

ART. LIV.—*On Earthquakes in the Vicinity of Wanganui.*

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As efforts are being made to determine the sources of earthquakes in the colony, any extended observations in a given locality may be of value. In the volume of the Transactions of the Institute lately to hand I notice a paper by Mr. G. Hogben on an earthquake which occurred in Wanganui on the 7th March, 1890, in which he fixes the source of the shock at a point under the sea about three hundred miles east of Wellington. In this he is certainly wrong, as his calculations are based upon the assumption that the times and direction recorded at the telegraph-stations are those not of the normal wave, but of an imaginary subsequent transverse one, at right-angles to it. I do not attach importance to such data, either as regards time or direction, as I know that in many cases (as in those quoted for this shock by Mr. Hogben) the times given are very uncertain, and the points of the compass are apt to be exactly reversed. That shock, like every other that has occurred in Wanganui since 1851, came from the south-west.

I have long been under the impression that an important earth-fissure passes beneath, or very close to, Wanganui; and the late Rev. Richard Taylor, the Church missionary at Putiki, who had paid considerable attention to the subject, entertained a similar opinion. He believed that there was a subterranean communication between Mount Erebus and Ngauruhoe, and that earthquakes hereabouts were caused by vast volumes of gas or superheated steam being suddenly formed in this passage, and rushing towards Ngauruhoe as a vent. Unfortunately, Ngauruhoe is not visible from my house, so that I am unable to observe whether our earthquake-shocks are succeeded by any unusual discharge of vapour from the volcano. About twenty years ago, however, as I was walking home from town one evening about 10 p.m., I heard an earthquake-explosion, and at once stopped to note the result. Before the shake had well passed, there was a very bright and prolonged explosion from the volcano, followed, after the usual five minutes' interval, by an unusually loud and prolonged report. This single observation certainly bore out the Rev. Mr. Taylor's theory that Ngauruhoe is our safety-valve.

I have paid particular attention to earthquakes for more than forty years, so can speak very positively respecting them as they affect this part of the colony. Slight earth-tremors often occur, and are not noticed by our local papers, unless in the

form of a telegram from some other place, where the motion has been more strongly felt. The shocks, however, which are noticed in the local papers follow an invariable course. First there is a dull explosion away in the south-west. This is followed, after an interval varying from one to three seconds, by a sharp upward jerk, also often very perceptibly from the south-west. Then comes a rapid horizontal vibration, evidently caused by waves travelling from south-west to north-east. A rumbling sound usually accompanies these, and sometimes slightly precedes them. As these die away, they are succeeded by a gyratory motion, usually, if not always, from left to right. It is not a steady gyration, but progresses by sharp jerks. If a person is standing up, he has to shift his feet to prevent falling; and in this way he describes sometimes a triangle, but more generally a square. It is this gyratory motion which is so destructive to chimneys. The courses of bricks are often twisted to the extent of  $20^{\circ}$  or  $30^{\circ}$ , and in severe shocks frequently at several different levels; thus necessitating the rebuilding of the chimney, even if it has not fallen. This usually concludes the performance, but occasionally some slight return-waves from north-east to south-west are felt afterwards. My own conviction is that in all our earthquakes there is an upheaval, which is maintained during the passage of the waves, and that the gyratory motion occurs during subsidence.

As no newspapers were published in Wanganui in the early days of the settlement, there is probably no record of the early shocks felt here, however violent. The shock in October, 1848, which caused such alarm in Wellington, seems to have been comparatively slightly felt here; but, on the other hand, one which occurred in 1841 was very severe. It occurred about midday; and persons who experienced it have often assured me that they were not only thrown down, but that they had to lay hold of the fern and grass to prevent themselves from being rolled about on the ground. No damage, however, appears to have been done, probably because there was nothing easily damaged. The shock of the 23rd January, 1855, seems, however, to have been the most severe that has been experienced since the foundation of the settlement—at any rate, there has been nothing since that could be compared with it. I was building a mill for the Maoris at Waitotara at the time, and was living in a toitoi whare, which I fully expected would be shaken to pieces over my head. There was a very peculiar condition of the atmosphere that day—I never experienced anything like it before or since; though, of course, I cannot say whether it was connected in any way with the earthquake. The day was perfectly calm, and unusually cold for the time of year. Dull,

