

NOTES ON ANTARCTIC LICHENS: VI. THE GENUS *Sphaerophorus* Pers.

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ABSTRACT. Three species of *Sphaerophorus* are discussed. *S. globosus* (Huds.) Vain. is reported as being widespread throughout the Antarctic Peninsula and Scotia Ridge. *S. melanocarpus* (Sw.) DC. is recorded from the Falkland Islands and South Georgia, while *S. tener* (Laur.) Vain. f. *globosoides* J. Murr. is reported from the Falkland Islands, the first record of this form outside New Zealand or Tasmania. All three species were found to contain squamatic acid. *S. globosus* exists as two chemical strains, one centred on the Falkland Islands and South Georgia, the other centred on the Antarctic Peninsula.

A GENUS of austral origin, most of the 12 known species of *Sphaerophorus* Pers. are restricted to certain regions of the Southern Hemisphere. Two species, *S. globosus* (Huds.) Vain. (= *S. coralloides* Pers.) and *S. melanocarpus* (Sw.) DC. (= *Sphaerophoron compressum* Ach.), are also found throughout the Northern Hemisphere, apparently being cosmopolitan in distribution. Little is known, however, about the distribution, ecology or chemistry of these two species in Antarctic regions.

The genus *Sphaerophorus* was first reported from the Antarctic by Hue (1908), who recorded *S. globosus* from localities on the west coast of the Antarctic Peninsula. Earlier, Vainio (1903), when commenting on the distribution of *S. tener* (Laur.) Vain., had noted that this species was found in Antarctic regions. This statement appears erroneous since all Antarctic material reacts K+ yellow, I+ blue, and so is referable to *S. globosus*, whereas Vainio's (1903) material was reported as giving a K- and I- reaction.

Both Darbishire (1912) and Hue (1915) reported further localities on the Antarctic Peninsula for *Sphaerophorus globosus*, and the former author also recorded, for the first time, *S. melanocarpus* from South Georgia. Apart from these publications, there appear to be no other records for species of *Sphaerophorus* from South Georgia or the Scotia Ridge-Antarctic Peninsula sector of the Antarctic.

The present study is based on material in the British Antarctic Survey herbarium, at present housed in the Department of Botany, University of Birmingham, and specimens in the British Museum (Nat. Hist.). Specimens examined are cited in the Appendix for each species and the herbaria to which duplicates have been distributed are indicated according to the contractions recommended by Lanjouw and Stafleu (1964). Specimens in the British Antarctic Survey herbarium are designated BIRM*.

Distribution data for the Falkland Islands and South Georgia are arranged according to the kilometre grids overprinted on the maps of these islands which accompany the floras of Moore (1968) and Greene (1964), respectively, but for records south of lat. 60° S. they are summarized by island group or coasts, the latter including all offshore islands. Field records are based on information provided by J. A. Edwards and D. W. H. Walton lodged in the Survey's botanical data bank.

Nomenclature follows that of Murray (1960) but for convenience the species are arranged alphabetically.

Sphaerophorus Pers.

Syn. *Sphaerophoronomyces* Ciferri and Tomaselli, 1953, p. 66.

Thallus fruticose, erect, terete or compressed, or foliose and ascending; branched, corticate. Apothecia terminal or subterminal, dehiscent or with thalline margin. Asci 8-spored, disintegrating. Ascospores simple, globose, dark epispore present or absent, forming mazaedium. Phycobiont trebouxoid.

Apothecia and pycnidia have only been seen in one specimen, although presumed apothecial initials have been observed in sections of branch tips of specimens of *Sphaerophorus globosus* from the Falkland Islands.

In the field the species of this genus may be confused with *Cornicularia aculeata* (Schreb.) Ach. and species of *Stereocaulon* Schreb. From the former, species of *Sphaerophorus* are

distinguished by the solid, not hollow, thallus, and from species of *Stereocaulon* by the soft, not wood-like, stems. The species may be distinguished from each other as follows:

1. Medulla I+ blue	<i>Sphaerophorus globosus</i>
Medulla I-	2
2. Branches always terete	<i>S. tener</i>
At least some branches flattened	<i>S. melanocarpus</i>

Sphaerophorus globosus (Huds.) Vain.

