AUSTRALASIAN ANTARCTIC EXPEDITION
1911-14.
UNDER THE LEADERSHIP OF SIR DOUGLAS MAWSON, D.Sc., B.E.

SCIENTIFIC REPORTS.
SERIES C.—ZOOLOGY AND BOTANY.
VOL. VII. PART 3.

THE VASCULAR FLORA OF MACQUARIE ISLAND

BY

T. F. CHEESEMAN, F.L.S., F.Z.S.

WITH MAP.

PRICE: SIX SHILLINGS AND SIXPENCE.
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CONTENTS.

THE VASCULAR FLORA OF MACQUARIE ISLAND.

By T. F. CHEESEMAN, F.L.S., F.Z.S., Curator of the Auckland Museum.

I. INTRODUCTORY NOTES.

Macquarie Island, named after the then Governor of New South Wales, was discovered in 1810 by Captain Hasselborough, of the ship "Perseverance," which had been dispatched from Sydney for the purpose of searching for islands inhabited by fur-seals. Not only were fur-seals (*Arctocephalus Forsteri*) found to be extremely numerous on the newly-discovered land, but great numbers of the sea-elephant (*Macrorhinus leoninus*) and sea-leopard (*Stenorhynchus leptonyx*) were also observed. This led to the rapid development of seal-hunting, and within a few years many vessels visited the island, landing parties of men to obtain the skins, and returning at frequent intervals to remove the spoil. It is said that one vessel alone, during the first year of its operations, took away more than 35,000 skins of the fur-seal. Unrestricted slaughter of that nature soon brought about its inevitable consequence, and in a very few years the species was nearly exterminated. It is now a rare occurrence to see a fur-seal on Macquarie Island.

But although the trade in fur-seals soon came to an end, the island was regularly visited for many successive years for the purpose of procuring sea-elephant oil and penguin oil, and as this trade was mainly in the hands of shipping firms at Invercargill or Port Chalmers, communication of a kind existed between New Zealand and the island. This led to the visit of Dr. Scott in 1880, and that of Mr. A. Hamilton in 1894. To these two gentlemen we are indebted for the first information of any value respecting the flora and fauna of Macquarie Island, and much credit is due to them for excellent work, performed under circumstances of great difficulty.

But it had long been obvious that a complete exploration of the island could not be achieved through the isolated visits of a few individuals, necessarily imperfectly equipped, and unable to make any lengthened stay. All naturalists, therefore, received with satisfaction the news that Sir Douglas Mawson, the leader of the Australasian Antarctic Expedition, had determined to establish a subsidiary base on Macquarie Island, leaving there a party of explorers for the whole period of the voyage. The result of this policy has been to obtain a vast amount of information respecting the island.

It has been regularly surveyed and mapped; its physiography and geology have been carefully investigated; and large collections have been made in all branches of biological science. Among the latter are the botanical specimens gathered by Mr. Harold Hamilton, upon which this memoir, dealing with the vascular plants of the island, is mainly based.

II. PHYSIOGRAPHY, GEOLOGY, METEOROLOGY.

The physical features, geology, and climate of Macquarie Island so largely affect its vegetation that a brief account is requisite for the proper understanding of the strictly botanical portion of this memoir. In what follows I have very largely drawn upon information contained in Sir Douglas Mawson's "The Home of the Blizzard," and other publications relating to the Expedition.

Macquarie Island is rather more than 600 miles to the south-west of New Zealand, and is approximately 920 miles south-east of Tasmania. It is quite 970 miles from the nearest point of the Antarctic Continent. It is situated in 54° 30′ S. lat. and 158° 57′ E. long., and consists of one long and narrow island with its axis lying north by east by south by west. Its greatest length is a little less than 21 miles, while its extreme breadth is under 4 miles. About 8 miles to the north are two isolated rocks known as the Judge and Clerk. They are about 80 feet in height, and are devoid of vegetation, but in the breeding season are covered with immense numbers of sea-birds. About 20 miles to the south of the main island, and in the same line as it, are two islets to which the names of Bishop and Clerk have been applied. The former, which is much the larger, is covered with a growth of tussock; the other is mostly bare rock. The whole group thus stretches over a distance of nearly 50 miles. As reefs and comparatively shallow water extend for some distance north and south of the main island, while immensely deep water is soon reached to the east and west, it is evident that the present islands are simply the summits of a continuous submarine ridge.

The main island is little more than a range of mountains, everywhere descending rapidly towards the sea, thus forming bold headlands or almost precipitous cliffs. Once beyond the coastal hills, which have an average height of from 500 to 700 feet, the centre of the island is seen to be occupied by a more or less undulating plateau, with occasional peaks rising to an altitude of 900 to 1,424 feet, the latter, or Mount Hamilton, being the highest point on the island. All the chief summits and the more exposed ridges are bare, barren and wind-swept, and present a most desolate appearance. In the hollows between the peaks, or among the minor undulations, are numerous lakes or tarns, some of considerable size. Most are comparatively shallow, and all are evidently of glacial origin. The coastal hills are deeply scored by ravines, down which small streams rush towards the sea, often forming waterfalls along their course.

There is no harbour, or even moderately sheltered bay, although several anchorages can be used on the eastern, or lee side of the island, from which, in ordinary weather, landing can be effected without much trouble. On the western shore an almost continuous swell constantly breaks, and even in the finest weather landing is a difficult if not a dangerous matter. It can hardly be said that there is any flat land near the coast, save on the north-west side, where a broad belt of raised beach exists, forming a peaty and swampy stretch, on which are numerous small lakelets. Elsewhere the beach is composed of huge waterworn boulders, or loose gravel or shingle, amongst which the streams coming down from the hills often lose themselves.

Within a comparatively short distance from the shore, both on the eastern and western sides of the island, the shore plunges abruptly into deep water, a sounding of over 2,000 fathoms having been obtained from the "Aurora" at a distance of only 8 miles. In fact, the soundings taken during the various cruises of the expedition show that on all sides, and for considerable distances, the ocean has a depth varying from 2,000 to 2,500 fathoms. It is not until within 200 miles of the Antarctic Continent that much shallower water is met with. These soundings have definitely proved that Macquarie Island has no connection with the shallow plateau that joins New Zealand with the Auckland and Campbell Islands, over which the average depth does not exceed 400 fathoms. The significance of this fact will appear when we come to discuss the origin and history of the Macquarie Island florula.

As it is hoped that a report on the geology of Macquarie Island will shortly appear, it is not necessary, for the purposes of this memoir, to do more than direct attention to two salient facts. First, that the geological structure of the island is purely volcanic, and that no rocks were collected by the expedition except those of volcanic origin. Secondly, that within comparatively recent times, the whole island has been over-ridden by an ice-sheet travelling from west to east. Previous writers, influenced by the descriptions of the physical features of the island given by Dr. Scott and Mr. A. Hamilton, had surmised that it had been heavily glaciated within a recent period, and possibly covered by a continuous ice-sheet. It is therefore satisfactory to find that the observations made and data obtained by the Mawson Expedition have proved the correctness of this view. How far it affects the history of the vegetation will appear later on.

The climate of Macquarie Island largely governs the character of its vegetation, and must be taken into account in any inquiry that may be made into its history and origin. I must therefore express my thanks to Mr. H. N. Hunt, Commonwealth Meteorologist, for supplying me with various weather statistics taken on the island for the years 1912 to 1915. Part of these are from the register kept by Mr. Ainsworth, of the Mawson Expedition, the remainder are from records obtained by two Commonwealth observers, who resided on the island during the years 1914 and 1915. From these I have extracted the following table, showing the temperature, velocity of the wind, and the rainfall.

MACQUARIE ISLAND, lat. 54° 30′ S., long. 158° 57′ E.

The temperature records are for 1912; the wind and rainfall for 1915.

Month.	Mean temperature.	Mean maximum temperature.	Mean minimum temperature.	Mean daily velocity of wind in miles.	Rainfall in inches. (1915).
January	44·9	48·3	41·9	454	5·15
February	43·1	45·3	41·2	381	3·22
March	41·8	44·0	39·7	540	4·53
April	40·9	43·4	38·3	478	4·44
May	40·0	42·4	37·2	446	3·95
June	38·0	40·6	35·1	410	3·44
July	37·7	40·3	34·7	588	3·93
August	38·1	41·1	35·0	350	3·73
September ...	38·6	41·5	35·7	382	3·29
October	39·6	42·5	36·1	464	3·24
November ...	41·6	44·8	38·7	309	3·36
December... ...	43·9	47·3	40·8	414	3·58
Year	40·7	43·5	37·9	435	45·86

Maximum temperature for the year 51·8°; minimum, 26°.

For comparison with the above, I now give weather statistics from two stations in nearly the same latitude as Macquarie Island. One, Orange Harbour, is situated in the extreme south of South America; the other, South Georgia, lies about 1,000 miles to the east. These I have taken from Dr. Skottsberg's interesting memoir "On the Zonal Distribution of South Atlantic and Antarctic Vegetation" (Geographical Journal, vol. 24, pp. 655 to 663).

ORANGE BAY, Tierra del Fuego. Lat. 55° 31′ S., long. 68° 5′ W. 1882–1883.

Month.	Mean temperature.	Mean maximum temperature.	Mean minimum temperature.	Velocity of wind, in feet per second.	Rainfall in inches.
January	46·00	51·35	38·82	30·1	6·4
February	48·05	60·33	39·79	25·5	3·4
March	42·62	51·26	36·91	21·6	6·0
April	40·89	46·87	35·17	19·3	7·0
May	39·91	44·98	34·88	19·5	4·5
June	36·19	40·30	31·37	18·2	4·8
July	37·76	42·78	35·54	19·8	1·5
August	37·45	43·70	32·09	19·3	5·4
September ...	.....	.....	.....	.....	.....
October	42·40	51·42	34·66	18·0	3·2
November ...	44·29	53·20	36·59	24·5	5·0
December... ...	46·22	55·45	38·32	27·7	5·9
Year (11 months)	41·98	49·24	35·83	21·9	53·1

NOTE.—The velocity of wind given, 21·9 feet per second, would correspond to 357 miles per day.

ROYAL BAY, South Georgia. Lat. 54° 31′ S., long. 36° W. 1882–1883.

Month.	Mean temperature.	Mean maximum temperature.	Mean minimum temperature.	Velocity of wind, in feet per second.	Rainfall in inches.
January	40·28	44·96	35·96	20·7	3·2
February	41·72	46·58	36·32	23·0	3·4
March	38·30	42·98	34·34	22·0	5·8
April	32·90	37·40	29·12	22·6	3·2
May	31·64	35·96	26·78	21·0	0·6
June	26·78	31·10	22·64	18·7	2·1
July	27·86	32·18	22·64	23·3	1·4
August	34·16	39·38	28·76	27·6	3·9
September ...	30·38	35·60	25·34	25·3	5·0
October	34·34	39·20	29·66	21·6	4·6
November ...	37·22	41·90	32·54	17·1	2·8
December... ...	38·66	43·70	34·34	23·6	2·9
Year	34·52	39·25	29·87	22·2	38·9

NOTE.—The velocity of wind given, 22·2 feet per second, would correspond to 364 miles per day.

The seasonal figures derived from the three tables are as under :—

Season.	Mean temperature. Macquarie Island.	Mean temperature. Orange Harbour, Fuegia.	Mean temperature. South Georgia.	Rainfall. Macquarie Island.	Rainfall. Orange Harbour, Fuegia.	Rainfall. South Georgia.
Spring	39·9	42·19	33·98	9·89	12·5	12·40
Summer	43·9	46·75	40·22	11·95	15·7	9·50
Autumn	40·9	41·13	34·28	12·92	17·5	9·60
Winter	38·6	37·13	29·60	11·10	11·7	7·40
Year	40·7	41·80	34·52	45·86	57·4	38·90

The outstanding peculiarity in the climate of Macquarie Island is its extraordinarily small diurnal and annual range of temperature. In this, however, it agrees with all the subantarctic islands situated in similar latitudes. According to the returns placed in my hands by Mr. Hunt, the extreme range of temperature during 1912 was only 25·8 F., while the mean range during the same year was only 5·6 F. More amazing still is the fact that the mean difference between the three summer months and the three winter was only 4·3 F. Figures like these compel agreement with Professor Rudmose Brown's dictum (Problems of Antarctic Plant Life, p. 5), where he says, "One could, with much truth, say that the antarctic summer is but an astronomical conception; those who have experienced it know how little reality it has." Another noteworthy feature is the excessive amount of wind, the mean daily velocity for 1912 being 435 miles, equivalent to 18 miles per hour. It is unexpected, however, to find that the force of the wind is greater at Macquarie Island than at South Georgia, where the mean daily velocity is 364 miles. It cannot be doubted that the low summer temperature, the large amount of cloud and fog, and the constant

high winds must co-operate in producing most unfavourable conditions for plant-life, and will go far towards explaining the poverty of the flora in Macquarie Island and the other islands of the subantarctic zone.

III. HISTORY OF BOTANICAL EXPLORATION.

Although Macquarie Island was discovered as early as 1810, it was not until 1830 that any knowledge was obtained of its vegetation. In that year, or thereabouts, Mr. C. Fraser, then Superintendent of the Sydney Botanical Gardens, sent to Sir W. J. Hooker, at Kew, a small collection of eight species of plants. It is not known how Mr. Fraser obtained the specimens; but it must have been through the agency of one of the sailing vessels which at that time were regularly trading between Macquarie Island and Sydney. The following is a list of the species, all of which are briefly mentioned in the first volume of Sir J. D. Hooker's Flora Antarctica :—

Acœna adscendens Vahl.
Acœna Sanguisorbæ Vahl.
Azorella Selago Hook. f.
Pleurophyllum Hookeri Buch.
Cotula plumosa Hook. f.
Luzula crinita Hook. f.
Poa foliosa Hook. f.
Aspidium vestitum Swartz.

It is worth mention that although the list is a small one, it nevertheless includes the whole of the conspicuous species of the florula, with the exception of *Stilbocarpa polaris*. It is difficult to imagine how such a striking plant was omitted from the collection, for it must have been noticed.

For half a century no further information was obtained, but near the close of 1880 Dr. J. H. Scott, of the Otago University, made a short visit for the special purpose of investigating the flora and fauna. On his return, he published the results of his observations in a paper printed in the Transactions of the New Zealand Institute (vol. XV, p. 484). This is the first published account of the physical features of the island and its natural productions, and thus possesses considerable importance. Many of his remarks on the character of the vegetation and its physiognomy are of value for the purposes of this memoir, and I propose to reproduce portions of some of them, preserving as far as possible his own words :—

> " The general appearance of a Macquarie Island landscape is barren in the extreme. There is not a tree or shrub, and what vegetation there is has a great deal of sameness, long stretches of yellowish tussock, with occasional patches of the bright green *Stilbocarpa polaris*, or of the peculiar sage green *Pleurophyllum*. These, with the rich brown mosses near the hill-tops, are all that strike the eye on

looking at the island from the sea. . . . The interior of the island shows the rocky tops of the hills blown perfectly bare by the winds, and fissured by the frosts, and in the hollows of the uplands lie a number of little lakes. . . . *Azorella Selago* grows on the hillsides, forming globular masses often 4 feet across. These are green on the surface, where the living part of the plant lies as a crust to the great mass of débris which forms the interior, through which the roots descend. The whole constitutes a solid mass upon which one can stand. The surface crust is particularly dense, and the young shoots so closely packed together, and so uniform in height, that lichens and other small plants sometimes grow upon it. . . . *Pleurophyllum* occurs in large patches all over the island, and is the handsomest plant thereon, its long sage-green leaves and purple flowers making it particularly noticeable. . . . *Stilbocarpa polaris* is the Macquarie Island cabbage of the sealers, and is found all over the island growing in large patches. In sheltered corners on the lower ground it is a handsome plant, and its bright green leaves are always conspicuous."

A list of the plants collected, determined by Mr. A. C. Purdie, is given by Dr. Scott. Owing to his visit being early in the season, several of the species were not yet in flower, and identification was consequently difficult. A few regrettable mistakes were made, most of which were corrected by Mr. T. Kirk in a short notice printed in vol. 3 of the Report of the Australasian Association (p. 226). In the light of the subsequent collections made by Mr. A. Hamilton in 1894, and by the Mawson expedition in 1912–1913, I have been able to compile the following amended list of the vascular plants actually gathered by Dr. Scott, the total number being eighteen.

Ranunculus biternatus Smith.
Stellaria decipiens Hook. f.
Colobanthus muscoides Hook. f.
Acæna adscendens Vahl.
Acæna Sanguisorbæ Vahl.
Tillæa moschata D.C.
Azorella Selago Hook. f.
Stilbocarpa polaris A. Gray.
Coprosma repens Hook. f.
Cotula plumosa Hook. f.
Pleurophyllum Hookeri Buch.
Luzula campestris D.C. var. *crinita*.
Poa foliosa Hook. f.
Poa annua Linn.
Festuca contracta T. Kirk = *F. erecta* D'Urv.
Lomaria penna-marina Trev.
Aspidium vestitum Swartz.
Polypodium australe Mett.

Dr. Scott's list, as printed in his paper, contains the names of 19 species. The number should have been 20, for an undoubted scrap of *Stellaria decipiens* was picked out of the collection by Mr. Kirk. On the other hand, the total must be reduced by the elimination of *Azorella lycopodioides*, of which Mr. Kirk writes: "I did not see anything resembling this plant in the collection. Possibly a form of *Colobanthus muscoides* with larger leaves than usual was mistaken for it." Two species of *Luzula* are given in the list; but it appears to me that both are referable to *L. campestris* var. *crinita*. With these alterations, the number of plants enumerated by Dr. Scott agrees with my list. The divergences in the nomenclature of the two lists will be best understood on reference to the synonyms given in my enumeration of the total florula of the island, which see.

