The Delineation of Natural Areas—Soils

I. L. Baumgart

Natural areas may be recognised by the living things within them. These living things acquire features which are related to environmental factors characteristic of the natural area. In this way, natural areas express themselves in living things, and living things show at what points variations in environmental factors are significant.

Soils, because of their ability to change with their environment, are considered as living things, and the distribution pattern of certain of their characteristics delineates natural areas. This concept of the relationship of soils to their environment is the basis of Taylor's genetic classification of N.Z. soils.

The soil is the product of five features—(1) *the parent material* from which it is derived — not just the geological bed on which it lies, but incidental accretionary material, volcanic ash, dust, drifts from sheet floods, animal droppings and other organic remains which would not concern the geologist. (2) *the climate*: not only rainfall and air temperature, but microclimatic features such as soil moisture, drainage, aeration, soil temperature ranges, and the addition of salts in rainwater. (3) *the soil life*: plant and animal, macro and micro-organisms—all of which take part in the building up or the breaking down of the organic fraction of the soil. (4) *time*: not just geological time, but the time for which the soil has been under the influence of its present environment, together with the time it was subjected to the influences of previous environments. (5) *topography*: ranging from the very steep slope — where water does not penetrate, where weathered rock fragments move quickly downhill, so that other factors do not get a chance to work on the soil at all—through hilly, rolling and flattish surfaces to under-drained hollows where soil processes are slow. These factors are not independent variables, for vegetation, microclimate and even certain features of topography depend on the soils as well as on each other.

A natural soil area is not a single unit of uniform characteristics extending from one firm boundary to another. Each unit, on however large a scale it is depicted, consists of a mosaic of smaller units, each governed by micro-variations in some of the soil environmental factors. We may consider natural areas on a world basis, or on a micro-basis, with units as small we care to make them. On a country-wide picture, the broad units of classification — say Yellow Grey Earths—correspond with broad, characteristic, easily recognized natural areas, but classification units right down to a very low order should represent small natural areas. Furthermore, since—with a few exceptions—the soil-forming factors vary gradually, rather than abruptly, soil units generally do not change abruptly. The delineation of natural areas does not simply involve putting lines round areas of soils with certain characteristics. It generally involves determining critical points on a range of continuous change—a common feature of the delineation of natural units.

In a typical landscape, topography is the most useful key to natural soil areas. In swampy hollows, the soils are gleyed and lack aeration: on recent alluvial flats they are closely related to the pattern of deposition of the alluvium and have developed little character of their own: on relatively stable rolling slopes where a climax vegetation has developed, the same soil processes have been going on a long time and have fully expressed themselves, producing a soil fully characteristic of the environmental zone: steep slopes have unstable soils, constantly moving downwards exposing new material so that processes never advance far: soils on high hills with greater precipitation are more leached with a greater accumulation of organic matter.

These natural areas stand out in a landscape and the same environmental approach can be applied on a country-wide basis.

Firstly, soils on which all the factors of the environment are fully expressed must be on a "normal" parent material which does not impose strong characteristics of its own, masking other factors: it must be one which

has been in position long enough for the other factors to be fully expressed. Greywacke and related or similar materials fulfill these conditions in New Zealand.

Greywacke is the parent material for soils from the extreme north to the extreme south. From about Auckland northwards, mean temperatures and rainfall are high, and the greywacke is typically strongly weathered into clays. On the higher land south of Kaikoura, mean temperatures are much lower and weathering weak, giving sandy textures. Between is a zone of moderate weathering and silty textures.

In general, the west and north of New Zealand have a higher rainfall than the east.

In the lower rainfall areas, tussock and scrub grew on the soils derived from greywacke: under the lowest rainfall the Brown-Grey Earths developed—typical of Central Otago and the Mackenzie Country. Under rather higher rainfull, but still under tussocks and scrub the Yellow-Grey Earths were formed—typical of the East Coast, especially in Canterbury and the Wairarapa.

With further rainfall increase, tussock and scrub give way to forest, and the soils on greywacke fall naturally into a new group—the Yellow-Brown Earths on which the natural weathering zones show up clearly. Superimposed is a pattern of leaching, increased in severity in the north due to specialized vegetation (kauri) and in the far south due to high rainfull, low temperatures and a different type of specialized vegetation (beech).

Those are the zonal soils on "normal" parent material. Over much of New Zealand, however, one or two dominating factors mask the influence of other factors. In the kauri forests of North Auckland vegetation dominates, inducing extreme leaching so that podzols are produced under the kauri trees, rendering the soil quite unlike any other in that region.

