

INSECTS OF MACQUARIE ISLAND. INTRODUCTION¹

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Abstract: Collections of land arthropods were made on Macquarie Island by J. L. Gressitt and J. H. Calaby, 4-10 December 1960, and by Keith Watson, December 1960-December 1961. This paper is a brief discussion of the geography and environment of Macquarie, introductory to the systematic papers describing the fauna. Watson, of the Australian National Antarctic Research Expeditions, will later publish his general ecological studies, when the species are all identified.

INTRODUCTION

This paper is a brief description of the geography and environment of Macquarie Island, as related to land arthropods. It is presented by way of introduction to the series of reports by various specialists on the land arthropod fauna of the island. The bulk of these reports immediately follow this article. (One Macquarie mite is discussed in the third of the preceding articles by Wallwork on Antarctic mites, and another is mentioned in his second article.) Others will appear in later issues, when they are completed. After publication of the bulk of these taxonomic reports, Keith Watson will publish his general report on the land arthropod fauna of Macquarie, incorporating his ecological studies on the fauna.

Through the kindness of Mr. P. G. Law, Director of the Antarctic Division, Australian Department of External Affairs, I was permitted to join the Australian National Antarctic Research Expedition for the annual resupply trip to Macquarie Island in early December 1960. The operation, supported by the chartered Danish ice-breaker *Magga Dan*, was carried on at Macquarie from 4th to 10th December. At the same time, Mr. Keith Watson of the Australian National Antarctic Expeditions arrived for a study of a full year to investigate the land arthropod fauna. Also, Mr. John H. Calaby of the Division of Wildlife Research, Commonwealth Scientific and Industrial Research Organization, Canberra, spent the same week giving instruction in faunal investigation and ecological field techniques to Mr. Watson. Mr. Calaby and I returned to Melbourne on the *Magga Dan* on 16 December 1960. Unreported material has also been taken by E. Shipp (1950), N. M. Haysom (1949), T. Manefield (1949) and K. G. Brown (1953), all on the A.N.A.R.E. program.

MACQUARIE ISLAND

Macquarie Island is of great interest to biologists and biogeographers because it is the southernmost major sub-Antarctic island. In all probability it is the farthest south with a

