT	122.74	329.8	M	17 03 00		
GTT	122.74	329.8	M	17 07 00		
GTT	122.74	329.8	M	17 14 18		
Additional Data					Amplitude	
SYD*	27.73	172.86	P	16 09 54	>17.5mm	-34.86
MEL*	31.5	183.4	iP	16 11 02.3	>17.5mm	-0.27
CHR	43.34	152.95	P	16 12 06		-36.38
COC	68.46	279.91	P	16 15 23		-11.47
VIC	94.22	41.81	P	16 18 00		0.85

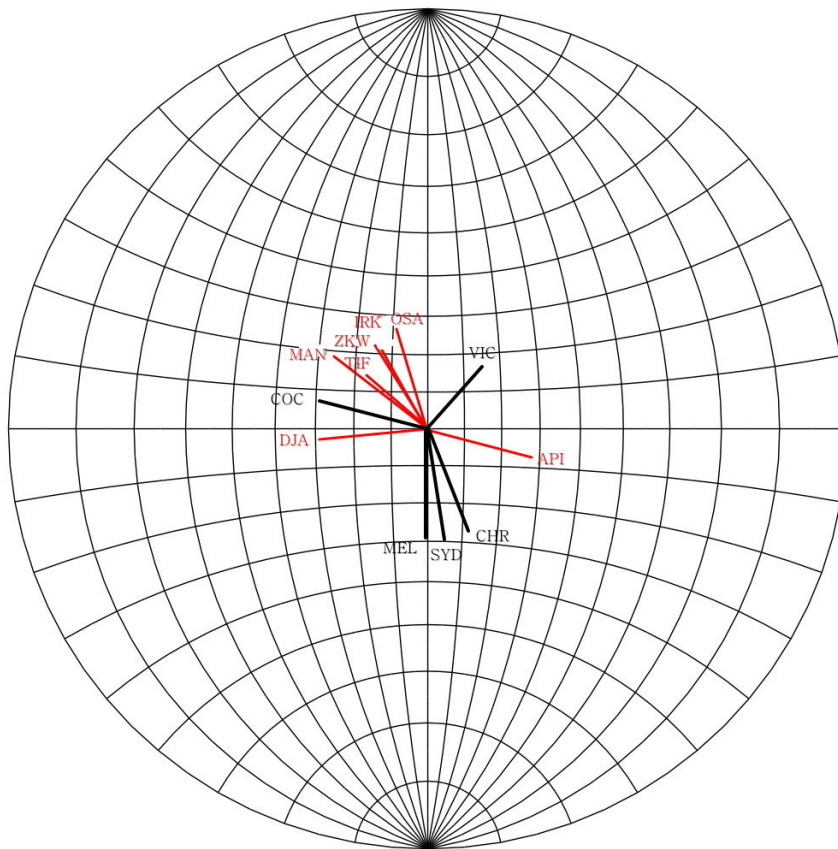
\* trace off scale, amplitude > 17.5mm

**Table 3** Mainshock magnitude 1906 earthquake New Guinea (from ISC)

Magnitude scale	Magnitude	N stations	Author
mB	7.8		ABE1
Ms	8.1		GUTE
MS	8.1		PAS
Ms	7.5		AN2
Mw	8.0		P&S
MS	8.1	4	ISC

The significance of the reduction in inter-station gap using the new P-phase arrival times data from the two Australian plus New Zealand and Canadian stations detailed in Table 2 above, is

illustrated in Figure 5. It is easy to see why, looking at Figure 7, the phase arrival time errors are so large and hence the location itself is so imprecise.



**Figure 5.** Wulff Stereographic projection of station azimuths from the first ISC location (red lines) and with our additional stations (black lines) from latest ISC-GEM location.

## FELT REPORTS

The Sattelberg Lutheran mission station was situated on a hill 900m above sea level about 8km inland from Finschhafen where the German vessel “Siar” was anchored at the time of the earthquake. The felt observations from the mission stations out of Sattelberg are detailed and most interesting (see Appendix) but we have been unable to find out how strongly the shaking was felt at Port Moresby or Rabaul nor any reports of its effects at Lae. A map of Kaiser-Wilhelmsland published in 1915 is reproduced in Figure 6 from which we were able to compile a list of place names and their coordinates in Table 4.