leaden clouds hung low, threatening rain. Altogether it seemed a day specially suited to hard work, and yet no one could work. I had a job on hand which I was anxious to complete, yet found it impossible to work at it for more than two or three minutes at a time, with long intervals between, owing to restlessness and lassitude. Every one in Wanganui seemed to have felt the same. The poultry crept about, with their wings and tails drooping, as if they were all ill. There was a herd of forty or fifty wild goats grazing near where I was at work. Ordinarily they ran like deer if any one approached within a hundred yards of them; but that day I had repeatedly to drive them out of the house or mill, and they even let me handle them. About 6 p.m. a steady drizzly rain began to fall, and continued up to the time of the earthquake, when it ceased quite suddenly. I had just turned in, at about 9 p.m., when I heard a very loud earthquake-explosion, which was followed by a sharp upheaval and violent shakes, accompanied by loud rumbling. I at once lighted a candle to see what was happening, and found everything rocking in a most alarming manner. There seemed to be three shocks joined together. Twice the motion slackened, and then became more violent again. The third time the motion was so violent that my table (a small one, and perhaps a little topheavy with a pile of English papers which I had just received, and which stood on top of it) was turned completely upside down. This was the culmination of the shock, which then gradually subsided, the gyratory action being so violent as to produce a feeling like sea-sickness. Altogether the shock must have lasted fully three minutes. It was succeeded by another, and then by a third, after which others occurred at longer intervals. There was a Wesleyan Mission family living about half a mile from me. The missionary had been away from home for some days, but had returned that evening, though I was not aware of his having done so. Thinking his wife and sister must be greatly alarmed, I dressed myself and started in the dark for their house. The track was merely a native path through high fern; and several times, as I went along, I was fairly thrown right and left into the fern, and could hardly keep my feet. On reaching the house, I found the family sitting with the doors open, ready to rush out if the house should be actually falling. The ladies were to carry blankets, which lay ready folded on the table, and the missionary was to snatch up the little girl, who was sleeping on a sofa. I remained there till morning. When daylight came, we found that the ground was cracked in all directions, and that on an alluvial flat just in front of the house there was a crack fully 50 yards long, through which sand and water had

been thrown up from a depth of 15ft. or 20ft., and scattered on the surface to a width of about 20ft., and to a depth of several inches. After taking a cup of coffee, I started for Wanganui, to see how my wife and children had fared. On reaching the pa where the track to Wanganui crossed the Waitotara River, I found the Maoris sitting outside their huts in great alarm. The ground was cracked in all directions, and, as the slight shocks passed along, the cracks could be seen to open and close—a thing which the Maoris said they had never known to occur previously. The Maori mailman was just on the point of starting for Wanganui, so we travelled together. On reaching the sea-beach, along which our route ran for about five miles, we found that the whole face of the cliff was thrown down, and that further small slips were constantly occurring. An isolated mass of shell-rock, called "Te Ihonga," similar to the Pulpit Rock at the Isle of Wight, which had stood at the top of the cliff, and had for ages marked the place at which to turn off from the beach to go across the sandhills to the Waitotara crossing, had been thrown down and dashed to pieces. On reaching Wanganui, I found that, though my own folks and property were safe, immense damage had been done, particularly in the stores and hotels. The ground was cracked in many places. The foreshore of the river fronting Taupo Quay (which faces south-east), from the quay roadway to low-water mark, was like an ill-ploughed field; and the alluvial flats beside the river were specially fissured. At what is known as "Sutherland's Flat," about five miles above the town, two cracks, fully 100 yards long, and from 30ft. to 50ft. asunder, extended from the river back into the flat, and the interval between them had sunk down fully 6ft., so that at high water boats could be taken into the flat. Except two low double ones, which were so built into the framework of a house that they could not move, every brick chimney in the neighbourhood was destroyed; but the pumice chimneys and houses, of which there were many at that time, all escaped injury. There was a brick church at Putiki, with walls about 8ft. high and a heavy roof. Though built with a mortar of shell-lime, specially burnt for the purpose, scarcely two bricks were left adhering to each other. This extraordinary disintegration was no doubt due to the weight of the roof, which had come down *en masse*, grinding the brickwork to pieces. A brick wall at the adjacent mission-station was also thrown down and broken to pieces. Prior to this earthquake, a good many houses had been what was called "brick-nogged"—*i.e.*, the intervals between the studs had been filled with brickwork, and the inner facing plastered. Nearly the whole of this brick-nogging was shaken down, and what was not so was so loosened as to be unsafe, and had to be removed.

There was no loss of life or limb, but several narrow escapes. In one case an old bed-ridden woman had just been carried into the next room while her bed was made, and all the brick-nogging beside it was shaken down on to the bed from which she had been removed. In another case a nurse and several children had to huddle together at one end of a room while the chimney fell between them and the door, and then scramble over the fallen brickwork to make their escape. The Rev. R. Taylor, too, and his family had rushed out of doors on feeling the shock, and had only just passed the brick wall when it fell and covered the path which they had traversed. A certain amount of good was done by the shock in draining swamps. These had been formed by layers of ironsand becoming rusted together and forming a pan, which prevented the surface-water from soaking downwards. The shock cracked these pans, and enabled the water to escape.

Shocks occurred at frequent intervals for some time afterwards—in fact, for several months it could never be said that the earth was still. Even when it was dead calm there was always a long, low swell running up the Wanganui River, and as we lay in bed at night we could feel that we were being gently rolled from side to side. It seemed as if every wave which broke on the beach continued its course through the land. This continued till the equinoctial gales of March and April rendered it no longer noticeable. Wanganui was upheaved by the shock to the extent of from 1ft. to 15in.; but all but about 6in. was gradually lost afterwards.

It was asserted that a fire, supposed to be volcanic, was observed in the vicinity of the Inland Kaikouras; and vessels sailing south of Wellington reported the sea covered with dead fish. The people on board a vessel, which reached Wellington a few days after the earthquake, reported having felt the shock fully 150 miles west of New Zealand. They had been much alarmed, as they thought the vessel was dragging over a shoal or reef not marked on the charts.

A friend, who had camped by the mouth of the Rangitikei River, with a herd of cattle, on the night of the earthquake, lately told me that the ground there was extensively and very deeply fissured, and that a sulphurous smell was distinctly perceptible. A similar smell was said to have been perceived at Wanganui, but I did not observe it at Waitotara.

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