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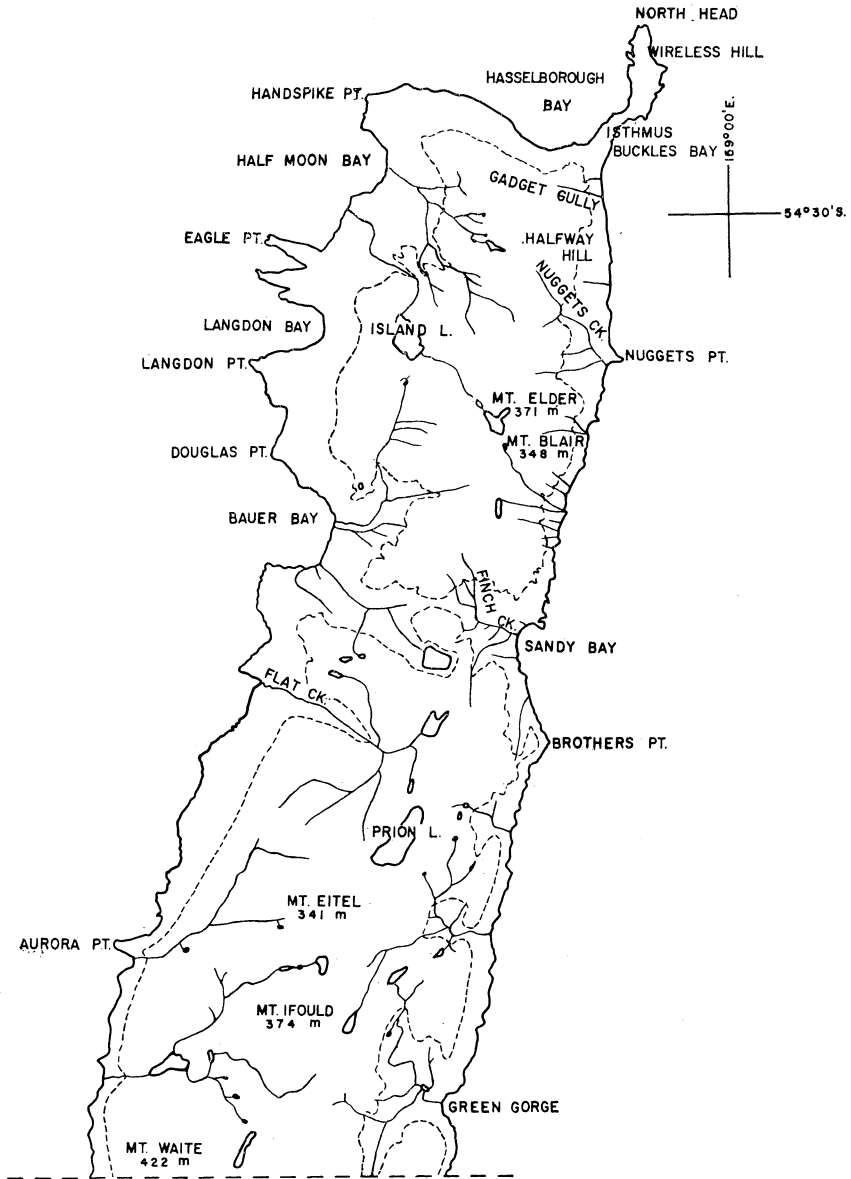
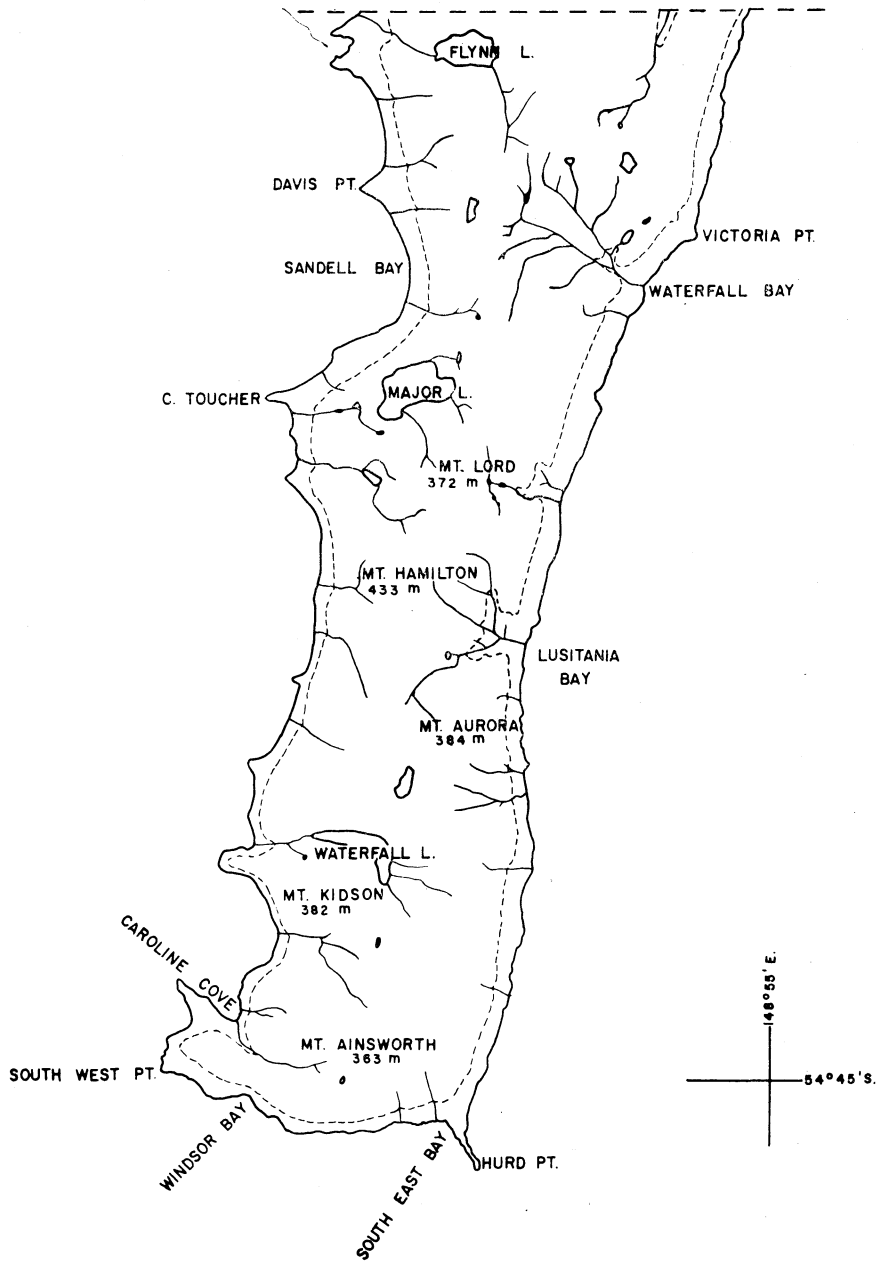