Sieberg’s comment that there was not enough data for an *isoseismic* map to be compiled is true enough. His detailed reports (translated) are reproduced as follows:

- At Wareo on Wamoro Mountain. Intensity 11 (acceleration averaging 4000mm/s<sup>2</sup>); all houses badly damaged, full water tanks hurled to the ground.
- At Sattelberg and Logaueng. Intensity 10 (about 1800mm/s<sup>2</sup>. At Sattelberg oldest house thrown from stilts, church tilted so badly it had to be demolished.



- At Logueang trees broke off.
- At Finchhafen. Similar to Sattelberg, 10.
- At the Island of Madang. Old houses on rotten stilts thrown to ground hurled 1-2m to SE.
- At Pola. Loose household effects thrown down, palms bent to ground, walking impossible.
- All coastal stations. Destruction of baking ovens, tilting of houses, overturning of cupboards and book shelves reported.
- Intensity greater in mountain than coastal areas.
- According to Hahl who visited the area in early February 1907, the most affected area was from Cape King William to Cape Cretin.
- Earth movements recorded from the west coast of New Britain.
- At Bulesom Deinzerhöhe and Cape Arcona. Intensity 5 (about 40mm/s<sup>2</sup>). Landslides in mountains between Cape Arcona and mouth of Markham R. near Preussenreede.
- At Tami Islands. Intensity 4 (about 18mm/s<sup>2</sup>).
- At Siassi and Ruk Islands. Slight
- At Astrolabe Bay and Potsdamhafen. Strong shocks reported.



**Figure 6.** Rare map of German New Guinea, published 1919. The red lines are access routes.

**Table 4** Geographical Locations in German New Guinea and assigned intensity

Sattelberg	-6.500	147.775	10	
Madang Island	-5.202	145.818	7	4.2km NE of Madang
Wareo	-6.425	147.783	11	
Logaueng	-6.6	147.85	11	Mission Sation, close to Finschhafen. Neudettelsauer Mission Society
Finschafen	-6.604	147.854	10	
Pola			10	Pola Mission Sation, Phalzer worked there Neudettelsauer Mission Society
Cape King William	-5.45	147.75		
Cape Cretin	-6.659	147.838		Near Finschhafen
Cretin Island	-6.77	147.92		Tami Island
Bulesom	-6.72	147.60	5	West of Finschhafen
Deinzerhöhe	-6.73	147.00	5	Close to Lae
Heldsbach	-6.55	147.85	10	A few kilometres N of Finschhafen
Cape Arcona	-6.733	147.358	5	
Preussenreeede	-6.73	147.00	5	near Lae
Tami Islands	-6.759	147.897	4	Tami S of Cape Cretin
Siassi Island	-5.63	147.93	5	Umboj, Rook, Rooke or Ruk Island
Astrolabe Bay	-6.35	145.92	6	Stephansort
Potsdamhafen	-4.275	144.983	6	Opposite Manam Is.
Herbertshöhe	-4.343	152.268		Kokopo ENBP no report
Stephansort	-5.221	145.786		Astrolabe Bay
Erima	-5.442	145.733		Bogadjim
Port Moresby	-9.443	147.180		No felt report
Yule Island	-8.833	146.533		No felt report

## AFTERSHOCKS

Within the first week of the mainshock, hundreds of aftershocks were felt by missionaries and local people near the epicentre, the largest was a magnitude 7.7 event on 2 October at 02:52 UTC, which triggered a 1m tsunami (Sieberg 1910). This pair of earthquakes could qualify as a doublet, rather than a mainshock and aftershock.

