

ENTOMOLOGY OF THE AUCKLANDS AND OTHER ISLANDS SOUTH OF NEW ZEALAND: INTRODUCTION¹

By J. L. Gressitt² and K. A. J. Wise³

Abstract: The Aucklands, Bounty, Snares and Antipodes are Southern Cold Temperate (or Low Subantarctic) islands south of New Zealand and north of Campbell I and Macquarie I. The Auckland group is the largest of all these islands south of New Zealand, and has by far the largest fauna. The Snares, Bounty and Antipodes, though farther north, are quite small islands with limited fauna. These islands have vegetation dominated by tussock grass, bogs with sedges and cryptogams, and shrubs at lower altitudes and in some cases forests of *Metrosideros* or *Olearia* near the shores, usually in more protected environments. Bounty Is have almost no vegetation. These islands are breeding places for many sea birds and for hair seals and fur seals. The insect fauna of the Aucklands numbers several hundred species representing most major orders of insects and other land arthropods. This is the introductory article to the first volume treating the land arthropod fauna of the Auckland, Snares, Bounty and Antipodes Islands.

The Auckland Islands (50°40' S; 166° E) form the largest island group south of New Zealand and Australia. Among other southern cold temperate and subantarctic islands they are only exceeded in area by the Falkland Is, South Georgia, Kerguelen and Tierra del Fuego. In altitude they are lower than South Georgia, Tierra del Fuego, Tristan da Cunha, Gough, Marion, Kerguelen, Crozets and Heard, and very slightly lower than the Falklands. The Aucklands are higher in altitude than Campbell, Macquarie, Bounty, Antipodes and Snares. The Snares, Antipodes and Bounty Is. are much smaller and lower in altitude than the Aucklands, and all are farther north than the Aucklands.

The Aucklands have long been called subantarctic islands (Chilton, ed. 1909) along with the other islands mentioned above. However, as mentioned in the Preface, M. Holdgate (1964), S. W. & D. M. Greene (1963) and N. M. Wace (1960) (modified) have proposed that the term "Subantarctic" be reserved for the six more southern island groups: South Georgia, Marion-Prince Edward, Crozets, Kerguelen, Heard and Macquarie (see Gressitt 1970). This would exclude those islands not close to the Antarctic Convergence or not under the influence of the cold Weddell Sea. Thus, the islands treated in this volume, together with Campbell I, would be "Cold Temperate" by that classification. An alternative would be to call the above-named six groups "High Subantarctic" and the islands south of New Zealand, other than Macquarie, "Low Subantarctic." The Falklands, Tierra del Fuego, Gough and Tristan da Cunha would also fall in the latter category. For the purposes of this volume, the question will not be resolved. The term "Subantarctic" as used in the articles in this volume has been left unchanged, and in those cases refers to the widest interpretation, including all the islands south of New Zealand—that is, south of South Island, Stewart I and the Chatham Is.

As pointed out in the introduction to the volume on Campbell I (Pacif. Ins. Monogr. 7, 1964), the fauna of the Auckland Is is much larger than that of Campbell. With the inclusion of the Snares, Bounty and Antipodes in the scope of the present series of studies, the

¹Contribution from Bishop Museum, and partly from the Auckland Museum; embodying results of field work partly funded by the National Science Foundation through the U. S. Antarctic Research Program (G-23720, GA-208).

²Bishop Museum, P. O. Box 6037, Honolulu, Hawaii 96818.

³Auckland Museum, Private Bag, Auckland C. 1, New Zealand.

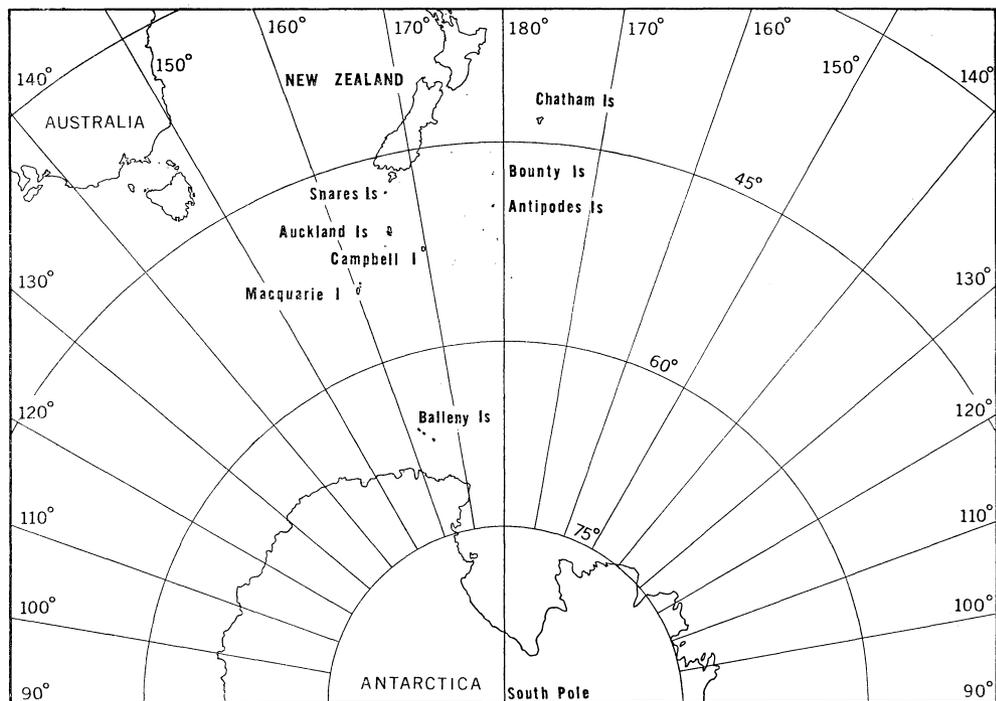


Fig. 1. Map of the area from New Zealand to the South Pole, showing locations of the islands discussed in this volume and neighboring areas.

extent of material to be reported upon has grown rather large. This volume will be the first collection of papers to cover the combined faunas of these islands. Further installments will be published Zealand.

Some general background data on Campbell I and its relationship to islands within the primary scope of this volume is presented in the above work (Pacif. Ins. Monogr. 7). Much of the information available on the entomology of Macquarie I is presented in a collection of articles in *Pacific Insects* following the introduction by Gressitt (1962), as well as in the ANARE work by Watson (1967) and in Gressitt (1970). Some articles (Forster, Richards, Kuschel) in Monograph 7 include Auckland Is and other islands in their scope, and Aucklands material is also treated in the appendix to Monograph 7.

The major part of the material forming the basis for the present studies was collected on two expeditions to the Auckland Is, in 1962-63 and 1966, respectively. These were organized by the Dominion Museum, Wellington and the New Zealand D.S.I.R. (primarily the Botany Division at Lincoln near Christchurch). The Entomology Division of the D.S.I.R., at Nelson, was involved in the second expedition. On the first expedition, Gressitt and Wise did a major portion of the insect collecting, both of them representing Bishop Museum and the U. S. Antarctic Research Program. L. J. Dumbleton (D.S.I.R., Lincoln) and Peter Johns (Canterbury University) were also on the first expedition. On the 1966 expedition, in the southern party on Adams I, insects were collected by G. Kuschel (D.S.I.R.), Wise (jointly representing

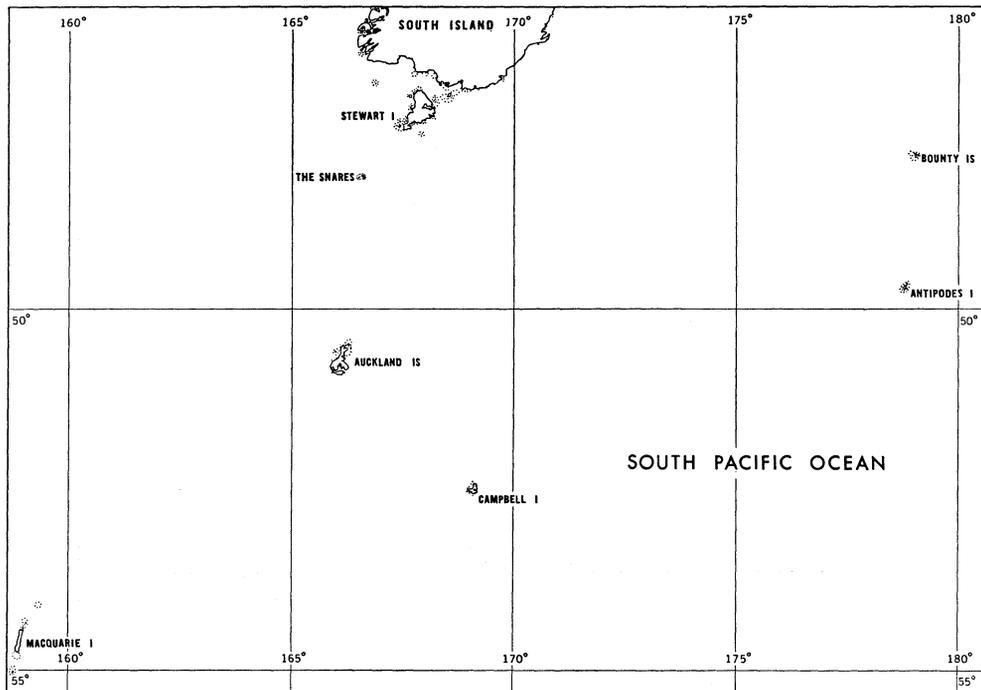


Fig. 2. Map showing the relationship of the islands treated in this volume to the southern end of New Zealand.

Bishop Museum and the Auckland Museum), as well as by Peter Johns (Canterbury U.). R. G. Ordish (Dominion Museum) was in the northern party of the second expedition. Other expeditions visited the Snares, Bounty I and the Antipodes Is, as detailed in the section on field work, below.

As with the Campbell I studies, primary types of new species to be described in this series will be deposited in New Zealand institutions, primarily in the D.S.I.R. at Nelson, but also in the Dominion Museum and the Auckland Museum. Those types and other specimens resulting from Bishop Museum collections and being deposited in New Zealand form part of a general exchange, by which types and other specimens from Polynesia and Melanesia emanating from New Zealand research will be deposited in Bishop Museum.

Acknowledgements: In the preparation of this introduction we are indebted to R. A. Falla, C. A. Fleming, E. J. Godley, G. Kuschel, P. M. Johns and E. G. Turbott, in particular. We are also grateful to the various authors of this volume and of the further reports to come later, for their interest in the undertaking. We are heavily indebted to the D.S.I.R. Botany, Entomology and Geology Divisions, the Dominion Museum and the Auckland Institute and Museum for various arrangements and facilities. We are grateful to the U. S. Antarctic Research Program and the U. S. Navy—Support Force Antarctica, for financial support and for transportation, respectively, and also to the Royal New Zealand Navy for transportation. The Royal New Zealand Army supplied much of the camping equipment for the field trips. The National Science Foundation (Information Services Program) has supplied part of the cost of

publishing this volume. We are indebted to various divisions of the D.S.I.R. for permission to use or adapt various maps and data. Mr Alan Hart of Bishop Museum has prepared the maps for this introduction. Miss S. Nakata, Mrs Carol Higa and Mrs Eileen D'Araujo have provided much assistance.

GENERAL HISTORY AND ENTOMOLOGICAL INVESTIGATIONS

In "The Subantarctic Islands of New Zealand," McNab (1909) and Chilton (1909) recorded and discussed the discovery, history and scientific investigation of the southern outlying islands in the New Zealand subregion. The most pertinent details are summarised below.

The Bounty Islands were discovered on 19 September 1788, by Bligh of the vessel "Bounty;" the Snares Is on 23 November 1791, by Vancouver of the "Discovery;" the Chatham Is. on 29 November 1791, by Broughton of the "Chatham;" the Antipodes Is on 3 March 1800, by Waterhouse of the "Reliance," being originally named the Penantipodes Is; the Auckland Is were discovered on 18 August 1806, by Bristowe (representing Messrs Enderby of London) of the "Ocean," being first named the Lord Auckland Group; and Campbell and Macquarie Is. in 1810, by Hasselbrough (representing Campbell & Co. of Sydney) of the "Perseverance."

The first sealers in the southern islands were landed on the Antipodes Is in about May 1804, by Pendleton of the "Union;" the first landing on the Auckland Is. was made in October 1807, by Bristowe (still representing Messrs Enderby) of the "Sarah;" and sealers were first landed on Bounty Islands in 1807, from the "Santa Anna." From then on, sealers were landed on all the southern islands from time to time for many years.

In November 1820, Macquarie I was visited by a Russian expedition under Bellingshausen; Auckland and Macquarie Is in early March 1840, by a United States expedition under Wilkes; Auckland Is in March 1840 by a French expedition under D'Urville, with the naturalists Hombron & Jacquinot; and in November-December 1840, Auckland and Campbell Is by an Antarctic expedition under Ross, with the botanists J. D. Hooker and Lyall.

On 4 December 1849, Mr Charles Enderby founded a settlement in Port Ross at the northern end of Auckland Island, but this only lasted 2-3 years. However introductions of fauna and flora could have occurred during this period.

From the 1830's on there were many shipwrecks in the southern islands, particularly on the Auckland Is. Of note was Capt. Musgrave, of the wrecked "Grafton," who recorded tem-

Table 1. Numbers of genera and species of terrestrial invertebrates recorded in "The Subantarctic Islands of New Zealand," 1909.

Groups	Auckland		Campbell		Antipodes		Bounty		Snares	
	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.
Araneae & Opiliones (Hogg 1909)	3	4	6	6			2	2	3	4
Chilopoda (Benham 1909)	1	1	1	1						
Diplopoda (Benham 1909)	1	1	1	1						
Collembola (Carpenter 1909)			1	1						
Orthoptera (Hudson 1909a)			1	1			1	1	1	1
Plecoptera (Hudson 1909a)			1	1						
Neuroptera (s. l.) (Hudson 1909a)	3?	3								
Coleoptera (Broun 1909)	17	29	6	9			1	1	7	7
Diptera (Lamb 1909)	21	30	10	14	3	3	1	1	6	6
Hymenoptera (Cameron 1909)	2	4								
Lepidoptera (Hudson 1909a, b)	14	26	6	6					3	3

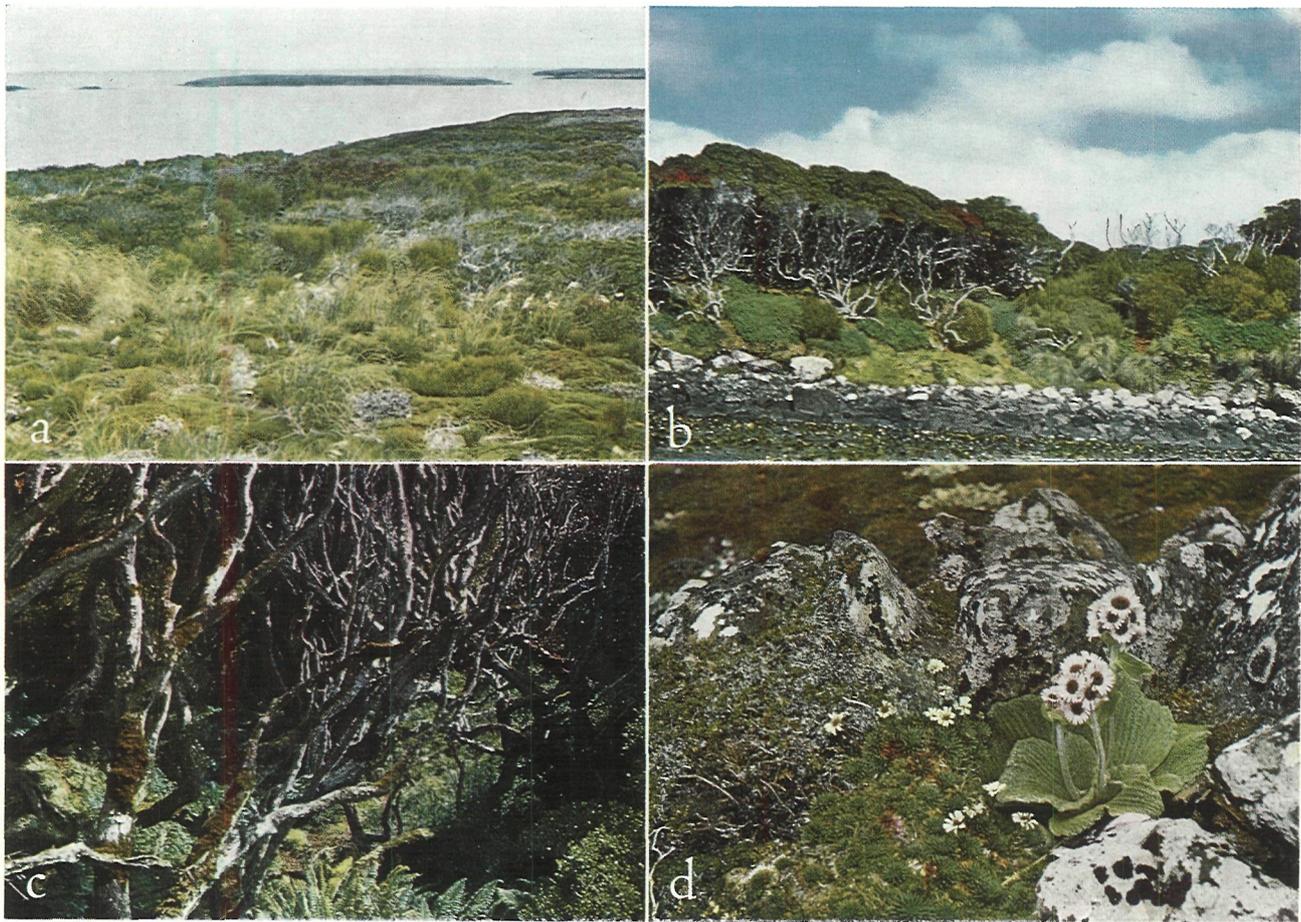


Fig. 4 a, View from north slope of Meggs Hill, Auckland I, showing *Poa* and sedges in foreground, with scrub of *Cassinia*, stunted *Metrosideros* and *Dracophyllum* in center, with *Metrosideros* forest on lower slopes, and Port Ross in background with Rose I at middle and west end of Enderby I at right; b, South shore Rose I at low tide, with kelp in foreground, dead *Metrosideros* at right and in middle and *Metrosideros* forest in background, partly in flower; c, Auckland I, near Ranui Cove in north, with dead *Metrosideros* trees, bearing epiphytic moss, and *Polystichum vestitum* in foreground; d, *Pleurophyllum speciosum*, and *Celmisia vernicosa* flowering, rocky area on Mt Eden, 400 m, with *Coprosma pumila* and lichens on rocks. (Gressitt 1962, 1963)