Syn. *Sphaerophorus coralloides* Pers.

Sphaerophoronomyces coralloidis Ciferri and Tomaselli, 1953, p. 66.

Thallus forming loose clumps up to 10 cm. tall. Branching sympodial with main axes up to 2 mm. in diameter, rather infrequent. Branches never appearing coralloid as, for example, in British material, smooth, terete, white to dark brown. Cortex 80–120 μ m. thick, merging gradually with the algal layer and medulla. Medulla I+ blue; K- and P- or K+ yellow and P+ yellow. Apothecia and pycnidia absent in the material examined. Murray (1960) reported the phycobiont as a species of *Cystococcus*.

S. globosus is a cosmopolitan species which is abundant in polar regions, Lyngé and Scholander (1932), for example, stating that it is one of the commonest lichens in the Arctic. Murray (1960) considered that all records of this species from New Zealand referred to *S. tener* f. *globosoides* J. Murr. The distribution of *S. globosus* in the Antarctic is given in Fig. 1.

A wide range of variation is found in Antarctic specimens mainly in three characters, namely colour of the thallus, degree of branching and chemical content. The amount of pigment varies with thallus colour which can be white, pink or shades of brown. The amount produced appears to be related to the amount of direct sunlight the plant receives, being greater in more exposed, unshaded habitats than in sheltered, shaded situations. In specimens which possess a large quantity of pigment a secondary feature is that the cortex is more conglutinate than in those lacking or with only a quantum of pigment.

Many of the specimens from South Georgia and localities farther south are sparsely branched, and these plants present the habit of *Sphaerophorus fragilis* (L.) Pers., a species apparently confined to the Northern Hemisphere. The distance between nodes is shorter in sub-Antarctic and Antarctic specimens than in material from the Falkland Islands but the cortex is only slightly thicker in the latter than in the former. Presumably some factor in the complex of exposure induces these slight modifications, and its influence becomes more apparent with increase in latitude.

The chemistry of this species appears to be relatively simple. The I+ blue reaction of the medulla is constant, and thus is a useful method for distinguishing *S. globosus* from the frequently morphologically identical *S. tener* f. *globosoides*. All specimens contained squamatic acid, as demonstrated by microcrystallization methods, but there are two chemical strains. One, which reacts K- and P- and contains squamatic acid only, corresponds to var. *globosus* and may be referred to as strain I, while the other reacts K+ yellow and P+ yellow and contains squamatic and thamnolic acids, as demonstrated by thin-layer chromatography, and may be designated strain II. The latter strain is apparently the same as the P+ yellow strain reported from Alaska and Scandinavia by Krog (1968).

These two chemical strains are found in otherwise identical plants, and overlap in distribution in the Fuegia-Scotia Ridge-Antarctic Peninsula region. Chemical strain I, also known from Fuegia (Hawksworth and Moore, 1969), appears to be more Antarctic in its distribution than chemical strain II (Table I). The reasons for this are at present unknown.

Sphaerophorus globosus has a wide ecological amplitude, growing on gravel, soil, peat, turves of *Chorisodontium* or *Polytrichum*, carpets of *Drepanocladus* and occasionally on rocks. It ranges from near sea-level to over 680 m. in the Falkland Islands, but this upper limit decreases with increase in latitude and at localities along the Antarctic Peninsula it has not been collected over 50 m. a.s.l.

The specimens examined are cited in the Appendix.