Fig. 1. Outline map of Macquarie Island, showing principal features, including



higher hills. Dashed line is 400 foot (120 meters) contour line (after Taylor).

fauna of more than say 50 species of free-living arthropods occurring in a limited area. Although the land arthropod fauna of the Antarctic continent is not yet adequately known, it appears possible that it may number fewer than 50 free-living species. There are some puzzling aspects of the Macquarie fauna, for several groups of insects occurring on islands of similar latitude, such as Kerguelen, Heard and South Georgia, appear to be lacking on Macquarie. Conspicuous among these are the weevils. This cannot be explained on the basis of latitude or present climate, as Macquarie is no colder than the other islands, and in fact has a milder climate, related to its lack of ice-cap or glaciers, which are possessed by the other islands, and to the fact that the Antarctic Convergence is farther south in the area of Macquarie. Furthermore, Macquarie is not greatly distant from Campbell Island, which though only two and one-half degrees farther north, possesses many more species of land arthropods, including representatives of a number of orders and families not found on Macquarie.

Geography: Macquarie is a slender island extending almost north and south in direction. It is 33 km (21 miles) long and up to 5 km (3 miles) wide, with an area of 118 sq. km (46 sq. miles). The highest altitude is 433 meters (1423 ft.). The island is located at 54° 30' S. Lat. and 158° 57' E. Long., and about 1300 km (800 miles) SE of Tasmania, 1000 km (600 miles) SW of New Zealand and 1450 km (900 miles) from the Antarctic continent. Much of Macquarie consists of a plateau with flat or gently sloping areas with occasional higher hills and dissected valleys. The sides of the plateau are mostly very steep, averaging at least 45° in slope. The plateau occupies much of the island, with very narrow coastal strips on the east coast, and in part somewhat wider coastal strips on the west side, particularly in the north. The northern tip of the island forms a small plateau, Wireless Hill, 100 meters in altitude, which is separated from the main part of the island by a very low isthmus, across parts of which waves sometimes cross in storms. The permanent weather and research station of A. N. A. R. E. is located at the north end of the isthmus, just at the south foot of Wireless Hill and immediately west of Camp Hill (Hut Hill).

The average altitude of the main plateau is between 200 and 250 meters, in general about 200 or more meters on the west side and 250 to nearly 300 meters on the east side. Slopes, in general, are quite gentle on the plateau areas. There are a number of small lakes and ponds on the plateau, most of them shallow tarns. Most of them have their outlets leading to the west coast, and some are drained by soakage.

