



SKRIFTER NR. 185

Botany of Bouvetøya, South Atlantic Ocean
I. Cryptogamic taxonomy and phytogeography



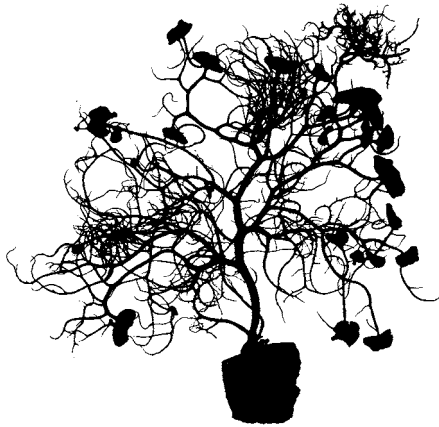
Usnea aurantiaco-atra (Jacq.) Bory
Bouvetøya, Moseryggen. 270 m a.s.l. (half size).

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Preface

Plant life under the extreme environmental conditions of Antarctic regions is of general interest to the study of polar and alpine floras.

The present volume is the first comprehensive contribution of the Norwegian Antarctic Research Expeditions on an isolated, maritime Antarctic flora.

Nearly two and a half centuries have passed since the discovery of the South Atlantic island of Bouvetøya by French navigators (Bouvet 1739). The *Valdivia* expedition of 1898 established a more accurate positioning of the island, and the first investigations on land were by the members of the *Norvegia* expedition in 1927. Bouvetøya became a nature sanctuary by ruling of Norwegian authorities on 17 December 1971.

Several problems, i.e. of vegetational history, remain to be elucidated as regards this mid-oceanic island. It is hoped that this volume will be useful in promoting exchange of information and cooperation among biologists dealing with Antarctic and sub-Antarctic regions.

I should like to thank the contributors, as well as the Norwegian Polar Research Institute and its managing editor for the work involved in the present publication.

Oslo 6 June 1986
Torstein Engelskjøn

General outline of the botanical investigations on Bouvetøya*

Engelskjøn, T. 1986: General outline of the botanical investigations on Bouvetøya. *Norsk Polarinstitutt Skrifter* 185: 5–9.

The geographical situation and nature of Bouvetøya are briefly outlined. Botanical field work and collecting by the Norwegian Antarctic Research Expeditions are reviewed. The details of bryophyte and lichen occurrences are now well documented for this part of the maritime Antarctic, whereas the algal and micromycete floras are still in need of exploration.

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A preliminary account of the terrestrial vegetation of Bouvetøya, a mid-oceanic, maritime Antarctic island, was published by Engelskjøn (1981). A specialist treatment of cryptogamic taxonomy was announced, and I am glad to be entrusted with editorial work involved in the present co-operative effort of cryptogam botanists at the Universities of Bergen, Oslo, and Trondheim, as well as Institutes in Great Britain.

The papers entered in this volume deal with the taxonomy of Bouvetøya bryophytes (Bell & Blom), foliose and fruticose lichens (Jørgensen), crustose lichens (Øvstedal), ascomycetes (Øvstedal & Hawksworth; Schumacher), and algae (Klaveness & Rueness), as well as aspects of their phytogeography (Engelskjøn & Jørgensen).

The contributors are mainly responsible for the results presented in their respective papers. They are fully aware that the material submitted may be incomplete in some instances. As to the larger bryophytes and more conspicuous lichens, however, I think the available material gives an adequate picture of the floristic composition of the Bouvetøya vegetation. The fungal and algal floras are certainly less well represented in the collections. Considering the present incomplete stage of Antarctic botanical exploration, even these groups deserve a mention, inasmuch as they are ecologically important and need the stimulus of further study, especially in extreme environments.

Engelskjøn & Jørgensen (1986) have summarized the composition of the flora and discussed aspects of chorology and phytogeography of Bouvetøya and other parts of the maritime Antarctic. It soon became evident that our actual knowledge is insufficient for regional comparisons. Promotion of international cooperation on taxonomy and phytogeography in Antarctic regions will be needed to develop such premises.

An Index which will be published separately (Engelskjøn 1986 a) provides a documentation of the about 400 plant collections which are now available from Bouvetøya, with quotations of determination results, location on the island, ecological notes, and distribution in herbaria dealing with Antarctic botanical research. Reference to these Index numbers is made throughout the taxonomical treatment because documentation is basic for future revisions of Bouvetøya collections in a circum-Antarctic context.

The following is a short description of the natural environment of Bouvetøya and of the main sites where the botanical material was collected. *Norsk Polarinstitutt Skrifter* 175 (Bouvetøya, South Atlantic Ocean) presents eleven articles on the climate, glaciology, geology, geophysics, and zoology of Bouvetøya. For updated reviews of Antarctic terrestrial ecology and botany, reference is made to Walton (1984) and Smith (1984).

Geographic outline of Bouvetøya

Bouvetøya is centred on 54°25' S Lat., 3°20' E Long. and is one of the most remote and isolated

* Publication No. 63 of the Norwegian Antarctic Research Expeditions 1976/77 and 78/79.

islands in the world. It is irregularly rectangular in outline, measuring 9.5 km × 7 km. The topography is that of a broad stratovolcanic cone of Pliocene and Pleistocene age (Prestvik & Winsnes 1981), of which large parts have been removed by marine abrasion, especially on the north, west and southwest coasts. Accordingly, the main crater occupies an eccentric position within the present land mass. Fig. 1 provides the place-names of the most important botanical localities visited.

The highest mountain summits are situated on the north-eastern crater rim, reaching altitudes of 753 m to 780 m above sea level. They are all ice- and firn-covered. The ice-filled crater bottom has an elevation of about 500 m a.s.l. whereas the evenly sloping flanks of the volcano extend down to about 60 m above sea level on the east coast and 100 m to 300 m on the south coast. On the west and north coasts the original slopes of the cone terminate in abrasion precipices 400 m to 500 m high with narrow beaches, which makes access to the island quite difficult.

The coastline has some prominent capes and promontories. On the east coast Kapp Meteor and Kapp Lollo reach about 80 m a.s.l. In the central part on the north coast the silicic dome of Kapp Valdivia rises to about 320 metres, but its main plateau is about 90 m above sea level. Kapp Valdivia is nearly barren because of its exposed location with excessive wind action, and possibly also because of the acid soil conditions. Nevertheless, some interesting species are present.

The northwestern corner of the island and the place first sighted by Bouvet in 1739 is named Kapp Circoncision. It is ice- and snow-free up to about 200 m above sea level and is the site of the largest penguin colony on Bouvetøya. Southeast of Kapp Circoncision and north of the new ground of Nyrøysa there are several vegetated patches, especially around the buttness 177 m above sea level.

Nyrøysa is a 1.5 km wide, supralittoral platform reaching 51 m above sea level. This is the most suitable area for landing and setting up

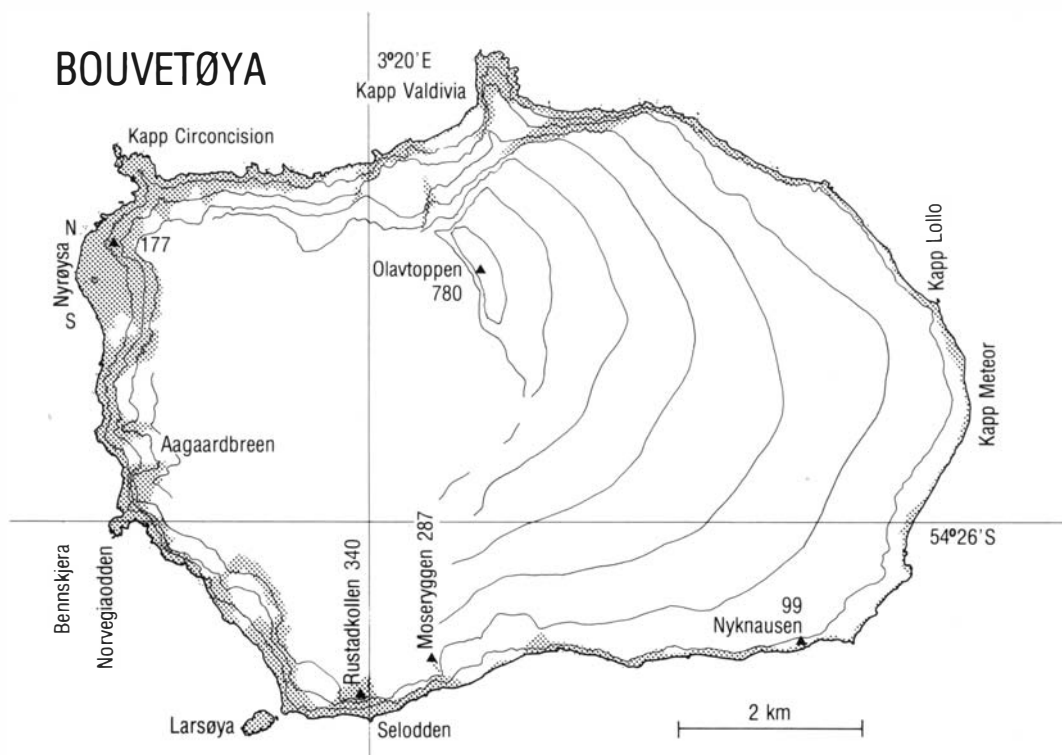


Fig. 1. Survey map of Bouvetøya. Contour interval: 100 m. Dashed: unglaciated areas. N: Nordstranda. S: Sørstranda.

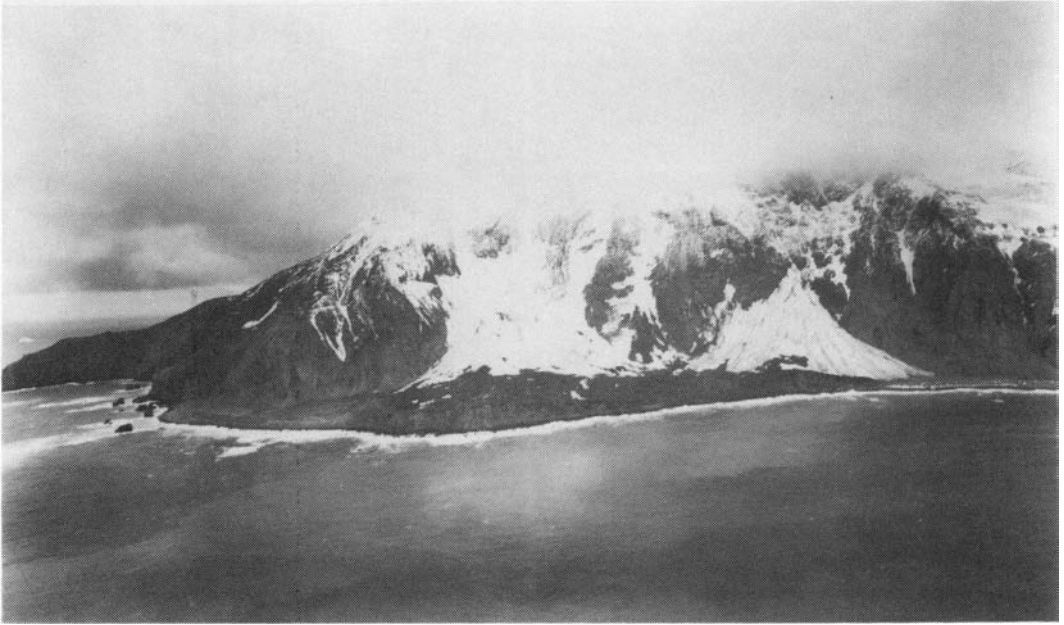


Fig. 2. Oblique air photograph of the northwest coast of Bouvetøya, showing the platform of Nyrøysa and surroundings, Kapp Circoncision to the left. Norsk Polarinstitutt 1 Jan 1979.

camp, but it is being rapidly eroded by wave action. It consists of scoria and some very large lava boulders from an enormous landslide which took place between 1955 and 1958, possibly in connection with seismic or volcanic activity.

It first received the unofficial name «Westwind Beach», but we now use the name Nyrøysa for the entire structure, and the informal names Nordstranda and Sørstranda for the lower shores to the north and south of the main platform, denoted N and S, respectively, on the survey map (Fig. 1). Fig. 2 is a survey photo of this north-western corner of Bouvetøya.

Nordstranda has a large penguin and seal colony, which interacts in a complex way with the sparse vegetation which is establishing on Nyrøysa. Less numerous seal colonies occur on Sørstranda. Outside this area, the cliffs and shore stacks and adjacent plateaux support a more stable vegetation which was certainly present before the great avalanche leading to the formation of Nyrøysa. Such areas, with bryophyte hummocks, were sighted on the crest north of Aagaardbreen (and visited by helicopter in 1985), on Norvegiaodden, and facing the islet of Larsøya on the southwest coast.

However, the majority of liverworts, moss and lichen species was found on the high ground on the south coast of Bouvetøya, especially on the ice-free summit plateau of Rustadkollen (Fig. 3A) reaching 340 m above sea level, and the nunatak ridge of Moseryggen (Fig. 3B), 287 m above seal level.

The causes of differing vegetation and flora are discussed by Engelskjøn & Jørgensen (1986) in this volume, and will be substantiated by the present author in a contribution on temperature conditions, edaphic variation, and plant communities on Bouvetøya (Engelskjøn 1986b).

It should be kept in mind, however, that most ice-free areas on the island are so steep and exposed to avalanches that only crustose lichen and algal formations have become established (Engelskjøn 1981).

The field work

A list of the sites visited, with dates, is presented in Table 1. A short flight to Rustadkollen and the western coast plateaux on 28 February 1985, which provided interesting supplementary observations, is not recorded.

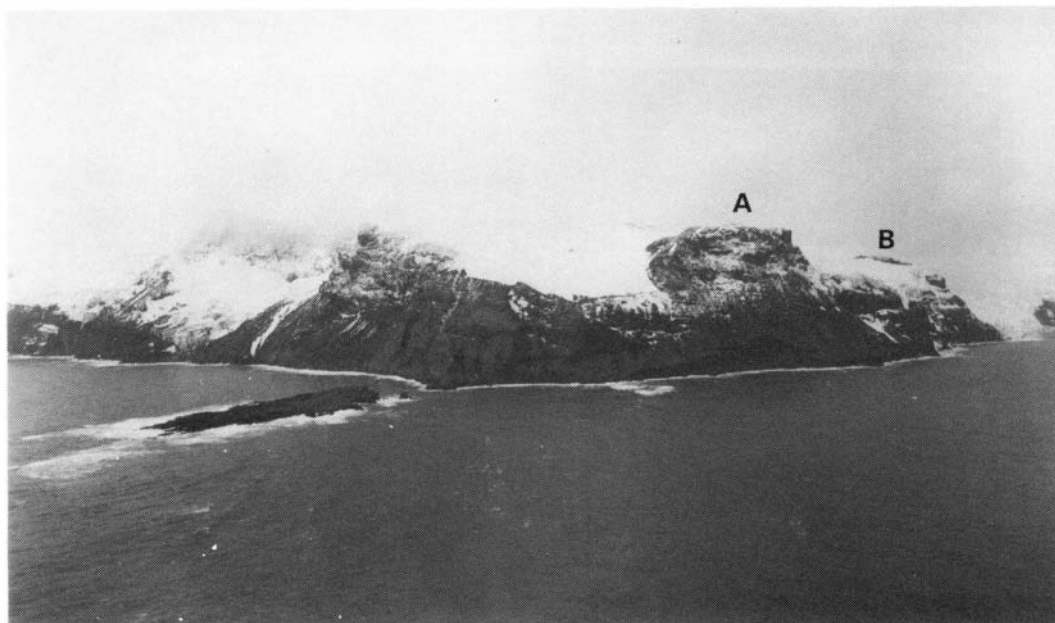


Fig. 3. Oblique air photograph of the SW corner of Bouvetøya. A. The ice-free area of Rustadkollen (340 m a.s.l.). B. The nunatak of Moseryggen (287 m a.s.l.). In the left foreground, the little island Larsøya. Norsk Polarinstitutt 27 Dec 1978.

Table 1. Localities visited for botanical collecting on Bouvetøya

	Altitude (m a.s.l.)	Dates of visit
<i>1. By T. Engelskjøn:</i>		
N coast:		
Kapp Valdivia	60—90	30 Dec 1978
Kapp Circoncision	5—10	23 Jan 1979
W coast:		
At hill 177 m a.s.l. N of Nyrøysa	160—200	29 Dec 1978
Nyrøysa, northern part	0—51	27 Dec 1978; 12, 13, 17, 20 Jan, 3, 8, 9, 12, 25 Feb, 3, 6 Mar 1979.
Nyrøysa, middle and southern part	0—35	28 Dec 1978; 11, 13, 14, 15, 16, 17, 19, 24, 28, 30, 31 Jan, 7, 10, 22 Feb, 5 Mar 1979.
S coast:		
Rustadkollen	300—340	23 Jan, 7 Mar 1979
Moseryggen	260—287	31 Dec 1978; 1 Jan 1979
Nyknausen	95—99	23 Jan 1979
<i>2. By previous or other collectors:</i>		
Nyrøysa		Holdgate 1964; Schoeman & Muller 1966; L. Somme 1977; B. Enoksen 1978.
Larsøya		T. Prestvik 1979.
High ground inside Larsøya		T. Prestvik 1979.
Moseryggen		B. Enoksen 1978; K. Bjørklund 1979.

The collections were dried and labelled according to usual procedures, and certain specimens were also preserved in fixation fluids.

The sample material was distributed to various specialist groups. During the course of the determination work it became evident that several collections contained surprisingly many species, e.g. of microlichens and liverworts accompanying the more conspicuous objects. Such samples have been kept together as far as is practical. In this way, the Index to the plant collections (Engelskjøn, 1986a) shows the usual combinations of species or micro-synusia often occurring in a single turf or on a stone slab.

The specimens will be distributed to various herbaria in due course as shown in the Index of plant collections from Bouvetøya.

Only a few plant collections had been made on Bouvetøya prior to the visits of the present author in 1978/79 and 1985, cf. Holdgate et al. (1968). These collections are especially mentioned in the contribution on bryophytes.

Acknowledgements

I should like to thank my companions on Bouvetøya, especially the men staying with me for 70 days — Øivind Grothe, Niels S. Nergaard, John Snuggerud, and Torgny Vinje — the latter in charge of the meteorological programme on Bouvetøya during the austral summer 1978/79. The Norwegian Polar Research Institute, which organized the NARE 1978/79 and 1984/85, is thanked for logistic and other practical support. The

assistance of my fellow contributors from Norway and Great Britain is greatly appreciated. Mr. Christopher Ennals assisted with linguistic advice. Dr. R. I. Lewis Smith, British Antarctic Survey, Cambridge, provided important information and advice when finally reviewing the manuscripts.

The Norwegian Research Council for Science and the Humanities financed part of the present study by grants D.70.49.049 and 085.

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Bryophytes of Bouvetøya*

Bell, B. G. & Blom, H. H. 1986: Bryophytes of Bouvetøya. *Norsk Polarinstitutt Skrifter* 185: 11–22.

The first major collection of bryophytes from Bouvetøya is described. Two hundred specimens of hepatics and mosses have been examined and are referred to taxa using currently available nomenclature and descriptions. Of the three hepatic and eleven moss genera reported, four, *Andreaea*, *Bryum*, *Dicranoweisia* and *Schistidium*, include several taxa found to be extremely difficult to determine. These and other species-related problems requiring detailed taxonomic revision in Antarctic regions are identified.

Taxonomic notes are provided where the Bouvetøya material differs from the appropriate published description. Notes on habitats and associated plant assemblages are provided for each taxon together with lists of specimens examined.

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Little of Antarctica and few of its off-shore islands have been extensively studied by biologists, but small, though often unrepresentative, botanical collections have been made from these regions. Collections of bryophytes are also lacking from some areas that have been visited by biologists. Hence, a fully comprehensive account of the bryoflora of Antarctic regions is not yet possible. However, as more regions are visited and check lists and synoptic floras published, the prospect of a definitive Antarctic Bryophyte Flora approaches.

The bryophytes of Bouvetøya have not previously been studied in detail, because no comprehensive collections have been made and, as a result, only scattered references to certain species are available, e.g. Holdgate et al. (1968) and van Zanten (1971).

During 1978/79 Engelskjøn made a collection of about 200 bryophyte specimens on the island. These specimens form the basis of the following account, which is designed to aid in the recognition of species by biologists visiting the island and to indicate to taxonomists that a good specimen base is now available for consultation in any wider consideration of bryophytes of Antarctic regions.

Having examined all of the available specimens, reference was made to the most recent relevant floras or taxonomic revisions to ascertain whether the discernible Bouvetøya taxa

could be readily referred to well-documented species. In some cases this was possible, in others, although the material could safely be referred to a particular genus, reference to species could not be made, due to problems of morphological variation or where no appropriate species description could be traced. A few specimens could not be referred with certainty even to genus.

It was clear that as further considerable time and effort would be necessary to answer some of the problems, which could delay the publication of a consideration of Engelskjøn's material, we should provide our judgement on all taxa collected from Bouvetøya whether or not we could provide a name. Thus by presenting notes and enumerating the specimens examined, the main purposes of the study are fulfilled. Hence, although the treatment of the taxa is inconsistent, the basis of each taxonomic decision is explained in the notes associated with each discernible group.

The genera and species are considered in alphabetical order. The reference number system is based on the Index to plant collections from Bouvetøya during the Norwegian Antarctic Research Expeditions 1978/79 and 1984/85 with quotations of determination results, location on the island, ecological notes, and distribution in herbaria dealing with Antarctic botanical research (Engelskjøn 1986). Divided collections are denoted e.g. as 049. 1-*n*, consisting of *n* parts which in several cases had different species content.

* Publication No. 64 of the Norwegian Antarctic Research Expeditions 1976/77 and 1978/79.

HEPATICOPHYTINA

Cephaloziella exiliflora (Tayl.) Steph.

This is a common species which agrees in all essential respects with that described by Fulford (1976). The Bouvetøya material is, however, much less variable and differs from Fulford's description in having vegetative leaves which have a smooth cuticle and thin-walled or slightly incrassate cells.

This species is easily recognised in the field by the glossy, dark purple tufts or mats.

Habitats: Moist turf and peaty ground on Rustadkollen (400) and Moseryggen (049.1, 4, 069.1, 100, 101, 102, 200, 210, 265, 268, 270, 306.1, 389, 391.2, 395.1, 399, 405), 280–325 m above sea level. It frequently occurs among stems of *Dicranoweisia grimmiacea* in the lowermost layer of the *Andreaea* — *Usnea* association as described by Engelskjøn (1981).

Herzogobryum atrocapillum (Hook. f. & Tayl.) Grolle

All important characters are in accord with the description given by Grolle (1966).

Habitats: On wet, peaty soils covering basaltic gravel on Moseryggen (044; 049.1, 3, 102; 103.2, 211, 308, 310, 391.1, 396, 398, 399, 404) and Rustadkollen (032.4, 5, 250, 329.1, 2), 270–340 m above sea level. Frequently creeping over crustose lichens, particularly *Pannaria hookeri* and *Psoroma hypnorum*, or on necrotic *Dicranoweisia* cushions.

Herzogobryum teres (Carringt. & Pears.) Grolle

Only scant material consisting of a few, scattered stems has been examined. However, the entire, strongly concave vegetative leaves with a very fragile hyaline border are characteristic of the species as described by Grolle (1966).

Habitats: In depressions kept wet by melt-water on Moseryggen, (213, 291, 396), 260–280 m above sea level. The species occurs in the *Andreaea* — *Stereocaulon* — *Usnea* community creep-

ing among *Pachyglossa dissitifolia* and *Herzogobryum atrocapillum*.

Pachyglossa dissitifolia Herzog & Grolle

This is a common plant in the south coast high ground vegetation which agrees fully with the description provided by Herzog & Grolle (1958). Although the taxon is not very variable on Bouvetøya, a form with widely-spaced, more regular bi-lobed leaves occurs at the edge of typical mats of the species and as scattered stems in tall moss cushions.

Habitats: Moss turves and in depressions influenced by melt-water, amongst *Andreaea* — *Usnea* communities and the *Drepanocladus uncinatus* — *Brachythecium austro-salebrosum* — *Pachyglossa dissitifolia* community (Engelskjøn 1981). Common from 270 to 340 m above sea level on the plateaux of Rustadkollen (224, 227, 234, 239, 240, 241, 244, 245, 249, 250, 253, 254, 377, 411) and Moseryggen (048.3, 100, 102, 103.1, 2, 3, 104, 213, 265, 306.2, 3, 4, 309, 310, 391.1, 394.2, 396, 402, 404, 405).

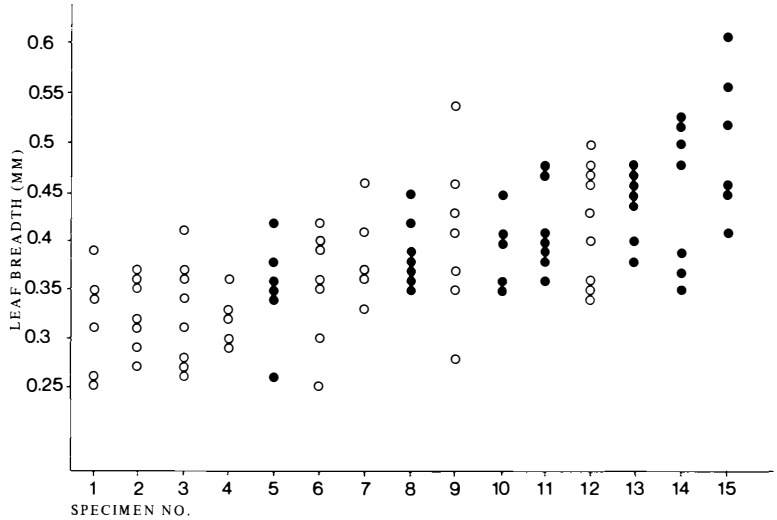
BRYOPHYTINA

Andreaea gainii Card.

This is a common and conspicuous species on the high ground of Bouvetøya. The specimens agree in all essential respects with the description provided by Greene et al. (1970) but are larger, forming turves and cushions (0.5-) 2.5–6.5 (-8) cm tall. Usually sterile.

In reducing *Andreaea parallela* to synonymy with *A. gainii*, Greene (1968) broadened the concept of the latter while retaining the identity of the former in creating the var. *parallela*. This variety is distinguished by its narrow leaves and the different shape of the leaf apex (Greene et al. 1970). Some Bouvetøya specimens approach the var. *parallela* but the material is extremely variable, particularly in the leaf breadth which varies within, as well as between, specimens. Fig. 1 shows the result of measuring the breadth of a number of leaves from each of 15 specimens of *A. gainii* provisionally assigned to either var. *parallela* or var. *gainii* on the basis of the leaf shape

Fig. 1. Variation of leaf breadth of 15 specimens with leaf shape predominantly approaching *Andreaea gainii* var. *parallela* (○), and *A. gainii* var. *gainii* (●). Abscissa: specimen number.



and the nature of the leaf apex. The former is said to have «leaves oblong below, ventricose above insertion, apex typically abruptly and longly apiculate to \pm acuminate» and the latter «widest at or above mid-leaf, moderately concave above, apex typically acute to shortly and broadly apiculate», although these, too, are extremely variable characters. Fig. 1 indicates that there is almost continuous and partly overlapping variation from specimens with leaf shape approaching the var. *parallela* type to those with predominantly var. *gainii* — type leaves. The Bouvetøya material also includes specimens which agree with Greene's (1968) statement that «a small number of leaves typical of the var. *gainii* are usually found on stems of the var. *parallela* . . .» We therefore consider it unwise to report the var. *parallela* from Bouvetøya but to refer all specimens to *A. gainii*. This situation indicates the necessity for a more detailed examination of the taxon in the Antarctic which should not be confined to a consideration from Bouvetøya alone.

Habitats: A dominant on peaty slopes and moist turf in *Andreaea* — *Usnea* communities (Engelskjøn 1981), from 260 to 380 m above sea level. Also occurring on basaltic boulders. Common and widespread on Rustadkollen (032.5, 202, 222, 227, 229, 245, 249, 255, 262, 320.3, 392, 400, 408.3, 411), and Moseryggen (042.2, 3, 044, 048.1,

2, 3, 049.1, 2, 3, 4, 057.2, 102, 103.2, 106, 268, 310, 391.2, 393).

Andreaea regularis C. Muell.

The Bouvetøya plants agree in all important respects with the description provided by Greene et al. (1970). However, most of the specimens are abundantly fertile.

Habitats: Growing on boulders and rock outcrops from 270 to 287 m above sea level on the elevated ridge of Moseryggen, usually in more dry and exposed sites than the preceding species (051, 106, 278, 279, 316, 319, 340.2, 394.2, 396).

Brachythecium austro-salebrosum (C. Muell.) Kindb.

This is a very common and ecologically important species in several parts of Bouvetøya. While agreeing in most respects with the description provided by Newton (1979) for South Georgian material the Bouvetøya specimens are extremely variable, but always sterile.