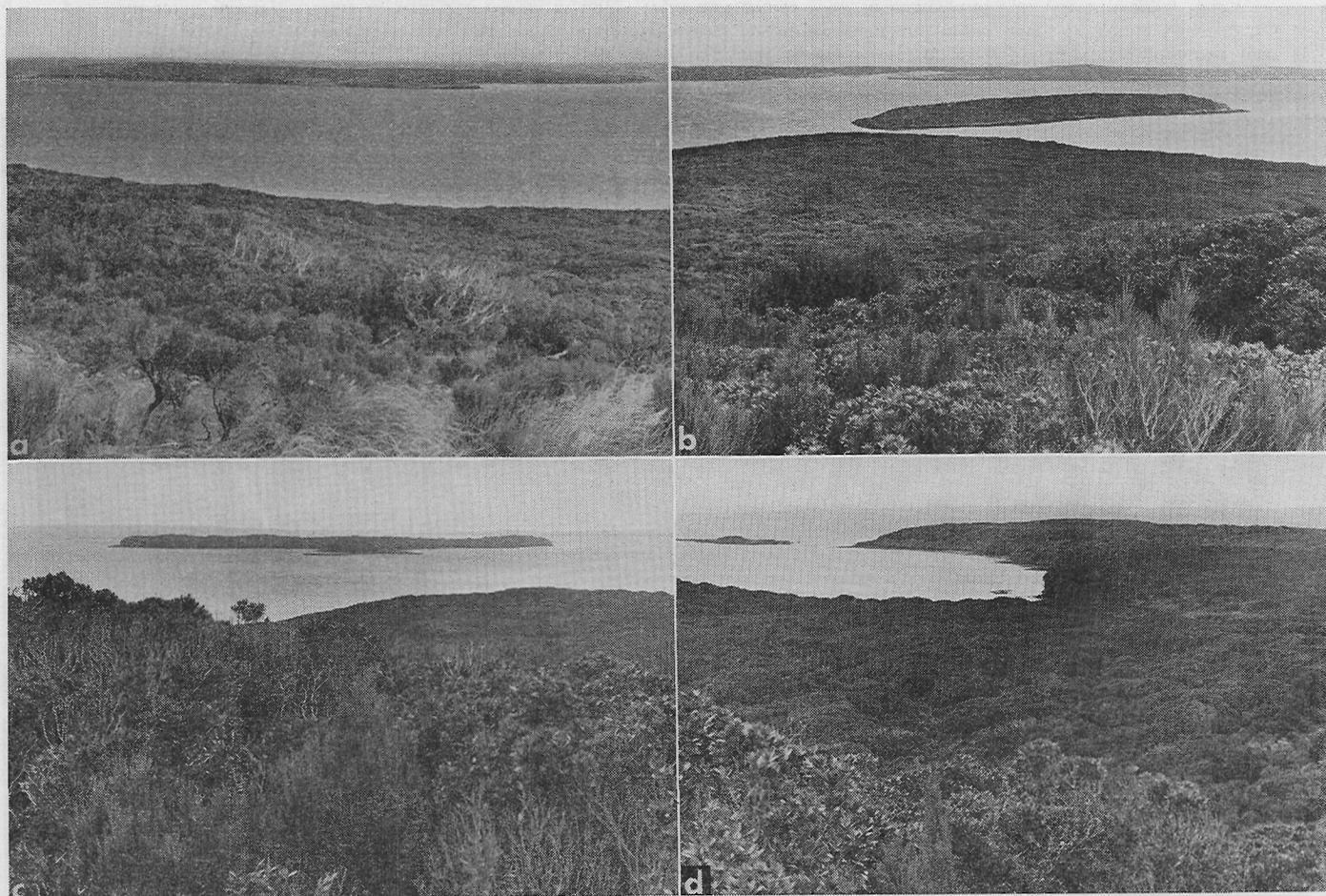


Fig. 5. Panorama from north slope of Meggs Hill, near NE corner of Auckland I: a, Rose I in background, *Metrosideros* forest in middle, *Dracophyllum* and *Chionochloa antarctica* in foreground; b, Ocean I in center, Enderby I in background and with *Cassinia* and *Dracophyllum* in foreground, above *Metrosideros* forest; c, Ewing I in background, with *Dracophyllum* and *Cassinia vauvilliersii* in foreground, above *Metrosideros* forest; d, Crozier Pt and part of French I, upper left, with *Metrosideros* and *Cassinia* in foreground, with *Metrosideros* with some *Neopanax* in center. (Gressitt 1963).

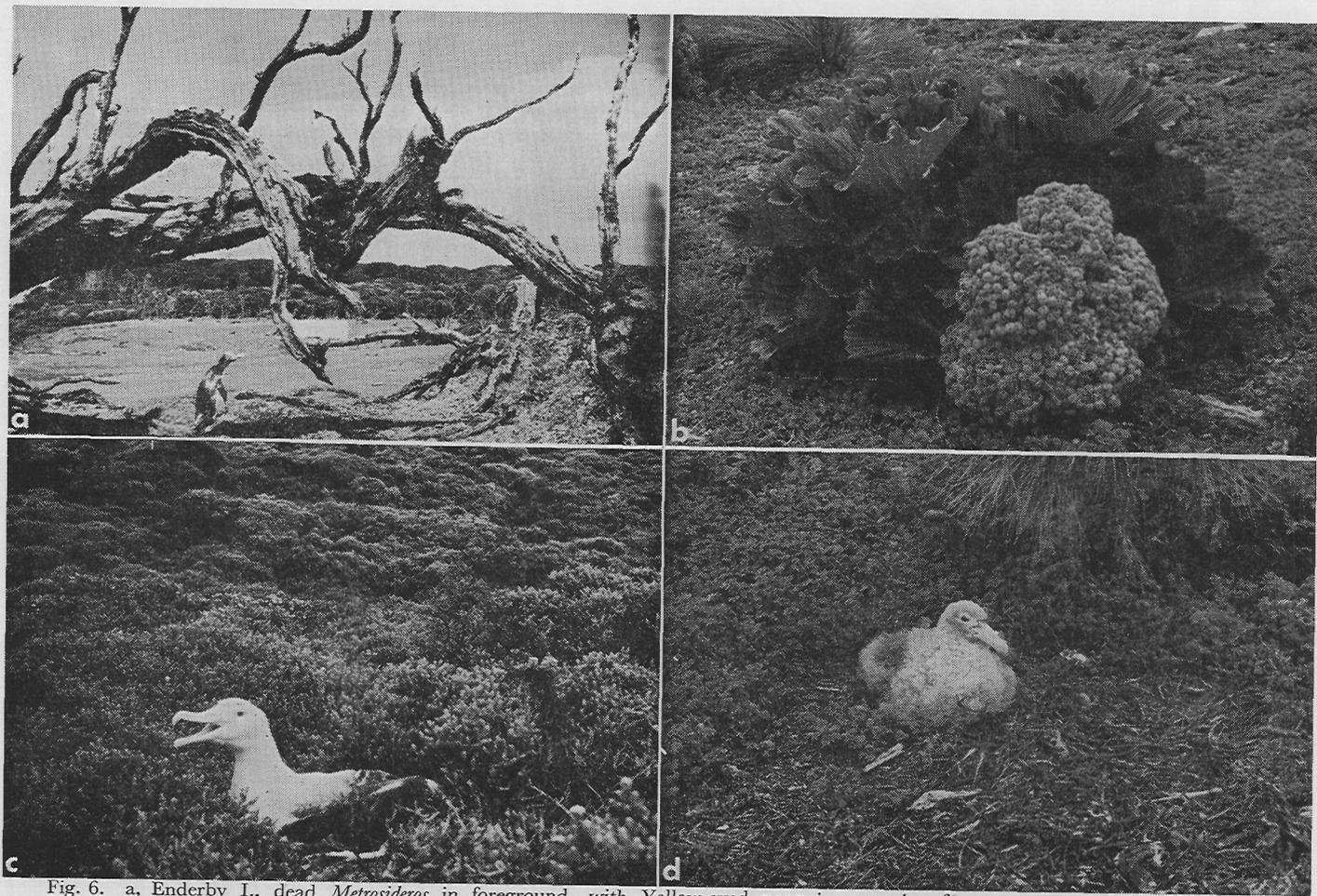


Fig. 6. a, Enderby I., dead *Metrosideros* in foreground, with Yellow-eyed penguin returning from sea; grassy area cropped by cattle in center; *Metrosideros* forest and some scrub in background; b, Ewing I., *Stilbocarpa polaris*, flowering and free from herbivorous mammal damage, with *Poa litorosa* at upper left, and *Acaena minor*; c, Enderby I., Royal albatross near nest, with *Hebe elliptica* in center and foreground, *Metrosideros* in upper right and upper left; d, Young Giant petrel in small rookery, Ocean I., with *Poa litorosa* at upper right and *Acaena minor* in center and left. (Gressitt 1962, 1963).

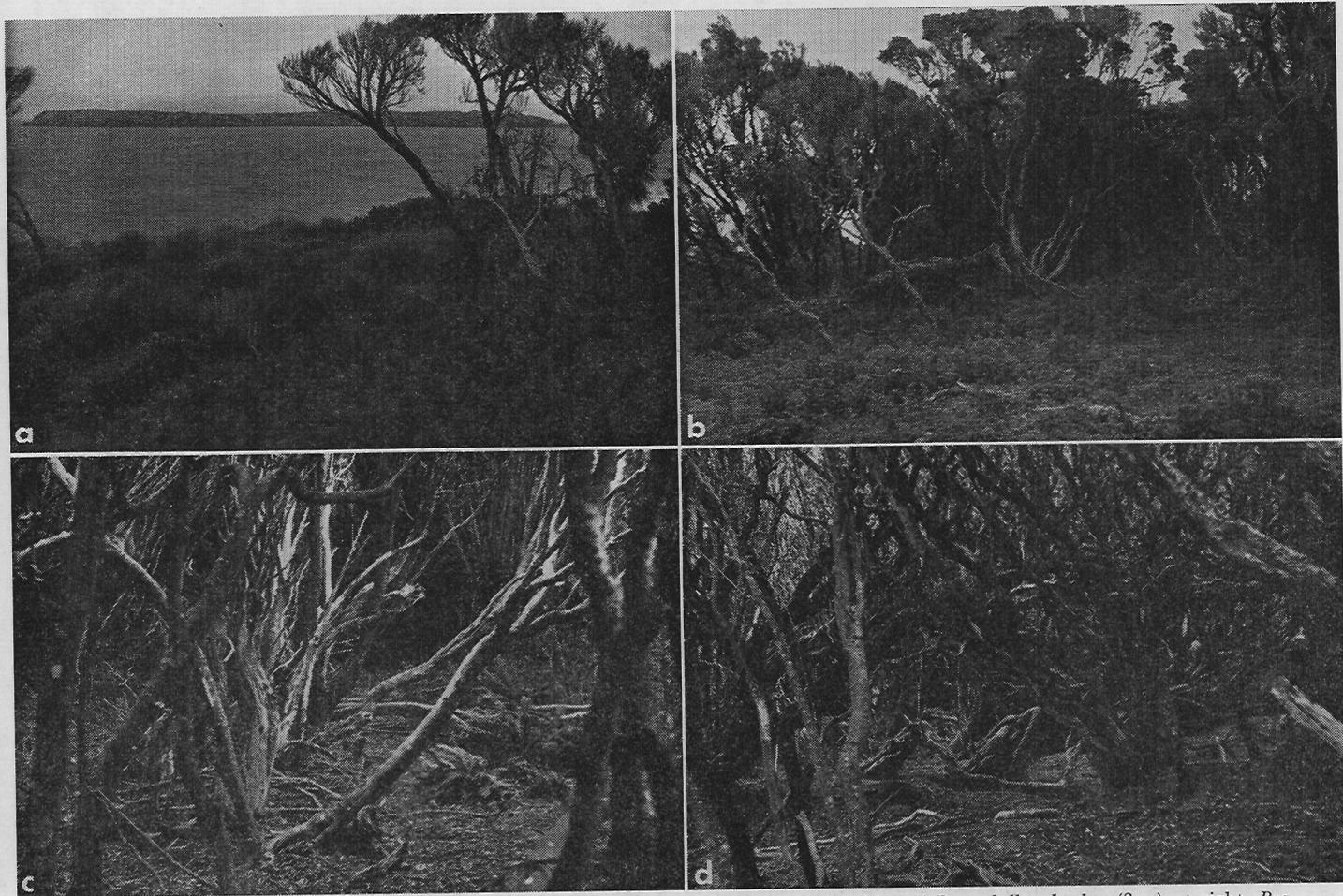


Fig. 7. Auckland I: Ranui Cove toward Crozier Pt: a, Ewing I in background, with tall *Dracophyllum* bushes (3 m) at right, *Poa foliosa* at left, and weeds in foreground; b, Clearing near shore, result of human activity, with *Dracophyllum* at left, *Metrosideros* at middle and right, partly dead, and weeds in foreground, with *Stilbocarpa* lower right corner; c, *Metrosideros* forest, partly dead, with *Asplenium* ferns at right center; d, same forest, showing largely bare substrate. (Gressitt 1962).

peratures, pressures, winds and seals in Carnley Hrbr, during the 20 months he was on the island.

In 1868 depots for shipwrecked mariners were laid on the Auckland and Campbell Is. from the "Amherst." Two woodhens were liberated on Enderby I, Auckland Is, and pigs on Campbell I. After 1868, a New Zealand Government steamer called at the various islands from time to time, and rabbits, sheep, goats and cattle were liberated at various times in conjunction with the upkeep of depots.

The era of scientific investigation really began with two expeditions for the observation of the transit of Venus in 1874; a French expedition, with the naturalist Filhol, was stationed on Campbell I and a German expedition, with the photographer-collector Krone, was on the northern end of Auckland I.

From 1900 to 1907 several scientists from New Zealand visited the islands and several Antarctic expeditions called in briefly.

The first major expedition mounted for the particular purpose of studying the zoology, botany and geology of the Auckland and Campbell Is was the Philosophical Institute of Canterbury Expedition, 1907, which sailed from New Zealand in the Government steamer "Hinemoa," on 14 November 1907. The Snares Is. were visited for a few hours on 15 November and the Auckland Is reached on 16 November, the Auckland Is party being landed at Carnley Hrbr where they spent 10 days. The Campbell I party was landed in Perseverance Hrbr on 17 November and was picked up 8 days later, after the "Hinemoa" had visited Antipodes and Bounty Is. After the Auckland I party was picked up two and a half days were spent in the east and north of the Auckland Is, while Disappointment I off the west coast was also visited.

Mr G. V. Hudson was the entomologist in the Auckland I party and Mr G. R. Marriner in the Campbell I party, although Prof. C. Chilton was also active as an insect collector in the latter. The results of this expedition were published in "The Subantarctic Islands of New Zealand" (Chilton, Ed. 1909) and Hudson (1909) discussed the general entomology of the Snares, Auckland and Campbell Is.

Few scientific investigations and very few entomological collections were made in the southern islands between 1907 and the period of the Second World War, 1939-45, although E. R. Waite, ichthyologist of the 1907 Auckland Is party was again on southern islands, including Auckland Is, in 1909 and 1912. G. Archey, of Canterbury Museum, collected on Auckland and other southern islands in March 1923.

During World War II, coast-watching units were stationed in the Auckland and Campbell Is, being known jointly under the code name of "Cape Expedition." Early in 1941, stations were established at Port Ross and Carnley Hrbr at the north and south of the Auckland Is respectively, and on Campbell I at Perseverance Hrbr. From 1942, the "Cape Expedition" included men with some professional qualifications in geology or biology and these, together with occasional help from other members, built up substantial biological collections. The main collectors were R. A. Falla, C. A. Fleming, J. H. Sorensen, W. H. Dawbin, E. G. Turbott and R. W. Balham, the principal entomological collectors being Turbott on Auckland Is (including Adams I) and Sorensen on Campbell I. Coast-watching was abandoned in 1944, the Auckland Is stations being closed, except that a survey and meteorological party remained at Port Ross until June 1945. Disappointment I (west coast, Auckland I) and the Snares were visited by members of the "Cape Expedition" in 1944. A meteorological station was continued on Campbell I, and collections made by field parties

Table 2. Numbers of genera and species of terrestrial invertebrates recorded in the "Cape Expedition Series," 1946-65.

Groups	Auckland		Campbell		Antipodes		Bounty		Snares	
	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.
Araneae (Forster 1955)	16	19	13	16	5	5	2	2		
Ticks (Dumbleton 1953)	1	2	1	1	1	2			1	1
Collembola (Salmon 1949)	11	15	22	33						
Plecoptera (Illies 1963)	2	2	2	3						
Coleoptera (Brookes 1951)	42	64	19	26			1	1	7	7
Diptera (Harrison 1955)	41	58	28	39						
Lepidoptera (Salmon & Bradley 1956)	18	27	14	20	5	7	1	1		

in 1944 and 1945 were included in the "Cape Expedition" collections. Results from these collections were later published in an intermittent "Cape Expedition Series" as papers 1-27.

