

(b.) *Dolerite Dykes, Enfield.*—The hills on each side of the Enfield Railway-station consist of dolerite dykes traversing greensand. The dolerite before cooling has picked up a large amount of quartz, and shows numerous inclusions, which will probably improve its resistance to erosion. It is the most suitable stone I have examined for the purposes required.

The geology of the hill on the western side of the station is not altogether clear. On the hill to the east of the station there is one distinct dyke, about 25 ft. thick, dipping 75° in a southerly direction. This dyke can be recognized on the west side of the railway at the northern end of the cliffs. About 15 yards farther south is another dyke of nearly the same thickness, followed to the south again by greensand for another 13 yards. From this point south the cliffs are formed by a massive dolerite, which is doubtless a dyke, but the relations of which are not clear. The doubt is how far this rock continues westwards into the hill before the greensand makes its appearance. Quarrying operations at the northern end of the hill, on the first two dykes mentioned, would be greatly hampered by the amount of greensand (waste) that would be encountered. Since the cliffs overlook the railway, it appears that objection might be taken by the Railway Department to a quarry in the main mass of the dolerite. There is, however, a small bay in the cliff at a point 50 yards north of the water-tank of the railway-station, where, in my opinion, a quarry might be started without damaging the railway if a protecting wall were built to a height of, say, 8 ft. for a length of a chain.

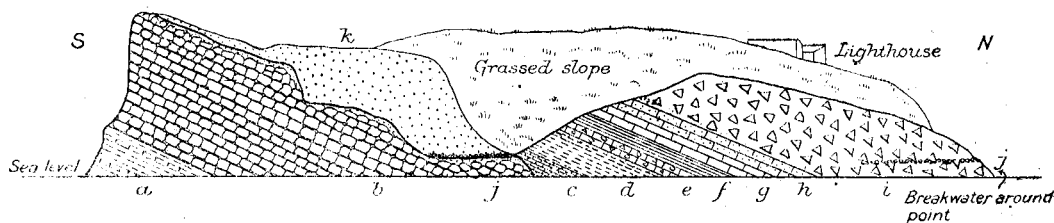
The main mass of the dolerite is not very badly jointed, and it should be possible by the use of a suitable explosive to get a fair proportion of heavy blocks, but there would certainly be a large amount of waste, the disposal of which would be a difficulty unless it could be sold as road-metal or ballast.

(c.) *Basalt, Mr. McFall's Farm, Totara.*—On the seaward side of the Totara Railway-station there is a small rounded hill covered with fair-sized boulders of a very scoriaceous and rather weathered rock, probably a basalt. Very few of the boulders, however, approach 12 tons in weight, and it is not probable, though it is possible, that many large blocks would be obtained by quarrying. Access to this hill is easy, and the facilities for bestowing spoil are good. In view of the uncertain prospects, however, I cannot recommend the selection of this locality, without at least an experimental quarry being opened.

(d.) *Basalt Breccia, Waiareka Valley, One Mile North-west of Alma.*—On a hill overlooking the Waiareka valley, on Mr. G. Ruddenklaus's property, there is a good outcrop of a hard calcareous breccia, equal in quality to the best stone in the Harbour Board quarry. The outcrops lie on top of the hill and near its base on the east side, the rest of the hill being smooth and well grassed. It is probable, therefore, that the whole hill consists of breccia similar to that showing in the outcrops, but with a weaker cement. While there is no doubt that much of the harder stone could be obtained in large blocks, the uncertainty as to the quality of the greater part of the hill, added to the distance from the railway (two miles and a half by road), makes the selection of this locality for a quarry inadvisable.

(e.) *Tachylite Breccia and Pillow Lava, Harbour Board Quarry and Cape Wanbrow.*—The Harbour Board quarry alongside the Oamaru Harbour is excavated in a rock that has long been known to geologists as the "tachylite breccia," from the amount of tachylite that it contains. Tachylite is a basic volcanic glass—that is to say, it is a basic lava that has been suddenly cooled to a glass without crystallizing into a basalt. In appearance it resembles dark bottle-glass. The rock consists mainly of tachylite and dull fine-grained basalt cemented by a calcareous cement, which is very uneven in hardness in different parts of the rock-mass. The rock is probably not a true volcanic ash (breccia or tuff), but a pillow lava broken up before cementation. A pillow lava is a submarine lava-flow that has separated into rounded masses or pillows of various sizes, the interstices being filled by marine deposits. The rock at Cape Wanbrow is a pillow lava, of which the pillows consist of basalt in the centre and tachylite on the exterior, pointing to a sudden cooling of the exterior of the pillows by immersion in sea-water, with slower cooling and nearly complete crystallization of the interiors. The spaces between the pillows are filled with calcareous matter, partly actual marine fossils, partly very hard limestone approaching in quality a lithographic stone. Similar pillows may be recognized in parts of the tachylite breccia, especially near its base.

The geological relationships of these two rocks may be seen in the accompanying diagram, which shows the sea-cliffs in section and the hills behind in perspective. The vertical scale is somewhat exaggerated, and the dip of the rocks in consequence appears greater than it really is—viz., 20°. To the south of Cape Wanbrow is a great thickness of soft decomposed tuffs. These are succeeded by the pillow lava, which is about 120 ft. thick. This rock forms the cape, and runs up the cliffs to a height



SECTION NORTH END OF OAMARU CAPE.

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| (a.) Tuffs with Limestone Bands. | (f.) Blue Tufaceous Clay. |
| (b.) Pillow-lava, with Fossiliferous Limestone between the Pillows. | (g.) Limestone. |
| (c.) Fine Tuffs, current-bedded. | (h.) Tufaceous Limestone. |
| (d.) Tuff Bed, very calcareous. | (i.) Broken Pillow-lava. |
| (e.) Limestone Band, with Rounded and Sub-angular Pieces of Volcanic Rock. | (j.) Raised Beach. |
| | (k.) Clay (? Loess). |