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INTRODUCTION TO SOUTH GEORGIA[1]

By **J. L. Gressitt[2] and Harry Clagg[2]**

Abstract: South Georgia is by far the largest subantarctic island, and is along with Macquarie Island, one of the two southernmost. It is also the highest, but it is not quite the coldest, as Heard Island has a more extensive ice cover. Among subantarctic islands, South Georgia has had the most extensive history of human exploitation. The land arthropod fauna is rather limited, numbering only about 148 species, with 37% apparent endemism.

South Georgia (fig. 1) is a major feature of the Scotia Ridge, connecting the southern tip of South America with the northern tip of the Antarctic Continent. Also on the ridge are the South Sandwich Is., the South Orkney Is. and the South Shetland Is. There are a number of volcanoes on this ridge, which seems to be somewhat plastic in nature. It is interesting that the ridge curves considerably to the east between the two continents, in the same direction as the strong sea and air currents rotating clockwise around the Antarctic Continent. This suggests that the ridge might have been pushed in this direction at times when the continents were further separating.

South Georgia is a large (170 km long) and fairly old island, without active volcanoes or obvious volcanic cones. However, there does not seem to be evidence of extensive evolution on the island, and the fauna is apparently poorer than those of some smaller islands nearly as far south, and farther from continents. There was probably a much more extensive fauna, with major extinction during the period of maximum glaciation of the Pleistocene.

South Georgia possesses several groups of insects (Homoptera, Thysanoptera, Coleoptera, Hymenoptera), as well as spiders, and a number of families of Acarina not found on the Antarctic Continent.

ENTOMOLOGICAL EXPLORATION OF SOUTH GEORGIA

In 1876 and 1879 Giebel described some Mallophaga from Kerguelen. Some of these are found on birds in South Georgia.

The first insect collecting in South Georgia may have been by the "Deutschen Südpolarexpedition zur Beobachtung des Venusdurchgangs," 20 August 1882 to early July 1883. Material collected included 3 species of Coleoptera taken by Dr Clauss: *Anisomera claussi*, *Mylops sparsutum* and *Perimylops antarcticus* (Müller 1884). In 1887 Behrens described 2 new genera and species for South Georgia beetles (*Thalassogeton wilkensi* and *Chorimerium antarcticum*), synonyms of preceding. Pfeffer (1890) recorded Collembola (unidentified) and others from South Georgia. In 1890 Gercke described a new chironomid fly (*Podonomus steineni*) from South Georgia from the German expedition. Schäffer (1891, 1897) described 3 species of Collembola from the same expedition; Michael (1895) described oribatid mites. In 1904 Fauvel described a staphylinid beetle (*Crymus antarcticus*). Both this and some of the preceding were taken by Steinen on the German expedition.

In 1902 the Swedish South Polar Expedition spent a month in South Georgia (Skottsberg 1902). Wahlgren (1906) recorded 7 species of Collembola from this expedition and Trägårdh described some mites.

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On Professor Einar Lönnberg's expedition in 1904, Erik Sörling of Stockholm collected 40 specimens of Coleoptera—the same 3 species taken by Clauss, and *Hydromedion nitidum* (Mjöberg 1906), a synonym of one of the others.

In 1909 Enderlein listed 13 species of insects from South Georgia. In 1912 he described one new dipteran, and in 1930 he listed 22 species, including Collembola but not Acarina. Among the Coleoptera was *Hydromedion sparsutum* ab. *muelleri*.

In 1913, Robert Cushman Murphy of New York carried out an expedition in South Georgia (Murphy 1914). Banks (1914) reported on part of the collection, describing a new spider and recording some mites. Kellogg (1914) described Mallophaga from South Georgia and the South Atlantic. C. Schaeffer (Schäffer) reported upon the Collembola, Diptera and others, naming 2 new Diptera.

Brethes (1925) described a new staphylinid beetle (*Austromalota rufimixta*) and a new fly (*Trichocerodes georgianus*) from South Georgia, both as types of new genera.

Bristowe (1931) described a spider, *Myro fulgida*. Holdhaus (1931) named a fly, *Archiborborus konigi*.

Brinck (1945) recorded several species of beetles, discussing their zoogeography. Schweiger (1952) discussed the beetle fauna of the general area.

Eichler in 1949 described some new Mallophaga from South Georgia. Viets (1950) recorded some marine mites from the area.

Tambs-Lyche in 1954 described 2 new species of spiders, *Perimaso grytvikensis* and *Micromaso flavus*.

Timmermann (1956) and Clay (1958) treated Mallophaga from South Georgia and other far southern areas.

Coope (1963) reported the occurrence of the beetle *Hydromedion sparsutum* in a peat profile on Jason I., South Georgia.

A number of the species mentioned above are synonyms and/or are now placed in different genera. Some of the South Georgia insect species were first named from other areas, like the Falklands, southern South America, Kerguelen, etc.

During recent decades, various collections have been made by members of the Falkland Islands Dependencies Survey (recently British Antarctic Survey). The largest of these collections was made by Neville Jones in 1961 and was very kindly turned over to Bishop Museum by Dr Martin Holdgate for inclusion in the present study. Duplicates will be deposited in the British Museum (Nat. Hist.).

DESCRIPTION OF SOUTH GEORGIA

Geography: South Georgia is located at 35°46′—38° W; 53°58′—54°53′ S, about 480 km east of Cape Horn, and is 4°C colder than Cape Horn. It consists of a large island, 170 km long and up to 36 km wide, somewhat crescentic in shape, extending WNW and SE and thus slightly concave on the SW side. Its area is about 3755 km^2. There are a number of deeply indented bays on the north and NE coasts, but only a few shallow ones on the SW side, except for two fjords near the NW end and one indenting the SE end. There are only a few off-shore islets, but many rocks. Principal islets are the Willis Is. and Bird I. off the NW tip, Cooper I. just off the SE tip, and Annenkov I. 15 km off the middle of the SW coast.