Little collecting was done in the next five years, although some specimens were taken by a party landing stores in the Auckland Is in May 1947, and Drs R. A. Falla and C. A. Fleming were on the Snares in November-December of the same year.

Gourlay (1950) discussed previous results from Auckland Is collections of Coleoptera.

Collections were made during the Antipodes-Bounty Islands Expedition, 1950, by Dr R. A. Falla, E. G. Turbott and R. K. Dell, on both those islands. Harrison (1953) recorded the Diptera. Some of the species collected were recorded together with "Cape Expedition" material in "Cape Expedition" reports by Forster (1955), Harrison et al. (1955) and Salmon & Bradley (1956).

The Auckland Is were visited by R. K. Dell in March 1954, and in November of the same year E. S. Gourlay, participating in the Dominion Museum-D.S.I.R. Expedition, made a large insect collection in the northern end of the Auckland Is plus a small one on Adams I.

Table 3. Numbers of genera and species recorded in "Insects of Campbell Island" (excluding some parasitic groups).

Groups	Aucklands		Campbell		Antipodes		Bounty		Snares	
	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.
Araneae	14	20	14	17					3	5
Opiliones	2	5	1	1					1	1
Pseudoscorpionida	2	3	2	2						
Acarina			21	39						
Chilopoda	3	3	1	1						
Diplopoda	3	3	2	2					1	1
Symphyla			2	2						
Collembola			26	46						
Plecoptera	1	1	2	3						
Orthoptera	1	1	1	1						
Psocoptera			3	3						
Homoptera (Cocc.)	3	3	3	4						
Trichoptera	1	1	1	1						
Lepidoptera			21	30						
Diptera			46	91						
Coleoptera (excl. Curc.)	4	4	26	29						
Curculionidae	13	24	13	14	1	1			7	7
Hymenoptera			9	9						

In 1952, the Danish Galathea Deep Sea Expedition had visited Campbell I., which was again visited, by a Denver Museum of Natural History Expedition, in 1958.

Since 1960, there has been increased interest and activity in the investigation of the zoology, botany and entomology of the southern islands.

An entomologist, P. M. Johns, of the University of Canterbury, was in a New Zealand party on Campbell I for 2 weeks in December 1960–January 1961. Prof. G. Knox began a series of University of Canterbury expeditions to the Snares in January 1961; followed by expeditions in January 1967, 1968–69, 1969–70 and November 1970, the 1967 party also having 2 days on Campbell I.

Since 1961, the Bernice P. Bishop Museum has been active in entomological investigations of Campbell and Auckland Is. K. A. J. Wise visited Campbell I on 23 October and 11 November 1961. J. L. Gressitt spent 5 weeks on Campbell I in November–December 1961, and K. P. Rennell collected periodically through the following 13 month period until early 1963. Gressitt and Wise were members of the New Zealand organised Auckland Islands Expedition, 1962–63, based at Port Ross in the north, then Wise spent almost 5 weeks on Campbell I from 31 January to 5 March 1963. As a joint Bishop Museum–Auckland Museum representative Wise also spent nearly 3 weeks on Adams I, at the south end of Auckland Is., during the Auckland Islands Expedition of 1966. The Campbell I collections made during the period 1961–63, were the basis for a monograph on the insects of Campbell I by Gressitt and Collaborators (1964), and that volume also included reports on some groups for Auckland Is (see Table 3).

The Auckland Islands Expedition, 1962–63, landed at Port Ross from HMNZS “Endeavour” on 26 December 1962. The party, which was comprised of Dr R. A. Falla (leader and ornithologist), Prof. G. A. Knox, J. Moreland, J. Yaldwyn (marine biologists), Dr E. J. Godley, F. Fisher (botanists), P. James (lichenologist), J. Wright (geologist), Dr J. L. Gressitt, L. J. Dumbleton, P. M. Johns, K. A. J. Wise (entomologists), B. D. Bell (wild life), E. Doley (carpenter) and McArthur (cook), was based in Ranui Cove at the old “Cape Expedition” camp. It was picked up on 20 January 1963, by the USS “Durant.”

The Auckland Islands Expedition, 1966, was in 2 parties under the overall leadership of Dr R. A. Falla. The northern party was put ashore from USS “Calcaterra” in Port Ross on 15 January 1966, and the southern party on the north coast of Adams I, south of Auckland I, the next day. The personnel of the northern party were Dr R. A. Falla (ornithologist), R. G. Ordish (entomologist), R. Taylor (zoologist), B. A. Fineran (botanist), C. Clark (general and radio), Burns (carpenter), and of the southern party, Dr E. J. Godley (leader and botanist), Dr G. Kuschel, P. M. Johns, K. A. J. Wise (entomologists), P. Rickwood (geologist), B. D. Bell (wild life and boat), J. Kendrick (wild life, radio and film). Both parties were picked up by “Calcaterra” almost 3 weeks later on 4 February 1966.

Mrs Marie Darby, zoologist of Canterbury Museum, collected on Bounty I in January 1968.

The University of Canterbury Antipodes Island Expedition, 1969, with J. Warham as leader, and Dr G. Kuschel and P. M. Johns as entomologists, spent the period 6–26 January 1969 collecting on Campbell I and were on Antipodes I from 28 January to 12 March.

GEOGRAPHY

Auckland Is. The Aucklands are situated between 50° and 51°30'S and constitute the

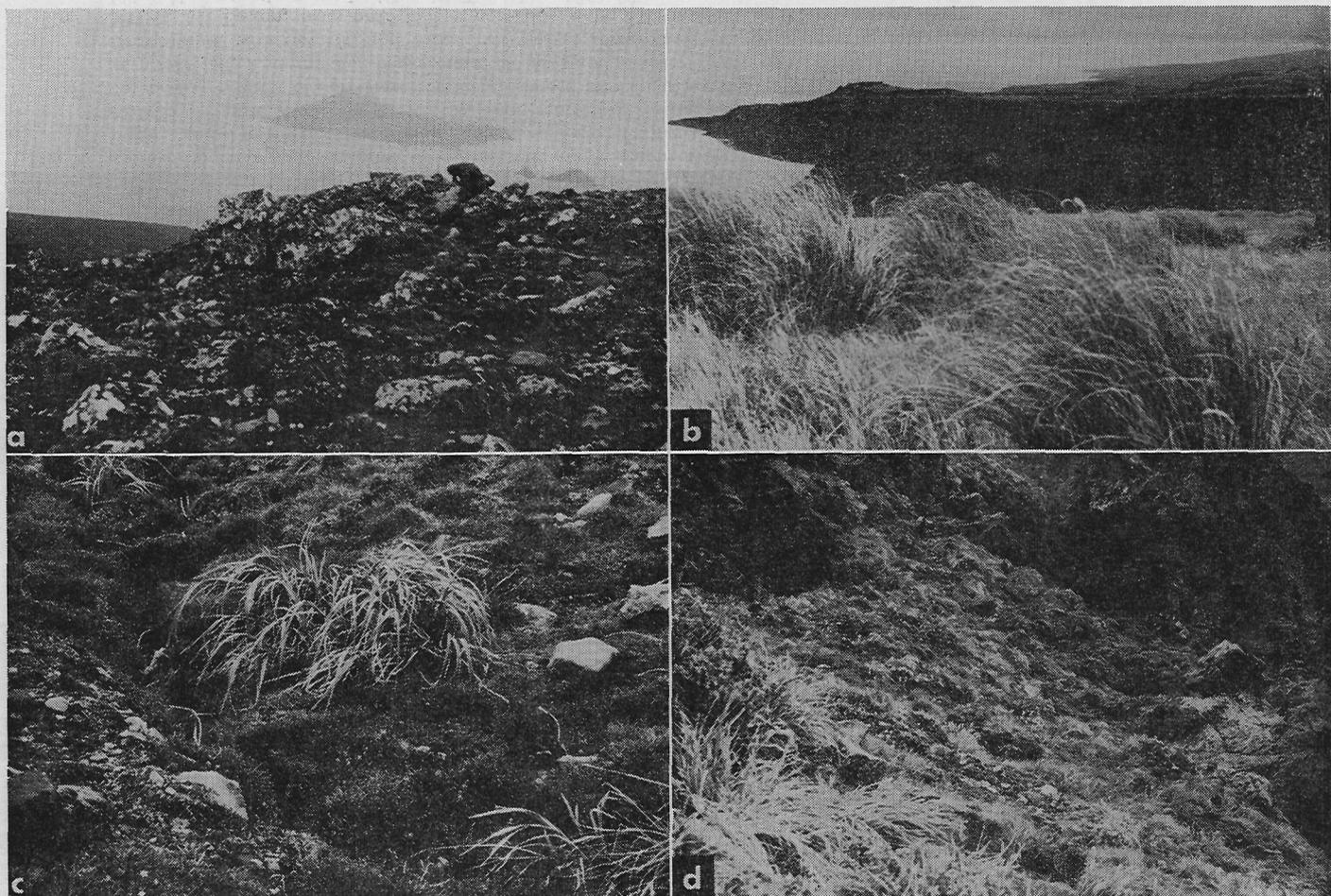


Fig. 8. Northcentral Auckland I: a, Disappointment I from Bleak Hill, 585 m, Fulton Fisher collecting plants; mosses, lichens, *Rostkovia* and *Ranunculus* in foreground; b, Looking south along east coast from near Mt Eden, 350 m, over Conical Hill, Twin Peaks and Haskell Bay and Chamber, Granger and Griffith Inlets, with *Chionochloa antarctica* foreground; in c, Near Mt Eden, 320 m, habitat of large wingless tipulid; d, Mt Eden, 370 m, *Chionochloa*, herbs, cryptogams; habitat of various apterous insects (Gressitt, Jan. 1963).

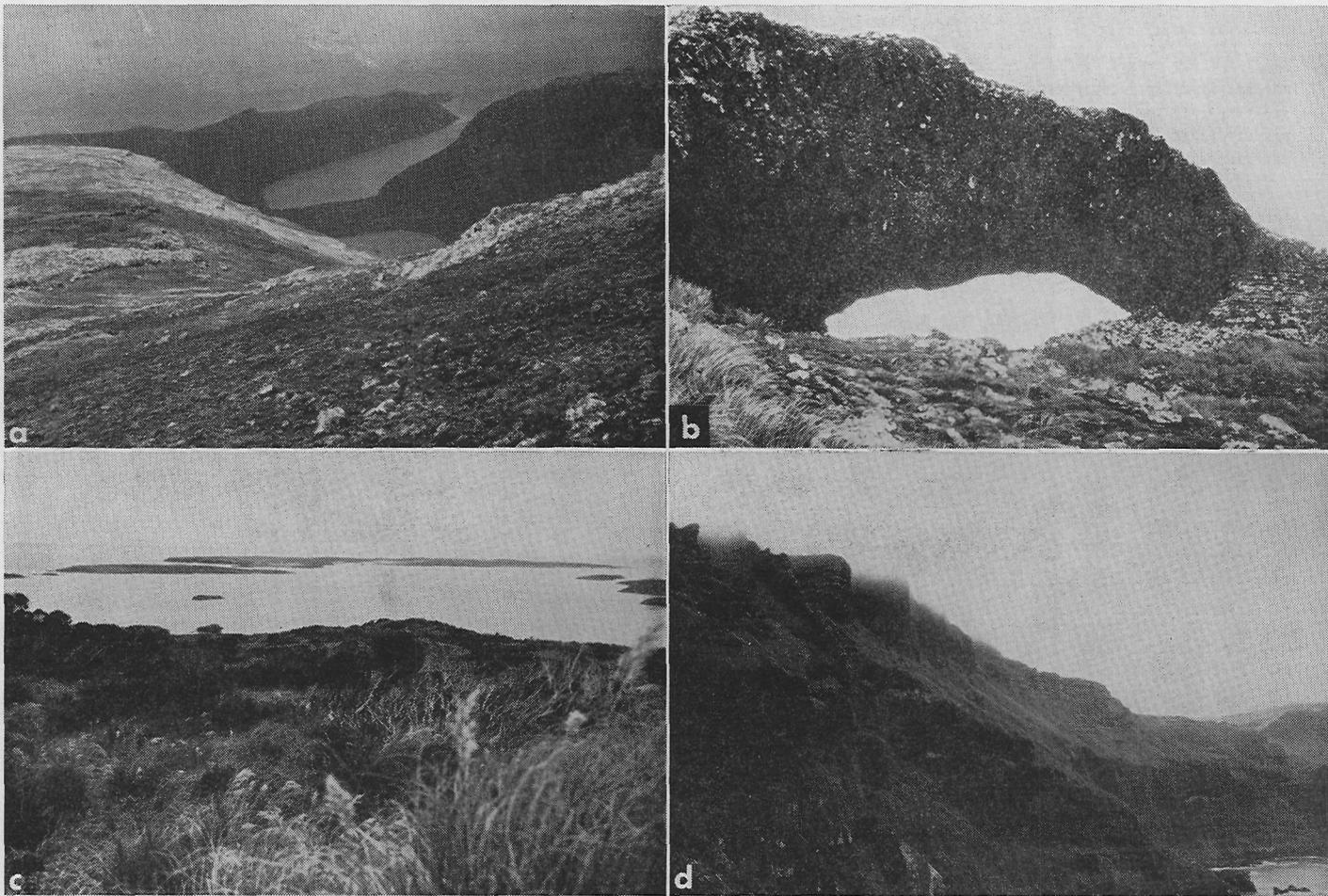


Fig. 9. a, Lake Hinemoa and Musgrave Inlet, east side above center of Auckland I, from just north of hill, 2007' (612 m), between Mt Easton and Bleak Hill; foreground with loose rocks; fell-field with mosses, *Rostkovia* and *Pleurophyllum hookeri*; b, Giant's Archway, central Auckland I, 462 m, from south side; with *Chionochloa* tussock at left, and *Rostkovia*, lichens and mosses on rocks; c, View of Port Ross from gentle sloped plateau between Meggs Hill and Mt Eden, at about 150 m, with Rose I at upper left, Enderby I in background, Ocean I and Tucker Pt at right, Shoe I and Davis I at left center; scrub, mainly *Dracophyllum*, with *Cassinia*, and with *Chionochloa* in foreground; d, West coast of Auckland I, looking south, toward point NW of Mt Easton, from near foot of non-cliffy slope SW of Stony Peak; prominent dykes visible at left; slopes mostly with *Chionochloa antarctica* tussock. (Gressitt, Dec.-Jan. 1962-63).



Fig. 10. a, View from between Meggs Hill and Mt Eden, Auckland I, well to left of fig. 3a and 7c, showing Hooker Hills in background, most of Laurie Harbor hidden behind low plateau in center, bearing scrub, with *Dracophyllum* dominating in foreground, with some *Cassinia* and *Neopanax*; b, View toward east coast of Auckland I, from behind Ranui Cove showing lowland scrub with *Dracophyllum*, *Neopanax* and *Cassinia*, with *Oreobolus* sedge, *Cyathodes*, gentians, orchids and *Schizaea*, as well a some *Chionochloa* tussock and stunted scrub; c, Cliffs on west coast, looking south, NW of Mt Easton, near area shown in fig. 7d; some scrub on slopes; *Chionochloa* tussock grass at left and on top of bluff; d, Cliffs and slopes SW of Stony Peak, looking north; *Metrosideros* stunted forest at left, with *Chionochloa* tussock in foreground; e, NW Cape, Auckland I, from tops of cliffs west of Bivouac Hill; plateau in foreground nearly Feldmark, with largely *Marsippospermum*, mosses and lichens, and bare rocks; f, West coast of Auckland I toward NW Cape, from top of cliffs west of Stony Peak, showing tops of cliffs west of Bivouac Hill at upper right, whence fig. 8d was taken. (Gressitt, Dec.-Jan. 1962-63).

