

Øvstedal, D. O., Tønsberg, T. & Elvebakk, A. 2009. The lichen flora of Svalbard. – Sommerfeltia 33: 1–393. ISBN 82-7420-029-2. ISSN 0800-6865.

742 species, including 151 reported for the first time, are treated from Svalbard (exclusive of Bjørnøya). New to science are: *Bryocaulon hyperborea* Øvstedal (also known from Greenland), *Buellia insularis* Øvstedal, *Lepraria svalbardensis* Tønsberg, *Placynthium pulvinatum* Øvstedal (also recorded from mainland Norway), *Rhizocarpon dahlii* Øvstedal, *R. tephromelae* Øvstedal, and *Tephromela lucifuga* Øvstedal & Tønsberg. New combinations are: *Aspicilia major* (Lynge) Øvstedal, *Aspicilia punctiformis* (Lynge) Øvstedal, *Cetraria racemosa* (Lynge) Øvstedal, *Miriquidica picea* (Lynge) Øvstedal, and *Stereocaulon compactum* (I. M. Lamb) Øvstedal. Information on morphology, anatomy, chemistry, substrate preferences and distribution is included for all taxa. Keys to genera and species are provided. Separate keys are provided for sorediate species on rock and on soil/bryophytes. 6 % of the species are defined as cosmopolitan. More than one third has a bipolar distribution, whereas about 60 % are restricted to the Northern Hemisphere, 52 species are high-arctic and lacking from Fennoscandia, and 12 species are at present known as Svalbard endemics.

Keywords: Ascomycetes, Bacidiomycetes, Lichens, Arctic, Svalbard, Flora, Taxonomy.

Dag Olav Øvstedal and Tor Tønsberg, Museum of Natural History, University of Bergen, Allégaten 41, P.O. Box 7800, N-5020 Bergen, Norway.

Arve Elvebakk, Tromsø University Museum, University of Tromsø, N-9037 Tromsø, Norway.

## INTRODUCTION

Svalbard means “the land with the cold coasts”, and the land is indeed cold, with winter temperatures often below  $-20^{\circ}\text{C}$ , and with plant life struggling to survive. Perhaps the most successful group is the lichens. They occur in most habitats, from sea-level to the highest peaks, and are most colourful constituents of some plant communities. Already the earliest botanical expedition to Svalbard, that of Phipps in 1773 (Lynge 1938) had a list of 11 lichens. However, identifying Svalbard lichens has often been a challenge, as there has been no flora with keys and descriptions for the arctic part of Europe including Svalbard. The checklist of Elvebakk & Hertel (1996) was a great inspiration and starting-point for this work, and we have built much of our research around that study.

In our days the climate is rapidly changing, especially in arctic areas, creating problems for much of the biota found there. This makes it urgent to understand and document the biodiversity found there before major changes occur, and we hope that the present study will be a help for future researchers studying changes in the Svalbard lichen flora. Also, a correct naming of the organisms is necessary for ecological, physiological and biogeographical studies.

However, no work of this kind is ever really finished, due to the continuing process of immigration and extinction, and also to our limited understanding of some species groups. After us, there will be a deluge of molecular data which hopefully will help with this understanding. Also, even after some 230 years of lichenological research on Svalbard, new major collections rarely fail to produce additional taxa.

This introduction would not be complete without a homage to the great expert on arctic lichens, Bernt Lynge (1884–1942). It is a great pity that he never finished his study of Svalbard lichens. We have had access to innumerable herbarium specimens collected by him, many of them bearing his comments. However, there is one problem regarding both his and other collections: nothing is usually indicated about the ecology of the specimens. Since the present authors only have limited first-hand knowledge of most of the species’ ecology, we have not been able to give as much information about this aspect as we would have liked to.

The history of lichenological investigations on Svalbard up to 1938 is found in Lynge (1938) and from 1938 to 1996 in Elvebakk & Hertel (1996).

## MATERIALS, METHODS, CIRCUMSCRIPTION OF THE AREA, AND TERMINOLOGY

### MATERIALS

The major part of the material examined is from the herbarium of the University of Oslo (O), where the collections of Lynge from his expedition to Svalbard in 1926 are deposited. Lynge published his study about the macrolichens (Lynge 1938), but most of the microlichens were not treated. This large material has now been studied and determined for this flora treatment, mostly by the first author. Lynge also had available much of the material collected by Th.M. Fries in Svalbard in 1868. This material is still in Oslo and has been available to us. Also O material from J. Lid, who visited Svalbard in 1920, and parts of the collections by O.A. Høeg, who was there in 1928, have been studied. Another great collector, Eilif Dahl, visited Svalbard in 1936, and most of his lichen collections are at O. Also a small, but important collection made by R. Haugan in 2002 is found in O. Some of Lynge's collections were distributed to the other University herbaria in Norway (BG, TRH, TROM).

Bergen (BG) houses collections made by T. Tønsberg in 1986, 2002 and 2003, especially *Lepraria* spp. and sorediate crustose lichens in general. In Trondheim (TRH), much of the material collected by O.A. Høeg in 1928 and determined by Lynge is deposited, in addition to a small but important collection by A. A. Frisvoll. In Tromsø (TROM), large collections by A. Elvebakk, partly also from his students, are deposited.

The material from various Swedish expeditions, with the exception of most of Th.M. Fries' 1868 material, is found at UPS or S. The materials from Poulsen's and Summerhayes and Elton's expeditions are supposed to be placed in BM, but we have not been able to obtain any of their lichen collections from Svalbard.

Important collections made by Polish researchers in Svalbard are located in Krakow (KRA, KRAM), mostly from the Hornsund and Sørkapp areas, and many of these have been on loan and restudied by us. The important Svalbard collections in München (M) published by H. Hertel have only partly been restudied by us.

A number of additional botanical expeditions to Svalbard have also collected lichens, but it has been impossible to search for all these, which in many cases have not resulted in any published lists of lichen species.

Lichenicolous, non-lichenized fungi are not included in the present treatment.

### METHODS

Microscopical details were obtained by examining hand-cut sections, squashed material and, occasionally, freezing microtome sections. Measurements given in mm are dissecting microscope measurements on dry material, whereas those given in µm are compound microscope measurements in water (sometimes with a drop of 10 % KOH added).

Chemical spot tests on thallus have mostly not been used as they sometimes may be misleading, and often not exact enough for our purpose, but have in some cases been performed: 10 % KOH (K),

50 % HNO<sub>3</sub> (N), Modified Lugol's solution (where water was replaced by 50 % lactic acid and the solution added after pre-treatment with KOH (K/I), iodine solution (iodine crystals dissolved in 70 % ethanol) (I), paraphenylendiamine saturated solution in 96 % ethanol (P) or commercial hypochlorite solution (C).

Thin-layer chromatography (TLC) has been performed on collections extensively in accordance with the standard methods of Culberson & Kristinsson (1970) and Culberson (1972), modified by Menlove (1974) and Culberson & Johnson (1982) for the determination of lichen compounds. In general, solvents A and B were used, in selected cases also solvent C. Fatty acids, which require glass plates to be detected, were not generally studied. Most specimens collected by T. Tønsberg and all specimens of *Lepraria* in addition to selected specimens of *Placopsis* and *Sporastatia*, as well as all cited isidiate and sorediate specimens were chromatographed in all three solvents using glass plates at least in solvent C to allow for the detection of fatty acids; specimens in which fatty acids were detected, were usually re-run on glass plates in all three solvents. High-pressure liquid chromatography (HPLC) was performed on a few specimens by J.A. Elix.

#### CIRCUMSCRIPTION OF THE AREA

The area for the flora comprises the Svalbard archipelago with the exclusion of Bjørnøya and is situated between 76°28' and 80°41' northern latitudes and between 10° and 35° longitudes east.

#### TERMINOLOGY

Geographical names follow 'The Place Names of Svalbard' (Anonymous 2003). However, under *Specimens seen* names are written according to the herbarium labels, whereas names in current use (if deviating) are given in brackets. It should be noted that Spitsbergen is not a synonym of Svalbard, but is the largest island of the archipelago.

#### DISTRIBUTION INFORMATION

The Svalbard Lichen Database (SLD, <http://www.nhm.uio.no/botanisk/lav>) hosted by the University of Oslo, at present includes collections from O, BG and TROM, and is under development.

World distribution patterns are indicated, based on a number of floras and updated web checklists, particularly from Fennoscandia (Santesson et al. 2004), North America (Esslinger 2008), Chile, including its claimed Antarctic territory (Galloway & Quilhot 1998), Argentina (Calvelo & Liberatore 2002), Australia (McCarthy 2008), New Zealand (Galloway 2007), and Antarctica (Øvstedal & Lewis Smith 2001). Species occurring in subantarctic islands are most often lumped with Antarctica.

Distributions within the Arctic are briefly cited. For a more detailed survey, consult the Panarctic Lichen Checklist (Kristinsson et al. 2006) at [http://archive.arcticportal.org/276/01/Panarctic\\_li-chen\\_checklist.pdf](http://archive.arcticportal.org/276/01/Panarctic_li-chen_checklist.pdf), which indicates presence/absence within 31 sectors of the Arctic.

## DESCRIPTION OF THE AREA

### TOPOGRAPHY

Svalbard is dominated by mountains, glaciers and strandflats. The mountains are often steep, with spectacular peaks, but where the layers are horizontal, table-mountains are found. The northern and western fjords are deeply indented by steep-sided fjords, and the two largest ones, Isfjorden and Wijdefjorden, nearly divide Spitsbergen in two parts. The strandflats, found around most of the islands, are flat to undulated or weakly sloping sedimentation plains, with scattered rock outcrops. They range from the sea to the foot of the mountains, and can be from 100 m to more than 10 km wide. The biomass of Svalbard is strongly concentrated to these strandflats. However, the highest productivity is found below the numerous birdcliffs, particularly along the western coast. Glaciers cover more than 60 % of the area of Svalbard.

### GEOLOGY

#### *Quaternary geology and glaciology*

The late Weichselian glacial maximum, approx. 18 000 years ago, covered practically all of Svalbard, and the northern parts of the Barents Sea were covered by a massive ice sheet, 2–3 km thick (Landvik et al. 1987, Svendsen & Mangerud 1992). A recent study from the islands Danskøya and Amsterdamøya, however, showed that the Late Weichselian glaciers covered their coastal areas, whereas their mountain plateaus > 300 m a.s.l. had been ice-free for > 80 000 years (Landvik et al. 2003).

Like in Fennoscandia, Svalbard temperatures have apparently been higher in the postglacial period 9000 – 3500 BP. One of the most convincing indications is the occurrence of thermophilous molluscs (*Mytilus edulis*), indicating a sea temperature 3-4 °C higher than at present (Salvigsen et al. 1992). The molluscs disappeared at about 3800 years BP. Pollen studies have shown higher abundance of *Cassiope tetragona* (Hyvärinen 1972); macrofossils of thermophilous species have been found (Birks 1991), as well as a postulated occurrence of fertile *Sphagnum* species during warmer periods (Flatberg & Thingsgaard 2004).

Most glaciers on Svalbard advanced during the ‘Little Ice Age’ to form extensive moraines, and reached their maximum Holocene position during the 19th century (Svendsen & Mangerud 1992). The glaciers retreated during a subsequent 20th century warming, with temperatures higher than during the preceding 500 years (Tarussov 1992).

#### *Bedrock*

Svalbard has a very complex geology (Fig. 1, p. 219). The oldest rocks are Precambrian, dating well over 400 mill years, and Cambrian and early Silurian rocks. These rocks are found on the west coast, on the peninsula between Wijdefjorden and Hinlopenstretet, on the northernmost part of Nordaustlandet

and on Kvitøya. The rock types are gneisses, schists, migmatites and granites, and they have previously been called the Hecla Hoek series. During the Caledonian orogeny, most of these rocks were folded, and they were transformed into metamorphic rocks. In Silurian time, they were invaded by molten magma, to form granites which make up some of the highest mountains on Svalbard. These ancient rocks form the basement which was covered by thousands of metres of sediments. The lowermost of these, from Devonian time, are mostly found in an area between Isfjorden and the north coast of Spitsbergen, and consist of conglomerates, shales and red sandstones. Several mountain slopes here are reddish due to the content of iron oxide in the sandstone. During the subsequent Carboniferous and Permian periods, mainly limestones layers were formed, and also some coal. Rocks from these periods are found in central Spitsbergen and on Nordaustlandet. Layers from the Mesozoic, with the Triassic, Jurassic and Cretaceous periods, are found in the central parts of Spitsbergen and on Edgeøya, mainly as sandstones and limestone.

During the Tertiary period, large earth movements took place, inducing the folding of parts of the bedrock on the west coast of Svalbard, which resulted in the dramatic mountain scenery found there today. Tertiary deposits were originally more than 4000 m thick, but the major part has been removed by erosion. The Tertiary deposits are concentrated to central southern Spitsbergen (Nordenskiöld Land, Nathorst Land), and consist of sandstones and limestones. For more information, consult the Bedrock Map of Svalbard and Jan Mayen (Dalland & Ohba 2002), or regional Svalbard maps, e.g. Hjelle & Lauritzen (1982).

## CLIMATE

Svalbard is entirely within the High Arctic, with a correspondingly severe climate. The weather pattern can roughly be characterized in high pressure situations, involving invading cold air from the north-east, or low pressure with mild, oceanic air from the south. The North Atlantic sea current explains the existence of unfrozen sea further to the north than elsewhere, a situation which has become more pronounced during the last decade.

Fog and precipitation near both the western and eastern coasts, and increasing continentality towards central parts of Spitsbergen, is an important aspect of the regional climate. Thus, highest summer temperatures occur in central, inland parts of Svalbard, and the climate becomes colder, not only towards the north, but also towards the west, east and the south. The southern part of Spitsbergen is a meeting point between eastern and western weather systems, and extremely glaciated and cold. Mean July temperatures at Hornsund in southernmost Svalbard is 4.0 °C compared to 6.5 °C at Longyearbyen in central Svalbard. Meteorological stations further to the north along the western coast have intermediate values: 4.7 °C at Isfjord Radio, and 4.9 °C at Ny-Ålesund. The only official meteorological station within the arctic polar desert zone, on the island Hopen, has a July value as low as 1.7 °C. Some short-time data series cited by Elvebakk & Spjelkavik (1995) from the north-easternmost areas are in the same range.

Mean annual precipitation is approximately 400 mm along the western coast, decreasing to 200-300 mm towards the heads of the fjords and inland areas (Steffensen 1982). In Wijdefjorden, it is probably considerably lower. Much of the precipitation falls as snow. Most of Svalbard is snow-covered between early September and early May. The active layer above the permafrost is 0.3–1.5 m thick. The melting ice keeps the surface soil layers water-saturated during spring, but well-drained areas become dry during the remaining summer season.

In a study of Svalbard meteorological data, Førland et al. (1997) found a complicated tem-

perature pattern, with an increase in annual temperatures from 1912 to the late 1930s, then a decrease until the 1960s, followed by an increase until present. Changes in winter temperatures dominate the changes in annual temperatures up to the 1960s, whereas changes in spring temperatures dominate the changes since the 1960s. The annual precipitation level has increased since 1912 by approximately 25 % (Førland et al. 1997).

Svalbard has arctic light conditions, and the periods of continuous daylight and darkness range from 120 to 140 days from southern Spitsbergen to the northernmost islands.

By means of a study of sediments in 24 Svalbard lakes, Birks et al. (2004) discussed recent environmental changes and atmospheric contamination on Svalbard. They found an increase in sediment organic-matter accumulation during the last 50-100 years, probably as a response to climate change. The atmospheric contamination was a combination of local and remote sources, but with little effect on lake-biota. Local sources (settlements with power stations) had a contamination effect reaching only 60-80 km away from the source (Rose et al. 2004), whereas a previous study (Lien et al. 1993) showed that critical loads of acidity reaches considerably further, although another study of Svalbard lakes (Jones & Birks 2004) showed no diatom evidence for acidification.

## BIOCLIMATIC ZONATION

The major factors determining the spatial distribution of vegetation and flora, are temperature, bedrock/soil chemistry, substrate texture and topography, in addition to historical factors. Regionally, temperature may be regarded as the primary factor, as each climate zone represents a framework for a particular set of vegetation types and species/species combinations which can be realized within a climatic zone, depending on environmental factors acting on a local scale. It is difficult to use meteorology data alone as a basis for a map of climate zones of Svalbard, because of lack of spatial resolution and the extrapolation challenges related to the great variation in topography. However, the use of vascular plants as climate indicators makes it possible to map bioclimatological zones.

Summerhayes & Elton (1928) were the first to present a map of bioclimatic zones of Svalbard. Three zones were mapped based on the occurrence of *Cassiope tetragona*, *Dryas octopetala* and a number of thermophilic species, respectively, while their fourth 'Barren Zone' was characterized by the lack of all these indicator species. Elvebakk (1985) proposed a slightly different subdivision and suggested a nomenclature related both to Fennoscandian and Russian traditions. Elvebakk also used higher phytosociological units as criteria, and later (1989) made a more detailed subdivision, now using all species defined as relatively thermophilic (= requiring mean July temperatures above 3 °C). In the adopted system, the High Arctic is subdivided into the **arctic polar desert zone**, the **northern arctic tundra zone** and the **middle arctic tundra zone**.

The arctic polar desert zone is considered to include areas with mean temperature of the warmest month below 3 °C, whereas the northern arctic tundra zone is distributed within the range 3–5 °C and the middle arctic tundra zone 5–7 °C. The southern arctic tundra zone, representing areas within the range 7–9 °C, is not represented with certainty on Svalbard, but may be represented by small areas with a high representation of thermophilic species (e.g. the *Betula nana/Campanula gieseckiana* locality in Colesdalen, the west-facing Ossian Sarsfjellet near Ny-Ålesund and the *Calamagrostis purpurascens* locality at Wijdefjorden. Elvebakk (2005) proposed a number of 'Arctic hotspot complexes' on Svalbard.

### *Vegetation of the arctic polar desert zone*

The arctic polar desert zone is characterized by a very low vegetation cover, with normally less than 1 % cover of vascular plants. Lichens and bryophytes may cover 20 % of the ground. Moist depressions can have a dense vegetation cover, mainly of bryophytes, but peat formation does not occur. A *Papaver dahlianum* community is considered to be characteristic and to represent the zonal vegetation of this zone (Elvebakk 1985). In moister sites, *Cerastium regelii* and *Phippsia algida* are characteristic components. A number of the phytogeographically most interesting lichens, such as *Fuscopannaria abscondita*, *Cladonia floerkeana*, *Tuckermanopsis inermis*, and *Pertusaria* sp. B are found in this vegetation zone.

As opposed to vascular plants, most Svalbard lichens are not favoured by the highest temperatures found on the island. Polar desert areas often have very strong cryoturbation movements and disturbed soil and rock surfaces with little lichen vegetation. However, also in apparently unstable soil in limestone areas, one can find abundant pebbles of harder rocks with crustose lichens, particularly *Aspicilia* spp., as well as scattered apothecia and perithecia indicating an easily overlooked, but species-rich lichen flora. Stable bedrock substrates are uncommon in the arctic polar desert zone, but where they occur they have a luxuriant lichen vegetation.

### *Vegetation of the northern arctic tundra zone*

The zonal vegetation of the northern arctic tundra zone is a moderate snowbed vegetation which phytosociologically has been referred to as the alliance *Luzulion nivalis* (Elvebakk 1994, 2005). This habitat covers most of the landscape and is normally free of snow around July 1. *Luzula arctica* is the characteristic species on alkaline and slightly acidic ground, but species like *Salix polaris* and *Saxifraga oppositifolia* are often dominant. *Cetrariella delisei* is very common in depressions. *Luzula confusa* characterizes a parallel community on acidic substrates. The strandflat on the western coast of Svalbard belongs to the northern arctic-tundra zone, and in many places the coarsely textured substrate makes the better drained areas relatively barren, while *Deschampsia alpina* mires without any significant peat accumulation occur in slight depressions, such as in Prins Karls Forland, Kvaldehuksletta and Kjærstranda (see Gjessing & Øvstdal 1975).

Three other characteristic communities also occur in the northern arctic tundra zone. A community dominated by *Dryas octopetala* is developed on ridges on weakly acidic and basic substrate, and is lacking from the arctic polar desert zone. Its name is *Caricion nardinae*, and a number of *Cladonia* spp. and cetrarioid lichens seem to be restricted to this vegetation.

The second and third communities are moss tundras and *Poa alpina* snow beds, neither of any importance as lichen habitats.

### *Vegetation of the middle arctic tundra zone*

Due to the higher temperatures in the middle arctic tundra zone both exposed ridges and flat and slightly sloping areas are free of snow before July 1. Such mesic slopes (see Elvebakk 1994) are habitats for dwarf-shrub heaths. In this zone, the only widespread species is *Cassiope tetragona*, while *Empetrum hermaphroditum* only occurs as scattered individuals, and *Vaccinium uliginosum* ssp. *microphyllum* and *Betula nana* are restricted to very few localities (see Alsos et al. 2004). The *Cassiope tetragona* community (belonging to *Caricion nardinae*) is the zonal community of the mid-

dle arctic tundra zone (Elvebakk 1985). A number of *Cladonia* spp. and cetrarioid lichens are found in this type of vegetation.

Other communities lacking in the previous zones are *Carex saxatilis* mires and Ranunculo-Oxyrion snowbeds, neither of which are habitats for many lichens.

## RESULTS AND DISCUSSION

### BIOGEOGRAPHY

Among the 748 lichen species recognized here from Svalbard, 93 % are also found in Fennoscandia (see Santesson et al. 2004). These species are mostly circumpolar and it has been taken for granted that after the Weichselian icecap melted away in Fennoscandia and lichens colonized the exposed rock and soil there, they continued further north to Svalbard. However, it is difficult to assess dispersal capacities among the smallest lichen diaspores, and no phylogeographical studies of lichen populations have been done in this area. In a recent study on populations of 9 widespread vascular plant species occurring in Svalbard, Alsos et al. (2007) found that most of them immigrated either from Russia or Greenland, and not from Fennoscandia. This may also be the case for many lichens, particularly where large lichen diaspores are involved, such as thallus fragments, which could have been more effectively transported across the polar sea ice, than through the air from the south. Among the 52 species (7 %) not found in Fennoscandia today, the largest group is those found in Greenland (partly also arctic North America) and Svalbard. To these belong *Aspicilia annulata*, *A. composita*, *A. culicis*, *A. eburnea*, *A. lesleyana*, *A. mastoidea*, *A. narssquensis*, *A. nathorstii*, *A. nikrapensis*, *A. pertusa*, *A. punctiformis*, *Bryocaulon hyperborea*, *Cetraria racemosa*, *Lecanora hadacii*, *Rhizocarpon anseris*, *R. occidentale*, *Stereocaulon compactum*, *S. groenlandicum*, and *Thelenella sordidula*.

The second largest group are those endemic to Svalbard: *Buellia insularis*, *B. postglacialis*, *Caloplaca elvebakkiana*, *C. scabrosa*, *Fuscopannaria abscondita*, *Lecanora griseofulva*, *Rhizocarpon dahlii*, *R. mahreri*, *R. tephromelae*, *Tephromela lucifuga*, *Verrucaria extrema*, and *V. wilczekii*. These 12 species are of particular importance, although most of them may exist undiscovered elsewhere.

An almost equally large group is found on Novaya Zemlya (and adjacent Russia) and Svalbard: *Aspicilia cingulata*, *A. heteroplaca*, *A. plicigera*, *Miriquidica picea*, *Thelidium microsporum*, and *Verrucaria obsoleta*.

A few species have very few occurrences and are difficult to place in a phytogeographic category, for instance *Lecidea himalayica*, which is a nondescript, sterile, sorediate species on rock, found only in Himalaya and on Svalbard. Probably, only fragments of its real distribution is known at present. To illustrate the situation how recent investigations may drastically change our understanding of a species' distribution, we may refer to the cases of *Tuckermanopsis inermis* and *Arctocetraria nigricascens*. These two species were regarded as amphi-Beringian by Thomson (1984), i.e. restricted to a small area on both sides of the Bering Strait, based on the available knowledge at that time. However, later investigations (summarized by Elvebakk & Hertel 1996) showed that both species, which occur on Svalbard (Elvebakk & Tønsberg 1992, Tønsberg & Elvebakk 1993), have a more or less circumarctic distribution.

One particular problem on Svalbard has been the 'North Coast Lichens' in the sense of Lynge (1932, 1933), i.e. lichens thought to be restricted to the northern coasts of Svalbard. The most distinguished ones were *Allocetraria madreporeiformis*, *Dactylina arctica* and *D. ramosa*. The former is restricted to the warmest part of the southern Wijdefjorden area, a surprisingly dry part of Svalbard with steppe-like vegetation and calcareous and saline soils (Elvebakk & Nilsen 2002). The species is known from Novaya Zemlya and arctic North America, but is lacking from Greenland. However, its major distribution is in mountains of central Europe, even reaching Sicily, and then in dry, continental parts of Asia and North America. It is always found on calcareous soil. Thus it appears that

its distribution on Svalbard can be explained by its demands for dry, calcareous habitats within an arctic-alpine environment.

*Dactylina arctica* is a circumarctic species (Lynge 1933) which since Lynge's time has been found a bit further south on Svalbard (Ossian Sarsfjellet, Kongsfjorden), whereas *D. ramulosa* has a discontinuous circumpolar distribution including northern Fennoscandia (Timdal 2004), and also with additional occurrences in central Spitsbergen (see Elvebakk & Hertel 1996). The restricted distribution of these two conspicuous species on Svalbard is still enigmatic, although their pattern is clearly related to continentality. *Hypogymnia austrodes* has a similar pattern as *D. ramulosa*.

Lynge's 'North Coast Lichens' also included quite a number of widespread *Cladonia* species, and species such as *Sphaerophorus fragilis*, *Arctoparmelia incurva*, *A. centrifuga*, *Parmeliopsis hyperopta* and *P. ambigua*. Most of these have now been found on hard siliceous rock substrates also further to the south in Svalbard, where such substrate types are less common. Thus, lack of knowledge of these areas explain the previous pattern discussed so much by Lynge. However, another conspicuous species, *Alectoria ochroleuca*, is still only known from northernmost Svalbard, a dsitribution pattern difficult to explain. Many species are widely distributed throughout Svalbard. Among the remaining ones, only a limited number of species can have a pattern defined and explained by environmental or historical factors. Further studies on habitat ecology of the many poorly known species is a key factor for an increased understanding of Svalbard lichens.

#### Bipolar species

The number of bipolar species is dependent on the definition of 'bipolar'. The classic definition was formulated by Du Rietz (1940): " Species occurring in polar and cool temperate regions of both Hemispheres, but absent from the tropical lowlands and with or without intermediate stations in mountains in the tropical regions". Following this definition, Ochyra & Buck (2004) found that 20 moss species have known trans-American bipolar distributions without intermediate occurrences in the tropical regions. Øvstedal & Lewis Smith (2001) concluded that 39 % of the 380 lichen species accepted for Antarctica were bipolar. Among the 748 Svalbard species treated here, no less than 34 % (257 species) are bipolar. As a contrast, only 6 % (47 species) are defined as cosmopolitan. The latter definition is used in a broad sense here, including species also widely distributed in low-latitude mountains.

Bipolar distributions will not be dealt with more here. However, it should be added that at least two bird species breed in the Arctic and migrate each year to the Antarctic. The widespread Arctic Tern (*Sterna paradisaea*) also breeds on Svalbard, and Baird's Sandpiper (*Calidris bairdii*) breeds from eastern Siberia to Point Barrow and Baffin Island (Matthiessen 2003: 78). One cannot exclude the possibility of rare events when these birds have brought lichen diaspores from one polar region to the other.

#### BIODIVERSITY

Svalbard lichens represent an important exception to the general pattern of decreasing species diversity towards higher latitudes. The fact that more than one third of the lichens species recorded from both Antarctica and Svalbard have bipolar distribution patterns, is an evidence that lichens can migrate efficiently. On the other hand, the lacking of as many as 52 high-arctic species from Fennoscandia,

among the lichenologically best investigated areas in the world, indicates that habitat suitability and/or historical factors still are very important factors to many lichens. The present status of 12 endemic species may, however, be a result of insufficient investigations elsewhere.

The currently accepted species number of 742 will certainly also increase in the future. The most evident indication of this is the fact that the present flora includes 27 taxa determined to genus level only. Most of these are supposed to represent undescribed taxa, but are at present poorly understood represented by too insufficient material to allow for formal descriptions.

The isolated Svalbard island Bjørnøya supports 17 species (not critically studied by us) listed in the catalogue of Svalbard lichens by Elvebakk & Hertel 1996 but not seen by us in the material from Svalbard exclusive of Bjørnøya. Thus, the lichen species number of all Svalbard is at present 759.

## MAJOR ECOLOGICAL FACTORS AND LICHEN HABITATS

Some ecological factors mostly act on regional scale or meso-scale (climate, reindeer grazing), others on local scales (manuring, hydrology, substrate instability, littoral influence) or on both (e.g. substrate chemistry). Thus, the spatial perspective and local conditions define which can be considered as 'the most important' habitat factors for lichens. Generally, the same important factors affect the distribution of lichens in Svalbard as elsewhere, e.g. substrate chemistry and hydrology.

However, two factors appear to be less decisive in Svalbard than elsewhere, climate and littoral effects. Rather few lichen species in Svalbard appear to be restricted by climatic parameters, but there are some southern species like *Peltigera polydactylon*, *Umbilicaria polyphylla* and *Nephroma parile* and species restricted to arid areas such as *Allocetraria madrensis* and *Caloplaca trachyphyllea*. The lichen flora and vegetation on rocks near the sea-shore is much poorer than elsewhere, probably due to the mechanical effects of the winter sea ice.

On the other hand, three or four environmental effects are of particular importance in Svalbard. One is the manuring caused by the transport of nutrients by sea birds from the sea to land. One of the most impressive sights on Svalbard is the colour contrasts near their nesting sites in bird cliffs (Fig. 2, p. 220). Species which nest in strong concentrations, like kittiwakes (*Rissa tridactyla*), produce manure in too strong concentrations to allow any saxicolous lichen vegetation. The centres of their nesting areas are coloured white by guano, and contrast the orange colours by the *Xanthoria elegans*-dominated saxicolous vegetation of moderately manured rock surfaces, surrounding the nesting centres. Other orange species also occur on manured limestone substrates, like *Caloplaca saxicola* and *C. decipiens*. The latter is the one tolerating the strongest faeces concentrations. Another character species on manured limestone is *Endocarpon pulvinatum*.

In siliceous bird cliffs, species like *Candelariella arctica*, *Acarospora molybdina*, *Amadinea coniops*, *Rhizoplaca melanophthalma*, *Lecidea atrobrunnea* and several *Umbilicaria* species dominate along with *Xanthoria elegans* and several members of Physciaceae which tolerate all kinds of manured rocks. These make up very colourful lichen communities, which are strongly contrasting the mosaics of various vividly green and golden colours produced by mosses (e.g. *Aulacomnium palustre*, *Dicranum angustum* and *Tomentypnum nitens*) and vascular plants in the slopes below the bird cliffs. In these slopes very few lichens are involved, except a peculiar form of *Cetraria islandica* (see p. 131).

This bird cliff flora on siliceous rocks has many species in common with the flora of the upper geolittoral zone, as it is also based on marine nutrients. Small islands of these communities are often found on isolated rocks in the tundra, used as bird perches. Here *Xanthoria candelaria* and the alga

*Prasiola crispa* often occur in the centre, whereas dominance of *Umbilicaria arctica* is observed in the more peripheral areas. Several *Caloplaca* and *Lecanora* species also grow on old felled reindeer antlers, another nutrient-rich microhabitat, and even on dried reindeer faecal pellets, which are not disintegrated when deposited on dry ridges.

Another lichen habitat of particular interest and importance in Svalbard is driftwood. These logs are transported down the Russian rivers and spend a long time in the Arctic Sea before they end, strongly eroded on Svalbard shores, where they remain for centuries and millennia. A specialized lichen community of many associated crustose lichens grow on these logs.

#### *Reindeer grazing*

Reindeer grazing is another very important ecological factor in Svalbard. The Svalbard reindeer is an endemic subspecies which has adapted to an oceanic arctic environment with commonly occurring rainfalls during winter. This creates a hard ice cover which makes it difficult for the reindeer to obtain winter food. This is compensated for by its sedentary habitat. Thus, Svalbard reindeer do not migrate, put on a lot of body fat, and can cope with less food during winter than reindeer elsewhere. This means that the Svalbard reindeer do not rely on lichens as a winter diet as much as other reindeer, and in areas where both winter and summer grazing areas are favourable, they occur in large populations which have removed practically all available fruticose lichens from exposed sites. In summer, such lichens should therefore be searched for in boulder slopes in protected sites with thick snow cover. These are not grazed by reindeer neither during summer nor winter.

Today, reindeer are lacking in the Sørkapp/Hornsund area towards the south, the Ekmanfjorden-Billefjorden area, and the area between Vestfjorden and Austfjorden, both in central Spitsbergen, and in the Prins Karls Forland/Krossfjorden area. On the Brøggerhalvøya peninsula at Ny-Ålesund, reindeer were reintroduced in 1978, and the present authors have witnessed how the carpets of fruticose lichens have been disappearing since. First, carpets near ridges of *Flavocetraria nivalis/cucullata* and *Cladonia arbuscula*, disappeared very soon (see illustration in Elvebakk 1997), whereas the *Cetrariella delisei* carpets are more protected during winter and have been gradually reduced during the decades following the reintroduction. Some of these areas had reindeer populations previously, but they were killed off by trappers many years ago. Probably, there are also areas where both summer and winter grazing areas are of too low quality, and such areas will not support permanent reindeer populations.

Some authors (e.g. Eurola 1968) claim that there is a climatically defined coastal section in Spitsbergen where fruticose lichens grow better than in the inland. Fruticose lichens near the coast probably have a higher growth-rate than in more continental inland areas, but the primary explanation is probably reindeer grazing. The heavily grazed Longyearbyen area is very poor in fruticose lichens, but at Ekmanfjorden further to the north but with a similar continental climate, lichens form immense carpets in the absence of reindeer (Elvebakk, pers. obs.). Similar results were shown from other non-grazed areas in inner parts of Isfjorden by van der Wal et al. (2001).

However, fruticose lichens are also practically absent from other inland areas where there is no significant reindeer population like Gipsdalen and the area between Austfjorden and Vestfjorden. These areas are strongly continental, but also alkaline, and it is proposed here that the instable and dry substrate with frequent wind abrasion and fine soil transport is the main reason why otherwise widely distributed fruticose lichens are practically absent.

### *Substrate chemistry*

Pure limestone has a very specialized lichen flora of genera such as *Farnoldia*, *Carbonea*, *Protoblastenia*, *Verrucaria* p.p., whereas several genera such as *Physcia* and *Xanthoria* grow both on limestone and calcium-rich schists. However, a high percentage of saxicolous lichen species are totally restricted to siliceous substrates. Some of these, e.g. *Pannaria hookeri*, *Vestergrenopsis elaeina*, *V. isidiata* and *Usnea sphacelata* are concentrated to weakly acidic sandstones (Elvebakk 1984b), others only to the hardest (*Ophioparma ventosa*, *Arctoparmelia* spp., *Sarcogyne privigna*).

Terricolous substrates have quite a number of species tolerating both alcaline and siliceous soils (*Flavocetraria* spp., *Cetraria islandica*, *Cetrariella delisei*, *Alectoria nigricans* etc.), but also exclusively limestone soil species (*Protoblastenia terricola*, *Fulgensia bracteata*, *Psora rubiformis*, *Toninia sediformis* etc.) and acidophilous species (*Solorina crocea*, *Sphaerophorus globosus*, *Cladonia rangiferina* and many other *Cladonia* species).

Many common Svalbard lichen species growing in exposed sites from genera such as *Pseudoepehebe*, *Melanelia*, *Umbilicaria*, *Brodoa*, *Cetraria*, *Bryoria* etc. have dark colours due to melanins, most probably as a protection against UV-B radiation, but the dark pigmentation is less pronounced than in Antarctic lichens.

### *Protected habitats in screes*

During visits to Kapp Laila and Bjørndalen, T. Tønsberg recently found a number of unexpected taxa previously unknown to Svalbard on shaded and protected rock surfaces (mostly on the under side of rocks) in screes. These taxa include, e.g., *Bacidina chlorotica*, *Micarea sylvicola*, *Opegrapha gyrocarpa*, *Porina chlorotica*, and the new species *Tephromela lucifuga*. A similar habitat is under study in arctic-alpine environments in Fennoscandia.

## TAXONOMY

### KEY TO GENERA

*Key to fruticose genera*

1	Photobiont cyanobacteria.....	<i>Polychidium</i>
1	Photobiont green algae.....	2
2 (1)	Thallus orange (with anthraquinones) .....	3
2	Thallus not orange (without anthraquinones) .....	5
3 (2)	On mostly organic soil .....	<i>Xanthoria subfruticosa</i>
3	On rock.....	4
4 (3)	Conidia 3–4 µm long .....	<i>Xanthomendoza borealis</i>
4	Conidia up to 2 µm long .....	<i>Xanthoria candelaris</i>
5 (3)	On rock.....	6
5	On soil or organic material.....	9
6 (5)	With perithecia.....	<i>Endocarpon pulvinatum</i>
6	With apothecia .....	7
7 (6)	Branches yellow-green, with central axis .....	<i>Usnea</i>
7	Branches grey, without central axis .....	8
8 (7)	Ascospores septate, with phyllocladia .....	<i>Stereocaulon</i>
8	Ascospores simple, without phyllocladia .....	<i>Pilophorus</i>
9 (5)	Thallus flattened.....	10
9	Thallus terete.....	14
10 (9)	Thallus yellow (usnic acid) .....	<i>Flavocetraria</i>
10	Thallus grey (no usnic acid) .....	11
11 (10)	Thallus with gyrophoric acid .....	<i>Cetrariella</i>
11	Thallus without gyrophoric acid .....	12
12 (11)	Thallus with rangiformic acid .....	<i>Arctocetraria</i>
12	Thallus with lichesterinic and protolichesterinic acids.....	13
13 (12)	With pseudocyphellae on lower side .....	<i>Cetraria</i>
13	Without pseudocyphellae on lower side .....	<i>Tuckermannopsis</i>
14 (9)	Thallus decumbent.....	15
14	Thallus erect .....	18

15 (14)	Without pseudocyphellae .....	16
15	With pseudocyphellae .....	17
16 (15)	Thallus white.....	<i>Thamnolia</i>
16	Thallus dark brown-black .....	<i>Pseudephebe</i>
17 (15)	Thallus yellowish, partly flattened .....	<i>Alectoria sarmentosa</i> ssp. <i>vexillifera</i>
17	Thallus brown, not flattened .....	<i>Bryoria</i>
18 (14)	Branches hollow or with very lax medulla .....	19
18	Branches solid .....	21
19 (18)	With inner stereome .....	<i>Cladonia</i>
19	Without inner stereome .....	20
20 (19)	Thallus with usnic acid and additional products .....	<i>Dactylina</i>
20	Thallus with usnic acid only .....	<i>Allocetraria</i>
21 (18)	Thallus greyish or yellowish .....	22
21	Thallus brown .....	23
22 (21)	With pseudocyphellae .....	<i>Alectoria</i>
22	Without pseudocyphellae .....	<i>Sphaerophorus</i>
23 (21)	Outer cortical layer composed of anticlinal cells .....	<i>Bryocaulon</i>
23	Outer cortical layer composed of isodiametric cells .....	<i>Cetraria</i>

*Key to foliose genera*

1	With perithecia .....	<i>Dermatocarpon</i>
1	With apothecia .....	2
2 (1)	Growing on rock .....	3
2	Growing on soil or organic material .....	19
3 (2)	Thallus with cyanobacteria .....	4
3	Thallus with green algae .....	7
4 (3)	Cortex absent .....	<i>Collema</i>
4	Cortex present .....	5
5 (4)	Thallus black .....	<i>Placynthium</i>
5	Thallus grey-brown .....	6
6 (5)	Ascospores simple .....	<i>Pannaria</i>
6	Ascospores septate .....	<i>Vestergrenopsis</i>
7 (3)	Thallus orange .....	<i>Xanthoria</i>
7	Thallus not orange .....	8
8 (7)	Thallus umbilicate .....	<i>Umbilicaria</i>
8	Thallus not umbilicate .....	9

9 (8)	Ascospores 1-septate, brown .....	10
9	Ascospores uncoloured, simple .....	11
10 (9)	Lower cortex prosoplectenchymateous, atranorin present.....	<i>Physcia</i>
10	Lower cortex pseudoparenchymateous, atranorin absent .....	<i>Phaeophyscia</i>
11 (9)	Cephalodia present.....	<i>Placopsis</i>
11	Cephalodia absent .....	12
12 (11)	Thallus with usnic acid .....	13
12	Thallus without usnic acid .....	14
13 (12)	Thallus without divaricatic acid.....	<i>Arctoparmelia</i>
13	Thallus with divaricatic acid.....	<i>Parmeliopsis ambigua</i>
14 (12)	Lower surface without rhizines.....	15
14	Lower surface with rhizines.....	17
15 (14)	Lobes hollow or with very lax medulla .....	<i>Hypogymnia</i>
15	Lobes solid .....	16
16 (15)	Upper cortex pseudoparenchymateous .....	<i>Brodoa</i>
16	Upper cortex prosoplectenchymateous .....	<i>Allantoparmelia</i>
17 (14)	Thallus brown .....	<i>Melanelia</i>
17	Thallus grey .....	18
18 (17)	Thallus without divaricatic acid, with linear pseudocyphellae, especially near the lobe ends .....	<i>Parmelia</i>
18	Thallus with divaricatic acid, without pseudocyphellae .....	<i>Parmeliopsis hyperopta</i>
19 (2)	Thallus with cyanobacteria .....	20
19	Thallus with green algae .....	29
20 (19)	Thallus without cortex .....	<i>Collema</i>
20	Thallus with cortex .....	21
21 (20)	Cortex one layer thick .....	<i>Leptogium</i>
21	Cortex more than one layer thick .....	22
22 (21)	Thallus black, pulvinate .....	<i>Placynthium pulvinatum</i>
22	Thallus not black, not pulvinate .....	23
23 (22)	Lobes less than 2 mm broad, brown, with isidia.....	<i>Massalongia carnosa</i>
23	Lobes broader,without isidia.....	24
24 (23)	Thallus subfoliose, subfruticose, squamulose to granular .....	25
24	Thallus distinctly foliose.....	26
25 (24)	Thallus homoiomerous; asci with narrow, amyloid tube .....	<i>Santesoniella arctophila</i>
25	Thallus heteromerous; asci without amyloid structure .....	<i>Protopannaria pezizoides</i>
26 (24)	Lobes narrower than 5 mm .....	27
26	Lobes broader than 5 mm .....	28

27 (26)	Asci with amyloid apical plug, brown .....	<i>Fuscopannaria</i>
27	Asci without amyloid apical structures, grey.....	<i>Pannaria</i>
28 (26)	Lower surface distinctly veined, tomentose.....	<i>Peltigera</i>
28	Lower surface not veined, naked or sparingly tomentose.....	<i>Nephroma</i>
29 (19)	Thallus with cephalodia .....	30
29	Thallus without cephalodia .....	35
30 (29)	Ascospores brown, 1-septate .....	<i>Solorina</i>
30	Ascospores colourless, simple to septate .....	31
31 (30)	Cephalodia on upper side of thallus (or free-living).....	32
31	Cephalodia internal or on lower side of thallus .....	33
32 (31)	Lower surface distinctly veined, tomentose.....	<i>Peltigera</i>
32	Lower side not veined .....	<i>Psoroma</i>
33 (31)	Cephalodia internal .....	34
33	Cephalodia on lower side of thallus .....	<i>Peltigera venosa</i>
34 (33)	Thallus yellow-green .....	<i>Nephroma arcticum</i>
34	Thallus brown .....	<i>Lobaria linita</i>
35 (29)	Ascospores brown.....	36
35	Ascospores colourless.....	37
36 (35)	Lobe ends upturned, heavily pruinose, broad .....	<i>Physconia</i>
36	Lobe ends not upturned, not pruinose, narrow .....	<i>Phaeophyscia</i>
37 (35)	Lobes hollow or with very lax medulla .....	<i>Hypogymnia</i>
37	Lobes solid .....	38
38 (36)	Thallus with divaricatic acid.....	<i>Parmeliopsis</i>
38	Thallus without divaricatic acid.....	<i>Parmelia</i>

*Key to crustose genera*

1	Ascocarps stalked.....	2
1	Ascocarps not stalked .....	3
2 (1)	With loose spore mass; thallus crustose.....	<i>Chaenotheca</i>
2	Without loose spore mass; thallus squamulose.....	<i>Baeomyces</i>
3 (1)	Thallus filamentous .....	4
3	Thallus not filamentous .....	5
4 (3)	Photobiont <i>Trentepohlia</i> .....	<i>Cystocoleus</i>
4	Photobiont <i>Stigonema</i> .....	<i>Spilonema</i>
5 (3)	Photobiont cyanobacteria.....	6
5	Photobiont not cyanobacteria.....	14

6 (5)	With perithecia.....	7
6	With apothecia .....	8
7 (6)	Perithecial wall cellular.....	<i>Collemopsidium</i>
7	Perithecial wall of a textura intricata .....	<i>Cercidospora</i>
8 (6)	Photobiont <i>Nostoc</i> .....	9
8	Photobiont not <i>Nostoc</i> .....	12
9 (8)	With cortex (one cell-layer thick) .....	10
9	Without cortex.....	11
10 (9)	Ascospores muriform.....	<i>Leptogium</i>
10	Ascospores septate .....	<i>Arctomia</i>
11 (9)	Apothecia with thalline margin.....	<i>Lempholemma</i>
11	Apothecia without thalline margin.....	<i>Leciophysma</i>
12 (8)	Photobiont <i>Calothrix</i> .....	<i>Thelignya</i>
12	Photobiont <i>Gloeocapsa</i> .....	13
13 (12)	Tholus K/I+ blue.....	<i>Pyrenopsis</i>
13	Tholus K/I- .....	<i>Euopsis</i>
14 (5)	Photobiont <i>Trentepohlia</i> .....	15
14	Photobiont other green algae .....	19
15 (14)	With perithecia.....	<i>Porina</i>
15	With apothecia .....	16
16 (15)	Ascospores septate .....	17
16	Ascospores simple .....	18
17 (16)	Apothecia with exciple .....	<i>Gyalecta</i>
17	Apothecia without exciple .....	<i>Arthonia</i>
18 (16)	Epithecum N- .....	<i>Ionaspis</i>
18	Epithecum N+ red.....	<i>Hymenelia</i>
19 (14)	With perithecia.....	20
19	With apothecia .....	34
20 (19)	With algae in hymenium .....	21
20	Without algae in hymenium .....	22
21 (20)	Thallus squamulose to minutely fruticose .....	<i>Endocarpon</i>
21	Thallus crustose .....	<i>Staurothele</i>
22 (20)	On rock.....	23
22	On soil and organic material .....	26
23 (22)	Ascospores simple .....	<i>Verrucaria</i>
23	Ascospores septate .....	24

24 (23)	Hamathecium persistent.....	<i>Thelenella</i>
24	Hamathecium soon disintegrating.....	25
25 (24)	Ascospores septate.....	<i>Thelidium</i>
25	Ascospores muriform.....	26
26 (25)	Perithecia with thalline excipie.....	<i>Sporodictyon</i>
26	Perithecia without thalline excipie.....	<i>Polyblastia</i>
27 (22)	Thallus crustose .....	28
27	Thallus squamulose.....	32
28 (27)	Hamathecium soon disintegrating.....	29
28	Hamathecium persistent.....	30
29 (28)	True excipie with three layers.....	<i>Agonimia</i>
29	True excipie with two layers.....	<i>Polyblastia</i>
30 (28)	Ascospores simple .....	<i>Thrombium</i>
30	Ascospores muriforme .....	31
31 (30)	Ascus apex K/I+.....	<i>Protothelenella</i>
31	Ascus apex K/I-.....	<i>Chromatochlamys</i>
32 (27)	Ascospores submuriform .....	<i>Dacampia</i>
32	Ascospores simple or 1-septate.....	33
33 (32)	Ascospores 1-septate.....	<i>Placiopsis</i>
33	Ascospores simple .....	34
34 (33)	Perithecia between squamules .....	<i>Involucropyrenium</i>
34	Perithecia on squamules.....	35
35 (34)	Upper cortex 30–130 µm, distinctly delimited against algal layer.....	<i>Placidium</i>
35	Upper cortex 10–30 µm, poorly delimited against algal layer .....	<i>Catapyrenium</i>
36 (19)	Thallus and/or apothecia strongly yellow to orange .....	37
36	Thallus and/or apothecia not yellow or orange.....	43
37 (36)	Thallus and/or apothecia K+, with anthraquinones .....	38
37	Thallus and/or apothecia K-, with other compounds .....	40
38 (37)	Ascospores polarilocular.....	<i>Caloplaca</i>
38	Ascospores simple .....	39
39 (38)	Thallus squamulose, on soil.....	<i>Fulgensia</i>
39	Thallus crustose, on calcareous rock .....	<i>Protoplasteria</i>
40 (37)	Asci multisporous .....	<i>Pleopsidium</i>
40	Asci 8-16-spored.....	41
41 (40)	Thallus with pulvinic acid derivates .....	<i>Candelariella</i>
41	Thallus with rhizocarpic acid.....	42

42 (41)	Thallus leprose; ascospores simple.....	<i>Psilolechia</i>
42	Thallus not leprose; ascospores septate .....	<i>Arthrorhaphis</i>
43 (36)	Asci multisporous.....	44
43	Asci 8-spored .....	47
44 (43)	Apothecia with thalline margin.....	<i>Acarospora</i>
44	Apothecia without thalline margin.....	45
45 (44)	Thallus with gyrophoric acid .....	<i>Sporastatia</i>
45	Thallus without lichen products.....	46
46 (45)	Disc with umbo; paraphyses anastomosing .....	<i>Polysporina</i>
46	Disc without umbo; paraphyses ± simple .....	<i>Sarcogyne</i>
47 (43)	Ascospores simple .....	48
47	Ascospores septate .....	106
48 (47)	Apothecia aspiciloid.....	49
48	Apothecia sessile.....	54
49 (48)	On soil and organic material .....	<i>Megaspora</i>
49	On rock.....	50
50 (49)	Ascospores K/I+ violet .....	<i>Bellemerea</i>
50	Ascospores K/I-.....	51
51 (50)	True exciple carbonaceous.....	<i>Clauroxzia</i>
51	True exciple not carbonaceous.....	52
52 (51)	Asci with K/I+ uniformly blue apical dome .....	<i>Eiglera</i>
52	Asci without K/I+ uniformly blue apical dome .....	53
53 (52)	Hymenium hemiamyloid; asci with outer coat K/I + blue; wall and tholus K/I- .....	<i>Aspicilia</i>
53	Hymenium euamyloid; asci with lateral parts of tholus K/I + blue.....	<i>Aspilidea</i>
54 (48)	On rock.....	55
54	On soil and organic material .....	86
55 (54)	Apothecia with thalline margin.....	56
55	Apothecia without thalline margin.....	62
56 (56)	Thallus umbilicate.....	57
56	Thallus not umbilicate.....	58
57 (56)	Thallus brown, with xanthones .....	<i>Arctopeltis</i>
57	Thallus yellow-green, with usnic acid .....	<i>Rhizoplaca</i>
58 (56)	Thallus squamulose/placodioïd.....	59
58	Thallus crustose .....	60
59 (58)	With usnic acid, asci of <i>Lecanora</i> -type .....	<i>Squamaria poeltii</i>
59	Without usnic acid, asci of <i>Aspicilia</i> -type .....	<i>Lobothallia</i>

60 (58)	Colour pure brown, with lobaric or norstictic acid .....	<i>Protoparmelia</i>
60	Colour never pure brown, with other or no products.....	61
61 (60)	Paraphysse with visible lumina .....	<i>Tephromela</i>
61	Paraphyses without visible lumina.....	<i>Lecanora</i>
62 (55)	True excipie not carbonaceous or dark brown .....	63
62	True excipie carbonaceous or dark brown .....	80
63 (62)	Asci of <i>Teloschistes</i> -type .....	<i>Cephalophysis</i>
63	Asci not of <i>Teloschistes</i> -type .....	64
64 (64)	Without true excipie.....	<i>Micarea</i>
64	With true excipie .....	65
65 (64)	Disc with K <sup>+</sup> red pruininum .....	<i>Adelolechia pilati</i>
65	Disc without K <sup>+</sup> red pruininum .....	66
66 (65)	Thallus with usnic acid .....	<i>Lecanora</i>
66	Thallus without usnic acid .....	67
67 (66)	Thallus with atranorin and zeorin .....	<i>Lecidella</i>
67	Thallus with other compounds.....	68
68 (67)	Thallus with atranorin and xanthones .....	69
68	Thallus with other compounds.....	70
69 (68)	Asci of <i>Lecanora</i> -type .....	<i>Lecanora</i>
69	Asci of <i>Lecidella</i> -type .....	<i>Lecidella</i>
70 (68)	With atranorin and griseofulvin .....	<i>Lecanora griseofulva</i>
70	With other compounds .....	71
71 (71)	With norstictic acid .....	72
71	Without norstictin .....	74
72 (72)	Thallus black to brown-black.....	<i>Rimularia</i>
72	Thallus shiny brown or pale.....	73
73 (72)	Medulla K/I+ blue.....	<i>Lecidea lapicida</i>
73	Medulla K/I-.....	<i>Miriquidica lulensis</i>
74 (71)	With miriquidic acid .....	<i>Miriquidica</i>
74	Without miriquidic acid .....	75
75 (74)	With gyrophoric acid .....	76
75	Without gyrophoric acid .....	77
76 (76)	Ascospores globose, uniseriate .....	<i>Schaereria</i>
76	Ascospores elliptic, biseriate .....	<i>Lecidea</i>
77 (75)	Ascospores with halo; asci of <i>Porpidia</i> -type .....	78
77	Ascospores without halo .....	79

78 (77)	With cephalodia .....	<i>Amygdalaria</i>
78	Without cephalodia .....	<i>Porpidia</i>
79 (78)	Asci of <i>Lecidea</i> -type .....	<i>Lecidea</i>
79	Asci of <i>Bacidia</i> -type .....	<i>Adelolechia kolaensis</i>
80 (62)	Disc slit-like .....	<i>Lithographa</i>
80	Disc not slit-like .....	81
81 (80)	Epithecum N- .....	<i>Clauzadea</i>
81	Epithecum N+ red .....	82
82 (81)	Ascospores ca 20 µm long .....	<i>Farnoldia</i>
82	Ascospores ca 12 µm long .....	83
83 (82)	Apothecia immersed in thallus; thallus rust-red .....	<i>Tremolecia</i>
83	Apothecia sessile; thallus not rust-red .....	84
84 (83)	Thallus dark brown or black .....	<i>Orphniospora</i>
84	Thallus white or grey .....	85
85 (84)	Asci of <i>Lecanora</i> -type; conidia 15–30 µm long .....	<i>Carbonea</i>
85	Asci of <i>Melanolecia</i> -type; conidia 4–8 µm long .....	<i>Melanolecia</i>
86 (54)	Apothecia with thalline margin .....	87
86	Apothecia without thalline margin .....	90
87 (87)	Asci of <i>Lecanora</i> -type .....	88
87	Asci of <i>Pertusaria</i> -type .....	89
88 (87)	Thalline exciple indistinct; outer part of true exciple composed of anastomosing hyphae in a gelatinous matrix .....	<i>Bryonora</i>
88	Thalline exciple prominent; true exciple indistinct .....	<i>Lecanora</i>
89 (87)	Apothecia sessile, with gyrophoric acid .....	<i>Ochrolechia</i>
89	Apothecia immersed in thallus, without gyrophoric acid .....	<i>Pertusaria</i>
90 (86)	Asci multisporous .....	91
90	Asci 8-spored .....	92
91 (90)	Apothecia perithecioid-like; disc almost closed .....	<i>Thelocarpon</i>
91	Apothecia not so; disc exposed .....	<i>Biatorella</i>
92 (90)	Thallus squamulose .....	93
92	Thallus crustose .....	96
93 (92)	Epithecum with anthraquinones (K+ red) .....	<i>Psora</i>
93	Epithecum without anthraquinones .....	94
94 (93)	Thallus brownish .....	95
94	Thallus whitish-grey .....	<i>Mycobilimbia</i>
95 (94)	Asci of <i>Bacidia</i> -type .....	<i>Mycobilimbia</i>
95	Asci of <i>Lecidea</i> -type .....	<i>Lecidoma</i>

96 (92)	Thallus dark brown .....	97
96	Thallus white to grey to grey-brown.....	99
97 (96)	Ascospores uniseriate; asci of <i>Schaereria</i> -type .....	<i>Schaereria parasemella</i>
97	Ascospores biseriate; asci otherwise.....	98
98 (97)	Asci of <i>Trapelia</i> -type .....	<i>Placynthiella</i>
98	Asci of <i>Bacidia</i> -type .....	<i>Japewia</i>
99 (96)	Thallus with sphaerophorin.....	<i>Frutidella</i>
99	Thallus without sphaerophorin .....	100
100 (99)	With cephalodia .....	101
100	Without cephalodia .....	102
101 (100)	With true excipie; thallus with atranorin and zeorin .....	<i>Pilophorus dovrensis</i>
101	Without true excipie; thallus lacking compounds.....	<i>Micarea</i>
102 (100)	Apothecia without true excipie .....	<i>Micarea</i>
102	Apothecia with true excipie .....	103
103 (102)	Asci of <i>Biatora</i> -type .....	<i>Biatora</i>
103	Asci of other types .....	104
104 (103)	Asci of <i>Psora</i> -type .....	<i>Protomicarea</i>
104	Asci of other types .....	105
105 (104)	Asci of <i>Lecidella</i> -type.....	<i>Lecidella</i>
105	Asci of other types .....	<i>Lecidea</i>
106 (47)	On rock.....	107
106	On soil and organic material .....	122
107(107)	Ascospores brown.....	108
107	Ascospores uncoloured .....	113
108 (107)	Ascospores 1-septate.....	109
108	Ascospores 2-many-septate.....	<i>Rhizocarpon</i>
109 (108)	Conidia 15–20 µm long .....	<i>Amandinea</i>
109	Conidia 2–5 µm long .....	110
110 (110)	Apothecia with thalline excipulum .....	<i>Rinodina</i>
110	Apothecia without thalline excipulum .....	111
111(110)	Paraphyses anastomosing.....	<i>Rhizocarpon</i>
111	Paraphyses simple.....	112
112 (112)	Thallus with usnic acid .....	<i>Dimelaena</i>
112	Thallus without usnic acid .....	<i>Buellia</i>
113 (107)	Ascospores 1-septate.....	114
113	Ascospores 2-many-septate.....	116

114 (114) Paraphyses anastomosing.....	<i>Rhizocarpon</i>
114       Paraphyses simple.....	115
115 (114) Ascospores without halo.....	<i>Catillaria</i>
115       Ascospores with halo.....	<i>Halecania</i>
116 (113) Apothecia without true exciple .....	<i>Arthonia</i>
116       Apothecia with true exciple .....	117
117 (116) Paraphyses anastomosing.....	<i>Rhizocarpon</i>
117       Paraphyses simple.....	118
118 (117) Disc red; apothecia immersed to sessile .....	<i>Ophioparma</i>
118       Disc brown to black; apothecia sessile .....	119
119 (118) Exciple brown-black in section.....	<i>Sagiolechia</i>
119       Exciple colourless in section.....	120
120 (119) Ascospores 5–8 µm broad, constricted at septa.....	<i>Gyalidea</i>
120       Ascospores up to 3 µm broad, not constricted at septa.....	121
121 (119) Exciple hyphae thick-walled.....	<i>Bacidia</i>
121       Exciple hyphae thin-walled.....	<i>Bacidiina</i>
122 (106) Ascospores brown .....	123
122       Ascospores uncoloured .....	126
123 (122) Apothecia urceolate; ascospores muriform.....	<i>Diploschistes</i>
123       Ascospores sessile; ascospores septate .....	124
124 (123) Thallus squamulose .....	<i>Phaeorrhiza</i>
124       Thallus not squamulose .....	125
125 (124) Paraphyses anastomosing.....	<i>Epilichen</i>
125       Paraphyses simple.....	<i>Buellia</i>
126 (122) Apothecia urceolate .....	<i>Absconditella</i>
126       Apothecia sessile.....	127
127 (126) Ascospores muriform .....	128
127       Ascospores septate .....	130
128 (127) Disc orange-brown; thallus with atranorin .....	<i>Brigantiaeae</i>
128       Disc dark brown; thallus without lichen compounds.....	129
129 (128) Ascii 1-spored .....	<i>Lopadium</i>
129       Asci with 2–8-spored .....	<i>Schadonia</i>
130 (127) Apothecia immersed in wood .....	<i>Xylographa</i>
130       Apothecia not so .....	131
131 (130) Disc red-brown; thallus with gyrophoric acid .....	<i>Anzina</i>
131       Disc black to brown; thallus without gyrophoric acid .....	132

132 (131) Thallus with lecanoric acid and lichenanthe.....	<i>Varicellaria</i>
132        Thallus with other or no compounds .....	133
133 (132) Thallus squamulose.....	134
133        Thallus crustose .....	136
134 (134) Ascii of <i>Toninia</i> -type.....	<i>Toninia</i>
134        Ascii of <i>Bacidia</i> -type .....	135
135 (134) Ascospores with warted epispor.....	<i>Bilimbia</i>
135        Ascospores with smooth epispor.....	<i>Mycobilimbia</i>
136 (133) Ascii of <i>Arthonia</i> -type .....	<i>Arthonia</i>
136        Ascii different.....	137
137 (137) Ascii of <i>Biatora</i> -type .....	<i>Biatora</i>
137        Ascii of <i>Bacidia</i> -type .....	138
138 (137) Ascospores 1-septate, 8–10 µm broad .....	<i>Megalaria</i>
138        Ascospores narrower and with more septa .....	139
139 (138) Excipular hyphae broader towards margin .....	<i>Lecania</i>
139        Excipular hyphae equally broad.....	<i>Bacidia</i>

Comments to the keys:

Basidiolichens are not included. Sorediate taxa which have not been found fertile on Svalbard are included in the key to sorediate species only.

## KEY TO STERILE SPECIES

### *Key to sorediate, crustose species on rock*

1        Thallus yellow or orange (anthraquinones) .....	2
1        Thallus not yellow or orange .....	4
2 (1)    Areolae peltate .....	<i>Caloplaca soropelta</i>
2        Areolae not peltate .....	3
3 (2)    At least some parts with cortex .....	<i>Caloplaca elvebakkiana</i>
3        Never with cortex .....	<i>Caloplaca xanthostigmoidea</i>
4 (3)    Thallus with xanthones .....	5
4        Thallus without xanthones .....	6
5 (4)    With atranorin and 3 undetermined xanthones .....	<i>Lecanora</i> sp. A
5        With atranorin, usnic acid and 1 undetermined xanthone.....	<i>Lecanora</i> sp. B
6 (4)    Thallus with usnic .....	7
6        Thallus without usnic acid .....	8

7 (6)	Soralia at margin of areolae .....	<i>Lecanora handelii</i>
7	Soralia centrally on areolae .....	<i>Lecanora soralifera</i>
8 (6)	Thallus with miriquidic acid .....	<i>Miriquidica nigroleprosa</i>
8	Thallus without miriquidic acid .....	9
9 (8)	Thallus with divaricatic acid .....	<i>Fuscidea gothoburgensis</i>
9	Thallus without divaricatic acid .....	10
10 (9)	Thallus with substictic acid .....	<i>Aspicilia mashingiensis</i>
10	Thallus without substictic acid .....	11
11 (10)	Photobiont <i>Trentepohlia</i> .....	12
11	Photobiont trebouxiod .....	14
12 (11)	Thallus with gyrophoric acid .....	<i>Opegrapha gyrocarpa</i>
12	Thallus without gyrophoric acid .....	13
13 (12)	With stictic acid .....	<i>Opegrapha gyrocarpa</i> forma
13	With two undetermined compounds .....	<i>Opegrapha</i> sp. A
14 (11)	Thallus with gyrophoric acid .....	15
14	Thallus without gyrophoric acid .....	18
15 (14)	Thallus white .....	16
15	Thallus grey to brown-black .....	17
16 (15)	Soralia delimited .....	<i>Ochrolechia androgyna</i>
16	Soralia as disintegrating protuberances .....	<i>Ochrolechia</i> sp. A
17 (15)	Thallus as scattered areolae .....	<i>Miriquidica furvella</i>
17	Thallus continous .....	<i>Rimularia radioatra</i>
18 (14)	Thallus with confluentic acid .....	19
18	Thallus without confluentic acid .....	20
19 (18)	Thallus orange-grey .....	<i>Porpidia melinodes</i>
19	Thallus grey .....	<i>Porpidia tuberculata</i>
20 (18)	Thallus with stictic acid .....	21
20	Thallus without stictic acid .....	24
21 (20)	Thallus white .....	<i>Pertusaria</i> sp. A
21	Thallus grey, green-grey, brown-grey etc. ....	22
22 (21)	Thallus orange-grey .....	<i>Porpidia ochrolemma</i>
22	Thallus grey to brown-grey .....	23
23 (22)	Areolae convex, dispersed .....	<i>Porpidia superba</i> f. <i>sorediata</i>
23	Areolae flat, rimose, coherent .....	<i>Porpidia soredizodes</i>
24 (20)	Thallus with norstictic acid .....	25
24	Thallus without norstictic acid .....	28

25 (24)	Thallus whitish, with crateriform soralia .....	<i>Bellemerea subsorediza</i>
25	Thallus brown, with flat to convex soralia .....	26
26 (25)	Norstictic acid only .....	27
26	With additional compound .....	" <i>Rimularia</i> " sp. B
27 (26)	Soralia convex; thallus grey .....	" <i>Rimularia</i> " sp. C
27	Soralia flat to crateriform .....	<i>Miriquidica atrofulva</i>
28 (24)	Thallus with atranorin .....	29
28	Thallus without atranorin .....	32
29 (28)	With atranorin and nephrosteranic or roccellic acid .....	<i>Lecanora caesiosora</i>
29	With other combinations .....	30
30 (29)	With atranorin and alectorialic acid .....	<i>Lecidea himalayica</i>
30	With other combinations .....	31
31 (30)	With atranorin, zeorin and bourgeanic acid .....	<i>Tephromela lucifuga</i>
31	With atranorin and zeorin .....	<i>Lecidella</i> sp. A
32 (28)	Thallus with rhizocarpic acid .....	<i>Lecanora subaurea</i>
32	Thallus without rhizocarpic acid .....	33
33 (32)	With two unidentified compounds .....	<i>Fuscidea</i> sp. B
33	With no lichen products .....	34
34 (33)	Thallus isidiose-sorediate .....	<i>Aspicilia leprosescens</i>
34	Thallus with delimited soralia .....	<i>Porpidia</i> sp. A

*Key to sorediate, crustose species on organic material*

1	On wood .....	2
1	On soil, moribund bryophytes etc .....	4
2 (1)	Soralia orange, with anthraquinones .....	<i>Caloplaca alaskensis</i>
2	Soralia greenish, yellowish .....	3
3 (2)	Soralia yellow-green, with usnic acid; soredia 16–18 µm .....	<i>Lecanora orae-frigidae</i>
3	Soralia pale ochre, no lichen products; soredia 20–30 µm .....	<i>Mycobilimbia</i> cf. <i>epixanthoides</i>
4 (1)	With alectorialic acid .....	5
4	With other compounds .....	6
5 (4)	Areolae globose .....	<i>Pertusaria geminipara</i>
5	Areolae flat .....	<i>Pertusaria</i> sp. B
6 (4)	With atranorin and zeorin .....	<i>Lecidella</i> sp. B
6	With gyrophoric acid .....	7
7 (6)	Thallus with spine-like extensions .....	<i>Ochrolechia frigida</i>
7	Thallus without spine-like extensions .....	8

- 8 (7) Thallus thick, on various substrates ..... *Ochrolechia androgyna* s. lat.  
8 Thallus very thin, on *Racomitrium lanuginosum* ..... *Ochrolechia grimmiae*

## DESCRIPTION OF THE TAXA IN ALPHABETICAL ORDER AND KEYS TO THE SPECIES

### **ABSCONDITELLA** Vězda (1965)

**Thallus** crustose, effuse, green-grey to brownish, gelatinous when wet. Photobiont trebouxioid. **Ascomata** apothecia; disc urceolate, pale brown, mostly immersed in thallus, without thalline exciple. True exciple pseudoparenchymateous or composed of parallel hyphae. Hymenium K/I –. Hamathecium of simple paraphyses. Ascii thin-walled, with a distinct apical dome which may have a narrow ocular chamber; dome K/I –. Ascospores ellipsoid, fusiform or acicular, uncoloured, 1–6-septate. No lichen products observed.

#### *Absconditella annexa* (Arnold) Vězda (1965)

**Thallus** brownish, granulose. **Apothecia** pale yellowish, 0.25–0.35 mm; disc urceolate. Hymenium 50–60 µm high. Ascospores 8 in ascci, acicular, 5–6-septate, 35–38 × 3–3.5 µm.

**Ecology.** Over moribund bryophytes.

**Distribution.** Only known from the Barentsburg area.

**Notes.** Description provided by Urbanavichene & Urbanavichus (pers. comm. 2005). World distribution: Europe.

**Specimens seen:** none seen, included on the basis of Urbanavichene & Koroleva (2008 and pers. comm.).

### **ACAROSPORA** A. Massal. (1852)

**Thallus** crustose to squamulose to placodioid, brown to yellow to rust-coloured; upper cortex pseudoparenchymatous, lower cortex variable. Photobiont trebouxioid. **Ascomata** apothecia, immersed to sessile; thalline margin ill-defined to prominent. Hamathecium of paraphyses, thin, sparingly ramified, conglutinated. Ascii clavate with distinct apical dome which is K/I –, polysporous (>100), ascospores round to elliptic, simple, colourless. Conidia broadly ellipsoid.

**Notes.** The circumscription of the taxa generally follows Magnusson (1929, 1935). He placed much weight on characters such as cortex tissue, shape of areolae, height of hymenium, roughness and colour of disc, and colour of lower surface. These characters are possibly subjected to modification by environmental factors; if so, the number of species on Svalbard would probably be reduced. The genus is badly in need of revision.

Key to *Acarospora* on Svalbard:

1	Thallus with gyrophoric acid (C + red).....	2
1	Thallus without gyrophoric acid (C –).....	4

2 (1)	Lower cortex black .....	<i>A. peliscypha</i>
2	Lower cortex pale .....	3
3 (2)	Apothecial margin distinct.....	<i>A. rugulosa</i>
3	Apothecial margin not visible.....	<i>A. fuscata</i>
4 (1)	Thallus with norstictic acid acid (K + red) .....	<i>A. smaragdula</i>
4	Thallus whithout norstictic acid (K -) .....	5
5 (4)	Thallus and apothecia blue-grey-pruinose .....	<i>A. glauccarpa</i>
5	Thallus and apothecia not pruinose.....	6
6 (5)	Thallus strongly rust-coloured .....	<i>A. sinopica</i>
6	Thallus not strongly rust-coloured .....	7
7 (6)	Growing on soil, with prominent rhizomorphs.....	<i>A. rhizobola</i>
7	Growing on rock, without prominent rhizomorphs .....	8
8 (7)	Apothecia distinctly sessile.....	<i>A. badiofusca</i>
8	Apothecia ± immersed in areolae .....	9
9 (8)	Thallus composed of radiating lobes .....	<i>A. molybdina</i>
9	Thallus areolate, without radiating lobes .....	10
10 (9)	Hymenium higher than 125 µm .....	<i>A. verruciformis</i>
10	Hymenium lower than 125 µm .....	11
11 (9)	Lower cortex black .....	<i>A. hospitans</i>
11	Lower cortex whitish to pale brown .....	12
12 (11)	Thallus rosulate .....	<i>A. rosulans</i>
12	Thallus not rosulate .....	13
13 (12)	Thallus pale brown; cortex cells thin-walled, 4–5 µm diam. ....	<i>A. veronensis</i>
13	Thallus dark brown; cortex cells thick-walled, 2–3 µm diam. ....	<i>A. persimilis</i>

*Acarospora badiofusca* (Nyl.) Th. Fr. (1861)

**Thallus** dark brown, crustose, areolate; areolae up to 1.5 mm diam., rounded, flat. **Apothecia** up to 1 mm wide, sessile, with distinct thalline margin; disc flat, darker than thallus. Hymenium 70–80 µm high. Ascospores 3–4 × 1.5–2 µm. Paraphyses 2.5–3 µm diam. at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous on both calcareous and non-calcareous rock; non-ornithocoprophilous.

**Distribution.** Widespread, not common.

**Notes.** This species is characterized by regular, flat areolae with fairly large, sessile apothecia. No other *Acarospora* species on Svalbard has distinctly sessile apothecia. World distribution: Circum-arctic and alpine in the Northern Hemisphere, South America, New Zealand, Antarctic islands.

**Specimens seen** (selected): Ny-Ålesund, 1986, A. Elvebakk (TROM); Barentsøya, 1.8.1936, E. Dahl (O).

*Acarospora fuscata* (Schrad.) Th. Fr. (1871)

**Thallus** crustose, 2–4 mm broad, flat, shiny brown, composed of angular areolae up to 0.5 mm broad; lower side pale. **Apothecia** 1–3 per areola, immersed in thallus, margin not visible. Hymenium 70–80 µm high. Ascospores 2.5 × 0.5 µm. Paraphyses 1.5 µm wide at base.

**Chemistry.** Gyrophoric acid.

**Ecology.** Saxicolous, possibly ornithocoprophilous.

**Distribution.** Known from a few scattered sites.

**Notes.** Differs from the two other species in the group containing gyrophoric acid by its pale lower surface and flat areolae. World distribution: Widely distributed in arctic, boreal/temperate and alpine parts of the Northern Hemisphere, South America, New Zealand, Australia.

**Specimens seen** (selected): Grønfjorden, 1.8.1968, Th.M. Fries (O); Longyearbyen, 5.7.1936, E. Dahl (O).

*Acarospora glaucocarpa* (Ach.) Körb. (1859)

**Thallus** crustose, up to 1.5 mm wide, of dispersed, round, convex, green-brown, pruinose areolae. **Apothecia** 1–2 per areola, with slightly raised margins, somewhat darker than thallus; disc concave to flat, strongly bluish-pruinose. Hymenium 70–75 µm high. Ascospores 4 × 2 µm. Paraphyses 1.5–2 µm wide at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous on calcareous rock, non-ornithocoprophilous.

**Distribution.** Known from a few scattered sites.

**Notes.** Easily recognized by the dispersed, convex areolae and the bluish pruina on areolae and apothecia. World distribution: Circum-arctic and boreal/alpine, southern South America, New Zealand.

**Specimens seen** (selected): Hiorthamn, 24.7.1936, E. Dahl (O); Grønfjorden, 1.8.1868, Th.M. Fries (O).

*Acarospora hospitans* H. Magn. (1924)

**Thallus** placodioïd, brown, up to 2.5 mm broad, with rounded diffuse lobes, areolate in inner part. **Apothecia** 2–5 per areola, slightly immersed; disc 0.2–0.3 mm broad, concolorous with thallus; margin obtuse. Lower side black. Hymenium 60–75 µm. Ascospores 3–4 × 2–2.5 µm. Paraphyses 1.5–2 µm wide at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous on siliceous rock near water, non-ornithocoprophilous.

**Distribution.** Only known from Hornsund, Forsbladhamna and Adventfjorden.

**Notes.** Very similar to *A. veronensis*, but differs above all in the black lower side. Magnusson (1929: 112) writes: “*A. hospitans* might at first sight be mistaken for *A. veronensis*, but it is an excellent species, distinguished by the dark lower side, the hymenial reaction, the broad ellipsoid spores and the habitat”. World distribution: Europe, North America (Greenland).

**Specimens seen:** Forsbladhamna, 29.7.1926, B. Lynge (O); Advent Bay [Adventfjorden], 5.8.1868, Th.M. Fries (O).

*Acarospora molybdina* (Wahlenb.) A. Massal. (1855)

**Thallus** placodioid, 2–3 cm wide (or more), brown, with radiating lobes; lobes up to 1 mm broad, flat to somewhat convex, inner part areolate; areolae angulate, up to 0.5 mm diam. **Apothecia** 1 per areola; thalline margin indistinct; disc concave, dark brown. Hymenium 130–140 µm high. Ascospores 3–3.5 × 1 µm. Paraphyses at base 1.5 µm wide.

**Chemistry.** Negative.

**Ecology.** Saxicolous on sea-shore cliffs and bird-cliffs.

**Distribution.** Widespread and common.

**Notes.** Characterized by the fairly large, placodioid dark brown thallus with radiating lobes. World distribution: Europe (on the mainland a subarctic species only known from the northernmost seashores of mainland Norway), Siberia, North America (including Greenland).

**Specimens seen** (selected): Barentsøya, 2.8.1936, E. Dahl (O); Krossfjorden, Elvebakk 85:235 (TROM).

*Acarospora peliscypha* Th. Fr. (1860)

**Thallus** subplacodioid, up to 5 mm diam., with shiny chestnut brown, convex lobes rounded at margin. Lower surface black. **Apothecia** numerous in inner part of thallus, when old almost covering thallus, up to 0.7 mm diam.; margin thin, raised, concolorous with thallus; disc dark brown, flat, slightly gyrose when old. Hymenium 110–125 µm high. Ascospores 3–4 × 1 µm. Paraphyses 1–1.5 µm wide at base; end cell 3–4.5 µm wide.

**Chemistry.** Gyrophoric acid.

**Ecology.** Saxicolous on non-calcareous rock, ornithocoprophilous.

**Distribution.** Only known from Grønfjorden.

**Notes.** *A. peliscypha* resembles *A. fuscata* which also contains gyrophoric acid, but is distinct by its convex areolae. World distribution: circum-arctic and alpine.

**Specimens seen:** Grønfjorden, 1.8.1868, Th.M. Fries (O; det. H. Magnusson); Adventfjorden, Grøndalen, 20.07.1924, J. Lid (O).

*Acarospora persimilis* H. Magn. (1935)

**Thallus** areolate, areolae dark brown, up to 1 mm diam., slightly to moderately convex, wrinkled. Lower side dark. Cortex cells thick-walled, 2–3 µm diam. **Apothecia** at first deeply imbedded in thallus, later expanding to 0.2–0.4 mm diam., with prominent margin; disc concave, black. Hymenium 90–100 µm high. Ascospores 2–3.5 × 1–1.5 µm.

**Chemistry.** Negative.

**Ecology.** Saxicolous.

**Distribution.** Only known from two localities.

**Notes.** Differs from *A. veronensis* mainly in its thick-walled cortex cells. Generally, cortex cells are influenced by environmental factors such as insolation, and therefore of little taxonomic value. However, the two specimens seen by us are strikingly different from *A. veronensis*, into which it has been placed in synonymy. Thus we follow Magnusson (1935) in accepting this taxon. World distribution: Svalbard, North America (Greenland).

**Specimens seen:** Forsbladhamna 27.7.1926, B. Lynge (O; det. H. Magnusson); Sveagruva, 13.8.1926, B. Lynge (O; det. H. Magnusson).

*Acarospora rhizobola* (Nyl.) Alstrup (1986)

**Thallus** as ± dispersed areolae; areolae pale brown, peltate, uniformly coloured, convex, up to 2.7 mm diam.; surface rugulose. Lower side pale, with a central well-developed rhizomorph attaching the areolae to the substrate. **Apothecia** immersed; disc red-brown, concave, 0.05–0.1 mm wide. Hymenium 250–300 µm high. Ascospores 4–4.5 × 2 µm.

**Chemistry.** Negative.

**Ecology.** Terricolous on calcareous soil.

**Distribution.** Rare.

**Notes.** Similar to specimens from Northern Norway, but lacks the pale areolum margin described by Purvis & James (1992). Characterized by its terricolous, peltate areolae with a strong rhizomorph. World distribution: Europe, Greenland, Taimyr (Andreev et al. 1996). New to Svalbard.

**Specimens seen:** Bünzow Land, Gipsdalén, A. Elvebakk 85:491B (TROM); Raudfjorden, Konglomeratodden, 21.7.1928, O.A. Høeg (TRH).

*Acarospora rosulata* (Th. Fr.) H. Magn. (1924)

**Thallus** crustose, coherently areolate, chest-nut brown; areolae at margin sterile, slightly lobate, angular, giving the thallus a rosulate appearance, in central part contiguous, 1 mm diam. Lower side pale. **Apothecia** 2–14 per areola at first punctiform, later expanding to 0.4 mm broad discs, about the same colour as thallus, and with an obscure thalline margin not raised above thallus. Hymenium 100–120 µm high. Paraphyses 1.5–2 µm wide at base. Ascospores 3–4 × 1.5–2 µm.

**Chemistry.** K –, C – (TLC not performed).

**Ecology.** Saxicolous, non-ornithocoprophilous.

**Distribution.** Only known from two localities.

**Notes.** According to Magnusson (1929) it is close to *A. veronensis*, but differs in the rosulate appearance, the flattened, shining areolae, and the I + blue reaction of the hymenium (wine-red in *A. veronensis* according to Magnusson 1929). World distribution: Europe, North America (Greenland).

**Specimens seen:** Adventfjorden, 1868, Th.M. Fries (O); Parryoya, 1868, Th.M. Fries (O).

*Acarospora rugulosa* Körber (1859)

**Thallus** minutely placodioid, up to 5 mm diam., brown, areolate in inner part; individual lobes at thallus margin 0.2–0.4 mm broad, thick, slightly convex. Lower side pale. **Apothecia** 1–4 per areola, at first immersed in thallus, later emerging to semi-sessile, with thick, brown thalline margin and concave dark brown disc. Hymenium 110–120 µm high. Ascospores 2 × 0.5 µm. Paraphyses 0.75 µm wide at base.

**Chemistry.** Gyrophoric acid.

**Ecology.** Saxicolous, possibly ornithocoprophilous.

**Distribution.** Widespread, but not common.

**Notes.** Differs from the other gyrophoric acid producing species by its pale lower surface. World distribution: Europe, North America (Greenland).

**Specimens seen** (selected): Davishamna, 1936, E. Dahl (O); Adventfjorden, 8.8.1868, Th.M. Fries (O).

*Acarospora sinopica* (Wahlenb.) Körb. (1859)

**Thallus** subplacodioïd, flat, strongly rust-coloured; marginal lobes up to 1 mm diam. **Apothecia** immersed in thallus, with punctiform disc. Hymenium 110–120 µm high. Ascospores 2–3 × 1–1.5 µm. Paraphyses 1–1.5 µm wide at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous on acidic, iron-rich rock, non-ornithocoprophilous.

**Distribution.** Widespread, but not common.

**Notes.** Easily recognized by its strongly rust-coloured thallus. World distribution: Incompletely circum-arctic/-alpine (lacking from western North America), Australia.

**Specimens seen** (selected): Kongsfjorden, 19.8.1868, Th.M. Fries (O); E of Austfjorden, N of Austbotnhytta, 2002, T. Tønsberg 31128 (BG).

*Acarospora smaragdula* (Wahlenb.) A. Massal. (1852)

Syn. *A. scyphulifera* Vain. (1909).

**Thallus** subplacodioïd, up to 3 mm diam., pale brown, without distinct marginal lobes, flat, fissured. **Apothecia** up to 0.3 mm diam., for a long time immersed in thallus; margin slightly protruding when old. Disc dark brown, concave to flat. Hymenium 80–90 µm high. Ascospores 2–3 × 0.5–1 µm. Paraphyses 1.5 µm wide at base.

**Chemistry.** Norstictic acid.

**Ecology.** Saxicolous.

**Distribution.** Widespread and common.

**Notes.** Easily recognized by the presence of norstictic acid. We follow Purvis & James (1992) in regarding *A. scyphulifera* as synonymous with *A. smaragdula*. World distribution: cosmopolitan.

**Specimens seen** (selected): Nordre Norskøy [Ytre Norskøy], 1.7.1928, O.A. Høeg (TRH); Adventfjorden, 5.8.1868, Th.M. Fries (O).

*Acarospora veronensis* A. Massal. (1852)

**Thallus** crustose, as dispersed areolae up to 0.7 mm diam., shiny brown, slightly convex, lower side black. Cortex cells 4–5 µm wide. **Apothecia** 1 per areola, immersed in thallus; margin not visible. Hymenium 55–60 µm high. Ascospores 3 × 0.5 µm. Paraphyses 1.5 µm wide at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous, probably ornithocoprophilous.

**Distribution.** Widespread and common.

**Notes.** A much more common species in Svalbard than previously realized. Recognized by the small, brownish convex areolae with immersed apothecia, the pale lower surface, the low hymenium, the pseudoparenchymateous cortex and the lack of lichen products. World distribution: Widely distributed in the Northern Hemisphere, New Zealand, Antarctica.

**Specimens seen** (selected): Sjuøyane, Phippsøya, 19.8.1936, E. Dahl (O); Adventfjorden, 5.8.1868, Th.M. Fries (O).

*Acarospora verruciformis* H. Magn. (1924)

**Thallus** crustose, 4–5 mm broad, composed of thick, convex areolae, up to 3 mm long, brown to dark brown. Lower surface pale. **Apothecia** 1–2 per areola, up to 0.4 mm broad; disc at first concave, later flat; margin raised, darker than the disc. Hymenium 100–110 µm high. Ascospores elliptic, 3 × 1 µm. Paraphyses 1.5 µm wide at base.

**Chemistry.** Negative.

**Ecology.** Saxicolous on sandstone, non-ornithocoprophilous.

**Distribution.** Known only from one locality.

**Notes.** Characterized by the swollen margins of the areolae and the high hymenium, otherwise fairly similar to members of the *A. veronensis* group. Similar in all diagnostic characters to specimens identified by Magnusson (O). World distribution: Europe, North America (Greenland), Argentina (Calvelo & Liberatore 2002). New to Svalbard.

**Specimen seen:** Ny-Ålesund, 4.-5.7.1936, E. Dahl (O).

**ADELOLECIA** Hertel & Hafellner (1984)

**Thallus** crustose, thin. **Ascomata** apothecia, black (when dry), sessile, without thalline exciple. True exciple prominent, composed of radiating hyphae with thick, gelatinous walls. Hamathecium paraphyses, simple, conglutinated. Asci of *Biatora*-type, 8-spored. Ascospores colourless, simple to 1-septate. Hypothecium thick, colourless. Conidia bacilliform.

**Note.** Two species recognized, mainly in cold areas of the Northern Hemisphere.

Key to *Adelolecia* on Svalbard:

- |   |  |                     |
|---|--|---------------------|
| 1 | Exciple with anthraquinone (K + red); ascospores 7–8.5 µm long ..... | <i>A. pilati</i>    |
| 1 | Exciple without anthraquinones; ascospores 9–11 µm long .....        | <i>A. kolaensis</i> |

*Adelolecia kolaensis* (Nyl.) Hertel & Rambold (1995)

Syn. *Lecidea migratoria* Lynge (1928)

**Thallus** crustose, rimose to areolate, or endolithic, dirty white, up to 0.3 mm thick. **Apothecia** black when dry, red-brown when wet, sessile, constricted at base, up to 1.1 mm diam., convex when old. Hymenium 40–60 µm high, uppermost part blue-green. Hypothecium colourless to pale grey-green. Paraphysis end cell enlarged to 3.5 µm; lumina visible, cylindrical. Ascospores narrowly ellipsoid to oblong, simple to 1-septate, 9–11 × 3.5–4 µm. Conidia 6–7 × 1 µm.

**Chemistry.** Negative or with traces of atranorin and xanthones.

**Ecology.** Saxicolous on both acidic and calcareous rocks; also on driftwood.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America, Siberia.

**Specimens seen** (selected): Bromelldalen, 9.8.1926, B. Lynge (O); Longyearbyen, July 2003, T. Tønsberg (BG).

*Adelolecia pilati* (Hepp) Hertel & Hafellner (1984)

**Thallus** crustose, rimose to areolate, whitish, up to 1 mm thick. **Apothecia** black, sessile, constricted below, up to 3 mm diam., slightly convex when old; margin prominent, sometimes rust-coloured. Hymenium 45–55 µm high; uppermost part greenish to blue-green. Exciple with yellow crystals (7-chloroemodin). Hypothecium colourless to pale brownish. Paraphysis end cell enlarged to 3.5 µm diam.; lumina visible. Ascospores oblong to ellipsoid, simple, 7–8.5 × 4–4.5 µm. Conidia 8 × 1 µm.

**Chemistry.** Atranorin (often absent), 7-chloremodin in apothecia.

**Ecology.** On vertical and overhanging, acid, rock walls.

**Distribution.** A few scattered occurrences.

**Notes.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen** (selected): Isfjorden, Russekeila, 12.7.1933, A. Hagen (O); Raudfjorden, 21.7.1978, O.A. Høeg (O).

**AGONIMIA** Zahlbr. (1909)

**Thallus** granulose to minutely squamulose, greenish to brown-black. Photobiont trebouxiod. Ascomata **perithecia**, globose, black. No involucellum present; true exciple with three layers, the outermost brown, the inner ones pale. Hamathecium of periphyses, paraphyses absent. Ascii with thin walls, K/I –. Ascospores muriform, 1–8 in ascii, colourless to yellowish.

*Agonimia tristicula* (Nyl.) Zahlbr. (1909).

**Thallus** thin, granular, green-brown to blackish. **Perithecia** 0.2–0.3 mm diam., rough in upper part. Ascospores 1–2 in ascii, elongate-ellipsoid, 110–120 × 35–45 µm.

**Chemistry.** Not studied.

**Ecology.** On moribund mosses on soil.

**Distribution.** Only known from Murchinsonfjorden.

**Notes.** New to Svalbard, det. M. Zhurbenko. World distribution: Europe, North America, Australia, Antarctica.

**Specimen seen:** Nordaustlandet, Murchinsonfjorden, Nordvika ('Nord Bay'), 19.8.2007, N. Matveeva (LEN, BG).

**ALECTORIA** Ach. (1810)

**Thallus** fruticose, yellowish to ash-grey, branches terete, without isidia or soredia, with pseudocyphellae. Cortex composed of hyphae running parallel to surface, embedded in large amounts of mucilage. **Apothecia** not seen in Svalbard material.

**Notes.** A small, mainly arctic-alpine genus. All but one species with usnic acid.

Key to *Alectoria* on Svalbard

- |       |   |  |
|-------|---|--|
| 1     | Thallus without usnic acid, greyish .....                 | <i>A. nigricans</i>                          |
| 1     | Thallus with usnic acid, yellowish .....                  | 2  |
| 2 (1) | Branches erect, terete, with diffractaic acid.....        | <i>A. ochroleuca</i>                         |
| 2     | Branches decumbent, flattened, with alectoronic acid..... | <i>A. sarmentosa</i> ssp. <i>vexillifera</i> |

*Alectoria nigricans* (Ach.) Nyl. (1861)

**Thallus** fruticose, erect, forming mats, up to 7 cm high, pale grey-brown to grey or pinkish at base, brown to blackish towards apices; branches anisotomically dichotomous, terete towards apices, more flattened at base; pseudocyphellae abundant, fissural, up to 1 mm long.

**Chemistry.** Alectorialic and barbatolic acids.

**Ecology.** Terricolous, on exposed ridges.

**Distribution.** Widespread and common.

**Notes.** World distribution: Europe, North America (including Greenland), southernmost South America, Antarctica, New Zealand, Australia.

**Specimens seen** (selected): Barentsøya, 1.8.1936, E. Dahl (O); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9886 (BG).

*Alectoria ochroleuca* (Hoffman) Mass. (1855)

**Thallus** fruticose, erect, up to 10 cm high; branches anisotomically dichotomous, yellowish to yellow-green, blackish toward apices, at base up to 3 mm wide, terete, sometimes ridged, with numerous, up to 1 mm long pseudocyphellae.

**Chemistry.** Usnic and diffractaic acids.

**Ecology.** Terricolous.

**Distribution.** Only known from the northeasternmost parts of Svalbard.

**Notes.** World distribution: Circumpolar arctic-alpine, southernmost South America, New Zealand, Antarctica.

**Specimens seen** (selected): Duvefjorden, 16.8.1936, E. Dahl (O); Rijpfjorden, 17.8.1936, E. Dahl (O).

*Alectoria sarmentosa* ssp. *vexillifera* (Nyl.) D. Hawksw. (1972)

**Thallus** fruticose, decumbent, up to 10 cm long; main branches anisotomically dichotomously branched, flattened, grey-green to yellowish, darker towards apices. Pseudocyphellae short and broad.

**Chemistry.** Usnic and alectoronic acids

**Ecology.** Terricolous.

**Distribution.** Only known from Kobbefjorden.

**Notes.** Both phytogeographically, ecologically and morphologically there are arguments for regarding this taxon as a good species, but traditionally it has been treated as a subspecies. The single specimen known from Svalbard is very similar to specimens from mainland Northern Norway. World distribution: Europe, eastern North America, Tanzania (Purvis 1992).

**Specimen seen:** Kobbefjorden, 1868, Th.M. Fries (O).

**ALLANTOPARMELIA** (Vain.) Essl. (1978)

**Thallus** foliose, closely adpressed, black to brown. Upper side without pseudocyphellae; lower side without rhizinae. Cortex prosoplectenchymateous, K<sup>-</sup>, N<sup>-</sup>. **Ascomata** apothecia, laminal, sessile, with thalline exciple. Ascospores 8 per ascus, colourless, simple. Conidia bifusiform to bacilliform.

**Notes.** Three (?) species in cold areas of the Northern Hemisphere.

Key to *Allantoparmelia* on Svalbard:

- |   |   |                    |
|---|---|--------------------|
| 1 | With alectorialic and barbatolic acids..... | <i>A. alpicola</i> |
| 1 | Without lichen products.....                | <i>A. sp.</i>      |

***Allantoparmelia alpicola* (Th. Fr.) Essl. (1978)**

**Thallus** foliose, black, up to 4–5 cm diam.; lobes radiating, nodulose, overlapping, in inner part coalescing to form an uneven crust, at margin nodules 1 × 1 mm. No pseudocyphellae or soralia. Pycnidia laminal, inconspicuous. Lower side black, longitudinally plicated, without rhizinae. **Apothecia** common.

**Chemistry.** Alectorialic and barbatolic acids.

**Ecology.** On hard rock, not ornithocoprophilous.

**Distribution.** Common and widespread.

**Notes.** World distribution: circumpolar, arctic-alpine.

**Specimens seen** (selected): Lady Franklinfjorden, Lågøya, 19.8.1936, E. Dahl (O); Phippsøya, 19.8.1936, E. Dahl (O).

***Allantoparmelia* sp.**

**Thallus** foliose to subcrustose, to 1 cm diam.; branches torulose, in central part confluent, forming a more or less uneven crust, at margin with finger-like, subterete tips to 0.2 mm diam., dark brown, shiny. No pseudocyphellae or soralia. Lower surface black, wrinkled, with no rhizinae. **Apothecia** and pycnidia not observed.

**Chemistry.** Negative.

**Ecology.** On siliceous rock, often together with *Melanelia disjuncta* and *Pseudephebe minuscula*.

**Notes.** This taxon is morphologically fairly similar to *A. almquistii* (Vain.) Essl., a species from Siberia and arctic North America, but differs by the lack of lichen compounds (*A. almquistii* has olivetoric acid).

**Specimens seen:** Barentsøya, N side of Steinbeisen, 1.8.1936, E. Dahl (O); Gipsdalen, A. Elvebakk 85:488; 85:740 (TROM); Edgeøya, between Rosenbergdalen and Kapp Lee, 6.8.1936, E. Dahl (O).

**ALLOCETRARIA** Kurok. & Lai (1990)

**Thallus** fruticose, yellowish, terete to flattened, with pseudocyphellae, no cilia or isidia. Cortex with anticlinally arranged hyphae. **Ascomata** apothecia. Ascii with no ring structure in tholus; axial body very broad. Ascospores globose. Conidia filiform.

*Allocetraria madreporiformis* (Ach.) Kärnefelt & Thell (1996).

Fig. 3 (p.220).

**Thallus** up to 1.5 cm high, 2 mm thick; branches not tapering, inflated dichotomously divided, pale yellow without pruina. Medulla arachnoid.

**Chemistry.** Usnic acid.

**Ecology.** In drought fissures in dry, fine-textured alkaline soils (absent on saline soils).

**Distribution.** Restricted to the arid area around inner, central Wijdefjorden, where it is widespread.

**Note.** World distribution: Europe, North America, Asia.

**Specimens seen** (selected): Wijdefjorden, Kartdalen, 23.8.1936, E. Dahl (O), Wijdefjorden, Purpurdalen, 24.8.1936, E. Dahl (O).

**AMANDINEA** M. Choisy (1950)

**Thallus** crustose to squamulose, grey to brownish. **Ascomata** apothecia, sessile, lecideine to lecanorine. Ascii of *Buellia*-type. Ascospores brown, 1-septate, often with a small thickening of the wall around the septum. Conidia filiform, curved.

Key to *Amandinea* on Svalbard:

1	Apothecia with thalline margin.....	<i>A. cacuminum</i>
1	Apothecia without thalline margin.....	2
2 (1)	Growing on rock; ascospores longer than 14 µm .....	<i>A. coniops</i>
2	Growing on organic material (rarely on rock); ascospores shorter than 14 µm .....	<i>A. punctata</i>

*Amandinea cacuminum* (Th. Fr.) H. Mayrhofer & Sheard (2002)

**Thallus** 2–5 mm wide, thick, brown, verrucose-lumped. **Apothecia** on lumps, up to 0.6 mm diam.; thalline margin thick, concolorous with thallus; disc flat, dark brown. Hymenium 45–50 µm high; epithecium brownish. Ascospores 8 per ascus, of *Beltraminiella*-type, 13–15 × 5–7 µm. Conidia 15–20 × 1 µm. **Chemistry.** Negative.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar, arctic-alpine.

**Specimens seen** (selected): Amsterdamøya, herb. Aptroot; Ullahamna, 25.7.1926, B. Lynge (O).

***Amandinea coniops*** (Wahlenb.) M. Choisy (1950)

**Thallus** medium thick, effuse, rimose-areolate, grey to grey-brown. **Apothecia** convex, up to 1 mm diam., black, when young with a thin true exciple, which later is excluded. Hymenium 70–80 µm high, epithecum brown, N –. Ascospores 13–18 × 7–9 µm. Paraphysis end cells enlarged to 4.5(–5.5) µm diam., brown. Hypothecium and excipulum dark brown. Conidia filiform, 18–22 × 1 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On sea-shore rocks, ornithocoprophilic.

**Distribution.** Widespread and common.

**Note.** World distribution: circumarctic, bipolar (Australia, Antarctica).

**Specimens seen** (selected): Krossfjorden, A. Elvebakk 85:306 (TROM); Akseløya, 21.8.1926, B. Lynge (O).

***Amandinea punctata*** (Hoffm.) Coppins & Scheid. (1993)

**Thallus** very thin, effuse, green-brown. **Apothecia** sessile, flat to convex, black, up to 0.7 mm diam.; true margin thin and little protruding. Hymenium 55–60 µm high, epithecum brown, N –. Paraphysis end cell enlarged to 4 µm diam., brown. Ascospores 12–17 × 6–10 µm. Conidia not seen in Svalbard material. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On wood, moribund bryophytes and rock.

**Distribution.** Common and widespread.

**Notes.** The specimens on rock have slightly larger ascospores and have been called *A. stigmatica* Körber. However, Scheidegger (1993) included them, although with some doubt, in *A. punctata* - a treatment which is followed here. World distribution: circumarctic and bipolar (southern South America, Australia, New Zealand, Antarctica).

**Specimens seen** (selected): Klovningen, 1928, O.A. Høeg (O); Brennevinsbukta [Brennevinsfjorden], 5.9.1868, Th.M. Fries (O).

**AMYGDALARIA** Norman (1853)

**Thallus** crustose, areolate, with cephalodia. Photobiont trebouxoid, in cephalodia *Stigonema* or *Gloeocapsa*. **Ascomata** apothecia, usually immersed in areolae; asci of *Porpidia*-type. Ascospores large, uncoloured, simple, with halo. Hamathecium of anastomosing, paraphysoid-like hyphae. Conidia bacilliform.

*Amygdalaria panaeola* (Ach.) Hertel & Brodo (1987)

**Thallus** crustose, composed of yellow-grey, scattered areolae, up to 0.6 mm diam., sorediate. Soralia in centre of areolae, convex, up to 0.3 mm diam. Cephalodia up to 1 mm diam., convex, pale grey, with pink spots. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar, arctic-alpine.

**Specimens seen** (selected): Kings Bay [Kongsfjorden], 19.8.1868, Th.M. Fries (O); Grønfjorden, 1.8.1868, Th.M. Fries (O).

*ANZINA* Scheid. (1982)

**Thallus** crustose, white. **Ascomata** apothecia, thalline exciple present, true exciple weakly developed. Ascii with weakly amyloid tip; inner layer bordered laterally by an amyloid ring and apically by an amyloid cap. Ascospores 4–8 in ascus, colourless, 1–3-septate. Hamathecium paraphysoids, anastomosing. Conidia bacilliform.

**Note.** The genus is monotypic.

*Anzina carneonivea* (Anzi) Scheid. (1982)

**Thallus** 1–2 cm wide, granulose-warted, white. **Apothecia** immersed in thallus, up to 0.8 mm diam.; disc dull orange. Hymenium 90–100 µm high. Paraphyses anastomosing. Ascii and ascospores not seen in Svalbard material.

**Chemistry.** Gyrophoric (major) and lecanoric acids.

**Ecology.** On old driftwood.

**Distribution.** Found once on Edgeøya.

**Notes.** New to Svalbard. World distribution: Europe, North America, Antarctica.

**Specimen seen:** Edgeøya, Kapp Heuglin, 9.8.1936, E. Dahl (O).

*ARCTOCETRARIA* Kärnefelt & Thell (1993)

**Thallus** fruticose, *Cetraria*-like, dark brown, with pseudocypellae and cilia. **Apothecia** marginal. Ascii with tholus with apical ring structure; ocular chambre conical with narrow beak and moderately broad axial body. Conidia bifusiform.

**Note.** Two species in arctic and boreal areas.

*Arctocetraria nigricascens* (Nyl.) Kärnefelt & Thell (1993)

**Thallus** fruticose, brown-black, lobes up to 2 mm broad, slightly channeled, with no or very few pseudocyphellae; margin with a few cilia.

**Chemistry.** Rangiformic and norrangiformic acids.

**Ecology.** On soil among bryophytes.

**Distribution.** Only known from Reindalen.

**Notes.** The Svalbard material was discussed by Elvebakk & Tønsberg (1992). World distribution: circumarctic.

**Specimen seen:** Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9921 (BG).

**ARCTOMIA** Th. Fr. (1860)

**Thallus** crustose to squamulose to foliose. Cortex one cell thick. Photobiont *Nostoc*. **Ascomata** apothecia, black to dark brown, without thalline margin. True margin of radiating hyphae. Hamathecium paraphyses, simple, with end cells enlarged. Ascospores colourless, 3–14-septate. Conidia bacilliform.

**Note.** A small genus of ca. three species on soil, bryophytes and bark in cold areas of the Northern Hemisphere.

Key to *Arctomia* on Svalbard:

- |   |   |                      |
|---|---|----------------------|
| 1 | Ascospores 3-septate, 24–26 µm long.....    | <i>A. interfixa</i>  |
| 1 | Ascospores 7–14-septate, 50–60 µm long..... | <i>A. delicatula</i> |

***Arctomia delicatula*** Th. Fr. (1860)

**Thallus** crustose, brown-black, up to 2–3 cm wide. **Apothecia** dark brown, up to 0.5 mm diam., emarginate. Hymenium 90–100 µm high. Ascospores 8 per ascus, 50–60 × 4–5 µm, 7–14-septate.

**Chemistry.** Negative.

**Ecology.** On calcareous soil and bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar, arctic-alpine.

**Specimens seen:** Bünzow Land, Gipsvika, A. Elvebakk 85:701 (TROM); Kobbefjorden, 1868, Th.M. Fries (O).

***Arctomia interfixa*** (Nyl.) Vain. (1909)

**Thallus** crustose, dark brown, with minute, terete lobes, up to 0.5 mm long and 0.1 mm thick. **Apothecia** convex, emarginate, up to 0.5 mm diam., dark brown. Hymenium 60–70 µm high, brownish in uppermost part. Hypothecium uncoloured. Ascospores 8 per ascus, 3-septate, 24–26 × 4–4.5 µm. Paraphysis end cell enlarged to 4 µm.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (including Greenland), scarce in Siberia.

**Specimens seen** (selected): Kings Bay [Kongsfjorden], 18.8.1868, Th.M. Fries (O); Grønfjorden, 31.7.1868, Th.M. Fries (O).

### ARCTOPARMELIA Hale (1986)

**Thallus** foliose, yellowish, with discrete, radiating lobes. Epicortex pored. Cell walls with *Cetraria*-type lichenan. Lower surface with sparse simple rhizinae. **Apothecia** laminal, spores ellipsoid. Pycnidia laminal, immersed. Conidia bifusiform.

**Note.** Five species in arctic-boreal areas.

Key to *Arctoparmelia* on Svalbard:

1	Thallus with soralia.....	<i>A. incurva</i>
1	Thallus without soralia.....	<i>A. centrifuga</i>

### *Arctoparmelia centrifuga* (L.) Hale (1986)

**Thallus** foliose, yellowish, up to 20 cm diam., often growing in concentric rings. Lobes 1–2 mm wide. No soralia or isidia. Lower surface pale, with darker rhizines.

