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1965/66

THE EFFECT AT RABAUL OF SEISMIC SEA WAVES GENERATED BY THE GREAT ALASKAN EARTHQUAKE OF 28TH MARCH, 1964

by

C.D. Branch

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SUMMARY

A seismic sea wave generated by the great Alaskan earthquake of 28th March, 1964, arrived in Rabaul at 0125 L.T. on the 29th. The initial wave height was four inches. A possible second seismic sea wave arrived at 0723 and a wave at 0933 had a crest to trough height of 16 inches. A maximum double amplitude of 24 inches was recorded at 1330, possibly caused by oscillations from the first and second seismic sea wave groups coming in phase. Oscillations of sea level due to this earthquake lasted four days. The velocity of the first seismic sea wave was calculated to be 444 miles per hour, and the average ocean depth between Alaska and Rabaul is 9000 feet.

EARTHQUAKE AND WARNING DATA

At 03 36 12.7 G.M.T. on the 28th March, 1964, an earthquake of magnitude 8.5 (CGS) occurred at latitude 61.1°N and longitude 147.6°W, at a depth of 20 kilometres. A seismic sea wave was generated which caused extensive damage throughout the Gulf of Alaska, along the west coast of North America, and in Hawaii.

A telegraphic bulletin advising that a seismic sea wave had been generated was issued from the Honolulu Magnetic Observatory to all stations in their seismic sea wave warning network in the Pacific. The bulletin also advised the expected arrival time of the wave at the various stations. Rabaul is not in the warning network, but the bulletin was overheard by the duty officer at the Overseas Telecommunications Station, Rabaul, and passed to the Vulcanologist at 2000 L.T. (1000 G.M.T.). The Rabaul harbour master was also notified, and on his own initiative advised all boats to move into mid-stream.

The first warning bulletin gave the expected arrival time of the wave at Guam as 1315 G.M.T. and at Samoa as 1430 G.M.T.. Later bulletins told of wave heights between 8 and 16 feet at Hawaii. The wave arrived half an hour later then expected at Guam and succeeding arrival times were changed accordingly.

An arrival time at Rabaul between 1430 and 1600 G.M.T. was calculated. Attempts to contact outlying Administration centres by radio, particularly Kavieng and Lorengau, to warn them of a possibly seismic sea wave and to receive details of the wave should it arrive so that appropriate precautions could be taken at Rabaul, were unsuccessful because no radio schedule is maintained at night. It was thought unwise to broadcast warning of the wave over the A.B.C. and Administration radio stations because of the unwarranted panic it may have caused.

EFFECT OF SEISMIC SEA WAVES AT RABAUL

The first wave arrived at 1525 G.M.T. (0125 L.T.). No withdrawal of water preceeded the wave, and it boiled in over mud flats around the head of Simpson Harbour. A wave height of four inches was recorded on the tide gauge at the Main Wharf (Pl.1). Succeeding waves arrived at 30 to 35 minute intervals and the fourth wave at 0315 L.T. had a trough to crest height of 10½ inches. It was concluded that a destructive wave would not arrive at Rabaul and warning of the seismic sea wave was withdrawn.

ANALYSIS OF TIDE GAUGE RECORD

Wave activity due to the first seismic sea waves was recorded from 0125 L.T. until 0645 L.T. and forms the first seismic sea wave group (Pl.1). At 0723 L.T. wave activity recommenced with a sudden withdrawal of three inches and at 0805 L.T. the ensuing smooth pattern of wave oscillations was abruptly disrupted. It is thought that one or other of these two times represents the first arrival of a second seismic sea wave group, generated by an aftershock of the main Alaskan earthquake. The recorded trace of following waves is irregular, indicating interference between the first and second seismic sea wave groups. Possibly because of the interference the amplitude of some waves was increased, and at Rabaul a maximum crest to trough height of 16 inches was recorded at 0933 L.T.

The second seismic sea wave group caused noticeable effects at Tabar Island (02°50'S., 152°00'E) where a rise and fall of sea level of about 12 inches commenced at 0830 L.T. and continued with a period of 15 minutes for some hours. Numundo Plantation (05°32'S., 150°07'E) reported that at 0845 L.T. the sea level rose about 12 inches and took about 15 minutes to fall to normal. This phenomenon occurred a further four times during the day.

About 12 noon on the 29th the wave motions due to the first and second seismic sea wave groups appear to have come in phase. A series of symmetrical oscillations were recorded, with a period of 30 to 33 minutes, which increased in double amplitude from 13 inches at 1220 L.T. to a maximum of 24" at 1330 L.T., then decreased in amplitude and became increasingly irregular during the next six hours. A rise in sea level of four feet was reported from Cape Gloucester (western end of New Britain) about 1400 hours. Irregular, small oscillations caused by the seismic sea waves continued until about 1600 L.T. on 1st April.

TRAVEL TIME AND OCEAN DEPTH

Assuming that the first seismic sea wave group was generated at the same time as the earthquake, it means that the wave took 12½ hours to travel the 5550 miles from Alaska to Rabaul. This is an average velocity of 444 miles per hour.

The average ocean depth between Alaska and Rabaul may be calculated using the following formula.

$$h = \frac{V^2}{g}$$

where h = average depth of ocean.

V = velocity of wave.

g = acceleration due to gravity.