Following is a description of the aftershock seismogram recorded at Perth Observatory (the main shock would have caused more than double the wave amplitude):

*Kalgoorlie Miner* (WA : 1895 - 1950), Thurs. 4 October 1906, page 5

*EARTH TREMORS RECORDED.*

*AT THE PERTH OBSERVATORY Perth, Oct. 3.*

*The Government Astronomer says that one of the most severe earth tremors, that have yet been experienced at the observatory was recorded on the seismograph yesterday. Preliminary tremors commenced at 10.3 a.m., and long waves followed at 10.8 a.m. Therefore, the centre of the disturbance does not seem to have been very far distant, say between 20 deg. and 30 deg. of the arc. There were two maxima, occurring respectively at 10.18 and 10.21, and at these times the pendulum swung right across the film, a thing which happens rarely. The whole disturbance lasted till 12.5, or just two hours.*

*Evening Journal* (Adelaide, SA : 1869 - 1912), Friday 5 October 1906, page 2

*EARTH SHOCKS.*

*CONFIRMATORY RECORDS. SYDNEY, October 4.*

*The seismograph at the Sydney Observatory when examined to-day gave evidence of severe tremors. Mr. Hunt, the Acting Government Meteorologist, stated that the oscillations were unusually large, and the greatest intensity lasted about 6 minutes. The records extended over two hours, and were coincident with the time recorded in Western Australia on Wednesday night. There was one decided shock and further slight tremors an hour or two later. He also stated that on September 15 the seismograph registered much more violent tremors than on the present occasion, and severe tremors were also recorded two days later. As neither of these shocks had been mentioned elsewhere the probability was that they were purely local.*

From Melbourne Observatory we have: *Age* (Melbourne, Vic. : 1854 - 1954), Saturday 6 October 1906, page 13.

*MELBOURNE OBSERVATORY RECORDS.*

*The seismograph record at the Melbourne Observatory is usually examined at the end of the week, the film which contains the week's record of seismic disturbances being then removed. Reports of severe earth tremors on Tuesday having occurred from Perth and Sydney, the film was removed earlier than usual, and shows several tremors to have taken place, that on Tuesday, 2nd October, at noon, corresponding with the shocks reported from Perth and Sydney. This disturbance is shown to have commenced at 12.2 p.m., and to have continued until 2 p.m.; the time of greatest intensity was from 12.10 to 12.15, when, as at Perth, the photograph of the swing of the pendulum appears right across the film. This shock, however, appears to have been no severer than one which occurred at 2.20 a.m. on 15th September; the*

*photograph of the pendulum appearing in this case right across the film. Other shocks occurred on 26th August at 2.32 p.m.; 17th September, at 7 p.m.; 2nd October, at 19.25 p.m., and 3rd October, at 1 a.m. Some of the records mentioned above will probably agree with the shocks reported from Sydney. The Government Astronomer of Western Australia reported that the earth tremor, recorded locally was one of the most severe that has yet been experienced at Perth.*

**Figure 7.** The Sydney Morning Herald reproduced this film copy of the SYD seismogram on a Milne seismograph of the main aftershock in their edition of Friday 5 October 1906, page 7. Mr Hunt, the Government Astronomer and seismologist, mentioned that the waves were not nearly as violent as those on 15th September though the recorder is saturated. The times marked are Eastern Standard Time e.g. 11.30 is 11.30am, 1.30 is 1.30pm.

On the basis of the felt reports and tsunami, we have assigned the aftershock epicentre to that of the mainshock, it certainly didn't originate in the Bismarck Sea, where the ISC have it located.

## LANDSLIDES FOLLOWING THE MAINSHOCK

The extent of landslides seems to have been comparable to that during the magnitude 7.5 Southern Highlands PNG earthquake on 25 February 2018 (McCue et al, 2018), or the September 1935 (Souter, 1966) M7.8 earthquake in the Torricelli Mountains.

Great slabs of weathered limestone, soil and vegetation collapsed in the Finisterre Ranges, on Umboi Island and in the mountains of West New Britain according to contemporary observations reported in Australian newspapers.

*The Advertiser* (Adelaide, SA : 1889 - 1931), Monday 5 November 1906, page 5: reported

*The mountain wall opposite to us shows numberless small and large earthslips, and the fresh chalk layers gleam through the dark forests. Brooks and rivers were filled and dammed up until, after a few days, the waters broke through their chalky obstruction, and now the milky waters have for days been flowing seawards. Further away, it is reported, numerous natives were killed by the earthslips.*

And later in the article, interesting observations of clefts (faulting?) :

*The Wamoru Mountain has been broken between the station Waleo and the coast by a deep cut, which occurred during the night of the severe earthquake. On the Sattelberg itself numerous earth-slips have occurred, and on the way up as well as near to the station, there are numerous clefts and cracks, so that further earth-slips must be*