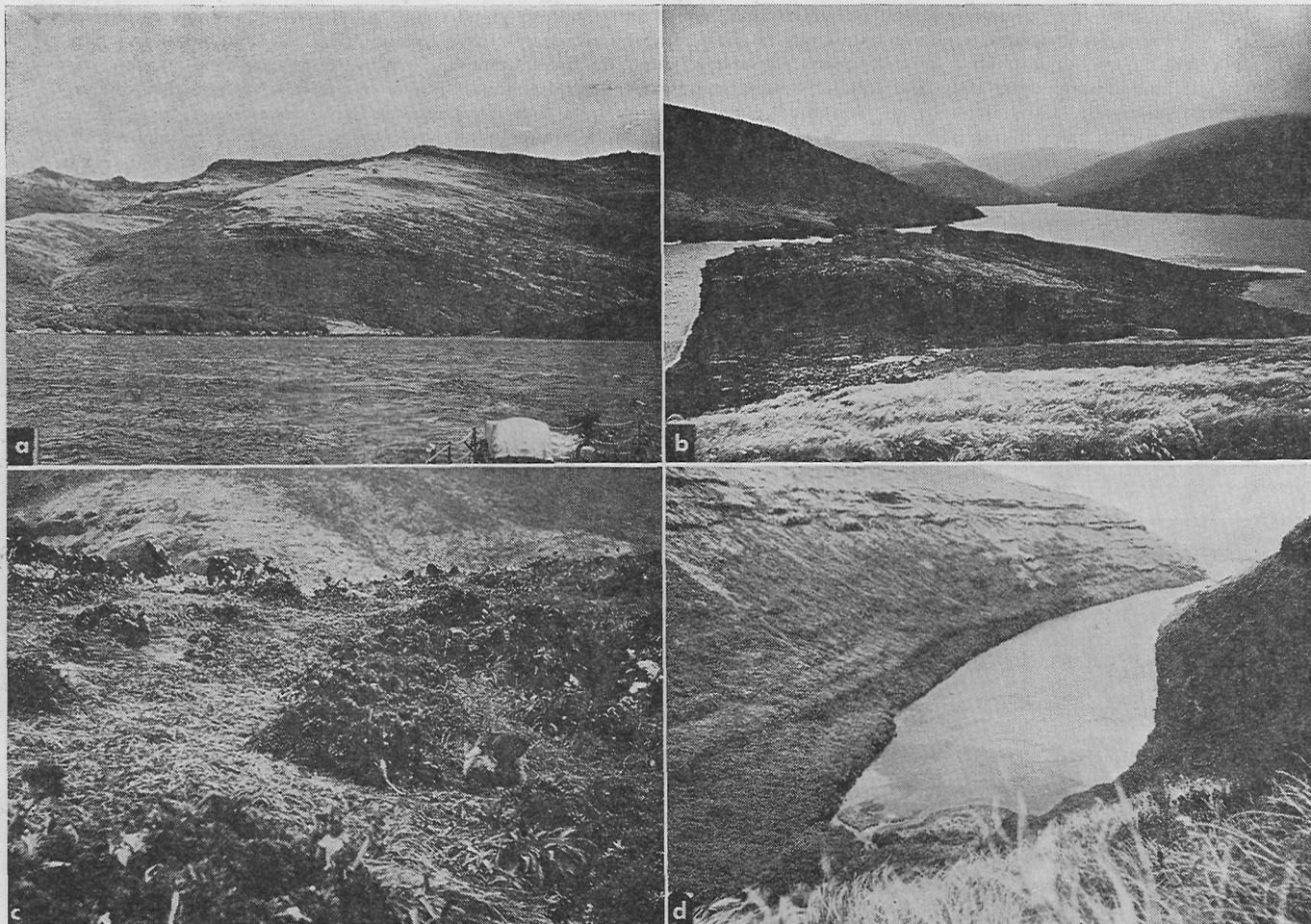


Fig. 11. Adams I. a, Magnetic Cove, north side, with east ridge leading to main divide; *Metrosideros* forest near shore; scrub in middle, with some *Oreobolus* lanes at right, and *Chionochloa* tussock grass above; b, NW Pt of Adams I, with Western Harbor, Auckland I in middle background and lower edge of Fairchild's Garden, with tussock grass in foreground, with some scrub and *Oreobolus* lanes in middle and in distance; c, Fairchild's Garden, showing Giant petrel nesting area, with clumps of *Anisotome latifolia* and trampled *Bulbinella*; d, Lake Turbott, south side of Adams I, near middle, showing slopes with scrub, *Metrosideros* near shore and *Chionochloa* tussock above; *Chionochloa* and *Dracophyllum*, right foreground. (Wise, 1966).

remains of a former somewhat larger land mass, as is the case with Campbell I. The effect of erosion from wind and waves is quite obvious, as is that from glaciation. Much of the western, windward side consists of cliffs falling into the sea. The fjords on the east side of the main Auckland I were formed by glaciers descending partly from valleys beheaded by erosion of the west coast. The Aucklands consist of a close-knit group of islands largely falling within the outline of a former single island, although now much indented and partly fragmented. Adams I, the second largest, forms a continuous outline with the southern part of Auckland I, having been separated by the erosion of a volcanic crater, and by subsidence, or by the post-glacial rise of sea level. Only Disappointment I, off the western cliffs of the northcentral part of Auckland I, is a sizeable well separated island. The other islands of any size are at the NE corner of Auckland I. Enderby, the largest of these, is farthest north and east, with Rose I between it and the main island. On the other side of the sunken valley forming Ross Hrbr are Ewing I, south of Enderby, with the much smaller Ocean I to its west and French Islet to SW, close to the main island. These appear to have been benched at a time of high sea level—probably during an interglacial period. Dundas Islet and other small ones are to the south of Ewing I. Most of the higher areas are parallel to the west side of the main island, as well as along the SW border of Adams I and between the fjords on the east side of the main island.

The Aucklands are not quite 500 km south of New Zealand. The intervening sea is not over 400 m deep. The main island is about 40 km N-S and about 27 km E-W. Adams I is about 23 km E-W and about 8 km wide. Disappointment I and Enderby I are each 3 to 4 km long, E-W and slightly narrower. The area of the Auckland group is nearly 600 sq km (main island 458 sq km; Adams I 90 sq km). The sea surrounding the islands is fairly shallow. Carnley Hrbr separates Adams I from Auckland I and is an erosion caldera developed by stream action, over the site of the vent of a former large volcano whose remaining fragments form Adams I and the south half of Auckland I. Most of the higher peaks of the Aucklands are along the western side of the main island, but some are on Adams I and on the eastern peninsula at the south end of the main island. There are 10 peaks of 600 m altitude or more. The highest are Mt Dick, 668 m, on Adams I and Cavern Peak, 664 m, near the base of the eastern peninsula at the south end of the main island.

The Auckland Is differ from Campbell I not only in being larger but in having much more extensive plateau land, with high ridges, partly in the form of narrow emarginated plateaux in part not much lower than the summits studded along them. Campbell I, on the contrary, has many of its peaks rising from low altitudes on all or most sides or with cliffs on one side. Furthermore, Campbell's peaks are lower, with none as high as 600 m. These differences result from more intensive erosion and glaciation at Campbell I of an original shield volcano that was formerly similar to one of the two shield volcanoes of the Aucklands. With the balancing differences in altitude and latitude, the summit environments of Auckland I and Campbell I are very similar. Both have an approach to Feldmark, which is much more pronounced on Macquarie I. This is a situation where only part of the ground is covered with vegetation and the latter occurs in isolated rows in line with the prevailing west winds.

Snares Is. The Snares are situated about 110 km SW of Stewart I, at lat. 48°S. They consist of a narrow triangular island with some projections and off-shore islets. The area is 2.6 sq km. The highest altitude is just under 200 m. Most of the shores consist of cliffs of 100 m or so in height. The greater part of the land surface is covered with peat to a depth of 2 m or more.

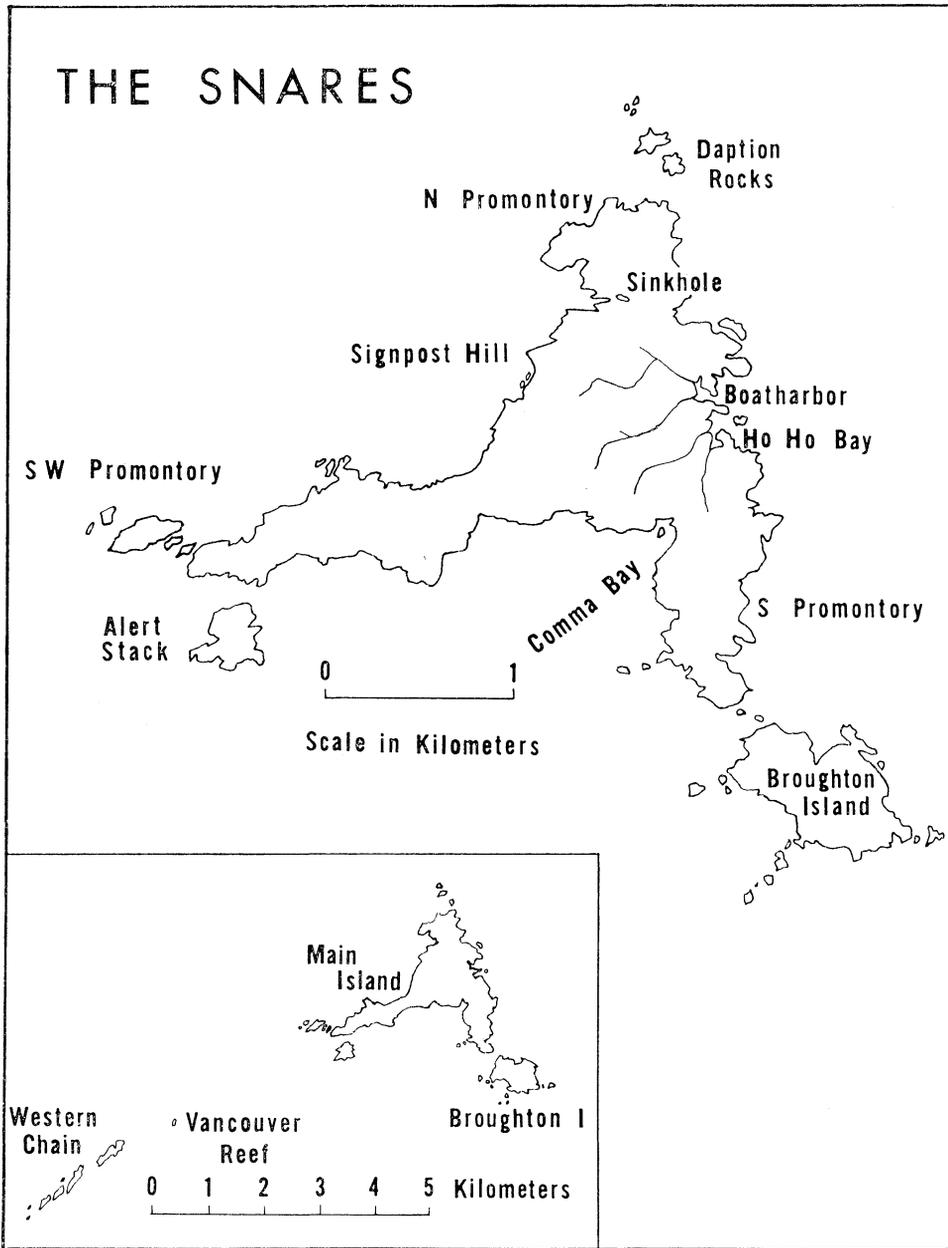


Fig. 12. Map of the Snares. The Boatharbor is situated at 48° 0.7'S; 166° 35.8'E.

Bounty I. The Bounty group consists of a semicircle of islets facing north, the largest just over 1 km long and just under 1 km wide. The group is located at 47°43'S and 179°E, 810 km east of Stewart I. There are 9 islets and several rocks. Highest altitude is just over 85 m, and several islets reach over 60 m high. The islets are severely eroded by the sea, but there are no bays. In rough weather spray reaches the highest altitudes. Rocks near sea level are worn smooth by the waves and by the feet of the millions of penguins, other sea birds and seals, which breed over most of the surface of the islets. Essentially the only plants are algae, but arthropods breed in the masses of seaweed washed up on the shores.

Antipodes Is. The Antipodes, located at 49°41'S and 178°43'E, are about 220 km south of the Bounty Is. They consist of a single triangular island about 9 × 6 km in size with 4 offshore islets and 3 very small ones, representing the relics of a volcano with a number of rather young (Quaternary) volcanic cones, some of which are well preserved (Cullen 1967). Highest altitude is just under 400 m. There are cliffs of 25 to 120 m on most sides, a plateau of 250 m height in the southwest and a lower area with swamp toward the northeast. Most of the surface is covered with peat from herbaceous plants.

GEOLOGY

Auckland Is. The Aucklands are to a great extent composed of basalt lavas, overlying older rocks. The former probably originated in the Pliocene, when the Aucklands consisted of two overlapping shield volcanoes. The cliffs of the west coast consist almost entirely of basalt flows and beds of scoria. The oldest rocks are of granite and gabbro, and these are overlaid by flows of trachyte and penetrated by dykes of trachyte, diabase and porphyrite. Above these are conglomerates formed of fragments of these granites, gabbros and trachytes, as well as gneisses and granites of different type. Still above these are series of porphyrites and diabases, and above these the basalt flows. The basalt is interwoven with dykes of diabase and basic porphyrites, some of which tend towards augite-comptonites. Disappointment I is composed of melaphyres and diabases (group 5 below). The general sequence may be indicated as follows (after Speight & Finlayson 1909; modified by Fleming 1968).

1. Granites and gabbros. Age undetermined (probably Paleozoic).
2. Trachytes—flows and dykes. Pre-Tertiary.
3. Camp Cove conglomerate. Pre-Tertiary.
4. Marine Tertiary, with fossils.
5. Older basic series, with dykes of dolerite, diabase and porphyrite. ?Middle Tertiary.
6. Younger basic series, with dykes of diabase and basic porphyrites. Late Tertiary (?Pliocene).

The Snares. The Snares consist largely of a moderately coarse muscovite granite of an even-grained character. It is nearly white, but becomes pink or red on weathering. The structure is gneissic, with quartz-feldspar, the feldspar mostly consisting of orthoclase, but with some oligoclase and a little perthite. Muscovite occurs in large plates, some bent, and there are some of biotite and some crystals of garnet. These rocks belong to the same plutonic complex as do Stewart I and SW Otago. Metamorphic rocks (schist) representing the country rock into which the granite was intruded occur on the remote western reef. (After Marshall 1909; Fleming et al. 1953). The present form of the islands may be the result of marine erosion of a larger land mass. On the other hand they might be a remnant of one of the deformed peneplains of southern New Zealand. The elevation of the surface above

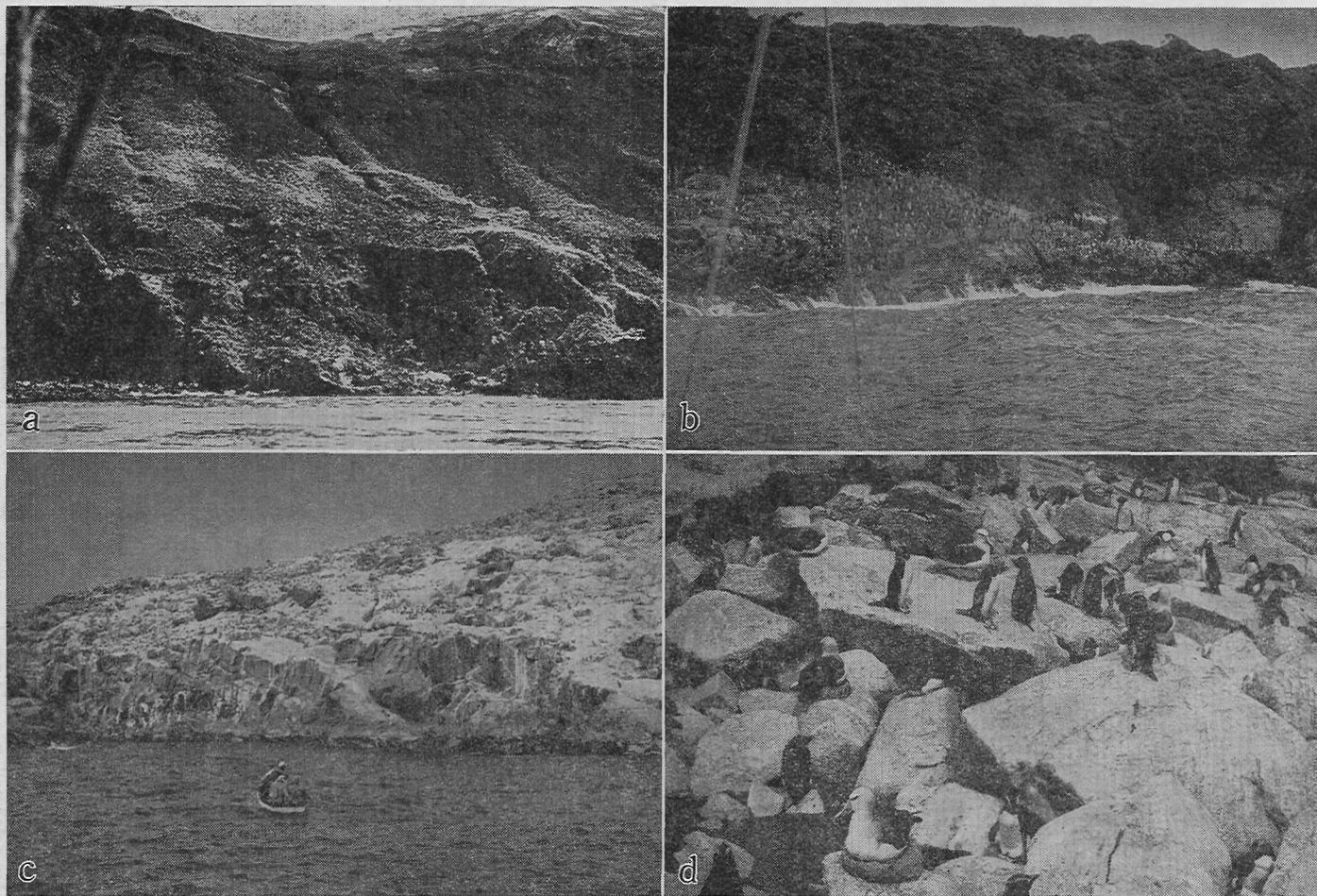


Fig. 13. a, Antipodes I. Coastal slopes: *Poa foliosa* about penguin colonies near shore; *Poa litorosa* on slopes above (A. J. Black, 1950). b, Snares I. Shore with penguin colonies and vegetation above (A. J. Black, 1947). c, Bounty I. Bare rock slopes (A. J. Black, 1950). d, Bounty I. Penguins and mollymawks on rock slopes (A. J. Black, 1950).

base-level may have been as late as post-Pliocene. The granite is closely jointed, mainly in two sets of intersecting joints, one parallel to quartz-feldspar and pegmatite veins, vertical or dipping steeply westward, with secondary joints vertical or dipping southward. There is a surface gravel, mostly of granite but partly basaltic, of regurgitated sea lion gastrolith pebbles. There is some mica schist on the surface in the Western Chain of the Snares. The peat is quite acid, of pH 3.8, with C content normal, N above average, percent of exchangeable lime is 22.8% and potash 1.4. Burning the peat leaves 4.04% mineral soil. (Fleming 1953).

Studies of Snares pollen samples collected by Fleming show a steady increase in grass pollen and decrease in forest pollen. The succession shown is first forest (*Olearia* dominant), then herb meadow (*Stilbocarpa* and *Anisotome* predominant) and finally tussock grassland (*Poa* dominant). Concentration of pollen on an average slide was 11,800 grains per sq. cm. Wind-borne pollen from New Zealand did not amount to 0.5% of the total pollen in any sample. Pollen of Umbelliferae, probably *Anisotome acutifolia*, constituted 43% of non-grass pollen in sample 6 of 13 (middle of the range). This species is now almost extinct. Estimate of the age of the peat is 2,500 years or less. (Harris 1953).