**Chemistry.** Usnic, atranorin, alectoronic acids.

**Ecology.** On hard, siliceous rock.

**Distribution.** Known from the northern and northwestern parts and from Sørkapp Land.

**Notes.** A specimen from Sørkapp Land was reported by Olech (1990); it has not been available to us. World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Krossfjorden, Signehamna, A. Elvebakk 85:287 (TROM); Amsterdamsøya, 26.8.1936, E. Dahl (O).

### *Arctoparmelia incurva* (Pers.) Hale (1986)

**Thallus** foliose, yellowish, up to 7–8 cm wide, sorediate. Lobes 0.2–0.8 mm wide, convex. Lower side brown, with black rhizines. Soralia laminal, globose; soredia  $29.1 \pm 1.92 \mu\text{m}$  ( $25\text{--}32 \mu\text{m}$ ).

**Chemistry.** Usnic and alectoronic acids.

**Ecology.** On hard, siliceous rock.

**Distribution.** Northern and northwestern Svalbard, in addition to Sørkapp Land and Bell-sund.

**Note.** World distribution: circumpolar, arctic-alpine.

**Specimens seen** (selected): Amsterdamsøya, 26.8.1936, E. Dahl (O); Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O).

**ARCTOPELTIS** Poelt (1983)

**Thallus** small, foliose, peltate, with cortex on both sides, brownish. **Ascomata** apothecia, sessile, laminal, with thalline margin. Asci of *Lecanora*-type. Ascospores 8 in ascii, simple, uncoloured. Hamathecium of paraphyses, little ramified. Conidia bacilliform.

**Note.** A monotypic genus.

*Arctopeltis thuleana* Poelt (1983).

Fig. 4 (221).

**Thallus** peltate, up to 1.5 cm diam., pale brown to grey-brown. **Apothecia** up to 7 mm diam., sessile, constricted below; disc at first concave, later saddle-formed, brown; thalline margin distinct. Hymenium 50–70 µm high; epithecum pale brown. Hypothecium colourless. Ascospores 8 per ascus, ellipsoid, 9–14 × 4–6 µm. Paraphysse end cell enlarged to 5 µm, with brown or green-brown pigment. Conidia 10–17 × 1 µm.

**Chemistry.** 2,5-dichloro-6-O-methylnorlichexanthone (major), atranorin (minor), 2,5-dichloronorlichexanthone (minor), 2-chloro-6-O-methyl-norlichexanthone (trace); J.A. Elix det. 2004.

**Ecology.** On bird-manured, siliceous rocks, near shores and on inland bird-cliffs.

**Distribution.** Widespread.

**Note.** World distribution: Arctic Eurasia and North America.

**Specimens seen** (selected): Mohnhøgda, 11.8.1936, E. Dahl (O); Nordaustfjorden [Nordaustlandet], Brennevinsbukta, [Brennevinsfjorden] 21.8.1936, E. Dahl (O).

**ARTHONIA** Ach. (1806)

**Thallus** crustose or absent (parasitic). Photobiont *Trentepohlia* or trebouxioid. **Ascomata** apothecia-like, usually convex and round, more rarely elongated. Thalline exciple absent. Proper exciple usually absent, but rudimentary in some species. Hymenium K/I + blue. Hamathecium of anastomosing paraphysoids in a gel; end cells often enlarged with a pigmented cap. Asci 8-spored, clavate to subglobose, with distinct apical dome and ocular chamber, K/I – or K/I + blue near apex of ocular chamber. Ascospores ellipsoid to oblong-ovoid, 1(–7)-septate, colourless when young, often somewhat brownish and warted when old. Conidia usually bacilliform.

**Notes.** A large and heterogeneous genus. Parasitic species are not included here.

Key to *Arthonia* on Svalbard:

- |      |   |                      |
|------|---|----------------------|
| 1    | On twigs of <i>Salix</i> and other organic material .....                                 | <i>A. muscigena</i>  |
| 1    | On rock .....   | 2                    |
| 2(1) | With <i>Trentepohlia</i> ; epithecum and hypothecium with K + purple-violet pigment ..... | <i>Arthonia</i> sp.  |
| 2    | With <i>Trebouxia</i> ; epithecum and hypothecium K – .....                               | <i>A. lapidicola</i> |

*Arthonia lapidicola* (Taylor) Branth & Rostrup (1869)

**Thallus** whitish to brownish, granular-floccose, 2–3 mm wide. Photobiont *Trebouxia*. **Ascocarps** 0.2–0.4 mm wide, brown-black, convex. Hypothecium brown. Hymenium 80–110 µm high, I + wine-red, K –. Ascii pyriform. Ascospores 8 per ascus, uncoloured, 1-septate, 12–15 × 5–6 µm.

**Chemistry.** Negative.

**Ecology.** Saxicolous on vertical cliffs.

**Distribution.** A few scattered localities.

**Notes.** We here follow Fries (1867) and Hafellner (1982) in regarding *A. lapidicola* as an autonomous lichen, although Alstrup & Hawksworth (1990) treated it as a parasite. World distribution: circumpolar, arctic-alpine, New Zealand, Antarctica.

**Specimens seen** (selected): Hesselmannodden, 22.7.1926, B. Lynge (O); Adventdalen, 21.8.2002, R. Haugan 6869 (O).

*Arthonia muscigena* Th. Fr. (1868)

**Thallus** not evident. **Ascocarps** up to 0.05 mm wide, black, convex. Hymenium 45–50 µm high, K/I + wine-red; epithecium brown-green to brown. Hypothecium colourless to brown. Ascospores 8 per ascus, 9–12(–15) × 3–5 µm, 1-septate, colourless; one cell often larger than the other.

**Chemistry.** Not performed.

**Ecology.** On leafscars of twigs of *Salix reticulata*, on *Cassiope tetragona*, and other plant remains.

**Distribution.** Only known from Kongsfjorden and Wijdefjorden.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimens seen:** Ossian Sarsfjellet, 1985, A. Elvebakk (TROM); Wijdefjorden, E of Austfjorden, SE of Finnekroken, the W-facing foothills of Finlandsvegen, 2002, T. Tønsberg 31048 (BG); Wijdefjorden, between Flatøyra and Ringhorndalen, the W-facing foothill of Mt. Heimdalkampen, T. Tønsberg 31220 (BG).

*Arthonia* sp.

**Thallus** minute, as fragments bordering ascocarps, yellow-brown, with *Trentepohlia*. **Ascocarps** up to 0.4 mm diam., black, slightly convex. Hymenium 30–35 µm high, Lugol + red; epithecium brown, K + violet. Ascii semiglobose; ascospores 8 per ascus, 18–22 × 10–13 µm, 1-septate; cells subequal, colourless. Paraphysoids anastomosing; end cell enlarged to 4 µm diam., with brown cap.

**Chemistry.** Not performed.

**Ecology.** On limestone, e.g. associated with *Caloplaca elvebakkiana*.

**Distribution.** Known from one locality only.

**Notes.** This specimen was reported as *Arthonia lapidicola* var. *ruderella* (Nyl.) de Lesd. by Hafellner (1982), but as it differs from *A. lapidicola* in having *Trentepohlia* as photobiont and a K + violet pigment in epithecium and hypothecium, we treat it here as distinct. No name has yet been found for it.

**Specimen seen:** Bockfjorden, Hafellner 8573 (GZU).

**ARTHORAPHIS** Th. Fr. (1860)

**Thallus** crustose, granular to squamulose-lobulate, yellow-green, mainly on bryophytes or soils. **Apothecia** black, sessile. Excipulum proprium little developed, of strongly swollen hyphae. Ascii clavate, K/I –, only weakly thickened at apex. Hamathecium of paraphyses, mostly anastomosing. Ascii 8-spored. Ascospores colourless, 7–18-septate, acicular.

**Notes.** A small genus mainly in cold regions of about ten species, some of which are parasitic.

Key to *Arthroraphis* on Svalbard:

1	Areolae finally sorediate .....	<i>A. citrinella</i>
1	Areolae not sorediate .....	2
2(1)	Ascospores 3-septate, 14–16 µm long .....	<i>A. vacillans</i>
2	Ascospores 9–10-septate, 35–60 µm long .....	<i>A. alpina</i>

*Arthroraphis alpina* (Schaer.) R. Sant. (1980)

**Thallus** composed of yellow-green, convex, corticate areolae, up to 1 mm diam. **Apothecia** black, up to 1.5 diam., between areolae, flat; margin becoming excluded. Exciple and hypothecium brown-black. Ascospores acicular, 9–11-septate, 35–60 × 2–4 µm.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On soil.

**Distribution.** Scattered but not rare.

**Note.** World distribution: bipolar (circumarctic, Chile, New Zealand, Antarctica).

**Specimens seen** (selected): Amsterdamøya, 3.8.1936, E. Dahl (O); Wargentindalen, 22.7.1931, P.F. Scholander (O).

*Arthroraphis citrinella* (Ach.) Poelt (1969)

**Thallus** composed of ± flat areolae up to 0.5 mm diam., yellow-green, soon becoming sorediate. **Apothecia** black, flat, between areolae, up to 1.5 mm diam. Ascospores acicular, 9–11-septate, 50–70 × 2–4 µm.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On soil and over bryophytes, in snowbeds.

**Distribution.** Common and widespread.

**Note.** World distribution: bipolar (circumarctic, Chile, Australia, New Zealand, Antarctica).

**Specimens seen** (selected): Colesbukta, Vestalfjellet NE, 2.8.1986, T. Engelskjøn & S. Spjelkavik (TROM); Ulahamna, 26.7.1936, B. Lyngé (O).

*Arthroraphis vacillans* Th. Fr. (1868)

**Thallus** as scattered pale yellow areolae, convex, corticate. **Apothecia** black, thin, up to 0.8 mm diam., with thin, distinct margin. Hymenium 70–80 µm high, brownish in uppermost part. Hypothecium and excipule dark brown. Ascospores 8 per ascus, uncoloured, 3-septate, 14–16 × 3.5–4 µm.

**Chemistry.** Rhizocarpid acid, epanorin.

**Ecology.** On soil.

**Distribution.** Widespread.

**Notes.** Differs from the superficially similar *A. alpina* in its small, 3-septate ascospores. World distribution: circumarctic.

**Specimens seen** (selected): Grønfjorden, 3.7.1868, Th.M. Fries (O); Lady Franklinfjorden, Wargentindalen, 22.7.1931, P.F. Scholander (O).

### ASPICILIA A. Massal. (1852)

**Thallus** placodioïd to crustose. Mono- or bimorphic. Photobiont green algae. **Ascomata** apothecia, immersed to sessile, disc flat to concave, brown-black to black, often pruinose. Thalline exciple usually poorly developed. True exciple colourless, often weakly developed. Hymenium hemiamyloid. Epithecum brown to green, N – or N + greenish. Hypothecium colourless. Ascii with outer coat K/I + blue, wall and tholus K/I –. Ascospores 4–8 per ascus, simple, colourless, thin-walled. Hamathecium of paraphyses, simple to anastomosing, often short-celled and moniliform. Pycnidia inconspicuous. Conidia filiform.

**Notes.** A difficult genus as little is known of the plasticity of the species. There are probably more species on Svalbard than reported here.

Keys to *Aspicilia* on Svalbard:

Key to thallus types (see Fig. 5, p. 222):

1	With radiating lobes .....	2
1	Without radiating lobes .....	3
2 (1)	Lobes connected by prothallus .....	Thallus type A
2	Lobes not connected by prothallus .....	Thallus type B
3 (1)	Lichenized thallus bimorphic, with thin, continuous, basal, thallus on which are scattered, large, mostly fertile areolae (see Fig. 6, p. 222) .....	Thallus type C
3	Lichenized thallus monomorphic, of ± uniform thickness .....	Thallus type D

Key A (to species with thallus type A):

1	Thallus with norstictic acid .....	<i>A. fimbriata</i>
1	Thallus without norstictic acid .....	2
2 (2)	Thallus brown; lobes convex .....	<i>A. rosulata</i>
2	Thallus white or grey; lobes flat .....	3
3 (2)	Disc pruinose .....	<i>A. nikrapensis</i>
3	Disc not pruinose .....	4
4 (3)	Thallus grey .....	<i>A. disserpens</i>
4	Thallus purely white .....	<i>A. alboradiata</i>

## Key B (to species with thallus type B):

1	Thallus dark brown .....	2
1	Thallus white, grey, beige, pale brown .....	3
2 (1)	With norstictic acid .....	<i>A. subradians</i>
2	Without norstictic acid .....	<i>A. perradiata</i>
3 (1)	Thallus white to pure grey .....	4
3	Thallus beige to pale brown .....	5
4 (5)	Thallus placodioid; apothecia not in zonate rings.....	<i>A. lesleyana</i>
4	Thallus crustose; apothecia in zonate rings .....	<i>A. cingulata</i>
5 (3)	Disc minute, poriform .....	<i>A. culicis</i>
5	Disc not poriform .....	6
6 (5)	Marginal areolae distinct; with substictic acid .....	<i>A. sublapponica</i>
6	Marginal areolae indistinct; without lichen compounds .....	<i>A. plicigera</i>

## Key C (to species with thallus type C):

1	Basal thallus indistinct; areolae white; ascospores 4 per ascus .....	<i>A. contorta</i>
1	Basal thallus distinct; areolae grey to ochre; ascospores 8 per ascus .....	2
2 (1)	Basal thallus very thin, without cortex, not rimose or areolate .....	3
2	Basal thallus corticate, rimose/areolate .....	6
3 (2)	Disc/pycnidia 0.05 mm wide .....	<i>A. punctiformis</i>
3	Disc at least 0.2 mm wide .....	4
4 (3)	Apothecia several in areolae .....	<i>A. pertusa</i>
4	Apothecia usually single .....	5
5 (4)	Ascospores 20–22 µm long; apothecia constricted below when old .....	<i>A. natherstii</i>
5	Ascospores 12–17 µm long; apothecia always broadly sessile .....	<i>A. annulata</i>
6 (2)	Areolae apothecia-like, with pale margins and pruinose central parts.....	<i>A. eburnea</i>
6	Apothecia present; areolae not as above .....	7
7(6)	With substictic acid.....	<i>A. narssauensis</i>
7	Without lichen products .....	<i>A. heteroplaca</i>

## Key D (to species with thallus type D):

1	Thallus sorediate or isidiate .....	2
1	Thallus without soredia and isidia .....	4
2 (1)	Thallus isidiate .....	<i>A. simoensis</i>
2	Thallus sorediate .....	3
3 (2)	With substictic acid .....	<i>A. mashiginensis</i>
3	Without lichen products .....	<i>A. leprosescens</i>

4 (1)	Thallus thick, white, faintly rimose .....	<i>A. calcarea</i>
4	Thallus grey, beige or brown, distinctly rimose/areolate .....	5
5 (4)	Thallus dark brown .....	6
5	Thallus grey or beige .....	8
6 (5)	Areolae smooth .....	7
6	Areolae gnarled-isidiate; with norstictic acid .....	<i>A. mastrucata</i>
7 (6)	With stictic acid complex .....	<i>A. berntii</i>
7	Without lichen products .....	<i>A. aliena</i>
8 (5)	Thallus with norstictic acid .....	<i>A. cinerea</i>
8	Thallus without norstictic acid .....	9
9 (8)	Ascospores 20–25 µm long .....	10
9	Ascospores smaller .....	11
10 (9)	Thallus blue-grey; disc strongly concave .....	<i>A. aquatica</i>
10	Thallus grey; disc flat .....	<i>A. caesiocinerea</i>
11 (9)	Areolae strongly convex .....	12
11	Areolae ± flat .....	15
12 (11)	Discs 2–3 together; ascospores 17–22 µm long .....	<i>A. composita</i>
12	Discs ± single in areolae; ascospores smaller .....	13
13 (12)	Fertile areolae elevated above sterile ones.....	<i>A. elevata</i>
13	Fertile areolae at same level as sterile ones .....	14
14 (13)	Areolae low, grey-beige; hypothallus visible between the areolae.....	<i>A. major</i>
14	Areolae high, pure grey; hypothallus not evident .....	<i>A. pergibbosa</i>
15 (11)	Disc pruinose; ascospores 17–19 µm long .....	<i>A. circularis</i>
15	Disc non-pruinose; ascospores smaller .....	16
16 (15)	Thallus brown-grey, with substictic acid .....	<i>A. arctica</i>
16	Thallus grey, with no lichen products .....	<i>A. supertegens</i>

***Aspicilia alboradiata* (H. Magn.) Oxner (1972)**

**Thallus** up to 2 cm diam., stellate-radiating, thin towards margin; lobes up to 5 mm long and 0.5 mm broad, areolate towards centre, chalky (to bluish) white. Cortex 30–35 µm high, pseudoparenchymatous; medulla with oxalate crystals. **Apothecia** numerous towards centre; disc up to 0.3 mm broad, mostly regular, black, non-pruinose. Margin K/I + blue. Hymenium 70–90 µm high. Ascospores 8 per ascus, 17–19 × 7.5–10 µm. Paraphyses sub-moniliform. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On both calcareous and non-calcareous rock.

**Distribution.** A few scattered occurrences.

**Notes.** Fairly similar to *A. nikrapensis*, but differs in its corticated areolae and non-pruinose discs. World distribution: Svalbard, Scandinavia, arctic Russia (Novaya Zemlya to Taimyr), arctic North America (including Greenland).

**Specimens seen** (selected): Adventdalen, Brentskaret, 25.7.1924, J. Lid (O); Dicksonfjorden, N side of Lyckholmdalen, 8.7.1936, E. Dahl (O).

***Aspicilia aliena*** (A. Zahlbr.) Oxner (1972)

**Thallus** dark brown, 3–4 cm wide, areolate; areolae interlocked and slightly convex. **Apothecia** at first innate, later sessile, up to 0.8 mm diam.; thalline margin prominent, smooth, brown. Disc flat, black. Hymenium 90–100 µm high. Paraphyses moniliform. Ascospores 8 per ascus, 12–14 × 8–9 µm.

**Chemistry.** Negative.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Notes.** Characterized by its smooth, dark brown thallus, regular apothecia and small ascospores. Apparently related to *A. mastrucata*, but the latter has gnarled-isidiate areolae and very irregular thalline margins of their apothecia. New to Svalbard. World distribution: arctic-alpine, very scattered.

**Specimens seen** (selected): Magdalenefjorden, 24.8.1928, O.A. Høeg (O); Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:075 (TROM).

***Aspicilia annulata*** (Lynge) Thomson (1987)

Type: Disko Island, W. Greenland, 1871, Th.M. Fries (O!).

Fig. 7 (p. 223).

**Thallus** bimorphic; basal thallus lichenized, 2–3 cm wide, very thin, pale ochre; fertile areolae dispersed over basal thallus, up to 0.7 mm wide; margin pale ochre; disc concave, occupying 2/3 of the fertile wart, black, non-pruinose, single. Hymenium 70–90 µm high. Ascospores 8 per ascus, 13–15 × 9–11 µm. Paraphyses moniliform. Medulla with oxalate crystals. Pycnidia not seen. Cortex 20–30 µm high, pseudoparenchymateous.

**Chemistry.** Negative.

**Ecology.** On slate and sandstone.

**Distribution.** Widespread and common.

**Notes.** The species is characterized by its thin, pale ochre primary thallus, single apothecia in raised warts and relatively small ascospores. New to Svalbard. World distribution: Svalbard, North America (Alaska, Greenland).

**Specimens seen** (selected): Wijdefjorden, N of Hårgardsbreen, 22.8.1924, alt. 10 m, J. Lid (TRH); Wijdefjorden, A. Elvebakk 01:204 (TROM).

***Aspicilia aquatica*** Körber (1855)

**Thallus** 2–3 cm wide, bluish-grey, rimose-areolate, thick, with an indistinct black prothallus; no radiating lobes at margin. **Apothecia** immersed in areolae; disc strongly concave, up to ca 0.5 mm diam., black, non-pruinose. Hymenium 130–140 µm high. Ascospores 8 per ascus, 22–24 × 12–14 µm. Paraphyses submoniliform. Oxalate crystals not present. Cortex 30–40 µm high. Conidia 9–18 µm long.

**Chemistry.** Negative.

**Ecology.** On wet rock.

**Distribution.** Only known from Kjellstrømdalen.

**Notes.** This species is characterized by its blue-grey rimose-areolate thallus, immersed apothecia with black, non-pruinose discs, large ascospores, and ecologically by growing in wet places. World distribution: Arctic North America (including Greenland), Europe, Severnaya Zemlya, New Zealand, possibly Antarctica.

**Specimen seen:** Kjellstromdal, 1986, D.O. Øvstedral (BG).

### *Aspicilia arctica* (Lynge) Oxner (1972)

Type: Disko Island, Greenland, 1871, Th.M. Fries (O!).

Fig. 8 (p. 223).

**Thallus** areolate, 3–4 cm wide, pale brown-grey to whitish; areolae 0.2–0.4 mm wide. **Apothecia** numerous, when mature sessile, up to 1 mm diam.; thalline margin distinct, concolorous with thallus; disc flat, often 2–3 together, black; outline somewhat irregular. Hymenium 80–90 µm high, uppermost part brownish. Ascospores 8 per ascus, 15–18 × 9–12 µm. Paraphyses moniliform. Oxalate crystals not present. Cortex 10–20 µm, with perpendicular hyphae. Conidia 15–23 µm long.

**Chemistry.** Substictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** This species looks like a *Lecidea*, but is easily recognized by its large, thin-walled ascospores, moniliform paraphyses and presence of substictic acid. New to Svalbard. World distribution: Europe, arctic North America (including Greenland), Chukotka.

**Specimens seen** (selected): Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O); Colesdalen, 20.8.2002, R. Haugan 6890 (O).

### *Aspicilia berntii* A. Nordin, Tibell & Owe-Larsen. (2008)

Syn. *A. mastoidea* (Lynge) Thomson (1987) nom. illeg., non *A. mastoidea* (Wedd.) Maheu & A. Gillet (1926).

**Thallus** brown to brown-black, verrucose-areolate, 3–5 cm wide; areolae contiguous, shiny, convex, 0.3–0.6 mm. Hypothallus not visible. **Apothecia** rare, elevated, up to 0.8 mm diam.; thalline margin thin, regular and slightly protruding; disc black. Hymenium 100–110 µm high, brownish green in upper part. Ascospores 8 in asci, broadly elliptic, 18–22 × 10–12 µm. Paraphyses moniliform; end cell 4–5 µm diam. Pycnidia abundant, single or contiguous, visible as black spots; conidia 15–18 × 1 µm.

**Chemistry.** Stictic acid complex.

**Ecology.** On schistose rock.

**Distribution.** Only found in Holmiabukta.

**Notes.** New to Svalbard. World distribution: Europe, arctic North America (including Greenland).

**Specimen seen:** Holmiabukta, 4.7.1928, O.A. Høeg (O).

### *Aspicilia caesiocinerea* (Nyl. ex Malbr.) Arnold (1886)

**Thallus** pale grey, 3–4 cm wide, rimose-areolate, thick, weakly white-pruinose. **Apothecia** 1–2 in areolae, disc flush with margin, black, non-pruinose, up to 0.6 mm diam. Hymenium 120–130 µm

high. Ascospores 4–6 per ascus,  $18\text{--}20 \times 10\text{--}12 \mu\text{m}$ . Paraphyses moniliform. Oxalate crystals not present. Cortex 25–30  $\mu\text{m}$  high. Conidia 7–12  $\mu\text{m}$  long.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by its grey colour and large ascospores. Some non-pruinose specimens from dry schists could not be conclusively assigned to *A. caesiocinerea*; these specimens were intermediate between this species and *A. permutata* found in northern Scandinavian mountains (Santesson et al. 2004) and require further study. World distribution: bipolar: Europe, Siberia, arctic North America (including Greenland), Argentina, Australia, New Zealand.

**Specimens seen** (selected): Isfjord, Kapp Thorsen, 20.7.1936, E. Dahl (O); Adventfjorden, above Longyearbyen, 23.7.1936, E. Dahl (O).

#### *Aspicilia calcarea* (L.) Mudd (1861)

**Thallus** 2–3 cm wide, chalky white, continuous. **Apothecia** immersed in thallus; disc black, non-pruinose, up to 0.5 mm diam. Hymenium 90–100  $\mu\text{m}$  high, epithecium blue-black. Paraphyses moniliform. Ascospores 4 per ascus, subglobose,  $18\text{--}30 \times 14\text{--}25 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Notes.** Characterized by its thick white thallus, 4-spored asci, fairly large ascospores, and by being restricted to limestone. World distribution: circumpolar, temperate to arctic, also in all major austral areas of the Southern Hemisphere.

**Specimen seen** (selected): Dicksonfjorden, SW av Biederhoffjellet, 8.7.1936, E. Dahl (O); Dickson Bay, 29.8.1924, J. Lid (O).

#### *Aspicilia cinerea* (L.) Körber (1855)

**Thallus** 3–15 mm wide, rimose-areolate, grey to pale ochre; areolae 0.3–0.7 mm wide. No prothallus seen. **Apothecia** common, immersed in areolae; thalline margin only rarely evident. Disc black, concave, 0.2–0.5 mm diam., non-pruinose. Hymenium 90–100  $\mu\text{m}$ . Ascospores 8 per ascus,  $13\text{--}14 \times 8\text{--}10 \mu\text{m}$ . Paraphyses moniliform. Conidia curved,  $13\text{--}17 \times 1 \mu\text{m}$ .

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** Found once on Sørkapp.

**Notes.** The species is characterized by its presence of norstictic acid, an areolate thallus, its thallus colour and relatively small ascospores. Compared with, e.g. Scandinavian specimens, the only specimen seen from Svalbard is somewhat smaller and thinner, but similar in all diagnostic characters. World distribution: circumpolar, temperate to arctic, Australia, New Zealand.

**Specimen seen:** Sørkapp, Nowak (KRAM: L-12406).

#### *Aspicilia cingulata* (Zahlbr.) Oxner (1972)

**Thallus** 2–3 cm wide, circular, chalky white to pale grey, with weak radiating fissures at margin and weakly rimose in inner part. **Apothecia** in circles, giving the thallus a zonate appearance. Prothallus

2–3 mm wide, pale brown, zonate. **Apothecia** immersed in thallus, up to 0.8 mm wide, concave, black, non-pruinose. Hymenium 90–110 µm high. Ascospores 8 per ascus, 17–19 × 9–11 µm. Paraphyses moniliform.

**Chemistry.** Negative.

**Ecology.** On Ca-rich rock.

**Distribution.** A few scattered occurrences.

**Notes.** Easily recognized by the apothecia forming circles. New to Svalbard. World distribution: Europe and North America, arctic-alpine.

**Specimens seen** (selected): Sørkappoya, Skottnes, 15.8.1920, J. Lid (O); Bünzow Land, Bjonahamna, 2001, A. Elvebakk 01:054 (TROM).

### *Aspicilia circularis* (H. Magn.) Oxner (1972)

Syn. *Lecanora lyngei* Zahlbr. (1928).

**Thallus** 3–4 cm wide, rimose-areolate, thick, whitish to pale grey to pale ochraceous. **Apothecia** numerous; disc immersed in thallus; thalline margin slightly elevated and darker than thallus. Disc 0.4–0.6 mm wide, with irregular outline, bluish pruinose. Hymenium 90–100 µm high. Ascospores 8 per ascus, 17–19 × 10–12 µm. Paraphyses submoniliform. Oxalate crystals in medulla. Conidia 16–18 µm long.

**Chemistry.** Negative.

**Distribution.** Widespread and common.

**Notes.** This species is characterized by its thick, areolate, whitish thallus with numerous apothecia with bluish pruinose discs. It appears to be one of the most common *Aspicilia* species on Svalbard. World distribution: Europe and North America, arctic-alpine.

**Specimens seen** (selected): Berzeliusfjellet, 21.7.1926, B. Lynge (O; as *Lecanora lyngei* Zahlbr.); Forsbladhamna, 29.7.1926, B. Lynge (O).

### *Aspicilia composita* (Lynge) Thomson (1984)

Type: Ymerøya, NE Greenland, 1929, B. Lynge (O!).

Fig. 9 (p. 223).

**Thallus** 5–10 mm wide, composed of strongly convex, agglomerated, pale grey areolae, 1 mm wide. **Apothecia** numerous in each areola; disc black, flush with margin, non-pruinose, up to 0.5 mm diam. Hymenium 70–80 µm high. Ascospores 8 per ascus, 15–22 × 7–11 µm. Paraphyses moniliform. Oxalate crystals present in the medulla. Cortex 20–25 µm high, of pseudoparenchymatous tissue. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On calcareous sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by its areolae with numerous apothecia. New to Svalbard. World distribution: Svalbard, North America (Greenland), Novosibirskiye Islands (Andreev et al. 1996)).

**Specimens seen** (selected): Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O); Adventfjorden, 5.8.1868, Th.M. Fries (O).

*Aspicilia contorta* (Hoffm.) Krempelh. (1861)

**Thallus** bimorphic; basal thallus indistinct; fertile areolae placodioid, dispersed, chalky white, 1–2 mm wide. **Apothecia** 1–2 in centre of areolae, 0.3–0.5 mm wide, immersed; disc white-pruinose. Hymenium 90–100 µm high. Ascospores 4 per ascus, 16–18 × 9–11 µm. Paraphyses submoniliform.

**Chemistry.** Negative.

**Ecology.** On calcareous rock.

**Distribution.** Only known from Wijdefjorden.

**Notes.** This species is characterized by its small, isolated white areolae, pruinose discs, 4-spored ascii and its restriction to calcareous rock. New to Svalbard. World distribution: bipolar, Europe, North America (including Greenland) and Chukotka, Australia, New Zealand.

**Specimen seen:** Wijdefjorden, Vestfjorddalen, 2001, A. Elvebakk 01:191 (TROM).

*Aspicilia culicis* (Lynge) Thomson (1984)

Type: Myggbukta, NE Greenland, 1929, B. Lynge (O!).

Fig. 10 (p. 224).

**Thallus** pale grey-ochre, 20–35 mm wide, with a thin indistinct pale ochre prothallus. Thallus with indistinctly radiating areolae at margin, in center areolate with isodiametric areolae. **Apothecia** 1–4 per areolae, immersed in thallus; disc 0.05–0.1 mm wide, poriform, surrounded by a dark ring. Hymenium 120–130 µm high, uppermost part greenish. Ascospores 8 per ascus, 14–17 × 7–10 µm. Paraphyses submoniliform. Cortex 40–50 µm high. Medulla with oxalate crystals.

**Chemistry.** Substictic acid.

**Ecology.** On sandstone.

**Distribution.** Rare.

**Notes.** Characterized by its small, poriform apothecia and presence of substictic acid. New to Svalbard. World distribution: Svalbard, North America (Greenland).

**Specimens seen:** Adventfjorden, above Longyearbyen, 50–100 m alt., 29.7.1936, E. Dahl (O); Calypso Bay [Calypsostranda], 12.7.1926, B. Lynge (O).

*Aspicilia disserpens* (Zahlbr.) Räsänen (1949)

**Thallus** as discrete, radiating lobes, 0.2–0.3 mm wide, pale grey to ochraceous, flat, with no prothallus between the lobes. **Apothecia** up to 0.5 mm wide; disc black, non-pruinose. Hymenium 70–80 µm high. Ascospores 16–18 × 9–11 µm. Paraphyses moniliform. Conidia 17–19 × 1 µm.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Notes.** Two other species have radiating lobes of the same dimensions: *A. rosulata* which differs by its brown, convex lobes, and *A. fimbriata* which has norstictic acid. World distribution: circumarctic.

**Specimens seen** (selected): Longyearbyen, 5.7.1936, E. Dahl (O); Klaasbillenbay [Billefjorden], 27.6.1925, Vogts Exped. (TRH).

*Aspicilia eburnea* (Lynge 1940 )

**Thallus** bimorphic; basal thallus crustose, pinkish, ovate to irregularly formed, up to 5 mm long and 2 mm broad. Areolae scattered, round to irregular, up to 0.5 mm diam., convex, with a whitish margin and a blue-pruinose central part which looks like a disc. In vertical transection the central part is seen as being composed by a cortical and an algal layer. **Apothecia** and pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On schists and sandstone.

**Distribution.** Only known from Wijdefjorden and Tysnes.

**Notes.** The anatomy of the areolae is evidently related to its protection against excessive radiation, with pruina and a brownish cortex protecting the algae. The type has not been available, but the specimens fit the description in Lynge (1940b). As it has never been found with apothecia, its generic affinity is not clear. New to Svalbard. World distribution: Svalbard, Greenland.

**Specimens seen:** Wijdefjorden, 2002, T. Tønsberg 31305 (BG); Tysnes, 2.8.1928, O.A. Høeg (O).

*Aspicilia elevata* (Lynge) Thomson (1981)

**Thallus** areolate, brown-grey. Areolae with **apothecia** elevated above sterile ones, up to 1 mm diam. Disc black, non-pruinose. Margin thick, elevated, concolorous with thallus. Hymenium 50–70 µm high; epithecium brownish. Ascospores 8 per ascus, 12–14 × 8–10 µm. Paraphyses moniliform. Cortex 30–35 µm high, pseudoparenchymateous. Medulla with oxalate crystals.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** World distribution: Svalbard, arctic North America (including Greenland).

**Specimens seen** (selected): Edgeoya, between Rosenbergdalen and Kapp Lee, 6.8.1936, E. Dahl (O); Gipsdalen, 1985, A. Elvebakk 85:458c (TROM).

*Aspicilia fimbriata* (H. Magn.) Clauzade & Rondon (1966)

**Thallus** crustose, grey-brown, up to 2.5 cm wide, composed of radiating lobes with no prothallus between lobes; lobes 0.2 mm broad; areolae in central part contiguous. **Apothecia** in inner part; disc black, non-pruinose, up to 0.5 m diam.; margin thick, brown. Hymenium 80–90 µm high; epithecium brownish. Ascospores 8 per ascus, 14–18 × 8–9 µm. Paraphyses non-moniliform. No oxalate crystals in medulla.

**Chemistry.** Norstictic acid.

**Ecology.** On sandstone and schists.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Svalbard, Siberia (Taimyr), Arctic North America.

**Specimens seen** (selected): Dicksonfjorden, 6.7.1936, E. Dahl (O); Forsbladhamna, 8.7.1920, J. Lid (O).

*Aspicilia heteroplaca* (Zahlbr.) Oxner (1972)

Type: Novaya Zemlja, B. Lynge (O!)

Syn. ?*A. gibbosa* (Ach.) Körb. (1855); ?*Lecanora ursina* (Lynge) H. Magn. (1944); ?*A. virginea* Hue (1910).

Fig. 11 (p. 224).

**Thallus** bimorphic; basal thallus up to 10 cm wide, thin, finely rimose, pale ochre. Fertile areolae up to 2 mm wide, with pale grey thalline margin and black, non-pruinose disc with crenulate margin. Hymenium 110–120 µm high; epithecium yellow-brown. Ascospores 8 per ascus, 18–20 × 10–12 µm. Paraphyses moniliform. Medulla with oxalate crystals.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Widespread.

**Notes.** *Aspicilia heteroplaca* is apparently a variable species. The Svalbard material agrees well in all diagnostic characters with the holotype (O) from Novaya Zemlja. *Aspicilia gibbosa*, *A. ursina* and perhaps also *A. virginea* may prove to be synonomous with *A. heteroplaca*. However, we have not seen type material of any of these species. World distribution: very scattered in the circumarctic area.

**Specimens seen** (selected): Dicksonfjorden, 1936, E. Dahl (O); Barentsøya, 1.8.1936, E. Dahl (O).

*Aspicilia leprosescens* (Sandst.) Havaas (1920)

**Thallus** crustose to subplacodioid, up to 2 cm diam., grey to blue-grey to olivaceous grey, granulose-sorediate. Marginal lobes distinct, to 0.8 mm long and 0.4 mm broad, with a thin, brown prothallus. Towards thallus centre with areolae producing granules to 0.1–0.2 mm diam.; granules indistinctly sorediate; soredia 33–37 µm diam., N–. Apothecia not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On sea-shore rocks, ornithocoprophilous.

**Distribution.** Widespread and common.

**Notes.** Distinguished by its diffusely granulose to sorediate thallus centre. New to Svalbard. World distribution: Europe, North America.

**Specimens seen** (selected): Kong Karls Land, Mohnhøgda, E. Dahl 14.8.1936 (O), Ytre Norskøya, 11.7.1928, O.A. Høeg (TRH).

*Aspicilia lesleyana* Darb. (1909)

**Thallus** subplacodioid, as small rosettes, up to 2 cm broad, chalky white with a bluish tinge. At margin areolae elongated, to 1 mm long and 0.4 mm broad, in inner part areolae angular, ± isodiametric, thick. Prothallus black. **Apothecia** 1–3 per areola, with thick thalline margin which is black near disc, otherwise concolorous with thallus; disc up to 0.3 mm diam., concave, black, non-pruinose. Hymenium 75–85 µm high; epithecium red-brown. Ascospores 8 per ascus, 9–16 × 8–10 µm. Paraphyses moniliform. Medulla with oxalate crystals. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On limestone and calcareous sandstones.

**Distribution.** Common and widespread.

**Notes.** Recognized by its small subplacodioid rosettes on limestone and calcareous sandstone. World distribution: Circumarctic, with large distribution gaps.

**Specimens seen** (selected): Wijdefjorden, Vestfjorden, Tysneset, A. Elvebakk 01:178 (TROM); Wijdefjorden, 2002, T. Tønsberg 31138 (BG).

### *Aspicilia major* (Lynge 1940) Øvstdal comb. nov.

Basionym: *Lecanora major* Lynge, 1940, Skrifter Svalbard Ishavet 81:86.

Type: Ymerøya, NE Greenland, 1929, B. Lynge (O).

Fig. 12 (p. 224).

**Thallus** up to 8 cm wide, with a thin black prothallus, areolate. Areolae zigzag-formed to rounded, convex, pale grey-brown, slightly elongate towards margin. Hypothallus grey, in inner part of thallus visible between the areolae. **Apothecia** common towards the thallus centre, up to 1 mm diam., when young erupting from areolae, with incurved margin and concave disc, when old constricted below, with slightly concave black, non-pruinose disc, and thin regular thalline margin concolorous with thallus. Hymenium 80–90 µm high, uppermost part yellow-brown. Ascospores 8 per ascus, 15–20 × 7–12 µm. Paraphyses moniliform. No oxalate crystals in medulla. Conidia 25–30 µm long (according to Lynge 1940b).

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** Only known from Wijdefjorden.

**Notes.** The thallus configuration of this species is intermediate between type B and D (Fig. 5, p. 222). The Svalbard specimen has more crowded areolae and somewhat smaller ascospores than the type (O) from Greenland, but is otherwise similar. New to Svalbard. World distribution: Svalbard, North America (Greenland).

**Specimen seen:** Wijdefjorden, just S of Smutsdalen, 2002, T. Tønsberg 31130 (BG).

### *Aspicilia mashiginensis* (Zahlbr.) Oxner (1972)

Syn. *Lecanora bennettii* Lynge (1940).

**Thallus** crustose, grey to brownish grey, forming small rosettes, slightly zonate, areolate; marginal areolae slightly elongate, in inner part angular and ± isodiametric; sorediate. Soralia in inner part, 0.2–0.3 mm broad, convex, blue-grey. Soredia 20–28 µm diam. **Apothecia** unknown.

**Chemistry.** Substictic acid; J.A. Elix det. 2004.

**Ecology.** On non-calcareous rock, ornithocoprophilous.

**Distribution.** A few scattered occurrences.

**Notes.** Distinguished by its discrete soralia and the production of substictic acid. World distribution: Europe, North America.

**Specimen seen** (selected): Litledalsfjellet, 17.8.1926, B. Lynge (O).

### *Aspicilia mastoidea* (Lynge) Thompson (1987)

**Thallus** 3–4 cm wide, composed by dark grey-brown, elevated, round areolae, 0.4–0.5 mm wide, 0.3–0.4 mm high; prothallus rough, black, visible between the areolae. Conidia 15–23 × 1 µm.

**Apothecia** rare, sessile with restricted base, up to 0.5 mm diam.; margin brown, thin, regular; disc concave, black, non-pruinose. Hymenium 90–100 µm high; epithecium yellow-brown. Ascospores 8 per ascus, 14–16 × 9–11 µm. Paraphyses submoniliform.

**Chemistry.** Substictic acid.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Svalbard, arctic North America (including Greenland), Siberia.

**Specimens seen** (selected): Sassendalen, Aug. 1986, D.O. Øvstedal (BG); Holmiabukta, 4.7.1928, O.A. Høeg (O).

#### *Aspicilia mastrucata* (Wahlenb.) Th. Fr. (1867)

**Thallus** areolate, brown, sometimes shiny, surface of areolae gnarled-uneven. **Apothecia** at first immersed in areolae, later almost sessile, up to 0.7 mm diam. Thalline margin strongly irregular, disc flat, brown. Hymenium 90–100 µm high. Ascospores broadly elliptic, 13–15 × 9–11 µm. Paraphyses moniliform.

**Chemistry.** Norstictic acid.

**Ecology.** On bird-manured rock.

**Distribution.** Widespread and common.

**Notes.** This species is characterised by its brown colour, gnarled surface of the areolae, very irregular margin of apothecia and its presence of norstictic acid. World distribution: Europe, North America (Greenland), Siberia.

**Specimens seen** (selected): Recherchejorden, Reinholmen, 16.7.1926, B. Lynge (O); Virgohamna, 7.1.1928, O.A. Høeg (O).

#### *Aspicilia narssquensis* (Lynge) Thomson (1987)

Type: Disco Island, W Greenland, 1871, Th.M. Fries (O!).

**Thallus** bimorphic; basal thallus 3–4 cm wide, pinkish. Areolae raised, often apothecia; disc irregular, slightly convex and sometimes pruinose, up to 0.7 mm diam. Hymenium 100–110 µm high. Ascospores 8 per ascus, 15–16 × 9–11 µm. Paraphyses submoniliform.

**Chemistry.** Substictic acid.

**Ecology.** On rock.

**Distribution.** Only known from Van Mijenfjorden.

**Notes.** New to Svalbard. World distribution: Svalbard, North America (Greenland).

**Specimen seen:** Van Mijenfjorden, 1926, O.A. Høeg (O!).

#### *Aspicilia natherstii* (Lynge) Thomson (1985)

Type: Dusénfjorden, NE Greenland, 1929, B. Lynge (O!).

Fig. 13 (p. 225).

**Thallus** bimorphic; basal thallus 2–4 cm wide, thin, pale ochre, non-rimose; fertile areolae as prominent apothecia strongly restricted below, up to 0.8 mm diam., pale brown; disc concave, non-pruinose, brown. Hymenium 120 µm high. Ascospores 8 per ascus, 20–22 × 13–15 µm. Paraphyses moniliform. Pycnidia not known.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Svalbard, arctic North America (including Greenland).

**Specimens seen** (selected): Kolfjellet, 19.8.1926, B. Lynge (O); Dicksonfjorden, 6.7.1936, E. Dahl (O).

### *Aspicilia nikrapensis* Darb. (1909)

**Thallus** 3–4 cm wide, at margin with discrete, somewhat irregular, flat, white, sometimes tinged pinkish, fluffy, non-corticate areolae; towards centre contiguous, rimose. **Apothecia** 0.4–0.7 mm wide; disc pruinose. Hymenium 110–130 µm high. Ascospores 8 per ascus, 20–24 × 13–15 µm. Paraphyses submoniliform. Oxalate crystals present. Cortex 30–35 µm thick. Conidia 20–32 µm long.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** Widespread and common.

**Notes.** Large ascospores, white, fluffy, non-corticate areolae and pruinose discs are characteristics of this species. World distribution: Svalbard, arctic North America (including Greenland).

**Specimens seen** (selected): Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O); Van Keulenfjorden, Berzeliusfjell, 21.7.1926, B. Lynge (O).

### *Aspicilia pergibbosa* (H. Magn.) Räsänen (1943)

**Thallus** 2–3 cm wide, bullate, pure grey; areolae 0.5–0.8 mm wide. **Apothecia** up to 0.8 mm wide; true exciple distinct; disc black, non-pruinose, flat. Hymenium 100–120 µm high. Ascospores 8 per ascus, 14–17 × 8–10 µm. Paraphyses moniliform. Oxalate crystals present in medulla. Cortex 25–30 µm high, pseudoparenchymateous. Conidia curved, 12–14 × 0.5 µm.

**Chemistry.** Negative.

**Ecology.** On rocks.

**Distribution.** Only known from Magdalenefjorden and Edgeøya.

**Notes.** This species is characterized by its strongly bullate, pure grey thallus, medium large ascospores, non-pruinose disc and lack of lichen products. Material reported from Hornsund by Nowak (1965) has not been available. World distribution: Europe, North America (Greenland).

**Specimens seen:** Magdalenefjorden, J. Vahl 1839 (O); Edgeøya, 6.8.1936, E. Dahl (O).

### *Aspicilia perradiata* (Nyl.) Hue (1912)

Type: Siberia, 1878/79, Almquist (H-Nyl 25591—holotype!).

Fig. 14 (p. 225).

**Thallus** dark brown, 2–3 cm wide, with closely adjoined, radiating lobes at margin; lobes 0.1–0.2 mm wide, distinct; prothallus present. **Apothecia** up to 0.7 mm diam.; thalline margin thick, concolorous with thallus; disc slightly convex, dark brown, non-pruinose. Hymenium 80–100 µm, epithecium green-brown. Ascospores 8 per ascus, 13–18 × 8–11 µm. Paraphyses submoniliform. Conidia filiform, 16–22 × 0.5 µm. Cortex 15–20 µm thick. No oxalate crystals in medulla.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rocks.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Svalbard and North America (including Greenland).

**Specimens seen** (selected): Sørkappøya, 12.8.1920, J. Lid (O); Forsbladhamna, 29.7.1926, B. Lynge (O).

### *Aspicilia pertusa* (Lynge) Thomson (1987)

Type: Husbukta, NE Greenland, 1929, B. Lynge (O).

Fig. 15 (p. 225).

**Thallus** bimorphic; basal thallus thin, effuse, weakly areolate, pale ochre; fertile areolae elevated, brown, crowded to dispersed, up to 0.8 mm wide, coneformed with several small discs. True exciple emergent, white-pruinose. Disc black, non-pruinose. Hymenium 110–120 µm high. Ascospores 8 per ascus, broadly elliptic, 22–25 × 17–18 µm. Paraphyses moniliform. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On crystalline rocks.

**Distribution.** Widespread but not common.

**Notes.** This species is recognized by its large ascospores and fertile areolae with several small discs. The Svalbard material, which is homogeneous, differs somewhat from the type from Greenland (O) in having higher, darker and more dispersed fertile warts, but is otherwise similar. The Svalbard specimens all grow on coarse, crystalline rocks, whereas the type from Greenland grew on a fine-grained rock; this may account for the different organization of the thallus. New to Svalbard. World distribution: Svalbard, arctic North America (including Greenland).

**Specimens seen** (selected): Dicksonfjorden, 6.7.1936, E. Dahl (O), Kong Karls Land, Mohnhøgda, 14.8.1936, E. Dahl (O).

### *Aspicilia plicigera* (Zahlbr.) Oxner (1972)

Type: Novaya Zemlya, 1921, B. Lynge (O!).

Fig. 16 (p. 226).

**Thallus** circular, 3–4 cm wide, with weak ridges and fissures at margin, weakly areolate in inner part. Areolae up to 1 mm wide. **Apothecia** up to 0.6 mm diam. Hymenium 100–110 µm high. Ascospores 8 per ascus, 12–14 × 6–9 µm. Paraphyses submoniliform. Oxalate crystals present. Cortex 30–35 µm thick. Conidia 27–30 µm long.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** A few scattered localities.

**Notes.** Close to *A. sublapponica*, but differs in its less developed marginal areolae and the lack of lichen compounds. New to Svalbard. World distribution: Canada, Alaska, Svalbard and Russia.

**Specimens seen** (selected): Sørkapp, Hornsund, Nowak (KRAM-L-12438); Kolfjellet, 19.8.1926, B. Lynge (O).

*Aspicilia punctiformis* (Lynge) Øvstedral comb. nov.

Basionym: *Lecanora punctiformis* Lynge; Skr. Svalbard Ishavet 81 (1940): 80.

Fig. 17 (p. 226).

**Thallus** bimorphic; basal thallus 4–6 cm wide, thin, pale grey-ochre, uniform but weakly zonate at margin. Areolae conical, scattered, brownish, up to 0.6 mm wide, a few with black minute openings (pycnidia or apothecium primordia). Conidia straight, 10–15 × 0.5 µm. Hymenium and ascospores not seen in Svalbard material, but based on material from Greenland, the ascospores are 20–25 × 12–16 µm (Lynge 1940b).

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** Only known from Blåhuken.

**Notes.** The type (from Greenland) has not been available, but the material agrees with the material described and illustrated by Lynge (1940b). New to Svalbard. World distribution: Svalbard, North America (Greenland).

**Specimen seen:** Blåhuken, 16.8.1926, B. Lynge (O).

*Aspicilia rosulata* Körber (1874)

Syn. *A. proserpens* (Nyl.) Hue (1912).

Fig. 18 (p. 226).

**Thallus** 1–2 cm wide, composed by separate, radiating, shiny brown lobes, 0.1 mm broad, not connected by protostellae. **Apothecia** in inner part, 0.2–0.3 mm wide, when mature elevated; disc concave, dark brown, non-pruinose; margin thin, regular, concolorous with thallus. Hymenium 60–90 µm high; epithecium brown-green. Ascospores 8 per ascus, 12–17 × 7–9 µm. Paraphyses submoniliform. Conidia 8–22 × 0.7 µm (according to herbarium material annotated by Magnusson/Vainio 1939).

**Chemistry.** Negative.

**Ecology.** On siliceous sandstone and limestone, not ornithocoprophilous.

**Distribution.** Widespread and common.

**Notes.** One of the most common *Aspicilia* species on Svalbard, characterized by its discrete, radiating, brown lobes and its lack of lichen products. New to Svalbard. World distribution: Svalbard, Siberia, North America (incl. Greenland).

**Specimens seen** (selected): Adventfjorden, 5.8.1868, Th.M. Fries (O); Wijdefjorden, 2002, T. Tønsberg 31245 (BG). The type of *A. proserpens* (H-Nyl 25652, from Siberia) seen.

*Aspicilia simoënsis* Räsänen (1925)

**Thallus** crustose, 10–15 mm wide, grey to blackish, areolate, isidiate. Isidia low, coarse, coraloid, a few with tips dissolved into coarse granules. **Apothecia** not seen in Svalbard material.

**Chemistry.** Norstictic acid.

**Ecology.** On sandstone.

**Distribution.** Only found once.

**Notes.** World distribution: Europe. New to Svalbard.

**Specimen seen:** Sydøstkysten [=Sydøst-Spitsbergen], S side of Kvalhovden, 30.7.1936, E. Dahl (O).

*Aspicilia sublapponica* (Zahlbr.) Oxner (1971).

Fig. 19 (p. 227).

**Thallus** 4–5 cm wide, greyish to grey-brown (always with a brown tinge). Marginal areolae elongate, distinct; areolae in center isodiametric, slightly bullate. **Apothecia** up to 0.5 mm diam., finally sessile, with a thalline margin which is grey in outer part and dark brown in inner part. Disc concave to flat, slightly white-pruinose. Hymenium 90–110 µm high. Ascospores 8 per ascus, subglobose, 11–13 × 9–11 µm. Paraphyses moniliform. Medulla with oxalate crystals.

**Chemistry.** Substictic acid.

**Ecology.** On schistose rock.

**Distribution.** Only known from Wijdefjorden.

**Notes.** Close to *A. plicigera*, but differs in its much more distinct marginal areolae and presence of substictic acid. The chemistry of the type has not been studied, but according to Zahlbrückner (1928:17) the medulla is K+ yellow—an indication of the presence of substictic acid. New to Svalbard. World distribution: North America (including Greenland), Svalbard, Sweden, Russia.

**Specimen seen:** Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdalen, 2002, T. Tønsberg 31141 (BG).

*Aspicilia subradicans* (Nyl.) Hue (1912)

Type: Siberia, 1878/79, Almquist (H-Nyl 25595!).

**Thallus** dark brown, 3–4 cm wide, at margin with radiating, somewhat convex lobes connected with a hypothallus, in inner part areolate and uneven. **Apothecia** rare, up to 0.5 mm diam., margin dark brown, prominent, disc brown-black, flat, non-pruinose. Hymenium 90–100 µm high. Ascospores 8 per ascus, 15–17 × 8–10 µm. Paraphyses submoniliform. Pycnidia not seen.

**Chemistry.** Norstictic acid.

**Ecology.** On sandstone.

**Distribution.** Only known from Bünzow Land.

**Notes.** New to Svalbard. World distribution: Svalbard, Siberia, arctic North America.

**Specimen seen:** Bünzow Land, Bjonahamna, A.Elvebakk 01:051 (TROM).

*Aspicilia supertegens* Arnold (1877)

**Thallus** up to 6 mm broad, areolate, pale ochraceous; areolae 0.4–0.5 mm diam. Prothallus not evident. Areolae with 1–4 apothecia. **Apothecia** immersed in thallus, up to 0.3 mm broad, concave, black (brown when wet), non-pruinose. No margin visible, but thallus surrounding disc bluish. Hymenium 120–130 µm high, epithecium brown-green. Ascospores 8 per ascus, 14–16 × 7–9 µm. Paraphyses moniliform. Medulla with oxalate crystals. Conidia 17–35 µm long.

**Chemistry.** Negative.

**Ecology.** On loose sandstone on wet ground, associated with *Hymenelia heteromorpha*.

**Distribution.** Only known from Colesbukta.

**Notes.** New to Svalbard, except for a report from Bjørnøya (Magnusson 1939). World distribution: Circumpolar, arctic-alpine, but with considerable distribution gaps.

**Specimen seen:** Colesbukta, 1.10.1999, S. Spjelkavik (BG).

**ASPILIDEA** Hafellner (2001)

**Thallus** crustose, corticate, whitish. **Ascomata** apothecia, aspicilioid. Hymenium euamyloid. Ascii with lateral parts of tholus K/I + blue. Ascospores 8 per ascus, simple, colourless. Hamathecium paraphyses, ramified to anastomosed. Pycnidia conspicuous. Conidia bacilliform. Chemistry: Stictic acid complex.

**Notes.** Close to *Aspicilia*, but differs in ascus structure, euamyloid hymenium, conspicuous pycnidia and presence of stictic acid (Svalbard specimens).

*Aspilidea myrinii* (Fr.) Hafellner (2001)

**Thallus** to several cm wide, yellow-white, shiny, thick, rimose. **Apothecia** immersed in thallus, with thin, pale thalline margin and shiny black, non-pruinose disc, up to 1 mm wide. Hymenium 50–60 µm high. Ascospores 8 per ascus, 12–14 × 9–10 µm. Paraphyses submoniliform. Medulla K/I + blue.

**Chemistry.** Norstictic and stictic acids.

**Ecology.** On rock.

**Distribution.** Only found on Davishamna.

**Notes.** Recognized by its large size, yellowish rimose thallus with innate black discs, and presence of norstictic and stictic acids. Although this species is very common in parts of the Scandinavian mountain chain, it is apparently rare both in Svalbard and other parts of the Arctic. New to Svalbard. World distribution: Europe, northern North America (including Greenland), northern Asia.

**Specimen seen:** Davishamna, 29.7.1936, E. Dahl (O).

**ATLA** S. Savić & Tibell (2008)

**Thallus** crustose, areolate to evanescent. Photobiont green algae or cyanobacteria. **Ascomata** perithecia, immersed in thallus or superficial. Involucellum well-developed. True exciple entire, brown to black. Ascii of *Verrucaria*-type, 8-spored. Ascospores muriform, colourless to brown. No lichen compounds found in the genus. A combined identification key to species of *Atla* and *Polyblastia* is given under *Polyblastia* below.

A recently described genus (see Savić & Tibell 2008).

*Atla alpina* S. Savić & Tibell (2008)

**Thallus** crustose, thin, with slightly uneven surface, grey to greenish grey. Perithecia 0.4–0.6 mm diam., black, globose, without thalline exciple. Involucellum prominent, reaching to base of perithecium. Exciple brown in upper part, merging with involucellum, pale in lower part. Ascospores 8 in ascii, muriform, dark brown, 70–83 × 39–49 µm.

**Ecology.** On wet rock.

**Distribution.** Only known from Kongsfjorden.

**Note.** World distribution: Europe.

**Specimen seen:** Kings Bay, [Kongsfjorden] 17.8.1868, Th.M. Fries (O).

**BACIDIA** De Not. (1846)

**Thallus** crustose, pale white-green to brownish. Photobiont green algae. **Ascomata** apothecia, without thalline margin, sessile, strongly convex to flat, black to pale. True exciple little to well-developed, composed of radiating hyphae. Hamathecium paraphyses, simple or branched; end cells often enlarged. Ascii of *Bacidia*-type. Ascospores 8 per ascus, colourless, 3–7-septate, bacilliform to acicular. Conidia of various forms.

**Notes.** Of the species listed in the current checklist for Svalbard (Elvebakk & Hertel 1996) *Bacidia subfuscula* (Nyl.) Th. Fr. has been moved to *Lecania*, while *B. venusta* Hepp ex Th. Fr., reported from Svalbard by Fries (1867) is regarded as a lignicolous form of *Lecania subfuscula* (Nyl.) S. Ekman (S. Ekman pers. comm. 2004).

Key to *Bacidia* on Svalbard:

1	Apothecium margin pruinose.....	<i>B. illudens</i>
1	Apothecium margin not pruinose.....	2
2 (1)	Ascospores 14–16 µm long .....	<i>B. coprodes</i>
2	Ascospores 25–45 µm long .....	<i>B. bagliettoana</i>

***Bacidia bagliettoana*** (Massal. & de Not.) Jatta (1900)

**Thallus** granular, thin, whitish to green-brown. **Apothecia** up to 0.8 mm diam., flat at first but becoming convex, brown to blackish, constricted below. Hymenium 40–50 µm high, epitheciun olive-green. Ascospores 8 per ascus, 25–45 × 2–3 µm, 3–5-septate.

**Chemistry.** Negative.

**Ecology.** On bryophytes over calcareous soil.

**Distribution.** Widespread and common.

**Note.** World distribution: Circumpolar, New Zealand, Antarctica.

**Specimens seen** (selected): Eholmen, 28.7.1926, B. Lynge (O); Van Keulenhamna, 5.8.1928, B. Lynge (O).

***Bacidia coprodes*** Körb. (1860)

**Thallus** crustose, thin scurfy, grey-black. **Apothecia** scattered, black, sessile, convex, to 0.7 mm diam., emarginate. Hymenium 40–60 µm high, faint reddish in thick sections; epitheciun greenish. Paraphyses thick, anastomosing. Ascospores 8 per ascus, 3-septate, 14–16 × 2.5 µm, uncoloured, often constricted at middle part. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Only known from Van Keulenfjorden.

**Notes.** New to Svalbard. World distribution: Europe, North America, Antarctica.

**Specimen seen:** Van Keulenfjorden, Ullafjell [Ullaberget], 29.7.1926, B. Lynge (O; det S. Ekman 2005).

***Bacidia illudens* (Nyl.) Oliver (1911)**

**Thallus** as small, greyish to yellow-grey areolae. **Apothecia** up to 1 mm diam., black, concave, with somewhat raised, pruinose margin. Hymenium 40–45 µm high; epithecium blue-green. Hypothecium red-brown. Paraphyses ramified to anastomosing; end cell enlarged to 2 µm diam. Ascospores 8 per ascus, 6–septate, 28–32 × 2–2.5 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** Widespread and common.

**Notes.** New to Svalbard. World distribution: Europe, Taimyr, arctic North America (including Greenland).

**Specimens seen** (selected): Forsbladhamna, 29.7.1926, B. Lynge (O); Bromelldalen, 9.8.1926, B. Lynge (O).

**BACIDINA Vězda (1990)**

**Thallus** crustose, green-grey. Photobiont green algae. **Ascomata** apothecia, without thalline margin, sessile, flat to convex, black to pale orange. True exciple composed of a pseudoparenchymateous tissue. Hamathecium paraphyses, simple or branched. Asci of *Bacidia*-type. Ascospores colourless, bacilliform to acicular, 3–7-septate. Conidia thread-formed.

***Bacidina chlorotica* (Nyl.) Vězda & Poelt (1990)**

**Thallus** crustose, thin to very thin, green to grey-green, granulose. Photobiont green algae. **Apothecia** pale orange, 0.1–0.2 mm diam., flat, constricted below. Hymenium 40–45 µm high, colourless. Hypothecium colourless. Exciple colourless, in inner part pseudoparenchymateous, with isodiametric, thin-walled cells, 4–5 µm diam., towards margin cells more elongate. Ascospores 8 in ascii, acicular, 1–3-septate, 23–40 × 1–3.5 µm.

**Chemistry.** Negative.

**Ecology.** On lower side of rocks in scree.

**Distribution.** Only found in Bjørndalen.

**Notes.** New to Svalbard. A sterile collection from the same locality and habitat (T. Tønsberg 31887, BG) had pycnidia with filiform conidia 20–30 µm long; this specimen may prove to be conspecific with *B. chlorotica*. World distribution: Europe.

**Specimens seen:** Bjørndalen, 2004, T. Tønsberg 31885 (BG; det S. Ekman 2005).

**BAEOMYCES Pers (1794)**

**Thallus** granular to squamulose, whitish to cream-gray. Photobiont green algae. **Ascomata** apothecia, brown to pale, on short stipes, without thalline margin. Asci with thin, K/I – apical part, or with a K/I + blue apical sheet. Ascospores 8 per ascus, uncoloured, simple to 3-septate. Hamathecium paraphyses, little branched. Conidia bacilliform.

Key to *Baeomyces* on Svalbard:

- |   |   |                   |
|---|---|-------------------|
| 1 | With stictic acid (norstictic acid absent or in trace amounts only) ..... | <i>B. rufus</i>   |
| 1 | With norstictic acid (major substance; stictic acid absent) .....         | <i>B. carneus</i> |

***Baeomyces carneus* Flörke (1821)**

**Thallus** 2–3 cm wide, areolate-squamulose, green-grey, squamules 0.4–0.8 mm wide, not overlapping. Prothallus thick, black, 2–3 mm wide. **Apothecia** present only as primordia in Svalbard material.

**Chemistry.** Norstictic acid (major), gyrophoric acid (trace).

**Ecology.** On rocks and detritus.

**Distribution.** Only known from Nordenskiöld Land (Urbanavichene & Koroleva 2008)

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Adventdalen, T. Tønsberg 31931a (BG). Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9902 (BG).

***Baeomyces rufus* (Huds.) Rebent. (1804)**

**Thallus** composed of overlapping, minute squamules, green-grey to brownish; soralia and schizidia sometimes present. **Apothecia** up to 2 mm wide, pink to red-brown, with a very short stipe. Hymenium 50–60 µm high. Hypothecium colourless. Ascospores 0–1-septate, 11–13 × 3.5–4 µm.

**Chemistry.** Stictic acid complex, gyrophoric acid.

**Ecology.** Saxicolous and terricolous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Longyearbyen, Bjørndalen, 2003, T. Tønsberg 31863 (BG); Kongsfjorden, 1 km S of Gluudneset, 2003, A. Elvebakk 03:140 (TROM).

***BELLEMERA* Hafellner & Cl. Roux (1984)**

**Thallus** crustose, rimose to areolate. Photobiont trebouxioid. **Ascomata** apothecia, immersed in thallus; disc concave to flat. Thalline margin very thin, not raised and difficult to observe. True margin very thin, colourless. Asci of *Porpidia*-type. Ascospores 4–8 per ascus, simple, colourless; episporite K/I + violet. Hamathecium of paraphyses, branched and anastomosing. Conidia shortly bacilliform. Medulla K/I + violet.

Key to *Bellemera* on Svalbard:

- |       |                                      |                            |
|-------|--------------------------------------|----------------------------|
| 1     | Thallus sorediate .....              | <i>B. subsorediza</i>      |
| 1     | Thallus not sorediate .....          | 2                          |
| 2 (1) | Thallus with norstictic acid.....    | <i>B. alpina</i>           |
| 2     | Thallus without lichen products..... | <i>B. cinereorufescens</i> |

***Bellemerea alpina*** (Sommerf.) Clauzade & Roux (1984)

**Thallus** 3–4 cm wide, crustose, grey, rimose, thick. **Apothecia** up to 1 mm wide, immersed in thallus, disc brown, surrounded by a thin, pale, true exciple. Hymenium 40–60 µm high, hypothecium uncoloured. Ascospores 8 per ascus, 11–13 × 7–9 µm, halonate, perispore K/I + violet. Paraphyses thick, strongly adglutinated, ramified to anastomosing; end cell not enlarged. Medulla K/I + strongly violet.

**Chemistry.** Norstictic acid.

**Ecology.** On hard rock, not ornithocoprophilous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Circumpolar/arctic-alpine, Chile, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Sydkappfjellet [Kistefjellet], Fisnes [Fisneset], 29.7.1920, J. Lid (O); Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O).

***Bellemerea cinereorufescens*** (Ach.) Clauzade & Roux (1984)

**Thallus** crustose, 4–5 cm diam., grey-brown, areolate. **Apothecia** aspicilioid to somewhat protruding, up to 0.8 mm broad, disc brown-black. Hymenium 85–100 µm high, epithecium brown. Ascospores 8 per ascus, colourless, halonate, 12–20 × 7–10 µm; perispore K/I + violet. Paraphyses moniliform. Hypothecium pale brown. Medulla K/I + violet.

**Chemistry.** Negative.

**Ecology.** On siliceous rock.

**Distribution.** Only known from North Spitsbergen.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen:** Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O).

***Bellemerea subsorediza*** (Lynge) R. Sant. (1987)

**Thallus** as ± discrete areolae on a black prothallus. Areolae flat, 0.4–0.5 (–1.0) mm diam., grey, sorediate. Soralia crateriform, 1 per areola, dark grey to black. Soredia 40–50 µm diam., green-brown, N + red, K + more distinctly blue-green. **Apothecia** and pycnidia not seen in Svalbard material.

**Chemistry.** Norstictic acid.

**Ecology.** On rock in snow-beds.

**Distribution.** Widespread but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Ny-Ålesund, Aug. 1973, D.O. Øvstedral (BG); Kongsfjorden, Ossian Sarsfjellet, 2003, A. Elvebakk 03:116 (TROM).

**BIATORA** Fr. (1817)

**Thallus** crustose, granulose to minutely squamulose. Photobiont green algae. **Ascomata** apothecia, pale to red-brown (black under strong radiation), convex, small, without thalline margin. Asci of

*Biatora*-type. Ascospores 8 per ascus, colourless, simple to 3-septate. Hamathecium paraphyses. Conidia bacilliform.

Key to *Biatora* species on Svalbard:

- |   |                                      |                     |
|---|--------------------------------------|---------------------|
| 1 | Thallus with argopsin.....           | <i>B. cuprea</i>    |
| 1 | Thallus without lichen products..... | <i>B. subduplex</i> |

***Biatora cuprea* (Sommerf.) Fr. (1831)**

**Thallus** crustose, 2–3 cm wide, as scattered to contiguous, white areolae, 0.2–0.3 mm wide. **Apothecia** numerous, sessile, with constricted base, up to 1.3 mm wide, brown, convex, emarginate. Hymenium 40–50 µm high; epithecium pale yellowish. Hypothecium colourless but with brownish spots. Ascospores simple, colourless, 8 per ascus, 11–13 × 3.5 µm. Paraphyses anastomosing; end cell not or little enlarged.

**Chemistry.** Argopsin.

**Ecology.** On moribund bryophytes.

**Distribution.** Widespread but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen** (selected): Colesbukta, Vestalfjellet, 150 m alt, in *Cassiope tetragona* heath, 3.8.1986, T. Engelskjøn & S. Spjelkavik (TROM).

***Biatora subduplex* (Nyl.) Printzen (1995)**

**Thallus** crustose, smooth to warted areolate, pale grey to ochre, 2–3 cm wide. **Apothecia** usually crowded, 0.2–0.5 mm broad, orange-brown to dark red-brown, flat to strongly convex; margin indistinct, usually paler than disc. Hymenium 40–55 µm high; epithecium yellowish. Hypothecium yellow-brown to dark brown. Ascospores 8 per ascus, narrow elliptic, simple to rarely 1-septate, 10–15 × 3.5–5 µm. Paraphysal end cells enlarged to 3 µm diam.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America.

**Specimens seen** (selected): Observatoriefjellet, 16.7.1926, B. Lyngé (TRH); Kobbefjorden, 1868, Th.M. Fries (O).

**BIATORELLA de Not. (1846)**

**Thallus** crustose, thin and poorly developed. Photobiont trebouxoid. **Ascomata** apothecia, convex, pale red-brown, with or without a thin, soon disappearing thalline exciple. True exciple thin. Asci with a K/I + blue gelatinous outer layer and a distinct tholus which is K/I – or faint blue; multisporous. Ascospores colourless, simple. Hamathecium paraphyses, simple, richly branched in uppermost part. Conidia not known.

***Biatorella hemisphaerica*** Anzi (1860)

**Thallus** only surrounding apothecia, thin, clear green, granulose to leprose. **Apothecia** pale red-brown, up to 1.1 mm diam., emarginate. Hymenium 200–210 µm high, epithecium colourless. Hypothecium pale brown. Ascospores > 100 per ascus, appearing 1-septate (plasma bridges), colourless, rectangular to bifusiform, 7–9 × 3 µm.

**Chemistry.** Not performed.

**Ecology.** Over bryophytes on calcareous ground.

**Distribution.** Only known from Wijdefjorden.

**Notes.** New to Svalbard. World distribution: Europe, North America, Chukotka.

**Specimens seen:** Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdalen, 2002, T. Tønsberg 31125, 31144 (both BG).

**BILIMBIA** De Not. (1846)

**Thallus** crustose, whitish to brown. Photobiont trebouxiod. **Ascomata** apothecia, black, sessile, with true exciple only. Asci of modified *Bacidia*-type. True exciple variable, pseudoparenchymaetous or composed of radiating hyphae. Hamathecium of paraphyses, simple to anastomosing. Ascospores 8 in ascii, colourless, simple to 6-septate, with warted perispore. These species are still mostly treated within *Bacidia* or *Myxobilimbia*. However, Veldkamp (2004) resurrected the old genus *Bilimbia*, and we follow his treatment.

Key to *Bilimbia* on Svalbard:

1	Hypothecium colourless.....	<i>B. microcarpa</i>
	Hypothecium brown.....	2
2(1)	Ascospores 1–3-septate .....	<i>B. lobulata</i>
	Ascospores 4–6-septate .....	<i>B. sabuletorum</i>

***Bilimbia lobulata*** (Sommerf.) Hafellner & Coppins (2004)

**Thallus** areolate-squamulose, whitish to grey, squamules continuous to overlapping, to 0.5 mm broad. **Apothecia** usually aggregated, black, sessile, convex, to 0.7 mm diam.; true margin indistinct. Hymenium 60–70 µm high; epithecium blue-black. Hypothecium red-brown to purplish. Paraphyses little ramified, strongly adglutinated. Ascospores 8 per ascus, 1–3-septate, 20–22 × 5–5.5 µm.

**Chemistry.** Zeorin.

**Ecology.** On soil and moribund bryophytes on calcareous ground.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by its distinct, squamulose, whitish thallus, red-brown hypothecium and 1–3-septate ascospores. World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Klovningen, 1928, O.A. Høeg (TRH); Edgeøya, Keilhaubukta, 8.8.1936, E. Dahl (O; E. Timdal det. 2005).

***Bilimbia microcarpa*** (Th. Fr.) Th. Fr. (1863)

**Thallus** crustose, thin, 1 cm diam., grey to greyish brown, subgelatinous. **Apothecia** black to brown-black, strongly convex, emarginated, up to 0.6 mm diam. Hymenium 90–100 µm high; uppermost part brown-green. Paraphyses anastomosing; end cell clavate, embedded in brown-green mucilage, 3 µm diam. Hypothecium colourless. Ascospores 8 per ascus, 3-septate, 21–23 × 3–5 µm.

**Chemistry.** Negative.

**Ecology.** Over moribund mosses.

**Distribution.** Only known from Smeerenburg.

**Notes.** Recognized by its pale hypothecium, constantly 3-septate ascospores, brown-green epithecum and its subgelatinous, thin, grey thallus. World distribution: Europe, Asia, North America.

**Specimen seen:** Smeerenburg 31.8.1868, Th.M. Fries (O).

***Bilimbia sabuletorum*** (Schreb.) Arnold (1869)

**Thallus** granular, greyish. **Apothecia** black, flattened convex, up to 0.7 mm diam., emarginate. Hymenium 55–60 µm high; epithecium blue-green. Hypothecium red-brown. Ascospores 8 per ascus, 5-septate, 21–23 × 4–5 µm.

**Chemistry.** Negative.

**Ecology.** On soil and over moribund bryophytes.

**Distribution.** Not uncommon.

**Notes.** Recognized by its thin, granulose thallus, red-brown hypothecium, and 4–6 septate ascospores. World distribution: Europe, Asia, North America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Sasselalen, 1987, D.O. Øvstedal (BG); Berzeliusfjell [Berzeliusfjellet], 25.7.1926, B. Lynge (O).

**BRIGANTIAEA** Trevis. (1853)

**Thallus** crustose, verrucose. Photobiont green algae. **Ascomata** apothecia, without thalline margin. True margin thick, composed of radiating hyphae. Asci with K/I + blue tholus. Ascospores 1–2 per ascus, muriform, colourless, thin-walled. Hamathecium paraphyses, straight, little ramified.

***Brigantiae fuscolutea*** (Dicks.) R. Sant. (1987)

**Thallus** white-grey, crustose, areolate, areolae gnarled-convex, shiny. **Apothecia** (not seen in Svalbard material) sessile, orange-brown, with thick margin, up to 2 mm diam. Ascospores muriform, colourless.

**Chemistry.** Atranorin (thallus), parietin (apothecia).

**Ecology.** Over bryophytes.

**Distribution.** Only known from Sørkapp Land.

**Notes.** Although the Svalbard material is sterile, it can be identified by thallus morphology and chemistry. World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand, Antarctica.

**Specimens seen:** Sørkapp Land, M. Olech (KRA-L; 2 specimens).

**BRODOA** Goward (1986)

**Thallus** foliose, lobes inflated, tubular to flattened, solid. Photobiont green algae. Upper cortex pseudoparenchymateous, with a thin polysaccharide-like covering, lower cortex plechtenchymateous, black, without polysaccharide-like covering and without rhizines. **Ascomata** apothecia, laminal, sessile, with thalline margin. Ascospores 8 per ascus, simple, colourless, subglobose. Conidia bifusiform.

**Note.** An arctic-alpine genus with three species.

*Brodoa oroarctica* (Krog) Goward (1986)

**Thallus** foliose, several cm wide, as radiating, flattened terete, solid, torulose to sausage-shaped lobes, up to 0.8 mm wide. Upper side grey to brownish-grey to almost black; lower side black, wrinkled, without rhizinae.

**Chemistry.** Atranorin, physodic acid.

**Ecology.** On rock.

**Distribution.** Widespread and common.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Bünzow land [Bünzow Land], Bjonahamna, 2001, A. Elvebakk 01:047 (TROM); Amsterdamøya, 26.8.1936, E. Dahl (O).

**BRYOCAULON** Kärnefelt (1986)

**Thallus** fruticose, dichotomous to subdichotomously divided, lobes ± erect, terete to angular, brown. Pseudocyphellae present, fusiform, raised or plane. Epicortex non-pored. Outer cortical layer composed of 1–3 layers of densely packed anticlinal hyphae; inner cortical layer composed of strongly gelatinized periclinal hyphae. Medulla lax or dense. **Ascomata** apothecia, developed laterally, with thalline margin. Ascospores 8 per ascus, simple, uncoloured, elliptic. Hamathecium paraphyses, branched; end cell capitate. Conidia bifusiform.

**Note.** A small genus of ca 4 species, mainly arctic-alpine in the Northern Hemisphere.

Key to *Bryocaulon* on Svalbard:

- |   |   |                      |
|---|---|----------------------|
| 1 | With olivetoric acid, pseudocyphellae wide open, with medulla emerging .. | <i>B. divergens</i>  |
| 1 | Without lichen compounds, pseudocyphellae almost closed.....              | <i>B. hyperborea</i> |

*Bryocaulon divergens* (Ach.) Kärnefelt(1986)

**Thallus** fruticose, erect to subdecumbent, to 8 cm high; main branches up to 2 mm diam., terete to angular, dark brown, shiny. Pseudocyphellae numerous, wide open; medulla emergent.

**Chemistry.** Olivetoric acid.

**Ecology.** On soil and among bryophytes; dry places.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:094 (TROM); Kongsfjorden, Ossian Sars-fjellet, 20.7.1974, A.A. Frisvoll (TRH).

### *Bryocaulon hyperborea* Øvstdal sp. nov.

*Bryocauloni divergenti* similis, sed sine acidis lichenosis, et pseudocyphellis lineatis et inapertis.

Holotype: Svalbard, Kong Karls Land, Hårfagrehaugen, 11.8.1936, Eilif Dahl (O).

**Thallus** fruticose, erect to decumbent, brown-black, terete to flattened in ramification parts. Main branches 0.7 mm diam. Division dichotomous or subdichotomous; angle between branches in upper part  $65 \pm 7$  degrees. Pseudocyphellae rare, linear, 0.2–0.3 mm long, mostly closed (medulla usually not visible). Cortex similar to that of *B. divergens*. **Apothecia** not seen.

**Chemistry.** Negative.

**Ecology.** Among bryophytes.

**Distribution.** A few scattered occurrences on Svalbard.

**Etymology.** “Hyperborea” refers to the distant land of the Hyperboreans, supposed by the ancients to dwell in the unknown land beyond the Boreas, the mythological seat of the North Wind.

**Notes.** This taxon differs from *Bryocaulon divergens* in the following characters: lack of lichen products (olivetoric acid in *B. divergens*), the nature of the pseudocyphellae (wide open, with emergent medulla in *B. divergens*), and the angle between the branches in the upper part of the thallus; angle  $78 \pm 5$  degrees in *B. divergens* (Svalbard material). It is superficially similar to the Greenlandic – North American *Bryoria subdivergens* (E. Dahl) Brodo & Hawksw., and in fact Eilif Dahl had annotated the type specimen from Svalbard as “*Alectoria subdivergens*”. *Bryoria subdivergens*, however, has a quite different type of cortex and also lacks pseudocyphellae. World distribution: Svalbard, North America (Greenland).

**Additional specimens seen:** Barentsøya, 1.8.1936, E. Dahl (O); Nordaustlandet, Rijpfjorden, 17.8.1936, E. Dahl (O); Greenland, Ivigtut, 1868, Schiødt (C); Greenland, Arsutfjorden (C; collector not indicated).

### BRYONORA Poelt (1983)

**Thallus** crustose, often indistinct. Photobiont green algae. **Ascomata** apothecia, brown. Thalline exciple indistinct, true exciple distinct, composed of swollen, strongly conglutinated, anastomosing hyphae. Hypothecium pale brown, with algae in lower part. Ascii with K/I – blue tholus, 8-spored. Ascospores colourless, ellipsoid, simple to 3-septate, thick-walled. Hamathecium paraphyses simple to ramified, with swollen brown end cells. Conidia bacilliform.

**Note.** A small genus of ca 10 species in cold areas of Europe and North America, also in Himalaya and Antarctica.

#### Key to *Bryonora* on Svalbard

1	With norstictic acid .....	2
1	Without norstictic acid.....	3
2 (1)	Ascospores < 24 µm long .....	<i>B. castanea</i>
2	Ascospores > 24 µm long .....	<i>B. curvescens</i>

- 3        With usnic acid, ascospores < 16 µm long..... *B. pruinosa*  
 3        With isousnic acid, ascospores > 16 µm long..... *B. septentrionalis*

***Bryonora castanea* (Hepp) Poelt (1983)**

**Thallus** evanescent to very thin, whitish to ochre. **Apothecia** up to 2 mm wide, brown, thin, constricted at base. Margin thin, paler than disc. Hymenium 50–60 µm high, brownish in uppermost part. Ascospores 8 per ascus, 0–2-septate, 18–20 × 6–7 µm. Paraphyses thick, flexuose; end cell enlarged to 4 µm diam. Hypothecium colourless.

**Chemistry.** Norstictic acid.

**Ecology.** Over moribund bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Circumpolar, New Zealand, Antarctica.

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk 86:393 (TROM); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9860 (BG).

***Bryonora curvescens* (Mudd) Poelt (1983)**

**Thallus** crustose, thin, granular, dark grey to brown. **Apothecia** up to 2 mm diam., dark brown, flat to concave, often slightly pruinose; margin prominent, concolorous or slightly paler than disc. Hymenium 60–70 µm high, uppermost part brownish. Ascospores mostly simple, but sometimes up to 4-septate, 25–39 × 4.5–7 µm.

**Chemistry.** Norstictic acid.

**Ecology.** On *Andreaea* or *Grimmia*.

**Distribution.** Only known from Kobbefjorden.

**Notes.** Differs from *B. castanea* mainly in its large ascospores. World distribution: Europe, Taimyr, North America (including Greenland).

**Specimens seen:** None seen by us but reported from Kobbefjorden by Holtan-Hartwig (1990) based on specimens collected by Th.M. Fries in 1868 (O).

***Bryonora pruinosa* (Th. Fr.) Holt.-Hartw. (1990)**

**Thallus** crustose, thin, brown, scurfy, 3–4 cm diam. **Apothecia** when young stipitate, concave, with thin margin darker than disc, when old flat, up to 1 mm diam.; disc red-brown. Hymenium 60–70 µm high, uppermost part brownish. Ascospores up to 13–15 × 4–5 µm, 1–3-septate. Paraphysse end cell enlarged to 3 µm diam.

**Chemistry.** Usnic acid.

**Ecology.** Over bryophytes.

**Distribution.** Only known from Kongsfjorden.

**Notes.** Characterized by its chemistry, short ascospores and margins darker than discs in young apothecia. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Ny-Ålesund, 4.-5.7.1936. E. Dahl (O).

***Bryonora septentrionalis*** Holt.-Hartw. (1990)

**Thallus** as a very thin crust, whitish to grey. **Apothecia** up to 2 mm diam., red-brown; disc pruinose, with concolorous margin. Hymenium 50–60 µm high, brownish in uppermost part. Ascospores consistently 1-septate in Svalbard material, 15–33 × 5–7 µm. Paraphysis end cells to 2.5 µm diam.

**Chemistry.** Isousnic acid (often in low concentrations).

**Ecology.** Over bryophytes, often in *Cassiope tetragona* heath.

**Distribution.** Widespread and common.

**Notes.** The most common *Bryonora* species on Svalbard, characterized by its relatively large, reddish, pruinose apothecia and presence of isousnic acid. World distribution: Europe, North America (Greenland).

**Specimens seen** (selected): Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9826 (BG); Colesbukta, Vestalfjellet NE, 3.8.1986, T. Engelskjøn & S. Spjelkavik (TRON).

***BRYORIA*** Brodo & D. Hawksw. (1977)

**Thallus** fruticose, erect, pendulous or prostrate, pale to dark brown to blackish. Branches terete, occasionally flattened; lateral spinules present in some species. Soralia present in many species. Pseudocyphellae often present, inconspicuous. Cortex composed of hyphae running parallel to surface, embedded in moderate amounts of mucilage. **Apothecia** not seen in Svalbard material.

***Bryoria chalybeiformis*** (L.) Brodo & D. Hawksw. (1977)

**Thallus** fruticose, up to 10 cm long, decumbent, dark brown. Main branches twisted, foveolate, up to 0.8 mm wide at base. Ramification isotomic dichotomous at base, anisotomic dichotomous towards apices. Soralia rare, convex, dark grey.

**Chemistry.** Fumarprotocetraric acid (in soralia).

**Ecology.** Among mosses on rock and on soil.

**Distribution.** Widespread but not common.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), southernmost South America.

**Specimens seen** (selected): Kong Karls Land, Holmsbukta [Holmbukta], 10.8.1936, E. Dahl (O); Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O).

***BUELLIA*** De Not (1846)

**Thallus** crustose to placodioid, also parasitic. **Ascomata** apothecia, without thalline margin, black to brown-black, sessile to immersed in thallus. True exciple usually broad and dark-coloured. Epitheciun brown to blue-green, N – to N + red. Hypothecium usually dark brown, but pale in some species. Hamathecium of paraphyses, simple to divided in upper part; end cell enlarged, pigmented. Asci of *Lecanora*-type. Ascospores usually 8 per ascus, brown, 1-septate, rarely 2–3-septate to sub-

muriform; wall usually of uniform thickness but sometimes with a small thickening around septum. Conidia short, rod-shaped.

Key to *Buellia* on Svalbard

1	On other lichens (also when old) .....	2
1	Autonomous .....	3
2 (1)	Thallus superficial, areolate, white .....	<i>B. insularis</i>
2	Thallus within host .....	<i>B. pulverulenta</i>
3 (1)	On soil, bryophytes or old driftwood .....	4
3	On rock .....	9
4 (3)	On old driftwood .....	<i>B. triphragmoides</i>
4	On soil or bryophytes .....	5
5 (4)	Thallus with xanthones .....	8
5	Thallus without xanthones .....	6
6 (5)	Ascospores 1-septate .....	7
6	Ascospores 3-septate .....	<i>B. geophila</i>
7 (6)	Without lichen compounds .....	<i>B. chiona</i>
7	With atranorin .....	<i>B. papillata</i>
8 (5)	Thallus with norstictic acid .....	<i>B. postglacialis</i>
8	Thallus without norstictic acid .....	<i>B. insignis</i>
9 (3)	Ascospores submuriform .....	<i>B. alboatra</i>
9	Ascospores 1–3 septate .....	10
10 (9)	Ascospores 3-septate .....	<i>B. subdispersa</i>
10	Ascospores 1-septate .....	11
11 (10)	Thallus with xanthones .....	12
111	Thallus without xanthones .....	13
12 (11)	Thallus placodioïd, ascospores 9–11 µm long .....	<i>B. jugorum</i>
12	Thallus crustose, ascospores 13.5–18 µm long .....	<i>B. concinna</i>
13 (11)	Thallus with norstictic acid .....	14
13	Thallus without norstictic acid .....	15
14 (13)	Thallus extensive, rimose-areolate .....	<i>B. aethalea</i>
14	Thallus as small scattered group of areolae .....	<i>B. ectolechioides</i>
15 (13)	Hypothecium and exciple strongly amyloid .....	<i>B. vilis</i>
15	Hypothecium and exciple weakly amyloid .....	16
16 (15)	Thallus brown .....	<i>B. badia</i>
16	Thallus white-grey .....	<i>B. leptocline</i>

***Buellia aethalea*** (Ach.) Th. Fr. (1874)

**Thallus** crustose, dark grey to grey-brown, rimose-areolate, up to 3–4 cm wide. **Apothecia** immersed in thallus, up to 0.4 mm wide; exciple usually not visible; disc flat, black. Exciple uniformly dark brown. Hypothecium brown. Hymenium 60–80 µm high; epithecium brown to brown-green, N + red. Ascospores 8 per ascus, 13–18 × 8–10 µm. Conidia 5 µm long.

**Chemistry.** Norstictic acid.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Widespread and common.

**Note.** World distribution: Europe, Asia, North America, Argentina, Australia, New Zealand, possibly Antarctica.

**Specimens seen** (selected): Forsbladhamna, 30.7.1926, B. Lynge (O); Reinodden, 29.7.1926, B. Lynge (O).

***Buellia alboatra*** (Hoffm.) Th. Fr. (1860)

Syn. *Diplotomma alboatrum* (Hoffm.) Flotow (1849).

**Thallus** white to grey-ochre, crustose, 3–4 mm wide, thick. **Apothecia** black, up to 1.5 mm wide, at first immersed, later emerging and ± sessile, convex, often white-pruinose. Hymenium 60–70 µm high; uppermost part brown. Ascospores submuriform, 14.5–17 × 7.5–9 µm, with 6–8 cells seen in optical view. Paraphysis end cell 6 µm diam.

**Chemistry.** Negative.

**Ecology.** Saxicolous, starting as a parasite on other lichens but becoming autonomous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, Australia, New Zealand.

**Specimens seen** (selected): Wijdefjorden, 25.8.1928, O.A. Høeg (TRH); Bergmannfjellet, 8.8.1926, B. Lynge (O).

***Buellia badia*** (Th. Fr.) A. Massal. (1853)

**Thallus** minutely squamulose, brown; squamules 0.4–0.6 mm broad and equally long. **Apothecia** black, convex, emarginate, to 0.5 mm diam. Hymenium 60–70 µm high, with no oil droplets; epithecium brown. Hypothecium brown. Ascospores 8 per ascus, 12–14 × 5–6 µm, of *Buellia*-type. Paraphysis end cell brown, to 3.5 µm diam.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** Svalbard specimens differ from mainland Norwegian ones in squamules being more dispersed. Externally fairly similar to *Amandinea coniops*, but differs in conidial characters as well as in its smooth and *Buellia*-type of ascospores (rough and of *Physconia*-type in *A. coniops*). New to Svalbard. World distribution: Europe, North America, Argentina.

**Specimens seen** (selected): Blåhuken, 16.8.1926, B. Lynge (O); Wahlenbergfjorden, 2.7.1931, P.F. Scholander (O).

***Buellia chionea* (Th. Fr.) Sheard (2002)**

**Thallus** crustose, 2–3 cm wide, white, papillate. Apothecia numerous, sessile, up to 0.5 mm wide, when young flat, with thalline margin, when old convex, emarginate, black, bluish pruinose. Hymenium faintly green, 80–90 µm high, in uppermost part brownish. Hypothecium dark brown. Ascospores 8 in ascii, 1-septate, 12–14 × 6–7 µm. Paraphysis end cell enlarged to 3 µm diam.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Notes.** New to Svalbard. World distribution: Iceland, Scandinavia, Svalbard, Novaya Zemlya, North America (Greenland).

**Specimen seen:** Wijdefjorden area, E of Austfjorden, T. Tønsberg 31076 (BG).

***Buellia concinna* Th. Fr. (1860)**

**Thallus** crustose, areolate, yellowish. Medulla K/I + violet. **Apothecia** up to 1 mm diam., black, lecideine, sessile, constricted at base. Hymenium 60–90 µm high; uppermost part brown. Hypothecium brown. Ascospores 13.5–18 × 7–8.5 µm. Conidia bacilliform, up to 5.5 µm long.

**Chemistry.** Arthothelin, trichlor-O-methylnorlichexanthone.

**Ecology.** On rock

**Distribution.** Only known from Adventdalen and Akseløya.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (Greenland).

**Specimens seen:** Adventdalen, 5.8.1924, J. Lid (O); Axeløya [Akseløya], 23.8.1926, B. Lynge (O).

***Buellia ectolechioides* (Vain.) Erichsen (1930)**

**Thallus** crustose, as scattered groups of 3–4 closely adpressed, brown-grey areolae. Apothecia immersed in areolae, up to 0.4 mm diam. Hymenium 60–80 µm high, uppermost part brownish. Exciple of *Aethalea*-type. Ascospores 13–18 × 7–10 µm.

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** The species is rather similar to *B. aethalea*, but differs mainly in its small thalli consisting of scattered areolae. World distribution: Europe, Chukotka, North America (Greenland).

**Specimens seen** (selected): Ullahamna, 26.7.1926, B. Lynge (O); Kong Karls Land, 11.8.1936, E. Dahl (O).

***Buellia geophila* (Sommerf.) Lynge (1937)**

**Thallus** crustose, white, thick, 1–2 cm wide. **Apothecia** black, slightly convex, up to 1.5 mm diam., sessile. Hymenium 130–140 µm high, uppermost part brownish. Ascospores 8 per ascus, brown, 3-septate, 25–27 × 9–11 µm. Paraphysis end cell enlarged to 4 µm diam.

**Chemistry.** Atranorin.

**Ecology.** Over moribund bryophytes, on calcareous ground.

**Distribution.** Only known from Adventdalen.

**Notes.** Previous reports from Svalbard have proven to be based on misidentifications (Nordin 1996). World distribution: Circumpolar.

**Specimen seen:** Adventdalen, 2002, R. Haugan 6848 (O).

***Buellia insignis*** (Naeg. ex Hepp) Th. Fr. (1860)

**Thallus** crustose, white to yellow-white to greenish-white, areolate, 2–3 cm wide. **Apothecia** up to 0.9 mm wide, black, when young flat with thin proper margin, when old slightly convex with disappearing margin. Hymenium 110–120 µm high; epithecium brown. Ascospores 1-septate, 22–243 × 9–11 µm. Paraphysis end cell enlarged to 3 µm.

**Chemistry.** 1–3 unidentified xanthones.

**Ecology.** On soil and over bryophytes.

**Distribution.** Widespread and common.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O); Adventfjorden, 9.8.1868, Th.M. Fries (O).

***Buellia insularis*** Øvstedal sp. nov.

Thallus dimidiatus, albus, 0.1–0.3 mm latus. Apothecia nigra, sessilia vel 0.5 mm lata. Sporae 8nae, 16–21 × 9–11 µm. Parasita in *Pannaria* et *Vestergrenopsis*.

Holotype: Svalbard, Berzeliusfjell, 21.7.1936, B. Lyng (O).

Fig. 20 (p. 227).

**Thallus** surrounding the apothecia, 0.1–0.3 mm wide, white. **Apothecia** up to 0.5 mm diam., black, lecideine, sessile, flat; exciple slightly protruding. Exciple of *Aethalea*-type, dark throughout. Hymenium 70–80 µm high, brown in uppermost part, N –. Ascospores 8 per ascus, 1-septate, 16–21 × 9–11 µm. Paraphysis end cells 4 µm diam., brown-capped. Medulla K/I –. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** Growing on *Pannaria hookeri* and *Vestergrenopsis* spp.

**Distribution.** Svalbard, endemic, rare.

**Notes.** We have found no reference to this species in Fries (1860, 1867), Scheidegger (1993) or Alstrup & Hawksworth (1990); it is therefore described as a new species.

**Additional specimens seen:** Nordenskiöld Land, Colesdalen, 2002, R. Haugan 6896 (O); Lifdefjorden, Siktefjellet, A. Elvebakk F 132 (TROM).

***Buellia jugorum*** (Arnold) Arnold (1884)

**Thallus** areolate, areolae thick, placodioid, yellow-brown, up to 1 mm broad, coalescing into composite thalli. **Apothecia** black, at first flat with thin proper margin, later slightly convex with margin excluded; up to 0.4 mm diam. Hymenium 50–60 µm high; epithecium brown. Ascospores 8 per ascus, 9–11 × 5–6 µm. Paraphysis end cell enlarged to 4 µm diam.

**Chemistry.** Unidentified xanthone.

**Ecology.** On sandstone.

**Distribution.** Only known from Smeerenburg.

**Notes.** Characterized by its thick, placodioid areolae containing a xanthone, and small apothecia and ascospores. New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Smeerenburg, 8.7.1928, O.A. Høeg (O).

***Buellia leptocline*** (Flotow) Körber (1855)

**Thallus** crustose, rimose, white-grey. **Apothecia** up to 1.2 mm diam., black, sessile; basis constricted; margin prominent. Hymenium 70–80 µm high; epithecium brown. Exciple of *Leptocline*-type. Ascospores 12–16 × 7–8 µm. Conidia bacilliform, 4–5 µm long.

**Chemistry.** Atranorin.

**Ecology.** On perpendicular to overhanging, siliceous rock.

**Distribution.** Only known from Tovedalshaugen and Colesdalnen.

**Note.** World distribution: Europe, Taimyr, North America (including Greenland), Argentina.

**Specimens seen:** Tovedalshaugen, 29.7.1924, J. Lid (O); Colesdalnen, 2002, R. Haugan 6931 (O).

***Buellia papillata*** (Sommerf.) Tuck. (1866)

**Thallus** crustose, white, granulose, up to 3–4 cm wide. **Apothecia** up to 1 mm wide, black, convex when old. Hymenium 90–100 µm high; epithecium brown. Ascospores 25–27 × 10–12 µm, 1-septate.

**Chemistry.** Atranorin.

**Ecology.** On soil and over bryophytes.

**Distribution.** Widespread and fairly common.

**Notes.** Specimens on old bones and antlers (Dicksonfjorden, Biederderffjellet, 3.7.1936, E. Dahl (O)), have distinctly smaller spores (up to 16 µm long). World distribution: Circumpolar, Antarctica.

**Specimens seen** (selected): (Dicksonfjorden, Biederderffjellet, 3.7.1936, E. Dahl (O); Calypso Bay, 1926, B. Lynge (O); Wijdefjorden, A. Elvebakk 01:110 (TROM)).

***Buellia postglacialis*** Hafellner (1982)

Type: Bockfjorden, Hafellner 5354 (GZU!)

**Thallus** crustose, 1–2 cm wide, off-white to pale grey, with a faint ochre tinge, composed of bullate areolae. **Apothecia** up to 0.7 mm wide, numerous, flat, black; margin thin but distinct. Hymenium 90–100 µm high; uppermost part green-brown. Exciple thin, 30 µm wide, of pseudoparenchymatous tissue. Ascospores 8 per ascus, 10–12 × 5–7 µm. Paraphysse end cell slightly enlarged, to 3 µm wide.

**Chemistry.** Norstictic acid, unidentified xanthone (at Rf-class 7–8 in solvent A and B).

**Ecology.** On soil.

**Distribution.** Rare.

**Note.** World distribution: Svalbard (endemic).

**Specimen seen:** Hinlopen [Hinlopenstretet], Kapp Torell, 4.7.1931, P.F. Scholander (O).

***Buellia pulverulenta*** (Anzi) Jatta (1900)

**Thallus** within other lichens. **Apothecia** up to 0.7 mm diam., at first within thallus of host, later emergent, flat, black. Hymenium 55–75 µm high; epithecium brown. Ascospores 15–20 × 6–8 µm.

**Chemistry.** Not performed.

**Ecology.** An endoparasite within members of *Physciaceae* and on *Xanthoria elegans*.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen:** Treurenberg Bay [Sorgfjorden], 1864, Malmgren (O).

### *Buellia subdispersa* Mig. (1924)

**Thallus** as scattered to crowded, white to pale grey, flat areolae, 0.3–0.8 mm wide. Apothecia black, up to 0.4 mm diam., immersed to sessile, flat, without pruina. Hymenium 60–70 µm high; epitheciun brown. Hypothecium brown. Ascospores 8 in ascii, brown, 3-septate, not or slightly constricted at septa, rugulose, 12–14 × 6–7 µm.

**Chemistry.** Negative.

**Ecology.** On limestone.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North and South America.

**Specimen seen:** Prins Karls Forland, 15.8.1868, Th.M. Fries (O).

### *Buellia triphragmioides* Anzi (1868)

**Thallus** within wood, or as a filmy crust. **Apothecia** subglobose, black, up to 1 mm diam. Hymenium 140–150 µm high, without oil droplets. Ascospores 8 per ascus, (1–) 3-septate, 22–30 × 9–11 µm, often curved. Paraphysis end cell enlarged to 5 µm.

**Chemistry.** Not performed.

**Ecology.** On old driftwood.

**Distribution.** Only known from northern Spitsbergen.

**Notes.** Previous reports of *B. disciformis* (Fr.) Mudd (Lynge 1924, 1939) may refer to this species, but no specimens were found in O. New to Svalbard. World distribution: Europe, Taimyr, North America (including Greenland).

**Specimen seen:** Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O).

### *Buellia vilis* Th. Fr. (1867)

**Thallus** within rock. **Apothecia** up to 0.8 mm diam., black, flat; margin distinct. Hymenium 60–80 µm high; uppermost part brown. Exiple of *Vilis*-type. Ascospores 13–15 × 6–8 µm. Hypothecium and excipie strongly amyloid.

**Chemistry.** Not performed.

**Ecology.** On hard rock.

**Distribution.** A few scattered occurrences.

**Notes.** Its excipie of *Vilis*-type and strongly amyloid excipie and hypothecium, as well as lack of thallus characterize this taxon. World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Adventdalen, 28.7.1924, J. Lid (O); Litledalen, 17.8.1926, B. Lynge (O).

**BYSSOLOMA** Trevis. (1853)

**Thallus** crustose, leprose. Photobiont green algae. **Ascomata** apothecia, without thalline margin, true margin sometimes byssoid. Hypothecium red-brown. Hamathecium of paraphyses, simple or branched. Ascii with an amyloid apical dome with a darker blue ring-structure and an amyloid fuzzy coat. Ascospores 8 in ascii, colourless, 3-septate. Conidia bacilliform, obpyriform or claviform. Mainly a tropical to subtropical genus.

Aff. *Byssoloma* sp.

**Thallus** crustose, thin, green-grey, leprose, 1–2 cm wide. **Pycnidia** numerous, half sunk in thallus, black, up to 0.1 mm wide, irregular in outline. Conidia colourless, 3.5–4 × 1.5 µm, bacilliform.

**Apothecia** not seen.

**Chemistry.** Negative.

**Ecology.** On lower side of rock in scree.

**Distribution.** Only found once.

**Notes.** According to E. Sérusiaux (pers. comm. 2006) this specimen belongs in Pilocarpaceae, and is likely a species of *Byssoloma* or *Fellhanera*. There are two other *Byssoloma* species in Scandinavia, i.e. *B. subdiscordans* and *B. marginatum* (see Santesson et al. 2004), but these have obpyriform or claviform conidia (see Sérusiaux 1998); *Fellhanera* has four species in Scandinavia (Santesson et al. 2004); all are restricted to organic material and have obpyriform conidia.

**Specimen seen:** Bjørndalen, 2004, T. Tønsberg 31886 (BG).

**CALOPLACA** Th. Fr. (1860)

**Thallus** usually orange (due to anthraquinones), rarely white or grey, crustose, placodioid; squamulose or invisible (parasitic or endolithic). Phycobiont trebouxioid. **Ascomata** apothecia, thalline exciple present or absent. True exciple usually well-developed, not carbonized. Hypothecium colourless. Hamathecium of paraphyses, simple to branched; end cell often enlarged. Ascii of *Teloschistes*-type, usually 8-spored. Ascospores polarilocular or very rarely simple. Conidia ellipsoid.

**Note.** A large and difficult genus, with cosmopolitan distribution.

Key to *Caloplaca* on Svalbard:

1	Growing on silty soil.....	<i>C. tominii</i>
1	Growing on rock or organic material.....	2
2 (1)	Growing on rock .....	3
2	Growing on organic material .....	25
3 (2)	Isidiate or sorediate .....	4
3	Not isidiate or sorediate .....	7

4 (3)	With isidia .....	<i>C. verruculifera</i>
4	With soralia .....	5
5 (4)	Thallus placodioid .....	<i>C. decipiens</i>
5	Thallus crustose .....	6
6 (5)	Thallus peltate.....	<i>C. soropelta</i>
6	Thallus not peltate.....	<i>C. elvebakkiana</i>
7 (3)	Thallus placodioid.....	8
7	Thallus crustose .....	13
8 (7)	Inland species.....	9
8	Species of sea cliffs.....	12
9 (8)	Thallus with long marginal lobes.....	10
9	Thallus bullate-squamulose; marginal lobes short.....	<i>C. paulii</i>
10 (9)	Cortex prosoplechtenchymateous .....	<i>C. trachyphylla</i>
10	Cortex pseudoparenchymateous .....	11
11 (10)	Lobe ends flat; ascospore septa 1.5 µm thick.....	<i>C. scopularis</i>
11	Lobe ends truncate; ascospore septa 3–4 µm thick .....	<i>C. saxicola</i>
12 (8)	Thallus with well differentiated marginal lobes .....	<i>C. scopularis</i>
12	Thallus without well differentiated marginal lobes .....	<i>C. alcarum</i>
13 (7)	Thallus whitish, grey or black.....	14
13	Thallus orange or lacking .....	15
14 (13)	Disc ferrugineus red; thallus scabrose .....	<i>C. scabrosa</i>
14	Disc brown to black; thallus smooth .....	<i>C. variabilis</i>
15 (13)	Parasitic.....	16
15	Not parasitic .....	21
16 (15)	On <i>Aspicilia</i> .....	17
16	On other genera.....	19
17 (16)	Apothecia blood-red.....	<i>C. coccinea</i>
17	Apothecia orange .....	18
18 (17)	Ascospores 9–13 µm long .....	<i>C. insularis</i>
18	Ascospores 15–16 µm long .....	<i>C. invadens</i>
19 (16)	On <i>Miriquidica nigroleprosa</i> .....	<i>C. magnii-fili</i>
19	On other genera.....	20
20 (19)	On <i>Rhizoplaca</i> and <i>Dimelaena</i> .....	<i>C. epithallina</i>
20	On <i>Placynthium</i> .....	<i>C. castellana</i>
21 (15)	Septum thin .....	22
21	Septum thick (more than 3 µm) .....	23

22 (21)	Ascospores up to 11 µm long.....	<i>C. approximata</i>
22	Ascospores longer than 11.5 µm.....	<i>C. fraudans</i>
23 (21)	Disc green to brown to blackish.....	<i>C. exsecuta</i>
23	Disc orange to rusty red .....	24
24 (23)	Apothecia rusty red.....	<i>C. fuscorufa</i>
24	Apothecia orange .....	<i>C. holocarpa</i>
25 (2)	Thallus completely composed of ecarticate granules .....	<i>C. xanthostigmoidea</i>
25	At least part of the thallus with cortex .....	26
26 (25)	Thallus sorediate .....	<i>Caloplaca alaskensis</i>
26	Thallus not sorediate .....	27
27 (26)	Exclusively growing on <i>Andreaea</i> and <i>Grimmia</i> .....	28
27	Growing on other substrates .....	29
28 (27)	Ascospores 27–32 µm long .....	<i>C. nivalis</i>
28	Ascospores 16–19 µm long .....	<i>C. tornoenensis</i>
29 (27)	On driftwood and plant detritus .....	30
29	On bryophytes .....	36
30 (29)	Disc reddish brown .....	31
30	Disc yellow to orange yellow to black .....	32
31 (30)	Apothecia up to 0.5 mm diam. ....	<i>C. caesiorufella</i>
31	Apothecia 0.5–0.7 mm diam. ....	<i>C. spitsbergensis</i>
32 (30)	Disc yellow to black.....	33
32	Disc orange to orange yellow .....	34
33 (32)	Margin darker than disc .....	<i>C. cerina</i>
33	Margin concolorous with disc .....	<i>C. celata</i>
34 (32)	Margin grey .....	<i>C. jemtlandica</i>
34	Margin yellow-orange .....	35
35 (34)	Ascospores 11–13 µm long .....	<i>C. pyracea</i>
35	Ascospores 16–18 µm long .....	<i>C. sibirica</i>
36 (29)	Thalline margin greyish; disc orange.....	<i>C. cerina</i>
36	Thalline margin orange, brown etc., not greyish .....	37
37 (36)	Disc and margin yellow to orange .....	38
37	Disc and margin rusty red to ferruginous red.....	40
38 (37)	Apothecia to 1.5 mm diam.; spore septum very thin .....	<i>C. jungermanniae</i>
38	Apothecia to 1 mm; spore septum well-developed.....	39
39 (38)	Ascospores 10–12 µm long; on <i>Saxifraga oppositifolia</i> .....	<i>C. saxifragarum</i>
39	Ascospores 15–17 µm long; on other substrates .....	<i>C. tirolensis</i>
40 (37)	Ascospores 4 per ascus .....	<i>C. tetraspora</i>
40	Ascospores 8 per ascus .....	41

41 (40)	Ascospores 19–23 µm long .....	<i>C. sinapisperma</i>
41	Ascospores 15–17 µm long .....	42
42 (41)	Apothecia 1 mm broad .....	<i>C. ammiospila</i>
42	Apothecia 0.2–0.3 mm broad .....	<i>C. phaeocarpella</i>

***Caloplaca alaskensis*** Wetmore (2004)

**Thallus** as scattered, minute, dark grey, sorediate areolae, 0.3–0.8 mm wide. Soralia orange, convex; soredia coarse, disrupting from centre of areolae. **Apothecia** not seen in our material.