South Georgia is very mountainous, and is the highest subantarctic island, but is only less than 200 m higher than Heard. The mountains extend throughout the island, and there are almost

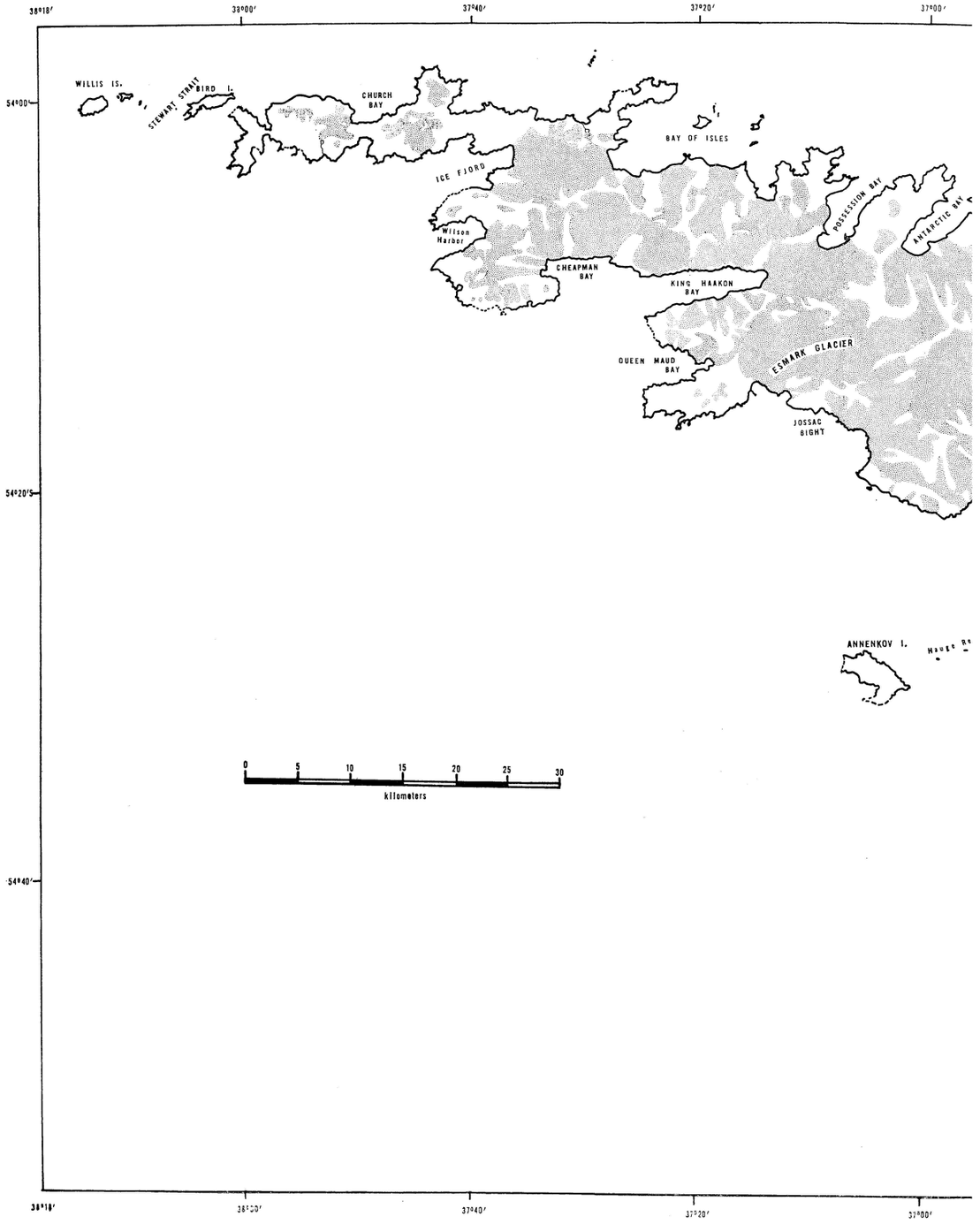

Fig. 1. Map of South Georgia. Shad

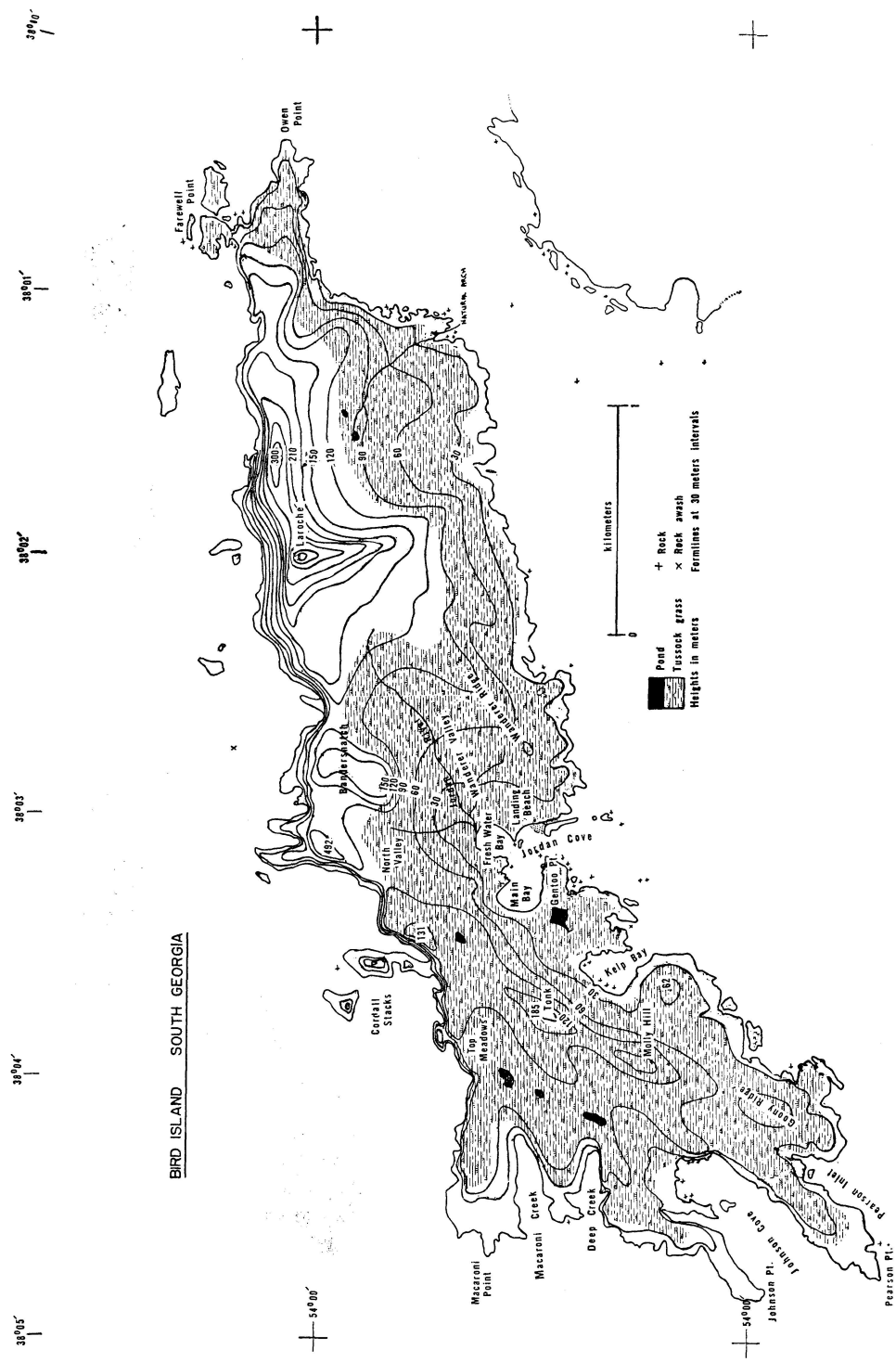

Fig. 2. Map of Bird Isladd.

no plateaux or coastal plains, though there are a few raised beaches and wave-cut platforms up to 7.5 m above sea level. The main range extends more or less in line with the long axis of the island, though portions of it in the central part are a little more E-W. In general the backbone is nearer the south coast. The highest peak is Mt. Paget, 2934 m, a little SE of the center, and much nearer the SW than the NE coast. Next highest in line are Mt. Nordenskjöld, 2355 m, and Mt. Roots, 2280 m, just to the SE; Mt. Carse, 2331 m, and Mt. Paterson, 2296 m, both ice-capped, not far from the SE end; the Three Brothers, 2040 m, Mt. Sugartop, 2323 m (fig. 3, a), and several others nearly as high, NW of Mt. Paget. The peaks become gradually lower to the west end, and the summit of Bird I. is only 365 m, with somewhat higher peaks on Willis I., Annenkov I. and Cooper I. The peaks on the northern peninsulas are mostly under 800 m in altitude.

South Georgia has very many glaciers. Though not many reach the north coast, many do reach the south coast, as well as the inner ends of the northern bays. Quite a few of the glaciers are connected in their upper portions or elsewhere. A number of passes are ice-covered and many narrowly protrude from the ice. There is more or less continuous ice-cover for most of the length of the island, except for a narrow break at Mt. Paget. The island is 56% ice-covered (Mercer 1967). Many of the glaciers are wider than long. There is no permanent ice on the off-shore islands.

