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SOME ASPECTS OF THE VEGETATION AND FLORA OF SOUTH ISLAND.

by J. Scott Thomson, F.L.S., F.C.S., Dunedin.

THE BANKS LECTURE FOR 1935.

Historical.

Though Banks and Solander were the first European botanists to visit South Island of New Zealand, it was not until Cook's second voyage in 1773, when Dr. J. R. Forster and his son landed at Dusky Bay, that the first examination of a portion of the real South Island vegetation was made; the plant-covering of Queen Charlotte Sound and Admiralty Bay—where Banks and Solander landed—being more closely related to that of North Island.

The next investigator of South Island plants was Menzies, the surgeon who accompanied Captain Vancouver on his 1791 voyage, when Dusky Bay was again visited. In 1827 came the French ship "Astrolabe" commanded by D'Urville; accompanying him was the naturalist Lesson, and collections were made at various places on the north coast of the island.

In the forties, Dieffenbach, Raoul, Sinclair and Lyall were all active in various localities, and subsequently Monro, Travers, Bidwill, Haast, Hector, Buchanan and Lindsay added greatly to the knowledge of the flora. Later came the period of Kirk, Cheeseman and Petrie, and since then there has been no lack of enthusiasts to carry on the work. For many years past, the outstanding figure in New Zealand botany has been the late Dr. Leonard Cockayne, the originator of so much that is new in botanical research, and the gifted author of many publications, culminating in his masterpiece "The Vegetation of New Zealand."

Plate 1.
Colony of Rhopalostylis sapida (nikau-palm), near Barrytown, Westland.

THE FLORA.

Altitude, latitude and proximity to the coast all have a marked bearing on the distribution of the species, but, so far as the coastal and lowland vegetation is concerned, neither Cook nor Foveaux Straits function as effective barriers to plant-distribution.

The influence of wet and dry local climates is astonishing, comparatively small areas having in many cases a number of species peculiar to themselves. Central Otago, for instance, possesses 15 locally endemic species, while the dry area of Marlborough, and the neighbouring wet north-west portion of Nelson, have respectively 36 and 39 local endemics.

The Flora of the island as a whole, comprising all the described indigenous flowering-plants and ferns, consists of 1,430 species, (pteridophytes 135, coniferae 17, monocotyledons 329, dicotyledons 949) which are contained in 102 families and 328 genera; in addition there are 324 hybrid groups, few of which are represented by one or two forms only, while many contain scores of distinct forms as in the genera Asplenium, Danthonia, Nothofagus, Hoheria, Myrtus, Epilobium, Coprosma, Olearia, Helichrysum and Gnaphalium—to mention only some of astonishing polymorphy.

The largest families and genera of the flora are as follows: (families) Compositae 204, Filices 118, Cyperaceae 110, Scrophulariaceae 100, Gramineae 96, Umbelliferae 73, Ranunculaceae 53, Orchidaceae 44, Onagraceae 41, Rubiaceae 39, Leguminosae 32, Epacridaceae 28, Boraginaceae 26, Juncaceae 26, Rosaceae 25, Liliaceae 24, Cruciferae 22, Gentianaceae 20; (genera) Hebe 54, Carex 51, Celmisia 49, Ranunculus 41, Epilobium 39, Coprosma 31, Aciphylla 27, Myosotis 26, Olearia 23, Senecio 23, Carmichaelia 23, Poa 22, Cotula 20 and Raoulia 20.

Of the 1,430 vascular species 1,110 are peculiar to New Zealand and of these no less than 505 are confined to South Island. Though the actual coastal and lowland vegetation on both sides of Cook Strait is practically identical, yet the northern part of South Island possesses, mainly in its mountains, 101 endemic species unknown in North Island.

Considering the life-forms contained within the flora, the following are the names and the numbers of species in each group: trees, including 7 tree-ferns, 107, 7%; shrubs 234, 16%; semi-woody plants, including 10 ferns with short trunks, 166, 11%; herbaceous plants, including 81 terrestrial ferns, 586, 41%; grass-like plants, 203, 14%; rush-like plants, 43, 3%; climbing plants, including 7 ferns, 44, 3%; epiphytes, including 26 ferns, 36, 2%; parasites 11, 0.8%. Nearly all the trees and shrubs are evergreen, and a large majority of the herbaceous and semi-woody plants are evergreen perennials. Annuals and biennials at most number 41.

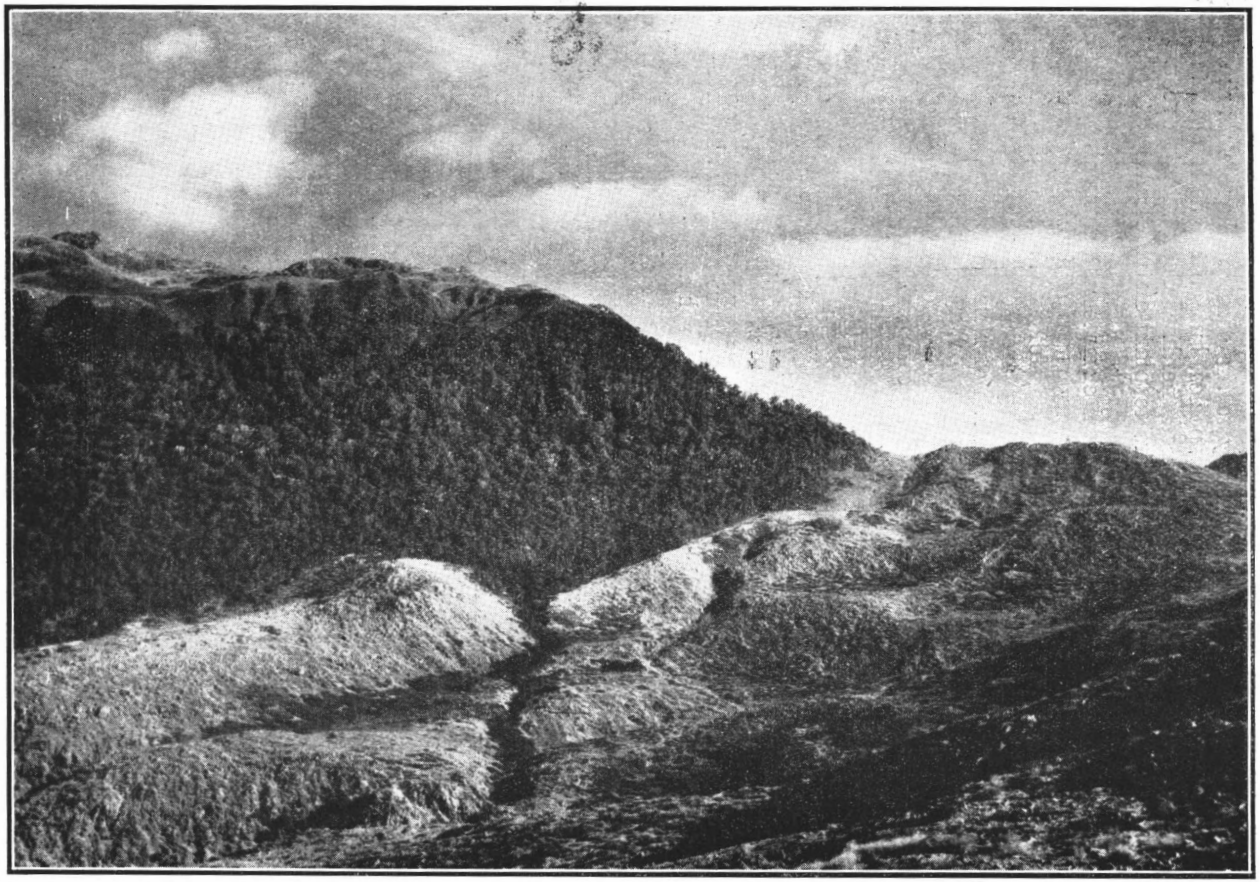


Plate 2.
Portion of the Red Hill country, South Westland.
Note heavy beech forest on the schist above, and the practically bare peridotite formation immediately below.

Dealing next with latitudinal distribution, 616 species extend from the north to the south, and to these may be added 66 species which extend through 6 degrees, so that a total of 682 species extend virtually throughout the length of the island. Latitude 42° forms a critical boundary with regard to plant-distribution, and the number of species which extend from the north to about this line or cross it for some distance, is 207.

With regard to the special distribution of the species, 68 extend five degrees, 103 four degrees, 175 three degrees, 215 two degrees and the remarkable total of 187 extend only one degree or less. The outstanding feature is that 241 South Island endemics extend only for two degrees or less of latitude.

Next comes the interesting matter of vertical distribution. The following figures are approximate only: confined to the coast line or vicinity, 96; to the lowland belt, 190; to the montane belt, 31; to the subalpine belt, 78; to the subalpine-alpine belt, 161; to the alpine belt, 63; and 1,128 species occur in the coastal-lowland-montane belt and, of these, 446 ascend to the subalpine and alpine belt.*

COASTAL.

A diversified coast-line such as South Island possesses, supplies a super-abundance of differing stations for plant-life; towering cliffs rising from the waters' edge, long stony or sandy beaches, huge stretches of sand-dunes, tidal estuaries, mud-flats, salt-meadows, and rock-faces all have their own special species or plant-associations. The coastal species fall into two classes, those, 96 in all, confined to the coast-line or its vicinity, and those which are common to other communities. Noteworthy in the latter class and lending a distinctive appearance to sections of our coastal scenery, are Arundo conspicua, Dracophyllum longifolium, Phormium tenax, Phormium Colensoi, Freycinetia Banksii, Metrosideros lucida, Melicytus ramiflorus, and Pachystegia insignis. Proximity to the coast favours the presence of those trees which are not frost-tolerant, such as Macropiper excelsum, Corynocarpus laevigata, and Dodonaea viscosa, all occurring on the coasts of the more northern portions of the island, while further south the only true coastal tree is the ngaio (Myoporum laetum).

A plant of great importance amongst the coastal species is the endemic sand-binder, Desmoschoenus spiralis, which, by rapid upward growth refuses to be buried by the moving sand, and quickly establishes itself over large areas by means of much-branching underground stems. When it is realised that sand-dunes in South Island occupy an area of over 22,000 acres, and that under certain conditions these dunes may move far inland, burying everything in their path, the presence of any species which helps to consolidate these wandering hills of sand is invaluable.

*Most of the above details appeared in "The Vegetation of South Island, New Zealand." Cockayne, Simpson & Scott Thomson. Vegetationsbilder R.22. H. 5/6. 1932. Jena.