Several habitat modifications occur and extreme forms fall outside the range of variation noted by Newton (1979). Two of these are conspicuous and clearly differ from the common and widespread form. One forms large, glossy mats with prostrate or pendent stems up to 25 cm long on the sides of steam vents and in moist holes in

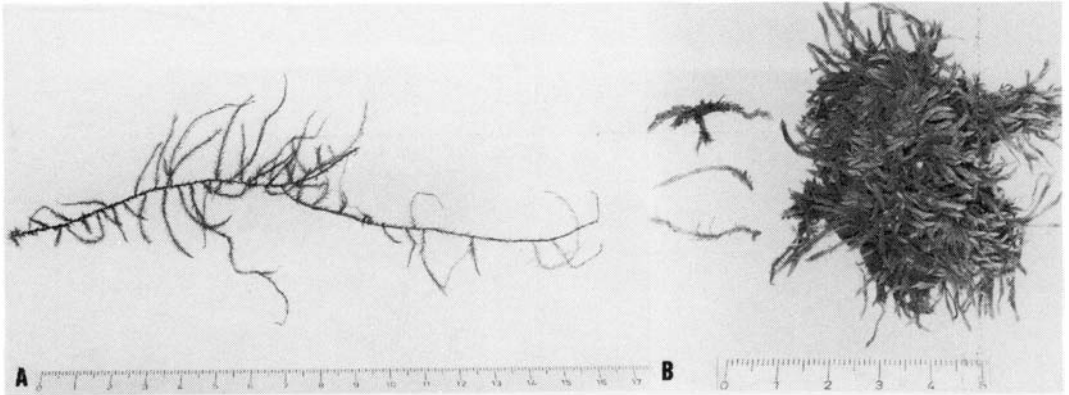


Fig. 2. Habitat modifications in *Brachythecium austro-salebrosum*. A. Specimen from fumarole area (313). B. Specimen from peaty soil (259).

the fumarole area (e.g. collections 276 and 313, see Fig. 2A). The leaves are widely spaced, plane or slightly concave, lanceolate to triangular, with long narrow cells $90\text{--}130\text{--}150 \times 6\text{--}7\ \mu\text{m}$. The second form (e.g. collection 259, see Fig. 2B) grows on wet, peaty soil and is characterized by having robust cushions with erect julaceous shoots. The ovate-lanceolate leaves abruptly contract to a fine point and orange alar cells form small auricles in most leaves. The leaf cells are short and wide ($55\text{--}60\text{--}70 \times 10\text{--}12\text{--}14\ \mu\text{m}$). This form is similar to *B. subplicatum* (Hamp.) Jaeg. but the non-decurrent auricles composed of small alar cells contrast with the decurrent auricles of inflated cells in that species.

Habitats: *B. austro-salebrosum* is an ubiquitous species on Bouvetøya (Engelskjøn 1981). It is dominating in many habitats including lava boulder pioneer communities from 2 to 30 m; moss hummock communities on gravelly slopes, and the *Drepanocladus uncinatus* — *Brachythecium* — *Pachyglossa dissitifolia* community on peaty soil in depressions on the South coast high ground, from 270 to 350 m above sea level. It was also observed forming extensive carpets on some inaccessible slopes on the West coast, e.g. above Kapp Circoncision; on mountain crests surrounding Aagaardbreen, and inside Larsøya. Specimens were examined from: mountain ridge 177 m a.s.l., north of Nordstranda (054.1, 2, 066.2); Nordstranda N of Nyrøysa (068); Nyrøysa (064, 065, 214, 276, 312, 313, 346.1, 2, 3, 353,

355, 358, 372, Holdgate 863a, 865, 866, 867 (all in BIRM)); precipices N of Aagaardbreen (369, 370, 371); Rustadkollen (228, 259); and Mose-ryggen (069.1, 2, 251, 307).

Bryum

Bryum cf. *algens* was mentioned by Engelskjøn (1981) from Bouvetøya, but there seems to be several taxa present. Specimens of the genus *Bryum* are often among the most difficult to identify to species. This is partly due to the frequent absence of sporophytes, features of which are often critical, and to the wide range of variation expressed by the vegetative leaves. It is, therefore, not surprising that the usually sterile, highly variable, Antarctic specimens of *Bryum* prove particularly difficult to name. The long list of species described from Antarctica indicates that taxonomists have tended to create more taxa rather than tackle underlying problems of variation. Clearly a thorough revision of *Bryum* in the Antarctic is long overdue, but it was beyond the scope of this paper to undertake such a revision. However, as the genus is well represented on Bouvetøya, as evidenced by Engelskjøn's collections, we sought the most appropriate way of providing information on the specimens which would be useful to whoever undertakes a generic revision. It was decided to group the specimens into six taxa and tabulate the characters associated with each. Table 1 provides information on each of 46 characters, the majority associated with vegetative leaves.

Table 1. Presence or absence of characters in the six taxa of *Bryum* from *Bouvetøya* together with measurements of shoot and vegetative leaf size based on examination of all specimens in each taxon (10 leaves from each specimen were measured).

Taxon no.	1	2	3	4	5	6
Number of specimens	2	3	6	8	3	9
Shoot height (cm)	0.2–0.4	0.3–0.5	1–2.5	1–4	3–6	0.5–4
Shoots with tomentum	0	0	0	x	x	x
Leaf size (mm)	(0.5–)0.6–0.8 × 0.4–0.5(–0.7)	0.8–0.9 × 0.6–0.8	0.8–1.2 × 0.4–0.7	0.8–1.4 × 0.4–0.7	(0.6–)0.9–1.2 ×(0.5–)0.7–0.9	(1.7–)2.1–3.7 × (0.5–)0.6–1.2
Sporophyte present	0	0	0	0	0	x
Gemmae						
axillary (bulbils with leaf primordia)	x	0	x	0	0	0
rhizoidal (spherical to ovoid)	0	0	0	x	0	0
Leaf shape						
ovate	x	0	0	0	0	0
broad ovate	0	x	0	0	0	0
broad ovate-oblong	0	0	0	0	x	0
short ovate-lanceolate	x	0	x	x	0	0
long ovate-lanceolate	0	0	0	0	0	x
lingulate to spathulate	0	0	0	0	x	0
strongly concave	x	x	0	0	0	0
plicate	0	0	x	0	x	0
Leaf arrangement						
imbricate	x	x	0	0	x	0
distant	0	0	x	0	0	0
comal tuft	0	0	0	x	0	x
Leaf apex						
rounded	0	x	0	0	0	0
obtuse	x	0	0	0	x	0
obtuse and apiculate	0	x	0	0	x	0
acute	x	0	x	x	0	x
subulate	0	0	x	0	0	x
Leaf nerve in bracts:						
excurrent	0	0	x	x	x	x
percurrent	x	x	0	0	x	0
ending below apex	x	0	0	0	0	0

Table 1, continued

Taxon no.	1	2	3	4	5	6
in vegetative						
leaves:						
excurrent	0	0	x	0	0	x
percurrent	x	x	x	x	x	0
ending below apex	x	x	x	0	x	0
Leaf margin						
in bracts:						
strongly revolute	0	0	0	0	x	0
in vegetative						
leaves:						
plane	x	x	x	x	0	x
recurved	0	0	x	x	x	x
denticulate						
towards apex	0	0	x	0	0	0
distinct border	0	0	0	0	0	x
Leaf cells						
Basal:						
rectangular	x	0	0	x	0	x
quadrate-short						
rectangular	0	x	x	x	x	0
irregular						
hexagonal-						
rectangular	x	x	0	0	0	x
lax	x	x	x	x	x	0
red pigmented	0	0	0	x	x	0
Upper median:						
rhomboidal	x	x	0	0	x	0
short irregular						
rhomboidal-						
hexagonal	x	x	0	x	x	0
long irregular						
rhomboidal-						
hexagonal	0	0	x	0	0	x
vermicular	0	0	0	0	0	x
lax	0	x	0	x	0	0
incrassate	0	0	x	0	x	0
collen-						
chymatous	0	0	0	0	x	0
pitted	0	0	0	0	x	0
cells in						
divergent rows	0	x	0	0	x	0

As many of the specimens of *Bryum* were collected near fumaroles, habitat modifications were common and frequently difficult to interpret. These have been excluded from consideration in the six groups but their collection numbers are provided in the list of specimens examined.

Taxon 1.

Habitats: On cryoturbated gravel and in wet rock crevices, 30 m above sea level.

Specimens examined: Nyrøysa: 070, 287.

Taxon 2.

Habitats: Growing on black tuff in a fumarole area.

Specimens examined: Nyrøysa: 349.1, 349.2, 349.4.

Taxon 3.

Habitats: On boulders and coarse lava gravel, 10–25 m above sea level.

Specimens examined: Nyrøysa: 027.1, 027.2, 072, 263, 292, «22.2.79».

Taxon 4.

Habitats: On tuff, gravel and in rock crevices.

Specimens examined: Nyrøysa: 071, 095.1, 095.2, 236, 300, 345, 349.3, 351.

Taxon 5.

Habitats: Growing at the side of a steam vent.

Specimens examined: Nyrøysa: 314, 323, 365.

Taxon 6.

Habitats: Beside steam vents and in crevices. Usually fertile.

Specimens examined: Nyrøysa: 090, 093.1, 272, 274, 275, 277, 314, 347, 357.

Other Bryum specimens examined: These grow in various habitats on and around Nyrøysa, up to about 100–180 m above sea level: 203, 204, 207, 209, 321, 346.3, 348, 350, 352, 368.

Ceratodon validus (Card.) Horikawa & Ando

The scant Bouvetøya material consists of two well developed specimens with robust stems and large vegetative leaves possessing a strong nerve and revolute margins throughout. The material is referred to *C. validus*, a taxon described by Cardot (1906b, as *C. grossiretis* var. *validus*) and elevated to the rank of species by Horikawa & Ando (1963). The leaves of the Bouvetøya plants are, however, slightly shorter (1.7–2.1 mm) than those described by Horikawa & Ando (1963) (1.8–2.4 mm) and the nerve not so regularly excurrent.

Habitats: Growing on sandy soil near steam vents at the centre of the Nyrøysa fumarole area, admixed with *Bryum* spp. and *Tortula filaris* (097, 314).

? *Ceratodon* sp.

A further taxon, represented by nine specimens from Bouvetøya, has some features, i.e. habit and leaf areolation, which suggest its inclusion in the genus *Ceratodon*. However, as this extremely variable material is depauperate and sterile, it is not clear whether *Ceratodon* is the most appropriate designation. Engelskjøn (1981) denoted it *Bryum* cf. *algens*, and found it to be an important constituent of the barren rhyolite sand vegetation on Kapp Valdivia. The material is described as follows:

Stems form compact, reddish-green tufts up to 8 mm high, frequently branched, fastigiate, the leaves loosely imbricate, erect when dry, erectopatent when wet. Leaves 0.6–0.9 × 0.3–0.4 mm on some stems, on others 1.4–1.9 × 0.6–0.8 mm; concave, ovate-lanceolate to oblong-lanceolate on small-leaved stems; on stems with large leaves, ovate-lanceolate to lingulate, tapering to a narrow, reddish or hyaline point. Margin plane or slightly incurved, entire or irregularly denticulate towards apex. Nerve narrow, shortly excurrent, percurrent or ceasing below apex. Cells

above 20–28 (–30) μm wide, quadrate to irregularly hexagonal, thin-walled, below rectangular, lax. Sporophyte absent.

Habitats: Growing on wind-swept sandy ground among rhyolite slabs on the promontory of Kapp Valdivia, 60–80 m above sea level (280, 281, 282.1, 2, 283.1, 2, 289, 304).

Dicranella cf. hookeri (C. Muell.) Card.

The Bouvetøya material consists of one depauperate specimen. Although smaller in all respects it agrees in several important leaf characters with the description of the well-known *D. hookeri* provided by Newton (1977) for South Georgian material.

However, the restricted material available from Bouvetøya precludes a definite determination, hence its referral to *D. cf. hookeri*.

Habitat: Collected in shade at the side of a steam vent on Nyrøysa, ca. 15 m above sea level, admixed with *Bryum* sp. (322).

Dicranoweisia

Antarctic and sub-Antarctic species of this genus are ill-defined and in need of revision. However, on Bouvetøya there are two clearly distinct taxa which can be referred to *D. grimmiacea* (C. Muell.) Broth. and *D. cf. antarctica* (C. Muell.) Kindb.

Dicranoweisia cf. antarctica (C. Muell.) Kindb.

Some character differences in the Bouvetøya specimens preclude direct referral of them to the well defined *D. antarctica* (Sainsbury 1955; Bell 1976), in particular the lack of clearly falcate vegetative leaves. Sporophytes were seen on several cushions.

It is clear that further study of this taxon must include a consideration of *Dicranoweisia brevisepta* Card., an ill-defined species reported from several Antarctic and sub-Antarctic localities (Cardot 1905; van Zanten 1971).

Habitats: A frequent species growing on moist, peaty ground chiefly in *Andreaea* – *Usnea* communities 270–340 m above sea level. Also col-

lected from the new ground on Nyrøysa at 30–40 m above sea level. Specimens were examined from Nyrøysa (361, 368, Holdgate 864 c), Rustadkollen (224, 234, 403.2, 3), and Mose-ryggen (023.1, 101, 102, 106, 268, 319, 391.1, 398).

Dicranoweisia grimmiacea (C. Muell.) Broth.

The specimens of this common species agree in all essential respects with the short description provided by Bell (1976) for material from Signy I., South Orkney Is. However, no sporophytes have been observed on Bouvetøya and the vegetative leaves differ from those of Signy Island material in possessing a narrower basal portion.

Habitats: A constituent of high ground climax communities of the S coast (Engelskjøn 1981), growing on moist, peaty soils and rock detritus between 270 and 340 m above sea level. Also found as a recent invader on the new ground of Nyrøysa at 25 m, but very restricted. Specimens were examined from Nyrøysa (033.1, 2), Rustadkollen (243, 258, 375, 400, 408.1, 2, 3), and Mose-ryggen (052.1, 118, 200, 201, 210, 265, 311, 316, 389, 391.2, 395.1, 402).

Drepanocladus uncinatus (Hedw.) Warnst.

This is a common species, locally of great ecological importance on the island. The Bouvetøya material is similar to that reported elsewhere from the Antarctic in having less denticulate leaves than populations in the Northern Hemisphere and only faint longitudinal plicae (Robinson 1972). In all other respects it agrees with the description provided by Smith (1978) for British material.

The growth form and morphology is extremely variable, from loose mats to turf-like carpets, but two clearly identifiable variants occur. One forms bright green mats on rhyolite sand alongside streams and possesses strongly curved leaves and short, wide leaf cells (026). The second form occurs within other tall moss turves as short stems with almost straight leaves (e.g. 223). All specimens were sterile.

Habitats: A dominant species on moist lithosol, basalt detritus and on boulders, as well as in depressions in the high ground climax vegetation

(Engelskjøn 1981), up to 340 m above sea level. Also occurring on sandy soil in ravines on Kapp Valdivia, 90 m above sea level, and in depressions and among boulders on the low ground of Nyrøysa at 20 to 35 m, associated with *Tortula filaris* and *Brachythecium austro-salebrosum*. Specimens were examined from Kapp Valdivia (026.1, 2, 284, 302, 304), Nyrøysa (206, 295, 366.1, 2, 367), Rustadkollen (031.1, 2, 034.1, 2, 041.1, 2, 114, 202, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231.1, 233, 234, 237, 238, 239, 243, 245, 247, 248, 249, 250, 253, 254, 255, 256, 257, 260, 261, 262, 356, 377, 392, 401.1, 2, 3, 406, 408.3, 411), and Moseryggen (042.2, 047.1, 2, 3, 048.1, 2, 3, 049.2, 050, 069.1, 2, 100, 101, 102, 103.1, 3, 106, 200, 213, 265, 270, 279, 291, 306.1, 2, 3, 4, 5, 307, 309, 310, 311, 316, 344, 360, 394.2, 395.1, 396, 399, 402, 404, 405, 410).

Pohlia nutans (Hedw.) Lindb.

The depauperate, sterile specimens from Bouvetøya agree in all essential respects with the Antarctic material described by Greene et al. (1970). However, they occur as loose rather than compact turves as well as scattered stems in other mosses. When dry, the leaf apices are twisted 180° on most stems.

Habitats: Associated with *Polytrichum alpinum* and *Stereocaulon glabrum* on moist basaltic lithosol in climax *Usnea* vegetation and within the *Drepanocladus* — *Brachythecium* — *Pachyglossa* community on Moseryggen, from 270 to 285 m above sea level (201, 213, 310, 344, 402).

Polytrichum alpinum Hedw.

The Bouvetøya specimens, although sterile, agree well with the descriptions provided by Greene et al. (1970) and Greene (1973), for material from the Antarctic and South Georgia, respectively.

Habitats: Peat banks and turf knolls within the *Andreaea* — *Usnea* and *Drepanocladus* — *Brachythecium* — *Pachyglossa* communities on the S coast high ground, 270 to 340 m above sea level. Fairly common on Rustadkollen (226, 244, 406) and Moseryggen (270, 306.1, 2, 3, 4, 5, 309, 310, 405).

Schistidium

Many Antarctic specimens of this genus are extremely difficult to determine and there is need for detailed revision to include material from both Antarctic and sub-Antarctic areas. Although it might have been expected that the small size of Bouvetøya would restrict the range of variation expressed by species of *Schistidium*, the material examined reflects the situation found elsewhere in the Antarctic botanical zone. In this context it is considered unwise to conclude, as Bremer (1980, 1981) has done, that many taxa should be considered part of a single extremely variable species i.e. *S. apocarpum*. The Bouvetøya material is therefore retained in one of four taxa, cf. also Bell (1984).

Schistidium cf. *antarcticum* (Card.) L.
Savicz & Z. Smirn.

This conspicuous but restricted species on Bouvetøya forms cushions up to 7.5 cm high. The material agrees in most essential respects with the description provided by Cardot (1906 b) and Robinson (1972).

Although *S. antarcticum* is easily distinguished from *S. apocarpum* in possessing smaller, narrowly oblong to ovate-lanceolate, vegetative leaves ((1.0—) 1.2—1.4 × (0.2—) 0.3—0.4 (—0.5) mm) generally with a short hyaline tip, the leaf characters are similar to those of *S. syntrichiaceum*. However, these two species are very different in habit and should not be confused. Both Cardot (1906 b) and Robinson (1972) mention that the distinct spiral arrangement of the leaves is characteristic of *S. antarcticum*. However, Bremer (1980) stated that this character is unique to *S. streptophyllum* (Sull.) Herz., a little known South American species. On Bouvetøya this feature has no discriminative value as it occurs, more or less pronounced, in all species of *Schistidium*.

Habitats: It is local and rare, growing on wet moss-peat in a limited area about 320 m above sea level on Rustadkollen (031.1, 2, 041.1, 2, 114, 400) where it is associated with *Andreaea gainii*, *Cephaloziella exiliflora*, *Drepanocladus uncinatus* and *Schistidium apocarpum* (tall tuft growth form).

Schistidium apocarpum (Hedw.) B. S. G.

A study of the variability in this species clearly forms the basis for a thorough understanding of the genus in the Antarctic. *Bouvetøya* specimens referred to *S. apocarpum* differ from populations in the Northern Hemisphere (cf. Smith 1978) in possessing widely ovate to ovate-lanceolate vegetative leaves ((1.2—) 1.3—1.6 × (0.5—) 0.6—0.7 mm) without hairpoints, but agree with those descriptions applied to material from the Southern Hemisphere by Robinson (1972) and Bell (1984). Leaf cell sinuosity is, however, more pronounced than that found in South Georgian material (Bell 1984).

Two apparently substrate-specific growth forms occur on *Bouvetøya*. On exposed lava rocks it forms small, dense cushions while in moist moss turves it forms tall, brown tufts resembling robust specimens of *Andreaea gainii*.

Habitats: A frequent and often fertile species of dry lava boulders on Nyrøysa, 15 m to 30 m above sea level (025, 062.1, 110, 111, 271, 296, 297, 364, Holdgate 868 b). It also occurs in high ground *Andreaea gainii* — *Polytrichum alpinum* — *Usnea* communities on Rustadkollen, 320 m to 340 m above sea level (041.1, 2, 225, 238, 260, 401.1, 2, 3), and on Moseryggen, 280 m above sea level (058.2).

Schistidium cf. celatum (Card.) B. G. Bell

The *Bouvetøya* specimens agree in most essential respects with the description by Cardot (1906 a) and Bell (1984) for South Georgian material. The basal leaf cells, however, are never lax as in South Georgian plants, which precludes direct referral of *Bouvetøya* specimens to *S. celatum*.

S. celatum is separated from the related *S. apocarpum* by the narrower lanceolate vegetative leaves with longer basal cells merging into strongly sinuous cells above. The leaves of *Bouvetøya* specimens are distinctly falcate when dry, a character which is not present in other *Schistidium* species on the island.

Habitats: An uncommon species growing on dry lava boulders on Nyrøysa, about 30 m above sea level (038, 062.2, 063, 113, 363, Holdgate 864 b).

Schistidium syntrichiaceum (C. Muell.)

B. G. Bell

The scant *Bouvetøya* material agrees in all essential respects with the description provided by Bell (1984) for South Georgian material. *S. syntrichiaceum* is readily identifiable in the field by its small reddish cushions and large imbricate perichaetal leaves.

This species is distinguished from *S. apocarpum* by the small ovate-lanceolate vegetative leaves frequently with short, distinct hairpoints. The regular cell structure composed of very thick-walled and scarcely sinuous cells will confirm *S. syntrichiaceum* under the microscope.

Habitats: Collected from boulders and cliffs on Nyrøysa, about 25 m above sea level (293, Holdgate 868 c).

Tortula filaris (C. Muell.) Broth.

Specimens of *T. filaris*, a common species on *Bouvetøya*, agree in all essential respects with the description provided for South Georgian specimens by Lightowers (1985). Some of the specimens, however, have much wider and more dentate leaves than South Georgian plants. All are sterile.

T. filaris is distinguished from other far southern *Tortula* species by the dentate vegetative leaves tapering from above mid-leaf and the characteristic cell structure of the leaf apex (Fig. 3). It is variable on *Bouvetøya* with regard to leaf size ((1.5—) 2.2—3.5 (—4.0) × (0.5—) 0.7—1.2 mm) and shape. In most specimens the leaves are broad (0.9—1.2 mm) and shortly tapering, while in others the leaves are narrow (0.5—0.8 mm), channelled above and tapering to a long point. However, as these forms are linked by intermediates, it is considered unwise to make a nomenclatural distinction.

Habitats: The species occurs in a wide range of habitats including moss hummock communities on gravel and lithosol usually derived from tuff and calcareous breccia. It is an important constituent of the *Brachythecium* — *Tortula* community on Nyrøysa and surrounding hillsides, especially the ridge 177 m above sea level (011, 027.2, 054.1, 2, 066.1, 2, 067, 073.1, 2, 074.1, 2, 075, 076,

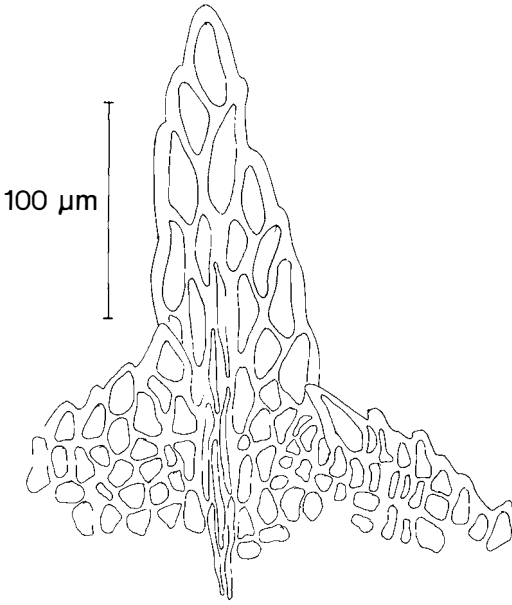


Fig. 3. Leaf apex of *Tortula filaris* (096).

093.2, 096.1, 2, 3, 097, 098, 112, 205, 207, 235, 242, 347, 373, Holdgate 863 b, 867 a, 868 c, Schoeman and Müller 25 (as *T. rubra*). Although also seen in the South coast high ground on Rustadkollen, above 300 m (240, 246, 252), *T. filaris* is much more common and better developed on the west coast (cf. Engelskjøn 1981).

Tortula princeps De Not. var. *conferta* (Bartr.) Lightowlers

T. conferta is an ill-defined species occupying doubtful taxonomic status (Robinson 1972). All *Tortula* specimens from Bouvetøya with short leaf hairpoints and a nerve apparently disappearing just below the apex may be referred to this taxon, following the nomenclature of Lightowlers (1985).

Habitats: An infrequent species of exposed, rather dry lava boulders and cliffs on Nyrøysa, 20 m to 30 m above sea level (006.2, 061, 084, 093.1, 2, 266, 362, 382.1, 385, 388).

Tortula princeps De Not. var. *princeps*.

The Bouvetøya material agrees with Cardot's (1906a) type description of *T. grossiretis*, a South Georgian species subsequently reduced to

synonymy with *T. princeps* var. *princeps* by Lightowlers (1985), although the length of the leaf hairpoint is more variable.

Habitats: This is a rare taxon generally growing on lava slabs and precipices on and around Nyrøysa from 15 m to 180 m (081.1, 085.2, 354, 373, Holdgate 864 a, 866, 867 a) but once collected from a high ground *Andreaea* — *Usnea* community on Moseryggen, 270 m above sea level (359).

Addendum

A further taxon in the Seligeraceae or possibly the Dicranaceae is represented by a single specimen. The material is too scarce for a reliable determination but can be described as follows:

Stems scattered, up to 7 mm high, mostly unbranched; leaves erect, frequently falcato-secund when moist, not much altered when dry, 2–4 mm long, increasing in size towards stem apex, lanceolate, tapering to a long, fragile channelled subula consisting mainly of nerve, margin entire, plane below, plane to inflexed above; nerve weak, indistinct in basal part of leaf, shortly excurrent, in cross section composed of homogeneous cells; upper cells irregularly quadrate to shortly rectangular, thin-walled, basal cells rectangular, thin-walled, chlorophyllose, alar cells quadrate, slightly inflated, in brownish indistinct groups. Sporophyte absent.

Habitat: Growing in dense carpets of *Pachygloussa dissitifolia* on peaty soil on Moseryggen (310), 270 m above sea level.

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Macrolichens of Bouvetøya*

Jørgensen, P. M. 1986: Macrolichens of Bouvetøya. *Norsk Polarinstitutt Skrifter* 185: 23—34.

Twelve species of foliose or fruticose lichens are reported from Bouvetøya, all for the first time. For some of them their known ranges of distribution have been considerably extended.

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The fruticose and foliose lichens play an important role in the flora and vegetation of Bouvetøya, which was surveyed by Engelskjøn during the austral summer 1978/79. His collections comprise about 50 specimens of macrolichens. The crustose lichens are treated by Øvstedal (1986) (this volume).

Methods

The specimens have been studied through binoculars, microscope and in some cases in SEM (JEOL SM-U3, voltage approximately 15 kV). Thin layer chromatography (TLC) has been performed on all specimens according to standard methods. Comparison has also been made with specimens from the herbaria of AAS, BM, H, KASSEL, M, O, PC, TUR, and US. In the following account, genera are arranged alphabetically and collection protocol numbers are given in parentheses, according to T. Engelskjøn (pers. comm.).

Cladonia pyxidata (L.) Hoffm.

Thallus consisting mostly of basal squamules, forming a crust. The best developed squamules are about 1 mm thick, 2—3 mm long, and greyish blue-green with slightly incised margins. The lower surface is greyish, mostly decorticated, but esorediate. Most squamules are smaller, brown and up to 2 mm thick.

Podetia are scarce and usually juvenile. The best developed ones are 5 mm high, of the same colour as the squamules, coarsely areolate and esorediate. Cups simple, 3 mm wide, quite deep

and the interior coarsely areolate; marginally with a few short proliferations.

Apothecia not observed.

Chemistry: Atranorin (abundantly) and fumarprotocetraric acid.

Taxonomic notes: *C. pyxidata* is a complex species (Ahti 1966; Sipman 1973), and the poor material does not offer possibilities for further refinement in the identification. The crust-like aggregation of the basal squamules indicates *C. pocillum*. The best developed squamules are, however, more typical of *C. pyxidata* s. str., and the condensed growth of the squamules is possibly only caused by the extreme growth conditions. Specimens from extreme habitats in Europe and the Arctic show similar tendencies, and also produce coarsely areolate podetia. In addition, the absence of soredia and the chemistry indicate that the specimens are referable to *C. pyxidata* s. str. Chemically there is, however, a deviation from the normal condition in that atranorin, which is very rarely found in the species (Ahti 1966), occurs in abundance.

Habitats: Restricted to Moseryggen, 285 m above sea level, growing on eroded cushions of *Dicranoweisia*, together with specimens of *Usnea* (102, 389).

Distribution: Cosmopolitan (Thomson 1968). In Antarctic regions recorded from Antarctic Pen., South Shetland Is., South Orkney Is., and South Georgia (Lindsay 1974). Also noted from Falkland Is., Marion I., and Campbell I. (Lindsay 1974).

* Publication No. 65 of the Norwegian Antarctic Research Expeditions 1976/77 and 1978/79.

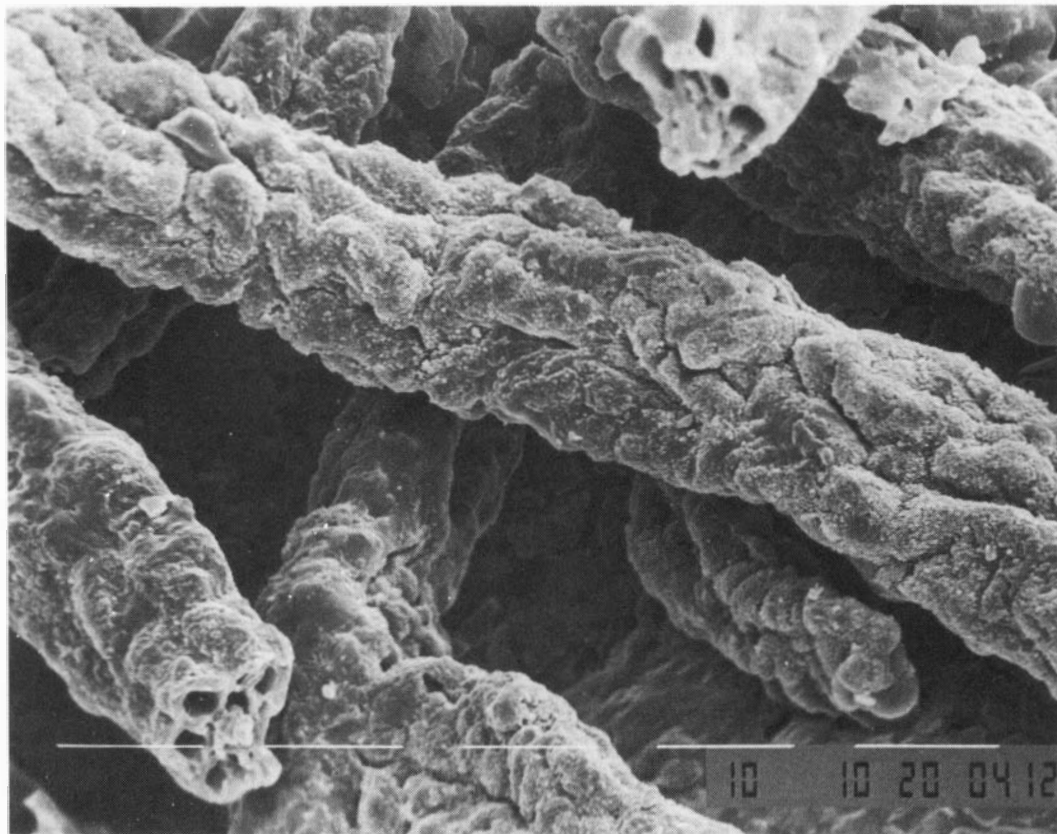


Fig. 1. *Cystocoleus ebeneus* from Bouvetøya (393), SEM pictures of filaments. Scale: 10 μm .