Ice-free areas on the mainland of South Georgia consist mainly of steep rock peaks, narrow ridges, scree, moraine, gravel, shingle and the steep to gentle slopes, mostly in the north, where vegetation occurs and where birds breed. Most of the limited flat areas consist of moraine. Much of the coastline consists of cliffs. Summer snow-line is at about 450–600 m in the north, but much lower in the south. One-fourth the area consists of steep rock above ice. Most of the whaling stations are in bays on the NE coast.

Geology: South Georgia largely consists of slightly metamorphosed quartzose and tuffaceous sedimentary rocks possibly of early Mesozoic to Cretaceous age. These rocks are slates, silts and grits of greywacke facies, with a variable amount of calcareous nodules, weathering to give a mainly acidic soil. There are thin bands, up to 5 cm thick, of impure limestone. An igneous complex of both acid and basic rocks occurs at the SE end of the mainland. Some Lower Cretaceous sedimentary rocks interbedded with lavas occur on the south coast.

Soils consist largely of leached soils and podsols. There is extensive humus accumulation in certain areas, and where this is waterlogged, peat deposits up to 3 m or more deep may develop. Peat also accumulates under *Poa flabellata* and may be up to 4.5 m deep. (Adapted from Greene 1964).

Climate: South Georgia has a subantarctic climate, as it lies south of the Antarctic Convergence. Winds are strong and from the west, as is typical for the subantarctic. Pack ice barely reaches the southern tip of the island. Meteorological records are from the station at King Edward Point in Cumberland East Bay (near Grytviken). This is in a protected area, with frequent föhn winds, and has a more moderate climate as compared with most other parts of the island.