On steep slopes, topography is dominant and prevents other factors expressing themselves because of the constant down-slope movement of the soils.

On recent alluvial soils, the factor of *time* dominates the soil. Because time is so short, the soils are still weakly weathered, and have not altered much from the original parent material. Vegetation and climate have made very little impression.

"Abnormal" parent materials, such as basalts and limestones, produce soils quite unlike the soils characteristic of the zone on "normal" parent materials, though with extreme age the differences tend to disappear. These parent materials therefore determine certain natural soil areas.

Blanket peats occur where the climate dominates the soil processes so that breakdown of organic matter is slower than its formation. These soils occur in New Zealand only in small areas of high precipitation and low temperatures, at high altitudes in Southland and Otago. In the sub-antarctic islands, however (Auckland and Campbell Islands) blanket peats are the zonal soil.

The recent soils from volcanic ash are dominated by two factors—time, and parent material. Because of their youth, the peculiar characteristics of the parent materials are the dominant features in the soils. However, when they become old, soils from rhyolitic volcanic ash take on most of the features of the zonal soil—in fact, it is suspected that many of our zonal soils do contain a proportion of volcanic ash.

Taylor's Soil Map of New Zealand (1948) is a delineation of natural soil areas. His classification demonstrates that soils are in themselves valid expressions of "natural areas" except where one or two of the soil forming factors become dominating.

KEYS TO CLIMATE AND SOIL MAPS

MAIN CLIMATIC DISTRICTS

(See map)

A. Very warm humid summers, mild winters. Annual rainfall 45-60 inches with maximum in winter. Prevailing wind south-westerly but occasional strong gales and heavy rain from east or northeast from Auckland northwards and about Coromandel Peninsula.

A_2 Similar to type A but much wetter; rain-60-100 inches.

B. Sunny, rather sheltered areas which receive rains of very high intensity at times from the northeast and north. Very warm summers and mild winters. Annual rainfall 40-60 inches with maximum in winter.

C. Very warm summers, day temperatures occasionally above 90°F with dry Foehn NW wind blowing. Rainfall 40-60 inches per annum; marked decrease in amount and reliability of rain in spring and summer; moderate winter temperatures with maximum rainfall in this season.

C_0 Drier than type C—rainfall 25-35 inches. Very sunny.

C_2 Cooler and wetter hill climates. Very heavy rains at times from east or southeast; annual rainfall mainly 60-80 inches.

D. West to northwest winds prevail with relatively frequent gales. Mean annual rainfall 35-50 inches; rainfall reliable and evenly distributed through the year. Warm summers, mild winters.

D_2 Wetter than D—rainfall 50-80 inches.

E. Mild temperatures, high rainfall increasing rapidly inland with height, minimum rainfall in winter especially in the south. Prevailing winds SW but gales not frequent at low levels in spite of exposed coastline.

F. Low rainfall, 23-30 inches; in the south slightly more in summer than in other seasons. Warm summers with occasional hot Foehn northwesterlies giving temperatures above 90°F, cool winters with frequent frosts and occasional light snowfalls. Prevailing winds NE near the coast, NW inland.

F_2 Cooler and wetter hill climates. Rainfall 30-60 inches. NW winds prevail with occasional very strong gales specially along river courses. Snow may lie for several weeks in winter..

F_0 Semi-arid areas, rainfall 13-20 inches. Very warm, dry summers; cold winters.

G. Warm summers, cool winters. Rainfall 25-35 inches, evenly distributed except for slight falling off in winter.

G_2 Wetter and slightly cooler than G climates; rainfall 35-50 inches; in coastal districts cloudy, windy conditions and frequent showers.

M. High rainfall, mountain climate.

"NATURAL AREAS" OF NEW ZEALAND SOILS.

(Boundaries generalized from Soil Map of N.Z. 1948.)

SOILS IN WHICH THE ENVIRONMENT IS FULLY EXPRESSED:

1. Soils of the cool semi-arid zone, developed under tussock grasses.
2. Soils of the mild sub-humid zone developed mainly under tussock grasses.
3. Soils of the humid zone developed mainly under forest.

SOILS IN WHICH THE ENVIRONMENT IS NOT FULLY EXPRESSED, DUE TO THE DOMINANCE OF CERTAIN FACTORS:

4. Skeletal soils on steep slopes dominated by the topography factor.
5. Recent soils from alluvium or volcanic ash, dominated by their youth—the time factor.
6. Soils from old volcanic ash, dominated by their abnormal parent material.
7. Soils from younger volcanic ash, dominated by their youth and their abnormal parental material.

