The snowfall, and especially the length of time that it lies on the ground, is a matter of much moment to plant-life and its distribution. From conversations with those who live in the neighbourhood, it appears that at an elevation of between 3,000 ft. and 4,000 ft. snow does not lie, usually, for above a few days, except where it has drifted. At above this elevation it is probable that snow lies for the whole of the winter months, while in the gullies and shaded places it does not entirely disappear before the beginning of March, a few small patches remaining all the year round even on Tongariro and Ngauruhoe, whereas, of course, in the deeper highest gullies and near the glaciers of Ruapehu there are perpetual snowfields. It is the melting of this snow, as shown further on, which leads to the occurrence of semi-bogs on the steppes, and on it depends to a considerable extent the underground water-supply which here and there oozes from the road-cuttings and from the surface of the ground.

As for the temperature of the district under consideration, I can give no exact particulars. The clear sky and the high elevation lead to a powerful direct action of the sun's rays, which is easily manifest by placing the hand upon the bare scoria-covered ground. Probably during the summer, notwithstanding the elevation, the heat of the sun will be as great as at any place in New Zealand. On the west and south of the mountains cloud and mist will be more frequent and the power of the sun generally less manifest than on the east.

Frost is extremely common all over the volcanic plateau, and is strongly felt even during the month of January, when shallow water frequently becomes covered during the night with a fairly thick coating of ice. At the same time, here as elsewhere in New Zealand it is probable that we are apt to overestimate the intensity of the cold, and it is reasonable to suppose that the thermometer will rarely sink below about 16° Fahr.

With regard to wind, the factor of all others of importance in relation to the special distribution of vegetation in New Zealand, and which also has a strong bearing on the life-forms of the plants, I can say very little. Judging from my own experiences, on the east at any rate, during the summer the wind factor is much less than is general in the New Zealand biological region. At the same time, the appearance of the plants and their distribution leads one to believe that high winds are not infrequent, and that in many parts of the district they exercise a very powerful influence.

V. GEOLOGY.

[By R. Speight, M.A., B.Sc., F.G.S.]

(A.) GEOLOGICAL HISTORY OF THE DISTRICT.

In order to understand the procession of events with regard to the evolution of the plant formations and the history of the vegetation generally it is necessary to discuss rather fully certain geological matters concerned with land beyond the confines of the park, and here the Kaimanawa Range comes especially into consideration.

The oldest rocks in the neighbourhood of the Tongariro National Park are the slates and sandstones of the Kaimanawa Mountains. These are probably of Carboniferous age, and form a portion of the structural axis of older rocks which extends through the North Island from near Wellington towards the eastern side of the Bay of Plenty. The Kaimanawas can hardly be called a mountain-range. Their southern portion, at any rate, is part of a plain of marine denudation formed in Tertiary times, and the tolerably level surface then acquired was subsequently raised above sea-level and thoroughly dissected by stream-action, so that now it is composed of a number of more or less isolated elevations. At the time of the submergence a great bay or strait must have occupied the middle of the North Island, extending north-east from Wanganui and probably cutting off the unsubmerged parts of the Kaimanawas and Ruahines from islands lying to the north-west. An archipelago then occupied the area now covered by the North Island. Thick and extensive deposits of marine clays and limestones, stretching in a broad band from the Ruahines across the middle courses of the Rangitikei, Wangaehu, and Wanganui Rivers towards the Tasman Sea in the west, prove that in Miocene times the sea transgressed over a great area in the south-western part of the Island. The limestone beds of this deposit now rise to a height of 3,700 ft. on the southern flank of the Kaimanawas, proving an elevation of at least that amount. Account must also be taken of the depth of the sea in which the beds were laid down, as this must be added in order to give a true measure of the elevation. However, it could not have been very great, as the presence of limestone, associated with detrital deposits, indicates somewhat shallow water conditions. It is highly likely the levelling of the surface of a part of the Kaimanawa country, mentioned previously, took place during this time of submergence of the land. In these beds no direct evidence of volcanic action is known. After their deposition elevation seems to have commenced, probably attended by volcanic outbursts further north. Possibly the elevation of the land, and also the volcanic action, as is known in other parts of the world, were due to a crustal movement but little understood. One result was to raise the centre of the Island into the form of a low flat dome, over the surface of which rivers run north, and west, and south. The drainage which has thus been recently established is called "consequent"—*i.e.*, following the general slope of the land-surface as it emerged from the sea. The rivers run usually in the direction of the dip, in deep, narrow channels. Their tributaries are slightly inclined to the main river, and they do not show yet any marked signs of the development of subsequent drainage. This is a very decided proof of the recency of the land-surface. The beds show on their northern side a very decided scarp-slope. Through this the rivers have cut their way.

The earliest undoubted proof of volcanic activity occurs in beds of Pliocene age overlying the limestones, and containing fragments of water-worn pumice. Occasionally whole beds are found of pumice sands. They are very strongly developed on the Pohangina River and in the beach near Kai Iwi. Where the pumice came from is uncertain. In any case, it did not come