Seasonal variation is rather limited in regard to temperature, as the minimum temperature is always relatively high. Mean monthly temperatures are usually below freezing from May to September. Coldest month is August with a mean of −2 °C, and warmest is February with a mean of 5 °C. Summer maxima reach 5° to 9 °C, and during the rest of the year 0° to 4.5 °C. Minimum temperatures reach −5 °C in summer and −15 °C in winter, but are usually in the range of −5° to −0.5 °C.

There is only slight seasonal variation in precipitation, with a usual maximum in winter.

Fig. 3. a, Mt Sugar Top, with opening of Hesteslatten Valley in Cumberland East Bay, South Georgia; b, Westernmost South Georgia from Bird I.; c, North Valley, Bird I., with Bandersnatch in center and Laroché behind; d, View to SW across a valley on Barff Peninsula, South Georgia; e, View from "The Lawns" west across "The Meadows", Macaroni Point, Bird I., with Willis Is. in background; f, Bird I.: Moss, lichens and grass, with pencil pointing to perimylopid beetle. (All taken by H. Clagg, USARP—Bishop Mus.)

The 1944–50 annual average was 1580 mm. Rain is frequent in summer and rare in winter. Snow that falls in summer rarely persists at low altitudes. Permafrost does not exist except very locally.

Barometric pressure ranges from 950–1032 mb, and fluctuates frequently. There are frequent gales and prevailing winds blow mainly from between north and west. Depressions generally approach from direction of the Antarctic Peninsula, to the SW, giving that side of the island a more severe climate. Although there is a general limited latitude of extremes, sudden changes are characteristic of South Georgia climate. The protected areas of the NE are more favorable for plants and animals.

There has been quite a bit of glacial recession during the past century, but also some advance in the case of a few glaciers.

FLORA AND VEGETATION

The native and naturalized vascular plants of South Georgia number 32 species, and the transient alien vascular plants number 19 species, according to Greene (1964). The names are listed at the end of this section. This is a very high ratio of introduced to native species, and strongly contrasts with the situation on Heard Island, where there are far fewer native species, and apparently no introduced ones. Compared with Campbell Island, for example, the South Georgia and Heard Island floras are very limited, with the latter two being subantarctic in the strict sense, and the former cold temperate. The South Georgia flora is slightly poorer than those of Kerguelen and Macquarie. These differences in the richness of flora are reflected rather closely in the relative representation of land arthropods. The correlation relates of course both to isolation, island size, climate, history, vagility, and to ecological diversity of the environment from the standpoint of establishment and persistence of fauna.

The vegetation of South Georgia was originally classified by Skottsberg (1912), but the classification has been modified by Greene (1964) as follows:

Plant	Communities
1. Tussock Formation	—*Poa flabellata* association
2. Grass Heath Formation	*Acaena*—*Tortula* association *Acaena*—*Festuca* association *Festuca*—*Acaena* association
3. Marsh and Bog Formation	*Juncus*—*Deschampsia* association *Rostkovia magellanica* association

4. In addition, cryptogamic communities of rocks and screes not treated in Greene's paper.

The above formations are summarized below (after Greene, 1964).

1. *Tussock Formation.* *Poa flabellata* is the only tussock-forming grass on South Georgia, occurring in coastal areas, from shore to 225 m altitude. The tussocks are usually 0.5–1.0 m in diameter and 1.0–1.5 m high, consisting of a large stool with a dense crown. Pure stands (closed tussock) shade out other plants, but open tussock is more common. With the lower density, the stools are well-formed. Closed tussock is more common on Bird I. and the NW end of the main island, near Elsehul, but poor or absent near Cumberland and Stromness Bays. The pure stands are best developed on horizontal to moderately sloping areas away from penguin rookeries. Open tussock generally occurs with *Callitriche*, *Deschampsia*, *Acaena*, and by streams *Montia* may be present. Bryophytes are also common here and the mosses *Polytrichum* and *Dicranum* may form deep peat deposits. On moderate slopes, penguins and seals reduce the plants between tussocks, and com-

press tussocks. On steep slopes the mollymawks (smaller albatrosses) tend to open the tussock. The growth may be lush with *Callitriche*, *Acaena* and the moss *Tortula* around abandoned nests. Apparently no ferns occur in the tussock association. Mosses and lichens are abundant in less disturbed portions. On Bird I. the bryophytes exceed the tussock growth and locally cover the latter. In grazing areas of introduced animals the tussock may be largely eliminated.

2. *Grass Heath Formation.* This is the richest in species and is the climax vegetation along the NE coast. It is lacking in mature form on Bird I. and the SW coast. This was called "grassy tundra" or "tundra-meadow" by Skottsberg (1912). It does not compete successfully with tussock. There are 3 stages: *Acaena—Tortula* pioneer community; open *Acaena—Festuca* stage; and closed *Fustuca—Acaena* climax heath.

Acaena—Tortula association: This may represent the first stage of conversion of scree slopes to grass heath. *A. adscendens* is a good colonizer of unstable ground. On rocky slopes the moss *T. robusta* is almost always associated with the former. Some *Deschampsia*, *Festuca* and *Phleum* may occur, and as *Festuca* increases this association grades into the next.

Acaena—Festuca association: *F. erecta* forms dense erect tufts 18–25 cm high. *Phleum* and *Deschampsia* may become more abundant than *Festuca* above 170 m. Near the upper limit *Acaena tenera* may become more abundant than *A. adscendens*. *Rostkovia* may also be present in wet areas at higher altitudes.

Festuca—Acaena association: On well-drained, more stabilized ground *Festuca* becomes dominant. In closed heath the *Festuca* become close. *Acaena* and *Tortula* still remain, but *Phleum* and *Rostkovia* become scarce. *Galium* and *Uncinia* are present on more sheltered slopes. Both open and closed heath are rich in bryophytes and fruticose lichens, but ferns are rare. *Rostkovia* and *Deschampsia* develop on wet humus from decaying bryophytes.