*anticipated. The clefts in the mountain are more serious and disquieting than the damage sustained by the buildings.*

*Steaming along the New Guinea Coast, the fissures in the mountain side were clearly visible from the deck of the Siar, and Captain Prejawa estimates that some of them were fully 200 feet long and 100 feet deep.*



**Photo 1.** Landslides on the Huon Peninsula (Neuhauss 1911).

## **TSUNAMI OBSERVATIONS**

According to Sieberg (1910), so-called tidal waves affected the coast from Heldsbach to Busega on Schollenbruchspitze in the Huon Gulf as well as the Tami and Siassi islands. The height above maximum tidal level was 1.2 to 1.5m only. According to Pfalzer, no flood wave was observed from the Island of Ruk but the water level receded. Some of the descriptions (of tidal waves) are quite detailed, others quite incredible. For example this story from the *Sydney Morning Herald* (NSW : 1842 - 1954), Saturday 20 October 1906, page 13.

*The news was brought to Sydney yesterday by the German New Guinea Company's steam yacht Siar that phenomenal tidal waves have been experienced along portions of the coast of German New Guinea, resulting not only in loss of life, but also in great destruction of property. Captain Prejawa, the commander of the Siar, says that*

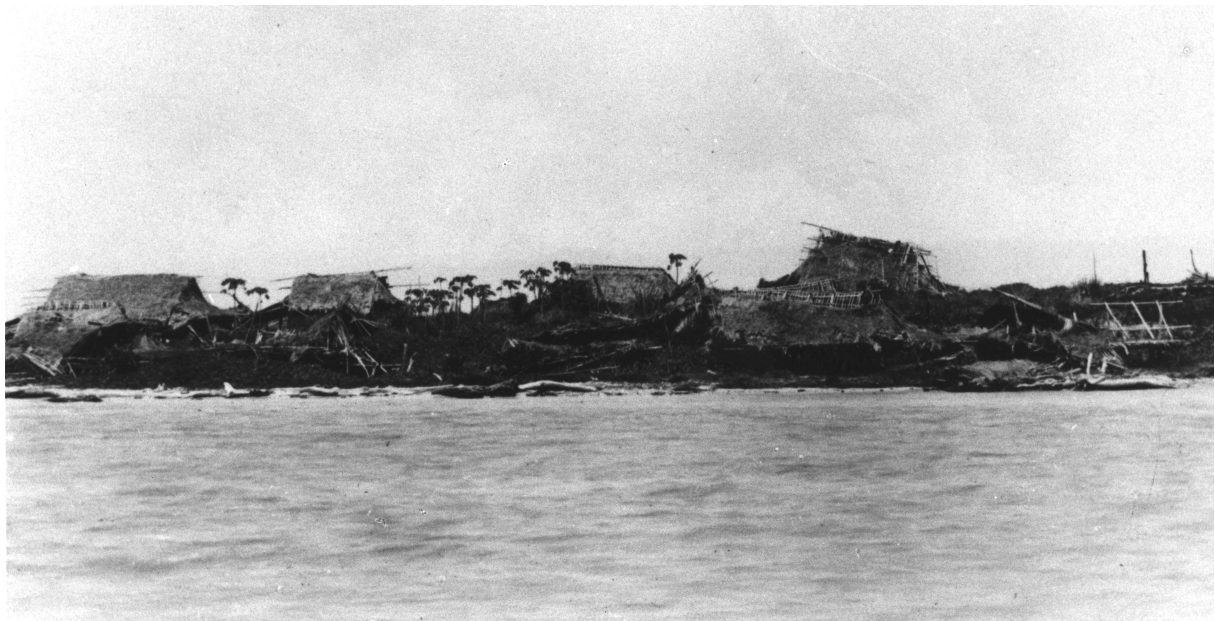
*from September 10 to September 15 enormous waves swept the south-eastern coast, and extended for a great distance inland, carrying away hundreds of native huts, and completely submerging many miles of country.*

*The first tidal wave, which proved the most severe, made its appearance without the slightest warning, and the terrified natives, believing that their country was to be swallowed up by the ocean, madly rushed for the highlands. Many, however, were unable to reach places of safety, and were drowned, while others were severely injured in their fight against the incoming volumes of water.*

*The Yass Evening Tribune (NSW : 1899 - 1928), Monday 22 October 1906, page 2. chipped in with:*

*At Chiassi Island (also known as Siassi, Rooke or Umboi Island), in the Dampier Straits, the tidal wave wrought great havoc, hardly a native hut being left standing. The natives of this island made for the highest point, and there remained in safety until the wave subsided.*

The observations are localised, not consistently high over large distances commensurate with the rupture length as would be expected if a great earthquake had ruptured the whole fault, perhaps 300km long and 5-6m high.