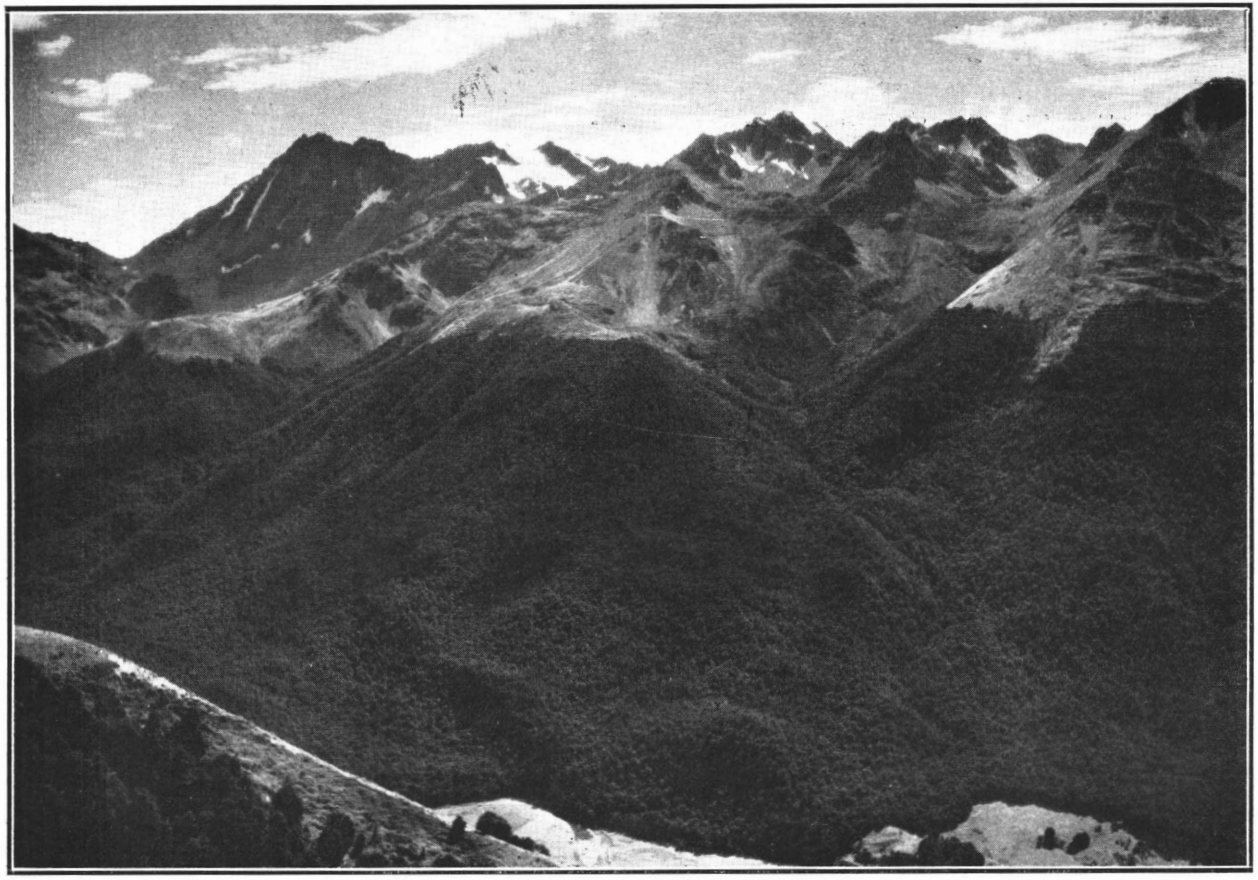


Plate 3.

Nothofagus forest, Humboldt Mountains. The tall trees of this forest are Nothofagus fusca, N. cliffortioides and N. Menziesii, the last being the sole species at the higher (4000ft.) altitudes.

An interesting denizen of coastal cliffs and a plant of remarkably restricted distribution is Helichrysum Selago var. tumida, which, though belonging to a typical alpine genus, is found only in two neighbouring spots on the Otago Peninsula. This species, and others of the same genus, afford splendid examples of leaf-reduction carried to extremes, the leaves being reduced to scales closely appressed to the stems, giving the effect of tightly plaited cords. The same peculiarity is observed in the so-called "whipcord" hebes. Another species belonging to an alpine genus and found only on the rock-faces of the south-east coast of Otago is Celmisia Lindsayi, which forms extensive colonies on the solid rock, and dominates this particular habitat.

Mention should also be made of the succulent Salicornia australis, which, when present in quantity on tidal mud-flats where the scour is not excessive, traps the silt and thus raises the level of the ground, so that, in time, other species may come in, salt-swamp or salt-meadow being eventually established. S. australis is usually only a few inches in height, but examples have been noted locally where this species, growing in the shade of Plagianthus divaricatus, has produced true flexible lianoid stems, reaching up through the shrub to a height of over 4 ft. Such extraordinary behaviour is not limited to this coastal plant, however, as certain species of Celmisia, notably C. Walkeri and C. Bonplandi, usually of mat-form, have been observed, when growing under dense subalpine scrub in the mountains of Otago, to develop climbing stems equalling in length those of the S. australis quoted above. Succulence is a characteristic feature of a considerable number of our coastal plants, and many show increased leaf-thickness owing to their proximity to salt-water. Myoporum laetum, Muehlenbeckia australis, Pittosporum tenuifolium, Cyclophorus serpens and Polypodium diversifolium all exhibit such increases, but the most striking example is Hebe elliptica which may develop swollen leaves no less than five times the normal thickness.

Coastal scrub is particularly characteristic of South Island, the most widely spread member being Hebe elliptica. Often associated with this species is H. salicifolia var. communis, and where these occur together an amazing number and variety of hybrid forms will be found, showing every transition in form of leaf and flower between the two parents. The most striking coastal scrub, however, occurs on the shores of the western fiords, where, in company with the hebes mentioned above, grow the magnificent composites Senecio rotundifolius and Olearia operina.

LOWLAND AND MONTANE.

Owing to the activities of man and his introduced animals, the plant-covering of the lowlands particularly, has been either destroyed, or so greatly modified as to lose altogether its primitive character. The high-mountain vegetation also has been affected, and of late years the damage done by deer to plant-life generally in this island

Plate 4.
Ranunculus Buchanani growing on rocky debris, Mt. French (7000 ft.).

has increased greatly. Nevertheless there still exist considerable areas where primitive New Zealand can yet be seen.

The conditions for plant-life in the lowlands are on the whole more uniform than those influencing the coastal communities, with the result that the lowland vegetation is fairly constant over wide areas. The two principal lowland plant-formations are forest and tussock-grassland.

Lowland forest belongs mainly to the great group "Subtropical rain-forest," though "Subantarctic rain-forest" (Nothofagus forest) is present also to a considerable extent. Subtropical rain-forest, occupying usually better land than does Nothofagus forest, forms the common lowland and coastal tree-communities of South Island. It is distinguished by the dominance of tall trees belonging to a number of genera, and by the presence in profusion of climbing plants, shrubs and ferns, tree-ferns being a noticeable feature. The taller members of the undergrowth consist of shrubs, small trees, and tree-ferns, and under these there are smaller shrubs, some of light-reducing divaricating form, and others twiggy and open, together with a multitude of taller ground ferns (spp. of Asplenium, Polystichum, Blechnum).

Subantarctic rain-forest, probably the earliest great tree-community of New Zealand, is dominated by one or more species of beech, and has a less luxuriant undergrowth and a smaller number of species than subtropical rain-forest; indeed, it may so lack the essential characteristics of rain-forest as hardly to warrant its inclusion in that type of vegetation. Economically it will probably become the most important indigenous timber-forest of this island, and already the demand for one species of beech (N. Menziesii) promises to assume considerable proportions.

One of the most serious obstacles to the regeneration of our indigenous forests is the presence therein of Blechnum discolor, which speedily forms far-extending colonies on the forest-floor, shutting off the light and thus forbidding the establishment of seedlings. This fern, in common with a number of other species of Belchnum, spreads rapidly by means of vegetative increase, sending out stolons in all directions from each of which a new individual arises. Polystichum vestitum is another fern forming close colonies, especially on the floor of sub-alpine forests; this species, however, does not possess the stoloniferous habit, but branches copiously from the parent trunk, each branch terminating in a wide-spreading crown of dark fronds.

A conspicuous semi-coastal and coastal species, common enough in North Island, but of more restricted distribution in this island, is the nikau-palm (Rhopalostylis sapida) (Plate 1). This plant, noteworthy as being the southern-most member of the palm family, reaches Banks Peninsula on the east and extends to Ross, south of

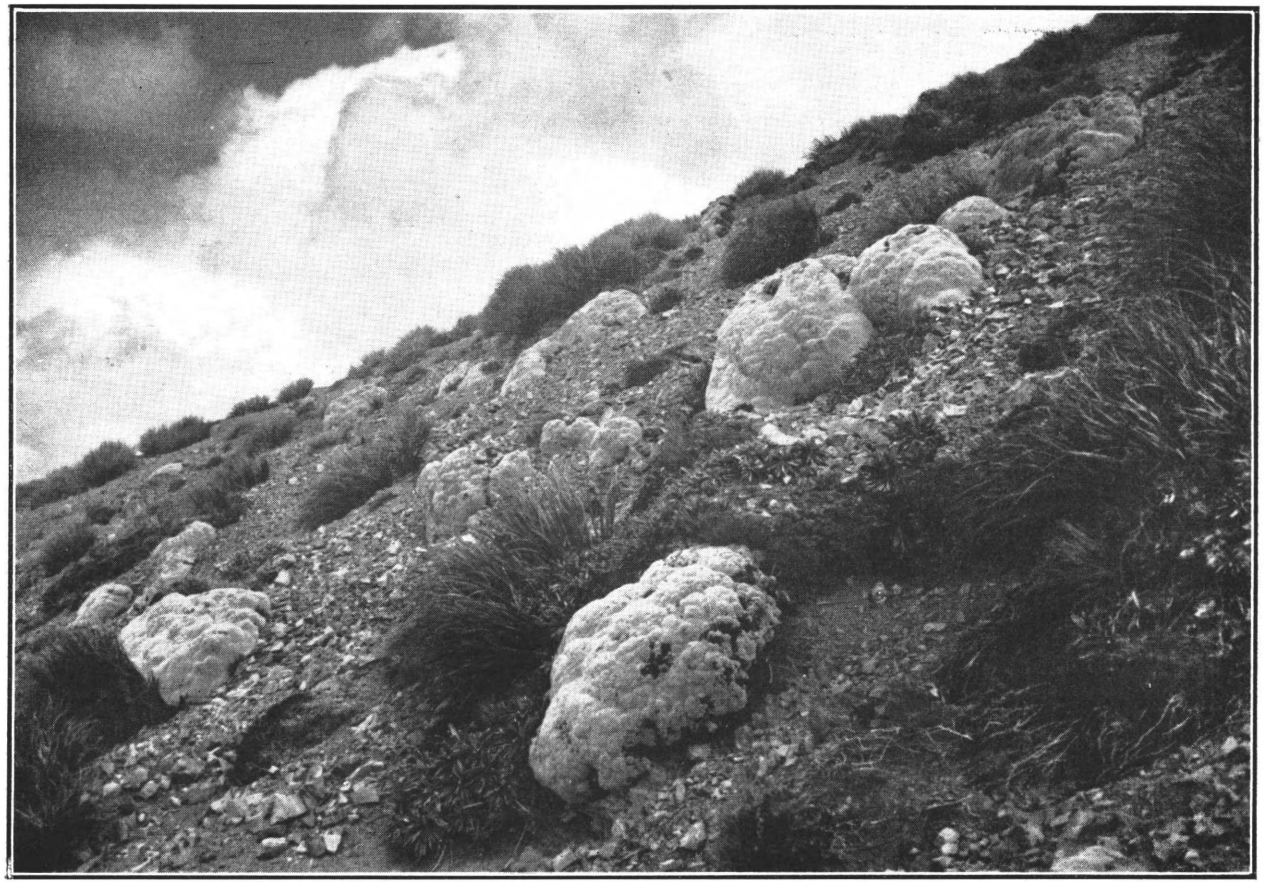


Plate 5.
A colony of vegetable-sheep (Raoulia eximia), Mt. Torlesse.

