1. Acanthodrilinae and Megascolecinae are found in all areas.
2. Area A differs from the remainder in the dominance of Megascolecinae (especially *Megascolides*), the large number of species and the small distributional area of individual species.
3. Area B has a fauna consisting almost entirely of Acanthodrilinae, some of which are closely related to the Acanthodrilinae of the northern portion of area A.
4. Area D is dominated by a few species, each with a very wide distributional area, which have apparently come from surrounding areas.
5. The position of Cook Strait has had little or no influence on the present distribution of earthworms.
6. Area F, which is very large, has a comparatively small number of species, each with a wide distributional area.
7. The fauna of area H includes a number of species not closely related to those of other South Island areas, but similar to species from Snares and Auckland Islands, and a few species which are closely related to species from area A.

This distribution pattern indicates that Megascolecinae have entered New Zealand (from the north) much more recently than Acanthodrilinae. Very recent volcanic activity in central North Island, together with changes in the distribution of land and sea, have prevented most Megascolecinae from advancing south of area A. Soils derived from the most recent Taupo ash shower (all of area D) have been repopulated from surrounding areas, and because of their peculiar physical and biological properties only a few species have succeeded in them, and they have become very widespread. These soils have, by forming a barrier to the distribution of Megacolecinae, allowed the fauna of area B to develop in isolation, and though strong resemblances exist between some of its species and the Acanthodrilinae of area A, species peculiar to the area are also found. Area E is populated by a forest soil earthworm fauna whose distribution indicates that Cook Strait is of very recent origin. The fauna of area F is apparently mainly derived from that of area E. There have been great changes in the vegetation of area F since the last glacial maximum, and most of the area has probably been repopulated since that time. Species have a broad distribution pattern similar to the dominant species of area D. Much of area G was recently covered with ice and it has been repopulated by species from areas E and H. That portion of the fauna of area H which is similar to the fauna of subantarctic islands is probably a relic of a pre-glacial fauna which survived in isolated pockets of forest in the south-west of the South Island during the last glaciation and spread out again as the glaciers retreated.

Natural Areas in New Zealand—Land Snails

R. K. Dell

The species that *can* be present in an area are regulated by the interplay of the two factors of the geological history of the area and the power of dispersal of the animals concerned. Ecological processes in the area then determine which of these possible species *will* be present in the area. An attempt to delineate natural areas presupposes a belief that ecological processes will act on each member of a group of species in the same way and that the boundaries of each member of the group will be similar. If such were the case this symposium would be unnecessary because the boundaries would be self-evident.

It is the writer's belief that the distribution patterns of invertebrate animals owe more to the factors of geological history, powers of dispersal and the re-occurrence of certain quite limited ecological niches throughout New Zealand than they do to any broad ecological boundaries.

Several different methods of analysis are

available to determine natural areas, if such exist:

1. Degree of endemism present in the whole fauna of a area.

2. Analysis of distribution of selected genera.

3. Position of replacement from one species to another or from one subspecies to another.

4. Position of changeover from one group of common forms to another.

5. Take over the system already worked out for another group, e.g., flowering plants, and fit the new patterns to that.

6. Discover the exact distributional range of every species concerned and analyse them to determine either;

(a) Limits.

(b) Mid-points of range.

All these methods have been used for different groups in different parts of the world —and seldom is there much agreement. Perhaps the unscientific "Look and Say" method is the best—Look at the evidence and say where the boundaries are.

In the land snails much remains to be done, both as regards systematic revision and exact knowledge of distribution before we can be sure of boundaries, if such exist. In some areas, e.g., the east coast of the South Island this may no longer be possible.

The following areas are "broad areas" with no subdivisions and little indication of the relationship of the areas to one another. They are possibly not all equal in value. The best analysed areas are those in the extreme north and south. The areas are named for convenience, but the names are as non-committal as possible.

A. *Three Kings*: 24 species and subspecies of which 21 are endemic. These include one group of the genus *Placostylus*. The three non-endemic species are widely distributed on the mainland.

B. *North Cape*: Total fauna not yet listed, somewhere over 25 species of which 16 are endemic. The endemic forms include some 10 subspecies of one group of *Placostylus*.

C. *Northland*: Some 62 species have been recorded of which 24 are endemic. Includes one group of *Placostylus*, one of *Paryphanta* and a large number of *Liarea*.

D. *Central North Island*: a rather generalised fauna with some "spot endemics." Central volcanic area still being colonised.

E. *Wellington*: Napier south including the Ruahines. Fauna not well studied but includes *traversi* group of *Paryphanta*. Some relationships with the Marlborough Sounds.