3. *Marsh and Bog Formation. Juncus-Deschampsia* association: In areas where summer melt water covers the ground, and along streams *Juncus scheuchzerioides* is often dominant, and associates are *Deschampsia*, *Rostkovia* and *Acaena adscendens*, one of the latter becoming dominant on wet slopes. Others on wet ground are *Callitriche*, *Ranunculus*, *Montia* and *Ophioglossum*, the latter 2 preferring north-facing sites. On north-facing slopes near Husvik, *Alopecurus*, *Cerastium* and *Blechnum* are casual, and *Poa annua* and *P. pratensis* occupy these slopes at Stromness and Prince Olav Harbors. On Bird I. and Elsehul, in particular, *Deschampsia antarctica* becomes the only constituent on flat wet areas. *Callitriche*, as well as *Deschampsia*, is a colonizer of bare peat, but the latter may displace the former.

Rostkovia magellanica association: This leafy rush forms fairly pure communities. *Rostkovia* bog develops on valley floors, gentle slopes or hollows where water table approaches the surface. In such places peat deposits up to 2–2.5 m deep may be formed. *Acaena*, with less abundant *Festuca* and *Phleum*, may also be present, with *Poa annua* in drier areas. In wetter areas these are replaced by *Juncus*, *Deschampsia* and rarely *Ranunculus*. The surface layer of the bogs is made up largely of mosses—*Acrocladium* and *Drepanocladus* in wetter areas and *Tortula* in drier places. Sometimes *Polytrichum*, *Dicranum* and *Aneura* may be present also. Rarely there are isolated *Sphagnum* carpets among *Rostkovia*, sometimes including some *Acaena* and rarely *Deschampsia*, *Festuca* and *Phleum*.

4. *Cryptogamic Communities of Rock and Scree.* On the NE coast no phanerogam-dominated communities were observed by Greene above 225–300 m. Upland rock ledges support a number of genera of bryophytes, varying with the type of surface and exposure. *Andreaea*, *Blindia* and *Dicranoweisia* occur on rock faces and *Bartramia*, *Brachythecium*, *Dicranum*, *Distichium*, *Drepanocladus*, *Pohlia*, *Polytrichum* and *Rhacomitrium* occur in crevices and on ledges. A few vascular plants occur in these communities to at least 375 m. On stable slopes and moraines some of the preceding

occur, as well as *Rostkovia*, *Ranunculus*, *Acaena*, *Colobanthus* and *Poa*. Lowland ledges and glacial detritus support most of the same genera, even close to glaciers. Farther from glaciers, *Lycopodium* occurs, and sometimes ferns. Certain ferns are found mainly on north-facing lowland ledges by Cumberland and Stromness Bays, but are lacking on sea cliffs.

South Georgia compared with other islands. The conspicuous plants of South Georgia are herbaceous angiosperms, and there are no woody plants. This characterizes the subantarctic, the antarctic having almost solely cryptogams. A number of the species occur widely, and different associations have different proportions of largely the same plants. Tussock is an exception. Greatest variety occurs in the NE, near Cumberland and Stromness Bays, up to 225 m or a bit more, with cryptogams occurring higher. Another characteristic of subantarctic vegetation is the lack of fern bush and cushion bogs. (Above, and following lists, after Greene, 1964).

List of native and naturalized South Georgia vascular plants

Pteridophyta (ferns)

Lycopodiaceae: *Lycopodium magellanicum* Sw.
Hymenophyllaceae: *Hymenophyllum falklandicum* Baker
Polypodiaceae: *Blechnum penna-marina* (Poir) Kuhn
Cystopteris fragilis (L.) Bernh.
Polystichum mohrioides (Bory) C. Presl. var. *plicatum* (Poepp.) C. Chr.
Grammitis kerguelensis Tard.
Ophioglossaceae: *Ophioglossum opacum* Carmichael

Spermatophyta—Angiospermae

Dicotyledones

Ranunculaceae: **Ranunculus repens* L.
biternatus Sm.
Caryophyllaceae: **Cerastium holosteoides* Fr.
Colobanthus crassifolius (D'Urv.) Hook. f.
subulatus (D'Urv.) Hook. f.
Polygonaceae: **Rumex acetosella* L.
Portulacaceae: *Montia fontana* L. ssp. *fontana*
Rosaceae: *Acaena adscendens* Vahl. ssp. *georgiae-australis* Bitter
tenera Alboff
Callitrichaceae: *Callitriche antarctica* Engelm.
Rubiaceae: *Galium antarcticum* Hook. f.
Compositae: **Taraxacum officinale* Weber

Monocotyledones

Juncaceae: *Juncus scheuchzerioides* Gaudich.
inconspicuus (D'Urv.) Hook. f.
Rostkovia magellanica (Lam.) Hook. f.
Cyperaceae: *Uncinia smithii* Philcox
Gramineae: *Festuca erecta* D'Urv.
Poa flabellata (Lam.) Hook. f.
**annua* L.
**pratensis* L.

*naturalized species.

Deschampsia antarctica Desv.
**caespitosa* (L.) Beauv.
**Agrostis tenuis* Sibth.
Phleum alpinum L.
Alopecurus antarcticus Vah.

List of transient alien South Georgia vascular plants

Dicotyledones

Cruciferae: *Thlaspi arvense* L.
Capsella bursa-pastoris (L.) Medic.
Caryophyllaceae: *Stellaria media* (L.) Vill.
graminea L.
Papilionaceae: *Trifolium repens* L.
Pisum sativum L.
Umbelliferae: *Carum carvi* L.
Polygonaceae: *Rumex crispus* L.
Urticaceae: *Urtica urens* L.
Solanaceae: *Solanum tuberosum* L.
Scrophulariaceae: *Veronica persica* Poir.
Compositae: *Senecio vulgaris* L.
Achillea millefolium L.

