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 particular locality today, or where forest tree species are absent, the flora is classed as glacial. Thus beds of probable Nukumaruan age at Ohuka Creek (West Auckland) and Nukumaruan beds at Esk Valley (Hawkes Bay) both contain *N. menziesii* and other forest species which in these latitudes now grow only at much higher altitudes, and which grow at sea level only much further south. It is suggested that these beds were laid down at about sea level when the vegetation belts were 700-800 m. lower than at present. Similarly, the absence of forest pollen and the presence of abundant grass and composite pollen at Orepuki (Southland) indicate that the southern limit of forests lay much further north at the time of deposition, and all these beds are classified as glacial. Absence of forest macro-fossils from beds at Palliser Bay is considered evidence for more arid conditions there during a glacial period. In general, Pleistocene floras have been considered interglacial when the Recent species found in them are the same as those of the present vegetation around the fossil locality. In contrast with the Pliocene floras and like those of the present day, interglacial floras show differences related both to latitude and to topographical features that can affect climate. The salient features of this paper are shown in the following table.

FLEMING, C. A. 1953. *New Evidence for World Correlation of Marine Pliocene.* (letter to Editor) Aust.J.Sci. *15 (4)*. 135-6.

Subdivisions (Present)			*Subdivisions (Suggested)*
Recent			Recent
Hawera Series (Pleistocene)		Some Warm, some Cold Temperate All Recent Species	
Wanganui Series (Pliocene)	Castlecliffian	Warm Temperate, nearly all Recent Species	Pleistocene
	Nukumaruan	Cold Temperate, many Recent species	
	Waitotaran	Not definitely known.	
	Opoitian	Warm Temperate, last appearance of large-lvd. *Nothofagus* and *N. cranwellae.*	Pliocene
Taranaki Series (Upper Miocene)	Kapitian Tongaporutuan	Warm Temperate, *N. cranwellae,* large lvd. beeches and *Triorites harrisii* dominant.	Upper Miocene

DISCUSSION

DR. C. A. FLEMING pointed out that he had put forward the working hypothesis that the Plio-Pleistocene boundary should be changed partly on molluscan evidence, but also from stratigraphical evidence from Ross (Westland) and from the indications of cooling brought out by Couper and Harris's work on micro-fossils at Wanganui.

W. F. HARRIS stressed the great importance of the Pleistocene for vegetation study. At that time large areas were devastated and revegetated. He wondered whether Pliocene floras did not show more affinity with Recent than with Miocene floras, and asked about Waiototaran and Opoitian floras.

MR. MCQUEEN and MR. COUPER replied that no definitely dated Waiototaran floras had been examined, although it is possible that floras of this age may be included in the lower Wanganuian floras discussed in this paper. Opoitian floras have species known elsewhere in New Zealand only from Miocene and older beds and also contain many Recent species.