**Photo 2.** The severely damaged small island village of Quampu located on Quamquam Island, off the coast of Sialum, close to Cape King William (S 6.065, E 147.581), Huon Peninsula, Morobe Province (Neuhauss 1911).

## DISCUSSION

One of the points of contention is where to assign the faulting; which fault(s) or plate boundary ruptured during the earthquake? Together, the felt reports, landslide distribution and tsunami observations support the ISC-GEM relocated mainshock using the latest travel-time



model, carefully selected station data plus the additional Australian station data. It is most likely that the 1906 earthquake ruptured faults in the shear zone along the north coast of New Guinea and out into Vitiaz Strait, generating a relatively small tsunami in the process. The epicentre is in the Finisterre Ranges, not on the Ramu-Markham Fault through Lae.

Another question focuses on the probability of another great earthquake near Lae. During the late 1970s Port Moresby OIC and senior seismologist Ian Everingham, was of the opinion (pers.comm.) that Lae was the most likely location in Papua New Guinea for the next great earthquake. Can we quantify that assertion now with more and better data?

We know from seismology and geodetic measurements that the Pacific Plate (or North Bismarck Sea Plate) is travelling WNW ( $292.5^\circ$ ) north of Lae at a very rapid absolute velocity of about 10cm/yr or 10m/100yr and is strongly coupled to the North Bismarck Sea Plate. The Australian Plate is moving to the NNE ( $22.5^\circ$ ) at about 7cm/yr or 7m/100yr so the stress in the Finisterre Ranges is composed of a left-lateral shear parallel to the north coast and compression perpendicular to the coast. On this basis we surmise that sufficient strain has accumulated since 1906 to generate another great earthquake and tsunami in the short term. Governments and emergency managers in Papua New Guinea and Australia ought to be aware of and plan for this risk.

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## ACKNOWLEDGMENTS

Before his untimely death this year Dr W. David Palfreyman sent Kevin McCue copies of various papers on PNG earthquakes including translation of extracts from Sieberg (1910), a remarkable collection. Robin Cooke compiled an impressive list of earthquakes and volcanoes in New Guinea before an eruption on Kar Kar Island prematurely ended his life in 1979. Ian Ripper our OIC at Port Moresby Observatory has actively supported our on-going interest in the seismicity of New Guinea and region. Dr Domenico Di Giacomo at ISC, UK kindly updated the mainshock relocation using our data and sent us the location details.

## APPENDIX: CONTEMPORARY AUSTRALIAN NEWSPAPER ARTICLES

*Sydney Morning Herald* (NSW : 1842 - 1954), Saturday 20 October 1906, page 13.

AN ISLAND DISASTER.

TIDAL WAVES AND EARTHQUAKES.

IN GERMAN NEW GUINEA.

The news was brought to Sydney yesterday by the German New Guinea Company's steam yacht *Siar* that phenomenal tidal waves have been experienced along portions of the coast of German New Guinea, resulting not only in loss of life, but also in great destruction of property. Captain Prejawa, the commander of the *Siar*, says that from September 10 to September 15 enormous waves swept the south-eastern coast, and extended for a great distance inland, carrying away hundreds of native huts, and completely submerging many miles of country. The *Siar* was in port at Finchhafen at the time, and lent every possible assistance to the distressed and homeless natives. The vessel was at anchor at the time, and luckily escaped damage.

The first tidal wave, which proved the most severe, made its appearance without the slightest warning, and the terrified natives, believing that their country was to be swallowed up by the ocean, madly rushed for the highlands. Many, however, were unable to reach places of safety,

and were drowned, while others were severely injured in their fight against the incoming volumes of water.