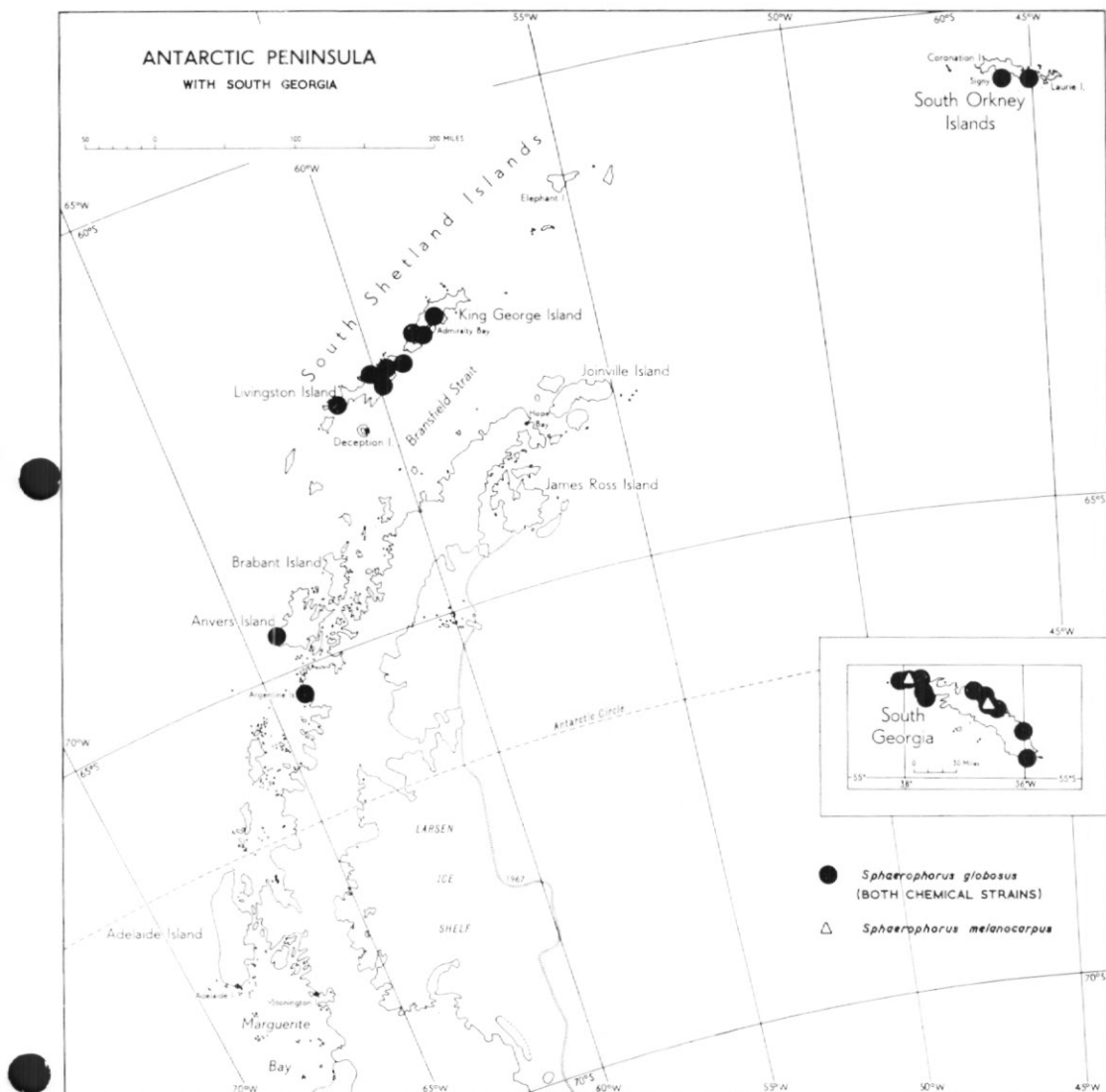


Fig. 1. Distribution of species of *Sphaerophorus* in the Antarctic Peninsula-Scotia Ridge sector of the Antarctic.

Sphaerophorus melanocarpus (Sw.) DC.

Syn. *Sphaerophoron compressum* Ach.

Forma *melanocarpus*

Thallus forming compact clumps up to 5 cm. tall. Branching di- or trichotomous or occasionally sympodial, rather infrequent. Branches up to 2 mm. in diameter, smooth, flattened, but usually appearing terete towards the base, white to a very dark brown. Cortex 100–140 μ m. thick, merging gradually with the algal layer and medulla. Medulla I—, K— and P—. Apothecia and pycnidia absent in the material examined.