Fourteen years after Dr. Scott's expedition, or in 1894, Mr. A. Hamilton, then Registrar of the Otago University, and a few years later Director of the Dominion Museum, Wellington, paid a visit to Macquarie Island, for the purpose, as he states, "of studying the plants and natural history of that remote speck in the southern ocean." He was accompanied by Mr. Jennings, the taxidermist to the Otago Museum, whose object was to obtain skins and skeletons of the sea-elephant (*Macrorhinus leoninus*), and of the various species of penguins. A stay of thirteen days was all that could be arranged for, but nevertheless collections of considerable importance were put together, both zoological and botanical. Unfortunately, a serious gale arose on the day of departure, and the weather became so bad that the vessel had to run for New Zealand without taking on board more than a very small part of the collections. A portion came up by the next trip of the vessel, but many valuable specimens were ruined by neglect, and others never reached New Zealand. Fortunately, the greater part of the botanical collections was saved.

An interesting account of his visit was prepared by Mr. Hamilton, and published in the Transactions of the New Zealand Institute (vol. 27, pp. 559-579). I quote the following remarks, in a slightly abbreviated form, because they afford a vivid picture of the vegetation.

> "The hut in which we lived at Lusitania (one of the sealing stations) stood on the crown of the shingle beach. Immediately behind it was a small creek coming down from the hills at the back, over a sloping terrace covered with a huge tussock grass. This grass (*Poa foliosa*) forms a huge stool, around which is usually a muddy pool, more or less deep, into which you plunge with unerring certainty when trying to cross the belt of tussock swamp. The only way to avoid this unpleasantness is to jump from the top of one tussock to another. Once beyond the belt of swamp, you ascend the steep slope of the hills, and here you struggle and wrestle with the huge leaves of the Macquarie Island Cabbage (*Stilbocarpa polaris*), a plant resembling very fine rhubarb. The tussocks and the *Stilbocarpa* become smaller as you ascend, and at about 300 feet you gain a plateau so swept by the antarctic gales that vegetation is reduced to compact closely-growing mosses and small

Uncinias, and the conspicuous cushions of *Azorella Selago*. In the hollows of the hills are countless little tarns or lakes, some of considerable extent. Round the tops of the hills the wind has cut out wonderful terraces from a few inches to a foot or two in height, with completely bare rock much disintegrated by the weather on the top. In some of the more sheltered places or gullies stunted plants of *Stilbocarpa* and *Pleurophyllum* cover the ground. The *Pleurophyllum* was, unfortunately, long past flower, and so I did not get any specimens showing the beautiful aster-like flower, with its purple ray-florets and yellow centre. The majority of the plants on the island are littoral, and are to be found on the swampy ground near the beach. From the ship it appeared as if there were some good-sized bushes or shrubs growing on the lower levels; but on landing these were found to be huge detached rocks overgrown with mosses and large tussocks of *Poa foliosa*. On the whole island there is not a shrub or plant large enough to make a pen-holder. Indeed, the only plant of a ligneous genus is the small creeping *Coprosma repens*. The large *Poa* tussocks are the great feature of the low levels; while on the hill-tops *Azorella* is most prominent, with its bright green closely growing convex masses of stems and leaves. These masses are so solid and elastic as to bear the weight of a man without material injury. On these cushions grow two small but interesting plants—*Coprosma repens*, with its dimorphous flowers and scarlet berries, and a very minute variety of a fern (*Polypodium australe*), the frond of which is about half-an-inch high. This truly alpine plant I have collected on the top of the Kaweka Mountain, in Hawke's Bay. Two other ferns are found on the island, one *Lomaria alpina*, the other *Aspidium aculeatum* var. *vestitum*."

The collection of plants made was examined by the late Mr. T. Kirk, whose report formed the basis of the list given in Mr. Hamilton's paper. This I reproduce below, premising that I have made a few alterations in the names of some of the species in order to comply with modern views of botanical nomenclature :—

Ranunculus biternatus Smith.
Cardamine corymbosa Hook. f.
Stellaria decipiens Hook. f.
Stellaria media Cyr. (naturalized).
Cerastium triviale Link (naturalized).
Colobanthus Billardieri Fenzl.
Colobanthus muscoides Hook. f.
Montia fontana Linn.
Acæna adscendens Vahl.
Acæna Sanguisorbæ Vahl.
Tillæa moschata D.C.
Callitriche antarctica Engl.
Epilobium linnæoides Hook. f.
Epilobium nummularifolium var. *nerterioides* A. Cunn.

Azorella Selago Hook. f.
Stilbocarpa polaris A. Gray.
Coprosma repens Hook. f.
Cotula plumosa Hook. f.
Pleurophyllum Hookeri Buch.
Luzula campestris D.C. var. *crinita* Hook, f.
Uncinia riparia R.Br. var. *Hookeri* Kuk.
Agrostis magellanica Lam.
Deschampsia Chapmani Petrie.
Deschampsia penicillata T. Kirk.
Poa foliosa Hook. f.
Poa Hamiltoni T. Kirk.
Poa annua Linn. (naturalized).
Festuca contracta T. Kirk = *F. erecta* D'Urv.
Lomaria penna-marina Trev.
Aspidium vestitum Swartz.
Polypodium australe Mett.
Lycopodium varium R.Br.

The total number of species collected is thus thirty-two, of which three are naturalised. This shows an increase of no less than fourteen on Dr. Scott's list, proving that Mr. Hamilton evidently made full use of the limited time that he was able to spend on the island. The most important result derived from his visit, however, was the totally unexpected discovery of three new species of grasses—*Deschampsia penicillata* T. Kirk, *Poa Hamiltoni* T. Kirk, and *Festuca contracta* T. Kirk. Up to that time, no one had even suspected that Macquarie Island had an endemic flora of its own, and the establishment of that fact not only marked an important advance, but also compelled a re-arrangement of all previous views on the history and development of the vegetation of the Island.

After Mr. A. Hamilton's visit, no information of any consequence bearing on the vegetation of the island was obtained for many years. In November, 1901, Captain Scott, in the "Discovery," landed on the eastern side to collect specimens, but his stay was limited to a few hours. In 1909, Captain J. K. Davis, then associated with the Shackelton expedition, and in command of the auxiliary vessel "Nimrod," made a similar brief visit.

On 12th December, 1911, the Australasian Antarctic Expedition's vessel "Aurora" arrived off the north end of the island. In the introductory notes to this memoir, I have mentioned the reasons that actuated Sir Douglas Mawson in deciding to establish a subsidiary base on Macquarie Island, and in leaving a party thereon. It is now necessary to say a few words respecting the constitution of the party, and the botanical work that it has performed. The explorers were five in number. G. F. Ainsworth was selected as leader, and acted as meteorologist; H. Hamilton was

biologist; L. R. Blake was surveyor and geologist; while C. A. Sandell and A. F. Sawyer were wireless operators and general assistants. But much mutual help was rendered by all the members of the party. For the character of the work, and the manner in which it was performed, reference should be made to chapters 25 to 27 of Sir Douglas Mawson's "Heart of the Blizzard" (vol. 2, pp. 167 to 254). These chapters, which have the respective headings of "Life on Macquarie Island," "A Land of Storm and Mist," and "Through another Year," were written by Mr. Ainsworth, and contain many observations of value respecting the flora and fauna, as well as the physical configuration and structure of the island. The party resided for nearly two years on the island, and visited every portion of it, taking its final departure on 28th November, 1913.

Mr. Harold Hamilton, who formed the biological collections secured by the party, was the son of the late Mr. A. Hamilton, who did such excellent work in Macquarie Island in 1894. He was a graduate of the Otago University, and prior to his engagement with the Mawson Expedition was employed for a short time on the staff of the New Zealand Geological Survey. At a later date he occupied the post of Entomological collector to the Dominion Museum, Wellington. After his return from Macquarie Island, he was appointed zoologist to the Dominion Museum. Shortly after came the outbreak of the present war. Like many others, he felt it his duty to volunteer for active service. He obtained a commission in the Motor Boat Reserve, and left New Zealand with the rank of Lieutenant. Unfortunately, I am not able to state his exact position at the present time. Personally, I much regret his absence, for he had engaged to supply me with much information that he had obtained respecting the ecology of the vegetation, and the distribution of the species upon the island, together with other particulars gathered during his stay. These, I hope, he will make public at a later date.

Mr. H. Hamilton's collection of the vascular plants of the island, which, as I have previously stated, forms the basis of this memoir, has been placed in my hands for examination and report. It is excellently preserved, and contains a fair number of specimens of most of the species, including all those collected by Dr. Scott and Mr. A. Hamilton, with two exceptions only—*Uncinia riparia* R.Br. var. *Hookeri*, and *Deschampsia penicillata* T. Kirk. In addition, it contains four species not previously recorded from the island, as under :—

Juncus scheuchzerioides Gaud.
Scirpus aucklandicus Boeck.
Carex trifida Cav.
Triodia macquariensis Cheesem., n.sp.

The last mentioned is a most interesting addition to the florula, increasing the number of endemic species to three.

The following detailed enumeration of the species will show how much additional matter has been derived from the study of Mr. Hamilton's specimens. It is, perhaps, as well to mention that he also collected various cryptogams, which I understand will be worked up in the other memoirs of this volume.

IV. ENUMERATION OF THE SPECIES.

RANUNCULACEÆ.

RANUNCULUS BITERNATUS *Smith.*

Ranunculus biternatus Smith in Rees's Cyclop. XXIX (1802) n. 48; Schenk in Pflanzengeographie der Subantarktischen Insel (1905), p. 26 t. 12, c.d.; Wildeman Res. Voy. "Belgica" (1905), p. 89; Cheesem. Subantarctic Islands of N.Z. II (1909), p. 398. *R. crassipes* Hook. f. Fl. Antarct. II (1847), p. 224 t. 81, also Phil. Trans. Roy. Soc. vol. 168 (1879), p. 17; T. Kirk Students' Fl. (1899), p. 17; Cheesem. Man. N.Z. Fl. (1906), p. 26.

Macquarie Island:—Not uncommon in the lower parts of the island, in swampy places and in the shelter of the tussocks of *Poa foliosa*. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

First collected by Dr. Scott. He referred his specimens, which were little more than scraps, to *R. acaulis* Banks and Sol. A. Hamilton remarks that it is very variable in size. This is borne out by Mr. H. Hamilton's specimens, some of which have petioles 20 cm. long, with the lamina of the leaf 4 cm. diameter, while the fruit is borne on peduncles 4 to 5 cm. long. On the other hand, depauperated states growing on wet gravel among tufts of *Colobanthus muscoides*, have leaves barely 5 mm. diameter, on petioles about the same length, while the fruit is almost sessile. A. Hamilton states that in exposed situations the carpels become scarlet when fully ripe, and are very conspicuous.

Ranunculus biternatus, taken in a wide sense, has an extensive geographical range. It has been found in Fuegia, Falkland Islands, South Georgia, Kerguelen, Marion and Crozet Islands, and New Amsterdam. The Kerguelen and Macquarie Island plant was separated by Hooker from that found in Fuegia and Falkland Islands (the original *R. biternatus*) on account of its greater size, more succulent habit, and less divided leaves with broader segments. But these are variable characters of comparatively small importance, and on reviewing the matter at a later date in the Philosophical Transactions (vol. 168, p. 17), Hooker definitely stated that he could "hardly doubt its being a derivative form of the Fuegian *R. biternatus*, with which it agrees in habit and in its thick-walled beaked carpels, but differs chiefly in its robustness and simple leaves." The more recent discovery of true *R. biternatus* in South Georgia and Marion Island is an additional argument in favour of the unity of the two plants. Both Dr. Schenk, in his "Plant Geography of the Subantarctic Islands," and Wildeman, in the "Results of the Voyage of the Belgica," have adopted this view. Dr. Skottsberg, however, in his memoir on the relations between the floras of subantarctic America and New Zealand (Plant World, May, 1915), is inclined to maintain the distinctness of the two plants on the ground that there are differences in the flower and fruit. I have not sufficient material of the South American plant to investigate this point.

CRUCIFERÆ.

CARDAMINE CORYMBOSA *Hook. f.*

Cardamine corymbosa Hook. f. Fl. Antarct. I (1844), p. 6, also Ic. Plant. t. 686 (1844); Schulz in Engl. Jahr. XXXII (1903), p. 561. *C. hirsuta* Linn. Sp. Plant. 655 var. *corymbosa* Hook. f. Handb. N.Z. Fl. (1864), p. 12; Cheesem. Subantarctic Islands of N.Z. II (1909), p. 398.

Macquarie Island:—Creek beds and wet ground near the sea. A. Hamilton (1894); H. Hamilton (1912–1913).

In the "Subantarctic Islands of New Zealand" (p. 399), I followed Hooker and others in retaining this as a variety of *C. hirsuta*. At the same time I expressed the opinion that many of the southern forms then included with *C. hirsuta* would ultimately be separated from that plant. Having now had an opportunity of studying an excellent series of *C. corymbosa* gathered by H. Hamilton, and of comparing the specimens with others collected in the Auckland and Campbell Islands by Tennant and Laing, I am now satisfied that *C. corymbosa* must be regarded as distinct. Whether it should also include some mountain forms from New Zealand proper, as has been done by Schulz, is a matter that I cannot go into in the present memoir.

H. Hamilton's specimens agree fairly with Hooker's description and the plate given in the Icones Plantarum in having a short perennial rootstock from the top of which spread a few filiform branchlets. But Hooker figures the leaves as being mostly 2-jugate with a terminal leaflet not remarkably larger than the lateral; whereas in the Macquarie Island plant there are first of all numerous simple long-petioled rounded leaves, and then others which are seldom more than 1-jugate (trifoliolate), and in which the terminal leaflet is many times larger than the lateral. The description of the leaves given by Schulz in Engler's Jahrbuch suits the Macquarie Island plant much better than Hooker's. The inflorescence is very curious. Usually the flowers are solitary in the axils of the leaves on a long slender peduncle. Sometimes two or more of these peduncles may spring from a single axil, thus forming a kind of false umbel. More rarely there is a few-flowered raceme at the top of the stem, the inflorescence then being much more normal.

H. Hamilton's specimens were carefully but unsuccessfully searched for the remarkable cleistogamic flowers discovered by Schulz in the examination of some of Hooker's specimens collected more than seventy years ago, and which I also observed in one of Tennant's collected at Port Ross. I have mentioned in the "Subantarctic Islands" that Schulz's statement to the effect that the ordinary flowers are apetalous is not correct, and my examination of Hamilton's Macquarie Island plant enables me to say that the flowers when they first expand are always furnished with petals, although these sometimes drop off very shortly after fertilisation.

In addition to the New Zealand Subantarctic Islands, Dr. Schulz has recorded *C. corymbosa* from Orange Harbour, Fuegia.

CARDAMINE GLACIALIS D.C.

var. SUBCARNOSA *O. R. Schulz.*

Cardamine glacialis D.C. Syst. II (1821) p. 265, var. *subcarnosa* O. R. Schulz in Engl. Jahr. XXXII (1903), p. 542; Cheesem. Subantarct. Islands of N.Z. II (1909), p. 398. *C. hirsuta* Linn. Sp. Plant. p. 655 var. *subcarnosa* Hook. f. Fl. Antarct. I (1844), p. 5; T. Kirk Students' Fl. (1899), p. 27; Cheesem. Man. N.Z. Fl. (1906), p. 33.

Macquarie Island:—A. Hamilton (1894)?

In the Students' Flora Mr. T. Kirk included this species in the Macquarie Island florula, presumably on the authority of A. Hamilton's collections, which he is known to have examined. But Hamilton referred his plant to *C. corymbosa*, and the statement he makes to the effect that "it formed a green margin to the vegetation on the top of the beach wherever a creek or swamp ran out to the sea" agrees perfectly with the habitat given by Hooker for *C. corymbosa* in Campbell Island—"turfy ground near the sea, common." It is also noteworthy that H. Hamilton's later collection includes specimens of *C. corymbosa* from several localities, but none of *C. glacialis*. On the other hand, Kirk was perfectly well acquainted with both plants, and gathered them during his visit to the Auckland and Campbell Islands in 1890. In any case, *C. glacialis* is a likely plant to occur in Macquarie Island; and it is just possible that specimens of both plants were included in A. Hamilton's collection unknown to him. I therefore retain the plant on the list until further inquiry can be made.

In addition to the New Zealand Subantarctic Islands, var. *subcarnosa* is found in Southern Chili, Fuegia, and Falkland Islands. The typical plant has a wide distribution in Chili and Patagonia.

CARYOPHYLLACEÆ.

STELLARIA DECIPIENS *Hook. f.*

Stellaria decipiens Hook. f. Fl. Antarct. I (1844), p. 7, and Ic. Plant. t. 680, also Handbk. N.Z. Fl. (1864), p. 23; T. Kirk Students' Fl. (1899), p. 57; Cheesem. Man. N.Z. Fl. (1906), p. 63, and Subantarctic Islands of N.Z. II (1909), p. 401.

Macquarie Island:—Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Dr. Scott was the first to collect this plant, although it is not recorded in the list given in his paper, published in Trans. N.Z. Inst., vol. 15. But in Kirk's Notes on the Botany of the Antarctic Islands (Rept. Austral. Assoc., vol. 3 (1891), p. 226), an amended list of Scott's plants is given, which contains the name of "*Stellaria elatinoides*," together with the remark "a small scrap, but unmistakeable, omitted by Dr. Scott." In a further note contributed by Kirk to A. Hamilton's list of 1894 it is explained that through a slip of the pen "*elatinoides*" was written in mistake for "*decipiens*."

H. Hamilton's specimens, which are all I have seen from Macquarie Island, are rather smaller than those which I possess from the Auckland and Campbell Islands. Hooker remarks in the "Flora Antarctica" that "the peduncles generally bear two pedicels," but I find that in all the specimens I have seen from the Southern Islands the majority of the peduncles are 1-flowered.