Bounty Is. The islets consist of granite of fairly uniform type, whitish or pale brown and include quartz, feldspar and biotite-mica. There are limited amounts of plagioclase feldspar (albite) and some minute flakes of muscovite and needles of apatite. These islands are near the east edge of the continental shelf and the ocean bottom descends rapidly to 4,000 m in depth. (After Speight & Finlayson 1909).

Antipodes Is. The Antipodes may consist entirely of basalt. Several young volcanic cones with craters have been built up above the older basalts. Reports of sedimentary rock are questioned. Some coal present was apparently formed by lava flowing over peat. The cliffs show regular flows of lava and beds of scoria. Some of the basalt contains augite and olivine. (Speight & Finlayson 1909; Cullen 1967).

SOILS

The soils of the Aucklands and nearby islands are dominated by peat. This consists of the skeletons of plants deposited in a wet environment, and is essentially wet humus. It may accumulate to considerable depths and may be subjected to a certain amount of pressure. The areas where peat accumulates are to some extent swamps, bogs or at least marshy. Rate of accumulation of peat may be as much as 10–15 cm/year. Peat may result from *Sphagnum* or other mosses, and various herbs, sedges, grasses, etc. Peat develops in areas with damp substrate, high humidity and cool climate. The ash contents of peat are largely oxides, with some chlorides and sulphates, but no carbonates and rather little potash. The Auckland peats are low in lime and sulphates but high in iron, alumina and rare earths. They are derived mainly from higher plants (Filices, Juncaceae, Gramineae, Araliaceae, Umbelliferae, Compositae, Liliaceae, Rubiaceae, Myrsinaceae and Epacridaceae) on the upper slopes above the forests, and from Filices, Myrtaceae, Araliaceae, Compositae and Epacridaceae in the forests. These peats are not formed in or under stagnant water, and many are formed on steep slopes. They support rich growth of higher plants, which generally require a soil rich in mineral nutrients. Thus they differ from usual peat soils. The Auckland peats must be classified as humus soils. The top layer is richest in nitrogen, but some of the lower layers are richer than some near the top. The upland soils contain the most ash. The Aucklands peat is antiseptic, and bacterial action is apparently replaced by that of molds and fungi. (After Aston 1909).

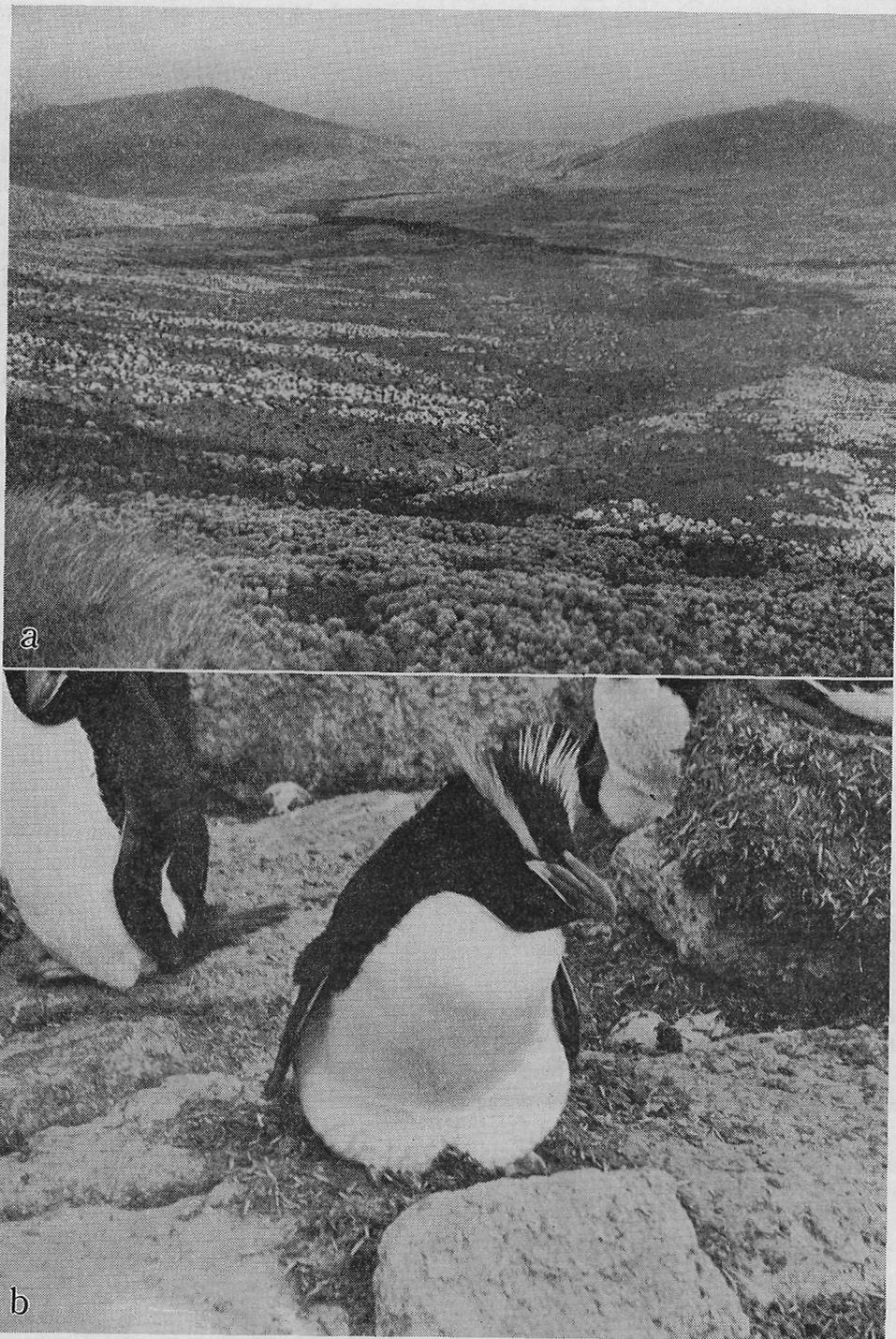


Fig. 14. a, Antipodes I. View over tableland; *Poa litorosa*, *Coprosma* and *Polystichum vestitum* (darkest bands) (E. G. Turbott, 1950). b, Bounty I. Loose feathers and guano of penguin nests; felted feathers and guano of mollymawk nest (top right). (E. G. Turbott, 1950).

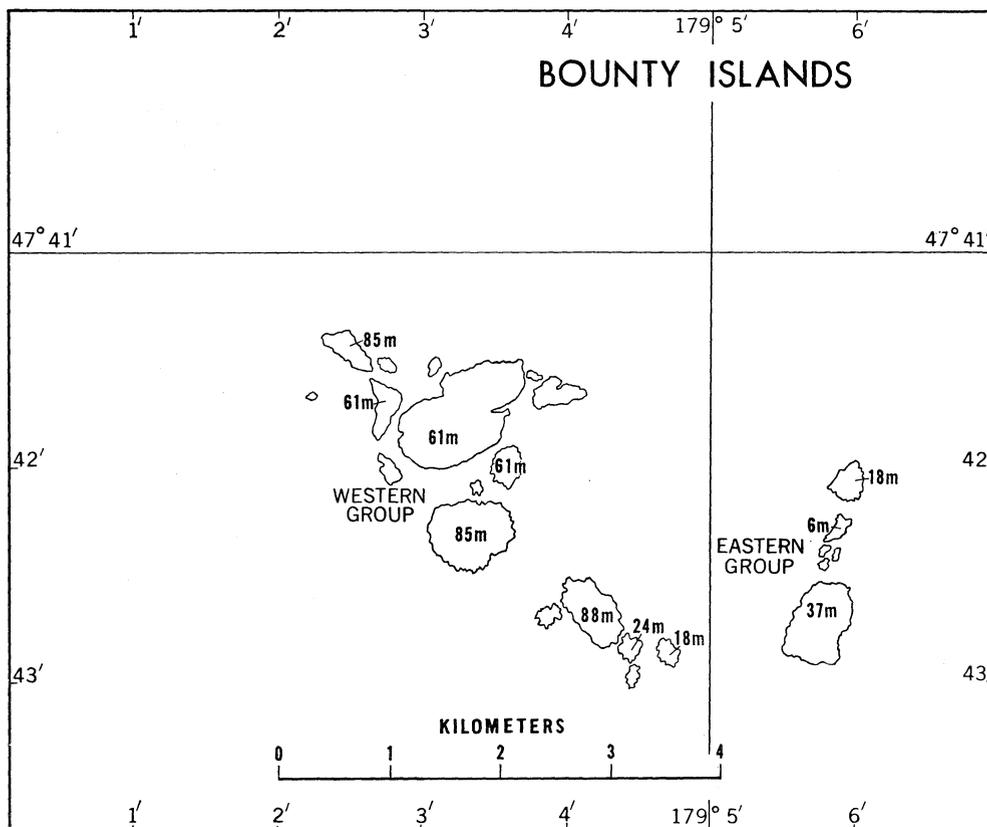


Fig. 15. Map of the Bounty Islands.

CLIMATE

Much of the general information on climate and weather systems written by de Lisle (1964) for Campbell I and the New Zealand—Campbell I area applies also to the Auckland Is and other islands south of New Zealand. Regular meteorological observations were made at the Auckland Is during the occupation of the "Cape Expedition" coast-watching stations, from May 1941, to March 1945, at Ranui Cove, Port Ross, and from May 1941, to April 1944, at Musgrave Pen., Carnley Hrbr. In general, these islands are wet and windy, the high sea cliffs on the west and south giving evidence of the prevailing westerlies and strong seas, compared to the more gentle topography and inlets of the east coast. Cloud often covers the higher hills and ridges above 300 m; consequently these are always wet. The situation of the Auckland Is, lying about 50°30' to 50°55'S, is less than 2° further north than Campbell I and the former are also cold climate (cool temperate), although not within the true (or "high") subantarctic zone (Wace 1960, Greene 1963, Holdgate 1964, Gressitt 1970). Gressitt quoted the mean monthly temperatures as 5°C minimum to 12° maximum for Auckland Is and 4°C minimum to 9°C maximum for Campbell I.

The following information, taken from published Auckland Is data (1950, N. Z. Meteorological

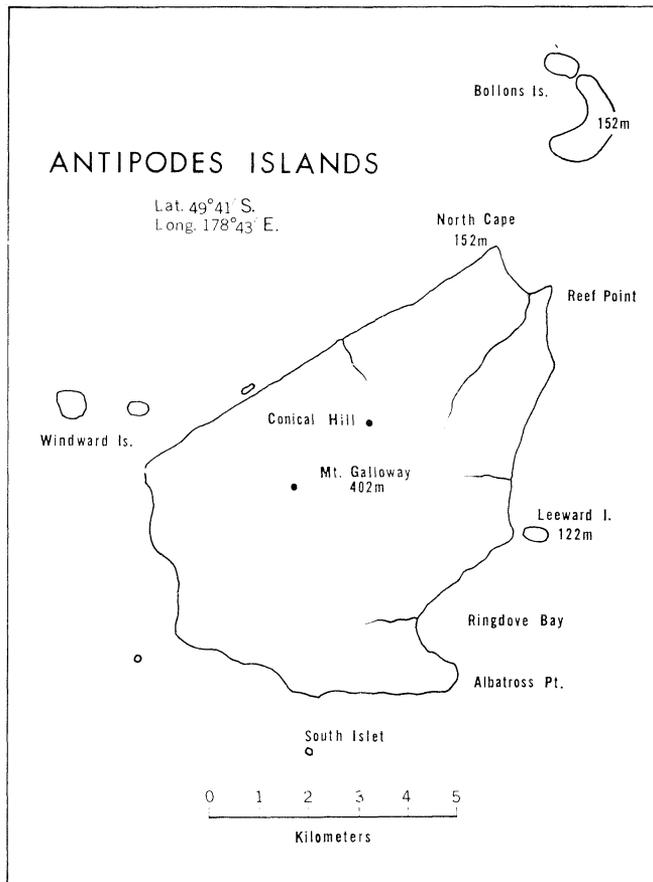


Fig. 16. Map of the Antipodes Islands.

Service Meteorological Observations for 1945) is the only long term information available and much of this only spans 2-3 years. In addition, except for temperatures, the data were from observations made only at 0900 hrs local time.

Monthly ranges of extreme temperatures ($^{\circ}\text{C}$) are as follows.

	Port Ross	Carnley Hrbr
Means of maxima	+6.78—+15.78	+6.56—+14.22
Means of minima	+2.28—+ 8.39	+2.50—+ 8.28
Extreme maxima	+9.83—+20.89	+10.56—+20.11
Extreme minima	-3.11—+ 3.28	- 2.78—+ 5.11

The indications are that the Carnley Hrbr site was neither as hot nor as cold as the Port Ross site. The total range of extreme temperatures for Auckland I is thus indicated as -3.11 to $+20.89^{\circ}\text{C}$ at Port Ross, the range of means of minima and maxima being $+2.28$ to $+15.78^{\circ}\text{C}$. However, mean annual temperatures for two complete years at Port Ross were $+8.00^{\circ}$, $+8.11^{\circ}$ and for 1 complete year at Carnley Hrbr, $+7.22^{\circ}$, indicating generally cooler conditions at the latter site.

Wind directions at Port Ross were mainly from the West ranging from NW to SW, on 249.5–265.5 days annually in 3 complete years, with some from the exposed direction North, and others around the compass; there were only 11 days of calm in the whole 3 years. At Carnley Hrbr, wind directions were mainly from the NW ranging NW to SW, on 247.5–283.5 days annually in 2 complete years, with some from the North and others around the compass; there were 55 days calm in the whole 2 years.

Total rainfall ranged 5.05–22.30 cm monthly and 141.27–163.17 cm annually (complete years only) at Port Ross, 8.66–30.40 cm monthly and 192.25–229.49 cm annually (complete years only) at Carnley Hrbr, suggesting that rainfall on the more exposed West and South is higher than at Ranui Cove on the NE.

At Port Ross, in 3 complete years, there were gales on 45–72 days, snow and/or hail on 38–69 days, and fog on 27–31 days, annually. At Carnley Hrbr, in 2 complete years, there were gales on 28–142 days, snow and/or hail on 89–145 days, and fog on 8–22 days, annually. Annual mean cloud cover was 7.9–8.9 tenths annually, for 3 complete years, at Port Ross and 8.8–9.1 tenths annually, for 2 complete years, at Carnley Hrbr. The weather, in general, tended to be worse in the South than in the North.

Temperatures and other observations, taken by Wise during the more recent expeditions at the north and south ends of the Auckland Is are as follows.

Port Ross, 31.XII.1962–20.I.1963, local times

Range of air temperatures, 0800	9.61°–13.33°C
Range of maxima preceeding 24 hrs	12.78°–24.17°C
Range of minima preceeding 24 hrs	2.22°–11.67°C
Range of air temperatures, 1200	10.56°–17.89°C
Range of air temperatures, 1800	10.00°–16.67°C

For the first 3 days observations were made at Ranui Cove once or twice each day but from 31 December 1962 they were made regularly 3 times a day. The following notes refer to the latter period of 20 days only. The original "Cape Expedition" observation site was re-occupied but only a small area was cleared of thick high fern. Only 3 days were fine and sunny with less than 5/10ths cloud, there was 8/10ths to 10/10ths cloud for the whole day on 11 days, of which 7 had complete cloud cover; rain or showers occurred on 14 days; winds were often strong about Port Ross but the observation site was sheltered. The high hills on the main ridge were often not visible from the Port Ross area because of cloud cover which was frequently low enough to cover the top of Mt Eden (420 m). One party spent 2 days and nights in the Mt Eden—Bivouac Hill area and could not see more than about 100 m for the whole time as it was cloudy and raining; a second party (Godley, Fisher, Gressitt & Wright) spent 10 days on the high ridges of which only 2.5 days were reasonable for working.

Adams I. 17.I.1966–3.II.1966, local times

Range of air temperatures, 0900	8.33°–13.33°C
Range of air temperatures, 1800	8.89°–14.72°C

19.I.1966	
Air temperature, 0900	10.56°C
Sea " "	8.89°C
Stream " "	7.78°C
Ground " "	8.61°C

During the 18 days at Magnetic Cove, Adams I, morning and evening weather observations were made on most days; only one day was fine and sunny, 6/8ths–8/8ths cloud being re-

corded for more than 3/4 of the observations, most of those being complete cloud cover; rain or showers occurred on 15 days including the last 7; winds were often strong although the observation site was partly sheltered. The main dividing ridge of Adams I, about 600 m, was often in cloud which was recorded at or below that height on 14 out of 15 days, being below 300 m on 7 of those days.

VEGETATION

Auckland Islands: The vegetation of much of the Aucklands has to a considerable extent been greatly altered by introduced vertebrate animals. This fact is very evident when comparing the main island (Auckland I) with Adams I in the south and various islands at the north end of the group. Adams I, Ewing I and French Islet have apparently never experienced introduced vertebrates and have vegetation in a fairly natural state. Ewing I, however, has had a history of interference by man and presents quite a different picture than Adams I. Rose I. and Enderby I have had a long history of damage by rabbits and cattle, with rabbits persisting to date on Rose I and rabbits and cattle on Enderby I. Ocean I had a history of 50 years with goats, which did great damage, but these were exterminated about 1943. The main island has suffered severely from long presence of pigs, all over the island, and goats at least in the north, with consequent changes in vegetation—particularly in the reduction of herbs and tussock.

