

## 9. STONE FOR HARBOUR-WORKS, NEW PLYMOUTH.

(By P. G. MORGAN.)

In accordance with the instruction of the Hon. the Minister of Mines I left Wellington for New Plymouth on the 16th June, 1921, in order to examine Paritutu and other possible sources of stone for the New Plymouth (Moturoa) harbour-works. While in New Plymouth, at the request of the Paritutu Preservation League Committee I made a special visit to the Pouakai Range in order to inspect an outcrop of rock reported to be suitable for harbour-works. On the 20th I returned to Wellington. My thanks are due to Mr. R. W. Davies, of New Plymouth, who motored me to various points requiring examination, and was my guide to the Pouakai Range. I also wish to acknowledge courtesies received from Mr. A. E. Watkins, and from the president (Mr. R. C. Hughes) and various other members of the Paritutu Preservation League.

Paritutu is the most prominent of the well-known Sugarloaves. Unlike the others, it is not an island, but rises almost perpendicularly from the edge of the sea, half a mile west of the base of the Moturoa breakwater, to a height of 505 ft. On the east, south, and west sides agglomerate deposits, capped by sand, mask its base to a height of perhaps 200 ft. or more. The hill itself is a plug of igneous rock, which in a bygone age rose in a fluid or semi-fluid condition from a molten mass of rock deep in the bowels of the earth through a vent which may be described as the throat of a volcano. Since that time it has been subjected to the usual geological vicissitudes, but appears to have lost little of its original dimensions—that is to say, its top and sides have not been greatly reduced by erosion. This view differs from that advanced by Mr. E. de C. Clarke in Bulletin No. 14 (pp. 21, 25), where Paritutu is regarded as formed of a lava flow or flows.\*

The Paritutu rock is a hornblende-andesite similar to that forming the other Sugarloaves. On the whole it is in a fairly fresh condition, but is somewhat affected by weathering, especially near joint-planes. The rock forming the north-eastern face of the hill is highly jointed, and even shattered; elsewhere it is more solid, and joints are much less prominent, but flaws are abundant. The hill is so situated as to offer unusual facilities for quarrying. All that is needed to destroy the upper 300 ft. is a few hundred feet of drives and, say, 100 tons of explosive. The larger masses of rock, although they will not be of the highest quality, will be suitable for the construction of a rubble mole or breakwater. I am of opinion that the proportion of small stone will be large; but since the cost of quarrying will be low, since much of the small material can be used for the breakwater-construction and since the remainder can be easily tipped into the sea, this will not be considered a serious objection from the utilitarian point of view to the proposed destruction of Paritutu.

A blast has already been fired on the south side of Paritutu, and is said to have dislodged 30,000 tons of rock. Personally, I would place the amount at somewhat less, but it is certainly well over 20,000 tons. According to a newspaper report (*Taranaki Herald*, 11th June, 1921), Mr. J. Blair Mason, consulting engineer to the New Plymouth Harbour Board, has reported that 20 per cent. of the broken rock is in masses of 2 tons to 30 tons, 30 per cent. in  $\frac{1}{2}$ -ton to 2-ton sizes, 35 per cent. in lumps of  $\frac{1}{2}$  cwt. to  $\frac{1}{2}$  ton, and 15 per cent. in small lumps. All the material, he states, can be used in the breakwater-construction. So far as I could judge from an inspection of the broken rock this estimate is fairly near the mark. Part of Paritutu, however, will yield very little large-dimension stone. It may be observed that about 1879 Mr. Rees, then Engineer to the New Plymouth Harbour Board, reported that Paritutu would yield only 10 per cent. of stone in large lumps (from  $\frac{1}{2}$  ton upward was, I think, his statement); and on the strength of this report Sir John Coode advised that a breakwater in the form of a concrete monolith should be constructed. I think that the upper 300 ft. of Paritutu will yield less than 20 per cent. of dimension stone (2 tons and upward), but probably more than 10 per cent. The lower 200 ft. (down to sea-level) may be somewhat better in this respect than the upper 300 ft., but there is no certainty about this.

A tram-line for the removal of the dislodged stone is under construction, but no further quarrying-work was being done at the time of my visit.

As requested by the president of the Paritutu Preservation League in his letter of the 31st May I examined the quarry at the Fishing-rocks (Motukuku and Ngataierua), between Paritutu and the breakwater. This quarry has been worked by the Harbour Board almost to high-water level, and must be regarded as exhausted. It was suggested to me that the quarry could be worked downward, below sea-level; but only a comparatively small amount of stone could be obtained in this way, and in any case the expense of quarrying under adverse conditions renders the proposal impracticable.

An attempt to quarry stone for harbour-works on the little island of Moturoa, which is less than half a mile north-west of the present breakwater, has lately been made. Some time ago this was abandoned owing, it is stated, to the lack of sufficient labour.† The island has been disfigured and a considerable expenditure incurred in this undertaking, which so far has been resultless.

The small Sugarloaves, Pakaraki, Mataora, and Motu-o-Tamatea, south-west of Paritutu, are composed of close-jointed andesite, and if quarried would afford only a small amount of large-dimension stone. I am informed that Motumahanga, or Saddleback Island, the Sugarloaf farthest to the north-west, is composed of good solid stone; but the island is in an exposed situation, and the cost of transporting the stone from it to its final resting-place would be great.

\* I am indebted to Professor W. N. Benson for drawing my attention to Alexander McKay's statement that Paritutu is a perfect example of a volcanic core. See Sollas and McKay: "Rocks of Cape Colville Peninsula," vol. 2, p. 162, 1906.

† As originally written this report stated that the work had been abandoned owing to the poor quality of the stone and the cost of transport. (See New Plymouth papers of January, 1921.) Messrs. Blair Mason, Lee, and Owen, however, in a letter dated 20th July, 1921, state that the work was discontinued solely because labour was not available at the time; and the report as now printed has been altered to conform with this authoritative statement.