Cystocoleus ebeneus (Dillw.) Thwaites
(Fig. 1)

Thallus filamentous, blackish brown, 2–3 mm long, growing in small cushions.

The filaments, 17–20 μm in diameter, have a central algal thread of *Trentepohlia* surrounded by 10–16 parallel, closely agglutinated fungal hyphae, 2.5–3 μm in diameter.

Chemistry: Not analysed.

Taxonomic notes: The forms of this species noted from Bouvetøya differ from the normal Northern Hemisphere material in many features. While it is normally a species forming matted patches on underhangs of shaded rocks, it is here found on the ground in dense cushions. Furthermore, some differences in the anatomy were observed, which initially suggested a new species. The rather numerous fungal hyphae run more paral-

lel and have straighter walls than usual. However, Prof. R. Santesson has provided material from Patagonia which has convinced me that these aberrations are due to environmental modification.

Habitats: On soil and eroded moss cushions, collected only on Moseryggen, 280 m above sea level, growing on *Andreaea gainii* (393).

Distribution: It has been recorded (as *C. niger*) by Lindsay (1971) from Antarctic Pen., South Orkney Is. and South Georgia. Dodge (1973) reports a *Racodium* sp. from Marie Byrd Land which from the description appears to be this species.

Leptogium puberulum Hue

Thallus foliose, growing in mats 2–8 cm wide. Lobes olivaceous to greyish brown, up to 160 μm

thick and 2–3 mm broad; margins undulate. Upper surface smooth to slightly wrinkled. Lower surface with some scattered pubescence. Only a few immature apothecia observed.

In section the upper cortex appears as yellowish-brown, 15–20 μm thick, consisting of one or two layers of more or less isodiametric cells. Lower cortex similar, but hyaline and with occasional hairs. The algae (*Nostoc*) in clusters which are distributed through the whole thallus, but concentrated in the lower and upper part thus leaving a narrow zone of medullary hyphae centrally.

Chemistry: Not analysed.

Taxonomic notes: The material compares well with other collections from the maritime Antarctic region and with Hue's description (1915). It differs mostly in the more appressed growth, but the specimens are small, probably young. In the best developed parts the lobes are more ascending and show a tendency to become tubular.

The lower surface has some hairs of the irregular type (Jørgensen 1973), and the species does not belong in the section *Mallotium* as claimed by Hue (1915) and Dodge (1973). It appears to be a species of the *L. azureum*-group with a tendency to develop hairs under certain circumstances, a phenomenon also known in *Collema* (Degelius 1954).

Habitats: Protected sites such as cavities on vesicular lava boulders and moss carpets between boulders. A fairly recent invader on the new ground of Nyrøysa, 15–30 m (030.1–2, 112, 378, 379, 380), but also found in *Drepanocladus uncinatus* carpets on the high ground of Rustadkollen, 310 m above sea level (248).

Distribution: Antarctic Pen. (Lamb 1948, Smith & Corner 1973); South Shetland Is. (type from King George I.); South Orkney Is. (Smith 1972); South Georgia (Lindsay 1974).

Massalongia carnos (Dicks.) Körb.

Thallus consisting of small brownish squamules, up to 3 mm long and 2 mm broad. Margins incised and with some secondary lobules. Apothecia not observed.

Thallus about 100 μm thick, consisting of two or three layers of rounded cells about 10 μm diam., the outermost brown pigmented. *Nostoc*-colonies in rather large aggregations with hyphae penetrating vertically in between them. No lower cortex.

Chemistry: No substances found.

Taxonomic notes: The material is poor, mainly consisting of small, stunted squamules. However, there are a few squamules which externally are quite typical of the species. The anatomy further supports the identification.

Habitats: Found only as an admixture on necrotic *Dicranoweisia* together with *Psoroma hypnorum* in a collection from Moseryggen 285 m above sea level (101).

Distribution: Bipolar (Lamb 1955). In the Southern Hemisphere recorded from Antarctic Pen. (Smith & Corner 1973), South Orkney Is., South Shetland Is., South Georgia, Falkland Is. (Lindsay 1974; R.I.L. Smith, pers. comm.) and New Zealand (Galloway 1985:263).

Mastodia tessellata auct.

Thallus olivaceous brown, foliose, growing in tufts 1–2 cm wide. Lobes 3–4 mm broad, slightly incised and crisped, warted with black perithecia up to 0.3 mm broad with sunken ostiolum. Sometimes with pycnidia. Thallus in section 50–60 μm thick, mainly consisting of *Prasiola* algal tissue, each cell cuboidal or rectangular, ca. $6 \times 10 \mu\text{m}$, in parallel rows. Perithecia with hyaline to pale brownish excipulum 15–20 μm thick, composed of \pm rectangular cells $3 \times 1.5\text{--}1.8 \mu\text{m}$, surrounded by a ca. 15–20 μm thick thalline tissue. Periphyses soon evanescent. Asci clavate, $30\text{--}40 \times 7\text{--}8 \mu\text{m}$. Spores simple, ellipsoid, hyaline, $10\text{--}12 \times 3\text{--}4 \mu\text{m}$. Sometimes also with pycnidia, producing simple, hyaline pycnoconidia ca. $1 \times 2 \mu\text{m}$.

Chemistry: Not analysed.

Taxonomic notes: For a discussion on the doubtful position of this species in the lichen system and its nomenclature, see Brodo (1976) and

papers cited there. It can only be added that *M. tessellata* on Bouvetøya appears to occur in habitats slightly drier than those of *Prasiola* (see below). Its correct name appears to be *Turgidoscolum complicatulum* Nyl. of E. Kohlmeyer.

Habitats: The single specimen was collected on a plateau on the southwest coast inside Larsøya at an altitude of 250 m above sea level (339). The site is a periglacial stonefield affected by bird droppings. It was also observed (Engelskjøn pers. comm.) on the west coast cliffs between Nyrøysa and Aagaardbreen, from about 5 m above sea level. Here it is plentiful, and the species is probably widespread at sites drier and more exposed than suitable for the phycobiont, *Prasiola crispa*.

Distribution: Probably bipolar (Brodo 1976). In the Antarctic region recorded from Fuegia. South Sandwich Is., South Orkney Is., South Shetland Is., South Georgia, Beauchêne I., Antarctic Pen., and Îles Kerguelen (Lindsay 1974; Smith, pers. comm.).

Pannaria hookeri (Borr. ex Sm.) Nyl.
(Fig. 2 A, B)

Thallus squamulose, growing in patches up to 5 cm in diameter. Marginal lobes enlarged, up to 4 mm broad, 5–6 mm long and 0.5 mm thick. Upper surface brownish, white-grey striated and with distinctly white-grey margins which are sometimes blackened. Apothecia common, up to 3 mm in diameter with black or dark brown discs. Thalline margin irregular and crenulate.

In section the upper cortex proves to be 70 µm thick, composed of thick-walled cells, 10–12 µm in diameter. No lower cortex, but the medulla forms a dense tissue of horizontally aligned short-celled hyphae. The algal layer consists of *Nostoc*-clusters with numerous vertically orientated fascicles of hyphae which extend up to the cortex, giving origin to the striate variegation of the upper surface. The algae in the upper part are yellowish-green in colour, probably dead.

Apothecia with thalline margin up to 250 µm thick. The hymenium about 150 µm thick, only partially coloured by iodine, particularly in the vicinity of the asci. Asci 80–90 × 15 µm without

any amyloid apparatus. Spores 12–14 × 10–12 µm, colourless, ellipsoid to globular and smooth-walled.

Chemistry: No substances found.

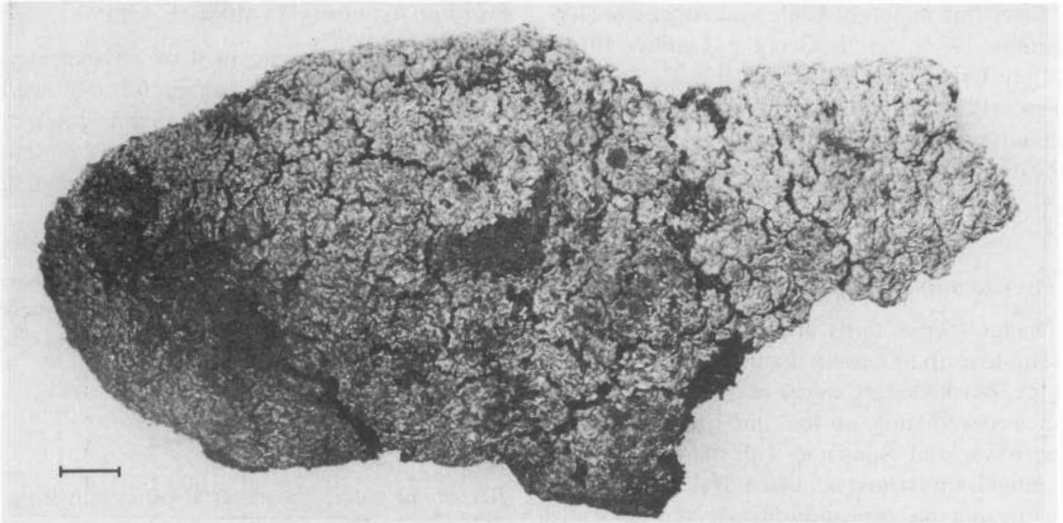
Taxonomic notes: The material varies little, except in the degree of development. However, it differs from Northern Hemisphere specimens, in its browner colour, generally larger lobes and apothecia and its different ecology (Jørgensen 1978). The browner colour appears, in addition to the pigmentation of the cortex, to be caused by the layer of yellowish-green algae below the cortex, and in this respect, the thallus resembles that of a *Psoroma*. However, these appear to be miscoloured (dead?) *Nostoc* algae, as there is a gradual change to the quite normal *Nostoc* clusters farther down in the thallus.

Its preference for open habitats may account for its relatively luxuriant growth and, as the anatomical characters are so similar to those of specimens from the Northern Hemisphere, it is impossible to separate them on specific level. The chemical difference is unimportant as it is often very difficult to demonstrate the presence of pannarin in *P. hookeri* (Jørgensen 1978).

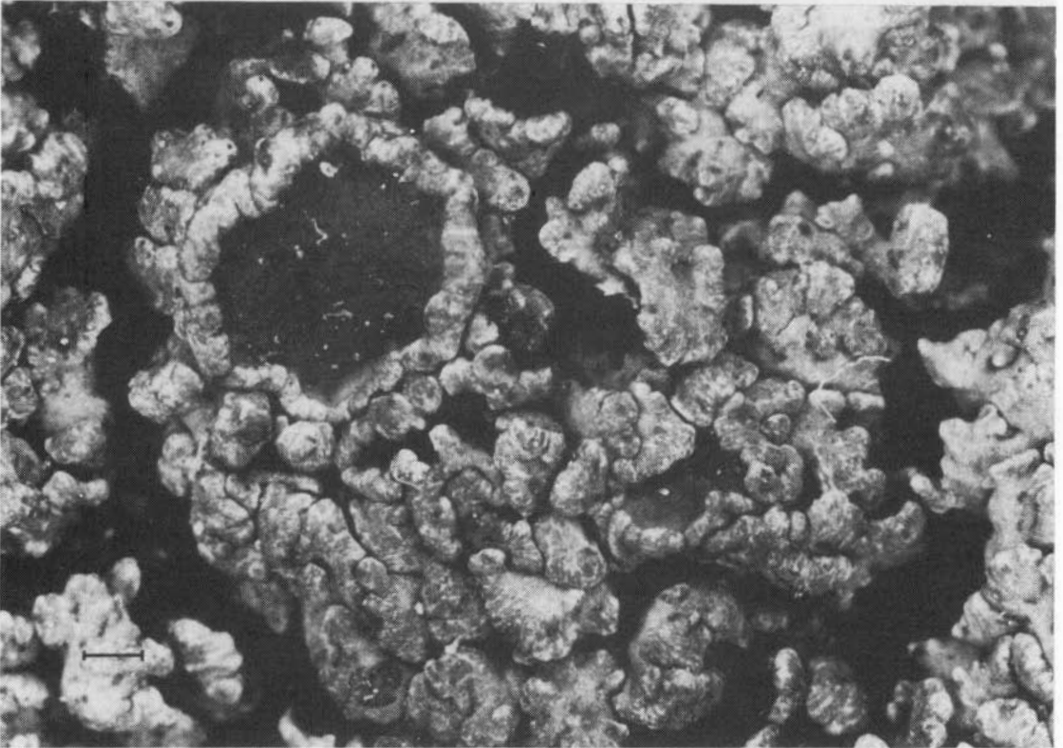
Examination of the type of *Pannaria dichroa* (Hook. & Tayl.) Croub., a species from Îles Kerguelen also occurring on Signy Island (R.I.L. Smith, pers. comm.), showed that this species has longer, or flabellate lobes, growing appressed to the rock and the colour is ochraceous brown. The apothecia are nearly pedicellate, *Lecanora*-like without the irregular thalline margin so typical of *Pannaria* spp, and the disc is bright brown. It is quite different from both northern and southern populations of *P. hookeri*.

Habitats: Confined to south coast high ground; frequent on the exposed summit plateau of Rustadkollen, 310–340 m above sea level, often as extensive stands covering cryoturbated lithosol (032.4, 5, 239, 240, 253, 317.1, 329.1, 2), as well as on Moseryggen on mossy cliffs and talus, 260–285 m above sea level (015, 051, 102, 316, 319).

Distribution: Bipolar (Lindsay 1974). In the Southern Hemisphere also recorded from the



A



B

Fig. 2. *Pannaria hookeri* from Bouvetoya (032). A. The cushion-like habit of the material. Scale: 0.5 cm. B. Detail of apothecium and lobules. Scale: 1 mm.

Magellanic region of Chile and Argentina (Jørgensen 1978); South Georgia (Lindsay 1974); South Orkney Is., South Shetland Is., Antarctic Pen. (R.I.L. Smith, pers. comm.), Marion I. (Lindsay 1976), and the South Island of New Zealand (Jørgensen 1978).

Physcia dubia (Hoffm.) Lett.

Thallus foliose, fairly appanate, irregularly rosette-like, up to 4 cm in diameter. Upper surface grey, blackened at apices and pruinose. Lobes incised, radiating, up to 2 mm broad, but often narrower and elongated with marginal coarse-grained, lip-shaped soralia. Lower surface pale with numerous brownish rhizinae, some of which are visible along the margins of the lobes. Upper cortex paraplectenchymatous, lower prosoplectenchymatous. Apothecia not observed.

Chemistry: Atranorin.

Taxonomic notes: There is some variation in the material, mainly relating to the width and elongation of the lobes, which is usual in this species and related to environmental conditions.

P. dubia is a variable species (Moberg 1977). These specimens are surprisingly uniform and similar to European material, except for being regularly pruinose, a character of little taxonomic importance.

Habitats: Confined to the northwest coast: on the mountain ridge 177 m a.s.l. north of Nyrøysa, 180–190 m a.s.l. (081.1–2, 109, 303), but also a frequent colonizer of new ground at Nyrøysa, 15–30 m a.s.l. (011.1–3, 046.1–3, 084, 085.1, 212, 267, 294, 385). Usually preferring smooth, somewhat protected rock surfaces visited by birds and often associated with *Lecania gerlachei* and *Xanthoria candelaria*.

Distribution: Bipolar. In the Antarctic regions only reported from the Soya coast (Nakanishi & Kashiwadani 1976). However, the specimens from South Georgia named *Ph. cf. wainioi* by Lindsay (1974) belong here as well. It has possibly been misinterpreted in the Antarctic region, and may be widely distributed there.

Psoroma hypnorum (Vahl) S. F. Gray

Thallus squamulose, up to 4 cm in diameter. Squamules ochre-brown, about 0.2 mm with crenulate margins, sometimes tending towards coralloid lobes. Cephalodia sometimes present in the form of ordinary squamules containing blue-green algae.

Apothecia cupuliform, up to 3 mm broad, with prominent, mostly smooth, but sometimes squamulose thalline margin. Disc brown, strongly concave. Spores large 20–26 × 9–12 μm, distinctly warted.

Chemistry: No substances found.

Taxonomic notes: The material varies only insignificantly, some of it being darker and more condensed, certainly due to external conditions. As pointed out previously (Jørgensen 1978) the southern populations are very similar to those of the Northern Hemisphere. There is, however, a slight tendency to form coralloid lobes. As this difference is not clear and the internal structures, including spore size and form, are identical, it is impossible to maintain two different species.

In the description, Dodge (1973) records the spore size of *P. follmannii* to be 15–16 × 8–9 μm indicating that this species has smaller spores than *P. hypnorum*. An isotype (KASSEL) has been studied and it proved to have quite typical *P. hypnorum* spores 19–24 × 9–12 μm large.

Habitats: On moist turf and peat banks on Mose-ryggen, often adjacent to snow-beds, 260–285 m a.s.l. (101, 103.1–3), and on the summit plateau of Rustadkollen, 340 m a.s.l. (240).

Distribution: Bipolar (Jørgensen 1978). In the Antarctic known from i.a. Antarctic Pen. (Lindsay 1974), South Shetland Is. (Lindsay 1974), South Orkney Is. (Smith 1972; Lindsay 1974), South Sandwich Is. (Longton & Holdgate 1979), South Georgia (Lindsay 1974).

Stereocaulonglabrum (Müll. Arg.) Vain.

Pseudopodetia erect or decumbent, up to 4 cm tall, usually much shorter, growing in cushions, anisotomic to irregularly branched. The stem is usually brownish, minutely tomentose, particu-

larly at the apices, becoming glabrous towards the base. Phyllocladia verrucose to incised squamulose, uniformly coloured grey, sometimes greenish, occasionally browned, distributed mainly on one side only. Cephalodia rare, small, verruculose, greyish brown-violet. Apothecia not observed.

Chemistry: Atranorin, stictic acid, norstictic acid (often in low concentration, and then difficult to demonstrate). As to chemical variability, see Huneck et al. (1984).

Taxonomic notes: The material varies somewhat in the degree of development. Much of it represents stunted, browned forms which have a dorsiventral habit (see Lamb 1978). The best developed specimens are, however, well in accord with typical material from the Magellanic region. Antarctic and sub-Antarctic *Stereocaulon* specimens have often incorrectly been called *S. antarcticum* (Lamb 1977). This species is closely related to *S. glabrum*, but differs in its finely granulose to sorediate phyllocladia.

Habitats: Confined to the south coast high ground, occurring abundantly on the plateau and summit ridges of Rustadkollen, 310–340 m a.s.l. (036, 233, 403.1–3) and Moseryggen 270–287 m a.s.l. (23.1, 2, 101, 115, 116, 118, 201, 210, 211, 291, 308, 391.1, 2, 396, 398). Often growing in cushions of *Andreaea* spp.

Distribution: Southern Chile including Juan Fernandez, Southern Argentina, Antarctic Pen., South Orkney Is., South Shetland Is., South Georgia, Tristan da Cunha (Lindsay 1974; Lamb 1977; Jørgensen 1979; Smith, pers. comm.).

Usnea antarctica Du Rietz (Fig. 3, 4A)

Thallus erect or subdecumbent, 2–10 cm tall, often greatly branched from the base, usually with distinct main branches; in the upper parts subdichotomously to isotomic-dichotomously branched, often rather sparingly and without spinules and fibrils.

The holdfast brownish black and nearby areas of the main branches often pinkish. Main bran-

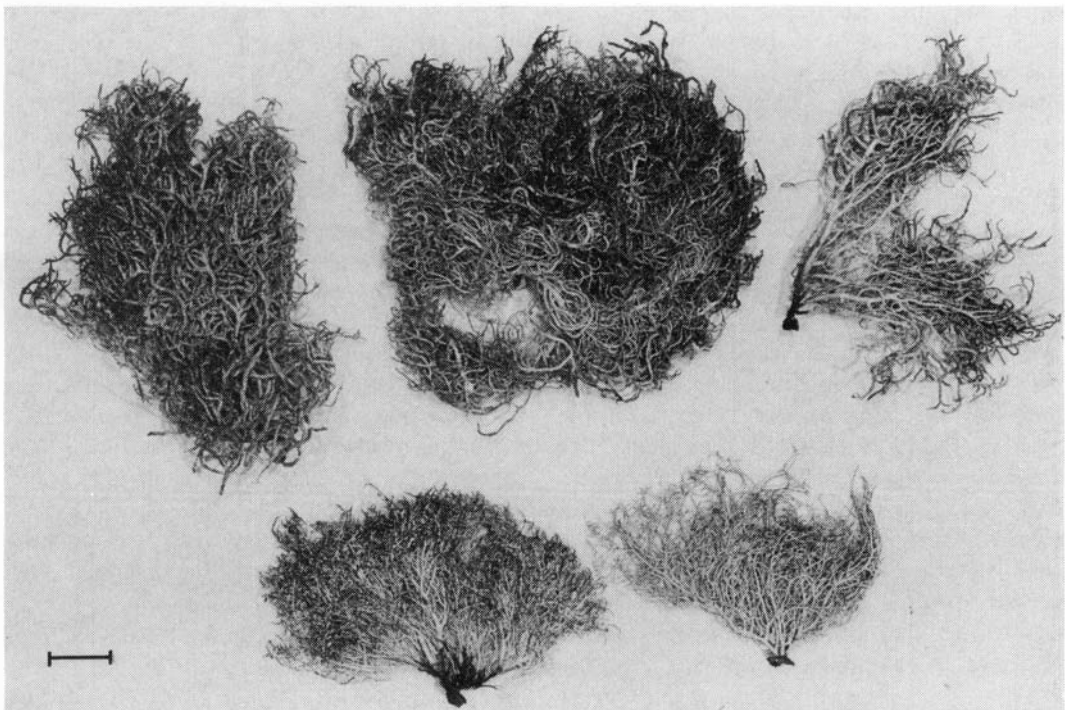


Fig. 3. Different growth forms of *Usnea antarctica* on Bouvetøya. Upper row: Old, entangled specimens from summit 177 m N of Nyrøysa (301). Lower row: Juvenile specimens from Nyrøysa (089). Scale: 2 cm.

ches and basal parts of the branchlets greenish yellow (changing slowly to yellow in herbaria), apical parts usually black variegated. Surface matt, roccelloid, on the main branches with scattered low tubercles which open and develop into circular crateriform soralia; on side branches and branchlets normally densely beset with soralia which there become protuberant and at times completely confluent. The soredia are coarse-grained, sometimes blackish, particularly in the basal parts of the thallus, and the soralia are occasionally surrounded by blackish, isidialike fibrils.

The axis is very prominent, solid and corneous, occupying most of the diameter of the branch and surrounded by a narrow whitish, rather compact medulla.

One immature concave apothecium found, about 1 mm broad, with smooth thalline margin and blackish disc. No ripe spores found.

Chemistry: Usnic acid. Some specimens also contain three unidentified substances, appearing as greyish spots on the TLC-plate after treatment with sulphuric acid (Rf-classes: 3–5–3, 2–5–2 and 2–3–1 in system A–B–C respectively). Other chemotypes are reported from elsewhere (Huneck et al. 1984; Walker, 1985).

Taxonomic notes: The species is very variable (Fig. 3). Some forms are low and entangled, with less distinct main branches and elongated, little branched side-branches, often covered in numerous \pm confluent blackish soralia, but usually without variegation. Other specimens are erect with distinct main branches and protruding side-branches. The apical parts are often black variegated caused by black bands of pigment. There are, however, intermediate forms and this variation appears to have been caused by environmental factors. The densest compact tufts with shining black apices are from the most exposed habitats, while a pale, sparsely branched form was collected in a sheltered site just above a fumarole. Age differences are also involved. Specimens colonizing the new ground of Nyrøysa are gracile and soft, and are presumed to have a maximum age of 15–20 years.

The chemical variation is not correlated to any of these growth forms. In seemingly homogeneous populations, the three unknown substances are present in some specimens, absent in others. They appear to be of no taxonomic importance.

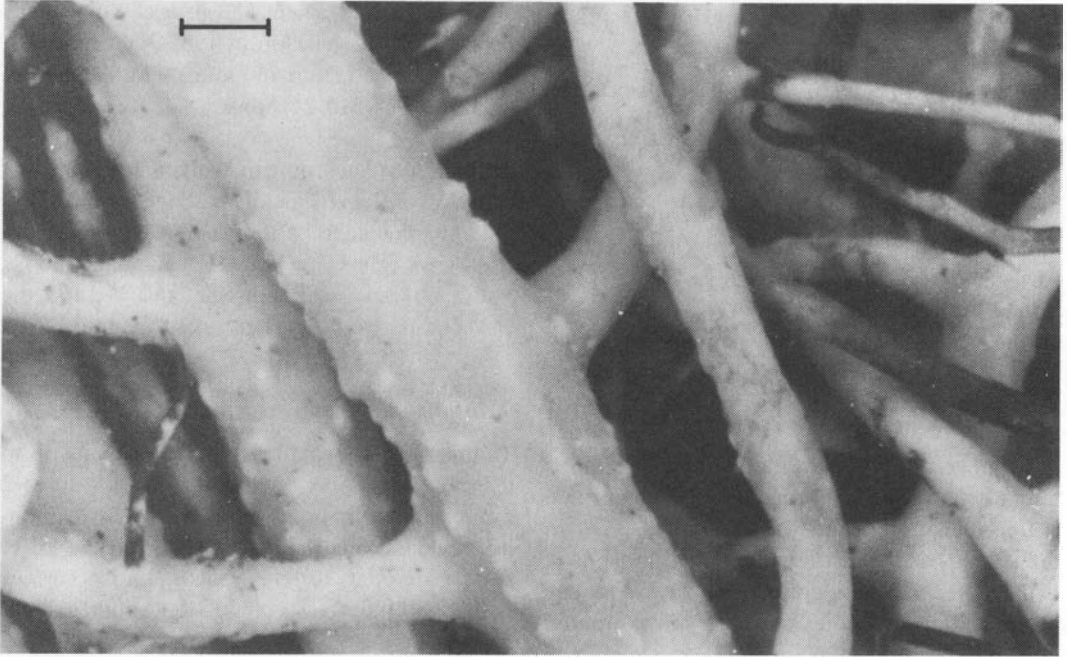
The central axis of the Bouvetøya material is unusually thick as compared with that of the type specimen. However, Walker (1985) in her revision of *Usnea* sect. *Neuropogon*, regards this as part of the variation within the species.

Sterile specimens of *U. aurantiaco-atra* and young specimens of *U. antarctica* where the soralia are poorly developed are sometimes difficult to separate. The best distinguishing character is the low tubercles (Fig. 4A) on the main stem of *U. antarctica* which differ markedly from the much coarser, verruculose (Fig. 4B) papillae of *U. aurantiaco-atra*. Even in young specimens the latter has conspicuously prominent main branches and is often subnitid.

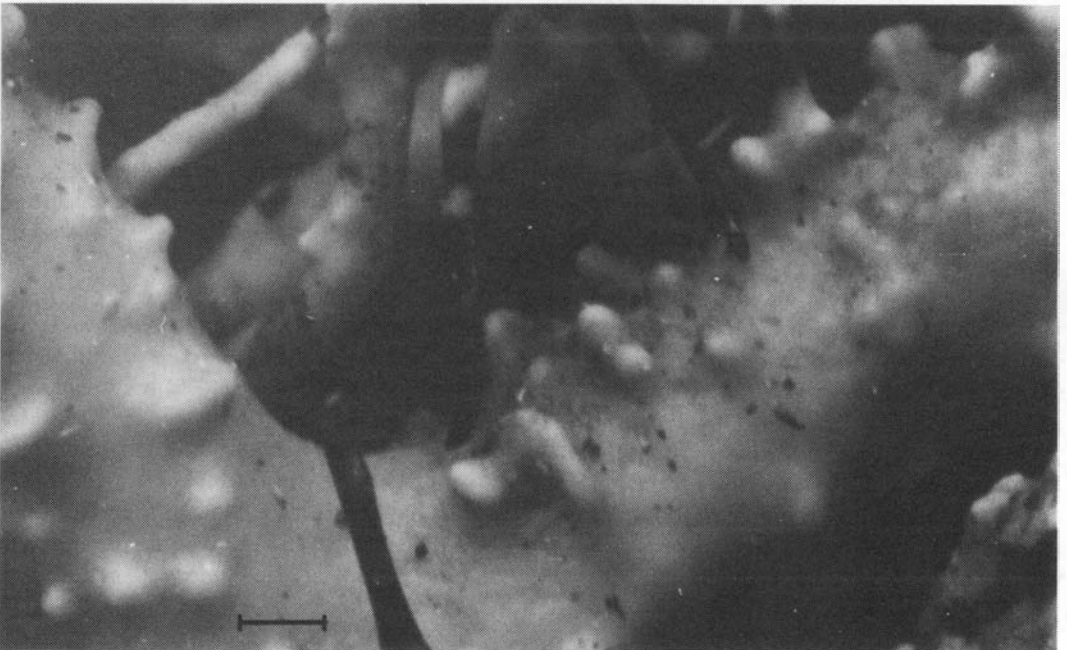
Habitats: Frequent on the northwest coast, with old specimens obtained from the mountain ridge 177 m a.s.l., north of Nyrøysa, 180–200 m above sea level, occurring abundantly on a wind-exposed lithosol escarpment (301). Also colonizing the new ground of Nyrøysa in suitable habitats at 20–35 m a.s.l. as juvenile specimens, seldom more than 5 cm high (088, 089, 298). In addition, on the south coast high ground, 310–330 m on Rustadkollen (008, 056, 094, 390, 392) and 260–285 m above sea level on Moseryggen (016.1–2, 391, 393, 399), but here less frequent than *U. aurantiaco-atra*.