**Chemistry.** Anthraquinones.

**Ecology.** On dead stem of *Dryas*, old bones, and driftwood.

**Distribution.** Scattered

**Note.** World distribution: Europe, North America.

**Specimens seen:** Kapp Wijk, July 1973, A.A. Frisvoll (TRH); Edgeøya, between Rosenbergdalen and Kapp Lee, 6.8.1936, E. Dahl (O).

***Caloplaca alcarum*** Poelt (1954)

**Thallus** 2–10 mm wide, mostly covered by apothecia but appearing as minute marginal lobes, up to 0.5 mm long and equally broad, orange. **Apothecia** crowded, up to 2.5 mm diam.; disc flat to slightly convex, orange, smooth, margin slightly elevated, somewhat paler than disc. Hymenium 50–60 µm high, epipsamma medium coarse. Ascospores 8 per ascus, 10–16 × 4–6 µm, septum 4–5.5 µm broad. Paraphysis end cells inflated, to 4 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On coastal cliffs strongly manured by birds.

**Distribution.** Widespread.

**Notes.** *C. alcarum* is characterized by its small pulvinate thalli almost completely covered by apothecia, and also its habitat: strongly manured sea-shore cliffs, where it grows together with species such as *Arctopeltis thuleana* and *Rhizoplaca melanophthalma*. World distribution: Europe, Taimyr, North America (incl. Greenland).

**Specimens seen** (selected): Lernerøyane, Liefdefjorden, A. Elvebakk 81:824; 81:1321 (TROM).

***Caloplaca ammiospila*** (Wahlenb.) H. Olivier (1909)

**Thallus** weakly developed, within wood or superficial as grey granules. **Apothecia** up to 1 mm diam.; disc ferruginous red to black, concave to plane; margin prominent, grey to orange, concolorous with disc. Hymenium 90–100 µm high, with coarse epipsamma. Ascospores often less than 8 per ascus, 15–17.5 × 6.5–9 µm; septum 4–6.5 µm broad. Paraphysis end cells to 3 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On driftwood and mosses.

**Distribution.** Widespread and common.

**Notes.** *C. ammiospila* is characterized by its ferruginous red to black discs with concolorous margin. Extreme forms of *C. cerina* may appear similar, but a grey margin will be found in sheltered apothecia. Also extreme forms of *C. tirolensis* may be similar, but the yellow-orange colour typical

of the latter species is developed at least in sheltered places. World distribution: Circumpolar, New Zealand, Antarctica.

**Specimens seen** (selected): Gipsdal, A. Elvebakk 85:610 (TROM); Amsterdamøya, 1.8.1936, E. Dahl (O).

***Caloplaca approximata* (Lynge) H. Magn. (1946)**

**Thallus** within rock. **Apothecia** up to 1.5 mm diam., constricted at base; disc flat to somewhat convex, orange; margin thin but protruding, more yellow than disc. Hymenium 45–50 µm high; episamma medium coarse. Ascospores 8 per ascus, 8–11 × 3.5–4.5 µm; septum a very thin wall. Paraphysis end cell 4–6 µm thick.

**Chemistry.** Anthraquinones.

**Ecology.** On nutrient-rich stone.

**Distribution.** A few scattered occurrences.

**Notes.** Characterized by its saxicolous habit, lack of epilithic thallus, orange discs, and very thin septa in the ascospores. World distribution: Europe, Siberia, North America (including Greenland), Antarctica.

**Specimen seen:** Nordenskiöld Land, Longyearbyen, 2003, A. Elvebakk 03:046 (TROM).

***Caloplaca caesiorufella* (Nyl.) Zahlbr. (1931)**

**Thallus** within wood. **Apothecia** up to 0.5 mm diam., sessile; disc flat, reddish brown; margin thin, finally level with and concolorous with disc. Hymenium 50–60 µm high; episamma fine. Ascospores 8 per ascus, 12–15 × 5–6 µm; septum 4–6.5 µm broad. Paraphysis end cell up to 5.5 µm broad.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood.

**Distribution.** Rare.

**Notes.** Among the species on old driftwood, *C. caesiorufella* is characterized by the reddish brown discs, the small apothecia and ascospores, and the margins that are concolorous or lighter than the disc. World distribution: Europe, North America (including Greenland).

**Specimen seen:** No specimen seen; included on the basis of Søchting et al. (2008).

***Caloplaca castellana* (Räsänen) Poelt (1978)**

**Thallus** as scattered, round orange-yellow to orange brown areolae, up to 1 mm wide. **Apothecia** sessile, up to 1 mm diam.; disc flat to slightly convex, orange brown; margin distinct, slightly protruding, concolorous with disc. Hymenium 65–70 µm high; episamma medium coarse. Ascospores 8 per ascus, 11–14 × 6–8 µm; septum 2.5–3.5 µm broad. Paraphysis end cell to 5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** Parasitic on other lichens, especially *Placynthium* spp.

**Distribution.** A few scattered occurrences.

**Notes.** This species is characterized by being parasitic on other lichens, especially lichens with cyanobacteria, orange brown apothecia and areolae, and relatively large ascospores. World distribution: Europe, North America (including Greenland), sub-Antarctic islands.

**Specimens seen:** Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:076 (TROM); Gipsdal, Aug. 1987, D.O. Øvstdal (BG).

*Caloplaca celata* Th. Fr. (1871)

**Thallus** within substrate, or very thin, greyish. **Apothecia** lecanorine, up to 0.9 mm diam., sessile, strongly constricted below, disc plane, black, smooth, often faintly white pruinose; margin distinct and persistent, black, usually violet pruinose. Hymenium 60–70 µm high, uppermost part violet and with crystals. Ascospores 8 in ascii, broadly ellipsoid, 14–17 × 6–8 µm, septum 5–7 µm.

**Chemistry.** Anthraquinones (K + violet).

**Ecology.** Lignum, dead plant remains, old bones.

**Note.** World distribution: Europe, North America (including Greenland)

**Specimen seen:** none seen; species included on basis of Søchting et al. (2008).

*Caloplaca cerina* (Ehrh. ex Hedw.) Th. Fr. (1860)

**Thallus** as a thin whitish to grey crust, or within wood. **Apothecia** sessile to almost stipitate, lecanorine, up to 1.3 mm diam.; disc yellow to orange, sometimes becoming almost black, slightly concave to flat; margin thick, grey to blackish, finally level with disc. Hymenium 60–70 µm; epipsamma fine. Ascospores 8 per ascus, 14–16 × 6–8 µm; septum 5.5–6.5 µm. Paraphysis end cell inflated to 5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** Over bryophytes and on old driftwood.

**Distribution.** Widespread and common.

**Notes.** One of the most common muscicolous species, characterized by its prominent grey margin darker than the disc, and ascospores with a broad septum. World distribution: Circumpolar, southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Ny-Ålesund, 5.7.1936, E. Dahl (O); Gipsdalen, A. Elvebakk, 85:316 (TROM).

*Caloplaca coccinea* (Müll.Arg.) Poelt (1958)

**Thallus** in host species. **Apothecia** up to 0.8 mm diam., carmine red; disc flat; margin thin. Hymenium 60–70 µm high; epipsamma coarse. Ascospores 8 per ascus, 11–15 × 7–8 µm, septum 3–5 µm broad.

**Chemistry.** Anthraquinones.

**Ecology.** Lichenicolous on *Aspicilia* spp.

**Distribution.** Rare.

**Notes.** No other *Caloplaca* species on Svalbard has carmine-red apothecia. World distribution: Europe.

**Specimens seen:** None seen; included on the basis of Søchting et al. (2008).

*Caloplaca decipiens* (Arn.) Blomb. & Forss. (1880)

**Thallus** placodioid, 2–3 cm wide, yellow-orange, at margin with radiating lobes up to 0.5 mm broad, in inner part areolate, sorediate. Soralia mostly laminal. **Apothecia** not seen in Svalbard material.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone heavily manured by birds; thermophilic.

**Distribution.** A few scattered occurrences.

**Notes.** The only placodioid *Caloplaca* species on Svalbard with soralia. World distribution: Europe, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Lyckholmdalen, 9.7.1936, E. Dahl (O); Gipsdal, 1987, D.O. Øvstdal (BG).

### *Caloplaca elvebakkiana* Søchting, Lorentsen & Arup (2008)

**Thallus** crustose, 1–2 cm wide, composed of scattered areolae, yellowish to pale orange, 0.3–0.5 mm wide, with irregular outline, convex, sometimes effigurate, sorediate. Soralia marginal, developing from lower side, sometimes helmet-shaped, often spreading inwards. No apothecia in the material seen by us.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone or Ca-rich rock.

**Distribution.** Fairly common.

**Notes.** Differs from the other non-placodioid sorediate *Caloplaca* on rock, *C. soropelta*, in its areolae, which are not peltate. World distribution: Svalbard endemic (Søchting et al. 2008).

**Specimens seen** (selected): Svalbard, Bellsund, Calypsobyen, 3.7.1936, E. Dahl (O); Nordkysten, Moffen, 26.8.1936, E. Dahl (O).

### *Caloplaca epithallina* Lynge (1940)

**Thallus** within other lichens. **Apothecia** up to 1 mm diam., disc flat, rusty red to almost black; margin prominent, concolorous with disc or sometimes darker. Hymenium 55–60 µm high, epipsamma coarse. Ascospores 8 per ascus, 11–13 × 7–8 µm; septum 2–3.5 µm broad. Paraphysis end cells inflated to 5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** Parasitic on *Rhizoplaca melanophthalma*, *Dimelaena oreina* and a few other species.

**Distribution.** Only known from Wijdefjorden.

**Notes.** The rust-red apothecia and choice of host species is characteristic. *C. castellana* which is fairly similar, always has some thallus areolae, and different host species. World distribution: Europe, Taimyr, North America (including Greenland).

**Specimen seen:** Wijdefjorden, A. Elvebakk 01:237 (TROM, on *Dimelaena oreina*).

### *Caloplaca exsecuta* (Nyl.) Dalla Torre & Sarnth. (1902)

**Thallus** within wood or rock. **Apothecia** up to 0.3 m wide, sessile, lecideine to biatorine. Disc flat, black with a yellowish tinge. Margin thick, black. Hymenium 60–65 µm high; epipsamma coarse. Ascospores 8 per ascus, 13–18 × 6.5–7 µm; septum 2–3 µm. True excipio well developed, in upper part with an emerald green pigment, K –.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood and on rock, avoiding limestone and the most acidic rock types.

**Distribution.** Rare.

**Notes.** Its lack of thallus, black apothecia and emerald green pigment in upper part of the true excipio are characteristic. World distribution: Europe, North America (including Greenland).

**Specimens seen:** None seen; included on the basis of Søchting & Olech (1995).

*Caloplaca fraudans* (Th. Fr.) Oliver (1909)

**Thallus** up to several cm diam., within wood or as dark grey areolae. **Apothecia** up to 1.2 mm diam., lecanorine, sessile; disc flat to slightly convex, dark brownish orange. Margin thick, bright orange, always contrasting with the darker disc. Hymenium 50–70 µm high; epipsamma fine. Ascospores 8 per ascus, 14.5–16 × 5–6 µm; septum 2.5–3 µm. Paraphysis end cell slightly inflated, to 2.5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood and on eutrophiated rock.

**Distribution.** Rare.

**Notes.** This species is characterized by its brownish orange disc with distinctly paler margins, and thin ascospore septum. World distribution: Europe, Taimyr, North America (Greenland).

**Specimen seen:** Sørkapp, J.Nowak KRAM-L-12393 (as *C. arenaria*)

*Caloplaca fuscorufa* H. Magn. (1945)

**Thallus** as ± thick, whitish to grey areolae up to 1.8 mm diam. **Apothecia** adnate to sessile, biatorine, with algae at base; disc slightly concave to strongly convex, dark orange to red orange in young ones, later ferruginous brown to dark brown, often with orange pruina. True margin distinct in young apothecia, later often excluded, concolorous with disc or darker, sometimes black. Hymenium 50–100 µm high, usually inspers; uppermost part with green pigment. Ascospores 8 in ascii, broadly elliptic, 14–18 × 7–9 µm; septum 4–7 µm. Paraphysis end cell enlarged to 4 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On rock, both acidic and calciferous.

**Distribution.** Widespread.

**Note.** World distribution: Europe.

**Specimens seen:** None seen; included on basis of Søchting et al. (2008).

*Caloplaca holocarpa* (Hoffm.) A.E. Wade (1965)

**Thallus** as small areolae around apothecia, yellow-orange. **Apothecia** up to 0.5 mm broad; disc flat to slightly convex, orange. Margin thin, regular, paler than disc. Hymenium 70–80 µm high; epipsamma fine. Ascospores 8 per ascus, 10–14 × 5–7 µm; septum 2.5–3.5 µm broad. Paraphysis end cells 4–5 µm diam.

**Chemistry.** Anthraquinones

**Ecology.** Ornithocoprophilic, on hard rock, non-maritime.

**Distribution.** Only known from Velkomstpynten.

**Notes.** Characterised by the very small (or absent) thallus, the orange apothecia and the fairly broad septa of the ascospores, in addition to the habitat. World distribution: Circumpolar, southern South America, Australia, New Zealand, Antarctica.

**Specimen seen:** Velkomstorten [Velkomstpynten], 26.8.1936, E. Dahl (O).

*Caloplaca invadens* Lyngé (1928)

**Thallus** as minute, scattered, orange areolae. **Apothecia** up to 0.8 mm diam., flat, lecanorine; true exciple indistinct, concolorous with disc; lecanorine margin thin, paler than disc; disc orange. Hy-

menium 60–70 µm high; epipsamma medium coarse. Paraphysse end cells inflated, to 4 µm diam. Ascospores 8 per ascus, 15–16 × 8–9 µm; septum 6–7 µm broad.

**Chemistry.** Anthraquinones.

**Ecology.** Parasitic on *Aspicilia heteroplaca*.

**Distribution:** Only known from Ossian Sarsfjellet.

**Note.** World distribution: North America (incl. Greenland) and northern Europe.

**Specimen seen:** Kongsfjorden, Ossian Sarsfjellet, on S-facing rather dry rock, alt. 50 m, 2003, A. Elvebakk 03:109 (TROM; det U. Søchting).

### *Caloplaca jemtlandica* H. Magn (1954)

**Thallus** several cm wide, dark grey. **Apothecia** up to 0.6 mm wide, substipitate; thalline margin distinct, dark grey, white-pruinose; disc flat, orange. Hymenium 55–60 µm high; epipsamma fine. Ascospores 8 per ascus, 12–14 × 6–7 µm; septum 4–6 µm. Cortex of apothecia 30–40 µm thick, of pseudoparenchymateous tissue.

**Chemistry.** Anthraquinones.

**Ecology.** On dead stem of *Dryas*.

**Distribution.** Only known from Kapp Wijk.

**Notes.** This specimen conforms with the description of *C. jemtlandica* from Greenland in Hansen et al. (1987). New to Svalbard. World distribution: Europe, North America (Greenland).

**Specimen seen:** Kapp Wijk, July 1973, A.A. Frisvoll (TRH).

### *Caloplaca jungermanniae* (Vahl) Th. Fr. (1860)

**Thallus** weakly developed, whitish as a thin crust. **Apothecia** up to 2 mm broad, restricted below; disc flat to slightly convex, orange yellow to brownish orange; margin thin, orange close to disc, otherwise greyish. Hymenium 80–100 µm high; epipsamma coarse. Ascospores 8 per ascus, 16–21 × 7–8 µm; septum weakly developed, 1–2 µm.

**Chemistry.** Anthraquinones.

**Ecology.** Over bryophytes on neutral to weakly acidic soil.

**Distribution.** A few scattered occurrences.

**Notes.** Among the muscicolous species with orange discs, this one is characterised by its large apothecia and ascospores, and with a weakly developed ascospore septum. World distribution: circumpolar.

**Specimen seen:** Barentsøya, 1.8.1936, E. Dahl (O).

### *Caloplaca magni-filii* Poelt (1958)

**Thallus** within host species. **Apothecia** up to 0.4 mm broad; disc flat, rust-red to orange-red; margin at first distinct, later almost excluded, in inner part concolorous with disc, in outer part greyish. Hymenium 55–60 µm high; epipsamma medium coarse. Ascospores 8 per ascus, 10–12 × 5–6 µm, septum 2.5–4 µm broad. Paraphysse end cells only little enlarged.

**Chemistry.** Anthraquinones.

**Ecology.** Parasitic in *Miriquidica nigroleprosa*

**Distribution.** Rare.

**Notes.** Mainly characterized by its host species. World distribution: Europe, North America (including Greenland).

**Specimens seen:** None seen; record based on material from Amsterdamøya cited by Hertel & Ullrich (1976).

*Caloplaca nivalis* (Körber) Th. Fr. (1871)

**Thallus** indistinct, as a thin whitish crust over bryophytes. **Apothecia** up to 0.5 mm broad, sessile, variable from lecideine to lecanorine. Disc flat to slightly convex, brownish orange, in exposed places olive green to blackish. Margin thin, at first brownish orange, later greenish to blackish. Hymenium 70–80 µm high, epipsamma coarse. Ascospores 8 per ascus, simple, 27–32 × 4–5.5 µm. Paraphysis end cell only slightly enlarged.

**Chemistry.** Anthraquinones.

**Ecology.** On mosses of the genera *Andreaea* and *Grimmia*.

**Distribution.** Rare.

**Notes.** Characterized by its long ascospores without septum and restriction to the moss genera *Andreaea* and *Grimmia*. World distribution: Europe, Taimyr, North America (including Greenland).

**Specimens seen:** None seen; included on basis of Søchting & Olech (1995).

*Caloplaca paulii* Poelt (1954)

**Thallus** as dispersed to agglomerate areolae; each up to 1 mm diam., orange-yellow, strongly convex. **Apothecia** almost covering thallus, up to 1 mm diam., zeorine; disc flat to slightly convex, orange to orange-brown; margin somewhat paler, little prominent. Cortex of thalline excipie composed of irregularly oriented hyphae. Hymenium 50–60 µm; epipsamma medium coarse. Ascospores 8 per ascus, 13–15 × 6–8 µm; septum 1–2 µm broad. Paraphysis end cells inflated to 5–6 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone, non-maritime, non-ornithocoprophilous.

**Distribution.** Only known from Akseløya and Dicksonfjorden.

**Notes.** Characterized by its strongly convex aeolae, orange colour, type of cortex of apothecia and thin septum of the ascospores. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimens seen:** Axeløya [Akseløya], 21.8.1926, B. Lynge (O); Dicksonfjorden 16.7.1936, E. Dahl (O).

*Caloplaca phaeocarpella* (Nyl.) Zahlbr. (1931)

**Thallus** within wood. **Apothecia** sessile, up to 0.5 mm diam. Disc at first concave, later slightly convex, black, at first with a yellow tinge, later with a reddish tinge. Margin prominent, becoming level with disc, black. Hymenium 55–60 µm high, with coarse epipsamma. Ascospores 8 per ascus, 15–17 × 7–8.5 µm, septum 3–8 µm broad. Paraphysis end cells inflated to 4 µm diam. A brown, K – pigment, is found in true excipie and in the paraphyses.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood and plant detritus.

**Distribution.** Rare.

**Notes.** Characterized by its lack of thallus, black apothecia, and brown pigment in upper

part of the true exciple. World distribution: Europe, Siberia, North America (including Greenland), Antarctica.

**Specimens seen:** None seen; included on basis of Søchting (1989).

*Caloplaca pyracea* (Ach.) Th. Fr. (1871) s. lat.

**Thallus** within wood. **Apothecia** broadly sessile, up to 0.8 mm diam., zeorine. Disc flat, orange yellow to yellow. True margin thin, slightly paler than disc, level with disc. Thalline margin usually hidden below true margin, greenish. Hymenium 40–60 µm high, with fine epipsamma. Ascospores 8 per ascus, 11–13 × 5–6.5 µm; septum 3–4 µm broad. Paraphysse end cell inflated to 5.5 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood.

**Distribution.** Rare.

**Notes.** Characterized by its growth on old driftwood, orange to yellow discs and small ascospores. World distribution: Europe, Asia, North America (Greenland), and the subantarctic Heard Island (McCarthy 2008).

**Specimens seen:** None seen, included on basis of Søchting (1989).

*Caloplaca saxicola* (Hoffm.) Nordin (1972)

**Thallus** placodioïd, up to 2–3 cm diam., with radiating lobes, lobes convex, to 0.4 mm diam., with a truncate apex. **Apothecia** up to 1 mm diam., sessile, lecanorine; disc at first concave, becoming flat, orange, concolorous with thallus; margin prominent, orange. Hymenium 60–70 µm high; epipsamma fine. Ascospores 8 per ascus, 12–13 × 6–7 µm, septum 3–4 µm broad. Paraphysse end cells inflated to 6 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** Ornithocoprophilous, non-maritime, on rock, rarely on wood.

**Distribution.** Widespread and common.

**Notes.** Externally rather similar to *Xanthoria elegans*, but differs from the latter by truncate lobe ends and lack of a proper lower cortex. *C. trachyphylla* has non-truncate lobe ends, and very thin ascospore septa. World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Krossfjorden, Signehamna, A. Elvebakken 85:297; 85:342 (TROM).

*Caloplaca saxifragarum* Poelt (1955)

**Thallus** evanescent. **Apothecia** up to 0.5 mm diam., yellow-orange, slightly convex; margin thin, concolorous with disc. Hymenium 45–50 µm high, epipsamma medium coarse. Ascospores 8 per ascus, 9–11 × 5–7 µm, septum 3.5–4 µm broad. Paraphysse end cell enlarged to 2.5 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On dead *Saxifraga oppositifolia*.

**Distribution.** A few scattered occurrences.

**Notes.** Close to *C. tirolensis*, but differs in its smaller ascospores. World distribution: Europe, Siberia, North America (Greenland).

**Specimens seen** (selected): Krossfjorden, Gluudneset, A. Elvebakken 85:218 (TROM); Nordfjorden Ø, Kapp Wijk, near Oxaashytta 30.6.1973, A.A. Frisvold (TRH).

***Caloplaca scabrosa*** Søchting, Lorentsen & Arup (2008)

**Thallus** crustose, rimose-areolate, to 2 cm diam., dirty white to greyish, exposed parts blackened, rough and scabrous. **Apothecia** biatorine, with algae at the base, up to 1.2 mm diam., semi-immersed to sessile, disc plane to convex, ferruginous brown to ferruginous red, occasionally with a blackish tinge; margin prominent, concolorous with or darker than disc. Hymenium 60–90 µm. Ascospores 6–8 in ascii, ellipsoid to broadly ellipsoid, 14–16 × 6–8 µm, septum 4–5 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On sandstone, exposed or partly shaded.

**Distribution.** Only known from Reindalen.

**Note.** World distribution. Known only from Svalbard, see Søchting et al. (2008).

**Specimens seen:** Nordenskiöld Land, Reindalen, near Sørhytta, 1986, T. Tønsberg 9877 (BG; det. Søchting 2008).

***Caloplaca scopularis*** (Nyl.). Lettau (1912)

**Thallus** placodioid, up to 6 mm diam., yellow-orange, lobes radiating, up to 2 mm long and 0.2–0.3 mm broad; ends slightly fan-shaped, in inner part thallus more areolate, with apothecia. **Apothecia** sessile, up to 0.7 mm wide, flat; margin indistinct, level with disc, somewhat paler than disc; disc orange. Hymenium 60–70 µm; epipsamma medium coarse. Ascospores 8 per ascus, 11–13 × 4–6 µm, septum 3–4 µm broad. Paraphysis end cells enlarged to 3 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On littoral rocks.

**Distribution.** Rare.

**Notes.** Characterized by its placodioid growth form, lack of soralia and isidia and by being restricted to littoral rocks. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** None seen; included on basis of Søchting & Olech (1995).

***Caloplaca sibirica*** H. Magn. (1952)

**Thallus** within wood. **Apothecia** up to 0.9 mm diam., zeorine. Disc at first flat, later slightly convex, orange yellow. Margin prominent, a little paler than disc. Hymenium 70–80 µm high; epipsamma medium coarse. Ascospores 8 per ascus, 16–18 × 7–9 µm. Septum 3–6 µm broad. Paraphysis end cells inflated, to 6.5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On old driftwood.

**Distribution.** Rare.

**Notes.** Close to *C. tirolensis*, with which it sometimes grows, but differs in the more orange discs and different structure of the hypothecium. World distribution: Europe, Siberia.

**Specimens seen:** None seen; included on basis of Søchting (1989).

***Caloplaca sinapisperma*** (Liam & DC.) Maheu & Gillet (1914)

**Thallus** thin, scale-like, up to 2 cm diam., white to greyish. **Apothecia** lecanorine, up to ca 0.6 mm diam., sessile, constricted below, becoming strongly convex, disc red-brown, sometimes almost black, rough; margin soon disappearing, concolorous with disc. Hymenium 100–120 µm high, epipsamma

medium fine. Ascospores 8 in ascii, broadly ellipsoid,  $19-22 \times 8-12 \mu\text{m}$ , septum  $2.5-4 \mu\text{m}$ .

**Chemistry.** Anthraquinones.

**Ecology.** On moribund bryophytes, on calcareous soil.

**Notes.** Fairly similar to *C. tetraspora*, but differs mainly in its 8-spored ascii. World distribution: Europe, Siberia, North America (incl. Greenland).

**Specimens seen:** None seen, included on basis of Søchting et al. (2008).

### *Caloplaca soropelta* (E.S. Hansen, Poelt & Søchting) Søchting (1989)

**Thallus** of crowded to dispersed, irregular squamules, up to 1 m diam., orange-yellow, peltate, sorediate. Soralia on margin of lower surface. Soredia  $20-30 \mu\text{m}$  diam. **Apothecia** very rare, lecanorine to zeorine, sessile, centrally on squamules, up to 0.6 mm diam. Disc concave to flat, orange. Margin distinct, concolorous with disc, sorediate in outer part. Ripe ascospores not found.

**Chemistry.** Anthraquinones.

**Ecology.** Ornithocoprophilous, on calcareous rock.

**Distribution.** A few scattered occurrences.

**Notes.** Among the sorediate species, *C. soropelta* is characterised by its peltate areolae with soralia arising from lower parts of margins. World distribution: Svalbard, North America (Greenland).

**Specimen seen** (selected): Mitterhuken [Midterhuken], 5.8.1926, B. Lynge (O).

### *Caloplaca spitsbergensis* H. Magn. (1944)

**Thallus** in substrate; sometimes small greyish areolae occur. **Apothecia** lecanorine to biatorine, up to 1 mm diam., strongly consticted below; disc at first plane, becoming convex, ferruginous red to dark brown, rough; margin at first distinct, becoming indistinct, grey. Hymenium  $60-70 \mu\text{m}$  high. Ascospores 8 in ascii, narrowly ellipsoid,  $13-15 \times 3.5-6 \mu\text{m}$ , septum  $3.5 \times 4 \mu\text{m}$ . Paraphysse end cell enlarged up to  $5 \mu\text{m}$  diam.

**Chemistry.** 7-chloroemodin, emodin, parietin, 1-O-methyl-7-chloroemodin, 7-chloro-1,6,8-trihydroxy-3-methyl-10-anthrone, 7-chlorocitroreosein, 7-chloroemodinal (Elix et al. 2000).

**Ecology.** On driftwood.

**Distribution.** A few scattered occurrences.

**Notes.** Differs from the very similar *C. ammiospila* in its smaller and mostly more convex apothecia, and smaller ascospores. There are also chemical differences (Søchting et al. 2008). World distribution: Europe, Siberia, North America (including Greenland).

**Specimen seen:** Nordaustlandet, Duvefjord [Duvefjorden], 16.8.1936, E. Dahl (O).

### *Caloplaca tetraspora* (Nyl.) H. Olivier (1909)

**Thallus** indistinct, as a greyish crust. **Apothecia** up to 1.5 mm diam., lecanorine, at first flat, later strongly convex; disc rusty red to rusty brown; margin thin, later excluded. Hymenium  $100-120 \mu\text{m}$  high; epipamma coarse. Ascospores 4 per ascus,  $22-28 \times 14-20 \mu\text{m}$ ; septum 1-2  $\mu\text{m}$  broad.

**Chemistry.** Anthraquinones.

**Ecology.** Over bryophytes.

**Distribution.** Widespread and common.

**Notes.** Its strongly convex, rusty-coloured apothecia and 4-spored ascii makes this species easy to recognize. World distribution: Circumpolar, Antarctica.

**Specimens seen** (selected): Nordre Norskøy [Ytre Norskøya], 19.7.1928, O.A. Høeg (TRH); Kongsfjorden, Ossian Sarsjellet, 2003, A. Elvebakk 03:123 (TROM).

***Caloplaca tiroliensis*** Zahlbr. (1909)

**Thallus** indistinct, as a whitish to grey crust. **Apothecia** up to 1 mm diam., yellow-orange; disc flat, margin prominent, concolorous with disc. Hymenium 70–80 µm high; epipsamma coarse. Ascospores 8 per ascus, 15–17 × 7–10 µm, septum 3–6 µm broad. Paraphysis end cell inflated to 6 µm.

**Chemistry.** Anthraquinones.

**Ecology.** Over bryophytes and on old driftwood.

**Distribution.** Widespread and common.

**Notes.** *C. tiroliensis* is one of the most common lichens of Svalbard, distinguished by its occurrence on mosses and lignum, lack of thallus and yellow to orange-yellow discs. For difference against *C. sibirica*: see below the latter. World distribution: Circumpolar, Antarctica.

**Specimens seen** (selected): Adventdalen [Hiorthamn] 24.7.1936, E. Dahl (O); Amsterdamøya, 26.8.1936, E. Dahl (O).

***Caloplaca tominii*** Savicz (1930)

**Thallus** as a few adjoined areolae, subplacodioïd, yellow-orange, sorediate. Marginal areolae sometimes elongated. Individual areolae to 1.5 mm wide; aggregations to 5 mm wide. Soralia laminal, yellow. **Apothecia** not seen in Svalbard material.

**Chemistry.** Anthraquinones.

**Ecology.** On calcareous silt.

**Distribution.** Rare.

**Notes.** The combination of habitat demands, subplacodioïd growth form and soralia makes this species unique among the Svalbard *Caloplaca* species. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** None seen; included on basis of Søchting (1989).

***Caloplaca tornoënsis*** H. Magn. (1944)

**Thallus** thin, indistinct, white-grey. **Apothecia** up to 0.5 mm broad; margin distinct, finally blackish; disc flat, orange-brown. Hymenium 70–80 µm high; epipsamma coarse. Ascospores 8 per ascus, narrowly elliptic, 16–19 × 6–8 µm, septum distinct, 1–2 µm thick.

**Chemistry.** Anthraquinones.

**Ecology.** Growing on *Andreaea* and *Grimmia* spp.

**Distribution.** Rare.

**Notes.** Externally similar to *C. nivalis*, but differs in its ascospore characters. World distribution: Europe, Taimyr, North America (including Greenland), New Zealand.

**Specimens seen:** None seen; included on basis of Søchting (1989).

*Caloplaca trachyphylla* (Tuck.) Zahlbr. (1931)

**Thallus** placodioid, 4–5 cm diam., orange; lobes radiating, ramified, convex, with an uneven-buckled surface. Upper cortex distinct, 30–35 µm high, prosoplectenchymateous, with strongly swollen hyphae with small lumina. Lower cortex lacking. Inner part of thallus areolated. **Apothecia** sessile, up to 0.9 mm diam., flat to slightly concave; disc orange; thalline margin thin to evanescent, paler than disc. Hymenium 70–80 µm high; epipsamma medium coarse. Ascospores 8 per ascus, narrowly elliptic, 11–13 × 3.5–4.5 µm; septum 1.5 µm broad. Paraphysse end cells slightly enlarged, to 2.5 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** Calcareous rocks.

**Distribution.** Only known from Wijdefjorden.

**Notes.** This taxon was described from dry areas in western North America (see Brodo *et al* 2001: 204), and was later found in Greenland (Hansen *et al* 1987) and Asia. It is habitually fairly similar to *Xanthoria elegans*, but differs above all in the lack of a lower cortex, and in its distinct type of upper cortex. See also Elvebakk & Øvstedral 2009. New to Svalbard. World distribution: North America (including Greenland), Turkey, Asia.

**Specimens seen:** Wijdefjorden, Vestfjordalen, between the mouths of Hagendalen and Bryhdalen. 2001, A. Elvebakk 01:230 (TROM); Wijdefjorden, entrance of Kartdalen, 23.8.1936, E. Dahl (O).

*Caloplaca variabilis* (Pers.) Müll. Arg. (1862)

**Thallus** crustose, areolate, up to 3 cm wide rosettes, at margin with a chondroid black prothallus; marginal areolae elongate, 0.6–0.7 × 0.4 mm; central areolae dispersed, isodiametric, brown-grey. **Apothecia** few, scattered in central part of thallus; disc brown to black; margin concolorous with thallus, up to 0.7 mm wide, zeorine; thalline margin almost filled with algae; cortex thin, of pseudoparenchymateous tissue; true margin 50–60 µm thick, in outermost part pseudoparenchymateous, with thick-walled hyphae, in inner parts more loosely arranged. Hymenium 55–60 µm high; epipsamma not evident. Ascospores 8 per ascus, 12–13 × 6–7 µm; septum 1.5–2 µm. Paraphyses little ramified; end cell enlarged to 2 µm diam.

**Chemistry.** Anthraquinones (?).

**Ecology.** On quartzite rock.

**Distribution.** Rare.

**Notes.** Its colour and habitats do not resemble a *Caloplaca*, but asci and ascospores are characteristic of the genus. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Bünzow Land, Gispvika, A. Elvebakk 85:746 (TROM).

*Caloplaca verruculifera* (Vainio) Zahlbr. (1931)

**Thallus** placodioid, with yellow-orange rosettes up to 1 cm diam.; lobes to 1 mm wide, convex, isidiate. Isidia sphaerical, in inner part of thallus. **Apothecia** to 1 mm diam., sessile; thalline margin regular, smooth, becoming crenulate. Ascospores 8 per ascus, 12–14 × 5–6 µm; septum 1–3 µm thick.

**Chemistry.** Anthraquinones.

**Ecology.** Ornithocoprophilous, on maritime rocks.

**Distribution.** Rare.

**Notes.** Characterized by its occurrence on maritime rocks, placodioid thallus and presence of

isidia. World distribution: Europe, arctic North America (including Greenland).

**Specimen seen:** Isfjord Radio, 1995, A. Elvebakk (TROM).

***Caloplaca xanthostigmoidea* (Räsänen) Zahlbr. (1940)**

Syn. *Caloplaca epiphyta* Lyngé (1940), *Caloplaca noeisii* Søchting ad int. (1989).

**Thallus** crustose, effuse, up to several cm diam., pale yellow, indistinctly areolate; areolae with isidioid protuberances up to 0.3 mm high composed of soredia-like “elements”, 15–40 µm diam. **Apothecia** rare, lecanorine or biatorine, up to 1 mm diam.; disc orange, flat to slightly convex; margin prominent, concolorous with or lighter than disc. Hymenium 60–100 µm high, with many oil droplets; epipsamma fine. Ascospores often less than 8 per ascus, 16–20 × 10–13 µm; septum 7–10 µm broad. Paraphysse end cells not or little enlarged.

**Chemistry.** Emodin, 7-chloremodin, parietin and fragilin (Søchting & Tønsberg 1997)

**Ecology.** On rock and old driftwood, ornithocoprophilous.

**Distribution.** Scattered but not common.

**Notes.** This species is unique among the Svalbard sorediate or pseudo-sorediate *Caloplaca* species by its presence of protuberances with soredia-like elements and its pale yellow colour. The other species have true soredia and a deeper orange colour. World distribution: Cosmopolitan.

**Specimen seen:** Bünzow Land, Gipsvika, A. Elvebakk 85:737 (TROM).

**CANDELARIELLA** Müll. Arg. (1894)

**Thallus** crustose to placodioid, yellow to yellow-green. Photobiont green algae. **Ascomata** apothecia, sessile, with thalline margin. True margin thin, colourless. Ascii of *Candelariella*-type. Ascospores 8–32 per ascus, simple, colourless. Hamathecium of paraphyses, simple to branched. Conidia bacilliform or ellipsoid.

Key to *Candelariella* on Svalbard:

1	Thallus placodioid.....	<i>C. arctica</i>
1	Thallus crustose .....	2
2 (1)	Growing on <i>Placynthium</i> spp. ....	<i>C. dispersa</i>
2	Not growing on <i>Placynthium</i> spp. ....	3
3 (2)	Asci 8-spored .....	<i>C. aurella</i>
3	Asci 16–32 spored .....	4
4 (3)	On soil, ± sorediate .....	<i>C. placodizans</i>
4	On rock, wood, lichens, rarely on soil, not sorediate.....	5
5 (4)	Thallus granules rounded, 0.01–0.05 mm diam. ....	<i>C. xanthostigma</i>
5	Thallus granules flattened, 0.1–0.5 mm.....	<i>C. vitellina</i>

***Candelariella arctica*** (Körber) R. Sant. (1966)

**Thallus** placodioid, up to 1.5 cm wide, pale yellow-green, composed of radiating lobes; lobes 0.3–0.4 mm broad, convex, with scurfy-warted surface, cuneate at margin. **Apothecia** in inner part of thallus, up to 0.7 mm wide; margin thick when young, thin when old, concolorous with thallus; disc flat to somewhat convex, dark yellow-green. Hymenium 70–80 µm high. Ascospores 12–16 per ascus, curved, 12–15 × 4–5 µm.

**Chemistry.** Pulvinic acid derivates.

**Ecology.** On shore cliffs, ornithocoprophilous with *Amandinea coniops* etc.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Bellsund, Midterfjorden [Van Keulenfjorden], B. Lynge (TRH); Krossfjorden, Kapp Mitra, A. Elvebakk 86:401 (TROM).

***Candelariella aurella*** (Hoffm.) Zahlbr. (1928)

**Thallus** as very small granules or evanescent, yellow. **Apothecia** up to 1 mm diam.; disc convex, yellow-orange; thalline margin thin, irregular. Hymenium 50–60 µm high. Ascospores 8 per ascus, 15–17 × 4–4.5 µm.

**Chemistry.** Pulvinic acid derivates.

**Ecology.** On limestone, ornithocoprophilous.

**Distribution.** Scattered, but not uncommon.

**Note.** World distribution: Circumpolar, Southern South America, New Zealand, Australia, Antarctica.

**Specimens seen** (selected): Kongsfjorden, Stuphallet, A. Elvebakk 85:342; Dicksonfjorden, 6.7.1936, E. Dahl (O).

***Candelariella dispersa*** (Räsänen) Hakulinen (1954)

**Thallus** as dispersed, yellow, composite areolae, up to 0.3 mm diam. **Apothecia** very rare, up to 1.3 mm wide; margin yellow, thin, crenulate-uneven; disc orange-green, slightly convex. Hymenium 60–70 µm high. Ascospores 8 per ascus, 16–17 × 6–7 µm.

**Chemistry.** Pulvinic acid derivates.

**Ecology.** Growing on *Placynthium* spp.

**Distribution.** Common and widespread.

**Notes.** This species was regarded as a cyanophilic form of *C. aurella* by Poelt & Mayrhofer (1988). However, as there are differences, although small, between these species in thallus and apothecial characters including ascospore size, in addition to its lichenicolous habit, we prefer to treat them as distinct. **World distribution:** Europe, North America (including Greenland).

**Specimens seen** (selected): Kjellstrømdalen Aug. 1986, D.O. Øvstdal (BG); Calypso Bay [Calypsostranda], 1.8.1926, B. Lynge (O).

***Candelariella placodizans*** (Nyl.) H. Magn. (1935)

**Thallus** granulose to subplacodioid, in the latter case up to 1 mm wide, with crenulate margins; some areolae sorediate. **Apothecia** up to 1.3 mm diam.; margin thin, sometimes crenulate, concolorous

with thallus. Disc flat, brownish-yellow. Hymenium 60–70 µm high. Ascospores 12–16 per ascus, 9–11 × 4 µm.

**Chemistry.** Pulvinic acid derivatives.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Ullafjell [Ullaberget], 25.7.1926, B. Lynge (O); Vogelsang [Fuglesongen], 8.7.1828, O.A. Høeg (TRH).

#### *Candelariella vitellina* (Ehrh.) Müll. Arg.(1894)

**Thallus** as small, dispersed, yellow areolae or granules. **Apothecia** ± regular in outline, up to 1 mm diam.; margin prominent, concolorous with thallus. Disc flat to somewhat convex, concolorous with or a little more greenish than thallus. Hymenium 70–80 µm high. Ascospores 12–16 per ascus, 13–15 × 5–6 µm.

**Chemistry.** Pulvinic acid derivatives.

**Ecology.** On moribund bryophytes, other lichens and bones.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America, southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Adventdalen, 5.8.1868, Th.M. Fries (O); Amsterdamøya, 1.8.1936, E. Dahl (O).

#### *Candelariella xanthostigma* (Ach.) Lettau (1912)

**Thallus** as ± crowded granules. Granules yellow, 0.04–0.05 mm wide. **Apothecia** not seen in Svalbard material.

**Chemistry.** Calycin, pulvinic acid derivatives.

**Ecology.** On wood.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (including Greenland), Australia, New Zealand.

**Specimen seen:** Amsterdamøya, 1.8.1936, E. Dahl (O).

#### **CARBONEA** (Hertel) Hertel (1983)

**Thallus** crustose, effuse, rimose to areolate, white to grey. Photobiont trebouxioid. **Apothecia** sessile, black, with true excipie only. True excipie carbonised. Asci of *Lecanora*-type. Ascospores 8 per ascus, simple, colourless. Conidia filiform.

Key to *Carbonea* on Svalbard

- |   |   |                   |
|---|---|-------------------|
| 1 | Parasitic (on <i>Lecidea lapicida</i> ) ..... | <i>C. intrusa</i> |
| 1 | Not parasitic .....                           | 2                 |

2 (1)	With thick thallus .....	<i>C. atronivea</i>
2	Almost without thallus.....	<i>C. vorticosa</i>

***Carbonea atronivea* (Arnold) Hertel (1983)**

**Thallus** 2–3 cm wide, composed of white, thick, dispersed to adjacent, convex areolae; areolae 0.2–0.3 mm wide. **Apothecia** black, flat, sessile. Margin distinct. Hymenium 40–50 µm high; epithecium blue-green. Hypothecium and exciple black. Ascospores 9–11 × 4–4.5 µm.

**Chemistry.** Atranorin.

**Ecology.** On limestone.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen:** van Mijenfjorden, H. Hertel (M).

***Carbonea intrusa* (Th. Fr.) Hertel (1983)**

**Thallus** 2–3 mm wide, composed convex, black areolae. **Apothecia** black, convex, up to 0.1 mm diam. Hymenium 30–40 µm high, uppermost part blue-green. Exciple and hypothecium brown to olive-green. Ascospores not seen in Svalbard material.

**Chemistry.** Not performed.

**Ecology.** Parasitic, on *Lecidea lapicida*.

**Distribution.** Rare.

**Note.** World distribution: Europe, Chukotka.

**Specimen seen:** Amsterdamøya, H. Hertel 17987 (M).

***Carbonea vorticosa* (Nyl.) Hertel (1983)**

**Thallus** absent or as small, scattered whitish areolae. **Apothecia** up to 0.7 mm diam., black, sessile; base constricted; margin thin but distinct; disc flat to somewhat convex. Hymenium 50–60 µm high; uppermost part blue-green. Ascospores 8 per ascus, 11–13 × 4.5–6 µm. Paraphyses ramified; end cell little enlarged.

**Chemistry.** Not performed.

**Ecology.** On Ca-rich rock and driftwood.

**Distribution.** Widespread, but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand, Antarctica.

**Specimen seen** (selected): Edgeøya, between Rosenbergdalen and Kapp Lee, 6.8.1936, E. Dahl (O); Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O; driftwood).

**CATAPYRENIUM** Flot. (1850) s. str.

**Thallus** squamulose, attached to substrate by rhizohyphae. Upper cortex thin (10–30 µm), poorly delimited against algal layer, pseudoparenchymateous, composed of rounded-angulate cells 5–8 µm diam. Lower cortex pseudoparenchymatous or lacking; rhizohyphae colourless or brown. Photobiont trebouxioid. **Ascomata** perithecia. Involucellum absent. Hamathecium of periphyses, paraphyses absent. Ascii clavate. Ascospores 8 in ascii, colourless, simple.

**Notes.** *Catapyrenium* s. lat. has now been split into *Catapyrenium* s. str., *Placidium* and *Involucropyrenium* (Breuss 1996).

Key to *Catapyrenium* on Svalbard:

1	With pseudoparenchymateous lower cortex .....	<i>C. cinereum</i>
1	Without lower cortex .....	<i>C. daedaleum</i>

***Catapyrenium cinereum* (Pers.) Körb. (1855)**

**Thallus** consisting of small, finely incised, pruinose squamules growing densely aggregated to form a crust. Lower cortex present, paraplectenchymateous. Rhizohyphae black. **Perithecia** immersed; exciple pale, dark around ostiole. Ascospores 17–23 × 6–9 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Circumpolar, Australia, New Zealand.

**Specimens seen:** Grønhamna, 31.7.1868, Th.M. Fries (O; det. Breuss); Calypso Bay [Calypsostranda], 14.7.1926, B. Lynge (O; det. Breuss).

***Catapyrenium daedaleum* (Krempelh.) B. Stein (1879)**

**Thallus** as thick squamules up to 4 mm across, often aggregated to form rosettes, brown, not pruinose. No lower cortex. Rhizohyphae black. **Perithecia** immersed; exciple at first pale, becoming brown. Ascospores 17–22 × 6–9 µm.

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), New Zealand, Antarctica.

**Specimens seen:** Bünzow Land, Gipsvika, A. Elvebakk 85:783; A. Elvebakk & L. Hodin 85:468 (TROM).

**CATILLARIA** A. Massal. (1852)

**Thallus** crustose, rimose to areolate. Photobiont green algae. **Ascomata** apothecia, sessile, black, without thalline margin. True margin well-developed, composed of radiating hyphae. Ascii with tholus uniformly K/I + blue. Ascospores 8 per ascus, uncoloured, 1-septate. Hamathecium of paraphyses, simple to branched; end cell enlarged. Conidia bacilliform to ellipsoid.

Key to *Catillaria* on Svalbard:

1	True exciple totally dark .....	<i>C. chalybeia</i>
1	True exciple pale in inner part .....	2
2 (1)	Apothecia 0.6 mm diam. or larger .....	<i>C. groenlandica</i>
2	Apothecia up to 0.4 mm diam. ....	<i>C. lenticularis</i>

***Catillaria chalybeia*** (Borrer) Massal. (1852)

**Thallus** very thin, grey-brown, crustose, effuse. **Apothecia** 0.2–0.4 mm broad, black, flat; margin indistinct. Hymenium 70–90 µm high; uppermost part brownish. Exciple and hypothecium brown-black. Ascospores 8 per ascus, 14–16 × 6–7 µm. Paraphysse end cell clavate, dark-pigmented.

**Chemistry.** Not performed.

**Ecology.** On rock.

**Distribution.** Only known from Grønfjorden.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand.

**Specimen seen:** Grønhamna [Grønfjorden, Ankerhamna], 1.8.1868, Th.M. Fries (O).

***Catillaria groenlandica*** Lynge (1937)

Type: W. Greenland, Nugssuaq, 1871, Th.M. Fries (O—holotype!).

**Thallus** little developed. **Apothecia** 0.6 mm wide, adpressed convex, without margin. Hymenium 35–40 µm high; epithecium brown, K + brownish violet. Ascospores 9–11 × 4.5–5 µm. Paraphysse end cell clavate, 5.5 µm diam. Hypothecium uncoloured.

**Chemistry.** Not investigated.

**Ecology.** On rock.

**Distribution.** Only found once.

**Notes.** Reported from Svalbard by Aptroot & Alstrup (1991). World distribution: Europe, North America (Greenland).

**Specimen seen:** Edgeøya, 1986, C.M. van Herk & L.M. Jalink (herb. Aptroot).

***Catillaria lenticularis*** (Ach.) Th. Fr. (1874)

**Thallus** very thin, effuse, beige to grey-brown. **Apothecia** 0.2–0.4 mm diam., dark brown to black; margin disappearing. Hymenium 35–50 µm high, yellow-brown in upper part. Hypothecium colour-

less. Ascospores  $7-10 \times 2.5-3.5 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On calcareous rock.

**Distribution.** Only known from Isfjorden.

**Note.** World distribution: Europe, North America (Greenland), Argentina, Australia.

**Specimen seen:** Isfjorden, Belvederefjellet, 10.7.1939, E. Hadac (O; det. B. Lyngé).

## CEPHALOPHYSIS H. Kilias & Schneid.(1985)

**Thallus** crustose, effuse. **Ascomata** apothecia, black, without thalline margin. Hypothecium and outer part of exciple red-brown. Asci of *Teloschistes*-type. Ascospores 8 per ascus, simple, uncoloured. Hamathecium of paraphyses, anastomosing.

### *Cephalophysis leucospila* (Anzi) H. Kilias & Schneid. (1985)

**Thallus** endolithic. **Apothecia** black, 0.2–0.3 mm wide, slightly convex, emarginate, restricted below. True exciple red-brown in outer part, K + violet, uncoloured in inner. Hypothecium red-brown, K + violet. Hymenium 40–50  $\mu\text{m}$  high; upper part strongly blue-green. Paraphyses anastomosing; end cell enlarged to 2–3  $\mu\text{m}$ . Ascospores uncoloured, simple, 8 per ascus,  $6-10 \times 4-5 \mu\text{m}$ .

**Chemistry.** Not performed.

**Ecology.** On calcareous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** None seen; record based on reports from Brøggerhalvøya and Nordenskiöldfjellet by Hertel (1977).

## CERCIDOSPORA Körber emend. Hafellner (1987)

Lichenicolous, or autonome as a thin, whitish crust, with trebouxioid algae. **Ascomata** perithecia, black; wall composed of a *textura intricata*, apically blackish blue, pale brown or colourless towards base. Hamathecium of anastomosing paraphysoids. Periphyses present or absent. Asci with no amyloid structures. Ascospores 4–8 in asci, colourless, septate. All known species are lichenicolous perhaps with the exception of the one treated below.

### *Cercidospora decolorella* (Nyl.) O.E. Erikss. & J. Z. Yue (1992)

**Thallus** crustose, whitish, smooth. **Perithecia** 0.1–0.2 mm wide, black, half sunk in thallus, with tiny ostiole. Ascospores 8 in asci,  $13-29 \times 3.5-7 \mu\text{m}$ , with 3 (rarely 1–6) septa.

**Chemistry.** Not performed.

**Ecology.** On sand and bryophytes.

**Distribution.** Smeerenburg.

**Notes.** We cannot decide whether this is an autonome lichen or a parasymbiont. Based on the description in Hertel & Ullrich (1976), it appears to be a lichen, and Santesson et al. (2004) write: "With *Gloeocapsa* etc. on terricolous mosses. Lichenized?". However, all other known species of *Cercidospora* are parasymbionts/parasites.

New to Svalbard. However, this species was probably reported by Olech (1990) from Sørkapp Land as *Geislera sychnogonioides* Nitschke, a report cited as *Strigula sychnogonioides* (Nitschke) R.C. Harris by Elvebakk & Hertel (1996). World distribution: Europe, Siberia, North America.

**Specimen seen:** none seen, record based on Hertel 16805 (M; det. A. Fryday, pers. comm. 2006).

### **CETRARIA** Ach. (1803)

**Thallus** fruticose, flattened to terete, brown; pseudocyphellae on margin or lower surface; cortex bistratose, N –; no rhizinae; cilia, if present, tapering. **Ascomata** apothecia. Asci with ring structure in tholus. Ascospores 8 per ascus, simple, colourless, ellipsoid to spherical. Conidia oblong and citriform.

Key to *Cetraria* on Svalbard:

1	Thallus flattened.....	2
1	Thallus terete.....	4
2 (1)	With fumarprotocetraric acid .....	<i>C. islandica</i>
2	Without fumarprotocetraric acid .....	3
3 (2)	Without or with indistinct pseudocyphellae; upper surface dark brown.....	<i>C. nigricans</i>
3	With distinct pseudocyphellae along margin; upper surface pale brown.....	<i>C. ericetorum</i>
4 (1)	Sorediate .....	<i>C. racemosa</i>
4	Not sorediate .....	5
5 (4)	Branches with many short branchlets; pseudocyphellae flat .....	<i>C. muricata</i>
5	Branches without short branchlets; pseudocyphellae concave .....	<i>C. aculeata</i>

### ***Cetraria aculeata*** (Schreb.) Ach. (1825)

**Thallus** fruticose, up to 5 cm high, richly dichotomously ramified, dark brown, in tufts. Main branches up to 1.5 mm diam. at base, terete but often angular; pseudocyphellae common, up to 1 mm long, concave.

**Chemistry.** Lichesterinic and protolichesterinic acids

**Ecology.** On soil.

**Distribution.** Common.

**Note.** World distribution: Circumpolar, southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Brenneviksbutka, 21.8.1936, E. Dahl (O); Longyearbyen, 23.7.1936, E. Dahl (O).

*Cetraria ericetorum* Opiz (1852)

**Thallus** fruticose; branches up to 5 cm high, and 2 mm broad, growing in loose tufts, canaliculate, with cilia in margin. Upper side brown; lower side pale brown, with weakly developed, elongate pseudocypellae close to margin.

**Chemistry.** Lichesterinic and protolichesterinic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Rare.

**Notes.** According to Kärnefelt (1979), *C. ericetorum* does not occur in the Arctic. However, the specimen cited below agrees in our opinion in all diagnostic characters with that species. World distribution: Circumpolar, southern South America.

**Specimen seen:** Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

*Cetraria islandica* (L.) Ach. (1803)

**Thallus** fruticose, up to 8 cm high and 10 mm broad, growing in loose tufts, weakly canaliculate; margin with cilia; upper side brown; lower side pale brown, with numerous laminal, ± roundish pseudocypellae.

**Chemistry.** Fumarprotocetraric, lichesterinic and protolichesterinic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Notes.** Ssp. *crispiformis*, reported as the most common one on Svalbard (Kärnefelt 1979), differs from ssp. *islandica* in its very small pseudocypellae and ridged lamina. Some specimens from moss mats below bird cliffs are 1–1.5 cm high, with very broad and little ramified lobes. As the pseudocypellae are small and the surface of the thallus ridged, it apparently belongs in ssp. *crispiformis* and may prove to represent an ecotype adapted to this nutrient-rich habitat. World distribution: Europe, Asia, North and South America, Australia, New Zealand, and Antarctica.

**Specimens seen** (selected): Vogelsang [Fuglesongen], sydspissen “below bird cliff”, 8.7.1928, O.A. Høeg (TRH; several specimens); Ny-Ålesund, 4.7.1936, E. Dahl (O).

*Cetraria muricata* (Ach.) Ach. (1810)

**Thallus** fruticose, up to 2 cm high and 2 mm broad at base, richly dichotomously branched, dark brown. Branches with many short, thorn-like lateral branchlets; pseudocypellae numerous, flat.

**Chemistry.** Protolichesterinic and lichesterinic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Widespread, but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O); Red Bay, 21.7.1928, O.A. Høeg (TRH).

*Cetraria nigricans* (Retz.) Nyl. (1859)

**Thallus** fruticose, growing in small tufts; lobes up to 1 mm broad, slightly canaliculate; margins with long cilia; upper side dark brown; lower side pale brown, with inconspicuous pseudocypellae.

**Chemistry.** Protolichesterinic acid.

**Ecology.** On soil.

**Distribution.** Only known from Nordaustlandet

**Note.** World distribution: circumpolar.

**Specimen seen:** Duvepynten, Nordaustlandet, 1936, E. Dahl (O).

***Cetraria racemosa* (Lynge) Øvstdal comb. nov.**

Basionym: *Cornicularia racemosa* Lynge, 1932, Skrifter Svalbard Ishavet 41: 83.

Type: Greenland, Husbukta, 1929, Scholander (O—isotype!).

**Thallus** fruticose, erect, shiny dark brown, 0.4–0.6 cm high, subdichotomously branched, sorediate. Main branches 0.8–0.9 mm wide at base, 0.3–0.4 mm wide at tips, terete to somewhat flattened; soralia on minute branchlets, rough, grey-brown, up to 0.8 mm diam. Pseudocyphellae very indistinct, closed, 0.5–0.1 mm long. Soredia 15–20 µm wide, brown-pigmented.

**Chemistry.** Lichesterinic and protolichesterinic acids.

**Ecology.** On soil.

**Distribution.** Rare.

**Notes.** The Svalbard material agrees in all diagnostic characters with the type from Greenland. The species is apparently close to *C. muricata*. However, in addition to the presence of soralia, it differs in at least two characters. In *C. muricata*, the diameter of the branch tips is relatively much smaller compared to the base diameter in *C. racemosa*. Also, *C. muricata* has distinct pseudocyphellae which are hardly present in *C. racemosa*. We accept *C. racemosa* as a distinct species here, but further studies are needed. The taxon has previously been reported from Svalbard by Lynge (1938) and Elvebakk & Hertel (1996). Kärnefelt (1979, 1986) suggested that the production of soredia in several *Cetraria* species is induced by a parasitic fungus. This fungus was later described as *Taeonella rolfii* Diederich & Zurb. (Diederich & Zurbenko 1997, 2001), and is also found in the Svalbard specimen of *C. racemosa* as hyphae in the soralia.

World distribution: Europe, Greenland.

**Specimen seen:** Kongsfjorden, Brøggerhalvøya; A. Elvebakk 86:100 (TROM).

**CETRARIELLA** Kärnefelt & Thell (1993)

**Thallus** fruticose, *Cetraria*-like, brown, with pseudocyphellae and cilia. **Apothecia** terminal on lobe ends. Asci with tholus moderately small; ocular chamber short and broad and axial body broad. Conidia sublageniform. Contains gyrophoric and hiascic acids.

Key to *Cetrariella* on Svalbard:

- |   |                                      |                      |
|---|--------------------------------------|----------------------|
| 1 | Lobes ± flat; tips acute .....       | <i>C. delisei</i>    |
| 1 | Tips canaliculate; tips obtuse ..... | <i>C. fastigiata</i> |

*Cetrariella delisei* (Bory ex Schaer.) Kärnefelt & Thell (1993)

**Thallus** fruticose, forming small tufts up to 3 cm high, strongly ramified; base broad and pale brown, upwards fast becoming thin and dark brown; lower side with pseudocyphellae; margins with short cilia.

**Chemistry.** Gyrophoric and hiascic acids.

**Ecology.** In snow-beds.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, Chile, New Zealand.

**Specimens seen** (selected): Sør-Østkysten [Sørøst-Spitsbergen], S-siden av Kvalhovden, E. Dahl 30.7.1936 (O); Edgeøya, S for Habenichtbukta, 7.8.1936, E. Dahl (O).

*Cetrariella fastigiata* (Delise ex Nyl.) Kärnefelt & Thell (1993)

**Thallus** fruticose, up to 4 cm high and 5 mm broad, dichotomously branched, canaliculate, with short lateral branches; tips obtuse, with indistinct laminal and marginal pseudocyphellae; cilia marginal.

**Chemistry.** Gyrophoric and hiascinic acids.

**Ecology.** Among bryophytes.

**Distribution.** A few scattered occurrences.

**Notes.** One collection (Dahl 12.8.1936, cited below) is sorediate, with round, white, convex, laminal soralia up to 0.6 mm diam. Soredia 8–10 µm diam., adglutinated into consoredia. No *Taeoniella* hyphae seen in sections (see comments under *Cetraria racemosa*). It is otherwise indistinct from normal non-sorediate specimens. World distribution: Circumpolar.

**Specimens seen** (selected): Prins Karls Forland, Fuglehukken, A. Elvebakk 94:023 (TROM); Kong Karls Land, Holmsbukta [Holmbukta], 10.8.1936, E. Dahl (O); Kong Karls Land, Retziusfjellet, 12.8.1936, E. Dahl (O).

**CHAENOTHECA** (Th. Fr.) Th. Fr. (1860)

**Thallus** crustose, granulose to squamulose. Photobiont *Dictyochloropsis*, *Stichococcus*, *Trebouxia* or *Trentepohlia*. **Ascomata** apothecia, stalked, stalk slender, composed of periclinally arranged, brown hyphae; head globose to subglobose, without thalline margin. True margin well-developed. Ascii early dissolving. Ascospores brown, simple, in a dry, brown spore mass.

*Chaenotheca furfuracea* (L.) Tibell (1984)

**Thallus** crustose, effuse, pale sulphur-yellow, 1–2 cm wide, thick, granulate. **Ascomata** 1 mm high, stalk 0.07–0.1 mm thick, covered with thick yellowish pruina. Capitulum spherical, 0.2 mm diam., with dense yellowish pruina. Ascospores spherical, 2.3–3 µm diam., with a minute ornamentation of small warts.

**Chemistry.** Vulpinic, pulvinic acids, pulvinic dilactone.

**Ecology.** Over moribund bryophytes and on rock.

**Distribution.** Rare.

**Notes.** Characterized by its yellowish pruina and thick thallus. In Svalbard material the ascomata are shorter than indicated by Tibell (1999). World distribution: Europe, North America (including Greenland), Asia, Australia.

**Specimens seen:** Vogelsang [Fuglesongen], 28.8.1928, O.A. Høeg (TRH); Bellsund, N of Millarodden, 8.7.2003, A. Elvebakk 03:062 (TROM).

### CHROMATOCHLAMYS Trev. (1860)

**Thallus** crustose to evanescent. Photobiont trebouxoid. **Ascomata** perithecia, immersed to partly sessile, pale to black. Ascii with thick wall, K/I -. Ascospores 1–8 per ascus, muriform, colourless to brownish. Hamathecium paraphyses, anastomosing, persistent; paraphysoids present towards ostiole.

#### *Chromatochlamys muscorum* (Fr.) H. Mayrhofer & Poelt (1985)

**Thallus** very thin, membranaceous, effuse, whitish to ochraceous. Perithecia up to 0.6 mm diam., round, immersed with only ostiole protruding; exciple up to 60 µm thick, brownish above, otherwise colourless. Ascospores 2–3 per ascus, muriform, colourless, becoming yellowish, 60–100 × 20–25 µm. Paraphysoids anastomosing, up to 1.5 µm thick.

**Chemistry.** Not performed.

**Ecology.** Over bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Europe, North Africa, Siberia, North America (Greenland), Antarctica.

**Specimens seen:** None seen; record based on material from Sørkapp Land cited by Olech & Alstrup (1989).

### CLADONIA P. Browne (1756)

**Thallus** of two kinds: primary thallus crustose, disappearing, with ecorcicate, richly branched secondary thallus (podetia) without squamules and with continuous growth (subg. *Cladina*); primary thallus squamulose, usually persistent but in some species evanescent, with corticate, little to moderately branched secondary thallus (podetia) usually without continuous growth (subg. *Cladonia*). Podetia hollow. Photobiont trebouxoid. **Ascomata** apothecia, rare or absent in many species, without thalline exciple. True exciple soon excluded. Ascii with a K/I + blue thallus and a K/I + blue coat. Ascospores 8 per ascus, colourless, simple. Hamathecium of paraphyses, simple to branched. Conidia thread-like to cylindrical.

**Notes.** The colour of the apothecia (and pycnidial gel) is a much used key character in *Cladonia*. As apothecia are rarely developed in Svalbard *Cladonia* specimens, this character is not used in the keys here, but included in the species descriptions. A few species have perforated axils or scyphi; when axils and/or scyphi are closed, this is not mentioned.

The *Cladonia* species have similar podetium anatomy consisting of an inner cartilaginous layer, a medulla with algae and usually a cortex. The relative width of the different layers may represent

environmental responses or genetically fixed characters. Measurements of these widths are indicated for most species.

Collections consisting of primary thalli only represent a problem. Those with a diagnostic chemistry, such as *C. galinézii*, are easy to recognize, but the majority of such collections, with fumarprotocetraric acid and  $\pm$  atranorin, cannot be determined to species with certainty. This complex may also include cryptic species.

Key to *Cladonia* on Svalbard:

- |       |  |       |
|-------|--|-------|
| 1     | Primary thallus not present (only in juvenile stage); growth continuous .....  | 2     |
| 1     | Primary thallus present; growth usually not continuous (subg. <i>Cladonia</i> pro max. parte)<br>.....                 | Key C |
| 2 (1) | Podetia little branched, stiff; apices abruptly tapering (subg. <i>Cladonia</i> , sect. <i>Unciales</i> )....<br>..... | Key B |
| 2     | Podetia tri- or tetrachotomously branched; apices not abruptly tapering (subg. <i>Cladina</i> ).<br>.....              | Key A |

Key A

- |       |  |                       |
|-------|--|-----------------------|
| 1     | Podetia forming 'heads'; apices not in one direction.....              | <i>C. stellaris</i>   |
| 1     | Podetia not forming 'heads'; apices in one direction.....              | 2                     |
| 2 (1) | With usnic acid.....   | <i>C. arbuscula</i>   |
| 2     | Without usnic acid .....   | 3                     |
| 3 (2) | Distinct blackish stereome at base; pycnidial gel red .....            | <i>C. stygia</i>      |
| 3     | Not distinct blackish stereome at base; pycnidial gel colourless ..... | <i>C. rangiferina</i> |

Key B

- |   |   |                       |
|---|---|-----------------------|
| 1 | With barbatic and usnic acid.....                       | <i>C. amaurocraea</i> |
| 1 | With squamatic and usnic acid, or usnic acid only ..... | <i>C. uncialis</i>    |

Key C

- |       |   |                        |
|-------|---|------------------------|
| 1     | Only primary thallus present.....           | 2                      |
| 1     | Podetia present.....                        | 8                      |
| 2 (1) | Lower side of squamules yellow.....         | <i>C. luteoalba</i>    |
| 2     | Lower side of squamules white to grey ..... | 3                      |
| 3 (2) | Squamules as a decumbent crust.....         | <i>C. pocillum</i>     |
| 3     | Squamules erect .....                       | 4                      |
| 4 (3) | With atranorin and norstictic acid.....     | <i>C. symphycarpia</i> |
| 4     | Without norstictic acid .....               | 5                      |
| 5 (4) | With atranorin and psoromic acid.....       | <i>C. dahliana</i>     |
| 5     | With other compounds .....                  | 6                      |

6 (5)	With fumarprotocetraric acid .....	<i>C. macrophyllodes</i>
6	Without fumarprotocetraric acid .....	7
7 (6)	With atranorin and porphyrylic acid .....	<i>C. galindezii</i>
7	With atranorin, rangiformic and norrangiformic acids .....	<i>C. cariosa</i>
8 (1)	With usnic acid.....	9
8	Without usnic acid .....	16
9 (8)	Podetia sorediate .....	10
9	Podetia not sorediate .....	14
10 (9)	With regular scyphi.....	11
10	Scyphi irregular or absent.....	12
11 (10)	Finely sorediate.....	<i>C. carneola</i>
11	Coarsely sorediate.....	<i>C. pleurota</i>
12 (10)	Podetia regular, escyphose, thin.....	<i>C. cyanipes</i>
12	Podetia irregular, thick, sometimes with scyphi .....	13
13 (12)	With usnic acid and zeorin.....	<i>C. deformis</i>
13	With usnic and squamatic acids .....	<i>C. sulphurina</i>
14 (9)	Podetia with horizontal squamules .....	<i>C. bellidiflora</i>
14	Podetia with downward-pointing squamules .....	15
15 (14)	With usnic and barbatic acids .....	<i>C. borealis</i>
15	With usnic acid and zeorin.....	<i>C. coccifera</i>
16 (8)	Podetia with longitudinal fissures, regular or irregular.....	17
16	Podetia without longitudinal fissures, ± regular .....	20
17 (16)	Podetia irregular, turgid .....	<i>C. turgida</i>
17	Podetia regular, not turgid .....	18
18 (17)	Podetia sorediate .....	<i>C. acuminata</i>
18	Podetia not sorediate .....	19
19 (18)	Podetia with squamules, without apothecia .....	<i>C. macrophylla</i>
19	Podetia without squamules, with apothecia .....	<i>C. cariosa</i>
20 (16)	Axils and scyphi open.....	21
20	Axils and scyphi closed .....	24
21 (20)	Podetia sorediate .....	<i>C. cenotea</i>
21	Podetia not sorediate .....	22
22 (21)	Podetia with numerous squamules.....	<i>C. squamosa</i>
22	Podetia with few or no squamules .....	23
23 (22)	Podetia decumbent, with melanotic base; scyphi-like cups and proliferations absent .....	<i>C. subfurcata</i>
23	Podetia upright, without melanotic base; scyphi-like cups with proliferations present.....	<i>C. crispata</i> var. <i>cetrariiformis</i>

24 (20)	Podetia sorediate .....	25
24	Podetia not sorediate .....	31
25 (24)	Scyphi broad .....	26
25	Scyphi narrow or absent .....	28
26 (25)	Finely sorediate .....	<i>C. fimbriata</i>
26	Coarsely sorediate .....	27
27 (26)	With fumarprotocetraric acid .....	<i>C. chlorophaea</i>
27	With merochlorophaeic acid .....	<i>C. merochlorophaea</i>
28 (25)	With barbatic acid .....	<i>C. floerkeana</i>
28	Without barbatic acid .....	29
29 (28)	With prominent squamules in lower part of podetia; soredia coarse .....	<i>Cladonia cf. islandica</i>
29	With indistinct squamules only in lower part of podetia; soredia fine .....	30
30 (29)	Podetia green-grey to pale brown, sorediate in upper 70% .....	<i>C. subulata</i>
30	Podetia brown-grey, sorediate in upper half .....	<i>C. groenlandica</i>
31 (24)	Primary squamules prominent as a flat crust .....	<i>C. pocillum</i>
31	Primary squamules absent or otherwise .....	32
32 (31)	Scyphi proliferating centrally .....	<i>C. verticilliata</i>
32	Scyphi proliferating marginally .....	33
33 (32)	Scyphi broad .....	34
33	Scyphi narrow or absent .....	35
34 (33)	With prominent black cartilaginous tissue in lower part .....	<i>C. albonigra</i>
34	Without prominent black cartilaginous tissue in lower part .....	<i>C. pyxidata</i>
35 (33)	With black decorticated areas at base .....	36
35	Without black decorticated areas at base .....	39
36 (35)	Surface subarachnoid, with fumarprotocetraric acid .....	<i>C. phyllophora</i>
36	Surface smooth, with atranorin and fumarprotocetraric acid .....	37
37 (36)	Scyphi proliferating from margin .....	<i>C. stricta</i>
37	Scyphi proliferating from centre .....	38
38 (37)	Podetia with abundant squamules; scyphi rare .....	<i>C. trassii</i>
38	Podetia with few or no squamules; scyphi common .....	<i>C. uliginosa</i>
39 (35)	Podetia erect, with smooth, ± evenly coloured surface .....	<i>C. gracilis</i> var. <i>elongata</i>
39	Podetia decumbent, with bullate surface with darker and paler parts .....	<i>C. macroceras</i>

***Cladonia acuminata* (Ach.) Norrl. (1875)**

**Primary thallus** as small, round, dispersed squamules, pale ochre, 0.1–0.2 mm wide. **Podetia** up to 2 cm high, subulate, often ramified in upper part, with longitudinal fissures, partly covered with

very pale yellow-ochre, round squamules; stereome visible, in transverse section 150–170 µm thick.

**Apothecia** brown.

**Chemistry.** Atranorin, norstictic, unidentified fatty acid (Rf values between those of rangiformic and norrangiformic acids).

**Ecology.** On soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimen seen:** Barentsøya, NV-siden av Steinbeisfjellet, 1.8.1936, E. Dahl (O).

#### *Cladonia albonigra* Ahti & Brodo (1996)

**Primary thallus** not seen. **Podetia** up to 4.5 cm high, to 2 mm wide at base; scyphi to 10 mm wide, with marginal proliferations. Cortex minutely areolate to subsquamulate in lower part, in upper part with minute, easily shed, soredia-like granules. Cartilaginous tissue black in lower part of podetia, with a few, small grey-brown plates. Scyphi with numerous grey-brown plates on the inside. Soredia absent (but present in mainland Norwegian and North American material).

**Chemistry.** Fumarprotocetraric and protocetraric acids.

**Ecology.** Among bryophytes.

**Distribution.** Only found twice.

**Notes.** Long podetia, extensive black cartilaginous tissue, and numerous proliferations characterize this species. New to Svalbard. World distribution: Europe, North America.

**Specimens seen:** Nordenskiöld Land, Reindalen, E slope of Mt. Lågsnyta, alt 140 m, 1986, T. Tønsberg s.n. (BG; conf. H. Holien 2005); Kobbefjorden, 1868, Th. M. Fries (O-L149659).

#### *Cladonia amaurocraea* (Flörke) Schaer. (1823)

**Primary thallus** not observed. **Podetia** 2–4 cm high, pale yellowish, tapering, with brown tips and smooth cortex. Transverse section 130–170 µm thick; cortex 18–19 %, medulla 41–46 % and stereome 35–41 %. **Scyphi** and **apothecia** absent in Svalbard material.

**Chemistry.** Usnic and barbatic acids.

**Ecology.** Among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Dicksonfjorden, Heimenfjellet, 30.7.1973, A.A. Frisvoll (TRH); Kapp Sabine [Sabineodden], 12.7.1928, O.A. Høeg (TRH).

#### *Cladonia arbuscula* (Wallr.) Flotow (1839)

Incl. *Cladonia mitis* Sandst. (1918).

**Primary thallus** not seen. **Podetia** to 4 cm high, yellow-green, fairly richly branched; branching trichotomous or tetrachotomous; tips oriented in one direction.

**Chemistry.** Usnic acid, and fumarprotocetraric acid or rangiformic acid.

**Ecology.** Among mosses.

**Distribution.** Rare (chemotype with fumarprotocetraric acid) to scattered (chemotype with

rangiformic acid).

**Notes.** The chemotype with rangiformic acid has been treated at specific level (*C. mitis* Sandst. 1918) or as a subspecies (*C. arbuscula* spp. *mitis* (Sandst.) Ruoss 1987). World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand, Antarctica.

**Specimens seen:** Chemotype with fumarprotocetraric acid: Liefdefjorden, A. Elvebakk 81:623 (TROM); chemotype with rangiformic acid: Kong Karls Forland, Fuglehuken, A. Elvebakk 94:045 (TROM); Amsterdamøya, 1.8.1936, E. Dahl (O).

#### *Cladonia bellidiflora* (Ach.) Schaer. (1823)

**Primary thallus** as strongly incised, ascending squamules, ochre-coloured at base. **Podetia** up to 3 cm high, yellow-green to grey-green, orange- to ochre-coloured at base, densely covered with horizontal squamules. Transverse section 290–310 µm thick, with cortex (when present) 7–10 %, medulla 30–35 %, and stereome 55–60 %. Scyphi absent in Svalbard material. **Apothecia** red.

**Chemistry.** Usnic and squamic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Antarctica.

**Specimens seen** (selected): Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9840 (BG); Lilliehöökfjorden, 22.7.1974, A.A. Frisvoll (TRH).

#### *Cladonia borealis* S. Stenroos (1989)

**Primary thallus** as ascending to decumbent squamules, to 5 mm long, yellow-green. **Podetia** pale yellow-green, to 2 cm high, scyphose; scyphi to 6 mm wide. Upper part of podetia with downward-oriented cortical plates; lower part areolate to continuously corticate. Transverse section 275–315 µm thick, with cortex 8–9 %, medulla 60–62 % and stereome 29–32 %. **Apothecia** red.

**Chemistry.** Usnic, barbatic and 4-O-dimethylbarbatic acids.

**Ecology.** On soil.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North, Central and South America, Antarctica.

**Specimens seen** (selected): Red Bay [Raudfjorden], 23.7.1923, Iversen (TRH); Indre Norskøy [Indre Norskøya], 4.7.1928, O.A. Høeg (TRH).

#### *Cladonia cariosa* (Ach.) Spreng. (1827)

**Primary thallus** as a flat crust, up to 4 cm wide and 2–3 mm high. Squamules in protected places ascending, recurved, thick, strongly incised, 1–3 mm broad and 2 mm high; margin thick, granular; upper side green-grey; lower side white; when exposed shiny brown. Pycnidia rare, brown-black, semiglobose, laminal. **Podetia** not found on Svalbard.

**Chemistry.** Atranorin, rangiformic and norrangiformic acids.

**Ecology.** On soil.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, North Africa, Asia, North America, southern South America.

**Specimen seen:** Nordenskiöld Land, Austre Tsvillingoden, A. Elvebakk 88:257 (TROM).

*Cladonia carneola* (Fr.) Fr. (1831)

**Primary thallus** as small, round, dispersed squamules, up to 0.5 mm diam., yellowish. **Podetia** pale yellowish, up to 2 cm high, at base 1.3 mm wide; scyphi flaring, to 5 mm wide and with marginal projections. Podetia at base with granules and minute squamules, otherwise finely sorediate. Hymenial gel pale brownish. Stereome 50–60 µm thick, consisting of coarse hyphae; medulla plus soredia 40–50 µm; soredia 25.6 ± 1.5 µm, often in consoredia. **Apothecia** pale brown.

**Chemistry.** Usnic, isousnic, zeorin, ± unidentified fatty acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America, southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Brennevinsbukta [Brennevinsfjorden], 8.7.1931, P.F. Scholander (O); Liefdefjorden, A. Elvebakk 81:599 (TROM).

*Cladonia cenotea* (Ach.) Schaer. (1823)

**Primary thallus** lacking. **Podetia** in dense tufts, up to 8 cm broad and 2 cm high (living parts); podetia up to 20 mm high and 2.7 mm broad, ascophose with blunt ends or scyphose; scyphi open, not widened, margin not incurved, with 3–4 long proliferations at margin; coarsely sorediate and with squamules. Squamules mostly broad and short, irregular-incised, sorediate on lower side and at margins. Sorediate spots present in middle and upper part of podetia, uppermost part granulose-sorediate. Lowermost part with cortex, non-sorediate. Colour yellowish-green in lower part, brown-green to brownish in upper part, sorediate parts brighter. In transection the cortex is 2.5–3 %, medulla 27.5–25 % and cartilaginous layer 70–72 %. Soredia 23.0 ± 2.2 µm, usually conglutinated into consoredia 40–45 µm. Apothecia or pycnidia not seen (**apothecia** brown).

**Chemistry.** Squematic acid.

**Ecology.** On soil.

**Distribution.** Known from Kobbefjorden and Nordaustlandet (stunted).

**Notes.** The specimens from Kobbefjorden, as described above, show considerable differences from typical specimens of this species. Typical *C. cenotea* always have scyphi which are broadened and where the margins are incurved. The sorediate part of typical *C. cenotea* is more uniform and more finely sorediate. The soredia of typical *C. cenotea* are 25.7 ± 2.4 µm diam., i.e. the same as those of the Kobbefjorden population, but they are not conglutinated in consoredia, thus they look much finer. The transect of the podetium of typical *C. cenotea* shows a cortex ca 9 %, medulla ca. 42 % and cartilaginous tissue ca 50 %. The difference in the volume of the various tissues may be explained by typical *C. cenotea* being a fast-growing species almost restricted to lignum in forests. In such protected and shaded sites, photosynthetic efficiency is more important than mechanical strength. The Kobbefjorden population is a slow-growing one on soil, probably also mosses, in a harsh climate where light exposure is not a limiting factor. Alternatively, these types may be taxonomically distinct, which would be a topic for further studies. World distribution: Europe, Asia, North America, southern South America.

**Specimens seen** (selected): Kobbs Bay [Kobbefjorden], 1868, Th.M. Fries (O; several specimens).

*Cladonia chlorophaea* (Flörke ex Sommerf.) Spreng. (1827)

**Primary thallus** prominent, composed of ascending squamules, to 3 mm long. **Podetia** up to 1.5 cm high, grey-green to grey-brown, scyphose, sorediate in upper part. Scyphi up to 8 mm broad. Stereome 80–100 µm thick. Soredia 60–65 µm diam. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Observatoriefjellet, 16.7.1926, B. Lynge (TRH); Kapp Hansteen, 1931, P.F. Scholander (TRH).

*Cladonia coccifera* (L.) Willd. (1787)

**Primary thallus** as decumbent to ascending squamules, yellow-green, to 5 mm long. **Podetia** pale yellow-green, to 2 cm high, scyphose; scyphi to 10 mm wide. Podetia areolate to continuously corticate, 260–280 µm thick; cortex indistinct, medulla 75–77 % and stereome 23–25 %. **Apothecia** red.

**Chemistry.** Usnic acid, zeorin, ± unidentified terpenoids (traces).

**Ecology.** On soil and among mosses.

**Distribution.** Common and widespread.

**Notes.** In herbarium specimens containing unidentified terpenoids, crystal needles are projecting from the surface (see Tønsberg 1992). World distribution: cosmopolitan.

**Specimens seen** (selected): Trinityhamna, 24.8.1928, O.A. Høeg (TRH); Barentsøya, 26.8.1936, E. Dahl (O); Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9858a (BG).

*Cladonia crispata* (Delise) Vainio var. *cetrariiformis* (Delise) Vainio (1887)

**Primary thallus** evanescent. **Podetia** up to 5 cm high and 2 mm wide, grey to brown-grey, irregularly ramified, often terminating in a cup-like structure which is a perforation surrounded by ± irregular proliferations, rarely squamulose. Base not melanotic. Podetium wall 145–180 µm thick, with cortex 17–21 %, medulla 28–41 %, and stereome 38–55 %. **Apothecia** brown.

**Chemistry.** Squematic acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common in the southern parts.

**Notes.** Differs from *C. subfurcata*, which also has squematic acid, in its paler colour, lack of melanotic parts at base, and cup-like structures with irregular proliferations. World distribution: Europe, North America (including Greenland), Asia, Australia.

**Specimens seen** (selected): Hornsund, 2002, P. Osyczka 313 (KRA); Bellsund, 1987, F. Swies 2522 (KRA).

*Cladonia cyanipes* (Sommerf.) Nyl. (1858)

**Primary thallus** not seen. **Podetia** up to 3 cm high and 4 mm broad, tapering, without scyphi, pale yellowish, sorediate, with naked spots where the sterome is visible. Stereome 55–65 µm thick; medulla plus soredia 110–130 µm. Soredia 28.8 ± 2.0 µm. **Apothecia** pale brown.

**Chemistry.** Usnic and barbatic acids.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Kong Karls Land, Retziusfjellet 12.8.1936, E. Dahl (O); Trinityhamna, Magdalena fjorden [Magdalenefjorden], 24.8.1928, O.A. Høeg (TRH).

### *Cladonia dahliana* Kristinsson (1974)

**Primary thallus** as 2–6 cm wide tufts; squamules erect, 4–5 mm high and up to 5 mm broad, often divided, with beige to brown corticate surface and white to dirty white, sometimes faintly striated ecorticate surface; margin sometimes pruinose in upper part. No **podetia** seen. Brown pycnidia rarely present, laminal.

**Chemistry.** Atranorin and psoromic acid.

**Ecology.** On soil.

**Distribution.** Scattered.

**Notes.** Described from Iceland (Kristinsson 1974) and claimed to have basal squamules different from those of its putative closest allies *C. symphyccarpia* and *C. cariosa*. It has never been found with podetia. As it has a distinct chemistry and also a geographical distribution different from its closest allies, we treat it here as a distinct species. New to Svalbard. World distribution: Europe (Scandinavia, Svalbard, Iceland), Siberia, North America (Greenland).

**Specimens seen** (selected): Longyearbyen, 1998, E. Vie (BG); Nordkapp, 7.9.1868, Th.M. Fries (O-L149658).

### *Cladonia deformis* (L.) Hoffm. (1796)

**Primary thallus** as ascending, fanshaped squamules, up to  $4 \times 2.5$  mm, lower side ochre, upper side yellowish. **Podetia** up to 2 cm high and 3 mm broad, with narrow scyphi, sorediate almost to base, yellowish. At base with cortex and small squamules. Stereome 340–350  $\mu\text{m}$ ; medulla with soredia 90–100  $\mu\text{m}$ . Soredia  $27.3 \pm 2.5 \mu\text{m}$ . **Apothecia** red.

**Chemistry.** Usnic acid, zeorin.

**Ecology.** On soil and among bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Amsterdamsøya, E. Dahl 26.8.1936 (O); Krossfjorden, A. Elvebakk 85:291 (TROM).

### *Cladonia fimbriata* (L.) Fr. (1831)

**Primary thallus** as ascending squamules, up to 2 mm high and 1 mm wide, simple or ramified. **Podetia** grey to grey-brown, up to 1.5 cm high and 7 mm wide (scyphi), midway up 1.3 mm wide, sorediate in uppermost 65%, lowermost part with small squamules, corticate. Scyphi flaring, with proliferations in margin. Podetium wall 330–340  $\mu\text{m}$  thick, with stereome 66–70% and medulla with soredia 30–34%. Soredia  $39.3 \pm 1.5 \mu\text{m}$ . **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South

America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Bockfjorden, A.A. Frisvoll 16.8.1974 (TRH); Davishamna, 29.7.1936, E. Dahl (O).

***Cladonia floerkeana* (Fr.) Flörke (1828)**

**Primary thallus** evanescent. **Podetia** up to 1.5 cm high, grey-brown, ramified in uppermost part, without scyphi, at base granulate, in upper part coarsely sorediate. Pycnidial gel brownish (Svalbard specimen). Stereome 80–85 µm thick; medulla (weakly developed) 20–40 µm thick. Soredia 32–36 µm.

**Chemistry.** Barbatic acid and an unidentified fatty acid.

**Ecology.** On soil.

**Distribution.** Only known from Sjuøyane.

**Notes.** The Svalbard specimen represents a pigment deficient chemotype, i.e. rhodocladonic acid is lacking. New to Svalbard. World distribution: Europe, Taimyr, North America, southern South America, Australia, New Zealand.

**Specimen seen:** Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O; det. T. Ahti 2003).

***Cladonia galindezii* Øvstedal (1988)**

**Primary thallus** as dense, flattened cushions, up to 8 cm wide and 5 mm thick, grey to pale ochre. Squamules 0.3–2 mm wide, often involute, sometimes finger-like or irregularly divided in upper part; upper side sometimes white-pruinose. **Podetia** not seen in Svalbard material.

**Chemistry.** Atranorin and porphyrilic acid.

**Ecology.** On soil.

**Distribution.** Only known from Moffen and Van Keulenhamna.

**Notes.** New to Svalbard. The chemistry and the involute squamules characterize this taxon, which appears to be rare on Svalbard. World distribution: Antarctica, Europe (Pyrenees and Svalbard).

**Specimens seen:** Van Keylenhamna [Van Keulenhamna], 4.8.1926, B. Lynge (O); Moffen, 23.6.1931, P. F. Scholander (O).

***Cladonia gracilis* (L.) Willd. ssp. *elongata* (Wulfen) Vain. (1922)**

**Primary thallus** not seen. **Podetia** up to 1 cm high and 0.9 mm wide, tapering, escyphose; surface smooth to slightly mottled greenish-grey-brown, with or without a few small squamules. Podetium wall 210–230 µm thick with cortex 10–14 %, medulla 33–35 % and stereome 53–57 %. **Apothecia** brown.

**Chemistry.** Atranorin and fumarprotocetraric acid.

**Ecology.** Among bryophytes.

**Distribution.** Very common and widespread.

**Notes.** The only infraspecific taxon of *C. gracilis* known to occur on Svalbard. World distribution: Europe, Asia, North America (including Greenland), southern South America.

**Specimens seen** (selected): Red Bay [Raudfjorden], 21.7.1928, O.A. Høeg (TRH); Amsterdamøya, 1.8.1936, E. Dahl (O); Barentsøya, Steinbeisfjellet, 2.8.1936, E. Dahl (O; det. T. Ahti 2001).

*Cladonia groenlandica* (E. Dahl) Trass (1972)

**Primary thallus** mostly present, as small, round ascending areolae. **Podetia** to 1.5 cm high, tapering or with narrow scyphi which proliferate from the margin, green-brown, sorediate, mostly with squamules in lower part. Soredia in upper part of podetia but sometimes reaching almost to base. Soredia 23–28 µm ( $25.6 \pm 1.58 \mu\text{m}$ ). Podetium wall 310–370 µm, with cortex 14–15 %, medulla 30–32 % and stereome 53–56 %. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil.

**Distribution.** Only known from Sjuøyane.

**Notes.** New to Svalbard. We have examined the material (O) studied by Dahl (1950) when he described this taxon (as *C. cornuta* var. *groenlandica*). The holotype is rather crushed, but several well preserved paratypes from Greenland have been examined; these showed a soredium size of 26–30 µm, and a transverse section of podetia showed a cortex of 7–9 %, medulla 29–35 % and a stereome of 46–61 %. The Svalbard collection has also been compared to collections of *C. cornuta* from Finnmark, mainland northernmost Norway (material in BG, 5 collections studied). These have a transverse section 150–235 µm thick, with cortex 13–15 %, medulla 47–56 % and stereome 28–25 %. Soredium size is 16–22 µm (mean  $18.9 \pm 1.87 \mu\text{m}$ ). *C. groenlandica* differs from *C. cornuta* in its persistent primary squamules and by podetia which usually have abundant squamules, scyphi with marginal proliferations, coarse soralia which often reach almost to the base of the podetia, larger soredia and relatively thicker stereome. As opposed to most flora/checklist treatments we believe this is a taxon at species level. World distribution: Europe, North America including Greenland).

**Specimen seen:** Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O).

*Cladonia cf. islandica* Kristinsson & Ahti ined.

**Primary thallus** persistent, as ascending, elongate squamules, up to  $2 \times 1.3$  mm, pale green-grey on upper side, white on lower side. **Podetia** 1.1–3.3 cm high, 1.1–1.4 mm wide, pale grey-brown, coarsely granular and minutely squamulose in lower part and coarsely granular in upper part. Stereome 210–230 µm thick, white medulla with granules 210–220 µm thick. Stereome blackened in lower part; no cortex present. Scyphi closed, narrow, with proliferating margin.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Iceland and Svalbard.

**Notes.** New to Svalbard. The Svalbard material differs in having mostly scyphose podetia, whereas Icelandic specimens mostly are ascophyse.

**Specimens seen:** Nordaustlandet, Rijpfjorden, 17.8.1936, E. Dahl (O); Brennevinsbukta [Brennevinfjorden], 21.8.1936, E. Dahl (O); Barentsøya, N side of Steinbeisen, 1.8.1936, E. Dahl (O).

*Cladonia luteoalba* A. Wils. & Wheld. (1907)

**Primary thallus** as broad, round (up to 10 mm) squamules with strongly incurved margins. Upper side grey-green; lower side yellow and fluffy. **Podetia** not seen in Svalbard material, escyphose, decorticate, rudimentary, never found with well-developed hymenial discs. Colour of **apothecia** unknown.

**Chemistry.** I: Usnic acid, zeorin, unidentified terpenoids; II: Usnic, squamicatic and didymic acids; III: Usnic acid, barbatic acid, 4-O-demethylbarbatic acid, ± unidentified pigment (at Rf-classes

B3, C3); IV: Usnic acid, didymic acid, unidentified substance with didymic acid (tr.), unidentified pigment (at Rf-classes A4, B4, C3); V: Usnic acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Scattered, but not rare.

**Notes.** In herbarium specimens of chemotype I crystal needles were projecting from the surface; this is apparently due to the presence of terpenoids (see Tønsberg 1992). The chemistry and morphology of *C. luteoalba* was treated by Stenroos (1990). The strain V above, with usnic acid only, appears to be new. World distribution: Europe, North America (Greenland), Asia, southern South America.

**Specimens seen** (selected): Nordenskiöld Land, Hollendarbukta, 1986, T. Tønsberg 9861 (chemotype I; BG); Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9925a (chemotype II; BG); Nordenskiöld Land, Reindalen, near Sørhytta, 1986, T. Tønsberg 9871, 9874 (chemotype III; BG); between Longyearbyen and Bjørndalen, 2003, T. Tønsberg 31848 (chemotype IV; BG); Nordenskiöld Land, Reindalen, E of Sørhytta, 1986, T. Tønsberg 9889 (chemotype V; BG).

### *Cladonia macroceras* (Delise) Hav. (1927)

**Primary thallus** as up to  $0.5 \times 1$  mm large squamules. **Podetia** usually decumbent (but see comments), to 2 cm long, with a brown distinctly bullate surface, without scyphi or with minute, blackish scyphi. A few small squamules usually present on podetia. Podetium wall 285–340  $\mu\text{m}$  thick, with cortex 15–16 %, medulla 56–59 % and stereome 12–26 %. **Apothecia** brown.

**Chemistry.** Atranorin and fumarprotocetraric acid.

**Ecology.** A wide range of habitats, from snow-beds to exposed ridges, from acid to calcareous ground.

**Distribution.** Widespread and common.

**Notes.** A deviating form is erect, up to 5 cm high, with scyphi repeatedly proliferating from margins, and with ovate openings. *C. macroceras*, represented by its main form, appears to be the most abundant *Cladonia* species on Svalbard; it has a wide ecological amplitude. World distribution: circumarctic-boreal.

**Specimens seen** (selected): Edgeøya, 7.8.1936, E. Dahl (O); Sørkapp, Keilhaufjellet, 12.7.1930, S. Kristoffersen (TROM, det. T. Ahti); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9849 (BG; det. T. Ahti 2001).

### *Cladonia macropylla* (Schaer.) Stenh. (1865)

**Primary thallus** as small, round squamules, up to  $1 \times 1$  mm. **Podetia** up to 2 cm high, densely covered by squamules, with longitudinal fissures. No scyphi. Stereome 350–400  $\mu\text{m}$  thick. **Apothecia** brown.

**Chemistry.** Psoromic, rangiformic and norrangiformic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Sjuøyane, Phippsøya, 19.8.1936, E. Dahl (O); Trinityhamna, 24.8.1928, O.A. Høeg (TRH).

### *Cladonia macrophyllodes* Nyl. (1875)

**Primary thallus** as tufts of broad, ascending squamules, up to 4–5 mm wide and equally high, brown-grey on upper side, white on lower side. A vertical transect showed a thickness of 190–200

$\mu\text{m}$ , with an upper cortex comprising 22–50 % of total thickness. Podetia not seen on Svalbard material. **Apothecia** brown.

**Chemistry.** Atranorin and fumarprotocetraric acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America.

**Specimens seen** (selected): Adventfjorden, Hotellneset, 25.7.1936, E. Dahl (O).

*Cladonia merochlorophaea* var. *merochlorophaea* Asah. (1940)

**Primary thallus** as small, ascending squamules. **Podetia** up to 1.5 cm high, brown to grey-brown, sorediate in upper part, scyphose. Scyphi to 8 mm wide. Stereome 140–190  $\mu\text{m}$  thick; medulla very variable; cortex absent. Soredia 60–80  $\mu\text{m}$  diam. **Apothecia** brown.

**Chemistry.** Merochlorophaeic and 4-O-methylcryptochlorophaeic acids.

**Ecology.** Among mosses.

**Distribution.** Only found once.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand.

**Specimen seen:** Nordan斯基old Land, Reindalen, 1986, T. Tønsberg 9833 (BG).

*Cladonia phyllophora* Hoffm. (1796)

**Primary thallus** as small, round squamules. **Podetia** up to 4 cm high, ramified, grey-brown, scyphose, older parts with black cartilaginous tissue visible, young parts subarachnoid. Cortex 11–12 %, medulla 57–60 % and stereome 28–30 %. Scyphi small, irregular, proliferating from margin.

**Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid,  $\pm$  atranorin.

**Ecology.** Among bryophytes.

**Distribution.** Scattered but not rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Antarctica.

**Specimens seen** (selected): Barentsøya, N.V.-siden av Steinbeisfjellet, E. Dahl 1.8.1936 (O); Trinityhamna, Magdalena-fjorden, 24.8.1928, O.A. Høeg (TRH).

*Cladonia pleurota* (Flörke) Schaer. (1850)

**Primary thallus** as ascending, yellow-green squamules. **Podetia** up to 1.5 cm high, scyphose, yellow-green, sorediate. Scyphi up to 8 mm broad. Stereome 100–110  $\mu\text{m}$  thick, with a medulla of variable thickness and no cortex. Soredia 36–40  $\mu\text{m}$ . **Apothecia** red.

**Chemistry.** Usnic acid, zeorin, porphyrilic acid.

**Ecology.** On soil and among bryophytes

**Distribution.** Widespread and common.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Trinityhamna, 24.8.1928, O.A. Høeg (TRH); Mohnhøgda, 14.8.1936, E. Dahl (O).

*Cladonia pocillum* (Ach.) O.J. Rich. (1878)

**Primary thallus** as a brown, 3–4 wide crust, composed of decumbent squamules. **Podetia** up to 1.5 cm high, grey-green to brown, scyphose, surface rough. Scyphi to 10 mm wide. Podetium wall 265–290 µm thick, with cortex 7–8 %, medulla 59–60 % and stereome 32–34 %. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On calcareous soil or on bryophytes on calcareous soil.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Forsbladhamna, 29.7.1926, B. Lynge (O); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9890 (BG).

*Cladonia pyxidata* (L.) Hoffm. (1796)

**Primary thallus** ± prominent, as ascending squamules, up to 5 mm long. **Podetia** up to 1.5 cm high, scyphose; cortex smooth, grey-green to grey-brown. Scyphi flaring, up to 8 mm broad. Podetium wall 330–340 µm, with cortex 7–10 %, medulla 35–40 %, and stereome 50–55 %. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil.

**Distribution.** Widespread and common.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Rijpfjorden, 7.8.1936, E. Dahl (O); Longyearbyen, 23.7.1936, E. Dahl (O).

*Cladonia rangiferina* (L.) Weber ex Wigg. (1780)

**Primary thallus** not seen. **Podetia** grey, richly branched, branching predominantly trichotomous; tips oriented towards one direction.

**Chemistry.** Atranorin and fumarprotocetraric acid.

**Ecology.** Among bryophytes.

**Distribution.** Scattered but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Kong Karls Land, Mohnhögda, 14.8.1936, E. Dahl (O); Nordenskiöld Land, N of Reindalen, 1986, T. Tønsberg 9916 (BG).

*Cladonia squamosa* Hoffm. (1796)

**Primary thallus** not observed. **Podetia** up to 3 cm high, erect, to 1.3 mm wide densely covered by erect to ascending squamules; non-scyphose, brown-grey. Axils perforate. **Apothecia** brown.

**Chemistry.** Squamic acid

**Ecology.** As tufts in moss polsters.

**Distribution.** A few scattered occurrences.

**Notes.** Characterized by its squamulose, non-scyphose podetia with squamic acid. World distribution: cosmopolitan.

**Specimens seen:** Barentsøya, Steinbeisen, 1.8.1936, E. Dahl (O); Indre Norskøya, 4.7.1928, O.A. Høeg (TRH).

*Cladonia stellaris* (Opiz) Pouzar & Vězda (1971)

**Primary thallus** not seen. **Podetia** to 3 cm high, grey-green, richly branched, appearing as compact heads; tips not oriented in one direction; branching predominantly trichotomous.

**Chemistry.** Usnic and perlatolic acids.

**Ecology.** On soil.

**Distribution.** Only known from Magdalene fjorden.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** None seen; based on material collected in 1814 and cited by Ahti (1984).

*Cladonia stricta* (Nyl.) Nyl. (1869) s. str.

**Primary thallus** not seen. **Podetia** in dense tufts, up to 2 cm high, 0.3 mm wide, wiry, green-grey; surface with convex, round areolae; most specimens tapering; no or little black tissue at base. Podetium wall 180–190 µm thick, with cortex 11–13 % of total thickness, medulla 36–38 % and stereome 50–52 %. Scyphi rare, with a few perforations, 2–4 × width of podetia, with marginal projections. Axils closed, **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid, ± atranorin

**Ecology.** On soil and among bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Sjuøyane, Phippsøya, E. Dahl, 18.8.1936 (O); Virgohamna, 7.7.1928, O.A. Høeg (TRH); both specimens det. T. Ahti 2003.

*Cladonia stygia* (Fr.) Ruoss (1985)

**Primary thallus** not seen. **Podetia** very similar to those of *C. rangiferina*, but differ in showing a more blackish stereome at base, and in having red gel in the pycnidia.

**Chemistry.** Atranorin, fumarprotocetraric acid.

**Ecology.** Among bryophytes.

**Distribution.** Rare.

**Notes.** From Svalbard previously only reported from Bjørnøya. World distribution: Europe, North America (Greenland).

**Specimens seen:** Ny-Ålesund, A. Elvebakk 99:229 (TROM); Prins Karls Forland, 2 km E of Fuglehuken, A. Elvebakk 94:019 (TROM).

*Cladonia subfurcata* (Nyl.) Arnold (1855)

**Primary thallus** not observed. **Podetia** often decumbent, somewhat turgid, up to 5 cm long and 3 mm broad, with at least some perforate axils, escyphose, green-brown, at base with blackish tissue between corticated areolae. **Apothecia** brown.

**Chemistry.** Squematic acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O); Signehamna, 1964, A. Hjelle (O); Carls [Prins Karls] Forland, 15.8.1868, Th.M. Fries (O-L149657).

*Cladonia subulata* (L.) Wigg. (1780)

**Podetia** up to 3 cm long, and 1.5 mm wide, subulate or very rarely with narrow scyphi, yellow-white to pale green-brown, sorediate in upper 70% of podetia, in lower 30% with plate-shaped, small, pale brown areolae and a few squamules perpendicular to surface. At base (corticated area) transverse section 390–410 µm, with cortex 5–10 %, medulla 50–55 % and stereome 40–45 %. Soredia 35–40 µm wide. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil.

**Distribution.** Scattered but not uncommon.

**Note.** World distribution: Europe, Asia, North America, Argentina, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Barentsøya, N of Steinbeisen, 1.8.1936, E. Dahl (O); Magdalenafljorden [Magdalenefjorden], 24.8.1928, O.A. Høeg (TRH).

*Cladonia sulphurina* (Michx.) Fr. (1831)

**Primary thallus** as ascending squamules, up to 5 mm high and 3 mm broad, ramified, grey-green on upper side, pale ochre on lower, sorediate in margin. **Podetia** up to 2.5 cm high, and 4 mm broad, escyphose, fissured and irregular, at base ocraceous green with cortex and a few squamules, otherwise green-grey and sorediate. Medulla with soredia 44–46 %, stereome 54–56 %. Soredia 21.5 ± 3.0 µm. **Apothecia** red.

**Chemistry.** Usnic and squamatic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America, southern South America, New Zealand, Antarctica.

**Specimens seen:** Krossfjorden, A. Elvebakk 85:274 (TROM); Prins Karls Forland, Fuglehuken, A. Elvebakk 94:001 (TROM).

*Cladonia symphyarpia* (Ach.) Fr. (1828).

**Primary thallus** as large, round ascending squamules, usually in dense tufts. Upper side grey-green, lower side white. In vertical section the squamule is 290–300 µm thick, with 28–32 µm thick cortex; ectocarpate lower side with protruding hyphae, coarsely warted, 5–6 µm thick. Podetia not seen. **Apothecia** brown.