Monocotyledones

Gramineae: *Festuca rubra* L. ssp. *rubra*
Lolium temulentum L.
Agropyron repens (L.) Beauv.
Avena fatua L.
Phleum pratense L.
Alopecurus geniculatus L.

BIRD ISLAND

Bird Island (fig. 2), off the NW end of South Georgia, was the site of the principal effort on the Johns Hopkins University-Bishop Museum (USARP) 1962–64 Bird Island–South Georgia ornithological-entomological expedition. The entomological work was done by Harry B. Clagg of Bishop Museum. The two ornithologists, representing Johns Hopkins University, were Lance Tickell and Ron Pinder.

Bird Island is located at 54°00′S, 38°02′W and is 0.7 km off the north coast of the west end of South Georgia. It is 5.6 × 1.2 km in size, running SW-NE and then W-E. The Willis Islands are 4 km to the WSW, across Stewart Strait (fig. 3, e). Bird I. is hilly, with 3 peaks over 150 m high. The highest is Laroché, 360 m (fig. 3, c). The north side of the island consists largely of cliffs, and the south and SE sides have beaches and rocky coasts, with many inlets and coves. The landing beach is in Jordan Cove.

The climate of Bird I. is fairly extreme, being less moderate than that of the whaling stations in the bays along the NE coast of South Georgia. Temperature extremes are 7°C to -26°C (45°F to -15°F), and perhaps a greater range, although winters are not as cold as one might expect. Precipitation averages about 50 mm/month. Relative humidity is usually 90–100%, but is less

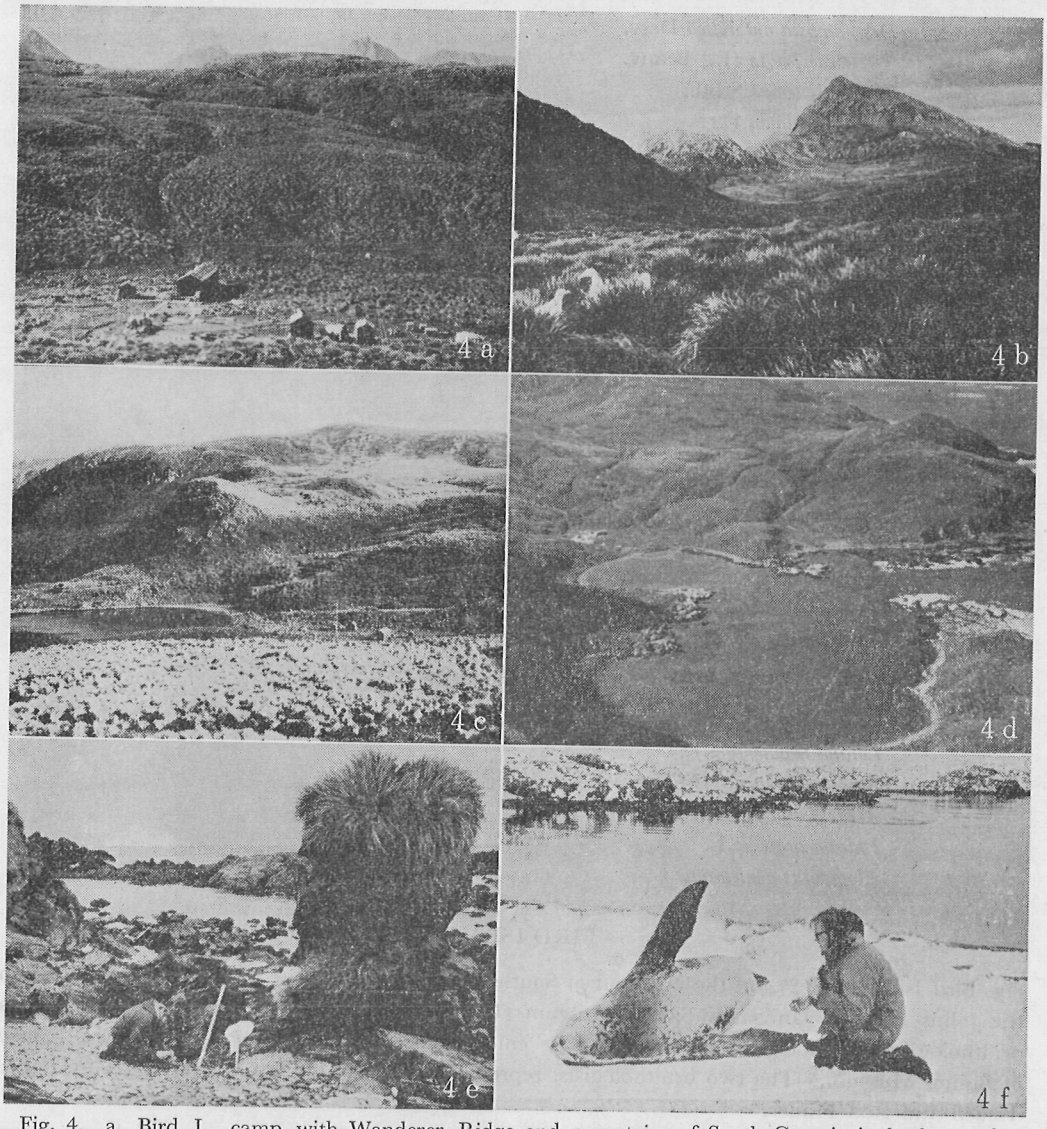

Fig. 4. a, Bird I., camp with Wanderer Ridge and mountains of South Georgia in background; b, Laroché Peak from Gooney Ridge, Bird I.; c, Fresh Water Bay and camp area, Bird I.; d, Jordon Cove, Bird I., with Fresh Water Bay and camp in left middle, Landing Beach in right middle, Gentoo Point in lower right, Stinker Cape in lower left, Wanderer Valley in upper left, and Wanderer Ridge in upper right; e, Harry Clagg collecting on Landing Beach, Bird I.; f, Harry Clagg collecting lice from sleeping leopard seal, Bird I.

in winter. Sunshine averages 2–3 hr/day. Sun, rain, snow, sleet or hail may all occur on the same day, and there may be heavy snow in summer. Average wind speed is 10–12 miles/hr, up to 35 knots, with gusts of 65 or more knots. The ground is always wet. The driest niches are dead tussock leaves not yet fallen to the ground, and certain scree slopes. There are many small streams

and ponds. Level areas are boggy. Maximum precipitation is in March and November.