Distribution: Recorded from many stations in the maritime and continental Antarctic (Lamb 1964), including Antarctic Pen. (Lamb 1948, 1964; Smith & Corner 1973), South Shetland Is. (Lindsay 1971; Allison & Smith 1973), South Orkney Is. (Smith 1972), South Sandwich Is. (Longton & Holdgate 1979), South Georgia (Lindsay 1974), and Greater Antarctica (Lamb 1964).

Presumably conspecific strains are recorded from sub-Antarctic regions of Fuegia, Îles Kerguelen, and Heard I. (Lamb 1964). The last revision by Walker (1985:61–62) summarizes localities of the different chemotypes.



A



B

Fig. 4. Stem protuberances of *Usnea* spp. from Bouvetøya. A. Tubercles on *U. antarctica* stems. B Papillae on *U. aurantiaco-atra* stems. Scales: 1 mm.

Usnea aurantiaco-atra (Jacq.) Bory
(Fig. 4B)

Thallus up to 10 cm tall, rather sparingly branched from the base, with prominent main branches; in upper parts more branched in a subdichotomous way.

The holdfast brownish-black. Main branches and branchlets yellow, apically black and yellow variegated, sometimes completely blackened and nitid. The surface is distinctly verruculose-papillate (Fig. 4B), and in old specimens often also scrobiculate. The axis is solid, corneous and very prominent occupying most of the diameter of the branch.

Apothecia normally abundantly developed laterally on the apical branchlets, concave when young, becoming flattened and up to 2 cm in diameter. Disc black, thalline margin yellow, usually verruculose-papillate and occasionally also with fibrilla. Spores simple, hyaline, broadly ellipsoid 9–11 × 4–6 µm.

Chemistry: Usnic acid, some specimens contain the same three unknown substances as in *U. antarctica*. Other chemotypes are reported from elsewhere (Huneck et al. 1984; Walker 1985).

Taxonomic notes: This species is much less variable on Bouvetøya than *U. antarctica*, but the material is nevertheless difficult to name. The *U. aurantiaco-atra* complex is problematic in Antarctica. There is a considerable variation both in morphology and chemistry. Although the taxonomy of the group has been revised several times (Motyka 1936; Lamb 1948, 1964; Dodge 1973), and most recently by Walker (1985), it is still problematic. Walker (1985) has lectotypified *U. aurantiaco-atra* on a Commerson specimen from the Magellan Strait, containing fumaroprotocetraric acid. The Bouvetøya population belongs to a chemically inactive form of this species, named f. *egentissimus* Lamb.

Habitats: Confined to the south coast high ground, occurring in great abundance on Rustadkollen, 300–340 m a.s.l. (028, 029, 039, 060, 407, 411) as well as on the small nunataks

north of Rustadkollen, 380 m a.s.l. (specimens collected by Engelskjøn in 1985), and east of it on Moseryggen from 260 m a.s.l. to the summit (053, 106, 117, 210, 211, 409).

Distribution: According to Walker (1985) the distribution of the chemically inactive form follows that of the main form, being known from southern Chile, Cape Horn, Fuegia, Falkland Is., South Orkney Is., South Shetland Is., and the west coast of Antarctic Pen. (cf. also Lamb 1964).

Xanthoria candelaria (L.) Th. Fr.

Thallus forming small pulvinate cushions up to 0.5 cm high. Lobes irregularly incised, up to 2 mm broad, more or less erect with coarse granular soredia along the margins and on the lower surface. Upper surface yellow, under surface white and faintly scrobiculate. Apothecia not observed.

Chemistry: Parietin.

Taxonomic notes: The material agrees well with collections from Lesser Antarctica, for which the name f. *antarctica* (Vain.) Hillm. has been used (sometimes regarded as a separate species *X. antarctica* (Vain.) Dodge & Baker). *X. candelaria* is a very variable species in northern Europe from where the type is described, with regard to stature, lobe width, degree of incision, soralia, etc.

There has been some discussion in the literature on the identity of *X. mawsonii* Dodge, described from Greater Antarctica. Both Filson (1974, 1975) and Lindsay (1972) are inclined to believe that it is a synonym for *X. candelaria*. Material from MacRobertson Land has been studied, and their view has been confirmed. As the type has not been available and there are some discrepancies between the type description and the topotype material, *X. mawsonii* is not listed as a synonym here.

Habitats: Moderately ornithocrophilous, on exposed ridges and boulders on and around Nyroysa, 50–190 m a.s.l., seldom abundant (022, 081.1–2, 109, 299, 387, 388). Also collected on Moseryggen, 260–270 m above sea level, on

bird-influenced screes, on boulders, or in moss cushions(042, 052, 264).

Distribution: Cosmopolitan (Poelt 1969). Probably present in most of the Antarctic region, being windspread on the Antarctic Pen. (Smith & Corner 1973; Lindsay 1972), South Shetland Is. (Allison & Smith 1973), South Orkney Is. (Smith 1972), South Sandwich Is. (Longton & Holdgate 1979), but rare on South Georgia (Smith, pers. comm.). In continental Antarctica it has been collected e.g. from Theron Mts. (Lindsay & Brook 1971), Vestfjella (Lindsay 1972), and inland mountains between 1° and 5° E long. (Engelskjøn, pers. comm.).

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Crustose lichens of Bouvetøya*

Øvstedal, D. O. 1986: Crustose lichens of Bouvetøya. *Norsk Polarinstitutt Skrifter* 185, 35—56.

32 crustose lichen species were recorded, belonging to 20 genera. The genus *Bouvetiella* with the species *B. pallida*, and the species *Arthonia subantarctica*, *Arthopyrenia maritima*, *Buellia bouvetii* and *Caloplaca tenuis* are described as new. One taxon, tentatively '*Lecidea*', is not allocated to genus or species, and two other taxa are not definitely allocated to species.

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In the austral summer 1978/79 Bouvetøya was surveyed by the Norwegian Antarctic Research Expedition (Engelskjøn 1981, 1986a). No phanerogams exist on the island, but there is a relatively high number of lichens and bryophytes. This paper deals with crustose lichens. The fruticose and foliose lichens are treated by Jørgensen (1986) in another contribution to this volume.

Methods

Chemical data were obtained by thin-layer chromatography (TLC) with the techniques described by Culberson & Kristinsson (1970) and Culberson (1972), modified by Menlove (1974).

Genera are arranged in alphabetical order and specimen collection numbers are given in parentheses, according to Engelskjøn (1986b).

Acarospora macrocyclos Vain.

One small, sterile rosette 4 mm in diameter, composed of radiating lobes 0.1 mm wide, apically subdichotomously divided. Upper surface smooth, dark brown. Thallus 120—180 µm thick. Upper cortex 20—30 µm thick, the upper part dark brown, composed of rather indistinct cells, 2—3 µm in diameter. The rest of the section up to 150 µm is composed of densely intricate hyphae and algae clusters. No lower cortex. Cells

of lower surface dark brown to black. Apothecia not found.

Chemistry: No substance found, nor was any found in the type (TUR).

Taxonomic notes: The single specimen found was juvenile and very similar to material from Signy Island, South Orkney Is., from where many specimens have been examined. It also compares well with Vainio's type (TUR, No. 25435). Magnusson (1929) found that *A. macrocyclos* and *A. molybdina* were closely related, and that the most reliable difference was the black lower surface of the thalluses of *A. macrocyclos*. According to Vainio's original description, this lichen differs from *A. molybdina* in the ellipsoid spores, larger apothecia and broader lobes.

Øvstedal (unpublished) found that a population of *A. molybdina* from Spitsbergen (79°N) differed from *A. macrocyclos* in apothecium size and in colour of lower surface of the thallus. Accordingly, he has kept the two species separate.

Habitats: Moseryggen, on dry basalt scree facing east, together with *Rhizoplaca melanophthalma* and *Caloplaca sublobulata*, 270 m above sea level (334).

Distribution: Antarctic Pen., South Orkney Is., South Shetland Is., South Sandwich Is. (Longton & Holdgate 1979), South Georgia (Lindsay 1972), and one doubtful record from Îles Kerguelen (Magnusson 1929).

* Publication No. 66 of the Norwegian Antarctic Research Expeditions 1976/77 and 1978/79.

Arthonia subantarctica Øvst. sp. nov.

Thallus minutus, fuscocinereus, crustaceus. Ascocarpia nigra, complanata, numerosa, 0.9 mm in diam. Thecium 35–40 µm altum, I + rube-scens. Hypothecium pallidum. Asci clavati, tholis juvenalibus, annulatis, pro parte amyloideis. Paraphysoidea anastomosantes. Sporae ellipsoi-dae, pallidae, 1-septatae, 9.5–14 × 3.5–7 µm.

Holotypus: Bouvetøya (Insula Bouvetii), Engelskjøn 001 (vide infra).

Thallus grey-brown, crustaceous, forming minute, more or less circular patches up to 4 mm in diameter, mainly covered in numerous black ascocarps, and cracked at the center. Ascocarps roundish, frequently irregular in outline, up to 0.9 mm diameter, aggregated, varying from flat to slightly convex. Phycobiont trebouxioid, about 10 µm diameter. Epithecium distinct, 5–10 µm, brown, K-. Hymenium 35–40 µm high, J + green-blue changing to red-brown. Subhymenial layer 30–40 µm high, hyaline to pale yellow. Paraphysoids with brown clavate tips, tips about 4 µm diameter; in middle parts of the hymenium about 2 µm diameter, anastomosing. Asci clavate, about 35 × 15 µm, when young with an apical, pale amyloid cap surmounted by a minute, deeply amyloid ring.

Spores 8 in ascus, hyaline, smooth, 1-septate, 9.5–14 × 3.5–5 µm (Fig. 1).

Chemistry: No substance found.

Taxonomic notes: This is not a typical *Arthonia*. The ascus is not of the typical broad, bitunicate type, but is much narrower and only doubtfully bitunicate. It has a structure similar to that of *Bryostigma* (Poelt & Döbberler 1979). However, according to B. Coppins (in litt.), this and similar ascus types are found in several species of *Arthonia* s. lat., e.g. *A. exilis*, *A. lapidicola* (in *Allarthonia*), *A. fuscopurpurea* (type species of *Celidium* Tul.), *A. clemens* (type species of *Conida* Mas-sal.). It is therefore better that this new species remains in *Arthonia* until a closer study of this evidently complex genus has been carried out.

Habitats: On the new ground of Nyrøysa, 30 m above sea level (001.2, Holotypus (BG); 091), and on south coast, Moseryggen, 270 m above sea level (002). Both places on smooth basalt slabs.

Distribution: Also known from Signy Island, South Orkney Is. (AAS) and Antarctic Pen. (BM).

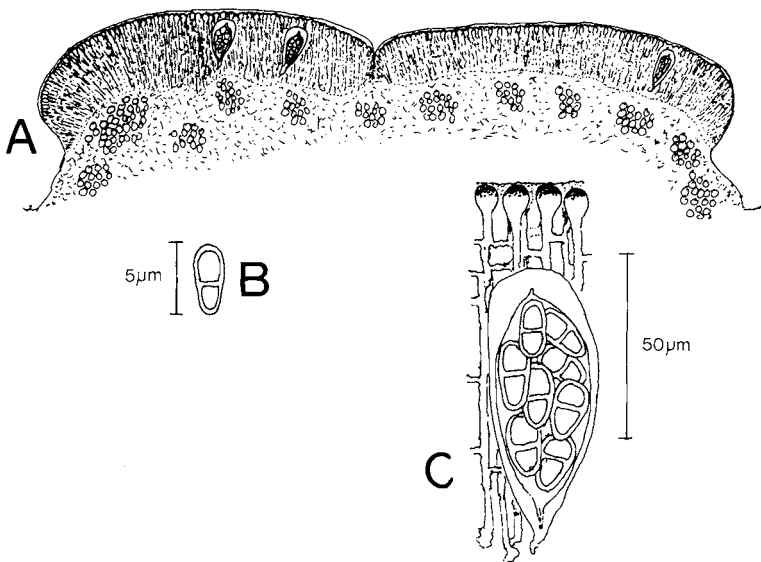


Fig. 1. *Arthonia subantarctica*. A. Section of ascocarp. B. Ascospore, C. Detail of ascus and paraphysoids.

Arthopyrenia maritima Øvst. sp. nov.

Thallus tenuis, areolatus, dispersus, hepaticus vel fuscogriseus. Perithecia ad 400 µm lata, fere superficialia, stratis exterioribus nigris et continuis; gelatinum hymenium JKJ-. Pseudoparaphysae trabeculatae et melanomataceae. Sporae 8:nae, biseriatae, ellipticae, 1-septatae, partes inaequales. Sporae 18–22 µm longae, 7–9 µm crassae, incolores. Asci bitunicatae cylindracei, 90–100 µm longi, 18–22 µm crassi. Micro-pycnidiosporae bacilliformae, 2–3 µm longi, 0.5–1 µm crassae.

Holotypus: Bouvetøya (Insula Bouvetii), Engelskjøn 332.2 (vide infra).

Thallus of scattered, pale brown areolae, ca. 1 mm in diameter. Algae green, trebouxoid, organized in one plane or in a round colony. Perithecia up to 400 µm in diameter, almost superficial, outer layer blackish and continuous around the ascocarp (Fig. 2), hymenial gelatin JKJ-. Pseudoparaphyses trabeculate and melanomataceous. Asci bitunicate, cylindrical, ca. 100 × 20 µm. Spores 8 in ascus, smooth, biseriatae, elliptical, 2-celled, cells unequal, spores about 20 × 8 µm. Microconidia rod-shaped, 2–3 × 0.5–1 µm. Macroconidia not seen.

Chemistry: No analyses.

Taxonomic notes: The bitunicate asci, trabeculate melanomataceous pseudoparaphyses, large colourless, unequal-celled smooth spores, distichously arranged in the asci, all point to the genus *Anisomeridium* (Müll. Arg.) Choisy, as treated by Harris (1975). However, in *Anisomeridium*, the phycobiont belongs to *Trentepohlia*, the microconidia are orbicular, elliptical or narrowly elliptical, and the macroconidia simple, orbicular or elliptical (Harris 1975). In the present taxon, the microconidia are rod-shaped, which is a characteristic of *Arthopyrenia* s. str. (Harris 1975).

Habitats: Nyrøysa, southern shore, 5 m above sea level, on loose breccia boulder (332.2, Holotypus (BG); 331).

Distribution: Also known from South Shetland Is., Livingston I., Lindsay 294 (AAS).

Bacidia tuberculata Darb.

Thallus effuse, granulate-furfuraceous, pale ochre to greenish, sometimes with a pink hue, up to 3 cm diameter. Granules with mean diameter 106 ± 21 µm (30 measurements). No prothallus seen. Apothecia biatorine, up to 1 mm in diameter, sessile. Thallus in section about 500 µm high, with cortex about 60 µm high, composed of colourless to pale yellow, ± subhorizontal to irre-

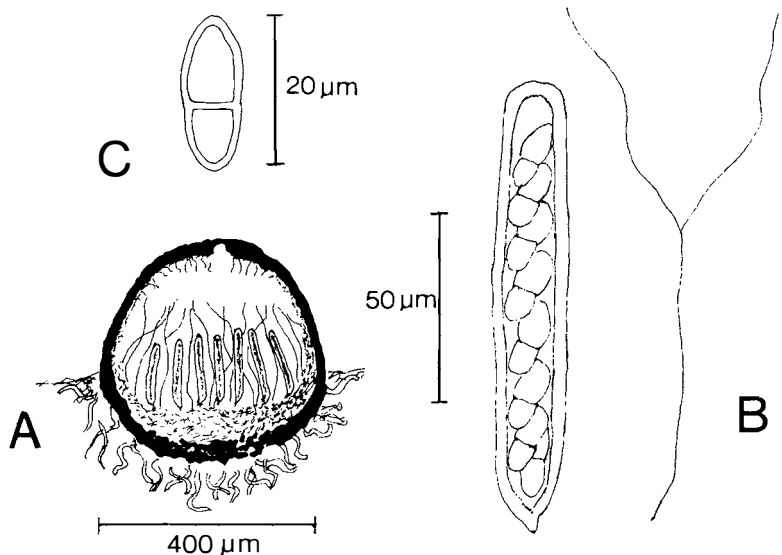


Fig. 2. *Arthopyrenia maritima*. A. Section of perithecium. B. Ascus. C. Ascospore.

gularly orientated, thin, long hyphae. Algal layer 200–250 µm high, with algae in distinct, round aggregations. Algae trebouxoid, individual cells about 7 µm in diameter. Underneath the medulla, tissue composed of colourless, thin, long, irregularly orientated hyphae.

Excipulum 40–50 µm, becoming excluded, concolorous with the disc, composed of ± elongated, radiating hyphae with irregularly shaped lumina. Subhymenium about 50 µm high, in its upper part dark brown, pseudoparenchymatous, in its lower part colourless, composed of unorientated, ± loosely interwoven hyphae. Hymenium up to 80 µm high, in the uppermost part aeruginous to blue-black, otherwise colourless. Paraphyses thin, simple to weakly anastomosing, end cell slightly clavate, about 4 µm diameter, aeruginous. Asci thin-walled, clavate, about 55 × 15 µm with a distinct persistently I+ blue, cone shaped tholus. Spores acicular, 30–45 × 3–4 µm, usually 5-septate, ± curved, colourless.

Chemistry: No substance found, including the type (S).

Taxonomic notes: The material compares well with the type (S) and the details of its description (Darbishire 1912).

Habitats: New ground of Nyrøysa, 10; 20–35 m above sea level; several places on moist lava and tuff gravel (010, 085.2, 093.1, 305, 381.1, 2, 382.1, 2,384,386.2), as well as on Rustadkollen, on lithosol 320 m above sea level (005, 252).

Distribution: Also known from Falkland Is. (Darbishire 1912).

Bouvetiella pallida Øvst. n. gen. & sp.

Thallus pulvinato-granulatus, gelatinosus, ad 1 cm diam. Apothecia semi-immersa vel sessilia,

Distribution: Recorded from the west side of the Antarctic Pen. as far south as Marguerite Bay, South Orkney Is., South Shetland Is. (Lamb 1968), South Sandwich Is. (Lindsay 1971), and South Georgia (Lindsay 1973).

Asci clavati, membranibus non incrassatis, sine tholi, KOH/I + coerulescentis. Acosporae 8, citriformes, hyalinae guttis oleorum, simplices,

14–16 × 5–6 µm. Pycnidia non vidi. Phycobionta Xanthocapsoidae.

Holotypus: Bouvetøya (Insula Bouvetii), Engelskjøn 414 (vide infra).

Thallus brown-black, up to 1 cm in diameter, pulvinate, gelatinose with small granulate squamules, definitely lichenized. Apothecia pale flesh-coloured to nearly white, about 0.2 mm diameter, slightly convex to nearly flat, situated between the squamules, which often appear as thalline margins. Distinctly biatorine with age. Excipulum very thin, hardly visible, only a few rows of elongated, colourless cells observed (Fig. 3). Hypothecium colourless, composed of densely packed, irregularly orientated hyphae, 80–100 µm thick. Hymenium about 70 µm thick, colourless. Paraphyses thin, flexuose, often branched, septated at long intervals. Asci thin-walled, 60 × 12–15 µm, with KOH/I + blue walls, clavate with no visible tholus. Spores 8 in ascus, lemon-formed, 14–16 × 5–6 µm, hyaline, thin-walled and containing numerous oil droplets.

Algae xanthocarpoid, individual cells 30–35 µm, with rather thick, hyaline to pale brownish wall.

Chemistry: No analyses.

Taxonomic notes: It has not been possible to match this species with any known lichen genus, consequently a new genus and species are described.

Habitats: Only seen on the new ground of Nyrøysa, 15–25 m above sea level. Usually encrusting stunted *Bryum* and *Tortula* communities on silt and scoria near a fumarole (382.1, 413, 414 Holotype (BG)).

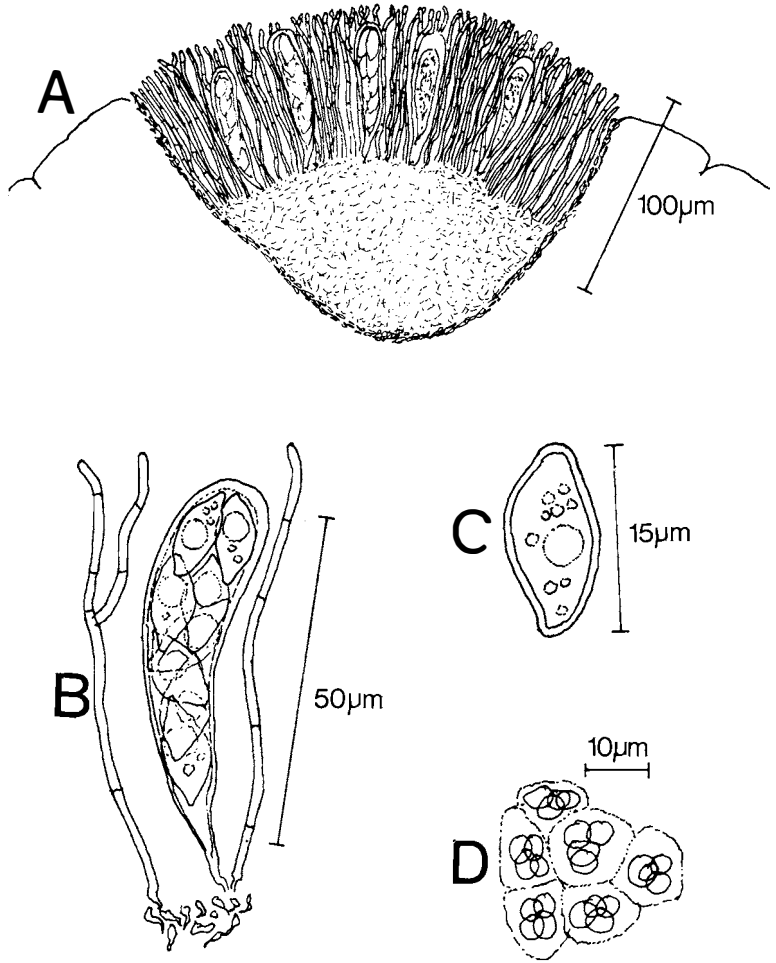
Distribution: So far known only from Bouvetøya.

Buellia anisomera Vain.

Thallus pale sulphur yellow, effuse, up to 2 cm in diameter, 0.6–0.8 mm thick, rimose-areolate with undulating to irregular sides of the areolae. Prothallus not observed.

Apothecia black, sessile, up to 0.8 mm diame-

Fig. 3. *Bouvetiella pallida*.
 A. Section of apothecium.
 B. Ascus and paraphyses.
 C. Ascospore. D. Cells of phycobiont.



ter, at first plane and indistinctly marginate, with age becoming slightly convex and immarginate. Excipulum 60–80 µm thick, dark brown. Hypothecium 200–300 µm high, dark brown. Hymenium 100 µm high. Paraphyses simple, but often divided in upper part; end-cell capitate, about 4 µm, and dark brown in upper part. Asci clavate, 80–90 × 15–18 µm. Spores hyaline, 1–2 septate, narrowly ellipsoid, 20–22 × 6–7 µm.

Chemistry: Arthothelin + one unknown substance.

Habitats: Restricted to the south coast on the nunatak of Moseryggen, growing on exposed boulders and dry screes, about 270 m above sea level (014, 016.3, 383).

Distribution: Recorded from the west side of the Antarctic Pen. as far south as Marguerite Bay, South Orkney Is., South Shetland Is. (Lamb 1968), South Sandwich Is. (Lindsay 1971), and South Georgia (Lindsay 1973).

Buellia babingtonii (Hook. fil et Tayl.) Lamb ex Dodge

Thallus mainly subeffigurate, growing in rosettes up to 4 cm in diameter. Prothallus pale brown to black-brown. Areolae crowded, grey to grey-brown, marginally slightly elongate and radially orientated. Apothecia black, sessile, 0.4–0.8 mm in diameter, thin but mostly distinct margin.

Excipulum proprium mostly thin, 50 µm, pale brown, surface cells dark brown, pseudoparen-

chymatous. Hypothecium brown, 130–160 μm high, composed of pseudoparenchymatous cells, downwards often ending with one or two rows of enlarged, dark brown cells. Hymenium colourless, 90–110 μm high. Paraphyses straight, often branched in upper part, end cells and subtending cell(s) enlarged, end cell brown, 4.5 μm diameter. Spores orbicular to slightly curved, brown, uniseptate, 15–18 \times 9–10 μm .

Chemistry: No substance found.

Taxonomic notes: The original collection of *Buellia babingtonii* was divided into three parts: 1) formerly at Kew, later moved to BM; 2) at BM; 3) in herb. Nylander (H), sub nom. *Lecidea australissima* Nyl. Lamb (1968) saw only 2) and 3), and based his redescription of the species on 3), since 2) was in a very bad state. 1) must be the holotype of *B. babingtonii*, since there is no proof that Hooker and Taylor used the specimens 2) and 3) when describing the species.

The author has had the opportunity to study the material, 1). It contains only one *Buellia* specimen which is in a good enough state to be identified. It is found on the largest piece of rock, which also contains a *Lecidea* s. lat. The *Buellia* specimen mentioned covers an uneven surface of about 4 \times 2.5 cm. The colour is grey, with a brown tinge. The thallus is areolate, with elongated areolae, sometimes almost effigurate, at the margin. The internal parts of the apothecia are similar to what is described from the Bouvetøya specimens attributed to this species. TLC on the holotype showed no substances.

The only characters given by Lamb (1968) to differentiate *Buellia babingtonii*, *B. fulvonitescens* and *B. latemarginata* are thallus colour, chemistry, areolae configuration and prothallus. The prothallus and the configuration of the thallus are not reliable taxonomic characters as they vary even within the same specimen. The same seems to be the case with the colour, although *B. babingtonii* generally is a more pure grey than the others. This may be a result of differences in chemistry: *B. babingtonii* has no substances, while the other two have norstictic acid.

Habitats: Frequent on boulders and lava slabs on Nyrøysa proper, often associated with *Calo-*

placa sublobulata, 15–30 m above sea level (001, 091, 092, 386.3); on the ridge about 177 m above sea level (019.1, 2, 109, 215.1, 3, 216, 219, 1, 2, 220); on a mountain slope below the glacier inside Larsøya, 250 m above sea level (339), as well as on Moseryggen, 270 m above sea level (016.3, 318, 328.2, 330.1, 2).

Distribution: Lamb (1968) reported it only from the Antarctic Pen. as far south as Marguerite Bay.

Buellia bouvetii Øvst. n. sp.

Thallus crustaceus, subeffiguratus, rimoso-areolatus, areolis planis aut convexiusculis, albus vel griseoflavus; prothallus fuscus. Apothecia numerosa, 0.5–1 mm lata, nigra, primo plana et marginata, dein convexa, marginibus tandem evanescentibus. Excipulum proprium angustum, fuscum. Hypothecium fuscum. Hymenium 120–140 μm altum, epithecio fusco, HNO_3^- . Paraphyses bene capitatae. Sporae 8:nae, 18–22 μm longae, 8–10 μm latae. Pycnidia nigra, conidiis filiformibus, arcuatis, 18–20 μm longis, 0.6–0.8 μm crassis.

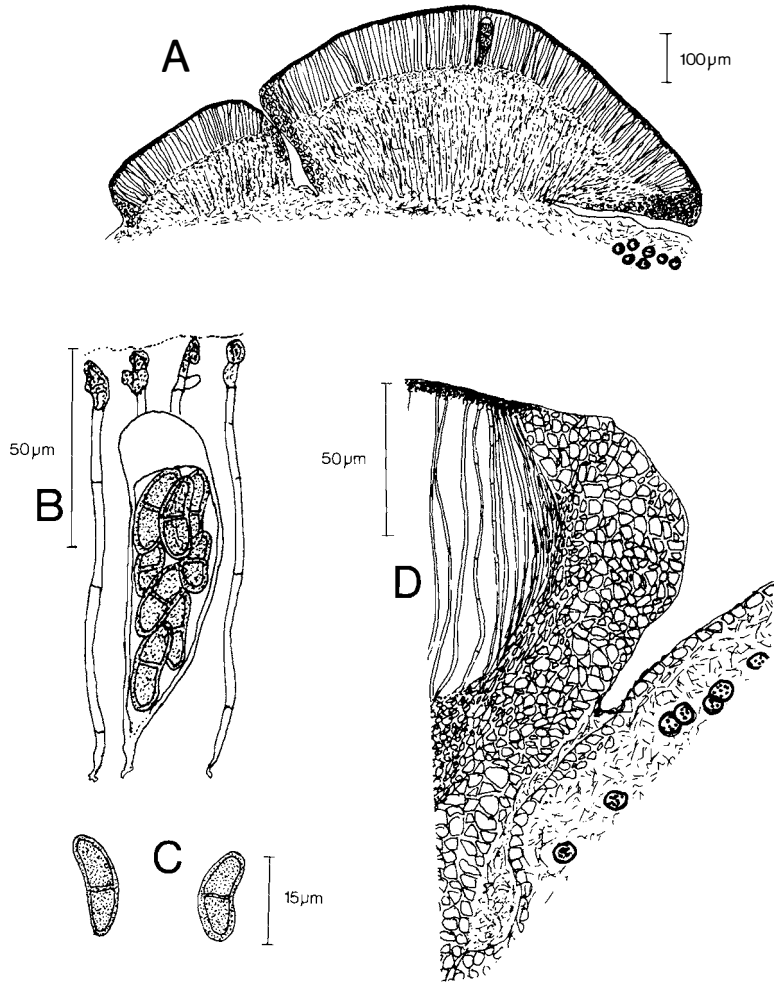
Holotypus: Bouvetøya (Insula Bouvetii), Engelskjøn 221 (vide infra).

Thallus pale yellowish ash-grey, verrucae often fused, giving the impression of a fissured thallus, on a thin filmy prothallus, with individual specimens up to 1 cm in diameter, but often several specimens emerging into one large crust.

Apothecia sessile, black, up to 1 mm in diameter, when young flat with thin margin, when old convex with no margin (Fig. 4), sometimes slightly pruinose.