Hokitika, on the west. It is a tuft-tree attaining a height of 30 ft., having a greenish, smooth trunk marked with pale rings of old leaf-scars, and furnished with reddish, short stout roots. The great pinnate leaves radiating upwards and outwards from the top of the trunk sometimes attain 8 ft. in length. R. sapida is but one of several tropical life-forms having their southern limit in the New Zealand region. The mangrove form Avicennia officinalis comes as far south in New Zealand as lat 38°, while the tree-fern form Hemitelia Smithii attains its southern limit at about lat 51° in the Lord Auckland group. Also the dracaena form Cordyline australis extends to Stewart Island lat. 47°, and the pandanus form Freycinetia Banksii reaches to about lat. 40° 50' on the west of South Island.

The plant-covering of the island, speaking generally, does not exhibit any marked "preference" or "aversion" regarding the nature of the under-lying rock. A striking exception, however, is the vegetation of magnesian soils. In the Red Hill country, South Westland, the junction between the schistose and magnesian soils can be determined at a great distance, the Nothofagus forest of the schist formation ceasing abruptly whenever the peridotite is met. (Plate 2). Species tolerating the magnesian soils in this locality are few, and Leptospermum scoparium, stunted and prostrate, is one of the most persistent. Metrosideros lucida, Dacrydium Bidwillii, D. laxifolium, hybrids between the last two species, Dracophyllum uniflorum, Hymenanthera alpina, Pimelea prostrata, Cyathodes acerosa and sparse scattered tussocks of Danthonia setifolia are also present, but, when viewed from a distance, the peridotite belt appears to be devoid of all plant-life. The influence of magnesian soils, however, can be more conveniently studied on the well-known Mineral Balt (Sounds-Nelson district).

The relation between the edaphic factors and the primitive plant-covering is a field that has been little explored in New Zealand. According to recent work elsewhere concerning one of these factors —soil reaction—it would appear that each species of higher plant has a definite range of soil reaction which it can tolerate. Preliminary investigations of the soils of some of the Otago forests point to the fact that each species affects the reaction of the soil in its immediate vicinity. If, for instance, the large trees in an association consist of one species only, as in a pure colony of Nothofagus Menziesii, then the P^H values of the soil of such an association remain—within certain limits—comparatively uniform. If, however, the soils of a mixed forest are examined, uniformity in values cannot be expected, readings taken from under different species only a few feet apart in some instances varying greatly, the degree of difference depending on the species from under which the soils are taken.

Assuming these local observations hold good when applied to investigations over wider areas, it may then be inferred that a plant-association determines its own soil reaction and only those species

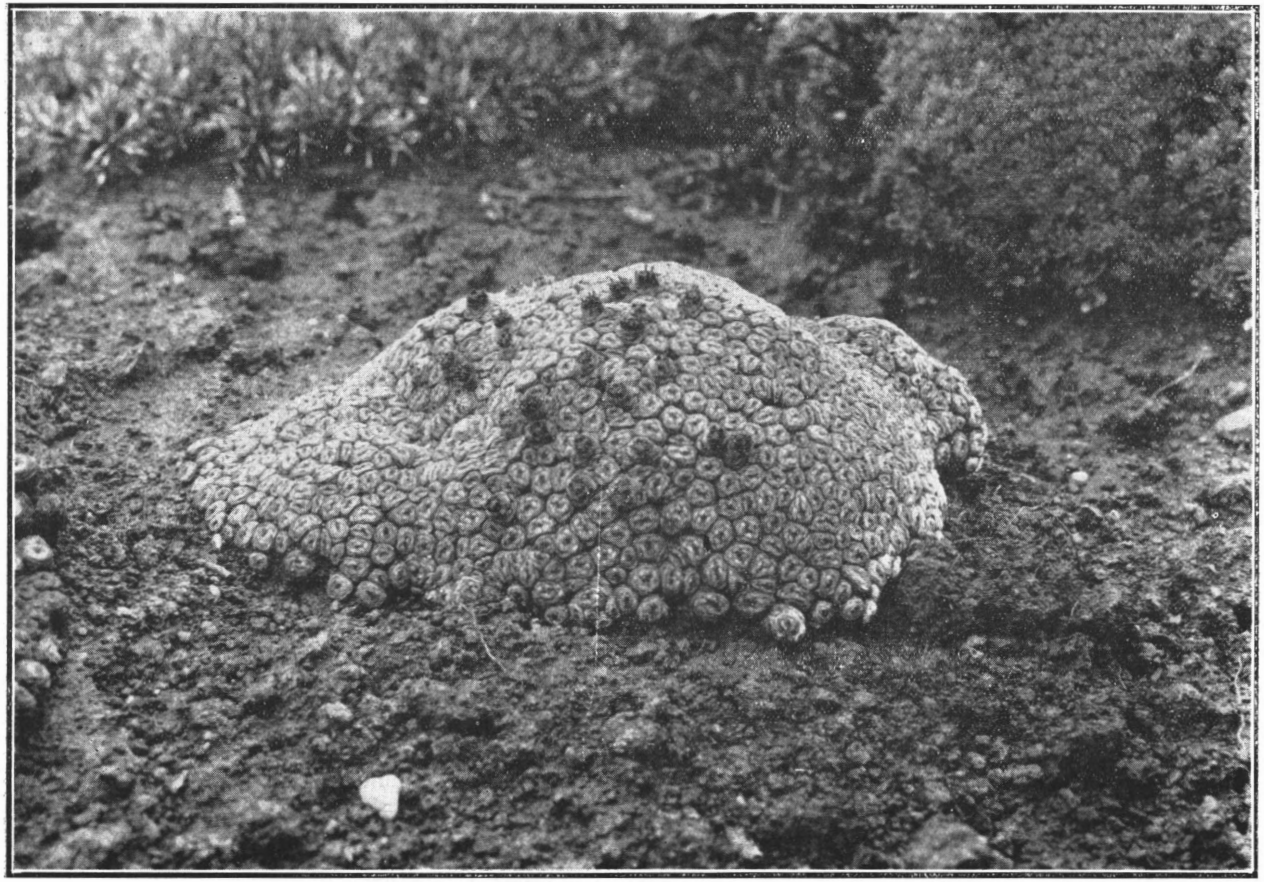


Plate 6.
Vegetable-sheep (Raoulia Buchanani) flowering in author's garden, Dunedin.

which can tolerate the particular range of the soil in that association can enter into it. Further, it may be possible in time, for an association to so modify its own soil reaction that the seedlings of its members cannot become established on the soil within that association. Of course, soil reaction is only one of the factors involved, but research on these lines may help to throw light upon such important matters as plant-distribution, plant-succession, and the composition of plant-associations.

As a matter of special interest to horticulturists, mention must be made of that remarkable assemblage of rock-plants, which occurs in the north-eastern corner of South Island. This association, though usually growing on limestone is nevertheless not confined thereto, and differs in composition in different parts of its area of occupation. The most striking member is Pachystegia insignis, the so-called rock tree-daisy, a robust spreading shrub with large thick coriaceous leaves crowded at the tips of the branches, and with long stout peduncles, each terminating in a single conspicuous hemispherical flower-head. Another member is Hebe Hulkeana, a slender laxly-branched shrub, known to gardeners as the New Zealand lilac, owing to its large panicles of lilac flowers. Usually present also, are one or other of the following noteworthy plants:—the deservedly-famous "pink broom" (Notospartium Carmichaeliae), another member of the broom family (Notospartium torulosum) with masses of small purple flowers, a golden-flowered buttercup (Ranunculus lobulatus), the blue or pale-lilac flowered Wahlenbergia Matthewsii, and the floriferous Senecio Monroi. Judging from field observations, both Pachystegia insignis and Hebe Hulkeana in their natural habitat are far from being in their optimum environment, as specimens growing locally easily excel in stature and wealth of flowers those growing wild in Marlborough.

GRASSLAND.

The primitive grasslands of New Zealand fall into two classes:—"low tussock-grassland," dominated in the main by the medium-sized tussocks of Festuca novae-zelandiae and Poa caespitosa, though both are not necessarily present on the same area, and "tall tussock-grassland" when the principal members are the large species of Danthonia.

Low tussock-grassland occupied great areas in South Island extending in places from sea-level to about 5,000 ft. Immediately to the east of the Divide, where owing to adverse climatic conditions, the advance of the forest from the west is stopped, low tussock-grassland suddenly appears and extends, except in the extreme north and south of the island, right to the east coast. Notwithstanding that it has been continuously grazed by sheep for the last 80

Plate 7.
Ourisia sessilifolia (in flower), Celmisia Hectori and Ranunculus Buchanani, growing at 7000 ft. altitude. Humboldt Mountains.

years, has been burnt time and again, and is the home of vast hordes of rabbits, this plant-formation, though more or less modified where it now exists, still appears to retain practically the whole of its primitive members.

Tall tussock-grassland, once common enough in certain lowland stations, is now confined mainly to the mountainous areas. On the Southland Plain, however, there still exist extensive areas of tall tussock-grassland with the large red tussock Danthonia Raoulii var. rubra, dominant; occurring as members of this association are Aciphylla squarrosa, Blechnum penna marina, Gaultheria perplexa, G. depressa, Astelia Cockaynei, Herpolirion novae-zelandiae, Cyathodes empetrifolia and Pentachondra pumila, all plants one associates with the mountains rather than with the plains.

High-mountain tall tussock-grassland, has, as its dominant, one or other of the forms of Danthonia Raoulii var. flavescens; this type of association, extremely modified by frequent burning, can be conveniently observed on the upper slopes of Mt. Flagstaff, near Dunedin.

SUBALPINE AND ALPINE.

Nothofagus forest (Plate 3) is pre-eminently the subalpine forest of South Island, and is absent only at the sources of the Kakaia and most of its tributaries, and from the River Teremakau to the Paringa on the west coast. Of the five species of beech in New Zealand, three only can be said to belong to the subalpine belt, N. cliffortioides and N. Menziesii, which ascend to the forest limit, and N. fusca which reaches the lower subalpine zone.

A very distinct association amongst the high-mountain tree-communities is tree-composite forest, a formation distinguished by the dominance of certain species of Olearia and Senecio, sometimes accompanied by the tuft-tree Dracophyllum Traversii. In the genus Dracophyllum horticulturists have at hand some unique species to select from, one or more of which should be in every garden, whether or not New Zealand plants are made a feature therein.