The vegetation of Bird Island consists largely of tussock (below 100 m) with scattered patches of moss, *Acaena* and small grasses. Moss is dominant above 100 m; lichens are usually dominant above 150 m, with scattered clumps of tussock that high, to summit of Tonk, 186 m. Only scattered lichens and moss occur above 210 m on Laroché.

The fauna of Bird I. consists of 3 seals and 26 birds (see lists). All are true denizens of the sea except 2 of the birds. Over 80 species of terrestrial arthropods were taken on Bird I., but more occur on the main island of South Georgia. The principal industries of South Georgia are whaling and sealing. Rats were introduced on the main island in the 1880's and reindeer on the Barff and Busen Peninsulas in the 1920's and 1930's, but these are lacking on Bird Island.

A trapping experiment on Bird I. to study local dispersal of insects failed because of strong winds damaging equipment.

Ectoparasites were collected from elephant seals and leopard seals, and from the following 10 species of birds.

Gentoo penguin
Wandering albatross
Black-browed albatross
Gray-headed albatross
South Georgian pintail
South Georgian diving petrel
South Georgian blue-eyed shag
Giant petrel
Dominican gull
Sheathbill

Nest material of 9 species of birds was extracted in berlese funnels.

Wandering albatross
Black-browed albatross
Gray-headed albatross
Light-mantled sooty albatross
Giant petrel
Wilson's petrel
Shoemaker
Dove prion
South Georgian diving petrel

Travel by the party to Bird I. was on the British Antarctic Survey's *R. R. S. Shackleton* from Southampton on 9 October 1962. Stops were made at Montevideo, Port Stanley, Grytviken, Elsehul and Right Whale Bay. The landing on Bird I. was 1 December 1962. Some of the equipment could not be landed then, and due to bad weather and other ports of call, the balance of the gear was not all landed until 2 months later, and during that period the *Shackleton* spent 3 weeks nearby waiting for weather conditions favorable for unloading.

The camp on Bird I. was at Fresh Water Bay (fig. 4, a), and consisted of 4 huts: A small shed built in 1958, and 3 more, including main hut, built during December 1962–February 1963. Electricity was provided by batteries recharged at intervals with a diesel generator, and heat was provided by a coal-burning cooking stove in the main hut.

Weather records were taken each day at 0700, 1300, 1900 and 0100.

Fieldwork

All habitats on Bird I. were sampled by one or more methods. Specimens were collected accompanied by all possible ecological data, including weather data. Six berlese funnels were in operation extracting specimens. Naphthalene was used for repelling the insects into the vials. Collecting was done with a hand net, with an aspirator, with a fine brush and with forceps. Feathers and nasal passages of birds, as well as vegetation, fresh water and other materials were examined for specimens with a binocular microscope.

For most samples, observations of environmental conditions were noted such as: moistness