TABLE I. DISTRIBUTION OF CHEMICAL STRAINS OF *Sphaerophorus globosus* (Huds.) Vain.

Region	Number of specimens examined	Number of specimens containing	
		Squamatic acid (Strain I)	Squamatic and thamnolic acid (Strain II)
Falkland Islands	6	0	6
South Georgia	8	0	8
South Orkney Islands	12	2	10
South Shetland Islands	12	8	4
Antarctic Peninsula	4	4	0

Forma ramosissimus J. Murr.

Thallus forming loose clumps up to 5 cm. tall. Branching sympodial with a main axis and numerous subsidiary branchlets. Branches up to 3 mm. in diameter, smooth, terete. Cortex 100–150 μm . thick, merging gradually with the algal layer and medulla. Medulla I–, K– and P–. Apothecia and pycnidia absent in the material examined.

This species is considered to be cosmopolitan and Lye (1969) has discussed its ecology and distribution based on the records available to him. The records listed here from South Georgia and shown in Fig. 1 for *forma melanocarpus* are the southernmost known, Lye (1969) having reported its most southerly localities from Fuegia and the Falkland Islands. The *forma ramosissimus* is more restricted in its distribution, being found in New Zealand and the Falkland Islands; *forma melanocarpus* is cosmopolitan.

Because of the paucity of material in the British Antarctic Survey herbarium, no comment can be made on the variation encountered in the two forms. All the material examined of both forms contained squamatic acid. According to Culberson (1969), this species also contains fragilin and sphaerophorin.

S. melanocarpus appears to have a similar broad ecological amplitude to *S. globosus* with a similar altitudinal range.

The specimens examined are cited in the Appendix.

Sphaerophorus tener (Laur.) Vain.

Forma globosoides J. Murr.

Since this form, when sterile, is morphologically identical to *S. globosus*, the morphological description of the plant body for that species will suffice for this taxon. However, the cortex in this form is much thinner than in *S. globosus*, being 40–70 μm . thick, although Murray (1960) stated it to be only 10–30 μm . thick. Apothecia in *forma globosoides* occur at the tips of branches and are black, hemispherical, with an evanescent thalline margin, and the asci on disintegration leave a black powdery mass of ascospores. The ascospores are hyaline, globose, 7–8 μm . in diameter, and, according to Murray (1960), are 8 per ascus. Only one specimen (R. Smith 1071) has been found in the fertile state.

Apothecial characters provide the only macroscopic criteria by which these two taxa can be separated, but as apothecia appear to be very rare in *forma globosoides* (Murray, 1960) the other definite method of distinguishing them is by the reaction of the medulla with I being negative in *S. tener* and positive (+ blue) in *S. globosus*.

Neither Culberson (1969) nor Sato (1969) have reported any lichen substances from *S. tener*. Using microcrystallization methods, *forma globosoides* from the Falkland Islands was shown to contain squamatic acid.

S. tener has been reported as being widely distributed in the Southern Hemisphere, but according to Sato (1969), *forma globosoides* is restricted to New Zealand and Tasmania. The

records cited below are thus the first for this form from the Magellanic region. Both specimens were found growing on peat beneath *Empetrum rubrum* at altitudes of 50–80 m.

The specimens examined are cited in the Appendix.

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APPENDIX

DETAILS OF SPECIMENS AND FIELD RECORDS EXAMINED

Sphaerophorus globosus (Huds.) Vain.