The high-mountain flora of South Island contains many species, which by reason of their strangeness and diversity of form, and by the beauty of their flowers, are known far beyond the Dominion.

Most abundant in practically all situations are the various species of Celmisia, ranging from the cushion-forming C. argentea to the magnificent C. coriacea. Nor must the mat-forming members of this genus be forgotten, one of the most striking being the silvery-leafed C. Hectori which, in certain localities, may cover acres at a time to the exclusion of practically all other plants. In direct contrast are those members of the carrot family, the species of Aciphylla

or spear-grasses, some quite small and others with flower-stalks 8 to 10 ft. high. All the species of this genus are quite amenable to cultivation, some indeed,—owing to prolific seeding—tend to become horticultural weeds. In the genus Ourisia are contained some of our most beautiful mountain species especially suitable for cultivation, being easy to establish, and forming colonies by means of branching rhizomes. A handsome plant also is Leucogenes grandiceps—the South Island edelweiss—with its glistening silvery leaves and large white bracts to the flower-heads, often forming extensive mats on the stony surface of alpine fell-field; the North Island species (L. leontopodium) has been recorded not only in the Nelson mountains, but occurs as far south as Mt. Peel in Canterbury.

No account of the alpine flora would be complete without some mention of the buttercups, South Island possessing over forty species. R. Lyallii is famous the world over and the cut-leafed white-flowered R. Buchanani (Plate 4) of the Otago mountains, though less known, is almost of equal merit. These two magnificent species have almost disappeared in certain localities owing to the ravages of deer. Confined to Marlborough is the splendid R. lobulatus, and scattered throughout the dry mountains of the island occurs the shingle-slip buttercup, R, Haastii, a plant most difficult to establish in gardens. Hitherto included in this genus under the name of Ranunculus tenuicaulis, but now to be known as Anemone tenuicaulis, is New Zealand's one and only Anemone. This species, with its reddish flowers, is plentiful enough in certain places and occurs in profusion on Swampy Hill, near Dunedin.

Growing on the huge unstable debris-slopes of the dry greywacke mountains of Marlborough and Canterbury, there exists a select community of plants the majority of which, some 20 or more, are confined to such inhospitable stations. Spaced widely apart on the shingle, they bear no relation to one another, and nearly all have thick fleshy or leathery leaves frequently resembling the grey colour of the stones. Most remarkable amongst these is Cotula atrata with much-cut fleshy leaves and jet-black flower-heads with golden stamens. Of particular interest also are Stellaria Roughii, the sweet-scented "pen-wiper plant" (Notothlaspi rosulatum), a plant of the carrot family (Anisotome carnosula) and a small grass (Poa sclerophylla).

The vegetation of high-mountain stable rock contains no less than 43 species practically confined to this kind of situation. Of surpassing interest amongst its members are those dense cushion-plants, the "vegetable-sheep," the larger species such as Raoulia eximia, (Plate 5), R, mammillaris, R, Buchanani, and Haastia pulvinaris being renowned throughout the botanical world. Vegetable-sheep are all constructed on the same plan, a deeply penetrating chief root and a central woody main stem radiating branches in all directions; these in turn branch again and again, each branchlet having its ex-

tremity covered with small woolly leaves, very tightly packed together and the whole forms a firm unyielding mass able to withstand the strongest gales. The interior contains wet peat—derived from the dead leaves and branchlets—into which the ultimate branchlets send their roots, so that the plant to a great extent lives on its dead self. Perched as epiphytes on these great cushions may often be found such species as Celmisia viscosa, C. spectabilis, Danthonia flavescens and D. setifolia.

The exceptional characteristic of the dead parts of a plant turning into peat, and remaining attached to the living individual, is an interesting feature in many of our alpine species, and its effect in ameliorating the conditions under which these plants grow must not be over-looked. Vegetable-sheep as a class are considered to be difficult to transplant, but the writer has succeeded in establishing, amongst others, a specimen of Raoulia Buchanani (Plate 6) in his garden where it has flowered regularly for the last seven years and is slowly increasing in size. Another rare rock species, the Marlborough coral-shrub (Helichrysum coralloides), also reputed to be difficult, offers no objection—judging from local experience—to being brought into cultivation, growing quite readily either from rooted pieces or cuttings.

Of particular interest are those hardy plants able to exist at high altitudes (Plate 7). Quite a number are to be found at about 6,000 ft. but the total is greatly reduced when the 7,000 ft. mark is reached, the following being an incomplete list of the species attaining that height:—Hectorella caespitosa, Pygmaea ciliolata, Ranunculus sericophyllus, R, Simpsonii, R, Buchanani, Senecio bellidioides, Pachycladon novae-zelandiae, Raoulia subulata, R. bryoides, R. eximia, Celmisia Hectori, Hebe Buchanani, H. Haastii var. macrocalyx, Ourisia sessilifolia, Marsippospermum gracile, Anisotome imbricata, A. pilifera, Haastia Sinclairii and Phyllachne clavigera. When the altitude is increased to 8,000 ft. still fewer species persist, amongst which are Veronica Birleyi, Myosotis pulvinaris, Poa sclerophylla, P. novae-zelandiae, Colobanthus acicularis, Luzula pumila and Carex acicularis. At 9,000 ft. or higher the number of species so far noted is extremely limited, and includes the following:—Ranunculus Grahami, Haastia pulvinaris, Hebe Haastii, Hebe epacridea and Veronica Birleyi. Certain species of lichens also ascend to high altitudes, and when fuller investigations have been made it will probably be found that these can live in even higher stations than the phanerogams.

THE LICHENS.

Lindsay, in his explorations in 1861, with Dunedin as a centre, assiduously collected the lichens and listed some 150 species, a number of them named as "new" by Nylander. Other enthusiastic collectors of the early days interested themselves in the group, but

for many years past the lichens have been completely neglected by local botanists. This is extremely unfortunate, as the lichens are of great ecological and phytogeographic importance. Another unfortunate result is that now the study is once more being taken up, the major part of the systematic work has to be done over again, so great have been the advances made while New Zealand slept.

How rich the field is may be glimpsed by the fact that our local collections of the last three years have already yielded a rich harvest of new species, although the bulk of the material is still awaiting critical examination. The family Stictaceae, for instance, is better represented in New Zealand than anywhere else, and if this fine family is to be monographed so that its ecology may be worked up, the services of botanists—especially of South Island—will be needed.

It has long been known that New Zealand shows in the lichens, as well as in the phanerogams, striking relationships with the flora of the southern part of South America. A noteworthy example is the alpine "old man's beard" (Usnea ciliata), which, though found only in New Zealand, belongs to a peculiar section of the sub-genus Neuropogon having its headquarters in subantarctic South America. Another species of this section, U. antarctica, has recently been described by Du Rietz, who remarks "one of the most conspicuous Antarctic lichen species, common wherever lichens have been collected in Antarctica, and also growing in the mountains of Tasmania and New Zealand, in Kerguelen, in Subantarctic South America and along the South American Andes as far north as Ecuador."

We have observed both of the above species in such widely separated localities as Mt. Tapuaenuku (Inland Kaikoura Mts), Mt. Torlesse (Canterbury), Mt. Pisgah (Kakanui Mts) and Mt. Watkins (near Waikouaiti). A single species of this section is found in the Arctic region, so the source of orign would appear to be the Antarctic.

Du Rietz, who made large collections of lichens during his visit to New Zealand, has recently pointed out that there is also a distinct Arctic element in the flora, as instanced by such species as Cetraria islandica and Alectoria nigricans, and emphasises the important bearing a study of the lichens is sure to have on questions of phytogeography.

A KEY TO THE SPECIES OF EUCALYPTUS GROWING IN NEW ZEALAND.

(Continued from October 1934 Journal.)

By Norman Hall.

Class I. Deciduous Barks.

A. Fruits not over three in an umbel.

(a). Valves sunken and usually deeply hidden.

1. Fruit urceolate.

1. 1. Simple umbels.

1. 1. 1. Fruit about $\frac{3}{8}$in. deep and $\frac{3}{8}$in. wide, with a conspicuous rim. Leaves about 4in. by $\frac{3}{8}$in. and of the same deep shiny green on either side. E. urnigera.

1. 1. 2. Fruit about $\frac{1}{2}$in. in depth and width, buds and fruit strongly biangular. Leaves deep green on either side. This is supposed to be a hybrid. E. globulus x E. urnigera. E. biangularis.

1. 2. Simple umbels forming part of a more complex inflorescence.

1. 2. 1. Fruit about $\frac{1}{2}$in. deep and $\frac{3}{8}$in. wide. Foliage markedly lemon-scented and leaves normally about 6 by $\frac{3}{4}$in., of equal shade on either side. E. citriodora.

1. 2. 2. Fruit about $\frac{1}{2}$in. deep and up to $\frac{3}{8}$in wide, more globose than in the preceding species, rather coarse with longitudinal markings. Leaves about 6 by 1in. and slightly paler on the lower side. Characteristic appearance of the main stem, where the bark has peeled off there is a surface spotted or blotched with darker and lighter shades. E. maculata.

2. Fruit non-urceolate.

2. 1. Fruit about $\frac{3}{8}$in. deep and less in width. Somewhat cylindrical in shape with short pedicels. Leaves about 3 by $\frac{1}{2}$-$\frac{3}{4}$in., hence much smaller than most species except various "peppermints." E. Gunnii.

2. 2. Fruit up to $\frac{1}{2}$in. diameter and width, goblet shape or pyriform, with characteristic long peduncles and pedicels. Leaves 6 by 1in. E. leucoxylon.

(b). Valves about rim level, usually small and inconspicuous.

1. Leaves sessile.

1. 1. Leaves heart-shape, slightly crenulate or indented at the edge. Fruit about $\frac{1}{2}$in. wide and slightly less deep, peduncle about $\frac{3}{8}$in. long and fruits almost sessile. E. cordata.

2. Leaves petiolate.

2.1. Fruit usually solitary. Up to 1in. diameter, semi-globular, sessile, rugose, constriction at rim. Conspicuous warty operculum. Leaves up to 12in. long, of the same shade on either side.
E. globulus.

2.2. Fruit the same type as above, but about ⅜in. diameter and in twos or threes. Other dendrological characteristics very similar.
E. bicostata.

2.3. Fruit rarely in threes, usually in fours to sixes. Over ½in. diameter, rim broad and smooth. Small orifice and valves in the centre of the disc like rim. Pedicels very short or absent. Leaves about 3in. and of the same shade on either side. Bud rough.
E. coccifera.

(c). Valves distinctly exserted, usually large and more or less claw-like.

1. Fruit small, about ¼in. diameter.

1.1. Usually four celled, the central of the 3 fruits with a distinct pedicel not seen in the other two. Leaves about 8 by ¾in. of the same shade on either side. E. viminalis.

1.2. Usually three celled and all fruits nearly sessile. Leaves about 6 by ¾in. Compare closely with E. viminalis.
E. Dalrympleana.