S. decipiens is confined to the Subantarctic Islands of New Zealand. It is closely allied to *S. media*, but is smaller, with smaller leaves and a less developed inflorescence; and it does not possess the pubescent line along the branches so evident in that plant.

Stellaria media *Cyr.*

Stellaria media Cyr. Char. Comm. (1784), p. 36; Hook. f. Fl. Antarct. I (1844), p. 8, also II (1847), p. 250; T. Kirk Students' Fl. (1899), p. 57; Cheesem. Subantarctic Islands of N.Z. (1909), p. 445.

Macquarie Island:—Abundantly naturalized. A. Hamilton (1894); H. Hamilton, (1912–1913).

A. Hamilton remarks that this is one of the plants that have succeeded in naturalizing themselves near the factories, having probably been introduced in the straw packing of the machinery. H. Hamilton has also informed me that he found it plentiful near the residences of the sealers.

Stellaria media was originally confined to the north temperate zone, extending northwards to the arctic circle, but during the last hundred years it has followed the footsteps of man all over the world, especially in cool damp climates. Although thin and delicate in habit and appearance, it is really one of the hardiest plants known; and as it produces seed from the beginning of spring to the close of autumn, its regeneration each year is assured. It is now spread all through the subantarctic regions, from Fuegia and the Falkland Islands to Kerguelen Island, South Georgia, Marion Island, St. Paul and Amsterdam Islands. In the islands to the south of New Zealand it is now found on every island of the group.

Cerastium triviale *Link.*

Cerastium triviale Link Enum. Hort. Berol. I (1821), p. 433; T. Kirk Students' Fl. (1899), p. 56; Cheesem. Man. N.Z. Fl. (1906), p. 1067.

Macquarie Island:—A. Hamilton (1894); H. Hamilton (1912–1913).

This species, like *Stellaria media*, has of late years spread from its original home in the north temperate zone to most parts of the world. It was first recorded from Macquarie Island by A. Hamilton, his specimens being identified by Kirk, who reported that they represented an unusually luxuriant state, with almost fleshy leaves. The same remarks can be applied to H. Hamilton's specimens, labelled "The Nuggets, near

the sealers' huts and works." I have also seen specimens collected by Tennant on Auckland Island, and by Laing on Campbell Island. It is naturalized in Southern Patagonia, Fuegia, and Falkland Islands. Dr. Schimper, in the "Valdivia" expedition, found it plentiful on Kerguelen Island, and remarked on its capability of flowering through the winter months. During the cruise of the "Challenger" it was gathered on Marion Island, one of the Crozet Group.

Colobanthus muscoides *Hook. f.*

Colobanthus muscoides Hook. f. Fl. Antarct. I (1844), p. 14, and Handbk. N.Z. Fl. (1864), p. 25; Homb. and Jacq. Voy. au Pôle Sud Bot. (1853), t. 17; T. Kirk Students' Fl. (1899), p. 62; Cheesem. Man. N.Z. Fl. (1906), p. 66, and Subantarct. Islands of N.Z. II (1909), p. 401.

Macquarie Island:—Rocky beaches and cliffs near the sea, abundant. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Colobanthus muscoides is abundant on coastal rocks and cliffs on the shore line of all the subantarctic islands of New Zealand, often in situations where, as A. Hamilton states, it must be frequently drenched with salt water. It does not stretch as far north as Stewart Island, nor is it found in the South Georgia and Kerguelen groups of islands, or in Fuegia. It forms bright green cushions of variable size, sometimes as much as 40 cm. in diameter, although usually much less. On the surface of these cushions other little plants grow, such as *Tillæa moschata*, *Scirpus aucklandicus*, and *Ranunculus biternatus*, together with a few mosses and Hepaticæ. The interior of the cushion is well described by Kirk "as consisting of the partially decomposed stems and leaves of old plants and the roots of young plants," forming a peaty mass usually saturated with water.

In the Flora Antarctica Hooker remarks that *C. muscoides* is "perhaps most nearly allied to the finest of the genus—a Kerguelen's Land species"—*C. Kerguelensis* Hook. f.

Colobanthus Billardieri *Fenzl.*

Colobanthus Billardieri Fenzl in Ann. Wien. Mus. I (1836), p. 49; Hook. f. Fl. Antarct. I (1844), p. 14, and Fl. Nov. Zel. I (1853), p. 27; T. Kirk Students' Fl. (1899), p. 60; Cheesem. Man. N.Z. Fl. p. 67, and Subantarctic Islands of N.Z. II (1909), p. 401.

Macquarie Island:—Locality not specified, A. Hamilton (1894); North end, and West Point, H. Hamilton (1912–1913).

Probably not a common plant in Macquarie Island. A. Hamilton explicitly states that it is not so plentiful as *C. muscoides*; and H. Hamilton nowhere speaks of it as widely distributed. In my memoir on the Subantarctic Islands I mention that all the specimens examined by me from the Southern Islands are referable to an unusually small state, barely more than 1·25 cm. high. A depressed patch without

locality collected by H. Hamilton is exactly that size, and matches Campbell Island specimens gathered by B. C. Aston. But two other sheets in H. Hamilton's collection contain much larger specimens with leaves and peducles 2 to 3 cm. long, thus approaching in size Kirk's var. *alpinus*.

In the New Zealand area *C. Billardieri* is abundant from the East Cape southwards. It is usually considered to be the same as a Victorian and Tasmanian plant. But quite lately Dr. Skottsberg has reaffirmed its distinctness. He unites the New Zealand plant with the Fuegian and Falklands *C. crassifolius* Hook. f. Not having seen specimens of this, I can offer no opinion of my own. The whole genus is much in need of a careful revision.

PORTULACACEÆ.

MONTIA FONTANA *Linn.*

Montia fontana Linn. Sp. Plant. (1753), 87; Hook. f. Fl. Antarct. I (1844), p. 13, also Fl. Nov. Zel. I (1853), p. 74, and Handb. N.Z. Fl. (1864), p. 27; T. Kirk Students' Fl. (1899), p. 65; Cheesm. Man. N.Z. Fl. (1906), p. 72, and Subantarctic Islands of N.Z. II (1909), p. 402.

Macquarie Island:—Not uncommon in streams or moist places near the sea, also in damp places on the sides of the hills. A. Hamilton (1894); H. Hamilton (1912–1913).

I have seen no specimens except those gathered by H. Hamilton, which show the usual differences in size and habit due to locality and environment. One sheet of specimens, from "rocks by the sea-coast, West Point," shows depressed and densely leafy tufts 3–4 inches in diameter, while another "from bed of creek" is composed of laxly branched tufts 2–5 inches high, strongly resembling what could be gathered in mountain districts in New Zealand. Another form, labelled "between clumps of *Poa foliosa* on a sheltered hill-side" is remarkable for its long straggling sparingly leafy branches 4 to 6 inches long.

Montia fontana is generally distributed throughout the North and South Temperate zones.

ROSACEÆ.

ACÆNA ADSCENDENS *Vahl.*

Acæna adscendens Vahl Enum. I (1804), p. 294; Hook. f. Fl. Antarct. I (1844), p. 10, and II (1847), p. 268, t. 96; Cheesem. Subantarct. Islands of N.Z. II (1909), p. 403; Bitter Monog. die Gattung *Acæna* (1910), p. 175.

Stems stout, procumbent, 3–5 dm. long; branches ascending, glabrous, reddish-purple or rubescent. Leaves 6–10 cm. long; stipules large, 2 cm. long or even more,

sheathing, purplish-red; laminae 6–7 foliolate, obovate or obovate-oblong, obtuse, deeply and coarsely serrate-dentate, firm in texture but not coriaceous; lower pairs much reduced in size, sometimes almost petioled, the upper two or three pairs the largest, 1–5 cm. long, rarely more, green on both sides, upper surface glabrous or very slightly pilose, lower surface and rhachis pilose with silky hairs. Scapes 8–14 cm. long, stout, erect, smooth and glabrous, reddish-purple. Flowers hermaphrodite in all the specimens seen by me. Sepals 4, oblong, obtuse or subacute, sparingly pilose on the outside, 5 mm. long. Anthers 4, filaments exceeding the sepals when mature, broadly oblong, 1·75–2 mm. long, 1·5–1·75 mm. broad, dark purple. Spines 4, subequal, about 7–8 mm. long, exceeding the sepals, furnished with yellowish barbs at the top, shaft smooth, dark purple. Stigma bilaterally plumose, 4 mm. long.

Macquarie Island :—Common near the sea, but also ascending to a considerable height on the hills. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Acæna adscendens was collected on Macquarie Island prior to 1830, together with *A. Sanguisorbæ* and several other plants, by the master of some sealing vessel, who handed his specimens to Mr. C. Fraser, then Superintendent of the Sydney Botanic Gardens. By him they were forwarded to Sir W. J. Hooker at Kew, the collection being the first received from any of the islands to the south of New Zealand.

Mr. H. Hamilton's collection includes three excellent sheets of specimens. The first, labelled as the " largest form," was collected on " terraces near the sea " at the north end of the island, and agrees wonderfully well with the fine plate of *A. adscendens* given by Hooker in the Flora Antarctica. The two other sheets, one from " Wireless Hill, alt. 300 ft." and the other from " Hillside, but no great distance from the sea," although both much smaller in size, nevertheless correspond so closely in all essential characters that I can see no reason for separating them as varieties.

A. adscendens is one of the most widely distributed species of the genus. It is found in Patagonia, Fuegia, Falkland Island, Kerguelen Island, Crozets, and South Georgia. Some specimens from the mountains of the South Islands of New Zealand were also referred to it by Hooker in the " Handbook." But most botanists now consider these to be distinct; and Bitter, in his recently published monograph of the genus, has described them as new species under the names of *A. saccaticupula, A. hirsutula,* and *A. fissistipula.* The two latter, however, are doubtfully distinct from one another.

Acæna Sanguisorbæ *Vahl var.* minor *Hook. f.*

Acæna Sanguisorbæ Vahl var. *minor* Hook. f. Fl. Antarct. I (1844), p. 9; Cockayne in Trans. N. Z. Inst. XLIX (1917), p. 56; *Acæna Sanguisorbæ* Vahl var. *antarctica* Cockayne in Trans. N. Z. Inst. XXXVI (1904), p. 319; Cheesem. Subantarctic Islands of N. Z. II (1909), p. 403; *Acæna Sanguisorbæ* Vahl var. *aucklandica* Bitter Monog. der Gattung *Acæna* (1910), p. 274.

Stems stout, long, procumbent, often elongated and much branched, glabrous or silky at the tips of the very young shoots. Leaves very variable in size, 3 to 8 cm. long; stipules large, sometimes as much as 1·5 cm. long, sheathing; laminæ four to six foliolate, the two lowest pairs much reduced in size, the lowest minute and distant from the others, the upper pairs close together, oblong to obovate, acutely and coarsely serrate-dentate, glabrous or nearly so above, beneath densely clothed with silky appressed hairs on the rhachis and primary veins, margins pilose with silky hairs and with the tips of the teeth furnished with a pencil of silky hairs, pale-green on both surfaces but paler beneath. Scape 3 to 7 cm. long, stout, erect, in the young state densely clothed with silky appressed hairs, becoming more glabrous in age. Heads variable in size, even when mature, 1 to 2 cm. diam., in colour ranging from stramineous to pale rubescent. Sepals four, pale green, broadly oblong, obtuse, 1·5 to 2 mm. long, glabrous above, pilose with appressed silky hairs beneath. Stamens two, filaments variable in length, sometimes barely exceeding the sepals, at other times nearly twice as long; anthers ·5 to ·6 mm. long, ·6 to ·75 mm. broad, broadly transversely oblong, pale purple or yellowish purple. Cupule broadly obconic, densely pilose with appressed hairs; spines four, subequal, exceeding the sepals, barbed at the tip. Stigma broadly bilaterally plumose.

Macquarie Island:—Common on the lower grounds, and on hillsides near the sea. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Like the preceding species, this was first recorded from Macquarie Island by Sir J. D. Hooker on the strength of specimens sent to Kew by Mr. C. Fraser, of Sydney. Dr. Scott, who gathered it during his visit of 1880, incorrectly referred it to *A. Buchanani*, which does not extend beyond the limits of New Zealand proper.

A form gathered by H. Hamilton at an elevation of 500 feet on the hills at the northern end of the island is much depressed, forming densely branched patches of considerable size. It has much smaller leaves and shorter scapes than the ordinary form, and is also darker in colour, but there are no other differences of importance.

I quite agree with Dr. Cockayne (Trans. N.Z. Inst. XLIX, p. 15) in restoring Hooker's varietal name of *minor*, thus relegating the later published names of *aucklandica* Bitter, and *antarctica* Cockayne, to the position of synonyms. As the Macquarie Island *Acænæ* have never been fully characterised, I have drawn up the above descriptions, following to a considerable extent the plan adopted in Bitter's elaborate monograph of the genus.

A. Sanguisorbæ, looking at it in its widest sense, has an extensive distribution. It is found in New Zealand, Australia, Tristan d'Acunha, Amsterdam Island, Auckland and Campbell Islands, Antipodes Island and Macquarie Island.

CRASSULACEÆ.

TILLÆA MOSCHATA *D.C.*

Tillæa moschata D.C. Prodr. III (1828), p. 382; Hook. f. Fl. Nov. Zel. I (1853), p. 76, and Handb. N.Z. Fl. (1864), p. 61, also Phil. Trans. Roy. Soc. vol. 168 (1879), p. 20; T. Kirk Students' Fl. (1899), p. 142; Cheesem. Man. N.Z. Fl. (1906), p. 140, and Subantarctic Islands of N.Z. (1909), p. 404. *Crassula moschata* Forst. Comm. Gott. IX (1789), p. 26. *Bulliarda moschata* D'Urv. Fl. Malouines (1826), p. 618; Hook. f. Fl. Antarct. I (1844), p. 15, and II (1847), p. 278.

Macquarie Island:—Rocks by the sea, common. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1914).

This is one of the circumpolar species of the southern hemisphere, found on the shores of all the lands between S. lat. 40° and 54°. In Macquarie Island it is abundant on coastal rocks, usually mixed with dense patches of *Colobanthus* and *Scirpus aucklandicus*, the vivid green of which contrasts sharply with the dull red of the *Tillæa*. On wet gravelly beaches it is often associated with *Ranunculus biternatus* and *Callitriche antarctica*, together with the *Scirpus* already mentioned.

Tillæa Sinclairii, included in Dr. Scott's list, is doubtless an error for *T. moschata*, which he does not mention.

HALORAGEÆ.

CALLITRICHE ANTARCTICA *Engelm.*

Callitriche antarctica Engelm. ex Hegelm. in Verh. Bot. Ver. Brand. IX (1867), p. 20; Kidder in Bull. U.S. Nat. Mus. III, p. 23; T. Kirk Students' Fl. (1899), p. 156; Cheesem. Man. N.Z. Fl. (1906), p. 158, and Subantarctic Islands of N.Z. II (1909), p. 404. *Callitriche verna* Linn. var. b *terrestris* Hook. f. Fl. Antarct. I (1844), p. 11. *C. verna* Linn. subsp. *obtusangula* Hook. f. Phil. Trans. Roy. Soc. vol. 168, p. 20 (1879).

Macquarie Island:—Common in wet places, often associated with *Cardamine* and *Montia*. A. Hamilton (1894); H. Hamilton (1912–1913).

I have seen very few specimens of this from Macquarie Island, and all of them in an unsatisfactory condition. They are in young flower only, and show no signs of fruit, making it difficult to be sure of the species, the characters of which depend largely on the shape of the fruit. But in habit and flower they agree so well with specimens from the Snares and Campbell Island bearing the fruit of *C. antarctica* that I cannot doubt their identity.

Like *Tillæa moschata*, this is a true circumpolar plant, and has been recorded from almost all the islands of the subantarctic zone.

ONAGRACEÆ.

EPILOBIUM LINNAEOIDES *Hook. f.*

Epilobium linnæoides Hook. f. Fl. Antarct. I (1844), p. 10, t. 6, also Fl. Nov. Zel. I (1853), p. 58, and Handb. N.Z. Fl. (1864), p. 77; Haussk. Monog. Epilob. (1884); T. Kirk Students' Fl. (1889), p. 173; Cheesem. Man. N.Z. Fl. (1906), p. 179, and Subantarctic Islands of N.Z. II (1909), p. 406.

Macquarie Island:—Along the sides of gullies and in moist sheltered places on hillsides. A. Hamilton (1894); H. Hamilton (1912–1913).

The few specimens of this species that I have seen from Macquarie Island agree very closely with Auckland Island specimens collected by Aston and others. But then it is remarkably uniform in its characters, compared with most of the species of the genus. From Macquarie Island it extends northwards through the Auckland Islands, Campbell Island, and Antipodes Island to Stewart Island and the main islands of New Zealand, reaching its extreme northern limit on the elevated volcanic plateau surrounding the base of Tongariro and Ruapehu.

EPILOBIUM NUMMULARIFOLIUM *R. Cunn.*

var. NERTERIOIDES *Hook. f.*

Epilobium nummularifolium R. Cunn. var. *nerterioides* Hook. f. Fl. Nov. Zel. I (1853), p. 57, and Handbk. N.Z. Fl. (1864), p. 77; T. Kirk Students' Fl. (1899), p. 174; Cheesem. Man. N.Z. Fl. (1906), p. 180, and Subantarctic Islands of N.Z. II (1909), p. 407. *E. nerterioides* A. Cunn. Precur. n. 541; Hook. f. Fl. Antarct. I (1844), p. 11. *E. pedunculare* A. Cunn. Precur. n. 536, var. *aprica* Haussk. Monog. Epilob. (1884), p. 303.

