These Ruapehu glaciers and the quite small ones on Mount Egmont are the only signs of glaciation that the North Island shows. It may be that the remains of very small glaciers may still be found in the Ruahines or Kaimanawas (see Hill, 28), but there is no probability that conditions ever existed resembling those which obtained over the South Island in Pleistocene and more recent times. This can be explained by supposing that the elevation of the land which took place in the South Island during the glacier epoch, and which explains the extension of the glaciers in that region, did not affect the North Island, or did not raise it sufficiently to allow glaciers to form. In the case of the South Island the recent major movements of the land have been downward (of course, there have been minor upward movements), whereas the great movement in the North Island has been upward. It is possible, therefore, that the mountains in the North Island were not high enough during the South Island glacial epoch to allow of great accumulations of snow. They are perhaps at the present time slowly approaching that height when glaciers can form.

If the country had been elevated as a whole 2,000 ft. above its present level during the glacial epoch, glaciers should have appeared in several parts of the North Island. Perhaps the crater of Ruapehu is such an excellent collecting-ground that these glaciers on its sides are formed under eminently favourable conditions. On the other hand, some of the Ruapehu glaciers have no connection with the hollow on the summit.

In connection with Ruapehu attention must be called to Hauhungatahi, the curious mountain which is such a feature from the Waimarino Plain. It is a parasitic cone belonging to Ruapehu and built up of scoria and lava flows somewhat similar in composition to those of the great volcano.*

(2.) Tongariro.

The geological history of Tongariro in its earlier stages is somewhat similar to that of Ruapehu: a great cone was built up by a succession of lava-flows and scoria-beds till it rivalled Ruapehu in height and size. The age of both mountains and the mineralogical composition of their ejectamenta are almost identical. The lavas are principally augite-hypersthene-andesites, although hornblende-bearing hypersthene-andesites also occur sparingly among the earlier flows. They vary in colour, but in the original Tongariro they are mostly grey, varying from a pale whitish shade to nearly black. After the cone had been formed, a catastrophe overtook it similar to that which befell its contemporary, but on a much larger scale. While an explosion reduced Ruapehu by several hundred feet, Tongariro was docked by two or three thousand, if not by more: the whole summit was destroyed, and an irregular crater-ring left. The general effect has been to leave Tongariro with no distinct peak or prominence marking its highest point, but with a rough mountainous area from which certain remnants rise to a higher level than their surroundings. If Ngauruhoe be left out of consideration, as it is a much more recent structure, these remnants attain a fairly uniform height of a little over 6,000 ft. The highest point is that known as Tongariro on the Survey maps, but others are nearly as high. The peak of Tama, south-west of Ngauruhoe, is also a part of the original Tongariro, and shows the structure of the irregular crater-ring perhaps better than any other locality.

After the catastrophe, lavas appear to have been poured out so that the flows abut against and overlie the edges of those of which the original mountain was built. Their light-grey appearance and microscopical characters show that they belong to the earlier phases of the history of the volcano. Soon after the great explosion, or perhaps partly contemporaneously with it, several minor explosion craters were formed.† The most important are the Central Crater, the South Crater, and the Oturere Crater. Above all there is the explosion crater of which the ridge of Tama forms the southern wall, and within which the cone of Ngauruhoe (the most recent of the volcanoes) has been more recently built up. The Central Crater has been much modified by subsequent volcanic action, and it is possible that the North Crater, and also the hollows occupied by the picturesque lakes called Nga Puna a Tama, between Ruapehu and Tongariro, also date from this time. Although these craters are probably not quite simultaneous, they are approximately all of the same age, and were formed under similar conditions. They may be due to the last paroxysmal efforts of the great volcano. They all have flat floors surrounded by cliffs which show clearly the edges of the lava-flows of the old mountain. They do not seem to have poured out molten rock, but a considerable amount of semi-fused scoriaceous material found everywhere may have been thrown out of them. Their formation marks the second stage in the volcanic activity of the region.

A long time seems to have elapsed before the third and last stage was entered on. During this interval the explosion craters were readily broken into and enlarged by the vigorous streams fed by the winter snows. Some of the valleys are comparatively wide in their upper portions and narrow considerably, so that the streams run in deep gorges on the outskirts of the mountain. During the third phase activity seems to have been localised along a great fissure whose direction passes through Ruapehu and Ngauruhoe, and forms a small section of the great Maori line of volcanoes. The only exception is the vent known as the North Crater, which apparently belongs to a fissure that runs more to the north, and intersects the other somewhere near the centre of the cone. The Ketetahi boiling springs (Photo. No. 7) above Lake Rotoaira are perhaps connected with this line of weakness. On the main fissures are situated the present active vents, Ngauruhoe, the Red Crater (Photo. No. 8), Te Mari, and a number of points where activity has ceased—*e.g.*, the Blue Lake (Photo. No. 9) and the hollows where the two lakes Nga Puna a Tama lie. But Ngauruhoe, the most active centre in the New Zealand area, is the most important, both from its geological and scenic interest.

---

* For specimens of rock from Hauhungatahi I am indebted to Mr. Louch, Chief Engineer on the Auckland section of the Main Trunk line.

† Some of the crateriform basins on Tongariro are perhaps "pseudo-craters" caused by the collapse and the sinking of more or less circular areas after the great explosion.