

of nearly 150 ft. Its resistant nature to erosion is shown by the fact that it runs farther out to sea in reefs than any other rock in the cape, and also attains the greatest height in the cliffs. The pillow lava is succeeded by a set of tufaceous beds interstratified with limestone bands, forming Boatman's Harbour. These in turn are succeeded by the tachylite breccia, which forms the cliffs from Boatman's Harbour to Oamaru Harbour. All these rocks are covered on the hill-slopes by a deposit of clay, which is very thin at the lighthouse, but much thicker along the coast-line, and especially so in Boatman's Harbour. A raised beach forms a shelf a little above spring-tide level at various points along the coast.

The tachylite breccia has been quarried close to Oamaru Harbour, and supplied material for the mole on the northern side of the harbour, in the construction of which blocks of a minimum of 1 ton were aimed at. Even with this low minimum it is estimated that 75 per cent. of the material went to waste, and that not a single block of 12 tons was obtained. This is due to the excessive jointing of the rock, but it is probable that too strong explosives were employed in quarrying, and that by using an explosive charge better adapted to its work a small proportion of large stones would be obtained. In view of this experience, however, I cannot recommend the further use of the present quarries, where the amount of waste will always be excessive, and its disposal attended with difficulties, since the quarries are alongside the harbour.

The lower part of the tachylite breccia appears to be more solid than the upper part, and this could be tested for its capacity to supply large blocks by carrying a face round the coast south-eastwards from the present breakwater towards Boatman's Harbour. The waste obtained from this operation, which would include a fair amount of clay, could be tipped straight to sea at a low cost, and would probably not affect the depth of the proposed channel. On this point, however, the advice of an expert in harbour-works should be obtained. I have ascertained that the Marine Department would probably make no objection to this course.

3. Limestone.

Apparently the possibility of using the well-known Oamaru limestone has not been considered in connection with the breakwater-extension scheme. This rock is easily quarried, may be obtained in blocks of any desired size, and is adjacent to the railway at many places. Although it is more friable than the tachylite breccia, it is a question whether it would not be cheaper in the end to use it, with occasional repairs, in view of the smaller initial cost. A limestone—harder certainly than the Oamaru limestone—is used at Greymouth for harbour-works with satisfactory results, and the seas are much heavier at that place. It is probable that a mixture of limestone and tachylite-breccia rubble for the base of the breakwater would set, by the action of the sea-water, into a solid mass. In view of the large expenditure that will be incurred if the proposals are given effect to, a preliminary experiment with limestone is certainly to be recommended.

CONCLUSION.

In view of the magnitude of the proposals, not only is experimental work of some extent desirable, but its omission would be unjustifiable, since thereby a considerable saving may be effected. If it should be found that a mixture of tachylite breccia and limestone, with a protective covering of large limestone blocks, will serve, this will undoubtedly be cheaper than to obtain stone from outside the district. It would be cheaper still to use the tachylite breccia alone; and if it or the above mixture is found suitable, then I strongly recommend that a face should be carved in the tachylite breccia seawards from the harbour. If, as is possible, a large proportion of heavy blocks is obtained, then it will not be necessary to bring much or any limestone.

Should the use of limestone not be found practicable, there is still the possibility of using the tachylite breccia near the harbour, the pillow lava of Cape Wanbrow, or the dolerite of Enfield; and for obvious reasons it is desirable to exhaust the possibilities of these before deciding to obtain outside stone. So far as geological considerations go, these stones are in ample amount and readily accessible for quarrying operations, and their jointing is apparently not too close-set to prevent sufficiently heavy blocks being obtained under suitable quarry methods. On this last point, however, I profess no expert knowledge, and recommend that the Director of the Geological Survey, or some other officer of the Mines Department who has such knowledge, should be asked to make an examination.

11. OIL-INDICATIONS IN THE BENMORE DISTRICT, EAST MARLBOROUGH

(By J. ALLAN THOMSON, Director of the Dominion Museum.)

In 1886 A. McKay* described a gas spring in the valley of the Kekerangu River, "just where the terrace on the right bank of the river abuts against the hill-slopes on its southern side." The gas escaped along the junction of the basal Cretaceous sandstones with the older (greywacke) rocks, and the spring was sufficiently strong to burn with a continuous yellowish flame when led through a broken bottle. During two visits to this neighbourhood in 1912 I did not find that any of the present-day settlers were aware of this gas spring.

In 1912 Messrs. Boyd Brothers, Blue Mountain Run, Ure River, conducted me to a strong gas spring in the valley of a small creek draining from the Blue Mountain, and joining the Ure River about a quarter of a mile above their homestead. This spring had been ignited at least three months previously, and had been burning since, with a flame about a foot high. It issued from a small hole in dry ground, and had so heated the surrounding rocks and mud that it proved impossible to put the

* Rep. Geol. Expl. during 1885, No. 17, 1886, pp. 86-87.