2. Fruit moderately large, about ½in. diameter.

2.1. Fruit to ½in. diameter, with a strong wing or angle, coarse. Large, smooth, dome like or conical operculum. Leaves to 8 by 1ft. Believed to be a hybrid E. globulus x E. viminalis. E. uniolata.

2.2. Fruit to ½in. diameter but less depth, ridged at sides. Operculum low, warty with a central projection. Fruit almost sessile as in preceding species. Leaves usually about 4 by 1in. E. Johnsoni.

2.3. Leaves heart shape, slightly crenulate or indented at the edge. Sessile. Fruit about ½in. diameter and slightly less depth. Peduncle about ⅜in. long and fruits almost sessile. E. cordata.

B. Fruits over three in an umbel.

(a). Valves sunken and usually deeply hidden.

1. Fruit of greater depth than width, about ½in. by ⅜in., contracted towards both orifice and pedicel, marked on surface with distinct longitudinal lines, the buds also being distinctly ribbed. Leaves normally about 5in. long and of the same shade on either side. E. cladocalyx.

2. Fruit about ⅜in. diameter, smooth, urceolate, somewhat flattened peduncle. Leaves distinctly dorsi ventral. E. diversicolor.

3. Fruit to ⅜in. diameter and ¼in. deep (var. micrantha fruit only half the size), more or less pilular, pyriform. Rim of cup slightly rising, usually blood coloured or brick-red. Leaves to 6in. and of the same shade on either side. E. haemostoma.

4. Fruit about ½in. deep and up to ⅝in. diameter, approx. globose, rather coarse with longitudinal markings. Leaves about 6 by 1in. and slightly paler on lower surface. Characteristic appearance of bark, where bark has peeled off surface is spotted or blotched with darker and lighter shades. E. maculata.

5. Fruit about ⅜in. diameter, more or less pyriform, descending rim. Leaves about 5 by 1½in., of same shade on either side. (Usually matted and fibrous bark for at least a few feet at the base.) E. gigantea.

(b). Valves about rim level, usually small and inconspicuous.

1. Fruit sessile or apparently so.

1. Fruit sessile or apparently so.

1.1. Fruit rarely in threes, usually in fours to sixes, over ½in. diameter, rim broad and smooth. Small orifice and valves in centre of disc like rim. Leaves about 3in. long and of same shade on either side. Bud rough. E.coccifera.

1.2. Fruit ¼in. diameter or slightly greater, pyriform, angular, usually three celled. Leaves up to 12in. long and of same shade on either side. Peduncle somewhat flattened. E. goniocalyx.

1.3. Fruit ¼in. diameter, tapering somewhat from rim to base. Peduncle flattened and pedicel very short. Leaves dorsi-ventral. E. saligna.

1.4. Fruit about ¼in. diameter, slightly deeper, sometimes with a very short pedicel, more or less barrel shape. Up to 7 flowers in umbel, rarely 3. Leaves up to 12in. and of same shade on either side. E. nitens.

2. Fruit with a distinct though perhaps short pedicel.

2.1. Fruit small, about ¼in. diameter.

2.1.1. Fruit up to ¼in. diameter, may be less, more or less pyriform. Leaves distinctly linear, about 4 by ⅛-⅜in. E. linearis.

2.1.2. Fruit slightly over ¼in. diameter and about ¼in. deep. Especially remarkable for rapid taper from rim to stalk, like an inverted cone. Normally 7 flowered umbels, valves show variation in degree of exsertion. Leaves rather distinct, ovate, about 4 by ⅝-1in. E. ovata.

2.2. Fruit moderately small to medium size, ⅜-½in.

2.2.1. Fruit as small as 5/16in. but up to ⅜in. In shape like a broad spinning top, broad rim. Leaves 5-6 by ⅜-⅝in. Frequently fruit crowded in umbels. E. Risdoni.

(Also see var. elata which is not clearly distinguished).

2.2.2. Fruit up to 7/16in., somewhat pyriform and 3 celled. Leaves characteristic, up to 7 by 1½in., with very conspicuous almost parallel venation. E. coriacea.

(c). Valves distinctly exserted, usually large and more or less claw-like.

1. Buds with conspicuous opercula.

1. 1. Operculum up to ½in. long, horn like, very distinctive. Fruit globular or obovoid, about 5/16in., rising convex rim. Leaves about 6 by ⅝in., same shade on either side. E. teretecornis.

1. 2. Operculum rostrate, pointed apex like the beak of a bird. Shorter than in 1. 1. but still distinct. Fruit about ¼in. diameter and more delicate than in 1. 1. Leaves rather similar. E. rostrata.

2. Buds with relatively low, small and inconspicuous opercula.

2. 1. Fruits small, about ¼in. diameter.

2. 1. 1. Peduncle about ½in. and somewhat flattened, pedicel short. Fruit about ¼in. diameter, 3-4 celled. Leaves 6 by ¾-1in. E. propinqua.

2. 1. 2. Peduncle to ½in. and pedicel to ⅛in. Fruit to ¼in., usually 3 celled. Leaves about 5in and paler on the lower side. E. Deanei.

2. 1. 3. Peduncle up to ½in. and pedicel about ⅛in. Fruit about ¼in. diameter. Umbel usually 7-flowered, fruit 3-4 celled, leaves 7 by ¾in. and of the same shade on either side. E. Smithii.

2. 1. 4. Peduncle about ½in., flattened, pedicel very short or absent. Fruit about 5-16in. with taper to stalk, 4 celled. Leaves rather larger than rest of group and dorsi ventral. E. grandis.

2. 2. Fruit small to moderate size, ⅜-½in.

2. 2. 1. Fruit about ⅜in., more or less egg shape. Peduncle flattened, up to ⅜in. long. Leaves about 5 by 1in. dorsi ventral. E. punctata.

2. 2. 2. Fruit about ½in. diameter, plain or slightly ridged with a rising rim. Peduncle up to ⅝in., thick and somewhat flattened, pedicel short and somewhat angular. Leaves up to 8in. and not dorsi ventral as in 2. 2. 1. E. Maideni.

CLASS II. "HALF-BARKED" OR "GUM TOPPED."

(a). Valves sunken and usually deeply hidden.

1. Fruit distinctive, roughly cylindrical, about 5/16in. deep and only 3/16 to ¼in. wide. Leaves of the same shade on either side, 5 by ⅜in. Infloresence commonly a panicle or a number of umbels grouped together, rarely a solitary umbel. E. hemiphloia.

2. Fruit about ⅜in. diameter, more or less pyriform, rim descending. Leaves about 5 by 1½in. ,same shade on either side. Bark usually matted and fibrous for at least a few feet at the base of the tree. E. gigantea.

3. Fruit about ⅜in. deep and slightly less in diameter, thin walls and open orifice. Distinct and thin peduncles and pedicels. Leaves about 5 by ⅜in., same shade on either side. Infloresence often in compound clusters or panicles. E. tessellaris.

(b). Valves about rim level, usually small and inconspicuous.

1. Fruit about ⅜in. diameter, usually 5 celled, more or less pyriform, distinct rim, peduncle to ½in. and somewhat flattened, pedicel very short. Umbel usually 7 flowered. Leaves 8 to ⅝in., same shade. E. oreades.

2 Fruit slightly over ¼in. diameter, especially remarkable for rapid taper from rim to stalk, like an inverted cone. Normally 7 flowered. Valves show variation in degree of exsertion. Leaves distinct, ovate, about 4 by ⅜-1in. E. ovata.

3. Fruit about ¼in. or slightly greater, fairly even taper to stalk, rim nearly flat. Peduncle about ½in., pedicel ⅜in. Umbel usually in pairs. Leaves about 5-7 by 1-1½in., of same deep green on either side. Bark falling away from branches and upper stem in long ribbons. E. regnans.

(c). Valves distinctly exserted.

1.Fruit about ¼in. diameter, usually 7 flowered umbel. Peduncle to ½in., pedicel ⅛in Fruit 3-4 celled, rim rising. Leaves about 7 by ¾in., of the same shade on either side. E. Smithii.

CLASS III. STRINGYBARKS.

(a). Valves sunken and usually deeply hidden.

1. Fruit small to moderately small, ¼-⅜in. diameter.

1. 1. Fruit about ¼in diameter, suddenly contracted into a slender pedicel ⅛-¼in. pyriform shape and usually 4 celled. Leaves about 4-5in. by 1in., thin, wavy margins and slightly paler on the lower surface. E. acmenioides.

1. 2. Fruit up to ⅜in. diameter, pyriform, distinct pedicel ⅛-¼in. Leaves of the same deep green on both sides, 4-6in. by 1-1½in, strongly oblique to the leaf stalk. E. obliqua.

2. Fruit of moderate size, about ½in. diameter.

2. 1. Fruit about ⅜in. diameter, 3 celled, contracted towards orifice and not recurved, rim plain and narrow. Leaves 3-5in. by 1-1¼in., slightly darker on the upper surface. Pedicels very distinct, about ¼in. E. marginata.

(b). Valves about rim level, usually small and not conspicuous.

1. Fruit small to moderately small, ¼-⅛in. diameter.

1. 1. Fruit ¼in diameter or slightly greater, approximately spherical with short but distinct pedicels, (rarely apparently sessile with ripe fruit somewhat crowded in the umbel heads). Leaves 3-5in. by ⅝-⅞in., of the same shade on both sides. E. eugenioides.

1. 2. Fruit about ¼in. diameter shortly pedicellate, rim thick, slightly convex and dull red. Leaves about 6in. E. Andrewsi.

2. Fruit moderate size, about ½in. diameter.

2. 1. Fruit nearly spherical and ⅜-½in. diameter, peduncle ⅜in. and pedicels short but distinct; hence fruit not crowded in the umbel heads. (Fruit about the same type at E. pilularis.) Leaves about 5 by 1in. of the same deep green on both sides. E. Muelleriana.

2. 2. Fruit remarkable for being broader than deep, about ½in. diameter, and ¼-⅜in. deep. Peduncle coarse and somewhat flattened and ½-¾in. Pedicels very short or absent. When absent ripe fruit distorted by crowding on umbel head. (This condition varies with the strains of the species.) Leaves unusually thick and coarse and markedly oblique. E. capitellata.

(c). Valves distinctly exserted, usually thick and more or less claw-like.

1. Fruit small to moderately small, ¼-⅜in. diameter.

1. 1. Fruit about 5/16in. diameter, whip-topped shape or sub-pyriform. Umbels commonly in pairs, with many flowers. Almost invariably 3 celled. Leaves about 5-6in. by ⅝in. and of the same green on both sides. Bark sometimes peeling from the top branches and less coarse than in most stringybarks. E. fastigata.

2. Fruit moderate size, about ½in. diameter.

2. 1. Fruit ½in. diameter and about ⅝in. deep, rim domed with grove below; operculum low and small. Leaves of the same deep green and very shiny on both sides, about 5-6in. by ¾-⅞in. E. laevopinea.

2. 2. Fruit about the same size as above, rim strikingly convex or domed, nearly always 3 celled. Operculum moderately long and somewhat beak-like. Leaves somewhat the same as the above sp. E. macrochyncha.