Ewing I has, in the middle, a dense forest of *Metrosideros*, with some *Olearia*, surrounded by a large nearly pure stand of *Olearia*, which may partly be on areas cleared of original forest long ago by man. The *Olearia* reaches heights of nearly 10 meters. Ferns—*Blechnum*, *Polystichum* and *Asplenium* occur sparingly in the *Olearia* forest. Areas of dense *Poa* tussock and herbs such as *Stilbocarpa* occur on some of the fringes of the forest. Many hair seals frequent the *Olearia* forest, near the west beach. The island is fairly low and flat, but shag and other birds nest on the low cliffs, and Yellow-eyed Penguins in the forest. *Olearia* trees, conspicuously abundant on Ewing, are hardly to be seen in the rest of the Aucklands, except for a patch on the former settlement area in Ross Hrbr, with a few trees in a few other isolated spots (Godley 1965, Fig. 4, 5). Godley stated that the *Olearia* is spreading in the Aucklands, and may have immigrated from the Snares in the early 19th century.

French Islet is fairly densely covered with representative vegetation, including *Metrosideros* trees, *Stilbocarpa* and other herbs, and *Poa* tussock, but the islet is small and low.

Ocean I has old dead *Metrosideros* trees, killed by goats, as well as new ones growing up since the extermination of the goats just over a quarter of a century ago. Herbs are beginning to come back, but there are many petrels nesting in the ground because of the lack of land vertebrates and loss of forest. *Rumex neglectus* grows in small swamps close to sea-level, with *Carex*, *Tillaea*, *Montia* and *Poa*.

Enderby I has fairly extensive *Metrosideros* forest, some of it somewhat stunted and opened up to a considerable extent by cattle. Herbs other than *Bulbinella* are rather scarce. There are some areas of *Colobanthus* mats near the tops of cliffs, and a few herbs such as *Anisotome* in spots where the rabbits and cattle cannot reach them among the cliff tops. Tussock grass is limited and cropped by rabbits. *Rumex neglectus* has colonized considerable areas of disturbed sand dunes on the north side. Godley (1965) presented a vegetation map, showing *Cassinia* west of the rata and *Bulbinella* along the NW coast. The effect of cattle and rabbits was severe. The rabbits were in good condition during our visit and the vegetation was suffering. Some of the cattle were shot during our visit.

Rose I is densely populated by rabbits, which have modified the vegetation, although Godley (1965) considered the island less changed than most of the others. The SE part has rata forest, partly dead (Fig. 2b), west of this there are areas of stunted scrub and cropped grasses, with a few introduced plants. On the north and west there is tussock grassland of *Poa litorosa*, and sward grassland between (map in Godley 1965). The rabbits were in poor condition during our visit and the vegetation tending to recover.

Adams I is by far the largest and highest island lacking introduced vertebrates, and has had the least disturbance by man of all the islands. Thus the vegetation is in a presumably original natural condition.

The probable natural vegetation of the Aucklands consists of some contrasting zones, with some degree of altitudinal stratification, as well as overlap. Although many of the species may occur at almost any altitude, there is distinct zonation, with many of the endemic herbs occurring primarily at higher altitudes. There may be mats of *Colobanthus*, the sedge *Scirpus aucklandicus*, mosses and lichens near the shore, with some *Poa foliosa* or *P. litorosa* grass tussock, *Carex* sedge, the ferns *Blechnum* and *Asplenium*, and herbs such as *Tillaea*, *Plantago*, and, in protected places, *Stilbocarpa*, *Pleurophyllum*, *Anisotome*, *Acaena* and *Cotula*. *Poa ramosissima* grows on wet cliffs.

A fairly narrow lowland zone is occupied by dense *Metrosideros* (rata) forest in the lower 50 meters or so of the slopes, sometimes extending higher in protected areas, and often lacking or stunted in exposed stretches on the windward (west) side or promontories. The trees may be as high as 12 meters, but are usually partly prostrate. There are some ferns, as well as *Callitriche*, and a few other herbs, and mosses, hepatics, lichens, etc, growing in the rata forest. Also sometimes *Dracophyllum* and *Neopanax* (*Nothopanax*), *Coprosma* and *Myrsine* (*Suttonia*).

Above the *Metrosideros* zone there are bogs dominated by *Oreobolus* sedge forming mats, alternating with *Chionochloa* tussock grass, *Cyathodes*, and scrub of such shrubs as *Dracophyllum*, *Myrsine*, *Neopanax*, *Hebe*, *Cassinia* and *Coprosma*. This was called Mountain Scrub or *Suttonia* Formation by Cockayne (1909). Godley (1965) has called it the Lowland Scrub, as it only occurs in dwarf form at higher altitudes. It is quite common for the scrub to have straight parallel series of open lanes extending through it, usually in line with prevailing winds (W-E). These lanes consist of the *Oreobolus* cushions with *Cyathodes* and *Schizaea*, but also some *Chionochloa* tussock and stunted shrubs of the above scrub species. The fern *Blechnum* may occur in the scrub. The shrub *Hebe* usually occurs near the shore, below the *Metrosideros*. *Dracophyllum* may also occur near the shore. *Ranunculus*, *Callitriche*, *Anisotome*, *Bulbinella*, *Pleurophyllum* and other herbs grow in the bog and tussock areas on the middle and higher altitude slopes, but these herbs (other than *Bulbinella*) have been largely eliminated by pigs and goats where those animals occur. The *Chionochloa* tussock is often interspersed with low bushes of *Coprosma*, *Dracophyllum*, *Cassinia* and sometimes *Hebe*. Open areas are occupied by *Celmisia* (composit), *Carpha* (sedge) and moss. Higher on the slopes the tussock grasses become smaller and disappear, and there is more of a tundra-like environment, with *Rostkovia* (Juncaceae), *Oreobolus*, *Gaimardia*, bryophytes and lichens forming bogs, with herbs in more protected places. Among these are *Drosera*, *Astelia*, and *Celmisia*. Cushion plants include *Gaimardia* and *Phyllacne*, besides the bryophytes and others. Normally this high environment is dominated by the *Pleurophyllum hookeri* formation, but the herbivores have greatly reduced the *Pleurophyllum*. *Carpha*, *Astelia*, *Hymenophyllum*, *Cardamine*, *Ranunculus*, *Plantago*, *Bulbinella*, *Gentiana*, *Abrotanella*, *Phyllachne*, *Agrostis* and stunted *Chionochloa*, *Aciphylla*, *Stilbocarpa* and *Pleurophyllum speciosum* may occur on the high moors. *Plantago* occurs in particular

where the surface is stony.

One of the most luxurious associations is the *Pleurophyllum* Meadow, which is only to be found in full complement at west tip of Adams I, and slightly reduced on Disappointment I. This consists of the large herbs in profusion, particularly all three species of *Pleurophyllum*, as well as *Stilbocarpa*, *Aciphylla*, *Bulbinella* and the fern *Polystichum*. Above this is the transition to *Chionochloa* tussock, with small herbs in sparser areas—*Gentiana*, *Cotula*, *Acaena*, *Epilobium*, *Nertera*, *Scirpus* and *Helichrysum*.

Swamp associations comprise *Carex*, *Juncus*, *Epilobium* and *Myrsine* as a rule. Bogs include *Oreobolus*, *Astelia*, *Drosera*, *Carex*, *Gaimardia* and *Stilbocarpa* in particular. The subalpine rock association consists of lichens, mosses, *Colobanthus*, *Geum*, *Cardamine*, *Polypodium* and *Hymenophyllum*. Locally, *Marsippospermum*, *Gaimardia* or *Carpha* may dominate or form pure growth or bogs. (Godley 1965).

Near the middle of the west coast of the main island in the splash zone and upward to about 30 meters altitude on the steep slopes there are mats of *Colobanthus*, *Hebe* shrubs and *Poa* tussock. From 30 to 60 meters altitude there is still *Hebe*, and tussock, with *Polystichum* ferns. From 30 to 90 meters in some areas there is *Metrosideros* forest, of relatively short stature. *Coprosma*, *Cassinia*, *Bulbinella* and small *Myrsine* bushes occur between 30 and 200 meters. Above 200 meters are small *Coprosma* and *Dracophyllum* bushes and above 300 meters mostly moss mats, *Oreobolus* cushions and other forms of tundra. *Sphagnum* moss occurs very rarely on Auckland I. Tree ferns have their southern limit near the middle of the east coast of the main island.

Snares Islands: The flora of the Snares includes 25 vascular species (Allan 1961; Fineran 1969). Endemic species are *Stilbocarpa robusta* (Kirk) Ckn and *Anisotome acutifolia* (Kirk) Ckn. Plants have been collected on the Snares by Kirk, Cockayne, Aston, Du Rietz, Oliver, Newcombe and Fineran, and Fleming collected peat samples.

The vegetation of the Snares is dominated by a scrub of *Olearia lyallii*, with *Senecio* on the east margin. The *Olearia* is about 4.5 m in height and there is no undergrowth except a few *Polystichum* or *Blechnum* ferns. There are two meadow formations of tussock grass, *Poa foliosa* being greener and occurring in more sheltered areas, and *Poa litorosa* being browner and existing in more exposed situations. The small pink, *Colobanthus muscoides*, forms green cushions near the coast. *Tillaea moschata* and *Callitriche antarctica* occupy crevices and wet peaty ground. *Hebe elliptica* shrubs occur near the edges of cliffs. The ferns *Blechnum* and *Asplenium* grow on rocks and peat. *Lepidium oleraceum* occurs sporadically on rocks. *Myosotis*, reported by Cockayne (1909), also from rocks, has apparently died out (Fineran 1969).

Antipodes Islands: The flora of the Antipodes numbers about 45 species of vascular plants. About four of these are lacking in the Auckland Is and only two, *Epilobium antipodum* Petrie and *Gentiana antipoda* Kirk, are endemic to the Antipodes.

The vegetation of the Antipodes consists largely of tussock and bog, with limited extent of scrub and swamp, besides plants growing on rocks and cliffs. The Tussock Meadow Formation consists mainly of *Poa litorosa* forming dense growth on peaty soil, quite deep in low and protected places, with some *Poa foliosa* and *Carex trifida*. Higher, the tussock is shallower, and mixed with *Polystichum* fern. Farther from the coast, there is further mixture of *Anisotome*, *Acaena* and the fern *Histiopteris*. Other species in more open spaces are *Blechnum*, *Asplenium*, *Hypolepis*, *Pratia*, *Luzula*, *Epilobium*, *Stellaria*, *Lycopodium*, *Helichrysum*, *Coprosma* and *Hymenophyllum*, besides lichens, hepatics, and mosses. In more protected places there is *Stilbocarpa*, with *Urtica*, *Poa foliosa*, *Polystichum* and *Coprosma*.

The bog formation occurs where the ground is very wet, usually in depressions in the tussock

meadow. *Carex ternaria* is the most abundant plant, and *Pleurophyllum criniferum* is the tallest, in the bog. Other elements are *Anisotome*, *Stilbocarpa*, *Coprosma*, *Hymenophyllum*, *Luzula*, *Gentiana*, *Uncinia* and the hepatic *Marchantia*. A swamp formation is distinguished by large size of *Poa litorosa*, along with *Carex appressa* and *Polystichum*.

On the coastal rocks and cliffs, where there is protection, *Apium*, *Colobanthus*, *Crassula*, *Scirpus*, *Cotula*, *Poa litorosa* and a dark green moss occur. On inland rocks occur lichens, *Anisotome*, *Lycopodium* and *Hymenophyllum*. (After Cockayne 1909).

LIST OF PLANTS OF THE AUCKLAND ISLANDS, SNARES AND ANTIPODES

(After Allan 1961, Godley 1969, Fineran 1969, Sainsbury & Allison 1962, Zotov 1965, Fisher & Hair 1963, Moore & Edgar 1970)

FILICES

Psilotaceae:	<i>Tmesipteris tannensis</i> Bernh.	K, N, S, St, Ch.
Lycopodiaceae:	<i>Lycopodium fastigiatum</i> R. Br.	N, S, St, Ch, C, Austr., Tasm., Antip.
	<i>L. ramulosum</i> T. Kirk	?N, S, St.
	<i>L. scariosum</i> Forst. f.	N, S, St.
	<i>L. sp.</i> Godley 1969, Fig. 1	end?
Schizaceae:	<i>Schizaea fistulosa</i> Labill.	N, S, St, Ch, C.
Hymenophyllaceae:	<i>Hymenophyllum sanguinolentum</i> (Forst. f.) Swartz	3 Kings, N, S, St.
	<i>H. villosum</i> Col.	N, S, St, C.
	<i>H. demissum</i> (Forst. f.) Swartz	K, N, S, St, Ch.
	<i>H. pulcherrimum</i> Col.	N, S, St.
	<i>H. multifidum</i> (Forst. f.) Swartz	N, S, St, Ch, C, Antip.
Cyatheaceae:	<i>Cyathea smithii</i> Hook.	N, S, St.
Polypodiaceae:	<i>Phymatodes diversifolium</i> (Willd.) Pic	K, N, S, St, Ch.
Gleicheniaceae:	<i>Gleichenia cunninghamii</i> Heward ex Hook.	N, S, St.
Grammitidaceae:	<i>Grammitis heterophylla</i> Labill.	N, S, St, Ch.
	<i>G. crassa</i> Fee	S, St.
	<i>G. billardieri</i> Willd.	N, S, St, Antip., C, M.
	<i>G. pumila</i> J.B. Armst.	N, S, St, C.
Dennstaedtiaceae:	<i>Hypolepis rugosula</i> (Labill.) J. Smith	N, S, Ch, C.
	<i>H. millefolium</i> Hook.	N, S, St, Antip., C.
Aspleniaceae:	<i>Asplenium lucidum</i> var. <i>aucklandicum</i> Hook. f.	end*
	<i>A. obtusatum</i> Forst.	K, 3 Kings, N, S, St, Ch, Antip., C.
	(& var. <i>obliquum</i> (Forst. f.) Hook)	S, Sn, C.
	<i>A. bulbiferum</i> Forst.	N, S, St, Ch, Antip.
Blechnaceae:	<i>Blechnum patersonii</i> (R. Br.) Mett.	N, S, St.
	<i>B. banksii</i> (Hook. f.) Mett. & Diels	N, S, St, C.
	<i>B. fluviatile</i> (R. Br.) Salom.	N, S, St, Ch, Austr., Tasm.
	<i>B. penna-marina</i> (Poir.) Kuhn	N, S, St, Ch, Antip., C, M.
	<i>B. procerum</i> (Forst. f.) Sw.	N, S, St, C.
	<i>B. durum</i> (Moore) Christen	Sn*, C.
Dryopteridaceae:	<i>Polystichum vestitum</i> (Forst. f.) Presl.	N, S, St, Ch, Antip., Sn, C, M.
	<i>P. cystostegia</i> (Hook.) Cheesem.	N, S, St, C.

ANGIOSPERMAE:	Dicotyledones	
Ranunculaceae:	<i>Ranunculus pinguis</i> Hook.	C.
	<i>R. acaulis</i> Banks & Sol. ex DC	N, S, St, Ch.
	<i>R. aucklandicus</i> Gray	end*
	<i>R. subantarcticus</i> Fisher & Hair	end*
Cruciferae:	<i>Lepidium oleraceum</i> Forst.	K, 3 Kings, N, S, St, Ch, Sn.
	<i>Cardamine corymbosa</i> Hook. f.	C, M.
	<i>C. subcarnosa</i> (Hook. f.) Allan	C.
	<i>C. depressa</i> Hook. f.	S, St, C.
	(& var. <i>stellata</i> Hook.)	C.
Crassulaceae:	<i>Tillaea moschata</i> (Forst. f.) DC	N, S, St, Ch, Sn, Antip., C, M.
Droseraceae:	<i>Drosera stenopetala</i> Hook. f.	N, S, St, C.
	<i>Cerastium glomeratum</i> Thuill.	wide
Caryophyllaceae:	<i>Stellaria decipiens</i> Hook. f.	Sn, C, M.
	<i>S. media</i> (L.) Vill.	Sn, A?
	<i>Colobanthus muscoides</i> Hook. f.	Sn, Antip., Ch, C.
	<i>C. hookeri</i> Cheesem.	C.
	<i>C. apetalus</i> (Labill.) Druce	N, S, C.
Portulacaceae:	<i>Montia fontana</i> L.	N, S, St, Antip., C, M.
	<i>Claytonia australasica</i> Hook. f.	C.
Polygonaceae:	<i>Rumex neglectus</i> Kirk	N, S, St, C.
Geraneaceae:	<i>Geranium microphyllum</i> Hook. f.	N, S, St, C.
Haloragaceae:	<i>Myriophyllum elatinoides</i> Gaud.	N, S, St, Ch, C.
Onagraceae:	<i>Epilobium nerterioides</i> A. Cunn.	N, S, St, Ch, C, M.
	<i>E. linnaeoides</i> Hook. f.	N, S, St, C, Antip., M.
	<i>E. confertifolium</i> Hook. f.	C.
	<i>E. findlayi</i> Allan	C.
	<i>E. antipodum</i> Petrie	Antip.*
	<i>E. alsinoides</i> A. Cunn.	N, S, St, Ch, Antip.*
	<i>Fuchsia excorticata</i> (J. R. & G. Forst.) L.	N, S, St.
Callitrichaceae:	<i>Callitriche antarctica</i> Engelm. ex Hegel.	Sn, Antip., C, M.
Thymelaeaceae:	<i>Drapetes lyallii</i> Hook. f.	S, St.
Myrtaceae:	<i>Metrosideros umbellata</i> Cav.	N, S, St.
Rosaceae:	<i>Acaena minor</i> (Hoof. f.) Allan	C, M.
	(& var. <i>antarctica</i> (Ckn) Allan)	C.
	<i>Geum parviflorum</i> var. <i>albiflorum</i>	
	(Hook. f.) Allan	end*
Papilionaceae:	<i>Ulex europaeus</i> L.	Wide
Urticaceae:	<i>Urtica australis</i> Hook. f.	Ch, Antip., C.
	<i>U. aucklandica</i> Hook. f.	end*
Araliaceae:	<i>Stilbocarpa polaris</i> (Homb. & Jacq.) Gray	Antip., C, M.
	<i>S. robusta</i> (Kirk) Ckn	Sn*
	<i>Neopanax simplex</i> (Forst. f.) Allan	
	(<i>Nothopanax</i>)	N, S, St.
Umbelliferae:	<i>Hydrocotyle novae-zelandiae</i> DC	N, S, St, Ch, C.
	<i>Anisotome latifolia</i> Hook. f.	C.
	<i>A. antipoda</i> Hook. f.	Antip., C.
	<i>A. acutifolia</i> (Kirk) Ckn.	Sn*
	<i>Lilaeopsis</i> sp.	*
Epacridaceae:	<i>Cyathodes empetrifolia</i> Hook. f.	N, S, St, C.
	<i>Dracophyllum longifolium</i> (J. R. & G. Forst.) R. Br.	N, S, St, C.

