Contributed Papers

Chairman — Prof. V. J. Chapman

How Old is the Vegetation on Rangitoto Island?

Dr. L. H. Millener

The gently sloping basaltic base of Rangitoto Island in Auckland Harbour shows stages in colonization by pohutukawa (*Metrosideros excelsa*) and the scoria cone above is covered with incipient pohutukawa forest. During a statistical investigation it became necessary to take the age of this vegetation into consideration in order to complete the picture.

Though the vegetation of Rangitoto is unique and has been said to be the most important in New Zealand little has been written about it. Kirk's three-page account of 1878 (T.N.Z.I.) is the longest. Most writers emphasize the slow progress of colonization that had gone on for hundreds or thousands of years. The present thesis is that the vegetation has developed mainly since the white man came to New Zealand, this conclusion being based on the following lines of evidence:—

1. Age of oldest trees. Up to 130 rings have been counted and 150-200 years may be taken as the maximum age of any tree on the island. The pohutukawas are all young and actively growing and trunk morphology also testifies to their youth.

2. Rate of spread of vegetation. There are still large areas of broken lava separating rather well-defined "islands" of vegetation. These "islands" are coalescing and most are actively growing. Counting the rings of *Metrosideros* has given a mean diameter increase of old-established "islands" of about 15cm. per year, and this wouid be the average over the last century for certain "islands". New "islands" are constantly forming and provided the past rate of progress is maintained another century would see almost all of the bare areas on Rangitoto covered. But the younger the "island" the more slowly it tends to grow. The classical lithosere hypothesis therefore seems quite untenable. This conclusion is supported also by the fact that most of the large communities of *Metrosideros* are even-aged.

3. Fragmentary nature of vegetation. Ecologically and floristically the vegetation is more fragmentary than one would expect if it were of great age. There are about 200 species, and there are slightly over sixty families each represented by only one species. Kirk in 1878 did not see any cabbage trees (though Cheeseman had seen them at that time.—Ed.) or tree-ferns or pine trees, and *M. excelsa* has transformed some places since then.

4. Animal colonization. Mr. and Mrs. Gardner have traced colonization from the adjacent Motutapu Island by about twelve species of molluscs; only one has yet encircled Rangitoto.

5. Literature. Published references have been carefully scanned and most mention stunted or scrubby vegetation. No writer before Kirk spoke of "trees" or "forest", though now trees reach 60 ft. and there are whole groves of pohutukawas 45-50 ft. tall and mangeao (*Litsaea calicaris*) up to 40 ft. This agrees with the observation that growth of pohutukawas in the shrubby stage was slow (up to 44 rings in the first inch). These shrubs probably began life about 1800. Early writers referred to loose cinders on the summit cone, with meagre and very short cover of plants.

6. Early paintings, sketches and maps.

7. Living memory. It is said that in 1890 there were few shade trees for picnicking, and an informant who climbed the island from the west in 1884 describes scrubby vegetation in the hollows and elsewhere open lava and scoria which 25 years later was covered by trees.

8. Maori myth and legend. In a thousand years there is no tradition of an eruption although forests of rata and pohutukawa were described there in the fifteenth century and even back to 1150.

9. Geological evidence. Geologists have assessed the time available for the vegetation to develop from features of the cliffs of Motutapu Island and from the boulder beach on the north, as well as from the absence of leaching and weathering on the cone. Their suggested minimum of 5000-10,000 years has come down to under 1000 years, maximum 4000 years.

10. A very recent ash shower on Rangitoto? Mr. N. H. Taylor allows an ash shower about 500 years ago over the whole island. In 1947 Mr. Healy found a Maori midden at Islington Bay probably buried by an ash shower. A cataclysmic shower is

pictured, depositing up to a metre thick of fine ash. Any earlier vegetation that this might have destroyed must have been very meagre as it has left no trace. The bare areas of today have never carried vegetation of any kind. The lava flows are 50 to 100 ft. deep, as can be seen in caves.

In some areas disturbed during military operations during the recent war there are some signs of establishment of the classical lithosere, but the prime colonizer is pohutukawa, which can establish in a few years on scoria or raw basalt. There has always been plenty of seed from the mainland and it is hard to imagine that, if the ash shower was 500 years ago, the island remained uncolonized for two to three hundred years after that. Yet everything points to the vegetation being little more than two hundred years old now.

DISCUSSION

DR. W. M. HAMILTON referred to a similar problem on White Island. There in a pure pohutukawa community the trees seem to be of even age, ring counts suggest about seventy years old. Yet there is no record of fire destroying the vegetation. Records of seventy to eighty years ago refer to scrub. These trees have about doubled in height since Dr. Oliver's visit forty years ago.

DR. J. A. RATTENBURY suggested that in colonizing places opened up recently by bulldozer seedlings would have available some substances derived from the present vegetation. If so the original colonization might well have been extremely slow by comparison. He asked whether *Coriaria* root-nodules here and on Mt. Tarawera might not compare with those of legumes on Krakatoa.

DR. MILLENER discounted this suggestion since there was no trace of soil where freshly fractured masses of basalt were colonized by the dominant in a year or two. In reply to Prof. Chapman Dr. Millener said he had carried out some falling-rate tests with pohutukawa seed and had no doubt it could be carried to the island by wind. A single tree could produce four million seeds in one season.

New Zealand Pliocene and Pleistocene Climates; Evidence from Fossil Floras

D. R. McQueen and R. A. Couper

This paper (to be published in full in N.Z.J. Sci.Tech.) discusses plant fossils from Upper Tertiary and Pleistocene beds and shows that paleobotanical evidence supports Fleming's (1953) suggestion that the Nukumaruan and Castlecliffian stages, at present considered to be Pliocene, should be included in the Pleistocene. The significant points are, that Nukumaruan and younger floras lack many species that are important in underlying Tertiary beds, and that some Nukumaruan floras indicate markedly cooler climates.

Microfloras of six Upper Miocene and six Pliocene beds, covering a wide geographic range, show a reasonably constant assemblage of spores and pollen grains attributable to forest species. Particularly important is *Nothofagus cranwellae* Couper, which first appears in the Eocene in New Zealand; the only living species of *Nothofagus* with similar pollen grains are those large-leaved ones recently discovered in New Guinea and New Caledonia. Another species which occurs first in Eocene beds is important here also, namely *Triorites harrisii* Couper, belonging to either Betulaceae or Casuarinaceae; neither of these families has recent representatives in New Zealand. Conifers, tree-ferns, and beeches with pollen grains like those of *N. fusca* (a group including all present-day New Zealand *Nothofagus* except *N. menziesii*) are comparatively minor elements in all these floras. Plant macrofossils from the upper Miocene (Great Barrier Island and Kaikorai Valley, Dunedin) and from the lower Pliocene (Upper Rangitikei Valley) include many extinct species, and, in particular, are characterized by large *Nothofagus* leaves.

The similarity over a wide latitudinal range of both micro- and macro- floras suggests a relatively uniform climate in the late Tertiary. The rarity of tree-fern spores possibly indicates conditions drier than at present, but there are so few Recent species of known ecological requirements that it is difficult to assess the climate.

Floras here classified as Pleistocene lack a number of Tertiary species, including the important *N. cranwellae* and *T. harrisii* and large-leaved *Nothofagus*. They include many Recent species, and show considerable variety within themselves and in relation to geographical position. Where the Recent forest species which are recognized suggest a cooler climate than is found in the