CLASS IV. PEPPERMINTS AND BOXES.

A. Fruits not over three in an umbel.

1. Fruit about ½in. deep and ⅝in. diameter, usually with a broad bevel below rim, sometimes angular. Long peduncles and pedicels. Operculum large, beak-like and relatively long. Leaves about 5-7in. by ¾-1in., same shade of green on both sides. E. longifolia.

B. Inflorescence commonly a panicle or a number of umbels grouped together, rarely a simple solitary umbel.

1. Leaves roundish or broadly ovate, about 2-3½in. by 1½-2in. Distinctive.

1. 1. Fruits quite small, usually less than ¼in .diameter, rim thin and cracked, valves below rim. Very short pedicels. E polyanthemos.

2. Leaves common type.

2. 1. Fruit up to ¼in diameter, slightly contracted towards orifice with ring around rim, short pedicels. Leaves usually about 4 by ⅝in.1. E. melliodora.

2. 2. Fruit distinctive, roughly cylindrical, about 5/16in. deep and only 3/16-¼in. diameter. Valves sunken. Leaves of the same dull green on both sides, about 4-5in. by ⅞-1in, sometimes much narrower. E. hemiphloia.

C. Inflorescence simple umbel.

(a). Valves sunken and usually deeply hidden.

Leaves roundish or broadly ovate, about 2-3½in. by 1½-2in. Distinctive.

1. 1. Fruits quite small, usually less than ¼in. diameter, rim thick and cracked. Very short pedicels. E. polyanthemos.

2. Leaves of the common type.

2. 1. Fruit up to ¼in. diameter slightly contracted towards the orifice, with ring round rim. Short pedicels. Leaves about 4 by ⅜in. E. melliodora.

2. 2. Fruit distinctive, roughly cylindrical, about 5/16in. deep and and only 3/16-¼in. diameter. Leaves of the same dull green on both sides, about 4-5in. by ⅜-1in., sometimes much narrower. E. hemiphloia.

2. 3. Fruit not constant but shows considerable variation, usually urn or egg-shape, about ¼in. diameter and up to ⅜in. deep. More distinctive are the buds—angular, curved inwards, very sharp pointed. Peduncle up to ⅜-1in. Bark may be deciduous from the smaller branches. E. piperita.

(b). Valves about rim level, usually small and not conspicuous.

(N.B.—These seven species should all be checked over when identifying a particular species, since they are not readily separated by means of a key. Separation by means of leaves of limited value.)

1. Leaves of moderate length, say 4-7in.; distinctly narrow, the leaves as a whole usually being linear; thin and drooping, giving the foliage a distinctive appearance.

1. 1. Leaves about 6 by ½in. Fruit quite small, not over ¼in. diameter, pyriform. Short and very slender pedicels. Umbel with up to 30 flowers. E. numerosa.

1. 2. Leaves markedly small and linear, 4 by ¼-in. Fruit rather similar to E. numerosa. Fewer flowers in the umbel. E. amygdalina.

1. 3. Leaves with a particularly strong scent of essential oil but otherwise not markedly distinct from E. numerosa and E. amygdalina. E. radiata.

(N.B.—The three above species were once all included in E. amygdalina and have been separated on small dendrological distinctions; hence they are extremely difficult to separate in a key. If anyone using this key considers a species to be one of these three, he should check the identification by means of some standard work.

2. Leaves not markedly linear.

2. 1. Leaves rather distinctive, ovate, about 4 by ⅜-1in. Fruit slightly over ¼in. diameter. "Especially remarkable for its rapid taper from rim to stalk." Like an inverted cone. Normally 7 flowered umbel. Valves show variation in the degree of exsertion. E. ovata.

2. 2. Leaves moderately narrow and falcate. Normally 7 flowered umbel. Fruit about ¼in. diameter, 3 celled, short but distinct pedicel. E. Macarthuri.

2. 3. Fruit about ¼in. diameter, short pedicellate, rim thick, slightly convex and dull red. Leaves about 6in. Bark tending to stringybark type. E. Andrewsi.

2. 4. Fruit ¼in. diameter, or slightly greater, very slightly contracted towards orifice. Peduncle about ½in. and pedicel ¼in. Leaves 6in. and rather narrow, tending to type in 1. 1., 1. 2, and 1. 3.

E. Bosistoana.

2. 5. Leaves more distinctive than most of the other species in this group, 5-7in. by 1-1½in., falcate and of the same rich green on both sides. Umbels usually in pairs. Peduncle ½in. and pedicel ⅜in. Fruit ¼in. diameter or slightly greater, fairly even taper to stalk, rim nearly flat. Bark falling away from branches and upper stem.

E. regnans.

(c). Valves distinctly exserted.

1. Bark completely persistent, scaly, thick and mealy on the main stem. Leaves up to 8 by 1-1½in., often with a double twist in the petiole, of the same deep green on both sides. Umbel usually 7 flowered. Peduncle ¼in., pedicel very short, fruit about ¼in. diameter, 3 celled, rim rising. E. Stuartiana.

2. Leaves of the same shade of green on both sides. Fruit up to ¼in. diameter, 3 celled, quite short peduncles and pedicels. Umbel usually 7 flowered. In many respects similar to E. Macarthuri.

E. aggregata.

3. Also see C. (b). 2. 1. E. Macarthuri which has valves slightly exserted.

CLASS V. IRONBARKS.

A. Inflorescence usually a panicle or group of umbels.

1. Fruit exceptionally small, only ⅛in. diameter. Valves deeply sunken., Leaves about 5 by ⅜in. Markedly narrow with characteristic drooping appearance of foliage. A distinctive species.

E. crebra.

2. Fruit about ¼in diameter with valves sunken or about rim level, rim narrow. Peduncle up to ⅜in. and somewhat flattened. Pedicel ¼in. and angular. Leaves about 5 by 1in., wavy margin and paler on the lower surface. E. paniculata.

B. Inflorescence simple umbel.

1. Fruit about 5/16in. diameter, somewhat hemispherical, valves conspicuously exserted, usually 4 celled. Peduncle ¾in. and pedicel ⅛in. Conspicuous elongated operculum about ½in. Few flowered umbels. Leaves about 6 by 1-1½in., of same green on both sides.

E. siderophloia.

2. Fruit about ⅜in. diameter, pyriform or goblet shape, valves deeply sunken, peduncle and pedicel both about ½in. 1. Usually 3-5 flowered umbels, but may be more. Dead stamens usually remain adherent to the interior of the orifice even after the valves have opened and the seed fallen. Leaves about 5 by ⅝in. of the same slaty or dull silvery green on both sides. E. sideroxylon.

3. Fruit 5/16in. diameter by ⅜in. deep, pyriform, rim flat or countersunk, peduncle flattened and pedicel slightly angular. Lateral veins of leaf at a very acute angle to midrib; leaf dark shiny green on both surfaces. Not a true ironbark, also dealt with in class VI. Old bark dark, firm, furrowed and becomes rather like ironbark as the tree increases in age. Bark on limbs and young trees shows a very distinct pinkish brown shade where not weathered.

E. Sieberiana.

CLASS VI. MISCELLANEOUS AND MINOR CLASSES.

A. Fruits not over three in an umbel.

1. Fruit about ½in. deep, ⅜in. diameter, usually with a broad bevel below rim, sometimes angular. Long peduncles and pedicels. Operculum large, beak-like, relatively long. Leaves about 5-7in. by ¾-1in., of the same shade of green on both sides. E. longifolia.

B. Fruits over three in an umbel.

(a). Valves sunken and usually deeply hidden.

1. Fruits small to moderately small, ¼-⅜in. diameter.

1. 1. Fruit about ¼in diameter suddenly contracted into a slender pedicel, ⅛-¼in. Pyriform shape, usually 4 celled. Leaves about 4-5in. by 1in.; wavy margins, paler on the lower surface. (Bark tending to stringybark type.) E. acmenioides.

1. 2. Fruit 5/16in. diameter by ⅜in. deep, pyriform, rim flat or countersunk, peduncle flattened, pedicels slightly angular. Lateral veins of leaf at a very acute angle to midrib, leaf dark shiny green on both sides. (Old bark dark , firm, furrowed: bark on limbs and young trees showing a very distinct pinkish brown shade where not weathered.) E. Sieberiana.

2. Fruit moderate size to large, from nearly ½in. to ¾in. diameter.

2. 1. Leaves of even shade on both sides.

2. 1. 1. Fruit up to ⅜in. diameter, globular and contracted towards the orifice; few fruits in an umbel; rim plain and narrow. Cells usually 4. Leaves about 4-8in. by 1in. E. patens.

2. 2. Leaves dorsi ventral, or at least distinctly paler on the lower surface.

2. 2. 1. Fruit ⅜-7/16in. diameter, slightly pyriform to pilular; 6-10 flowers on an umbel, peduncle up to 1in. and flattened, pedicel short. Leaves paler on the lower side. E. pilularis.

2. 2. 2. Fruit ¾in. deep, ½-⅝in. diameter, urceolate, often in a somewhat irregular infloresence. Peduncle up to 1in. and pedicel ⅜in. Leaves 5-7in. by ¾-1in., distinctly dorsi ventral. Bark wholely persistent, scaly or flaky, thick. E. corymbosa.

2. 2. 3. Fruit distinctive, cylindrical, about ½in. diameter. Nearly ¾in. deep. Valves deeply placed but quite visible. Peduncle 1-1½in.1 flattened: pedicel about ¼in. Operculum elongated conical, large and distinctive. Leaves 6-7in. by 2in., distinctly dorsi-ventral. Bark soft, brittle and ultimately very thick and furrowed. E. robusta,

2. 2. 4. Also see E. botryoides under (b). This species has valves of a similar type to E. robusta but they are nearer rim level.
E. botryoides.

3. Fruit very large, up to 1-1½in. diameter and depth, few flowered umbels with peduncles 1in. Leaves distinctly dorsi ventral.
E. calophylla. E. ficifolia.

(See p. 35, "Eucalypts in N.Z." where the author gives the following data for the separation of these two rather similar species.)
E. calophylla—
Juvenile leaves—often peltate, wavy.
Flowers—normally white or cream coloured.
Peduncle, pedicel—medium in length.
Seeds—very large, wingless, black.
E. ficifolia—
Juvenile leaves—rarely peltate, not so wavy.
Flowers—normally scarlet to orange.
Peduncle, pedicel—very long.
Seeds—smaller, winged, pale-coloured.

(b). Valves about rim level, usually small and not conspicuous.
1. Fruit small to moderately small, ¼-⅜in. diameter.

1. 1. Leaves dorsi ventral, or at least distinctly paler on the lower surface.

1. 1. 1. Fruit ¼-5/16in. diameter, and up to ½in deep, roughly cylindrical, usually angular at the sessile base, short flattened peduncle. The four valves viewed from above appear llike a Maltese Cross. Leaves nearly balanced, distinctly dorsi-ventral.
E. botryoides.

1. 1. 2. Fruit up to ¼in diameter of indefinite length due to gradual taper to stalk, slightly contracted to orifice. Peduncle about ½in. Leaves are very distinctively arranged in two ranks on opposite sides of the twigs; thin, wavy, and somewhat dorsi-ventral.
E. microcorys.