F. *Nelson*: contains the *hochstetteri* group of *Paryphanta*.

G. *West Nelson*: contains the *gilliesi* group of *Paryphanta*.

H. *West Coast*: contains *lignaria* and *rossiana* groups of *Paryphanta*.

I. *East Coast South Island*: Poorly known but rather generalised.

J. *Fiordland*: 33 species of which 11 are endemic. Shows some relationship with East Coast South Island and stronger with Stewart Island.

K. *Stewart Island*: 33 species of which 11 are endemic.

Natural Areas in the Distribution of Freshwater Fish

K. Radway Allen

New Zealand possesses some twenty species of native freshwater fish, but they have been so little studied that natural areas based on their distribution cannot yet be defined. More is known of the distribution of the introduced fish and this paper deals with the the two main species.

These are brown and rainbow trout. They were introduced about 1870 and 1884 respectively and rapidly became established so that by 1900 a clear distribution pattern had emerged. Each species became dominant in part of the country and four main geographical regions can be distinguished—two dom-

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.

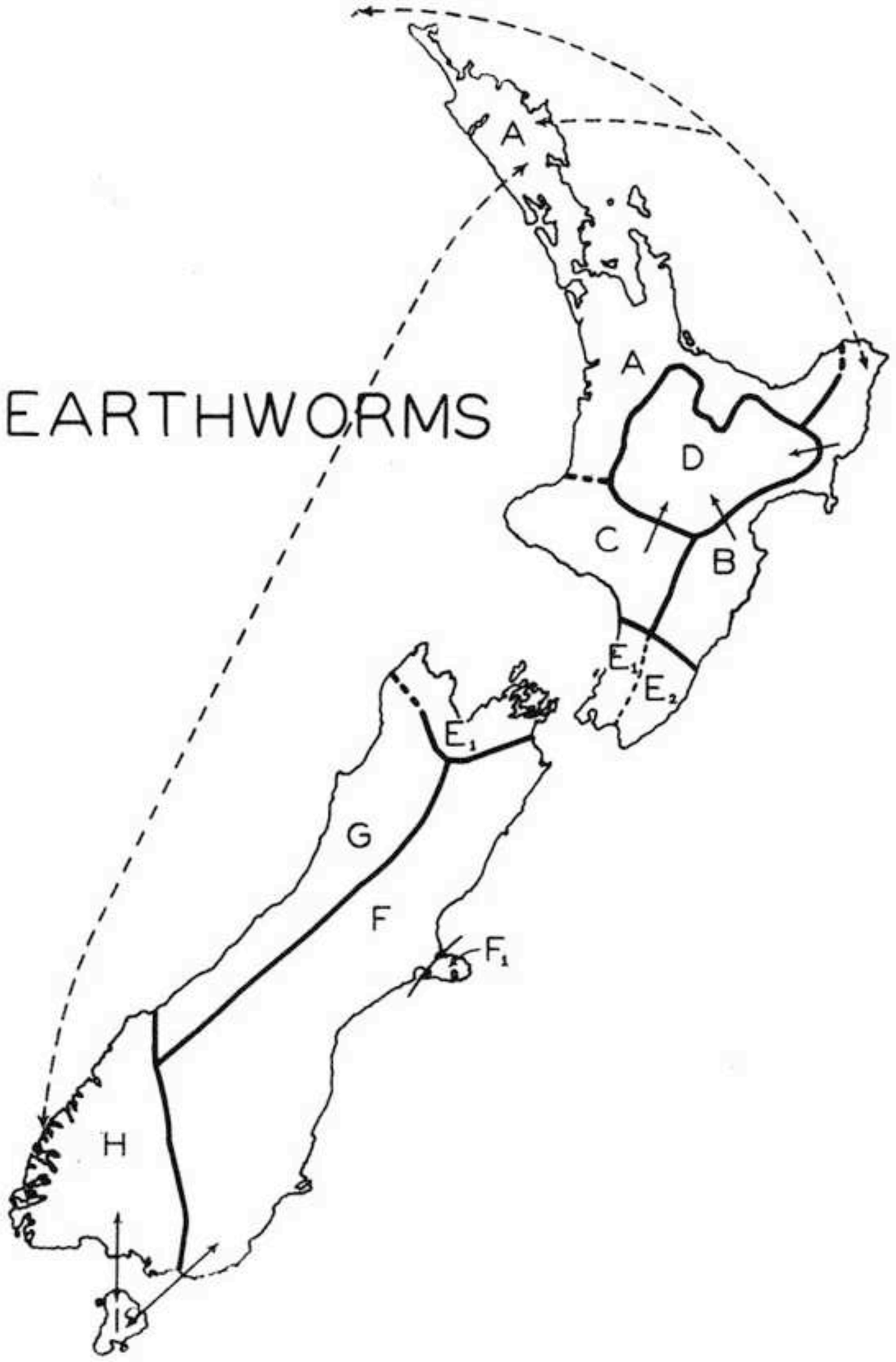
2. Western Lake Forest Reserve: Beech forest here comes down to the edge of Lake Wairarapa. Mr. Poole and Mr. Druce explained some features of the forest.