The only European property destroyed was the storehouse belonging to the German Protestant Missionary Society, which was completely swept away, together with all its contents. Commander Prejawa says that when he finally left Finchhafen, on October 5, tidal waves were still being experienced daily, although they were by no means as severe as those which occurred early in September.

As far as he could gather, the affected area was confined to between 50 and 60 miles of the south-eastern coastline of German New Guinea, but he had been unable to ascertain the death rate.

Earthquakes occurred several times daily throughout the visitation, and some of the shocks were very severe. In places the ground had opened, and the natives were much alarmed. Earth tremors were by no means rare in German New Guinea, but the long succession of shocks experienced in September and October was, as far as he could learn, without precedent.

The Siar, which is employed in the work of recruiting black labour for the plantations of the German New Guinea Company, and in returning time-expired men to their native homes, has come to Sydney for her periodical overhaul in dock.

*Register* (Adelaide, SA : 1901 - 1929), Friday 2 November 1906, page 7.

#### THE EARTHQUAKES IN NEW GUINEA.

##### ONE HUNDRED DISTINCT SHOCKS.

The recent severe earthquakes in German New Guinea are graphically described by the Rev. Joh Flierl, a pioneer missionary among the natives of New Guinea, who writes, inter alia, to the publishers of the official organ of the Evangelical Lutheran Mission of South Australia:— Sattelberg, September 23. The following short report of a terrible earthquake extending over the whole of the territory of our Neuendetelesau Mission might be published for the information of our esteemed Australian mission friends. Last Friday week, as I ploughed between the young cocoa palms in Helsbach, I did not for a moment anticipate that the next night would become one of terror. Towards evening my little son came out to the field in which I was ploughing and in-formed me that missionary Pfalzer with two new missionaries had come on a visit. Shortly afterwards I unharnessed my team and returned to the station. We spent a delightful evening with a large company. I was enabled to greet the new arrivals (Messrs. Bottcher and Raum), and as our conference for the Gade district had been arranged for next Thursday Mrs. Lehner, Miss Keppler, and my two younger children were also down in Helsbach. We retired shortly before midnight, but I could not sleep, and lay awake until 2 o'clock. At that hour I felt a slight tremor, which, however, grew to such an alarming extent as had never been experienced by me during my 20 years sojourn in New Guinea. The house creaked and groaned all over, and, although it was quite new, one could not discard the anxious fear that it would be utterly ruined by the terrible shaking, turning, and twisting which it underwent. Therefore as soon as the first terrible shock had subsided, and we had somewhat recovered from our fright, we all became animated and rushed out. The earth-shocks now frequently returned in longer or shorter intervals, although not so severely as at the beginning. No one could sleep any more that night although we attempted to do so, first in

the verandah and eventually in the open yard. Severe shocks continually terrified us and kept slumber from our eyes. After a while people also came from the surrounding villages. They had been roused by the frightful shocks and now came to camp with us on the roomy plateau of the station enclosure. "What will be the effect of this on the Sattelberg" was my first thought, for according to our present experiences in New Guinea the earthshocks are much more severe on the high mountains than near the coast. (Sattelberg is the locality in which the missionary lives.)

—After the Shocks.—

When it had become day we viewed the damage. It was very considerable. Bake oven, cooking house, and pigsty had fallen in, while the buildings had been little damaged. That could soon be remedied. We had to anticipate worse damage on Sattelberg, and the bad news from there was not long in coming. Our breakfast, which was being prepared in the open, was not yet ready, when a couple of school boys came down from the mountain with a note from Brother Keyser, informing me that my house had been thrown off its supports, but the occupants had escaped without injury. We had barely read this news when a messenger arrived from Finchport with the written communication that the earthquake and tidal wave had effected much damage to the mission property; Brother Pfalzer and the new missionaries should return to attend to the baggage. Brother Pfalzer, who had intended to come to Sattelberg to attend the baptism, returned to his station after breakfast, while I wended my steps up to the mountain. On my way I met another messenger with a written communication from my people, urging me to come. I arrived at noon, and saw and heard what had gone on. The house presented a sorry sight. The verandah round about lay totally ruined, and the house itself had been thrown 6 ft. from its supports, and lay rather crooked on the broken posts, which had penetrated the flooring in numerous places. The well-made walls with ceilings and roof, had, however, held together. A heavy cupboard had been thrown across my fortunately, empty, bed, and while endeavouring to effect her escape my wife had had her knee slightly injured. Our boy Willie had to escape through the window, as his door had become jammed. Dora, in company with little Magdalene Hansche, also reached the open safely. The bedstead of the latter was smashed by a penetrating post, but the child escaped without a scratch. In the convalescent house, where Mrs. Decker lived alone, the inhabitants of Sattelberg were all happily united. Brother Keysser and Willie went back into our house, by way of the windows, to obtain the necessary clothes and rugs. Thus we are at present living in the convalescent home.