Excipulum proprium thin, brown, 30–50 μm , pseudoparenchymatous. Hypothecium brown, about 250 μm high, composed of pseudoparenchymatous cells, often \pm vertically orientated, the lowermost often in rows of 1–2 dark brown enlarged cells. Hymenium 120–140 μm high, colourless except in the uppermost part which is brown. Paraphyses \pm straight, end cell and subtending cell swollen and brown, end cell 4–5 μm in diameter. Asci clavate, about 80 \times 15 μm . Spores ellipsoid, two-celled, brown, 18–22 \times 8–10 μm . Pycnoconidia filiform, curved, 18–20 \times 0.6–0.8 μm .

Fig. 4. *Buellia bouvetii*. A. Section of apothecium. B. Ascus and paraphyses. C. Ascospores. D. Section of apothecium margin (detail).



Chemistry: No substance found.

Taxonomic notes: This species bears some superficial similarity to *B. granulosa*, but differs from that species in the form of the pycnidia and the chemistry. It belongs in the «*coniops*-assemblage» (Lamb 1968). It has been compared to the type of *B. subviolascens* (Müll. Arg.) Zahlbr., a species that, according to Lamb (1968), belongs to the same group. This species, however, differs from the present one in its flat and thin, areolated thallus, and smaller and relatively broader spores (about $17 \times 10 \mu\text{m}$). It is identical to *B. coniops*, as already described by Lindsay (1973).

Habitats: Mountain ridge north of Nyrøysa, near point 177 m above sea level, on a buttress with cape pigeon nests (221, Holotypus (BG); 021, 218); Kapp Valdivia about 80 m above sea level, outermost summit of promontory, above cape pigeon nests (342.1, 2).

***Buellia falklandica* Darb.**

Thallus crustose, sordid grey-green, effuse, small-granulose to sorediate, effigurate, up to 10 cm in diameter. Prothallus when present thin, white. Soredia $78 \pm 8 \mu\text{m}$ (15 measurements).

Apothecia brown, often immersed among the thallus granules, flat to convex with thin pale

brown margin, 0.4–0.7 mm, sometimes covered in thallus granules. Disc scabrous.

Excipulum pale to dark brown, compactly cellular, 15 μm in lower part, broadening to 40–50 μm at the margins. Hypothecium dark brown, 150–200 μm high. Hymenium about 100 μm high, colourless except in upper part (about 15 μm) which is brown. Paraphyses simple or sometimes branched apically, not anastomosing. End cells slightly clavate, brown, about 3–4 μm in diameter. Asci clavate, about 45 \times 15 μm , spores 16–18 \times 7–10 μm , slightly bent, with thin wall and thin septum sometimes slightly constricted at septum.

Chemistry: No substance found, nor in the type (S).

Habitats: New ground of Nyrøysa, confined to lava slabs in snow protected depressions, 10–20 m above sea level and locally abundant (013.1–5).

Distribution: Previously recorded only from Falkland Is. (Darbishire 1912).

Buellia melanostola (Hue) Darb.

Thallus effuse, grey-brown, consisting of dispersed to crowded, thin verrucae which are imbedded in thick, black, hypothalline layer, of added thickness about 300 μm , up to 1 cm in diameter.

Apothecia black, half immersed to sessile, when sessile almost convolute, 0.3–0.5 mm in diameter with a thin, distinct margin.

Excipulum proprium up to 30–40 μm thick, consisting of pseudoparenchymatous cells. Hypothecium brown, 200–230 μm high, cells \pm globose, pseudoparenchymatous. Hymenium colourless, 70–80 μm high, except in uppermost part which is dark brown (HNO_3 + red). Asci clavate, ca. 70 \times 15–20 μm . Paraphyses slender, flexuose, end cell slightly swollen, brown, 3–3.5 mm in diameter. Spores elliptic, brown, two-celled, as young polardimorphic, at maturity 15–19 \times 8–9 μm .

Chemistry: No substance found.

Taxonomic notes: The specimens differ from the

description in Lamb (1968) in some details: the hypothalline layer is not as well developed and the thalline margin is better developed than recorded in his description. Lamb (1968) also reports a PD + yellow reaction in the cortical layer, but no substances were detected in the specimens from Bouvetøya. The type has not been available.

Habitats: On the exposed plateaux of Rustadkollen and Moseryggen, 270–320 m above sea level, on slabs embedded in lithosol (003, 007, 014, 015, 340.2).

Distribution: Antarctic Pen. (northernmost tip), South Orkney Is. (Lamb 1968), and South Georgia (Lindsay 1973).

Buellia russa (Hue) Darb.

Thallus cream-coloured to pale brown, with a coppery tinge, crustose, forming small (up to 2 mm), irregular patches along fissures in rock, areolate, individual areolae (0.4)–0.5–(0.7) mm in diameter, plane, \pm isodiametric. Prothallus very narrow, dark brown, amorphous.

Apothecia immersed when young, black, becoming sessile, round, flat to slightly convex, up to 0.7 mm in diameter, thin margin that is usually persistent.

Excipulum proprium thin, dark brown, HNO_3 + red in patches, composed of pseudoparenchymatous tissue. Hymenium colourless, about 60 μm high, HNO_3 + red in patches. Hypothecium brown. Paraphyses \pm lax, often branched in upper part, end cell slightly enlarged, about 3–4 μm in diameter, end cell and subtending cell brown. Asci clavate, about 16 \times 45 μm . Spores 8 in ascus, brown, with one septum, 15–18 \times 7.5–9 μm , usually straight but sometimes slightly curved.

Chemistry: Norstictic acid.

Taxonomic notes: These specimens were originally considered to be diminutive forms of *B. babingtonii*, but the chemical analyses showed them to contain norstictic acid, thus excluding that species. *B. latemarginata*, which also contains norstictic acid, has no HNO_3 + red reac-

tion in the excipulum and hymenium, and the thallus is also usually subeffigurate.

Habitats: The nunatak Moseryggen, about 270 m above sea level (016.3, 328.2).

Distribution: *B. russa* is a widespread and variable species in the maritime Antarctic (Lamb 1968).

Caloplaca cirrochroides (Vain.) Zahlbr.

Thallus foliose, forming small rosettes closely adherent to the rock, 5–8 cm in diameter, yellowish orange. Lobes 0.3–0.4 mm thick, individual lobes fairly distinct, radiating at the periphery. Central part becoming areolate with age. Soredia formed on the lower surface of the slightly upturned, ascending margins, later also along the margins, and old specimens may be completely covered in soredia.

Apothecia rare, 0.5 mm in diameter, concolorous with thallus. When young almost globular and perithecia-like, opening with age, sometimes ovate with disc as a slit, but normally circular with a smooth to crenulate thalline margin, sometimes sorediate and with scabrous disc.

Excipulum proprium thin, 25–30 μm , composed of long, radially orientated, densely agglutinate hyphae. Subhymenium 150–200 μm high, colourless, composed of irregular, densely agglutinate hyphae. Hymenium about 90 μm high, colourless, except in upper part where it is covered with yellow granules (about 10–15 μm). Paraphyses slender, flexuose, agglutinate, end cell slightly swollen, 3–4 μm in diameter. Asci clavate, 80 \times 15 μm . Spores polarilocular, ellipsoid, hyaline, 14–23 \times 6–9 μm with septae (3)–4–(5) μm broad.

Chemistry: No analyses.

Taxonomic notes: The material is well in accord with the type specimen (TUR).

Habitats: Very common on cliffs, precipices and rocky promontories of the north and west coast at all levels (019, 020, 021, 077, 083, 218, 219, 269, 324, 325, 336, 337, 341.1, 342, 343).

Distribution: Antarctic Pen.; South Shetland Is. (Dodge 1973), South Orkney Is. (BG), Beauchêne I. (Smith, pers. comm.), and Marion I. (Lindsay 1976 a).

Caloplaca sublobulata (Nyl.) Zahlbr.

Thallus orange, rosette-like, up to 5 cm in diameter. Centrally with flattened areolae 0.3–0.5 mm in diameter, marginally often with thin, fused marginal lobes on a white hypothallus; in some cases completely suffused in an amorphous structure with no individual lobe-differentiation.

Apothecia orange, up to 2 mm, often crowded, particularly in the centre of each thallus, innate when young, emerging from verrucae, sessile at maturity. Thalline margin rather prominent in young apothecia, at maturity thin and irregular. Disc slightly convex and scabrous, darker than the margin.

In section, thallus 200–300 μm thick, with a distinct cortex about 50 μm thick, composed of rather irregular ellipsoid cells. Algal layer about 100 μm thick with trebouxioid phycobiont, individual cells 12–15 μm in diameter; not sharply differentiated from the medullary layer which is composed of densely woven hyphae about 4 μm broad.

Excipulum thallinum about 100 μm thick. Excipulum proprium 25–40 μm thick, consisting of densely agglutinated periclinal hyphae. Hypothecium hyaline, up to 140 μm broad centrally, but narrowing towards the margin, composed of intricately woven hyphae. Hymenium up to 120 μm high, colourless except in the upper part where it is orange-brown. Paraphyses simple or often apically dichotomously branched, with swollen end cells suffused with orange granules. Asci clavate, 60–70 \times 15 μm . Spores polarilocular, ellipsoid, hyaline, 15–18 \times 6–7 μm , septum 4.5–6 μm broad.

Chemistry: No analyses.

Habitats: A very common species on cliffs, precipices, rocky promontories and lithosol on the western and southern coasts, and especially a prominent colonizer on the new ground of Ny-røysa. Judged from distance observation, it also occurs at Kapp Lollo on the east coast. Ascend-

ing to 380 m above sea level (001, 009, 012, 085, 091, 092, 109, 215, 216, 219, 285, 286, 318, 330, 331, 334, 338, 339, 379, 386).

Distribution: Argentinian and Chilean Tierra del Fuego, Isla de los Estados, Falkland Is. (including Beauchêne I.), South Orkney Is., South Shetland Is. (Dodgè 1973), New Zealand, and Australia (BG).

Caloplaca tenuis Øvst. n. sp.

Thallus effusus, crustaceus, pallide ochraceo-griseus vel griseus, ab 1 cm diam., sorediatus. Soralia flava, dispersa et discreta ad confluentia. Apothecia flava, 0.1–0.2 mm diam. Thecium 90 µm altum. Hypothecium 40–80 µm altum, pallidum. Paraphysae apicae 4 µm crassum. Sporae 8, polarilocularoidae, 12–13 × 6–7 µm, septum 2.5–4 µm crassum. Holotypus: Bouvetøya (Insula Bouvetii), Engelskjøn 335 (vide infra).

Thallus crustaceus, effuse, smooth to uneven, pale ochraceous grey, up to 1 cm in diameter, with radiation fissures. Central parts areolate. Thallus with yellow pustules, 0.05–0.1 mm in diameter, breaking up into citrine yellow, flat soralia which at times become confluent. Soredia 30–40 µm in diameter.

Apothecia innate when young, sessile at maturity, 0.1–0.2 mm in diameter. Disc concave, uneven, apricot yellow. Thalline margin prominent in all stages, concolourous with or slightly paler than the disc when dry.

Thallus in section 100–150 µm. Cortex 15–25 µm, composed of short, thick-walled cells. Layer below with algae in colonies in a medullary tissue formed of thick-walled and glutinate hyphae.

Excipulum thallinum formed by pseudo-parenchymatous tissue (Fig. 5), individual cells 5–10 µm in diameter. Excipulum proprium about 25 µm thick in the thickest parts, formed by long, parallel hyphae. Hypothecium 40–90 µm high, hyaline, composed of plectenchymatous tissue. Hymenium about 90 µm high, I + deep blue, K + pink. Epithecium yellow-orange, K + pink to red. Paraphyses simple or very rarely branched, 1–1.5 µm thick, apical to subtending cells (1–2) swollen, up to 4 µm thick. Asci 50–60 × 12–15 µm. Spores polarilocular, ellipsoid, 12–13 × 6–7 µm, septum 2.5–4 µm. Pycnidia not observed.

Chemistry: Parietin.

Taxonomic notes: The combination of the small, thin, greyish thallus, the small apothecia and the

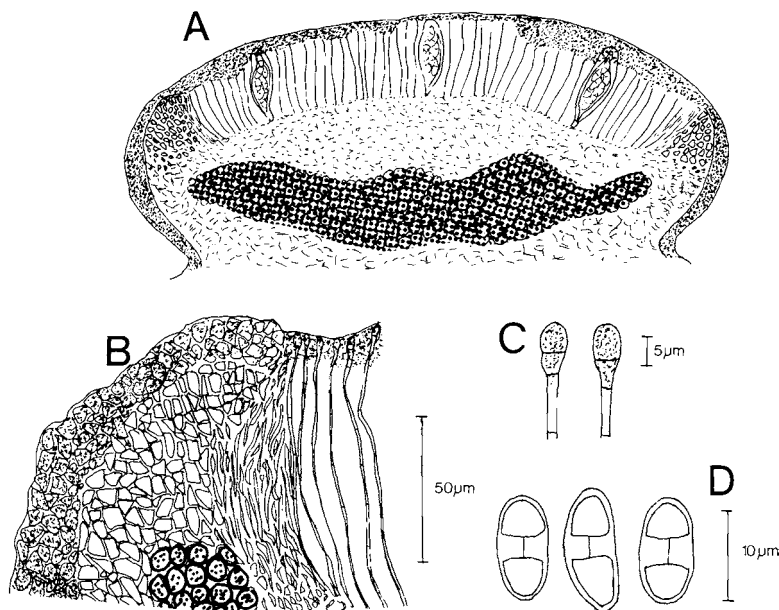


Fig. 5. *Caloplaca tenuis*. A. Section of apothecium. B. Section of apothecium margin (detail). C. Apex of paraphyses. D. Ascospores.

soralia separates this from all Antarctic *Caloplaca* species found in the literature, and in the available Antarctic material.

Habitats: New ground of Nyrøysa, middle part close to the seaward margin. Restricted to an extensive north-facing boulder surface, 20 m above sea level (335, Holotype (BG) and Isotypes).

Distribution: Provisionally considered restricted to Bouvetøya.

Huea grisea (Vain.) Lamb

Small pulvinate tufts, about 0.5–1 cm in diameter, usually grey-brown but sometimes clear brown and with waxy, sometimes greenish hue, composed of rounded to digitate papillae, each about 110 μm in diameter (Fig. 6), with an about 15 μm thick cortex, rather irregular and with an outer amorphous layer.

One young apothecium was found and squashed. The spores observed were ellipsoid, hyaline and polarilocular, measuring about 15–20 \times 8–10 μm .

Chemistry: No substance found.

Taxonomic notes: Dodge (1973) claims that the basionym *Pertusaria grisea* Vain. could be a synonym of *Huea coralligera* (Hue) Dodge & Baker or just a variation of *Pertusaria corallophora* Vain. Vainio's types of these two species were examined. They are tiny and sterile, but undoubtedly represent two different species. The type of *P. corallophora* has coarse isidia and a distinct cortex, very like that found in *Pertusaria* s. str. The type of *P. grisea* has the typical waxy hue, due to the outer amorphous layer of the cortex and low brownish papillae, just as in the Bouvetøya material. As Vainio's name is the oldest, it cannot possibly be a synonym of *Huea coralligera*. The opposite is much more likely. Although Hue's type has not been available, Lamb is probably correct in this matter, since no other papillate *Huea* species is known in the region, and since Hue's description (1915) compares well with the material from Bouvetøya.

The diameter of papillae of 30 fertile speci-

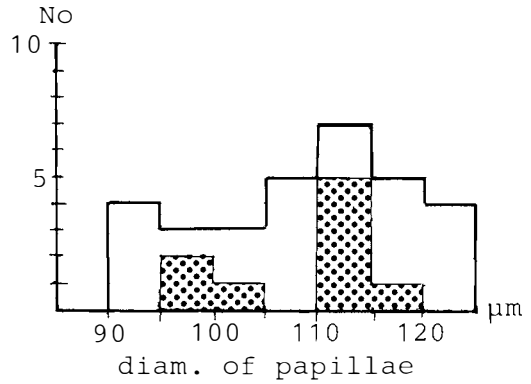


Fig. 6. *Huea grisea*. Distribution of papillar size (diameter of papillae).

▨: Specimen from Bouvetøya.

□: Specimen from the Antarctic Pen.

mens from Galindez I., Bourgeois Fjord and Berthelot I., all Antarctic Pen., was measured and compared with measurements of the same species from Bouvetøya (Fig. 6); they are of the same size.

The genus *Huea* is here only provisionally accepted, although the grey thallus and the distinctly lecideine, black apothecia obviously separate it from most *Caloplaca* species. As pointed out by Poelt & Hafellner (1980) there are, however, some questions; one being that the type of the genus, *Huea flava* Dodge & Baker, appears from the description to be quite different from the others.

Habitats: On rock, rarely also on necrotic turf, on the southwest side of Rustadkollen (107) and on Moseryggen (016.2, 315), 270–310 m above sea level.

Distribution: Antarctic Pen. (Dodge 1973, also material in BM), South Orkney Is. (BG).

Lecania gerlachei (Vain.) Darb.

Thallus squamulose, greyish ochre to dark grey-brown, up to 10 cm in diameter. Individual lobes up to 1 mm wide, flattened and distinct in marginal parts, often pruinose. Lower surface whitish to pale ochre with white rhizinae, sometimes protruding from the thallus margin. In the inner part of the thallus there are sometimes subfruticose, terete lobes.

Apothecia lecanorine, up to 3 mm in diameter. Disc brown to blackish, sometimes bluish pruinose. Thalline margin thick, granulose, concolourous with the thallus.

Excipulum thallinum about 250 μm , with a 40 μm colourless cortex. Hypothecium colourless, 150–180 μm high, of irregularly orientated, long hyphae. Hymenium about 70 μm high, with a 10 μm high, pale brown epithecium Paraphyses lax, often branched; end cells lightly enlarged, measuring 3–4 μm . Asci clavate, 40 \times 10–15 μm , Spores (10)–14–15–(18) \times 4–5 μm .

Chemistry: No substance found.

Taxonomic notes: The Bouvetøya material is quite uniform and matches the type in all details. It appears superficially to be different from *Lecania brialmontii* (Vain.) Zahlb, which is a species with fruticose thallus and terete, ramulose branches differing from the flat squamulose ones of *L. gerlachei*. This difference is also present in material from areas where both species are present.

Lamb (1948 b) has re-examined the distinguishing characters listed by Vainio, and added two. He concluded that there is only one, variable species present. Both types as well as many specimens named «*Thamnolecania*» were examined in the course of the present study. It was found that the difference in spore-size recorded by Vainio (1903) is valid. Although there is a slight overlap, the spores of *L. gerlachei* are usually 15 μm long, while those of *L. brialmontii* are 20 μm (Fig. 7). It is therefore concluded that the species can be kept separate.

These species are referred to *Lecania* s. lat. rather than *Thamnolecania*, since the growth form of the thallus is not so taxonomically important.

Habitats: Common on the west coast, especially on mountain ridges, larger boulders, and manured cliffs around the new ground of Nyrøysa; also occurring as a colonizer. Collected in several localities from 5 m to 200 m above sea level (004, 006, 012, 019, 078, 079, 080, 082, 083, 086, 087, 109, 218, 266, 269, 290, 299, 303, 332, 337, 338.3, 386).

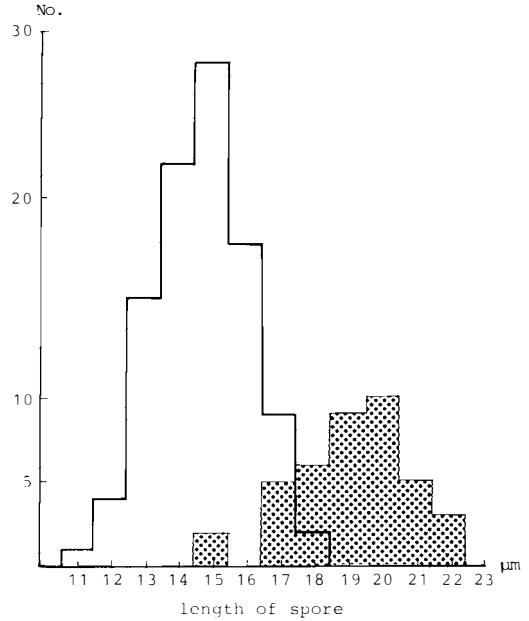


Fig. 7. Distribution of spore size in two *Lecania* spp.
 ▨: *L. brialmontii* from the western maritime Antarctic.
 □: *L. gerlachei* from Bouvetøya.

Distribution: Antarctic Pen., South Shetland Is. (Dodge 1973), and South Georgia (AAS).

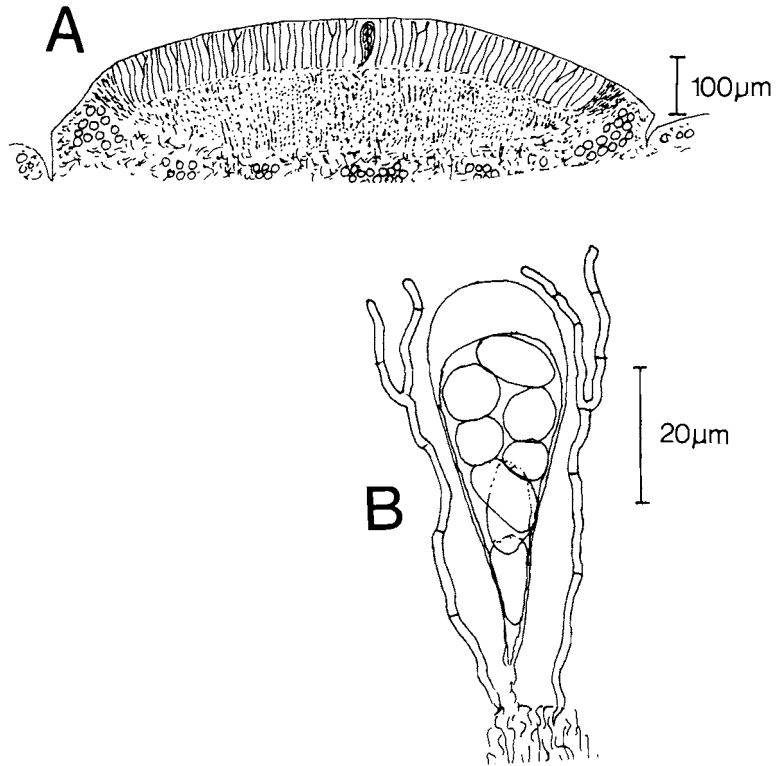
Lecanora sp.

Thallus crustose, cracked, pale ochre to brown-grey, up to 1 cm in diameter. Apothecia lecanorine, thalline margin rather indistinct (Fig. 8) and of the same colour as the thallus. Apothecia developing from thallus verrucae with age separated from the thallus by cracks.

Thallus in section 250–300 μm thick, with pseudoparenchymatous cortex; outermost cells pale brown, below colourless, individual cells about 6 μm in diameter. Medulla composed of \pm densely interwoven, long hyphae with trebouxoid algae, individual cells 5–8 μm in diameter.

Excipulum proprium 20–30 μm , colourless, composed of radially orientated hyphae. Hypothecium pale yellowish, up to 150 μm wide, composed of \pm vertically orientated, agglutinate hyphae. Hymenium about 100 μm high, colourless. Paraphyses slender, flexuose, often branch-

Fig. 8. *Lecanora darbshirei*.
 A. Section of apothecium.
 B. Ascus and paraphyses.



ed; end cell not swollen, about 1 µm diameter. Asci clavate, 50–60 × 16–19 µm, apically thickened with an amyloid tholus. Spores 8 in ascus, simple, colourless, 10–14.5 × 5–7 µm.

Chemistry: No substance found.

Taxonomic notes: This taxon belongs in the genus *Lecanora* s. lat., although the apothecia do not have a distinct thalline margin. It looks like pale forms of *Lecanora badia* from shaded habitats, and some of the internal structures are somewhat like those recorded by Eigler (1969) for that species. It differs, however, in some characteristics, the most important being the paraphyses which are much stouter, normally sparsely branched and with a swollen end cell in *L. badia*, a species which also normally contains lobaric acid.

Treatment of the genus *Lecanora* is particularly difficult concerning the Antarctic region, since most types of the many species described by Darbishire, Dodge, Hue and Zahlbruckner have been impossible to obtain on loan.

Habitats: Rustadkollen, in the lithosol understorey of *Usnea* vegetation, 310 m above sea level (099).

Distribution: South Orkney Is.; Signy I. (AAS) is the only hitherto recorded station outside Bouvetøya.

Lecanora cf. *lavae* Darb.

Thallus poorly developed as a very thin film of irregularly arranged, pale hyphae enclosing algae and mineral crystals. No cortex observed, and sometimes without any visible thallus.

Apothecia often clustered (cauliflower-like), up to 3 mm in diameter, slightly stalked (Fig. 9). Disc dark or reddish brown, flat to slightly convex, sometimes pruinose. Thalline margin rather thick, ± crenulate, pale grey.

Excipulum thallinum 40–60 µm thick. Excipulum proprium 10–15 µm, composed of elongated cells running parallel to the paraphyses, best developed in the upper part of the margins. Hypothecium 15–20 µm high, hyaline,

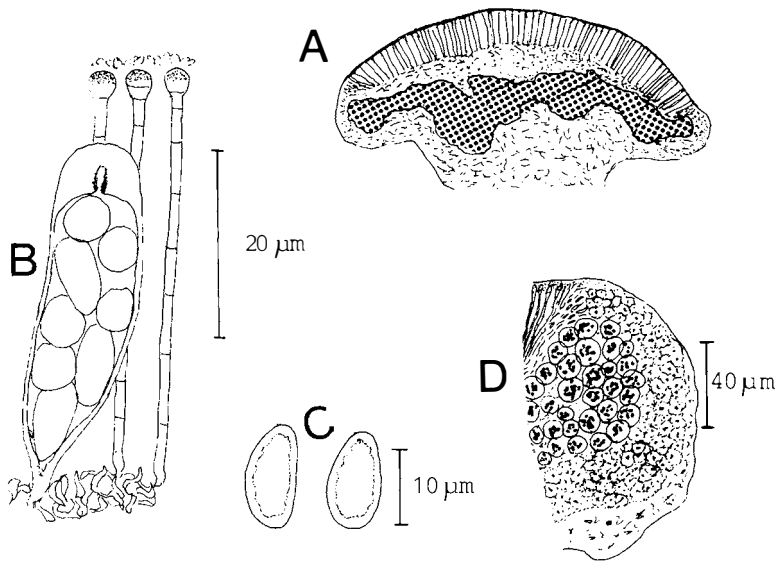


Fig. 9. *Lecanora* cf. *lavae*.
 A. Section of apothecium.
 B. Ascus and paraphyses.
 C. Ascospores.
 D. Section of apothecium margin (detail).

composed of irregular to \pm isodiametric, agglutinated cells. Hymenium $60 \mu\text{m}$ high, colourless except in the upper part ($5\text{--}10 \mu\text{m}$), tips thickened, with an amyloid tholus. Spores simple, hyaline, ellipsoid, $10\text{--}15 \times 5\text{--}7 \mu\text{m}$.

Chemistry: No substance found.

Taxonomic notes: The specimens vary somewhat in the degree of development of the thallus. This is never so well developed as indicated in the description of Dodge (1973). However, Darbishire (1910) describes a «granular mass of sterile tissue containing gonidia» which is similar to that found in specimens from Bouvetøya. The characters of the apothecia are also very close to the original description, except that the spores are slightly larger than described originally. Since type material has not been located at BM, BRISTOL, UPS, or S, the identification is not quite certain.

Habitats: Widely dispersed, but seldom abundant, on the west and south coasts; on exposed cliff and boulder surfaces under a slight influence of bird droppings, from 5 m to 270 m above sea level. A frequent colonizer on the new ground of Nyrøysa (001, 002, 009, 216, 269, 285, 286, 331, 335, 337, 338, 386).

Distribution: Antarctica from Ross I. to Knox Coast (Dodge 1973), and Beauchêne I. (Smith, pers. comm.).

Lecidea aff. *aglaea* Sommerf.

Thallus areolate, only a thin crustaceous border surrounding the apothecia, greyish white. A very thin black prothallus present. Apothecia up to 1.4 mm in diameter, with a \pm flat, black to brown-black (when wet), scabrous disc. Margin indistinct.

Thallus in section up to $200 \mu\text{m}$ thick, with a distinct cortex $30\text{--}40 \mu\text{m}$ broad, composed of isodiametric cells, on the outer side with an uncoloured, necrotic layer. Medulla composed of loosely interwoven, short hyphae. Algae trebouxoid, individual cells $5\text{--}8 \mu\text{m}$ in diameter.

Excipulum very thin, difficult to define, not distinct from the hypothecium. Hypothecium $30\text{--}40 \mu\text{m}$, pale, composed of irregularly orientated, short, \pm agglutinate hyphae. Hymenium $60\text{--}70 \mu\text{m}$ high, hyaline except in the upper part, $8\text{--}10 \mu\text{m}$, where it is emerald green-coloured. Paraphyses slender, simple or rarely branched, $1.7\text{--}2.5 \mu\text{m}$ in diameter, apically only slightly swollen, up to $3.5 \mu\text{m}$. Asci clavate, $50\text{--}60 \times 18\text{--}20 \mu\text{m}$, with a weakly amyloid tholus and with a thin amyloid apical cap. Spores ellipsoid

to oblong-ellipsoid, 8.5–15 µm. Pycnidia not seen.

Chemistry: No substance found. Cortex and medulla I+ dark violet.

Taxonomic notes: This taxon seems to be related to *Lecidea aglaea* (H. Hertel, pers. comm.). It differs, however, in some details, the most obvious being the I+ violet reaction of the cortex and medulla. Also, the spores are more slender, and the paraphyses are more or less unchanged in KOH.

Habitats: Rustadkollen, on slabs and lithosol about 330 m above sea level (317.2).

Distribution: Because the determination is provisional, it is only noted that *L. aglaea* was described from the Northern Hemisphere.

«*Lecidea*» sp.

Thallus greyish white, sometimes ochraceous, relatively thick (up to 0.3 mm), rimulose, effuse and up to 4 cm in diameter. Prothallus normally well developed, black. Apothecia black, often angulate, up to 0.6 mm in diameter, sessile and often crowded, with a thin, protruding margin.

Thallus in section showing no differentiated cortex, but with a amorphous, thin, colourless layer above a layer of vertically orientated hyphae, 50–80 µm high. Medullary layer of rather loosely interwoven hyphae with protococcoid algae.