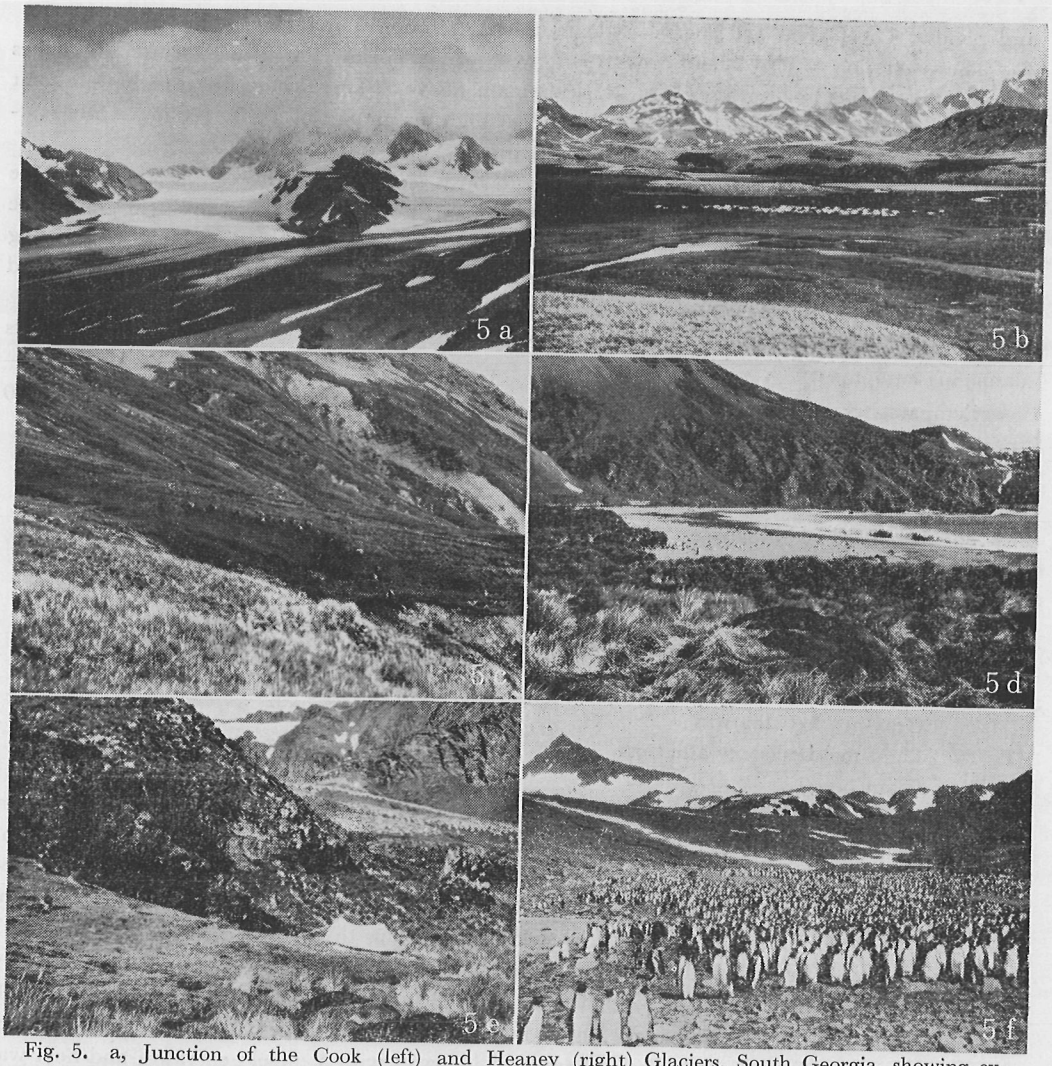

Fig. 5. a, Junction of the Cook (left) and Heaney (right) Glaciers, South Georgia, showing extensive moraine covering; b, Reindeer herd in Carlita Bay Valley, South Georgia; c, Reindeer on Busen Peninsula, South Georgia; d, Doris Bay Beach with penguins, foreground with elephant seals; e, Camp at Doris Bay, South Georgia, with young elephant seals in tussock in foreground; f, King penguins at St. Andrews Bay, South Georgia.

or dryness, associated vegetation, proximity to rookeries, streams, scree slopes, beaches with or without seals, and hosts of parasites. During January 1963, soil temperatures and ground level humidity observations were carried out in Wanderer Valley from sea level at the base, to the 500 foot (151 m) level on Laroché Peak. Observation stations were located at every 100 foot (30 m) rise in elevation, with a few extra stations in areas of special interest.

Entomological fieldwork was carried out on Bird I. from December 1962 to November 1963. Then, Clagg travelled by sealing ship to King Edward Point, near Grytviken, via Right Whale

Bay, Welcome Bay, Sunset Fjord, Fortuna Bay, and Enten Bay, arriving at King Edward Point 7 November 1963.

Grytiviken Peninsula. Collecting was done over this Peninsula, which divides Cumberland Bay into E and W parts. Nests of Gentoo penguin and Shoemaker were sampled with berlese funnels. Ectoparasites were taken from Elephant seal and Brown skua. The first collection of Thysanoptera from South Georgia was made here. The terrain is mountainous, with little vegetation except in low valleys, and with a narrow coastal strip of tussock, moss, etc. The only flat land is at Hesteslatten, a broad glacial valley paved with glacial debris with sparse vegetation, mostly grass. A few lakes are located here. The mountains mostly rise abruptly from the water to 400–700 m. Above 300 m, or over 2 km from the coast, only scattered lichens and mosses occur. The base of the peninsula is bounded by the Lyell and Hamberg glaciers, separated by Mt. Sugartop. Five weeks were spent there, of which 3 weeks were good weather.

Stromness-Busen Peninsulas. On 16 December 1963, Clagg moved from Grytviken to Husvik, where he worked for 4 weeks. He collected from Fortuna Bay to Cumberland West Bay, packing to Jasen Harbor. Here Dominican gull nests, and moss, were extracted with berlese funnels. Ectoparasites were collected from South Georgia diving petrel, Dove prion and Elephant seal. There are 4 glaciers behind the whaling stations—1 behind Leith, 1 behind Stromness and 2 behind Husvik (Konig and Neumayer glaciers). There is little vegetation except along the coast. In Olsen Valley there are *Rostkovia* peat bogs, with streams and pools. In this area there are 140 reindeer.

Barff Peninsula. On 13 January 1964, the *Shackleton* picked up the group at Husvik and moved them to the Barff Peninsula, where camp was made on a rocky beach, and a 40-year old mail hut repaired. An advance base and radio were also set up at Ocean Harbor across the peninsula. Clagg collected mainly between 54°20′S and the Nordenskjöld, Heaney and Cook glaciers. Barff Peninsula is mountainous, with some broad valleys, and the Szielaski Ice Cap on the higher parts. Vegetation is similar to those of the other peninsulas. The fauna differs in the absence of small burrowing birds and the presence of about 1800 reindeer. Weather alternated between good and bad. Ectoparasites were taken from a South Georgia diving petrel, but none were found on a reindeer.

Royal Bay area. After a week back at King Edward Point, Clagg and Chris Jefferies were moved by the *Shackleton* to Moltke Harbor, Royal Bay. They were let off on the beach on 26 February 1964 and camped there for 5-1/2 weeks, mostly in bad weather. The area worked was between Royal Bay and St. Andrews Bay, and is mountainous, reaching to 750 m, with small glaciers. It is separated from the main part of the island by the Ross, Webb and Cook glaciers. On 4 April 1964 the *Shackleton* picked up the party and left South Georgia for Port Stanley, via Signy Island, South Orkneys. Departure from Port Stanley was 15 April, and from Montevideo 21 April, arriving in Southampton on 15 May. Trap nets were run on the ship for airborne insects most of the way back.

Note: References will be found at end of final chapter of this volume.