from Ruapehu or Tongariro, as their lavas are exclusively andesitic. It probably came from the vicinity of Lake Taupo, possibly from the site of the lake itself, as near it there are extensive flows of rhyolite identical in chemical and mineral composition with the pumice.

Since that period pumice has been discharged from time to time, so that it forms an important constituent of recent deposits, especially of surface soils, both in the middle of the Island and in the coastal districts. The possibility of its wide distribution by paroxysmal eruptions is made manifest by the great area over which recently the ash from Tarawera was scattered. The transporting power of water acting on such a light material accounts for its rapid movement along river-valleys, in the lower part of which it is particularly abundant, and for its association with marine deposits. The pumice may have been formed either, like the Tarawera ash, from comminuted and partially fused fragments of former consolidated lava-flows, which have been reduced to powder by the rending force of steam, or it may have been a primary product of the original volcanoes. Doubtless some of the earlier deposits are due to the latter cause. Its present distribution as a surface deposit on the top of the recent andesitic lavas of Ruapehu and Tongariro, as well as on the slates of the Kaimanawas, lying, regardless of the form of the landscape, sometimes as a thin coating and close by in thick drifts, shows that quite recently it has fallen in heavy showers.

All over the central plateau the pumice is full of the charred remains of forest-trees, sometimes 2 ft. in diameter and from 10 ft. to 12 ft. in length. These have probably been destroyed where they lie by a hail of hot pumice, but were covered so quickly that they were prevented from actually burning away. The occurrence of such wood shows that much of the treeless district round Ruapehu was covered at one time with heavy forest.

As these pumice soils are so widely distributed, a complete investigation of their possibilities is urgently needed. They cover a wide area in the North Island, and, with the possible exception of the loess of the South Island, are the most widely distributed type of soil in the whole Dominion. In the interior of the North Island they are associated with scanty vegetation, but this is largely due to the fact that they have not sufficiently weathered. In time, however, they will form a very fair soil. No doubt the richness of the soil of certain parts of the Hawke's Bay district is partly due to the admixture of decayed pumice.

It is possible that both Ruapehu and Tongariro were originally submarine volcanoes, but this cannot be stated for certain, as their base is in no place exposed to view. Where contact with the older rocks no doubt exists, a surface accumulation of drift prevents satisfactory examination. The fact that no trace of volcanic rocks has been found in the Miocene clays and limestones of the Upper Rangitikei, which lie within a few miles of the great volcanoes, makes it probable that such action had not begun in the locality at the end of the Miocene period. The occurrence of pumice in Pliocene beds does not help us as regards Ruapehu and Tongariro, except as showing that volcanic action had begun further north in Pliocene times. The succession of volcanic rocks in New Zealand does not help us much either, since the evidence furnished by the sequence in the Coromandel Peninsula, at Mount Somers, and at Gebbie's Valley is contradictory. It is hardly safe to conclude that the andesites forming the base of Ruapehu and Tongariro are subsequent to the rhyolites of Taupo, although it is probable that such is the case.

Inclusions of what is apparently a partially fused rhyolite frequently occur in the lava-flows of Ngauruhoe and Ruapehu. If this diagnosis is correct, it points to the existence of rhyolite rocks under the main mass of the great volcanoes, and this would fix their age with tolerable certainty.

After a general consideration of all the circumstances it seems reasonable to say that the foundations of Ruapehu and Tongariro were laid in late Pliocene times — *i.e.*, they are geologically very young—and that activity has persisted since then right up to the present day.

During all this time lavas and scoriaceous matter have been erupted, and, accumulating round the volcanic vents, have built up the cones. The chemical composition of the lava varies somewhat, and the later flows show a close relationship to basalts. The lavas all contain the mineral hypersthene or its near relative enstatite as a characteristic constituent, though hornblende and augite also occur, the former being of somewhat rare occurrence, while the latter is extremely common. The hornblende crystals are further of interest as they are often corroded by the solvent action of the liquid magma in which they floated before it finally solidified. The reported existence of trachyte and phonolite seems to me to be based on an incorrect identification. The whitish and light-grey rocks which might reasonably be mistaken for trachytes appear under the microscope to be hypersthene-andesites. After a careful examination of the slopes of Ruapehu I have not been able to discover any true phonolites, as the rocks which have split into thin slabs, and ring when struck with the hammer, which were originally identified as phonolites are also undoubtedly andesites. Even the later flows, which are basaltic in appearance and sometimes contain a little olivine, also contain a small amount of hypersthene, and thus must be classified as hypersthene-andesites.

The pouring-out of this variety of andesite has more than mere local interest. It is found with remarkable persistence along a line of volcanic vents stretching from Ruapehu in a northeasterly direction far out into the Pacific. Hypersthene-andesites are found at Mount Horohoro, near Rotorua, and at White Island, in the Bay of Plenty. Dr. Marshall informs me that he has found hypersthene in some of the bombs thrown out from Tarawera. It occurs also in the Kermadec rocks.

The similarity in the mineral composition of the lavas and the linear arrangement of the centres of activity point to some deep-seated cause affecting the whole area. No doubt a line of weakness in the earth's crust extends in an approximately straight line from Ruapehu through Tonga and Samoa towards distant Hawaii. This line may perhaps be called the "Maori line" of volcanoes, as no doubt the first Maori immigrants to the country followed its direction more