—Water Famine on the Mountain.—

As nearly all the tanks burst we have a water famine on the mountain, and the boys have to obtain the water from the nearest brook. The kitchen building is irreparably crooked, and the bake-oven and cookhouse in ruins, while the other buildings have been left standing. Again we have much anxiety and work with difficult repairs. We had hoped that the building operations had been happily ended for a while on the Sattelberg. Fortunately, Brother Keppler could return from Bukana, where the new station is almost complete. Meanwhile news has come in from all the stations. In Waleo great damage has been sustained in the effect of the shocks on the buildings, but the inhabitants escaped in safety. The old shaky house in Simbang has been preserved wonderfully. Brother Pilhofer slept in it alone. Brother Schnabel,

living in a village on the road to Sattelberg, hurried back next morning, full of anxiety for his co-worker, who, however, he found well and the house standing. Brother Bamber's provisional house on the Lo Ganey tumbled together over himself and his son, but without injury to them. Brother Zalm, in Yabun, had his wrist slightly injured while hurrying out. The family Hoh were on the canoe in the night, purposing to row to their island, but the tidal wave forced them back to the mainland, where they safely reached a village.

—Some Earthslips.—

On the most southern stations, Deinzerhoh and Bukana, the earthquake was less severe. It appears to have been worst north from here. The mountain wall opposite to us shows numberless small and large earthslips, and the fresh chalk layers gleam through the dark forests. Brooks and rivers were filled and dammed up until, after a few days, the waters broke through their chalk obstruction, and now the milky waters have for days been flowing seawards. Further away, it is reported, numerous natives were killed by the earthslips. The Wamoru Mountain has been broken between the station Waleo and the coast by a deep cut, which occurred during the night of the severe earthquake. On the Sattelberg itself numerous earthslips have occurred, and on the way up, as well as near to the station, there are numerous clefts and cracks, so that further earthslips must be anticipated. The clefts in the mountain are more serious and disquieting than the damage sustained by the buildings. But God, who protected us against danger during the first terrible night, will continue to be our protector and comforter. As far as can be ascertained, there never has been so severe an earthquake here, for within the one week there were at least 100 distinct shocks; but they are now gradually diminishing. God can also bid the earth to again observe silence for a long time.

*Advertiser* (Adelaide, SA : 1889 - 1931), Monday 5 November 1906, page 5

#### EARTHQUAKES IN NEW GUINEA.

##### A MISSIONARY'S EXPERIENCE.

The Rev. Joh Flierl, a pioneer Lutheran missionary among the natives of New Guinea, who was in that country during the recent earthquake-shocks, has written a description of his experiences for the benefit of friends of the mission in South Australia, under date September 23. The following is extracted:-

"Last Friday week I spent a delightful evening at Helsbach, in company with three missionaries, two of them new arrivals, who had come to visit me. We retired to rest shortly before midnight, but I could not sleep, and lay awake until 2 o'clock. At that hour I felt a slight tremor, which, however, grew to such an alarming extent as had never been experienced by me during my 20 years sojourn in New Guinea. The house creaked and groaned all over, and, although it was quite new, one could not discard the anxious fear that it would be utterly ruined by the terrible shaking turning, and twisting which it underwent. Therefore as soon as the first terrible shock had subsided, and we had somewhat recovered from our fright, we all became animated and rushed out. The earthshocks now frequently returned in longer or shorter intervals, although not so severely as at the beginning. No one could sleep any more that night, although we attempted to do so, first in the verandah, and eventually in the open yard. Severe shocks continually terrified us and kept slumber from our eyes. After a while people also came from the surrounding villages. They had been roused by the frightful