Excursion

On Saturday, May 12th, there was an excursion by bus from Wellington, over the Rimutaka Range, to the southern portion of the Wairarapa district.

During the excursion stops were made at the following places:

1. Summit of Rimutaka Range: Mr. A. L. Poole and Mr. A. P. Druce pointed out features of the vegetation, which consists of scrub (manuka and some sub-alpine species) and remnants of the red beech and silver beech forest which formerly covered the area.

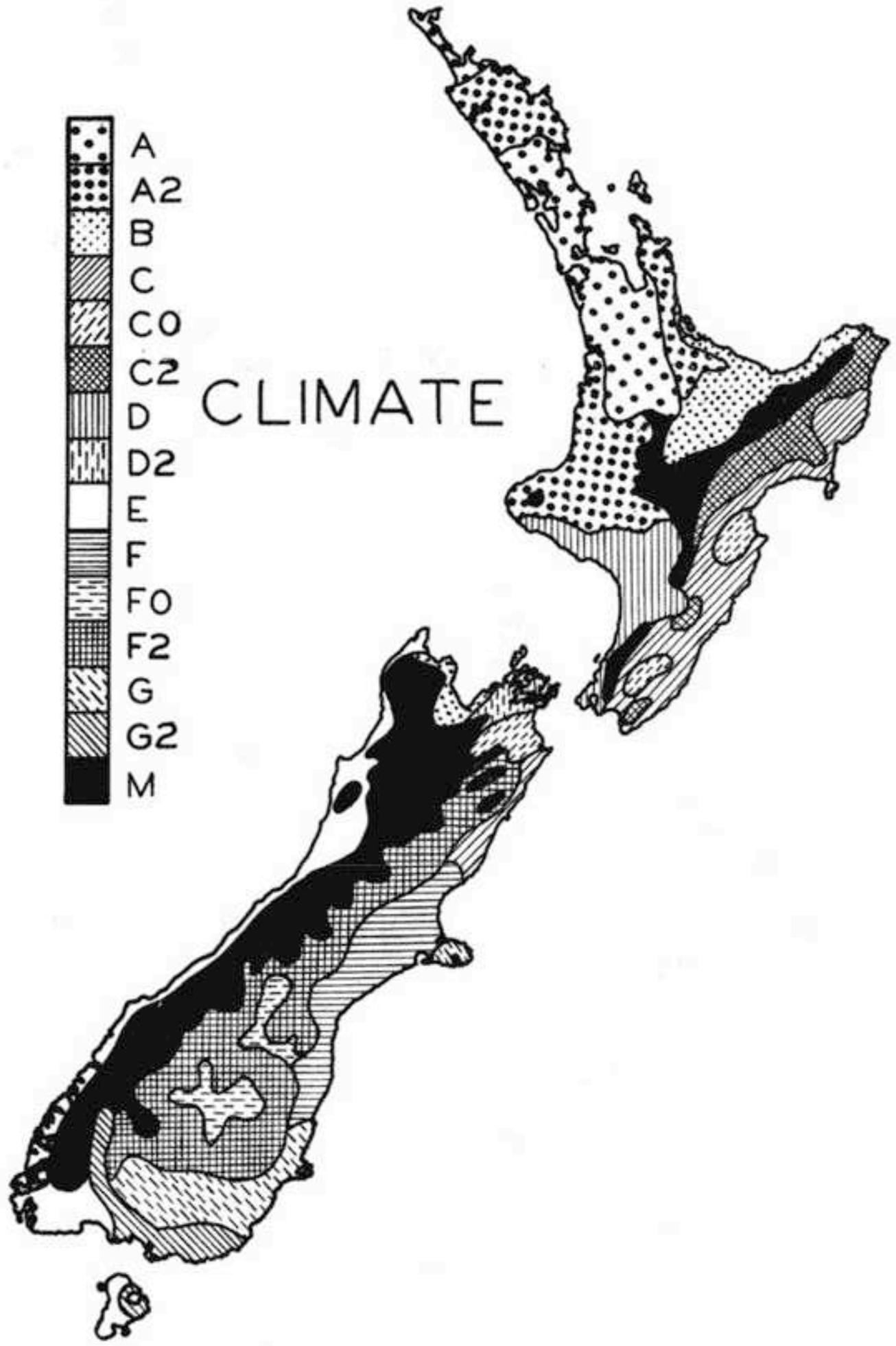
2. Western Lake Forest Reserve: Beech forest here comes down to the edge of Lake Wairarapa. Mr. Poole and Mr. Druce explained some features of the forest.