1. 2. Leaves of about same shade on both sides.

1. 2. 1. Leaves rather distinct, ovate, about 4 by ⅝-1in. Fruit over ¼in .diameter and "Especially remarkable for the rapid taper from rim to stalk." Like an inverted cone. Normally 7 flowered umbels, valves show variation in degree of exsertion. E. ovata.

1. 2. 2. Fruit ¼in. diameter or slightly greater, very slightly contracted towards orifice. Peduncle about ½in., pedicel to ¼in. Leaves about 6in. and rather narrow, ⅜in. wide. E. Bosistoana.

1. 2. 3. Leaves about 6in. Fruit ¼in. diameter shortly pedicellate; rim thick, slightly convex and dull red. Bark tending to stringybark type. E. Andrewsi.

1. 2. 4. Also see E. Macarthuri under (c) 1.1.1.

. Fruit moderate size to moderately large, ⅜-¾in. diameter.

2.1. Leaves dorsi ventral, or at least distinctly paler on the lower surface.

2.1.1. Fruit sometimes slightly over ⅜in. diameter though usually smaller, roughly cylindrical, usually angular at the sessile base. Short flattened peduncle. The four valves viewed from above appear like a Maltese Cross. Leaves nearly balanced, distinctly dorsi ventral. E. botryoides.

2.1.2. Also see E. robusta, (a) 2.2.3. E. robusta.

(c). Valves distinctly exserted, usually large and more or less claw-like.

1. Fruit usually small, about ¼in. diameter.

1.1. Leaves of about the same shade on both sides.

1.1.1. Leaves moderately narrow and falcate. Fruit about ¼in. diameter, 3 celled, short but distinct pedicel. Usually 7 flowered umbels. E. Macarthuri.

1.1.2. Bark completely persistent, scaly, thick, mealy. Leaves 8 by 1-1½in., often with a double twist in the petiole. Usually 7 flowered umbel. Fruit about ¼in .diameter, 3 celled, rim rising, peduncle ¼in., pedicel very short. E. Stuartiana.

1.1.3. Umbel usually 7 flowered. Fruit up to ¼in diameter. 3 celled, quite short peduncle and pedicel. In many respects similar to E. Macarthuri. E. aggregata.

1.1.4. Usually 7 flowered umbel. Fruit about ¼in. diameter, about the shape of a top, rising rim and often 3 celled. Peduncle about ⅜in. and pedicel short but distinct. Leaves about 8 by ¾in., rich in essential oils. E. Smithii.

1.2. Leaves dorsi ventral, or at least distinctly paler on the lower side.

1.2.1. Fruit ¼-5/16in. diameter, nearly hemispherical, rim rising, valves markedly long, acute, far protruding. Peduncle ⅜in.1. flattened, pedicel short and somewhat angular. Bark thick, flaky, wholely persistent. E. resinifera.

2. Fruit moderate size to moderate large, over ⅜-¾in. diameter.

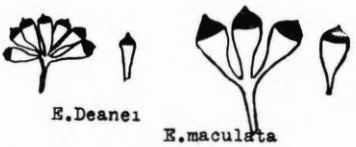
2.1. Operculum exceptionally long, up to 1½in., horn like. Fruit sub-cylindric, ⅜in. diameter, usually 3 celled, valves exceptionally long, protruding for ⅜in. or more, often adherent at the tips. Peduncle up to 1in., pedicel absent. Leaves about 4 by ⅝in. Bark rough, hard, sub-fibrous. E. cornuta

2.2. Extraordinary broad strap-like peduncle, pedicel absent. Fruit bell shape, up to ¾in. deep and ⅝in. diameter. Very coarse and strong valves. Operculum very large button-mushroom type. Very distinctive, usually 4-7 flowered umbels. Leaves about 7 by ⅝in. A very distinctive species. E. gomphocephala.

1. Hemispherical or low dome

E.microcorys E.coriacea

2. Hemispherical or low dome plus a small tip or beak.



E.Deanei E.maculata

3. Hemispherical - conical

E.viminalis E.acmenioides

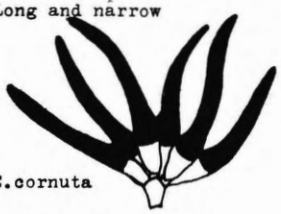
4. Conical

E.pilularis E.leucoxylon

5. Elongated conical

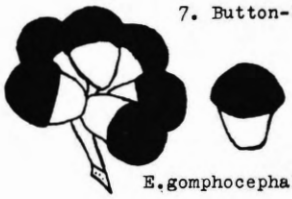
E.marginata E.siderophloia

6. Long and narrow



E.cornuta

7. Button-like

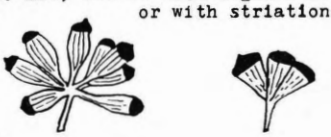


E.gomphocephala

8. Low, rugose or warty

E.globulus

9. Bud, either with angular markings or with striations.

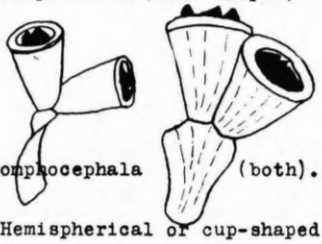


E.cladocalyx E.coccifera

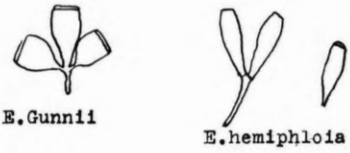
1. Globular, spherical or roughly so.

2 Egg-shaped or partly egg-shaped

3. Campanulate (bell-shaped)

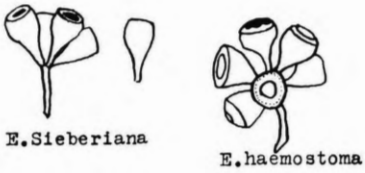


4. Long and narrow, more or less cylindrical.

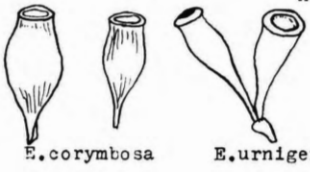


5. Hemispherical or cup-shaped

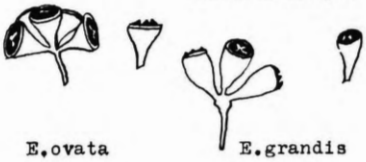
6. Pear-shaped)pyriform)



7. Vase-shaped, with a distinct neck.



8. Inverted cone-shape, top or funnell shape.



1. More or less deeply sunken, inconspicuous

E.citriodora

E.maculata

2. Visible, about rim level.

E.saligna

E.ovata

2. Exserted, claw-like, coarse, strong.

E.gomphocephala

E.punctata

4. Exserted, more or less awl-like.

E.resinifera

E.tereticornis

5. Exserted, very long and conspicuous.

E.cornuta

SUMMARY OF PROCEEDINGS OF TWELFTH ANNUAL CONFERENCE.

Held in the Y.M.C.A. Hall, Moray Place, Dunedin on Thursday, 24th January, 1935 at 11 a.m.

REPORTS.—The following reports were received and adopted:—

1. Executive (with Statement of Accounts).—See Journal of October, 1934.
2. Examining Board.—See Journal of October, 1934.
3. Action on Remits etc. passed at the 1934 Conference.

ELECTION OF OFFICERS, ETC.—

President: Mr. F. J. Nathan, on the nomination of the Executive, was unanimously re-elected.

Vice-Presidents: Messrs. T. L. Lancaster (Auckland), F. E. Smith (Hawkes Bay), J. G. MacKenzie (Wellington), P. Black (Palmerston North), J. Rigg (Nelson), J. A. McPherson (Canterbury), D. Tannock (Otago) and Sir R. A. Anderson, C.M.G. (Southland).

Executive Committee: Mrs. Knox Gilmer, Professor H. B. Kirk, Dr. W. R. B. Oliver, Messrs. J. A. Campbell, T. Waugh, F. J. Shanks, F. S. Pope, W. C. Hyde, W. T. Goodwin, W. S. Mason, G. A. Green, B. C. Aston, T. C. Brash, A. H. Cockayne and H. J. Poole.

Representative of N.Z. Farmers Union: W. J. Polson, M.P.
Hon. Auditor: Mr. J. L. Arcus (Re-appointed).

Hon. Fellow: C. S. Longuet.

Honorary (Overseas) Members: Sir Frederick W. Moore, MA., V.M.H., Curator of the Royal Botanic Gardens, Glasnevin, Dublin and Dr. J. C. Willis, M.A., D.Sc. (Cantab.).

REMITS ADOPTED.

1. LORD BLEDISLOE: "That the Institute expresses its appreciation to His Excellency the Governor-General, Lord Bledisloe, for his splendid services towards the advancement of horticulture and forestry during his term of office. That the Secretary send a suitably worded letter to His Excellency, Lord Bledisloe, expressing the deep appreciation of this Conference of the very great assistance he has rendered to horticulture during his stay in New Zealand, both practically and by means of addresses delivered from time to time throughout the country. Whilst realising that the departure of Lord and Lady Bledisloe is inevitable, horticulturists, together with the people of New Zealand generally, will regret this necessity, but at

the same time, will appreciate that New Zealand's loss will represent a gain to some other part of the world, preferably within the Empire."

2. DISTRICT COUNCIL MINUTES: "That all District Councils be again urged to forward copies of Minutes of Meetings to other District Councils, as well as to the Dominion Executive, or failing such Mnutes, a periodical report of their activities."

4. MEMBERS IN ARREARS: "That any member owing more than two years' subscriptions be considered unfinancial, and be not permitted to speak or vote at Annual Conference without special permission from the Chairman."

5. MEMBERSHIP: "That consideration be given to ways and means of retaining and increasing the membership of the Institute." It was further resolved that this matter should be referred to District Councils also re Local Bodies being asked to join up.

6. JOURNAL: "That Conference approves of the Executive Council giving favourable consideration to the question of reverting to quarterly publication of the Journal."—Referred to Executive with a recommendation for quarterly publication if finances permit.

7. FINANCIAL YEAR: "That the Institute's financial year should end on the 30th September, instead of on the 31st March."—Referred to the Executive Council with power to act.

8. GARDENING STUDENTS: "(a) That Municipalities, Nurserymen, Institutions and individuals possessing suitable nurseries or gardens be urged to provide facilities for the employment of students who desire to take up horticulture as a profession. (b) That employers of gardening students remind them of the necessity for registration with the Institute if they wish to qualify to sit for the Institute's Examinations."

FOREST PRESERVATION:

9. "That appreciation be expressed of the action of the Government in introducing the Native Plants Protection Act, the objects of which have the whole-hearted support of the Institute and it is hoped that the Act will be strictly enforced."

10. "That the Institute wishes the N.Z. Forestry League and the N.Z. Native Bird Protection Society every success in their efforts for the preservation of forests and scenic reserves, and trusts that the co-operation, which has hitherto existed, will continue."