The coastal strips are mostly low and flat, though some are a bit elevated. They are difficult to traverse because of boulders, pits, bogs, deep tussock and seal wallows. The coastal strips ring much of the island, but on parts of the southern part of the west coast, and south coast, there are vertical cliffs.

Geology: Macquarie is evidently the remainder of a former land mass of much greater area, of volcanic origin. There is abundant evidence of former glaciation which indicates that the island was much more extensive to the west, the direction from which the strong wind and water currents come, providing a very strong force of erosion. All the plateau and its hills show the effect of glaciation, and there is no evidence of nunataks which penetrated the ice-cap. Thus it is probable that the entire land fauna is post-glacial. In other words, post-Pleistocene.

The island appeared in the Cretaceous, and originally consisted of basaltic lava flows

and sills which were eroded, sunken and covered with globigerina ooze. This was followed by a volcanic period which resulted in a larger land area, later completely glaciated. The island consists of basic igneous rock including gabbros, ultrabasics, pegmatites, calc-alkali dolerites, alkali dolerites, calc-alkali basalts and alkali basalts. There are no sedimentary rocks. The surface of the plateau consists largely of gravel, with some boulders, and the coastal terraces consist of beach sands and gravels. The beaches are of rounded shingle or of gray sand from basic rocks (Mawson, 1943; Taylor, 1955).

Climate: For its latitude, the climate of Macquarie is unexpectedly moderate and uniform. There is very little range in the annual cycle of temperature. The highest recorded temperature is 11.4° C. (52.7° F.) and the lowest -8.3° C. (17.0° F.). The mean temperatures range from 3.0° C. (37.4° F.) to 6.3° C. (43.4° F.). Thus most of the time the temperature is a little above freezing. Rainfall is moderate, and is rather uniform throughout the year. The monthly means vary from 67 mm (2.64 inches) in June to 104 mm (4.08 inches) in March, with a mean annual total of 1438 mm (40.54 inches). Relative humidity is high, varying from 90 to 94 percent. Fog is very common, and average daily hours of sunshine vary from less than half an hour in June to just over three hours in

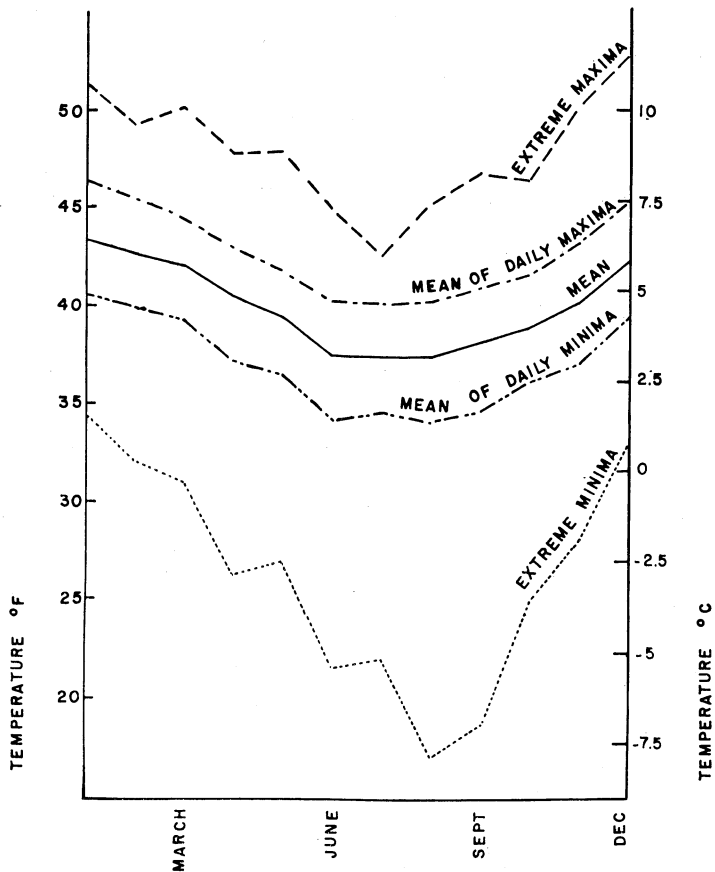


Fig. 2. Graph of temperature means for the annual cycle on Macquarie Island.