Macquarie Island:—In swamps. A. Hamilton (1894); H. Hamilton (1912–1913).

H. Hamilton's specimens, which are all that I have seen, are very imperfect and few in number, and quite insufficient for the proper determination of the species. They bear no fruit, although portions of the previous year's peduncles are present, and the flowers are in very young bud only. Consequently no safe conclusions can be drawn from the inflorescence. The leaves are larger than is usual in var. *nerterioides*, and are much narrower, being ovate-oblong, instead of rounded-oblong or orbicular. The specimens do not correspond with examples gathered by Aston and Tennant on Auckland Island, or with New Zealand specimens of the plant, and it is quite possible that they may belong to another species. At the same time, it should be mentioned that the late Mr. T. Kirk examined A. Hamilton's specimens, which I have not seen, and had no hesitation in referring them to var. *nerterioides*.

UMBELLIFERÆ.

AZORELLA SELAGO *Hook. f.*

Azorella Selago Hook. f. Fl. Antarct. II (1847), p. 284, t. 99, and Phil. Trans. Roy. Soc. vol. 168 (1879), p. 20; T. Kirk Students' Fl. (1899), p. 191; Schenk in Pflanzengeogr. Subantark. Insel (1905), p. 29, tt. 1 to 10; Cheesem. Man. N.Z. Fl. (1906), p. 200, and Subantarctic Islands of N.Z. II (1909), p. 407.

Macquarie Island:—Abundant, ascending to the tops of the hills. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

This remarkable plant was originally discovered in Kerguelen Island in 1776 by Mr. W. Anderson, the surgeon during Cook's third voyage. At that time, not much interest was taken in Antarctic plants, and Anderson's specimens remained undescribed until Hooker published the Flora Antarctica in 1844–1847. Prior to that time, however, it had been collected in Fuegia by Darwin and Captain King, and Hooker himself had found it to be most abundant in Kerguelen. During the "Challenger" expedition it was also collected on the Crozets, Marion Island, and Heard Island. For the first information respecting its occurrence on Macquarie Island we are indebted to Mr. C. Fraser, for some time Superintendent of the Sydney Botanic Gardens, who, prior to 1832, sent specimens of it to Kew. In 1880 the species was gathered by Dr. Scott, who remarks that " it grows on the hillsides, forming globular masses often 4 feet across." A. Hamilton, when describing his visit to Macquarie Island in 1894, says that on the hill-tops the special feature of the vegetation was the *Azorella*, with its bright green convex masses of stems and leaves. H. Hamilton verbally informed me that it is abundant on the hills and open plateaux, at the higher levels forming the chief component of the scanty vegetation.

Professor Mosely, in a descriptive account of Marion Island (Notes by a Naturalist on the "Challenger," pp. 163–170), draws attention to the fact that at an elevation of 900 feet, where the temperature of the air was 45°F., the thermometer, when plunged into the centre of a mass of *Azorella*, rose to 50°. He argues that " it is evident that these mounds retain and store up a considerable quantity of the sun's heat, and this fact yields a partial explanation of their peculiar form, which is that of so many otherwise widely different Antarctic plants, and of some New Zealand alpine plants (*Raoulia*, *Haastia*). No doubt, power gained of resistance to wind is one of the chief causes of assumption of this form."

The magnificent series of plates given by Dr. Schenk in his " Pflanzengeographie der Subantarcktischen Insel" shows how much the physiognomy of the vegetation of the islands of the Kerguelen Group (Kerguelen, Crozets, Marion, &c.) is affected by the presence of the hummocks of *Azorella*. And Mr. A. Hamilton's explicit statement " that at about 300 feet you gain a plateau so swept by the antarctic gales that vegetation is reduced to compact closely growing mosses, small *Uncinias*, and the conspicuous cushion-like masses of *Azorella Selago*" shows that the same is the case in the uplands of Macquarie Island.

ARALIACEÆ.

STILBOCARPA POLARIS *A. Gray*.

Stilbocarpa polaris A. Gray Bot. U.S. Expl. Exped. (1854), p. 714; Hook. f. Handbk. N.Z. Fl. (1864), p. 100; T. Kirk Students' Fl. (1899), p. 215; Cheesem. Man. N.Z. Fl. (1906), p. 227, also Illustr. N.Z. Fl. I (1914), t. 70, and Subantarctic Islands of N.Z. II (1909), p. 409. *Aralia polaris* Homb. et Jacq. ex Hook. f. Fl. Antarct. I (1844), p. 19; Hook. f. Ic. Plant. t. 701; Homb. et Jacq. Bot. Voy. Astrol. et Zel. (1852), p. 55, t. 2 Dicot.

Macquarie Island:—Abundant on the slopes of the hills, and ascending almost to their summits. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

As I have elsewhere remarked, the discovery of *Stilbocarpa* dates back to 1840, in which year it was collected in the Auckland Islands, in quick succession, by Dr. Holmes of the American Exploring Expedition; by Admiral D'Urville, the commander of the French ships "Astrolabe" and "Zélée," and by Sir J. D. Hooker, who accompanied the Antarctic Expedition of Sir James Clark Ross. It was made known to the scientific world in 1843, under the name of *Aralia polaris*, through a beautiful plate issued in advance of the "Botany of the Astrolabe and Zélée," but Hooker's description in the Flora Antarctica, published in 1844, was the first good account to appear. Since then it has been observed and admired by every visitor to the Subantarctic Islands of New Zealand.

As for the physiognomy of *Stilbocarpa*, so many excellent accounts have been published that it is not necessary to repeat information already widely known. I may be allowed, however, to quote Hooker's remarks to the effect that it is "one of the most handsome and singular of the vegetable productions in the group of islands that it inhabits, which certainly contains a greater proportion of large and beautiful plants, relatively to the whole vegetation, than any country with which I am acquainted. Growing in large orbicular masses, on rocks and banks near the sea, or amongst the dense and gloomy vegetation of the woods, its copious bright green foliage, and large umbels of waxy flowers, often nearly a foot in diameter, have a most striking appearance." The above words refer to its appearance in Auckland Island, where it is associated with many other striking plants. In Macquarie Island, where *Pleurophyllum* is the only other really handsome species, *Stilbocarpa* is still more conspicuous.

Stilbocarpa was first observed on Macquarie Island by Dr. Scott in 1880. He remarks that it "is found all over the island, growing in large patches. In sheltered corners on the lower ground it is a handsome plant, and its bright green leaves are always conspicuous." A. Hamilton, in the account of his later visit in 1894, says, "Once beyond the belt of swamp you ascend the steep slopes of the hills, and here you struggle and wrestle with the huge leaves of the Macquarie Island Cabbage (*Stilbocarpa polaris*), a plant resembling very fine rhubarb . . . . . Round the tops of the hills in some of the more sheltered places or gullies stunted plants of *Stilbocarpa* and

Pleurophyllum cover the ground." It was also collected by H. Hamilton in 1912; and an excellent photograph taken by him is reproduced at p. 232 of vol. 2 of Mawson's "Home of the Blizzard." Unfortunately the publishers have appended to the illustration the very inaccurate title of "Kerguelen Cabbage"; but it nevertheless gives a good idea of the habit of the plant.

The origin of *Stilbocarpa* has yet to be explained. As I have elsewhere stated (Subantarctic Islands of New Zealand, II, p. 464) "*Stilbocarpa* has no near relatives in New Zealand, Australia, or South America, and must be looked upon as the most isolated genus in the flora of the southern islands, occupying a similar position to that of *Pringlea* in Kerguelen Island. Its presence is a most remarkable fact in botanical geography, and no satisfactory explanation of its origin has yet been advanced."

RUBIACEÆ.

Coprosma repens *Hook. f.*

Coprosma repens Hook. f. Fl. Antarct. I (1844), p. 22, t. 16A, also Fl. Nov. Zel. I (1853), p. 110, and Handb. N.Z. Fl. (1864), p. 119; T. Kirk Students' Fl. (1899), p. 245; Cheesem. Man. N.Z. Fl. (1906) and Subantarctic Islands of N.Z. II (1909), p. 412.

Macquarie Island:—Not uncommon, ascending to the summits of many of the hills. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

A. Hamilton states that *C. repens* is chiefly found on the masses of *Azorella* and amongst the tufts of mosses on the higher grounds, and H. Hamilton gives similar particulars on his labels. All the specimens that I have seen correspond well with the usual state of the species in New Zealand. Scott's specimens were not in flower; A. Hamilton's, as Kirk remarks, have most frequently four stamens, and the females four styles. H. Hamilton's are all females, and the flowers all have four styles. But this peculiarity is common in New Zealand.

C. repens is an abundant plant on the mountains of New Zealand, and extends southwards to Auckland Island, Campbell Island, and Antipodes Island. It is also found in Victoria and Tasmania.

COMPOSITÆ.

Pleurophyllum Hookeri *Buch.*

Pleurophyllum Hookeri Buch. in Trans. N.Z. Inst. XVI (1884), p. 395; T. Kirk Students' Fl. (1899), p. 278; Cheesem. Man. N.Z. Fl. (1906), p. 296, also Subantarctic Islands of N.Z. II (1909), p. 414, and Illustr. N.Z. Fl. I (1914), t. 92. *P. Hookerianum* T. Kirk in Trans. N.Z. Inst. XXIII (1891), p. 435, t. 40. *P. Gilliesianum* T. Kirk in Trans. N.Z. Inst. XXIII (1891), p. 435.

Macquarie Island:—Abundant in most parts of the island, ascending almost to the tops of the hills. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

This fine plant was one of the eight species collected on Macquarie Island prior to 1832, and forwarded to Kew by Mr. C. Fraser. Since then, it has been observed by all visitors interested in the vegetation of the island. Dr. Scott states " This, like the *Stilbocarpa*, occurs in large patches all over the island, and is the handsomest plant thereon. Its long sage-green leaves and purple flowers make it particularly noticeable." A. Hamilton remarks " This handsome plant was long past flowering when we landed, and the tips of the silvery leaves were frost-bitten. The last flowering did not seem to have been very general, as a very small percentage bore the dry flower-spikes. On one plant there were nine of these, bearing the remains of 164 flowers. The seedlings, even when the leaves are less than three inches long, have strong stout rootlets which go down through the mass of vegetable matter in which they grow. There is absolutely no sand or loam for them to grow in—nothing but decayed vegetable matter. In a specimen before me, in which the leaves are about 20 mm. long, the rootlet is 160 mm. in length. Mr. Kirk notes that the leaves of the young plants approach those of *P. criniferum* more nearly than specimens from Auckland and Campbell Islands . . The silvery patches of this handsome plant show out plainly among the mosses and grasses in the drier parts of the swamps, and in sheltered places on the uplands."

Like *Stilbocarpa*, *Pleurophyllum* is a genus confined to the islands to the south of New Zealand, and like it has three well defined species, of which *P. Hookeri* is the only one that extends to Macquarie Island. *Pleurophyllum*, however, is by no means so isolated in its characters as *Stilbocarpa*; for although its habit is most distinct, its floral characters are those of *Olearia*, *Celmisia*, *Aster* and *Erigeron*. Its nearest relatives are probably the macrocephalous species of *Olearia*.

Cotula plumosa *Hook. f.*

Cotula plumosa Hook. f. Handb. N.Z. Fl. 1864, p. 141, and Phil. Trans. Roy. Soc., vol. 168 (1879), p. 20; T. Kirk Students' Fl. (1899), p. 323; Cheesem. Man. N.Z. Fl. (1906), p. 352, and Subantarct. Islands of N.Z. II (1909), p. 416. *Leptinella plumosa* Hook. f. Fl. Antarct. I (1844), p. 26, t. 20.

Macquarie Island:—Abundant all along the shores of the island, on rocks and gravel, or in grassy places, but never far from the sea. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

According to Hooker (Fl. Antarct. I, p. 27), this handsome plant, which is by far the finest species of the genus, was originally discovered on Macquarie Island, " from whence specimens were received by Mr. Fraser in New Holland, and by him transmitted to England; but it is not ascertained who found them." It has since been observed by all visitors to the island. It is also found on the Auckland Islands, Campbell Island, and Antipodes Island; and occurs in great quantities on Kerguelen Island and the Crozets. Hooker remarks that on Kerguelen it forms " immense luxuriant blue-green patches where the soil is enriched by the dung of birds and seals." No doubt the growth of the plant in Macquarie Island is influenced in a similar manner.

H. Hamilton's collection contains an excellent series of specimens, which I have carefully compared with others from the Auckland and Campbell Islands. With the exception that the Macquarie Island plant is obviously smaller (which might be predicted from its more southerly habitat), I can see no differences of importance.

JUNCACEÆ.

JUNCUS SCHEUCHZERIOIDES *Gaud.*

Juncus scheuchzerioides Gaud. in Ann. Sc. Nat. V (1825), p. 100; Hook. f. Fl. Antarct. I (1844), p. 80, and II (1847), p. 358, also Phil. Trans. Roy. Soc., vol. 168 (1879), p. 21; Buchen. Monog. Junc. (1890), p. 61, and Pflanzenr. Heft 25 (1906), p. 171, t. 86; Cheesem. Man. N.Z. Fl. (1906), p. 731.

Macquarie Island:—Marshy ground, north end. H. Hamilton (1912–1913).

H. Hamilton's specimens, referred to above, are the first collected in Macquarie Island. They exactly correspond with examples gathered by Kirk on Antipodes Island, and by Aston on Auckland Island; but hardly agree with Buchenau's fine plate in the Pflanzenreich, being smaller, less branched, and with much less conspicuous leaf-sheaths. Buchenau appears to doubt the identity of the New Zealand plant with the South American, but does not state how they differ. *J. scheuchzerioides* is very closely allied to *J. novæ-zealandiæ* and *J. pusillus*, and small specimens, especially when in young flower, may easily be confused with either of them.

J. scheuchzerioides ranges southwards from Argentina to Fuegia and Falkland Islands. It has also been recorded from South Georgia, Kerguelen Island, and the Crozets, but there is a doubt as to whether the specimens from some of these localities would not be more correctly placed under *J. novæ-zealandiæ* or *J. pusillus*. It was gathered by Hooker on Auckland Island and Campbell Island, and by Kirk on Antipodes Island. In the Handbook of the New Zealand Flora, Hooker records it from the Lake District of Otago, on the authority of specimens collected by Hector and Buchanan, but it does not seem to have been met with of late years.

LUZULA CAMPESTRIS D.C.

var. CRINITA *Hook. f.*

Luzula campestris D.C. Fl. Franc. III (1905), p. 161, var. *crinita* (Hook. f.) Buchen. in Osterr. Bot. Zeit. (1898), p. 215, also Pflanzenr. Heft 25 (1906), p. 93; Cheesem. Man. N.Z. Fl. (1906), p. 737, and Subantarct. Islands of N.Z. II (1909), p. 432. *L. crinita* Hook. f. Fl. Antarct. I (1844), p. 84, t. 48, and II (1847), p. 545, also Handbk. N.Z. Fl. (1864), p. 293; Buchenau Monog. Junc. (1890), p. 151.

Macquarie Island:—Plentiful, especially in damp peaty places. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Prior to 1898, when Dr. Buchenau, the great authority on the *Juncaceæ*, published his masterly memoir on "*Luzula campestris* and its allied species" (Oesterr. Bot. Zeit. (1898), all botanists were practically agreed in maintaining *Luzula crinita* as a separate species. It is true that Hooker, who, when he originally described it in 1844, remarked that "this appears to be a very distinct species, most nearly allied to *L. Alopecurus* Desv," had twenty years later acquired some doubts as to its distinctness, for in the "Handbook" he says "probably only a gigantic form of *L. campestris*, with broader leaves and more ciliated bracts." Still, so far as I am aware, no botanist proposed any change until Buchenau approached the subject. The robust habit, and particularly the broad leaves and bracts, with their distinctly thickened and conspicuously ciliate margins, the compact and dark-coloured inflorescence, usually reduced to a single conglobate head, undoubtedly give the plant a most distinct appearance. But all the above characters are uncertain and highly variable; and Buchenau is perfectly justified in remarking that "this form cannot be kept up as a species, as the degree of ciliation, and the breadth of the leaves, &c., are unreliable characters." Students of the genus would do well to carefully study Buchenau's memoir, quoted above, and also his later summary given in the Pflanzenreich (25, pp. 84 to 95).

Var. *crinita* has been observed by all visitors to Macquarie Island, and appears to be generally distributed in suitable localities from sea-level to a considerable height on the hills. H. Hamilton's collection contains six sheets of specimens, showing great variation in size, degree of robustness, length of leaves as compared with that of the culms, degree of ciliation, &c. The inflorescence, however, is in almost cases massed into a single conglobate head. Specimens gathered on swampy flats about 50 feet above sea-level reach a height of from 25 to 40 cm., the leaves, however, often not attaining half that length. This form appears to have the leaves and bracts much less ciliate, but this may be due to the specimens being well advanced in age. On the other hand, specimens collected on wind-swept ridges range from 5 to 10 cm. in height, the culms being considerably overtopped by the leaves; and the whole plant is stouter and more rigid.

The geographical range of var. *crinita* is commonly supposed to be limited to the islands to the south of New Zealand. But I possess specimens from Stewart Island which I cannot distinguish from others gathered on Auckland Island.

CYPERACEÆ.

SCIRPUS AUCKLANDICUS *Boeck.*

Scirpus aucklandicus Boeck in Linnaea, XXXVI (1869–1870), p. 491; Cheesem., Man. N.Z. Fl. (1906), p. 773, and Subantarct. Islands of N.Z. II (1909), p. 433. *Isolepis aucklandica* Hook. f., Fl. Antarct. I (1844), p. 88, t. 50, and Handbk. N.Z. Fl. (1864), p. 302; Hemsl. in Bot. Chall. Exped., Part III (1885), p. 266.