Excipulum black, up to 50–60 µm broad. Subhymenium colourless, 80–90 µm thick, composed of densely crowded, irregularly arranged hyphae, the upper part including large groups of orange pigmented cells. Hymenium colourless, 70–80 µm high, upper part brown-black. Paraphyses slender, 1–2 µm in diameter, simple, agglutinated with slightly swollen dark end cells, 3.5–7 µm in diameter. Asci 40–50 × 10–15 µm, with a distinct amyloid tholus. Spores hyaline, simple 10–16 × 5–7.5 µm.

Chemistry: Atranorin, medulla I+.

Taxonomic notes: The generic affinities of this taxon is at present under study (H. Hertel, in litt.).

Hertel, who examined the material, reports that this may be a new species, the description of which awaits closer examination of more material from other austral islands.

Habitats: Confined to Moseryggen on the south coast, where it seems to be quite frequent on dry, northeast-facing scree slabs as well as on the very summit point, from 270 m to 287 m above sea level (340, 383, 397.1).

Distribution: South Shetland Is. and Heard I. (H. Hertel, in litt.) in addition to Bouvetøya.

Lecidella bullata Körb.

Thallus pale grey, crustose, up to 1 cm diameter. Areolae bullate, up to 1.5 mm thick. Prothallus not observed.

Apothecia black, up to 1.2 mm in diameter, when young flat with prominent and slightly protruding margin, when old convex with margin excluded. Excipulum 30–40 µm, brownish, composed of elongated, closely agglutinated cells, radially orientated. Hypothecium colourless, composed of ± vertical, slender hyphae with inspersed crystals (oil droplets?). Hymenium 65–70 µm high, colourless except in the upper part (about 15 µm), where it is blue-green to dark brown. Paraphyses thin, 1.5–1.8 µm, simple, with slightly enlarged end-cell. Asci 40–50 × 12–13 µm, with amyloid tholus. Spores hyaline, simple, ellipsoid, $12.67 \pm 1.39 \times 5.46 \pm 0.40$ µm (12 measurements).

Chemistry: Atranorin, zeorin and two unknown substances, corresponding well with finds of Huneck et al. (1984).

Taxonomic notes: The material is morphologically indistinguishable from Northern Hemisphere specimens but differs chemically, cf. Hertel (1977). Presently, the Antarctic material can be interpreted as a chemotype of the main species.

Habitats: High ground of the south coast (Rustadkollen and Moseryggen), a frequent accessory species on exposed basalt boulders and lithosol, 270–310 m above sea level (016.2, 3, 056, 328.2, 3).

Distribution: Widespread in the Northern Hemisphere (Hertel 1977). Its occurrence on Bouvetøya was the first austral record having been previously reported by Hertel (1981).

Microglæna cf. *mawsonii* Dodge

Thallus crustose, effuse, olive brown, up to 1 cm in diameter, cracked. Fruitbodies shiny black, conical perithecia with depressed ostiole, 0.30–0.35 mm in diameter, almost superficial.

Thallus up to 300 µm high, in section mostly with three layers. The uppermost about 15 µm high, amorphous (probably necrotic). Below that, a brown layer, composed of ± round, weakly agglutinated cells. The lowest layer, the medulla, is partly composed of cells similar to that of the middle layer, partly of elongate, interwoven hyphae. Green algae, about 5 µm in diameter, in the two uppermost layers. Semi-opaque crystals were found through most of the thallus section.

Involucrellum consisting of dark, short, thick-walled cells, merging gradually into the thalline tissue. Excipulum pale yellow, formed of tangential hyphae, with oblong cells which become rectangular in the lower part. Periphyses few, short, flexuose. Paraphyses branched, not capitate, about the same length as the mature asci, septated with septa ca. 2 µm apart. Asci I—, thin-walled, ca. 120 × 30 µm, without tholus. Spores 8 in ascus, ellipsoid, muriform, colourless, 30–40 × 14–17 µm.

Chemistry: No analyses.

Taxonomic notes: The Bouvetøya specimen keys out as this species in Lindsay's treatment (1976 b) of the genus in Antarctica. *M. mawsonii* is described by him as having smaller perithecia, 0.20–0.25 mm. However, the size of the perithecia is not definitely stated in the original description of *M. mawsonii* (Dodge 1948).

Another Antarctic species, *M. kerguelana* (Nyl. ex Cromb.) Zahlbr., has perithecia of the same size as our material. However, the spores are significantly smaller in that species, 16–25 × 7–10 µm. As the characteristics of the present material are the same as the description of *M.*

mawsonii, it has been tentatively placed in that species, although the type has not been available for study.

Habitats: Only found on the high ground of Rustadkollen, on windexposed lithosol, about 330 m above sea level (317.1).

Distribution: Previously recorded only from Kerguelen (Dodge 1948).

Ochrolechia parella (L.) Mass.

A sterile, white crust, found in one locality.

Chemistry: Variolaric acid.

Taxonomic notes: Øvstedal (unpublished) reduced both *Ochrolechia antarctica* Müll. Arg. and *O. deceptionis* Darb. to synonyms of *O. parella*. All these taxa contain variolaric acid. The thallus from Bouvetøya is similar to material seen from South Shetland Is., South Orkney Is., South Georgia, and Falkland Is. The distinctive chemistry must be regarded as an indication that it belongs to this genus, even if variolaric acid is found in some *Pertusaria* spp. (Hanko 1983).

Habitats: Mountain ridge above Nyrøysa, 177 m above sea level, on a lava buttress; local and sparse (220).

Distribution: Bipolar, in the Antarctic region known from South Orkney Is., South Shetland Is., South Georgia, and Falkland Is., according to own revisions.

Placopsis contortuplicata Lamb

Thallus pale ochre to white, up to 1–2 mm thick, effigurate, up to 10 cm in diameter, growing tightly attached to the rocks and stones; sometimes more loosely over necrotic bryophytes. Individual lobes in the marginal parts usually confluent and rather indistinct, separated only by folds. Inner part of thallus contorted-verrucose, nearly cerebriform. Cephalodia red-brown, up to 4 mm brown, effigurate. Apothecia often abundant, up to 4 mm in diameter. Thalline margin well developed, 0.5 mm thick, and con-

colourous with the thallus, excluded in large apothecia. Disc concave, scarlet; red-brown and faded in dried material. Spores 18–20 × 9–10 μm.

Chemistry: Gyrophoric acid.

Habitats: Confined to the high ground of the south coast, especially frequent on exposed lithosol on the summit plateau of Rustadkollen, 330 m to 340 m above sea level (018, 317, 320), and on southeast-facing cliffs on the nunatak Mose-rygen, 260 m above sea level (051).

Distribution: Tierra del Fuego; Antarctic Pen. (E and W side); South Shetland Is.; South Orkney Is. (Lamb 1947), South Georgia (Smith pers. comm.).

Rhizocarpon geographicum (L.) DC. s. lat.

Thallus up to 7 cm in diameter, consisting of ± bullate, round, intensely yellow-green areolae 0.3–0.8 mm broad, 0.3 mm thick, on a black hypothallus. Medulla I+ blue.

Apothecia sparse, black, round to weakly angular, up to 1 mm, flat with a slightly protruding margin when young; convex with excluded margin when old. Disc scabrous. Excipulum proprium thin, about 50 μm, with pseudoparenchymatous cells. Subhymenium round, about 500 μm thick. Hymenium 100–120 μm high, colourless, unless in the upper part which is brown with a faint violet tinge. Paraphyses anastomosing, end cell enlarged, brown, but without distinct granules. Asci thinwalled, 100–150 × 25 μm. Spores dark, 30–34 × 12–14 μm, usually broader in one end, with 3 longitudinal septae, 3–4 transversal ones, without a distinct halo.

Chemistry: Rhizocarpic and psoromic acids which are well known components of *R. geographicum* (Huneck et al. 1984).

Taxonomic notes: The large spores and chemical characteristic place the material in the *Rhizocarpon geographicum* group. It is, however, difficult to identify further. In spite of Runemark's (1956a) thorough treatment of the European members of the group, there are still problems

with the taxonomy within its European area (Poelt 1969). The material from the Southern Hemisphere has never been critically revised, and several species which obviously belong in the *R. geographicum* group have been described from that region.

The Bouvetøya material is uniform and keys out as *R. nidificum* (Hue) Darb. in Dodge (1973). However, Hue (1915) and Dodge (1973) remark that the medulla in this species should be I–, and the paraphyses should have fuscous granules. *R. melanostictum* (Hue) Darb., according to the description of Dodge (1973) differs from the Bouvetøya material only in the higher hymenium and the thicker areolae. The types have, unfortunately, not been available for study. It is therefore also difficult to relate them to the system proposed by Runemark. However, our material appears to match ssp. *prospectans* (Räs.) Hawksw. & Sowter fairly well, as also noted by Runemark (1956a) for the type of *R. geographicum* var. *falklandicum* Räs. It is perhaps noteworthy that *R. geographicum* on Bouvetøya grows together with *Lecidella bullata*, a species with its main distribution in the Northern Hemisphere.

Habitats: Restricted to the nunatak of Moserygen, on a solitary basalt boulder on the summit ridge, 270 m above sea level. Grows abundantly with several other crustose lichens, particularly *Lecidella bullata* (016, 315, 327, 328).

Distribution: Widespread (Runemark 1956 b). Taxa of this group are recorded from several parts of the Antarctic and nearby regions. Ssp. *prospectans* appears to have an oceanic trend in its distribution (Runemark 1956 b).

Rhizoplaca melanophthalma (Ram.) Leuckert & Poelt

Thallus yellow-green, weakly lobate, up to 4 mm in diameter. Apothecia crowded, often completely obscuring the thallus, up to 2 mm in diameter. Disc colour varying from pale yellow-green to blackish brown. Thalline margin inconspicuous in mature apothecia.

Thallus in section up to 250 μm thick, with a cortex mainly composed of two rows of rectangular, closely agglutinated cells, of thickness up

to 30 μm . Medulla composed of unorientated, loose hyphae. Algae trebouxoid, individual cells 15–20 μm in diameter.

Excipulum up to 100 μm broad, in upper part without algae, composed of radially orientated hyphae. Subhymenium up to 60–70 μm high centrally, composed of irregular, loose hyphae. Hymenium 50–90 μm high, colourless except in the upper part, which is aeruginose. Paraphyses stout, about 2 μm broad, often branched and apically enlarged up to 3 μm . Asci broadly clavate, 30–40 \times 15 μm , with a distinct amyloid tholus. Spores hyaline, simple ellipsoid and thick walled, 11.5–14 \times 5.5–7 μm .

Chemistry: Usnic acid, zeorin, rangiformic and norrangiformic acids.

Taxonomic notes: Dodge (1973) records ten species of this genus (as *Omphalodina*) from the Antarctic. The taxonomy is based on colour of the disc and of the thallus, size of the apothecia, thickness of hymenium and size of the spores — all characteristics known to be variable also in material from the Northern Hemisphere. On 1 cm^2 in a growth of *R. melanophthalma* from Bouvetøya there is a variation in the disc colour from green to light brown, dark brown and blackish, just as observed by Filson (1966). The same wide variation is seen in the size of apothecia and the hymenium thickness. Material from the Antarctic Pen. and Dronning Maud Land (Vestfjella) has also been examined. This falls within the same variation and has the same characteristic chemistry. Although none of the types of the species recognized by Dodge (1973) could be examined, it is most probable that the number of Antarctic species would be considerably lower than asserted by him.

It is also difficult to clarify the position of the material in comparison with the Northern Hemisphere representatives. There, the species is variable with respect to morphology and chemistry (Leuckert & Poelt 1978). As in *Acarospora macrocyclos*, the Antarctic material shows characters which are almost all present in northern material, but in differing combinations. The Antarctic material usually displays small thalli with depauperate lobes, which may be caused by the extreme growth conditions. Chemically it is distinct

from northern material (cf. Leuckert & Poelt 1978) in containing zeorin and two fatty acids. It is best regarded as a chemotype of the aggregate species *R. melanophthalma*.

Habitats: Confined to the high ground of the south coast, usually on exposed boulders and slabs, and rather frequent on Rustadkollen (005, 007) as well as on Moseryggen (334, 338, 412) between 270 and 320 m above sea level.

Distribution: Bipolar. Known in several forms of uncertain taxonomic status from all over the Antarctic region, according to own revisions.

Rinodina deceptionis Lamb

Thallus crustose, areolate, grey, 0.5–1.0 mm thick, 6–7 cm in diameter, diffuse. No individual lobes, but the whole thallus transected by \pm deep fissures.

Apothecia numerous, at first aspicilioid, but later often emerging and becoming rounded or irregularly angulose, 0.3–0.6 mm broad with distinct thalline margin concolourous with the thallus. Disc black.

Excipulum thallinum about 100 μm broad, with prominent algal layer. Cortex with thick-walled agglutinated cells, brownish outwards and having a white necrotic layer on the surface. Excipulum proprium clearly differentiated only marginally, composed of long, somewhat irregular hyphae, orientated parallel to the paraphyses, up to 40 μm broad, peripherally brown. Subhymenium hyaline, 80–100 μm , composed of irregular, short hyphae. Hymenium 80–100 μm thick, hyaline except in upper parts where it is brown. Paraphyses simple, 1.5–2 μm thick, end cell swollen, 3.5–4 μm in diameter, brown pigmented. Asci about 75 \times 20 μm . Spores 20–25 \times 11–13 μm , of the dubyana type (Mayrhofer & Poelt 1979), with septum smaller than the spore diameter, so that a thickening is formed around the septum. There are often extensions at the spore ends, but with no special colour differentiation. The lumen is sometimes small and multi-angled.

Chemistry: Three terpenes, one of which is zeorin. The holotype (FH) proved to have the same chemical pattern.

Taxonomic notes: The restricted material from Bouvetøya has been compared with the type, and found to be identical in all essential characters. The only difference found is in the shape of apothecia. They are more appressed in the type and have a more circular outline than the Bouvetøya specimen, a character probably depending on the stage of development.

Habitats: Only found on the northwest promontory of Kapp Valdivia, where it is confined to an exposed rhyolite buttress, 80 m above sea level (325.1).

Distribution: Described from the South Shetland Is. (Lamb 1968) and also recorded from South Georgia (Lindsay 1973).

Rinodina turfacea (Wahlenb.) Körb.

Thallus poorly developed, completely obscured by the apothecia. Apothecia 0.5–0.8 mm in diameter, scutelliform with a prominent brownish thalline margin. Disc blackish, scabrous.

Thalline margin about 100 µm, with thick-walled, agglutinate hyphae, containing trebouxoid algae, individual cells about 12 µm in diameter, bounded by a cortical layer about 30 µm thick. Excipulum 10–15 µm in upper part, widening to 60 µm at the margin. Hypothecium about 30 µm high, colourless, composed of ± agglutinated globular cells. Hymenium 60 µm high, pale except in upper part where it is brownish. Paraphyses thin, flexuose with slightly enlarged end-cells 2.5–3 µm in diameter. Asci clavate, 60 × 20 µm. Spores brown, ellipsoid, transversely 1-septate with thickened (2–3 µm) septum and pale, swollen ends, 26–28 × 10–11 µm; when old the spores are thin-walled and with marked, often central, oil droplets.

Chemistry: No substance found.

Taxonomic notes: The material is similar to specimens from the Northern Hemisphere, superficially, and in all the important internal characteristics as well. It is difficult to interpret Dodge's (1973) treatment of large-spored Antarctic *Rinodina* species. He proposed that there are three separate species, none of which is referable to *R. turfacea*.

Habitats: Found as an accessory species in moss turf vegetation on the exposed plateaux of Rustadkollen (032.1–5) and Moseryggen (045). Locally, it may predominate on stable soil in areas of patterned ground.

Distribution: Bipolar (Lamb 1968). In the Antarctic recorded from Antarctic Pen., South Shetland Is., South Orkney Is. (Lamb 1968), and Greater Antarctica (Filson 1975; Lamb 1968 loc. cit.), as well as from South Georgia (Lindsay 1973).

Verrucaria dispartita Vain.

Thallus thin, 0.1–0.3 mm, black. Normally 1–2 cm in diameter, rarely as wide as 7–8 cm. Usually as small, confluent patches, sometimes with rimose to areolate thallus. Surface minutely roughened.

Perithecia black, 0.2 mm in diameter, emergent about half. Excipulum brown, 20–25 µm broad, with broad rectangular cells 6 × 4 µm. Paraphyses crowded in the upper part of the perithecium, mostly unbranched and stout. Asci clavate, 30–40 × 10 µm. Spores simple, hyaline, 8.5 × 5–7 µm.

Chemistry: No analyses.

Taxonomic notes: The material varies according to the development of the thallus. Lamb (1948a) had apparently seen only less well developed specimens. As pointed out by him, the species is close to *V. microspora*. The Bouvetøya specimens have, however, a different habit and differ from *V. microspora* also in the minutely roughened thallus and surface of perithecia, a difference already noted by Lamb.

Habitats: On cliffs, rock surfaces, and basalt or rhyolite slabs. Dispersed from Kapp Valdivia on the north coast (80–100 m above sea level), on the mountain ridge about 177 m above sea level of Nyrøysa, throughout the shore cliffs of Nyrøysa, and rather unexpectedly also collected on the high ground of Rustadkollen, 320 m above sea level (005, 019, 020, 325, 343).

Distribution: Antarctic Pen. (Lamb 1948a) and South Orkney Is. (Øvstedal, unpublished) apart from Bouvetøya.

Verrucaria elaeoplaca Vain.

Thallus about 0.5 mm thick, 1.5–2.5 mm in diameter, pale ochreous, fissured. Perithecia immersed half to one third. Ostiole somewhat depressed. Involucrellum pale brown, about 30 µm in the upper part. Excipulum about 30 µm broad, hyaline, composed of rectangular cells, 7–8 × 2–3 µm. Periphyses crowded in upper part of the perithecium, rarely branched, 1–1.2 µm thick. Asci clavate, thin-walled, about 50 × 20 µm. Spores 10.5–13 × 7–8 µm.

Chemistry: No analyses.

Taxonomic notes: This species belongs to the difficult *tesselatula* group. It appears to differ from the other entities of this complex by its larger perithecia, smaller spores, different ecology (Lamb 1948a), and the pale fissures. The Bouvetøya material is similar in all essential details to the type material (TUR, Herb. Vainio 30281, 30282, 30283), and has the same ecology.

Habitats: Only at Kapp Valdivia, on rhyolite slabs below cape pigeon nests, 80 m above sea level (341.1).

Distribution: Antarctic Pen. (Lamb 1948a), South Orkney Is. (Øvstedal unpublished), South Shetland Is., and South Georgia (Smith, pers. comm.).

Verrucaria mucosa Wahlenb.

Thallus 0.4 mm thick, subgelatinous, in scattered, irregular and confluent patches with a few irregular cracks, otherwise smooth, olivaceous grey.

Perithecia immersed in hemispheric warts, 0.2–0.3 mm, inner diameter about 150 µm. Involucrellum brownish above, hyaline in lower part. Excipulum 20 µm, consisting of isodiametric to short rectangular cells. Periphyses crowded in upper part, simple to sparsely branched, about 2 µm thick. Asci 35–40 × 10 µm. Spores hyaline, simple, 9–10 × 5 µm.

Chemistry: No analyses.

Taxonomic notes: The material is somewhat variable in relation to the number and nature of the

thalline fissures. Some specimens are so rimose that they have the appearance of *V. ceuthocarpa* Wahlenb. However, typical specimens of this taxon in northern Europe have clearly areolate thallus which is almost black, as well as slightly protruding perithecia which are smaller than those of *V. mucosa*. A study of the Antarctic available material has shown that specimens named *V. ceuthocarpa* are quite variable and approach *V. mucosa*. Further studies on austral material are necessary. Neither of the species are identical to material from the Northern Hemisphere. Santesson (1939) mentions specimens of *V. mucosa* from New Zealand which differ from the North European species according to the same characteristics as recorded here.

Habitats: Found on shore cliffs at Cape Circumcision (017) and Nyrøysa (333), at both places in the spray zone up to 10 m above sea level.

Distribution: Bipolar (Lamb 1948a). In the Southern Hemisphere recorded from Antarctic Pen., Fuegia, Beauchêne I., Auckland I. and Campbell I. (Lamb 1948a; Smith, pers. comm.), as well as Marion I. (Lindsay 1976) and New Zealand (Santesson 1939).

Verrucaria tesselatula Nyl.

Thallus pale brown-grey with a reddish tinge, 0.5 mm thick, with an irregular system of dark cracks.

Perithecia emergent to one third, surface dark brown, up to 0.3 mm. Involucrellum weakly developed, brown in the uppermost part. Excipulum hyaline, about 30 µm thick, composed of tangentially arranged cells, 4–5 × 5–8 µm. Periphyses crowded in upper part of perithecium, often branched, flexuose, apically about 1 µm thick. Asci clavate, 35–40 × 15–18 µm. Spores hyaline, simple 12–15 × 7–9 µm.

A somewhat different type from Kapp Valdivia has a sooty black thallus, 0.4 mm thick. The perithecia are, however, quite typical: 0.2–0.3 mm in diameter. Upper part of involucrellum brownish. Excipulum hyaline, about 25 µm thick, of oblong cells. Spores 12–15 × 7–9 µm.

Chemistry: No analyses.

Taxonomic notes: The material shows a considerable variability as to colour, rimosity and perithecia emergence, but even the extreme blackish form recorded above has fairly typical characteristics. The species has a wide ecological amplitude on Bouvetøya, which accounts for the diversity in appearance. Some measurements in the Bouvetøya population were statistically treated and the results compared with corresponding measurements of the type from Îles Kerguelen. It is evident that the samples belong to the same species.

Habitats: On shore cliffs and precipices rising from the shores as well as on rocky buttresses on mountain ridges. Very common along the coasts from Kapp Valdivia, over Kapp Circoncision, the mountain ridge 177 m above sea level, parts of Nyrøysa, and on cliffs around Aagaardbreen. Usually from near the spray zone to about 200 m above sea level. Not seen in the pioneer vegetation on the new ground of Nyrøysa, but common on old coastal stacks northwest of it (017, 019, 020, 217, 218, 324, 325, 326.1, 333, 341.2, 343).

Distribution: Probably circum-Antarctic or sub-Antarctic (Lamb 1948a).

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Lichenicolous ascomycetes from Bouvetøya*

Øvstedal, D. O. & Hawksworth, D. L. 1986: Lichenicolous ascomycetes from Bouvetøya. *Norsk Polarinstitutt Skrifter* 185, 57—60.

Five lichenicolous ascomycetes are reported from Bouvetøya (54°25'S, 3°20'E), of which three are described as new: *Clypeococcum placopsiiphilus*, *Didymella epimelanostola* and *Phaeospora subantarctica*.

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Introduction

The Norwegian Antarctic Research Expedition 1978/79 made extensive collections of Bouvetøya cryptogams. A preliminary report on the terrestrial vegetation is given by Engelskjøn (1981), botanist to the expedition.

The material of lichenicolous ascomycetes treated here was all collected by Engelskjøn and is deposited in BG. For documentation we refer to the collection numbers of Engelskjøn (1986) which are given in parantheses.

Enumeration of species

Arthonia epiphyscia Nyl.

Ascomata up to 0.2 mm wide. Ascospores $11.10 \pm 1.13 \times 4.15 \pm 0.34 \mu\text{m}$ (means \pm standard deviation, $n = 10$). Hymenium I+ vineous red. On *Physcia dubia* (Hoffm.) Lettau. This species has been thoroughly described by Santesson (1960) and Hawksworth (1975). According to Santesson (1960), it is also known from Argentina and Chile as well as the Northern Hemisphere.

Specimen examined: Nyrøysa (266).

Clypeococcum placopsiiphilus Øvst. & D. Hawksworth sp. nov.

Fungus lichenicola. Pseudothecia immersa, globosa, ostiolata, nigra, ca. 100 μm diam., in clypeo aggregata, muris textura intricata, ca. 30 μm cras-

sis, ex hyphis 2—2.5 μm constructis. Paraphyses distinctae, filiformes, ramosae et anastomosantes, 1.5—2.5 (—3) μm latae, centrum I—. Asci elongato-cylindrici, bitunicati, 85—110 \times 15 μm , 8-spori. Ascosporae ellipsoideae, 1-septatae, olivaceo-atrobrunneae, levitissimo-verruculosae, 15.5—18 \times 8—10 μm .

Holotypus: Insula Bouvetii, Rustadkollen, in *Placopsis contortuplicata*. 320.2 (BG).

Ascomata perithecioid, immersed, globose, ostiolate, no paraphyses, about 100 μm in diameter, aggregated into a clypeus, pseudothecial wall about 30 μm thick, texture, intricate, formed of

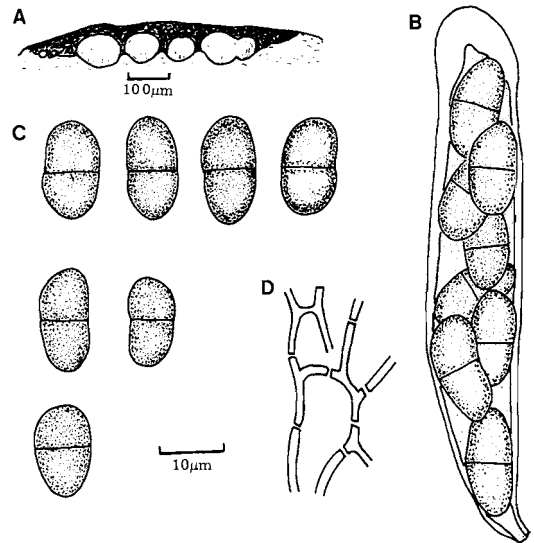


Fig. 1. *Clypeococcum placopsiiphilus* sp. nov. A. vertical section of clypeate ascomata; B. ascus; C. ascospores; D. anastomosing pseudoparaphyses. 320.2 (BG).

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Table 1. *Measurements of asci, ascospores and the lichen hosts of Clypeococcum species, given in µm.*

	<i>C. cladonema</i> (Wedd.) D. Hawksworth	<i>C. grossum</i> (Körber) D. Hawksworth	<i>C. hypocenomyceae</i> D. Hawksworth	<i>C. placopsiiphilus</i> sp. nov.
Ascospore size	14–16 × 6–7	14–17.5 × 7–9	10–12 × 5–6	15.5–18 × 8–10
Ascus size	60–70 × 10–14	c. 60 × 16	45–55 × 12–15	85–110 × 15–16
Host species	<i>Parmelia verruculifera</i> and <i>Cetrelia olivetorum</i>	<i>Umbilicaria</i> spp.	<i>Hypocenomyce scalaris</i>	<i>Placopsis contortuplicata</i>

intertwined thick-walled olivaceous brown hyphae about 2–2.5 µm thick. Paraphyses (pseudoparaphyses) distinct, persistent, filiform, branched and anastomosing, septate, 1.5–2.5 (–3) µm thick; centrum I–. Asci cylindrical, 85–100 × 15 µm, 8-spored. Ascospores irregularly distichous, ellipsoid, rounded at the apices, 1-septate, slightly constricted at the septum, dark olivaceous brown, ± smooth to slightly verruculose, 15.5–18 × 8–10 µm. In the thallus of *Placopsis contortuplicata*.

Clypeococcum D. Hawksworth (1977) differs from *Polycoccum* Sauter ex Körber primarily in that its pseudothecia are united in a clypeus and that the pseudothecial wall consists of textura intricata (Hawksworth 1980). The present species differs from the three others so far recognized in the genus in that its asci are more cylindrical and longer, the spores tend to be longer and broader, and in its different host (Table 1).

Three other taxa with brown 1-septate ascospores have been described from *Placopsis* thalli: *Polycoccum squamarioides* (Mudd) Arnold (isotype in E studied), with ascomata 75–100 µm diam., and ± smooth ascospores (18–) 19–26 × 5.5–7 (–9) µm (see also Vězda 1969); *Polycoccum gelidaria* (Mudd) D. Hawksworth (holotype in BM studied) with 4-spored asci and strongly verruculose spores about 18 × 10.5 µm; and *Microthelia perrugosaria* Lindsay (type material not traced, probably a *Polycoccum*; see Hawksworth 1985). Other reports of lichenicolous fungi in this genus are compiled by Lamb (1947). He accepted records of *Polycoccum microstictum* (Leighton) Arnold for *Placopsis*; this is a true *Polycoccum* with pseudoparenchymatous walls to the ascomata, 4–8 spored cylindrical asci, and coarsely ornamented spores 14.5–18 × 7–8.5 µm (authentic material studied). We have seen *P. microstictum* only from *Acarospora* thalli.

Didymella epimelanostola Øvst. & D. Hawksworth sp. nov.

Fungus lichenicola. Pseudothecia semiimmersa, subglobosa, ostiolata, nigra, ca. 90–120 µm diam. Peridium pseudoparenchymaticum, e cellulis atrobrunneis compositum. Paraphyses cellululae, flexuosae, ca. 20 × 0.5–1 µm. Periphyses crassae, ca. 20 × 3 µm. Asci clavati, bitunicati, 30–35 × 12–15 µm, 4-spore, I–. Ascospores irregulariter ordinatae, ellipsoideae, 1-septatae, in medio non constrictae, incoloratae, 8–10 × 5–7 µm.

Holotypus: Insula Bouvetii, Rustadkollen, in *Buellia melanostola*. 003.2 (BG).

Ascomata perithecioid, semi-immersed, subglobose, ostiolate, black, about 90–120 µm in diameter, the ostiole often almost a slit, peridium composed of 3–4 rows of uncoloured, rectangular cells. Above the peridium there is a thick, dark pseudoparenchymatous layer, composed of ± isodiametrical cells, and below that a ± uncoloured tissue composed of rounded, closely agglutinated cells. Periphyses stout, about 20 × 3 µm, composed of 2–4 rectangular cells, paliade-like when young. Paraphyses (pseudoparaphyses) thin, flexuose, cellular, branched, about 20 × 0.5–1 µm. Asci clavate, bitunicate, 30–35 × 12–15 µm, 4-spored, I–. Ascospores irregularly arranged, ellipsoid, 1-septate, when young with small lumina and thick walls and septum, when old with a thin wall and septum, not constricted at the septum, hyaline, 8–10 × 5–7 µm. In the thallus of *Buellia melanostola*.

Other specimen: Moseryggen, 270 m above sea level (340.2).