February. Wind is generally strong, with a mean velocity of 22.7 to 35.7 km/hr (14.1 to 22.2 miles per hour), being strongest from May to September and weakest in November and December. Wind direction varies from N through W and S to ESE, but is from WNW, NW, W, or WSW most of the time (Taylor, 1955).

Soils: There are two main types of soils on Macquarie, peat and mineral soils. The peat soils are divided into: 1) highmoor peats, 2) fen peats, and 3) bog peats. Highmoor peats cover all the subglacial herbfields and wet tussock grassland. Fen peats occur on flat land or gentle slopes with high water table, and may be rich or poor in dissolved mineral salts. Bog peats occur in flat country with a permanent water table which has never been in contact with mineral soil, and are thus very low in salts. The mineral soils are divided into poorly drained and well drained dry tundra soils. They are gravelly loams with a high percentage of organic matter, and are identical in occurrence with the feldmark. Thus they occur on high exposed windy areas where vegetation cover is generally incomplete and insufficient to produce peat (Taylor, 1955).

VEGETATION

Macquarie has a remarkably rich flora and extensive vegetation for its latitude. This may be explained partly on the basis of its lack of ice cover and moderate minimum and mean temperatures. These are again related to the Antarctic Convergence being south of Macquarie. Macquarie has 35 species of vascular plants, as compared with only 19 for South Georgia, 29 for Kerguelen, 8 for Heard and 17 for Crozet.

The Macquarie species of vascular plants are listed in table 1. The three species asterisked are endemic to the island. The genus *Hydrocotyle* occurs also in Tristan da Cunha, New Zealand and Australia.

The vegetation may be classified in five principal formations: grassland, herbfield, fen, bog and feldmark. These are discussed briefly here (after Taylor, 1955):

1). *Grassland (wet tussock)*: This is found on all the coastal slopes and most of the coastal terraces. It consists of pure *Poa foliosa* association, or of associations of *Poa* and *Stilbocarpa polaris* (Gressitt, 1961, fig. 20e), or *Polystichum* ferns, or other combinations of these, or coastal mats of various small vascular plants, mosses or lichens (fig. 3, c, e and Gressitt, 1961, fig. 20f).

2). *Herbfield*: This occurs on slopes and flats with moderate wind, or areas with high water table and not too severe wind. It is dominated by the large herb *Pleurophyllum hookeri* (fig. 3, a, b and Gressitt, 1961, fig. 20, c, d), but others, including *Festuca erecta*, *Carex trifida* and *Stilbocarpa polaris* are also involved in the various associations. It occurs up to 360 meters in altitude.

3). *Fen*: This occurs on valley floors of the plateau and in patches on raised beach terrace. It is found only where the water table is at or above the ground surface, and where water is neutral or alkaline as a result of contact with basic rocks and mineral soil. The dominant plant is *Juncus scheuchzeroides*, sometimes in combination with *Scirpus aucklandicus* and *Deschampsia penicillata*.