	(& var. <i>cockayneanum</i> (Du Rietz) W.R.B. Oliver)	C.
Myrsinaceae:	<i>Myrsine divaricata</i> A. Cunn. (<i>Suttonia</i>)	N, S, St, C.
Rubiaceae:	<i>Coprosma pumila</i> Hook. f.	N, S, St, Antip., C, M.
	<i>C. antipoda</i> W.R.B. Oliver	S, Antip.*
	<i>C. ciliata</i> Hook. f.	N, S, St, C.
	<i>C. foetidissima</i> J. R. & G. Forst.	N, S, St.
	<i>Nertera depressa</i> Banks & Sol. ex Gaertn.	N, S, St, C.
Compositae:	<i>Lagenophora pumila</i> (Forst. f.) Cheesem.	K, 3 Kings, N, S, St, Ch, Antip., C.
	<i>Pleurophyllum speciosum</i> Hook. f.	C.
	<i>P. criniferum</i> Hook. f.	Antip., C.
	<i>P. hookeri</i> Buchan.	C, M.
	<i>Celmisia vernicosa</i> Hook. f.	C.
	<i>Olearia lyallii</i> Hook. f.	Sn.
	<i>Cotula plumosa</i> Hook. f.	Antip., C, M.
	<i>C. lanata</i> Hook. f.	C.
	<i>C. potentillina</i> (F. Muell.) Druce	Ch.
	<i>Abrotanella spathulata</i> Hook. f.	C.
	<i>Gnaphalium luteo-album</i> L.	K, 3 Kings, N, S, St, Ch.
	<i>Helichrysum bellidioides</i> (Forst. f.) Willd.	N, S, St, Ch, Antip., C.
	(& var. <i>prostratum</i> (Hook. f.) Kirk)	C.
	<i>Cassinia vauvilliersii</i> (Homb. & Jacq.) Hook. f.	N, S.
	<i>Senecio biserratus</i> Belcher	S.
	(= <i>Erech. minima</i> var. <i>angustata</i> Allan)	
	<i>Sonchus asper</i> (L.) Hill	Wide, weed
Gentianaceae:	<i>Gentiana cerina</i> Hook. f.	end*
	(& var. <i>suberecta</i> (Kirk) Cheesem.)	end*
	<i>G. concinna</i> Hook. f.	end*
	<i>G. antipoda</i> Kirk	Antip.*
Primulaceae:	<i>Samolus repens</i> (J. R. & G. Forst.) Pers.	K, N, S, St, Ch.
Plantaginaceae:	<i>Plantago aucklandica</i> Hook. f.	end*
	<i>P. triantha</i> Spreng.	end*
Lobeliaceae:	<i>Pratia arenaria</i> Hook. f.	S, Ch, Antip., C.
Stylidiaceae:	<i>Phyllachne clavigera</i> (Hook. f.) F. Muell.	S, C.
Boraginaceae:	<i>Myosotis capitata</i> Hook. f.	C.
	<i>M. rakiura</i> L.B. Moore	S, St, Sn*
Scrophulariaceae:	<i>Hebe elliptica</i> (Forst. f.) Pennell	N, S, St, Ch?, Sn, C.
	<i>H. odora</i> (Hook. f.) Ckn.	N, S, St.
	<i>H. benthamii</i> (Hook. f.) Ckn & Allan	C.
	Monocotyledones	
Gramineae:	<i>Puccinellia antipoda</i> (Petrie) Allan & Jansen	Antip.
	<i>P. chathamica</i> (Cheesem.) Allan & Jansen	Ch, Antip., C.
	<i>Poa ramosissima</i> Hook. f.	C.
	<i>P. astonii</i> Petrie	S, St, Sn.
	<i>P. novae-zelandiae</i> var. <i>desiliens</i> Zotov	S, St, C.
	<i>P. poppelwellii</i> Petrie	St, Sn.*
	<i>P. foliosa</i> (Hook. f.) Hook. f.	St, Antip., C, M.
	<i>P. litorosa</i> Cheesem.	Antip., C.
	<i>P. laevis</i> R. Br.	S, St, Antip., Austr., Tasm.
	<i>P. aucklandica</i> Petrie	C.

	<i>P. tennantiana</i> Petrie	St, Sn, Antip.
	<i>P. breviglumis</i> var. <i>moarii</i> Zotov	end*
	<i>P. incrassata</i> Petrie	end*
	<i>P. pratensis</i> L.	wide, C.
	<i>P. antipoda</i> Petrie	St, Antip., C.
	<i>P. trivialis</i> L.	wide, St, C.
	<i>P. annua</i> L.	wide, St, Sn, C, M.
	<i>Trisetum spicatum</i> (L.) Richt.	wide, C.
	<i>Deschampsia chapmanii</i> Petrie	S, St, Antip., C, M.
	<i>D. gracillima</i> T. Kirk	St, C.
	<i>Hierochloa redolens</i> (Vahl) Roem. & Schult.	S, St, C, Tasm., Fuegia.
	<i>H. brunonis</i> Hook. f.	C.
	<i>Deyeuxia aucklandica</i> (Hook. f.) Zotov	N, S, St.
	<i>D. tenuis</i> Zotov	S, St, (A?)
	<i>Agrostis magellanica</i> Lam.	St, Antip., C, M. circum-antar.
	<i>A. subulata</i> Hook. f.	S, St, C.
	<i>A. tenuis</i> Sibth.	wide, C.
	<i>Lachnagrostis leptostachys</i> (Hook. f.) Zotov	Antip., C.
	<i>L. richardii</i> Zotov	N, S, St.
	<i>Alopecurus geniculatus</i> L.	wide, St, C.
	<i>Microlaena avenacea</i> (Raoul) Hook. f.	N, S, St.
	<i>M. thomsonii</i> (Petrie) Petrie	S, St.
	<i>Chionochloa antarctica</i> (Hook. f.) Zotov	C.
Cyperaceae:	<i>Carex appressa</i> R. Br.	N, S, Antip., C, Austr., Tasm.
	<i>C. ternaria</i> Forst.	N, S, Antip., C.
	<i>C. trifida</i> Cav.	N, S, Sn, Antip., C, Chile, F. I.
	<i>Uncinia strictissima</i> Petrie	N, S.
	<i>U. hookeri</i> Boott. in Hook. f.	Antip, C, M.
	<i>U. aucklandica</i> Hamlin	S, St, C.
	<i>U. uncinata</i> (Linn. f.) Kük.	N, S, St, Ch.
	<i>Oreobolus pectinatus</i> Hook. f.	N, S, St, C.
	<i>Schoenus pauciflorus</i> (Hook. f.) Hook. f.	N, S, St, Ch.
	<i>Cyperus alpina</i> R. Br.	wide
	<i>Scirpus aucklandicus</i> Boeck.	N, S, Antip., C, Tasm., N Amst.
	<i>S. cernuus</i> Vahl.	wide, Sn, Antip.
	<i>S. praetextatus</i> Edgar	N, S, St, C.
	<i>S. habrus</i> Edgar	N, S, St, Ch, C.
Juncaceae:	<i>Gaimardia pallida</i> Hook. f.	N, S, C.
	<i>G. ciliata</i> Hook. f.	N, S, St, C.
	<i>Luzula crinita</i> Hook. f. var. <i>crinita</i> Buchen.	Antip., C, M.
	<i>L. banksiana</i> Meyer var. <i>acra</i> Edgar	S, St, Ch.
	<i>Juncus bufonis</i> L.	wide, Sn. (died out).
	<i>J. antarcticus</i> Hook. f.	N, S, St, C.
	<i>J. scheuchzerioides</i> Gaud.	Antip., C, circum-antar.
	<i>J. pusillus</i> Buch.	N, S, St.
	<i>Rostkovia magellanica</i> Hook. f.	C, circum-antarc.
	<i>Marsippospermum gracile</i> (Hook. f.) Buch.	S, C.
Agavaceae:	<i>Phormium tenax</i> J.D. et G. Forst.	N, S, St, Ch.
Liliaceae:	<i>Astelia linearis</i> Hook. f.	N, S, C.
	<i>A. subulata</i> Cheesem.	S, C.
	<i>Bulbinella rossii</i> Benth. & Hook. f.	C.

Potamogetonaceae:	<i>Potamogeton ochreateus</i> Raoul	N, S.
Orchidaceae:	<i>Corybas oblonga</i> (Hook. f.) Reichb. f.	N, S., St, Ch, C.
	<i>C. rivularis</i> (A. Cunn.) Reichb. f.	N, S, St.
	<i>C. trilobus</i> (Hook. f.) Reichb. f.	N, S, St, Ch, C.
	<i>C. micranthus</i> (Hook. f.) Reichb. f.	N, S, St, Ch, C.
	<i>Chiloglottis cornuta</i> Hook. f.	N, S, St, Ch, C.
	<i>Caladenia lyallii</i> Hook. f.	N, S, St.
	<i>C. carnea</i> R. Br. var. <i>minor</i> (Hook. f.) Rupp et Hatch	N, S, St, Ch.
	<i>Aporostylis bifolia</i> (Hook. f.) Rupp et Hatch	N, S, St, Ch, Antip., C.
	<i>Lyperanthus antarcticus</i> Hook. f.	N, S, St, C.
	<i>Prasophyllum colensoi</i> Hook. f.	N, S, Antip.*
	<i>Thelymitra longifolia</i> J.R. et G. Forst.	N, S, St, Ch.
	<i>T. venosa</i> R. Br.	N, S, St, Ch.
	<i>Acianthus viridis</i> Hook. f.	N, S, St, C, Tasm.
MUSCI		
Sphagnaceae:	<i>Sphagnum australe</i> Mitt.	C.
	<i>S. falcatulum</i> Besch.	?
Andreaeaceae:	<i>Andreaea acuminata</i> Mitt.?	?
Polytrichaceae:	<i>Polytrichum gracile</i> Sm.	?
	<i>Polytrichadelphus magellanicus</i> (Hedw.) Mitt.	C.
Fissidentaceae:	<i>Fissidens asplenioides</i> Hedw.	?
Grimmiaceae:	<i>Racomitrium crispulum</i> (H. f. & W.) H. f. & W.	C.
Ditrichaceae:	<i>Ditrichum punctulatum</i> Mitt.	C.
	<i>Ceratodon purpureus</i> (Hedw.) Brid.	Cosmop.
Dicranaceae:	<i>Campylopus arboricola</i> Card. & Dix.	?
	<i>C. clavatus</i> (R. Br.) H. f. & W.	C.
	<i>C. torquatus</i> Mitt.	? Sn.
	<i>Dicranoloma billardieri</i> (Schwaegr.) Par.	C.
	<i>D. menziesii</i> var. <i>rigidum</i> (H. f. & W.) Par.	? Sn.
	<i>D. robustum</i> (H. f. & W.) Par.	C.
	<i>D. robustum</i> var. <i>setosum</i> (H. f. & W.) Sainsb.	C.
	<i>Eriopus apiculatus</i> (H. f. & W.) Mitt.	Sn.*
Orthotrichaceae:	<i>Macromitrium longirostre</i> (Hook.) Schwaegr.	C, Sn.
Bryaceae:	<i>Bryum blandum</i> H. f. & W.	?
Rhizogoniaceae:	<i>Rhizogonium bifarium</i> (Hook.) Schimp.	? Sn.
	<i>R. distichum</i> (Sw.) Brid.	?
	<i>R. mnioides</i> (Hook.) Schimp.	?
	<i>R. novae-hollandiae</i> Brid.	?
Bartramiaceae:	<i>Bartramia papiliata</i> H. f. & W.	C.
	<i>B. robusta</i> H. f. & W.	C.
	<i>Breutelia elongata</i> (H. f. & W.) Mitt.	C.
	<i>B. pendula</i> (Hook.) Mitt.	C.
	<i>Philonotis tenuis</i> (Tayl.) Jaeg.	?
Hypnodendraceae:	<i>Mniodendron comosum</i> (La Bill.) Lind.	?
Hedwigiaceae:	<i>Rhacocarpus humboldtii</i> (Hook.) Lind.	?
Sematophyllaceae:	<i>Acanthocladium extenuatum</i> (Brid.) Mitt.	Sn.*
Ptychomniaceae:	<i>Ptychomnion aciculare</i> (Brid.) Mitt.	C.
Meteoriaceae:	<i>Weymouthia cochlearifolia</i> (Schwaegr.) Dix.	C.

Neckeraceae:	<i>Thamnum pandum</i> (H. f. & W.) Par.	?
Lembophyllaceae:	<i>Camptochaete gracilis</i> (H. f. & W.) Par.	?
	<i>C. ramulosa</i> (Mit.) Jaeg.	?
	<i>Lembophyllum clandestinum</i> (H. f. & W.) Lindb.	?
Hookeriaceae:	<i>Distichophyllum crispulum</i> (H. f. & W.) Mitt.	?
	<i>D. pulchellum</i> (H. f. & W.) Mitt.	?
	<i>Pterygophyllum distichophylloides</i> Broth. & Dix.	Sn.*
Hypopterygiaceae:	<i>Hypopterygium novae-seelandiae</i> C.M.	?
	<i>Cyathophorum bulbosum</i> (Hedw.) C.M.	?
Thuidiaceae:	<i>Thuidium furfurosum</i> (H. f. & W.) Jaeg.	C.
Brachytheciaceae:	<i>Eurynchium austrinum</i> (H. f. & W.) Jaeg.	?
Sematophyllaceae:	<i>Sematophyllum tenuirostre</i> (Hook.) Dix.	?
	<i>S. contiguum</i> (H. f. & W.) Mitt.	? + Sn.*
Hypnaceae:	<i>Hypnum cupressiforme</i> Hedw. var. <i>chryogaster</i> (C. M.) Sainsb.	C.
Brachytheciaceae:	<i>Rhynchostegium laxatum</i> (Mitt.) Par.	Sn.*
Orthotrichaceae:	<i>Muelleriella angustifolia</i> (H. f. & W.) Dus.	Sn.*
	<i>M. crassifolia</i> (H. f. & W.) Dus.	Sn.*
HEPATICAEE (Snares only)		
	<i>Frullania patula</i> Mitt.	Sn.
	<i>Lophocolea minor</i> Nees	Sn.
	<i>L. multipenna</i> (Hook & Tyl.) G. L. & N.	Sn.
	<i>L. lenta</i> (H. f. & T.) G. L. & N.	Sn.
	<i>L. subporosa</i> Mitt.	Sn.
	<i>Marchantia berteroaana</i> L. & L.	Sn.
	<i>Metzgeria furcata</i> var. <i>disciformis</i> (Evans) Hodgson	Sn.
	<i>Siphonolejeunea nudipes</i> (H. f. & T.) Herzog	Sn.
	<i>Telaranea remotifolia</i> (Hodgson) Hodgson	Sn.
	<i>T. roseana</i> (Steph.) Hodgson	Sn.
	<i>T. patentissima</i> (H. f. & T.) Hodgson	Sn.
	<i>T. sp.</i>	Sn.

Abbreviations: Antip. = Antipodes; B = Bounty; C = Campbell; Ch = Chatham Is.; K = Kermadec Is; M = Macquarie; N = North Island of New Zealand; S = South Island of New Zealand; Sn = Snares; St = Stewart I. An asterisk indicates that species was described as endemic; end* indicates presumably endemic to the Auckland Is. All the species of higher plants are assumed to occur in the Aucklands unless indicated as endemic to some other island group.

FAUNA

The fauna of the Auckland Islands is in many groups much richer than that of Campbell Island. Among the vertebrates the species are to a great extent the same, or related, except that there are more species of introduced birds, and a few more of mammals, in the Aucklands than on Campbell. On the smaller islands there are in general fewer species, and on Bounty Is there are extremely few, although many of the sea birds are present. On the Snares and Antipodes there are some New Zealand or endemic species not found on the islands to the south.

It will be impossible to adequately analyze the insect fauna of the Aucklands or the other islands until the systematic studies are completed. Below, following the lists of mammals and birds of the Aucklands, are some tabulations from field notes and summaries of numbers of

species recorded earlier. Various nematodes have been recorded from the Aucklands (Clark 1963, 1964; Grandison 1964), as well as pulmonate mollusks (Climo 1969).

The introduced mammals on the main Auckland I (pigs, goats, cats, mice) have to a great extent reduced breeding of sea birds. The lack of albatross colonies is particularly noticeable. As noted above, cattle and rabbits have had a great effect on the vegetation of Enderby I in particular, and rabbits have affected Rose I. Goats did a great deal of damage to Ocean I in the past, but were exterminated about 1943. Sheep were maintained on Ocean I for a few years during the "Cape Expedition" period, but were then removed.

In the following list of mammals, the hair seal and fur seal breed in the Aucklands, but the leopard seal and elephant seals are only visitors. Introduced animals in the Aucklands are cattle, goat, pig, cat, rabbit and mouse. None of these are present on the Snares, Antipodes or Bounty.

In the bird list the thrushes, finches, white-eye and starling are introduced. Woodhens were liberated on Enderby in 1868, but did not establish.