11. "That all possible steps be taken to ensure the preservation and permanent protection of suitable areas of indigenous forest throughout New Zealand, and to urge the pressing necessity of immediate action in this connection."

12. ROAD BEAUTIFICATION: "That District Councils should seek the co-operation of Local Automobile and other Associations in any schemes of road beautification."

13. LEONARD COCKAYNE MEMORIAL: "That favourable consideration be given to the advisability of establishing a prize or scholarship, to be known as the Dr. Leonard Cockayne Memorial Prize, to be competed for annually amongst candidates for the N.D.H. (N.Z.), or amongst trainees in horticulture."

14. INSTITUTE CHALLENGE CUPS: "That consideration be given to the advisability of making available further Institute Challenge Cups for competition at horticultural shows."

15. NATIONAL BOTANIC GARDEN: "That the Government be again urged to consider favourably the necessity for the establishment of a National Botanic Garden."

16. FOREST PRESERVATION: "That the Government be urged to appoint an inspector of Scenic Reserves in order that steps may be taken as soon as possible to prevent further damage to them, and that the Unemployment Board be asked to provide the necessary labour to have them cleared up as much as possible."—Referred to the Executive Council with power to act.

17. "That action should be taken to press forward the Rating exemption of preserved bush areas, the elimination from Crown Leases of clauses providing for the clearing of areas still under bush and the conservation for scenic and water purposes of the upper slopes of Mount Pirongia from (say) the 1,500 feet level to the top." —Referred to the Executive Council with a view to thorough discussion with the Department of Lands and Survey.

OTHER BUSINESS.

CONDOLENCE: The Chairman referred to the loss sustained by the Institute of its most distinguished member, the late Dr. Cockayne, who guided its educational and other activities for many years and also to the recent death of Mr. A. M. O'Brien, Knottingley Park, Waimate, a member of the Association of Directors of Parks and Reserves.—A motion of condolence was carried.

LODER CUP COMPETITION: The altered conditions of the Loder Cup competition were explained and it was advised that the award for 1934 had been made to Lord Bledisloe. It was resolved that the altered conditions should be referred back to the Executive Council.

NATIONAL CONFERENCE CONDITIONS: Standard conditions for the future conduct of Horticultural Week were adopted.

LOCATION OF NEXT CONFERENCE ON HORTICULTURE: An invitation was received from Auckland for the next National Conference and

Flower Show (1936) to be held in the last week in February and on terms for the National Flower Show of 50% profit or loss to the Auckland Horticultural Society. It was decided that it should be a recommendation to the Permanent Committee that the invitation should be accepted on the usual terms as to date and proportion profit or loss.

BANKS LECTURE.

The Banks Lecture for 1935 was given by J. Scott Thomson, Esq., F.L.S., F.C.S., Dunedin. There was a crowded attendance and the lecture was excellent, well delivered, and illustrated with a large collection of coloured lantern slides taken by the lecturer himself. A copy of th Lecture appears in this issue and it will be found to be a most valuable addition to those already given.

NATIONAL CONFERENCE ON HORTICULTURE.

The fifth National Conference on Horticulture held in Dunedin consisted of the annual gathering of the Institute, The New Zealand Horticultural Trades' Association, the Horticultural Seedsmen's Association of New Zealand and the Association of Directors of Parks and Reserves. The delegates were given a civic welcome which was combined with the opening of the National Conference and National Flower Show by the Mayor of Dunedin (Rev. E. T. Cox). The Show was a wonderful display and largely attended and reflects great credit on all the Bodies and officials connected therewith. The Annual meetings of the Bodies mentioned followed after the first day of the Show and delegates, including the ladies, enjoyed pleasant outings and social functions.

REVIEWS.

The R.H.S. Lily Year-Book, 1934.

It is my privilege to again submit a brief review of the excellent production awaited with so much interest by the great majority of lily growers, the Royal Horticultural Society's Lily Year Book. The 1934 issue more than maintains the high standard set by the Society's other Annuals. A foreword by Mr. F. C. Stern, Chairman of the Lily Committee, serves as a fitting introduction to the wealth of information that follows.

A valuable addition to the recent literature on the genus is provided in Dr. A. M. Vollmer's article on the Californian lilies in cultivation. The writer describes his investigations, extending over some years, of these lilies in their natural surroundings and his efforts to produce in his garden the lessons learned in this special study. This is a welcome contribution particularly to New Zealand readers, few of whom have the advantage of access to any considerable literature on the subject. A paragraph is devoted to each of the well known and several of the rarer lilies that are natives of California. The writer's conclusions on the dangers inherent in the desiccation of lily bulbs and the causes of failure through lack of appreciation of the fact that the lily is always a growing plant, as distinct from a periodically dormant bulb, will be endorsed by all who have given any study to the cultivation of lilies. Successful cultivation of Californian lilies in the writer's garden is described, a particularly interesting feature being the high proportion of gravel used by him in the soil mixture.

A very interesting and informative article on lilies for the woodland is contributed by Mr. R. L. Harrow. Many New Zealand gardens have a corner planted with deciduous trees and shrubs where light penetrates with varying intensity. This article describes many lilies that are at home in such a situation. The presence of a few evergreens in such a corner would not adversely affect lilies in New Zealand gardens where the sunshine average is high. The late G. F. Wilson, whose portrait is the frontispiece of this issue and who did much for this form of gardening, is referred to in the editorial comment.

Dr. Fred Stoker's observations under the heading of "Gleanings and Siftings" have the authority associated with all this experienced grower's contributions on the subject. His comments on the growing of liliums chalcedonicum and candidum in more shade than is usually given these species in gardens are of particular interest. The suggestion that the healthy condition of Lilium candidum in many cottage gardens in England is possibly due to the tangle of plants surrounding them, is supported by many instances in this country, and deliberate plantings in such surroundings have remained healthy while others, in more usual places, have not flourished. A brief reference to the vexed question of manuring lilies is contained in

this article, without, unfortunately, the writer's own views which would have been of value.

A simple method of propagation of lilies by scales in heat is described in an article by Mr J. Ingram.

Notes on Tibetan liliaceae, with particular reference to the distribution of Lilium Wardii, by Captain Kingdon Ward are of considerable value to the increasing number of readers who are interested in the romance of plant collecting. The difficulties surrounding the correct classification of new plants are well illustrated by this article.

Of similar interest is the article by Mr. E. K. Balls on lilies in the Pontus. It is obvious from the writer's comments that a good deal more has yet to be recorded on the subject of the monadelphum group of lilies. The soil conditions in which these lilies were found should afford valuable information regarding their treatment in gardens.

Very informative reports of discussions at meetings of the lily group on (1) the planting and transplanting of lilies, (2) fritillaries and (3) nomocharis are a feature of the Year Book. The first mentioned subject contains valuable hints for all lily growers. The discussion on fritillaries appears to indicate that these interesting and beautiful flowers are not as widely grown as they deserve to be. The liberal use of gravel is recommended for the Californian species.

The increasing interest in nomocharis has produced in this Annual a wealth of information on the subject, and it may be predicted that further experience will show that the cultivation of some at least of the species will present no greater difficulties than are met in the successful treatment in gardens of some of the newer lilies.

A discussion that followed the exhibition of lilies on the 10th July last produced much useful information from well known growers and exhibitors. The condition of the lilies exhibited apparently was remarkably good, notwithstanding an unfavourable season. The possible origin of Lilium pardalinum var. giganteum will be of interest to all who possess this fine lily. One feature of this Annual is the increasing toleration of lime in the soil for many lilies, voiced by several growers. One hopes that the lilies themselves will be equally tolerant. A much less debatable conclusion is the absolute need for adequate drainage in preparing the soil for most lilies and the advantage of having a gravel subsoil. In this connection the Wisley experiments described by Dr. Tincker are of real value.

An interesting note on Lilium Alexandrae, of many synonyms, is contributed by Mr. J. Coutts with observations on this lily's claims to specific rank, also its propagation from seed. This process is quite successful in New Zealand, and the plants appear to be true to type.

Contributions as follows—The Chromosomes of Lilium, Decay of lily bulbs during storage, Origin of botrytis disease outbreaks on Lilium candidum, Notes on diseases of Lilium longiflorum in Ber-

muda—are of real value, though perhaps of less general interest to gardeners.

As usual, the illustrations are a feature of the publication, and the pages devoted to notes, an increasingly interesting part of the Annual, supply valuable information from many sources. Space will not permit of fuller reference to the notes on the success of Lilium chalcedonicum in Northumberland, the genus Notholirion and lilies in Kenya. The last mentioned contribution indicates clearly, however, how really adaptable some lilies are. Lilium Sargentiae also flourishes in several widely separated New Zealand gardens.

This publication should be in the possession of every gardener interested in lilies.

F. J. SHANKS.

THE R.H.S. DAFFODIL YEAR-BOOK, 1934.

The Royal Horticultural Society's Daffodil Year-Book for 1934 contains as usual many interesting features.

Mr. Guy L. Wilson contributes a most readable article on "White Daffodils." Mr. Jan de Graaff deals very fully with "Daffodils in the Pacific Coast States." "The Cultivation of Narcissi in Bowls" by Mr. G. W. Leak, V.M.H. gives much needed information on this phase of growing. Mr. Gordon W. Gibson, F.L.S. of the Experimental Station, Isles of Scilly, traces the early history of the Scillonian Flower Industry through all its vicissitudes to its present flourishing condition. Old catalogues are always of great interest and in "Early Daffodil Catalogues" Mr. A. F. Calvert has unearthed a vein of poetry and poetical expression much more natural and convincing than present day raisers' descriptions. Dr. William Edward de Mol of Amsterdam traces "The Origin of Double Daffodils" and Mr. P. D. Williams, V.M.H. in "Narcissus and R.H.S." acknowledges the debt of gratitude due to the Royal Horticultural Society and its Narcissus Committee.

The reports on the Daffodil Dinner, English and Overseas Shows and the Notes make interesting reading and suitable illustrations complete a publication which is well up to the usual high standard and on which the Royal Horticultural Society and its Year-Book sub-committee are to be complimented.

INSTITUTE NOTES.

The provisions of the "Native Plants Protection Act, 1934" will not be fully operative until a warrant has been issued under Section 3 thereof declaring what natives plants are to be protected. In order to simplify matters, it is proposed by the Department of Lands and Survey that the warrant shall declare all native plants to be protected with certain exceptions. A report of a Sub-Committee of the Executive Council has been adopted and sent on accordingly.

A letter of thanks has been sent to the N.Z. Horticultural Trades' Association in respect of its generous offer of four silver medals for the National Show, 1936, which are to be allotted at the discretion of the Show Committee. A similar donation was made to the recent National Flower Show at Dunedin.

The Auckland District Council is giving its active support towards the preservation of native bush on Waiheke Island and at Orakei and Awaiti Gorge, Urewera.

The Hawkes Bay District Council reports that a visit has been arranged to the Tangoio White Pine Reserve in conjunction with the local Chambers of Commerce and Rotary Clubs and invitations are being extended to all those who contributed to the local funds for fencing the Reserve.

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NEW ZEALAND

INSTITUTE OF HORTICULTURE

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