

flanks of the old volcano of Lyttelton. But, after all, it is that last phase of geological activity which impresses the human mind most and is the especial subject of this brief description.

THE GEBBIE'S PASS VOLCANO.

Long ago, before there was any volcano at all, in the neighbourhood of Lyttelton, how many thousands, or even millions, of years ago it is impossible to say, the land consisted of old sedimentary rocks, slates and sandstones, now exposed at the surface on or near the low ridge which divides Gebbie's Valley from Teddington. Whether this was an island or part of a great extent of land we cannot say, but, in all probability the first eruptions took place near the borders of the sea which then covered the major portion of the area now occupied by the Dominion of New Zealand. These eruptions were violent in character, and the ashes and stones were hurled forth and piled in huge heaps near the present crest of Gebbie's Pass. Following this were great outpourings of lava, white or pinkish in colour, and known to geologists as Rhyolite, similar in nature to that discharged about the same time from centres at Malvern, Rakaiia Gorge, and Mount Somers. These floods of liquid rock ran down in a southerly direction to the floor of Gebbie's Valley, while to the north they extended as far as the back of Quail Island and the eastern shores of Charteris Bay, and formed the long peninsulas which stretch in to the upper portion of the present harbour opposite Governor's Bay. These lava flows and the sedimentaries underlying them were rent at the same time by fissures, and through these poured liquid material which solidified sometimes as rock, and sometimes as volcanic glass, the latter known generally as pitchstone, being closely related to the obsidian which the Maoris used for scrapers and rude knives. Such injected fissures are called dykes, and, as they are generally of harder nature than the surrounding rocks, they stand up as walls above the surface. Good examples of these are to be seen near the summit of Gebbie's Pass, and particularly in the hills which surround the Harbour, but the last belong to a later period of activity.

The first eruptions were, however, mild in character compared with those which built up Mount Somers and the Rockwood Hills, but the second phase produced a volcanic mass which is probably greater in bulk than any other existing in New Zealand. What space of time elapsed before the second period commenced is impossible to say, but opportunity was

afforded for wearing down the original cones, and a part of the debris derived therefrom formed deposits of sandstone which have been quarried for building stone at Little Quail Island and at Governor's Bay.

THE LYTTTELTON VOLCANO.

The centre of eruption appears to have moved from near Gebbie's Pass to the middle of what is now known as Lyttelton Harbour. From this vent poured forth enormous flows of lava and showers of stones and ashes. The latter form layers of rubbly rock interstratified with the lava, and are to be clearly seen in many places, but especially so in the old sea cliff which threatens the road to Sumner. The solid lava here forms masses which project beyond the more easily weathered fragmentary layers, and apparently overhang the road. Could one see the internal structure of the old volcano, it would disclose a similar interbedding of solid rock and rubble in all parts.

Radiating from the harbour as a centre, like the spokes of a wheel or like the cracks in a broken pane of glass, are numerous dykes, from mere ribands an inch or so in width, to masses, exceeding a hundred feet in thickness, cutting, like vertical walls, the solid flows and rubble layers. Some stand out far above the surface, owing to their resistant nature, and form notable features of the landscape, e.g., Castle Rock above Heathcote, the Giant's Causeway on Witch Hill above Rakaiia; but they also occur on almost every chain of the track, cutting across it nearly at right angles, and all, or nearly all, pointing to the neighbourhood of Quail Island. Some of these dykes have been quarried for building stone, notably that on Marley's Hill, which supplied the stone for the Cathedral and the Bank of New Zealand, and the one in Kennedy's Bush itself, from which the Colonial Bank building, now the Tourist Office, and other buildings in Christchurch are constructed. These dykes form, as it were, the ribs of the mountain, holding it firmly together and helping it to resist the enormous strains to which it is exposed before and during eruptions. They were formed at widely different intervals, and they differ much in chemical composition and in internal structure. Judging from the persistent nature of these dykes, it is clear that the mountain must have been split at times from top to bottom, and the liquid material, which welled from the fissures, must have looked at night like a red-hot streak across the country. At different points the discharge would approximate to those from a small volcano, and miniature lava cones were built up.

326430