AUCKLAND ISLANDS MAMMALS

PINNIPEDIA

Otariidae:	<i>Neophoca hookeri</i> (Gray).	New Zealand hair seal (sea lion)
	<i>Arctocephalus forsteri</i> (Lesson)	New Zealand fur seal
Phocidae:	<i>Hydrurga leptonyx</i> (Blainville)	Leopard seal
	<i>Mirounga leonina</i> (Linn.)	Southern elephant seal

AUCKLAND ISLANDS BIRDS

SPHENISCIFORMES

Spheniscidae:	<i>Megadyptes antipodes</i> (Homb. & Jacq.)	Yellow-eyed penguin
	<i>Eudyptes crestatus</i> Miller	Rockhopper penguin
	<i>E. sclateri</i> Buller	Erect-crested penguin

PROCELLARIIFORMES

Diomedidae:	<i>Diomedea exulans</i> Linn. subsp.	Wandering albatross
	<i>D. epomophora mccormicki</i> Mathews	Auckland Islands royal albatross
	<i>D. cauta cauta</i> Gould	Shy mollymawk (white-capped)
	<i>Phoebastria palpebrata</i> (Forster)	Light-mantled sooty albatross
Procellariidae:	<i>Macronectes giganteus</i> (Gmelin)	Giant petrel
	<i>Diapton capensis</i> (Linn.)	Cape pigeon
	<i>Pachyptila desolata alter</i> (Mathews)	Antarctic prion
	<i>P. crassirostris eatoni</i> (Mathews)	Lesser fulmar prion
	<i>Puffinus griseus</i> (Gmelin)	Sooty shearwater
	<i>P. assimilis elegans</i> Gigl. & Salvad.	Subantarctic allied shearwater
	<i>Procellaria aequinoctialis steadi</i> Mathews	Cape hen (white-chinned petrel)
	<i>Pterodroma lessoni</i> (Garnot)	White-headed petrel
	<i>P. inexpectata</i> (Forst.)	Mottled petrel
Hydrobatidae:	<i>Garrodia nereis</i> (Gould)	Grey-backed storm petrel
	<i>Fregatta tropica</i> (Gould)	Black-bellied storm petrel
	<i>Pelagodroma marina</i> (Latham)	White-faced storm petrel
	<i>Pelecanoides urinatrix exsul</i> Salvin	Subantarctic diving petrel
	<i>P. georgicus</i> Murphy & Harper subsp.	South Georgian diving petrel

PELECANIFORMES

Phalacrocoracidae:

Phalacrocorax colensoi Buller

Auckland Island shag

ANSERIFORMES

Anatidae:

Anas (Nesonetta) aucklandica Gray

Auckland Island duck

A. superciliosa Gmelin

Grey duck

A. boschas Linn.

Mallard

A. rhynchos variegata (Gould)

Shoveller

Mergus australis Hombr. & Jacq.

Auckland Island merganser

FALCONIFORMES

Accipitridae:

Circus approximans gouldi Bonaparte

Australasian harrier

Falconidae:

Falco novaeseelandiae Gmelin

New Zealand falcon

GRUIFORMES

Rallidae:

Rallus pectoralis muelleri Rothschild

Auckland Island rail

CHARADRIIFORMES

Charadriidae:

Charadrius bicinctus Jord. & Selby subsp.

Auckland Islands banded dotterel

C. dominicus fulvus Gmelin

Pacific golden plover

Arenaria interpres (Linn.)

Turnstone

Scolopacidae:

Calidris ruficollis (Pallas)

Red-necked stint

Limosa melanuroides Gould

Asiatic black-tailed godwit

Coenocorypha aucklandica (Gray)

Auckland Island snipe

Stercorariidae:

Catharacta loenbergi Mathews

Brown skua

Laridae:

Larus dominicanus Lichtenstein

Black-backed gull

L. scopulinus Forster subsp.

Red-billed gull

Sterna vittata bethunei Buller

Antarctic tern

S. paradisaea Pontoppidan

Arctic tern

S. striata (Gmelin)

White-fronted tern

PSITTACIFORMES

Psittacidae:

Cyanoramphus novaeseelandiae Sparrman

Red-fronted parakeet

C. auriceps (Kuhl)

Yellow-crowned parakeet

PASSERIFORMES

Muscicapidae:

Petroica macrocephala marrineri

(Mathews & Iredale)

Auckland Island tit

Turdidae:

Turdus ericetorum Turton

Song thrush

T. merula Linn.

Blackbird

Motacillidae:

Anthus novaeseelandiae (Gmelin)

New Zealand pipit

Meliphagidae:

Anthornis melanura Sparrman

Bellbird

Prothemadera novaeseelandiae (Gmelin)

Tui

Zosterops lateralis (Lath.)

White-eye

Fringillidae:

Acanthis cabaret (Müller)

Redpoll

Fringilla coelebs gengleri Kleinschmidt

Chaffinch

Ploceidae:

Passer domesticus Linn.

House sparrow

Sturnidae:

Sturnus vulgaris Linn.

Starling

NOTES FROM THE AUCKLAND ISLANDS EXPEDITION, 1962-63

The Auckland I Expedition, 1962-63, was based at the old "Cape Expedition" camp in Ranui Cove, Port Ross.

Sorties were made around the coast and the hills in the neighborhood of Ranui Cove, to most of the neighboring off-shore islands, particularly Ocean, Ewing and Enderby, to the northern east coast, to the upper Port Ross area, and to the higher areas of the main Auck-

land I. ridge. The inter-tidal zone and supralittoral areas were searched particularly about Ranui Cove and the adjacent coast from Tucker Point to Crozier Pt.

Ocean I. Ocean Island was visited several times. During the "Cape Expedition" sheep were kept on this island and hay was imported from New Zealand. Yellow-eyed penguins, a nest of the giant petrel and petrel burrows were investigated in addition to the usual plant and ground collections, such as seepage pools, *Stilbocarpa*, supra-littoral, under logs and debris, and a grove of *Dracophyllum*.

Ewing I. Supra-littoral, outer low shrub area including *Urtica*, and the *Olearia* belt were examined, the last appearing to be almost barren of insect life.

Enderby I. Modification of the vegetation by cattle and rabbits is very obvious, particularly where the typical coastal rata belt has been replaced by a close-cropped grass sward. The sandy beach, which had an active sea-lion colony, and coastal areas on the south side of the island were investigated and also two lakes and several small streams. The lakes were alkaline and contained little, if any, life but near-by streams and a short outlet stream from one of the lakes contained an abundant aquatic fauna. The rata belt, and above that the *Casinia* and tussock—*Bulbinella* areas were all investigated as were swampy areas, cliff tops and the upper areas of the island. Royal albatrosses were nesting on the upper slopes and these and their nests were examined as was the edge of an Auckland Island cormorant colony on steep cliffs. Night collecting was also carried out.

Head of Port Ross. Grey Duck Creek was investigated but little aquatic life was found. Collecting was carried out at Erebus Cove which was the site of the Enderby Settlement of the early 1850's, at Terror Cove and the site of the German Transit of Venus Expedition of 1874, and also on the Hooker Hills. Dea's Head was also visited.

Littoral and supra-littoral. Tipulid, coelopid and other flies were present and sometimes abundant, Collembola were on seepage pools at the top of beaches and micro-caddis larvae and pupae were in open seepage pools on the rock platform at Tucker Pt. *Aquatic.* Trichoptera, Plecoptera, Ephemeroptera, Diptera: Simuliidae, Chironomidae, Culicidae and others. Caddis, stonefly, may-fly and sand-fly larvae were present in streams while midge and mosquito larvae were in isolated pools. *Apterous.* Apterous species of Diptera (incl. Tipulidae), Hymenoptera, Lepidoptera, Plecoptera and Coleoptera. Also, brachypterous Tipulidae and Lepidoptera.

Bird parasites. Lice (Mallophaga) were taken from Auckland Island prion (*Pachyptila desolata alter*), white-headed petrel (*Pterodroma lessoni*), sub-antarctic diving petrel (*Pelecanoides exsul*), black-bellied storm petrel (*Fregatta tropica*), white-chinned petrel (*Procellaria aequinoctialis*), royal albatross (*Diomedea epomophora epomophora*) and both lice and ticks were taken from the rare Auckland Island snipe (*Coenocorypha aucklandica*). Other birds examined were the yellow-eyed penguin (*Megadyptes antipodes*) and the southern skua (*Catharacta loembergi*).

Rata forest above shore—west side of Ranui Cove. This is mainly tall (ca. 10 m in height) *Metrosideros* with some *Neopanax* and occasional tall *Dracophyllum*. On the forest floor there are fallen trunks and branches and in parts a great deal of litter. There is fern in patches and occasional grass patches in more open glades.

During a systematic search under rata logs the following were found, mostly in very small numbers except for the Collembola, Isopoda and Amphipoda.

Colcoptera	Carabidae	4 spp.
	Carabid larvae	
	Curculionidae	3 or more spp.

	Curculionid larvae	
	Coccinellidae	1 sp.
	Staphylinidae	1 apterous sp.
Diptera	Tipulidae	1 small apterous sp.
	Tipulid larva	
	? larva	
	? pupae	1 tiny sp.
Hemiptera	Henicocephalidae	1 sp. <i>Phthirocoris</i>
Collembola		3 spp.
Lepidoptera	larva	
	pupa	
Symphyla		1 sp.
Diplopoda		1 or more sp.
Chilopoda		2 spp.
Araneae		2 spp.
Opiliones		1 sp.
Tricladida		1 planarian sp.
Isopoda		1 or more sp.
Amphipoda		1 or more sp.
Oligochaeta		1 or more sp.
Acari		probably many species

Amphipods and isopods were by far the most numerous.

Scrub above Rata forest—west side of Ranui Cove, above ca. 15 m. This is tall scrub ca. 3.5 m in height, mainly of mixed *Metrosideros*, *Cassinia* and *Dracophyllum*. Floor very clean, no undergrowth, moss under trees and moss mats in open areas, no logs but some fallen branches. Search under fallen branches revealed (asterisked groups numerous):

Coleoptera	Carabid larva	1 sp.
	Curculionidae	1 sp.
	Coccinellidae	1 sp.
Diptera	larvae	1 sp.
	pupae	1 sp.
*Collembola		1 or more sp.
*Araneae		1 or more sp.
*Diplopoda		1 or more sp.
Tricladida		1 planarian sp.
*Isopoda		1 or more sp.
*Amphipoda		1 or more sp.
*Acari		1 or more sp.
Mollusca		1 or more sp.

High country at Bivouac Hill, ca. 500 m. On rock faces and under stones in tussock and fern. The following collected by searching (only Collembola and Acarina numerous):

Coleoptera	Carabidae	1 sp.
	Curculionidae	1 sp.
	? + larva	1 or 2 spp.
	Staphylinidae	1 sp.
Hymenoptera		2 spp.
Diptera	?	1 or more sp.
	Tipulidae	3 or more spp.
Lepidoptera	Tortricidae	1 sp.

	Crambidae	1 sp.
	?	1 sp.
Collembola		1 or more sp.
Plecoptera		1 sp.
Ephemeroptera		1 sp.
Mollusca		3 slug spp.
Chilopoda		1 sp.
Diplopoda		1 or more sp.
Araneae		1 or more sp.
Opiliones		1 or more sp.
Acari		1 or more sp.

The last three lists above give a comparison of faunas but do not necessarily include all groups present. In the higher country above Bivouac Hill fewer species were taken, but some were found only there, or were very rare at lower altitudes.

AUCKLAND ISLANDS EXPEDITION, 1966

The southern party of the Auckland Is Expedition, 1966, was landed in a small bay, where there had been a previous magnetic station, on the north side of Adams I. For this reason the camp area was known as Magnetic Cove, but was later called M3 Bay after markings on the magnetic station marker. Sorties were made from there up the ridge east of the cove to the higher tussock areas, to the top of the main divide, and one across to the southern side to Lake Turbott situated at the bottom of a deep glacial valley. Others were made by boat along the north shore of Adams I, particularly to the *Pleurophyllum* meadow, known as Fairchild's Garden, on the NW point of the island, and across Carnley Hrbr to several sites on the south end of Auckland I, these being Western Hrbr, Camp Cove which was the site of the 1907 Expedition, Masked I, and also the neck of Musgrave Pen., where the southern "Cape Expedition" camp was situated.

Magnetic Cove had a running stream and small bog while on the western side the typical coastal rata forest was backed by a scrub belt. The small northern point of this western side of the cove was identical in situation to the northern point on the western side of Ranui Cove, at the north end of Auckland I, and it was noticeable that the coastal forest was very similar in appearance being more open on the north side than in the sheltered side of the cove. Thick mixed scrub, on steep slopes, surrounded the cove above the rata. Above this, tussock covered the hillsides but on the top of the main ridge was replaced by fell-field with low plants. As on the main island, the top of the main ridge was often cloud-covered and consequently always wet.

Fairchild's Garden is unusual in having a particularly thick growth of *Pleurophyllum* and other large herbs, tussock and fern, although it is in a very exposed position at the west end of the island, on the northern point above Victoria Passage. On the eastern side of this area, however, steep slopes are covered in *Metrosideros* and *Dracophyllum*. Towards the lower tip of the point low grass and low plants occur in areas used by the giant petrels for nesting and landing. There are also rock outcrops and seepage streams. All these and the inner, Carnley Hrbr, shore were thoroughly searched and collecting was done at night.

Lake Turbott, which is ca. 1.8 km in length but only 6 m above sea level, almost fills the lower floor of its steep-sided glacial valley. A large stream, originating from a high cirque

at the head of the valley, flows in at the head of the lake and a short swift outlet stream flows to the sea. About the head of the lake there is an open bog flanked by tall *Metrosideros* and thick *Metrosideros*—*Dracophyllum*—mixed scrub extending partway down the sides of the lake. Towards the mouth a more open tussock—*Pleurophyllum*—*Anisotome* association was dominant. Moss was present about the lake edge and in wet patches, and some *Myriophyllum* in the lake. Slimeweed was abundant in pools at the top of the outlet stream.

Extractions from litter and other material were carried out by means of several unheated funnels in a tent, during the whole collecting period on Adams I, and a Malaise trap was also operated, mainly in a small grove of trees at the edge of the bog in Magnetic Cove. Some night collecting was done as well.

Aquatic. The following were all taken on Adams I.

Streams: Plecoptera, adult and immature. Ephemeroptera, adult and immature

Diptera: Simuliidae, adult and immature. Trichoptera 2 spp.

Surface of pools (incl. seal wallows): Diptera: apterous

Diptera: Chironomidae

Collembola

Lake Turbott: Plecoptera, immature

Pools at outlet stream of L. Turbott: Plecoptera, immature

Diptera: Chironomidae & Simuliidae, immatures

Trichoptera: Hydroptilidae, immature 2 spp.

Trichoptera: Rhyacophilidae, immature 1 sp.

Mollusca: ?*Potamopyrgus*

Vegetation: Trichoptera 1 sp. ad. only

Marine littoral and supra-littoral. Groups known to have been collected on Adams I. and the south end of Auckland I. were Coleoptera: ?, Coleoptera: Staphylinidae, Coleoptera: Carabidae, Collembola: 3 or more species, Diptera: ?, apterous, Diptera: Coelopidae, Diptera: Tipulidae (littoral), Hymenoptera: ?, apterous.

Other animals. Seen on and about Adams I. were fur seal, sea-lion. Birds were noticeably more common on Adams I than on the north or south of Auckland I. Among those nesting or probably nesting on Adams I were the following: Giant petrel, Wandering albatross, Sooty albatross, Black-bellied storm petrel, White-headed petrel, Sooty shearwater, Snipe, Red-crowned parakeet, Auckland I. tit, Auckland I. rail (previously thought to be extinct), Penguins, Skuas. Also sighted were Blackbird, Redpoll, Hedge sparrow. Nesting on rock in Western Passage: Black-backed gull, White-fronted terns, Antarctic terns.

Northwest point of Adams I. including Fairchild's Garden. During searches of this area the following fauna were noted. They do not necessarily represent the whole fauna.

Carnley Hrbr beach: Diptera: Coelopidae

Coleoptera: ?

Coleoptera: Staphylinidae

Collembola on seepage pools

Seal wallows: Diptera: Chironomidae

Surface of pools: Diptera, apterous

Under tussock: Diptera: Tipulidae, apterous

Coleoptera

- On *Poa foliosa*: Collembola: Sminthuridae
 Lepidoptera
 Diptera
- Stream: Plecoptera, immature
 Ephemeroptera, immature
- On *Hebe elliptica*: Hemiptera: aphids
 Hemiptera: mealybugs
 Psocoptera
- Metrosideros-Dracophyllum* at night: Lepidoptera, 6 or more spp.
 Orthoptera: wetas
 Coleoptera: 4 or more spp. (incl. Carabidae) some taken on rocks and moss mats amongst trees
- Top of main divide ridge (ca. 500 m)*. A few species of Plecoptera (apterous), Coleoptera, and Collembola; and a few other groups.
- Lake Turbott (6 m)*. Inlet stream. Diptera: Chironomidae midges flying
 Diptera: Tipulidae flying
 Diptera: Simuliidae, immature
 Ephemeroptera flying
 Ephemeroptera, immature
 Plecoptera flying
 Trichoptera: Hydroptilidae flying
 Lake edge. Diptera: Simuliidae biting
 Plecoptera, emerging from lake
 Lake. Plecoptera, immature
 Rock face. Lepidoptera running on rock
 Outlet stream. Trichoptera: Hydroptilidae, immature 2 spp.
 Trichoptera: Rhyacophilidae, immature 1 sp.
 Plecoptera, immature
 Diptera: Simuliidae & Chironomidae, immatures
 Mollusca: ?*Potamopyrgus*

Adams I had been particularly chosen for investigation as it was believed that no predatory or domestic animals had been introduced and that none had become established accidentally, so that the fauna and flora could be expected to be in a more natural condition than on the other islands in the group. No sign of any introduced animals, such as cats, pigs, etc., were seen during this expedition and there is no doubt that birds and some insects were more abundant on Adams I. The re-discovery of the ground inhabiting Auckland I. rail also tends to confirm the suspicion that this and other fauna have been depleted or destroyed on the main Auckland I.

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