4). *Bog*: This occurs extensively only at Handspike Point, on raised beach terrace. It exists only where water table is at the surface or above, and where soil is acid and low in soluble salts because of contact with peat soil. It is dominated by mosses or vascular

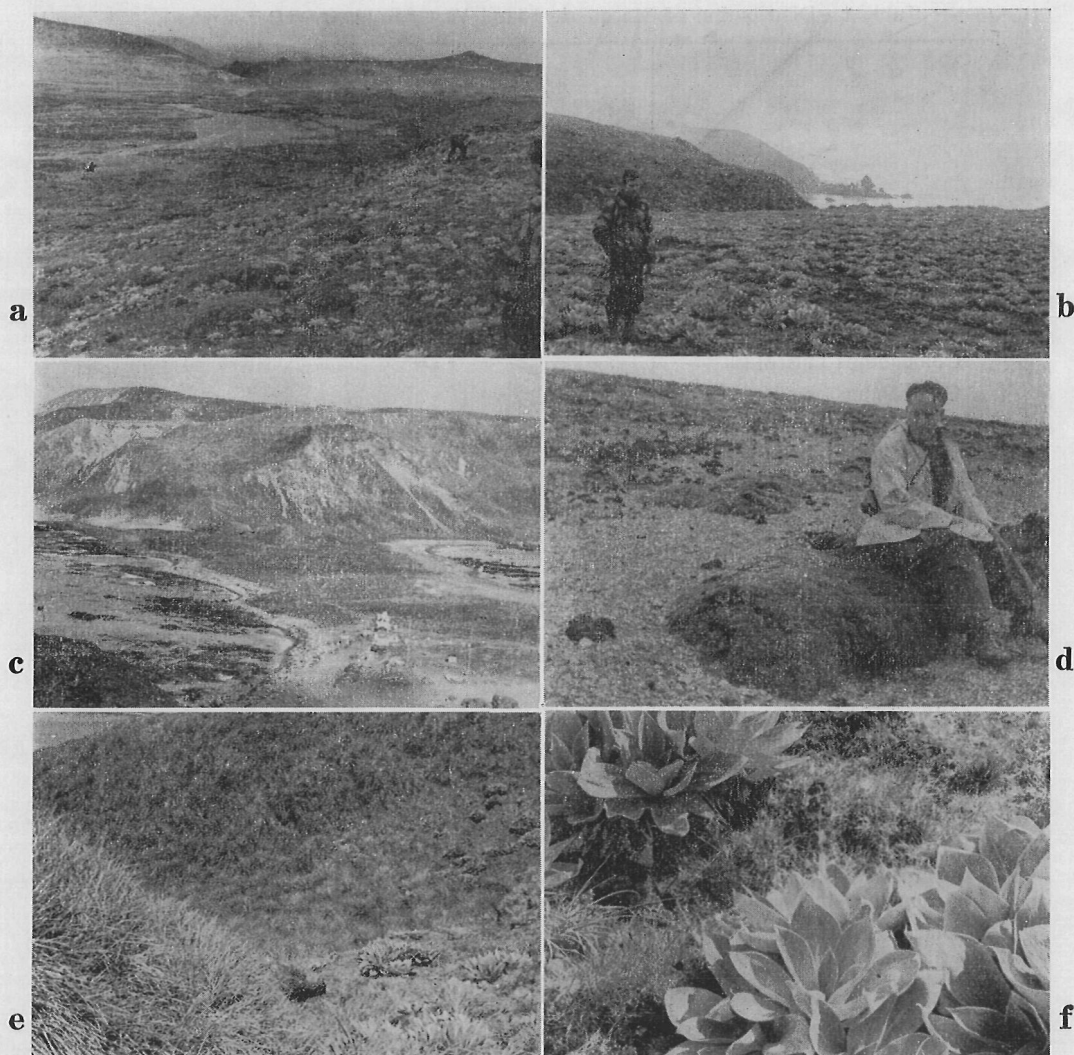


Fig. 3. a, west-central plateau Macquarie I., with *Pleurophyllum* and *Azorella*; b, plateau, Macquarie I., with *Pleurophyllum*, moss; c, plateau and isthmus from Wireless Hill; d, Feldmark: *Azorella* in rows; J. Calaby (C.S.I.R.O.), Dec. 1960; e, *Poa* and *Pleurophyllum*, Wireless Hill; f, *Pleurophyllum* and grass, same locality as e. (Macquarie I.)

plants in mats. Subdivisions of the formation are dominated by *Breutelia pendula*, *Sphagnum falcatulum*, and *Colobanthus muscoides*.