Macquarie Island:—Wet places near the sea. H. Hamilton (1912–1913).

Scirpus aucklandicus was first gathered on Macquarie Island by H. Hamilton, who observes that it occurs in small patches in swampy hollows, and on low-lying coastal flats. Probably it is abundant in suitable localities all round the island. It is the most plentiful species of the genus in the islands to the south of New Zealand, and is common in mountain districts in New Zealand itself. It has also been recorded from Tasmania, and from the isolated Amsterdam Island.

Uncinia riparia *R.Br. var.* Hookeri *Kukenth.*

Uncinia riparia R.Br. Prodr. Fl. Nov. Holl. (1810), p. 241, var. *Hookeri* (Boott) Kukenth. in Pflanzenr. Heft 38, p. 63; Cheesem. Subantarct. Islands of N.Z. II (1909), p. 434. *U. Hookeri* Boott in Hook. f. Fl. Antarct. I (1844), p. 91, t. 51. *U. rupestris* Boott in Hook. f. Fl. N.Z., I (1853), p. 286, and Hook. f. Handb. N.Z. Fl. (1864), p. 310; Cheesem. Man. N.Z. Fl. (1906), p. 804.

Macquarie Island:—Ascending the hills to a considerable height. A. Hamilton (1894).

I have seen no specimens of any species of *Uncinia* from Macquarie Island, and there are no examples in H. Hamilton's collection. But it is quite certain that a species of the genus was collected during the earlier visit of A. Hamilton. His specimens were examined by Kirk, who referred them to *U. nervosa* Boott. He remarked that "this is intermediate between *U. compacta* R.Br. and *U. tenella* R.Br.; the leaves closely approach those of the former, while the fruits resemble the latter, but are of a darker colour, and more glossy." I am informed that at a later date Kirk referred the specimens to *U. rupestris* Raoul, in which he also included the *Uncinias* gathered by himself on the Auckland Islands and Antipodes Island in 1890. In this view he was no doubt influenced by the opinion of the late Mr. C. B. Clarke, who had previously referred Boott's *U. Hookeri* from Auckland and Campbell Islands to *U. rupestris*. I adopted the same view in the "Manual," but when preparing my memoir on the Subantarctic Islands, I was led to re-examine the question in the light of much more complete material. I now agree with Kukenthal, who has made a special study of the genus, in considering that neither Hooker's nor Kirk's specimens agree with Raoul's description and plate, and are much better included in R. Brown's *U. riparia*. Until further information is obtained respecting the Macquarie Island plant it is better to treat it in the same manner.

Carex trifida *Cav.*

Carex trifida Cav. V (1799), p. 41, t. 465; Hook. f. Fl. Antarct. I (1844), p. 89, also II (1847), p. 368, and Fl. Nov. Zel. (1853), p. 284; Cheesem. Man. N.Z. Fl. (1906), p. 833, and Subantarct. Islands of N.Z. II (1909), p. 434.

Macquarie Island:—Fringing swamp-holes on flats at West Point. H. Hamilton (1912–1913).

Mr. H. Hamilton is the first to gather this species on Macquarie Island, where it seems to be rare, for he remarks on his labels that it was only seen in the locality quoted above. His specimens correspond very well with others that I have examined from Auckland Islands and the Snares. It has also been recorded from Campbell Island and Antipodes Island. In New Zealand it is sparingly found near the coast from Queen Charlotte Sound southwards to Foveaux Straits. In South America it was collected by the illustrious Darwin at Cape Tres Montes, to the south of the Chonos Archipelago; and Sir J. D. Hooker found it abundant on the Falkland Islands; but so far as I am aware, it has not been recorded in the intervening districts of Patagonia and Fuegia. It is also unknown in the South Georgia and Kerguelen groups. *C. trifida* is the only species of *Carex* confined to temperate South America and the New Zealand area, unless Kükenthal is correct in identifying a Chatham Island plant with the South American *C. Darwinii*.

GRAMINEÆ.

Agrostis magellanica *Lam.*

Agrostis magellanica Lam., Illustr. I (1791), p. 160; Hook. f. Phil. Trans. Roy. Soc. (1879), p. 21; Cheesem. Man. N.Z. Fl. (1906), p. 862; Petrie in Subantarct. Islands II (1909), p. 473. *Agrostis antarctica* Hook. f. Fl. Antarct. II (1847), p. 374, t. 132, and Handb. N.Z. Fl. (1864), p. 327. *Agrostis multicaulis* Hook. f. Fl. Antarct. I (1844), p. 95.

Macquarie Island:—Common all over the island, in swampy places and on the hillsides. A. Hamilton (1894); H. Hamilton (1912–1913).

This is a widely distributed species. It is found in southern Chili, Fuegia, and the Falkland Islands; and has also been recorded from Kerguelen Island, Marion Island, and Heard Island, but curiously enough has not yet been detected in South Georgia. It is abundant in the Subantarctic Islands of New Zealand; and has also been gathered in a few localities in New Zealand proper. It is thus a true circumpolar species, and its wide distribution, together with that of a few other species, must be taken into account in considering the origin and development of the southern circumpolar flora generally.

It is somewhat remarkable that Dr. Scott did not collect *A. magellanica* on Macquarie Island; for both the Hamiltons assure me that it is abundant thereon. The numerous specimens collected by H. Hamilton prove that it varies greatly in size, as also in the length of the awn, and the degree of development of the palea.

Deschampsia Chapmani *Petrie.*

Deschampsia Chapmani Petrie, in Trans. N.Z. Inst. XXIII (1891), p. 401, and in Subantarctic Islands of N.Z. II (1909), p. 877. *D. Hookeri* T. Kirk in Journ. Bot. XXIV (1891), p. 237. *Catabrosa antarctica* Hook. f. Fl. Antarct. I (1844), p. 102, t. 56. *Triodia antarctica* Benth. in Journ. Linn. Soc. XIX (1881), p. 111.

Macquarie Island:—Swampy flats near the sea, not uncommon. A. Hamilton; H. Hamilton (1912–1913).

There are several sheets of specimens of this species in H. Hamilton's collection. Although variable in size, and in the degree of development of the panicle, its floral characters appear to be fairly constant, and agree well with specimens that I have examined from Auckland Island, Canterbury, and Otago. It was first collected by Sir J. D. Hooker on Campbell Island in 1840.

D. Chapmani is closely allied to the two New Zealand species, *D. novæ-zealandiæ* and *D. tenella*. The first of these is best distinguished by the total absence of the dorsal awn; the second is separated by the hairy rhachilla. In habit and mode of growth there is little to separate the three plants, and they were grouped together by T. Kirk under the name of *D. Hookeri*. It is really little more than a matter of taste whether this view is adopted, or whether the three species are kept up.

Deschampsia penicillata *T. Kirk.*

Deschampsia penicillata T. Kirk in Trans. N.Z. Inst. XXVII (1895), p. 354; Cheesem. Man. N.Z. Fl. (1906), p. 879; Petrie in Subantarct. Islands of N.Z. II (1909), p. 475.

Macquarie Island:—In swamps. A. Hamilton (1894).

I regret that this species was not collected by H. Hamilton during his recent visit. Our knowledge of it is thus confined to the two specimens originally described by Kirk. While it has the hairy rhachilla of *D. tenella* and *D. gracillima*, it differs from both in the total absence of the dorsal awn, and in the rhachilla being produced beyond the upper flower, often bearing a rudimentary glume at the tip. It is presumably confined to Macquarie Island.

Triodia macquariensis *Cheesem. n.sp.*

Gramen perenne, dense caespitosum. Culmi numerosi, erecti vel geniculati, multinodi, 6–12 cm. alti, laeves, glabri, ad paniculam vaginati. Folia summa paniculam excedens, linearia, 1–2 mm. lata, glabra, profunde striata, plana vel involuta, apice calloso-indurata; ligula lata, scariosa; vaginae elongatae, latae, albidae, membranaceae. Panicula contracta, glabra, 2–3 cm. longa, parce ramosa. Spiculae 6–15, 3–5 florae, 6–7 mm. longae; rhachilla inter flores elongata, glabra. Glumae vacuae inaequales, quam florentes multo minores, oblongae, obtusae, trinerves. Glumae florentes ovatae vel lata oblongae, 5-nerves, glabrae, apice minute 3-dentatae vel irregulariter erosae. Palea lata, 2-carinatae, carinis ciliatis. Lodiculae acutae membranaceae.

Macquarie Island:—Rocks and cliffs near the coast. H. Hamilton (1912–1913).

Apparently perennial, tufted, often forming dense patches, smooth and glabrous. Culms numerous, erect or geniculate at the base, 6–12 cm. long, leafy to the base of the panicle. Leaves equalling the culms or longer than them, rather narrow, 1–2 mm.

broad, deeply striate, quite glabrous, flat or involute, margins thickened, tips obtuse, callous; ligules broad-ovate, thin and membranous; sheaths unusually long, much broader than the blades, sometimes as much as 5 mm. across, smooth, pale and membranous. Panicle narrow, glabrous, 2–3 cm. long; branches few, short, erect. Spikelets 6–15, 3–5 flowered, 6–7 mm. long, the lowest flower sessile at the base of the spikelet, the upper usually remote from one another. Empty glumes unequal, the lower half to two-thirds the length of the upper, glabrous, oblong, obtuse, 3-nerved. Flowering glumes ovate or broadly ovate-oblong, rounded at the back, not keeled, 5-nerved, glabrous or very faintly pubescent on the nerves, minutely 3-toothed at the tip or irregularly erose. Palea broad, 2-keeled, the keels ciliolate. Lodicules 2, acute.

H. Hamilton remarks that this is a common coastal grass, found in crevices in bare rock or on the cliffs. Some of his specimens are plentifully mixed with *Tillæa moschata* and *Colobanthus muscoides*, both of them plants common in littoral situations. Scraps of *Callitriche antarctica* are also present. Its discovery adds another species to the list of those endemic in Macquarie Island, of which three species are now known —*Deschampsia penicillata*, *Poa Hamiltoni*, and *Triodia macquariensis*. I trust to show in this memoir that this fact is not without significance when the previous history of the florula is considered.

Triodia macquariensis is a puzzling plant to place. It differs from *Poa* principally in the flowering glumes being rounded on the back, and minutely 3-toothed (or irregularly erose) at the tip. It agrees with *Atropis* in the flowering glumes being rounded on the back, but differs in habit and in the 3-toothed tip of the flowering glume. Although it is not a typical *Triodia*, it must be kept in the vicinity of the New Zealand *T. australis*.

Poa foliosa *Hook. f.*

Poa foliosa Hook. f. Handb. N.Z. Fl. (1864), p. 338, excl. var. b.; Buch. N.Z. Grasses (1878), t. 42; Cheesem. Man. N.Z. Fl. (1906), p. 900; Petrie in Subantarct. Islands of N.Z. (1909), p. 476. *Festuca foliosa* Hook. f. Fl. Antarct. I (1844), p. 99, t. 55.

Macquarie Island:—Abundant throughout the island, from sea-level to a considerable height on the hills. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Poa foliosa is the most important constituent of the vegetation of Macquarie Island, and the one which affects its physiognomy to the greatest extent. How much this is the case, is evident from an inspection of the illustrations of Macquarie Island scenery given in Sir Douglas Mawson's "Home of the Blizzard" (see particularly those opposite pages 166, 172 and 188 of vol. 2), while additional proof can be obtained from the published accounts of various visitors, as Dr. Scott, Mr. A. Hamilton and several members of the Mawson Expedition. Speaking generally, it can be said that low-lying and swampy situations near the coast are almost invariably covered with a more or less dense growth of this species, perched on tall stools or trunks several feet in height,

around which, according to A. Hamilton (see his paper in Trans. N.Z. Inst. XXVII, pp. 564–568), " is usually a muddy pool more or less deep, into every one of which you plunge with unerring certainty when trying to cross the belt of tussock-grass." Later on he says: " This noble grass forms huge tussocks, especially in the damper portions, where the drainage and the liquid manure from the penguin rookeries assist its growth. In such places one can walk between the columns with the plant waving far overhead."

Poa foliosa also occupies no small part of the hillsides, as the following quotation from the " Home of the Blizzard " will prove :—" The hillsides are deeply ravined, and the slopes covered with a dense growth of tussock, which renders progress uncertain and laborious " (vol. 2, p. 172). Dr. Scott also speaks of the " long stretches of yellowish tussock, with occasional great patches of the bright green *Stilbocarpa polaris*, or of the peculiar sage green *Pleurophyllum*." Further quotations could be given, but it is abundantly evident that it is the dominating plant of the island.

Outside Macquarie Island, *Poa foliosa* is commonly found on all the other islands to the south of New Zealand proper. It is also a close relative of the Kerguelen Island *P. Cookii* and the Fuegian and Falkland Island *P. flabellata* Hook. f. (*Dactylis cæspitosa* Forst.).

Poa Hamiltoni *T. Kirk.*

Poa Hamiltoni T. Kirk in Trans. N.Z. Inst. XXVII (1894), p. 353; Cheesem. Man. N.Z. Fl. (1906), p. 1156; Petrie in Subantarct. Islands of N.Z. II (1909), p. 477.

Macquarie Island:—On rocks near the sea, usually fringing the *Poa foliosa* formation. A. Hamilton (1894); H. Hamilton (1912–1913).

Perennial, densely tufted, 1–5 dm. high. Culms shorter than the leaves, erect, stout, sometimes 5 cm. diam. below, compressed, leafy almost up to the base of the panicle. Leaves numerous, subdistichous, lower much reduced in size and sheathing the culm, gradually passing into the upper, which usually far overtop the panicle, 4–7 mm. diam. at the base, from thence gradually tapering into a long acuminate point, flat, coriaceous, many-striate, smooth and glabrous, not scabrid; ligules large, broad, ovate, membranous, deeply and irregularly laciniate; sheaths long, compressed, thin and rather membranous, regularly striate. Panicle linear-oblong or linear-obovate, sometimes almost clavate, dense and contracted, rarely sub-lobed towards the base, 5–9 cm. long, 1·0 to 1·3 cm. broad, usually strict and erect; branches close set, rarely more than 2 cm. long. Spikelets rather large, compressed, 5–7 mm. long, 2–4 flowered; lower flower almost sessile, upper pedicelled. Outer glumes unequal, but not remarkably so, ovate-lanceolate, acuminate, 3-nerved; flowering glumes lanceolate or ovate-lanceolate, acuminate or almost awned, incurved at the tip, keeled, 5-nerved, scabrid on the keel and nerves, shortly hairy on the sides towards the base, but not webbed. Palea linear-oblong, bifid at the tip, ciliate on the margins and keels, about one-third shorter than the glume. Lodicules broad-ovate, acute. Anthers large, narrow-linear, 3 mm. long.

Kirk's original description was evidently based on incomplete material, which apparently has been lost. As the species is endemic in Macquarie Island, and thus possesses considerable interest, I have prepared the above diagnosis, using the excellent specimens brought back by H. Hamilton. As a species, *P. Hamiltoni* is best characterised by the short strict culms, the deeply laciniate ligule, and the short and narrow much-contracted panicle. Kirk states that its nearest allies are *P. foliosa* and *P. anceps*. It doubtless belongs to the *P. foliosa* group; but it has little affinity with *P. anceps*, from which it differs in the mode of growth, in the leaves, and particularly in the deeply laciniate ligule, which is widely different from the truncate rim-like ligule of *P. anceps*, also in the acuminate and incurved flowering glumes, and the large anthers.

Poa annua *Linn.*

Poa annua Linn. Sp. Plant. 68; Hook. f. Fl. Antarct. I (1844), p. 101; Cheesem. Man. N.Z. Fl. (1906), p. 1091, and Subantarct. Islands of N.Z. II (1909), p. 445.

Macquarie Island:—Naturalized. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Poa annua is one of those plants which penetrate into any locality capable of supporting phænogamic vegetation, however remote or inhospitable it may be. Sir J. D. Hooker, in the Flora Antarctica, states that when Ross's expedition visited the Auckland Islands in 1840 it was "abundant on the tomb of a French sailor, growing with *Stellaria media*, both undoubtedly introduced"; remarking, however, that "it has not as yet spread far from the above locality." Since that time it has become abundant in all the subantarctic islands. It was first observed in Macquarie Island by Dr. Scott, who observed that it was found near one of the sealers' huts. A. Hamilton, writing fourteen years later, states that it was naturalized, and doing well. He also adds that "it is interesting to see how the introduced *Poa annua* has taken possession of the highly-manured soil on the crown of the beach, and radiates from the settlements, together with some other introduced weeds." H. Hamilton informed me that at the time of his visit it was plentiful near all the residences of the sealers.

Festuca erecta *D'Urville.*

Festuca erecta D'Urv. in Mem. Soc. Linn. Paris IV (1826), p. 601; Hook. f. Fl. Antarct. II (1847), p. 384. *Festuca contracta* T. Kirk in Trans. N.Z. Inst. XXVII (1898), p. 353; Cheesem. Man. N.Z. Fl. (1906), p. 919; Petrie in Subantarc. Islands of N.Z. II (1909), p. 479.

Macquarie Island:—Rocks near the sea. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Perennial, densely tufted, 20–30 cm. high. Culms strict, erect, 2-noded or rarely 3-noded, the lowest node near the base, quite smooth and glabrous. Leaves usually overtopping the culms, narrow, strict, erect, quite glabrous; sheaths rather lax,

much broader than the blades, 4–7 mm. diam., pale, thin and membranous, striate; blades narrow, 2–3 mm. across, complicate and appearing almost terete, quite smooth, faintly 10–12 ribbed on the outside, the ribs much more prominent on the inner face, which is usually furnished with short stiff hairs; apex of leaf rigid and pungent. Panicle contracted, narrow, erect, 6–10 cm. long; rhachis angular, finely scabrid on the angles; branches solitary, or sometimes a very short one at the base, close together or the lower a little remote; lateral branches very short. Spikelets 10–12 mm. long including the awns, 2–3 flowered; two outer glumes unequal, lanceolate, acuminate, from three-fourths to four-fifths the length of the entire spikelet; lower faintly three-nerved, upper distinctly three-nerved. Flowering glumes lanceolate, rounded on the back, faintly scaberulous, rather thin, distinctly five-nerved, narrowed into a short stiff awn. Palea shorter than the glume, narrow lanceolate, scaberulous on the keel. Grain narrow-obovoid; hilum long, linear.