Therefore, the average ocean depth between Alaska and Rabaul is 9000 feet.

It is of great importance to know the travel times for seismic sea waves so that if waves are generated by future earthquakes in the same area, their arrival time may be calculated reasonably accurately. This is particularly so for the Alaskan area which is highly seismic and from where more seismic sea waves must be expected. In the case of the March 1964 earthquake it was impossible to predict the arrival time of the wave within one or two hours, but with the data presented here, future predictions will be far more precise.

The Chilean area is another from which seismic sea waves may be expected. Earthquakes in that area in May 1960 generated seismic sea waves which reached Rabaul. For reference and comparison, the data calculated by Taylor & Barrie (1960) are included here: velocity of wave 385 m.p.h., and an average ocean depth of 6790 feet along the wave path.

RECOMMENDATIONS

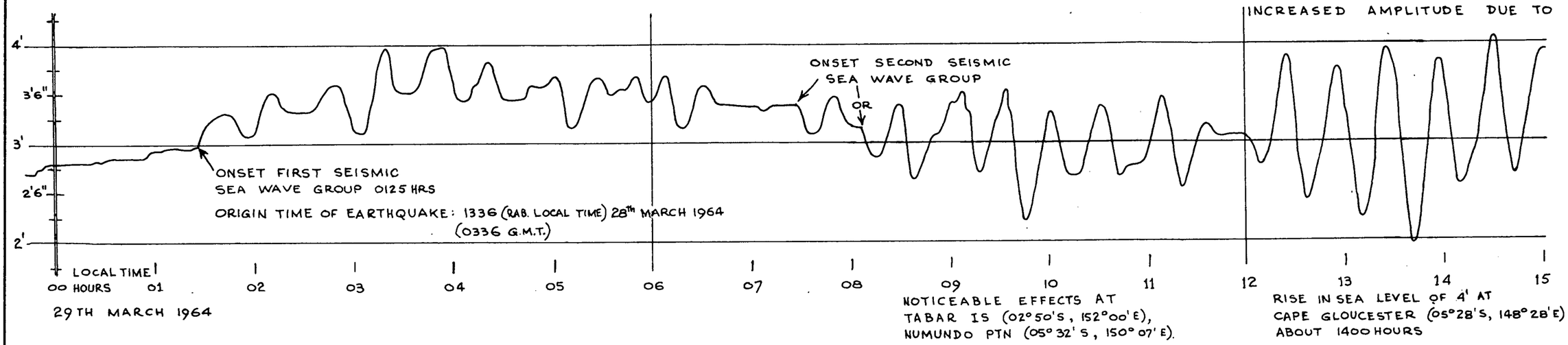
It is considered vital for the safety of the sea board population in the Territory that adequate warning of seismic sea waves be received at the major centres, and that radio channels be maintained to disseminate the information to outlying centres. At present, the receipt of warning from the Honolulu Magnetic Observatory, which maintains a seismic sea wave warning network, is haphazard because no centre in the Territory is a station in the warning network. To overcome this, a submission has been sent to the Administrator requesting that application be made to join the network, and for some responsible authority in the Territory to receive and disseminate the warning bulletins.

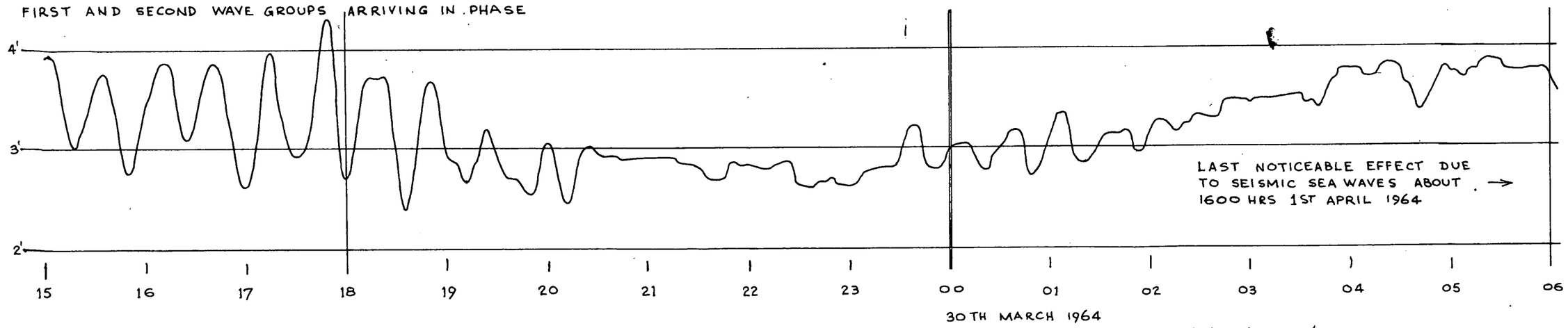
REFERENCE

TAYLOR, G.A. & BARRIE, J., 1960 - Tsunamis in the Territory of New Guinea from South American earthquakes May 1960. Bur.Min.Resour.Aust.Rec., 1960/65 (unpubl.).

TIDE GAUGE RECORD AT RABAUL OF SEISMIC SEA WAVES GENERATED BY THE GREAT ALASKAN EARTHQUAKE OF 28TH MARCH 1964

Plate 1





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Bureau of Mineral Resources, Geology and Geophysics

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