5). *Feldmark*: This occurs in all areas subject to high wind velocity. It is dominant above 200 meters altitude, but sometimes occurs at lower altitudes. It comprises two alliances, one dominated by *Azorella selago* (fig. 3d) sometimes with *Rhacomitrium crispulum* (Gressitt, 1961, fig. 20b) the other by *Dicronoweisia antarctica*.

FAUNA

Aside from terrestrial arthropods, several of the groups of soil or fresh-water invertebrate animals are present, including a small land snail, earthworms, tardigrades, rotifers and others. There are no fresh-water fish, amphibians or reptiles. There are no native land birds, but sea birds are abundant, with quite a number of species breeding on, or visiting, the island. A few land birds appear as stragglers or temporary residents. A duck is present. There used to be a parakeet and a rail, but these are extinct. A large flightless rail, the "Weka" (*Gallirallus australis scotti*) introduced from New Zealand, is very abundant. There are no land mammals which are native, but cats, rabbits, sheep and rats have been introduced and established. The rats are scarce and only near the coast. The sheep are only on Wireless Hill, but the cats and rabbits are widespread, and even occur on the plateau. The rabbits have had a great effect on the vegetation, rendering some plant species rare or perhaps extinct. The rabbits have also been the cause of much soil erosion and modification of original plant formation.

Large marine mammals dominate the beaches. Most abundant is the elephant seal, but fur seals, sea lions, leopard seals and others are occasionally seen. The elephant seals have a great effect on the lower terraces, flattening vegetation and creating wallows between the tussocks, or making ponds in bogs.

The terrestrial arthropod fauna of Macquarie appears to consist of approximately 110 species. These are comprised roughly as follows, although the complete analysis and zoogeographical discussion must await completion of the taxonomic studies. This is about double the number of species recorded earlier (See Gressitt & Weber, 1960).

Arachnida—Araneida: 2 species.

Acarina: Possibly 3 species of ticks and over 35 species of mites, including representatives of about 30 families.

Collembola: Ten or more species.

Anoplura: Perhaps one species on each species of seal.

Mallophaga: Probably at least one species on each bird species, and thus potentially about 25 species or more.

Hemiptera (Homoptera): Two species of aphids.

Thysanoptera: One species of a new genus of thrips.

Psocoptera: One species of a new genus.

Diptera: About 15 species, representing Tipulidae, Psychodidae, Ceratopogonidae, Chironomidae, Sciaridae, Dolichopodidae, Coelopidae, Ephydriidae, Chloropidae and Miliichiidae.

Siphonaptera: Five species of fleas.

Lepidoptera: One species of the Pyralidae.

Coleoptera: Five species of the Staphylinidae.

Hymenoptera: Two species representing Scelionidae and Diapriidae.

A possible explanation for the great disharmony of the Macquarie arthropod fauna may be in the relative youth of the island biologically. Possibly the ice cap persisted rather late, and completely covered the island, so that no prior populations survived. The apparently lower percentage of wingless insects than with some of the other sub-Antarctic islands again suggest this. Presumably much of the fauna (and flora) came to the island from the west, through air currents, sea currents or birds (see Holgate, 1961). Thus

Australia and New Zealand might have had little effect on the island. The great distance from source areas of southern South America might explain greater relative poverty as compared with the fauna of Kerguelen, for instance. On the other hand the relative wealth of flowering plants on Macquarie seems to dispute this.