Originally discovered in Macquarie Island by Dr. Scott. His specimens were much too immature for correct identification, but were provisionally referred to *F. duriuscula*, with which it has no affinity. In 1894 it was again collected by A. Hamilton, but the material which he brought back consisted only of two very indifferent examples. These were described by T. Kirk as a new species under the name of *Festuca contracta*. Fortunately H. Hamilton was able to collect a fair number of specimens. From an examination of these it became evident that the plant was either very closely allied to the Fuegian and Kerguelen *Festuca erecta* D'Urv., or positively identical with it. There being no authenticated specimens of *F. erecta* in New Zealand, I applied to Dr. Stapf, of the Kew Herbarium, with the view of having a comparison made. This he has kindly done, with the result of proving that the Macquarie Island plant is identical with *F. erecta*.

Three other plants—*Ranunculus biternatus*, *Acæna adscendens*, and *Azorella Selago*—agree with *Festuca erecta* in being found in Fuegia, Kerguelen, and Macquarie Island, and in not extending to the New Zealand Subantarctic Islands. Their existence in Macquarie Island is a most remarkable fact, and can only be explained as an instance of comparatively recent migration through the agency of oceanic birds, carried before the continuous westerly winds.

As no recent description of *Festuca erecta* has been published, I have prepared the preceding one for this memoir.

FILICES.

Lomaria penna-marina *Trev.*

Lomaria penna-marina Trev. in Att. Inst. Ven. XIV (1869), p. 570; Cheesem. Subantarct. Islands of N.Z. II (1909), p. 439. *Polypodium penna-marina* Poir. Encycl. V (1804), p. 529. *Stegania alpina* R.Br. Prodr. (1810), p. 152. *Lomaria alpina*

Spreng. Syst. Veg. IV (1827), p. 62; Hook. f. Fl. Antarct. II (1847), p. 393, t. 150, and Handb. N.Z. Fl. (1864), p. 368; Cheesem. Man. N.Z. Fl. (1864), p. 980. *Blechnum alpinum* Mett. Fil. Lips. (1856), p. 64. *B. penna-marina* Kuhn Fil. Afr. (1869), p. 92.

Macquarie Island:—Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

It is remarkable that although this species is abundant on Antipodes Island, and is evidently not uncommon on Macquarie Island, it has not yet been found on either Auckland or Campbell Island. This is all the more curious, from the fact that it occurs on almost all lands between lat. 35° S. and lat. 55° S. It is common in New Zealand proper, except in the extreme north, and has an extensive range in extra-tropical Australia, while in South America it ranges southwards from Chili to Fuegia and Falkland Islands. In the circumpolar islands it has been recorded from Tristan d'Acunha, Amsterdam and St. Paul Islands, also from Kerguelen Island and the Crozets.

The fine series of specimens gathered by H. Hamilton agree well with New Zealand examples.

Aspidium vestitum *Swartz.*

Aspidium vestitum Swartz Syn. Fil. (1806), p. 53 and 234; Cheesem. Subantarct. Islands of N.Z. II (1909), p. 441. *Polypodium vestitum* Forst. Prodr. (1786), n. 445. *Polystichum vestitum* Presl. Tent. Pterid. (1836), p. 63; Homb. and Jacq. Voy. au Pôle Sud. Crypt. t. 4, fig. S. *Polystichum venustum* Homb. and Jacq. ex Hook. f. Fl. Antarct. I. (1844), p. 106, and Voy. au Pôle Sud (1853), t. 5, fig. N. *Aspidium aculeatum* Linn. var. *vestitum* Hook. f. Handb. N.Z. Fl. (1864), p. 375; Cheesem. Man. N.Z. Fl. (1906), p. 997.

Macquarie Island:—Not uncommon. Fraser; Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Aspidium vestitum was one of the eight species sent from Macquarie Island to the Kew Herbarium by Mr. C. Fraser, of the Sydney Botanic Gardens, more than eighty years ago. It is noteworthy that this little collection was the first to reach Europe from any of the New Zealand Subantarctic Islands. Since that time, it has been observed by every visitor to the Island who has interested himself in its vegetation, and is evidently plentiful in all suitable localities. It is also the most abundant fern of the New Zealand Outlying Islands generally. It is abundant in New Zealand proper, and is not rare in extra-tropical Australia and Tasmania. In South America it occurs on Juan Fernandez, Fuegia, and the Falkland Islands. So far it has not been observed in the South Georgia to Kerguelen group of islands.

Polypodium australe Mett.

Polypodium australe Mett. Polyp. (1857), p. 36; Hook. f. Handb. N.Z. Fl. (1864), p. 380; Cheesem. Man. N.Z. Fl. (1906), p. 1010, and Subantarct. Islands of N.Z. II (1909), p. 442. *Grammitis australis* R.Br. Prodr. (1810), p. 146; Hook. f. Fl. Antarct. I (1844), p. 111; Homb. and Jacq. Voy. au Pôle Sud Crypt. (1853), t. 2, fig. G. *Grammitis Billardieri* Willd. Sp. Plant. V (1810), p. 139. *G. rigida* Homb. and Jacq., l.c. t. 2, fig. F. *G. humilis* Homb. and Jacq., l.c. t. 2, fig. H.

Macquarie Island:—Not uncommon, ascending to the tops of the hills. Scott (1880); A. Hamilton (1894); H. Hamilton (1912–1913).

Polypodium australe was first collected on Macquarie Island by Dr. Scott in 1880. He remarks that "my specimens show an extremely alpine form." It was gathered again by A. Hamilton in 1894, who also draws attention to its small size, "about ½ inch long," and further states that it was plentiful on the top of the convex masses of *Azorella* growing on the higher parts of the island. The more recent specimens obtained by H. Hamilton are also of small size. They evidently correspond with the *Grammitis humilis* of Hombron and Jacquinot's "Voyage au Pôle Sud," gathered on Auckland Island in 1840, when he also collected the much larger *G. rigida*, and the intermediate *G. australis* R. Brown. Sir J. D. Hooker, in the Flora Antarctica, reduced all three to *G. australis*, remarking "That a copious suite of specimens, collected at different levels from the sea to an altitude of 1,400 feet, prove all the three species figured by MM. Hombron and Jacquinot to belong to states of one plant." The same great difference also occurs in New Zealand, and Armstrong's *G. pumila* is very near to, if not identical with the Macquarie Island plant. At the same time, I must confess that I am inclined to doubt the specific identity of the whole of the forms at present "lumped" under the name of *Polypodium australe*, or *Grammitis australis*, which appears to be the more fashionable title at the present time.

Polypodium australe has a wide range. In addition to the whole of the islands to the south of New Zealand and New Zealand proper, it occurs in many parts of Australia and Tasmania, and is not uncommon in Fuegia and Falkland Islands. It has also been recorded from Kerguelen Island, Marion Island, and from Tristan d'Acunha and Amsterdam Island.

LYCOPODIACEÆ.

Lycopodium varium R.Br.

Lycopodium varium R.Br. Prodr. (1810), p. 165; Hook. f. Fl. Antarct. I (1844), p. 115, also Fl. Nov. Zel. II (1853), p. 52, and Fl. Tasm. II (1860), p. 155, t. 170, and Handbk. N.Z. Fl. (1864), p. 389; Cheesem. Man. N.Z. Fl. (1906), p. 1035, also Subantarct. Islands of N.Z. II (1909), p. 444.

Macquarie Island:—A. Hamilton (1894); H. Hamilton (1912–1914).

This species was added to the florula by A. Hamilton in 1894. He remarks (Trans. N.Z. Inst. XXVII, p. 569) that "The habit is like that of *L. Selago*, but denser; the leaves are much broader. Seedling plants growing amongst the stems have distant oblong leaves. Found on the hills immediately behind Lusitania Bay." His specimens were submitted to the late Mr. Kirk, who identified them as "*L. Billardieri* Spreng. var. *varium*"—equivalent to *L. varium* R.Br. It was also collected by H. Hamilton, who states on the ticket accompanying his specimens that they were "Localised to a wind-swept plateau alt. 500 feet, near South-east Harbour." They have the habit and appearance of *L. Selago*, from which they differ mainly in forming dense much-branched compact tufts, often with an even surface at the top. The leaves are larger, broader, and more coriaceous. As is often the case in *L. Selago*, numerous gemmæ occur among the leaves, and these often produce shoots sometimes 2–3 inches long, bearing distant ovate or oblong leaves. These shoots evidently answer to the "seedling plants" of A. Hamilton. The fructification is much more like that of *L. Selago* than that of the usual state of *L. varium*, for in most cases the sporangia are produced for a considerable distance down the branches in the axils of unaltered leaves, exactly as in *L. Selago*; but in two or three specimens the upper portion of the branches is slightly narrowed, and the leaves smaller, thus showing an approach to the spicate character of *L. varium*. But for these examples, I should have treated the plant as a form of *L. Selago*.

Sir J. D. Hooker has repeatedly drawn attention to the fact that *L. varium* approaches very close to *L. Selago* on the one hand, and on the other appears to pass insensibly into *L. Billardieri*, thus "blending the two divisions *Selago* and *Phlegmaria*." His remarks, given in the Flora Antarctica and Flora of New Zealand, may be read with profit at the present time. In the Flora of Tasmania (vol. II, pp. 155–156) he again recurs to the matter, figuring five states of *L. varium* collected in Tasmania, which appear to gradually approach *L. Selago*. Although New Zealand botanists are well acquainted with varieties linking up *L. varium* and *L. Billardieri* (see Kirk's paper in Trans. N.Z. Inst., vol. XVI, p. 376), I am not aware that an approach to *L. Selago* so close as that shown by the Macquarie Island plant has been previously recorded from the New Zealand area.

States of *L. varium* are not uncommon in mountainous districts in New Zealand and throughout the islands to the south. The species is also found in Victoria and Tasmania. True *L. Selago* has not yet been definitely recorded from any of the southern circumpolar islands; but the closely allied *L. Saururus* Lam. exists in the Falkland Islands, Kerguelen Island, Marion Island, and Tristan d'Acunha. It is quite possible that the Macquarie Island plant may be referable to it, but *L. Saururus* appears to have stouter stems, and larger and narrower leaves; so that I hesitate to unite the two without having an opportunity of comparing specimens of both.

V. AFFINITIES, HISTORY, AND ORIGIN OF THE FLORA.

(In my memoir "On the Systematic Botany of the Islands to the South of New Zealand" (Subantarctic Islands of New Zealand, vol. II, pp. 289 to 471), I have discussed at considerable length the character of the flora of the subantarctic islands to the south of New Zealand, including Macquarie Island. In that memoir, I have passed in review the whole of the vascular plants found in the area, examining their affinities, and tabulating their geographical range. I have also attempted to inquire into the possible origin of the flora, and to show how it has acquired its present composition. Much that I have written therein is closely applicable to Macquarie Island, and should be perused by all students of this paper.)

Macquarie Island occupies a peculiarly interesting position for the plant geographer. Situated rather more than 600 miles to the south-west of New Zealand, and approximately 920 miles to the south-east of Tasmania, it is the last outpost of Australasia in the direction of Antarctica, from the nearest point of which it is distant about 970 miles. Auckland Island and Campbell Island make the nearest approach to it, but they lie quite 400 miles to the north-east. Away to the eastward rolls the vast expanse of the South Pacific, with no trace of land until the extreme termination of South America is reached, a distance of quite 4,600 miles. Further still to the eastward, and in precisely the same latitude as Macquarie Island, lies South Georgia, distant approximately 5,800 miles. And if we turn to the opposite direction, and travel westward from Macquarie Island, nothing but open ocean is seen until Kerguelen Island is reached, about 3,250 miles away. What is the nature of the vegetation that inhabits an island so far removed from any source of supply? A reply to this question will be afforded by the following list of the vascular flora, so far as it is known at present, accompanied by particulars as to the distribution of the species.

Catalogue of the Vascular Plants found on Macquarie Island, showing their geographical distribution (naturalized plants excluded).

1. *Ranunculus biternatus* Smith. Fuegia, Falkland Islands, South Georgia, Kerguelen Island, Marion and Crozet Islands, Amsterdam Island. A true circumpolar species.
2. *Cardamine corymbosa* Hook. f. Auckland and Campbell Islands, Fuegia.
3. *Cardamine glacialis* D.C., var. *subcarnosa* Schulz. Auckland and Campbell Islands. The typical plant is found in Chili, Fuegia, and the Falkland Islands.
4. *Stellaria decipiens* Hook. f. Auckland and Campbell Islands.
5. *Colobanthus muscoides* Hook. f. Auckland and Campbell Islands.

6. *Colobanthus Billardieri* Fenzl. Auckland and Campbell Islands, New Zealand, Australia and Tasmania. According to Dr. Skottsberg, the Australian plant is distinct, and the New Zealand one identical with the Fuegian and Falkland Islands *C. crassifolius* Hook. f.

7. *Montia fontana* Linn. Generally distributed throughout the north and south temperate zones.

8. *Acæna adscendens* Vahl. Patagonia, Fuegia, Falkland Islands, Kerguelen Island, Crozets, South Georgia.

9. *Acæna Sanguisorbae* Vahl, var. *minor* Hook. f. The variety is confined to the Auckland and Campbell Islands and Macquarie Island. The species is a circumpolar plant, and also occurs in Australia, Tasmania, and New Zealand proper.

10. *Tillæa moschata* D.C. A true circumpolar species, found in Chili and Fuegia, Falkland Islands, Kerguelen Island, Marion Island, Auckland and Campbell Islands, and New Zealand proper.

11. *Callitriche antarctica* Engelm. Another circumpolar plant. It is known from Fuegia and the Falkland Islands, Kerguelen Island, Marion and Heard Islands, South Georgia, and the New Zealand Subantarctic Islands.

12. *Epilobium linnæoides* Hook. f. New Zealand, and the New Zealand Subantarctic Islands.

13. *Epilobium nummularifolium* R. Cunn., var. *nerterioides* Hook. f. A doubtful determination. If correct, it occurs also in the Auckland and Campbell Islands and throughout New Zealand.

14. *Azorella Selago* Hook. f. Fuegia, Falkland Islands, Kerguelen Island, Marion and Crozet Islands. This must be classed as a circumpolar plant, notwithstanding its curious absence from the New Zealand Subantarctic Islands.

15. *Stilbocarpa polaris* A. Gray. New Zealand Subantarctic Islands.

16. *Coprosma repens* Hook. f. New Zealand Subantarctic Islands and New Zealand proper, Victoria, and Tasmania.

17. *Pleurophyllum Hookeri* Buch. New Zealand Subantarctic Islands.

18. *Cotula plumosa* Hook. f. New Zealand Subantarctic Islands, Kerguelen Island, and the Crozets. Might also be included in the list of circumpolar plants, though it does not occur in South Georgia, Falkland Islands, or Fuegia.

19. *Juncus scheuchzerioides* Gaud. New Zealand Subantarctic Islands, Fuegia, Falkland Islands, South Georgia, Kerguelen Island.

20. *Luzula campestris* D.C., var. *crinita* Buchen. The variety is confined to the New Zealand Subantarctic Islands; the species is world wide.

21. *Scirpus aucklandicus* Boeck. New Zealand Subantarctic Islands, New Zealand proper, Tasmania, and reported from Amsterdam Island.

22. *Uncinia riparia* R.Br., var. *Hookeri* Kuken. The variety confined to the New Zealand Subantarctic Islands and Macquarie Island; the species extends to New Zealand proper, Victoria, and Tasmania.

23. *Carex trifida* Cav. Almost a circumpolar plant, found in Fuegia, Falkland Islands, Auckland and Campbell Islands, and New Zealand proper.

24. *Agrostis magellanica* Lam. A true circumpolar species, recorded from Chili, Fuegia, Falkland Islands, Kerguelen Island, Marion and Heard Islands, Subantarctic Islands of New Zealand, and New Zealand proper.

25. *Deschampsia Chapmani* Petrie. Subantarctic Islands and New Zealand.

26. *Deschampsia penicillata* T. Kirk. Endemic.

27. *Triodia macquariensis* Cheesem. n.sp. Endemic.

28. *Poa foliosa* Hook. f. New Zealand proper and its Subantarctic Islands.

29. *Poa Hamiltoni* T. Kirk. Endemic.

30. *Festuca erecta* D'Urv. Fuegia, Falkland Islands, South Georgia, Kerguelen Island. Not found in the New Zealand Subantarctic Islands, but otherwise a circumpolar species.

31. *Lomaria penna-marina* Trev. A circumpolar species. It is recorded from Chili, Juan Fernandez, Fuegia, Falkland Islands, Kerguelen Island, Crozets, Tristan d'Acunha, Amsterdam and St. Paul Islands, Antipodes Island, New Zealand, Tasmania, and extra-tropical Australia.

32. *Aspidium vestitum* Swartz. New Zealand and its Subantarctic Islands, Tasmania and Australia, Fuegia and Juan Fernandez.

33. *Polypodium australe* Mett. A circumpolar species. Fuegia, Falkland Islands, Kerguelen Island, Marion Island, Tristan d'Acunha and Amsterdam Island, New Zealand and its Subantarctic Islands, Australia and Tasmania.

34. *Lycopodium varium* R.Br. Subantarctic Islands of New Zealand, New Zealand proper, Victoria, and Tasmania.