Falkland Islands East Falkland

- UC65 Corner 82 (BIRM*, IAA), Corner 124 (BIRM*, CHR, MEL, US)
 UC77 Corner 254 (BIRM*)
 VC37 Lindsay 1637 (BIRM*, TNS), Taylor 199a (BM), Taylor 500 (BM), Walton 639 (BIRM*)

South Georgia

- 030 150 Greene 353b (BIRM*), Greene 1171 (BIRM*), J. Smith M222 (BIRM*), J. Smith M225 (BIRM*)
 030 155 Greene 1158 (BM, S)
 040 145 Field record 1705
 050 150 Field record 1697
 055 140 Greene 1155a (BIRM*)
 055 150 Clarke and Greene CG29 (BIRM*)
 080 125 J. Smith M211 (BIRM*)
 105 145 Field record 1716
 120 130 Greene 3036 (BIRM*)
 130 125 Greene 1976 (BIRM*)
 155 095 Greene 2226 (BM)
 160 060 Greene 2467 (BM)

South Orkney Islands

- Coronation Island
 Above Shingle Cove Lindsay 1165 (BIRM*, LE), Lindsay 1342 (BIRM*)
 Olivine Point Lindsay 1028 (BIRM*, PC), R. Smith 153a (BIRM*, CHR, FH, IAA, PRE, US)
- Lynch Island
 Marshall Bay Lindsay 951 (BIRM*)
- Signy Island
 South of Stygian Cove R. Smith 376 (BIRM*, MEL, PC)
 Mooring Point Holdgate 262 (BIRM*, CHR)
 Berntsen Point Holdgate 204 (BIRM*, SGO, TNS), Holdgate 209 (BM, FH, PRE, US),
 Holdgate 214b (BM), Taylor 403 (BIRM*, S), Taylor 410 (BIRM*), Taylor 412 (BIRM*), Lindsay 1228 (BIRM*)
 Observation Bluff Holdgate 272c (BM), Holdgate 275a (BIRM*, MEL)
 Between Factory Cove and
 Paal Harbour Holdgate 229b (BIRM*, IAA)
 Port Jebson Longton 1205 (BIRM*, SGO)
 Fredriksen Island Disc. Invest. St. 1090 (BM), Disc. Invest. 41 (BM)

South Shetland Islands

- King George Island
 Keller Peninsula Taylor 279 (BIRM*, LE), Taylor 290a (BIRM*, TNS), Taylor 293 (BIRM*, SGO)
 Point Hennequin Lindsay 845 (BIRM*)
 Fildes Peninsula John and Sugden 24 (BIRM*, LE, PC)
 Barton Peninsula Lindsay 770 (BIRM*)
- Robert Island
 Edwards Point Lindsay 605 (BIRM*)
- Greenwich Island
 Duff Point Lindsay 557 (BIRM*)
 Spark Point Lindsay 635 (BIRM*, MEL)
- Half Moon Island
 Near station Lindsay 577 (BIRM*, CHR, IAA)
- Livingston Island
 Near Clark Nunatak Lindsay 132 (BIRM*, S, SGO, TNS)
 East end of South Beaches Lindsay 498 (BIRM*)
 Near Hell Gates Lindsay 272 (BIRM*, FH, PRE, US)

Anvers Island

- Hermit Island R. Smith 897 (BIRM*, BM)
 Laggard Island Longton 1303 (BIRM*, S)

Graham Coast

- Argentine Islands
 Uruguay Island Corner 741a (BIRM*, LE, PC)
 Galindez Island BGLE 1058e (BM), BGLE 1116c (BM), BGLE 1140 (BM), BGLE 1325e (BM), Corner 478 (BIRM*)
 Near Cape Tuxen Archibald 26 (BIRM*, FH)
- Berthelot Islands
 Green Island BGLE 1075p (BM), BGLE 1077 (BM)

Sphaerophorus melanocarpus (Sw) DC.
 forma *melanocarpus*

South Georgia

- 030 155 Field record 1696
 125 125 Greene 1618 (BIRM*)
 forma *ramosissimus* J. Murr.

Falkland Islands East Falkland

- UC76 Corner 223 (BIRM*), Corner 268 (BIRM*), Corner 322a (BIRM*)
 VC37 Lindsay 1656b (BIRM*), Lindsay 1674a (BIRM*), Lindsay 1679a (BIRM*)

Sphaerophorus tener (Laur.) Vain.
 forma *globosoides* J. Murr.

Falkland Islands East Falkland

- VC37 Lindsay 1673 (BIRM*, BM), R. Smith 1071 (BIRM*), Taylor 229a (BM), Walton 638 (BIRM*)