FIELD WORK

I collected the first day (4 Dec. 1960) for a short time at Green Gorge on the middle of the east coast. Here several of the most common species were taken, including several flies, spiders, springtails, the moth and a small wasp (which later was not taken elsewhere). The rest of the week I worked on the northern quarter of the island, primarily on Wireless Hill and its slopes and shores, the Isthmus, Gadget Gully and the northern part of the plateau. On the 6th I went with John Warham, John Calaby and others up Gadget Gully, across the plateau, past Island Lake, down to Bauer Bay, up over a hill and down again to the coast south of Mawson Point, then up the coastal terrace to Bauer Bay again and over the plateau back to the Isthmus. Each night I returned to the ship to sleep.

Most of my collecting consisted of searching through the tussock grass (*Poa*), *Azorella*, *Pleurophyllum*, *Stilbocarpa* and other plants, particularly in the roots, as well as under stones, kelp and debris in and around decaying corpses of seals or birds, in rookeries, and around the edges of seal wallows. I operated three Berlese funnels continuously, using mainly decaying vegetation, mat plants, such as *Azorella*, debris and humus. I also preserved in alcohol some rich humus with algae and roots, as well as debris from beneath *Pleurophyllum* plants, which obviously included insects, and also searched through bagged plant materials aboard the Magga Dan during the return voyage to Melbourne. In addition, several living or dead birds or nestlings were examined for ectoparasites. John Calaby collected at essentially the same localities as I did. Keith Watson, during his year on Macquarie collected at a number of other localities. Those that are not indicated on the map (fig. 1) are listed at the end of this article.

Since there is not a great difference in the make-up of Watson's and my collections, in terms of species collected, it may be assumed that a large percentage of the total land fauna was taken by us. My collection appears to comprize about four-fifths as many species as does Watson's, although the figures for some groups will not be known until the collections have been further studied.

Aboard the "Magga Dan" going to Macquarie from Melbourne, while anchored leeward of the Isthmus at Macquarie, and during the return voyage, trapping of air-borne insects was carried on (Gressitt, 1961, fig. 20a). The results of this trapping were published in 1961 (Gressitt, Leech, Leech, Sedlacek and Wise).

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APPENDIX

Following is a list of place-names used for insect collections which are not indicated on the map, with indication of their location.

Aerial Cove.	Middle of W. side of NE peninsula.
Camp.	A.N.A.R.E. station, NE part of Isthmus, by Camp Hill.
Camp Beach.	W. side, N. end of Isthmus.
Camp Hill.	Same as Hut Hill, NE end of Isthmus.
Catch-me Pt.	W. side of NE peninsula, just N. of Camp Beach.
Catch-me Cave.	Just S. of Catch-me Pt., NE peninsula.
Cave.	Just SE of North Head.
Cosray Beach.	Isthmus, just SW of Camp Beach.
Douglas Bay.	Just N. of Douglas Pt., W. coast.
Eagle Cave.	Just SE of Eagle Pt., W. coast.
Finch Creek.	Inland from Sandy Bay, N. of Brothers Pt., E. coast.
First Gully.	Same as #1 Gully, between Isthmus and Gadget Gully, E. coast.
Garden Cove.	E. coast of NE peninsula, just E. of Camp Hill and Isthmus.
Lambing Gully.	E. coast of NE peninsula, N. of Isthmus and Garden Cove.
No. 1 Gully.	Same as First Gully, just S. of Isthmus, E. coast.
North End.	Applies mainly to area of Camp Hill and Garden Cove.
North Head.	N. end of NE peninsula.
Northeast Coast.	Beaches between Gadget Gully and Garden Cove.
Northwest Coast.	Beach and raised beach on W. side of Hasselborough Bay.
Plateau.	Inclusive of most of inland area, as indicated by contour lines on map.
Pyramid Peak.	Above head of Sawyer Valley, S. of Green George, E. coast.
Radio Beach.	E. side of Isthmus, near Camp; Buckles Bay.
Sawyer Valley.	Inland from Green George, E. coast.
Scoble Lake.	Midway between Island Lake and base of Isthmus.
Tent Hill.	Same as Razorback Hill, base of Isthmus.