The following conclusions can be drawn from the above catalogue. First, that the thirty-four species inhabiting Macquarie Island include three endemic plants not known elsewhere—a very important fact. Secondly, of the remaining thirty-one, all but four are found in the New Zealand Subantarctic Islands. Eighteen extend to New Zealand proper, and eleven are found in no other country. The New Zealand area is so much nearer to Macquarie Island than any other land that these figures are in no way surprising. On the contrary, the natural assumption is that the New Zealand

element in the flora would much surpass any other. But if the distribution of the thirty-one non-endemic plants of Macquarie Island be further examined, the remarkable fact appears that fifteen, or practically one-half, are also found in Fuegia or the South Georgia to Kerguelen groups of islands. In other words, they inhabit a ring or zone of widely separated lands surrounding the Antarctic Continent within the parallels 45° S. to 60° S. I give a list of these "circumpolar" species, as they are now often termed.

PLANTS with a more or less circumpolar distribution found in Macquarie Island :—

Ranunculus biternatus Smith.
Cardamine corymbosa Hook. f.
Montia fontana Linn.
Acæna adscendens Vahl.
Tillæa moschata D.C.
Callitriche antarctica Engelm.
Azorella Selago Hook. f.
Cotula plumosa Hook. f.
Juncus scheuchzerioides Gaud.
Carex trifida Cav.
Agrostis magellanica Lam.
Festuca erecta D'Urv.
Lomaria penna-marina Trev.
Aspidium vestitum Swartz.
Polypodium australe Mett.

The presence of these "circumpolar" species on Macquarie Island would alone demand some explanation; but when we learn that they form as large a proportion of the non-endemic vegetation of Kerguelen and South Georgia as they do of Macquarie Island, notwithstanding the immense distance between the three localities, then it becomes evident that no inquiry into the origin and history of the Macquarie florula can be successfully carried out without dealing with the whole of the Subantarctic zone surrounding the Antarctic Continent, and that continent itself. In my memoir on the Subantarctic Islands of New Zealand, previously alluded to, I have treated at some length of this branch of the subject. I will therefore refer the reader to that publication for many minor details which it is unnecessary to mention here, confining myself to the elucidation of the proper subject of this memoir, and to the presentment of those facts, old and new, that are necessary to support the views advanced.

If first of all we take the Antarctic Continent, at present almost entirely covered with an everlasting mantle of snow and ice, we find that two Fuegian plants, *Colobanthus crassifolius* and *Deschampsia antarctica*, constitute the whole of the vascular vegetation. Neither of these is known from Macquarie Island, but as two species of both genera occur thereon, a certain amount of affinity is evident.

But although the living flora of Antarctica has been reduced to such small dimensions as to be of little use in tracing the origin and connections of the subantarctic flora, it is quite different with respect to the fossil flora. In Graham Land and the adjacent islands, which collectively make the nearest approach to South America,

Dr. J. G. Andersson, of the Swedish Antarctic Expedition, was fortunate enough to discover two fossil floras—one of Jurassic age, containing many ferns and conifers; the other of late Cretaceous or Early Tertiary date, comprising species of the well-known genera *Sequoia, Araucaria, Knightia, Drimys, Fagus*, and many others. As I have elsewhere remarked, the importance of this discovery can hardly be overestimated, and further exploration will probably throw a flood of light on the composition of the former vegetation of the Antarctic Continent, and give great aid in working out the origin of southern floras generally. Dr. Skottsberg, in his excellent paper on the "Relations between the Floras of Subantarctic America and New Zealand" (Plant World, vol. 18 (1915), pp. 129 to 142), speaking of Andersson's discoveries, says: "With these facts at hand, it becomes evident that there existed an Antarctic Tertiary Flora bearing resemblances to the present floras of Subantarctic America, New Zealand and Australia, and that the Antarctic Continent may have been a centre from which animals and plants wandered north." Further discussion on this point, however, is better deferred until we can consider the relationship between the vegetation of the southern portion of South America, the Subantarctic Islands, and the Antarctic Continent.

Let us first turn to the Subantarctic zone. This is most conveniently divided into the following sectors:—1. South Georgia. 2. Kerguelen, including the Crozets, Marion and Prince Edward Islands, and Heard Island. 3. Macquarie Island. 4. The New Zealand Subantarctic Islands, comprising Auckland, Campbell, and Antipodes Islands. 5. Fuegia and the Falkland Islands.

South Georgia lies about 1,000 miles to the eastward of Cape Horn, and about 750 miles from the nearest portion of the Antarctic Continent. It is of considerable size, being ninety-five miles in length, by twenty miles in greatest breadth, but is little more than a high mountain range, several of the summits of which exceed 6,000 feet. There are extensive snowfields in the interior, and glaciers discharge into all the fiords. Evidences of extreme recent glaciation are everywhere conspicuous, and geologists are agreed in believing that within a recent period the whole island has been covered with a continuous ice-sheet. As will be seen from the meteorological tables given in a previous portion of this memoir, the climate is cold, wet and stormy. The mean temperature for the year (34·5°) is six degrees lower than that (40·7°) of Macquarie Island, and the mean temperature of the winter months (29·8°) is quite nine degrees below. Under such conditions, a numerous flora cannot be expected, and it is not surprising that although the island has several times been botanically explored, only eighteen vascular plants have been detected.

The flora of South Georgia is thus not much more than half as extensive as that of Macquarie Island, which includes thirty-four species. Further than that, Macquarie Island has three endemic plants, whereas it can hardly be said that South Georgia has one. It is true that Bitter, in his monograph of *Acæna*, has described a sub-species

of *A. adscendens* as peculiar to the island, but its differences from the type are very slight. Comparing the distribution of the non-endemic plants of Macquarie Island with the South Georgian flora, a remarkable parallelism appears. The thirty-one non-endemic plants, with four exceptions, extend to the New Zealand Subantarctic Islands, which constitute the nearest land, but no less than fifteen reach Fuegia and the South Georgia and Kerguelen groups of islands. Similarly, the eighteen species inhabiting South Georgia, with one exception, are all found in Fuegia, which is the nearest land with a well-developed vascular vegetation. Further, no less than thirteen out of the eighteen occur in some parts of the Kerguelen, Macquarie, and New Zealand group of Islands. The one fact that underlies the peculiarities of the South Georgian flora, is that it is essentially Fuegian in its origin, and of comparatively modern date. For it cannot be doubted that the ice-sheet which, not so long ago, overspread the whole island, must have blotted out the pre-glacial vegetation, with the exception of a few cryptogams, and that the present vegetation must be looked upon as being composed of immigrants from Fuegia, of which all are true natives.

Before leaving South Georgia, another important fact should be mentioned. It stands about half way along a broad and comparatively shallow bank which curves eastwards from Cape Horn and the Falkland Islands and then turns sharply to the west, successively reaching the South Orkneys, the South Shetlands and Graham Land. On no part of this bank does the depth of the ocean much exceed 1,000 fathoms, and in some places it is much less. If a land communication ever existed between South America and the Antarctic Continent, this submarine bank probably indicates its course.

Travelling eastwards from South Georgia, we next arrive at three groups of islands which we shall collectively include under the name of the Kerguelen Islands. The most westerly group comprises Marion Island and Prince Edward Island, approximately 4,250 miles from Cape Horn. Marion Island, which is the larger of the two, is about ten miles in diameter and attains a height of 4,250 feet. Quite 450 miles to the eastwards lies the Crozets, of which there are three principal islands, the largest being Possession Island, which is eighteen miles in length by half the width. Finally, and approximately 750 miles still further to the east, comes Kerguelen Island, which much exceeds the others in size. It has an extreme length of eighty-five miles and a greatest breadth of seventy-nine; but its coast-line is so much indented by deep bays or fiords that its total area does not exceed 2,000 square miles. The interior is rugged and mountainous, many peaks reaching heights between 5,000 and 6,000 feet. There are snowfields of considerable size, from which small glaciers radiate in different directions. Signs of recent glaciation are everywhere plentiful; and there can be little doubt that at no very distant period the whole island was covered with a continuous ice-sheet. Its present climate is cold, wet, and tempestuous. Nevertheless, the range of temperature is not excessive, the thermometer at sea-level seldom falling much below 30° F. in winter, or rising much above 60° in summer.

Immediately surrounding each of the three groups is an area of small size over which the depth of the ocean varies from 500 to 1,000 fathoms. This may point to a previous period of elevation, during which the islands would be much larger and possibly may have been united. But eastwards and westwards of this and as far south as the ice-barrier of the Antarctic Continent, the ocean is immensely deep. For the greater part of the distance between Kerguelen and South Georgia it exceeds 3,000 fathoms. With an abyss so great to fill, a recent land connection with the Antarctic Continent in this sector appears to be wildly improbable.

The flora of the Kerguelen group is poor and scanty, only thirty species of vascular plants having been recorded. But in sharp contrast with that of South Georgia, it includes no less than six endemic species. Two of these, *Pringlea* and *Lyallia*, are monotypic genera of remarkable distinctness, with no near allies. Their existence seems to prove that the ice-sheet which in South Georgia blotted out all pre-glacial vegetation, in Kerguelen left a vestige behind, from which a faint idea may be drawn of an older and more extensive flora—now vanished for ever. As for the twenty-four non-endemic species, with one exception (*Cotula plumosa*), which has probably travelled from the New Zealand Subantarctic Islands, they are all natives of Fuegia, and most of them are found in South Georgia as well. The affinities of the flora are thus unmistakably Fuegian; but nevertheless eighteen of the species are circumpolar, twelve of them being found in Macquarie Island as well.

Still travelling to the eastward, a journey of about 3,250 miles brings us to Macquarie Island, the subject of this memoir. I have already given particulars of its position, size, and physical features, and I have mentioned the pertinent fact that it has been recently overridden by an ice-sheet travelling from west to east. I have also given full particulars of the existing flora, together with the geographical range of the species. Attention has also been drawn to the fact that the ocean surrounding the island is everywhere of great depth, and that it is not until the close neighbourhood of the Antarctic Continent is reached that shallower water is met with. It is quite clear that Macquarie Island, in its physical features and climate, its situation in the middle of an immensely deep ocean, and its poor and scanty flora, has many points of agreement with South Georgia and the Kerguelen group.

The extraordinarily scanty flora of the South Georgia–Kerguelen–Macquarie areas demands a passing notice. Many years ago, Sir J. D. Hooker said, "The three small archipelagos of Kerguelen Island (including the Heard Islands), Marion and Prince Edward's Islands, and the Crozets, are individually and collectively the most barren tracts on the globe, whether in their own latitude or in any higher one, except such as lie within the Antarctic circle itself, for no land, even within the North Polar area, presents so impoverished a vegetation." (Phil. Trans. Roy. Soc., vol. 168, p. 10). This vivid statement has since been proved to be just as true of South Georgia and Macquarie as of Kerguelen. Yet these three areas all lie within the parallels of 54° 30′ S. and 46° 30′ S., roughly corresponding to the north of England and the centre

of France. In Norway, beyond the Arctic circle, pine forests and cultivated farms exist. Spitzbergen, which extends as far north as lat. 80°, possesses 120 vascular plants, and botanists estimate that not less than 400 species are found within the arctic circle. Why should there be this extraordinary difference between the northern and southern floras ?

No doubt the explanation is mainly climatic. But the winter temperatures of the subantarctic zone are certainly not excessive, and in most localities are milder than those obtaining in similar latitudes in the northern hemisphere. Professor Rudmose Brown (Problems of Antarctic Plant Life, p. 5) is probably right in concluding that the short and inadequate summer, with its comparatively low temperatures, is the most powerful reason. It does not provide a sufficiently long season of growth to enable most plants to reach their flowering stage, or to mature their fruit. In Macquarie Island the mean temperature of the three summer months is as low as 43·9°, and only exceeds the mean of the three winter months by 5·3°. But I have already pointed out that the small yearly range of temperature is one of the peculiarities of the climate of the subantarctic zone. The almost continuous westerly gales must also exercise an adverse influence on plant-growth, especially on Macquarie Island, where the statistics obtained by the Mawson Expedition have proved that the force of the wind considerably exceeds that recorded in South Georgia and Kerguelen. Professor Rudmose Brown has also drawn attention to another factor inimical to vegetation in " the myriads of penguins which occupy almost every bare spot of ground during the nesting and breeding season," and which must have a great effect in preventing the establishment of vegetation, or in destroying it when established. But although the reasons given above must have a powerful effect, they do not seem to be altogether sufficient, and I must agree with Dr. Skottsberg in considering the paucity of phanerogams in South Georgia (to which I would add Kerguelen and Macquarie Island) as altogether inexplicable.

A little less than 400 miles north-east of Macquarie Island lies Auckland Island, the chief of the New Zealand outlying islands. Campbell Island, the next in size, is a trifle more remote, and more to the east. Antipodes Island is situated about 400 miles east-north-east of Campbell Island, while the Snares, the only other island that supports a phanerogamic vegetation, is not far from half-way between Stewart Island and Auckland Island As the physical features, climate and vegetation have all been fully described in my recent memoir on the Subantarctic Islands of New Zealand, I propose to give a very brief account here.

The first point to emphasise is that instead of rising from an ocean with an average depth of more than 2,000 fathoms, which is the case with the South Georgia—Kerguelen—Macquarie Islands, the New Zealand Subantarctic Islands stand upon a shallow plateau extending without a break to Stewart Island and far to the eastward of the South Island of New Zealand. In a straight line between Stewart Island and Auckland Island the depth is nowhere more than 400 fathoms, and in some places

much less. This submarine plateau stretches for some little distance to the east of the Chatham Islands, or more than 500 miles from New Zealand, before water with a greater depth than 1,000 fathoms is obtained. It then sinks rapidly until depths of over 2,500 fathoms are reached. Going south from Auckland Island, and within 100 miles of it, a depth of 2,430 fathoms was recorded by the "Aurora." These sudden dips from comparatively shallow water into the enormous depths which surround the greater part of New Zealand may be reasonably taken as evidence of a "continental shelf," indicating the former boundary of a "Greater New Zealand" in the far remote past.

The extent to which the New Zealand Subantarctic Islands have been glaciated in recent times has not been definitely settled, although there can be no doubt that they have been subjected to a moderately severe glaciation, but probably not sufficient to produce a continuous ice-sheet, although quite ample to cause great climatic and biologic changes.

The present climate can be best described as cold, windy, foggy or cloudy, and rainy. Like all portions of the subantarctic zone, it is mainly remarkable for the small diurnal and annual variation. In Macquarie Island the mean temperature for the year can be given as 40·7°, and the mean range between summer and winter as 5·3°. In Campbell Island the mean temperature is 44·5°, and the mean range between summer and winter 10·0°, while the rainfall is 53·8 inches.

As might be predicted from the more northerly latitude and less severe climate, the flora of the New Zealand Subantarctic Islands is much more copious than that of the islands previously treated of. The total number of species recorded is 194, of which 53 are endemic. For the first time we see a true ligneous vegetation. Many orchids appear, as also representatives of the genera *Veronica*, *Myosotis*, *Gentiana*, and others. The endemic species are greatly increased in number, and what is still more important, include genera or groups of a distinctive character, which can only be looked upon as ancient and long-isolated types. Elsewhere I have shown that the flora contains three main elements, which may be particularised as follows:—First, an endemic element, consisting of two parts, one comprising plants like *Stilbocarpa*, *Pleurophyllum*, the *Ionopsis* section of *Celmisia*, &c., which are probably the remnants of an ancient flora, which ages ago occupied the islands; the other consisting of species closely allied to plants at present living in New Zealand. Second, an element which includes the greater part of the flora, and which is composed of species at present living in New Zealand proper, and which must be looked upon as immigrants of recent date. Third, a Fuegian element, also consisting of two parts, one much older than the other, and composed of such genera as *Colobanthus*, *Abrotanella*, *Phyllachne*, *Rostkovia*, &c., the other including plants living in both countries at the present time, as *Cardamine glacialis*, *Callitriche antarctica*, *Tillæa moschata*, *Nertera depressa*, *Carex trifida*, &c.

We thus find that even in the New Zealand Subantarctic Islands, separated from Fuegia by quite 4,500 miles of trackless ocean, there still exists a Fuegian element in the flora. Further inquiry shows that there are twenty-nine species that are found in both localities. But as this deals solely with specific identity, it does not fully represent the affinity between the vegetation of the two countries. I have elsewhere stated that out of eighty-eight genera found in the southern islands of New Zealand, no less than fifty-six have representatives in Fuegia.

A few words may now be said on the flora of the southern portion of South America, including Fuegia, Falkland Islands, and South America as far north as lat. 45°. This area contains a moderately rich flora of certainly not less than 750 species. I have already pointed out that twenty-nine of these extend to the outlying islands of New Zealand, and that fifty-six Fuegian genera have representatives in the same locality. Nevertheless, there are important differences between the flora of Fuegia and that of New Zealand. Quoting from my previous memoir, the Fuegian flora "contains thirteen families of plants not found in that country, and twice that number represented in New Zealand do not occur in Fuegia proper. This alone would give a different aspect to the two floras, but there are many other divergences of a marked character. For instance, the *Compositæ* constitute the largest family in Fuegia, exactly as in New Zealand, but the genera are almost altogether different; out of twenty-four found in Fuegia, only six occur in New Zealand, not one of them, with the exception of *Senecio*, forming a noteworthy feature in the vegetation. *Olearia*, *Celmisia*, *Raoulia*, and *Cassinia* are all entirely absent. The arborescent *Compositæ*, so conspicuous a feature in the New Zealand flora, even as far south as the Auckland Islands, are unknown in Fuegia. Similarly, the arborescent *Rubiaceæ* (*Coprosma*), everywhere present in the New Zealand area, are conspicuous by their absence in Fuegia. *Veronica*, with its eighty-four species in New Zealand, has only three or four in Fuegia. Only five orchids occur, against fifty-seven recorded from New Zealand. On the other hand, there are several remarkable points of agreement. Perhaps the most striking is the presence, almost as far south as Cape Horn, of forests mainly composed of small leaved beeches (*Fagus*) exactly as in the south of New Zealand, the species, it is true, being different in the two countries. And on the open mountain tops, above the level of the beech forest, we find, mixed with northern types, respresentatives of the genera *Colobanthus*, *Acæna*, *Azorella*, *Nertera*, *Abrotanella*, *Phyllachne*, *Astelia*, *Rostkovia*, *Gaimardia*, and *Oreobolus*—all characteristic of the mountain flora of New Zealand, and all extending as far south as the Auckland Islands. But in this case, although the genera are identical, the species are in most cases different."