**Chemistry.** Atranorin, norstictic acid.

**Ecology.** On calcareous soil.

**Distribution:** Common and widespread.

**Note.** World distribution: Europe, Asia, North America, southern South America..

**Specimens seen** (selected): Nordaustlandet, Brennevinsbukta [Brennevinsfjorden], 21.8.1936, E. Dahl (O); Lomfjorden, indenfor Klettbrean, 13.8.1931, Scholander (O-L149677).

***Cladonia trassii*** Ahti (1998)

Type: Sweden, Lappland, 1922, C. Stenholm (Sandstede: Cladoniae exsiccatae 1134, [H!]).

**Primary thallus** of up to 5 mm wide squamules. **Podetia** 3–8 cm high, up to 3 mm thick, grey, usually becoming brown, with numerous large squamules, scyphose; axis closed; base melanotic, with checkered surface. Scyphi narrow and often irregular, with central proliferations. Podetium wall 215–225 µm thick, with cortex 9–12 %, medulla 42–44 %, and stereome 44–49 %. **Apothecia** brown.

**Chemistry.** Atranorin, fumarprotocetraric acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Widespread in the southern part.

**Notes.** Differs from the two other species of the *C. stricta* complex, *C. stricta* and *C. uliginosa*, in the following characters: *C. stricta* has scyphi proliferating from margins and with well-developed perforations, squamules that are small and few, and atranorin is often lacking; *C. uliginosa* has regular scyphi which proliferate, often repeatedly, from centre and podetia with a few large squamules (Ahti 1998, Osyczka 2005). World distribution: Europe (in mainland Norway, common only in Troms and Finnmark [Ahti pers. comm. 2005]), Siberia, arctic North America (incl. Greenland), Argentina.

**Specimens seen** (selected): Hornsund, 2002, P. Osyczka 282, 283 (KRA).

***Cladonia turgida*** (Ehrh.) Hoffm. (1796)

**Primary thallus** as ascending, irregularly divided squamules, up to 10 mm high and 2 mm wide, green-grey on upper side and white on lower side. In vertical transections the squamules are 230–250 µm thick, with an upper cortex 30–60 µm high, composed of a pseudoparenchymateous tissue with relatively large, thickwalled cells with small lumina, a medulla 100–190 µm high, with algae just below cortex, pseudoparenchymateous with indistinct cells in central parts, towards lower side cell walls more distinct. **Podetia** turgid, up to 3 cm high and 4 mm broad, when young fairly regular with indistinct, perforate scyphi, later becoming distorted, split and ragged with indistinct scyphi, grey-green, esorediate, tessellate in upper part with pale stereome showing. Pycnidium gel brown.

**Chemistry.** Fumarprotocetraric acid, ± atranorin.

**Ecology.** On soil and among bryophytes.

**Distribution.** Only found once in Virgohamna.

**Notes.** The specimen was cited by Lyngé & Scholander (1937: 33) and accepted by Lyngé and Sandstede. It could not be traced in O. The description above is based on a specimen (BG) from the mountains of mainland Norway. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Virgohamna, 1928, O.A. Høeg (O; not seen, record based on Lyngé & Scholander 1937).

***Cladonia uliginosa*** (Ahti) Ahti (1998)

**Primary thallus** evanescent. **Podetia** up to 3 cm high and 3 mm wide, grey, usually somewhat brownish, with few to many squamules, usually scyphose; axis closed; base melanotic, with checkered surface; scyphi narrow, regular, usually repeatedly proliferating from centre. **Apothecia** brown.

**Chemistry.** Atranorin, fumarprotocetraric acid.

**Ecology.** On soil and among bryophytes.

**Distribution.** Only found once.

**Notes.** New to Svalbard. The Svalbard specimen is not typical, with podetia with numerous squamules. The diagnostic characters vs. *C. stricta* and *C. trassii*, are discussed below *C. trassii*. World distribution: Europe, North America.

**Specimen seen:** Prins Karls Forland, Fuglehuken, A. Elvebakk 94:026/27 (TROM; det T. Ahti 2003).

### *Cladonia uncialis* (L.) Wigg. (1780)

**Primary thallus** not seen. **Podetia** 1–2 cm high, pale yellowish; tips brownish. Cortex smooth. No scyphi or apothecia. Podetium wall 150–160 µm thick, with cortex 17–20 %, medulla 50–53 % and stereome 27–33 %. **Apothecia** brown.

**Chemistry.** Usnic acid, ± squamatic acid.

**Ecology.** Among bryophytes.

**Distribution.** Common and widespread.

**Notes.** The collections from Svalbard all belong to ssp. *uncialis*. World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Edgeøya, 7.8.1936, E. Dahl (O); Van Keylenhamna [Keulenhamna], 3.8.1926, B. Lynge (BG).

### *Cladonia verticillata* (Hoffm.) Schaeer. (1823)

**Primary thallus** not seen. **Podetia** up to 4.5 cm high, scyphose. Stem green-grey with dark areas, to 2 mm wide, with a few, small squamules; scyphi flaring, to 8 mm wide, repeatedly proliferating from centre. Podetium wall 190–200 µm wide, with cortex 10–11 %, medulla 42–45 % and stereome 47–50 %. **Apothecia** brown.

**Chemistry.** Fumarprotocetraric acid.

**Ecology:** Among bryophytes and on soil.

**Distribution.** Only known from Reindalen.

**Notes.** New to Svalbard. World Distribution: Europe, Asia, North America, Argentina.

**Specimen seen:** Reindalen, Elvebakk 86:514 (TROM; det. T. Ahti 2000).

### **CLAUROUXIA** D. Hawksw. (1988)

**Thallus** crustose, areolate. Photobiont trebouxioid. **Ascomata** apothecia, black, immersed in thallus, without thalline margin. True margin ± raised, carbonised, easily fragmented. Hypothecium black, continuous with excipulum. Asci strongly thickened at apex; inner wall K/I + blue; apical cushion K/I –. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, unbranched, moniliform; end cell enlarged, with brown cap. Pycnidia not known.

### *Claurouxia chalybeoioides* (Nyl.) D. Hawksw. (1988)

**Thallus** black, medium thick, rimose, 2–3 cm wide. **Apothecia** immersed in thallus, black, 0.2–0.4 mm wide; true excipulum slightly protruding. Hypothecium and excipulum brown-black. Hymenium 50–60

$\mu\text{m}$  high. Epitheciun aeruginose. Ascospores 8 per ascus, subglobose,  $9–11 \times 7–8 \mu\text{m}$ . Paraphyses branched, almost moniliform in upper part.

**Chemistry.** Negative.

**Ecology.** On siliceous rock in wet habitats.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe.

**Specimens seen** (selected): Kobbefjorden, Th.M. Fries 1868 (O); A. Elvebakk 81:1334 (TROM); Ahlstrandodden, 20.7.1926, B. Lynge (O).

#### CLAUZADEA Hafellner & Bellem. (1984)

**Thallus** crustose, mostly immersed. Photobiont *Trebouxia*. **Ascomata** apothecia, blackish to red-brown, immersed to sessile, without thalline margin. True exciple black to brownish in section. Hypothecium colourless to red-brown. Asci of *Porpidia*-type. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, branched to anastomosing; end cell little or not enlarged. Conidia bacilliform.

**Note.** A small genus found on calcareous rock.

#### *Clauzadea monticola* (Ach.) Hafellner & Bellem. (1984)

**Thallus** indistinct, within rock. **Apothecia** up to 0.5 mm diam., sessile, disc dark brown, flat, true margin raised, black. Hymenium  $60–65 \mu\text{m}$  high, uppermost part yellowish to brownish, N $-$ . Exciple and hypothecium red-brown. Ascospores  $8–12 \times 5–7 \mu\text{m}$ . Paraphyses somewhat ramified, end cell not enlarged.

**Chemistry.** Not performed.

**Ecology.** On Ca-rich sandstone, with *Placynthium* sp.

**Distribution.** Only known from Grønfjorden.

**Notes.** Externally similar to species of *Lecidella*, *Farnoldia* and *Carbonea*. *Lecidella* differs in having a pale hypothecium, whereas *Farnoldia* and *Carbonea* have black exciples and N + red epithecia. New to Svalbard. World distribution: Europe, Siberia, North America (including Greenland), New Zealand.

**Specimen seen:** Grønfjorden, 31.7.1868, Th.M. Fries (O).

#### COLLEMA F.H. Wigg. (1780)

**Thallus** foliose, rarely crustose or fruticose, blackish, swelling when wet. Cortex absent. Photobiont *Nostoc*. **Ascomata** apothecia, sessile to stalked, with thalline exciple. True exciple distinct, of various tissue types. Asci with K/I + blue tholus. Ascospores 2–16 in ascus, colourless, septate to muriform. Hamathecium of paraphyses, simple to branched. Conidia cylindrical.

No lichen substances.

Key to *Collema* on Svalbard:

1	Thallus as narrow, convex, radiating lobes .....	<i>C. parvum</i>
1	Lobes broader .....	2
2 (1)	On rock .....	3
2	On soil or over bryophytes .....	4
3 (2)	Margin with globose isidia .....	<i>C. cristatum</i>
3	Margin without isidia .....	<i>C. polycarpum</i>
4 (2)	Lobes ascending, terete .....	<i>C. ceraniscum</i>
4	Lobes ± decumbent, flat .....	5
5 (4)	Apothecium margin coarsely crenate .....	<i>C. bachmannianum</i>
5	Apothecium margin regular .....	6
6 (5)	With laminal, squamiform isidia .....	<i>C. flaccidum</i>
6	Without isidia .....	<i>C. tenax</i>

***Collema bachmannianum* (Fink) Degel. (1954)**

**Thallus** foliose, 5–10 mm wide, with irregular outline, dark olive green. Isidia rare, large, globose. **Apothecia** up to 1.3 m diam.; disc concave, red-brown, thalline margin coarsely crenate with lobules. Ascospores 8 per ascus, submuriform, 24–26 × 10 µm.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Brøggerhalvøya, Kjærstranda, 16.8.1976, A. Elvebakk (TRH); Isfjorden, Diabasodden, 11.7.1939, E. Hadač (O); Degelius det. 1950).

***Collema ceraniscum* Nyl. (1865)**

**Thallus** as small tufts, up to 1 cm wide, composed of ascending, intricately branched, terete at tips, 0.5–1 mm wide, black lobes. **Apothecia** urceolate; disc to 0.5 mm wide, red-brown; thalline margin thin, mostly regular but with a few globose outgrowths. Ascospores 4 per ascus, muriform, subglobose, 20–30 × 15–20 µm.

**Ecology.** Over bryophytes.

**Distribution.** Common.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Kong Karls Land, Retziusfjellet, 12.8.1936, E. Dahl (O); Adventfjorden, Hotellneset, 25.7.1936, E. Dahl (O).

***Collema cristatum* (L.) Weber ex F.H. Wigg. (1790)**

**Thallus** several cm wide, dark olive green; lobes narrow, concave, with thickened margins with globose isidia. **Apothecia** rare, laminal, up to 1 mm wide, with flat, red-brown disc and thin, somewhat

irregular thalline margin. Ascospores 4–8 per ascus, muriform, 15–22 × 8–12 µm.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Kongsfjorden, Gluudneset, A. Elvebakk 85:322 (TROM); Kongsfjorden, Blomstrandhalvøya, 13.7.2003, A. Elvebakk 03:113 (TROM).

#### *Collema flaccidum* (Ach.) Ach. (1810)

**Thallus** 2–3 cm wide, with broad lobes, olive green to blackish. Lobes thin, rounded, to 10 mm broad, with laminal squamiform isidia. **Apothecia** laminal, up to 0.6 mm wide, sessile with constricted base; margin thin, regular, slightly paler than disc. Ascospores 8 per ascus, 3-septate to submuriform, 17–19 × 5–7 µm.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, Australia.

**Specimens seen** (selected): Adventfjorden [Hiorthhamn], 24.7.1936, E. Dahl (O); Edgeøya, 7.8.1936, E. Dahl (O).

#### *Collema parvum* Degel. (1954)

**Thallus** foliose, dark olive green to blackish, as elongate, convex lobes, 1.5 mm long and 0.2–0.4 mm broad, fan-shaped at end. Isidia absent. **Apothecia** not seen in Svalbard material.

**Ecology.** On limestone.

**Distribution.** Only known from Bockfjorden.

**Note.** World distribution: Europe.

**Specimen seen:** Bockfjorden, 1979, J. Hafellner (GZU).

#### *Collema polycarpon* Hoffm. (1796)

**Thallus** foliose, blackish, 1–2 cm wide, as ascending canaliculate lobes 0.5–1 mm wide with thickened margin. **Apothecia** common, at end of lobes, to 1.5 mm wide, flat; disc red-brown; thalline margin thin, regular. Ascospores fusiform, 3-septate, 18–22 × 5–7 µm.

**Ecology.** On limestone.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 1975 (TRH); Dicksonfjorden, Lyckholmdalen, 9.7.1936, E. Dahl (O).

#### *Collema tenax* (Sw.) Ach. em Degel. (1810)

**Thallus** up to 1 cm diam., dark olive green, as irregularly divided, flat to concave lobes with thickened margin. **Apothecia** marginal, up to 1.5 mm diam.; disc red-brown; thalline margin thin, regular. Ascospores 8 per ascus, fusiform, 3-septate, 14–16 × 4–6 µm.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America.

**Specimens seen** (selected): Dicksonfjorden, 6.7.1936, E. Dahl (O); Lyckholmdalen, 9.7.1936, E. Dahl (O).

## COLLEMOPSIDIUM Nyl. (1872)

**Thallus** crustose, subgelatinous. Photobiont cyanobacteria. **Ascomata** perithecia; involucellum usually absent; true exciple dark brown; tissue cellular, melanized. Ascospores 1-septate, colourless, 8 per ascus. Hamathecium pseudoparaphyses, branched to anastomosing, septate. Conidia ellipsoid to bacilliform.

Key to *Collemopsidium* on Svalbard:

1	On barnacles.....	<i>C. sublitorale</i>
1	On bryophytes .....	<i>C. bryosporum</i>

### *Collemopsidium bryosporum* (Nyl.) Coppins (2003)

Fig. 21 (p. 228).

**Thallus** 2–3 cm wide, dark grey to dark grey-brown, non-corticate, thick to thin. Photobiont a golden brown cyanobacteria, with colonies 50–60 µm wide; individual cells 5–6 µm, with a thick, gelatinous sheath. **Perithecia** black, 0.2–0.3 mm diam., half sessile; ostiole central. Ascomata wall brown-black, composed of a textura intricata. Ascii sub-cylindrical, 85–90 × 18–20 µm, with a distinct ocular chambre. Ascospores 8 in ascus, in one or two rows, uncoloured, 1-septate with cells unequal in size, constricted at septum, 28–32 × 7–9 µm; surface smooth; inner wall uneven. Pseudoparaphyses thin, flexuose, ramified to anastomosing. Hymenial gel K/I –. Pycnidia not seen.

**Chemistry:** Not studied.

**Ecology.** On moribund bryophytes.

**Distribution.** Rare.

**Notes.** New to Svalbard. World distribution: North Europe, North America.

**Specimen seen:** Nordenskiöld land, between Vestpynten and Bjørndalen, Haugan 6914 (O).

### *Collemopsidium sublitorale* (Leight.) Grube & B.D. Ryan (2002)

**Thallus** immersed in substratum. **Perithecia** up to 1.5 mm diam., immersed in substratum. True exciple dark brown, cellular. Involucellum absent. Ascospores 8 per ascus, colourless, 1-septate with cells unequal in size, 12–20 × 5–10 µm. Pseudoparaphyses anastomosing.

**Chemistry.** Not studied.

**Ecology.** On barnacles.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (Greenland), Asia, New Zealand.

**Specimen seen:** Barentsøya, 1.8.1936, E. Dahl (O).

**CYSTOCOLEUS** Thwaites (1949)

**Thallus** filamentous, brown-black, with fungal hyphae surrounding the algal filaments; growing in dense mats. Photobiont *Trentepohlia*. **Apothecia** and pycnidia unknown.

*Cystocoleus ebeneus* (Dillwyn) Thwaites (1949)

**Thallus** filamentous, black, growing in dense mats. Filaments 14–16 µm diam., consisting of a *Trentepohlia* filament surrounded by fungal hyphae.

**Chemistry.** Negative.

**Ecology.** Among bryophytes.

**Distribution.** Only known from Bockfjorden and Wargentindalen.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimen seen:** Bockfjorden, Trolltindane, 16.8.1974, A.A. Frisvoll (TRH).

**DACAMPIA** Massal. (1853)

**Thallus** crustose or lichenicolous. **Ascomata** perithecia, with dark, true exciple. Ascospores muriform, brown. Hamathecium paraphyses.

*Dacampia hookeri* (Borrer) Massal. (1853)

**Thallus** crustose, 1–2 cm wide, white, sublobulate at margins; surface powdery to smooth. Lowermost part of thallus of brown-pigmented hyphae; medulla dense, with algae (*Coccomyxa*); uppermost part a ± thick epinectral layer (no cortex present). **Perithecia** up to 0.3 mm wide; ostiole protruding. True exciple dark. Paraphyses persistent, branched. Ascospores 8 per ascus, muriform, brown, 28–32 × 11–13 µm. Sometimes with cephalodia.

**Chemistry.** Negative.

**Ecology.** on soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Mountains of Europe and North America (Henssen 1995), Siberia (Kristinsson et al. 2006).

**Specimens seen** (selected): Lovénfjellet, 1861, K. Chydenius (UPS; det A. Henssen); Sassendalen, A. Elvebakk 86:553 (TROM).

**DACTYLINA** Nyl. (1858)

**Thallus** fruticose, ± dichotomously branched, yellowish, without rhizines. Cortex 1- or 2-layered; interior becoming hollow or arachnoid. Photobiont trebouxiod. **Apothecia** terminal, with thalline margin. Ascospores 8 per ascus, sphaerical, uncoloured, simple. Paraphyses little branched. Conidia citriform

**Note.** See also *Allocetraria*.

Key to *Dactylina* on Svalbard:

- |   |   |                    |
|---|---|--------------------|
| 1 | Thallus with medulla; containing physodic and physodalic acids..... | <i>D. ramulosa</i> |
| 1 | Thallus without medulla, with gyrophoric acid .....                 | <i>D. arctica</i>  |

***Dactylina arctica*** (Richards.) Nyl. (1858)

Fig. 22 (p. 228).

**Thallus** 2 cm high, and up to 5 mm broad at base, tapering, inflated, pale yellow, little ramified. No medulla.

**Chemistry.** Usnic and gyrophoric acids.

**Ecology.** Among bryophytes.

**Distribution.** Scattered in N and NW parts of Svalbard.

**Note.** World distribution: circumarctic.

**Specimens seen** (selected): Bockfjorden, Sverrefjellet, A. Elvebakk 81:1029; 81:1215 (TROM).

***Dactylina ramulosa*** (Hook.) Tuck. (1862)

**Thallus** 0.5–1 cm high, 1–3 mm wide, terete, pale yellow, dichotomously ramified (often compact so that ramification system little evident); tips violet-pruinose. Medulla web-like.

**Chemistry.** Usnic, physodic and physodalic acids.

**Ecology.** In moderate snowbeds or protected boulder fields associated with species such as *Cassiope tetragona* and *Dicranoweisia crispula*.

**Distribution.** Scattered in the N and NW parts of Svalbard.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Nordaustlandet, Brennevinsbukta [Brennevinsfjorden], Depotodden, 21.8.1936, E. Dahl (O); Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O).

**DERMATOCARPON** Eschw. (1824)

**Thallus** foliose, with one or several holdfasts. Upper side grey to brownish, often with a white pruina. Lower side smooth, ridged in some species, never with rhizinae or tomentum. Photobiont green algae. **Ascomata** perithecia, immersed in thallus, ostiole as dark spot. No involucellum present. Hamathecium of periphyses. Ascospores 8 per ascus, simple, colourless.

Conidia bacilliform. No lichen compounds present.

**Notes.** *Dermatocarpon rivulorum* has been reported from Hornsund (Olech 1987); we have seen one of the specimens on which this report was based, and found it to represent a young specimen of *D. polyphyllum*. Since we have seen no Svalbard material of the former species, it is omitted from the treatment below. *Dermatocarpon spitsbergense* Lynge was shown by Heiðmarsson (2001) to be conspecific with *D. polyphyllum*.

***Dermatocarpon polyphyllum* (Nyl.) Blomb. & Forssell (1921)**

**Thallus** foliose, polyphyllous, up to 2 cm wide, lobes 5–6 mm wide and up to 10 mm long, dark grey; lower side pale brown, often with a distinct net of ridges. Inner diameter of perithecia 200–220 µm. Ascospores broadly ovate, 11–13 × 7–9 µm. Medulla I + pink. Thallus 250–270 µm thick.

**Ecology.** On wet rock.

**Distribution.** Scattered but not uncommon.

**Note.** World distribution: Europe, North America, Antarctica.

**Specimens seen** (selected): Kongsfjorden, Brøggerhalvøya, A. Elvebakk 86:316 (TROM); Edgeøya, 7.8.1936, E. Dahl (O).

**DIMELAENA Norman (1852)**

**Thallus** crustose to placodioid, yellowish. **Ascomata** apothecia, sessile, with thalline margin. Asci of *Buellia*-type. Ascospores 8 per ascus, brown. 1-septate, thin-walled. Hamathecium of paraphyses, little ramified. Conidia bacilliform.

***Dimelaena oreina* (Ach.) Norman (1852)**

**Thallus** placodioid, yellow-white, with a greenish flush; marginal lobes radiate, 2 mm long and 1.5 mm broad, in inner part thallus rimose, with wide gaps between areolae. Prothallus black, often prominent. **Apothecia** in inner part, up to 1.3 mm diam., at first innate, later sessile, with a thin thalline margin becoming excluded; disc black, finally convex. Hymenium 100–110 µm high, epithecium blue-green. Ascospores 8 per ascus, brown, 1-septate, thin-walled.

**Chemistry.** Usnic acid, zeorin, undetermined xanthone.

**Ecology.** On rock

**Distribution.** A few scattered occurrences.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Amsterdamsøya, 26.8.1936, E. Dahl (O); Gipsdalens, A. Elvebakk 85:485 (TROM).

**DIPLOSCHISTES** Norman (1853)

**Thallus** crustose, pale. Photobiont *Trebouxia*. **Ascomata** apothecia, at first urceolate (perithecia-like), later more open, with a ± indistinct thalline margin. Ascii with apex K/I -. Ascospores 4–8 per ascus, brown (often pale when young), muriform. Hamathecium of paraphyses, unbranched. Conidia bacilliform to ellipsoid.

***Diploschistes muscorum*** (Scop.) R. Sant. (1980)

**Thallus** whitish, pruinose, continuous, verrucose. **Apothecia** up to 2 mm wide, urceolate; thalline margin indistinct; disc pruinose. Hymenium 90–100 µm high. Ascospores 4 per ascus, 28–32 × 11–13 µm.

**Chemistry.** Lecanoric acid, unidentified compound.

**Ecology.** Over bryophytes.

**Distribution.** Only known from Blomesletta.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America, Argentina, Australia, New Zealand.

**Specimen seen:** Blomesletta, 1974, A.A. Frisvoll (TRH).

**EIGLERA** Hafellner (1984)

**Thallus** crustose, epilithic. Photobiont trebouxioid. **Ascomata** apothecia, immersed in thallus, with true exciple only. Ascii with a K/I + blue tholus, and a K/I + blue fuzzy coat. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, simple to ramified. Conidia bacilliform.

***Eiglera flava*** (Hepp) Hafellner (1984)

**Thallus** crustose, up to 2 cm wide, smooth to cracked, without cortex, thin, pale yellow-grey. **Apothecia** immersed in thallus, up to 0.3 mm wide, black, without thalline exciple. Hymenium 60–80 µm high; epithecium blue-green. N + red. Hypothecium colourless. Ascospores 8 per ascus, simple, colourless, 12–15 × 7–9 µm. Paraphyses somewhat ramified; end cell enlarged to 2 µm diam. Conidia bacilliform, 4 × 1 µm. Medulla K/I -.

**Chemistry.** Negative.

**Ecology.** On wet sandstone.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Australia, Antarctica.

**Specimens seen** (selected): Berzeliusfjellet, 21.7.1926, B. Lyngé (O); Hopen, 30.7.1924, Iversen & Kofoed (TRH).

**ENDOCARPON** Hedw. (1789)

**Thallus** squamulose to minutely fruticose. Cortex pseudoparenchymateous. Photobiont *Stichococcus*, both in thallus and hymenium. **Ascomata** perithecia, immersed to protruding. No involucellum. True exciple brown. Ascii thick-walled, with a chitinous plug stained red in Congo Red. Ascospores 1–2 per ascus, multiseptate to muriform, colourless, often brownish when old. Hamathecium periphyses, hymenium with 1–2-celled hymenial algae. Conida rod-shaped.

*Endocarpon pulvinatum* Th. Fr. (1868)

syn. *E. tortuosum* Herre (1911).

**Thallus** as pulvinate tufts, up to 1 cm diam., with terete to irregular outgrowths, brown. **Perithecia** scattered on thallus, semiglobose, black, up to 0.5 mm diam. Perithecia with thalline margin. Cortex weakly pseudoparenchymateous, brown in outermost part. True exciple colourless, composed of short, strongly adglutinated hyphae running parallel with surface. Ascospores 2 per ascus, brown, muriform, 48–52 × 20–24 µm. Hymenial algae cylindrical, 1–2-celled, 8–14 × 2 µm, straight to curved. Paraphyses lacking, periphyses numerous.

**Chemistry.** Negative.

**Ecology.** On dry limestone, ornithocoprophilous.

**Distribution.** Common.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:086 (TROM); Bünzow Land, Gipsvika, A. Elvebakk 85:776 (TROM).

**EPILICHEN** Clem. (1909)

**Thallus** crustose to subsquamulose, or absent. Photobiont green algae. **Ascomata** apothecia, without thalline margin. True margin and hypothecium brown-black. Ascii with apex of tholus K/I + blue. Ascospores 8 per ascus, brown, 1-septate. Hamathecium of pseudoparapysoid-like filaments, anastomosing; end cell not enlarged.

*Epilichen scabrosus* (Ach.) Clem. (1909)

**Thallus** crustose, pale yellow-green, areolate. **Apothecia** black, sessile, up to 0.8 mm broad, with a thin true exciple; hypothecium dark brown, continuous with the dark exciple. Hymenium 70–90 µm high; epithecium brownish. Ascospores 8 per ascus, brown, 1-septate, 9–17 × 6–10 µm.

**Chemistry.** Not investigated.

**Ecology.** Growing on thalli of *Baeomyces rufus*.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europa, Asia, North America (including Greenland).

**Specimens seen** (selected): Grønhamna, Th.M. Fries 31.7.1868 (O); Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:091 (TROM).

**EUOPSIS** Nyl. (1875)

**Thallus** crustose, minutely squamulose to granular, red-brown, gelatinous when moist. Photobiont *Gloeocapsa*, in some species also *Trebouxia* in addition. **Ascomata** apothecia, developing from hyphal web of generative tissue, with a well developed thalline margin. Ascii with an amyloid collar surrounding the upper part. Ascospores 8 per ascus, simple, uncoloured. Hamathecium of paraphyses, little branched. Conidia bacilliform.

Key to *Euopsis* on Svalbard:

- |   |   |                     |
|---|---|---------------------|
| 1 | Thalline margin pale, containing green algae; thallus with pale spots .....     | <i>E. granatina</i> |
| 1 | Thalline margin red-brown, with cyanobacteria; thallus without pale spots ..... | <i>E. pulvinata</i> |
|   | .....   |                     |

***Euopsis granatina*** (Sommerf.) Nyl. (1875)

**Thallus** as granulose, convex red-brown lumps, with white spots (*Trebouxia*), 1–3 mm diam. **Apothecia** with dark brown disc, up to 0.5 mm diam. Thalline margin concolorous with thallus and with white spots. Hymenium 70–80 µm high. Ascospores 10–12 × 6–7 µm. Photobiont *Gloeocapsa* with inspersed colonies of *Trebouxia*.

**Chemistry.** Negative.

**Ecology.** On moist, acidic rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimen seen:** Kobbefjorden, 1868, Th.M. Fries (O).

***Euopsis pulvinata*** (Schaer.) Vain. (1881)

**Thallus** as rugulose red-brown convex lumps, 2–3 mm wide. **Apothecia** with expanded glossy brown convex discs and irregular granulose thalline margins, concolorous with thallus, 0.3–0.5 mm wide. Hymenium 70–80 µm high. Ascospores 8 per ascus, uncoloured, simple, 11–13 × 7–9 µm. Paraphyses thin, branched. End cell not enlarged. Photobiont *Gloeocapsa*.

**Chemistry.** Negative.

**Ecology.** On soil and moist rock.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Kings Bay [Kongsfjorden], 1868, Th.M. Fries (O); Kobbefjorden, 1868, Th.M. Fries (O).

**FARNOLDIA** Hertel (1983)

**Thallus** crustose, superficial or immersed. Photobiont trebouxioid. **Ascomata** apothecia, sessile, black, without thalline margin. True margin well-developed, dark brown, friable. Hypothecium

colourless to dark brown. Ascii of *Porpidia*-type. Ascospores 8 per ascus, colourless, simple, fairly large. Hamathecium of anastomosing paraphyses. Conidia bacilliform.

Key to *Farnoldia* on Svalbard:

1	Thallus thick .....	<i>F. micropsis</i>
1	Thallus very thin or lacking .....	2
2 (1)	Hypothecium paler than exciple .....	<i>F. jurana</i>
2	Hypothecium darker than exciple .....	<i>F. hypocrita</i>

#### *Farnoldia hypocrita* (Massal.) Hertel (1983)

**Thallus** lacking, or within rock. **Apothecia** up to 2.5 mm diam., black, not pruinose; base constricted; margin broad, distinct. Hymenium 70–90 µm high; uppermost part blue-green, N + red. Exciple dark brown. Hypothecium brown, in thin sections distinctly darker than exciple. Ascospores 8 per ascus, 16–21 × 7–9 µm, with halo. Conidia 6–7 × 1 µm.

**Chemistry.** Negative.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen:** Kings Bay [Kongsfjorden], 19.8.1868, Th.M. Fries (O); Dicksonfjorden, Lyckholmdalen, 9.7.1936, E. Dahl (O).

#### *Farnoldia jurana* (Schaer.) Hertel (1983)

**Thallus** not visible, or as a thin, white-grey crust. Medulla K/I + violet. **Apothecia** sessile, 0.5–1 mm wide, constricted below, with or without a white-blue pruina; margin ± prominent. Hymenium 80–95 µm high; epithecium greenish. Exciple brown-black. Hypothecium brown-black, in thin sections paler than exciple. Ascospores 8 per ascus, 13–28 × 7–14 µm, halonate. Conidia 5–6 × 1 µm.

**Chemistry.** Negative.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Gipsdalen, 1987, D.O. Øvstdal (BG); Van Keylens Havn [Van Keulenhamna], 6.8.1926, B. Lynge (O).

#### *Farnoldia micropsis* (Massal.) Hertel (1983)

**Thallus** areolate, medium thick (to 0.15 mm), white; medulla K/I -. **Apothecia** 0.2–0.5 mm broad, black, not pruinose, constricted below; margin conspicuous; disc flat to slightly convex. Hymenium 75–95 µm high; epithecium greenish. Hypothecium pale. Exciple black. Ascospores ellipsoid, 8 per ascus, halonate, 16–23 × 7–12 µm.

**Chemistry.** Negative.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Dicksonfjorden, Lyckholmdalen, 9.7.1936, E. Dahl (O); Axeløya [Akseløya], 23.8.1926, B. Lynge (O).

### FLAVOCETRARIA Kärnefelt & Thell (1994)

**Thallus** fruticose, flattened, yellow; cortex two-layered; excipulum two-layered. **Ascomata** apothecia with thalline margin. Ascii with ring structure in tholus and very small axial body. Conidia bifusiform.

Key to *Flavocetraria* on Svalbard:

- |   |  |                     |
|---|--|---------------------|
| 1 | Lobes flat, turning yellowish brown in dying basal parts ..... | <i>F. nivalis</i>   |
| 1 | Lobes cucullate, turning red in dying basal parts .....        | <i>F. cucullata</i> |

#### *Flavocetraria cucullata* (Bellardi) Kärnefelt & Thell (1994)

**Thallus** fruticose, pale yellow, up to 5 cm high, ramified in upper part, cucullate. Stalked black pycnidia along margin and small pseudocyphellae on lower side.

**Chemistry.** Usnic and protolichesterinic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Bolivia and Peru.

**Specimens seen** (selected): Phippsøya, 18.8.1936, E. Dahl (O); Hårfagrehaugen, 18.8.1936, E. Dahl (O).

#### *Flavocetraria nivalis* (L.) Kärnefelt & Thell (1994)

**Thallus** fruticose, up to 5 cm high, pale yellow; lobes flat, rugulose to wrinkled; margins involute; lower side with scattered pseudocyphellae. **Apothecia** terminal, up to 15 m diam., saddle-formed; lower side with network of ridges. Thalline margin very thin, warted. Disc pale orange-brown. Hymenium 40–45 µm high; uppermost part yellow-brown. Ascospores 8 per ascus, simple, droplet-formed, 7–8 × 3–4 µm.

**Chemistry.** Usnic and protolichesterinic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Notes.** Fertile specimens are rare on Svalbard and have only been found on Nissenfjella (leg. A. Hjelle (O)). According to A. Thell (pers. comm.) it is typical for this species that fertile specimens have a restricted distribution. World distribution: Europe, Asia, North America (including Greenland), Peru, Patagonia, New Zealand.

**Specimens seen** (selected): Gipsdal, 18.7.1985, A. Elvebakk (TROM), Longyearbyen, 23.7.1936, E. Dahl (O); Nissenfjella, 1964, A. Hjelle (O; fertile).

**FRUTIDELLA** Kalb (1994)

**Thallus** crustose, areolate; areolae convex. Photobiont trebouxoid. **Ascomata** apothecia, sessile, emarginate, convex, black. Hamathecium of paraphyses, anastomosing; end cell not enlarged. Ascii of *Bacidia*-type, 8-spored. Ascospores simple, colourless, non-halonate.

**Note.** A monotypic genus.

*Frutidella caesioatra* (Schaer.) Kalb (1994)

**Thallus** 2–3 cm wide, crustose, effuse, areolate; areolae convex, 0.1 mm diam., corticated, grey with a violet tinge. **Apothecia** between areolae, black, convex, sessile, emarginate, white-blue pruinose, up to 1 mm diam. True exciple composed of prosoplectenchymateous tissue, colourless except in outer part which is aeruginose. Hymenium 80–90 µm high; uppermost part aeruginose. Hypothecium pale brown. Ascospores narrowly ellipsoid, colourless, thick-walled, 15–17 × 7–9 µm. Paraphyses slender, strongly adglutinated.

**Chemistry.** Sphaerophorin, unidentified xanthones.

**Ecology.** Over bryophytes, often associated with *Ochrolechia frigida*.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Virgohamna, 7.7.1928, O.A. Høeg (TRH); Amsterdamøya, 26.8.1936, E. Dahl (O).

**FULGENSIA** Massal. & de Not. (1855)

**Thallus** placodioïd to scattered lobes, yellow-orange. Photobiont green algae. **Ascomata** apothecia, with thalline margin. Ascii of *Teloschistes*-type. Ascospores 8 per ascus, simple to rarely 1-septate, colourless, never polarilocular. Hamathecium of paraphyses, little ramified. Conidia bacilliform.

*Fulgensia bracteata* (Hoffm.) Räsänen (1931)

**Thallus** placodioïd or as dispersed lobes, pale yellow-orange, 1–2 cm wide. Lobes to 0.5 mm broad, convex, articulated. **Apothecia** up to 1 mm diam.; disc flat, red-orange; margin thin, level with disc, pale yellow. Hymenium 60–70 µm high; epipsamma medium coarse. Ascospores 8 per ascus, elliptic, 18–22 × 5–7 µm, simple. Paraphysse end cells not or lightly enlarged.

**Chemistry.** Anthraquinones.

**Ecology.** On mosses on Ca-rich soil.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand.

**Specimens seen** (selected): Wijdefjorden, Krosspynten, A. Elvebakk 01:167 (TROM); Wijdefjorden, Vestfjordddalen, A. Elvebakk 01:216 (TROM).

**FUSCIDEA** Wirth & Vězda (1972)

**Thallus** crustose to subeffigurate, rimose to areolate. Photobiont trebouxioid. **Ascomata** apothecia, sessile to immersed, dark brown to almost black; thalline exciple absent. True exciple usually well-developed, with unevenly thickened hyphae. Ascii with amyloid tholus which lacks axial structures and with a thick amyloid outer layer. Hamathecium of paraphyses, simple to weakly branched. Ascii 8-spored. Ascospores simple, colourless to pale brown when old, straight to curved. Conidia cylindrical to bacilliform.

Key to *Fuscidea*:

1	Thallus with lichen products.....	2
1	Thallus without lichen products.....	<i>Fuscidea</i> sp. A
2	Thallus with divaricatic acid.....	<i>F. gothoburgensis</i>
2	Thallus with two undetermined products.....	<i>Fuscidea</i> sp. B

***Fuscidea gothoburgensis* (H. Magn.) Wirth & Vězda (1972)**

**Thallus** 1–4 cm wide, composed by a black hypothallus with dispersed areolae. Areolae brown-grey, 0.2–1 mm wide, rounded-irregular, convex, sorediate. Soralia laminar, 1–3 on areolae, with a thin raised white margin, concave, dark-spotted. Soredia 20–24 µm diam.; surface cells brown-pigmented. **Apothecia** or pycnidia not seen on Svalbard material.

**Chemistry.** Divaricatic acid.

**Ecology.** On upper side of stones in sandstone scree, with *Porpidia melinodes*.

**Distribution.** Only known from the Longyearbyen area.

**Notes.** Further to the south, e.g. in mainland Norway, *F. gothoburgensis* is a species of vertical, somewhat overhanging rock surfaces. On Svalbard, however, the only specimen found grew exposed to rain and snow. This may be an adaptation to a more continental climate, see also *Ploeopsidium chlorophanum*. New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Longyearbyen, Bjørndalen, 2003, T. Tønsberg 31867 (BG).

***Fuscidea* sp. A**

**Thallus** crustose, 1–4 cm wide, with a thin black prothallus and black hypothallus, areolate, grey with a brown-violet tinge. Areolae cerebriform in outline, flattened convex, separated by hypothallus. No **apothecia** or pycnidia seen.

**Chemistry.** Negative.

**Ecology.** On limestone.

**Notes.** This species is tentatively assigned to *Fuscidea*, on account of its morphology which is similar to species such as *F. gothoburgensis* and *F. maculosa* (H. Magn.) Poelt.

**Specimen seen:** Kongsfjorden, Gluudneset, 2003, A. Elvebakk 03:136 (TROM).

***Fuscidea* sp. B**

**Thallus** crustose to sub-placiodoid, brown-grey, rimose, up to 20 mm diam., sorediate, at margins with enlarged areolae; prothallus thin, black. Soralia diffuse, blackish, in centre of areolae, flat to concave, coarse. Soredia without protruding hyphae,  $18.8 \pm 1.7 \mu\text{m}$  (16–22  $\mu\text{m}$ ). **Apothecia** not seen.

**Chemistry.** Two undetermined compounds.

**Ecology.** On limestone.

**Distribution.** Only known from Dicksonfjorden.

**Note.** This taxon is very similar to *Fuscidea recensa* (Stirt.) Hertel, V. Wirth & Vězda, but differs above all in its chemistry.

**Specimen seen:** Dicksonfjorden, N-siden av Lyckholmdalen, 8.7.1936, E. Dahl (O).

**FUSCOPANNARIA P.M. Jørg. (1993)**

**Thallus** squamulose, mostly brown, with pseudoparenchymateous upper cortex and weakly developed to lacking lower cortex. Photobiont cyanobacteria. **Ascomata** apothecia, mostly with thalline margin. Ascii with amyloid apical plug. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, little ramified. Thallus with terpenoids and fatty acids.

Key to *Fuscopannaria* on Svalbard:

1	Squamules erect, claviform .....	<i>F. abscondita</i>
1	Squamules decumbent, imbricate .....	2
2 (1)	Marginal squamules with white-blue “pruinose” protuberances .....	<i>F. praetermissa</i>
2	Marginal squamules without protuberances .....	<i>F. hookerioides</i>

***Fuscopannaria abscondita* P.M. Jørg. (2003)**

**Thallus** up to 3 cm diam., brown, cushion-formed, composed of erect to ascending claviform squamules, apically widened to 2 mm diam. Photobiont *Nostoc*. **Apothecia** up to 5 mm diam., ± hidden between squamules; disc convex; margin excluded, surrounded by projecting claviform squamules. Hymenium up to 150  $\mu\text{m}$  high. Ascospores 8 per ascus, ellipsoid, 20–22  $\times$  10–11  $\mu\text{m}$ . Pycnidia not seen.

**Chemistry.** Negative.

**Distribution.** Svalbard (endemic).

**Note.** World distribution: Svalbard.

**Specimens seen:** Barentsøya, N side of Steinbeisen, 1.8.1936, E. Dahl (O); Edgeøya, between Rosenbergdalen and Kapp Lee, 6.8. 1936, E. Dahl (O).

***Fuscopannaria hookerioides* P.M. Jørg. (2001)**

**Thallus** squamulose, grey-brown to greenish brown, 1–2 cm wide, as convex clumps; squamules 0.2–0.4 mm wide, crowded-imbricate; marginal lobes not enlarged. **Apothecia** (not seen in Svalbard

material) up to 1 mm diam., with well-developed thalline margin concolorous with thallus, and black, concave disc. Ascospores elliptical,  $10-12 \times 6-7 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** Saxicolous and on compacted mineral soil.

**Distribution.** Only known from Blomesletta and Barentsøya.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimens seen:** Blomesletta, 24.7.1973, A.A. Frisvoll (TRH; det. P.M. Jørgensen). Barentsøya, between Steinbeisfjellet and Kapp Wojekow, 1.8.1936, E. Dahl (O; det. P.M. Jørgensen 2006).

### *Fuscopannaria praetermissa* (Nyl.) P.M. Jørg. (1993)

**Thallus** squamulose, with rounded, incised, thick, brown to brown-grey, imbricate squamules. Marginal squamules with thick white-blue-”pruinose” protuberances. **Apothecia** not seen in Svalbard material.

**Chemistry.** Terpenoids.

**Ecology.** On bryophytes on base-rich soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Kapp Thordsen, 20.7.1936, E. Dahl (O); Barentsøya, 2.8.1936, E. Dahl (O).

### **GYALECTA** Ach. (1808)

**Thallus** crustose, effuse, pale. Photobiont *Trentepohlia*. **Ascomata** apothecia; thalline exciple absent; disc usually concave, pinkish to brownish. True exciple well developed, colourless. Ascii with thin wall which is K/I + blue. Ascospores 8 per ascus, colourless, septate to muriform. Hamathecium of paraphyses, simple. Conidia rod-shaped.

Key to *Gyalecta* on Svalbard:

1	On soil or bryophytes, ascospores 3-septate .....	3
1	On rock.....	2
2 (1)	Ascospores submuriform .....	<i>G. subclausa</i>
2	Ascospores septate.....	<i>G. erythrozona</i>
3 (1)	Apothecia restricted below; ascospores up to $3.5 \mu\text{m}$ wide.....	<i>G. friesii</i>
3	Apothecia embedded in thallus; ascospores $5 \mu\text{m}$ wide .....	<i>G. foveolaris</i>

### ***Gyalecta erythrozona*** Lettau (1937)

**Thallus** crustose, thin, granular, green-grey with an orange tinge. Apothecia half sunk in thallus, up to  $0.3 \text{ mm}$  wide, concolorous with thallus; disc  $0.1 \text{ mm}$  wide, deeply concave, warm brown. Hymenium  $60-65 \mu\text{m}$  high, colourless. Ascospores  $6(?)$  in ascii, 4–6-septate,  $18-26 \times 4.5-6 \mu\text{m}$ .

**Chemistry.** Not studied.

**Ecology.** On rock.

**Distribution.** Only known from Bjørndalen.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Bjørndalen, 2003, T. Tønsberg 31883 (BG).

### *Gyalecta foveolaris* (Ach.) Schaer. (1836)

**Thallus** as whitish lumps, embedded in soil. **Apothecia** up to 1.3 mm diam., embedded in soil, urceolate; margin distinct, concolorous with thallus; disc concave, flesh-coloured. Hymenium 60–65 µm high. Ascospores 8 per ascus, 3-septate, constricted at septa, 13–15 × 5–5.5 µm.

**Chemistry.** Not studied.

**Ecology.** On calcareous soil.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Dicksonfjorden, Kapp Smith, 6.7.1936, E. Dahl (O); Kings Bay [Kongsfjorden], 18.8.1868, Th.M. Fries (O; det. A. Vězda 1964).

### *Gyalecta friesii* Flotow ex Körb. (1855)

**Thallus** thin green-grey, granulose. **Apothecia** lecanorine, up to 2 mm diam. constricted below; thalline margin scurfy-granulose, grey-green. Disc concave, flesh-coloured. Ascospores 8 per ascus, 3-septate, 13–15 × 3.5 µm.

**Chemistry.** Not studied.

**Ecology.** On bryophytes in shaded cave in soil bank.

**Distribution.** Only known from Wijdefjorden.

**Notes.** Differs from *G. foveolaris* in its apothecia which are constricted at base, granulose thallus margin, and narrower ascospores. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimens seen:** S of Wijdefjorden, E of Austfjorden, N of Austfjordneshytta, 2002, T. Tønsberg 31159, 31163 (both BG).

### *Gyalecta subclausa* Anzi (1860)

**Thallus** thin, dark green-brown. **Apothecia** 0.2–0.4 mm wide; margin prominent; disc concave, dark brown. Hymenium 50–60 µm high; epipsamma fine, K + purplish. Ascospores 8 per ascus, uncoloured, submuriform, 11–13 × 7–9 µm.

**Chemistry.** Not studied.

**Ecology.** On wet rock.

**Distribution.** Rare, perhaps overlooked.

**Note.** World distribution: Europe.

**Specimens seen:** Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9848a (BG; det. Vězda 1987); cf. *Gyalecta subclausa*, Nordenskiöld Land, Reindalen, near Sørhytta, 1986, T. Tønsberg 9876 (BG; det. Vězda 1987).

**GYALIDEA** Lettau ex Vězda (1966)

**Thallus** crustose, effuse, usually inconspicuous. Photobiont green algae. **Ascomata** apothecia, urceolate, without thalline exciple. True exciple prominent, colourless. Asci thin-walled except for a slightly thickened tholus. Ascospores 4–8 per ascus, septate to muriform, colourless, constricted at septa, often with perispore. Hamathecium of paraphyses, simple to branched. Conidia bacilliform.

Key to *Gyalidea* on Svalbard:

- |   |                           |   |
|---|---------------------------|---|
| 1 | Ascospores muriform.....  | <i>G. fritzei</i> var. <i>rivularis</i> |
| 1 | Ascospores 3-septate..... | <i>Gyalidea</i> sp.                     |

***Gyalidea fritzei*** (Stein) Vězda var. ***rivularis*** (Eitn.) Vězda (1966)

**Thallus** pale, very thin. **Apothecia** 0.2–0.4 mm wide, with brown margin and red-brown, concave disc. Ascospores 8 per ascus, muriform, colourless, 16–18 × 6–7 µm.

**Chemistry.** Negative.

**Ecology.** On rock in stream.

**Distribution.** Rare.

**Note.** World distribution: Europe.

**Specimen seen:** Nordenskiöld Land, Reindalen, 1986, T. Tønsberg (BG).

***Gyalidea*** sp.

**Thallus** crustose, 1 cm wide, areolate; areolae grey, 0.1–0.3 mm wide, on a very thin dark grey hypothallus. **Apothecia** broadly sessile, up to 0.7 mm diam.; true margin black, distinct; disc violet brown, flat. Hymenium 90–100 µm high, hyaline; uppermost part pale yellowish. Exciple 60–70 µm wide, outermost 15 µm dark brown, becoming hyaline inwards. Hypothecium dark brown. Ascospores 6–8 per ascus, 12–14 × 5.5–6 µm, 3-septate, halonate, constricted at septa. Paraphyses simple; end cells not enlarged.

**Chemistry.** Negative.

**Ecology.** On lower side of sandstone in scree, with *Opegrapha* and *Rimularia* sp.

**Distribution.** Only known from one locality.

**Note.** Apparently related to *G. hyalinascens* (Nyl.) Vězda (see Vězda 1966) from which it differs in its dark hypothallus, smaller ascospores and habitat ecology.

**Specimen seen:** Longyearbyen, Bjørndalen, 2003, T. Tønsberg (BG).

**HALECANIA** M. Mayrhofer (1987)

**Thallus** crustose, effuse, rimose-areolate. Photobiont green algae. **Ascomata** apothecia, with thalline margin. Asci of *Catillaria*-type. Ascospores 8 per ascus, colourless, 1-septate, halonate. Hamathecium of paraphyses, simple to branched, with distinctly swollen end cell. Conidia bacilliform.

***Halecania alpivaga*** (Th. Fr.) M. Mayrhofer (1987)

**Thallus** as dispersed granules or small areolae, green to brown-green. **Apothecia** sessile, up to 0.8 mm dim.; disc dark brown to black; thalline margin narrow, concolorous with thallus. Hymenium 55–75 µm high; epithecium brown. Hypothecium colourless. Ascospores 8 per ascus, colourless, 1-septate, 13–18 × 5.5–7 µm, with halo. Paraphysis end cells swollen, with brown pigment cap.

**Chemistry.** Negative.

**Ecology.** Parasitic on other lichens.

**Distribution.** Rare

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen:** Van Mijenfjorden, Kjellstrømdalen, August 1986, D.O. Øvstedral (BG).

**HYMENELIA** Kremp.(1852)

**Thallus** crustose to immersed. Photobiont *Trentepohlia* or trebouxioid algae. **Ascomata** apothecia, pink to blackish, sessile to immersed in rock, without thalline margin. Epithecium N + red. Asci without distinct tholus, tip K/I–. Ascospores colourless, simple. Hamathecium of paraphyses, anastomosing. Conidia bacilliform. Growing on rock. A small genus mainly in cold and wet habitats.

Key to *Hymenelia* on Svalbard:

1	Apothecia immersed in pits .....	2
1	Apothecia not in pits .....	3
2 (1)	Exciple and epithecium with blue pigment .....	<i>H. melanocarpa</i>
2	Exciple and epithecium without blue pigment .....	<i>H. epulotica</i>
3 (1)	Exciple and epithecium with blue pigment .....	<i>H. heteromorpha</i>
3	Exciple and epithecium without blue pigment .....	4
4 (3)	On wet rock; ascospores up to 12 µm long .....	<i>H. arctica</i>
4	On dry rock; ascospores longer than 12 µm .....	<i>H. rhodopis</i>

***Hymenelia arctica*** (Lynge) Lutzoni (1995)

**Thallus** thin, grey-ochre, 2–3 mm wide. Photobiont *Trentepohlia*. **Apothecia** immersed in thallus, 0.2–0.3 m wide; disc pink to brown; margin inconspicuous. Hymenium 40–50 µm high; uppermost part yellowish. Ascospores 8 per ascus, 8–12 × 5–6 µm.

**Chemistry.** Negative.

**Ecology.** On wet, hard rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Calypso Bay [Calypsostranda], 13.7.1926, B. Lynge (O); Davishamna, 29.7.1936, E. Dahl (O).

***Hymenelia epulotica* (Ach.) Lutzoni (1995)**

**Thallus** invisible, within rock. Photobiont *Trentepohlia*. **Apothecia** immersed in pits, when dry separated from pit by a circular fissure, up to 0.5 mm diam., pink-pale ochre, with thin, elevated margin and concave to flat disc. Hymenium 140–150 µm high. Hypothecium colourless. Ascospores 8 per ascus, 13–15 × 5–7 µm. Paraphyses anastomosing; end cell not enlarged.

**Chemistry.** Negative.

**Ecology.** On limestone, with, e.g. *Verrucaria rejecta* and *Protoblastenia incrustans*.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America.

**Specimens seen:** Kongsfjorden, 17.8.1868, Th.M. Fries (O); Liefdefjorden, 2.9.1868, Th.M. Fries (O).

***Hymenelia heteromorpha* (Krempelh.) Lutzoni (1995)**

**Thallus** crustose, pale ochre, rimose, 3–4 mm wide. Photobiont *Trentepohlia*. **Apothecia** with disc immersed in thallus; disc black, concave, 0.2–0.3 mm wide, when wet with a dark true exciple and a paler central part. Hymenium 70–90 µm high; uppermost part bluish, N + red. Ascospores 12–14 × 4–6 µm.

**Chemistry.** Negative.

**Ecology.** On moist sandstone, schist and limestone.

**Distribution.** Common and widespread.

**Notes.** The most common *Hymenelia* on Svalbard. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Bromelldalen, 9.8.1926, B. Lynge (O), Ullafjell [Ullaberget], 25.7.1926, B. Lynge (O).

***Hymenelia melanocarpa* (Krempelh.) Arnold (1847)**

**Thallus** endolithic. Photobiont *Trentepohlia*. **Apothecia** in pits in limestone, up to 0.5 mm wide, with an irregular outline. True margin white, elevated; disc black, concave. Hymenium 90–100 µm high, uppermost part bluish. Ascospores 8 per ascus, 15–17 × 7–9 µm.

**Chemistry.** Not studied.

**Ecology.** On limestone.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America.

**Specimen seen:** Lomfjorden, 1868, Th.M. Fries (O).

***Hymenelia rhodopis* (Sommerf.) Lutzoni (1995)**

Syn. *H. epulotica* var. *crustosa* H. Magn.

**Thallus** crustose, up to 10 mm diam., thick, rimose, pale ochre. Photobiont *Trentepohlia*. **Apothecia** up to 0.4 mm wide, immersed in thallus; exciple concolorous with thallus, indistinct; disc concave, flesh-coloured to brown. Hymenium 70–80 µm high. Ascospores 8 per ascus, 13–15 × 5–7 µm.

**Chemistry.** Negative.

**Ecology.** On dry sandstone.

**Distribution.** Rare.**Note.** World distribution: Europe, Taimyr, Alaska.**Specimen seen:** Bromelldalen 9.8.1926, B. Lynge (O; det. H. Magnusson, as *H. epulotica* var. *crustosa*).**HYPOGYMНИA (Nyl.) Nyl. (1896)**

**Thallus** foliose; lobes inflated, often tubular, hollow or with very lax medulla. Photobiont green algae. Both upper and lower cortex pseudoparenchymateous, with a polysaccaride-like covering. Lower cortex black, without rhizines. **Ascomata** apothecia, sessile or stalked, with prominent thalline margin. Ascospores 8 per ascus, simple, uncoloured, subglobose. Conidia bifusiform.

Key to *Hypogymnia* on Svalbard

- |   |  |                      |
|---|--|----------------------|
| 1 | Thallus esorediate or with laminal soralia; without physodalic acid..... | <i>H. austerodes</i> |
| 1 | Thallus with lip-shaped soralia; with physodalic acid.....               | <i>H. physodes</i>   |

***Hypogymnia austerodes* (Nyl.) Räs. (1943)**Syn: *H. subobscura* (Vain.) Poelt (1962).

**Thallus** as small rosettes, 3–4 cm wide, with radiating lobes. Lobes pinnately to dichotomously to irregularly branched; upper side brownish, with black margins (continuous with lower side); lobes at thallus margin 1–1.5 mm wide, with upturned margins. Lower side black, without rhizinae. Sometimes sorediate; soralia laminal in inner part of thallus.

**Chemistry.** Atranorin, physodic acid, ± unknowns.**Ecology.** On rock.**Distribution.** A few scattered occurrences.

**Notes.** We have included *H. subobscura* (Vainio) Poelt in *H. austerodes*. The type of *H. subobscura* (TUR, herb. Vainio 03491) is pinnately branched, without soralia and with small papillae-like lobes on the margin borders of the upper surface. However, we have seen such lobes also on typical *H. austerodes* from mainland Norway, and believe that they are part of the vegetative reproduction system and regulated by environmental factors. In many specimens from Svalbard there are tendencies to soralia outbreaks in the inner part of the thallus. Contrary to what was indicated by Poelt (1969) and Thomson (1984) the type of *H. subobscura* appears to contain the same secondary products as *H. austerodes* (TLC on type performed by L.N. Pike 1974, annotated on envelope). World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Gipsvika, A. Elvebakk 85:581, 85:674 (TROM).***Hypogymnia physodes* (L.) Nyl.(1896)**

**Thallus** foliose, as small rosettes; lobes radiating, up to 3 cm wide, pinnately or irregularly branched, with terminal, labriform soralia. Upper side grey, with black margins; lower side brown towards apices, black towards center, wrinkled, without rhizinae.

**Chemistry.** Atranorin, physodic, physodalic acids, with accessories.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** Usually easy to recognize on its labriform soralia and grey upper side. However, a few specimens lack soralia and have a very dark upper surface and may come close to esorediate specimens of *H. austerodes*, in such cases the presence of physodalic acid is conclusive. World distribution: Europe, Asia, North America (including Greenland), Africa.

**Specimen seen** (selected): Gipsvika, A. Elvebakk 85:575 (TROM).

## INVOLUCROPYRENIUM O. Breuss (1996)

**Thallus** squamulose, appearing as a crust. Upper cortex pseudoparenchymateous. Rhizohyphae dark brown. **Ascomata** perithecia, between squamules. Involucellum present, entire. Ascospores uncoloured, simple.

### *Involucropyrenium waltheri* (Krempelh.) Breuss (1996)

**Thallus** squamulose, squamules small and growing together so that the thallus appears as a crust; brown. Rhizohyphae dark brown, forming a black hypothallus. **Perithecia** between squamules, black, protruding. Involucellum entire; true exciple brown. Ascospores  $17-20 \times 8-10 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, North America (Greenland).

**Specimens seen** (selected): Kings Bay [Kongsfjorden], 17.8.1868, Th.M. Fries (O); Moskudalen, 29.7.1987, D.O. Øvstedral (BG; det. A. Orange 2005).

## IONASPIS Th. Fr. (1871)

**Thallus** crustose, effuse, smooth. Photobiont trebouxioid or *Trentepohlia*. **Ascomata** apothecia, aspicilioid. Epithecium N -. Ascospores simple, uncoloured.

### *Ionaspis lacustris* (With.) Lutzoni (1995)

**Thallus** crustose, smooth, continuous, cream-coloured to pale reddish. **Apothecia** up to 0.5 mm diam., immersed in thallus; margin slightly raised; disc concave, darker than thallus. Hymenium 90–100  $\mu\text{m}$  high; epithecium yellowish. Ascospores 8 per ascus, simple, uncoloured,  $13-18 \times 6-10 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On wet rock.

**Distribution.** Common and widespread.

**Notes.** *Ionaspis odora* (Ach.) Th. Fr. was reported from Edgeøya by Aptroot & Alstrup (1991).

We have seen the specimen, which in our opinion belongs to *I. lacustris*. World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand.

**Specimens seen** (selected): Bromelldalen, 9.8.1926, B. Lynge (O); Amsterdøya, 1.8.1936, E. Dahl (O).

### JAPEWIA Tønsberg (1990)

**Thallus** crustose, effuse, brown. **Ascomata** apothecia, brown, sessile with true exciple only. Ascii of *Bacidia*-type, 8-spored. Ascospores colourless, simple, with very thick wall. Hamathecium of paraphyses, branched to anastomosing.

**Note.** A small genus of two species.

### *Japewia tornoensis* (Nyl.) Tønsberg (1990)

**Thallus** effuse, continuous, dark brown. **Apothecia** usually crowded, biatorine, dark brown, shiny, up to 1 mm diam. Hymenium yellowish, 130–150 µm high, epithecium pale brown. Hypothecium yellowish. Ascospores broadly elliptic, with very thick wall, 13–15 × 9–11 µm. Paraphyses thick, strongly adglutinated; end cell enlarged to 4 µm diam.

**Chemistry.** Negative.

**Ecology.** Over bryophytes and on wood.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimen seen** (selected): Nordre Norskøy [Ytre Norskøya], 1.7.1928, O.A. Høeg (TRH).

### LECANIA Massal. (1853)

**Thallus** crustose, areolate. Photobiont green algae. **Ascomata** apothecia, with or without thalline margin. True margin inconspicuous or well-developed. Ascii of *Bacidia*-type. Ascospores 8 per ascus, 1–3-septate, uncoloured, non-halonate. Hamathecium paraphyses, simple.

Key to *Lecania* on Svalbard:

1	Growing on bryophytes, rarely on wood .....	<i>L. subfuscula</i>
1	Growing on rock .....	2
2 (1)	Ascospores 3-septate .....	3
2	Ascospores 1-septate .....	4
3 (2)	Thallus granulose; paraphysis end cell 3 µm diam. ....	<i>L. cuprea</i>
3	Thallus areolate; paraphysis end cell up to 8 µm diam. ....	<i>L. suavis</i>
4 (2)	Thallus with blastidia .....	<i>L. erysibe</i>
4	Thallus without blastidia .....	<i>L. aipospila</i>

*Lecania aipospila* (Wahlenb.) Th. Fr. (1867)

**Thallus** crustose, grey-brown, areolate to warted. **Apothecia** up to 1 mm diam.; thalline margin persistent, concolorous with thallus; disc red-brown. Hymenium 70–80 µm high; uppermost part red-brown. Hypothecium colourless. Ascospores 8 per ascus, 1-septate, 10–14 × 4–6 µm. Paraphyses submoniliform.

**Chemistry.** Unidentified terpenoids.

**Ecology.** On rock.

**Distribution.** Only known from Hornsund.

**Note.** World distribution: Europe, Siberia.

**Specimen seen:** none seen; included on the basis of Fries (1867).

*Lecania cuprea* (Massal.) v.d. Boom & Coppins (1992)

**Thallus** granulose, grey-green. **Apothecia** lecideine, up to 0.8 mm diam., flesh-coloured, flat, strongly constricted below. Ascospores 8 per ascus, 13–15 × 2.5–3 µm, 3-septate. Paraphysse end cell 3 µm diam.

**Chemistry.** Negative.

**Ecology.** On sheltered rock in scree.

**Distribution.** Only known from Wijdefjorden.

**Notes.** Close to *L. subfuscula*, but differs in its flat apothecia, narrow paraphysse end cells, and habitat ecology (*L. subfuscula* always occurs in exposed places and on organic material). New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Wijdefjorden, 2002, T. Tønsberg (BG).

*Lecania erysibe* (Ach.) Mudd (1861)

**Thallus** crustose, cracked-areolate, blastidiate, green-grey to grey-brown. **Apothecia** up to 0.4 mm diam.; thalline margin blastidiate; disc brown. Hymenium 50–60 µm high; uppermost part yellow-brown. Ascospores 8 per ascus, 1-septate, 9–15 × 3–5 µm. Paraphysse tips not enlarged.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Only known from Lovénberget.

**Note.** World distribution: Europe, Asia, North America, Argentina, Australia, New Zealand.

**Specimen seen:** None seen; included on the basis of Fries (1867).

*Lecania suavis* (Müll. Arg.) Miq. (1926)

**Thallus** areolate; areolae dispersed, convex, yellowish white to brown. **Apothecia** up to 0.6 mm, convex; thalline exciple almost excluded. Hymenium 50–65 µm high; epithecium brownish. Ascospores lens-shaped, 3-septate, 13–20 × 4–4.5 µm. Paraphysse end cells strongly swollen, to 8 µm diam.

**Chemistry.** Negative.

**Ecology.** On calcareous rock, possibly ornithocoprophilous.

**Distribution.** Rare. Only known from Trollsteinen near Longyearbyen.

**Note.** World distribution: Europe.

**Specimen:** None seen; included on the basis of M. Mayrhofer (1988).

*Lecania subfuscula* (Nyl.) S. Ekman (1996)

**Thallus** very thin to evanescent, greyish. **Apothecia** black, dispersed to crowded, flat, with thin, raised margin. Hymenium 70–80 µm high, greenish-brown in upper part. Hypothecium pale. Ascospores 8 per ascus, 3-septate, 20–23 × 2.5–4 µm.

**Chemistry.** Negative.

**Ecology.** On moribund bryophytes and on wood.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Amsterdamøya, 1.8.1936, E. Dahl (O); Van Keulenhamna, 6.7.1926, B. Lynge (O).

**LECANORA** Ach. (1810)

**Thallus** crustose to placodioid. Photobiont trebouxiod. **Ascomata** apothecia, sessile to immersed; thalline margin absent or present. Ascii with tholus which is amyloid in the lateral part, and with a non-amyloid apical cushion; 8-spored. Ascospores simple, colourless. Hamathecium of paraphyses, simple to branched and anastomosing. Conidia bacilliform, arc-like.

Key to *Lecanora* on Svalbard:

1	Thallus sorediate .....	2
1	Thallus not sorediate .....	9
2 (1)	On old driftwood .....	<i>L. orae-frigidae</i>
2	On rock .....	3
3 (2)	Thallus with atranorin .....	4
3	Thallus without atranorin .....	6
4 (3)	With atranorin and fatty acids .....	<i>L. caesiosora</i>
4	With other compounds in addition .....	5
5 (4)	With atranorin, usnic acid, xanthone, triterpenes .....	<i>Lecanora</i> sp. B
5	With atranorin and 3 xanthones .....	<i>Lecanora</i> sp. A
6 (3)	Thallus leprose .....	<i>L. ecorticata</i>
6	Thallus not leprose .....	7
7 (6)	With rhizocarpic acid .....	<i>L. subaurea</i>
7	With usnic acid .....	8
8 (7)	Soralia marginal .....	<i>L. handelii</i>
8	Soralia central .....	<i>L. soralifera</i>
9 (1)	Apothecia without thalline margin .....	10
9	Apothecia with thalline margin .....	16
10 (9)	Thallus very thin .....	<i>L. michelieri</i>
10	Thallus thick .....	11

11 (10)	With usnic acid .....	12
11	Without usnic acid .....	14
12 (11)	With usnic acid only .....	<i>L. marginata</i>
12	With additional lichen products .....	13
13 (12)	With stictic acid .....	<i>L. atromarginata</i>
13	With atranorin .....	<i>L. sulphurea</i>
14 (11)	Thallus with griseofulvin .....	<i>L. griseofulva</i>
14	Thallus without griseofulvin .....	15
15 (14)	Areolae flat; ascospores subglobose .....	<i>L. hadacii</i>
15	Areolae bullate; ascospores ellipsoid .....	<i>L. formosa</i>
16 (9)	On bryophytes and old driftwood .....	17
16	On rock .....	23
17 (16)	On old driftwood .....	18
17	On soil and bryophytes .....	21
18 (17)	Disc yellowish; thallus with usnic acid .....	<i>L. symmicta</i>
18	Disc brown; thallus without usnic acid .....	19
19 (18)	With fumarprotocetraric acid .....	<i>L. pulicaris</i>
19	Without fumarprotocetraric acid .....	20
20 (19)	Without lichen substances .....	<i>L. zosterae</i>
20	With atranorin .....	<i>L. circumborealis</i>
21 (17)	With usnic acid .....	<i>L. luteovernalis</i>
21	Without usnic acid .....	22
22 (21)	With atranorin .....	<i>L. epibryon</i>
22	Without lichen products .....	<i>L. umbrina</i>
23 (16)	With usnic acid .....	24
23	Without usnic acid .....	28
24 (23)	With xanthone .....	<i>L. atrosulphurea</i>
24	Without xanthone .....	25
25 (24)	Areolae strongly convex .....	<i>L. frustulosa</i>
25	Areolae flat .....	26
26 (25)	Thalline exciple soon excluded; with atranorin .....	<i>L. sulphurea</i>
26	Thalline exciple persistent; without atranorin .....	27
27 (26)	Areolae outline incised; with two terpenoids .....	<i>L. intricata</i>
27	Areolae outline even; with zeorin only .....	<i>L. polytropa</i>
28 (23)	Thallus with xanthones .....	29
28	Thallus without xanthones .....	36
29 (28)	Thallus placodioid .....	<i>L. straminea</i>
29	Thallus areolate or lacking .....	30

30 (29)	Thallus lacking .....	31
30	Thallus present .....	32
31 (30)	Epithecum granules insoluble in K and N .....	<i>L. dispersa</i>
31	Epithecum granules soluble in K, insoluble in N .....	<i>L. semipallida</i>
32 (30)	Thallus minute, brown .....	<i>L. contractula</i>
32	Thallus different .....	33
33 (32)	Thallus as small areoles around apothecia .....	<i>L. torrida</i>
33	Thallus extensive, grey, rimose .....	34
34 (33)	Apothecia strongly convex .....	<i>L. swartzii</i>
34	Apothecia flat .....	35
35 (35)	Apothecium margin dark in inner part .....	<i>L. bicincta</i>
35	Apothecium margin entirely white .....	<i>L. rupicola</i>
36 (28)	Thallus thick, white.....	37
36	Thallus thin or absent, grey or dark .....	38
37 (36)	Without lichen products .....	<i>L. albescens</i>
37	With atranorin and psoromic acid.....	<i>L. hadacii</i>
38 (36)	Thallus ± absent .....	39
38	Thallus present.....	42
39 (38)	Epithecum not granular .....	<i>L. zosterae</i>
39	Epithecum granular .....	40
40 (39)	Granules soluble in K, insoluble in N .....	<i>L. semipallida</i>
40	Granules insoluble in K and N .....	41
41 (40)	With small areoles around apothecia .....	<i>L. torrida</i>
41	Thallus endolithic .....	<i>L. dispersa</i>
42 (38)	Thallus minute, black, without lichen products.....	<i>L. carbonea</i>
42	Thallus grey, yellow-grey or brownish, with lichen products .....	43
43 (42)	Thallus yellowish grey to brownish, with atranorin, sometimes with xanthones .....	<i>L. cenisia</i>
43	Thallus brown, with unidentified compound .....	<i>L. nordenskioeldii</i>

***Lecanora albescens* (Hoffm.) Flörke (1828)**

**Thallus** small, to 2 mm diam., minutely lobate, cretaceous white. **Apothecia** up to 0.8 mm wide; thalline margin prominent, concolorous with thallus; disc flat, brown, non-pruinose. Hymenium 45–55 µm high, epithecium with granules (pol. light +). Hypothecium colourless. Thalline exciple filled with algae and numerous large uncoloured crystals; cortex of irregularly oriented hyphae. Ascospores 8 per ascus, 11–13 × 5–7 µm. Paraphyses stout, adglutinated; end cells enlarged to 3 µm diam.

**Chemistry.** Negative. Sliwa (2007) found two chemotypes in this species: one with 2,7-dichlororonorlichexanthone and ± pannarin, and one with no lichen products.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Argentina, New Zealand.

**Specimens seen** (selected): Sørhukken, 13.7.1926, B. Lynge (O); Midterhuksetta, 5.8.1926, B. Lynge (O).

#### *Lecanora atromarginata* (H. Magn.) Hertel & Rambold (1996)

**Thallus** crustose, yellow-white, soft, usually 3–4 cm broad, somewhat rimose. **Apothecia** black, up to 1 mm diam., without thalline margin, when young with a thin true margin; non-pruinose. Hymenium 70–90 µm high; uppermost part brown-green. Ascospores 8 per ascus, 9–11 × 4–6 µm. Paraphyses thick, strongly adglutinated; end cells enlarged to 2.5 µm diam.

**Chemistry.** Usnic and stictic acids.

**Ecology.** On rock, mostly calcareous sandstone.

**Distribution.** Common and widespread.

**Notes.** This species belongs to the *Lecanora marginata*-group, which has black apothecia without thalline margin. It superficially looks like a *Lecidea*. Its chemistry is particularly diagnostic. World distribution: Europe, North America, Antarctica.

**Specimens seen** (selected): Velkomstpynten, 26.8.1926, E. Dahl (O); Wijdefjorden, 17.7.2001, A. Elvebakk 01:183 (TROM).

#### *Lecanora atrosulphurea* (Wahlenb.) Ach. (1814)

**Thallus** crustose, up to 3 cm diam., areolate; areolae 0.2–0.3 mm wide, pale yellowish. **Apothecia** when young with prominent thalline margin, when old up to 2.2 mm wide and with very thin thalline margin; disc black, slightly to strongly convex, non-pruinose. Hymenium 50–60 µm high; uppermost part blue-green. Ascospores 8 per ascus, 11–13 × 4–6 µm. Paraphyses thin, flexuose, little ramified; end cell not enlarged.

**Chemistry.** Usnic and thiophanic acids, triterpenes.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Nordaustlandet, Duvefjorden, 16.8.1936, E. Dahl (O); Rijpfjorden, 17.8.1936, E. Dahl (O).

#### *Lecanora bicincta* Ram. (1825)

**Thallus** crustose, rimose, ivory white, 3–4 cm diam. **Apothecia** up to 1 mm diam., convex, with thin dark exciple, bluish pruinose. Hymenium 50–60 µm high; uppermost part green-brown. Ascospores 8 per ascus, broadly elliptic, 10–11 × 7–8 µm. True exciple expanded in uppermost part, pseudoparenchymateous, greenish black. Thalline margin with algae in inner part; cortex 13–17 µm thick, with anastomosing hyphae perpendicular to surface.

**Chemistry.** Atranorin, sordidone.

**Ecology.** On rock.

**Distribution.** Only found in Colesdalen.

**Notes.** Close to *L. rupicola* from which it differs in its convex apothecia with a dark true exciple,

evanescent thalline exciple and broader ascospores. New to Svalbard. World distribution: Europe, Siberia, North America, Argentina, Australia, New Zealand.

**Specimen seen:** Colesdalen, 2002, R. Haugan (O; det. Haugan).

### *Lecanora caesiosora* Poelt (1966)

**Thallus** crustose, 4–5 cm wide; areolae uneven to papillate, pale ochre, sorediate. Prothallus evident, thin, white, arachnoid. Papillae eventually developing into soralia, up to 1 mm wide, convex, somewhat irregular in outline, pale green-white. Soredia  $31.2 \pm 1.30 \mu\text{m}$ , N +. No apothecia or pycnidia seen.

**Chemistry.** I: Atranorin, nephrosteranic acid. II: Atranorin, roccellic acid.

**Ecology.** Saxicolous in shaded and sheltered niches.

**Distribution.** Only found twice.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9880 (BG); Bjørndalen, 2003, T. Tønsberg 31891 (BG [sub *Tephromela lucifuga*])

### *Lecanora carbonnea* Räsänen (1931)

Type: Petsamo (H!); TLC: negative.

**Thallus** crustose, granulose, as scattered, brown-black clumps, 2–3 mm wide, granules 0.1–0.2 mm wide. **Apothecia** up to 0.8 mm diam., thin, sessile; thalline margin thin, concolorous with thallus; disc flat, more brown than margin. Hymenium 40–50  $\mu\text{m}$  high; uppermost part blue-green. Thalline exciple almost filled with algae, cortex 25–30  $\mu\text{m}$  thick, composed of thick-walled, strongly adglutinated radiating hyphae. Ascospores 8 per ascus, globose, 9–11  $\mu\text{m}$  diam. Paraphyses stout, little ramified, strongly adglutinated; end cell enlarged to 2.5  $\mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On limestone, ornithocoprophilic.

**Distribution.** Not uncommon.

**Notes.** New to Svalbard. World distribution: Europe.

**Specimens seen (selected):** Sørhukten, 13.7.1926, B. Lynge (O; det. M. Andreev); Mariaholmen, 23.9.1926, B. Lynge (O).

### *Lecanora cenisia* Ach. (1810)

**Thallus** up to 3–4 cm wide, areolate-verrucose; areolae convex, yellowish, yellow-grey to pale brown. **Apothecia** up to 1.8 mm wide, with constricted base; thalline margin regular, fairly thick, concolorous with thallus, in section with large uncoloured crystals. Disc brown, bluish pruinose, slightly convex. Hymenium 70–80  $\mu\text{m}$  high; uppermost part brownish. Ascospores 8 per ascus, 13–16  $\times$  8–10  $\mu\text{m}$ . Paraphyses thin, flexuose; end cell not or little enlarged.

**Chemistry.** Atranorin,  $\pm$  xanthones,  $\pm$  unidentified compounds. **Ecology.** On rock, possibly ornithocoprophilous.

**Distribution.** Scattered, but not uncommon.

**Notes.** The material is chemically variable and in need of further studies. World distribution: Europe, Siberia, North America (including Greenland), Chile.

**Specimens seen (selected):** Magdalenefjorden, 1839, J. Vahl (TRH); Barentsøya, 1.8.1936, E. Dahl (O).

*Lecanora circumborealis* Brodo & Vitikainen (1984)

**Thallus** medium thick, dirty white, 2.3 cm diam., with a few white, raised warts. **Apothecia** lecanorine, up to 0.9 mm diam.; thalline margin at first thick and somewhat irregular, later becoming thinner and more regular, concolorous with thallus; disc flat, dark brown. Hymenium 50–60 µm high; epithecium brown. Cortex of thalline margin 40–50 µm thick, composed of a weakly pseudoparenchymateous tissue, finely inspers. Ascospores 8 in ascii, 15–17 × 6–9 µm, thick-walled.

**Chemistry.** Atranorin, fatty acids.

**Ecology.** On old driftwood.

**Distribution.** Found only once.

**Notes.** Distinguished from the other two similar species growing on driftwood, i.e., *L. zosterae* and *L. pulicaris*, by its chemistry and distinctly larger ascospores. World distribution: Europe, Siberia, North America (including Greenland), Argentina. New to Svalbard.

**Specimen seen:** Hiorthamn, 24.7.1936, E. Dahl (O).

*Lecanora contractula* Nyl. (1866)

**Thallus** up to 1 mm wide, minutely placodioïd, flat, pale brown; margins flexuose. **Apothecia** numerous, brown, up to 0.5 m diam., often covering the whole thallus, sessile, flat; thalline margin thin, concolorous with disc. Hymenium 80–90 µm high; uppermost part brownish. Ascospores 8 per ascus, 9–11 × 5–7 µm.

**Chemistry.** 6-O-methyl-2,5-dichloronorlichexanthone (Elix 1999, Svalbard material not analysed).

**Ecology.** On maritime rocks, partly as a juvenile parasite on other lichens, growing together with *Arctopeltis thuleana* and *Caloplaca alcarum*.

**Distribution.** Rare.

**Notes.** In Svalbard previously only known from Bjørnøya. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Kongsfjorden, Stuphallet, A. Elvebakk 86:312 (TROM); Smeerenburg, 8.7.1928, O.A. Høeg (TRH; cf.).

*Lecanora dispersa* (Pers.) Sommerf. (1826)

**Thallus** endolithic. **Apothecia** constricted at base, concave, up to 0.9 mm diam.; thalline margin prominent, whitish, disc grey-brown to brown, not or a little pruinose. Hymenium 45–70 µm high, epithecium brown, with granules (+ pol. light) which are insoluble in K and N. Ascospores 8 in ascii, 8–12 × 4.5–6 µm. Paraphyses branched and with a few anastomoses, 1.5 µm wide; end cell not enlarged.

**Chemistry.** 2,7-dichlorolichexanthone, ± pannarin, or no lichen products (Sliwa 2007).

**Ecology.** On siliceous or weakly calcareous rock (L. Sliwa pers. comm.).

**Distribution.** Sørkapp, but probably overlooked.

**Notes.** Probably a rare species in the Arctic (L. Sliwa pers. comm.). World distribution: Europe, North America, Asia, South America, Australia, New Zealand.

**Specimens seen:** None seen, based on a specimen determined by Sliwa (L. Sliwa pers. comm. 2008), will be published in a paper by Krzewicka & Maciejowski (submitted).

***Lecanora ecorticata*** J.R. Laundon (2003)

Type: England, North Devon, VC 4: Ilfracombe, Torrs Walks, on shaded, vertical rocks, 1971, Laundon 2851 (holotype—BM!); TLC: usnic acid (major), atranorin (trace), terpenoids.

**Thallus** crustose, leprose, pale yellowish (grey-yellow when old), covering several cm<sup>2</sup>, with variable thickness; medulla and marginal lobes absent. Soredia 26–32 µm ( $28.9 \pm 1.58$  µm). **Apothecia** not known.

**Chemistry.** Usnic acid (major), atranorin (trace), unidentified terpenoids (traces).

**Ecology.** Vertical rock and below stones in scree.

**Distribution.** Only known from one locality.

**Notes.** Most specimens have usnic acid only, the additional compounds listed may be contaminants. New to Svalbard (probably overlooked). World distribution: Europe, Antarctica.

**Specimens seen:** Near Longyearbyen, Bjørndalen, 2003, T. Tønsberg (BG).

***Lecanora epibryon*** (Ach.) Ach. (1810)

**Thallus** evanescent or very thin, whitish. **Apothecia** constricted below, up to 1.1 mm diam.; disc flat, warm brown; thalline margin thick, white, crenulate. Cortex of thalline margin composed of thick, radiating hyphae. Hymenium 60–70 µm high; uppermost part pale green-brown. Ascospores narrowly elliptic, straight to somewhat curved, 12–15 × 4–5 µm. Paraphyses stout, little ramified; end cell enlarged to 3 µm diam.

**Chemistry.** Atranorin.

**Ecology.** On moribund bryophytes, often with *Rinodina roscida* and *Caloplaca* spp.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan in cold areas.

**Specimens seen** (selected): Ossian Sarsfjellet, July 1973, D.O. Øvstdal (BG); Wijdefjorden, Krosspynten, A. Elvebakk 81:102 (TROM).

***Lecanora formosa*** (Bagl. & Carestia) Knoph & Leuckert (2000)

**Thallus** crustose, areolate; areolae strongly convex, up to 1.3 mm wide, white. **Apothecia** convex, up to 1 mm diam., black, emarginate, faintly bluish-pruinose. Hymenium 45–50 µm high, uppermost part blue-green. True exciple of radiating hyphae, blue-green in outer part, hyaline in inner. Ascospores 8 per ascus, 9–11 × 4–6 µm.

**Chemistry.** Atranorin, zeorin, psoromic acid.

**Ecology.** On sandstone, associated with *Rhizocarpon bolanderi*, *Aspicilia supertegens* and *Tremolecia atrata*.

**Distribution.** Only known from Colesbukta.

**Notes.** This species has been confused with *Lecidella bullata*, which, however, is known only from its type locality in Poland (Knoph & Leuckert 2000). Diagnostic characters are its strongly convex areolae, emarginate apothecia and chemistry. New to Svalbard. World distribution: Europe, Asia.

**Specimen seen:** Colesbukta, 1.10.1999, S. Spjelkavik (BG).

***Lecanora frustulosa* (Dicks.) Ach. ( 1810)**

**Thallus** crustose, grey-green, areolate; areolae round, convex, up to 1.5 mm diam., sometimes becoming contiguous and fused forming large continuous patches. **Apothecia** sessile, up to 1.2 mm diam.; thalline margin thick, concolorous with thallus. Disc dark brown, flat, non-pruinose. Thalline excipie almost filled with algae; cortex indistinct, composed of irregularly oriented hyphae. Hymenium 70–90 µm high; uppermost part greenish. Ascospores 8 per ascus, 11–13 × 6–8 µm. Paraphysse end cell enlarged to 2 µm diam.

**Chemistry.** Usnic acid, zeorin.

**Ecology.** On siliceous rock

**Distribution.** A few scattered localities.

**Notes.** From Svalbard previously only known from Bjørnøya. World distribution: Europe, Siberia, North America (including Greenland), Argentina, Antarctica.

**Specimens seen** (selected): Calypsostranda, 12.7.1926, B. Lynge (O); Lady Franklinfjorden, Lågøya, 19.8.1936, E. Dahl (O).

***Lecanora griseofulva* Elix & Øvstedral (2004)**

Type: Svalbard, van Keylenhamna, 1926, B. Lynge (O!).

**Thallus** subplacodioid to crustose, thick, yellow-white to very pale ochre, bullate–areolate, to 2 cm wide. **Apothecia** numerous, black, non-pruinose, sessile, to 1.8 mm diam., often coalescing forming composite ones; true margin when young flat and indistinct, when old excluded, colourless except outermost part which is brownish green, composed of thick, swollen radiating hyphae. Hymenium 120–140 µm high; uppermost part brownish green. Hypothecium with some brownish spots, otherwise colourless, without algae, with irregular clusters of small crystals. Ascii of *Lecanora* (?)–type. Ascospores 8 per ascus, 13–15 × 7–8 µm. Paraphyses thin, flexuose, little ramified; end cell enlarged to 3 µm diam. Pycnidia not seen.

**Chemistry.** Atranorin (minor), (+)-griseofulvin (major), (+)-dechlorogriseofulvin (minor), alternariol (trace).

**Ecology.** On schistose rock.

**Distribution.** Only known from Van Keulenhamna.

**Notes.** This species may resemble *Lecanora hadacii*, but is distinct by its larger ascospores and chemistry (atranorin and psoromic acid in *L. hadacii*).

World distribution: Known from Svalbard only.

**Specimen seen** (additional): Van Keulenhamna, 6.8.1926, B. Lynge 1926 (O; two specimens).

***Lecanora hadacii* Lynge (1940)**

Type: Isfjorden, Lædalen, 6.7.1939, E. Hadac (O!—type of *Lecanora hadacii* Lynge);  
Syn. *Lecanora scrobiculata* (Th. Fr.) Øvstedral & Elix (2004); Type: Lomfjorden, A.J. Malmgren (UPS!—lectotype of *Lecidea scrobiculata* Th. Fr.); non *Lecanora scrobiculata* Gyelnik (1996); *Lecanora cladonioides* Lynge (1940).

**Thallus** crustose, very thick, to 2 cm diam., creamy white, folded-wrinkled, matt. **Apothecia** up to 3 mm diam., when young ± with thin white thalline margin; disc flat, black, rough, when old emarginate, convex, irregularly saddle-formed, shiny. Thalline excipie almost filled with algae; cortex weakly developed. True excipie 15–20 µm wide, colourless, composed of short, thick hyphae, strongly ad-

lutinated and running parallel with paraphyses. Hymenium 45–50 µm high; uppermost part greenish brown, N + red, with small granules. Hypothecium colourless. Ascii of *Lecanora*-type. Ascospores 8 per ascus, 7.5–9 × 6.5–7 µm.

**Chemistry.** Atranorin and psoromic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Arctic North America.

**Other specimens seen** (selected): Blåhuken, 16.8.1926, B. Lyngé (O); Forsbladhamna, 29.7.1926, B. Lyngé (O).

#### *Lecanora handelii* Steiner (1909)

**Thallus** crustose, areolate, thick, pale ochre to yellow-white, sorediate. Soralia coarse, concolorous with areolae, on margin of areolae. Soredia  $34.2 \pm 1.79$  µm, N + red, conglutinated into consoredia.

**Apothecia** or pycnidia not seen in Svalbard material.

**Chemistry.** Usnic acid, zeorin.

**Ecology.** On rock.

**Distribution:** Only known from Smeerenburg.

**Notes.** New to Svalbard. World distribution: Europe, Antarctica.

**Specimen seen:** Smeerenburg, 8.7.1928, O.A. Høeg (TRH).

#### *Lecanora intricata* (Ach.) Ach. (1810)

**Thallus** crustose, areolate; areolae discrete, finely incised, to 0.8 mm diam., yellow-green. **Apothecia** at first with distinct thalline margin, later margin excluded; disc up to 0.7 mm diam., convex, more ochre than thallus. Hymenium 45–50 µm high; uppermost part colourless. Ascospores 8 per ascus, 10–12 × 5–6 µm. Paraphyses thin, not adglutinated; end cell slightly enlarged to 1.5–2 µm.

**Chemistry.** Usnic acid, zeorin, unidentified terpenoid (just below zeorin on TLC plates), two fatty acids.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** Close to *L. polytropa* from which it differs in its incised margin of areolae and chemistry. World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Virgohamna, 7.7.1928, O.A. Høeg (TRH); Barentsøya, NW side of Steinfjorden, 1.8.1936, E. Dahl (O).

#### *Lecanora luteovernalis* Brodo (1981)

**Thallus** crustose, pale yellow, verrucose to granulose, effuse. **Apothecia** up to 0.8 mm diam., yellowish pink to pale brown to black, convex; thalline margin thin, soon becoming excluded. Hymenium 65–75 µm high; uppermost part yellowish to yellow-green. Ascospores 8 per ascus, ellipsoid, 12–16 × 4.5–6 µm. Paraphysal cell not enlarged.

**Chemistry.** Usnic acid, zeorin, unidentified terpenoids, ± porphyrilic acid.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered localities.

**Notes.** World distribution: Svalbard, arctic North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, 1981, A. Elvebakk 81:1354 (TROM); Bockfjorden, 1981, A. Elvebakk 81:1043 (TROM).

***Lecanora marginata*** (Schaer) Hertel & Rambold (1985)

**Thallus** crustose, 7–12 mm wide, areolate-rimose, yellowish white, thick. **Apothecia** black, without thalline margin, up to 1.1 mm diam., when young with thin indistinct true margin, when old slightly convex with margin excluded. Hymenium 50–60 µm high; uppermost part greenish. Ascospores 8 per ascus, 9–11 × 4–6 µm. Paraphysse end cell 2–3 µm diam. Hypothecium colourless. Exciple brown-green in outer part, pale in inner part.

**Chemistry.** Usnic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** This species can be confused with the much more commonly occurring *L. atromarginata*, but differs in having a more yellowish and thicker thallus, and another chemistry. World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimens seen** (selected): Forsbladhamna, 29.7.1926, B. Lynge (O); Sørkapp, 29.7.1920, J. Lid (O).

***Lecanora micheleri*** (Hertel) Hertel (1991)

**Thallus** crustose, very thin, grey to yellow-grey, several cm diam. **Apothecia** scattered, black, up to 1 mm diam., with a wavy outline. Thalline margin lacking; true margin thin but distinct. Disc bluish pruinose. Hymenium 40–50 µm high; uppermost part blue-green. True exciple blue-green in outer part, colourless in inner. Ascospores 10–12 × 5–5.5 µm. Paraphysse end cell slightly enlarged to 2 µm diam.

**Chemistry.** Not studied (material insufficient).

**Ecology.** On sandstone; probably not ornithocoprophilous.

**Distribution.** Rare.

**Note.** World distribution: Europe.

**Specimen seen:** Longyearbyen area, H. Hertel 17190 (M).

***Lecanora nordenskioeldii*** Vain. (1909)

Type: Siberia (TUR! [herb. Vainio 04939, 04940, 04941, 04942, 04943], not yet lectotypified).

**Thallus** crustose, 2–3 cm wide, areolate; areolae round in outline, flattened convex, brown, waxy, 0.1–0.3 mm diam. **Apothecia** 0.5–0.6 (–1) mm diam., strongly constricted below to substipitate; thalline margin thin, paler than disc; disc flat, brown. Hymenium 70–75 µm high; uppermost part yellow-brown. Thalline margin with a pseudoparenchymateous cortex, 40–50 µm thick. Ascospores 8 per ascus, 10–12 × 5–6 µm. Paraphysse end cell enlarged to 4 µm diam., brown. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On granitic rock.

**Distribution.** Only known from Sabineodden.

**Notes.** The type material (“oligotypes”) is scarce and could not be subjected to anatomical studies. This species is characterised by the small, brown, substipitate apothecia with pale margin,

and the chemistry. In Svalbard previously only known from Bjørnøya. World distribution: Europe, Chukotka, North America.

**Specimen seen:** Kapp Sabine [Sabineodden], 12.7.1928, O. A. Høeg (O).

***Lecanora orae-frigidae*** R. Sant. (1984)

**Thallus** crustose, areolate, yellow-green, 2–3 cm wide, sorediate. Areolae convex, up to 1.5 mm wide, ± waxy. Soralia centrally on areolae, up to 0.4 mm diam., blue-grey. Soredia 16–18 µm diam., conglutinated into consoredia 30–35 µm diam., N + red. **Apothecia** rare, up to 0.7 m diam., irregular in outline, with distinct thin thalline margin which is concolorous with thallus and often sorediate. Disc vivid red-brown, non-pruinose, flat. Hymenium up to 60 µm high; uppermost part brownish. Ascospores 8 per ascus, 10–14 × 4–5 µm.

**Chemistry.** Usnic acid, zeorin, thiophanic acid, unidentified compounds.

**Ecology.** On old driftwood on shores.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumarctic.

**Specimens seen** (selected): Kong Karls Land, 11.8.1936, E. Dahl (O).

***Lecanora polytropa*** (Hoffm.) Rabenh. (1845)

**Thallus** crustose, areolate, pale yellowish to yellow-green, sometimes lacking. **Apothecia** up to 1 mm diam., with thalline margin which is concolorous with thallus; disc flat to slightly convex, greenish to flesh-coloured. Hymenium 60–70 µm high; uppermost part uncoloured to yellowish. Ascospores 8 per ascus, 11–13 × 5–7 µm. Paraphyses thin, not adglutinated, ramified; end cell not or slightly enlarged to 1.5 µm diam.

**Chemistry.** Usnic acid, zeorin, 1–4 fatty acids, including rangiformic acid.

**Ecology:** On rock.

**Distribution.** Common and widespread.

**Notes.** A very common and variable species. World distribution: cosmopolitan.

**Specimens seen** (selected): Edgeøya, 8.8.1936, E. Dahl (O); Adventfjorden, Hiorthamn, 24.7.1936, E. Dahl (O).

***Lecanora pulicaris*** (Pers.) Ach. (1814)

**Thallus** thick, several cm wide but often interrupted, areolate, pale ochre to yellow-white, glossy, often disappearing below apothecia; apothecia up to 1.2 mm diam., strongly constricted below; disc flat, warm brown; thalline margin thin, pale. Hymenium 40–50 µm high; uppermost part yellow-brown. Cortex of thalline exciple thin, pseudoparenchymateous. Large colourless crystals in lower part of true exciple. Ascospores 8 per ascus, narrowly ellipsoid, 11–13 × 3.5–4.5 µm.

**Chemistry.** Fumarprotocetraric acid, unidentified compounds.

**Ecology.** On old driftwood.

**Distribution.** Only known from Nordfjorden.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Nordfjorden, Sabineodden, 16.7.1973, A.A. Frisvoll (TRH).

*Lecanora rupicola* (L.) Zahlbr. (1928)

**Thallus** crustose, rimose, 4–5 cm wide, pinkish grey. **Apothecia** immersed between areolae, up to 1 mm diam., flat, with white thalline margin and white-blue pruinose disc. Hymenium 40–50 µm high; uppermost part greenish. True exciple not expanded above, pale throughout. Thalline exciple prominent, with algae in inner part, cortex 20–25 µm thick, composed of anastomosing, distinctly swollen hyphae perpendicular to surface. Ascospores 8 per ascus, elliptic, 8–10 × 4–4.5 µm.

**Chemistry.** Atranorin, sordidone.

**Ecology.** On vertical, siliceous rock.

**Distribution.** A few scattered occurrences.

**Notes.** Differs from the related *L. bicincta* in its prominent white exciple, flat apothecia and narrower ascospores. World distribution: Europe, Asia, North America (including Greenland), Argentina, Australia, New Zealand.

**Specimens seen** (selected): Adventfjorden, 5.8.1868, Th.M. Fries (O); Bünzow Land, Bjonahamna, 2001, A. Elvebakk 01:062 (TROM).

*Lecanora semipallida* H. Magn. (1940)

**Thallus** endolithic. **Apothecia** broadly sessile, up to 1 mm diam.; thalline margin thick, whitish, ± entire, disc concave, grey-brown to brown, non-pruinose. Thalline margin almost filled with algae, cortex indistinct. Hymenium 70–80 µm high, epithecium brown, with granules which dissolve in K but not in N. Ascospores 8 in asci, elliptic, 10–13 × 5–6 µm. Paraphyses non-ramified, straight, 1.5 µm diam., end cell enlarged to 2–2.5 µm.

**Chemistry.** Unidentified xanthone (probably vinetorin).

**Ecology.** On limestone (sometimes growing on other lichens).

**Distribution.** Scattered.

**Notes.** Specimens of *L. semipallida* were originally named *L. flotoviana* auct (non Sprengel), but Sliwa (2007) has recently demonstrated that this name belongs to a different taxon. Most probably the species is common on Svalbard, since it is common in other arctic areas (see Sliwa 2007). World distribution: Europe, North America, Asia, New Zealand, Antarctica.

**Specimen seen:** Sassendalen, August 1986, D.O. Øvstedral (BG).

*Lecanora soralifera* (Suza) Räsänen (1931)

**Thallus** crustose, covering several cm<sup>2</sup>, composed of dispersed to agglomerated, strongly convex, 0.3–0.6 mm diam., yellow-white areolae, sorediate. Soralia erupting from centre of areolae, flat, coarse, concolorous with areolae, often coalescing to 1–2 mm diam. Soredia 25–35 µm diam., often in consoredia 60–100 µm diam., N + red. **Apothecia** very rare, up to 0.6 mm diam., sessile, flat; thalline margin thin, flexuose, regular, paler than disc; disc greenish grey. Thalline exciple with very few algae at base, composed of radiating hyphae; outer part with grey-green crystals. Hymenium 50–60 µm high, uppermost part greenish brown. Ascospores 8 per ascus, elliptic, 9–11 × 4–6 µm. Paraphyses ramified; end cell enlarged to 3 µm diam.

**Chemistry.** Usnic acid, zeorin.

**Ecology.** On basic sandstone, in moderate snow-beds.

**Distribution.** Scattered.

**Notes.** New to Svalbard. World distribution: Europe.

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk F-134 (TROM); Kongsfjorden, Ossian Sarsfjellet, 2003, Elvebakk 03:119 (TROM).

***Lecanora straminea*** (Wahlenb.) Ach. (1810)

**Thallus** placodioid, straw-coloured; lobe-ends 0.2–0.8 mm wide, convex, surface rough-scabrid, with gnarled outgrowths in inner part of thallus. **Apothecia** up to 2 mm diam., when young slightly stipitate, with thick crenulate thalline margin concolorous with thallus and brown, concave disc, when old with almost no thalline margin. Hymenium 80–90 µm high, uppermost part yellowish. Ascospores 8 per ascus, broadly elliptic, 9–11 × 5–7 µm. Paraphyses thin, flexuose, little ramified; end cell little or not enlarged.

**Chemistry.** Thiophanic acid, arthothelin, 4,5-dichloronorlichexanthone, 2,4-dichlorolichexanthone, 4-chlorolichexanthone and 5-chlorolichexanthone (Elix 1999 based on material from Europe; no material from Svalbard analysed).

**Ecology.** On bird cliffs.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Asia.

**Specimens seen:** none seen; record based on Fries (1867) who cited a specimen from western Svalbard. (The morphological and anatomical description above is based on a specimen from Bjørnøya, Bustnes leg. [TROM].)

***Lecanora subaurea*** Zahlbr. (1928)

**Thallus** crustose, as dispersed areolae on an indistinct, blackish prothallus. Areolae up to 0.5 mm diam., irregularly rounded in outline, flat to slightly convex, pale yellow-green, sorediate. Soralia marginal, coarse, concolorous with thallus. Soredia 20–26 µm diam., in consoredia of variable size.

**Chemistry.** Pannarin, rhizocarpic acid, zeorin.

**Ecology.** On iron-rich sandstone.

**Distribution.** Only found twice.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Sydøst-Spitsbergen, Davishamna (S of Hambergbreen), 29.07.1936, E. Dahl (O); Bjørndalen, 2004, T. Tønsberg 31879 (BG).

***Lecanora sulphurea*** (Hoffm.) Ach. (1810)

**Thallus** crustose, 1–3 cm wide, yellow-white to yellow-grey, thick, rimose. **Apothecia** originally immersed, later slightly expanding, up to 1 mm diam., thalline margin soon disappearing; true margin distinct, black; disc flat, later convex, black, ± white-pruinose. Hymenium 40–50 µm high; uppermost part blue-grey to brown-green, with small crystals. Ascospores 8 per ascus, 9–12 × 5–6 µm. Paraphyses stout, ramified; end cell enlarged to 3 µm diam.

**Chemistry.** Atranorin, usnic acid, zeorin, unidentified terpenoids.

**Ecology.** On rock; ornithocoprophilous.

**Distribution.** Widespread.

**Notes.** Differs from specimens from the British Isles in its broader ascospores, and lack of  $\alpha$ -collatolic acid and gangaleoidin (see Hawksworth & Dalby 1992). New to Svalbard. World distribution: Europe, Taimyr, Argentina.

**Specimens seen** (selected): northernmost part of Prins Karls Forland, 15.8.1868, Th.M. Fries (O); Storøya, 14.8.1936, E. Dahl (O).

*Lecanora swartzii* (Ach.) Ach. (1810)

**Thallus** crustose, areolate, pale ochre to pinkish grey; areolae up to 1 mm diam., round. **Apothecia** sessile, strongly convex, up to 1.5 mm diam., blue-pruinose. Thalline exciple half filled with algae; cortex thick, composed of radiating, swollen hyphae. Hymenium 55–60 µm high; uppermost part brownish. Ascospores 8 per ascus, 12–14 × 6–7 µm. Paraphyses strongly adglutinated; end cell not enlarged.

**Chemistry.** Atranorin, thiophanic acid, sordidone.

**Ecology.** On vertical rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America (Greenland), Australia, New Zealand.

**Specimens seen:** Adventfjorden, above Longyearbyen, 23.7.1936, E. Dahl (O); Colesdalen, 2002, R. Haugan 6863 (O).

*Lecanora symmicta* (Ach.) Ach. (1810) s. lat.

**Thallus** very thin to evanescent. **Apothecia** up to 0.7 mm diam., yellow-green, becoming dark in exposed places, flat; thalline margin soon excluded. True exciple composed of radiating hyphae. Hymenium 50–60 µm high; uppermost part yellowish. Ascospores 8 per ascus, 9–14 × 4–5 µm. Paraphyses ramified, adglutinated; end cell not enlarged.

**Chemistry.** Usnic acid, ± zeorin, 2–3 unidentified xanthones.

**Ecology.** On old driftwood.

**Distribution.** Only known from Forsbladhamna.

**Notes.** The colour of the apothecia differ from that of material from mainland Europe in being more grey-green and even blackish. As the xanthone constitution of the thallus also may prove to differ we assign the Svalbard material to *L. symmicta* s. lat. Apparently the material is in need of further study. World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand, Antarctica.

**Specimen seen:** Forsbladhamna, 27.7.1926, B. Lynge (O; 2 specimens).

*Lecanora torrida* Vain. (1909)

**Thallus** as small white areolae around apothecia. **Apothecia** up to 0.6 mm diam., constricted below; thalline margin thin, white, almost filled with algae; cortex indistinct, composed of irregularly oriented hyphae. Disc flat, black, rough. Hymenium 35–45 µm high; uppermost part greenish, N + red-violet, epithecium with granules (in pol. light) insoluble in K and N. Ascospores 8 per ascus, 9–11 × 4–6 µm. Paraphyses thin, flexuose; end cell slightly enlarged to 2 µm diam.

**Chemistry.** Not studied. Sliwa (2007) found two chemotypes in this species: one with 2,7-dichloronorlichenxanthone and ± pannarin, and one with no lichen products.

**Ecology.** On limestone, not ornithocophilous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Kapp Hesselmann, 22.7.1926, B. Lynge (O); Krosspynten, 2.8.1928, O.A. Høeg (TRH).

***Lecanora umbrina*** (Ach.) A. Massal. (1852)

Syn. *L. hagenii* (Ach.) Ach. (1810).

**Thallus** evanescent. **Apothecia** up to 0.6 mm diam., thin, flat; thalline margin thin, white; disc black. Hymenium 40–45 µm high; uppermost part green-brown. Ascospores 8 per ascus, 9–11 × 5–5.5 µm. Paraphysis end cell up to 3 µm diam.

**Chemistry.** Negative.

**Ecology.** On plant remains.

**Distribution.** A few scattered occurrences.

**Notes.** Rather similar to *L. epibryon*, but differs in its smaller apothecia with black disc, smaller ascospores and lack of atranorin. Probably overlooked. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Kongsfjorden, A. Elvebakk 85:316; Krossfjorden, A. Elvebakk 85:217 (TROM).

***Lecanora zosterae*** (Ach.) Nyl. (1876)

**Thallus** within substrate or as a thin, green-grey, disrupted crust. **Apothecia** up to 0.8 m diam., constricted below; thalline margin white, regular, thin, persistent, filled with algae; thalline cortex in vertical section colourless, 25–30 µm thick, composed of thick hyphae perpendicular to surface (palisade tissue). Hymenium 30–40 µm high; epithecium not granular (in pol. light). Ascospores 8 per ascus, 11–13 × 5–5.5 µm. Paraphyses stout; end cell 2–2.5 µm diam.

**Chemistry.** Negative.

**Ecology.** On bones, driftwood and limestone.

**Distribution.** Common and widespread.

**Notes.** Specimens within the *L. dispersa* complex are common on limestone, and most of them probably belong to this taxon. The relationship between populations on driftwood/bones and on limestone is unclear. *L. zosterae* var. *beringii* (Nyl.) Sliwa with raised apothecia (see Sliwa 2007) is probably also represented in the material. New to Svalbard. World distribution: Europe, Siberia, North America, subantarctic Heard Island (McCarthy 2008).

**Specimens seen** (selected): Bellsund, 18.8.1936, B. Lynge (O); Gipshukken, Gipshukken, on rock, A. Elvebakk (TROM); det. L. Sliwa 2008.