shocks, and now came to camp with us on the roomy plateau of the station enclosure. At daylight we viewed the damage, which was very considerable. Bake oven, cooking-house, and pigsty had fallen in, while the buildings had been little damaged. We anticipated worse news from Sattelberg (my home in the mountains), and soon learned that my house had been thrown off its supports, but the occupants had escaped without injury. A messenger from Finch-port then brought the news that the earthquake and tidal wave had effected much damage to the mission property there. On visiting Sattelberg I found that the house presented a sorry sight. The verandah round about lay totally ruined, and the house itself had been thrown 6 ft. from its supports, and lay rather crooked on the broken posts, which had penetrated the flooring in numerous places. The well-made walls, with ceilings and roof, had, however, held together. A heavy cupboard had been thrown across my, fortunately, empty bed, and while endeavouring to effect her escape my wife had had her knee slightly injured. Our boy Willie had to escape through the window, as his door had become jammed. Dora, in company with little Magdalene Hansche, also reached the open safely. The bedstead of the latter was smashed by a penetrating post, but the child escaped without a scratch. As nearly all the tanks burst, we have a water famine on the mountain. The kitchen building is irreparably crooked, and the bake oven and cook-house are in ruins, while the other buildings have been left standing. We have much anxiety and work with difficult repairs. In Waleo great damage was done to the buildings, but the inhabitants escaped in safety. The old shaky house at Simbang has been preserved wonderfully. Missionary Bambers' provisional house in the Lo Ganey tumbled over himself and his son, but without injury to either. Other missionaries had narrow escapes. The mountain wall opposite to us shows numberless small and large earthslips, and the fresh chalk layers gleam through the dark forests. Brooks and rivers were filled and dammed up until, after a few days, the waters broke through their chalky obstruction, and now the milky waters have for days been flowing seawards. Further away, it is reported, numerous natives were killed by the earthslips. The Wamoru Mountain has been broken between the station Waleo and the coast by a deep cut, which occurred during the night of the severe earthquake. On the Sattelberg itself numerous earth-slips have occurred, and on the way up as well as near to the station, there are numerous clefts and cracks, so that further earth-slips must be anticipated. The clefts in the mountain are more serious and disquieting than the damage sustained by the buildings. As far as can be ascertained, there never has been so severe an earthquake here, for within the one week there were at least 100 distinct shocks, but they are now gradually diminishing."

*Yass Evening Tribune* (NSW : 1899 - 1928), Monday 22 October 1906, page 2.

More Earthquakes.

IN THE AUSTRALIAN ZONE.

German New Guinea, in the Bismarck Archipelago, has been visited by a series of alarming earthquake shocks, and, according to news brought to Sydney by the German steamer *Siar* on Friday gaping fissures are now to be seen in the mountains and along the highlands in the vicinity of Finchhafen.

The earthquakes started about the middle of September, and Captain Prejawa, of the *Siar*, states that the shocks occurred daily until the early part of this month. One of the heaviest shocks took place while the *Siar* was anchored off the Finchhafen, and caused considerable



alarm on board. The sensation is described as being most peculiar, the vessel rolling and vibrating considerably. For a time it was thought that the anchor cable had carried away, and the vessel driven on to a reef, but investigations proved that matters were not so serious, and that the experience was all due to a submarine disturbance. On the following day the appearance of the coast line afforded ample evidence of the severity of the shock, huge rocks being displaced, and gaping holes being visible in the sides of the mountains. The disturbance was followed by a tidal wave which swept over the low-lying coastal districts, and caused much destruction. Native houses and boats were carried away, and for a distance of 40 to 50 miles the country was completely devastated. Captain Prejawa states that as far as he could learn no loss of life occurred, the natives having had timely warning, and sought shelter on the highlands. A few, however, were maimed, and sustained broken limbs. At Chiassi Island, in the Dampier Straits, the tidal wave wrought great havoc, hardly a native hut being left standing. The natives of this island made for the highest point, and there remained in safety until the wave subsided. Steaming along the New Guinea Coast, the fissures in the mountain side were clearly visible from the deck of the Siar, and Captain Prejawa estimates that some of them were, fully 200 feet long and 100 feet deep.