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.

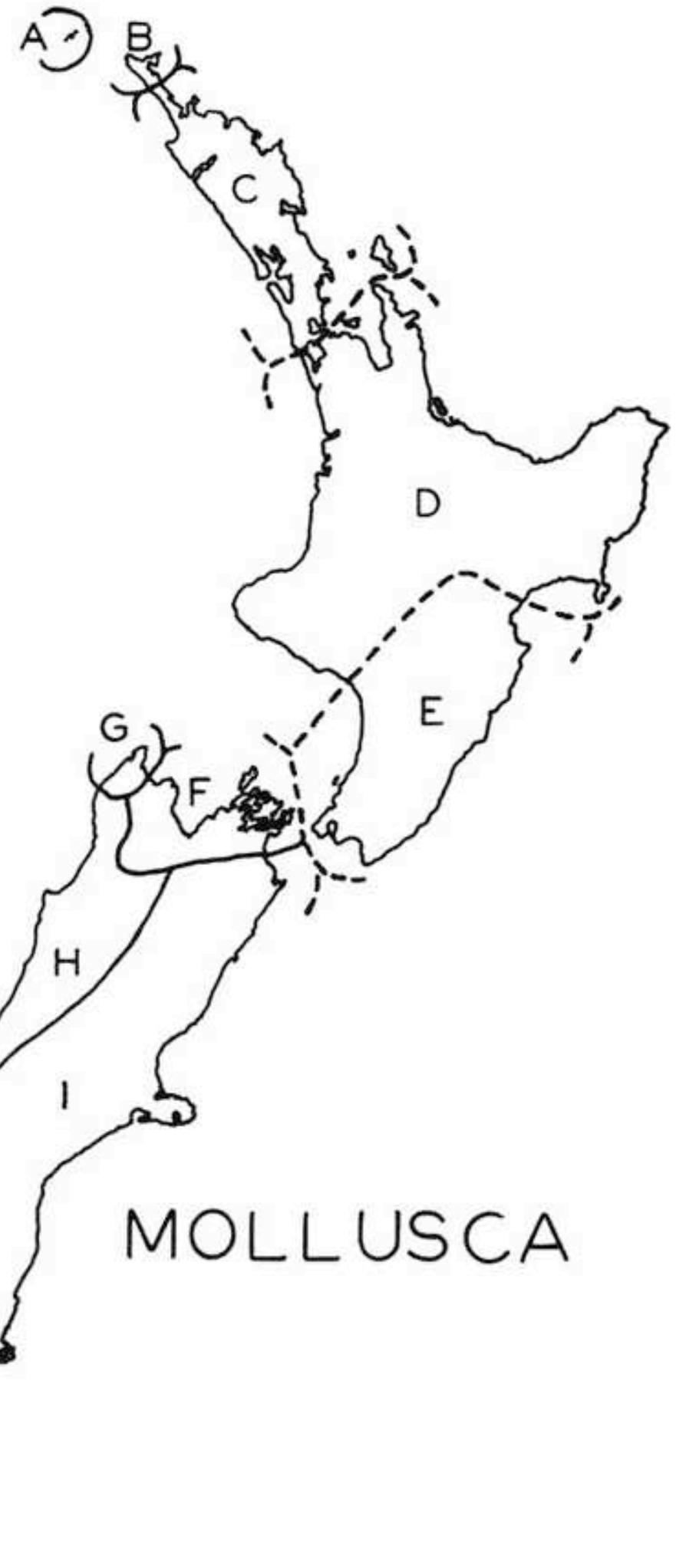
4. Top of hill above Lake Onoke: From this point an excellent view was obtained of Palliser Bay, Lake Onoke, which is separated from the sea by a long narrow shingle spit, Lake Wairarapa, and the southern portion of the Wairarapa district, bounded on the east by the Aorangi Range.

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.



EARTHWORMS



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