***Lecanora* sp. A.**

**Thallus** crustose, areolate; arolae dispersed, thick, up to 1 mm diam., pale grey-brown, sorediate. Soralia marginal, coarse, checkered grey and black. Soredia 22–28 µm, in consoredia 40–50 µm wide, N + red. **Apothecia** and pycnidia not seen.

**Chemistry.** Atranorin, three undetermined xanthones.

**Ecology.** On schistose rock, ornithocoprophilous.

**Distribution.** Only known from Liefdefjorden.

**Notes.** Morphologically similar to sorediate members of the *L. rupicola* group, but they have chromones and a different ecology (overhangs, vertical rock faces).

**Specimens seen:** Liefdefjorden, A. Elvebakk 81:1523a (BG), 81:1520 (TROM).

***Lecanora* sp. B**

**Thallus** marginally with a few convex, yellow-grey, corticated areolae up to 0.5 mm diam., otherwise composed of soralia. Soralia convex, to 7 mm diam., yellow-grey. Soredia 28–30 µm diam., N + red, very loosely organized. **Apothecia** and pycnidia not found in Svalbard material.

**Chemistry.** Atranorin, usnic acid, unidentified xanthone, zeorin, unidentified terpenoids.

**Ecology.** On shaded, vertical rock.

**Distribution.** Only found once.

**Notes.** This taxon keyed out as *L. chloroleprosa* (Vain.) H. Magn. in floras covering Northern Europe, but this species has a more yellow-brown thallus and contains usnic acid, placodiolic acid and several terpenoids, including zeorin (type in TUR studied). World distribution: Europe, North America (Greenland).

**Specimen seen:** Nordenskiöld Land, Kapp Laila, T. Tønsberg 9887 (BG).

**LECIDIA Ach. (1803)**

**Thallus** crustose, effuse to areolate, white to grey-brown to shiny brown. Photobiont trebouxiod. **Ascomata** apothecia, black, sessile to immersed, with only true exciple. Ascii with tholus with an amyloid cap (however, see below), 8-spored. Ascospores simple, colourless. Conidia filiform.

**Notes.** In a key to *Lecidea* s. str. in Europa, Hertel (1995) stated that about half of the species previously assigned to the genus did not belong in *Lecidea* s. str. as they had different ascus types. This may prove largely true also for the *Lecidea* species treated below. *Lecidea* s. str. is considered a saxicolous genus; most probably all the terricolous and muscicolous species treated below do not belong in *Lecidea* s. str.

Key to *Lecidea* on Svalbard:

Key A (to species on soil):

1	Thallus with pannarin .....	<i>L. alpestris</i>
1	Thallus without pannarin .....	2
2 (1)	Thallus minutely fruticose; apothecia flat.....	<i>L. ramulosa</i>
2	Thallus not fruticose; apothecia convex .....	<i>L. collodea</i>

Key B (to species on bryophytes):

1	On leaves on <i>Polytrichum</i> (or <i>Gymnomitrion</i> ) .....	2
1	Not on leaves of <i>Polytrichum</i> (or <i>Gymnomitrion</i> ) .....	3
2 (1)	Thallus with usnic and psoromic acid; ascospores longer than 8 µm.....	<i>L. polytrichina</i>
2	Thallus with alectorialic acid; ascospores up to 8 µm long .....	<i>L. polytrichinella</i>
3 (1)	Thallus minutely fruticose .....	<i>L. ramulosa</i>
3	Thallus not fruticose .....	4

4 (3)	Thallus with atranorin .....	<i>L. ileiformis</i>
4	Thallus without atranorin .....	5
5 (4)	Apothecia flat, black .....	<i>L. ementiens</i>
5	Apothecia convex, brown .....	<i>L. collodea</i>

## Key C (to species on rock):

1	Thallus sorediate .....	<i>L. himalaica</i>
1	Thallus not sorediate .....	2
2 (1)	Apothecia aspicilioid, immersed in rock or thallus .....	3
2	Apothecia not aspicilioid .....	4
3 (2)	Thallus endolithic .....	<i>L. cavatula</i>
3	Thallus epilithic, thick .....	<i>L. rhagadiella</i>
4 (2)	Asci of <i>Lecanora</i> -type; algae below hymenium .....	<i>L. polycocca</i>
4	Asci not of <i>Lecanora</i> -type; no algae below hymenium .....	5
5 (4)	Asci of <i>Catillaria</i> -type; ascospores dumb-bell-shaped .....	<i>L. commaculans</i>
5	Asci of <i>Lecidea</i> -type; spores not dumb-bell-shaped .....	6
6 (5)	Growing on other lichens .....	<i>L. verruca</i>
6	Not growing on other lichens, at least when old .....	7
7 (6)	Medulla K/I + violet .....	8
7	Medulla K/I – .....	39
8 (7)	On calcareous rock .....	9
8	On siliceous rock .....	10
9 (8)	Thallus K + red (norstictic acid) .....	<i>L. lapicida</i> , chemotype
9	Thallus K – .....	<i>L. umbonata</i>
10 (8)	Ascospores 2.4–4.0 µm broad .....	11
10	Ascospores > 4 µm broad .....	15
11 (10)	Thallus areolate, shiny brown ( <i>atrobrunnea</i> -type) .....	12
11	Thallus continuous or endolithic, not shiny brown .....	13
12 (11)	Thallus K + red (norstictic acid) .....	<i>L. syncarpa</i>
12	Thallus K – (2'-O-methylperlatolic acid) .....	<i>L. atrobrunnea</i>
13 (11)	Hypothecium colourless .....	14
13	Hypothecium brown .....	<i>L. auriculata</i>
14 (13)	Thallus thick, epilitic .....	<i>L. tesselata</i>
14	Thallus endolithic .....	<i>L. steineri</i>
15 (10)	Ascospores 4.1–5.0 µm broad .....	16
15	Ascospores > 5.0 µm broad .....	28
16 (15)	Thallus of <i>atrobrunnea</i> -type .....	17
16	Thallus not of <i>atrobrunnea</i> -type .....	18

17 (16)	Thallus with stictic acid .....	<i>L. paupercula</i>
17	Thallus with 2'-O-methylperlatolic acid.....	<i>L. atrobrunnea</i>
18 (16)	Epilithic thallus lacking .....	19
18	Epilithic thallus present.....	22
19 (18)	With norstictic acid .....	<i>L. ecrustacea</i>
19	Without norstictic acid.....	20
20 (19)	Hypothecium colourless.....	<i>L. lapicida</i>
20	Hypothecium brown .....	21
21 (20)	Ascospores up to 7.5 µm long .....	<i>L. auriculata</i>
21	Ascospores >8.2 µm long .....	<i>L. lapicida</i>
22 (18)	Thallus K + red (norstictic acid) .....	23
22	Thallus K + yellow or - .....	24
23 (22)	Hypothecium colourless to pale brown .....	<i>L. lapicida</i> v. <i>pantherina</i>
23	Hypothecium brown-black .....	<i>L. swartzioidea</i>
24 (22)	Hypothecium colourless to pale brown .....	25
24	Hypothecium brown to dark brown .....	26
25 (24)	With confluentic acid .....	<i>L. tesselata</i>
25	With stictic acid .....	<i>L. lapicida</i> v. <i>lapicida</i>
26 (24)	True exciple broad, with hyphae up to 3 µm broad .....	<i>L. auriculata</i>
26	True exciple narrow, with hyphae 3–4.5 um broad .....	27
27 (26)	With stictic acid .....	<i>L. lapicida</i> v. <i>lapicida</i>
27	With confluentic acid .....	<i>L. confluens</i>
28 (15)	With norstictic acid .....	29
28	Without norstictic acid .....	32
29 (28)	Without epilithic thallus .....	<i>L. ecrustacea</i>
29	With epilithic thallus .....	30
30 (29)	Thallus of <i>atrobrunnea</i> -type .....	<i>L. syncarpa</i>
30	Thallus not of <i>atrobrunnea</i> -type .....	31
31 (30)	Hypothecium colourless to pale brown .....	<i>L. lapicida</i> v. <i>pantherina</i>
31	Hypothecium dark brown .....	<i>L. swartzioidea</i>
32 (28)	Without epilithic thallus .....	<i>L. lapicida</i> v. <i>lapicida</i>
32	With epilithic thallus .....	33
33 (32)	Thallus of <i>atrobrunnea</i> -type .....	<i>L. paupercula</i>
33	Thallus not of <i>atrobrunnea</i> -type .....	34
34 (33)	Thallus rusty red, bullate .....	<i>L. silacea</i>
34	Thallus flat, not rusty red .....	35

35 (34)	With stictic acid .....	<i>L. lericida</i> v. <i>lericida</i>
35	Without stictic acid .....	36
36 (35)	Without lichen products .....	37
36	With confluentic acid .....	38
37 (36)	Ascospore width 5.5–6 µm .....	<i>L. symphycarpea</i>
37	Ascospores width 7.5–8.5 µm .....	<i>Lecidea</i> sp.
38 (36)	Ascospores with thick wall .....	<i>L. tesselata</i>
38	Ascospores with thin wall .....	<i>L. confluens</i>
39 (7)	Hypothecium colourless .....	<i>L. plana</i>
39	Hypothecium brown .....	40
40 (39)	With gyrophoric acid .....	<i>L. fuscoatra</i>
40	Without gyrophoric acid .....	<i>L. auriculata</i>

***Lecidea alpestris* Sommerf. (1825)**

**Thallus** lumpy to granulate, ± thick, white-grey. **Apothecia** up to 1 mm diam., strongly convex, black, emarginate. Hymenium 40–60 µm; uppermost part blue-green. True exciple of radiating hyphae. Hypothecium red-brown, K + intensifying. Paraphyses anastomosing; end cell not enlarged. Ascii of *Catillaria*-type. Ascospores 8 per ascus, narrowly elliptic, 11–13 × 2.5–3 µm.

**Chemistry.** Pannarin.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Notes.** The externally similar *Lecidea limosa* was recently moved to the new genus *Protomicarea* by Hafellner & Türk (2001). World distribution: Europe, Siberia, North America (Greenland).

**Specimens seen** (selected): Akseløya, 21.8.1926, B. Lynge (O); Adventfjorden, Hiorthhamn, 24.7.1936, E. Dahl (O).

***Lecidea atrobrunnea* (Ram. ex Lam. & DC) Schaer. (1928)**

**Thallus** rimose-areolate, shiny red-brown; areolae convex. **Apothecia** black, up to 1.6 mm diam., with distinct true margin, becoming convex by age. Hymenium 40–55 µm high, epithecium green to blue-green. Hypothecium pale brown to brown. Exciple greenish black in outer part, pale in inner part. Ascospores 8 per ascus, 7–9 × 3–5 µm.

**Chemistry.** 2'-O-methylperlatolic acid.

**Ecology.** On rock.

**Distribution.** Widespread and common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, Antarctica.

**Specimens seen** (selected): Adventfjorden, 1868, Th.M. Fries (O); Ullaberg, 1926, B. Lynge (O).

*Lecidea auriculata* Th. Fr. (1861)

**Thallus** areolate, grey; areolae flat, continuous to dispersed, prothallus prominent, black. **Apothecia** saddle-formed, black, up to 2 mm diam., true margin distinct. Hymenium 30–50 µm high, epithecium blue-green. Exciple red-brown in outer part, reddish in inner part. Hypothecium brown to dark brown. Ascospores 8 per ascus, 8–12 × 3–3.5 µm. Conidia thread-formed, 10–15 × 0.8–1 µm. Medulla K/I + violet.

**Chemistry.** Confluent acid.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia.

**Specimens seen** (selected): Adventfjorden, 1868, Th.M. Fries (O); Indre Norskøya, 1928, O.A. Høeg (TRH).

*Lecidea cavatula* Nyl. (1863)

**Thallus** endolithic, as a white decoloration on rock, 3–4 cm wide. **Apothecia** sunk in pits in rock, up to 0.8 mm diam., when dry divided from rock by a fissure, true margin slightly raised, blue-grey, disc black. Hymenium 110–130 µm high, pale bluish, N + red. Hypothecium and exciple yellowish. Ascospores 8 per ascus, 15–17 × 7–9 µm. Paraphyses ramified, strongly conglutinated, end cell not enlarged.

**Chemistry.** Not performed.

**Ecology.** On limestone.

**Distribution.** Only known from Kongsfjorden and Bockfjorden.

**Notes.** The generic affinities of this species is uncertain, it is not a *Lecidea* s. str. World distribution: Europe.

**Specimens seen** (selected): Ny-Ålesund, 1975, H. Hertel 16823 (M); Kongsfjorden, 1 km SE of Gluudneset, 2003, A. Elvebakk 03:137 (TROM).

*Lecidea collodea* (Th. Fr.) Leight. (1878)

**Thallus** crustose, very thin, grey-ochre. **Apothecia** sessile, strongly convex, constricted below, brown, up to 1.3 mm diam., emarginated. Hymenium 110–130 µm high, uppermost part brownish. Hypothecium colourless, of a *textura intricata*. Asci of *Porpidia*-type. Ascospores 8 per ascus, 10–14 × 4–5 µm, with halo. Paraphyses anastomosing; end cell enlarged to 2 µm, embedded in a gelatinous matrix.

**Chemistry.** Negative.

**Ecology.** Over moribund bryophytes.

**Distribution.** A few scattered localities.

**Notes.** The generic affinities of this species in uncertain, it is not a *Lecidea* s. str. World distribution: Europe, Severnaya Zemlya (Kristinsson et al. 2006).

**Specimens seen** (selected): Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9831 (BG); Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9841 (BG, det. Ch. Printzen 2000).

*Lecidea commaculans* Nyl.(1868)

**Thallus** as small (up to 0.2 mm diam.), white, dispersed, flat areolae. **Apothecia** black, sessile, up to 0.6 mm diam., emarginate, convex. True exciple composed of radiating hyphae, greenish in outer part, pale in inner. Hypothecium pale brown, K + intensifying red. Paraphyses stout, little ramified, tips embedded in a gelatinous matrix. Hymenium 35–40 µm high; epithecium grey-green. Asci of *Catillaria*-type. Ascospores dumb-bell shaped, 9–11 × 3–3.5 µm.

**Chemistry.** Not performed.

**Ecology.** On rock.

**Distribution.** Rare.

**Notes.** This species is characterized by its exciple which is pale in inner part and greenish in outer, hypothecium which is K + intensifying red, dumb bell-shaped ascospores and ascus type. The description is based on Hertel 22199 from Iceland (M). World distribution: Europe, North America.

**Specimen seen:** none seen; record based on material cited by Hertel (1981) from Ny-Ålesund.

*Lecidea confluens* (Web.) Ach. (1803)

**Thallus** crustose, rimose, thin, plumbeous grey. **Apothecia** black, up to 1 mm diam., usually several growing together in a cauliflower-like fashion, true margin thin, distinct. Hymenium 50–60 µm high; epithecium blue-green. True exciple dark brown in outermost part, pale in inner part. Hypothecium dark brown. Ascospores 10–15 × 5–7 µm. Medulla K/I + violet.

**Chemistry.** Confluentic acid.

**Ecology.** On siliceous rock, ornithocoprophilous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Argentina, Australia.

**Specimens seen** (selected): Wijdefjorden, 2001, A. Elvebakk 01:188, 01:229 (TROM).

*Lecidea ecrustacea* (Anzi ex Arn.) Arn. (1876)

**Thallus** endolithic. **Apothecia** flat, black, up to 1.5 mm diam.; margin distinct. Hymenium 30–60 µm; epithecium blue-green. Exciple pale brown, darker in outer part, K + red (norstictic acid). Hypothecium pale brown. Ascospores 10–14 × 5–6 µm.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Siberia, North America.

**Specimen seen:** None seen; record based on material cited by Hertel (1977) from Van Mijenfjorden.

*Lecidea ementiens* Nyl. (1884)

**Thallus** thin, blue-grey, with warted-coralloid outgrowths. **Apothecia** up to 1 mm diam., thin, dark brown-black, with undulate margin. Hymenium 40–45 µm high; epithecium brown. Exciple composed of radiating, strongly swollen hyphae. Hypothecium colourless, composed of irregularly arranged hyphae. Paraphyses anastomosing, septate; end cell slightly enlarged to 2.5 µm. Ascospores 8 per

ascus,  $10-12 \times 4-4.5 \mu\text{m}$ . Ascii of *Bacidia*-type.

**Chemistry.** Negative.

**Ecology.** On bryophytes, detritus etc.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Adventdalen, Hotellneset, O.A. Høeg, 19.9.1928 (TRH); Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9841b (BG; det. Chr. Printzen 2000).

### *Lecidea fuscoatra* (L.) Ach. (1803)

**Thallus** crustose, grey-brown, in protected places with shiny brown areoles, cracked, thin to moderately thick,  $3-4 \text{ cm diam.}$  **Apothecia** up to  $1.3 \text{ mm diam.}$ , black, sessile, flat, with constricted base; true margin thin but distinct. Hymenium  $45-50 \mu\text{m}$  high; epithecium with both greenish and brownish pigment. Hypothecium dark brown. Exciple narrow, pale brown to yellowish. Ascospores 8 in ascii,  $8-12 \times 5-6 \mu\text{m}$ .

**Chemistry.** Gyrophoric acid.

**Ecology.** On sandstone.

**Distribution.** Adventfjorden.

**Notes.** According to Hertel (1995), this species does not reach the Arctic, so the occurrence in Adventfjorden was unexpected. However, it reaches Finnmark in northernmost mainland Norway (material in BG), and also two other arctic sectors (Kristinsson et al. 2006). World distribution: Europe, North America (including Greenland), Asia. New to Svalbard.

**Specimen seen:** Adventfjorden, 5.8.1868, Th.M. Fries (O).

### *Lecidea himalaica* Hertel (1977)

Type: Himalaya, Khumbu Himal, 1962, Poelt (M 00 25482!).

**Thallus** crustose, areolate, up to  $2 \text{ cm wide}$ , with a thin white prothallus, sorediate. Areolae pale ochre, thick,  $0.4-0.6 \text{ mm wide}$ , with soralia developing both centrally and marginally, concolorous or slightly paler than cortex. Soredia  $20-25 \mu\text{m diam.}$ , adglutinated into consoredia  $50-60 \mu\text{m diam.}$

**Apothecia** (not seen in Svalbard material) biatorine, up to  $1 \text{ mm diam.}$ , sessile, constricted below, dark brown-grey, somewhat tuberculate. Hymenium  $60-65 \mu\text{m}$  high; uppermost part yellow-brown. Ascospores  $8-11 \times 4-5.5 \mu\text{m}$ . Paraphyses little ramified, flexuose, tips not widened.

**Chemistry.** Atranorin and alectorialic acid.

**Ecology.** On rock.

**Distribution.** Rare.

**Notes.** The type from Himalaya is similar to the Svalbard material except that it is more brownish. The chemistry indicates affinity to the genus *Tephromela*, but the anatomy of the apothecia does not support this. New to Svalbard. World distribution: Europe, Asia.

**Specimens seen:** Liefdefjorden, A. Elvebakk 81:1195 (TROM); Hinlopenstretet, Store Russeøya, 22.8.1936, E. Dahl (O).

***Lecidea ileiformis* Fr. (1831)**

**Thallus** bluish white, thick, continuous, uneven to bullate; surface smooth. **Apothecia** sessile, black, to 0.8 mm diam.; base constricted; disc flat, becoming convex in old age; margin thin, distinct, minutely roughened. Hymenium 50–60 µm high; upper part strongly aeruginose. True exciple composed of radiating hyphae, outermost part strongly aeruginose. Hypothecium colourless. Ascii broadly clavate, of *Lecanora* (?) type. Ascospores 8 per ascus, droplet-shaped, 11–13 × 7–9 µm. Paraphyses thin, flexuose, ramified; end cells not enlarged. Pycnidia not seen.

**Chemistry.** Atranorin, zeorin, unidentified compound.

**Ecology.** Over bryophytes.

**Distribution.** Rare; only found once.

**Notes.** Recognized by its thick white thallus (looking like a *Ochrolechia*), aeruginose hypothecium and outer part of exciple, and chemistry. World distribution: Europe, North America (Greenland).

**Specimen seen:** Bockfjorden, 1979, Hafellner 5421 (GZU).

***Lecidea lapicida* (Ach.) Ach. (1803)**

**Thallus** crustose, rimose-areolate, grey, thick, sometimes rust-coloured, prothallus often present. **Apothecia** up to 1.5 mm broad, black, sessile; true margin thin but distinct. Hymenium 50–80 µm high; hypothecium blue-green. Hypothecium brown. Exciple blue-green in outer part, pale in inner part. Ascospores 10–15 × 5–8 µm. Conidia filiform, 12–14 × 1 µm. Medulla K/I + violet.

**Chemistry.** Two chemotypes: I) stictic acid + accessories, II) norstictic acid + accessories (including stictic acid).

**Ecology.** On siliceous rock, not ornithocoprophilous.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Adventdalen, Longyearbyen, E. Dahl, 23.7.1936 (O); Amsterdamøya, 1.8.1936, E. Dahl (O).

***Lecidea paupercula* Th.Fr. (1868)**

**Thallus** rimose-areolate, grey-brown to red-brown, ± thick. **Apothecia** immersed in thallus, black, up to 2 mm diam., flat to somewhat convex; true margin distinct. Hymenium 40–60 µm high, hypothecium green-brown. True exciple brown in outermost part, pale in inner. Hypothecium dark brown. Ascospores 8 per ascus, 9–14 × 4–7 µm. Medulla K/I + violet.

**Chemistry.** Stictic acid complex.

**Ecology.** Saxicolous on siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America.

**Specimen seen:** Amsterdamøya, 26.8.1936, E. Dahl (O).

***Lecidea plana*** (J. Lahm) Nyl. (1872)

**Thallus** crustose, granulose to areolate, pale grey. **Apothecia** sessile, black, up to 1.5 mm diam., with raised proper margin. Hymenium 40–50 µm high, uppermost part green-black. Hypothecium colourless. Ascospores 8 per ascus, 8–12 × 3.5–5 µm. Medulla K/I –.

**Chemistry.** Planaic and 4-0-demethylplanaic acids.

**Ecology.** On siliceous rock.

**Distribution.** Only known from Isfjorden.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Argentina, Australia, New Zealand.

**Specimens seen:** none seen, included on the basis of Lynge (1940a).

***Lecidea polycocca*** Sommerf. (1826)

**Thallus** as small (0.2–0.4 mm) grey areolate, dispersed or continuous. **Apothecia** black, sessile with constricted base, flat; true exciple thin but evident, composed of radiating hyphal strands in a gelatinous matrix; outermost part green-grey, in part with red-brown streaks from hypothecium. Hypothecium red-brown, intensifying red in K. Hymenium 50–60 µm high, epithecium green-grey. Paraphyses swollen, anastomosing. Asci of *Lecanora*-type. Ascospores simple, 8 per ascus, 9–11 × 4–4.5 µm.

**Chemistry.** Not studied.

**Ecology.** On limestone.

**Distribution.** Rare.

**Notes.** Characterized by its small ascospores, swollen, anastomosing paraphyses, K + intensifying red hypothecium and *Lecanora*-type ascii. It probably belongs in *Lecanora*. World distribution: Europe, Siberia, North America.

**Specimen seen:** Brøggerhalvøya, H. Hertel 17579 (M).

***Lecidea polytrichina*** Hertel (1968)

**Thallus** crustose, granulose, yellow-white, on leaves of *Polytrichum* spp. or *Gymnomitrion* spp. **Apothecia** biatorine, convex, emarginate, up to 0.6 mm broad, 0.4 mm high, black in exposed sites, pale yellow-brown in protected sites. Hymenium up to 60 µm high; uppermost part olive brown, with crystals. Hypothecium colourless. Asci of *Biatora*-type. Ascospores 8 per ascus, colourless, simple, 9–11 × 3–4.5 µm. Paraphyses strongly adglutinated, ramified to anastomosing; end cell not enlarged.

**Chemistry.** Usnic acid, psoromic acid, and atranorin

**Ecology.** On leaves of *Polytrichum* spp. and *Gymnomitrion* spp.

**Distribution.** Rare.

**Note.** World distribution: Scandinavia, mountains of central Europe.

**Specimen seen:** none seen, record based on material cited by Obermayer & Poelt (1994) from Hinlopenstredet.

***Lecidea polytrichinella*** Hertel, W. Obermayer & Poelt (1994)

**Thallus** evanescent, or as small, white granules, on leaves of *Polytrichum* spp. **Apothecia** up to 0.3 mm diam., brown, blackish when exposed, biatorine, semiglobose. Hymenium up to 35 µm high;

uppermost part brown. Hypothecium brownish. Exciple of radiating hyphae. Ascii of *Biatora*-type. Ascospores 8 per ascus,  $6-8 \times 2.5-3.5 \mu\text{m}$ . Paraphyses adglutinated, in upper part ramified and somewhat broadened.

**Chemistry.** Alectorialic acid with accessories

**Ecology.** On leaves of *Polytrichum* spp.

**Distribution.** Rare.

**Note.** World distribution: Scandinavia, mountains of Central Europe.

**Specimen seen:** Amsterdamøya, H. Hertel 16660 (M).

#### *Lecidea ramulosa* Th. Fr. (1866)

**Thallus** thick, bluish-white, lumpy to subfruticose. **Apothecia** flat, black, sessile, with persistent margin. Hymenium  $70-80 \mu\text{m}$  high, uppermost part slightly bluish. Exciple of strongly gelatinous, pseudoparenchymateous tissue. Hypothecium colourless. Paraphyses simple, strongly swollen; end cell to  $7 \mu\text{m}$  diam., lumina distinctly visible,  $2 \mu\text{m}$  diam. Ascii of *Bacidia*-type. Ascospores  $9-10 \times 3.5-5 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On soil and moribund bryophytes in snowbeds on calcareous ground.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Van Mijenfjorden, 17.8.1926, B. Lynge (O); Ny-Ålesund, 4.-5.7.1936, E. Dahl (O).

#### *Lecidea rhagadiella* (Nyl.) Th.Fr. (1868)

Syntype: Finland (H-Nyl. !)

**Thallus** crustose, 2–3 cm wide, thick, brilliantly white, with thin black prothallus. **Apothecia** numerous, angular in outline, up to 1 mm diam., immersed in thallus, with an elevated, thin, white-pruinose margin split from thallus; disc flat, black. Hymenium  $110-120 \mu\text{m}$  high, uppermost part green-brown. Hypothecium with clusters of yellowish granules, otherwise colourless. Paraphyses ramified to anastomosing, submoniliform. Ascospores 8 per ascus,  $18-20 \times 8-12 \mu\text{m}$ .

**Chemistry.** Unidentified compound (Rf classes: 3, 3.3).

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Notes.** Description based on the syntype from Finland (H-Nyl). World distribution: Europe.

**Specimen seen:** none seen, record based on material cited by Lynge (1940a) from Isfjorden.

#### *Lecidea silacea* (Ach.) Ach. (1803)

**Thallus** areolate, areolae strongly convex, rust-red. **Apothecia** up to 1.5 mm diam., black, among the areolae, flat to convex; true exiple finally excluded. Hymenium  $40-60 \mu\text{m}$  high; uppermost part blue-green. Hypothecium dark brown. Ascospores 8 per ascus,  $10-15 \times 5-6 \mu\text{m}$ . Paraphyses weakly anastomosing; end cells enlarged.

**Chemistry.** Porphyritic acid.

**Ecology.** On metal-rich, siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Antarctica.  
**Specimen seen:** Colesdalén, 2002, R. Haugan (O).

***Lecidea steineri*** Hertel (1975)

**Thallus** very thin to nonexistent, grey. **Apothecia** black, to 1.2 mm diam., often in crowded groups, sessile; true margin visible in young apothecia, excluded in older. Hymenium 40–45 µm high; epithecium brown-green. Hypothecium colourless to faintly brown. Tissue below hypothecium K/I + violet. Ascospores 8 per ascus, 7–9 × 3–5 µm.

**Chemistry.** Negative.

**Ecology.** Siliceous rock.

**Distribution.** Only known from the Longyearbyen area.

**Note.** World distribution: Europe, North America.

**Specimen seen:** none seen, included on the basis of Hertel (1981).

***Lecidea swartzioidea*** Nyl.(1859)

Similar to the norstictic acid chemotype of *Lecidea lapicida* var. *pantherina* except that the hypothecium is brown-black (almost uncoloured to pale brown in *L. lapicida* var. *pantherina*).

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America, New Zealand.

**Specimen seen:** Mariaholmen, 23.8.1926, B. Lynge (O).

***Lecidea symphycarpea*** Lynge (1928)

**Thallus** crustose, 2–3 cm wide, blue-grey, thin, with faintly cracked, with narrow blackish prothallus. **Apothecia** sessile, up to 1.3 mm wide, with regular to somewhat wavy outline: disc black, flat; true margin thin, white-pruinose. Hymenium 65–70 µm high; epithecium blue-green. Hypothecium brown. Ascospores 11 × 5.5–6 µm. Medulla K/I + blue.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Only known from Litledalsfjellet.

**Notes.** A critical taxon, close to *L. lapicida*, but differs in its thinner and more bluish thallus, lack of lichen products and pruinose margin of the apothecia. World distribution: Svalbard, Novaya Zemlya.

**Specimen seen:** Litledalsfjellet, Aug. 1926, B. Lynge (O; det. M. Andreev).

***Lecidea syncarpa*** Zahlbr. (1918)

**Thallus** rimose-areolate, shiny dull brown. **Apothecia** black, up to 2 mm diam., convex; margin distinct. Hymenium 40–60 µm high; epithecium greenish. Hypothecium brown. Ascospores 8 per ascus, 7–9 × 3–5 µm.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America.

**Specimens seen** (selected): Elvebakk 81:1098 (TROM); Magdalenefjorden, Aug. 1839, J. Vahl (TRH).

### *Lecidea tessellata* Flörke (1819)

**Thallus** areolate to rimose, pale ochraceous grey. **Apothecia** up to 2 mm diam., flush with thallus, flat, black, with thin, crenulate margin. Hymenium 50–75 µm high; epithecium blue-green. True exciple dark brown in outermost part, pale in inner part. Hypothecium colourless or yellowish. Ascospores 7–16 × 4–8 µm. Medulla K/I + violet.

**Chemistry.** Confluentic acid

**Ecology.** On siliceous rock

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Antarctica.

**Specimens seen** (selected): Dicksonfjorden, Lyckholmdalen, 9.7.1936, E. Dahl (O); Braganzavågen, 1925, Lagercrantz (O).

### *Lecidea umbonata* (Hepp) Mudd (1861)

**Thallus** brilliantly white, continuous to slightly rimose, often zonate with black hypothallus lines. **Apothecia** immersed in thallus to sessile, up to 2 mm diam.; margin prominent; disc flat, with central umbo of sterile tissue. Exciple with dark green outer part, and pale inner part. Hymenium 50–80 µm high; epithecium green to green-brown. Hypothecium pale or pale brownish. Ascospores 8–15 × 5–8 µm. Medulla K/I + violet.

**Chemistry.** Negative

**Ecology.** On calcareous rock

**Distribution.** Ny-Ålesund.

**Note.** World distribution: Europe, Asia, North America (Greenland), southern South America.

**Specimens seen:** none seen, record based on material cited by Hertel (1977) from Ny-Ålesund.

### *Lecidea verruca* Poelt (1961)

**Thallus** crustose, areolate-rimose, pale grey, 4–6 mm wide. **Apothecia** up to 1 mm diam., flush with thallus, flat, black, with thin, crenulate margin. Hymenium 50–75 µm high; epithecium blue-green. True exciple dark brown in outermost part, pale in inner part. Hypothecium colourless or yellowish. Ascospores 7–16 × 4–8 µm. Medulla K/I + violet.

**Chemistry.** Confluentic acid.

**Ecology.** Lichenicolous on *Aspicilia* spp.

**Distribution.** Rare.

**Note.** World distribution: Europe, southern South America, New Zealand.

**Specimens seen:** Longyearbyen, 2002, R. Haugan 6925 (O).

*Lecidea* sp.

**Thallus** 3–5 cm wide, bullate-rimose, pale blue-green; areolae up to 2 mm diam.; surface rough. **Apothecia** up to 1.5 mm diam., sessile, with a thick, wrinkled, blue-grey true margin. Disc flat, black, non-pruinose. Hymenium 40–45 µm high; uppermost part vividly blue-green. Exciple up to 180 µm thick, blue-green in outermost part, inwards colourless, composed of an indistinct *textura intricata*. Hypothecium pale brown. Paraphysis end cells slightly enlarged to 2.5 µm diam. Ascospores 8 per ascus, broadly elliptic, 15–17 × 7–9 µm. Medulla K/I + violet.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Adventfjorden.

**Notes.** The species is characterised by its blue-grey thallus without lichen products and blue-green exciple. According to A. Fryday (pers. comm. 2004) the species belongs in *Lecidea* s. str.

**Specimen seen:** Adventfjorden, 5.8.1868, Th.M. Fries (O).

**LECIDELLA** Körber (1855)

**Thallus** crustose to squamulose, white to blue-grey. Photobiont trebouxioid. **Ascomata** apothecia, black, sessile, thalline exciple absent. True exciple prominent, of radiating hyphae. Epothecium green or blue-green. Ascii of *Lecidella*-type. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, little ramified. Conidia thread-like.

Key to *Lecidella* on Svalbard:

1	On rock .....	2
1	On organic material.....	7
2 (1)	Thallus sorediate .....	<i>Lecidella</i> sp. A
2	Thallus not sorediate .....	3
3 (2)	Hymenium with oil droplets .....	<i>L. patavina</i>
3	Hymenium without oil droplets .....	4
4 (3)	Hypothecium dark .....	5
4	Hypothecium pale .....	6
5 (4)	Hymenium 70–80 µm high.....	<i>L. carpathica</i>
5	Hymenium 50–60 µm high .....	<i>L. effugiens</i>
6 (4)	Ascospores narrow .....	<i>L. aemulans</i>
6	Ascospores broad .....	<i>L. stigmatica</i>
7 (1)	Thallus granulose-sorediate .....	<i>Lecidella</i> sp. B
7	Thallus not granulose-sorediate .....	8
8 (7)	On wood .....	<i>L. elaeochroma</i>
8	On mosses .....	<i>L. wulfenii</i>

*Lecidella aemulans* Arnold (1871)

**Thallus** as small, dark grey, convex, dispersed areolae. **Apothecia** up to 0.6 mm diam., black, convex, emarginate. Hymenium 35–40 µm high; epithecium green-black, K + violet. Hypothecium colourless. True exciple very thin, composed of radiating hyphae and with K + violet veins. Ascospores 8 per ascus, 13–17 × 4–6 µm. Paraphysis end cell enlarged to 2.5 µm.

**Chemistry.** Not tested (material scarce).

**Ecology.** On limestone.

**Distribution.** Only known from Blomstrandhalvøya.

**Notes.** Characterized by its narrow ascospores, K + violet reaction in epithecium and exciple, and uncoloured hypothecium. World distribution: Europe.

**Specimen seen:** Blomstrandhalvøya, H. Hertel 16405 (M).

*Lecidella carpathica* Körber (1861)

**Thallus** as small white flattened areolae, to 0.3 mm wide. **Apothecia** up to 0.5 mm diam., black, flat, with distinct true margin. Hymenium 75–80 µm high; uppermost part blue-green. Hypothecium golden brown. Exciple brown, blue-green in outermost part. Ascospores 8 per ascus, 9–11 × 5–7 µm. Paraphyses ramified; end cell enlarged to 2 µm diam. Pycnidia not seen.

**Chemistry.** Atranorin, unidentified xanthone (according to Knoph & Leuckert 1994: atranorin, thuringione, diploicin).

**Ecology.** Growing on *Vestergrenopsis elaeina* (Svalbard specimen).

**Distribution.** Only known from Gipsdalen.

**Notes.** *L. carpathica* is close to *L. effugiens*, but differs, apart from its chemistry, in thicker hymenium and broader exciple (Knoph & Leuckert 1994). New to Svalbard. World distribution: Europe, Asia, North America, southern South America, Australia, New Zealand.

**Specimen seen:** Gipsdalen, August 1987, D.O. Øvstdal (BG).

*Lecidella effugiens* (B. Nilsson) Knoph & Hertel (1990)

**Thallus** as small round dispersed whitish areolae. **Apothecia** black, sessile, up to 0.5 mm diam., flat; margin protruding. Hymenium to 60 µm high; uppermost part blue-black. True exciple pale in inner part (but with brown veins extending from hypothecium), blue-black in outer. Hypothecium vivid brown, intensifying in K. Ascospores 8 per ascus, broadly elliptic, 10–12 × 5–6 µm. Paraphysis end cell enlarged to 3 µm diam.

**Chemistry.** 2,5,7-trichloro-3-O-methylnorlichexanthone, aotearone, atranorin.

**Ecology.** On rock.

**Distribution.** Only known from Isfjorden.

**Note.** World distribution: Europe, Asia, North America (Greenland), southern South America, New Zealand.

**Specimen seen:** None seen, record based on material cited by Hertel in Leuckert et al. (1992) from Isfjorden.

*Lecidella elaeochroma* (Ach.) M. Choisy (1950)

**Thallus** crustose, areolate, smooth, grey to yellow-grey. **Apothecia** black, when young with a thin true margin, when old margin mostly excluded. Hymenium 60–70 µm high; uppermost part blue-green. Hypothecium brown. Ascospores 8 per ascus, simple, colourless, elliptic, 10–12 × 6–7 µm. Paraphyses slender, flexuose, little ramified; end cell slightly enlarged to 2 µm.

**Chemistry.** Aotearone, capistratone, thiophanic acid, isoarthothelin.

**Ecology.** On old driftwood.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Sasselalen, 1986, D.O. Øvstedral (BG); Van Keulenhamna, 1926, B. Lynge (O).

*Lecidella patavina* (A. Massal.) Knoph & Leuckert (1990)

**Thallus** variable, from dispersed, white areolae to a coherent, areolate, greyish crust. **Apothecia** up to 1 mm diam., sessile, flat; margin prominent. Hymenium 70–80 µm high, with small oil droplets; epithecium blue-green. Hypothecium colourless. Ascospores broadly elliptic, 12–16 × 7–8 µm. Paraphysse end cell 3 µm diam.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On hard rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Argentina, Antarctica.

**Specimens seen** (selected): Kongsfjorden, Gluudneset, A. Elvebakk 03:135 (TROM); Adventdalen, 2002, R. Haugan 6887 (O; det. Haugan).

*Lecidella stigmataea* (Ach.) Hertel & Leuckert (1969)

**Thallus** as scattered, round, white to grey areolae. **Apothecia** up to 1 mm diam., black, flat, with distinct margin. Hymenium 60–70 µm high; epithecium green-brown. Hypothecium yellowish or uncoloured. Ascospores broadly elliptic, 13–15 × 8–10 µm.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America, southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Ny-Ålesund, 4.–5.7.1936, E. Dahl (O); Amsterdamøya, 26.8.1936, E. Dahl (O).

*Lecidella wulfenii* (Hepp) Körber (1865)

**Thallus** evanescent or as a very thin, grey crust. **Apothecia** flat, black, up to 0.7 mm diam.; margin distinct. Hymenium 80–90 µm high; epithecium brownish. Hypothecium and exciple brown. Ascospores 8 per ascus, broadly elliptic, 12–15 × 8–9 µm. Paraphysse end cell 3 µm diam.

**Chemistry.** Negative or with xanthones

**Ecology.** Over bryophytes.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America, New Zealand, Antarctica.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O); Reinholmen. 16.7.1926, B. Lynge (O).

### *Lecidella* sp. A

**Thallus** crustose, thin, rimose, 1–2 cm wide, green-grey, sorediate. Soralia 0.2–0.3 mm wide, convex, later coalescing into larger ones, paler than thallus. Soredia  $23.2 \pm 1.47 \mu\text{m}$  (21–25  $\mu\text{m}$ ) diam., with smooth surface, without protruding hyphae, coalescing to consoredia. **Apothecia** not seen.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On sandstone.

**Distribution.** Only found once.

**Note.** This taxon is only tentatively placed in *Lecidella*, as no apothecia were present; but the chemistry points to this genus.

**Specimen seen:** Kongsfjorden, Brøggerhalvøya, A. Elvebakk 86:433 (TROM).

### *Lecidella* sp. B

**Thallus** crustose, thick, rimose, pale yellow-grey, granulose-sorediate. **Apothecia** black, up to 1 mm diam., sessile, constricted below, flat when young, convex when old, with a thin, indistinct proper margin. Hymenium 75–90  $\mu\text{m}$ , uppermost part aeruginose, pigment K –, N + red, HCl + reddish-violet. Hypothecium colourless. Exciple aeruginose in outermost part, colourless in inner, composed of radiating hyphae. Paraphyses simple to sparingly branched; end cell not enlarged. Ascospores 8 in ascii, mostly aborted, broadly ellipsoid, subglobose to globose,  $7–8.5 \times 8–13 \mu\text{m}$ .

**Chemistry:** Atranorin, zeorin.

**Ecology:** On old bone.

**Distribution:** Only known from Longyearbyen.

**Note:** We have found no name for this characteristic species.

**Specimen seen:** near Longyearbyen, 23.7.1936, E. Dahl (O).

### LECIDOMA G. Schneid. & Hertel (1981)

**Thallus** squamulose, dark brown. Upper surface with plechtenchymateous cortex; lower side undifferentiated, ending in a hyphal web. Photobiont green algae. **Ascomata** apothecia, immersed; disc brown, without thalline margin. Asci of *Porpidia*-type. Ascospores 8 per ascus, simple, ellipsoid, colourless. Hamathecium of paraphyses, anastomosing.

**Note.** A monotypic genus.

### *Lecidoma demissum* (Rutstr.) G. Schneid. & Hertel (1981)

**Thallus** squamulose, 3–4 cm diam.; squamules rounded to angular, overlapping to continuous, brown, to 1 mm diam. **Apothecia** almost immersed, dark brown to black, to 1 mm diam.; true margin thin

and excluded in old apothecia. Hymenium 60–70 µm high, colourless except uppermost part which is red-brown. Hypothecium colourless. Paraphyses stout, adglutinated; end cell enlarged to 4 µm diam. Ascospores 9–11 × 4–4.5 µm.

**Chemistry.** Negative.

**Ecology.** On soil and over bryophytes

**Distribution.** Scattered.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand, Antarctica.

**Specimens seen** (selected): Albert I Land, Flathukken, 2003, A. Elvebakk 03:097 (TROM); Lågøya, Malmgren (O).

### LECIOPHYSMA Th. Fr. (1865)

**Thallus** granulose to subfruticose, without cortex. Photobiont *Nostoc*. **Ascomata** apothecia, without thalline margin; true margin with radiating hyphae. Ascospores 8 per ascus, simple, uncoloured. Hamathecium of paraphyses, little branched. Conidia short, cylindrical.

Key to *Leciophysma* on Svalbard:

1	Thallus subfruticose .....	<i>L. finmarkicum</i>
1	Thallus granulose .....	<i>L. furfurascens</i>

### *Leciophysma finmarkicum* Th. Fr. (1865)

**Thallus** subfruticose, growing in small cushions up to 10 mm broad; lobes terete, erect; branches up to 1.5 mm long and 0.3 mm broad, black. **Apothecia** strongly convex, emarginate, black, sessile, up to 1 mm diam. Hymenium 100–150 µm high; epithecium brownish. Hypothecium yellowish. Ascospores 8 per ascus, colourless, simple, subglobose, 15–20 × 10–14 µm.

**Chemistry.** Negative.

**Ecology.** Over and among bryophytes on calcareous soil and rock

**Distribution.** Common.

**Note.** World distribution: circumpolar.

**Specimens seen** (selected): Moskusdalen, 1986, D.O. Øvstedral (BG); Gipsdal, A. Elvebakk 85:697 (TROM).

### *Leciophysma furfurascens* (Nyl.) Gyeln (1939).

**Thallus** black, crustose, with warts and protuberances. **Apothecia** sessile, up to 0.5 mm diam.; true margin thick, dark brown. Disc flat, rough, red-brown. Hymenium 50–70 µm high; epithecium golden-brown. Hypothecium colourless. Hypothecium and exciple of pseudoparenchymateous tissue. Paraphyses slender, little ramified; end cell not enlarged. Ascospores 8 per ascus, simple, colourless, broadly elliptic, 13–15 × 7–9 µm.

**Chemistry.** Negative.

**Ecology.** Over bryophytes on calcareous soils

**Distribution.** Only found on Amsterdamsøya.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).  
**Specimen seen:** Amsterdamøya, 26.8.1936, E. Dahl (O).

### LEMPHOLEMMA Körber (1855)

**Thallus** crustose to minutely fruticose, blackish, gelatinous, without cortex. Photobiont *Nostoc*. **Ascomata** apothecia, mostly laminal, immersed to sessile; thalline margin prominent; disc poriform or expanded. True exciple thin. Ascii without apical structures, K/I -. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, simple to branched. Conidia bacilliform.

#### *Lempholemma isidiooides* (Nyl. ex Arnold) H. Magn. (1939)

**Thallus** cushion-formed, up to 5 mm wide, green-black, composed of short digitate outgrowths. **Apothecia** lecanorine, concave, to 0.3 mm diam. Hymenium 40–50 µm high. Hypothecium colourless. Ascospores 8 per ascus, simple, colourless, subglobose, 10–12 × 9–11 µm.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Only known from Sassendalen.

**Note.** World distribution: Europe, Chukotka, North America.

**Specimen seen:** Sassendalen, 1986, D.O. Øvstdal (BG).

### LEPRARIA Ach. (1803)

**Thallus** diffuse to delimited, even to folded, well fastened to or, more rarely, becoming easily free from the substratum, irregularly spreading to rosette-forming, with or without lobes, leprose throughout or stratified with a leprose upper surface, a medulla and sometimes a distinct hypothallus which may be pigmented; leprose parts composed of granules (soredia and consoredia). Granules variable; in one extreme they are soft, loosely constructed and occur in a loose powdery mass; projecting hyphae may be common; in another extreme the granules are firm and compact and may be large (up to 0.4 mm), especially along the thallus margin; intermediates between these extremes occur. Photobiont trebouxioid. **Ascomata** and conidiomata absent. On soil, detritus, mosses and rock; sometimes over other lichens. In dry and shaded to rain-exposed niches.

**Notes.** The number of chemotypes in *Lepraria* is much higher than the number of currently accepted species (see, e.g., Leuckert et al. 1995, Orange 1997, and Tønsberg 2004). As little still is known about the phylogeny of the majority of taxa and chemotypes of *Lepraria* (see also Ekman & Tønsberg 2002), we here treat all chemotypes separately with regard to ecology and distribution. The assigning of the chemotypes to species should be regarded as tentative only. The material with alectorialic acid, a very common substance in *Lepraria* in Svalbard and present as the only diagnostic substance, as well as in combination with other substances, is particularly polymorphic. Only a rough treatment of that material is given below.

In parts of the Svalbard archipelago, e.g. in the extremely dry southernmost parts of the Wijdefjorden area, where large part of the recent material available for study has been collected, species that elsewhere (e.g. in mainland Norway) are restricted to dry overhangs, may occur in open situations subjected to direct precipitation. It is uncertain how this affects thallus morphology.

The arctic species of *Lepraria* are badly in need of revision. More studies, including material from other continents and the application of molecular techniques, are necessary before the taxonomy of *Lepraria* in the Arctic (and elsewhere) can be given a more satisfying treatment.

A variety of diagnostic fatty acids occur in the genus. Unfortunately, it is not possible to separate angardianic acid and roccellic acid, and jackinic acid and rangiformic acid by TLC (Leuckert et al. 1995).

#### Key to *Lepraria* on Svalbard:

- 1 Thallus diffuse, widespread; surface powdery; lobes not evident or fragile and obscure; granules not becoming distinctly larger along margin, loose, usually with at least some projecting hyphae..... 2
- 1 Thallus forming rosettes from a few mm to about 1–2 cm in diam. (individual thalli may become contiguous forming widespread colonies, but rosette forming thalli evident at least at colony margins) or irregularly spreading and to a dm or more in diam.; lobes indistinct to distinct; granules compact, firm and without projecting hyphae, sometimes largest along thallus margin ..... 4
- 2 (1) Granules always with long projecting hyphae; nephrosteranic acid present .... *L. rigidula*
- 2 Granules with or without projecting hyphae; fatty acids absent..... 3
- 3 (2) Thallus usually greenish; projecting hyphae on granules prominent; with atranorin, stictic acid and zeorin ..... *L. lobificans*
- 3 Thallus usually greyish (but becoming pinkish in the herbarium); projecting hyphae on granules not evident or short; with alectorionic acid ..... *L. eburnea*
- 4 (1) Pannaric acid 6-methyl ester present ..... *L. vouauxii*
- 4 Pannaric acid 6- methyl ester absent..... 5
- 5 (4) Stictic acid present ..... *Lepraria svalbardensis*
- 5 Stictic acid absent..... 6
- 6 (5) Alectorionic acid present ..... 7
- 6 Alectorionic acid absent..... 8
- 7 (6) Angardianic/roccellic acid present..... *L. neglecta*
- 7 Fatty acids absent..... *Lepraria gelida*
- 8 (6) Porphyrylic acid present ..... 9
- 8 Porphyrylic acid absent..... 10
- 9 (8) Fatty acids absent..... *Lepraria* sp.
- 9 Angardianic/roccellic acid or jackinic/rangiformic acid present ..... *L. alpina*
- 10 (8) Jackinic/rangiformic acid or angardianic/roccellic acid present ..... 11
- 10 Granulata unknown 1 present ..... *Lepraria granulata*
- 11 (10) Jackinic/rangiformic acid present ..... *L. borealis*
- 11 Angardianic/roccellic acid present..... *Lepraria alpina*

***Lepraria alpina*** (de Lesd.) Tretiach & Barutto (2006)

Syn. *L. cacuminum* (Massal.) Kümmerl. & Leuckert (1995).

**Thallus** of *L. neglecta*-type forming small, whitish to pale bluish grey rosettes to a few mm in diam.; rosettes often becoming contiguous and confluent forming colonies to several cm diam.; thalline margin more or less abruptly delimited; lobes absent or obscure; granules globose to rounded elongate, to 0.6 mm, without projecting hyphae, often white pruinose; medulla usually not evident, white, compact; hypothallus not evident.

**Chemistry.** Chemotype I: atranorin, porphyrilic acid, angardianic/roccellic acid. Chemotype II: atranorin, porphyrilic acid, jackinic/rangiformic acid ± with norjackinic/norrangiformic acid. Chemotype III: atranorin, angardianic/roccellic acid.

**Ecology.** Chemotype I: Terricolous and muscicolous in dry and sheltered situations between rocks and on the ground in open situations. Chemotype II: muscicolous and terricolous, often between rocks in scree, on rock overhang and on upper face of big boulder. Chemotype III: Terricolous in open situation and terricolous/muscicolous in dry and sheltered situation between rocks.

**Distribution.** Chemotype I: Nordaustlandet and Wijdefjorden area. Chemotype II: Nordenskiöld Land and Wijdefjorden area. Chemotype III: Only known from the Wijdefjorden area.

**Notes.** According to Leuckert et al. (1995) *L. alpina* [as *L. cacuminum*] usually produces angardianic acid and/or rarely roccellic acid or very rarely only rangiformic acid. Similar to *L. borealis* (atranorin, jackinic/rangiformic acid), but distinct by its presence of porphyrilic acid, the more densely packed granules, and absence of projecting hyphae. According to Baruffo et al. (2006) the chemical constituents of the type specimen of *L. alpina* are atranorin, porphyrilic and angardianic (roccellic) acids and thus in agreement with chemotype I above. New to Svalbard. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Chemotype I: Nordaustlandet, Brennevinsbukta [Brennevinsfjorden], Depotodden, 1936, E. Dahl (O); Wijdefjorden, between Reinsbukkdalen and Flatøyra, the W-facing slope of Gjallarhornhallet, 2002, T. Tønsberg 31290 (BG). Chemotype II: Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9881 (BG); Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31180; Wijdefjorden, Flatøyrdalen, near Cookbreen, 2002, T. Tønsberg 31265a (BG). Chemotype III: Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31097, 31174 (BG).

***Lepraria borealis*** Lothander & Tønsberg (1994)

Type: Norway, Nord-Trøndelag, Namsskogan, Børgefjell National Park, Namskroken, N bank of river Namsen E of Mattisflya, 23 Aug. 1975 ["6 June 1977"], Tønsberg 1519 (BG!—holotype, H, UGDA—isotypes).

**Thallus** of *L. neglecta*-type, forming small, whitish grey to pale bluish grey rosettes to about a mm diam.; rosettes becoming contiguous and more or less confluent forming colonies to a few cm diam.; margin more or less abruptly delimited; lobes absent or obscure, formed by a few large granules; granules to 0.2 mm, rather loosely packed, largest along thallus margin, often on top of each other, sometimes with very short, projecting hyphae; medulla not evident; hypothallus not evident.

**Chemistry.** Atranorin, jackinic/rangiformic acid with norjackinic/norrangiformic acid.

**Ecology.** Over mosses and other lichens, more rarely directly on soil, in dry and sheltered niches between rocks in boulder fields as well as in open situations.

**Distribution.** Widespread.

**Notes.** *L. borealis* is a member of the *L. neglecta* group. Orange (1999) treated this species as a chemotype of *L. caesioalba*. New to Svalbard. World distribution: Europe, North America, Antarctica.

**Specimens seen** (selected): Wijdefjorden, Flatøyrdalen, 2002, T. Tønsberg 31254 (BG); Kongsfjorden, Ossian Sarsfjellet, 2003, A. Elvebakke 03:111 (TROM); Bjørndalen, 2003, T. Tønsberg 31893 (BG).

***Lepraria eburnea*** J. R. Laundon (1992)

**Thallus** widespread, sometimes forming circular patches with poorly defined margin, thin to thick, pale bluish grey, pale greenish grey to greenish white; surface powdery; granules with shortly projecting hyphae (at least in sheltered parts of thallus); medulla white, indistinct to distinct.

**Ecology.** In shaded and sheltered niches in boulder fields.

**Chemistry.** Alectorialic acid with satellites.

**Distribution.** Widespread.

**Note.** Specimens with distinct hyphal projections on the granules may be morphological similar to *L. rigidula*. *Lepraria eburnea* is distinct from the latter species by the production of alectorialic acid and by the lack of atranorin and nephrosteranic acid. In other parts of its range, *L. eburnea* may be found with either protocetraric acid or psoromic acid in addition to alectorialic acid (Orange 1997). New to Svalbard. World distribution: Europe, North America, Australia, New Zealand.

**Specimens seen** (selected): Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31156 (BG); along the road from Longyearbyen to Bjørndalen, 2003, T. Tønsberg 31854b (BG).

***Lepraria gelida*** Tønsberg & Zhurb. (2006)

Type: Svalbard, Spitsbergen, SSE of Wijdefjorden, E of Austfjorden, SE of Finnekroken, the W-facing foothills of Finlandsveggen, 78°56.09'N 16°30.19'E, alt. 20–30 m, on soil in *Dryas octopetala* heath, 5 July 2002, Tønsberg 31049 (BG!—holotype, NMW!—isotype).

Fig. 23 (p. 229).

**Thallus** very variable, chalky white to yellowish white, to several cm diam., more or less abruptly delimited, in one extreme the thalli are up to a few cm in diam., ± circular and often folded, in another extreme extensive colonies are formed by minute thalli up to a few mm in diam.; lobes obscure, to 1.6(–1.9) mm wide; granules variable in size and form, to 0.5(–0.6) mm, mostly globose, sometimes elongate; marginal granules sometimes with projecting hyphae; thick specimens often with a thick, chalky white medulla to 0.5 mm thick; hypothallus not prominent, but underside of thallus brown in exposed parts.

**Chemistry.** Chemotype I: alectorialic (with satellites) and porphyritic acids; chemotype II: alectorialic acid (with satellites) only.

**Ecology.** Mainly over calciferous and saline soil(?); close associates included, e.g., *Fulglesia bracteata*, *Lepraria vouauxii*, *Solorina biformis*, and *Toninia sedifolia*.

**Distribution.** Common, perhaps especially in low precipitation areas.

**Notes.** A broad concept of *L. gelida* is taken here. Although the two extremes described above are very distinct we assign them to one and the same species as they are united by intermediates. Well-developed, chalky white specimens (sometimes easily mistaken for species of *Ochrolechia* in the field) correspond well morphologically to the type specimen of *Lepraria frigida* Laundon (from Scotland, 1964, P.W. James (BM!)). However, protocetraric acid found in the type of this species in addition to alectorialic acid (see Orange 1997) has not been demonstrated in *L. gelida* (or in any other species of *Lepraria* on Svalbard). Chemotype II, with alectorialic acid only as diagnostic substance, corresponds chemically to Orange's (1997, 1999) chemotype III of *L. eburnea*. However, according to Orange (1999) that species is pale blue-grey to greenish cream in the field, not chalky to yellowish white as in *L. gelida*. Porphyritic acid is not known to occur in *L. eburnea* s. lat. (with *L. frigida* included, see Orange 1997, 1999). In some specimens assigned to chemotype II (alectorialic acid only) of *L. gelida*, a faint trace of a substance possibly identical to porphyritic acid could sometimes be observed.

**Additional specimens seen** (selected): Chemotype I: Wijdefjorden, E of Austfjorden, Einsteinodden, 2002, T. Tønsberg 31052; Wijdefjorden, E of Austfjorden, near Austbotnhytta, 2002, T. Tønsberg 31069 (BG); Ny Ålesund, 4–5.7.1936, E. Dahl (O); Kongsfjorden, Blomstrandhalvøya, A. Elvebakke 01:085 (TROM); Van Keylenhamna [Keulenhamna], 5.8.1926, Lyngé (4 specimens; O); Nord-kysten, Velkomstpynten, 26.8.1936, E. Dahl (O); Edgeøya, syd for Habenicht-bukta, 7.8.1936, E. Dahl (O). Chemotype II: Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdalen, 2002, T. Tønsberg 31122 (BG); Wijdefjorden S, between Austfjordnes and Reinsbukkddalen, the W-facing foothill of Mt. Rutherfordfjellet, 2002, T. Tønsberg 31187 (BG); Wijdefjorden, N of Flatoyra, the W-facing slope of Mt. Heimdalkampen, 2002, T. Tønsberg 31230 (BG); Isfjorden, Kapp Thordsen, 20.7.1936 E. Dahl (O); Lady Franklinfjorden, Lågøya, 19.08.1936, E. Dahl (O).

### *Lepraria granulata* Slavíková (2007)

**Thallus** widespread, to a few cm diam., pale green, thin, discontinuous, diffuse, composed of granules with no tendency of forming lobes; granules to 70 µm diam., rather evenly sized, soft, hardly with projecting hyphae; medulla not evident, hypothallus not evident.

**Chemistry.** Atranorin, unidentified fatty acid (similar in chromatographic characteristics to jackinic/rangiformic acid in solvent A and C, but runs to a distinctly lower position in solvent B).

**Ecology.** Terricolous on gravelly soil in scree.

**Distribution.** Known from one site only.

**Notes.** Morphologically rather similar to *L. borealis*. World distribution: Europe. Previously known from central Europe at altitudes between 1359 and 2410 m (Slavíková-Bayerová & Fehrer 2007). Apparently an arctic-alpine species.

**Specimen seen:** Between Longyearbyen and Bjørndalen, the NW-facing foothill of Mt Platåberget, 2003, T. Tønsberg 31840 (BG).

### *Lepraria lobificans* Nyl. (1873)

**Thallus** widespread, thick and soft; soredia green, soft, loosely arranged in large granules, some with projecting hyphae; medulla distinct, loosely arranged, white.

**Chemistry.** Atranorin, stictic acid (with satellites), and zeorin.

**Ecology.** Terricolous and over mosses in deeply shaded and sheltered cavities in soil banks and between rocks in screes.

**Distribution.** Wijdefjorden area.

**Notes.** Easily recognized, even in the field, by its soft, green thallus with loose white medulla. New to Svalbard. World distribution: Europe, Asia, North America (including Greenland), Chile, Australia, New Zealand.

**Specimens seen** (selected): Wijdefjorden, E of Austfjorden, Austfjordneshytta, 2002, T. Tønsberg 31155, 31162 (BG); Nordenskiöld Land, Colesdalen, 2002, R. Haugan 6858 (O).

### *Lepraria neglecta* (Nyl.) Lettau (1958)

**Thallus** forming small, pale bluish grey rosettes to a few mm diam.; rosettes often becoming contiguous and confluent forming colonies to a few cm diam.; margin more or less abruptly delimited; lobes absent or obscure; granules without projecting hyphae, to 0.3 mm, becoming largest along thallus margin; medulla not evident; hypothallus not evident.

**Chemistry.** Alectorialic acid and angardianic/roccellic acid.

**Ecology.** On mosses and detritus over sandy soil on the ground in exposed situation and in a dry niche between boulders in scree, usually forming mosaics with other crustose lichens.

**Distribution.** Widespread.

**Notes.** *Lepraria neglecta* may resemble the much more commonly occurring *L. gelida*, but is distinct, e.g., by its bluish colour, absence of a medulla, and presence of a fatty acid. According to Leuckert et al. (1995) the fatty acid in *L. neglecta* is angardianic acid. World distribution: Europe, Asia, North America, Australia, New Zealand, Antarctica.

**Specimens seen:** Nordaustlandet, Phippsøya, 19.8.1936, E. Dahl (O; 2 specimens); Van Mijenfjorden E, Sveagruva W, 1990, A. Elvebakk 90:282 (TROM); Wijdefjorden, E of Austbotnhytta, the SW-facing slope of Mt. Lemstrømfjellet, 2002, T. Tønsberg 31096 (BG); Wijdefjorden, N of Austfjordnes, the W-facing foothill of Mt. Rutherfordfjellet, 2002, T. Tønsberg 31181a (BG).

### *Lepraria rigidula* (de Lesd.) Tønsberg (1992)

**Thallus** widespread, diffuse, soft, forming an irregularly spreading, more or less continuous, grey to greyish blue crust to a dm or so diam. Granules usually with long projecting hyphae (sometimes not so prominent on exposed parts of thallus). A distinct, white medulla is evident in well-developed specimens.

**Chemistry.** Atranorin and nephrosteranic acid.

**Ecology.** Muscicolous (most specimens) or over other lichens, in shaded and sheltered cavities between rocks in screes.

**Distribution.** Scattered.

**Notes.** Easily recognized, even in the field by its soft, widespread, grey thallus composed largely of granules with long projecting hyphae. *Lepraria lobificans* may be similar morphologically, but its surface is green. New to Svalbard. World distribution: Europe, North America, Antarctica.

**Specimens seen** (selected): Barentsøya, NV-siden av Steinbeisfjellet, 1936, E. Dahl (O); along the road between Longyearbyen and Bjørndalen, 2002, T. Tønsberg 31854a, 31855, 31856 (BG).

### *Lepraria svalbardensis* Tønsberg sp. nov.

*Leprariae neglectae* similis, sed acidum sticticum, jackinicum/rangiformicum et atranorimum continens.

Type: Svalbard, Spitsbergen, the W-facing foothill of Mt Platåberget, uphill from the road between Longyearbyen and Bjørndalen, 78°14.347'N, 15°20.987'E, alt. 70–75 m, muscicolous in dry niche in scree, 26 June 2003, T. Tønsberg 31851 (BG—holotype, UGDA—isotype).

Fig. 24 (p. 229).

**Thallus** of *L. neglecta* type, bluish grey to whitish, composed of granules becoming contiguous and confluent forming colonies to a few cm diam.; margin more or less abruptly delimited; lobes absent or obscure; granules firm, without projecting hyphae, to 0.3(–1.0) mm, often largest along thallus margin; medulla sometimes present, white; hypothallus not evident.

**Chemistry.** Atranorin, stictic acid with satellites, jackinic/rangiformic acid ±with norjackinic/norrangiformic acid (tr.).

**Ecology.** Mostly muscicolous, sometimes over other lichens, rarely terricolous. In shaded niches between rocks in screes and in open situations.

**Distribution.** Probably common.

**Notes.** *L. svalbardensis* is a species of the *L. neglecta* group. It is distinct from other species in this group by the presence of stictic acid as a major substance in combination with atranorin and jackinic/rangiformic acid. It appears to be widespread and chemically uniform on Svalbard; this prompted us to give it specific rang. *Lepraria humida* Slavíková & Orange (Slavíková-Bayerová & Orange 2006) recalls *L. svalbardensis* chemically. However, in that species stictic acid is an accessory

constituent occurring in minor amounts only. *L. svalbardensis* is further distinct from that species in having much larger granules and a non-powdery surface. Morphologically and chemically similar material from SW North America (see Tønsberg 2004 [as *L. caesioalba*, chemotype IV]) is tentatively assigned to *L. svalbardensis*. That material, comprising two specimens, was collected at altitudes of 2000 and 3000 m. Specimens of the *L. neglecta*-group corresponding chemically to *L. svalbardensis* and assigned to *L. caesioalba* by Leuckert et al. (1995; no distributional information given), Baruffo et al. (2006) from Italy, and Saag (2008) from Greenland, probably belong to *L. svalbardensis*. *L. svalbardensis* may prove to have an arctic-alpine distribution pattern. World distribution: Europe, North America (possibly incl. Greenland).

**Additional specimens seen (selected).** **Svalbard.** Forsbladhamna, 30.7.1926, B. Lynge (O; 2 specimens); Kobbe Bay [Kobbefjorden], 1868, Th.M. Fr. (O); Van Mijenfjorden, Braganzavågen, 1986, D.O. Øvstedral (BG); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9918 pro parte (BG); S of Adventdalen, Endalen, downhill from mine Gruve 5, 78°11.001'N, 15°45.661'E, alt. 80–90 m, muscicolous on shaded and sheltered rock in scree, 28 June 2003, T. Tønsberg 31919 (BG); Wijdefjorden, E of Austfjorden, E of Austbotnhytta, the SW-facing slope of Mt. Lemstromfjellet, 78°59.35'N 016°27.59'E, c. 170 m, muscicolous in dry cavity between rocks, 6 July 2002, T. Tønsberg 31093a (BG); Wijdefjorden, E of Austfjorden N, N of Austfjordnes, the W-facing foothill of Mt. Rutherfordfjellet, 79°08.23'N 016°10.50'E, alt. 10 m, over mosses and among other lichens in dry situation between rocks in scree, 8 July 2002, T. Tønsberg 31182 (BG); Wijdefjorden, between Flatøyra and Ringhorndalen, the W-facing foothills of Mt. Heimdalkampen, S of the cabin belonging to the Governor of Svalbard, 79°17.85'N 015°56.64'E, alt. 30 m, 9 July 2002, T. Tønsberg 31223 (BG); Wijdefjorden, N of Flatøyrdalen, the W-facing slope of Mt. Heimdalkampen, 79°17.406'N, 16°04.696'E, 320 m, terricolous in dry niche in scree, 9 July 2002, T. Tønsberg 31240 (BG); Wijdefjorden, Flatøyrdalen, near Cookbreen, beneath the SSE-facing wall of Mt. Heimdalkampen, 79°16.76'N 016°12.02'E (WGS84), alt. 220 m, muscicolous/terricolous on rock in open situation in a S-facing boulder field below a bird cliff, 10 July 2002, T. Tønsberg 31266 (BG). **Tentatively assigned to *L. svalbardensis*:** U.S.A. Arizona, Apache National Forest, White Mountains, Green Peak, 34°06'00"N 109°34'00"W, on mosses, elev. 3000 m, 18 August 1977, T. H. Nash 38980 (ASU). California, Los Angeles Co., Edge of San Gabriel Wilderness: Survey 7, start of Pacific Crest Trail, off Hwy 2, 34°22'N 117°52'W, 2000 m, 11 October 1989, B. Ryan 26266 (ASU).

### *Lepraria vouauxii* (Hue) R.C. Harris (1987)

**Thallus** forming rosettes or irregularly spreading, thick, to a dm or more diam., greenish yellow, often with a pale orange-brown to pale brownish tinge, whitish in eroded parts; lobes obscure, fragile, rounded, a few mm wide and with large granules (consoredia) along the margin; granules variable in size and form, up to 0.8 mm diam., rounded, flattened to subcylindrical, often projecting above the general level giving the thallus a very rough surface; medulla distinct, thick (to a mm or more), white, compact.

**Chemistry.** Pannaric acid 6-methyl ester, roccellic acid, unidentified diagnostic substances.

**Ecology.** Terricolous and over mosses and lichens in open situations.

**Distribution.** Common.

**Notes.** Distinct by its yellowish colour and large, irregular consoredia. World distribution: Europe, Asia, North America, Australia, New Zealand, Antarctica.

**Specimens seen (selected):** Gipsdalen, 1987, D.O. Øvstedral (BG); Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdalen, 2002, T. Tønsberg 31145 (BG); Wijdefjorden, between Austfjordnes and Reinsbukkdalen, the W-facing foothill of Mt. Rutherfordfjellet, Tønsberg 31185 (BG); Dicksonfjorden, 1936, E. Dahl (O); Forsbladhamna, Bell Sund [Bellsund], 1926, B. Lynge (O).

### *Lepraria* sp.

**Thallus** forming rosettes to 3.5 cm diam., thick, pale yellowish white, coarsely folded, rather abruptly delimited, obscurely lobed; granules to 30–100 µm in diam., medulla distinct, thick; hypothallus not evident.

**Chemistry.** Atranorin, porphyrilic acid.

**Ecology.** Over calcareous soil in a dry area.

**Distribution.** Only known from one collection.

**Notes.** Thallus superficially similar to robust forms of *L. gelida*. It is distinct from that species by its smaller granules, and also by containing atranorin. The common production of both atranorin and porphyrilic acid is also seen in *L. alpina* which, however, also contains fatty acids as diagnostic substances. Morphologically, these species are quite distinct: thallus being distinctly stratified in *Lepraria* sp. B., and mainly composed of aggregated censoredia in *L. alpina*. *Lepraria* sp. A probably represents an undescribed species.

**Specimen seen:** Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdalen 2002, T. Tønsberg 31146 (BG).

### LEPTOGIUM (Ach.) S.F. Gray (1821)

**Thallus** crustose to foliose, grey-blue to black, corticated on both sides (except in crustose ones); cortex of one cell layer; lower side densely hairy in some species. Photobiont *Nostoc*. **Ascomata** apothecia; thalline margin soon excluded; true margin prominent, of pseudoparenchymateous tissue. Ascii with a K/I + blue tholus which has a darker stained tube. Ascospores 4–8 per ascus, submuriiform to muriform, colourless. Hamathecium of paraphyses, simple, strongly conglutinated. Conidia bacilliform.

Key to *Leptogium* on Svalbard:

1	Thallus crustose .....	<i>L. byssinum</i>
1	Thallus foliose or squamulose .....	2
2 (1)	Thallus squamulose .....	3
2	Thallus foliose .....	4
3 (2)	Thallus wrinkled when dry .....	<i>L. intermedium</i>
3	Thallus not wrinkled when dry .....	<i>L. imbricatum</i>
4 (2)	Lower side densely covered with hairs .....	<i>L. saturninum</i>
4	Lower side without hairs .....	4
5 (4)	Lobes erect, thin, bluish, never with apothecia .....	<i>L. lichenoides</i>
5	Lobes decumbent, thick, brown, often with apothecia .....	<i>L. gelatinosum</i>

### *Leptogium byssinum* (Hoffm.) Zwackh ex Nyl. (1856)

**Thallus** crustose, black, 1–2 cm wide, surface rugulose to granulose. **Apothecia** sessile to subimmersed in thallus, up to 0.6 mm diam.; thalline margin regular; disc flat, brown. Ascospores 8 per ascus, muriform, 28–32 × 13–17 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America.  
**Specimen seen** (selected): Sasselalen, 1986, D.O. Øvstedal (BG).

***Leptogium gelatinosum* (With.) Laundon (1984)**

**Thallus** foliose, brown, decumbent, growing in tufts; lobes to 1 mm wide and 100 µm thick; margins upturned, rarely with roundish, to 40 µm wide blastidia. **Apothecia** not rare, to 1.6 mm wide, with distinct thalline margin and brown disc. Hymenium 100–110 µm high; uppermost part yellowish. Ascospores 8 per ascus, muriform, 24–32 × 10–11 µm.

**Chemistry.** Negative.

**Ecology.** Among bryophytes on calcareous substrate.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimens seen** (selected): Moskusdalen 1986, D.O. Øvstedal (BG); Amsterdamøya, 26.8.1936, E. Dahl (O).

***Leptogium imbricatum* P.M. Jørg. (1994)**

**Thallus** minutely squamulose, 1 cm wide, dark brown. Squamules 0.2–0.3 mm wide and 0.3–0.4 mm long, with rounded lobes, adpressed to substrate but margins somewhat raised. In vertical section thallus 90–100 µm thick, cellular throughout and with *Nostoc* in short chains. **Apothecia** sessile, up to 0.6 mm diam., with thick thalline margin; disc concave to flat, vivid brown. Hymenium 130–140 µm high; uppermost part yellow-brown. Ascospores 8 per ascus, 20–24 × 12–16 µm, muriform, colourless.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** Only known from Grønfjorden (Urbanavichene & Koroleva 2008) and Moskusdalen

**Notes.** World distribution: Europe, North America, Asia.

**Specimen seen:** Moskusdalen, 31.7.1987, D.O. Øvstedal (BG).

***Leptogium cf. intermedium* P.M. Jørg. (1994)**

**Thallus** 1–3 cm wide, dark brown, appearing crustose, composed of imbricate, closely packed squamules, at margin of thallus squamules irregularly rounded, 0.2–0.4 mm wide, with upturned margin. In vertical section the thallus is 65–70 µm high, with distinct cortex and medulla, medulla with cyanobacteria fairly compact. **Apothecia** few to numerous, when young deeply urceolate, with irregularly expanded thalline margin, when old up to 1 mm diam., flat, with thin thalline margin, disc concolorous with thallus. Hymenium 160–170 µm high, ascospores 8 in asci, submuriform, 24–28 × 8–12 µm.

**Chemistry.** Negative.

**Ecology.** On soil and among bryophytes.

**Distribution.** Only known from Calypsostranda.

**Notes.** The specimen is not well-developed and could therefore not be conclusively assigned to *L. intermedium*, a species not reported from Svalbard before. The description of apothecial characters is based on a specimen from Disco, Greenland (O, det. P.M. Jørgensen 2005). World distribution: Europe, North America.

**Specimen seen:** Calypsostranda, 12.7.1926, B. Lynge (O, det. P.M. Jørgensen 2005).

***Leptogium lichenoides* (L.) Zahlbr. (1924)**

**Thallus** foliose, blue-brown, upright, thin (to 40 µm), lettuce-like, in dense cushions, 2–3 cm wide; margin with isidia-like extensions. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** Among bryophytes

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen (selected):** Raudfjorden, 4.7.1928, O.A. Høeg (O).

***Leptogium saturninum* (Dickson) Nyl. (1856)**

**Thallus** foliose, up to 5 cm diam.; lobes rounded, to 10 mm broad, black. Lower side tomentose; hairs with elongate cylindrical cells. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On rock

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar.

**Specimen seen (selected):** Blomesletta 28.7.1973, A.A. Frisvoll (TRH).

**LICHENOMPHALIA Redhead et al. (2002)**

**Thallus** squamulose or granular. Photobiont *Coccomyxa*. Basidiomata agaricoid, with basidia on gills. Cap small, often umbilicate, pale to brownish.

Key to *Lichenomphalia* on Svalbard:

1	Primary thallus squamulose .....	<i>L. hudsoniana</i>
1	Primary thallus granulose .....	2
2 (1)	Cap and stem brown.....	<i>L. velutina</i>
2	Cap and stem pale ochraceous, yellow or whitish.....	3
3 (2)	Cap and stem yellow; primary thallus weakly developed .....	<i>L. alpina</i>
3	Cap and stem pale ochraceous to whitish; primary thallus well-developed	<i>L. umbellifera</i>

***Lichenomphalia alpina* (Britz.) Redhead et al. (2002)**

**Primary thallus** crustose, dark green, composed of globose granules 0.1–0.2 mm diam., well-developed. **Cap** 5–20 mm diam., convex with depressed centre, translucently striate, yellow. Stem 10–40 × 1–3 mm, smooth, concolorous with cap. Gills decurrent, distant, deep yellow. Basidiospores 4 per basidium, ellipsoid, 6–9 × 3.5–5 µm.

**Ecology.** On soil or among bryophytes, from ridges to bogs.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Longeardalen, Nybyen, 2003, A. Botnen & T. Tønsberg 31914 (BG); Albert I Land, Flathukken, 10.7.2003, A. Elvebakk (TROM).

***Lichenomphalia hudsoniana* (Jenn.) Redhead et al. (2002)**

**Primary thallus** squamulose; squamules ear-formed, up to 5 mm diam., grey-green; margins ascending. **Cap** 10–30 mm diam., convex to plane, when moist cream-yellow and translucently striate; margin crenulate. Stem 15–25 × 1.5–3 mm, pubescent, yellowish, paler than cap. Gills decurrent, distant, bright yellow. Basidiospores 4 per basidium, ellipsoid, 7–9 × 4–5 µm.

**Ecology.** On bryophytes, in heaths and bogs.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen** (selected): Bockfjorden, 12.8.1974, A.A. Frisvoll (TRH).

***Lichenomphalia umbellifera* (L.: Fr). Redhead et al. (2002)**

Syn. *Omphalina ericetorum* (Fr.) M. Lange ex H.E. Bigelow.

**Primary thallus** crustose, dark green, composed of globose granules 0.1–0.2 mm diam., usually not well-developed. **Cap** 5–20 mm diam., plane with depressed centre, or deeply infundibuliform, translucently striate, pale ochraceous to pale yellow to whitish. Stem 10–30 × 1–3 mm, smooth except base which is weakly pubescent, concolorous with cap except for apex which is vinaceous brown when young. Gills decurrent, distant, whitish to pale yellow. Basidiospores ellipsoid, 8–10 × 5–7 µm.

**Ecology.** On bryophytes (mainly *Sphagnum*) on soil etc.

**Distribution.** Widespread.

**Notes.** There are two forms of this taxon, both occurring on Svalbard, one grey and one whitish yellow (Høiland 1987). World distribution: Europe, North America (including Greenland), Australia, New Zealand.

**Specimens seen:** None seen; included on the basis of Høiland (1987).

***Lichenomphalia velutina* (Quel.) Redhead et al. (2002)**

**Primary thallus** crustose, dark green, composed of globose granules 0.1–0.2 mm diam., medium well-developed. **Cap** 5–10 mm diam., convex to plane with depressed centre, translucently striate, grey-brown to brown; margin crenulate. Stem 15–30 × 1–3 mm, pubescent, concolorous with cap. Gills decurrent, distant, grey. Basidiospores ellipsoid, 6–9 × 3–5 µm.

**Ecology.** A pioneer on naked soil and sand, on mineral soil in *Dryas* tundra, and in snowbeds.

**Distribution.** Scattered.

**Note.** World distribution: Europe, North America.

**Specimens seen:** none seen; included on the basis of Høiland (1987).

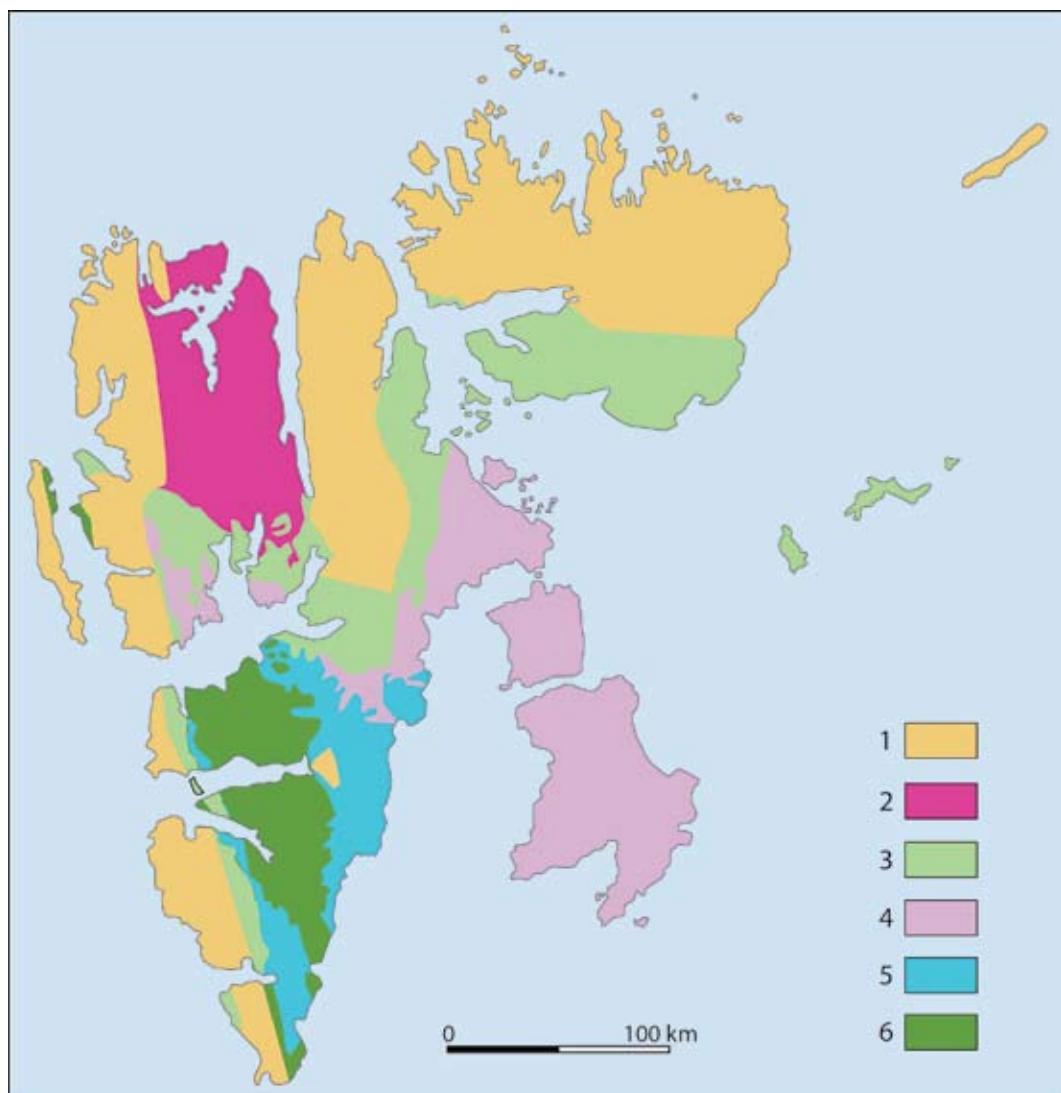


Fig. 1. Geological map of Svalbard. 1: Cambrium-Precambrium; 2: Devon; 3: Carbon-Perm; 4: Trias; 5: Jura-Cretaceous; 6: Tertiary.



Fig. 2. Luxuriant green vegetation below bird cliffs, due to influx of nutrients (N, P) from the sea as bird droppings. Krossfjorden, Casimir-Périerkammen. Photo A. Elvebakk (2002).



Fig. 3. *Allocetraria madreporeiformis*. Wijdefjorden, near Kartdalen, fine-textured alkaline soil. 2002. A. Elvebakk photo.



Fig. 4. *Arctopeltis thuleana*. Casimir-Périerkammen. 2002. A. Elvebakk photo.

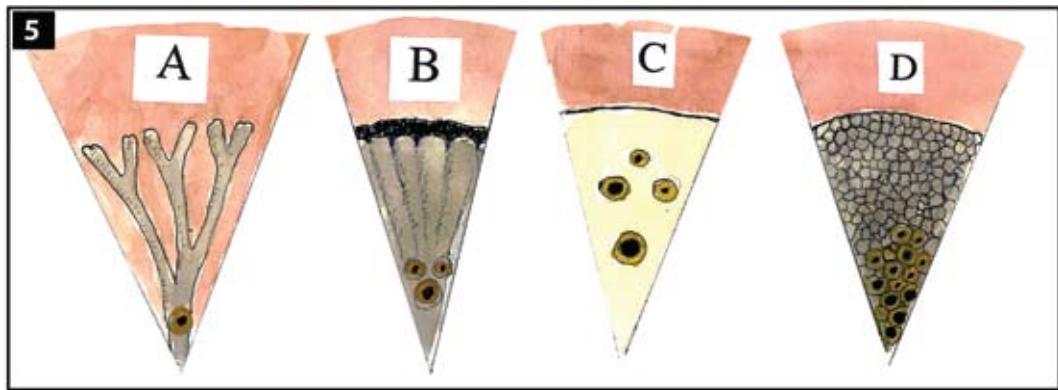


Fig. 5. Thallus types of *Aspicilia*.

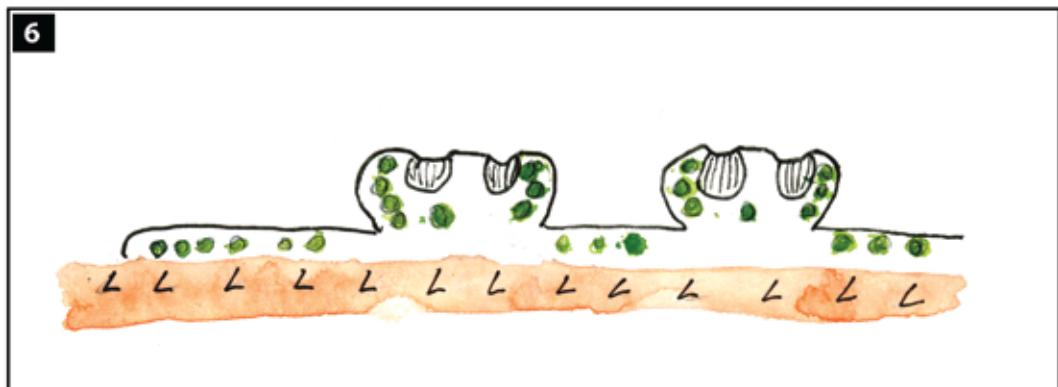


Fig. 6. *Aspicilia*: transect through thallus and apothecia of bimorphic species.



Fig. 7. *Aspicilia annulata*. Holotype (O). Scale 1 mm.



Fig. 8. *Aspicilia arctica*. Holotype (O). Scale 1 mm.



Fig. 9. *Aspicilia composita*. Holotype (O). Scale 1 mm.



Fig. 10. *Aspicilia culicis*. Calypso Bay, 1926, B. Lynge (O). Scale 1 mm.



Fig. 11. *Aspicilia heteroplaca*. Dicksonfjorden, 1936, E. Dahl (O). Scale 2 mm.



Fig. 12. *Aspicilia major*. Holotype (O). Scale 1 mm.



Fig. 13. *Aspicilia natherstii*. Holotype (O). Scale 1 mm.



Fig. 14. *Aspicilia perradiata*. Kolfjellet, 1926, B. Lynge (O). Scale 1 mm.



Fig. 15. *Aspicilia pertusa*. Holotype (O). Scale 1 mm.



Fig. 16. *Aspicilia plicigera*. Bromelldalen, 1926, B. Lynge (O). Scale 1 mm.



Fig. 17. *Aspicilia punctiformis*. Blåhuken, 1926, B. Lynge (O). Scale 1 mm.

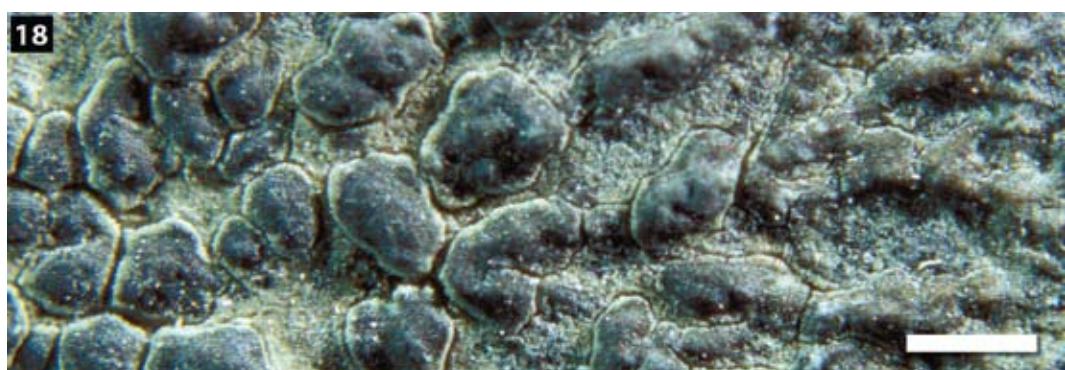


Fig. 18. *Aspicilia rosulata*. Edgeøya, 1936, E. Dahl (O). Scale 0.5 mm.



Fig. 19. *Aspicilia sublapponica*. Wijdefjorden, 2002, T. Tønsberg 31141 (BG). Scale 1 mm.

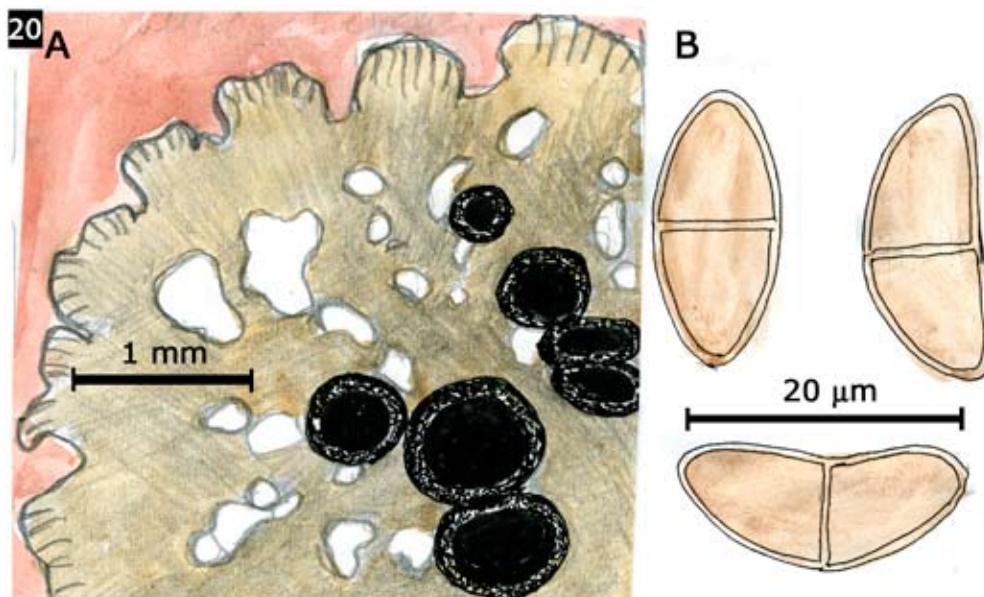


Fig. 20. *Buellia insularis*. Holotype (O). A: areolae and apothecia on *Vestergrenopsis elaeina*; B: ascospores.

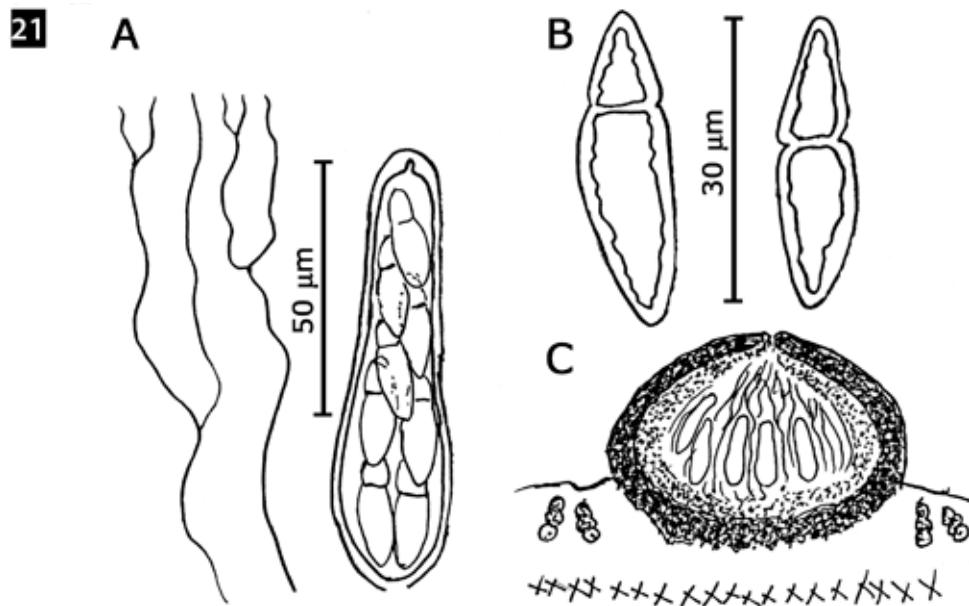


Fig. 21. *Collemopsidium bryospilum*. Between Vestpynten and Bjørndalen, 2001, R. Haugan 6914 (O). A: ascus and paraphyses; B: ascospores; C: vertical transect through perithecium.



Fig. 22. *Dactylina arctica*. Kongsfjorden, Ossian Sarsfjellet. 2002. A. Elvebakk photo.



Fig. 23. *Lepraria gelida*. Part of holotype (BG). Scale 1 mm.

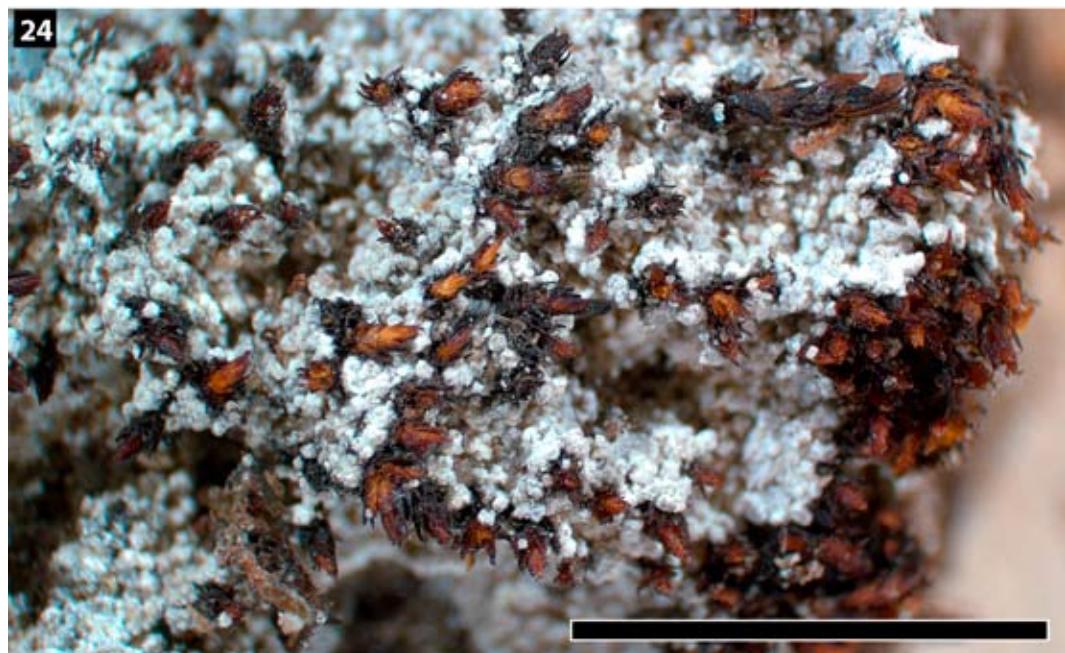


Fig. 24. *Lepraria svalbardensis*. Kobbe Bay, 1868, Th. Fries (O-L149707). Scale 5 mm.

25

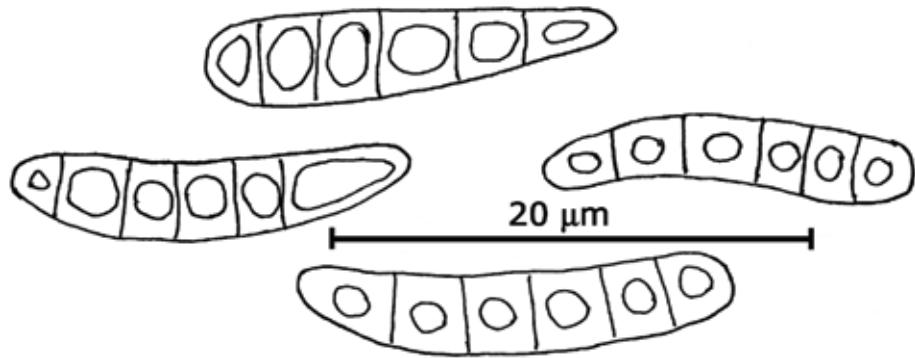


Fig. 25. *Placynthium pulvinatum*. Holotype (BG). Ascospores.

26



Fig. 26. *Rhizocarpon atroflavescens*. Holotype (O). Ascospores

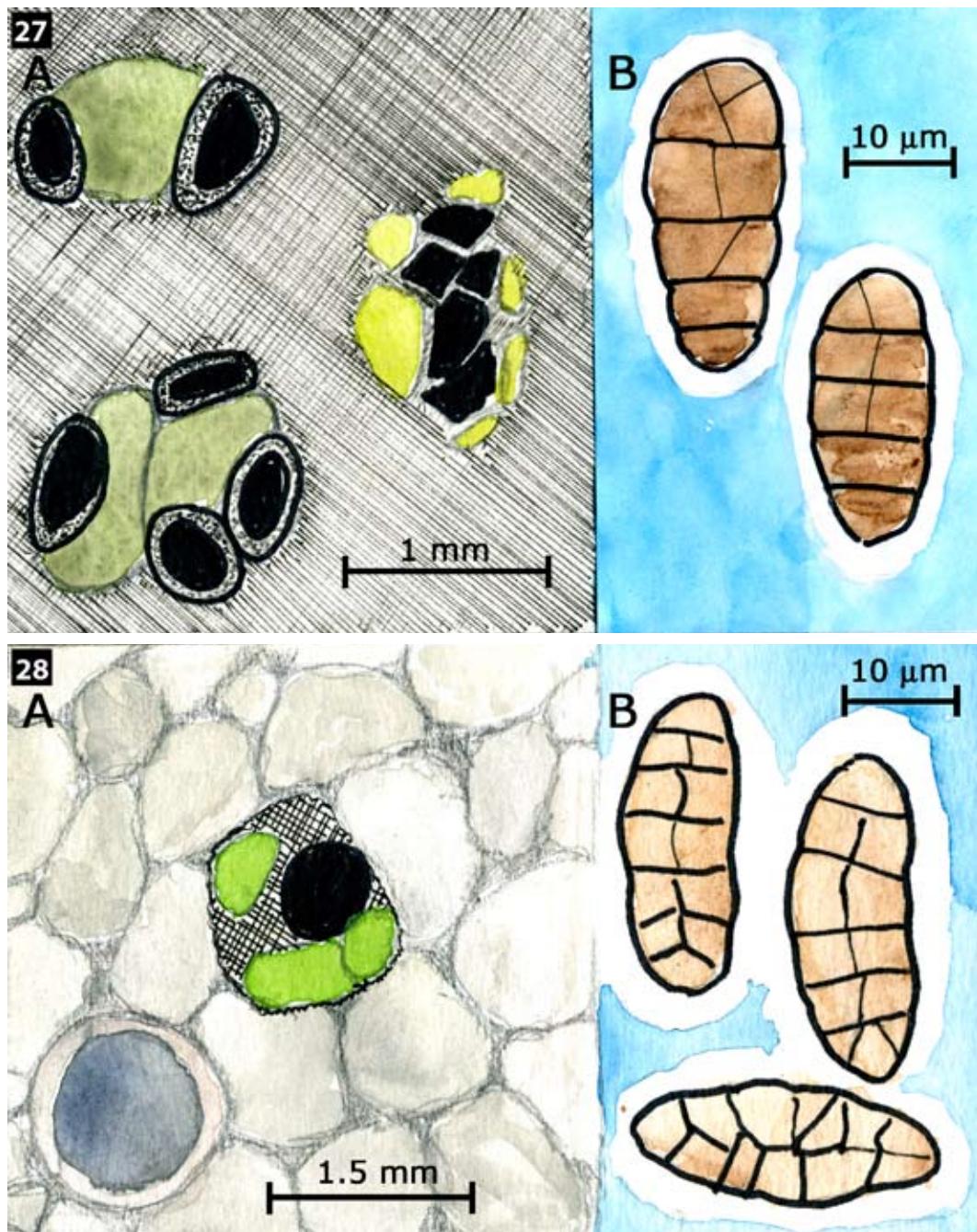


Fig. 27. *Rhizocarpon dahlii*. Holotype (O). A: to the left two thalli with apothecia on prothallus of *Rhizocarpon geographicum*; to the right areolae and apothecia of *R. geographicum*.

Fig. 28. *Rhizocarpon tephromelae*. Holotype (O). A: thallus and apothecia on *Tephromela atra*; B: ascospores.



Fig. 29. *Sporodictyon schaeerianum*. Barentsøya, 1936, E. Dahl (O). Scale 1 mm.

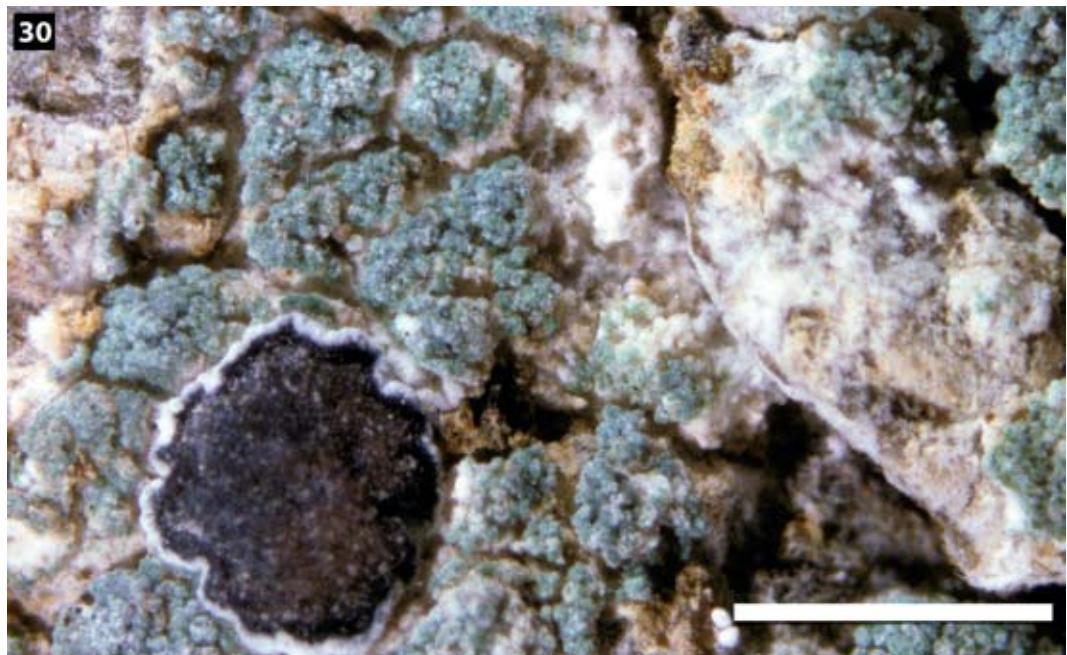


Fig. 30. *Tephromela lucifuga*. Holotype (BG). Scale 1.5 mm.

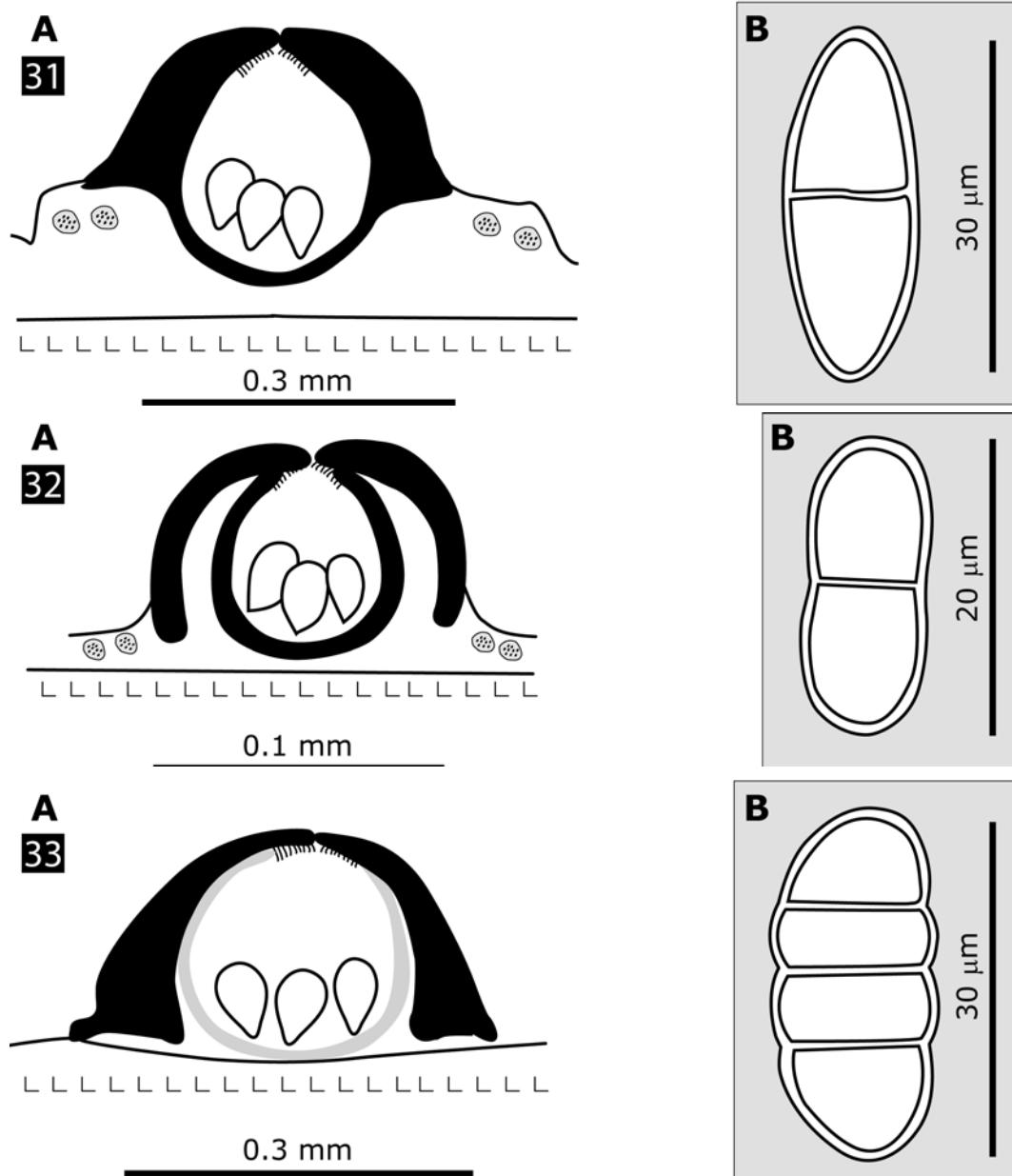


Fig. 31. *Thelidium aeneovinosum*. Blåhuken, 1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.