So far in this memoir, whenever plants have been mentioned that are generally distributed in the subantarctic zone, they have, as a matter of convenience, been treated as of Fuegian origin. In one case, that of *Cotula plumosa*, which is found in Kerguelen, Macquarie Island, and the New Zealand outlying islands, but not in Fuegia, I have suggested that it has originated on the New Zealand side of the zone, but has

failed to complete the circuit. Similarly, in a previous paper, I have drawn attention to *Veronica elliptica*, which, though found in Fuegia, is evidently a stranger therein, far removed from its immediate allies in New Zealand. I have also specified the case of *Sophora tetraptera* as having been probably carried from New Zealand to Chili and Juan Fernandez. Obviously, all those species which girdle the globe along the subantarctic zone require close analysis before we can safely state their probable origin.

This branch of the subject, until lately much neglected, has been briefly discussed by Dr. Skottsberg in his paper on the "Relations between the Floras of Subantarctic America and New Zealand," already quoted from in this memoir. He says (p. 138), "We know, just as we did before, that, judging from the actual distribution of plants, there is an Australian and New Zealandic element in Andine and Subantarctic America, that there is an Andine element in New Zealand and Australia, and that there remain genera, or even orders, which are virtually bicentric, and form what one might call the old Antarctic element." Dr. Skottsberg gives examples of these groups, a few of which I will quote here. First, as representing the New Zealand and Australian element, the following genera:—*Dacrydium*, *Astelia*, *Lomatia*, *Drimys*, *Aristotelia*, *Drapetes*, *Pseudopanax*, *Veronica* (section *Hebe*), *Myosotis*, and others. Secondly, as illustrating the Andine element, *Ourisia*, *Calceolaria*, *Pernettya*, *Oreomyrrhis*, *Azorella*, *Fuchsia*, *Discaria*, *Enargea*, &c. Thirdly, he specifies the following as bicentric or Antarctic:—*Oreobolus*, *Carpha*, *Uncinia*, *Gaimardia*, *Rostkovia*, *Libertia*, *Nothofagus*, *Laurelia*, *Muhlenbeckia*, *Colobanthus*, *Gunnera*, *Donatia*, and others. Without subscribing to every one of the details of arrangement given above, we can readily admit that Dr. Skottsberg has supplied us with valuable and pregnant ideas concerning the relationships between the floras of South America, New Zealand, and Australia.

Having examined the main features of the vegetation of the various land areas of the subantarctic zone, and having compared the vegetation of each area with that of the rest, we can proceed to enquire what conclusions can be derived from the accumulated facts. I think it can be safely said that during Tertiary times there have been only two directions in which the vegetation of the rest of the world can have approached the Subantarctic Zone and Antarctica itself, or along which an interchange of species could have taken place—the direction of New Zealand (possibly with Tasmania as well), and that of South America.

In New Zealand we have a country stretching from S. lat. 34° to S. lat. 47° and possessing a rich and varied flora, evidently of ancient date, but obviously with Australian, Pacific, and Malayan alliances. An Andine and Fuegian affinity, on a smaller scale, is also sufficiently evident. Extending southwards from New Zealand is a broad submarine plateau, on the southern edge of which the New Zealand Subantarctic Islands stand. These possess a vegetation mainly allied to that of New Zealand, but with a decidedly greater Fuegian affinity. There are many reasons for supposing that during Early Tertiary times a period of elevation existed, during which

the New Zealand Subantarctic Islands were joined to the mainland of New Zealand, thus forming, with other extensions, a "Greater New Zealand" many times larger than its present size. If at the same time there was a northward extension of Antarctica, and a similar southern prolongation of the New Zealand area, the distance which at present separates Antarctica and the New Zealand Subantarctic Islands might be reduced to a space considerably smaller than what is known to have been crossed by plants and animals in other parts of the world.

But in South America we can find a direction along which it is possible to reconstruct a land connection with Antarctica without involving enormous geographical changes for which there is little or no geological or physical support. I have previously shown that curving round by way of the Falkland Islands and South Georgia there is a comparatively shallow bank which connects the northernmost extremity of Antarctica with South America, and on which, for the greater part of the distance, the depth of the ocean does not much exceed 1,000 fathoms. For long stretches it is even much less, for South Georgia, the Sandwich Group, and the South Orkneys, all stand on this bank, and are each surrounded by considerable areas of shallow water. Along this line, I believe that in Oligocene times, or thereabouts, Antarctica and Fuegia were either connected by a continuous land-bridge, which seems the most probable, or by a chain of closely-placed islands of considerable size.

Under this view, we distinctly connect the fossil tertiary flora discovered by Dr. Andersson in Graham Land with the progenitors of the present flora, and at once account for their resemblances. We may, too, have a dim vision of an Antarctica largely free from ice and snow, and supporting a numerous flora extending right and left along the shores of the whole continent. We may imagine a regular interchange of species between Antarctica and Fuegia. And, although I consider it improbable that New Zealand and Antarctica have ever been directly connected during Tertiary times, they may, as I have previously suggested, approached near enough to admit of the passage of species from one to the other. We may suppose that the American element in the New Zealand flora—*Fuchsia*, *Calceolaria*, *Gunnera*, *Oreomyrrhis*, *Azorella*, *Caltha*, *Pernettya*, *Enargea*, &c., after travelling from Fuegia to Antarctica, and then along its coasts, may have crossed to New Zealand. And, is it not possible that genera like *Dacrydium*, *Drimys*, *Drapetes*, *Astelia*, and many others, all of which are much better represented in New Zealand than in America, may have travelled in the reverse direction? Such a hypothesis seems to me to be the only way to account for the presence of a New Zealand element in the South American flora, and a South American element in New Zealand. Direct communication across the Pacific by means of a huge land-bridge I regard as altogether chimerical, and without sufficient geological or physical support.

It must be borne in mind that in the above speculations we are dealing with times far removed from the present, and most probably separated from it by the greater part of the Tertiary period. Those plant-migrations of a distant past that were responsible

for building up the connections between the New Zealand and the South American floras must have endured for long periods of geological time; and we do not know how far they were aided or hindered by oscillations of climate, or changes in the relative level of land and sea. The duration of what may be called the active or colonising period of the Antarctic fauna and flora will remain hidden from us until the study of the geological record in Antarctica discloses new facts and new ideas. But we do know that, sooner or later, a change arrived and a gradual refrigeration of the whole of Antarctica took place. During this, the once luxuriant vascular flora slowly perished, or was driven northwards; the remnants, with two exceptions, being buried under a perennial ice-sheet. What lapse of time was occupied by this refrigeration it is impossible to say; nor is there any evidence to show whether it was subject to oscillation, further than it is well established that the ice-sheet had a greater development some little time further back than it has at present.

If it be asked what effect antarctic refrigeration has had upon the land areas to the north, the reply is that it is known that the whole of the subantarctic zone, including the southern portions of New Zealand and South America, everywhere presents proof of a parallel refrigeration. This, at the time of its greatest extent, doubtless caused much extinction of species, many changes in the composition of the vegetation, and probably induced many migrations. The islands of South Georgia, Kerguelen, and Macquarie constitute that part of the subantarctic zone that has suffered most from Antarctic refrigeration. In the case of South Georgia, most authorities consider that the vascular vegetation was entirely destroyed. Dr. Skottsberg explicitly says "It seems hardly possible that the higher flora survived the glacial epoch." Schimper and Schenk argue with great strength and probability that it was entirely destroyed, to be replaced, later on, through the agency of pelagic birds. With regard to the Kerguelen Group and Macquarie Island, I have already pointed out that they agree with South Georgia in their scanty flora, but differ in possessing a few endemic species. Here, too, the balance of what evidence we possess is in favour of the belief that the whole flora perished, except the endemic species and possibly a few others, of which *Azorella Selago* appears to be the most likely to have survived.

At the close of the glacial epoch, then, the position in the subantarctic zone may be shortly stated as follows:—Macquarie Island had lost its vascular flora except two or three grasses; Kerguelen had been almost as badly treated; while in South Georgia the whole of the higher flora had perished. When, therefore, a milder climate prevailed and the islands became once more capable of supporting a vascular flora, only two sources of supply remained—one from Fuegia; the other from the New Zealand area. I have already shown that South Georgia, situated at no great distance from Cape Horn, and the Kerguelen Group, both favourably placed in the line of the constant westerly winds, have received almost the whole of their flora from Fuegia. Macquarie Island, on the other hand, is so much nearer to the New Zealand Subantarctic Islands that it was naturally stocked from thence.

As for the mode in which the islands were repopulated, I agree with Schimper and Schenk in considering that it was mainly effected through the agency of birds, carried before the prevailing westerly winds. On this point, Professor Rudmose Brown very aptly says (Problems of Antarctic Plant Life, p. 6), "Almost everywhere that snow-free land occurs on the coast of Antarctica in summer, innumerable birds find nesting places, and these are the places where or near most of the vegetation occurs." It is possible that wind-transport may also be more efficient than I previously supposed, judging from the discovery made by Dr. F. E. Fritsch of pollen-grains of *Podocarpus* among patches of red-snow on the South Orkneys. As Professor Rudmose Brown states, these pollen-grains can only have come from South America. But if such can be carried, surely the seeds of phanerogams may also be conveyed.

In conclusion, it is evident that the present flora of Macquarie Island, excepting only the three endemic grasses, does not date further back than the close of the last glacial epoch. Since then, in agreement with the other islands of the subantarctic zone, its history has been a history of plant-migration, mainly from the New Zealand outlying islands, but in some cases from the far-distant Kerguelen Group—as, for instance, *Ranunculus biternatus*, *Acæna adscendens*, *Azorella Selago*, and *Festuca erecta*. But if Macquarie Island existed in Early Tertiary times, when we know that Antarctica was peopled with a rich and luxuriant flora, and when in all probability geographical and climatic considerations co-operated in facilitating intercourse between Antarctica and the New Zealand area, then its position would be of the utmost consequence. It would occupy an important stage in a chain of plant migrations that might have extended from Chili to Antarctica and from Antarctica to the north of New Zealand—a chain that has left traces still visible in the floras of both New Zealand and South America.

VI. LIST OF THE PRINCIPAL BOOKS CONSULTED IN THE PREPARATION OF THIS MEMOIR.

I have made no effort to prepare a complete bibliography of the publications that have appeared bearing upon the Subantarctic Zone. Nor is such really necessary; an admirable list having been given by Professor Chilton at the close of the two volumes of "Reports on the Subantarctic Islands," edited by him. But I certainly think that it is incumbent upon me to gratefully acknowledge the assistance I have received from many authors, a list of whose publications I have given below.

ALBOFF, N.—Essai de Flore Raisonnée de la Terre de Feu. Ann. Mus. de la Plata, Bot. I, 23.

BROWN, PROFESSOR R. N. RUDMOSE.—The Problems of Antarctic Plant Life. Botanical Results of the Scottish National Antarctic Expedition, 1912.

CHAPMAN, MR. JUSTICE.—The Outlying Islands South of New Zealand. Trans. N.Z. Inst. XXIII (1891), p. 491.

CHEESEMAN, T. F.—Manual of the New Zealand Flora. 1906.

CHEESEMAN, T. F.—The Systematic Botany of the Islands to the South of New Zealand. Subantarctic Islands of New Zealand, vol. II, pp. 389 to 471. 1909.

CHEESEMAN, T. F.—Illustrations of the New Zealand Flora. 2 vols. 1914.

COCKAYNE, L.—A Botanical Excursion during Midwinter to the Southern Islands of New Zealand. Trans. N.Z. Inst. XXXVI (1904), p. 225.

COCKAYNE, L.—New Zealand Plants and their Story. 1910.

EATON, REV. A. E.—Introductory Notes to the Collections from Kerguelen Island. Phil. Trans. Roy. Soc., vol. 168, pp. 1–8.

FORBES, H. O.—Antarctica, or a Vanished Austral Land. Ann. Rep. Smithsonian Inst. (1894), pp. 297–316.

FRICKER, K.—The Antarctic Regions. 1900.

GUPPY, H. B.—Observations of a Naturalist in the Pacific between 1896 and 1899. Vol. I, Vanua Levu, Fiji, 1903. Vol. II, Plant Dispersal. 1906.

HAMILTON, A.—Notes on a visit to Macquarie Island. Trans. N.Z. Inst. XXVII (1895), pp. 559–579.

HEDLEY, C.—Considerations on the Surviving Refugees in Austral Lands of Ancient Antarctic Life. Proc. Roy. Soc. N.S.W. XXIX (1895), pp. 278–286.

HEMSLEY, W. B.—Report on the Present State of knowledge of various Insular Floras. Scientific Results of the "Challenger" Expedition, Botany, vol. I, 1885.

HOOKER, SIR J. D.—The Botany of the Antarctic Voyage of H.M. Discovery Ships "Erebus" and "Terror" in the years 1839–1843—

I. Flora Antarctica. 2 vols. 1844–1847.

II. Flora Novae Zealandiae. 2 vols. 1853–1855.

III. Flora Tasmaniae. 2 vols. 1860.

HOOKER, SIR J. D.—Handbook of the New Zealand Flora. 1864–1867.

HOOKER, SIR J. D.—Observations on the Botany of Kerguelen Island. Phil. Trans. Roy. Soc. Vol. 168 (1879), pp. 9–23.

HUTTON, F. W.—On the Geographical Relations of the New Zealand Fauna. Trans. N.Z. Inst. V (1873), pp. 227–256.

HUTTON, F. W.—The Origin of the Fauna and Flora of New Zealand, parts 1 and 2. N.Z. Journ. of Science II, parts 1 and 2, p. 249.

HUTTON, F. W.—Index Faunae Novae Zealandiae. 1904.

HOMBRON AND JACQUINOT.—Voyage au Pôle Sud et dans l'Océanie. Botanique. 1852.

KIRK, T.—On the Botany of the Antarctic Islands. Rep. Austral. Assoc. III (1891), pp. 213–251.

KIRK, T.—Description of New Grasses from Macquarie Island. Trans. N.Z. Inst. XXVII (1895), pp. 353–354.

KIRK, T.—The Students' Flora of New Zealand and the Outlying Islands. 1899.

MAWSON, SIR DOUGLAS.—The Home of the Blizzard, being the Story of the Australasian Antarctic Expedition. 2 vols. 1914.

MOSELEY, H. N.—On the Botany of Marion Island, Kerguelen's Land, and Yong Island of the Heard Group. Journ. Linn. Soc. Bot., vol. XIV (1875), p. 387.

MOSELEY, H. N.—Notes on the Flora of Marion Island. Journ. Linn. Soc. Bot., vol. XV, p. 481.

MOSELEY, H. N.—Notes by a Naturalist on the "Challenger." 1879.

MURRAY, G.—The Antarctic Manual. 1901.

NARRATIVE OF THE CRUISE OF THE "CHALLENGER," vol. I, parts 1 and 2. 1885.

NATIONAL ANTARCTIC EXPEDITION.—Reports on the Scientific Results. (In course of Publication.)

ROSS, SIR J. C.—A Voyage of Discovery and Research in the Southern and Antarctic Regions. 2 vols. 1847.

SCHENK, H.—Vergleichende Darstellung der Pflanzengeographie der subantarktischen Inseln inbesondere uber Flora und vegetation von Kerguelen. Ergebnisse der Deutschen Tief-see Expedition. 1905.

SCOTT, J. H.—Macquarie Island. Trans. N.Z. Inst. XV (1883), pp. 484–493.

SCOTT, SIR R. F.—The Voyage of the "Discovery." 2 vols. 1905.

SCOTTISH NATIONAL ANTARCTIC EXPEDITION.—Reports on the Scientific Results. (In course of publication.)

SHACKELTON, SIR E. H.—The Heart of the Antarctic, being the Story of the British Antarctic Expedition, 1907–1909. 1909.

SKOTTSBERG, C.—On the Zonal Distribution of South Atlantic and Antarctic Vegetation. Geogr. Journ., vol. XXIV (1904), pp. 655–663.

SKOTTSBERG, C.—Notes on the Relations between the Floras of Subantarctic America and New Zealand. Plant World, vol. XVIII (1915), pp. 129–142.

SMITH, G. W.—A Naturalist in Tasmania. 1909.

SUBANTARCTIC ISLANDS OF NEW ZEALAND.—Reports by various authors. Edited by Professor C. Chilton. 1909.

TERRA NOVA EXPEDITION.—Reports on the Scientific Results. (In course of publication.)

THISTLETON DYER, SIR W.—The Geographical Distribution of Plants. Darwin and Modern Science, pp. 294–318. 1910.

WALLACE, A. R.—Geographical Distribution of Animals. 2 vols. 1876.

WALLACE, A. R.—Island Life, or the Phenomena and Causes of Insular Faunas and Floras. 1880.

WILDEMAN, E. DE.—Les Phanerogames des Terres Magellaniques. (Results of the Voyage of the "Belgica.") 1905.

WILKES, C.—Narrative of the U.S. Exploring Expedition. 4 vols. 1845.

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