D. epimelanostola differs from the known lichenicolous species of *Didymella* Sacc. above all in its spores which are not constricted at the septum, the paraphyses which are not anastomosing, the ostiole which usually is elongated as a slit and the periphyses which are much better developed than in other species of the genus. The periphyses of, for example, *Didymella sphinctrioides* Berl. & Vogl. are thin, flexuose to almost decumbent, about $5-10 \times 0.5 \mu\text{m}$. The placement in *Didymella* is clearly inappropriate and is only a temporary disposition dependent on a thorough revision of that genus.

Phaeospora subantarctica Øvst. & D. Hawksworth sp. nov.

Fungus lichenicola. Pseudothecia dispersa, subglobosa, ostiolata, nigra, $55-75 (-100) \mu\text{m}$ diam. Peridium pseudoparenchymaticum, e cellulis nigrescentibus vel atrobrunneis compositum. Paraphyses nullae.Periphyses filiformes, ramosae, ca. $1 \mu\text{m}$ latae, $10-20 \mu\text{m}$ longae. Asci clavati, bitunicati, $45-58 \times 15-23 \mu\text{m}$, I+ rubescenti, 8-spori. Ascospores irregulares in asco, ellipsoideae, 3-septatae, in medio constrictae, incoloratae vel plerumque ad finem brunneae, $15.5-18 \times 5-7 \mu\text{m}$.

Holotypus: Insula Bouvetii, Nyrøysa, in *Lecania gerlachei*. 086 (BG).

Ascomata semi-immersed in the thallus of the host, globose to subglobose, scattered, ostiolate, black, $55-75 (-100) \mu\text{m}$ in diameter. Paraphyses absent.Periphyses numerous, flexuose, branched, about $1 \mu\text{m}$ wide and up to $20 \mu\text{m}$ long. Asci clavate, bitunicate, thin-walled, about $45 \times 15 \mu\text{m}$, I+ vinous red. Ascospores irregularly arranged, ellipsoid, 3-septate, hyaline for a considerable time but finally becoming brown, $15.5-18 \times 5-7 \mu\text{m}$. In the thalli of *Lecania gerlachei* (Vainio) Darbish.

This species is close to *Phaeospora rimosicola* (Leighton ex Mudd) Hepp, but differs from that species in that the spores are often markedly constricted centrally and remain uncoloured for a long time, the smaller ascomata, and in different host. Two types of pycnidia are present on infected material, one on the apothecial margins with bacillariform conidia $3-4.5 \mu\text{m}$, and one on the thallus with the sigmoid conidia expected in *Lecania*. It is possible that the former is an anamorph of the *Phaeospora*.

Other specimens: Mountain ridge above Ny-

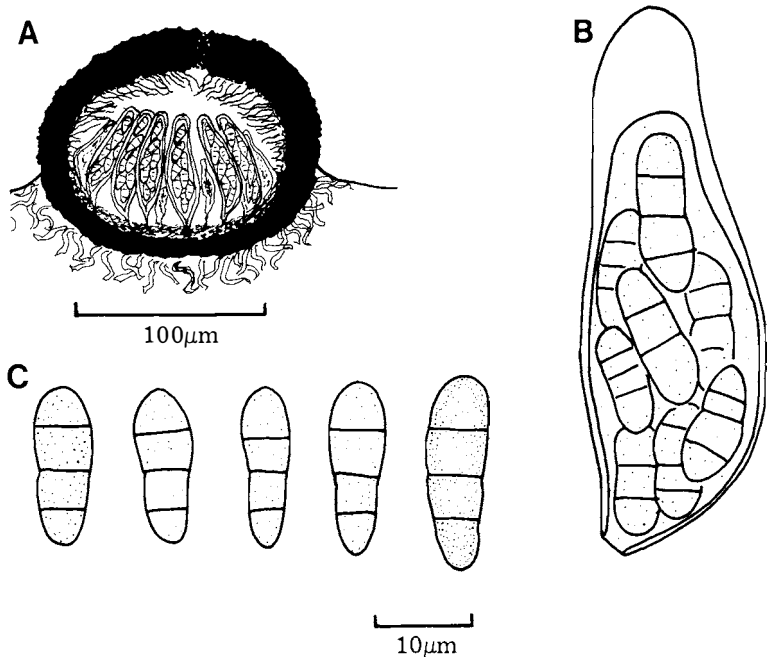


Fig. 2. *Phaeospora subantarctica* sp. nov. A. vertical section of ascoma (diagrammatic); B. ascus; C. ascospores. 303 (BG).

røysa, many places 180—200 m above sea level (006, 080, 082, 087, 299, 303).

Polycoccum rugulosarium (Lindsay) D. Hawksworth

This species has recently been discussed and illustrated by Hawksworth in Pegler et al. (1980). On Bouvetøya it occurs on *Caloplaca sublobulata* and *C. cirrochroides*.

Specimen examined: Above southern part of Nyrøysa (336), avalanched licheniferous boulders less than 20 m above sea level.

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Lamprospora miniatopsis Spooner, a bryophilous discomycete from Bouvetøya*

Schumacher, T. 1986: *Lamprospora miniatopsis* Spooner, a bryophilous discomycete from Bouvetøya. *Norsk Polar-institutt Skrifter* 185, 61–64.

The operculate discomycete *Lamprospora miniatopsis* Spooner, growing in turves of *Tortula excelsa*, is recorded from Bouvetøya. The species is compared with other reticulate-spored *Lamprospora* species being associated with the bryophyte genus *Tortula*. The new combination *Lamprospora retispora* (Itzerott & Thate) T. Schumacher is necessitated.

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During the Norwegian Antarctic Research Expedition 1978/79 to Bouvetøya the only macro-mycete recorded was a conspicuous, scarlet-coloured discomycete growing in tussocks of *Tortula filaris*. A preliminary examination of the material revealed a member of the poorly understood taxa around *Lamprospora miniata* de Not. (= *L. crouani* (Cooke) Seaver), the type species of the genus *Lamprospora* de Not. The material was treated as *L. miniata* in a report by Engelskjøn (1981). Recently, a new taxon within this complex, *Lamprospora miniatopsis* Spooner, was described from the South Orkney Islands (Pegler et al. 1980). The description and the habitat fit our fungus from Bouvetøya in all details. The Bouvetøya material has been re-examined and is compared with material of the *L. miniata* complex from Norway. Collection numbers given in parentheses follow Engelskjøn (1986).

Taxonomy

A close study of the Bouvetøya specimens seems to justify the erection of *L. miniatopsis* within the *L. miniata* complex. Compared with the 'typical' *L. miniata*, growing on *Tortula ruralis*, the Bouvetøya material has been found distinct in several respects. The ascospores of *L. miniata* are perfectly globose, while those of *L. miniatopsis* are subglobose to broadly ellipsoid. The orna-

mentation of the ascospore wall is different; the reticulate ascospores in *L. miniata* have more or less even ridges, the reticulum in *L. miniatopsis* is uneven with irregular, nodular thickenings (Fig. 1 A, B, C, D). Another taxon which might have intergrading characters with *L. miniatopsis*, is *L. miniata* var. *retispora* (Itzerott & Thate) Itzerott & Thate. I have not seen material of this taxon. The original description is short, and authentic material is apparently scarce, however, the recorded ascus size and the dimensions and shape of the ascospores seem to exclude the possibility of a common assignment with *L. miniatopsis* (cp. Itzerott & Thate 1974, as *Octospora retispora*). In my opinion *L. miniata* var. *retispora* is distinct from *L. miniata* as well as from *L. miniatopsis*. *L. miniata* var. *retispora* was originally described as *Octospora retispora* (Itzerott & Thate 1974). It was later referred to the genus *Lamprospora* as a variety of *L. miniata* (Itzerott 1978). The description qualifies for *Lamprospora*, however, based on the many distinguishing characters of the typical *L. miniata*, I find it reasonable to discriminate the taxon on species level (cp. Table 1).

Consequently, the new combination *Lamprospora retispora* (Itzerott & Thate) *comb. nov.* is necessitated:

[*Basionym*: *Octospora retispora* Itzerott & Thate, *Kew Bull.* 29:506. 1974. *syn. Lamprospora miniata* de Not. var. *retispora* (Itzerott & Thate) Itzerott & Thate in Itzerott, *Nova Hedwigia* 30:146. 1978.]

The important characteristics of the recognized reticulate-spored *Lamprospora* species being

* Publication No. 68 of the Norwegian Antarctic Research Expeditions 1976/77 and 1978/79.

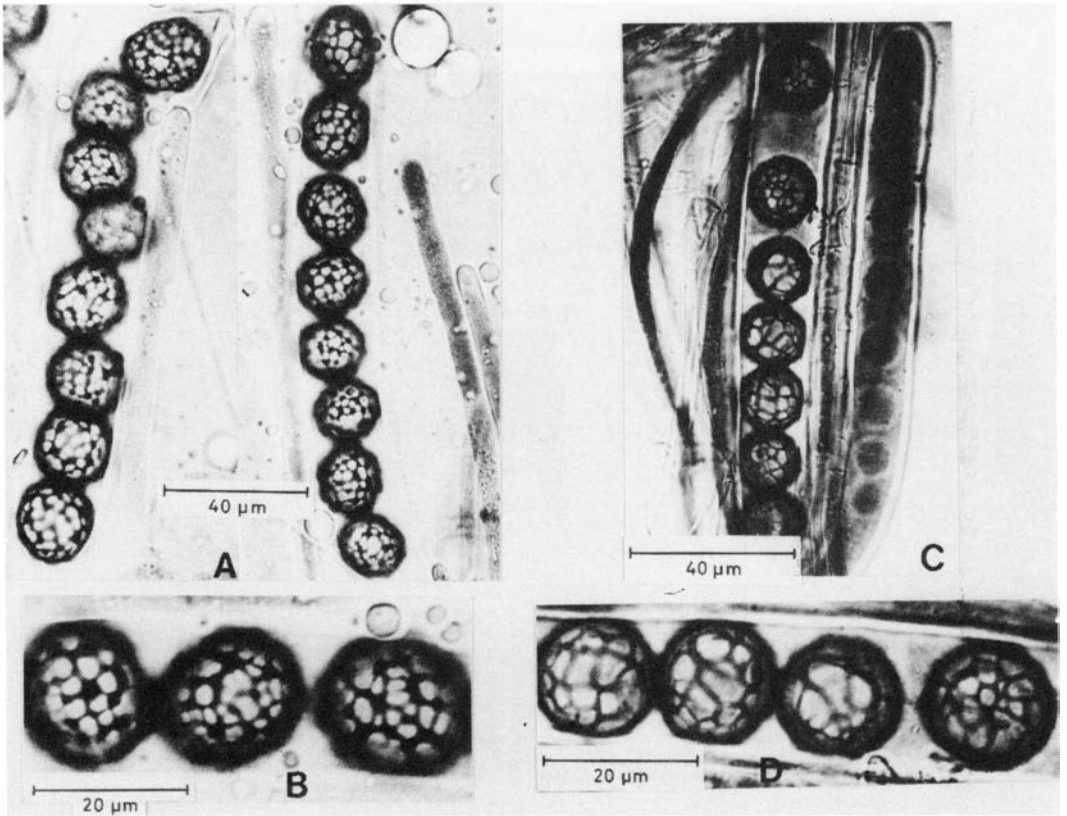


Fig. 1. *Lamprospora miniatopsis* and *L. miniata*, details of hymenium mounted in Cotton Blue. A, B. *L. miniatopsis*: asci and ascospores. T. Engelskjøn No. 119 (herb. BG), on *Tortula filaris*. C, D. *L. miniata*: asci and ascospores. Lista, Norway. K. Høiland 10.3.1973 (herb. O), on *Tortula ruralis*.

associated with bryophytes of the genus *Tortula*, are summarized in Table 1. Based on the new collections of *L. miniatopsis* from Bouvetøya, a description, as well as some preliminary comments on ecology and chorology of the species, is provided:

Lamprospora miniatopsis Spooner, in Pegler et al., *Kew Bull.* 35: 539. 1980.

Apothecia sessile, gregarious, 0.7–2.4 mm in diameter, disc scarlet red, drying orange, receptacle concolourous, shallow cup-shaped to flat, with a prominent, raised, dentate-fimbriate margin projecting to 300–500 µm beyond the disc. Ectal excipulum 30–70 µm wide, of textura angularis to textura globulosa, 3–5 cells wide, cells 8–22 µm in diam., outermost cells give rise to scattered tomentum hyphae; towards the

margin ectal excipulum of prismatic cells longitudinally to apothecial surface, running out in textura porrecta beyond the disc and forming the dentate, fimbriate margin. Medullary excipulum 20–80 µm wide, of compact textura intricata, hyphae 5–10 µm broad. Subhymenium a compact zone 10–20 µm wide, of densely packed, short-celled hyphae about 5 µm broad.

Asci cylindric, 250–320 × 18–24 µm, 8-spored, attenuated below into a long base, arising from croziers. Ascospores uniseriate, hyaline, subglobose to broadly ellipsoid, containing one large internal guttule, in the ascospores of rehydrated material also frequently with one de Bary bubble, spore wall with a reticulum, meshes 1.0–3.1 µm broad, ridges of variable thickness to 0.8 µm broad by 0.5 µm high, inbetween interconnecting ridges with irregularly and expanded nodes up to 2.2 µm across (Fig. 1 A, B). In Cotton

Table 1. Morphological, distributional and habitat characteristics of *Lamprospora* species on *Tortula* hosts.

	<i>L. miniatopsis</i>	<i>L. miniata</i>	<i>L. retispora</i>
Ascospore shape	subglobose to broadly ellipsoid	globose	broadly ellipsoid
Ascospore size	16–19.5 × 14–17 µm	15–18 µm	19–22 × 15–17 µm
Reticulum of ascospores	meshes 1–3 µm wide, ridges of variable thickness with prominent, nodular thickenings	meshes 1–5 µm wide, ridges 0.5–1 µm broad without nodular thickenings	* meshes 1–3 µm wide * ridges of variable thickness * slightly nodular thickenings
Ascus size	270–320 × 20–23 µm	290–320 × 16–22 µm	210–240 × 18–24 µm
Distribution	Antarctic (South Orkney Is., Bouvetøya)	Europe, North America, Austral-Asia	Germany
Host	<i>Tortula filaris</i> <i>Tortula fuscoviridis</i>	<i>Tortula ruralis</i> <i>Tortula norvegica</i> (and apparently an associate of many acrocarpous bryophytes)	<i>Tortula ruralis</i> <i>Grimmia pulvinata</i>

* characters interpreted from available figures in original descriptions (cp. Itzerott & Thate 1974; Itzerott 1978).

Blue the ascospores measure 16.0–19.5 × 14.0–17.2 µm. Paraphyses 2–3 µm in diam., septate, simple or branched from below, at tips inflated to 5–8 µm, filled with granular (coloured) content.

Material examined:

Bouvetøya:

Nyrøysa — middle part, 10 February 1979 (119)
Nyrøysa — south-eastern part, 30 January 1979 (120), Nyrøysa — northern elevation, 10 m SE of small skua hillock, 12 February 1979 (121), Nyrøysa — northern elevation, 15 m SE of small skua hillock, 12 February 1979 (122). All specimens in tufts of *Tortula filaris* (C. Muell) Broth. The collections are deposited in herb. BG and O (abbreviation according to Index Herbariorum).

Ecology and chorology

The Bouvetøya collections of *L. miniatopsis* were growing in turves of *Tortula filaris*. The type specimen from South Orkney Islands was recorded to be associated with *Tortula fuscoviridis* Card., which is hardly to be distinguished from *T. filaris*. The apothecia are found amongst moss

shoots or on soil between fresh or decaying shoots of the moss. Consequently, it is reasonable to conclude that *L. miniatopsis* is a bryophilous species, as is the majority of *Lamprospora* species. An intimate fungus — host relationship has been demonstrated in bryophilous *Lamprospora* species. The hyphae of the fungus form a 'cap' around the rhizoids of the host, and an infectious apparatus of haustoria and appressors penetrate the host rhizoidal cells (Döbbeler 1979). Most *Lamprospora* species seem to have a restricted host range, being associated with a single host species or host genus (Dennis & Itzerott 1973; Benkert 1976; Itzerott 1981). This appears also to be the case in *L. miniatopsis*.

The species has been searched for in Norwegian collections of *Lamprospora* on *Tortula* hosts as well as among the available reticulate-spored *Lamprospora* specimens from Norway, but with negative result. Thus, *L. miniatopsis* would appear to have a rather limited distribution, (cp. Table 1); the available collections are all from the maritime Antarctic.

The Bouvetøya collections were made at the end of the summer. Even in this period of the year night frost and snow all are frequent, and *L.*

miniatopsis must tolerate low diurnal temperatures slightly above or even below 0°C (see Engelskjøn 1981, Fig. 5). Whether the species has specific demands in this respect, being unable to colonize or fruit in a temperate climate, remains unknown.

Acknowledgements

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The supralittoral, freshwater and terrestrial algal vegetation of Bouvetøya*

Klaveness, D. & Rueness, J. 1986: The supralittoral, freshwater and terrestrial algal vegetation of Bouvetøya. *Norsk Polarinstitutt Skrifter* 185, 65–69.

Based on available collections, the algal taxa occurring on Bouvetøya are reviewed, with short descriptions and comments. Cryoseston communities are well developed and *Prasiola* spp. are important in terrestrial plant communities.

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The freshwater and terrestrial algal vegetation of the Antarctic mainland and associated islands has been the subject of investigations for almost 100 years (see references in West & West 1911). For obvious reasons the areas studied are far apart and unevenly explored, and generally the algal flora of the Antarctic is still poorly known. Recent exploration of Antarctic regions has added considerably to the knowledge of the algal flora, see bibliographies and check-lists of Papenfuss (1964), Prescott (1979), and Broady (1984).

This paper is based on a small collection of algae from Bouvetøya provided by T. Engelskjøn, and references are made either to his fluid fixation (F) or collection protocol numbers, given in parentheses, cf. Engelskjøn (1986).

There are three principal habitats occupied by algae on Bouvetøya. The supralittoral here includes areas affected by breaking waves and spray. Because of the exceptionally exposed nature of the coastline this influence penetrates to more than 200 m above sea level and is reflected in the distribution of communities comprising hygrohaline algae and lichens.

Foliose and filamentous Chlorophyceans occupy bird-cliffs and seal areas, and also grow in pools and wet soil influenced by animal manure.

The third major habitat comprises the cryophilic communities of snow algae which are developed extensively on the glacial firn areas. Melt-

water ponds and channels and littoral, brackish pools support specific algal assemblages. Recent progress in the study of snow algae may lead to revisions of the *Chlamydomonas*-like species reported here, cf. Hoham (1980).

Genera and species

Class Cyanophyceae

Oscillatoria sp. Locality: Nyrøysa, Sørstranda towards Aagaardbreen, vertical basalt cliff 2 m above sea level with seeping water, accompanied by *Ulothrix* sp. (F 07).

Phormidium antarcticum West & West (Fig. 1 a). Locality: Nyrøysa, border between seal and penguin area N of camp, 5 m a.s.l. (F 35).

Phormidium sp. Locality: As for *Oscillatoria* sp. (F 07).

Synechococcus sp. (Fig. 1 b). Locality: As for *Phormidium antarcticum* (F 35).

Class Bacillariophyceae

Gomphonema sp. Locality: Nyrøysa, Nordstranda 3 m a.s.l. on rocks occupied by seal. Epiphytic on *Rhodymenia palmatiformis* (F 47).

Licmophora sp. Locality: As for *Gomphonema*, and same habitat (F 47).

Melosira sp. Locality: As for *Gomphonema*, and same habitat (F 47).

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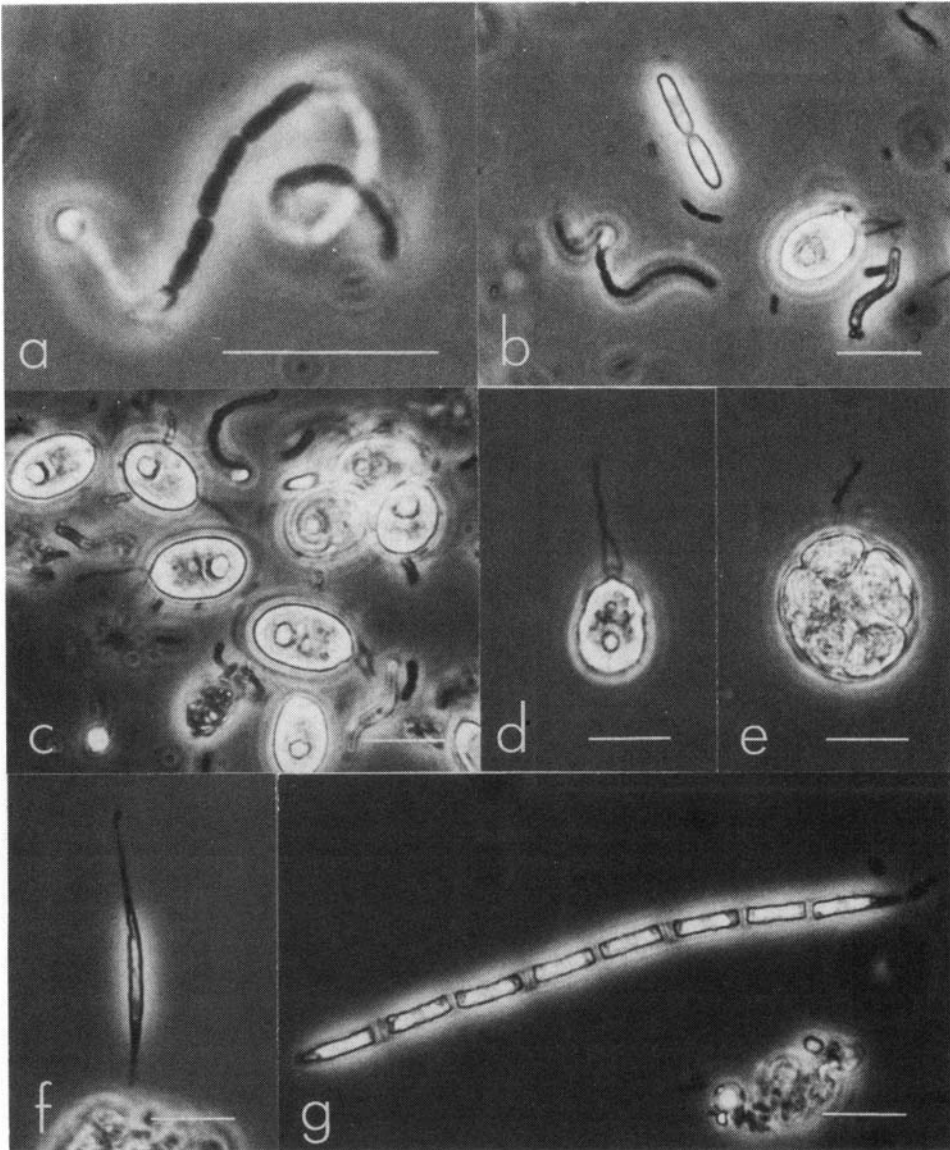


Fig. 1. a. *Phormidium antarcticum* West & West. b. *Synechococcus* sp. (top) with *Phormidium* and other undetermined microorganisms. c. *Chlamydomonas* sp. II in the same community. d–e. *Chlamydomonas ballenyana*, single vegetative cell and mother cell with 8 daughter cells, from snow. f. *Koliella* cf. *tatrae* (Kol in Györfly) Hindak, from a cryophilic (snow) community. g. *Ulothrix* sp. from snow. Another, slightly broader *Ulothrix* was also present in snow. Scale bar = 10 μ m.

Navicula sp. Locality: Between Sørstranda and Aagaardbreen, on rocks washed by the sea. Growing in gelatinous tubes (F 46). Nordstranda, 3 m a.s.l. on rocks occupied by seal, associated with *Rhodymenia palmatifomis* (F 47).

Class Phaeophyceae

Durvillea cf. *antarctica* (Ham.) Skotts. Locality: Found drifted ashore several times on Nordstranda and identified from a photograph (416).

Class Chlorophyceae

Chlamydomonas ballenyana Kol & Flint (Fig. 1 d, e). Locality: Nyrøysa, on snowfield close to Sørstranda, resting site for giant petrels. Dominant in a mixed community giving rise to green snow (F 23).

Chlamydomonas sp. I. Locality: Nyrøysa north of camp, 15 m a.s.l. at the periphery of the main penguin colony. Abundant in a strongly fertilized pond (F 34).

The chromatophore is cup-shaped, parietal and lacking a pyrenoid. The papilla is indistinct and the flagellae are of the length of the cell. Cells are elliptical or elliptical-cylindrical, 13–17 × 8–10 μm. Similar, but not identical to *C. guanophila* Skuja (Skuja 1948; Huber-Pestalozzi 1961).

Chlamydomonas sp. II (Fig. 1 c). Locality: Nyrøysa, border between seal and penguin area N of camp, 5 m a.s.l. in a strongly manured pond (F 35).

This sample had a very dense growth of green algae and also contained *Phormidium antarcticum* and *Synechococcus* sp. The cells of this abundant *Chlamydomonas* sp. measure 9–17 × 6–10 μm.

Hormidium sp. Locality: Nyrøysa, on snowfield close to Sørstranda, resting site for giant petrels. In cryoseston community (F 23).

Koliella cf. *tatrae* (Kol in Györfy) Hindak (Fig. 1 f). Locality: As for *Chlamydomonas ballenyana* and *Ulothrix* sp. (F 23) and growing in snow.

Prasiola spp. Localities: Representatives of the genus are ubiquitous on Bouvetøya, extending to about 300 m a.s.l. (Engelskjøn 1981) and being especially prominent in bird-cliff areas. It was the only representative of macrovegetation on the moraine hill of Nyknausen, inside the glacier (T. Engelskjøn, pers. comm.).

The dried herbarium material (024.1–5, 035, 037.1–3, 042.1–3, 208, 415) and the fluid fixation (F 03) are readily identified as *Prasiola crispata* (Lightf.) Menegh., a species with a wide or cosmopolitan distribution from the Arctic to continental Antarctica (cf. Wille 1902). Some samples,

however, contain a filamentous growth form of *Prasiola*, with constrictions at the base, sometimes referred to as a separate genus, *Rosenvingiella* Silva (see Edwards 1975). A similar growth form has previously been recorded from Antarctica under the designation *Prasiola calophylla* (Carmich.) Menegh. (see Broady 1982).

Ulothrix spp. (Fig. 1 g). Localities: Between Sørstranda and Aagaardbreen, 2 m a.s.l., on basalt cliff with seeping water (F 05). Snowfield close to Sørstranda, resting site for giant petrels (F 23). Also collected on Nyrøysa NW of the camp, growing on ledges with cape pigeons, 10 m a.s.l. (420), and on shore cliffs at Kapp Circoncision, 10 m a.s.l., in company with *Verrucaria* spp. (017).

Representatives of the genus seem frequent at lower levels on Bouvetøya.

Class Rhodophyceae

Porphyra columbina Montagne (Fig. 2 a, b, c). Localities: Nordstranda on shore cliffs 1 m a.s.l. (F 01, 02), Sørstranda, in the spray zone 1–2 m a.s.l. (F 44), base of Kapp Valdivia, 1 m a.s.l. (421), and bay W of Kapp Valdivia on boulder on the gravelly shore, 1 m a.s.l. (422).

This conspicuous alga is frequent in the littoral zone, forming dense stands from 1 m to 3 m above sea level. It is very similar to *P. umbilicalis* (L.) Kütz. of North Atlantic shores, both with respect to its range of forms, colour, and habitat preferences. *P. umbilicalis* has been recorded from the sub-Antarctic and Antarctic (Kylin & Skottsberg 1919; Taylor 1939) but, as pointed out by Papenfuss (1964), more than one species may be included in these records.

However, *P. columbina*, originally described from Auckland Islands, has been confused with *P. umbilicalis* both in southern Australia (Levring 1953; Womersley & Conway 1975) and in Chile (Levring 1960). *P. columbina* differs from *P. umbilicalis* in being monoecious and in the number of carpospores produced in the gonimoblast (Levring 1953). In these respects the alga from Bouvetøya is in accordance with the description of *P. columbina*.

Leptosomia alvicornis (Skotts.) Kylin (= *Lepto-*

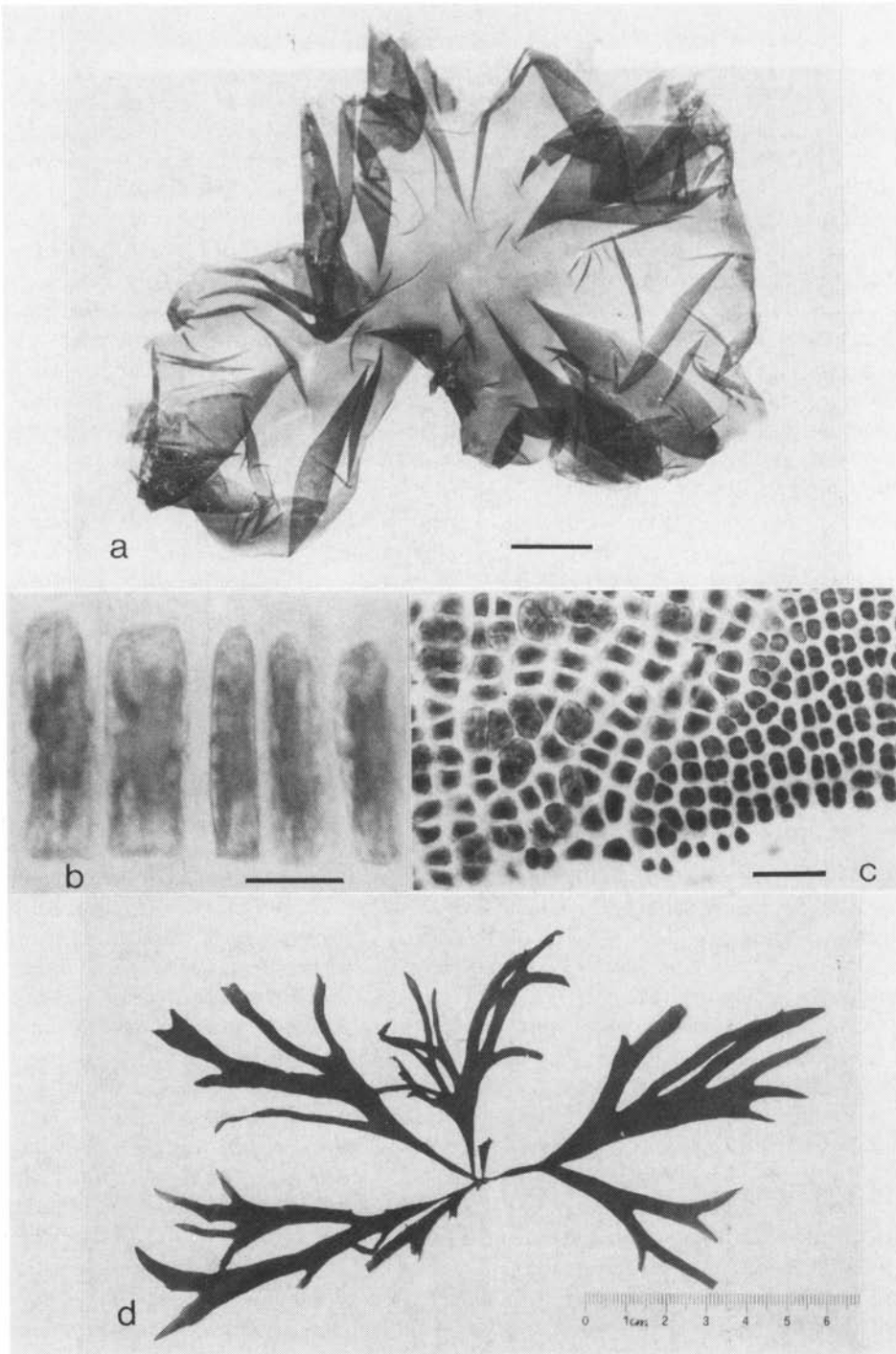


Fig. 2. *Porphyra columbina* Mont. a. Habit. Scale = 1 cm. b. Cross section of vegetative cells. Scale = 20 μ m. c. Surface view of area with carposporangial groups, vegetative cells and spermatangia. Scale = 50 μ m. d. *Rhodymenia palmatiformis* Skottsb. Habit.

sarca alvicornis Skotts.). Locality: Larseøya, SW side in the littoral zone growing in crevices (417).