Fig. 32. *Thelidium antoniellarum*. Barentsøya, 1973, H. Hertel 16481 (M). A: vertical section of perithecium; B: ascospore.

Fig. 33. *Thelidium papulare*. Cap Blix, 1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.



Fig. 34. *Usnea sphacelata*. Wijdefjorden, acidic boulder slope near Reinsbukkdalen. 2003. A. Elvebakk photo.

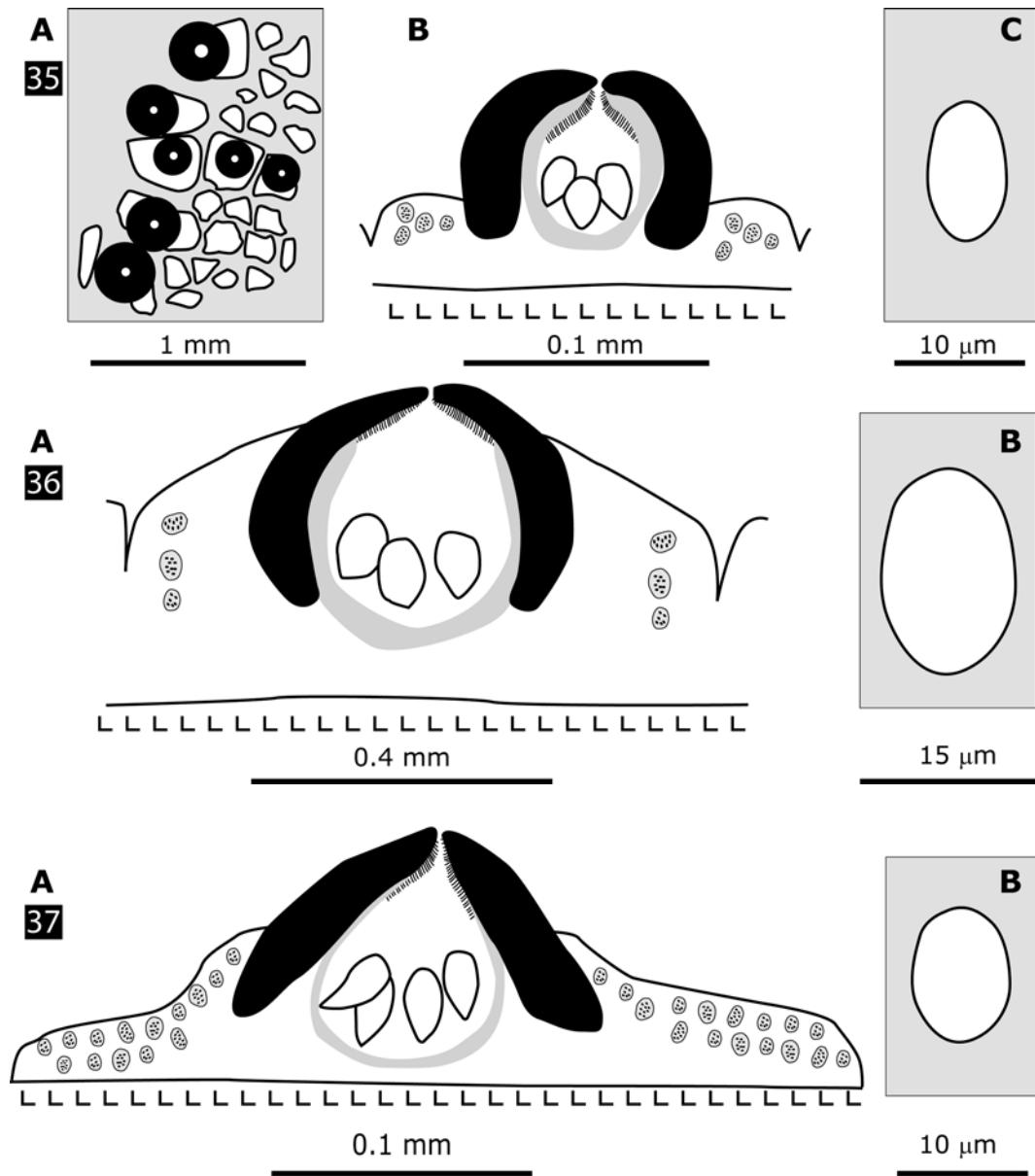


Fig. 35. *Verrucaria acrotella*. Litledalen, 1926, B. Lynge (O). A: thallus with perithecia; B: vertical section of perithecium; C: ascospore.

Fig. 36. *Verrucaria aethiobola*. Forsbladhamna, 29.7.1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.

Fig. 37. *Verrucaria arctica*. Lectotype (O). A: vertical section of thallus and perithecium; B: ascospore.

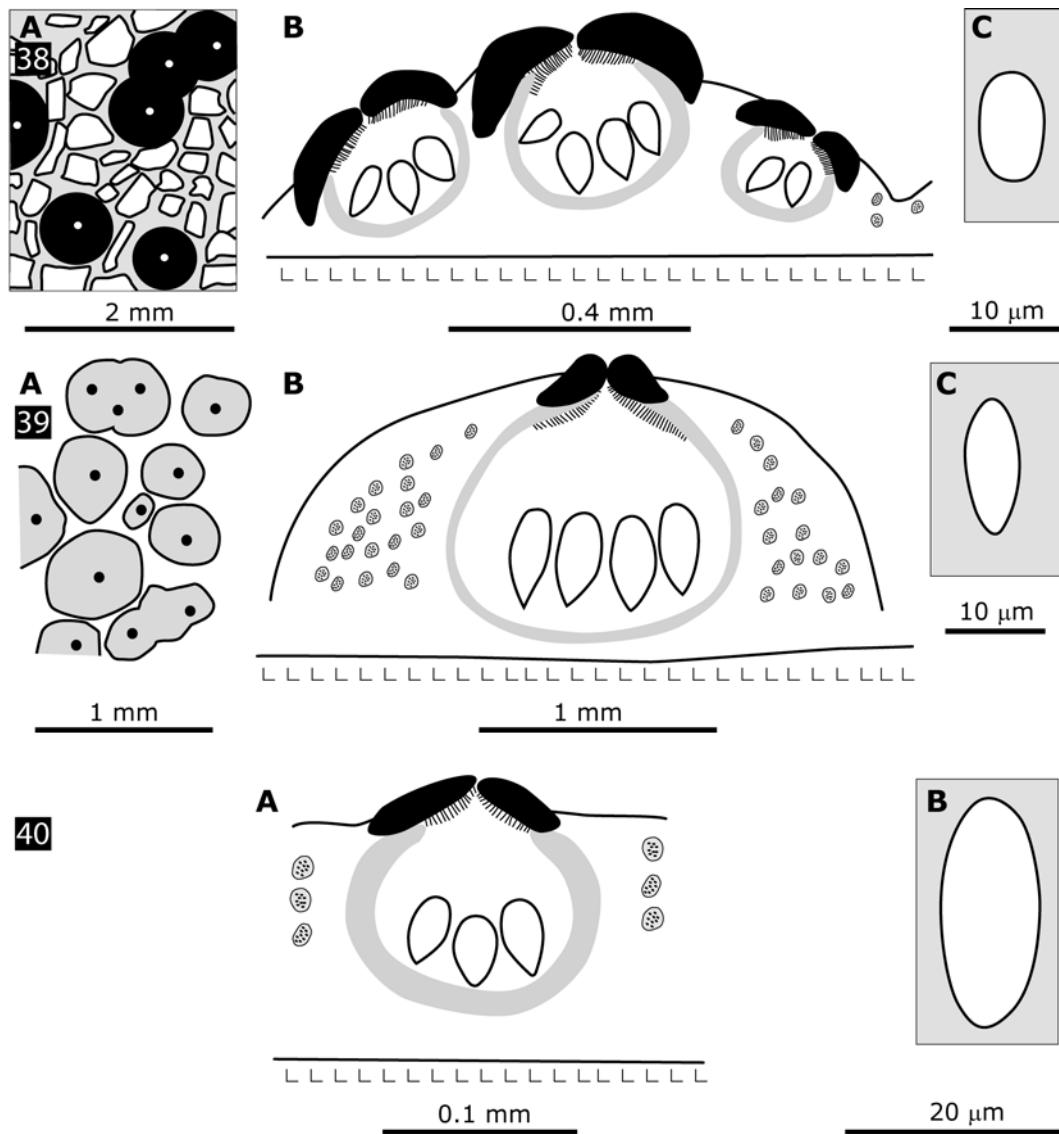


Fig. 38. *Verrucaria* cf. *bulgarica*. Bromelldalen, 1926, B. Lynge (O). A: thallus with perithecia; B: vertical section of thallus and perithecia; C: ascospore.

Fig. 39. *Verrucaria bullata*. Dicksonfjorden, 1926, B. Lynge (O). A: perithecial warts; B: vertical section of perithecial wart; C: ascospore.

Fig. 40. *Verrucaria caerulea*. Kings Bay, 1868, Th. M. Fries (O). A: vertical section of peritheciellum; B: ascospore.

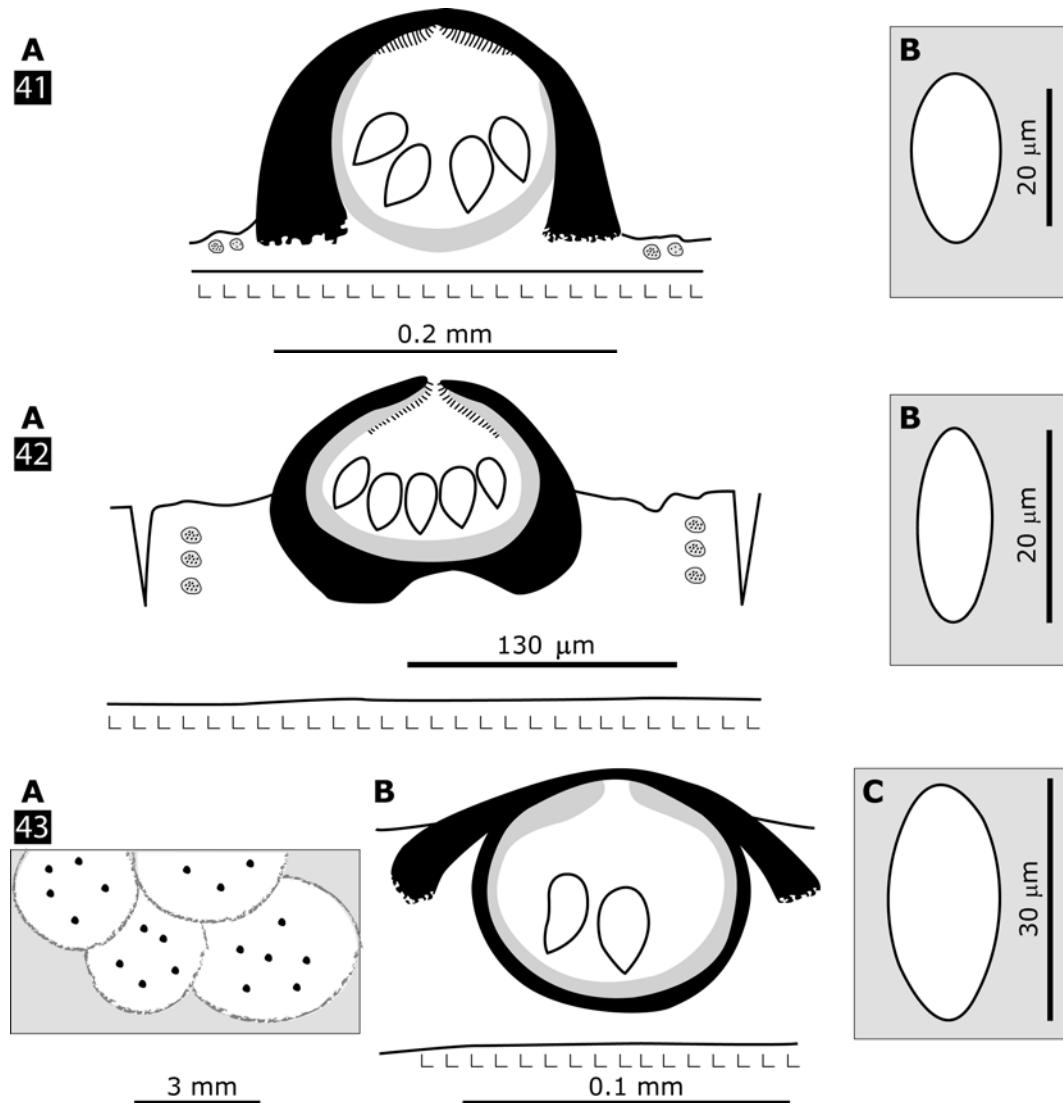


Fig. 41. *Verrucaria divergens*. Klovningen, 1928, O. A. Høeg (O). A: vertical section of perithecium; B: ascospore.

Fig. 42. *Verrucaria extrema*. Holotype (UPS). A: vertical section of perithecium; B: ascospore.

Fig. 43. *Verrucaria glauicina*. Prins Karls Forland, 1868, Th. M. Fries (O). A: composite thallus; B: vertical section of perithecium; C: ascospore.

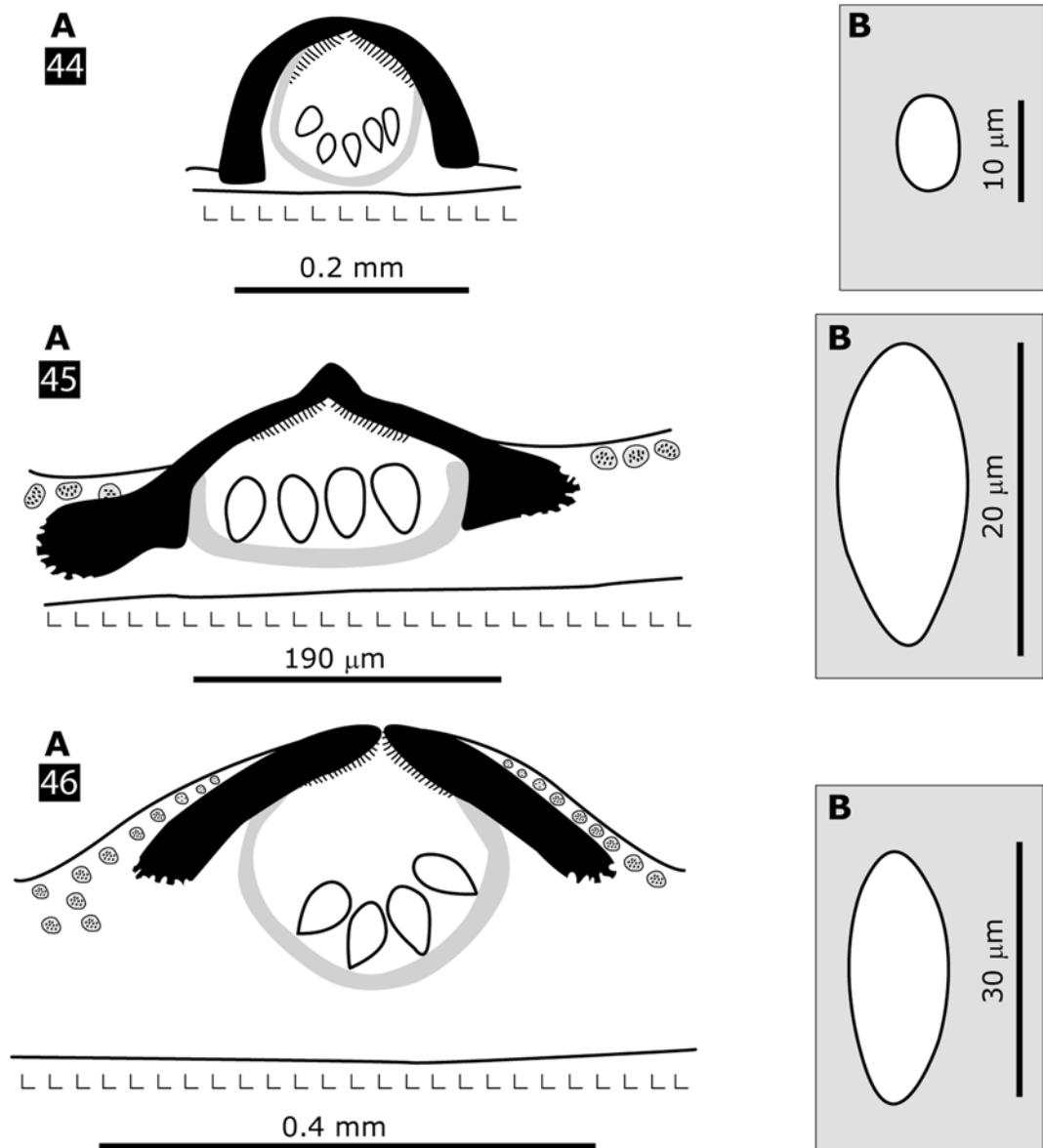


Fig. 44. *Verrucaria haliza*. Virgohamna, 1928, O. A. Høeg (TRH). A: vertical section of perithecium; B: ascospore.

Fig. 45. *Verrucaria hydrela*. Wijdefjorden, 2002, T. Tønsberg 31273 (BG). A: vertical section of perithecium; B: ascospore.

Fig. 46. *Verrucaria margacea*. Kobbefjorden, 1868, Th. M. Fries (O). A: vertical section of perithecium; B: ascospore.

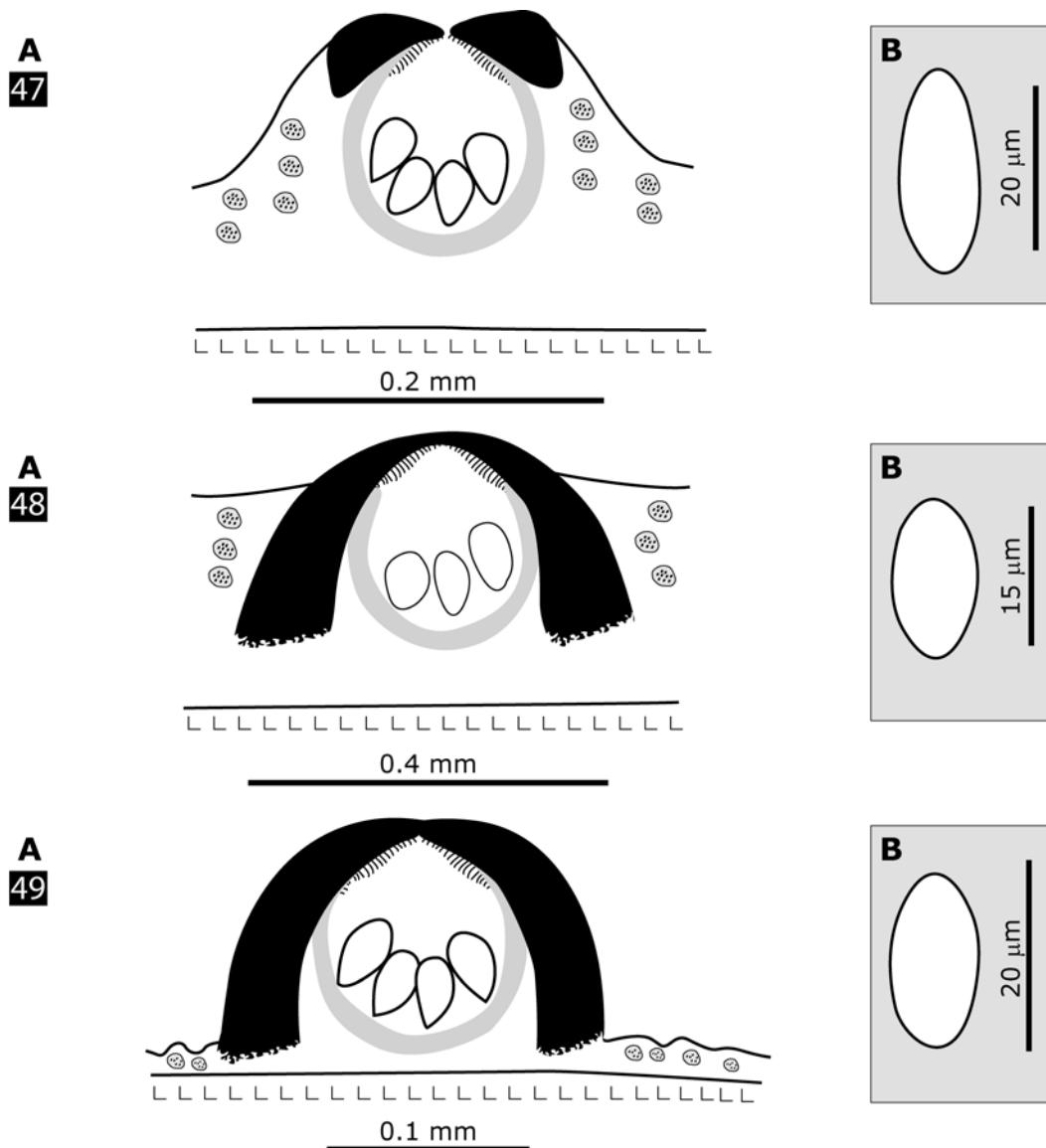


Fig. 47. *Verrucaria muralis*. Bellsund, 1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.

Fig. 48. *Verrucaria nigrescens*. Mitterhuken, 1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.

Fig. 49. *Verrucaria obsoleta*. Cap Blix, 1926, B. Lynge (O). A: vertical section of perithecium; B: ascospore.

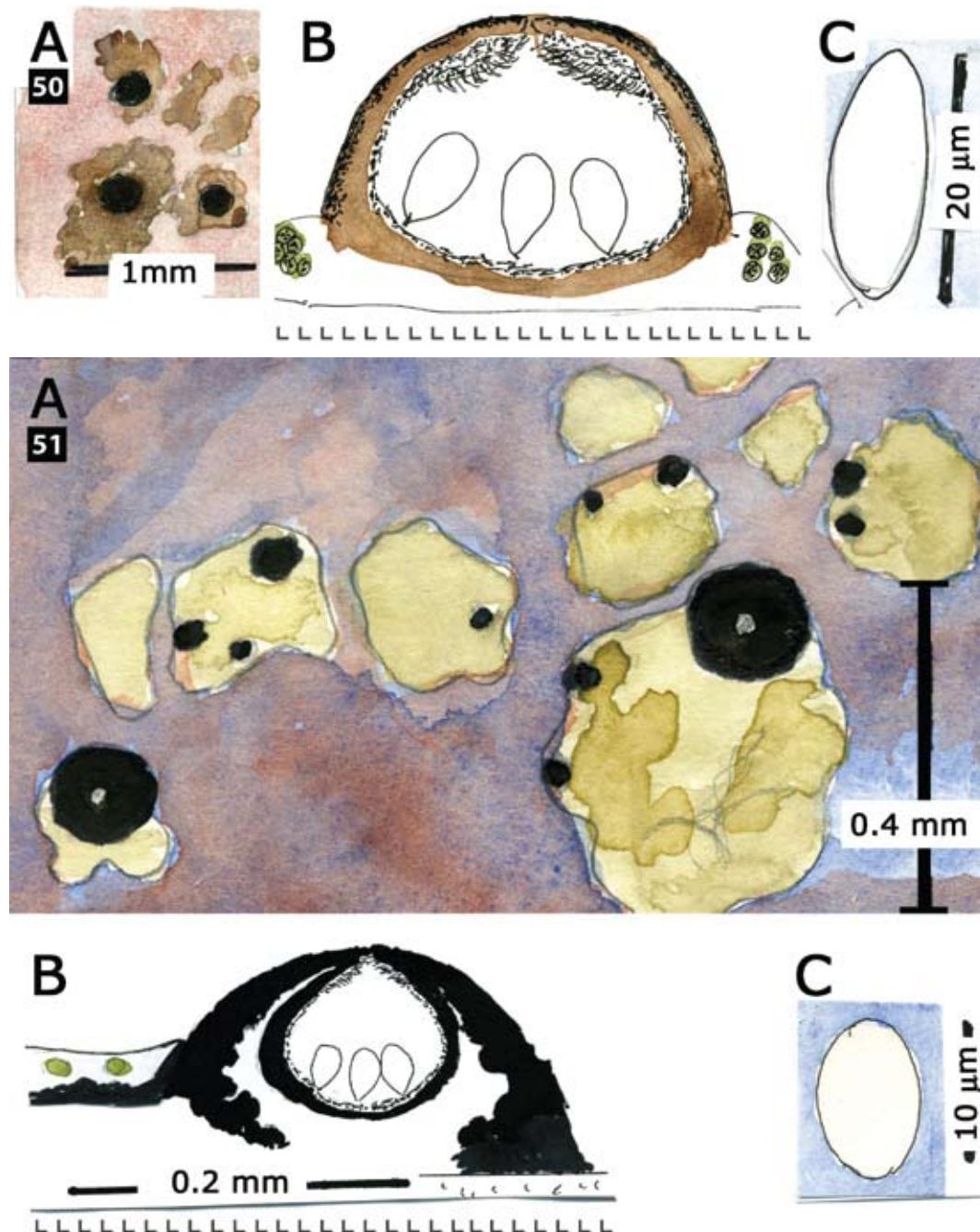


Fig. 50. *Verrucaria rejecta*. Holotype (UPS). A: thallus with perithecia; B: vertical section through perithecium; C: ascospore.

Fig. 51. *Verrucaria wilczekii*. Holotype (L). A: areolae with perithecia; B: vertical section through perithecium; C: ascospore.

**LITHOGRAPHA** Nyl. (1856)

**Thallus** crustose, areolate. **Ascomata** apothecia, ± elongate with slit-like disc, black, without thalline margin. Exciple black in section. Asci of *Rimularia*-type. Ascospores 8 per ascus, simple, hyaline. Hamathecium of paraphyses, little branched.

*Lithographa tesserata* (DC. in Lam. & DC.) Nyl. (1856)

**Thallus** crustose, granular, thick, areolate, grey-brown. **Apothecia** elongate, with incurved margin and slit-like black disc. True exciple black, thick. Ascospores 8 per ascus, ellipsoid, colourless, simple, 9–15 × 5–8 µm.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** Only known from Kongsfjorden.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Kongsfjorden, 1868, Th.M. Fries (O).

**LOBARIA** (Schreber) Hoffm. (1796)

**Thallus** foliose, spreading in an irregular way, lobes rounded. Photobiont green (*Myrmecia* or *Trebouxia*) or cyanobacteria (*Nostoc* or *Scytonema*); cyanobacteria sometimes in internal or external cephalodia. Upper side smooth to ridged. Lower side tomentose, with rhizines, without cyphellae or pseudocyphellae. **Ascomata** apothecia, with thalline exciple. Asci of *Peltigera*-type. Ascospores 8 per ascus, colourless or pale brown, 1–7-septate. Hamathecium of paraphyses, little ramified. Conidia cylindrical.

*Lobaria linita* (Ach.) Rabenh. (1845)

**Thallus** up to 10 cm diam.; upper surface brownish to brown-green, buckled-uneven, with ascending lobes up to 2 cm broad. Lower surface brown, with pale, naked spots. Photobiont green algae. Internal cephalodia present. **Apothecia** not seen in Svalbard material.

**Chemistry.** Tenuiorin, methylgyrophorate, ± ?gyrophoric acid (tr.), ± unidentified substance at A7, B8, C8, and ± unidentified terpenoid.

**Ecology.** Among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America.

**Specimens seen** (selected): Liefdefjorden, 22.8.1974, A.A. Frisvoll (TRH); Reindalen near Sørhytta, A. Elvebakken 86:483 (TROM).

**LOBOTHALLIA** Hafellner (1991)

**Thallus** placodioïd, with radiating, terete to flattened end lobes. Photobiont trebouxioïd. **Ascomata** apothecia, sessile, with thalline margin. Ascii of *Aspicilia*-type. Ascospores 8 in ascii, simple, uncoloured. Hamathecium of paraphyses, ramified, ± moniliform.

**Note.** A small genus segregated from *Aspicilia*.

***Lobothallia alphoplaca* (Wahlenb.) Hafellner (1991)**

**Thallus** placodioïd, 2–3 cm wide, grey to yellow-grey, with radiating lobes. Lobes torulose-intricately ramified to parallel and little ramified, at end free, terete to somewhat flattened, to 0.6 mm diam. Lower side pale grey to grey orange, corticated, with no rhizinae. **Apothecia** up to 1.3 mm diam., strongly constricted below; thalline margin thin, regular, concolorous with thallus; disc flat, dark brown to brown-black. Hymenium 75–80 µm high, uppermost part pale brown. Hypothecium colourless. Most thalline exciple and subhymenial tissue filled with algae. Cortex 50–60 µm thick, composed of intricate hyphae; outermost part brown. Ascospores subglobose to broadly elliptic, 9–11 × 6–8 µm. Paraphysse end cells moniliform. Pycnidia abundant.

**Chemistry.** Norstictic acid.

**Ecology.** On schists, siliceous rock and wet sandstone rock, also on mineral soil.

**Distribution.** Scattered.

**Notes.** Both *Lobothallia alphoplaca* and *L. melanaspis* (Ach.) Hafellner have been reported from Svalbard (Elvebakk & Hertel 1996). We have studied all available material from Svalbard and also a number of specimens from Fennoscandia filed as *L. melanaspis* (BG), and a number of *L. alphoplaca* collections from the Alps (GZU). According to Poelt (1969) and Thomson (1997), the main distinguishing character between these two species are chemistry (abundant norstictic acid in *L. alphoplaca*, traces of norstictic acid and placodin in *L. melanaspis*), morphology/anatomy (gelatinous outer layer of thalline exciple and thick walls of medullar hyphae in *L. alphoplaca* versus no gelatinous layer and thin walls of medullary hyphae in *L. melanaspis*, in addition to more branched and flattened lobes in *L. alphoplaca*), ecology (periodically inundated river banks for *L. melanaspis*; dry-warm rock for *L. alphoplaca*). All specimens from Svalbard had abundant norstictic acid, while all specimens from Scandinavia had norstictic acid in trace amounts and an unidentified compound. One of the Scandinavian specimens, however, was examined by J. Elix who found norstictic acid and traces of fatty acids. None of the specimens investigated had a gelatinous outer layer of the thalline exciple and the cell walls of the medullary hyphae were of equal thickness. The ramification and flatness of the lobe ends varied considerably in both the Svalbard and Scandinavian material. As to ecology, all Scandinavian specimens grew on river banks or at least in wet places, while there was some variation in the Svalbard material, some specimens were from wet, some from relatively dry rock. We have assigned all Svalbard specimens to *L. alphoplaca* regarding the chemical criterion to be the most important one (see Poelt 1969). The morphological/anatomical characters used by Thomson (1997) could not be verified by us. The specimens from the Alps of *L. alphoplaca* all contain norstictic acid in high concentrations, and were otherwise similar, e.g. in morphological variation, to the Svalbard specimens. The ecology represents a problem. The habitat of *L. alphoplaca* is generally described as dry-warm rock, and it has been reported from the dry inner valleys of the Alps (Buschardt 1979), while on Svalbard some populations are found in periodically inundated brook margins, i.e., having an ecology typical of *L. melanaspis*. This needs further study. However, it seems justified to

exclude *L. melanaspis* from the Svalbard flora until more evidence for its occurrence there has been documented. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, Spjelkavik & Elvebakk 81:745 (TROM); Raudfjorden, 22.7.1928, O.A. Høeg (TRH); Adventdalen, Longyearbyen, 23.7.1936, E. Dahl (O).

## LOPADIUM Körber (1855)

**Thallus** crustose, granulose to coralloid. **Ascomata** apothecia, without thalline margin; true margin prominent. Disc flat to concave. Ascospores 1–8 per ascus, muriform, colourless to brownish. Hamathecium of paraphyses, simple to branched.

Key to *Lopadium* on Svalbard:

- |   |                                 |                        |
|---|---------------------------------|------------------------|
| 1 | Thallus coralloid-isidoid.....  | <i>L. coralloideum</i> |
| 1 | Thallus granulose-areolate..... | <i>L. pezizoideum</i>  |

### *Lopodium coralloideum* (Nyl.) Lynge (1940)

**Thallus** 2–3 cm wide, coralloid-isidoid, dark brown; branches terete, 0.1–0.2 mm wide, 0.4–0.5 mm high. **Apothecia** up to 1 mm wide, sessile, with distinct dark brown margin; disc flat to somewhat concave, rough, black. Hymenium 150–160 µm high; epithecium dark brown. Ascospores 1 per ascus, muriform, colourless, 90–95 × 40 µm. Paraphysis end cells to 7 µm diam., with dark pigmented cap.

**Chemistry.** Negative.

**Ecology.** On bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Phippsøya, 18.8.1936, E. Dahl (O); Wijdefjorden, N of Austfjordnes, the W-facing foothill of Mt. Rutherfordfjellet, 2002, T. Tønsberg 31183 (BG).

### *Lopodium pezizoideum* (Ach.) Körber (1855)

**Thallus** composed of ± dispersed, grey-brown, slightly convex areolae. **Apothecia** with broad stipe, up to 0.5 mm broad; stipe brown; margin concolorous with stipe, prominent; disc black, rough, flat. Hymenium 110–120 µm high; epithecium brown. Ascospores 1 per ascus, muriform, uncoloured, 65–70 × 28–32 µm. Paraphyses anastomosing; end cells to 5 µm wide, dark brown pigmented.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Holmiabukta, 4.7.1929, O.A. Høeg (TRH); Nordaustlandet, Rijpfjorden, 14.8.1936, E. Dahl (O).

**MASSALONGIA** Körb. (1855)

**Thallus** foliose, brown, with elongated lobes forming rosettes, with flattened isidia at margins, 1–2 cm wide. Upper side with pseudoparenchymateous cortex, lower side without cortex but with interwoven, horizontally oriented hyphae. Photobiont cyanobacteria. **Ascomata** apothecia, with true exciple only. Ascii with an amyloid ring-like structure in the inner part, 8-spored. Hamathecium of paraphyses, ramified.

*Massalongia carnosa* (Dicks.) Körb. (1855)

**Thallus** foliose, forming rosettes to 2 cm diam., red-brown to dark brown; lobes squamulose with isidia on margin and rarely in inner parts. Upper cortex 20–40 µm high, pseudoparenchymateous, with thick-walled cells. Lower side weakly defined. Photobiont *Nostoc*. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** Among bryophytes.

**Distribution.** Only known from Gipsvika, Bünzow Land.

**Notes.** This species was reported by Olech (1990) from Sørkapp; we have seen one specimen which belongs in *Placynthium* sp. (P. M. Jørgensen det. 2001). World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Australia, Antarctica.

**Specimen seen:** Bünzow Land, S slope of Gispvika. 1985, A. Elvebakk 85:701c (TROM).

**MEGALARIA** Hafellner (1984)

**Thallus** crustose, with *Trentepohlia* or trebouxioid algae. **Ascomata** apothecia, without thalline margin. True exciple composed by radiating, swollen hyphae. Ascii of modified *Lecanora*- or *Bacidia*-type. Ascospores 1-septate (rarely simple). Hamathecium paraphyses, simple. Conidia not known.

*Megalaria jemtlandica* (Th. Fr. & Almq.) Fryday (2004)

Syn. *Lecidea sublimosa* Nyl. (1868).

**Thallus** crustose, grey to brown-grey, subgelatinous, thin, 1–2 cm wide. Photobiont trebouxioid; cells 10 µm diam. **Apothecia** black, flattened convex, emarginate, up to 0.8 mm diam., often several merged together. Hymenium 90–100 µm high, uppermost part blue-green. Hypothecium colourless. True exciple weakly developed, composed by radiating hyphae. Ascii of *Bacidia*-type. Ascospores 8 per ascus, simple or 1-septate, 18–20 × 8–10 µm. Paraphyses simple; end cells not enlarged, embedded in gelatinous tissue.

**Chemistry.** Negative.

**Ecology.** On moribund mosses.

**Distribution.** Scattered.

**Notes.** Morphologically similar to *Lecidea alpestris* and *Protomicarea limosa*, but recognized

by its much broader ascospores of which a few are 1-septate. New to Svalbard. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Nordenskiöld Land, between Vestpynten and Bjørndalen, 2002, R. Haugan 6953 (O); Prins Karls Forland, 5.8.1868, Th.M. Fries (O).

### MEGASPORA (Clauzade & C. Roux) Hafellner & V. Wirth (1987)

**Thallus** crustose, effuse. Photobiont trebouxioid. **Ascomata** apothecia, immersed in thallus; thalline exciple present. Asci of *Pertusaria*-type, 4–8-spored. Ascospores large, simple, uncoloured; wall uniformly thickened. Hamathecium of paraphyses, branched and anastomosing; end cell not enlarged.

**Note.** A monotypic genus.

#### *Megaspora verrucosa* (Ach.) Hafellner & V. Wirth (1987)

**Thallus** effuse, very thin, white to yellowish-white. **Apothecia** urceolate; young discs with a pore-like opening; older discs expanding to 0.5 mm diam., concave, black, non-pruinose; thalline margin blackish around pore opening, otherwise whitish. True exciple and hypothecium colourless. Hymenium 120–140 µm high, uppermost part pale brownish. Ascospores 8 per ascus, broadly elliptic, 35–45 × 18–22 µm. Paraphyses thin, anastomosing and septate. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, New Zealand, Antarctica.

**Specimens seen** (selected): Kong Karls Land, Hårfagrehaugen, 11.8.1936 E. Dahl (O); Wijdefjorden, Krosspynten, A. Elvebakk 01:101 (TROM).

### MELANELIA Essl. (1978)

**Thallus** foliose to subcrustose, corticated on both sides, with rhizines on lower side. Upper side brown to black; cortex N –, often with pseudocyphellae. **Ascomata** apothecia, with thalline margin. Asci of *Lecanora*-type. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, simple to branched. Conidia bifusiform to citriform.

Key to *Melanelia* on Svalbard:

1	Thallus sorediate or isidiate .....	2
1	Thallus not sorediate or isidiate .....	6
2 (1)	Thallus isidiate .....	3
2	Thallus sorediate .....	4

3 (2)	Isidia simple to isotomically branched .....	<i>M. infumata</i>
3	Isidia anisotomically branched .....	<i>M. elegantula</i>
4 (2)	Thallus with gyrophoric acid .....	<i>M. tominii</i>
4	Thallus without gyrophoric acid .....	5
5 (4)	Soralia on small lobe-ends .....	<i>M. sorediata</i>
5	Soralia laminal, sessile .....	<i>M. disjuncta</i>
6 (1)	With stictic acid; pycnidia marginal .....	<i>M. hepatizon</i>
6	Without lichen products; pycnidia mainly laminal .....	7
7 (6)	Lower side black; pycnidia immersed or slightly protruding .....	<i>M. stygia</i>
7	Lower side whitish to pale brown; pycnidia broadly attached .....	<i>M. agnata</i>

***Melanelia agnata* (Nyl.) Thell (1995)**

**Thallus** foliose, 3–4 cm wide, composed of radiate lobes; lobes flat, parallel, 0.8–1.0 mm broad, dull black in inner part, shiny brown-black in outer parts, wrinkled, canaliculate in outer part. Lower side whitish to pale brown, wrinkled, with a few simple rhizinae. Pseudocyphellae only visible in lobe tips, round to somewhat elongate, 0.05 mm wide. Pycnidia numerous, on lamina, broadly attached; conidia not found.

**Chemistry.** Negative.

**Ecology.** On exposed rock.

**Distribution.** Common and widespread.

**Notes.** New to Svalbard. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Bünzow Land, Bjonahamna, A. Elvebakk 01:048 (TROM); Bünzow Land, Gipsvika, A. Elvebakk 85:714 (TROM).

***Melanelia disjuncta* (Erichs.) Essl. (1978)**

**Thallus** foliose, 2–3 cm wide, with radiating lobes, dark brown, shiny. Lobes confluent, nodulose, sorediate; lobe-ends 0.2–0.3 mm broad, flat to slightly convex, with very small, circular to elliptic pseudocyphellae. Soralia in inner part of thallus, laminal, sessile, blue-grey, often confluent, convex. Lower surface brown-black, wrinkled, with a few dark, simple rhizines.

**Chemistry.** Perlatolic and stenosporic acids (concentrations often low).

**Ecology.** On rock.

**Distribution.** Common.

**Notes.** One specimen (Elvebakk 86:397) was esorediate, but otherwise similar to typical *M. disjuncta*. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Gipsdalen, A. Elvebakk 85:484 (TROM); Krossfjorden, A. Elvebakk 86:347, 86:397 (TROM).

***Melanelia elegantula* (Zahlbr.) Essl. (1978) s.lat.**

**Thallus** foliose, 2–3 cm wide, upper side dark brown, not pruinose, with numerous isidia. Isidia anisotomically divided, with an indistinct pseudocyphella at tip. Lower side pale brown, with a few pale rhizinae. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On bird-manured cliffs.

**Distribution.** A few scattered occurrences.

**Notes.** Reported from Van Keulenfjorden and Adventfjorden by Esslinger (1977), but not included in Elvebakk & Hertel (1996). Differs from *M. infumata* mainly by its isidia, which in *M. infumata* are simple to isotomically divided and never have apical pseudocyphellae. In Scandinavia *M. elegantula* is regarded as a southern species of nutrient-enriched bark (Almborn 1948; see also Santesson et al. 2004). The occurrence of this species in the Arctic (as well as in the Antarctic) is enigmatic and in need of further studies. World distribution: Europe, North America (including Greenland), southern South America, Antarctica.

**Specimens seen:** Wijdefjorden, E of Austfjorden, E of Austbotnhytta, 2002, T. Tønsberg 31091 (BG); Barentsøya, between Steinbeisfjellet and Kapp Voejkov, 1.8.1936, E. Dahl (O).

#### *Melanelia hepatizon* (Ach.) Thell (1995)

**Thallus** 3–4 cm wide, foliose, dark brown; lobes radiating, overlapping, at margin 1.1–1.3 mm wide, flat, with upturned margins. Lower surface brown-black, wrinkled, with a few dark simple rhizines. Pseudocyphellae mostly on or close to margin on upper side, elliptic, 0.1 mm long. Pycnidia numerous, mostly on margin, black, barrel-shaped. Conidia 4 × 1 µm, bifusiform. **Apothecia** rare, laminal.

**Chemistry.** Stictic acid complex.

**Ecology.** On hard rock.

**Distribution.** Common and widespread.

**Notes.** There appears to be some variation in the Svalbard material of this species especially in lobe dimensions, but all specimens examined have stictic acid, a dark lower surface and bifusiform conidia. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Edgeøya, 7.8.1936, E. Dahl (O); Barentsøya, 1.8.1936, E. Dahl (O).

#### *Melanelia infumata* (Nyl.) Essl. (1978)

**Thallus** foliose, 3–4 cm wide, brown, lobes 1.5 mm broad, thin, with upturned margins, isidiate. Lower side brown, with simple brown rhizinae. Isidia club-shaped, up to 0.4 mm high and 0.2 mm broad. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On rock; ornithocoprophilous

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Velkomstpynten, 27.8.1936, E. Dahl (O); Liefdefjorden, 2.9.1868, Th.M. Fries (O).

#### *Melanelia soreciata* (Ach.) Goward & Ahti (1995)

**Thallus** foliose, 2–3 cm wide, with radiating lobes; lobes dull pale brown, flat, uneven, 0.6–0.7 mm broad, sorediate. Soralia in inner parts, small, on erect lobe-ends, up to 1 mm diam., blue-grey, convex. Pseudocyphellae inconspicuous, small, round to elliptic. Lower surface black, wrinkled, with dichotomously divided, black rhizinae. **Apothecia** not seen in Svalbard material.

**Chemistry.** Perlatolic and stenosporic acids (often in low concentrations).

**Ecology.** On exposed rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen** (selected): Barentsøya, 2.8.1936, E. Dahl (O).

#### *Melanelia stygia* (L.) Essl. (1978)

**Thallus** foliose, 1–3 cm wide, with radiating, overlapping lobes, 0.5–0.8 mm wide, black. Lower side black to brown-black. **Apothecia** rare, laminal. Pycnidia laminal, immersed or slightly protruding.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Scattered but not uncommon.

**Notes.** All specimens examined from Svalbard belong to ssp. *septentrionalis* Lyngé, which is characterized by its lack of lichen compounds. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Krossfjorden, A. Elvebakk 85:240 (TROM); Gipsdal, A. Elvebakk 85:607 (TROM).

#### *Melanelia tominii* (Oxner) Essl. (1978)

**Thallus** foliose, 1–2 cm wide, sorediate, with radiating, overlapping lobes, which in inner part coalesce and form a crust; lobe-ends slightly convex, to 0.7 mm broad, with round to elliptic, to 0.2 mm long pseudocyphellae. Lower side dark brown, wrinkled, with a few simple, brown-black rhizinae. Soralia sessile, laminate, blue-grey, convex, to 1.2 mm diam. **Apothecia** or pycnidia not seen.

**Chemistry.** Gyrophoric acid and two unidentified compounds.

**Ecology.** On rock.

**Distribution.** Only known from Edgeøya.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Edgeøya, 6.8.1936, E. Dahl (O).

#### MELANOLECIA Hertel (1983)

**Thallus** within rock. **Ascomata** apothecia, without thalline margin. True margin brown-black in section. Hypothecium brown-black. Ascii with weakly K/I + blue tholus. Ascospores 8 per ascus, simple, uncoloured, with halo. Hamathecium paraphyses, anastomosing.

**Note.** A monotypic genus.

#### *Melanolecia transitoria* (Arnold) Hertel (1983)

**Thallus** endolithic, not evident. **Apothecia** black, sessile, up to 0.5 mm diam., outline somewhat irregular; true margin distinct, elevated. Hymenium 55–60 µm high; epithecium green-black, K + olivaceous, N + red. Excipulum brown-black, of a *textura intricata*. Hypothecium brown-black, K +

red-brown. Ascospores 8 per ascus,  $7.5-11 \times 5.5-7 \mu\text{m}$ , with halo. Paraphyses anastomosing; end cell not enlarged. Medulla K/I + blue.

**Chemistry.** Not performed.

**Ecology.** On limestone, with *Xanthoria sorediata* etc.

**Distribution.** Only known from the Ny-Ålesund area.

**Notes.** Limestone inhabiting species of *Farnoldia* and *Carbonea* also have brown-black exciple and hypothecium, N + red epithecium and an endolithic thallus; they have asci of *Lecanora-* and *Porpidia*-type, respectively.

*Melanolecia transitoria* is recognized by its smaller apothecia and ascospores, and different asci. World distribution: Europe, North America (Greenland).

**Specimens seen:** Ny-Ålesund, H. Hertel 17220 (M); Brøggerhalvøya, Stuphallet, A. Elvebakk 85:330 (TROM).

## MICAREA Fr. (1825)

**Thallus** crustose, effuse, some species with cephalodia. Photobiont green algae, micareoid ( $4-7 \mu\text{m}$  diam.) or not. *Nostoc* or *Stigonema* in cephalodia. **Ascomata** apothecia, pale to black, small, thalline exciple absent. True exciple absent to well-developed, composed of radiating hyphae. Asci with K/I + blue outer layer and apical done which may have internal structures. Ascospores 8 per ascus, simple to septate, colourless. Hamathecium of paraphyses, simple to branched. Conidia of various types.

Key to *Micarea* on Svalbard:

1	Thallus with cephalodia .....	2
1	Thallus without cephalodia .....	3
2 (1)	Hypothecium dark red-brown, K – .....	<i>M. incrassata</i>
2	Hypothecium purple-brown, K + intensifying .....	<i>M. assimilata</i>
3 (1)	On rock .....	5
3	On soil and moribund bryophytes; photobiont micareoid .....	4
4 (3)	Thallus black, no lichen products found .....	<i>M. turfosa</i>
4	Thallus grey-green, with micareic acid .....	<i>M. prasina</i>
5 (3)	Photobiont not micareoid ( $5-12 \mu\text{m}$ diam.); ascospores $7-9 \mu\text{m}$ long .....	<i>M. tuberculata</i>
5	Photobionts micareoid ( $4-6 \mu\text{m}$ diam.); ascospores $5.5-6 \mu\text{m}$ long .....	<i>M. sylvicola</i>

## *Micarea assimilata* (Nyl.) Coppins (1983)

**Thallus** whitish, composed of confluent verrucose areolae; areolae up to 0.3 mm diam. Cephalodia present, red-brown, areolate, with *Nostoc*. **Apothecia** up to 1 mm diam., black, convex, emarginate. Hymenium  $45-50 \mu\text{m}$  high; epithecium greenish. Hypothecium purple-brown, K + intensifying. Ascospores simple to 1-septate,  $12-17 \times 4 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On soil and over moribund bryophytes

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia.  
**Specimen seen:** Van Mijenfjorden, Berzeliusdalen, A. Elvebakk 86:118 (TROM).

*Micarea incrassata* Hedl. (1892)

**Thallus** crustose, grey- to grey-brown, composed of confluent verrucose areolae to 0.3 mm diam. Cephalodia areolate, red-brown, with *Nostoc*. **Apothecia** black, up to 1 mm diam. Hymenium 45–50 µm high; epithecium greenish. Hypothecium dark red-brown, K –. Ascospores simple to 1-septate, 12–16 × 3–5 µm.

**Chemistry.** Negative.

**Ecology.** On soil and over moribund bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg s.n. (BG); Wijdefjorden, E of Austfjorden, between Austbotnhytta and Smutsdal, 2002, T. Tønsberg 31122 (BG; in a collection of *Lepraria gelida*).

*Micarea prasina* Fr. (1825) s. str.

**Thallus** crustose, grey-brown, granulose, composed of aggregated goniocysts; goniocysts 30–60 µm diam. Algal cells 4–6 µm diam. **Apothecia** single to composite, semiglobose, up to 0.6 mm diam., pink in protected parts, greyish in exposed parts. Hymenium 40–45 µm high, colourless throughout. Hypothecium colourless. Excipulum evanescent. Ascospores 8 in ascii, oblong to oblong-ellipsoid, 0–1-septate, 9–11 × 3–3.5 µm. Pycnidia not seen.

**Chemistry.** Micareic acid.

**Ecology.** Over moribund bryophytes and *Lecidoma demissa*.

**Distribution.** Only known from one site.

**Notes.** New to Svalbard. World distribution: Europe, North America, southern South America, New Zealand.

**Specimen seen:** Brennevinsfjorden, 5.9.1868, Th.M. Fries (O).

*Micarea sylvicola* (Flotow) Vězda & V. Wirth (1976)

**Thallus** granulose, thin, pale grey-green, 5–10 mm wide. Photobiont cells 4–6 µm. **Apothecia** black to dark grey, single or tuberculate, 0.2–0.6 mm wide, convex, emarginate; surface rough. Hymenium 50–55 µm high; epithecium colourless. Hypothecium dirty green in upper part, dark red-brown in lower part. Ascospores 8 in ascii, 5.5–6 × 2.5–3 µm. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** On lower side of stone in scree.

**Notes.** New to Svalbard. World distribution: Europe, Siberia, North America, Australia.

**Specimen seen:** Bjørndalen 2004, T. Tønsberg 31834, 31033 (BG).

*Micarea tuberculata* (Sommerf.) R. A. Anderson (1974)

**Thallus** crustose, effuse, granulate, green-grey. **Apothecia** scattered, convex, emarginate, dark grey-brown, up to 0.5 mm diam. Hymenium 45–50 µm high; epithecium pale brown. Hypothecium

blue-green. Ascospores 8 per ascus, 0–3-septate, 7–9 × 2.5–3 µm.

**Chemistry.** Not performed.

**Ecology.** On vertical rock, protected.

**Distribution.** Only known from the Longyearbyen area.

**Notes.** New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Longyearbyen, 2002, T. Tønsberg (BG).

### *Micarea turfosa* (Massal.) DR. (1923)

**Thallus** black, wrinkled, 1–2 cm wide. **Apothecia** up to 1 mm diam., emarginate, convex, black. Hymenium 35–40 µm high, partly red-brown; uppermost part greenish, K –. Hypothecium uncoloured to mottled brownish. Ascospores 8 per ascus, simple, 9–11 × 3–3.5 µm.

**Chemistry.** Negative.

**Ecology.** Over moribund bryophytes.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, arctic North America (including Greenland), Australia, Antarctica.

**Specimens seen:** Nordenskiöld Land, between Vestpynten and Bjørndalen, 2002, R. Haugan 6912 (O); Virgohamna, 7.7.1928, O.A. Høeg (TRH).

### *MIRIQUIDICA* Hertel & Rambold (1987)

**Thallus** crustose, areolate. **Ascomata** apothecia, sessile to immersed in thallus, black. Thalline excipite present or absent. Asci of *Lecanora*-type. Ascospores 8 per ascus, simple, uncoloured. Hamathecium paraphyses, simple to branched. Most species contain miriquidic acid.

Key to *Miriquidica* on Svalbard:

1	Thallus sorediate .....	2
1	Thallus not sorediate .....	3
2 (1)	With norstictic acid .....	<i>M. atrofulva</i>
2	With miriquidic and psoromic acids .....	<i>M. nigroleprosa</i>
3 (1)	Areolae shiny brown .....	4
3	Areolae grey or black .....	5
4 (3)	With miriquidic acid only .....	<i>M. deusta</i>
4	With miriquidic acid and stictic acid .....	<i>M. garovagliai</i>
5 (3)	Areolae black, with lobaric acid .....	<i>M. picea</i>
5	Areolae grey, without lobaric acid .....	6
6 (4)	Thallus as isolated areolae, with miriquidic acid.....	<i>M. griseoatra</i>
6	Thallus continuous, rimose, with norstictic acid .....	<i>M. lulensis</i>

*Miriquidica atrofulva* (Sommerf.) Schwab & Rambold (1987)

**Thallus** areolate, brownish to red-brown, mostly as isolated areolae, sorediate. Areolae round, convex, up to 0.7 mm diam.; soralia crateriform, central. **Apothecia** not seen.

**Chemistry.** Norstictic acid.

**Ecology.** Mostly on iron-rich rocks.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Antarctica.

**Specimen seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O).

*Miriquidica deusta* (Sten.) Hertel & Rambold (1987)

**Thallus** areolate; areolae flat, dark brown-grey to brown, some of which shiny and with a paler margin, 0.3–0.8 mm wide, dispersed, with a disintegrated, thin, black prothallus. **Apothecia** partly free, partly attached to and partly sunk in areolae, flat, black, with a very thin true margin, up to 0.5 mm diam. Hymenium 35–40 µm, uppermost part yellow-brown. Hypothecium yellowish. Ascospores 8 per ascus, 9–11 × 5–6 µm.

**Chemistry.** Miriquidic acid.

**Ecology.** On pebble on ground.

**Distribution.** Only known from Colesdalen.

**Notes.** The specimen is untypical in having a thin and disintegrated prothallus, and dispersed areolae; this may be due to the harsh environment. New to Svalbard. World distribution: circumarctic-alpine, Australia, New Zealand.

**Specimen seen:** Colesdalen, 2002, C. Printzen 6983 (TROM).

*Miriquidica garovagliai* (Schaerer) Hertel & Rambold (1987)

**Thallus** areolate, up to 4–5 cm wide, shiny brown. Areolae 0.3–0.8 mm, convex, angular. **Apothecia** sessile, to 2 mm broad, brown, when young with very thin but distinct margin, when old slightly convex with excluded margin. Excipulum pale, of radiating hyphae. Hypothecium uncoloured. Hymenium 110–120 µm high; uppermost part yellow-brown. Ascospores 8 per ascus, uncoloured, simple, 9–11 × 4–5 µm. Paraphyses stout, little ramified, septate; end cell with lumina, 2.5 µm broad, brown.

**Chemistry.** Miriquidic and stictic acids.

**Ecology.** On hard rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** none seen, record based on material cited by Hertel (1991) from Isfjorden and Kongsfjorden.

*Miriquidica griseoatra* (Flotow) Hertel & Rambold (1987)

**Thallus** areolate; areolae discrete, round, somewhat convex, 0.5–2.0 mm wide, dark grey. **Apothecia** black, to 0.8 mm wide. Hymenium 55–60 µm high; epithecium greenish. Ascospores 8 per ascus, 9–11 × 4–6 µm. Hypothecium colourless.

**Chemistry.** Miriquidic acid.

**Ecology.** On hard rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Akseløya 21.8.1926, B. Lynge (O); Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

### *Miriquidica lulensis* (Hellbom) Hertel & Rambold (1987)

**Thallus** areolate, 3–4 cm wide; areolae contiguous, up to 1 mm diam., flat, grey. **Apothecia** up to 1.2 mm diam., at first immersed in thallus, later somewhat raised, black, flat; margin thin, distinct. Hymenium 70–80 µm high; uppermost part pale brown. Ascospores 8 per ascus, 8–15 × 4–7 µm. Medulla K/I –.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** Widespread and common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Longyearbyen, 5.7.1936, E. Dahl (O); Grønhamna, 1.8.1868, Th.M. Fries (O).

### *Miriquidica nigroleprosa* (Vain.) Hertel & Rambold (1987)

**Thallus** of contiguous to dispersed areolae; areolae to 0.8 mm diam., round, convex, grey-black, sorediate. Soralia central on areolae, to 0.2 mm diam., dark grey, white where eroded. Soredia N + red. Apothecia not seen.

**Chemistry.** Miriquidic, ± psoromic acid.

**Ecology.** On exposed, siliceous rock.

**Distribution.** Scattered.

**Notes.** Only var. *nigroleprosa* has been collected on Svalbard. World distribution: Europe, Siberia, North America (including Greenland), New Zealand.

**Specimen seen** (selected): Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O).

### *Miriquidica picea* (Lynge) Øvstdal comb. nov.

Basionym: *Lecidea picea* Lynge (1928); Rep. Sci. Results Norwegian Exped. Novaja Zemlja 1921. 43: 108.

**Thallus** crustose, areolate, up to 2 cm wide, black; areolae angular, 0.5–0.7 mm diam. **Apothecia** dispersed, up to 2 mm diam., adpressed, at first flat with very thin true margin, later convex with excluded margin. Disc black (also when wet), non-pruinose. Hymenium 130–140 µm; epithecium blue-green or brown-green. Inner part of true exciple and central part of hypothecium violet. Ascospores 8 per ascus, 5–7 × 3.5–4 µm. Paraphyses strongly adglutinated; end cell only slightly enlarged. Medulla K/I –.

**Chemistry.** Lobaric acid (major), miriquidic acid (minor), colensoic acid (trace), oxolobaric acid (trace) and norlobaric acid (trace). (J.A.Elix det.)

**Ecology.** On hard rock.

**Distribution.** Only known from Colesbukta and Nordaustlandet.

**Notes.** *M. picea* differs from *M. deusta* by containing miriquidic and lobaric acids and by its somewhat larger ascospores (Andreev in litt. 2002). World distribution: Svalbard, Novaya Zemlya, Wrangell Island, arctic North America.

**Specimens seen:** Colesbukta, 1.10.1999, S. Spjelkavik (BG; det. M. Andreev 2002); Nordaustlandet, Murchinsonfjorden, Kapp Sparre [=Sparreneset], 18.7.1931, P.F. Scholander (O; det. Lynge).

**MYCOBILIMBIA** Rehm (1890)

**Thallus** crustose to subsquamulose, whitish to brown. Photobiont trebouxiod. **Ascomata** apothecia, black, sessile, often aggregated, with true exciple only. Ascii of *Bacidia*-type. True exciple variable, pseudoparenchymateous or composed of radiating hyphae. Hamathecium of paraphyses, simple to anastomosing. Ascospores 8 per ascus, colourless, simple to 6-septate. Conidia filiform.

**Notes.** See also *Bilimbia*.

Key to *Mycobilimbia* on Svalbard:

1	Ascospores simple .....	2
1	Ascospores septate .....	4
2 (1)	Thallus brown .....	<i>M. lurida</i>
2	Thallus white to grey .....	3
3 (2)	Thallus white, thick; paraphysse end cell 4 µm wide .....	<i>M. berengeriana</i>
3	Thallus thin, grey; paraphysse end cell 3 µm wide .....	<i>M. hypnorum</i>
4 (1)	Thallus sorediate .....	<i>M. aff. epixanthoides</i>
4	Thallus esorediate .....	5
5 (4)	Thallus thick, brown, subsquamulose .....	<i>M. tetramera</i>
5	Thallus thin, grey, crustose .....	<i>M. carneoalbida</i>

***Mycobilimbia berengeriana*** (A. Massal.) Hafellner & V. Wirth (1987)

**Thallus** crustose, effuse, white, medium thick, tartareous (folded). **Apothecia** sessile, dark brown, flattened convex, emarginate when old, to 1 mm wide. Hymenium 60–80 µm high; epithecium yellow-brown. Hypothecium brownish. Ascospores 11–13 × 4–4.5 µm, simple. Paraphysse end cell 4 µm broad. Pycnidia not seen.

**Chemistry.** Negative.

**Ecology.** Over moribund mosses.

**Distribution.** A few scattered localities.

**Notes.** Differs from the related *M. hypnorum* in its thicker, white thallus, broader paraphysse end cells, narrower ascospores and lack of blue “crystals” in the hymenium (Svalbard material). World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Tessinbreen, O.A. Høeg 1928 (TRH); Akseløya, 21.8.1926, B. Lynge (O).

***Mycobilimbia carneoalbida*** (Müll. Arg.) Printzen (2004)

**Thallus** crustose, very thin, granular to evanescent, pink-grey. **Apothecia** pale pink to ivory-coloured, flattened convex, emarginate, up to 1.2 mm diam. Hymenium 50–60 µm high; epithecium colourless. Hypothecium colourless. Ascospores 8 per ascus, (1–) 3-septate, 11–13 × 3–3.5 µm. Paraphyses anastomosing.

**Chemistry.** Not performed.

**Ecology.** Over bryophytes on calcareous ground.

**Distribution.** Rare.

**Notes.** Reported by Eurola (1968), but this material has not been available. Recognized by its pink-ivory, convex apothecia with no pigmentation in inner parts and small ascospores. World distribution: Europe, North America.

**Specimen seen:** Wijdefjorden, 2002, T. Tønsberg 31099 (BG; det C. Printzen 2003).

***Mycobilimbia* cf. *epixanthoides*** (Nyl.) Printzen (2004)

**Thallus** crustose, thick, pale ochre, up to 5 mm wide, dissolved into soredia. Soredia 20–30 µm diam. **Apothecia** sessile, emarginated, up to 0.8 mm diam., slightly convex, outline somewhat irregular; disc pale brown. Hymenium 45–50 µm high. Hypothecium without algae, colourless, very thick. Paraphyses simple; tips not or only slightly thickened, to 3.5 µm wide. Ascospores 8 per ascus, colourless, 3-septate, 15–22 × 2–3 µm.

**Chemistry.** Possible trace of pigment (Rf-class 7 in solvent A; from a contaminant?).

**Ecology.** On old bone.

**Distribution.** Only found on Barentsøya.

**Notes.** The ascospores were slightly broader than indicated by Coppins (1992) from the British Isles; we have therefore not conclusively assigned the specimen to *M. epixanthoides*. New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Barentsøya, between Steinbeisen and Kapp Voejkov, 1.8.1936, E. Dahl (O).

***Mycobilimbia hypnorum*** (Lib.) Kalb & Hafellner (1989)

**Thallus** crustose, effuse, granular, grey (to grey-brown). **Apothecia** sessile, black, up to 1.5 mm diam., flat, with thin, elevated, true margin. Hymenium 60–70 µm high, with blue “crystals”. Hypothecium red-brown. Paraphyses thick, adglutinated, ramified; end cell not enlarged. Ascospores 8 per ascus, simple to rarely 1-septate, 9–11 × 5–7 µm.

**Chemistry.** Negative.

**Ecology.** Over moribund mosses.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by the blue “crystals” in the hymenium and its mostly simple ascospores. World distribution: Europe, Asia, North America (including Greenland), Australia, Antarctica.

**Specimen seen** (selected): Moskusdalen, 1987, D.O. Øvstedral (BG).

***Mycobilimbia lurida*** (Ach.) Hafellner & Türk (2001)

**Thallus** 3–4 cm wide, composed or pale brown, overlapping squamules. Lower surface dark. **Apothecia** up to 1 mm wide, brown, flat when young, becoming convex; true margin darker than disc. Hymenium 50–70 µm high, epithecium brown. Hypothecium colourless. Ascospores 8 per ascus, simple, 9–11 × 6–8 µm. Conidia 4–6 × 2 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North Africa, Asia, North America.

**Specimens seen** (selected): Nordaustlandet, Rijpfjorden, 17.8.1936, E. Dahl (O); Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

***Mycobilimbia tetramera*** (De Not.) Vitik. et al. (2000)

**Thallus** squamulose, fairly thick, brown to grey-brown. **Apothecia** black, at first flat with distinct margin, later becoming somewhat convex with excluded margin. Hymenium 60–70 µm high; uppermost part green-black. Hypothecium yellowish. Ascospores colourless, 3-septate, 16–22 × 3–4 µm.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered occurrences. World distribution: Europe, Siberia, North America (Greenland).

**Notes.** Recognized by its thick brown thallus and pale hypothecium.

**Specimens seen** (selected): Forsbladhamna, 30.7.1926, B. Lynge (O); Amsterdamsøya, 26.8.1936, E. Dahl (O).

**MYCOBLASTUS** Norman (1852)

**Thallus** crustose, granulose to continuous. Photobiont green algae. **Ascomata** apothecia, black, flat to convex, sessile, without thalline margin. True margin prominent, sometimes excluded when old. Hypothecium colourless, brown or red. Asci very thick-walled; apical dome K/I + blue, with a distinct ocular chamber; ascus apex coated by a thick, K/I + blue, outer layer. Ascospores 1–2 per ascus, simple, uncoloured, large, with very thick wall. Hamathecium of paraphyses, anastomosing. Conidia bacilliform.

***Mycoblastus alpinus*** (Fr.) Kernst. (1893)

**Thallus** crustose, effuse, with low, grey warts, sorediate. Soralia coarse, yellowish, up to 2 mm diam. but often coalescing to larger ones, flat to slightly convex. Soredia 40–46 µm diam., (44.0 ± 4.3 µm).

**Apothecia** not seen in Svalbard material.

**Chemistry.** Atranorin, usnic and isousnic acids.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (Greenland).

**Specimens seen:** Krossfjorden, Signehamna, A. Elvebakk 85:283 (TROM); Moskudalen, 1987, D.O. Øvstedral (BG).

**NEPHROMA** Ach. (1810)

**Thallus** foliose, rosette-forming, lobes rounded, often ascending. Photobiont green algae (*Coccomyxa*) or cyanobacteria (*Nostoc*); cephalodia with *Nostoc* internal in species with green algal photobiont. Lower surface corticate, naked to tomentose. **Ascomata** apothecia, sessile, with thalline margin, on lower side of lobe tips; disc brown. Asci of modified *Peltigera*-type. Ascospores 8 per ascus, 3-septate, pale brown. Hamathecium of paraphyses, little ramified. Conidia bacilliform.

Key to *Nephroma* on Svalbard:

1	Thallus yellow-green .....	<i>N. arcticum</i>
1	Thallus brown to brown-green.....	2
2 (1)	Thallus sorediate.....	<i>N. parile</i>
2	Thallus not sorediate.....	<i>N. expallidum</i>

***Nephroma arcticum* (L.) Torss. (1843)**

**Thallus** foliose, up to 15 cm wide, yellow-green; lobes rounded, 2–3 cm wide. Upper side glabrous, with small, pale, cephalodial warts. Lower side black and tomentose towards centre, pale brown and glabrous towards margin. Photobiont green. **Apothecia** 2–3 cm wide, dark brown.

**Chemistry.** Nephroarctin, phenarctin,  $\pm$  methylgyrophorat, usnic acid, hopane-6 $\alpha$ , 22-diol. (James & White 1987; Svalbard specimens not studied).

**Ecology.** On bryophytes on acidic substrate.

**Distribution.** Rare.

**Note.** World distribution: circumpolar, arctic to boreal.

**Specimens seen** (selected): Nordenskiöld Land, near Kapp Laila, A. Elvebakk 86:439 (TROM); Reindalen near Sørhytta, A. Elvebakk 86:505 (TROM).

***Nephroma expallidum* (Nyl.) Nyl. (1865)**

**Thallus** foliose, up to 10 cm diam.; lobes up to 2 cm wide; margin often wavy. Upper side brownish green, naked or somewhat tomentose. Lower side black and densely tomentose towards centre, paler and less tomentose towards margin. Cephalodia on lower side, small, round. Photobiont green. **Apothecia** not seen. Medulla white.

**Chemistry.** 15- $\alpha$ -aceroxyhopan-22-ol; hopane-6 $\alpha$ , 22-diol and hopane-15 $\alpha$ , 22-diol, in addition two unknown compounds (James & White 1987; Svalbard specimens not studied).

**Ecology.** On calcareous ground.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar.

**Specimen seen** (selected): Prins Karls Forland, Fuglehuken, A. Elvebakk 94:058 (TROM).

***Nephroma parile* (Ach.) Ach. (1810)**

**Thallus** foliose, 3–4 cm broad. Lobes to 7 mm broad, brown, wrinkled, naked, overlapping, sorediate. Soralia along margins and rarely laminal, very coarse. Lower side smooth, pale brown. Photobiont blue-green. **Apothecia** not seen.

**Chemistry.** Three chemotypes reported by James & White (1987; Svalbard specimen not studied).

**Ecology.** Over bryophytes and on soil.

**Distribution.** Only known from Sørkapp.

**Notes.** Of the 3 chemotypes reported by James & White (1987) one, chemotype 3, appears to be mainly Arctic as it is the only one in Greenland and occurs very rare in mainland Europe. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Sørkapp, Sergeevfjellet, 22.7.1985, M. Olech (KRA-L).

**OCHROLECHIA** A. Massal. (1852)

**Thallus** crustose, granulose to warted, whitish, some species with cartilaginous spine-like outgrowths. Photobiont green algae. **Ascomata** apothecia, with prominent thalline exciple. True exciple weakly developed. Ascii of *Pertusaria*-type. Ascospores 2–8 per ascus, simple, colourless; wall uniform, thick. Hamathecium of paraphyses, thin, flexuose, branched to anastomosing. Conidia cylindrical.

Key to *Ochrolechia* on Svalbard:

1	On rock.....	<i>Ochrolechia</i> sp.
1	On organic material.....	2
2 (1)	With apothecia; without isidia or soredia .....	3
2	Without apothecia; with isidia or soredia .....	5
3 (2)	With spine-like extensions .....	<i>O. frigida</i>
3	Without spine-like extensions .....	4
4 (3)	On <i>Racomitrium lanuginosum</i> , with gyrophoric acid .....	<i>O. grimmiae</i>
4	On other bryophytes, with variolaric acid.....	<i>O. uppsaliensis</i>
5 (2)	Isidiate.....	<i>O. inaequatula</i>
5	Not isidiate, with soralia .....	6
6 (5)	Thallus with spine-like extensions.....	<i>O. frigida</i>
6	Thallus without spines .....	<i>O. androgyna</i>

***Ochrolechia androgyna* (Hoffm.) Arnold (1885) s. lat.**

**Thallus** thick, granular-verrucose, dark grey to whitish. Soralia up to 3 mm wide, convex, yellow-green. Soredia 45–55 µm diam., in large consoredia. No spine-like extensions. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric and lecanoric acids in variable relative amounts, ± variolaric acid.

**Ecology.** Muscicolous and saxicolous.

**Distribution.** A few scattered localities.

**Notes.** *O. androgyna* s. lat., is a species complex which is in need of revision (see Tønsberg 1992). World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimens seen** (selected): Raudfjorden 1928, O.A. Høeg (TRH); Ytre Norskøya 6.7.1928, O.A. Høeg (TRH); Wijdefjorden, 2002, T. Tønsberg 31202 (BG); Colesdal, 2002, R. Haugan 6899 (O).

***Ochrolechia frigida* (Sw.) Lynge (1928)**

**Thallus** crustose, effuse, uneven-granulate, with spine-like extensions, whitish to yellow-white, sometimes with soralia. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric and lecanoric (trace) acids.

**Ecology.** Over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America, South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Ny-Ålesund, 4.7.1936, E. Dahl (O); Kong Karls Land, 12.8.1936, E. Dahl (O).

*Ochrolechia grimmiae* Lyngé (1921)

**Thallus** very thin, greyish; very rarely with soralia. **Apothecia** common, up to 2.5 mm diam., constricted below; margin thick, crenulate, whitish; disc flat to slightly convex, pale, brown-orange. Hymenium 110–120 µm high; epithecium yellowish. Ascospores 8 per ascus, 32–36 × 13–15 µm. Paraphysis end cells not enlarged.

**Chemistry.** Gyrophoric acid.

**Ecology.** Growing on *Racomitrium lanuginosum*.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Liefdefjorden, Hesteskoen, A. Elvebakk 81:658 (TROM); Colesbukta, 1986, T. Engelskjøn & S. Spjelkavik (TROM).

*Ochrolechia inaequatula* (Nyl.) Zahlbr. (1913)

**Thallus** coarsely granulate-areolate, isidiate; isidia coarsely sorediate at tips. **Apothecia** not seen in Svalbard material.

**Chemistry.** Unidentified compound (PD + pale orange).

**Ecology.** Over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen** (selected): Edgeøya, 1936, E. Dahl (O).

*Ochrolechia upsaliensis* (L.) Massal. (1852)

**Thallus** crustose, thin, warded, whitish to pale ochre. **Apothecia** numerous, almost covering the thallus, thin, up to 3 mm diam.; thalline margin concolorous with thallus; disc slightly convex, pale ochre, white-pruinose or not. Hymenium 170–180 µm high; epithecium yellowish. Ascospores 8 per ascus, 50–55 × 16–18 µm.

**Chemistry.** Variolaric, murolic and neodihydromurolic acids.

**Ecology.** On calcareous soil and over detritus.

**Distribution.** Only known from four sites.

**Notes.** The material cited by Summerhayes & Elton (1923) has not been available to us. World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimens seen:** Nordfjorden, top of Kongressfjellet, alt 600 m, 1973, A.A. Frisvoll (TRH); Sasselalen, 1988, D.O. Øvstedral (BG); Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31077 (BG); Liefdefjorden, 1868, Th.M. Fries (O).

*Ochrolechia* sp.

**Thallus** crustose, 1–2 cm wide, whitish, with irregular outline, granular-rimose, without prothallus. In inner part with vertical, irregular protuberances, up to 1.5 mm high, with tips often eroded and

with white medulla protruding. No **apothecia** seen.

**Chemistry.** Gyrophoric acid.

**Ecology.** On sandstone.

**Distribution.** Widespread.

**Notes.** The known *Ochrolechia* species on rock from northern Scandinavia are *O. tartarea*, *O. parella* and *O. rhodoleuca*. Whereas *O. parella* is always fertile, *O. tartarea* has a thallus which is distinctly different from the present taxon. This leaves *O. rhodoleuca*, which has multiostiolate apothecia and which contains gyrophoric, variolaric and alektoronic acids (Brodo 1988), but which has the same loose organization of the thallus, with vertical protuberances, as the present species (specimens in BG examined). We leave the identity open until apothecia are found on this species which is widespread on Svalbard.

**Specimens seen** (selected): Svalbard, Kong Karls Land, Retziusfjellet, 1936, E. Dahl (O); Velkomstpynten, 1936, E. Dahl (O).

## OPEGRAPHA Humb. (1793)

**Thallus** crustose. Photobiont *Trentepohlia*. **Ascomata** apothecia, usually lirellate, without thalline margin. True margin carbonized, continuing below hypothecium. Ascospores multiseptate, fusiform to acicular, colourless, 8 per ascus. Hamathecium paraphysoid, septate, branched to anastomosing. Conidia various.

Key to *Opegrapha* on Svalbard:

- |   |                                       |                     |
|---|---------------------------------------|---------------------|
| 1 | With gyrophoric or stictic acid ..... | <i>O. gyrocarpa</i> |
| 1 | With other compounds .....            | <i>O. sp.</i>       |

## *Opegrapha gyrocarpa* Flotow (1825)

**Thallus** thin, up to 5–10 mm diam., pale green-brown to dark chocolate brown, with thin, dark prothallus; sorediate. Soralia in inner part, somewhat convex, green-grey, up to 0.4 mm diam., often coalescing into larger ones. Soredia 18–22 µm diam. **Apothecia** or pycnidia not seen in Svalbard material.

**Chemistry.** Gyrophoric acid or stictic acid.

**Ecology.** On shaded and sheltered lower sides of rocks in screes.

**Distribution.** Probably not rare.

**Notes.** Stictic acid has not previously been reported from *O. gyrocarpa*. As this material is morphologically and ecologically similar to material with typical chemistry, i.e., gyrophoric acid, it is here tentatively regarded as a chemotype of *O. gyrocarpa*. The stictic acid chemotype is known from the Kapp Laila area only. *Opegrapha gyrocarpa* is new to Svalbard. World distribution: Europe, Asia, North America.

**Specimens seen** (selected): Bjørndalen, 2003, T. Tønsberg 31898 (BG); Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9846 (BG, UPS).

*Opegrapha* sp.

**Thallus** up to 10 mm wide, thick, grey-orange, areolate, bullate, sorediate, with a thin brown protallus. Areolae 0.4–0.6 mm broad; surface scabrous. Soralia on center of areolae, up to 0.6 mm wide, convex, checkered white and black, coarse. Soredia 16–22 µm wide. Photobiont *Trentepohlia*. **Apothecia** not seen.

**Chemistry.** Two undetermined compounds.

**Ecology.** On exposed side of rock (associated with heliophilous lichens).

**Distribution.** Only known from Dicksonfjorden.

**Notes.** Morphologically it is similar to *Opegrapha gyrocarpa*, but as it differs in both ecology and chemistry, it is probably distinct.

**Specimen seen:** Dicksonfjorden, N side of Lyckholmdalen, 8.7.1936, E. Dahl (O).

**OPHIOPARMA** Norman (1835)

**Thallus** crustose, effuse. Photobiont trebouxiod. **Ascomata** apothecia, with or without thalline margin. True margin usually prominent. Disc red. Ascii with a K/I + uniform blue apical dome. Ascospores 8 per ascus, spirally arranged, colourless, fusiform, transversely septate. Hamathecium paraphyses, little branched; end cell only slightly enlarged. Conidia rod-shaped.

*Ophioparma ventosum* (L.) Norman (1853)

**Thallus** covering several cm, thick, uneven, areolate, yellow-green to greyish. **Apothecia** up to 2.5 mm wide, immersed to somewhat protruding; disc blood-red, flat; thalline exciple prominent. Hymenium 60–70 µm high; uppermost part orange-red. Hypothecium orange-red. Ascospores 3–7-septate, 40–50 × 4.5–5 µm. Paraphyses simple to somewhat branched; end cell not enlarged.

**Chemistry.** I: Divaricatic (major), nordivaricatic and usnic (major) acids; II: Thamnolic (major), divaricatic (major), nordivaricatic and usnic (major) acids; III: Hypothamnolic (major), divaricatic (major), nordivaricatic, and usnic (major) acids; IV: Hypothamnolic (major), divaricatic (major), nordivaricatic, atranorin, and usnic (major) acids

**Ecology.** On siliceous rock.

**Distribution.** Common and widespread.

**Notes.** Chemically very variable (see Lefall 2001), probably there are also other combinations than those indicated above. World distribution: Europe, Asia, North America (including Greenland), Argentina (Calvelo & Liberatore 2002).

**Specimens seen** (selected): Krossfjorden, Signehamna, A. Elvebakk 85:283 (TROM); Kongsfjorden, Blomstrandhalvøya, A. Elvebakk 01:078 (TROM).

**ORPHNIOSPORA** Körber (1874)

**Thallus** crustose. Photobiont green algae. **Ascomata** apothecia, black, without thalline margin. True margin and hypothecium dark brown. Ascii with narrow, K/I + weakly blue apical dome, with a strongly K/I + blue cap. Ascospores 8 per ascus, colourless to dark brown, thick-walled, simple or indistinctly 1-septate. Hamathecium of paraphyses, simple to anastomosing. Conidia bacilliform.

*Orphniospora moriopsis* (Massal.) D. Hawksw. (1982)

**Thallus** of discrete, subsquamulose, brown-black clumps, 2–4 mm wide. **Apothecia** black, without thalline margin, to 1 mm wide. Hymenium 120–130 µm high; epithecium pale brown, K + purplish. Ascospores 8 per ascus, dark brown, simple (rarely 1-septate), 12–14 × 6–8 µm, broadly elliptic. Paraphyses thick, stout, strongly conglutinated; end cell enlarged to 4–5 µm diam.

**Chemistry.** Stictic acid complex.

**Ecology.** On rock.

**Distribution.** Widespread but not common.

**Note.** World distribution: Europe, Asia, North America (Greenland), Australia.

**Specimens seen** (selected): Grønhamna, 1.8.1868, Th.M. Fries (O; 2 specimens); Adventfjorden, 9.8.1868, Th.M. Fries (O).

**PANNARIA** Delise ex Bory (1828)

**Thallus** foliose to squamulose, often growing on a thick felt of rhizohyphae. Photobiont cyanobacteria. **Ascomata** apothecia, with thalline excipie. Ascii without amyloid apical structures. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, little ramified. **Thallus** with pannarin and/or related compounds.

*Pannaria hookeri* (Borrer ex Sm.) Nyl. (1857)

**Thallus** placodioïd, 4–5 cm wide, grey to grey-brown, usually with paler lobe margins and with striation on upper surface. Marginal squamules broadened to 3–4 mm. Photobiont *Nostoc*, in clusters.

**Apothecia** sessile, to 3.5 mm diam., with black disc and thalline, crenulate margin which is concolorous with thallus. Ascospores 8 per ascus, subglobose, 12–15 × 10–13 µm, colourless, smooth.

**Chemistry.** Pannarin (usually difficult to demonstrate).

**Ecology.** On rock, rarely on soil and bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, Africa, North America, southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk 81:1295 (TROM); Lågøya, 19.8.1936, E. Dahl (O).

**PARMELIA** Ach. (1803)

**Thallus** foliose, flattened, corticated on both sides, with rhizines on lower side. Lobes with linear or effigurate pseudocyphellae on upper side; epicortex non-pored. Rhizines simple, bifurcate or rarely squarrose. Photobiont trebouxioid. **Ascomata** apothecia, with thalline margin. Ascii of *Lecanora*-type. Ascospores 8 per ascus, simple, colourless, relatively small. Hamathecium of paraphyses, simple to branched. Conidia cylindrical or bifusiform.

Key to *Parmelia* on Svalbard:

1	Sorediate or isidiate.....	2
1	Without soralia or isidia.....	3
2 (1)	With soralia.....	<i>P. sulcata</i>
2	With isidia (or sorediate isidia).....	<i>P. saxatilis</i>
3 (1)	Lobes broad, with very few pseudocyphellae.....	<i>P. skultii</i>
3	Lobes narrow, with numerous pseudocyphellae .....	<i>P. omphalodes</i>

***Parmelia omphalodes* (L.) Ach. (1803)**

**Thallus** foliose, brown; lobes to 1 mm broad, with a dense network of linear pseudocyphellae. No isidia or soralia. Lower side black, with simple to squarrose rhizinae.

**Chemistry.** ±Atranorin, salazinic acid, norstictic acid.

**Ecology.** On rock and over bryophytes.

**Distribution.** Widespread but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimens seen** (selected): Prins Karls Forland, 7.1981, D.O. Øvstedal (BG); Hinlopen, Torellneset, [further label data not indicated] (BG-73351).

***Parmelia saxatilis* (L.) Ach. (1803)**

**Thallus** foliose, grey, lobes to 2 mm wide, with a network of linear pseudocyphellae, isidiate. Isidia simple to ramified, terete, marginal and laminal. Lower side black, with simple to squarrose rhizines.

**Chemistry.** Atranorin, salazinic acid.

**Ecology.** On rock and over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Reinholmen, Recherchefjorden, 16.7.1926, B. Lynge (BG); Liefdefjorden, Lernerøyane, 27.07.1981, A. Elvebakk 81:520 (TROM).

***Parmelia skultii* Hale (1987)**

**Thallus** foliose, brown; lobes to 5 mm broad, with very few linear pseudocyphellae. No isidia or soralia. Lower side black, with simple to squarrose rhizines.

**Chemistry.** Atranorin, norstictic acid, salazinic acid.

**Ecology.** On rock and over bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, North America.

**Specimen seen** (selected): Reindalen, the S slope of Mt. Langnosa, near Sørhytta, 4.8.1986, T. Tønsberg 9870 (BG).

### *Parmelia sulcata* T. Tayl. (1836)

**Thallus** foliose, grey; lobes to 3 mm wide, with a network of linear pseudocyphellae eventually turning into soralia. Lower side black, with short simple or squarrose rhizines.

**Chemistry.** Atranorin and salazinic acid.

**Ecology.** On rock and over bryophytes.

**Distribution.** Common.

**Note.** World distribution: cosmopolitan.

**Specimen seen** (selected): E of Wijdefjorden, Flatøyrdalen, 10 July 2002, T. Tønsberg 31257 (BG).

### **PARMELIOPSIS** (Nyl.) Nyl. (1866)

**Thallus** foliose, lobes radiating, cortex on both sides. Upper cortex with a pored epicortex. Lower side pale, with simple rhizines. Photobiont green algae. **Ascomata** apothecia, laminal, sessile, with thalline margin. Asci of *Lecanora*-type. Ascospores 8 per ascus, simple, uncoloured. Hamathecium paraphyses, little ramified. Conidia ampulliform.

Key to *Parmeliopsis* on Svalbard:

- |   |                               |                     |
|---|-------------------------------|---------------------|
| 1 | Thallus with usnic acid ..... | <i>P. ambigua</i>   |
| 1 | Thallus with atranorin .....  | <i>P. hyperopha</i> |

### *Parmeliopsis ambigua* (Wulfen) Nyl. (1886)

**Thallus** foliose, 1–2 cm wide, of radiating lobes; lobes irregularly divided, at end 0.4–0.6 mm wide, pale yellow, sorediate. Soralia in inner part, laminal, convex, often confluent to cover large parts of thallus. Soredia 26–33 µm diam. (mean  $29.5 \pm 2.24$  µm). Lower side dark brown to black with brown rhizines.

**Chemistry.** Usnic, divaricatic, and 4-0-dimethyldivaricatic acids.

**Ecology.** On rock, driftwood and partly over bryophytes.

**Distribution.** Rare.

**Notes.** Differs from mainland Norwegian populations in the larger soredia (19–24 µm in Norwegian ones). World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimens seen:** Bellsund, N of Millarodden below Ingeborgfjellet, Elvebakk 03:072 (TROM); Nordaustlandet, Brennevinsfjorden, 21.8.1936, E. Dahl (O).

***Parmeliopsis hyperopta* (Ach.) Arn. (1880)**

**Thallus** foliose, 1–3 cm wide, grey, as small rosettes with radiating lobes; lobes 1 mm wide, sorediate. Soralia laminal, whitish, diffuse. Soredia 42–50 µm wide (mean  $45.9 \pm 2.47$  µm). Lower surface brown, with a few simple, dark rhizines. **Apothecia** not seen in Svalbard specimens.

**Chemistry.** Atranorin, divaricatic acid ± accessories.

**Ecology.** On old wooden boards on the tundra.

**Distrubution.** Only known from the Bellsund area.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (including Greenland), Africa, southern South America, Australia.

**Specimen seen:** Bellsund, N of Millarodden below Ingeborgfjellet, A. Elvebakk 03:073 (TROM).

***PELTIGERA* Willd. (1787)**

**Thallus** foliose, forming wide rosettes; lobes flat, broad, green to bluish or brown. Upper side corticated. Lower side ecorticated; tomentum distinct in many species; veins distinct to indistinct. Cephalodia present in some species. Photobiont cyanobacteria (*Nostoc*), or green algae (*Coccomyxa*). **Ascomata** apothecia, flattened or saddle-shaped, on vertical or horizontal lobes. Ascii with two walls, the inner one with a K/I + blue plug at the tip; 8-spored. Ascospores colourless to pale brown, fusiform, transversely septate. Hamathecium of paraphyses, simple to branched. General notes on chemistry follow Vitikainen (1994).

Literature: Vitikainen (1994).

Key to *Peltigera* on Svalbard

1	Thallus green; cephalodia present .....	2
1	Thallus blue-grey to brown-green; cephalodia absent .....	4
2 (1)	Thallus < 2 cm; apothecia common .....	<i>P. venosa</i>
2	Thallus > 5 cm; apothecia very rare .....	3
3 (2)	Lower surface not or only vaguely veined .....	<i>P. aphthosa</i>
3	Lower surface distinctly veined .....	<i>P. leucophlebia</i>
4 (1)	Soralia or isidia present .....	5
4	Soralia or isidia not present .....	7
5 (4)	Soralia present .....	6
5	Isidia present .....	<i>P. lepidophora</i>
6 (5)	Soralia laminal; upper side tomentose .....	<i>P. didactyla</i>
6	Soralia marginal; upper side not tomentose .....	<i>P. collina</i>
7 (4)	Upper side tomentose .....	8
7	Upper side smooth or scabrid .....	12
8 (7)	Lower side distinctly veined .....	9
8	Lower side without veins .....	<i>P. malacea</i>

9 (8)	Rhizines in marginal parts slender, simple .....	<i>P. ponojensis</i>
9	Rhizines in marginal parts richly branched .....	10
10 (9)	Lobe-ends downturned; rhizines whitish .....	<i>P. canina</i>
10	Lobe-ends upturned; rhizines soon darkened .....	11
11 (10)	Upper side with thick, grey adpressed tomentum; veins narrow; interstices angular .....	<i>P. rufescens</i>
11	Upper surface towards margins with thin, erect tomentum and minutely scabrose; veins broad; interstices rounded .....	<i>P. kristinssonii</i>
12 (7)	Upper surface scabrous, matt .....	13
12	Upper surface smooth, glossy .....	15
13 (12)	Lower side without veins .....	<i>P. lyngei</i>
13	Lower side distinctly veined .....	14
14 (13)	Rhizines fasciculate, soon blackened .....	<i>P. scabrosa</i>
14	Rhizines simple, pale .....	<i>P. scabrosella</i>
15 (12)	Veins less than 1.5 mm broad, flattened .....	<i>P. polydactylon</i>
15	Veins more than 2 mm broad, elevated .....	16
16 (15)	Upper surface bluish; venation reticulate, blackish; phlebic acids absent .....	<i>P. neckeri</i>
16	Upper surface brownish; venation fan-shaped; phlebic acids present .....	<i>P. frippii</i>

***Peltigera aphthosa* (L.) Willd. (1787)**

**Thallus** up to 10 cm diam.; lobes obtuse, 1.5–3 cm broad, with upturned margins, green when wet, brownish green when dry. Upper side with tomentum near margins, glabrescent in central parts. Lower side pale towards margins, blackening in centre, with a few broad veins or veinless. Rhizines few, simple to fasciculate, dark. **Apothecia** 7–15 mm diam., with a continuous lower surface. Cephalodia on upper surface, strongly attached, up to 2 mm diam.

**Chemistry.** Tenuior, methyl gyrophorate, gyrophoric acid, phlebic acids A and B, zeorin, dolichorizin, hopane-15 $\alpha$ , 22-diol, unidentified substances.

**Ecology.** On soil and mosses.

**Distribution.** Widespread and common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimens seen** (selected): Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Trinityhamna, 24.8.1928, O.A. Høeg (TRH).

***Peltigera canina* (L.) Willd. (1787)**

**Thallus** up to 10 cm diam.; lobes 1–2 cm broad, grey, with inflexed margins. Upper side densely tomentose. Lower side whitish, with veins which are whitish near margin and brownish towards centre. Rhizines pale at margin, brown towards centre, long, penicillately branched. **Apothecia** saddle-formed, 4–10 mm broad. Photobiont *Nostoc*.

**Chemistry.** Negative.

**Ecology.** On soil and mosses.

**Distribution.** Widespread and common.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Nordfjorden, Kapp Wijk, 29.6.1973, A.A. Frisvoll (TRH); Indre Norskøya, 12.7.1928, O.A. Høeg (TRH).

***Peltigera collina* (Ach.) Schrad. (1803)**

**Thallus** 5–10 cm wide; lobes 0.5–1 cm wide. Upper side brown-grey, smooth to somewhat scabrous; margins upturned, undulated, sorediate; soralia linear. Lower side pale; veins flat, diffuse; rhizines simple to tufted. **Apothecia** 3.5–5 mm broad, mostly saddle-shaped.

**Chemistry.** Tenuinorin, methyl gyrophorate, gyrophoric acid, zeorin, peltidactylin, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, unknowns.

**Ecology.** Among mosses.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America.

**Specimens seen:** none seen; record based on Elvebakk & Hertel (1996) who cited deviating specimens from Van Keulenfjorden and Bohemanneset of this otherwise thermophilous species.

***Peltigera didactyla* (With.) J. Laundon (1984)**

**Thallus** 1–4 cm diam.; lobes 0.5–1 cm broad; margins flat to raised, sorediate. Upper side grey to brown, with maculiform to partly confluent soralia. Lower side with narrow whitish to brownish veins; rhizines dense, pale to brownish. **Apothecia** 3–4 mm broad, convex.

**Chemistry.** Negative, or with gyrophoric acid and methyl gyrophorate.

**Ecology.** Among bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: cosmopolitan.

**Specimens seen:** Nordfjorden, Kapp Wijk, 27.6.1973, A.A. Frisvoll (TRH); Ytre Norskøya, 11.7.1928, O.A. Høeg (TRH).

***Peltigera frippii* Holt.-Hartw. (1988)**

**Thallus** up to 10 cm wide; lobes up to 1 cm wide, irregular, often deeply incised; margins undulate, ascending to involute. Upper side grey-brown to brown, smooth, atomentose, maculate (visible when moist). Lower side whitish to pale brown towards margins, brown-black towards centre; veins colourless to brown-black, fan-shaped to parallel; rhizines brown, brush-shaped. Photobiont *Nostoc*.

**Chemistry.** Tenuinorin, methyl gyrophorate, zeorin, phlebic acids A and B, unknowns.

**Ecology.** Among bryophytes

**Distribution.** Rare.

**Note.** World distribution: circumarctic to circumboreal.

**Specimen seen:** none seen, records based on Vitikainen (1994) who cited specimens from Lady Franklinfjorden and Brennevinsfjorden.

*Peltigera kristinssonii* Vitik. (1985)

**Thallus** up to 10 cm wide; lobes 1–1.5 cm wide. Margins often inflexed. Upper side tomentose, grey-brown to brown. Lower side pale in marginal parts, with a distinct network of dark, tomentose, flat veins in the central part; interstices round, white. Rhizines fasciculate, dark, squarrosely branched. Photobiont *Nostoc*. **Apothecial** discs revolute, up to 10 mm wide.

**Chemistry.** Negative.

**Ecology.** Among mosses.

**Distribution.** Rare.

**Note.** World distribution: circumpolar to circumboreal.

**Specimen seen:** None seen, record based on Elvebakk & Hertel (1996), who cited specimens from Murchinsonfjorden, Linnédalen and Gluudneset.

*Peltigera lepidophora* (Vain.) Bitter (1904)

**Thallus** small, up to 5 cm diam.; lobes 5–10 mm broad; margins often raised. Upper side grey-brown, tomentose, with peltate to squamulose isidia. Lower side pale, with narrow, flat, brown veins. Rhizinae simple to confluent. **Apothecia** saddle-formed, up to 7 mm diam.

**Chemistry.** Negative.

**Ecology.** Among bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Hawaii, Chile, Australia.

**Specimens seen:** Nordfjorden, Kongsfjellet, 1.8.1973, A.A. Frisvoll (TRH); Raudfjorden, 21.7.1928, O.A. Høeg (TRH).

*Peltigera leucophlebia* (Nyl.) Gyeln.(1932)

**Thallus** up to 20 cm diam.; margin plane to ascending, flexuose. Upper side grey-green, tomentose towards margins, glabrous near centre. Cephalodia present. Lower side with reticulate, dark veins. Rhizinae simple, tufted or fasciculate. **Apothecia** saddle-formed, up to 7 mm wide; lower side with green, corticate patches.

**Chemistry.** Tenuinorin, methyl gyrophorate, gyrophoric acid, unknowns.

**Ecology.** Over bryophytes.

**Distribution.** Scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Ytre Norskøya, 6.7.1928, O.A. Høeg (TRH).

*Peltigera lyngei* Gyeln. (1932)

**Thallus** up to 7 cm broad, thick, rigid; lobes up to 1 cm broad; margin mostly plane. Upper side scabrous, green-grey to brownish. Lower side veinless, blackish in central part, with a few small white depressions. Rhizines fasciculate, short. Mature **apothecia** not seen.

**Chemistry.** Tenuinorin, methyl gyrophorate, gyrophoric acid, peltidactylin, dolichorizin, hopane-7 $\beta$ , 22-diaol, hopane-15  $\alpha$ , 22-diol.

**Ecology.** On bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Svalbard, Iceland, Siberia, Gough Island in the South Atlantic Ocean.

**Specimens seen:** Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Ytre Norskøya, 11.7.1928, O.A. Høeg (TRH).

### *Peltigera malacea* (Ach.) Funck. (1827)

**Thallus** up to 15 cm broad, thick; lobes up to 3 cm broad, and 10 cm long; margins inrolled, undulate. Upper side bluish, greenish or brownish grey, tomentose near margin, sometimes scabrous, often glabrescent towards centre. Lower side veinless or with a few diffuse veins, black towards centre, pale brown near margin. Rhizines bush-shaped, black, short. **Apothecia** on short stalks, convex, up to 8 mm broad.

**Chemistry.** Gyrophoric acid, methyl gyrophorate, tenuiorin, zeorin, dolichorhizin, unidentified triterpenes.

**Ecology.** On bryophytes.

**Distribution.** Scattered but not uncommon.

**Note.** World distribution: circumpolar, Argentina, New Zealand.

**Specimen seen:** Bockfjorden, 12.8.1974, A.A. Frisvoll (TRH).

### *Peltigera neckeri* Hepp ex Müll. Arg. (1862)

**Thallus** up to 5 cm wide; lobes up to 1 cm wide and 3 cm long, with upturned margins. Upper side brownish grey, pruinose near margin. Lower side with diffuse, reticulate veins, whitish towards margin, dark towards centre. Rhizines brown to black, fasciculate or diffuse, up to 6 mm long. **Apothecia** saddle-formed, on short stalks up to 8 mm long.

**Chemistry.** Tenuiorin, gyrophoric acid, methyl gyrophorate, zeorin, dolichorhizin, unknown triterpenes.

**Ecology.** On bryophytes

**Distribution.** A few scattered localities.

**Note.** World distribution: circumpolar, New Zealand, Antarctica.

**Specimen seen:** none seen, included based on Vitikainen (1994).

### *Peltigera polydactylon* (Neck.) Hoffm. (1790)

**Thallus** up to 10 cm diam.; lobes up to 15 mm broad and 2–3 cm long; margins crisped, often with phyllidia. Upper side smooth, grey to grey-brown. Lower side with flat, distinct, brown to blackish vein with rounded, white interstices. Rhizines fasciculate, brown, up to 5 mm long. **Apothecia** saddle-formed, dark brown; stalks up to 1 cm long.

**Chemistry.** Tenuiorin, gyrophoric acid, methyl gyrophorate, peltidactylin, dolichorhizin, zeorin, hopane-15 $\alpha$ , 22-diol, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, unidentified triterpenes.

**Ecology.** On bryophytes.

**Distribution.** A few scattered localities.

**Note.** World distribution: cosmopolitan.

**Specimen seen:** none seen, included on the basis of Elvebakk & Hertel (1996) who cited specimens from Lomfjorden, Kapp Thordsen, and Agardhdalen.

*Peltigera ponogensis* Gyeln. (1931)

**Thallus** up to 8 cm wide; lobes up to 1 cm broad and 4–5 cm long; margins upturned. Upper side tomentose, pale grey when dry. Lower side whitish, with very pale veins up to 0.8 mm broad. Rhizines 3–7 mm long, simple or somewhat branched.

**Chemistry.** Negative.

**Ecology.** Among mosses.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America.

**Specimen seen:** none seen; record based on Vitikainen (1994) who cited specimens from Kongsfjorden and Isfjorden.

*Peltigera rufescens* (Weiss.) Humb. (1793)

**Thallus** up to 10 cm diam.; lobes up to 5 mm broad and 4 cm long; margins turned upwards, sometimes fragile and easily shedding thallus fragments. Upper side tomentose, brownish. Lower side with some darkening and elevated veins. Rhizines early dark brown to blackish, in dense rows along veins, up to 5 mm long. **Apothecia** saddle-shaped, with dark discs.

**Chemistry.** Negative.

**Ecology.** Among bryophytes and between stones in scree.

**Distribution.** Common.

**Notes.** One specimen (T. Tønsberg 31853) had a verdigris upper surface in the field when wet as well as markedly crisp and fragile lobe margins which easily shed thallus fragments in the plant press. According to Jolanta Miadlikowska (pers. comm. 2004) this particular specimen (which was subjected to ITS sequencing) is morphologically well within the variation range of *P. rufescens*. World distribution: cosmopolitan.

**Specimens seen:** Amsterdamsøya, 26.8.1936, E. Dahl (O); between Longyearbyen and Bjørndalen, 2003, T. Tønsberg 31853 (BG; det. Miadlikowska 2004).

*Peltigera scabrosa* Th. Fr. (1868)

**Thallus** up to 10 cm diam.; lobes up to 20 mm broad and 5–10 cm long; margins upturned and plane. Upper side scabrous, non-tomentose, green when wet, grey when dry. Lower surface with distinct veins; veins up to 1.2 mm broad, brown to black, interstitials 1–2 mm. Rhizines mostly up to 3 mm long, fibrillose to fasciculate, brown to black. **Apothecia** up to 6 mm wide, convex, dark brown.

**Chemistry.** Tenuiorin, gyrophoric acid, methyl gyrophorate, peltidactylin, dolichorizin, zeorin, hopane-6 $\alpha$ , 7 $\beta$ -22-triol, unidentified triterpenes

**Ecology.** On bryophytes.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Chile.

**Specimens seen** (selected): Trinityhamna, 24.8.1928, O.A. Høeg (TRH); Sørøstkysten, south side of Kvalhovden, 30.7.1936, E. Dahl (O).

*Peltigera scabrosella* Holt.-Hartw. (1988)

**Thallus** up to 2 cm diam.; lobes imbricate, acute, short and narrow; margins ascending. Upper side scabrous, grey to greyish brown. Lower side pale; veins diffuse, ochraceous. Rhizines simple, slender, white to pale brown.

**Chemistry.** Gyrophoric acid, methyl gyrophorate, tenuiorin, dolichorrhizin, zeorin, two unidentified triterpenes unique to the species.

**Ecology.** Attached to mosses on moist, vertical rock walls, also in snow-beds in alpine areas.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (Greenland).

**Specimen seen:** Colesdalén, 2002, R. Haugan 6833 (O; det. Haugan).

*Peltigera venosa* (L.) Hoffm. (1789)

**Thallus** up to 2 cm diam.; lobes fan-shaped or single. Upper side smooth, green when wet, green-grey when dry. Lower side with dark brown, villose and fan-shaped veins, with small, grey, leaf-shaped cephalodia attached. **Apothecia** one to several per lobe, rounded and flat.

**Chemistry.** Tenuiorin, gyrophoric acid, methyl gyrophorate, peltidactylin, unidentified substances.

**Ecology.** On bare soil

**Distribution.** Common and widespread.

**Notes.** The morphotype with *Nostoc* as the main photobiont (see Tønsberg & Holtan-Hartwig 1983) has not been found on Svalbard. World distribution: circumpolar, temperate to arctic.

**Specimens seen** (selected): Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Prins Karls Forland, A. Elvebakk 94:45 (TROM).

**PERTUSARIA DC. (1805)**

**Thallus** crustose, white to yellow-grey. Photobiont trebouxioid. **Ascomata** apothecia, of two types, a) sessile, with expanded disc; b) peritheциum-like, with almost closed disc, immersed in areolae. Ascii with K/I – wall and K/I + blue outer coat. Ascospores 1–8 per ascus, relatively large, thick-walled. Hamathecium of paraphyses, branched and anastomosing. Conidia bacilliform or acicular.