3. Lake Pounui: This is a small lake which is a bird sanctuary, and since the shooting season was in progress considerable numbers of waterfowl were seen. A stop was made at this point for lunch.

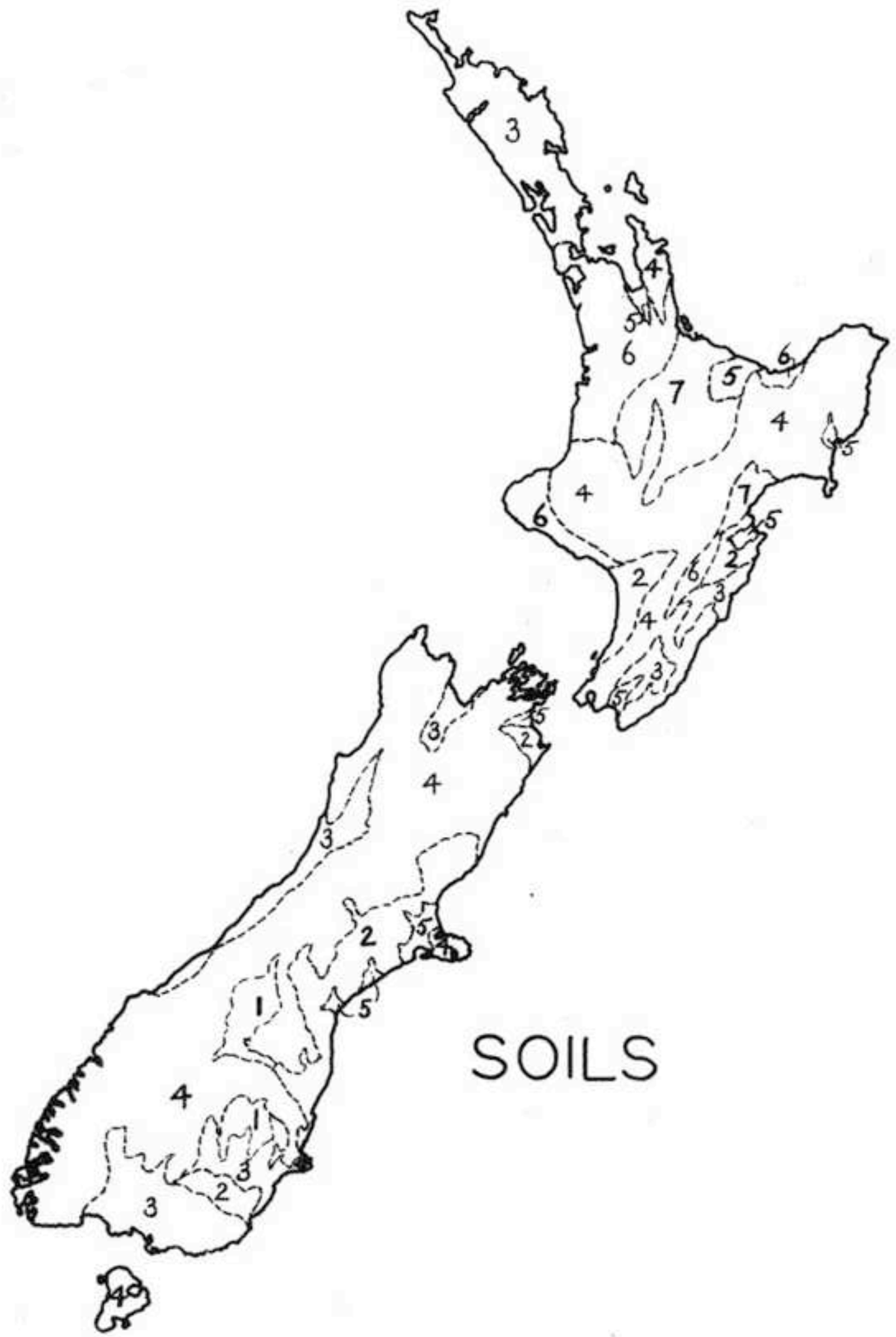
4. Top of hill above Lake Onoke: From this point an excellent view was obtained of Palliser Bay, Lake Onoke, which is separated from the sea by a long narrow shingle spit, Lake Wairarapa, and the southern portion of the Wairarapa district, bounded on the east by the Aorangi Range.

5. Lake Onoke: Most of those present walked along the narrow spit and examined contrasting conditions on the seaward and landward sides.

From Lake Onoke the bus returned to Wellington over the same route. Commentaries on points of interest near the road were given throughout the excursion by various members, using the loudspeaker system in the bus.



CLIMATE



SOILS