

These rocks, which contain no interval evidence of age, lithologically resemble the greywacke and argillite of the central mountain ranges and are probably of Mesozoic age.

*Mokau Beds.*—Sandstone and argillaceous sandstone, with thin bands of greywacke conglomerate, striking east and dipping gently south, cover a considerable area in the north-west part of the district. They outcrop more or less continuously in the steep cliffs bordering the Whakapapa River and in places contain fossils of Mokau age. Similar beds outcrop on the upper Wanganui River, and the exposures between this and the Whakapapa River are probably part of the same series.

*Pliocene Beds.*—Beds of Pliocene age outcrop along the southern edge of the district, but no section shows the contact of the Mokau with them. They contain few fossils, so that it is difficult to correlate them. Even the fossils that have been found do not definitely fix the series age. These were collected in three localities, one south-west of the Kaimanawa Range, where 300 ft. of calcareous soft sandstone and mudstone are exposed in a railway cutting about three-quarters of a mile north of Waiouru station, the second two miles west of Raetihi, and the third in a railway cutting a mile and a half north of Ohakune. In an earlier account of the district the first collection was regarded as Nukumaruan and the last one as Taranakian; but as a result of a further examination Dr. Marwick is of opinion that all the collections could be Waitotaran.

*Pleistocene and Recent.*—East of the volcanoes alternating beds of coarse and fine fluvial conglomerates 125 ft. thick are exposed on the east bank of the Wangaehu River, and similar beds outcrop in places along the Waikato River and its branches from the east. West of the volcanoes similar conglomerates are exposed in the gorges of the deeply entrenched streams and on the Waimarino Plains. In the lower Whakapapa valley high river terraces are composed largely of pumiceous material.

Recent and Pleistocene deposits are not separated on the accompanying map.

#### VOLCANOES.

Volcanic activity began in Pliocene times, and still continues. Ruapehu has been built up by successive lava-flows and showers of scoria and ash. Its old top down to the 7,000 ft. level was removed by collapse and by explosions, but later eruptions have almost restored the mountain to its former size and shape. Three ridges of grey andesite extend up to 7,000 ft., the most prominent being that on which stand the needle-shaped rocks called the Pinnacles. The latest lava-flows—hypersthene andesites—extend far down into the valleys. They are dark-coloured and have a rough surface.

The top of Ruapehu is above the permanent snow-level, and several glaciers occur, each fed from the main crater glacier, which is nearly circular and about a mile across. In the centre of this is a hot lake, about 30 chains in diameter, bounded on the south and west sides by vertical cliffs of ice; on the north-east side lava walls are visible, and on the east a cinder cone rises to a height of 250 ft. above the level of the lake. At the time the lake was visited (February, 1930) the temperature of the water was below blood-heat; previous observers have seen steam rising from the water, and on two occasions—in 1886 and 1926—it has been frozen over. No outlet is visible, but the evidence points to an underground outlet to the Wangaehu River.

Mud-flows have swept down the slopes of Ruapehu. One that rushed down the north-western slopes extended a few miles beyond the National Park—Tokaanu Road and left numerous conical hills up to about 18 ft. in height and composed of coarse agglomerate. The latest one came down the Wangaehu in 1869 and spread out on the flats immediately west of the Waiouru—Tokaanu Road without forming any conical hills.

Hauhangatahi, a low flat cone 4,983 ft. high lying to the west of Ruapehu, owes its present outline to the fact that a lava-flow has protected the underlying Tertiary rocks from erosion. It erupted a purplish-grey andesite in which greenish augite phenocrysts are conspicuous.

The history of Tongariro is similar to that of Ruapehu. It, too, is formed of grey andesite; it was reduced from its ancient form by collapse and by explosions on an even grander scale than Ruapehu. New craters were formed and later explosions built scoria cones, much the largest being Ngauruhoe (7,515 ft.), which is still in active eruption. Though the major cones are built mainly of hypersthene augite andesite, the minor surrounding ones have erupted more basic lavas. Thus Pukeonake (4,018 ft.) on the west flank of Tongariro is formed of olivine basalt; Tama Lakes, on the saddle between Ruapehu and Tongariro, lie in explosion craters from which dense black augite andesites were erupted; and a viscous flow of dark olivine basalt poured out of a fissure on Pukekaikiore and ran several chains down the side of the hill.

Te Mari, an active scoria cone on the northern slope of Tongariro, has within tolerably recent times poured out a dark andesite lava which cut a path through the bush at the foot of the mountain. It was last in active eruption in 1896, but the only present sign of activity is a line of weak fumaroles high on the eastern rim of the crater.

At Ketetahi, about a mile west of Te Mari there is a group of fumaroles and small hot springs in a depression some 12 chains square. Fumaroles occur also on Tongariro and Ngauruhoe, and hot springs near Tokaanu, on Lake Taupo (1,200 ft.). Taumatapuhipuhi, a small geyser at Tokaanu, plays regularly to a height of 20 ft. at intervals varying from twelve to fifteen minutes.

The extinct volcanoes Pihanga, Tihia, and Kakaramea, aligned in a south-east to north-west direction, occupy the north-eastern corner of the district. Their northern slopes end near Tokaanu. Pihanga, a conical mountain without a crater, is composed of basalt. Kakaramea and Tihia are of hypersthene augite andesite.