Key to *Pertusaria* on Svalbard:

1	On twigs .....	<i>P. sommerfeltii</i>
1	On bryophytes, soil or rock .....	2
2 (1)	Thallus isidiate/verrucose or sorediate .....	3
2	Thallus not sorediate or isidiate/verrucose .....	7
3 (2)	Thallus isidiate/verrucose .....	4
3	Thallus sorediate .....	5
4 (3)	With fumarprotocetraric acid .....	<i>P. oculata</i>
4	With hypothamnolic acid .....	<i>Pertusaria</i> sp. D

5 (3)	On rock; with stictic acid .....	<i>Pertusaria</i> sp. A
5	On bryophytes or soil .....	6
6 (5)	Areolae globose, with alectorialic and barbatolic acids .....	<i>P. geminipara</i>
6	Areolae flat, with alectorialic acid only .....	<i>Pertusaria</i> sp. B.
7 (2)	Thallus with xanthones .....	<i>Pertusaria</i> sp. C
7	Thallus without xanthones .....	8
8 (7)	With gyrophoric acid and stictic acid complex .....	<i>P. bryontha</i>
8	With stictic acid complex only .....	9
9 (8)	With apothecia; asci 2-spored .....	<i>P. coriacea</i>
9	Without apothecia (Svalbard material); asci 4-spored .....	<i>P. glomerata</i>

***Pertusaria bryontha* (Ach.) Nyl. (1861)**

**Thallus** thick, continuous, white-grey, wrinkled-nodulose. Fertile warts abundant, with one expanded, rough apothecial disc; disc up to 1 mm diam., brown to blackish, finally convex; thalline margin warted-irregular. Hymenium 140–150 µm high; epithecium brown-black, K + violet. Ascospores 1 per ascus, 150–210 × 60–90 µm; wall double.

**Chemistry.** Stictic and gyrophoric acids.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Adventfjorden, 9.8.1868, Th.M. Fries (O); Prins Karls Forland, 15.8.1868, Th.M. Fries (O).

***Pertusaria coriacea* (Th. Fr.) Th. Fr. (1871)**

**Thallus** crustose, thick, knotted, yellow-white, 3–4 cm wide. Fertile verrucae in various shapes, often rounded to conglomerate, with many small ostioles. **Apothecia** immersed. Ascospores 2 per ascus, 160–230 × 35–70 µm.

**Chemistry.** Norstictic acid.

**Ecology.** Over bryophytes and soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Adventfjorden, Hotellneset, 25.7.1936, E. Dahl (O); Liefdefjorden, 2.9.1868, Th.M. Fries, (det. Lynge) (O).

***Pertusaria geminipara* (Th. Fr.) C. Knight (1883)**

**Thallus** composed of crowded, round granules up to 0.2 mm wide, greyish or yellowish white; apices finally coarsely sorediate. Soredia 26–30 µm wide. **Apothecia** not seen in Svalbard material.

**Chemistry.** Alectorialic and barbatolic acids.

**Ecology.** On soil.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Nordkapp, 7.9.1868, Th.M. Fries (O); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9872 (BG).

***Pertusaria glomerata* (Ach.) Schaer. (1826)**

**Thallus** crustose, 3–4 cm wide, thick, yellow-white, bullate to granulose, no prothallus seen. **Apothecia** or pycnidia not seen. Asci 4-spored (based on material from outside Svalbard).

**Chemistry.** Norstictic acid (major), connorstictic acid (minor), salazinic acid (minor), subnorstictic acid (trace) (J.A. Elix det. 2005).

**Ecology.** Over moribund bryophytes.

**Distribution.** Only found at Adventfjorden.

**Notes.** The material seen by us is sterile, but in thalline characters it is identical to fertile specimens. The species was reported from Svalbard by Summerhayes & Elton (1928) and Olech & Alstrup (1989), but we have not had access to their material. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Adventfjorden, Hiorthamn, 24.7.1936, E. Dahl (O).

***Pertusaria oculata* (Dickson) Th. Fr. (1871)**

**Thallus** thin, white-grey, with abundant isidia; isidia up to 3 mm long and 0.4 mm wide, often branched and darkened at tips. **Apothecia** not seen in Svalbard material.

**Chemistry.** Fumarprotocetraric acid.

**Ecology.** On soil and over bryophytes

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimens seen** (selected): Krossfjorden, A. Elvebakk 86:339A (TROM); Liefdefjorden, A. Elvebakk 81:564 (TROM).

***Pertusaria sommerfeltii* (Flörke) Fr. (1831)**

**Thallus** white-ochre, crustose, composed by low, rounded, fertile warts, up to 1.3 mm diam., with 1–7 black, concave discs. Hymenium not properly developed in Svalbard material; dark part in section K + violet.

**Chemistry.** Norstictic and stictic acids with accessory compounds.

**Ecology.** On dead twig of *Betula nana*.

**Distribution.** Only found once in Colesbukta.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Colesbukta, 2001, R. Haugan 6959 (O).

***Pertusaria* sp. A**

**Thallus** crustose, 10–40 mm wide, warted-papillose, white to off-white, with a white prothallus. Papillae up to 1 mm wide and 0.7 mm high; the largest ones sorediate. Soralia coarse, white. Soredia 20–22 µm wide with protruding hyphae at surface. **Apothecia** and pycnidia not seen.

**Chemistry.** Stictic acid,  $\pm$  norstictic acid with satellites.

**Ecology.** On sandstone.

**Distribution.** Not uncommon.

**Notes.** The specimens are sterile and we only tentatively assigned them to *Pertusaria*. The thallus resembles coarse forms of the chemically similar *P. pseudocorallina*, but more and especially fertile material is necessary to clarify the identity of the species. In the Fennoscandian flora (Santesson et al. 2004), the only saxicolous *Pertusaria* with stictic acid as dominant compound is *P. chiodectonoides*, which, however, is a very different species.

**Specimens seen** (selected): Dicksonfjorden, SW of Biederhoffjellet, 8.7.1936, E. Dahl (O); Dicksonfjorden, Lyckholmdalen, 9.7.1936, E. Dahl (O).

#### *Pertusaria* sp. B

**Thallus** crustose, 2–3 cm wide, yellow-grey to pale brown, areolate, sorediate. Areolae 0.2–0.6 mm wide, flat, with a fatty tinge. Soralia marginal on areolae, blue, grey, coarse. Soredia 20–22  $\mu\text{m}$  wide, conglutinated into larger consoredia (70–90  $\mu\text{m}$  wide). **Apothecia** or pycnidia not seen.

**Chemistry.** Alectorialic acid.

**Ecology.** On soil and over bryophytes.

**Distribution.** Only found once.

**Note.** As the material is sterile, the placement in *Pertusaria* is tentative.

**Specimen seen:** Nordaustlandet, Phippsøya, 19.8.1936, E. Dahl (O).

#### *Pertusaria* sp. C

**Thallus** crustose, thick, yellow-white, warted. **Apothecia** and pycnida not seen.

**Chemistry.** 6-O-methylarthothelin (major), 4,5-dichloro-6-O-methylnorlichexanthone (trace), stictic acid (major), cryptostictic acid (trace), perstictic acid (trace), and constictic acid (trace) (J.A. Elix det. 2005).

**Ecology.** On soil.

**Distribution.** Only found once.

**Note.** As the material is sterile, the placement in *Pertusaria* is tentative.

**Specimen seen:** Adventfjorden, 20.7.1936, E. Dahl (O).

#### *Pertusaria* sp. D

**Thallus** bimorphic, composed of a thin, grey, bullate-uneven crust, up to 10 cm wide and white, erect, club-like verrucae, up to 2.5 mm high and 0.5 mm wide, with small ramifications, crowded in center of crust. Prothallus not evident. **Apothecia** and pycnidia not seen.

**Chemistry:** Hypothamnolic acid, 2 undetermined fatty acids.

**Ecology:** Over moribund bryophytes.

**Distribution:** Only found once.

**Note:** Hypothamnolic acid was reported by Dibben (1980) from two species of *Pertusaria* restricted to North America, but the combination of this depside and fatty acids appears to be unique within the genus. *Pertusaria* sp. D may prove to represent an undescribed species. More material, preferably with apothecia, would be necessary before this can be settled.

**Specimen seen:** Austfjorden/Wijdefjorden, between Austfjordnes and Reinsbukkdalen, 2002, T. Tønsberg 31194 (BG).

**PHAEOPHYSCIA** Moberg (1977)

**Thallus** foliose, brown-grey. Lobes radiating, both sides with a pseudoparenchymateous cortex; lower side black, with rhizines. Photobiont trebouxioid. **Ascomata** apothecia, sessile, with thalline exciple. Ascii of *Lecanora*-type. Ascospores 8 per ascus, brown, 1-septate, with apical thickening and thin septum. Hamathecium of paraphyses, simple to branched. Conidia ellipsoid.

Key to *Phaeophyscia* on Svalbard:

1	Thallus sorediate or isidiate .....	2
1	Thallus not sorediate or isidiate .....	4
2 (1)	Lobes < 0.3 mm wide .....	<i>P. nigricans</i>
2	Lobes > 0.3 mm wide .....	3
3 (2)	With isidia only .....	<i>P. sciastra</i>
3	With isidia and lobules .....	<i>P. kairamoi</i>
4 (1)	Lobes ascending; lower side grey-white .....	<i>P. constipata</i>
4	Lobes decumbent; lower side blackish .....	<i>P. endococcinea</i>

***Phaeophyscia constipata*** (Norrl. & Nyl.) Moberg (1977)

**Thallus** foliose, in tufts up to 2–3 cm wide. Lobes green-brown to pale brown, up to 0.5 mm wide, without isidia or soralia, ascending. Lower side white to grey with simple, white to black rhizines. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** Over bryophytes on calcareous ground.

**Distribution.** Rare and in continental areas only.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Chile (Elvebakk & Moberg 2002).

**Specimens seen** (selected): Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31089, 31090 (both BG); Blomstrandhalvøya, 2.8.1975, A. Elvebakk (TRH).

***Phaeophyscia endococcinea*** (Körber) Moberg (1977)

**Thallus** foliose, 1–5 cm wide, forming rosettes with radiating lobes. Lobes grey to brown-grey, up to 1 mm wide, without isidia or soralia. Lower side blackish to pale, often with red spots, with black to pale rhizines. **Apothecia** up to 4 mm diam., constricted below. Hymenium 65–70 µm high. Ascospores 8 per ascus, brown, 1-septate, 20–23 × 8–10 µm. Paraphysse end cell enlarged to 4 µm.

**Chemistry.** Zeorin and skyrin.

**Ecology.** On damp rock faces.

**Distribution.** Scattered.

**Notes.** Some specimens, e.g., Elvebakk 81:596, 81:633, having a luxuriant growth and a pale lower side, seem to agree well with *P. decolor* (Kashiw.) Essl. However, we follow Moberg (1977) and regard these specimens as representing an extreme form of *P. endococcinea*. In this species there

seems to be all stages from a black to a pale lower surface. World distribution: Europe, Asia, North America (including Greenland), Chile, Antarctica.

**Specimens seen** (selected): Klovningen, 14.7.1928, O.A. Høeg (TRH); Liefdefjorden S, the central ridge of Keisar Wilhelmhøgdene, 28.7.1981, A. Elvebakk 81:633 (TROM).

***Phaeophyscia kairamoi* (Vain.) Moberg (1977)**

**Thallus** foliose, up to 1 cm diam. Lobes up to 1 mm broad, upper side brown, with upturned margin. Margins with isidia which develop into lobules. Lower side black, with simple rhizines. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On rock, ornithocoprophilic.

**Distribution.** Only known from Bünzow Land.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Bünzow Land, Gipsdalen, A. Elvebakk 85:490-91 (TROM); Gipsvika A. Elvebakk 85:791 (TROM).

***Phaeophyscia nigricans* (Flörke) Moberg (1977)**

**Thallus** foliose, up to 1 cm wide. Lobes dark brown, 0.05–0.2 mm wide; ends ascending; sorediate isidia along margin. Lower side grey, with simple, grey to black rhizines. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On calcareous rock.

**Distribution.** Only known from Repøyane.

**Note.** World distribution: Europe, Taimyr, North America (Greenland). This occurrence on northern Svalbard of such a thermophilous species is surprising.

**Specimen seen:** Repøyane, 1868, Th.M. Fries (UPS; det. R. Moberg) (see Elvebakk & Hertel 1996).

***Phaeophyscia sciastra* (Ach.) Moberg (1977)**

**Thallus** foliose, 1–2 cm wide. Lobes up to 0.8 mm broad, dark grey-brown, with isidia along margin. Lower side black, with simple rhizines. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Eholmen, 28.7.1926, B. Lynge (TRH); Kong Karls Land, Mohnhøgda, 14.8.1936, E. Dahl (O).

**PHAEORRHIZA** H. Mayrhofer & Poelt (1979)

**Thallus** foliose, as small rosettes on soil, corticated on both sides. Upper side smooth, white-pruinose. Lower side dark, with brown rhizines. Photobiont trebouxioid. **Ascomata** apothecia, with or without thalline margin. Ascii of *Lecanora*-type. Ascospores 8 per ascus, 1-septate, brown. Hamathecium of paraphyses, simple to branched. Conidia bacilliform.

***Phaeorrhiza nimbosa*** (Fr.) H. Mayrhofer & Poelt (1979)

**Thallus** minutely foliose, closely adpressed to substrate; individual thalli 3–4 mm wide, coalescing to form composite thalli of several cm diam., brown-grey, white-pruinose; marginal lobes fan-shaped, up to 1 mm broad. **Apothecia** sessile, lecanorine, up to 1 mm broad; thalline margin thick, concolorous with thallus; disc brown, concave, blue-pruinose. Hymenium 140–150 µm high; uppermost part brown. Hypothecium colourless. Ascospores brown, 1-septate, 20–30 × 8–11 µm. Paraphyses thin, strongly adglutinated; uppermost cell only slightly enlarged.

**Chemistry.** Negative.

**Ecology.** On calcareous soil, e.g. with *Protoblastenia terrigena*, *Buellia* spp., and *Rinodina roscida*.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Chile, Antarctica.

**Specimens seen** (selected): Sassendalen, 1986, D.O. Øvstdal (BG); Bockfjorden, A. Elvebakk 81:1047 (TROM).

**PHYSCIA** (Schreb.) Michx. (1803)

**Thallus** foliose, with radiating lobes, grey to brown-grey. Lobes corticated on both sides, lower side pale, with rhizinae. Upper cortex pseudoparenchymateous, lower cortex prosoplectenchymateous. Photobiont trebouxioid. **Ascomata** apothecia, sessile, with thalline excipite. Ascii of *Lecanora*-type. Ascospores 8 per ascus, brown, 1-septate, with apical thickening and thin septum. Hamathecium of paraphyses, simple to branched. Conidia bacilliform.

Key to *Physcia* on Svalbard:

1	Lobes with cilia on margin .....	<i>P. tenella</i>
1	Lobes without cilia on margin .....	2
2 (1)	Soralia laminal; with atranorin and zeorin .....	<i>P. caesia</i>
2	Soralia marginal; with atranorin .....	<i>P. dubia</i>

***Physcia caesia*** (Hoffm.) Fürnr. (1839)

**Thallus** foliose, to 3–4 cm wide. Lobes grey, maculated, with blue or whitish pruina, to 1 mm diam., sorediate. Soralia convex, laminal or terminal on small lobes. Lower side whitish to dark, with whit-

ish to dark rhizines.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On rock and over other lichens and bryophytes, ornithocoprophilic.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Kongsfjorden, A. Elvebakk 85:239 (TROM); Amsterdamøya, 26.8.1936, E. Dahl (O).

### *Physcia dubia* (Hoffm.) Lettau (1912)

**Thallus** foliose, to 2–3 cm wide, often coalescing to larger thalli. Lobes grey to brown-grey, rarely white-pruinose, without distinct maculae, sorediate, to 1 mm wide; soralia marginal, lip-shaped. Lower side whitish to brown, with whitish to brown rhizinae.

**Chemistry.** Atranorin.

**Ecology.** On rock and over other lichens and bryophytes

**Distribution.** Common.

**Note.** World distribution: cosmopolitan.

**Specimen seen** (selected): Isfjorden, Kapp Thordsen, 1936, E. Dahl (O).

### *Physcia tenella* (Scop) DC. (1805)

**Thallus** foliose, 1–2 cm wide, as small rosettes. Lobes radiating, to 1 mm wide, dichotomously divided, sorediate. Upper side grey to brownish-grey, lower side pale. Pycnidia laminal, black, conidia  $2-2.5 \times 0.5 \mu\text{m}$ , bacilliform. Marginal cilia present, black, up to 2 mm long. Soralia at ends of lobes, both lip- and helmet-shaped, soredia  $35.2 \pm 2.3 \mu\text{m}$ . **Apothecia** not seen.

**Chemistry.** Atranorin.

**Ecology.** On cliffs near the sea, ornithocoprophilous.

**Distribution.** Rare.

**Notes.** The small *Physcia* with marginal cilia growing on maritime rocks have traditionally been regarded as a form of *P. tenella*. However, the Arctic specimen seen has some helmet-shaped soralia in addition to the lip-shaped ones. Lynge (1928) who studied the taxon in the field, and named it *P. marina* (E. Nyl.) Lynge, wrote: “The more I have studied this plant in nature the more I have felt convinced of its specific rank”. More field studies are necessary. World distribution: Europe, North America, Argentina (Calvelo & Liberatore 2002).

**Specimen seen:** Klovningen, 9.7.1928, O.A. Høeg (TRH).

### **PHYSCONIA** Poelt (1965)

**Thallus** foliose, with radiating lobes, grey to grey-brown. Lobes with cortex on both sides, lower side whitish to black-brown, with rhizines. Upper cortex pseudoparenchymateous or scleroplectenchymateous; lower side prosoplectenchymateous. Photobiont trebouxiod. **Ascomata** apothecia, sessile, with thalline exciple. Ascii of *Lecanora*-type. Ascospores 8 per ascus, brown, 1-septate, without apical thickening but with thick septum. Hamathecium of paraphyses, simple to branched. Conidia bacilliform.

***Physconia muscigena*** (Ach.) Poelt (1965)

**Thallus** foliose, to 5 cm broad, lobes ± irregular, to 2 mm broad, with upturned margins, upper side brown with grey to violet tinge. Lower side pale at margin, dark towards the centre, with black rhizines. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Antarctica.

**Specimens seen** (selected): Wijdefjorden, E of Austfjorden, 2002, T. Tønsberg 31114 (BG); Barentsøya, 1.8.1936, E. Dahl (O).

***PILOPHORUS*** Th. Fr. (1857)

Primary thallus crustose, granular to areolate. Secondary thallus (not present in *P. dovreensis*) as pseudopodetia, with areolate to granular surface. Photobiont trebouxioid. Cephalodia red-brown, with *Nostoc*. **Ascomata** apothecia, terminal on pseudopodetia, black, without thalline margin. Asci of *Porpidia*-type. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, anastomosing. Hypothecium brown. Conidia sickle-shaped.

Key to *Pilophorus* on Svalbard:

1	Thallus crustose .....	<i>P. dovreensis</i>
1	Thallus fruticose .....	2
2 (1)	Pseudopodetia unbranched, sorediate .....	<i>P. cereolus</i>
2	Pseudopodetia branched, not sorediate .....	<i>P. robustus</i>

***Pilophorus cereolus*** (Ach.) Th. Fr. (1857)

Primary thallus persistent, composed of grey, flat areolae; cephalodia brown, semiglobose, up to 1 mm diam. Pseudopodetia 2 (–10) mm high, compact, thickest at middle, sorediate in uppermost part. Soredia 20–24 µm (mean  $22.9 \pm 1.46$  µm) diam., conglutinated into consoredia, 40–50 µm wide. Some pseudopodetia with apothecia. **Apothecia** terminal, emarginate, globose, black, up to 0.4 mm diam. Hymenium 40–50 µm high; epithecium bluish. Hypothecium brown. Ascospores 8 per ascus, elliptic,  $9–11 \times 5.5–6$  µm.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On rock and pebbles in moist situations, often with *Placopsis gelida*.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Chukotka, North America (Greenland).

**Specimens seen** (selected): Coloradoplattået, E of Sassendalen, 1985, A. Elvebakk (TROM); Adventdalen, 2003, T. Tønsberg 31927 (BG); Nordenskiöld Land, Kapp Laila, 1986, T. Tønsberg 9852 (BG).

***Pilophorus dovrensis*** (Nyl.) Timdal, Hertel & Rambold (1991)

**Thallus** areolate; areolae dispersed to crowded, convex, white, up to 0.4 mm. Cephalodia between areolae, red-brown, up to 0.5 mm diam. **Apothecia** common, semiglobose, emarginate, up to 1.3 mm diam. Hypothecium red-brown. Hymenium 55–60 µm high; epithecium brown-green. Ascospores 8 per ascus, narrowly elliptic, simple, colourless, 15–17 × 5–7 µm. Paraphyses stout, little ramified; end cell not enlarged.

**Chemistry.** Atranorin, zeorin.

**Ecology.** Over bryophytes.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Moskusdalen, 1988, D.O. Øvstedral (BG); Colesdalen, 2002, R. Haugan 6862 (O; Haugan det.).

***Pilophorus robustus*** Th. Fr. (1857)

Primary thallus evanescent. Pseudopodetia up to 3 cm high, ramified, compact or partly hollow, with conspicuous cephalodia at base. **Apothecia** numerous, crowded at the tips of pseudopodetia, up to 2.5 mm broad, globose, black. Hymenium 70–75 µm high. Ascospores 8 in ascii, 15–16 × 6–7 µm. Hypothecium red-brown.

**Chemistry.** Atranorin, zeorin.

**Ecology.** On rock

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Reindalen, near Sørhytta, A. Elvebakk 86:496 (TROM); Longyearbyen, Platåberget, 2003, T. Thórhallsdóttir 03:045 (TROM).

**PLACIDIOPSIS** Beltr. (1858)

**Thallus** squamulose to crustose. Upper cortex pseudoparenchymateous; lower side attached to substrate with black rhizinae. Photobiont trebouxioid. **Ascomata** perithecia, immersed in the squamules. Involucellum absent or present. Hamathecium of periphyses; paraphyses absent. Asci thin-walled, clavate. Ascospores 8 per ascus, colourless, 1-septate. Pycnidia unknown.

***Placiopsis pseudocinerea*** Breuss (1983)

**Thallus** squamulose; squamules up to 3 mm diam., pale brown, closely adpressed to substrate; margin not raised. Perithecia almost immersed in squamules, up to 0.4 mm wide. No involucellum. True exciple dark brown around ostiole, otherwise pale brown. Ascospores 15–18 × 8–10 µm.

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America.

**Specimen seen:** Gipsdalen, 1987, D.O. Øvstedral (BG).

**PLACIDIUM** A. Massal. (1855)

**Thallus** squamulose, attached to substrate by rhizohyphae. Upper cortex thick (30–130 µm high), distinctly delimited against algal layer, pseudoparenchymateous, composed of large (6–20 µm diam.), angular, strongly adglutinated cells. Lower cortex pseudoparenchymateous or lacking; rhizohyphae colourless or brown. Photobiont trebouxoid. **Ascomata** perithecia. Involucellum absent. Hamathecium of periphyses; paraphyses absent. Ascii cylindrical. Ascospores 8 in ascii, colourless, simple.

Key to *Placidium* on Svalbard:

- |   |  |                      |
|---|--|----------------------|
| 1 | Pycnidia marginal on areolae; ascospores 14–18 µm long ..... | <i>P. lachneum</i>   |
| 1 | Pycnidia immersed in areolae; ascospores 16–23 µm long ..... | <i>P. norvegicum</i> |

***Placidium lachneum* (Ach.) de Lesd. (1932)**

Syn. *Catapyrenium lachneum* (Ach.) R. Sant. (1980).

**Thallus** as crowded, up to 8 mm wide, brown areolae. Lower side with pseudoparenchymateous cortex; rhizohyphae colourless. Black pycnidia on margin of areolae. **Perithecia** immersed; exciple pale, dark around ostiole. Ascospores 14–18 × 6–8 µm.

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** none seen; included on the basis of Breuss & Hansen (1988).

***Placidium norvegicum* (Breuss) Breuss (1996)**

Syn. *Catapyrenium norvegicum* Breuss (1987).

**Thallus** squamulose, squamules brown, almost rosette-like. Rhizohyphae colourless. Pycnidia immersed in thallus. Perithecia immersed; exciple pale brown, dark brown around ostiole. Ascospores 16–23 × 8–11 µm.

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** A few scattered occurrences.

**Notes.** Rather similar to *C. lachneum*, but differs in the almost rosette-like thallus, the immersed pycnidia and the larger ascospores. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Gipsdalen, 18.7.1985, A. Elvebakk 85:446 (TROM).

**PLACOPSIS** (Nyl.) Lindsay (1867)

**Thallus** crustose to squamulose, in most cases, placodioïd. Photobiont green (*Protococcus*). Cephalodia present, containing cyanobacteria (*Nostoc*, *Stigonema* or *Scytonema*). **Ascomata** apothecia, sessile to immersed, thalline excipie usually prominent. True excipie colourless. Asci of *Trapelia*-type. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, branched to anastomosing. Conidia thread-like.

**Note.** Mainly a Southern Hemisphere genus.

Key to *Placopsis* on Svalbard.

1	Thallus with gyrophoric acid only .....	<i>P. gelida</i>
1	Thallus with gyrophoric and 5-O-methylhiascic acids .....	<i>P. lambii</i>

***Placopsis gelida*** (L.) Lindsay (1867)

**Thallus** placodioïd, pinkish white to pale yellowish-brown, up to 4 cm diam., with radiating marginal lobes, and cracked-rimose inner part, with cephalodia, sorediate. Cephalodia red-brown, up to 2 mm diam., placodioïd, usually in centre of thallus. Soralia ulcerose, white, up to 1 mm diam., in inner part of thallus. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On schists in moist places.

**Distribution.** Widespread, but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand.

**Specimens seen** (selected): Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9842 (BG); Coloradoplatået, E of Sassendalen, 1985, A. Elvebakk (TROM).

***Placopsis lambii*** Hertel & V. Wirth (1987)

**Thallus** placodioïd, pinkish white to pale yellowish brown, up to 3 cm diam., with radiating, overlapping marginal lobes; with cephalodia, sorediate. Cephalodia in inner part, brown, non-lobate. Soralia in concentric circles. **Apothecia** not seen.

**Chemistry:** Gyrophoric acid, 5-O-methylhiascic acid (possibly restricted to soralia), lecanoric acid (trace).

**Ecology:** On rock.

**Distribution:** Only found twice.

**Notes.** New to Svalbard. World distribution: Europe, Africa, North America (including Greenland), Chile, New Zealand.

**Specimens seen** (selected): Kong Karls Land, Retziusfjellet, 12.8.1936, E. Dahl (O); Bjørndalen, 2003, T. Tønsberg 31878 (BG)

**PLACYNTHIELLA** Elenkin (1909)

**Thallus** crustose, granular, effuse, dark brown. Photobiont trebouxioid. **Ascomata** apothecia, dark brown, sessile, without thalline exciple. Ascii of *Trapelia*-type. Ascospores 8 per ascus, simple to 1-septate, colourless. Hamathecium of paraphyses, simple to branched; end cell enlarged, dark brown.

Key to *Placynthiella* on Svalbard:

- |   |   |                     |
|---|---|---------------------|
| 1 | With coralloid isidia; gyrophoric acid present..... | <i>P. icmalea</i>   |
| 1 | Isidia absent; lichen products absent.....          | <i>P. uliginosa</i> |

***Placynthiella icmalea* (Ach.) Coppins & P. James (1984)**

**Thallus** crustose, effuse, 2–3 cm diam., dark brown, completely composed of isidia. Isidia 0.5–1 mm high, coralloid, composed of barrel-shaped elements 15 × 20–25 µm. **Apothecia** thin, flat, red-black, up to 0.5 mm diam. Hymenium 40–50 µm high; uppermost part brown-green. Hypothecium colourless. Ascospores colourless, simple, with numerous oil-droplets, narrowly ellipsoid, 13–14 × 4–5 µm. Paraphyses stout; end cell 4–5 µm diam., with brown cap.

**Chemistry.** Gyrophoric acid.

**Ecology.** Over bryophytes.

**Distribution.** Only known from Sørkapp.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia, Antarctica.

**Specimen seen:** Sørkapp, J. Nowak (KRAM-L-206).

***Placynthiella uliginosa* (Schrader) Coppins & P. James (1984)**

**Thallus** crustose, brown, 3–4 cm wide, granulose; granules globose, 80–90 µm diam. **Apothecia** or pycnidia not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On soil and moribund bryophytes.

**Distribution.** Only known from Adventdalen

**Notes.** The specimen is sterile, but similar in thalline characters to typical, fertile *P. uliginosa*. The report from Svalbard by Nowak (1965) is based on misidentified material of *P. icmalea* (KRAM-L-206). World distribution: Europe, Asia, North America (including Greenland), Chile, Australia, New Zealand.

**Specimen seen:** Nordenskiöld Land, Adventdalen, Todalen, 21.8.2002, R. Haugan 6777 (O).

**PLACYNTHIUM** (Ach.) S.F. Gray (1821)

**Thallus** crustose to placodioid; lobes often radiating, closely attached to substrate, black to greenish. Lower surface blue-green. Photobiont cyanobacteria (*Rivularia* or *Scytonema*). **Ascomata** apothecia,

without thalline exciple. Asci of *Peltigera*-type. Ascospores 8 per ascus, 2–5-septate, ellipsoid to fusiform, colourless. Hamathecium of paraphyses, simple or branched.

Key to *Placynthium* on Svalbard:

1	As small pulvinate cushions on soil .....	<i>P. pulvinatum</i>
1	As flat rosettes on stone .....	2
2 (1)	Margin of thallus without distinctly extended lobes .....	3
2	Margin of thallus with distinctly extended lobes .....	4
3 (2)	With prothallus; excipular cells rectangular .....	<i>P. nigrum</i>
3	Without prothallus; excipular cells isodiametric .....	<i>P. asperellum</i>
4 (2)	Marginal lobes 0.05–0.2 mm wide .....	<i>P. asperellum</i>
4	Marginal lobes 0.2–0.5 mm wide .....	5
5(4)	Marginal lobes 0.4–0.5 mm, cuneate, with prothallus .....	<i>P. rosulans</i>
5	Marginal lobes 0.2–0.4 mm, not cuneate, without prothallus .....	<i>P. subradiatum</i>

### *Placynthium asperellum* (Ach.) Trevisan (1869)

**Thallus** 1–2 cm wide, growing as small rosettes, olive-black, with no prothallus. Lobes 0.05–0.2 mm wide, up to 2 mm long, usually radiating at margin, in centre of thallus becoming crowded-isidiate and forming thick areolae. **Apothecia** up to 1 mm wide, flat, immersed to half-sessile, olive-black. Ascospores 8 per ascus, 3-septate, constricted at septa, 15–19 × 5–7 µm.

**Chemistry.** Not investigated.

**Ecology.** On wet sandstone, limestone and schists.

**Distribution.** Widespread, but not common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Notes.** Some specimens do not have radiating marginal lobes. Such specimens may be difficult to distinguish from *P. nigrum*, but the cells of the exciple are diagnostic, being more or less isodiametric in *P. asperellum* and distinctly rectangular in *P. nigrum*.

**Specimens seen** (selected): Elvebakk 86:314; 81:1137 (TROM); Holmiabukta, 4.7.1928, O.A. Høeg (TRH).

### *Placynthium nigrum* (Huds.) Grey (1821) s. lat.

**Thallus** 2–3 cm wide, brown-black to black, composed of crowded, flat, granular squamules, sometimes with granular isidia, with conspicuous blue-black prothallus. **Apothecia** sessile to half-sessile, to 1 mm wide, flat, brown-black, with distinct margin. Ascospores 8 per ascus, 1–3-septate, broadest on the middle, 9–18 × 3.5–5.5 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous rocks.

**Distribution.** Common.

**Notes.** According to P.M. Jørgensen (pers. comm. 2005), the Svalbard specimens are not typical and are in need of more studies. World distribution: Europe, Asia, North America (including Greenland), Chile, Australia, New Zealand.

**Specimens seen** (selected): Kongsfjorden, Glundneset, 16.7.1974, A.A. Frisvoll (TRH); Kjellstrømdalen, Aug. 1986, D.O. Øvstedal (BG).

***Placynthium pulvinatum* Øvstedal sp. nov.**

P. nigrum similis, sed epigaeus et ascosporae 4–5-septatae.  
Holotype: Svalbard, Gipsdalen, 26.8.1987, D.O. Øvstedal (BG).

Fig. 25 (p. 230).

**Thallus** as up to 25 mm broad, round, flattened convex cushions, composed by small, pale brown, interwoven areolae. No prothallus. **Apothecia** rare, sessile, flat, up to 1 mm broad, black, with thin proper margin. Hymenium 65–70 µm high; uppermost part pale yellow-green. Ascospores 20–24 × 4–5 µm, 4–5-septate; sides parallel; ends rounded. Paraphyses straight, 1 µm wide, ramified in upper part; end cell not enlarged. Cells in excipulum proprium ± isodiametric, thick-walled; lumina 5–7 µm wide, becoming somewhat elongate towards margin. Hypothecium dark red-brown.

**Chemistry.** Negative.

**Ecology.** On silt and fine to coarse sand.

**Distribution.** Only known from the five collections cited here.

**Notes.** *P. pulvinatum* is distinct from *P. nigrum* above all in ascospore characters. In the latter species the ascospores are tapering towards the ends, up to 16 µm long, and 3-septate. *P. pulvinatum* is a soil-binder and probably restricted to base-rich sands and silts. World distribution: Europe (Svalbard, Iceland, mainland Norway).

**Other specimens seen:** Gipsdalen, 1987, D.O. Øvstedal (BG); Sassendalen, 1986, D.O. Øvstedal (BG). Adventdalen, Endalen, 2002, R. Haugan 6834 (O). **Norway.** Troms, E. Dahl (O).

***Placynthium rosulans* (Th. Fr.) Zahlbr. (1925)**

**Thallus** 2–3 cm wide, as brown-black rosettes, lobes terete, to margin of prothallus, cuneate, to 0.5 mm broad; central lobes crowded, with coraloid isidia. **Apothecia** up to 1 mm broad, concolorous with thallus. Ascospores 8 per ascus, 1–3-septate, 14–18 × 5–5 µm.

**Chemistry.** Not investigated.

**Ecology.** On wet, calcareous rock.

**Distribution.** Only known from Raudfjorden.

**Note.** World distribution: Europe, North America.

**Specimen seen:** Raudfjorden, Konglomeratodden, 22.7.1928, O.A. Høeg (O; det. P.M. Jørgensen 2005).

***Placynthium subradiatum* (Nyl.) Arnold (1884)**

**Thallus** black, 5–10 mm broad, as small rosettes, dying in center. Lobes radiating, flattened, 0.2–0.4 mm wide, not divided at end. No prothallus. **Apothecia** not seen.

**Chemistry:** Negative.

**Ecology.** On dry limestone.

**Distribution.** Rare.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Gipsdalen, 1987, D.O. Øvstedal (BG; det. P.M. Jørgensen 2005).

**PLEOPSIDIUM** Körber (1855)

**Thallus** crustose to squamulose, yellow. Upper cortex prosenchymatous. Lower cortex lacking. Photobiont trebouxioid. **Ascomata** apothecia, half immersed to sessile; thalline margin indistinct to prominent. Hamathecium of paraphyses, thin, little ramified, conglutinated. Ascii with a distinct apical dome which is K/I ± on the flanks and with a K/I + blue gelatinous coat. Ascospores > 100 per ascus, globose to elliptic, simple, colourless. Conidia ellipsoid.

**Note.** Previously included in *Acarospora*.

**Pleopsidium chlorophanum** (Wahlenb.) Zopf (1855)

**Thallus** effigurate to areolate, often pulvinate, up to 2 cm diam., sulphur-yellow, at margin areolae short and broad. **Apothecia** usually covering most of the inner part of the thallus, up to 2.5 mm diam., somewhat darker than thallus, when old strongly convex, wrinkled; margin excluded. Hymenium 100–110 µm high, colourless except in upper part which is encrusted with yellow granules. Ascospores globose, 2 µm diam. Paraphyses flexuose, richly branched; end cell only little enlarged.

**Chemistry.** Rhizocarpic acid, ± fatty acids.

**Ecology.** On dry overhangs. However, in the dry steppe areas of Wijedefjorden, the species grows on exposed, horizontal rock surfaces.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Adventdalen, 28.7.1924, J. Lid (TRH); Magdalenefjorden, 24.8.1928, O.A. Høeg (TRH).

**POLYBLASTIA** Massal. (1852)

**Thallus** crustose, superficial to evanescent. Photobiont green algae. **Ascomata** perithecia, immersed in thallus or superficial. Involucellum present or absent. True exciple dark or pale. Ascii of *Verrucaria*-type, 1–8-spored. Ascospores muriform, colourless to brown. Hamathecium of periphyses; paraphyses absent. Conidia bacilliform. No lichen compounds found in the genus.

Note: See også *Atla* and *Sporodictyon*. For recent taxonomic studies in Verrucariaceae, see Savić & Tibell (2008, 2009) and literature cited there.

Key to *Polyblastia* and *Atla* on Svalbard:

1	Growing on soil or over bryophytes	2
1	Growing on rock	7
2 (1)	Ascospores colourless	3
2	Ascospores brown	6
3 (2)	Ascospores < 30 µm long	4
3	Ascospores > 30 µm long	5

4 (3)	Ascospores 14–16 µm long .....	<i>P. sendtneri</i>
4	Ascospores 26–28 µm long .....	<i>P. epigaea</i>
5 (3)	Perithecium without involucellum .....	<i>P. gelatinosa</i>
5	Perithecium with involucellum .....	<i>P. bryophila</i>
6 (2)	Asci 8-spored .....	<i>P. gothica</i>
6	Asci 2-spored .....	<i>P. helvetica</i>
7 (1)	Ascospores colourless, yellowish or pale brown .....	8
7	Ascospores dark brown.....	17
8 (7)	Ascospores submuriform .....	9
8	Ascospores muriform .....	11
9 (8)	Ascospores > 24 µm long .....	<i>P. epomphalica</i>
9	Ascospores < 24 µm long .....	10
10 (9)	Ascospores cubic .....	<i>P. singularis</i>
10	Ascospores elongate, length/width ~2 .....	<i>P. intermedia</i>
11 (8)	Perithecia in pits in limestone .....	12
11	Perithecia not in pits .....	13
12 (11)	10–12 cells in ascospores (in optical view) .....	<i>P. albida</i>
12	6–8 cells in ascospores (in optical view) .....	<i>P. sepulta</i>
13 (11)	Perithecia almost immersed in thalline warts .....	14
13	Perithecia not immersed in thalline warts.....	15
14 (13)	Thallus areolate, grey to ochre .....	<i>P. cupularis</i>
14	Thallus continuous, white .....	<i>P. cf. fuscoargillacea</i>
15 (13)	Ascospores < 45 µm long .....	16
15	Ascospores > 45 µm long .....	<i>P. inumbrata</i>
16 (15)	Perithecia 0.3–0.5 mm diam.; ascospores 25–40 µm long, on calcareous rock .....	<i>P. hyperborea</i>
16	Perithecia 0.2–0.3 mm diam.; ascospores 22–26 µm long, on siliceous rock .....	<i>P. septentrionalis</i>
17 (7)	Ascospores < 40 µm long .....	<i>P. melaspora</i>
17	Ascospores > 50 µm long .....	18
18 (17)	Thallus thick, rimose-areolate, warted .....	<i>P. theleodes</i>
18	Thallus thin, almost smooth .....	<i>Atla alpina</i>

***Polyblastia albida* Arnold (1858)**

**Thallus** immersed in rock. **Perithecia** in pits, 0.2–0.4 mm diam., black, without involucellum; true exciple black; base often paler. Ascospores 8 per ascus, colourless, muriform, 25–40 × 12–20 µm. Mean cell number in ascospores (in optical view): 11.0 (10–12).

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Notes.** This species is recognized by its immersed thallus, small perithecia immersed in pits, lack of an involucellum, and colourless ascospores. *P. sepulta* is similar in having small perithecia without involucellum being immersed in pits in limestone. The latter species, however, has a thin brownish thallus, and ascospores with 6–8 cells (in optical view). World distribution: Europe, North America.

**Specimens seen** (selected): Gipsdalen, Aug. 1987, D.O. Øvstedral (BG); Kongsfjorden, 17.8.1868, Th.M. Fries (O).

#### *Polyblastia bryophila* Lönnroth (1858)

**Thallus** as a thick, grey to white-grey crust. **Perithecia** immersed in thallus, up to 0.3 mm diam. Involucellum only in uppermost part. True exciple thin, brown, entire. Ascospores 8 per ascus, uncoloured, muriform, 25–40 × 14–18 µm.

**Ecology.** Over moribund bryophytes

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** none seen, record based on Fries (1867), who reported it from Fosterøyane, Lovénberget, Lomfjorden and Repøyane.

#### *Polyblastia cupularis* Massal. (1852)

**Thallus** as isolated to crowded areolae, grey to pale ochre, 0.7–0.8 mm thick. **Perithecia** 0.2–0.3 mm diam., 2/3 immersed in thallus; ostiole part depressed. Involucellum in upper part only. True exciple colourless. Ascospores 8 per ascus, colourless, 16–35 × 12–14 µm.

**Ecology.** On limestone and sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. Reported by Summerhayes & Elton (1923) from Bjørnøya. World distribution: Europe, Siberia, North America (including Greenland), Australia.

**Specimens seen** (selected): Adventfjorden, 5.8.1868, Th.M. Fries (O); Bünzow Land, Bjonahamna, A. Elvebakk 01:044 (TROM).

#### *Polyblastia epigaea* A. Massal. (1854)

**Thallus** crustose, dark brown to black, 1–4 mm wide, composed of a pseudoparenchymateous tissue. **Perithecia** half protruding, 0.2–0.3 mm diam.; involucellum in upper part; exciple pale brown to colourless. Ascospores 8 per ascus, colourless, muriform, 26–28 × 18–20 µm.

**Ecology.** On soil, apparently only observed associated with *Dacampia hookeri* (see Henssen 1995).

**Distribution.** Only known from Lovénberget.

**Notes.** Apparently an overlooked member of the poorly known soil crust mycobiota. World distribution: Europe, North America.

**Specimen seen:** Lovénberget, 1861, K. Chydenius (UPS; det. A.Henssen).

*Polyblastia epomphalia* (Nyl.) Zschacke (1934)

**Thallus** very thin, grey-ochre. **Perithecia** sessile, 0.3–0.4 mm diam., black. Involcrellum prominent, reaching to base of perithecium. True exciple brown. Ascospores 8 per ascus, colourless, with 4 transverse septa and 0–2 longitudinal ones,  $30–40 \times 15–18 \mu\text{m}$ .

**Ecology.** On old mortar and calcareous rock.

**Distribution.** Only known from Amsterdamøya and Kong Karls Land.

**Note.** World distribution: Europe.

**Specimens seen:** Amsterdamøya, H. Hertel 16630 (M); Kong Karls Land, Hårfagrehaugen, 1936, E. Dahl (O).

*Polyblastia cf. fuscoargillacea* Anzi (1864)

**Thallus** medium thick, dirty white; composite thallus 4–5 cm wide; individual thalli 4–6 mm wide, differentiated by shallow grey demarcation lines. **Perithecia** 2/3–3/4 sunk in thallus, 0.2–0.4 mm wide. Involucrum only in upper part, spreading. Exciple brown. Ascospores 8 in asci, yellowish, muriform,  $26–30 \times 12–14 \mu\text{m}$ , with 20–22 cells in optical view.

**Ecology.** On limestone.

**Distribution.** Only found once.

**Notes.** The specimen has somewhat larger ascospores than indicated for the present species in Zschacke (1934). Externally very similar to *Verrucaria glauicina*. New to Svalbard. World distribution: Europe, Asia, North America (Greenland).

**Specimen seen:** Prins Karls Forland, 1868, Th.M. Fries (O; det. O. Breuss 2005).

*Polyblastia gelatinosa* (Ach.) Th. Fr. (1862)

**Thallus** crustose, effuse, black, with scabrid surface, ± gelatinous when wet, 2–3 cm diam. **Perithecia** 1/3 to 2/3 embedded in thallus, black, up to 0.4 mm diam. Inner diameter of perithecia 350–360  $\mu\text{m}$ . Ascospores 8 per ascus, faintly brown, muriform,  $52–56 \times 23–29 \mu\text{m}$ . Involucrum absent, true exciple thin, black.

**Ecology.** Over bryophytes and on soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (including Greenland), Antarctica.

**Specimen seen:** Smeerenburg, 31.8.1868, Th.M. Fries (O).

*Polyblastia gothica* Th. Fr. (1865)

**Thallus** thick, black, granular, effuse. **Perithecia** 1/3 to 2/3 immersed in thallus. Involucrum lacking. True exciple brown. Ascospores 8 per ascus, brown, muriform,  $20–30 \times 10–15 \mu\text{m}$ .

**Ecology.** On soil.

**Distribution.** Rare.

**Notes.** Probably one of the more important members of the soil crust biota, but much overlooked.

World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimen seen** (selected): Rijpfjorden, 17.8.1936, E. Dahl (O).

***Polyblastia helvetica*** Th. Fr. (1865)

**Thallus** thick, grey, somewhat gelatinous. **Perithecia** 0.3–0.5 mm wide, half immersed in thallus. Involucellum lacking, true exciple brown. Ascospores 2 per ascus, brown, muriform, 65–70 × 32–35 µm.

**Ecology.** On soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (Greenland).

**Specimen seen:** Lomfjorden, Th.M. Fries, 9.9.1868 (O).

***Polyblastia hyperborea*** Th. Fr. (1861)

**Thallus** thick to thin, grey-ochre. **Perithecia** 0.2–0.4 mm diam., sessile to 1/3 immersed in thallus. Involucellum prominent, reaching to base of perithecia and spreading. True exciple entire, brown. Ascospores 8 per ascus, muriform, colourless, 25–40 × 14–21 µm.

**Ecology.** On base-rich rock, including sandstone.

**Distribution.** A few scattered localities.

**Notes.** See note under *P. septentrionalis*. World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Blixodden (= Cape Blix), 10.8.1926, B. Lynge (O); Dicksonfjorden, SW side of Biederdorffjellet, 8.7.1936, E. Dahl (O).

***Polyblastia intermedia*** Th. Fr. (1877)

**Thallus** thin, whitish to grey. **Perithecia** 0.2–0.3 mm wide, ½ protruding, black. Involucellum prominent, to base of perithecium. Exciple brown, entire but somewhat paler in lowest part. Ascospores 8 per ascus, 15–21 × 7–10 µm, submuriform (6–8 cells in optical view), uncoloured.

**Ecology.** On base-rich rock, including sandstone.

**Distribution.** A few scattered localities.

**Notes.** Fries (1877) found 8–12 cells in the ascospores of Scandinavian specimens. See also note under *P. septentrionalis*. World distribution: Europe, Asia, North America (Greenland).

**Specimens seen** (selected): Edgeøya, 6.8.1936, E. Dahl (O); Adventdalen 21.8.2002, R. Haugan 6869 (O).

***Polyblastia inumbrata*** (Nyl.) Arnold (1870)

**Thallus** dark brown, 1–2 cm wide, medium thick, slightly bullate. **Perithecia** dark brown, up to 0.5 mm diam., outermost with a thin thalline layer, with a thick, black involucellum. True exciple brown, entire. Ascospores 8 per ascus, muriform, 40–55 × 19–25 µm, yellowish.

**Ecology.** On shaded and sheltered faces of sandstone in boulder field.

**Distribution.** Rare; only found twice.

**Notes.** New to Svalbard. World distribution: Europe.

**Specimens seen:** Kongsfjorden, 17.8.1868, Th.M. Fries (O); Adventdalen, 2003, T. Tønsberg 31928 (BG).

***Polyblastia melaspora*** (Taylor) Zahlbr. (1921)

**Thallus** warty, grey to grey-brown, distinct to evanescent. **Perithecia** 0.4–0.6 mm diam.,  $\frac{1}{2}$  immersed. Involucellum well-developed, reaching to base of perithecium. Exciple pale brown. Ascospores 8 per ascus, muriform,  $20–28 \times 12–20 \mu\text{m}$ , soon becoming brown.

**Ecology.** On basic rock, including schists.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Siberia, North America (Greenland), New Zealand.

**Specimens seen** (selected): Isfjorden, Kapp Linné, 8.7.1933, A. Hagen (O); Kongsfjorden, 17.8.1868, Th.M. Fries (O).

***Polyblastia sendtneri*** Krempelh. (1855)

**Thallus** crustose, areolate; areolae dirty-white, 0.3–1 mm wide, often coalescing to an uneven coherent crust. **Perithecia** in margins of areolae, half-sessile, black, up to 0.2 mm diam. Involucellum in upper half of perithecium. Exciple brown. Ascospores 8 per ascus, colourless, muriform,  $14–16 \times 9–10 \mu\text{m}$ .

**Ecology.** On seasonally moist silty and calcareous soil.

**Distribution.** A few scattered occurrences, but probably common.

**Notes.** An important soil-binder. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Wijdefjorden, A. Elvebakk 0.1: 154 (TROM); Lomfjorden, 10.9.1868, Th.M. Fries (O).

***Polyblastia septentrionalis*** Lyngé (1928)

**Thallus** thick to thin, grey-brown, often evanescent. **Perithecia** 0.2–0.3 mm wide,  $\frac{1}{4}$  immersed. Involucellum prominent, reaching to base of perithecia. True exciple brown. Ascospores 8 per ascus, colourless,  $22–26 \times 13–17 \mu\text{m}$ , with 3–5 transverse and 1–2 longitudinal septa.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Notes.** *P. hyperborea*, *P. septentrionalis* and *P. intermedia* differ mainly in ascospore characters, and substrate preferences. *P. hyperborea* grows on calcareous rock and has muriform ascospores (14–24 cells in optical view),  $25–40 \times 14–21 \mu\text{m}$ . *P. septentrionalis* grows on siliceous rock, has muriform ascospores (10–11 cells in optical view)  $22–26 \times 13–17 \mu\text{m}$ . *P. intermedia* grows on calcareous rock, and has submuriform ascospores (6–8 cells in optical view),  $15–21 \times 7–10 \mu\text{m}$ . However, in the material there are also specimens with fairly large ascospores ( $24–30 \mu\text{m}$  long), but with ascospores with 7–10 cells in optical view; such specimens, which appear to grow on intermediate (Ca-rich) sandstone, cannot at present be assigned conclusively to any of the species. Apparently the whole complex is in need of revision. World distribution: Europe, Siberia, North America (Greenland).

**Specimens seen** (selected): Brennevinsfjorden, leg K. Chydenius (UPS); N end of Prins Karls Forland, 15.8.1868, Th.M. Fries (O).

***Polyblastia sepulta*** A. Massal. (1856)

**Thallus** grey-brown, thin, often evident only as a stain on rock. **Perithecia** 0.3–0.4 mm diam., immersed in pits in rock. Involucellum lacking; true exciple brown. Ascospores 8 per ascus, submuri-

form,  $25-60 \times 10-20 \mu\text{m}$ , colourless, with 6–8 cells (in optical view).

**Ecology.** On limestone.

**Distribution.** Rare.

**Notes.** *P. albida* also has small perithecia without involucellum that are immersed in pits in limestone. However, it has no endolithic thallus and there are 10–12 cells in the ascospores (in optical view). World distribution: Europe.

**Specimen seen:** Kings Bay [Kongsfjorden], 17.8.1868, Th.M. Fries (O).

### *Polyblastia singularis* Arnold (1868)

**Thallus** thin, brown. **Perithecia** sessile, black, 0.1 mm diam. Involucellum prominent, spreading. True excipie yellowish. Ascospores 8 per ascus, uncoloured, cubic to subcubic in outline, with 1–2 transverse septa and 1 longitudinal one,  $18-21 \times 12-13 \mu\text{m}$ .

**Ecology.** On wet rock.

**Distribution.** Only known from Bellsund.

**Notes.** New to Svalbard. World distribution: Europe.

**Specimen seen:** Bellsund, 1926, B. Lynge (O).

### *Polyblastia theleodes* (Sommerf.) Th. Fr. (1867)

**Thallus** thick, rimose-areolate, warted, grey. Perithecia up to 1 mm diam.,  $\frac{1}{2}$  immersed, often with thalline warts attached. Involucellum prominent, reaching to base of perithecia; true excipie pale brown. Ascospores 8 per ascus,  $60-100 \times 30-60 \mu\text{m}$ , muriform, brown.

**Ecology.** On basic rock.

**Distribution.** Only found twice.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Grønfjorden, 1.8.1868, Th.M. Fries (O); Adventdalen, 2002, R. Haugan 6809 (O; Haugan det.).

## POLYCHIDIUM (Ach.) Gray (1821)

**Thallus** minutely fruticose, composed of dichotomously branched, terete threads, brown-green. Cortex 1–3 cell layers thick, surrounding a strand of medullary hyphae. Photobiont *Nostoc* or *Scytonema*. **Ascomata** apothecia, lateral; disc concave; thalline margin absent. Asci with broad, K/I +blue apex. Ascospores 8 per ascus, colourless, simple to 1-septate. Hamathecium of paraphyses, simple. Conidia bacilliform.

### *Polychidium muscicola* (Sw.) Gray (1821)

**Thallus** as brown-black, richly branched filaments,  $70-100 \mu\text{m}$  wide, forming loose cushions. Cortex 1–3 cells thick. Photobiont *Nostoc*. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** Among bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Bromelldalen, 9.8.1926, B. Lynge (O); Barentsøya, 1.8.1936, E. Dahl (O); Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9857 (BG).

### POLYSPORINA Vězda (1978)

**Thallus** crustose, inconspicuous. Photobiont chlorococcoid. **Ascomata** apothecia, black, at first with a central pore which later expands to a slitlike disc, surrounded by a fissured margin; disc with central umbo. No thalline margin. True margin with dark brown outer part; inner part pale. Ascii with distinct, K/I –apical dome; wall K/I –; outer coat K/I + blue. Ascospores >100 per ascus, simple, uncoloured, small. Hamathecium of paraphyses, anastomosing. Conidia ellipsoid.

Key to *Polysporina* on Svalbard:

- |   |   |                     |
|---|---|---------------------|
| 1 | On limestone; ascospores 2 µm long .....        | <i>P. urceolata</i> |
| 1 | On siliceous rock; ascospores 3–5 µm long ..... | <i>P. simplex</i>   |

### *Polysporina simplex* (Davies) Vězda (1978)

**Thallus** within rock. **Apothecia** sessile to somewhat immersed, up to 1 mm diam., round, true exciple with splits. Disc with prominent central umbo. Hypothecium colourless. Hymenium 90–120 µm; epithecium pale brown. Ascospores >100 per ascus, colourless, 3–5 × 1–1.5 µm. Paraphyses richly branched and anastomosing.

**Chemistry.** Not tested.

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: cosmopolitan.

**Specimen seen:** Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

### *Polysporina urceolata* (Anzi) Brodo (1987)

**Thallus** endolithic, or as tiny white areolae at base of apothecia. **Apothecia** black, appearing cerebriform, with split true exciple. Hymenium 55–60 µm high; epithecium brown-black. Hypothecium uncoloured. Ascii multisored. Ascospores 2 × 1 µm. Paraphyses anastomosing; end cells not enlarged.

**Chemistry.** Not tested.

**Ecology.** On limestone.

**Distribution.** Only known from Brøggerhalvøya and Dicksonfjorden.

**Note.** World distribution: Europe, Asia.

**Specimens seen:** Brøggerhalvøya, H. Hertel 16825 (M); Dicksonfjorden, 6.7.1936; E. Dahl (O).

**PORINA** Müll. Arg. (1883)

**Thallus** crustose, immersed to superficial. Photobiont *Trentepohlia*. **Ascomata** perithecia, immersed or superficial. Involucellum present or absent. Asci thin-walled, slightly thickened at the apex. Ascospores 8 per ascus, colourless, 3–7 septate. Hamathecium of paraphyses, thick, simple to sparsely ramified; periphyses absent. Conidia cylindrical, short; micro- and macro-conidia may be present. Lichen substances absent.

Key to *Porina* on Svalbard:

1	Saxicolous .....	<i>P. chlorotica</i>
1	Terricolous .....	<i>P. mammillosa</i>

***Porina chlorotica*** (Ach.) Müll. Arg. (1884)

Syn. *Pseudosagedia chlorotica* (Ach.) Hafellner & Kalb (1995).

**Thallus** crustose, thin, continuous, scabrous, grey-brown. Photobiont *Trentepohlia*. **Perithecia** numerous, semiglobose, black, up to 0.1 mm diam. Involucellum reaching down to base. True exciple red-brown, entire. Ascospores 8 in ascii, 3-septate, 18–22 × 4–5 µm. Pycnidia not seen.

**Ecology.** On sheltered faces (e.g., the lower side) of stones in scree.

**Distribution.** Known from two collections.

**Notes.** New to Svalbard. Easily overlooked; probably not uncommon. World distribution: cosmopolitan.

**Specimens seen:** Bjørndalen, 2003, T. Tønsberg 31896 (BG); Adventdalen, 2003, T. Tønsberg 31930 (BG).

***Porina mammillosa*** (Th. Fr.) Vain. (1921)

**Thallus** 1–4 mm broad, dark brown, with partly squamulose margins. Photobiont *Trentepohlia*. **Perithecia** sessile, semiglobose, black, 0.3–0.4 mm diam.; surface scabrose; ostiole part not depressed; in vertical section: outer layer black, composed of a *textura intricata* with the inclusion of a few algal groups in lower part; central layer red-brown; inner layer 160–180 µm wide, pink to colourless. Ascospores 8 per ascus, colourless, 3-septate, 21–30 × 4–5 µm.

**Ecology.** On sandy soil, among and over bryophytes.

**Distribution.** Only known from Sørkapp.

**Note.** World distribution: Europe, Siberia, North America (Greenland).

**Specimen seen:** Sørkapp, 1985, M. Olech (KRA-L).

**PORPIDIA** Körber (1855)

**Thallus** crustose, effuse, areolate to rimose, white, grey or orange. Photobiont trebouxiod. **Ascomata** apothecia, black, half-immersed to sessile, with only true margin. Asci of *Porpidia*-type, with 8 spores.

Ascospores simple, colourless, with halo. Hamathecium of paraphyses, ramified to anastomosing. Conidia bacilliform.

Key to *Porpidia* on Svalbard:

1	Thallus sorediate .....	2
1	Thallus not sorediate .....	7
2 (1)	Thallus at least partly orange .....	3
2	Thallus grey .....	4
3 (2)	With confluentic acid .....	<i>P. melinodes</i>
3	With stictic acid .....	<i>P. ochrolemma</i>
4 (2)	With lichen products .....	5
4	Without lichen products .....	<i>Porpidia</i> sp.
5 (4)	With confluentic acid, ± 2'-0-methylsuperphyllinic acid .....	<i>P. tuberculosa</i>
5	With stictic acid .....	6
6 (5)	Areolae confluent, flat .....	<i>P. soredizoides</i>
6	Areolae dispersed, convex .....	<i>P. superba</i> f. <i>sorediata</i>
7 (1)	Thallus at least partly orange .....	8
7	Thallus grey .....	9
8 (7)	With confluentic acid .....	<i>P. flavicunda</i>
8	Thallus without lichen products .....	<i>P. flavocruenta</i>
9 (7)	Thallus with confluentic acid .....	<i>P. speirea</i>
9	Thallus with stictic acid or negative .....	10
10 (9)	Areolae flat; disc black .....	<i>P. thomsonii</i>
10	Areolae bullate; disc with brown tinge .....	<i>P. superba</i> f. <i>superba</i>

***Porpidia flavicunda* (Ach.) Gowan (1989)**

**Thallus** crustose, areolate, orange to orange-grey. **Apothecia** up to 2 mm diam., black, flat to somewhat convex; margin distinct; disc pruinose. Hymenium 85–100 µm, epithecium greenish-brown. Hypothecium dark brown. Ascospores 9–14 × 4–7 µm. Medulla K/I –.

**Chemistry.** Confluentic acid.

**Ecology.** On siliceous rock.

**Distribution.** Scattered but not common.

**Note.** World distribution: Europe. Asia, North America (Greenland), Australia.

**Specimens seen** (selected): Elvebakk 81:1034 (TROM); Ytre Norskøya, 11.7.1928, O.A. Høeg (TRH).

***Porpidia flavocruenta* Fryday & Buschbom (2005)**

Thallus crustose, rimose, thick, rust-coloured, 3–4 cm wide. Apothecia black, halfway sunk in thallus, up to 1.6 mm diam., disc flat, non-pruinose, proper margin thin and indistinct. Hymenium 90–100

$\mu\text{m}$  high, uppermost part green-brown. Hypothecium red-brown. Outermost part of exciple blackish, innermost part yellow-brown, hyphae in exciple K + red-brown. Ascospores 8 in ascii,  $13-17 \times 5-8 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** Known from one site only.

**Notes.** New to Svalbard. Differs from the externally similar *P. flavicunda* in the lack of lichen products and the K + red hyphae in the exciple. World distribution: Europe, North America.

**Specimen seen:** Ullahamna, 26.7.1926, B. Lynge (O).

#### *Porpidia melinodes* (Körber) Hertel (1987)

**Thallus** crustose, rimose, orange to grey-orange, sorediate. Areolae 0.8–1.5 mm diam., bullate, with mostly one dark grey central soralium; soralia up to 0.8 mm diam., with raised, pale margin. Soredia 18–22  $\mu\text{m}$  diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Confluentic acid with accessories.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Notes.** One of the most common lichens of Svalbard. For differences against *P. ochrolemma*, see below the latter species. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Sveagruva, 13.8.1926, B. Lynge (O), Kong Karls Land, Härfagrehaugen, 11.8.1936. E. Dahl (O).

#### *Porpidia ochrolemma* (Vain.) Brodo & R. Sant. (1995)

**Thallus** crustose, ochraceous, 4–5 cm wide, rimose, sorediate. Areolae flat, 0.3–0.5 mm diam., with mostly one central, dark grey soralium; soralia up to 0.2 mm diam., irregular in outline, slightly concave; margin not raised. Soredia 18–20  $\mu\text{m}$ . **Apothecia** and pycnidia not seen.

**Chemistry.** Stictic acid.

**Ecology.** On sandstone.

**Distribution.** Rare.

**Notes.** Quite similar to *P. melinodes*, but the latter species has larger, bullate areolae with soralia with raised, pale margins, and a different chemistry. Previously reported from Sørkapp by Olech (1990), but we have not seen this material. World distribution: Europe, North America.

**Specimen seen:** Longyearbyen, Bjørndalen, 27.6.2003, T. Tønsberg (BG).

#### *Porpidia soredizodes* (Lamy ex Nyl.) Laundon (1989)

**Thallus** crustose, grey to very pale ochre, 2–3 cm diam., without prothallus, rimose, medium thick, sorediate. Soralia 0.2–0.4 mm diam., convex, coarse, green-grey. Soredia  $18.3 \pm 1.4 \mu\text{m}$ , conglutinated into consoredia ca 30  $\mu\text{m}$  diam., N + red. No apothecia seen.

**Chemistry.** Stictic acid.

**Ecology.** Saxicolous.

**Distribution.** Only found once.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America, Australia.

**Specimen seen:** Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg 9848c (BG).

***Porpidia speirea* (Ach.) Krempelh. (1861)**

**Thallus** crustose, areolate, grey. **Apothecia** up to 1.5–3.5 mm diam., black, with thin but distinct margin; disc pruinose when young. Hymenium 75–100 µm, uppermost part green-brown. Hypothecium dark brown. Ascospores 12–19 × 6–7 µm. Medulla K/I + violet.

**Chemistry.** Confluentic acid and accessories.

**Ecology.** Schistose rock, Ca-rich sandstones.

**Distribution.** Common and widespread.

**Notes.** Some specimens with apothecia up to 3.5 mm, and becoming pruinose when old (e.g. H. Hertel 16250 and Lid s.n.) are externally similar to *P. trullisata* (Ach.) Körber, a species known from the Alps, but the latter species has stictic acid. World distribution: Europe, Asia, North America (including Greenland), Australia, New Zealand.

**Specimens seen** (selected): Forsbladhamna, 29.7.1926, B. Lynge (O); Amsterdamøya 26.8.1936, E. Dahl (O); Isfjorden, H. Hertel 16250 (M); Barentsburg, 1924, Lid (O).

***Porpidia superba* f. *sorediata* Fryday (2004)**

**Thallus** crustose, 2–3 cm wide, areolate, sorediate, yellowish grey, with a thin brown-grey hypothallus and prothallus. Areolae up to 1.2 mm wide, convex, dispersed, somewhat irregular in outline. Soralia initially on margin of areolae, later expanding to most of surface, coarse, brown-grey, convex to excavate. Soredia  $36.3 \pm 3.7 \mu\text{m}$  (32–42 µm). Medulla K/I –. **Apothecia** not seen.

**Chemistry.** Stictic acid.

**Ecology.** On schistose rock, with *Tremolecia atrata*.

**Distribution.** Rare.

**Note.** World distribution: Europe.

**Specimen seen:** Ytre Norskøya, 17.7.1928, O.A. Høeg (O; det. Fryday 2004).

***Porpidia superba* (Körber) Hertel & Knoph (1984) f. *superba***

**Thallus** bullate, composed of crowded to dispersed, convex, white areolae, up to 0.7 mm diam., with a scabrid surface. **Apothecia** when young with a distinct true margin, when old margin excluded, convex, up to 1 mm diam.; disc with a brown tinge in protected parts, black in exposed parts. Hymenium 90–100 µm high; epithecium orange-brown. Hypothecium brown-black. Exciple red-brown throughout. Ascospores 8 per ascus, 15–18 × 6–8 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On schistose rock.

**Distribution.** Only known from Sørkapp. Cited from Kolfjellet by Fryday (2005).

**Notes.** This species is characterized by its bullate, white areolae with a scabrid surface and apothecia with an orange-brown epithecium and often brownish disc. World distribution: Europe, Asia, North America, New Zealand.

**Specimens seen:** Sørkapp, M. Olech (KRA-L); Kolfjellet, Van Mijenfjorden, 1926, B. Lynge (O; det. Fryday 2004).

***Porpidia thomsonii*** Gowan (1989)

**Thallus** crustose, areolate, grey. **Apothecia** in mean 1.2 mm diam. (0.8–2.0 mm diam.), flat, black, margin thin but distinct; disc non-pruinose. Hymenium 70–110 µm high; uppermost part olive-brown. Hypothecium dark brown. Ascospores 13–20 × 6–11 µm. Medulla K/I –.

**Chemistry.** Stictic acid or negative.

**Ecology.** On siliceous rock.

**Distribution.** Common and widespread.

**Notes.** *P. thomsonii* belongs in the *P. macrocarpa* group and differs from *P. macrocarpa* s. str. by its smaller apothecia and ascospores. World distribution: Europe, Siberia, Arctic North America.

**Specimens seen** (selected): Amsterdamøya, H. Hertel 16229 (M); Sveagruva, 13.8.1926, B. Lynge (O).

***Porpidia tuberculosa*** (Sm.) Hertel & Knoph (1984)

**Thallus** 1–2 cm wide, thin, grey, sorediate. Soralia laminal, convex, round, regular, 0.2–0.3 mm wide, dark grey. Soredia  $17.3 \pm 1.82$  µm, outer layer with protruding hyphae, blackish, N + red. **Apothecia** not seen. Medulla K/I ± blue.

**Chemistry.** Confluentic acid, ± 2'-O-methylsuperphyllinic acid.

**Ecology.** On weakly acidic rock, e.g. with *Pannaria hookeri*, and *Farnoldia jurana*.

**Distribution.** Scattered.

**Notes.** The K/I reaction of the medulla is quite variable and not a reliable character. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Moskusdalen 1986, D.O. Øvstedral (BG); Bjørndalen, 2003, T. Tønsberg 31870 (BG; det. A. Fryday 2004).

***Porpidia*** sp.

**Thallus** 4–5 cm wide, pale ochre, thick, falted-wrinkled, ± sorediate. Soralia up to 0.4 mm diam., crateriform with pale margin, grey- and black-mottled. Soredia 20–25 µm wide. Medulla K/I – or K/I + weakly blue. **Apothecia** black, sessile, up to 2 mm diam., somewhat flexuose; true margin thin but distinct. Hypothecium thick, brown-black. Exciple brown-black, composed by a textura intricata. Hymenium 70–90 µm high; uppermost part dull blue-green but incrusted with brown granules and appearing greenish brown. Paraphyses strongly adglutinated; end cells slightly enlarged to 2.5 µm diam. Ascospores 8 per ascus, 10–11 × 5–6 µm.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** Scattered.

**Notes.** The fertile material apparently belongs in the *P. macrocarpa* aggr., but has an unusually dark exciple and small ascospores; probably it represents an undescribed species. A number of sterile specimens are identified as *Porpidia* sp.; as there is some variation in the material, e.g. in size and texture of soralia, there is a possibility that the species is heterogenous.

**Specimens seen:** Blixodden, 10.8.1926, B. Lynge (O; 3 specimens; one specimen identified as *P. macrocarpa* aggr. by Fryday 2004); Kolfjellet, 19.8.1936, B. Lynge (O); Kongsfjorden, Ossian Sarsfjellet, 11.7.2003, A. Elvebakk 03:120 (TROM).

**PROTOBLASTENIA** (Zahlbr.) Steiner (1911)

**Thallus** crustose, saxicolous, superficial to immersed. Photobiont green algae. **Ascomata** apothecia, orange to orange-brown, convex, without thalline margin. Asci of *Porpidia*-type. Ascospores 8 per ascus, simple, uncoloured. Hamathecium of paraphyses, branched to anastomosing.

Key to *Protoblastenia* on Svalbard:

1	On calcareous soil .....	<i>P. terricola</i>
1	On limestone .....	2
2 (1)	Ascospores globose .....	<i>P. cyclospora</i>
2	Ascospores ellipsoid .....	3
3 (2)	Thallus superficial .....	4
3	Thallus immersed .....	5
4 (3)	Hypothecium colourless to weakly yellow; apothecia orange .....	<i>P. rupestris</i>
4	Hypothecium brown; apothecia becoming orange-brown to brown ....	<i>P. siebenhaariana</i>
5 (3)	Apothecia immersed in pits, 0.2–0.5 mm .....	<i>P. incrustans</i>
5	Apothecia not in pits, 0.5–1 mm .....	<i>P. calva</i>

***Protoblastenia calva*** (Dickson) Zahlbr. (1930)

**Thallus** inconspicuous, immersed in rock. **Apothecia** not in pits, up to 1.5 mm diam., strongly convex, orange to red-orange. Hypothecium colourless. Ascospores ellipsoid, 8–15 × 5–8 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Australia.

**Specimen seen:** Kongsfjorden, 17.8.1868, Th.M. Fries (O).

***Protoblastenia cyclospora*** (Hepp ex Körber) Poelt (1975)

**Thallus** superficial, thin white. **Apothecia** convex, orange to brown-orange, up to 0.8 mm wide, convex, superficial. Hymenium 65–70 µm high. Ascospores globose, 8–9 µm diam.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone.

**Distribution.** Only known from Ny-Ålesund.

**Notes.** Similar to *P. rupestris*, but is recognized by its globose ascospores. New to Svalbard. World distribution: Europe, Chukotka.

**Specimen seen:** Ny-Ålesund, 4.–5.7.1936. E. Dahl (O).

*Protoblastenia incrustans* (DC.) J. Steiner (1911)

**Thallus** within rock. **Apothecia** immersed in pits, orange, convex, up to 0.4 mm diam. Hymenium 85–90 µm high. Ascospores 8–9 × 5–6 µm.

**Chemistry.** Anthraquinones

**Ecology.** On limestone

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, 17.8.1868, Th.M. Fries (O); Sassendalen, 1986, A. Elvebakk (TROM).

*Protoblastenia rupestris* (Scop.) J. Steiner (1911)

**Thallus** epilithic, thin, grey, 2–3 mm diam. **Apothecia** sessile, orange, up to 0.9 mm diam. Hymenium 65–70 µm high. Ascospores 9–11 × 5.5–6 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Raudfjorden, 'Spruce Pynt', 22.7.1928, O.A. Høeg (TRH); Moskusdalen, 1988, D.O. Øvstedral (BG).

*Protoblastenia siebenhaariana* (Körb.) J. Steiner (1911)

**Thallus** epilithic, ± areolate, whitish to dirty brown. **Apothecia** up to 1.5 mm diam., orange-brown, later becoming dull brown, strongly convex. Hypothecium pale brown. Ascospores 9–13 × 4.5–6 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On limestone and schists.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (Greenland).

**Specimen seen:** none seen, record based on Hertel (1977,) who cites specimens from Ny-Ålesund and Boltendalen.

*Protoblastenia terricola* (Anzi) Lyngé (1921)

**Thallus** crustose, thick, warted-areolate, white, extensive. **Apothecia** semiglobose, orange-brown, up to 1.5 mm diam. Hypothecium colourless to pale brown. Ascospores ellipsoid, 7–10 × 4–5 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On calcareous soil.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimen seen** (selected): Sassendalen, 1987, D.O. Øvstedral (BG).

**PROTOMICAREA** Hafellner (2001)

**Thallus** crustose, effuse. Photobiont trebouxioid. **Ascomata** apothecia, black, without thalline margin. Ascii of *Psora*-type. Ascospores simple, uncoloured, 8 per ascus. Hamathecium paraphyses, adglutinated, simple.

**Note.** A monotypic genus.

*Protomicarea limosa* (Ach.) Hafellner (2001)

**Thallus** crustose, effuse, granular-verrucose, whitish to grey. **Apothecia** up to 1 mm diam., black, convex. True exciple soon excluded, thin, composed of radiating hyphae. Hymenium 45–60 µm high, bluish-green. Hypothecium reddish brown. Ascospores narrowly elliptic, 10–14 × 3–4.5 µm.

**Chemistry.** Pannarin.

**Ecology.** On soil.

**Distribution.** Rare.

**Notes.** Externally very similar to *Lecidea alpestris*, but differs in its ascus type and broader ascospores (see Lynge 1940a: 27). Also reported by Olech (1990) and Eurola (1968), but we have not had access to their material. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Sassendalen, Aug. 1986, Øvstdal (BG).

**PROTOPANNARIA** (Gyeln.) P.M. Jørg. & S. Ekman (2000)

**Thallus** squamulose to crustose. Photobiont *Nostoc*. **Ascomata** apothecia with granular thalline margin. Hymenium K/I + blackish blue. Ascii without amyloid apical structure. Ascospores 8 per ascus, simple, uncoloured, often rugulose. Hamathecium paraphyses, little ramified. No lichen substances.

*Protopannaria pezizoides* (Weber) P.M. Jørg. & S. Ekman (2000)

**Thallus** squamulose, 2–3 cm wide, squamules imbricate, brown to bluish brown. **Apothecia** up to 2 mm wide, thalline margin crenulate, prominent, concolorous with thallus. Disc orange-brown to dull brown, finally convex. Ascospores 25–30 × 9–12 µm, with warted perispore.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** Common.

**Notes.** Some specimens from *Gymnomitrion* carpets, consisted only of apothecia surrounded by glomerules of cyanobacteria; no thallus was evident. They may belong to a different taxon. World distribution: Europe, Africa, Asia, North America (including Greenland).

**Specimens seen** (selected): Nordenskiöld Land, W of Kapp Laila, 1986, T. Tønsberg s.n. (BG); Indre Norskoya, 12.7.1928, O.A. Høeg (TRH).

**PROTOPARMELIA** M. Choisy (1929)

**Thallus** crustose, effuse, brown. Photobiont trebouxiod. **Ascomata** apothecia, sessile. Thalline margin prominent to almost evanescent. True margin colourless. Ascii of *Lecanora*-type. Ascospores 8 per ascus, simple, colourless. Conidia bacilliform.

Key to *Protoparmelia* on Svalbard:

1	Parasitic on other lichens; with thallospores.....	<i>P. nephaea</i>
1	Not parasitic; without thallospores .....	2
2 (1)	With lobaric acid.....	<i>P. badia</i>
2	With stictic acid complex.....	<i>P. atriseda</i>

***Protoparmelia atriseda*** (Fr.) R. Sant. & V. Wirth (1986) s. lat.

**Thallus** 2–3 cm wide, variable, from dense to crowded, erect yellow-white papillae, 0.3 mm across and 1.5 mm high, often irregularly ramified to flat, pale brown areolae. **Apothecia** to 2 mm wide, thin; margin recurved, saddleformed, dark brown. Hymenium 30–35 µm high; epithecium greenish. Hypothecium colourless. Ascospores 8 per ascus, simple, sometimes apparently 1-septate, with rounded ends, 10–12 × 4–4.5 µm.

**Chemistry.** Norstictic or stictic acids.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** There is a considerable chemical and morphological variation in the material which consists of five specimens. It may prove to represent more than one taxon. World distribution: Europe, North America.

**Specimens seen** (selected): Bockfjorden, top of Trolltindane mountains, A.A. Frisvoll 1974 (TRH); North point of Prins Karls Forland, 15.8.1868, Th.M. Fries (O).

***Protoparmelia badia*** (Hoffm.) Hafellner (1984)

**Thallus** crustose, thick, bullate, pale brown to brown. **Apothecia** sessile to immersed, up to 2.2 mm diam.; thalline margin, concolorous with thallus; disc dark brown. Hymenium 50–60 µm high; epithecium yellow-brown. Ascospores 8 per ascus, ellipsoid-fusiform, 8–13 × 3–5 µm. Conidia 8–11 × 0.7–1 µm.

**Chemistry.** Lobaric acid

**Ecology.** On siliceous rock

**Distribution.** Widespread, but not common.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl(O); Elvebakk 81:1189 (TROM).

***Protoparmelia nephaea*** (Sommerf.) R. Sant. (1990)

**Thallus** as discrete areolae which have chestnut-brown, glossy central parts and raised, sooty-black margins; margins composed of 2-celled, green-black thallosepores, 8–10 µm in diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Stictic acid.

**Ecology.** On saxicolous crustose lichens.

**Distribution.** Only known from Sassendalen.

**Note.** New to Svalbard. World distribution: Europe, Chukotka, North America.

**Specimen seen:** Sassendalen, 1986, D.O. Øvstedral (BG).

***PROTOTHELENELLA*** Räsänen (1943)

**Thallus** pale, granular, often gelatinous when wet. Photobiont *Elliptochloris*. **Ascomata** perithecia, mostly immersed in thallus. Involucellum absent. True exciple composes of anastomosing hyphae. Ascii cylindric, thick-walled, two-layered; apex with a K/I + blue plug. Ascospores 8 per ascus, septate to muriform, colourless. Hamathecium of paraphysoids, strongly branched and anastomosing.

Key to *Protothelenella* on Svalbard:

1	Ascospores 25–34 µm long, muriform .....	<i>P. sphinctrinoidella</i>
1	Ascospores 35–50 µm long, submuriform .....	<i>P. sphinctrinoides</i>

***Protothelenella sphinctrinoidella*** (Nyl.) H. Mayrh. & Poelt (1985)

**Thallus** thin, membranaceous, grey. **Perithecia** to 0.3 mm diam.,  $\frac{1}{2}$  immersed, black. No involucellum. True exciple dark brown in upper part, pale in lower. Ascospores 8 per ascus, submuriform, uncoloured,  $25–34 \times 9–11$  µm. Paraphysoids persistent, anastomosing.

**Chemistry.** Not performed.

**Ecology.** Over bryophytes.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimen seen:** Nordaustlandet, Brennevinsbukta, Depotodden, 21.8.1936, E. Dahl (O).

***Protothelenella sphinctrinoides*** (Nyl.) H. Mayrh. & Poelt (1985)

**Thallus** thin, membranaceous to evanescent, pale grey. **Perithecia** up to 0.6 mm diam., dark brown to black,  $\frac{1}{2}$  to entirely immersed in thallus. No involucellum. True excipel dark brown in upper part, pale in lower. Ascospores muriform, uncoloured,  $35–50 \times 10–15$  µm. Paraphysoids thin, persistent, anastomosing.

**Chemistry.** Not performed.

**Ecology.** Over bryophytes.

**Distribution.** Rare.**Note.** World distribution: Europe, Asia, North America (including Greenland).**Specimen seen:** Kobbefjorden, 1868, Th.M. Fries (O).**PSEUDEPHEBE** M. Choisy (1930)

**Thallus** minutely fruticose, branched, prostrate to straggling, attached to substrate by hapters, brown to black; branches thin, terete to somewhat flattened. Cortex of longitudinally oriented hyphae becoming prosoplectenchymateous to pseudoparenchymateous at surface. Photobiont green algae. **Ascomata** apothecia, with thalline exciple. Ascospores 8 per ascus, simple, colourless. Hamathecium of paraphyses, simple to branched. No isidia, soralia, pseudocyphellae or lichen products.

**Note.** A small genus of only two species.Key to Svalbard species of *Pseudephebe*:

- |   |   |                     |
|---|---|---------------------|
| 1 | Branches flattened, with lateral spinules ..... | <i>P. minuscula</i> |
| 1 | Branches terete, without lateral spinules ..... | <i>P. pubescens</i> |

***Pseudephebe minuscula* (Nyl. ex Arnold) Brodo & D. Hawksw. (1977)**

**Thallus** minutely fruticose, prostrate, usually forming a circular thallus several cm diam. Branches flattened, dark brown to black, usually shining, with lateral spinules.

**Chemistry.** Negative.**Ecology.** On siliceous rock.**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Colesbukta, Vestafjellet, 1986, T. Engelskjøn & S. Spjelkavik (TROM); Bünzow Land, Bjonahamna, A. Elvebakk 01:057 (TROM).

***Pseudephebe pubescens* (L.) M. Choisy (1930)**

**Thallus** fruticose, straggling, up to 5–6 cm diam. Branches terete, dark brown to black, dull to shining.

**Chemistry.** Negative.**Ecology.** On siliceous rock.**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Barentsøya, Steinbeisen, 1.8.1936, E. Dahl (O); Reinholmen, 16.7.1926, B. Lynge (O).

**PSIOLECHIA** Massal. (1860)

**Thallus** leprose or crustose, yellow-green to greyish. Photobiont *Stichococcus* or *Trebouxia*-like. **Ascomata** apothecia, without thalline margin. True margin weakly developed. Hypothecium colourless. Ascii with apical dome K/I + pale blue with dark blue apical tube. Ascospores 8 per ascus, simple, colourless, often teardrop-like. Hamathecium paraphyses, little ramified. Conidia ovoid to pyriform.

***Psilolechia lucida*** (Ach.) M. Choisy (1949)

**Thallus** leprose, 2–3 cm wide, pale yellow-green. Photobiont in Svalbard specimens *Stichococcus*. **Apothecia** pale yellow, up to 0.3 mm diam., convex, emarginate. Hymenium 20–25 µm high, colourless. Ascospores 4–5 × 1 µm. Paraphyses simple to divided. Pycnidia not seen.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On rock faces protected from direct rain.

**Distribution.** Rare.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Nordenskiöld Land, Vestalbekken river gorge, 1986, T. Tønsberg 9865 (BG); between Vestpynten and Bjørndalen, 2003, T. Tønsberg 31843 (BG), near Bjørndalen, 2003, T. Tønsberg 31910 (BG).

**PSORA** Hoffm. (1796)

**Thallus** squamulose, with cortex on both sides. Photobiont green algae. **Ascomata** apothecia, sessile, laminal or marginal, convex, without thalline margin; true margin evanescent. Ascii with a K/I + blue tholus with a deeper stained tube. Ascospores 8 per ascus, simple, uncoloured. Epitheciun with anthraquinones (K + red). Hamathecium paraphyses, simple to ramified. Conidia bacilliform.

Key to *Psora* on Svalbard:

1	Squamules with upturned, white margins .....	<i>P. decipiens</i>
1	Squamules otherwise .....	2
2 (1)	With usnic and gyrophoric acids .....	<i>P. rubiformis</i>
2	Without lichen products .....	<i>P. globifera</i>

***Psora decipiens*** (Hedw.) Hoffm. (1794)

**Thallus** as round squamules, up to 5 mm wide, pale brown to orange; margins upturned, pale. Lower side white, cortex poorly developed, attached by a hyphal web. **Apothecia** up to 2 mm diam., marginal on squamules, black, subglobose, emarginate. Ascospores 10–13 × 5–6 µm.

**Chemistry.** Negative or norstictic acid.

**Ecology.** On calcareous soil.

**Distribution.** Scattered, but not uncommon.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Liefdefjorden, Roosneset, A. Elvebakk 81:1059 (TROM); Reindalen near Sørhytta, A. Elvebakk 86:465 (TROM).

***Psora globifera* (Ach.) Massal. (1852)**

**Thallus** as ± scattered, brown, slightly convex, wrinkled squamules, up to 1.5 mm diam. **Apothecia** laminal, sessile, semiglobose, up to 0.6 mm diam., black, emarginate. Hymenium 55–60 µm high; uppermost part red-brown, intensifying in K. Hypothecium red-brown. Ascospores 8 per ascus, ellipsoid, 10–12 × 5–6 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil in a *Protoblastenia terricola* dominated community.

**Distribution.** Only known from Sassendalen

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland), Australia.

**Specimen seen:** Sassendalen, 1987, D.O. Øvstdal (BG).

***Psora rubiformis* (Ach.) Hook. (1844)**

**Thallus** as scattered, thick, brownish squamules, up to 4 mm diam. **Apothecia** up to 2 mm diam., sessile, black, emarginate. Ascospores 8 per ascus, 9–14 × 5–7 µm.

**Chemistry.** Usnic and gyrophoric acids.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimen seen:** Reindalen, A. Elvebakk 86:553 (TROM).

**PSOROMA** Ach. ex Michx. (1803)

**Thallus** squamulose, brownish to greenish, with cortex on upper and lower side. Photobiont *Myrmecia*. Cephalodia present, containing *Nostoc*. **Ascomata** apothecia, strongly concave, with thalline excipie. Asci with an amyloid tube. Ascospores 8 per ascus, simple, colourless; episporule warted-ridged.

Key to *Psoroma* on Svalbard

1	Thallus with porphyrilic acid .....	<i>P. tenue</i>
1	Thallus without lichen products .....	<i>P. hypnorum</i>

***Psoroma hypnorum* (Vahl) Gray (1821)**

**Thallus** as crowded to dispersed squamules, up to 0.5 mm diam., yellow-brown, thick. Cephalodia usually rounded, red-brown, same size as squamules and found between them. **Apothecia** frequent,

up to 3 mm diam.; disc brown; thalline margin with large squamules, rarely smooth, concolorous with thallus. Hymenium 100–110 µm high; epithecium brownish. Ascospores 8 per ascus, 20–30 × 8–10 µm; episporae warty. Paraphysis end cell enlarged to 5 µm.

**Chemistry.** Negative.

**Ecology.** On soil and over bryophytes.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Sasselalen, 1988, D.O. Øvstedral (BG); Amsterdamøya, 1936, E. Dahl (O).

### *Psoroma tenue* Henssen var. *boreale* Henssen (1981)

**Thallus** squamulose, up to 2 cm diam. Squamules low, round to flattened, reddish-brown, shiny. **Apothecia** up to 2 mm diam., concave, with crenulate margin which is concolorous with thallus; disc concave, rough, brown-black. Hymenium 100–110 µm high; epithecium brownish. Ascospores 8 per ascus, warty 13–15 × 7–8 µm. Cephalodia small, dark brown, clustered, among squamules.

**Chemistry.** Porphyritic acid.

**Ecology.** On bryophytes.

**Distribution.** A few scattered occurrences.

**Notes.** World distribution: Europe, North America (including Greenland). The species is bipolar.

**Specimens seen** (selected): Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O); Smeerenburg, 1928, O.A. Høeg (TRH).

### *PYRENOPSIS* (Nyl.) Nyl. (1858)

**Thallus** granulose-areolate to squamulose, black to red-black, gelatinous when wet. No cortex. Photobiont cyanobacteria, *Chroococcidiopsis* or *Gloeocapsa*. **Ascomata** apothecia. Thalline margin distinct to indistinct. True exciple usually inconspicuous. Ascii clavate, with apical dome K/I + blue. Hypothecium colourless or yellowish. Ascospores 8 or numerous per ascus, uncoloured, globose to selliploid, simple to pseudoseptate. Hamathecium of paraphyses, simple to branched, often moniliiform. Conidia shortly elliptic to bacilliform.

### *Pyrenopsis furfurea* (Nyl.) Leight. var. *terrigena* Th. Fr. (1865)

**Thallus** red-brown, granulose, up to 2 mm wide. **Apothecia** up to 0.8 mm wide, red-brown; thalline margin thin; disc convex. Ascospores 8 per ascus, 11–13 × 5–7 µm, simple but often with a strongly developed plasma bridge which appears as a septum.

**Chemistry.** Negative.

**Ecology.** On soil.

**Distribution.** Only known from Colesbukta.

**Notes.** The specimen conforms with the type of *P. furfurea* var. *terrigena* Th. Fr. (UPS). It differs from *P. furfurea* var. *furfurea* in its convex discs, terricolous habit on soil and pseudosepta in the ascospores. *P. furfurea* var. *furfurea* has urceolate apothecia, grows on rock and has no pseudosepta

in ascospores. The variety should be studied closer, as it may represent a separate species. World distribution: Europe, North America (Greenland).

**Specimen seen:** Colesbukta, 1988, T. Engelskjøn & S. Spjelkavik (TROM).

### RHIZOCARPON Ramond ex. DC (1805)

**Thallus** crustose, areolate; prothallus black. Photobiont green algae. **Ascomata** apothecia, black, without thalline margin, directly on prothallus. True margin ± prominent, of radiating hyphae. Ascii with distinct tholus, K/I + blue near apex; no ocular chamber present. Ascospores 1–8 per ascus, colourless to dark brown, 1-septate to muriform, with halo. Conidia acicular to cylindrical.

**Notes.** The parasitic *Rhizocarpon* species on Svalbard (see, e.g. key E below) are not well understood. The thalli are usually very small and there appear to be few diagnostic characters; these are mainly the K/I reaction and the ascospore size and septation. The importance of the host species remains unsettled. Poelt (1990) and Timdal (1987) often had more than one host species for each species treated, but recent molecular evidence from fungal parasites on vasculars (see e.g. O'Donell et al. 2004) indicates that each host species may have its own parasite species. Thus there may be a number of cryptic species among the ones treated here.

The non-yellow species of *Rhizocarpon* with hyaline and muriform ascospores were recently treated for the Nordic countries by Ihlen (2004).

Key to *Rhizocarpon* on Svalbard:

Key A: Thallus yellow; ascospores 1-septate.

Key B: Thallus yellow; ascospores 3-septate or muriform.

Key C: Thallus white to grey to brown; ascospores 1-septate.

Key D: Thallus white to grey to brown; ascospores 3-septate or muriform.

Key E: Lichenicolous species.

Key A (Thallus yellow; ascospores 1-septate):

1	Ascospores longer than 18 µm .....	2
1	Ascospores shorter than 18 µm .....	3
2 (1)	Medulla K/I + intense violet .....	<i>R. eupetraeoides</i>
2	Medulla K/I – or weakly blue .....	<i>R. inarens</i>
3 (1)	Thalli very small, dispersed .....	<i>R. norvegicum</i>
3	Thalli larger, composite .....	4
4 (3)	White medulla between hypothecium and substrate .....	5
4	No medulla below dark hypothecium .....	<i>R. dispersum</i>
5 (4)	Thallus with stictic acid .....	<i>R. superficiale</i>
5	Thallus with norstictic acid .....	<i>R. occidentale</i>

## Key B (Thallus yellow; ascospores 3-septate or muriform):

1	Ascospores mostly with 3 transverse septa .....	<i>R. intermediellum</i>
1	Ascospores with longitudinal septa .....	2
2 (1)	Areolae crescent-shaped .....	<i>R. ferax</i>
2	Areolae not crescent-shaped .....	
3 (2)	Mean number of cells in ascospores (in optical view) c. 4 .....	<i>R. atroflavescens</i>
3	Mean number > 6 .....	4
4 (3)	Mean number 6–15 .....	<i>R. geographicum</i>
4	Mean number 15–20 .....	<i>R. saanaense</i>

## Key C (Thallus white to grey to brown; ascospores 1-septate):

1	Areolae peltate .....	<i>R. rittokense</i>
1	Areolae not peltate .....	2
2 (1)	Ascospores remaining hyaline .....	3
2	Ascospores soon dark .....	10
3 (2)	Thallus pure white .....	4
3	Thallus whitish, grey or brown .....	5
4 (3)	Medulla with norstictic acid .....	<i>R. caeruleoalbum</i>
4	Medulla without lichen products .....	<i>R. chioneum</i>
5 (3)	Medulla K/I + violet .....	<i>R. polycarpum</i>
5	Medulla K/I – .....	6
6 (5)	Medulla with norstictic acid .....	7
6	Medulla without lichen compounds .....	8
7 (6)	Thallus pale ochre; epithecium red-brown .....	<i>R. mahreri</i>
7	Thallus grey; epithecium greenish .....	<i>R. cinereovirens</i>
8 (6)	Areolae whitish to blue-grey .....	9
8	Areolae grey-brown .....	<i>R. hochstetteri</i>
9 (8)	Ascospores 11–14 µm long .....	<i>R. glaucescens</i>
9	Ascospores 14–17 µm .....	<i>R. expallescens</i>
10 (2)	Without lichen products .....	<i>R. badioatrum</i>
10	With lichen products .....	11
11 (10)	With stictic acid .....	<i>R. jemtlandicum</i>
11	With norstictic acid .....	<i>R. copelandii</i>

## Key D (Thallus white to grey to brown; ascospores 3-septate or muriform):

1	Areolae peltate .....	<i>R. bolanderi</i>
1	Areolae not peltate .....	2

2 (1)	Thallus rust-coloured .....	<i>R. oederi</i>
2	Thallus not rust-coloured .....	3
3 (2)	2 spores per ascus .....	<i>R. geminatum</i>
3	8 spores per ascus.....	4
4 (3)	Ascospores early dark brown .....	5
4	Ascospores persistently colourless .....	6
5 (4)	With gyrophoric acid .....	<i>R. grande</i>
5	With norstictic acid .....	<i>R. eupetraeum</i>
6 (4)	Thallus K/I + violet.....	<i>R. distinctum</i>
6	Thallus not K/I – .....	7
7 (6)	Thallus pruinose .....	8
7	Thallus not pruinose .....	9
8 (7)	Ascospores less than 30 µm long .....	<i>R. umbilicatum</i>
8	Ascospores longer than 30 µm .....	<i>R. petraeum</i>
9 (7)	Ascospores persistently 3-septate .....	<i>R. anseris</i>
9	Ascospores submuriform or muriform .....	10
10 (9)	Thallus with stictic acid .....	<i>R. reductum</i>
10	Thallus without stictic acid .....	11
11 (10)	Epitheciwm with K + purple pigment (Atra red) .....	<i>R. roridulum</i>
11	Epitheciwm with N + red pigments (Atra brown) .....	12
12 (11)	Ascospores 34–44 × 14–19 µm .....	<i>R. lavatum</i>
12	Ascospores 25–30 × 10–12 µm .....	<i>R. anaperum</i>

## Key E (Lichenicolous species):

1	Thallus K/I + strongly violet .....	2
1	Thallus K/I – (or faintly coloured) .....	6
2 (1)	Ascospores 1-septate .....	<i>R. aff. parvum</i>
2	Ascospores muriform .....	3
3 (2)	On <i>Sporastatia</i> spp. and <i>Lecanora</i> cf. <i>sulphurea</i> .....	4
3	On other lichens .....	5
4 (3)	Ascospores 26–30 µm long .....	<i>R. sp. C</i>
4	Ascospores 20–23 µm long .....	<i>R. sp. A</i>
5 (3)	On <i>Rhizocarpon geminatum</i> and <i>Lecidea</i> spp. ....	<i>R. furax</i>
5	On <i>Tremolecia atrata</i> .....	<i>R. cf. rapax</i>
6 (1)	Ascospores 1-septate .....	<i>R. pusillum</i>
6	Ascospores muriform .....	7
7 (6)	On <i>Aspicilia</i> cf. <i>aliena</i> .....	<i>R. kakurgon</i>
7	On other lichens .....	8

8 (7)	On <i>Tephromela atra</i> .....	<i>R. tephromelae</i>
8	On other lichens.....	9
9 (8)	On <i>Tremolecia atrata</i> .....	<i>R. sp. B</i>
9	On <i>Rhizocarpon geographicum</i> .....	<i>R. dahlii</i>

***Rhizocarpon anaperum* (Vain.) Vain. (1922)**

**Thallus** crustose, thin, secondary cracked, grey to grey-brown, 1–2 cm wide. **Apothecia** black, half immersed in thallus, non-pruinose, 0.3–0.4 mm wide; margin distinct. Hymenium 100–120 µm high, epithecium with olivaceous, N + red pigment. Ascospores 8 per ascus, uncoloured, muriform, 25–30 × 10–12 µm.

**Chemistry.** Negative.

**Ecology.** On various kinds of rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, North America.

**Specimens seen** (selected): Bergmannsfjellet, 8.8.1926, B. Lynge (O); Van Keulenhamna, Ullafjellet, 25.7.1926, B. Lynge (O).

***Rhizocarpon anseris* Lynge (1928)**

Type: Novaya Zemlya, 1921, B. Lynge (O!).

**Thallus** crustose, areolate, up to ca 4 mm wide, with a thin, black prothallus. Areolae flattened convex, pale grey-brown, dispersed. **Apothecia** up to 0.5 mm diam., black, flat, margin only slightly protruding. Hymenium 90–110 µm high; epithecium greenish, with purple spots. Ascospores 8 per ascus, consistently 3-septate, uncoloured, 27–35 × 9–12 µm.

**Chemistry.** Stictic and norstictic (trace) acids.

**Ecology.** On sandstone, with *Placopsis gelida* and *Ionaspis lacustris*.

**Distribution.** Only known from Barentsburg.

**Notes.** Recognized by its consistently 3-septate ascospores. New to Svalbard. The specimen has been compared to the type from Novaya Zemlya (O!) and found to be similar in all essential details. World distribution: Novaya Zemlja, Svalbard, arctic North America (including Greenland).

**Specimen seen:** Barentsburg, 3.9.1924, J. Lid (O).

***Rhizocarpon atroflavescens* Lynge (1928)**

Type: Novaya Zemlya, 1921, B. Lynge (O!).

Fig. 26 (p. 230).

**Thallus** 3–4 cm wide, areolate, continuous; areolae flat, angular, pale yellow-green. Black prothallus white-pruinose, emerging between the areole and along margin of thallus. **Apothecia** up to 1.5 mm broad, flat, between areole; margin indistinct. Hymenium up to 100 µm high; epithecium red-brown. Ascospores 8 per ascus, soon becoming dark brown, 20–22 × 9–10 µm, with 2–3 transverse septa and 0–1 longitudinal septa (mean number of cells in optical view:  $4.0 \pm 0.77$ , based on holotype in O). Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On slightly calcareous rock.

**Distribution.** A few scattered occurrences.

**Notes.** This species is recognized by its white-pruinose prothallus, and the low number of cells in optical view of the ascospores. *R. geographicum* has 6 cells or more in optical view in the ascospores (mean number). World distribution: Europe, Siberia, North America (Greenland).

**Specimen seen:** Colesdalen, 20.8.2002, R. Haugan 6904 (O).

#### *Rhizocarpon badioatrum* (Flörke ex Spreng.) Th. Fr. (1874)

**Thallus** areolate; areolae brown, usually in dispersed groups; black prothallus prominent. **Apothecia** up to 0.9 mm diam., black, flat; margin distinct. Hymenium up to 130 µm high; epithecium red-brown. Ascospores 8 per ascus, early brown, 1-septate, 22–30 × 14–16 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On siliceous rocks.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by its brown areolae, 1-septate ascospores which become dark at an early stage, red-brown epithecium and lack of lichen compounds. World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, Antarctica.

**Specimens seen:** Virgohamna, 7.7.1928, O.A. Høeg (TRH); Sørkappøy, 15.8.1920, J. Lid (O; B. Lynge det.).

#### *Rhizocarpon bolanderi* (Tuck.) Herre (1910)

**Thallus** 1–2 cm wide, composed of ± dispersed areolae on a grey to black hypothallus. Areolae umbilicate, round, up to 0.4 mm diam., thick, with dull brown central part and thick, somewhat fluffy, grey margin. **Apothecia** black, up to 4 mm diam., flat; margin slightly raised. Hymenium 110–120 µm high; epithecium redbrown. Ascospores 2 per ascus, brown, muriform, 42–45 × 20–22 µm. Medulla K/I –.

**Chemistry.** Material too scanty for analysis.

**Ecology.** On sandstone.

**Distribution.** Only known from Colesbukta and Billefjorden.

**Notes.** Recognized by its umbilicate areolae with a fluffy, raised, pale margin. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimens seen:** Colesbukta, 1999, S. Spjelkavik (BG); Billefjorden, Th. Vogt's exped. 1925 (TRH).

#### *Rhizocarpon caeruleoalbum* (Kremp.) Zahlbr. (1926)

**Thallus** up to 1 cm wide, thick, rimose, brilliantly white, without prothallus. **Apothecia** immersed in thallus; margin not visible; disc black, partly white-pruinose, to 1 mm wide. Hymenium 110–120 µm high; uppermost part red-brown, K + intensifying red. Ascospores 8 per ascus, 1-septate, for a long time uncoloured, 18–20 × 8–10 µm. Medulla K/I –.

**Chemistry.** Norstictic acid ± accessories.

**Ecology.** On limestone.

**Distribution.** Rare.

**Notes.** Differs from *R. chioneum* by its larger ascospores and presence of norstictic acid in the

thallus. The description is based on material from central Europe. World distribution: Europe.

**Specimens seen:** none seen, record based on Fries (1867) who reported specimens from Sørfjorden and Wahlenbergfjorden.

***Rhizocarpon chioneum* (Norman) Th. Fr. (1874)**

**Thallus** up to 1 cm diam., pure white, rimose to continuous, without prothallus. **Apothecia** black, immersed, up to 1 mm diam., disc black, non-pruinose, flat. Hymenium 100–110 µm high, uppermost part red-brown, intensifying in K. Ascospores 8 per ascus, colourless for a long time, 1-septate, 12–16 × 6–10 µm. Medulla K/I –.

**Chemistry.** Thallus: negative; apothecia: stictic acid.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Notes.** Differs from *R. caeruleoalbum* in its smaller ascospores and lack of lichen products in the thallus. World distribution: Europe, Asia, North America.

**Specimens seen** (selected): Ullafjellet, 25.7.1926, B. Lyngé (BG); Berzeliusfjellet, 21.7.1926, B. Lyngé (O).

***Rhizocarpon cinereovirens* (Müll. Arg.) Vain. (1922)**

**Thallus** crustose, areolate, grey; areolae flat, to somewhat convex, angular, up to 0,5 mm diam. **Apothecia** up to 0.9 mm diam., slightly convex, with thin but distinct margin. Hymenium 80–100 µm high; epithecium greenish, K –. Ascospores 8 per ascus, colourless, 1-septate, 15–20 × 8–9 µm. Medulla K/I –.

**Chemistry.** Norstictic or stictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Kong Karls Land, Mohnhøgda, 14.8.1936, E. Dahl (O); Ytre Norskøya, 17.7.1828, O.A. Høeg (TRH).

***Rhizocarpon copelandii* (Körb.) Th. Fr. (1874)**

**Thallus** crustose areolate; areolae grey-brown, flat, up to 0.6 mm broad, embedded in a black prothallus. **Apothecia** up to 1.1 mm diam., flat, margin distinct. Hymenium 120–140 µm high, epithecium green-brown, K + green. Ascospores 8 per ascus, soon becoming pigmented, 1-septate, 20–22 × 8–10 µm. Medulla K/I –.

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, New Zealand, Antarctica.

**Specimens seen** (selected): Bockfjorden, Hafellner 5378 (GZU; as *R. vainioense*); Norskøya, 1936, E. Dahl (O).

***Rhizocarpon dahlii*** Øvstedral sp. nov.

Thallus lichenicolus, griseo-viridis, minutus. Apothecia ad 0.5 mm diam., nigra. Epithecium brunneum. Ascosporae 8nae, brunneae, muriformae, 26–30 × 10–12 µm.

Holotype: Svalbard, Barentsøya, between Steinbeisfjellet and Kapp Wojeikow, 1. Aug. 1936, E. Dahl (O).

Fig. 27 (p. 231).

**Thallus** areolate, areolae dispersed, 0.4–0.7 mm diam., convex, grey-green; no hypothallus seen.

**Apothecia** 1–3 on margin of areolae, black, non-pruinose, up to 0.5 mm diam., with thick, elevated true margin. Hymenium 120–140 µm high; epithecium brownish, K + burgunder. Ascospores 8 in asci, soon becoming dark, 26–30 × 10–12 µm, with 6–9 cells in optical view. Medulla K/I –.

**Chemistry.** Rhizocarpic acid.

**Ecology.** Parasitic on prothallus of *Rhizocarpon geographicum*.

**Distribution:** Only known from Barentsøya.

**Notes.** Among the parasitic species of *Rhizocarpon* on Svalbard, this species is unique in inhabiting another green *Rhizocarpon*. *R. kakurgon* has apothecia which are ¾ sunken in prothallus, and somewhat smaller ascospores, as well as a different host (*Aspicilia* cf. *aliena*). *Rhizocarpon* sp. B has a distinct prothallus and apothecia which are convex when old, while *R.* sp. C has a distinct prothallus and a weak K/I + reaction; these species are parasitic on *Tremolechia atrata*, and on *Sporastatia cinerea* and *Lecanora* cf. *sulphurea*, respectively. Named after Eilif Dahl, the eminent lichenologist who collected the type specimen.