According to the collector, T. Prestvik, it is abundant on partly seawashed rocks of fine-crystalline, resistant lava.

Rhodymenia palmatifomis Skotts. (Fig. 2 d). Locality: Nordstranda, seal rocks 1 m above sea level (F 47 and 423.1—4). Frequent in this area, which is much exposed to breaker waves, and sometimes ascending to 2—3 m a.s.l.

Rhodymenia sp. Locality: Sørstranda, shore cliffs near sea level (418).

Platyclina fuscorubra (Hook. & Harv.) Levr. Locality: Washed ashore on Sørstranda (419.1—2). Specimens with tetrasporangia.

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Phytogeographical relations of the cryptogamic flora of Bouvetøya*

Engelskjøn, T. & Jørgensen, P. M. 1986: Phytogeographical relations of the cryptogamic flora of Bouvetøya. *Norsk Polarinstitutt Skrifter* 185, 71–79.

The flora of Bouvetøya is basically an impoverished version of that found farther west in the maritime Antarctic. It seems to have reached the island by trans-oceanic dispersal during the Quaternary. The importance of the westwind drift and of birds as agents for long distance dispersal is emphasized. Nearly one third of the lichens have a bipolar or cosmopolitan distribution, the remainder belonging to a Southern Hemisphere element which has connections to Lesser Antarctica and the Magellanic region.

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An exhaustive phytogeographical analysis of the flora of Bouvetøya is not possible because of the incompleteness of taxonomic assessments of cryptogamic collections from localities in the maritime and continental Antarctic, as well as sub-Antarctic islands, and also because of the unrepresentativeness of collections throughout these biomes. However, some distribution patterns are obvious and will be discussed here.

As mentioned by Engelskjøn (1986a), Bouvetøya is among the most isolated pelagic islands in the world. The approximate distances to the nearest archipelagos and continents are given in Table 1. The nearest lands are the South Sandwich Islands (see Longton & Holdgate 1979 for botanical description) and Gough Island (see Wace 1961). They are situated in maritime Antarctic and temperate environments, respectively. The nearest continent is Antarctica, the coast of which belongs to a climatic zone very different from Bouvetøya as regards temperature regime (Vinje 1965, 1981; MacNamara 1973) and vegetation (Aleksandrova 1980).

Geological setting of Bouvetøya

Bouvetøya is situated within the Antarctic plate on the southwestern flank of the Atlanto-Indian spreading ridge. The triple junction of the Ant-

arctic, American, and African plates is situated about 260 km to the west of the island (Sclater et al. 1976). The Bouvet and Moshesh transverse fracture zones are marked by depressions in the sea bottom 70 km to the west and a similar distance to the east. A group of underwater peaks to the east has been conjectured as a possible site of the enigmatic «Thompson Islands» (Baker 1967; Lamb 1967), which no longer exist and may possibly be based on a mis-interpretation

Table 1. *Approximate distances (in km) from Bouvetøya (at 54° 26' S Lat, 3° 17' E Long) to the nearest islands and continents.*

<i>Distances to the W and WSW</i>	
South Sandwich Is.: Candlemas I.	1910
South Georgia: Cape Vahsel	2525
South Orkney Is.: Laurie I.	2920
South Shetland Is.: Clarence I.	3480
Antarctic Pen.: Hope Bay	3580
Falkland Is.: Stanley	4095
Cabo de Hornos (Cape Horn)	4500
<i>Distances to the S</i>	
Antarctica: Dronning Maud Land at 70° S, 0°	1740
<i>Distances to the NNW, NE and ENE</i>	
Gough I.	1860
Cape Agulhas, Africa	2600
Prince Edwards Is.: Marion I.	2560
Îles Crozet: Îles Cochon	3450
Îles Kerguelen: Cap Bourbon	4500
Heard I.	4620
Macquarie I.	9680

* Publication No. 70 of the Norwegian Antarctic Research Expeditions 1976/77 and 1978/79.

of sea surface phenomena, e.g. remote icebergs, like so many austral 'islands' reported by early explorers.

On the basis of the distance of Bouvetøya from the main spreading axis, the age of the surrounding ocean floor crust is estimated to be 4.5–5 Ma (Sclater et al. 1976). Bouvetøya rises from the ocean floor as a volcanic cone. There are so far no indications of a continental shelf around the island (Parsons & Sclater 1977), nor are there sediments of continental derivation on the sea bottom according to the local hydrographic map (Purdy & Twitchell 1978; Fjørtoft 1981).

It is concluded from the present configuration of the volcanic cone and its submarine areas, that the land mass of the island probably never exceeded some 20 km in diameter. The resulting land area available for plant colonization would then be of the order of 300 km².

Important for our biogeographical discussion is the geological age of the terrestrial and shallow water areas of Bouvetøya. Prestvik & Winsnes (1981, p. 63, 65) reported ages between 0.71 and 0.068 Ma of lavas from Nyrøysa, whereas the oldest basalts investigated had an apparent age of 1.39 Ma. The silicic rocks of Kapp Valdivia are dated to about 0.1 Ma. The volcanic activity on Bouvetøya appears to be on the decline (Prestvik & Winsnes 1981), and the youngest lava flow dated is 68,000 years old. However, geothermal heat and fumaroles still occur. Recent observations show that volcanic events may develop rapidly in areas close to the mid-Atlantic ridge, as was seen during the eruptions on Tristan da Cunha (Baker et al. 1964), the creation of Surtsey (Thórarinnsson 1964), and the unexpected eruption on Jan Mayen (Siggerud 1972). Subsequent plant colonization has especially been studied on Surtsey (Fridriksson 1968, 1975; Guenther & Klug 1970).

Pleistocene glaciations

Bouvetøya is heavily glacierized (Orheim 1981) and the ice-free areas available to vegetation other than snow algae are restricted to about 7% of the land area. Little is known of the glacial past of the island, apart from the fact that the main ice cap has covered the most important vegetated sites of Rustadkollen and Moseryggen

(Prestvik & Winsnes 1981, pp. 53–54) for an unknown duration. Orheim (1981) suggested that the positions of the glacier snouts are mainly determined by the topography. This would enable the promontories of Kapp Valdivia and Kapp Circoncision to stay outside the ice cap during periods of heavier glaciation than at present, as would the 300–400 m high precipices of the south and west coast.

Chorological agents

After the emergence of Bouvetøya from the sea, presumably during the Pliocene-Pleistocene transition, it became available for colonization by biota. Wind, sea currents and accompanying animals may have contributed to the transport of diaspores over wide expanses of ocean. The role of flying birds, penguins and seals must be seen in close connection with the large-scale atmospheric circulation. Because of their profound climatic influence, the Westwind drift, the Weddell Sea gyre and the position of the Antarctic Convergence are major determinants of the composition and survival of terrestrial life on South Atlantic islands.

1. *The bird element*

The potential of birds as spore vectors has been only briefly examined, cf. Falla (1960) and Baily & James (1979).

Little is known about the migratory routes of Antarctic birds breeding on Bouvetøya (Haftorn, pers. comm.; cf. also Watson 1975; Croxall 1984).

The numerically most important flying birds on Bouvetøya are the petrels. Among the larger avifauna, giant petrels (*Macronectes giganteus*) also breed on the Falkland Islands, Isla de los Estados, and Gough Island, and are known for their extensive migrations (Johnstone et al. 1976; Haftorn & Voisin 1982).

Some medium-sized petrels occur in very great numbers in partially vegetated sites of Bouvetøya, e.g. *Fulmarus glacialisoides* and *Daption capensis*. Several small, soil-burrowing species also breed on Bouvetøya and are known to migrate great distances within the Westwind drift (Holgersen 1945, 1960). There are also two petrel species of continental Antarctic affinity, viz.

Pagodroma nivea and *Thalassoica antarctica*, but they are few in number and anyway the latter hardly breeds on Bouvetøya, according to observations made by Engelskjøn in several altitudinal belts.

The skuas (*Catharacta skua* s. lat.) are known to perform extensive seasonal migrations, including to the Northern Hemisphere (Croxall 1984). It spends much of its time ashore, near the rookeries of other birds but also roams around other habitats at various altitudes and distances from the sea. It may therefore play an important role as a dispersal agent, both distant and locally.

The penguin populations vary according to the breeding areas available (Haftorn et al. 1981). The most numerous species on Bouvetøya — the macaroni penguin (*Eudyptes chrysolophus*) and the chinstrap penguin (*Pygoscelis antarctica*) — both have affinities with the more southerly maritime Antarctic region, and also with South Georgia. Most of them are believed to spend the winter at sea close to the pack ice edge north of Bouvetøya. Because their existence is mainly pelagic, they may be of lesser importance as dispersal agents for terrestrial cryptogams.

2. The invertebrate element

The occurrence of small terrestrial arthropods on Bouvetøya presents a chorological problem of its own. These animals are closely associated with existing lichen and moss vegetation, and with the bird rookeries. The oribatid mite *Alaskozetes antarcticus* was often seen foraging on lichens, being especially numerous on apothecia of *Lecania gerlachei*. The collembolan *Cryptopygus antarcticus*, known to feed on fungal hyphae and algae (Broady 1979), is very numerous in the turves of *Brachythecium* or *Stereocaulon*. If these tiny invertebrates or their larval stages are attached to birds, they could probably act as spore vectors (cf. Gressitt et al. 1961; Clagg 1966).

3. The mammalian element

The most important seals on Bouvetøya are the fur seal (*Arctocephalus gazella*) and the elephant seal (*Mirounga leonina*). Little is known about these animals as plant dispersal vectors, but their migrations at sea are extensive.

4. Wind action

Bouvetøya is situated in the path of the westerlies and cyclone passages are frequent, often with two or more storms per week. Average wind-speed in the region is 9–10 m s⁻¹ according to the Atlas of the Ocean (1977). Radiosonde ascents (Vinje 1981) show that more than 70% of the wind directions lie between south and west northwest. Considering the predominant westerly wind direction and the rapid nature of these air movements (Solot 1967), it would be expected that they carry diaspores from the rest of the maritime Antarctic, South Georgia and the Magellanic area, towards Bouvetøya.

5. Sea currents, drifting ice, and ice-bergs

Bouvetøya is also influenced by the Antarctic Circumpolar current to the south of the Antarctic Convergence (Foldvik et al. 1981). The current flows from west southwest to east northeast at a speed of about 0.2 km h⁻¹. Drifting icebergs from continental Antarctica are frequent around Bouvetøya; these often expose enclosed mud and stones, which could serve as a substrate possessing propagules of terrestrial plants (Hultén 1962).

It is also assumed that spores of littoral and marine lichens are dispersed by sea currents (Santesson 1939).

Present composition of the flora

The lichen and bryophyte taxa so far known from Bouvetøya are listed in Table 2 and Table 3, with a provisional assignment of their global distribution ranges. For most taxa we lack documented information from the eastern sub-Antarctic area (Prince Edward Islands, Îles Crozet, Îles Kerguelen, Heard Island, and Macquarie Island). Regrettably, we have not examined specimens collected on the South Sandwich Islands. Comparison with this flora is essential for a more detailed discussion.

Among the 44 lichen species (Table 2, based on Jørgensen 1986 and Øvstedal 1986), five are described as new to science. Until further notice three are considered endemic, though they may occur elsewhere. Together with 24 other species they constitute a Southern Hemisphere element,

Table 2. Enumeration of lichen species from Bouvetøya.

Southern hemisphere element	Bipolar or cosmopolitan element	Miscellaneous
<i>Acarospora macrocyclos</i>	<i>Cladonia pyxidata</i>	<i>Lecidea</i> aff. <i>aglaea</i>
<i>Arthonia subantarctica</i>	<i>Cystocoleus ebeneus</i>	<i>Lecidea</i> sp.
<i>Arthopyrenia maritima</i>	<i>Lecidella bullata</i>	<i>Mastodia tessellata</i>
<i>Bacidia tuberculata</i>	<i>Massalonia carnosa</i>	<i>Microglæna</i> cf. <i>mawsonii</i>
* <i>Bouvetiella pallida</i>	<i>Ochrolechia parella</i>	(4)
<i>Buellia anisomera</i>	<i>Pannaria hookeri</i>	
<i>B. babingtonii</i>	<i>Physcia dubia</i>	
* <i>B. bouvetii</i>	<i>Psoroma hypnorum</i>	
<i>B. falklandica</i>	<i>Rhizocarpon geographicum</i>	
<i>B. melanostola</i>	<i>Rhizoplaca melanoophthalma</i>	
<i>B. russa</i>	<i>Rinodina turfæa</i>	
<i>Caloplaca cirrochrooides</i>	<i>Verrucaria mucosa</i>	
<i>C. sublobulata</i>	<i>Xanthoria candelaria</i>	
* <i>C. tenuis</i>	(13)	
<i>Huea grisea</i>		
<i>Lecania gerlachei</i>		
<i>Lecanora</i> sp.		
<i>L.</i> cf. <i>lavæ</i>		
<i>Leptogium puberulum</i>		
<i>Placopsis contortuplicata</i>		
<i>Rinodina deceptionis</i>		
<i>Stereocaulon glabrum</i>		
<i>Usnea antarctica</i>		
<i>U. aurantiaco-atra</i>		
<i>Verrucaria dispartita</i>		
<i>V. elaeoplaca</i>		
<i>V. tessellatula</i>		
(27)		

* Provisionally considered endemic.

Table 3. Enumeration of bryophyte taxa from Bouvetøya.

Hepaticophytina	Bryophytina
<i>Cephaloziella exiliflora</i>	<i>Andreaea gainii</i>
<i>Herzogobryum atrocapillum</i>	<i>A. regularis</i>
<i>H. teres</i>	<i>Brachythecium austro-salebrosum</i>
<i>Pachyglossa dissitifolia</i>	<i>Bryum</i> spp. (six entities)
(4)	? <i>Ceratodon</i> sp.
	<i>Ceratodon validus</i>
	<i>Dicranella</i> cf. <i>hookeri</i>
	<i>Dicranoweisia</i> cf. <i>antarctica</i>
	<i>D. grimmiacea</i>
	<i>Drepanocladus uncinatus</i>
	<i>Pohlia nutans</i>
	<i>Polytrichum alpinum</i>
	<i>Schistidium</i> cf. <i>antarcticum</i>
	<i>S. apocarpum</i>
	<i>S. celatum</i>
	<i>S. syntrichiaceum</i>
	<i>Tortula filaris</i>
	<i>T. princeps</i> var. <i>conferta</i>
	<i>T. princeps</i> var. <i>grossiretis</i>
	Seligeraceae sp.
	(25)

the majority of which is concentrated on the Antarctic Peninsula and the islands of the Scotia Ridge.

Several different patterns are obvious in the Southern Hemisphere element. Some species have northerly extensions, being also present in Fuegia, the Falkland Islands, or even in the Tristan da Cunha — Gough Island archipelago. Examples are *Placopsis contortuplicata* (Fig. 1) and *Stereocaulon glabrum*. Only two have a wide austral distribution, viz. *Caloplaca cirrochroides* and *C. sublobulata*. Finally, only two species seem to have a circumantarctic range, *Usnea antarctica* (Fig. 2, cf. also Walker 1985) and *Verrucaria tessellatula* (Øvstedal 1986).

At last thirteen of the lichen species are also found in the Northern Hemisphere and some others are closely related to northern taxa. Some of these, like *Cladonia pyxidata*, are approaching a worldwide distribution. Others, like *Pannaria hookeri* (see Jørgensen 1978, p. 25), are typical bipolar species.

Finally, the identity of four taxa is uncertain and these are not included in this survey. One of them, *Microglaena* cf. *mawsonii*, would seem to be the only instance of a species from Bouvetøya hitherto unknown in the western maritime Antarctic.

Similar patterns are found among the bryophytes (Table 3, based on Bell & Blom 1986), although not as pronounced as among the lichens. Because of taxonomic ambiguity it is also more difficult to interpret the relations of the bryophyte flora. Four liverworts and 25 mosses are recorded, but of these, 11 are assigned a cf. or only referred to genus. The majority belongs, however, to a Southern Hemisphere element. Only four species (*Drepanocladus uncinatus*, *Pohlia nutans*, *Polytrichum alpinum*, and *Schistidium apocarpum*) are bipolar, but several others are closely related to Northern Hemisphere taxa. Unlike the lichens most of the bryophytes (Bell & Blom 1986) have a wide austral distribution, many of them reaching the Prince Edward Islands or Îles Kerguelen. A few, e.g. *Cephaloziella exiliflora*, even occur in Tasmania and New Zealand. Some are also present in continental Antarctica, but here problems in dealing with e.g. *Bryum* and *Grimmia* preclude a comparison with the sparse moss flora of i.a. Dronning Maud

Land and MacRobertson Land. Three species are clearly recruited from western maritime Antarctic regions (*Pachyglossa dissitifolia* (Fig. 3), *Tortula filaris*, and *Schistidium syntrichiaceum*). All bryophyte species on Bouvetøya occur in the latter region and several are important constituents of the vegetation there, e.g. *Andreaea* spp., *Brachythecium austro-salebrosum*, *Schistidium* spp., and other bryophytes.

Distribution patterns within Bouvetøya

As mentioned by Engelskjøn (1981) local distribution patterns within the restricted area of Bouvetøya pose certain clues as to the age and origin of the vegetation and flora. *Usnea aurantiaco-atra* (*U. fasciata* p.p), for instance, is strictly confined to the *Andreaea* — *Usnea* communities on the elevated basalt plateaux on the south coast, as are *Placopsis contortuplicata* and all the hepatic species. None of them has yet colonized the new ground of Nyrøysa. Conversely, *Tortula* spp. and other supposedly basiphilic mosses are plentiful on calcite-bearing pyroclastics on the northwest coast including Nyrøysa.

Such local distribution patterns may reflect successional stages created by pedological differences which are related to the volcanic and erosional history of Bouvetøya. Some species may also be nitrophobous and therefore confined to places away from the bird rookeries.

These matters are further elucidated by Engelskjøn (1986b) in relation to spatial differentiation of vegetation and soils of Bouvetøya.

Discussion

On the basis of current taxonomic knowledge three main features in the phytogeography of the Bouvetøya lichen and bryophyte flora are evident.

1. Low percentage of endemism

The number of endemic species is low, amounting to less than 5% of the total, but once taxonomic assessments from the rest of the maritime Antarctic are more advanced, this proportion may be reduced. Such low endemism suggests that this is a relatively young flora, a conclusion that is supported by the geological history of the

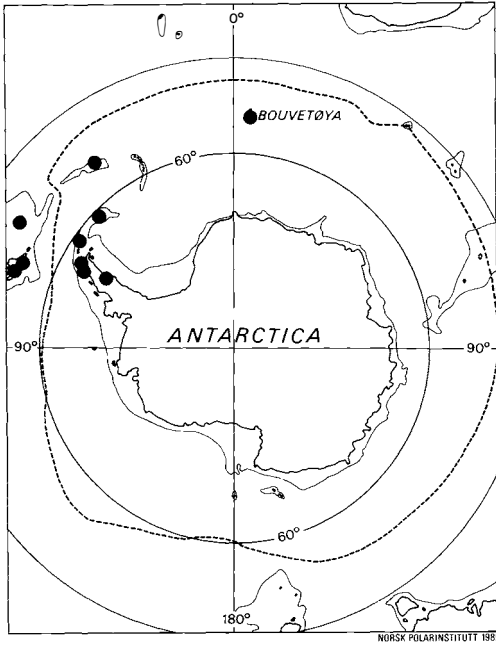


Fig. 1. *Placopsis contortuplicata* Lamb.

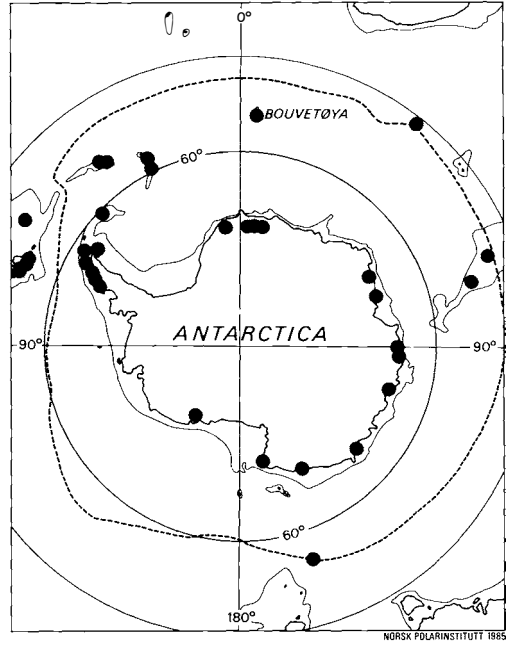


Fig. 2. *Usnea antarctica* Du Rietz (= *Neuropogon antarcticus* (Du Rietz) Lamb).

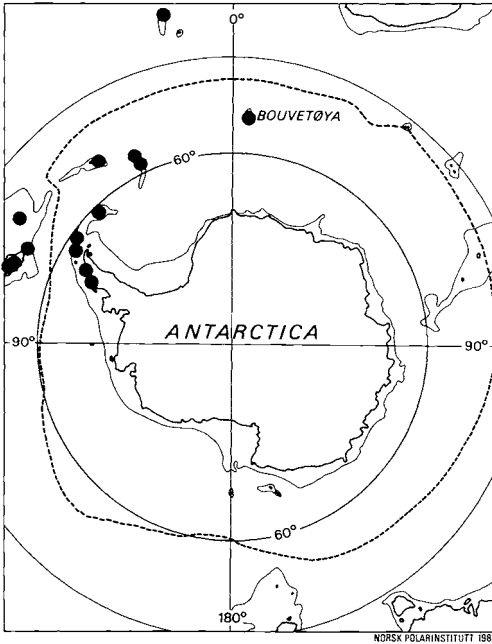


Fig. 3. *Pachyglossa dissitifolia* Herzog & Grolle.

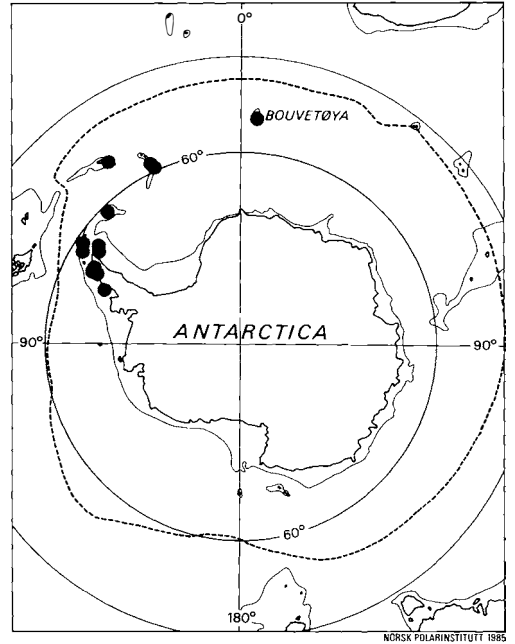


Fig. 4. *Buellia anisomera* Vain.

Figs. 1—4. Distribution maps within the southern circumpolar area of some cryptogams occurring on Bouvetøya. Thin outline: 1000 m depth contour. Broken line: Average position of Antarctic convergence. Distribution data compiled from sources given by Bell & Blom (1986), Jørgensen (1986), Øvstedal (1986), with additional information from R. I. Lewis Smith (personal communication).

island. It is not clearly known how much of the island was ice-covered during various glacial maxima, but because of the precipitous topography there has probably always been some exposed rocks. However, the range of habitats may have been restricted, and possibly some species arrived fairly recently. The climax vegetation on the South coast high ground (Rustadkollen and Moseryggen) appears to be oldest and it is also rich as to species content.

2. Chorological relations with the maritime Antarctic

Bouvetøya is the eastern outpost of the cryptogamic formation of the maritime Antarctic as defined by Smith (1984). The community structure and floristic composition is very similar to corresponding sites in the South Shetland Islands, the South Orkney Islands, and some islands in the South Sandwich group. All positively identified species growing on Bouvetøya except the endemic lichens referred to above, are known to occur farther west. The geological history of Bouvetøya indicates that it is a young island which has not taken part in major tectonic movements since its emergence (Løvlie & Furnes 1978). Nor has its position relative to continents and the nearest islands changed much during its relatively short life-span. The presence of an impoverished flora closely related to that of the far distant Lesser Antarctica flora is best explained by long distance dispersal, which has a powerful vector in the strong wind and current systems operating persistently from the west (Jørgensen 1979, p. 2280), including the immense number of flying birds within the Westwind drift.

Relevant to this discussion is the selection of species that have reached Bouvetøya. In the well-revised genus *Buellia* (Lamb 1968) with 24 species in the area discussed, 21 are confined to the maritime Antarctic. Only four have been recorded on Bouvetøya, among them the common and ecologically aggressive species, *Buellia russa* (Lindsay 1977, p. 205). On the other hand, the common *B. coniops* which is recorded from the South Sandwich Islands (Longton & Holdgate 1979, p. 8) has not been found on Bouvetøya, whereas the quite rare *B. babingtonii* is present, being one of the most important colonizers on

Nyrøysa. Conversely, the western Antarctic *B. anisomera* (Fig. 4) is restricted to one site on Bouvetøya, namely the Moseryggen nunatak.

A random selection of taxa is typical of long distance dispersal. The species composition recorded on Bouvetøya is similar to that of the South Sandwich Islands in a general way (Longton & Holdgate 1979). The lichen flora of these islands is not well known but appears to be relatively poorer than that of Bouvetøya in view of the fact that the South Sandwich group consists of 12 main islands arranged along a regional climatic gradient from north to south. The absence of *Usnea aurantiaco-atra* and other maritime Antarctic species in the South Sandwich Islands is remarkable. On the other hand, the bryophyte flora is rich, with a notable number of hepatics and species of the genus *Campylopus*. These seem, however, to be dependent on extensive fumarole activity, especially on Candlemas Island, which is also the most intensively studied island of the group.

Another feature typical of floras derived by long distance dispersal is a large number of genera compared to that of species. On Bouvetøya there are 44 species of lichens and 29 different genera (ratio 1.5) and 29 bryophytes of 15 genera (ratio 1.9).

In the lichens, there is a particular complication arising from long distance dispersal. Spores (or conidia) only disperse one of the components of the thallus, and therefore resynthesis is necessary to establish the lichen in a new locality. It is very difficult to prove that this takes place in nature, and the importance of spores in the dispersal of lichens is controversial. Soredia and isidia carry both components and seem to spread the lichen more efficiently. It is noteworthy that most of the lichen species occurring on Bouvetøya only produce spores. Only six are sorediate and, in general, sorediate species are rare in the Antarctic, being mainly encountered among foliose and fruticose forms (Lindsay 1977, pp. 204–205).

This constitutes the best circumstantial evidence for the efficiency of spore dispersal known at present. It is possible that the resynthesis is facilitated by the nitrophilous environment in which many of the lichens settle.

There is an over-representation of nitrophilous

or littoral lichen species in the flora of Bouvet-øya. This is probably due to the prevalence of marine and bird-influenced habitats, but it may also be an indication of a selective dispersal factor, namely migratory sea birds. The nitrophilous lichen communities are mostly found in connection with bird rookeries and it is reasonable to suppose that birds breeding in this environment are important carriers of lichen diaspores. Further research like that reported in Bailey & James (1979) should be carried out.

In addition, moss fragments may possibly be carried in this way. Most bryophytes do not produce sporophytes in the Antarctic biome, but disperse and establish by various vegetative propagules such as leaf or stem fragments (Smith 1984, pp. 101–102).

Finally, it is worth noting the difference between the distribution patterns of the lichens and the bryophytes. Why are the bryophytes more widespread? Are there differences involved in the process of biotype evolution or do they disperse more easily? Or is this only an artefact due to differences in the state of taxonomy in the groups? Only further studies can answer these questions — but they are worthy of investigation.

3. High incidence of bipolar distribution

About one third of the lichens and one sixth of the bryophytes are found in both hemispheres, and if closely related taxa are included, the proportion is even greater. Many of them show a distinct bipolar pattern.

There is no reason to believe that the island of Bouvetøya should be special in this respect. A more critical comparison with boreal and Arctic taxa would prove valuable in view of these results. It is not appropriate here to discuss the broad concept of bipolar plant distribution, and we refer to recent accounts on the subject (Kärnefelt 1979; Lindsay 1977; Schuster 1969).

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