**Specimen seen:** Only known from the holotype.

***Rhizocarpon dispersum*** Runemark (1956)

**Thallus** crustose, 2–3 cm wide, composed of a thick black prothallus with numerous apothecia and widely scattered, greenish, round areolae, 0.3–0.4 mm diam. **Apothecia** up to 2 mm diam., sessile, with a thick true margin and central ridges on disc. Hymenium 120–130 µm high; uppermost part greenish, K + faint red-violet. Hypothecium reaching down to hypothallus. Ascospores 8 per ascus, 1-septate, soon becoming dark, 18–20 × 8–10 µm.

**Chemistry.** Rhizocarpic and norstictic acids.

**Ecology.** Mainly on siliceous rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe.

**Specimen seen:** Nordaustlandet, Duvefjorden, 16.8.1936, E. Dahl (O).

***Rhizocarpon distinctum*** Th. Fr. (1871)

**Thallus** crustose, very thin, covering 1–2 cm in discontinuous patches, areolate-rimose, pale grey-ochre, sometimes with areolae with pale margins. Prothallus thin, black, visible from above. **Apothecia** up to 0.5 mm diam., flat; margin thin and indistinct. Hymenium 80–90 µm high; uppermost part red-brown, intensifying in K. Ascospores 2–8 per ascus, colourless, submuriform, 28–30 × 15–16 µm; 7 cells (in mean) seen in optical view. Medulla K/I + blue.

**Chemistry.** Stictic, ± gyrophoric acids.

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (including Greenland), southern South

America, Australia, New Zealand, Antarctica.

**Specimen seen:** Bromelldalen, 9.8.1926, B. Lynge (O).

***Rhizocarpon eupetraeoides* (Nyl.) Blomb. & Forsell (1880)**

**Thallus** as 1–3 mm wide, yellow-white composite areolae embedded in a black prothallus. **Apothecia** immersed in areolae, up to 0.7 mm wide, margin distinct. Hymenium 120–130 µm high; epithecium greenish. Ascospores 8 per ascus, soon becoming dark, 1-septate, 18–20 × 7–9 µm. Medulla K/I + blue.

**Chemistry.** Rhizocarpic and stictic acids.

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** none seen, record based on Hertel & Ullrich (1976), who reported it from Amsterdamøya.

***Rhizocarpon eupetraeum* (Nyl.) Arnold (1870)**

**Thallus** areolate; areolae 0.2–0.3 mm diam., round, convex, dispersed, grey-brown, embedded in a black prothallus. **Apothecia** up to 0.7 mm diam., black, without margin, slightly convex. Hymenium 90–100 µm high; epithecium red-brown, K + purplish. Ascospores 8 per ascus, soon becoming brown, muriform, 20–28 × 14–16 µm. Medulla K/I + violet.

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen:** Lågøya, Chydenius (S); Adventdalen, 2002, R. Haugan 6871 (O).

***Rhizocarpon expallescens* Th. Fr. (1874)**

**Thallus** as bluish-white to lead-coloured composite areolae, 2–3 mm wide. Prothallus not evident. **Apothecia** up to 1 mm diam., emarginate, convex. Hymenium 80–90 µm high; epithecium blue-green. Ascospores 8 per ascus, 1-septate, uncoloured, 14–17 × 6–7 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** Siliceous rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen (selected):** Braganzavägen, 1925, Lagercrantz (O); Grönhamna, 31.7.1868, Th.M. Fries (O).

***Rhizocarpon ferax* H. Magn. (1948)**

**Thallus** composed of scattered, crescent-shaped, yellow-green, 0.2–0.3 mm wide areolae surrounding the apothecia. **Apothecia** up to 0.5 mm diam.; margin prominent. Hymenium 90–100 µm high; epithecium blue-green. Ascospores 8 per ascus, muriform, soon becoming brown, 28–30 × 11–13

$\mu\text{m}$ . Medulla K/I + violet.

**Chemistry.** Rhizocarpic and psoromic acids.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Edgeøya, Keilhaubukta, 8.8.1935, E. Dahl (O); Bünzow Land, Bjonahamna, 2001, Elvebakk 01:042 (TROM).

### *Rhizocarpon furax* Poelt & Wirth (1970)

**Thallus** minute, up to 1 mm wide, as a single areola with one to two apothecia, convex, often crescent-shaped. No prothallus seen. **Apothecia** up to 0.5 mm wide, with a broad sausage-shaped margin and small concave disc. Hymenium 75–80  $\mu\text{m}$  high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, soon becoming dark, 3-septate and with 1–3 longitudinal septa, 25–28  $\times$  10–12  $\mu\text{m}$ . Medulla K/I + intense violet.

**Chemistry.** Not performed (K –).

**Ecology.** Lichenicolous on *Rhizocarpon geminatum* and *Lecidea lapicida*.

**Distribution.** A few scattered occurrences.

**Notes.** The Svalbard material has somewhat larger ascospores than material from the Alps discussed by Poelt (1990). New to Svalbard. World distribution: Europe.

**Specimens seen** (selected): Wijdefjorden, 2002, T. Tønsberg 31104 (BG); Nordaustlandet, Brennevinsfjorden, 21.8.1936, E. Dahl (O).

### *Rhizocarpon geminatum* Körber (1861)

**Thallus** grey-brown, areolate; areolae convex, 0.2–0.7 mm diam., embedded in a black prothallus. **Apothecia** up to 1 mm diam.; margin thin but distinct. Hymenium 100–120  $\mu\text{m}$ ; epithecium red-brown. Ascospores 2 per ascus, soon becoming brown, muriform, 35–50  $\times$  18–25. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On calcareous and siliceous rock.

**Distribution.** Common.

**Notes.** One specimen (Hårfagrehaugen) had unusually large areolae, barrel-shaped apothecia and contained stictic acid. World distribution: Europe, North America (including Greenland), Argentina, New Zealand, Antarctica.

**Specimens seen** (selected): Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O); Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Bünzow Land, Bjonahamna, 2001, Elvebakk 01:056 (TROM).

### *Rhizocarpon geographicum* (L.) DC. (1805)

**Thallus** up to several cm wide, areolate, yellow-green; prothallus black. Apothecium up to 1.5 mm wide; margin thin but distinct. Hymenium 100–120  $\mu\text{m}$  high; epithecium red-brown. Ascospores 8 per ascus, soon becoming brown, muriform, 20–35  $\times$  12–18  $\mu\text{m}$ . Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid,  $\pm$  psoromic acid.

**Ecology.** On siliceous rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Dickson Land, Pyramiden, Elvebakk 01:065 (TROM); Nordkysten, Velkomstpynten, 26.8.1936, E. Dahl (O).

***Rhizocarpon glaucescens* (Th. Fr.) Zahlbr. (1926)**

**Thallus** areolate, whitish to blue-grey. **Apothecia** black, up to 0.8 mm diam., flat. Hymenium 90–110 µm high, uppermost part red-brown, K + intensifying. Ascospores 8 in ascii, uncoloured, 1-septate, 11–14 × 5–6 µm.

**Chemistry.** Negative.

**Ecology.** On rock.

**Note.** World distribution: Europe, Siberia.

**Specimen seen:** none seen, record based on Hertel & Ullrich (1976), who reported it from Amsterdamøya.

***Rhizocarpon grande* (Flörke ex Flotow) Arnold (1871)**

**Thallus** 2–3 cm wide, with a prominent black prothallus, areolate; areolae dispersed, brown-grey, convex, up to 0.4 mm diam., **Apothecia** immersed between areolae, up to 0.5 mm diam., flat; true margin very thin. Medulla K/I –. Hymenium 90–100 µm high, epithecium red-brown, intensifying in K. Ascospores 8 per ascus, becoming brown by age, muriform, 24–28 × 10–14 µm.

**Chemistry.** Gyrophoric acid.

**Ecology.** On sandstone.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, New Zealand, Antarctica.

**Specimens seen** (selected): Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Klovingen, 9.7.1928, O.A. Høeg (TRH).

***Rhizocarpon hochstetteri* (Körber) Vainio (1922)**

**Thallus** very thin, rimose-areolate; areolae indistinct, dark brown. **Apothecia** up to 1 mm diam., flat; margin thin but persistent. Hymenium 100–120 µm; epithecium red-brown to green-brown. Ascospores 8 per ascus, colourless, 1-septate, 25–36 × 12–15 µm. Medulla K/I –.

**Chemistry.** Stictic acid or no compounds.

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimen seen:** none seen, record based on Hertel & Vohla (unpubl.; see Elvebakk & Hertel 1996), who cited specimens from Ny-Ålesund.

***Rhizocarpon inarensse* (Vain.) Vain. (1922)**

**Thallus** as ± dispersed, yellow-green, round areolae, up to 0.8 mm diam., on a black prothallus. **Apothecia** up to 0.8 mm diam.; margin distinct. Hymenium 120–130 µm high; epithecium red-brown. Ascospores 8 per ascus, early brown, 1-septate, 18–21 × 10–11 µm. Medulla K/I + faintly blue.

**Chemistry.** Rhizocarpic, norstictic,  $\pm$  stictic acids.

**Ecology.** On siliceous rock.

**Distribution.** Scattered but not uncommon.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Nordre Norskøya, 19.7.1928, O.A. Høeg (TRH); Sjuøyane, Phippsøya, 18.8.1936, E. Dahl (O).

### *Rhizocarpon intermediellum* Räsänen (1943)

**Thallus** 3–20 mm wide, composed of scattered areolae on a black prothallus. Areolae yellow-green, up to 0.4 mm wide, with a dark margin. **Apothecia** up to 0.8 mm diam.; margin distinct. Hymenium 80–90  $\mu\text{m}$  high; epithecium red-brown. Ascospores 8 per ascus, 3-septate, soon becoming brown, 15–17  $\times$  5–7  $\mu\text{m}$ . Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid.

**Ecology.** This species starts as a parasite on other lichens, later it becomes independent and saxicolous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Kapp Laila, Elvebakk 86:430 (TROM); Colesbukta, 1999, S. Spjelkavik (BG).

### *Rhizocarpon jemtlandicum* (Malme) Malme (1914)

**Thallus** rimose-areolate, brown; prothallus black. **Apothecia** up to 1.5 mm diam., with thick persistent margin. Hymenium 130–140  $\mu\text{m}$  high; epithecium blue-green. Ascospores 8 per ascus, soon becoming brown, 1-septate, 20–30  $\times$  12–15  $\mu\text{m}$ . Medulla K/I –.

**Chemistry.** Stictic acid, sometimes with norstictic acid.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen:** Adventfjorden, Hiorthhamn, 24.7.1936, E. Dahl (O); Sabineodden, 22.7.1928, O.A. Høeg (TRH).

### *Rhizocarpon kakurgon* Poelt (1960)

**Thallus** 1–5 mm wide, often as a black prothallus with dispersed areoale 0.3–0.4 mm wide. **Apothecia**  $\frac{3}{4}$  immersed in prothallus, up to 0.6 mm wide;, margin thick, sausage-shaped; disc small, concave. Hymenium 90–110  $\mu\text{m}$ ; epithecium red-brown. Ascospores 8 per ascus, soon becoming dark, muri-form, 8–9 cells (in optical view), 23–25  $\times$  10–11  $\mu\text{m}$ . Medulla K/I –.

**Chemistry.** Rhizocarpic acid.

**Ecology.** Lichenicolous on *Aspicilia* cf. *aliena*.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. According to Poelt (1990) it is lichenicolous on *Aspicilia candida* and related species. World distribution: Europe, North America (Greenland).

**Specimens seen** (selected): Lady Franklinfjorden, Lågøya. E. Dahl 19.8.1936 (O); Gipsdal, Elvebakk 85:533 (TROM).

*Rhizocarpon lavatum* (Fr.) Hazsl. (1884)

**Thallus** crustose, areolate; areolae flat, crowded leaving no prothallus visible, pale grey-ochre. **Apothecia** up to 0.8 mm diam., black, thick; margin prominent; disc flat. Hymenium 120–130 µm high; epithecium greenish-brown, K–. Ascospores 8 per ascus, colourless, 38–40 × 14–18 µm; 15–17 cells seen in optical view. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On schists and siliceous rock, not ornithocoprophilous.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (Greenland), New Zealand.

**Specimen seen:** Van Keulenhamna, 1926, B. Lynge (O; det. Ihlen 2004).

*Rhizocarpon mahreri* Hafellner (1982)

Type: Bockfjorden, 1979, Hafellner 8577 (GZU!).

**Thallus** pale ochre, areolate; areolae flat to slightly convex, round, ± dispersed, 0.1 – 0.2 mm diam. **Apothecia** flat, up to 0.3 mm diam.; margin distinct. Hymenium 45–50 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, uncoloured, 11–13 × 5–7 µm. Medulla K/I –.

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** Svalbard (endemic).

**Notes.** Close to *R. cinereovirens*, but differs in its pale ochre areolae, red-brown epithecium intensifying in K, and medulla reaction.

**Specimen seen:** type only.

*Rhizocarpon norvegicum* Räsänen (1943)

**Thallus** as dispersed areolae, single or 2–3 together, up to 1 mm diam. **Apothecia** convex, emarginate, on sides of areolae, up to 0.6 mm diam. Hymenium 75–80 µm; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, soon becoming brown, 1-septate, 8–10 × 5–6 µm. Medulla K/I + blue.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimen seen:** Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

*Rhizocarpon occidentale* Lynge (1932)

**Thallus** 2–3 cm wide, with a very prominent hypo- and prothallus. Prothallus at margin white-pruinose. Areolae pale green, dispersed on prothallus, composite of several smaller ones, flat. **Apothecia** up to 0.9 mm diam., flat; margin white-pruinose, thin but distinct. Hymenium 90–100 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, 1-septate, soon becoming brown, 13–15 × 6–6.5 µm. Medulla K/I + weakly blue.

**Chemistry.** Rhizocarpic and norstictic acids.

**Ecology.** On schistose rock.

**Distribution.** A few scattered occurrences.

**Notes.** This taxon has often been lumped with *R. superficiale*, but we agree with Lynge (1936), that it is a separate species, differing from *R. superficiale* in its chemistry, large, composite areolae, and smaller ascospores. World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, Blomstrandhalvoya, 13.7.2001, Elvebakk 01:079 (TROM); Albert I Land, Flathukken, Elvebakk 03:102b (TROM).

### *Rhizocarpon oederi* (Weber) Körber (1861)

**Thallus** rimose-areolate, rust-coloured, with indistinct prothallus. **Apothecia** up to 0.5 mm diam., flat; margin distinct; disc usually umbonate. Hymenium 90–100 µm high; epithecium green-black. Ascospores 8 per ascus, uncoloured, 3-septate, 12–18 × 5–7 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On siliceous rock rich in Fe.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America, Antarctica.

**Specimen seen:** none seen, record based on Eurola (1968), who cited a specimen identified by Thomson.

### *Rhizocarpon* aff. *parvum* Runem. (1956)

**Thallus** 1–2 cm wide, as scattered, rounded, flattened, convex, pale green areolae, 0.4–0.7 mm wide, on a black prothallus. Marginal areolae not elongated. **Apothecia** mostly immersed in centre of areolae, rarely on margin, up to 0.4 mm diam.; margin very thin; disc flat to concave, slightly white-pruinose. Hymenium 110–120 µm high; epithecium red-brown, K + burgunder red. Hypothecium dark brown, penetrating down into hypothallus. Ascospores 8 per ascus, 1-septate, soon becoming brown, 17–19 × 7–9 µm. Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid.

**Ecology.** Lichenicolous on *Aspicilia* sp. on sandstone.

**Distribution.** Only known from Wijdefjorden.

**Notes.** New to Svalbard. The specimen differs from the material discussed by Poelt (1990) by its larger ascospores and a different host. The Svalbard specimen may well prove to represent a distinct species. World distribution: Europe, North America (Greenland).

**Specimen seen:** Wijdefjorden, Elvebakk 01:233 (TROM).

### *Rhizocarpon petraeum* (Wulfen) A. Massal. (1852)

**Thallus** 1 cm wide, thin, rimose, pale ochraceous grey, with oxalate crystals. **Apothecia** up to 0.5 m diam.; margin medium prominent, white-pruinose (oxalate crystals); disc flat, black. Hymenium 110–120 µm high; epithecium blue-green, K + red. Ascospores 8 per ascus, uncoloured, 30–33 × 14–15 µm, 18–25 cells in optical view.

**Chemistry.** Stictic acid.

**Ecology.** On Ca-rich sandstone and schists.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (Greenland), Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Van Mijenfjorden, Bromelldalen, 9.8.1926, B. Lynge (O); Van Mijenfjorden, 17.8.1926, B. Lynge (O).

***Rhizocarpum polycarpum*** (Hepp) Th. Fr. (1874)

**Thallus** areolate, thin, 2.3 cm wide; areolae 0.5–0.5 mm wide, flat, round, immersed in black hypothallus, grey-brown. **Apothecia** numerous, flat, 0.6–0.7 mm wide, with very thin true margin. Hymenium 90–100 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, 1-septate, for a long time uncoloured, 24–28 × 9–11 µm. Medulla K/I + violet.

**Chemistry.** Norstictic acid.

**Ecology.** On schistose rock.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina, Australia, New Zealand, Antarctica.

**Specimen seen** (selected): Klovningen, 1928, O.A. Høeg (TRH).

***Rhizocarpon pusillum*** Runem. (1956)

**Thallus** minute, as a few scattered, round, yellow-green areolae, up to 0.5 mm diam. **Apothecia** on margin of areolae, up to 0.3 mm diam. Hymenium 80–90 µm high. Ascospores 8 per ascus, soon becoming brown, 1-septate, 15–17 × 8–10 µm. Medulla K/I –.

**Chemistry.** Rhizocarpic and psoromic acids.

**Ecology.** Lichenicolous on *Sporastatia testudinea*.

**Distribution.** Only known from Longyearbyen and Gipsdalens.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen:** Adventfjorden, ovenfor Longyearbyen, 100–200 m alt, 23.7.1936, E. Dahl (O); Bünzow Land, Gipsdalens, Elvebakk & A. Hodin 85:419 (TROM).

***Rhizocarpon* cf. *rapax*** V. Wirth & Poelt (1970)

**Thallus** 2–3 mm wide, composed of a black prothallus with dispersed areolae; areolae round, 0.2–0.4 mm wide, K –, K/I + strongly violet. **Apothecia** flat, angular, with thin, raised margin, to 0.6 mm wide. Hymenium 120–130 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, soon becoming dark, submuriform (2–7 cells in optical view), 18–20 × 9–10 µm.

**Chemistry.** Not performed.

**Ecology.** Lichenicolous on *Tremolecia atrata*.

**Distribution.** Rare.

**Notes.** Based on anatomical and morphological characters the specimen agrees well with *R. rapax* which is, however, lichenicolous on *Aspicilia* and *Acarospora* (Poelt 1990). Further studies based on more material are necessary to clarify its identity. New to Svalbard. World distribution: Europe.

**Specimen seen:** Isfjorden, Kapp Thordsen, 20.7.1926, E. Dahl (O).

***Rhizocarpon reductum*** Th. Fr. (1871)

**Thallus** 2–3 cm wide, thin, rimose-areolate, blue-grey; prothallus pale. **Apothecia** up to 0.7 mm wide, sessile, black; margin thin, but distinct, shiny. Hymenium 90–100 µm high; epithecium blue-green. Ascospores 8 per ascus, uncoloured, muriform, 27–29 × 18–20 µm; 16–18 cells seen in optical view. Medulla K/I –.

**Chemistry.** Stictic acid.

**Ecology.** On schistose and siliceous rock.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, Asia, Argentina, New Zealand.

**Specimens seen** (selected): Hopen, 1930, O. Hansson (O); Adventdalen, 27.7.1924, J. Lid (O).

***Rhizocarpon rittokense*** (Hellb.) Th. Fr. (1874)

**Thallus** areolate; areolae shiny brown, subumbilicate, embedded in a black prothallus; margin white-eroded, black in protected places. **Apothecia** up to 1 mm diam., convex; margin distinct. Hymenium 120–140 µm; epithecium brown. Ascospores 8 per ascus, colourless at first, but becoming brown with age, 1-septate, 24–26 × 12–14 µm. Medulla K/I –.

**Chemistry.** Stictic or barbatic acid.

**Ecology.** On siliceous rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** none seen, record based on Fries (1867), who cited a specimen from Hornsund.

***Rhizocarpon roridulum*** (Th. Fr.) H. Olivier (1881)

Thallus areolate; areolae scattered, up to 0.8 mm diam., convex, rounded, incised, pale grey to grey-ochre. Hypothallus pale, indistinct. **Apothecia** when young with very prominent margin, up to 0.9 mm diam., sessile. Disc concave, slightly pruinose. Hymenium up to 140 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, colourless, submuriform to muriform, 36–38 × 13–15 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by its scattered, grey areolae without lichen products, pruinose discs, high hymenium, red-brown epithecium and large ascospores which remain colourless. World distribution: Europe, Chukotka.

**Specimens seen** (selected): Adventfjorden, ovenfor Longyearbyen, 100–200 m alt, 23.7.1936, E. Dahl (O); Adventfjorden, Øvre Torvedal, 29.7.1924, J. Lid (O).

***Rhizocarpon saanaense*** Räsänen (1942)

**Thallus** several cm broad, areolate; areolae up to 2 mm diam., yellow-green, pruinose; prothallus black, pruinose, prominent. **Apothecia** immersed in prothallus, up to 0.5 mm diam. Hymenium 170–180 µm high; epithecium red-brown. Ascospores 8 per ascus, soon becoming brown, muriform, 25–40

$\times$  12–17; cells in optical view  $>$  14. Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid.

**Ecology.** On basic rock.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Colesbukta, 1999, S. Spjelkavik (BG); Kongsfjorden, Ossian Sars-fjellet, 2003, A. Elvebakk 03:121 (TROM).

### *Rhizocarpon superficiale* (Schaerer) Vainio (1922)

**Thallus** continuous or as scattered, composite areolae up to 2 mm wide, yellow-green. Prothallus black. **Apothecia** up to 1 mm wide; margin thin. Hymenium 70–80  $\mu\text{m}$  high; epithecium dark brown. Hypothecium brown-black; medulla white, visible between the hypothecium and the prothallus. Ascospores 8 per ascus, soon becoming brown, 1-septate, 11–13  $\times$  5–7  $\mu\text{m}$ . Medulla K/I –.

**Chemistry.** Rhizocarpic and stictic acids.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Wijdefjorden, A. Elvebakk 01:185 (TROM); Kongsfjorden, Blomstrandhalvøya, 15.7.01, A. Elvebakk 01:096 (TROM).

### *Rhizocarpon tephromelae* Øvstedral sp. nov.

Thallus lichenicolus, supra *Tephromela atra*, flavo-luteus, minutus. Apothecia ad 0.5 mm diam., nigra. Epithecum brunneum. Ascosporae 8nae, muriformae, 30–33  $\times$  12–14  $\mu\text{m}$ , 10–13 cellularis per microscopicum observatae. Holotype: Svalbard, Longyearbyen, 5.9.1936, E. Dahl (O).

Fig. 28 (p. 231).

**Thallus** 1–4 mm wide, composed of a black hypothallus with scattered areolae; areolae round, 0.2–0.4 mm diam., greenish. **Apothecia** up to 0.5 mm diam., when young flat with distinct margin, when old somewhat convex with excluded margin. Hymenium 110–120  $\mu\text{m}$ ; epithecium brownish. Ascospores 8 per ascus, soon becoming dark, muriform, with 10–13 cells in optical view, 30–33  $\times$  12–14  $\mu\text{m}$ . Medulla K/I –.

**Chemistry.** Not performed.

**Ecology.** Lichenicolous on *Tephromela atra*.

**Distribution.** Only known from Longyearbyen (presently known as endemic).

**Notes.** Differs from *R. dahliae* in the presence of a prothallus, more pure green areolae, larger number of cells in ascospores, and host. World distribution: Svalbard.

**Other specimen seen:** Adventfjorden, Longyearbyen, 23.7.1936, E. Dahl (O).

### *Rhizocarpon umbilicatum* (Ram.) Flagey (1894)

Syn. *R. pseudospeireum* (Th. Fr.) Lynge (1926).

**Thallus** thick, 1–2 cm wide, whitish to grey-white, fluffy, bullate-rimose. **Apothecia** sessile to half-immersed in thallus, up to 1 mm diam., often several grouped together, flat; margin flexuose, thin, white-pruinose; disc black, non-pruinose. Hymenium 80–90  $\mu\text{m}$  high; epithecium blue-green, with

brown spots. Ascospores submuriform (5–7 cells in optical view), colourless, 17–19 × 7–9 µm. Medulla K/I –.

**Chemistry.** Stictic acid.

**Ecology.** On limestone.

**Distribution.** Common and widespread.

**Notes.** In Svalbard previously only known from Bjørnøya. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Van Keulenhavna, 6.8.1926, B. Lynge (O); Prins Karls Forland, 15.8.1868, Th.M. Fries (O).

### *Rhizocarpon* sp. A

**Thallus** as dispersed areolae; prothallus not evident. Areolae 0.2–0.6 mm wide, ± crescent-formed.

**Apothecia** sessile, up to 0.5 mm wide; margin distinct. Hymenium 110–120 µm high; epithecium red-brown, intensifying in K. Ascospores 8 per ascus, muriform soon becoming dark, 20–23 × 10–14 µm. Medulla K/I + violet.

**Chemistry.** Not performed.

**Ecology.** Lichenicolous on *Sporastatia testudinea*.

**Distribution.** Known from one site only.

**Note.** Apparently undescribed, but the material is too scanty for a formal description.

**Specimen seen:** Adventfjorden, Hiorthhamn, 24.7.1936, E. Dahl (O).

### *Rhizocarpon* sp. B

**Thallus** 2–3 mm wide, as a black prothallus with a few rounded to angular, green areolae. **Apothecia** up to 0.5 mm wide, flat, with moderately prominent margin. Hymenium 100 µm high; epithecium brown, K + red-brown. Ascospores 8 per ascus, dark brown, muriform, 24–30 × 12–13 µm, with 6–8 cells in optical view. Medulla K/I + weakly blue.

**Chemistry.** Rhizocarpic acid.

**Ecology.** Lichenicolous on *Tremolecia atrata*.

**Distribution.** Known from one site only.

**Notes.** Probably undescribed, but material insufficient for formal description.

**Specimen seen:** Colesbukta, 1.10.1999, S. Spjelkavik (BG).

### *Rhizocarpon* sp. C

**Thallus** areolate; areolae as crescent-shaped collars flanking the apothecia or more rarely dispersed, ovate, up to 1.2 mm diam., slightly convex, yellow-green. **Apothecia** round to angular, up to 0.5 mm diam.; proper margin thin, slightly raised. Hymenium 120–130 µm high, colourless to slightly yellowish; epithecium red-brown, K + purplish. Ascospores 8 per ascus, rather soon becoming dark, 26–30 × 12–14 µm, muriform, with 11–13 cells in optical view. Medulla K/I + violet.

**Chemistry.** Rhizocarpic acid.

**Ecology.** Lichenicolous on *Sporastatia cinerea* and *Lecanora cf. sulphurea*.

**Distribution.** Only known from Longyearbyen.

**Note.** Probably an undescribed species, but material insufficient for formal description.

**Specimens seen:** Adventfjorden, Hiorthhamn, 24.7.1936, E. Dahl (O); Longyearbyen, 23.7.1936, E. Dahl (O).

**RHIZOPLACA** Zopf (1905)

**Thallus** umbilicate, monophyllous to squamulose, yellow-green, corticated on both sides. Photobiont trebouxioid. **Ascomata** apothecia, laminal, with thalline margin. Asci of *Lecanora*-type, 8-spored. Ascospores simple, colourless. Hamathecium of paraphyses, simple to branched. Conidia filiform, curved.

***Rhizoplaca melanophthalma*** (Ram.) Leuckert & Poelt (1977)

**Thallus** lobate, up to 2–3 cm wide, yellow to yellow-green to green-ochre. **Apothecia** usually crowded, up to 3 mm diam., with yellow-green disc and thalline margin concolorous with thallus. Hymenium 60–90 µm high; uppermost part aeruginose. Ascospores 11–14 × 5–7 µm.

**Chemistry.** Usnic, ± rangiformic, ± norrangiformic and unidentified fatty acid.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Common.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Austfjorden, Jäderindalen, A. Elvebakk 01:131 (TROM); Krossfjorden, A. Elvebakk 86:236 (TROM).

**RIMULARIA** Nyl. (1868)

**Thallus** crustose, areolate, effuse, brown to blackish. Photobiont trebouxioid. **Ascomata** apothecia, black, sessile, with true exciple only. Hypothecium brown, continuous with exciple. Asci with tholus K/I + blue laterally and at upper central part. Ascospores 8 per ascus, simple, colourless to yellowish. Hamathecium of paraphyses, anastomosing. Conidia bacilliform.

Key to *Rimularia* on Svalbard:

1	Thallus sorediate or as granulate clumps .....	2
1	Thallus otherwise .....	5
2 (1)	Thallus granulate clumps .....	<i>R. furvella</i>
2	Thallus sorediate .....	3
3 (2)	Thallus coherent .....	4
3	Thallus as dispersed areolae .....	<i>R. sp. B</i>
4 (3)	With gyrophoric acid .....	<i>R. badioatra</i>
4	With norstictic acid .....	<i>R. sp. C</i>
5 (1)	Parasitic .....	<i>R. insularis</i>
5	Non-parasitic .....	6
6 (5)	Medulla K/I + violet .....	<i>R. psephota</i>
6	Medulla K/I – .....	7

- 7 (6)      Hymenium with sterile columns ..... *Rimularia* sp. A  
 7            Hymenium without sterile columns ..... *R. impavida*

***Rimularia badioatra* (Krempelh.) Hertel & Rambold (1990)**

**Thallus** 1–2 cm diam., crustose, bullate-rimose, thick, grey-brown, sorediate. Areolae up to 1 mm diam. Soralia central on areolae, dark brown-grey, flush with surface, 0.1–0.2 mm diam. Soredia brown, with smooth surface, 16–20 µm wide, consoredia 40–50 µm wide. **Apothecia** not seen.

**Chemistry.** Gyrophoric acid.

**Ecology.** On sandstone.

**Distribution.** Only known from Braganzavågen.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America.

**Specimen seen:** Braganzavågen, 1986, D.O. Øvstedral (BG).

***Rimularia furvella* (Nyl.) Hertel & Rambold (1990)**

**Thallus** as 0.3–1 mm wide, convex, dark brown, granulose clumps; granules 25–30 µm diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** Lichenicolous on unidentified crustose lichen.

**Distribution.** Rare.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimens seen:** Reindalen, Elvebakk 85:313 (TROM); Kongsfjorden, Brøgger-halvøya, A. Elvebakk 85:313 (TROM).

***Rimularia impavida* (Th. Fr.) Hertel & Rambold (1990)**

**Thallus** crustose, effuse, areolate. Areolae convex, with wrinkled surface, black, thick. **Apothecia** up to 1 mm diam.; true margin thin and indistinct when young with, later excluded. Hymenium yellowish, 100–120 µm high; uppermost part brownish. Hypothecium dark brown, in some specimens with violet patches. True exciple thin, brown. Ascospores 8 per ascus, simple, colourless, 9–11 × 6–8 µm. Paraphyses thin, anastomosing; end cell not enlarged, embedded in mucilage.

**Chemistry.** Norstictic acid.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Colesdal, 2002, R. Haugen 6832 (O); Kongsfjorden, Blomstrandhalvøya, 1975, H. Hertel 16654 pro. parte (M).

***Rimularia insularis* (Nyl.) Rambold & Hertel (1990)**

**Thallus** as a few dark brown bullate areolae 0.2–0.4 mm diam. **Apothecia** up to 0.5 mm diam., round, black, sessile, with flat disc and narrow but distinct margin. Hymenium 55–70 µm high; epithecium brown. Hypothecium brown-black; true exciple dark brown in outer part, paler in inner

part. Ascospores 8 per ascus,  $8-14 \times 4.5-6 \mu\text{m}$ .

**Chemistry.** Gyrophoric acid.

**Ecology.** A parasite on *Lecanora rupicola* s. lat.

**Distribution.** Rare.

**Note.** World distribution: Europa, North America (Greenland), Chile, Australia, New Zealand.

**Specimens seen:** Longyearbyen, 1975, H. Hertel 16577 (M); Colesdal, 2002, R. Haugan 6908 (O).

#### *Rimularia psephota* (Tuck.) Hertel & Rambold (1990)

**Thallus** crustose, effuse, rimose-areolate, greyish. **Apothecia** with irregular to crenulated outline, black; true margin prominent; disc flat, often umbonate. Hymenium  $40-50 \mu\text{m}$  high; uppermost part green-brown, K + violet. Exciple brown in outer part, pale in inner. Hypothecium dark brown. Ascospores  $13-21 \times 7-10 \mu\text{m}$ .

**Chemistry.** Norstictic acid.

**Ecology.** On siliceous rock

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, southern South America, New Zealand, Australia, Antarctica.

**Specimens seen:** none seen, record based on Hertel (1985), who reported specimens from Longyearbyen.

#### *Rimularia* sp. A

**Thallus** thin, granulose, green-grey, several cm wide. **Apothecia** up to 0.7 mm wide, dark brown to black, convex, emarginate; disc surface irregular to pitted. Hymenium  $80-90 \mu\text{m}$  high, with 3–4 sterile columns in vertical section. Epithecium yellow-brown. Hypothecium dark brown, composed of a *textura intricata*. True exciple pale brown, composed of an open *textura intricata*; hyphae in outermost part radiating. Asci of *Rimularia*-type. Paraphyses anastomosing; end cell not enlarged. Ascospores 8 per ascus, uniseriate,  $6-8 \times 4-4.5 \mu\text{m}$ . Medulla K/I –.

**Chemistry.** Norstictic acid.

**Ecology.** On lower side of stones in scree, with e.g. *Opegrapha*.

**Distribution.** Known from one site only.

**Notes.** In the key to *Rimularia* in Hertel & Rambold (1990), this taxon keys out in the vicinity of *R. impavida* and *R. gyrizans*, but may not prove to represent any of these. It has the ascospore dimensions of *R. impavida*, the apothecium organization of *R. gyrizans*, and a distinct habitat ecology.

**Specimen seen:** Longyearbyen, Bjørndalen, 27.6.2003, T. Tønsberg (BG).

#### *Rimularia* sp. B

Thalus crustose, 2–15 mm wide, with a black, dendroid prothallus and scattered, dark brown-grey, round areolae, 0.2–0.7 mm wide, sorediate. Soralia central, diffuse, white-eroded. Soredia 14–16  $\mu\text{m}$  wide, with brown, globose cells on the surface. **Apothecia** or pycnidia not seen.

**Chemistry.** Norstictic acid and unidentified compound (Rf-classes A 3, B 4–5).

**Ecology.** On schistose rock.

**Distribution.** Known from one site only.

**Notes.** As the specimen is sterile, we only tentatively assign it to *Rimularia*. The general appearance and chemistry agree with this genus.

**Specimen seen:** Lady Franklinjorden, Lågøya, 19.8.1936, E. Dahl (O).

### *Rimularia* sp. C

**Thallus** crustose, dark grey to grey-brown, coherent, finely rimose, 2–3 cm wide, sorediate. Soralia convex, sometimes raised on a small tubercle, 0.4–0.6 mm diam., coarse, chequered. Soredia 54–65 µm wide, in consoredia of variable size. **Apothecia** not seen.

**Chemistry.** Norstictic acid.

**Ecology.** On sandstone.

**Distribution.** Known from one site only.

**Note.** As the specimens are sterile, we only tentatively assign them to *Rimularia*. Its general appearance and chemistry agree with this genus.

**Specimen seen:** Bjørndalen, 2003, T. Tønsberg 31876a,b (BG).

### **RINODINA** (Ach.) S.F. Gray (1821)

**Thallus** crustose to placodioïd. Photobiont trebouxioïd. **Ascomata** apothecia, thalline margin persistent or soon excluded. Ascii of *Lecanora*-type. Ascospores 8 per ascus, 1-septate, brown, double-walled, walls thickened in various ways. Hamathecium of paraphyses, simple. Conidia bacilliform.

Key to *Rinodina* on Svalbard:

1	Parasitic .....	<i>R. parasitica</i>
1	Not parasitic .....	2
2 (1)	Growing on organic substrate .....	3
2	Growing on rock .....	9
3 (2)	Growing on wood .....	<i>R. archaea</i>
3	Growing on bryophytes or detritus .....	4
4 (3)	Ascospores 3-septate .....	<i>R. conradii</i>
4	Ascospores 1-septate .....	5
5 (4)	Ascospores shorter than 25 µm .....	6
5	Ascospores longer than 25 µm .....	7
6 (5)	Ascospores 18–22 µm long, with colourless protuberances at ends .....	<i>R. terrestris</i>
6	Ascospores 20–25 µm long, without protuberances .....	<i>R. olivaceobrunnea</i>
7 (5)	Disc strongly convex; with orange spots in medulla .....	<i>R. mniaraea</i>
7	Disc flat; without orange spots in medulla .....	8
8 (7)	Apothecia white-pruinose; thallus indistinct .....	<i>R. roscida</i>
8	Apothecia not pruinose; thallus distinct .....	<i>R. turfacea</i>

9 (2)	On calcareous rock; thallus mostly lacking .....	<i>R. calcigena</i>
9	On siliceous rock; thallus present .....	10
10 (9)	Thallus isidiate-sorediate .....	<i>R. balanina</i>
10	Thallus not isidiate-sorediate .....	<i>R. milvina</i>

***Rinodina archaea* (Ach.) Arnold (1887)**

**Thallus** crustose, irregularly wrinkled to areolate, thick, brown, 1–2 cm wide. **Apothecia** 0.4–0.7 mm wide, between areolae; thalline margin slightly raised, concolorous with thallus; disc flat, brown. Hymenium 110–120 µm high; uppermost part yellow-brown. Ascospores 8 per ascus, brown, 1-septate, with thick torus, 20–30 × 8–10 µm. Paraphyses stout; end cell enlarged to 4 µm diam.

**Chemistry.** Negative.

**Ecology.** On old driftwood.

**Distribution.** Only known from Magdalenefjorden and Grønfjorden.

**Notes.** In Svalbard previously only known from Bjørnøya. World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimen seen:** Magdalenefjorden, J. Vahl 1839 (TRH; det. H. Mayrhofer).

***Rinodina balanina* (Wahlenb.) Vainio (1909)**

**Thallus** placodioid, 2–3 cm wide; marginal lobes thick, irregularly branched, to 0.4 mm wide, brown. Inner part areolate, covered with round, closely aggregated isidia. **Apothecia** not seen in Svalbard material.

**Chemistry.** Negative.

**Ecology.** On maritime rocks, ornithocoprophilous.

**Distribution.** Scattered.

**Notes.** Easily recognised by its habitat, and the brown, placodioid thallus with gnarled isidia towards the centre. World distribution: amphi-Atlantic and amphi-Beringian areas.

**Specimen seen** (selected): Klovningen, 6.7.1928, O.A. Høeg (TRH).

***Rinodina calcigena* (Th. Fr.) Lynge (1921)**

**Thallus** evanescent or as scattered, brown-grey areolae, up to 0.2 mm diam. **Apothecia** up to 1 mm diam., constricted below; thalline margin prominent, concolorous with thallus; disc flat, black. Hymenium 60–70 µm high, with oil droplets, uppermost part red-brown. Ascospores 16–24 × 10–13 µm, of Bischoffii-type. Paraphysal end cells enlarged to 6 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous rock, not ornithocoprophilous.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Siberia, North America.

**Specimen seen** (selected): Grønhamna, 1.8.1868, Th.M. Fries (O).

***Rinodina conradii*** Körber (1855)

**Thallus** disappearing, greyish. **Apothecia** up to 0.8 mm diam., sessile; thalline margin distinct, regular, concolorous with thallus; disc dark brown, flat, later becoming convex. Hymenium 90–120 µm; epithecium red-brown. Ascospores mostly 3-septate; lumina rounded with uniform thick walls (*Conradi*-type), 18–30 × 9–14 µm.

**Chemistry.** Negative.

**Ecology:** On soil and on moribund bryophytes.

**Distribution.** Rare.

**Note.** World distribution: cosmopolitan.

**Specimen seen:** none seen, record based on Magnusson (1947) who cited specimens from Nordaustlandet.

***Rinodina milvina*** (Wahlenb.) Th. Fr. (1861)

**Thallus** crustose, thick, areolate, grey to grey-brown. **Apothecia** up to 1 mm diam., crowded, somewhat immersed to sessile. Thalline exciple entire, prominent, concolorous with thallus. Disc black. Hymenium 90–120 µm, uppermost part brownish. Ascospores 8 per ascus, 16–22 × 8–12 µm, with finely roughened surface, constricted at septum, of *Milvina*-type.

**Chemistry:** Negative.

**Ecology.** On rock, or sometimes lichenicolous on crustose lichens, ornithocoprophilous.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, Africa, North America (including Greenland).

**Specimens seen:** Bohemannset, Aug. 1924, O.A. Høeg (TRH); Reinholmen, 16.7.1926, B. Lynge (O).

***Rinodina mniaraea*** (Ach.) Körber (1855)

**Thallus** crustose, warted, thick, brown-grey; medulla with orange parts. **Apothecia** up to 1.5 mm diam., soon becoming strongly convex, dark brown, with excluded margin. Hymenium 100–150 µm high; uppermost part pale brown. Ascospores 8 per ascus, of *Physcia*-type, 32–35 × 11–16 µm.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Sveagruva 13.8.1926, B. Lynge (O); Kong Karls Land, Hårfagrehaugen, 16.8.1936, E. Dahl (O).

***Rinodina olivaceobrunnea*** Dodge & Baker (1938)

**Thallus** thin, granulose, ± evanescent, brown-grey. **Apothecia** up to 0.6 mm diam., thin, sessile; thalline margin thin, grey to pale brown-grey; disc flat to slightly concave, dark-brown. Thalline exciple up to 100 µm thick, composed of pseudoparenchymateous tissue. True exciple thin. Hymenium 80–90 µm high; uppermost part brown. Ascospores 8 per ascus, 20–25 × 7–9 µm; ascospore wall ± evenly thick at apex. Paraphysse end cell 2 µm thick.

**Chemistry.** Negative.

**Ecology.** On dead plant remains (*Cassiope tetragona*).

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand, Antarctica.

**Specimens seen** (selected): Sørkapp, 1965, J. Nowak (KRAM); Liefdefjorden, peninsula at Glopbrean, A. Elvebakken 81:553 (TROM).

### *Rinodina parasitica* H. Mayrh. & Poelt (1979)

**Thallus** inconspicuous, 2–10 mm wide, composed of dispersed brown areolae. **Apothecia** dark brown, up to 0.3 mm diam., lecanorine; margin concolorous with disc, sessile, constricted below. Hymenium 55–60 µm high; epihymenium redbrown. Ascospores 8 per ascus, 15–17 × 7–9 µm, of *Buellia*-type, with a distinct torus. Paraphysis end cell brown, up to 4 µm wide.

**Chemistry.** Negative.

**Ecology.** Parasitic on *Rhizocarpon geminatum*.

**Distribution.** Only known from Ullafjellet.

**Notes.** Recognized by being lichenicolous and by the small, dark brown apothecia. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Ullafjellet, 29.7.1926, B. Lynge (O).

### *Rinodina roscida* (Sommerf.) Arnold (1887)

**Thallus** indistinct, granular, greyish. **Apothecia** up to 1 mm broad, sessile; thalline margin distinct, concolorous with thallus; disc black, white-pruinose. Hymenium 110–130 µm high; uppermost part red-brown. Ascospores 8 per ascus, 30–40 × 12–17 µm; torus broad; locules angular; tips mucronate. Paraphysis end cells enlarged to 6 µm.

**Chemistry.** Negative.

**Ecology.** On soil and bryophytes and plant remains on calcareous ground.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Dicksonfjorden, 6.7.1936, E. Dahl (O); Kapp Hesselman, 22.7.1926, B. Lynge (O).

### *Rinodina terrestris* Tomin (1929)

**Thallus** crustose, grey, 5–10 mm wide, almost covered by apothecia. **Apothecia** crowded, sessile, up to 0.8 mm diam., with grey thalline margin and brown disc. Hymenium 60–70 µm high. Ascospores 8 in ascii, 18–22 × 7–10 µm, with colourless protuberances at ends. Paraphysis end cell enlarged to 3 µm diam.

**Chemistry.** Negative.

**Ecology.** On moribund bryophytes.

**Distribution.** Only found once.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Kobbefjorden, 1868, Th.M. Fries (O).

***Rinodina turfacea*** (Wahlenb.) Körber (1855)

**Thallus** crustose, thick, verrucose to almost squamulose, brown. **Apothecia** up to 2 mm broad, flat, thin, with a thin ± crenulated thalline margin concolorous with thallus; disc red-brown to dark brown. Hymenium 110–120 µm high; uppermost part brownish. Ascospores 25–36 × 11–17 µm, with distinct porus; apical walls thickened around lumina. Paraphysis end cells to 3.5 µm diam.

**Chemistry.** Negative.

**Ecology.** On soil and over moribund bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar arctic-alpine, southern South America.

**Specimens seen** (selected): Indre Norskøya, 12.7.1928, O.A. Høeg (TRH); Amsterdamøya, 26.8.1936, E. Dahl (O).

**SAGIOLECHIA** Massal. (1854)

**Thallus** crustose, thin, effuse. Photobiont *Trentepohlia*. **Ascomata** apothecia, without thalline margin, black. True margin prominent, black, crenulate. Ascus wall K/I + blue; apical dome K/I –. Ascospores 8 per ascus, 3-septate, uncoloured. Hamathecium paraphyses, simple to anastomosing; end cells enlarged; periphyses present or not. Conidia bacilliform.

Key to *Sagiolechia* on Svalbard:

1	Growing on bryophytes .....	<i>S. rhexoblephara</i>
1	Growing on rock .....	<i>S. protuberans</i>

***Sagiolechia protuberans*** (Ach.) A. Massal. (1854)

**Thallus** within rock. **Apothecia** 0.5 mm diam., black, half-immersed or sessile, appearing gyrose. True exciple with splits, thick, dark brown, merging below with hypothecium. Disc minute, with a central sterile plug. Hymenium 100–110 µm high; epithecium brown. Hypothecium brown-black. Ascii 100–140 × 10–20 µm. Ascospores 8 per ascus, colourless, 3-septate, 12–25 × 6–9 µm.

**Chemistry.** Not performed.

**Ecology.** On limestone.

**Distribution.** A few scattered occurrences.

**Notes.** The Svalbard specimens differ from Fennoscandian ones in apothecia lacking a sterile central part, and individual discs being evenly spaced. World distribution: Europe, Siberia, North America (including Greenland).

**Specimen seen** (selected): Gipsdal, 1986, Øvstedral (BG).

***Sagiolechia rhexoblephara*** (Nyl.) Zahlbr. (1913)

**Thallus** inconspicuous. **Apothecia** up to 2 mm diam., black; true exciple with splits, thick, dark brown, merging below with hypothecium. Disc concave at first, later flat, brown, black. Hymenium 90–120 µm; epithecium brown-black. Ascii 70–100 × 12–14 µm. Ascospores 8 per ascus, uncoloured,

3-septate, 16–24 × 5–7 µm.

**Chemistry.** Not performed.

**Ecology.** On bryophytes on weakly calcareous soil.

**Distribution.** Widespread.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen** (selected): Ny-Ålesund, 1973, Øvstedal (BG).

#### SANTESSONIELLA Henssen (1997)

**Thallus** subfruticose to granulose, corticate on all surfaces; lobes flattened or terete, often knotted. Photobiont *Nostoc*. **Ascomata** apothecia, biatorine; true exciple composed of radiating hyphae. Ascus apex with narrow, amyloid tube. Ascospores 8 per ascus, simple, colourless, ellipsoid, smooth to warted. Hamathecium of paraphyses, little ramified.

**Note.** A genus mainly found on the Southern Hemisphere.

#### *Santessonella arctophila* (Th. Fr.) Henssen (1997)

**Thallus** gelatinous, granular, brown-black, wrinkled when dry. **Apothecia** up to 2.5 mm diam., orange brown, convex when old, with pale indistinct true exciple. Ascospores colourless, ellipsoid, simple, 16–23 × 8–12 µm, with rugulose surface.

**Chemistry.** Negative.

**Ecology.** On base-rich soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar arctic-alpine.

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk 81:567 (TROM); Barentsøya, N side of Steinbeisen, 1.8.1936, E. Dahl (O).

#### SARCOGYNE Flotow (1851)

**Thallus** crustose, often immersed in substrate. Photobiont green algae. **Ascomata** apothecia, sessile or immersed in pits in substrate, black, without thalline margin. True margin prominent, black, sometimes crenulate. Asci strongly thickened at apex; apical dome K/I –; outer coat K/I + blue. Ascospores > 100 per ascus, uncoloured, simple. Hamathecium of paraphyses, simple to branched; end cells enlarged. Conidia ellipsoid to subglobose.

Key to *Sarcogyne* on Svalbard:

- |   |   |                    |
|---|---|--------------------|
| 1 | On limestone; ascospores 3 µm long .....      | <i>S. algoviae</i> |
| 1 | On siliceous rock; ascospores 2 µm long ..... | <i>S. privigna</i> |

*Sarcogyne algoviae* H. Magn. (1935)

**Thallus** within rock. **Apothecia** sessile, barrel-shaped, with thalline margin, 0.3–0.5 mm broad. Ascospores  $3\text{--}3.5 \times 1\text{--}1.5 \mu\text{m}$ .

**Chemistry.** Not performed.

**Ecology.** On limestone.

**Distribution.** Only known from Gipsdalen.

**Note.** World distribution: Europe.

**Specimen seen:** Gipsdalen, 1986, A. Elvebakk 85:738 (TROM).

*Sarcogyne privigna* (Ach.) A. Massal. (1854)

**Thallus** within rock. **Apothecia** sessile, 0.6 mm wide, barrel-shaped, with prominent margin, concolorous with disc; disc slightly convex, dark brown. Hymenium 90–100  $\mu\text{m}$  high; uppermost part brownish. Hypothecium pale. Asci multisporous. Ascospores colourless, simple,  $2 \times 0.5 \mu\text{m}$ . Paraphyses simple, sparingly clavate at tip.

**Chemistry.** Not performed.

**Ecology.** On siliceous rock, with *Lecanora polytropa* etc.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: cosmopolitan.

**Specimens seen:** Dunøyen, 23.7.1920, J. Lid (O); Klovningen, 9.7.1928, O.A. Høeg (TRH).

**SCHADONIA** Körber (1859)

**Thallus** crustose. Photobiont green algae. **Ascomata** apothecia, sessile, constricted at base; disc black, concave; thalline margin absent. True margin prominent, of pseudoparenchymateous tissue. Asci of *Bacidia*-type. Ascospores 2–8-spored, muriform, colourless. Hamathecium of paraphyses, anastomosing, not or slightly enlarged at apex.

*Schadonia fecunda* (Th. Fr.) Vězda & Poelt (1980)

**Thallus** crustose, scurfy-verrucose, thick, dark grey-brown. **Apothecia** up to 1.5 mm diam.,  $\frac{3}{4}$  immersed in thallus; margin prominent, concolorous with thallus; disc flat, black. Hymenium 140–150  $\mu\text{m}$  high. Hypothecium pale brown. Ascospores 8 per ascus, colourless, muriform,  $22\text{--}26 \times 11\text{--}13 \mu\text{m}$ . Paraphyses anastomosing; end cells not enlarged.

**Chemistry.** Negative.

**Ecology.** Over bryophytes.

**Distribution.** Only known from Amsterdamøya and Wijdefjorden.

**Note.** World distribution: Europa, Asia, North America (including Greenland).

**Specimens seen:** Amsterdamøya, (herb. Aptroot); Wijdefjorden, between Austfjordnes and Reinsbukkdalen, 2002, T. Tønsberg 31186 (BG).

**SCHAERERIA** Körber (1855)

**Thallus** squamulose or crustose. **Ascomata** apothecia, immersed or sessile, black; thalline margin absent. True exciple composed of dark brown, globose cells. Ascii cylindrical; tholus thin, slightly amyloid or non-amyloid. Ascospores 8 per ascus, simple, globose to ellipsoid, colourless. Hamathecium of paraphyses, simple to branched; end cell enlarged in some species. Conidia bacilliform.

Key to *Schaereria* on Svalbard:

1	Hypothecium colourless .....	<i>S. endocyanea</i>
1	Hypothecium brown .....	2
2 (1)	Epithecum blue-green .....	<i>S. fuscocinerea</i>
2	Epithecum green-black .....	<i>S. parasemella</i>

***Schaereria endocyanea* (Stirt.) Hertel & G. Schneider (1980)**

**Thallus** 1 cm diam., squamulose; squamules crowded, 0.2–0.3 mm diam., brown. **Apothecia** up to 0.7 mm diam., brown-black, between squamules, flattened convex, emarginate. Hymenium 120–130 µm high; uppermost part violet. True exciple violet in outermost part, pale in inner part. Hypothecium colourless. Ascospores 8 per ascus, uniseriate, subglobose, 9–11 × 6–8 µm.

**Chemistry.** Negative.

**Ecology.** On moribund bryophytes.

**Distribution.** Only known from Adventfjorden.

**Notes.** This taxon has been placed in synonymy with *S. fuscocinerea*, however, we believe that it merits species status. It is recognized by its violet pigment in the epithecium and outer part of the exciple, pale hypothecium and subglobose ascospores. Normally, the species grows on rock, but it seems that several saxicolous *Schaereria* species may also grow on bryophytes. New to Svalbard. World distribution: Europe, Asia, North America (Greenland).

**Specimen seen:** Adventfjorden, 9.8.1868, Th.M. Fries (O).

***Schaereria fuscocinerea* (Nyl.) Clauzade & C. Roux (1985)**

**Thallus** crustose, 1–2 cm wide, dark brown, areolate. **Apothecia** black, at first immersed but later sessile, up to 0.5 mm diam., with or without thalline margin. Hymenium 70–90 µm high; uppermost part blue-green with violet granules. Hypothecium and true exciple dark brown. Paraphyses lax, little ramified; end cell somewhat enlarged. Ascospores 8 per ascus, subglobose to broadly ellipsoid, uniseriate, 6–11 × 4–6 µm.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: circumpolar, Africa, Australia, New Zealand, Antarctica.

**Specimen seen:** Recherchefjorden, 17.7.1926, B. Lyngé (O).

*Schaereria parasemella* (Nyl.) Lumbsch (1997)

**Thallus** several cm wide, thick, granulose, pale ochre in protected places, blackened in exposed places. **Apothecia** numerous, sessile, somewhat constricted below, brown-black to black, flat, up to 0.4 mm diam., with thin elevated proper exciple. Hymenium 40–45 µm, pale reddish; epithecium green-black. Hypothecium red-brown. Exciple composed of swollen, radiating hyphae, with red-brown “veins”. Ascospores 8 in ascii, uniseriate, subglobose, 6–7 × 4–5 µm.

**Chemistry.** Negative.

**Ecology.** Over moribund bryophytes.

**Distribution.** Only found once.

**Notes.** New to Svalbard. World distribution: Europe, Siberia, North America (Greenland).

**Specimen seen:** Smeerenburg, 31.8.1868, Th.M. Fries (O).

**SOLORINA** Ach. (1808)

**Thallus** foliose, adpressed to soil, in one species only as a narrow rim around the apothecia. Upper side grey-green, with cortex. Lower side grey-green (orange in one species), with veins and rhizines. Photobiont *Coccomyxa*; cephalodia internal or external, with *Nostoc*. **Ascomata** apothecia, urceolate, without thalline margin; disc red-brown. Asci of *Peltigera*-type. Ascospores 1–8 per ascus, brown, 1–2-septate; surface ornamented. Hamathecium of paraphyses, simple.

Key to *Solorina* on Svalbard:

1	Lower side of thallus vivid orange .....	<i>S. crocea</i>
1	Lower side of thallus brownish to grey-green .....	2
2 (1)	Thallus as a narrow border around apothecia, on a matrix of cyanobacteria/cephalodia ..	<i>S. spongiosa</i>
2	Thallus wide; cephalodia internal .....	3
3 (2)	Ascospores 1 per ascus .....	<i>S. monospora</i>
3	Ascospores 2–8 per ascus .....	4
4 (3)	Ascospores 2 per ascus .....	<i>S. bispora</i>
4	Ascospores 4–8 per ascus .....	5
5 (4)	Ascospores 4 per ascus .....	<i>S. saccata</i>
5	Ascospores 8 per ascus .....	<i>S. octospora</i>

***Solorina bispora*** Nyl. (1860)

**Thallus** consisting of scattered, ± rounded lobes, up to 10 mm wide, with a single urceolate apothecium in centre. Photobiont *Coccomyxa*. Cephalodia internal, with *Nostoc*. Ascospores 2 per ascus, 65–70 × 30–32 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Raudfjorden, 21.7.1928, O.A. Høeg (TRH); Klovningen, 9.7.1928, O.A. Høeg (TRH).

### *Solorina crocea* (L.) Ach. (1808)

**Thallus** forming 5–6 cm large rosettes composed of thick rounded lobes; upper side olive-green, brown when dry; lower side orange, tomentose, with veins. **Apothecia** depressed into thallus, to 1 cm wide; disc brown. Cephalodia internal. Ascospores 6–8 per ascus,  $35\text{--}45 \times 10\text{--}14 \mu\text{m}$ .

**Chemistry.** Solorinic acid.

**Ecology.** On snowbeds on acidic soil.

**Distribution.** Common in areas with acidic rock.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Prins Karls Forland, Fuglehukken, A. Elvebakk 94:043 (TROM); Adventfjorden, Longyearbyen, 23.7.1936, E. Dahl (O).

### *Solorina monospora* Gyelnik (1932)

**Thallus** as scattered,  $\pm$  round lobes, up to 3–4 mm wide, greyish, with a single, deeply urceolate **apothecium**. Photobiont *Coccomyxa*. Cephalodia internal, with *Nostoc*. Hymenium 180–190  $\mu\text{m}$  high. Ascospores 1 in asci, 1–2-septate, brown,  $92\text{--}96 \times 24\text{--}28 \mu\text{m}$ .

**Chemistry.** Negative.

**Distribution.** Only known from Kong Karls Land

**Ecology.** On soil.

**Notes.** New to Svalbard. World distribution: Europe, Asia (Martinez & Burgaz 1998).

**Specimen seen:** Svalbard, Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

### *Solorina octospora* Arnold (1876)

**Thallus** up to 2–3 cm wide, or less extensive and then surrounding the apothecium; upper side red-brown; lower side somewhat paler; with internal cephalodia. **Apothecia** immersed in thallus, to 5 mm broad, dark brown. Ascospores 8 per ascus,  $35\text{--}40 \times 18\text{--}20 \mu\text{m}$ .

**Chemistry.** Methylgyrophorate.

**Ecology.** On calcareous soil.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Amsterdamsøya, 26.8.1936, E. Dahl (O); Edgeøya, Kapp Heuglin, 9.8.1936, E. Dahl (O).

### *Solorina saccata* (L.) Ach. (1810)

**Thallus** well-developed, 3–6 cm wide, composed rounded lobes; upper side grey to brown-grey; lower side whitish, tomentose. Cephalodia internal. **Apothecia** deeply concave, immersed in thallus; disc to 5 mm diam., dark brown. Ascospores 4 per ascus,  $30\text{--}50 \times 18\text{--}25 \mu\text{m}$ .

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** Quite common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, Hesteskoen, A. Elvebakk 81:691 (TROM); Barentsøya, 2.8.1936, E. Dahl (O).

### *Solorina spongiosa* (Ach.) Anzi (1862)

**Thallus** as a thin, irregular border around apothecia; apothecia up to 5 mm diam., situated on a blackish warted-nodulose matrix of cephalodia. Ascospores 2–4 per ascus, 30–50 × 18–25 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous soil.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimens seen** (selected): Reindalen, A. Elvebakk 86:387 (TROM); Dicksonfjorden, Kapp Smith, 8.8.1973, A.A. Frisvoll (TRH).

### SPHAEROPHORUS Pers. (1794)

**Thallus** fruticose, growing in coraloid tufts to 10 cm high; branches terete, sympodially branched, grey to orange-brown. Photobiont trebouxioid. **Ascomata** apothecia, terminal, rare, globose, irregularly split open; mature ascospores broadly ellipsoid, forming a mazaedium, and covered by a thick black ornamentation deposited when inside the ascii; ascospores numerous. Conidia bacilliform.

Key to *Sphaerophorus* on Svalbard:

1	Without distinct main branches; medulla K/I – .....	<i>S. fragilis</i>
1	With distinct main branches; medulla K/I + blue .....	<i>S. globosus</i>

### *Sphaerophorus fragilis* (L.) Pers. (1794)

**Thallus** fruticose, growing in dense tufts, to 10 cm wide and 2 cm high; branches dichotomously divided, without distinct main branches, grey to grey-brown. Medulla K/I –. **Apothecia** not seen in Svalbard material.

**Chemistry.** Sphaerophorin, hypothamnolic acid, ± squamatic acid.

**Ecology.** Among bryophytes and in crevices on strongly acidic substrates.

**Distribution.** Scattered, mostly in northern Svalbard.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimens seen** (selected): Duvefjorden, 16.8.1936, E. Dahl (O); Lady Franklinfjorden, 19.8.1936, E. Dahl (O).

***Sphaerophorus globosus* (Huds.) Vainio (1903)**

**Thallus** fruticose, forming tufts up to 10 cm diam., and 4–6 cm high, branched; branching sympodial, with main branches up to 2 mm diam., orange-brown to grey-brown above, whitish below. Medulla K/I + blue. **Apothecia** not seen in Svalbard material.

**Chemistry.** Two chemical strains: a) squamatic acid, sphaerophorin; b) squamatic and thamnolic acids, sphaerophorin.

**Ecology.** Among bryophytes on ridges on acidic substrates.

**Distribution.** Common and widespread.

**Note.** World distribution: circumpolar boreal-arctic, southernmost South America, Antarctica.

**Specimens seen** (selected): Phippsøya, 18.8.1936, E. Dahl (O); Edgeøya, 7.8.1936, E. Dahl (O).

***SPILONEMA* Bornet (1856)**

**Thallus** composed of filaments, containing *Stigonema* surrounded by a network of periclinal hyphae, attached to rock with black-blue rhizomorphs; forming mats or small cushions. **Ascomata** apothecia, black-brown, convex, sessile, true exciple excluded. Hymenium with blue-green or violet pigments in upper part. Ascii with internal amyloid structures. Ascospores 8 in ascii, uncoloured, simple. Hamathecium of parpahyses, stout, branched. Conidia bacilliform.

***Spilonema paradoxum* Bornet (1856)**

**Thallus** as filaments, prostrate to ascending, interwoven, up to 45 µm diam., dark olive to blackish, at base with blue-black rhizoids; forming mats up to 3 mm diam. Individual *Stigonema* cells: 4–6 × 8–11 µm. No **apothecia** seen.

**Chemistry.** Negative.

**Ecology.** In fissures in limestone.

**Distribution.** Only known from Gipsdalen.

**Notes.** New to Svalbard. World distribution: temperate to arctic parts of Europe and North America, southern South America, Australia.

**Specimen seen:** Gipsdalen, W slope of Gipshukken, A. Elvebakk 85:683/684 (TROM).

***SPORASTATIA* A. Massal. (1854)**

**Thallus** crustose, areolate, usually with distinct marginal areolae. Photobiont trebouxioid. **Ascomata** apothecia, black, immersed; thalline exciple absent. Ascii with thick, uniformly K/I + blue tholus. Ascospores 100–200 per ascus, small, simple, subglobose to globose, colourless. Hamathecium of paraphyses, simple to branched; end cell enlarged. Conidia bacilliform.

Key to *Sporastatia* on Svalbard:

1	Thallus shiny brown to blackish; marginal areolae elongate .....	<i>S. testudinea</i>
1	Thallus whitish to brown-grey; marginal areolae quadratic .....	2
2(1)	Thallus whitish; 5-O-methylhiascic acid major substance .....	<i>Sporastatia</i> sp.
2	Thallus grey to brown-grey; gyrophoric and 5-O-methylhiascic acids major substances ... .....	<i>S. polyspora</i>

***Sporastatia polyspora* (Nyl.) Grumm. (1963)**

**Thallus** subeffigurate, growing in rosettes to 2 cm diam., grey to yellow-grey, matt. Prothallus black, narrow. Marginal areolae not elongated. **Apothecia** black, immersed in areolae, up to 0.5 mm diam., with thin, protruding true margin and rough, flat to slightly convex disc. Hymenium 90–100 µm high; epithecium brownish. Ascospores globose, 3–3.5 µm diam. Paraphyses stout, little or not ramified; end cell only slightly enlarged.

**Chemistry.** 5-O-methylhiascic (major), gyrophoric (major), and lecanoric (trace) acids.

**Ecology.** On siliceous and calcareous rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Wijdefjorden, A. Elvebakk 01:172 (TROM); S of Wijdefjorden, at Austfjordneshytta, 2002, T. Tønsberg 31148a (BG). Sabineodden, 12.7.1928, O.A. Høeg (TRH).

***Sporastatia testudinea* (Ach.) A. Massal. (1854)**

**Thallus** subeffigurate, as small rosettes up to 1 cm diam., brown, shiny, areolate; marginal areolae elongate; prothallus narrow, black. **Apothecia** in inner part of thallus, black, up to 0.4 m diam., flush with thallus; margin thin, raised, disc concave. Hymenium 130–140 µm; epithecium blue-green to greenish. Ascospores globose, 2.5–3.5 µm.

**Chemistry.** 5-O-methylhiascic acid (major), gyrophoric acid (moderate), and lecanoric acid (trace).

**Ecology.** On siliceous rock.

**Distribution.** Common and widespread.

**Notes.** *S. tenuirimata* (Th. Fr.) Lyngé, described as *S. moria* ssp. *tenuirimata* Th. Fr. (1867) has been regarded as distinct, although with some doubt (see Poelt 1969). The type of *S. tenuirimata* (Lomfjorden, Malmgren (UPS!)) has rimose areolae making it strikingly distinct from *S. testudinea*, as well as somewhat elevated apothecia. However, it has the typical blue-green epithecium of *S. testudinea*, and we consider it as likely that the rimose areolae are caused by environmental factors. We treat *S. tenuirimata* as an extreme form of *S. testudinea*. World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): S of Wijdefjorden, E of Vestfjorden, the W-facing foothills of Gråkammen, Tysneset, 2002, T. Tønsberg 31301 (BG); S of Wijdefjorden, E of Austfjorden, at Austfjordneshytta, 2002, T. Tønsberg 31149 (BG).

*Sporastatia* sp.

**Thallus** crustose, thick, non-rimose, whitish (with a brown tinge). **Apothecia** common, almost immersed in thallus, up to 1 mm wide, with a thin, pale pseudothalline margin; disc dark brown, non-pruinose. Hymenium 80–100 µm high; epithecium yellowish. Hypothecium pale brown. Ascii with thin walls, outer coat K/I + blue. Ascospores > 100 per ascus, globose, 4 µm diam. Paraphyses with clavate end cells.

**Chemistry.** 5-O-methylhiascic acid (major), and gyrophoric acid (trace).

**Ecology.** Saxicolous in sheltered niche in scree.

**Distribution.** Only found once.

**Notes.** This taxon differs from the two other ones in its dirty white and little rimose thallus, chemistry (with gyrophoric acid present in trace amounts only) and ecology (protected rock faces). It may prove to be an undescribed species.

**Specimen seen:** Wijdefjorden, N of Flatoyrldalen, 2002, T. Tønsberg (BG).

## SPORODICTYON A. Massal. (1852)

Thallus crustose, areolate, with trebouxioid algae. Perithecia covered with thalline margin, protruding part black. Ascospores pale to dark brown, muriform. Thallus usually associated with cyanobacteria in weakly defined cephalodia. The species have previously usually been included in *Polyblastia* (see Savić 2007, Savić & Tibell 2009).

Key to *Sporodictyon* on Svalbard:

1	Ascospores uncoloured or yellowish when old .....	<i>S. terrestre</i>
1	Ascospores brown when old .....	2
2	Thallus thin; ascospores 50–70 µm long .....	<i>S. cruentum</i>
2	Thallus thick; ascospores 63–77 µm long .....	3
3	Perithecia initiated from centre of areolae, perithecium cover regular .....	<i>S. arcticum</i>
3	Perithecia initiated from below areolae, perithecium cover with outgrowths .....	<i>S. schaerelianum</i>

*S. arcticum* S. Savić & Tibell (2009)

**Thallus** as scattered, grey areolae 0.5–0.8 mm diam. Cephalodia usually present, up to 0.6 mm diam., red-brown to dark brown, encrusting the areolae or inserted in them, with *Nostoc*. **Perithecia** 0.8–1.2 mm diam., initiated in centre of areolae, subglobose, almost covered by thalline exciple and only ostiole visible. Involucrellum prominent, reaching down to base. Exciple brown in upper part, merging with involucrellum, pale in lower part. Ascospores 8 in asc, dark brown, muriform, 63–77 × 36–43 µm.

**Ecology.** On Ca-rich rock.

**Distribution.** Rare

**Notes.** This species differs from the closely related *S. schaerelianum* in its perithecia which

are initiated in the centre of the areolae, and the ± smooth and uniform cover of the perithecia. World distribution: Svalbard including Bjørnøya, Novaya Zemlya, North America (Greenland) (Savić & Tibell 2007).

**Specimens seen** (selected): Adventfjorden, Hiorthhamna, 24.7.1936, E. Dahl (O); Barentsøya, between Steinbeisfjellet and Kapp Wojelkow [Kapp Voejkov], 1.8.1936, E. Dahl(O).

### *Sporodictyon cruentum* (Körber) Körber (1863)

**Thallus** superficial, gelatinous, olivaceous green. **Perithecia** sessile, up to 0.8 mm broad, with well-developed thalline margin; involucellum well-developed, reaching to base of perithecium; true exciple colourless. Ascospores 8 per ascus, pale brown, muriform, 50–70 × 25–30 µm.

**Ecology.** On wet to submerged rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), Australia, New Zealand.

**Specimen seen:** Amsterdamøya, 26.8.1936, E. Dahl (O).

### *Sporodictyon schaeerianum* A. Massal. (1852)

Fig. 29 (p. 232).

**Thallus** as small, up to 0.8 mm diam., grey, convex, scattered to contiguous areolae. Cephalodia present, up to 0.7 mm diam., red-brown to dark brown, encrusting the areolae or inserted in it, verrucose, with *Nostoc*. **Perithecia** up to 1 mm diam., initiated from below areolae, covered with thalline tissue with outgrowths; ostiole part black. Involucellum prominent, reaching to base of perithecium. True exciple pale brown. Ascospores 2 per arscus, 48–52 × 30–34 µm, muriform, brown.

**Ecology.** On sandstone

**Distribution.** Not uncommon.

**Note.** World distribution: Europe.

**Specimens seen** (selected): Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O); Barentsøya, between Steinbeisfjellet and Kapp Wojelkow [Kapp Voejkov], 1.8.1936, E. Dahl (O).

### *Sporodictyon terrestre* (Th. Fr.) S. Savic & Tibell (2008)

Syn. *Polyblastia sommerfeltii* Lyngé (1937).

**Thallus** subsquamulose, uneven, thick, grey-green to grey-brown, effuse. **Perithecia** 0.4–0.8 mm diam., with a fairly thick thalline margin with algae; involucellum subentire, exciple colourless to yellowish. Ascospores 8 per ascus, muriform, colourless to yellowish, 50–80 × 25–35 µm.

**Ecology.** On basic rock.

**Distribution.** A few scattered localities.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Green Harbour [Grønfjorden], Th.M. Fries 1868 (O); Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

**SQUAMARINA** Poelt (1958)

**Thallus** squamulose, often pruinose. Photobiont trebouxiod. **Ascomata** apothecia, with thalline exciple. Ascii of *Bacidia*-type. Ascospores 8 per ascus, simple, uncoloured. Hamathecium of paraphyses, little ramified. Conidia filiform.

*Squamaria poeltii* Vänskä (1995)

**Thallus** squamulose; squamules thick, 1–2 mm broad, 2–4 mm long, pale cream-yellow, bluish black along edge. **Apothecia** up to 1 mm diam., broadly sessile; thalline margin prominent, concolorous with thallus; disc flat, brown-black to black. Hymenium 60–65 µm high; epithecium olive-brown. Hypothecium colourless. Ascospores 8 per ascus, colourless, elliptic, 8–10 × 6–7 µm. Paraphyses branched; end cell enlarged to 3 µm diam.

**Chemistry.** Usnic acid.

**Ecology.** On siliceous rock.

**Distribution.** A few scattered occurrences.

**Notes.** Very close to *S. scopulorum* Haugan & Timdal (1992), which occurs in mainland Norway and Sweden. World distribution: Europe (Novaya Zemlya, Svalbard), North America (Greenland).

**Specimens seen** (selected): Sørøstkysten [Sørøst-Spitsbergen], S side of Kvalhovden, 30.7.1936, E. Dahl (O); Forsbladhamna, 29.7.1926, B. Lynge (O).

**STAUROTHELE** Norman (1853)

**Thallus** crustose, superficial or immersed in substrate; no lichen compounds. Photobiont *Stichococcus*. **Ascomata** perithecia, immersed in thallus or superficial. Hymenial algae present, apparently the same as in thallus. Involucellum present or absent. Ascii of *Verrucaria*-type. Ascospores 2–8 per ascus, muriform, colourless to brown. Hamathecium of periphyses; paraphyses absent. Conidia bacilliform.

Key to *Staurothele* on Svalbard:

1	Ascospores up to 26 µm long .....	<i>S. arctica</i>
1	Ascospores 37–42 µm long .....	2
2 (1)	Thallus thin; perithecia protruding .....	<i>S. fuscocuprea</i>
2	Thallus thick; perithecia completely covered .....	<i>S. areolata</i>

*Staurothele arctica* Lynge (1937)

**Thallus** very scanty, dark brown. **Perithecia** 0.5–0.15 mm wide, with constricted base. No involucellum; true exciple prominent, black, colourless below base. Ascospores 2 per ascus, brown, muriform, 24–26 × 10–12 µm. Hymenial algae rectangular, 7–8 × 0.5 µm.

**Ecology.** On hard rock.

**Distribution.** Only known from Hopen.

**Notes.** Differs from *S. fuscocuprea* in its smaller ascospores with fewer septa, and the almost complete lack of thallus. New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimen seen:** Hopen, Lyngefjellet, 15.9.1930, "M/S Sotra" (O).

#### *Staurothele areolata* (Ach.) Lettau (1912)

**Thallus** thick, warm brown, rimose-areolate, up to 2–3 cm diam. **Perithecia** completely immersed in areolae except for a minute, protruding ostiole, up to 0.4 mm diam. Involucellum in upper half; true exciple pale but with dark spots. Ascospores 2 per ascus, brown, muriform, 37–42 × 18–20 µm. Hymenial algae rectangular, 8–9 × 1 µm.

**Ecology.** On dry limestone, ornithocorophilic.

**Distribution.** Common and widespread.

**Notes.** Differs from *S. fuscocuprea* in its thick, 'warm-brown' thallus with perithecia completely immersed in areolae, i.e. the whole involucellum covered by thalline tissue. The thallus of *S. fuscocuprea* is very variable, but the colour is always dark dull-brown, with a greyish tinge, and the upper part of the involucellum is always visible. *S. arctica* differs in its considerably smaller ascospores and very scanty thallus. World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Gipsdalen, A. Elvebakk 85:322 (TROM); Gipsdalen, Aug. 1986, D.O. Øvstedral (BG).

#### *Staurothele fuscocuprea* (Nyl.) Zschacke (1913)

**Thallus** thin, extensive, dull dark brown, rimose. **Perithecia** up to 0.3 mm diam.; involucellum in upper part, protruding, black; true exciple pale. Ascospores 2 per ascus, brown, muriform, 38–42 × 16–20 µm. Hymenial algae shortly rectangular, 4–6 × 1.5 µm.

**Ecology.** On schists, sandstone and limestone.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, North America (Greenland).

**Specimens seen** (selected): Berzeliusfjellet, 21.8.1926, B. Lynge (O); Forsbladhamna, 29.7.1926, B. Lynge (O).

#### **STEREOCAULON** Hoffm. (1796)

**Thallus** of a) a primary, crustose to squamulose thallus which in most cases is evanescent, and b) a secondary thallus of pseudopodetia (not always present), corticated or not, ± covered with squamulose or wart-like phyllocladia. Photobiont trebouxiod. Cephalodia present, containing cyanobacteria (*Stigonema* or *Nostoc*). Medulla lax. Axis of chondroid tissue. **Ascomata** apothecia, terminal; thalline margin not present. Asci of *Porpida*-type. Ascospores 8 per ascus, colourless, mostly acicular, septated, in one species muriform. Hamathecium of paraphyses, simple. Conidia cylindrical to filiform.

Key to *Stereocaulon* on Svalbard:

1	With primary thallus only; no pseudopodetia .....	<i>S. cumulatum</i>
1	With pseudopodetia .....	2
2 (1)	Primary thallus present .....	3
2	Primary thallus absent .....	4
3 (2)	Pseudopodetia sorediate .....	<i>S. capitellatum</i>
3	Pseudopodetia not sorediate .....	<i>S. glareosum</i>
4 (2)	Phyllocladia shield-like .....	5
4	Phyllocladia not shield-like .....	6
5 (4)	On rock .....	<i>S. vesuvianum</i>
5	On soil .....	<i>S. arcticum</i>
6 (4)	With lobaric acid .....	7
6	Without lobaric acid .....	9
7 (6)	Growing firmly attached to rock .....	<i>S. compactum</i>
7	Loosely attached, among bryophytes .....	8
8 (7)	All phyllocladia digitate .....	<i>S. alpinum</i>
8	Both digitate and papilliform phyllocladia present .....	<i>S. grande</i>
9 (6)	With stictic acid .....	<i>S. tomentosum</i>
9	Without stictic acid .....	10
10 (9)	Pseudopodetia erect; firmly attached to stone .....	<i>S. botryosum</i>
10	Pseudopodetia decumbent; loosely attached among bryophytes .....	11
11 (10)	With bourgeanic acid .....	<i>S. depressum</i>
11	Bourgeanic acid absent .....	12
12 (11)	With miriquidic acid .....	<i>S. groenlandicum</i>
12	Without miriquidic acid .....	13
13 (12)	With perlatolic, anziaic or lobaric acids .....	<i>S. rivulorum</i>
13	With porphyrylic acid .....	<i>S. botryosum</i>

*Stereocaulon alpinum* Laur. (1827)

Primary thallus not seen. Pseudopodetia up to 3 cm high, mostly growing in dense cushions, dying away at base. Main stem distinct, with a thick, grey tomentum. Phyllocladia verrucose to crenulated-squamulose. Cephalodia small, botryose, brownish to bluish, with *Nostoc*. **Apothecia** not found in Svalbard material.

**Chemistry.** Atranorin and lobaric acid.

**Ecology.** Among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen (selected):** Gipsvika, A. Elvebakk 85:705 (TROM); Sørøstkysten [Søraust-Spitsbergen], Kvalhovden, 30.7.1936, E. Dahl (O).

***Stereocaulon arcticum*** Lynge (1938)

Primary thallus not seen. Pseudopodetia decumbent, to 3 cm long, dying away at base, growing single or in tufts. Main stem distinct, with grey tomentum. Phyllocladia peltate, with green-grey centers and pale margins. Cephalodia small, red-brown, botryose, with *Nostoc*. **Apothecia** not seen.

**Chemistry.** Atranorin and stictic acid.

**Ecology.** On soil in snowbeds.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Siberia, North America (including Greenland).

**Specimens seen** (selected): Sydpolkysten [Søraust-Spitsbergen], Kvalhovden, 30.7.1936, E. Dahl (O), Nordvestkysten [NW Spitsbergen], Kvædfjordbukta, 4.7.1936, E. Dahl (O).

***Stereocaulon botryosum*** Ach. em. Frey (1933)

Primary thallus not seen. Pseudopodetia attached to rock (or on soil, see Notes below), in tufts, radiating from a center; base often ochraceous. Main stem branched, with perpendicular, stout branches. Phyllocladia concentrated towards tip of branches, granular to verrucose. Cephalodia inconspicuous, bluish, botryose, with *Nostoc*.

**Chemistry.** Atranorin and porphyrylic acid.

**Ecology.** On rock or soil.

**Distribution.** Widespread.

**Notes.** A few specimens were growing on soil and had very small, granulose phyllocladia. However, the general appearance and chemistry were like that of typical *S. botryosum*. World distribution: Europe, Asia, North America (including Greenland), Argentina.

**Specimens seen** (selected): Kong Karls Land, Retziusfjellet, 12.8.1936, E. Dahl (O); Ny-Ålesund, 4.7.1936, E. Dahl (O).

***Stereocaulon capitellatum*** H. Magn. (1926)

Primary thallus as crenulated, flat, conglomerated, grey areolae, up to 0.7–0.8 mm broad. Cephalodia between areolae, red-brown, convex, up to 1 mm broad. Pseudopodetia with a distinct main stem, up to 4 mm high, with small branches perpendicular to stem. Sometimes the side branches are numerous giving the pseudopodetia a subglobose appearance. Phyllocladia flattened verruciform, crowded towards tips of stems, sorediate. Pseudopodetial cephalodia few, small, grey-blue, inconspicuous, high up on pseudopodetia. Soredia  $26.9 \pm 3.20 \mu\text{m}$  (20–31  $\mu\text{m}$ ). **Apothecia** not seen.

**Chemistry.** Atranorin, anziaic, perlatolic acids.

**Ecology.** On sandy, moist soil.

**Distribution.** Only known from Reindalen and Ny-Ålesund.

**Notes.** A distinct primary thallus in *S. capitellatum* has apparently not been observed previously, as it was not mentioned in Lamb (1977, 1978), Krog et al. (1994), Carlin & Silväng (1982) or Thomson (1984). World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Reindalen, Reindalspasset, alt 190 m, 1990, A. Elvebakk s.n. (TROM); Ny-Ålesund, 1973, D.O. Øvstedral (BG, Lamb det 1975).

***Stereocaulon compactum* (I.M. Lamb) Øvstdal comb. nov.**

Basionym: *Stereocaulon intermedium* f. *compactum* I.M. Lamb.— J. Hattori Bot. Lab. 43: 223 (1977). Type: Alaska, G.A. Llano 1277 (US!).

Primary thallus absent. Pseudopodetia up to 10 mm high, erect, ramified; main stem little distinct, up to 0.8 mm wide, tomentose; tomentum pale grey to pale ochre. Phyllocladia wart-like to indistinct coralloid. Cephalodia inconspicuous, pale bluish, in lower parts of stems, almost hidden in tomentum. **Apothecia** terminal, up to 4 mm broad, when young with pseudomargin.

**Chemistry.** Atranorin and lobaric acid.

**Ecology.** Firmly attached to rock.

**Distribution.** A few scattered occurrences.

**Notes.** The five specimens known from Svalbard are similar to the type in diagnostic characters. In the type the pseudopodetia are less firmly attached to rock and the cephalodia are somewhat larger and more concentrated in the upper part of the pseudopodetia. It is clearly different from *S. intermedium* s. str. New to Svalbard and Europe. World distribution: Arctic Europe, North America.

**Specimens seen** (selected): Lady Franklinfjorden, Lågøya, 19.8.1936, E. Dahl (O); Nordkysten [Nord-Spitsbergen], Velkomstpynten, 26.8.1936, E. Dahl (O).

***Stereocaulon cumulatum* (Sommerf.) Timdal (2002)**

**Thallus** up to 3–4 cm wide, crustose, white, composed of bullate areolae; areolae 0.2–0.4 mm wide. Pseudopodetia absent. **Apothecia** crowded, brown-black, flattened convex, emarginate, up to 0.3 mm diam. Hymenium 60–70 µm high; uppermost part green-brown. Hypothecium brown-black. Ascospores 8 per ascus, uncoloured, 1(–3)-septate, 13–18 × 4–5 µm. Paraphyses strongly ramified, adglutinated.

**Chemistry.** Atranorin, lobaric acid.

**Ecology.** Growing over bryophytes, often with *Arctomia delicatula*.

**Distribution.** Scattered.

**Note.** World distribution: Europe, Asia, North America.

**Specimens seen** (selected): Gipsvika, A. Elvebakk 85:701 TROM); Ny-Ålesund, 4–5.7.1936, E. Dahl (O).

***Stereocaulon depressum* (Frey) Lamb (1969)**

Primary thallus not seen. Pseudopodetia firmly attached to rock, decumbent, growing in dense tufts. Main stem indistinct, strongly ramified, with a thin grey tomentum. Phyllocladia wart-like to squamulose. Cephalodia inconspicuous, botryose, bluish. **Apothecia** terminal, brown, up to 5 mm diam., saddle-formed. Ascospores 2–3-septate, 18–22 × 2.5–3 µm.

**Chemistry.** Atranorin and bourgeanic acid.

**Ecology.** On rock.

**Distribution.** Only known from Reindalen

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9910 (BG); Reindalen, A. Elvebakk 86:511 (TROM).

***Stereocaulon glareosum* (Sav.) H. Magn. (1928)**

Primary thallus as up to 1 mm long terete, grey papillae, with brown cephalodia between papillae. Pseudopodetia up to 10 mm high, with a distinct main stem. Phyllocladia as small papillae. Cephalodia small, bluish, botryose, high up on pseudopodetia. **Apothecia** not seen.

**Chemistry.** Atranorin, lobaric acid

**Ecology.** On soil.

**Distribution.** Rare.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America.

**Specimen seen:** Reindalspasset, 1981, A. Elvebakk s.n. (TROM).

***Stereocaulon grande* (H. Magn.) H. Magn. (1928)**

Pseudopodetia up to 4 cm high, slightly dorsiventral. Phyllocladia of two kinds, 1) flattened, with digitate outgrowths at margin (like those of *S. alpinum*), 2) clusters of papillae (similar to those of *S. paschale*). Tomentum grey. Cephalodia in upper part of pseudopodetia, small, bluish, partly hidden by tomentum. **Apothecia** not seen.

**Chemistry.** Atranorin, lobaric acid.

**Ecology.** Among bryophytes.

**Distribution.** Only known from Sørkapp.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimen seen:** Sørkapp, 1985, M. Olech (KRA-L).

***Stereocaulon groenlandicum* (E. Dahl) I.M. Lamb (1973)**

Primary thallus absent. Pseudopodetia up to 3 cm high, subdecumbent, little ramified, ligneous, pale grey, glabrous, up to 0.8 mm thick at base. Phyllocladia grey, wart-like to digitate squamiform. Cephalodia in upper part of pseudopodetia, inconspicuous, grey, woolly, up to 0.9 mm diam. **Apothecia** terminal, up to 5 mm broad, emarginate. Hymenium 40–50 µm high. Ascospores fusiform, 30–34 × 4–4.5 µm, 3-septate.

**Chemistry.** Atranorin, ± miriquidic acid (trace).

**Ecology.** Firmly attached on gravelly soil and small pebbles.

**Distribution.** Rare.

**Notes.** There are three specimens from Svalbard determined by Lamb, one has atranorin only while the two others have atranorin and traces of miriquidic acid. The specimens have main stems distinctly more ligneous and prominent than most *S. rivulorum* collections seen from Svalbard, but there are intermediate specimens which are difficult to classify. The chemical content of the type is atranorin, perlatolic, anziaic, miriquidic acid plus accessories, but Lamb (1977: 221) writes that a deficient phase with only atranorin is of moderately common occurrence. We are in doubt about the status of this taxon, as it is close to the variable *S. rivulorum* in morphological characters. However, we accept *S. groenlandicum*, as it seems to be chemically distinct. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** Isfjorden, west coast of Grønfjorden, Aug. 1966, Univ. of Turku Expedition to Spitzbergen (TUR, 3 collections).

***Stereocaulon rivulorum*** H. Magn. (1926)

Primary thallus not seen. Pseudopodetia 1–2 cm high, decumbent to somewhat ascending, richly branched. Main stem indistinct, with a pink tomentum. Phyllocladia granular to elongated. Cephalodia inconspicuous, pink to brownish. **Apothecia** terminal, brown, up to 5 mm diam., saddle-formed. Ascospores 1–3 septate, 16–26 × 2–5 µm.

**Chemistry.** Three chemotypes found: 1) atranorin only (most specimens); 2) atranorin and lobaric acid; 3) atranorin, perlatolic, anziaic acids.

**Ecology.** On sand, gravel and among bryophytes.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Lady Franklinfjorden, Lågøya, 19.8.1936, E. Dahl (O); Longyearbyen, 23.7.1936, E. Dahl (O).

***Stereocaulon tomentosum*** Fr. (1825)

Primary thallus not seen. Pseudopodetia subdecumbent, 2–3 cm high, with grey tomentum. Phyllocladia crenate-squamulose. Cephalodia indistinct, botryose, bluish, in upper part of pseudopodetia.

**Apothecia** not seen.

**Chemistry.** Atranorin and stictic acid.

**Ecology.** Among bryophytes.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, Asia, North America (including Greenland), southern South America.

**Specimens seen** (selected): Sørkapp, 16.7.1970, Sig. Kristoffersen (TROM); Nordaustlandet, Brenneviksbukta [Brenneviksforden], 21.8.1936, E. Dahl (O).

***Stereocaulon vesuvianum*** Pers. (1811)

Primary thallus not seen. Pseudopodetia attached to rock; main stem distinct, without tomentum, sorediate. Phyllocladia peltate, with grey-green central part and whitish margin. Cephalodia brown, with *Stigonema*. Soralia on top of small branchlets terminal on pseudopodetia. **Apothecia** not seen in Svalbard material.

**Chemistry.** Atranorin and stictic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Ytre Norskøya, 2.7.1928, O.A. Høeg (TRH); Longyearbyen, 5.7.1936, E. Dahl (O).

**TEPHROMELA** M. Choisy (1929)

**Thallus** crustose, warted to areolate. Photobiont trebouxioid. **Ascomata** apothecia, sessile to immersed; disc black; thalline margin present or absent. True margin thin, usually inconspicuous. Epitheciun and/or hymenium mostly with violet, N + red pigments. Asci of *Bacidia*-type. Ascospores 8 per ascus,

simple, colourless, thick-walled. Hamathecium of paraphyses, simple or sparsely branched; end cells with a gelatinous coat swelling in water; lumina distinct. Conidia filiform.

**Note.** Hafellner & Türk (2001) describe *Calvitimela* as a segregate of *Tephromela* comprising the species without a redbrown pigment in the hymenium. Below we treat *Tephromela* in the wide sense (including *Calvitimela*) as there are species of *Tephromela*, e.g. in the Southern Hemisphere, which have yet to be studied in this context.

Key to *Tephromela* species on Svalbard:

1	Thallus sorediate .....	<i>T. lucifuga</i>
1	Thallus not sorediate .....	2
2 (1)	Apothecia with thalline margin .....	<i>T. atra</i>
2	Apothecia with true margin only .....	3
3 (2)	Thallus yellowish (with usnic acid) .....	<i>T. aglaea</i>
3	Thallus pale bluish to greenish-green, ochre or red-brown (usnic acid absent) .....	4
4 (3)	Thallus PD – (atranorin, bourgeanic acid and zeorin present) .....	<i>T. lucifuga</i>
4	Thallus PD + sulphuric yellow (alectorialic acid or psoromic acid present) .....	5
5 (4)	Thallus with psoromic acid; ascospores broadly elliptic (8–10 × 6–7 µm) .	<i>T. melaleuca</i>
5	Thallus with alectorialic acid; ascospores elliptic (10–12 × 5–6 µm) .....	<i>T. armeniaca</i>

#### *Tephromela aglaea* (Sommerf.) Hertel & Rambold (1985)

**Thallus** 5–10 mm wide, composed of ± adglutinated areoles; areoles round, convex, yellowish to grey-yellow, up to 2 mm wide, with blackened margin. **Apothecia** black, without thalline margin, convex, up to 1.1 mm wide. True exciple soon excluded, composed of radiating hyphae. Hymenium 90–100 µm high; uppermost part blue-green. Hypothecium brown. Ascospores 8 per ascus, 9–11 × 4–5 µm. Paraphyses with end cells 7–8 µm wide; lumina 2–3 µm wide.

**Chemistry.** Usnic acid.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** We have only found usnic acid in Svalbard specimens. According to Haugan & Timdal (1994) this would indicate that Svalbard material are best assigned to *T. agaeida* Nyl., known from Siberia and Alaska. However, as Haugan & Timdal (1994) could not find any taxonomically important differences between *T. agaeida* and *T. aglaea*, we believe that the Svalbard material is best assigned to *T. aglaea* in spite of the lack of chemical constituents other than usnic acid. World distribution: circumpolar.

**Specimen seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O).

#### *Tephromela armeniaca* (DC.) Hertel & Rambold (1985)

**Thallus** areolate, on a blackish prothallus; areolae dispersed to crowded, flat, chestnut brown, to 1 mm wide. **Apothecia** up to 3 mm wide, black, flat. Hymenium 120–130 µm high; uppermost part blue-green. Ascospores elliptic, 10–12 × 5–6 µm. Paraphysse end cells 4–6 µm wide; lumina 1.5–2 µm wide. Hypothecium yellowish.

**Chemistry.** Alectorialic, rangiformic, and norrangiformic acids.

**Ecology.** On rock.

**Distribution.** A few scattered occurrences.

**Notes.** There are two entities of the *T. armeniaca* complex in Svalbard which differ both morphologically and chemically. One has chestnut-brown areolae and contains alectorialic, rangiformic and norrangiformic acids. It also has relatively narrower ascospores than the other entity, but since many specimens do not have apothecia, this is an insufficient character for separating them. The other entity has psoromic and roccellic acids. According to Hertel & Rambold (1985) and Rambold (1989), *T. armeniaca* has alectorialic acid, while the other actual taxon, *T. melaleuca*, has psoromic acid. However, according to Haugan & Timdal (1994), *T. armeniaca* invariably has alectorialic acid, while *T. melaleuca* may have any combination of alectorialic, norstictic and psoromic acid. The lectotype of *T. melaleuca* has alectorialic, psoromic and roccellic acid (Haugan & Timdal 1994). However, as the limited Svalbard material follows the traditional concept (i.e. that of Hertel & Rambold 1987), we choose to divide the material into *T. armeniaca*, with alectorialic, rangiformic and norrangiformic acids, and *T. melaleuca*, with psoromic and roccellic acids, since no other combinations are found, but we are fully aware that a larger material might show that there is only one variable species. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Barentsøya, Steinbeisfjellet, 2.8.1936, E. Dahl (O); Calypso-Sørhukten, 12.7.1926, B. Lynge (O).

### *Tephromela atra* (Huds.) Hafellner (1983)

**Thallus** crustose, areolate, white, thick, several cm wide. **Apothecia** with thalline margin, concolorous with thallus. Disc black. Hymenium pale violet, 80–95 µm high. Ascospores 15–18 × 9–11 µm. Paraphysis end cell 11–12 µm wide. Hypothecium brown.

**Chemistry.** Atranorin,  $\alpha$ -collatolic,  $\pm$  alectoronic acids.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Mitterhukten [Midterhukten], 6.8.1926, B. Lynge (O); Lomfjorden, 10.9.1868, Th.M. Fries (O).

### *Tephromela lucifuga* Øvstdal & Tønsberg sp. nov.

*Tephromelae atrae similis, sed sorediatus et atranorin, zeorin et acidum bourgeanicum continens.*

Type: Svalbard, Spitsbergen, Bjørndalen, N of the mine, along and uphill from the gravel road, 78°13.45'N, 15°19.99'E (WGS84), alt. 50–60 m, on the shaded and sheltered face of rock in scree, 27 June 2003, T. Tønsberg 31901 (BG—holotype).

Fig. 30 (p. 232).

**Thallus** crustose, 4–5 cm wide, areolate on an uneven, thin, white hypothallus; areolae unevenly dispersed, up to 1.5(–1.8) mm wide, irregularly rounded, sometimes becoming  $\pm$  cerebriform, pale bluish- to greenish-grey, matt, esorediate or sorediate. Sorediate areolae composed in upper part of fragile aggregations of consoredia, whitish within, green on the upper surface. Superficial consoredia to 0.12 mm, composed of green soredia, 20–30 µm diam. **Apothecia** single or 2–3 together, sessile, with uneven outline, up to 1.5 mm diam., sometimes with a conspicuous, white rim of pruina (crystals visible in K), when young flat with thin black true margin, when old convex with true margin persisting; disc black, rough, thinly white-pruinose. True exciple 130–140 µm wide, blue-green (*Cinererorufa*-

green of Meyer & Printzen 2000) and with minute granules in outer part, composed of thick, swollen radiating hyphae; pigment K -. At surface hyphae 10 µm broad; lumina distinct, small. Hymenium 65–80 µm high; uppermost part greenish, K -, N + blue turning purplish/reddish (with traces of *Cinereorufa*-green). Epiphyllum with crystals (pruina). Paraphyses stout, little ramified, 1–2 µm wide; end cells 4–4.5 µm wide, with visible lumina. Ascii clavate to subcylindrical, 45–55 × 9–13 µm. Ascospores 8 per ascus, often bi- or sub-uniseriately arranged in ascii, mostly broadly elliptic, more rarely subglobose to globose, 8–12 × 5–8 µm, thin to thick-walled. Hypothecium colourless to yellowish or brownish (traces of *Cinereorufa*-green, and unidentified brownish pigment).

**Chemistry.** Atranorin, zeorin, bourgeanic acid.

**Ecology.** On the shaded and sheltered lower side of rocks in scree.

**Distribution.** Only known from Bjørndalen.

**Notes.** The development of soredia in this species may be confined to specimens growing in particularly shaded and dry habitats. Soredia were observed only in the holotype which also had a few esorediate areolae at the margin of the thallus near the edge of the rock surface supporting the specimen. *Opegrapha gyrocarpa* and *Lecanora caesiosora*, both typical species of shaded overhangs, were close associates (i.e., occurring with *T. lucifuga* on the same small piece of rock).

**Specimens seen** (additional): W of Longyearbyen, Bjørndalen, N of the mine, just uphill from the road, 78°13.41'N, 15°19.99'E, alt. 60 m, saxicolous on shaded and sheltered surfaces in W-facing scree, 27 July 2003, T. Tønsberg 31891, 31892 (BG).

#### *Tephromela melaleuca* (Sommerf.) Haugan & Timdal (1994)

**Thallus** areolate on a thick black hypothallus; areolae dispersed, to 2 mm wide, yellow-grey, glossy, convex. **Apothecia** up to 2 mm diam., often saddle-like. Hymenium 140–150 µm high; uppermost part blue-green. Ascospores broadly elliptic, 8–10 × 6–7 µm. Paraphysis end cells 4–6 µm wide; lumina 2–3 µm wide. Hypothecium pale in upper part, yellow-brown in lower part.

**Chemistry.** Psoromic, and roccellic acids.

**Ecology.** On rock.

**Distribution.** Common.

**Notes.** See comments under *T. armeniaca*. World distribution: circumpolar.

**Specimens seen** (selected): Recherche Bay [Recherchefjorden], 17.7.1926, B. Lynge (O); Sveagruva, 13.8.1926, B. Lynge (O).

#### THAMNOLIA Ach. ex. Schaeerer (1850)

**Thallus** fruticose, decumbent, white, somewhat ramified, terete. Cortex pseudoparenchymateous. Medulla thin, composed of longitudinally oriented hyphae. Central part hollow. Photobiont trebouxoid. **Apothecia** and pycnidia unknown.

#### *Thamnolia vermicularis* (Sw.) Schaeerer (1850)

**Thallus** fruticose, white, decumbent, often in small tufts, simple or irregularly branched, up to 4 cm long and 2 mm wide, hollow. Some pointed, short, lateral branches usually present.

**Chemistry.** Baeomycetic and squamatic acids.

**Ecology.** On soil and among bryophytes.

**Distribution.** Common and widespread.

**Notes.** Only var. *subuliformis* (Ehrh.) Schaefer is known from Svalbard. World distribution: cosmopolitan.

**Specimens seen** (selected): Wijdefjorden, A. Elvebakk 01:151 (TROM); Red Bay [Raudfjorden], 21.7.1928, O.A. Høeg (TRH).

### THELENELLA Nyl. (1855)

**Thallus** crustose, rimose to bullate. Photobiont green algae. **Ascomata** perithecia, often immersed. Involucellum present in some species. Ascii with thick double wall, K/I –, 1–8-spored. Hamathecium composed of paraphyses which are branched and anastomosing, and periphysoids. Ascospores muriform, colourless to pale brown. Conidia filiform.

#### *Thelenella sordidula* (Th. Fr.) H. Mayrh. (1987)

**Thallus** crustose, thin, rimose, green-grey. **Perithecia** up to 0.8 mm diam.; ostiole and surrounding area black, protruding. Excipule brown in upper part, pale in lower. Ascospores 8 per ascus, muriform, 24–30 × 9–13 µm.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Only known from Colesdalen.

**Notes.** New to Europe and Svalbard. World distribution: arctic Europe, arctic Canada, Greenland.

**Specimen seen:** Colesdalen, 2002, R. Haugan 6821 (O; det. A. Fryday 2004).

### THELIDIUM A. Massal (1855)

**Thallus** crustose, superficial to immersed. Photobiont green algae. **Ascomata** perithecia, sessile or immersed in thallus or pits in rock. Involucellum present or absent. True excipule brown or colourless. Ascii with ocular chamber and K/I – thickening at apex. Ascospores 8 per ascus, colourless, 1–5 septate. Hamathecium of paraphyses; paraphyses absent.

Key to *Thelidium* on Svalbard:

1	Ascospores 1-septate .....	2
1	Ascospores 3-septate .....	6
2 (1)	Ascospores >30 µm long .....	<i>T. aeneovinosum</i>
2	Ascospores smaller .....	3
3 (2)	Thallus granulate, black .....	<i>T. minimum</i>
3	Thallus continuous, grey to grey-brown .....	4

4 (3)	Perithecia in pits in limestone .....	<i>T. decipiens</i>
4	Perithecia sessile .....	5
5 (4)	Thallus grey, thick; ascospores 9–11 µm long .....	<i>T. microsporum</i>
5	Thallus thin, grey-brown; ascospores 18–22 µm long .....	<i>T. antoniellum</i>
6 (1)	Thallus epilithic .....	7
6	Thallus endolithic .....	<i>T. papulare</i>
7 (6)	Thallus thin, grey-green .....	<i>T. cataractarum</i>
7	Thallus thick, white .....	<i>T. pyrenophorum</i>

***Thelidium aeneovinosum* (Anzi) Arnold (1868)**

Fig. 31 (p. 233).

**Thallus** thin, dark brown, often with a violet tinge, 2–3 cm wide. **Perithecia** sessile, without thalline covering, 0.3–0.4 mm broad. Involucellum halfway down the perithecium, somewhat spreading. Exciple dark brown. Ascospores 8 per ascus, 1-septate, 30–33 × 9–11 µm.

**Ecology.** On wet sandstone, often with *Eiglera flava* and *Hymenelia heteromorpha*.

**Distribution.** Common and widespread.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Blåhuken 16.8.1926, B. Lynge (O; det. A. Orange 2003); Sveagruva, 13.8.1926, B. Lynge (O).

***Thelidium antoniellanum* Bagl. & Car. (1881)**

Fig. 32 (p. 233).

**Thallus** several cm across, thin, smooth, grey-brown. **Perithecia** black, 0.1 mm diam., semiglobose. Involucellum distinct, reaching to base of perithecium. Exciple entire, dark brown. Ascospores 8 per ascus, 18–22 × 8–10 µm, 1-septate.

**Ecology.** On hard crystalline rock.

**Distribution.** Only known from Amsterdamøya.

**Note.** World distribution: Europe.

**Specimen seen:** Amsterdamøya, 1975, H. Hertel 16481 (M).

***Thelidium cataractarum* (Hepp) Lönroth (1859)**

**Thallus** thin, grey-green, cracked. **Perithecia** up to 0.3 mm diam., black, sessile, flattened. Involucellum in upper part only. True exciple brown in upper part, pale in lower. Ascospores 8 per ascus, 3-septate, constricted at septa, 32–34 × 13–14 µm.

**Ecology.** On limestone.

**Distribution.** Rare

**Notes.** In Svalbard previously only known from Bjørnøya. World distribution: Europe.

**Specimen seen:** Kong Karls Land, Hårfagrenuten, 11.8.1936, E. Dahl (O).

***Thelidium decipiens*** (Nyl.) Krempelh. (1861)

**Thallus** endolithic, or forming whitish patches on rock. **Perithecia** immersed in pits in limestone, 2–2.5 mm diam. Involucellum not present, exciple brown. Ascospores 8 per ascus, 1-septate, 20–30 × 10–15 µm.

**Ecology.** On limestone.

**Distribution.** Only known from Gipsdalen.

**Notes.** New to Svalbard. World distribution: Europe, Siberia.

**Specimen seen:** Gipsdalen, Aug. 1987, D.O. Øvstdal (BG).

***Thelidium microsporum*** Lyngé (1928)

**Thallus** 2–3 mm diam., grey, thick, rimose-areolate, with distinct marginal areolae. **Perithecia** 0.1–0.2 mm wide, half immersed in thallus, with ostiole partly depressed. Involucellum reaching almost to base of perithecium; exciple in upper part merging with involucellum, in lower part colourless. Ascospores 8 per ascus, broadly elliptic, 9–11 × 5–7 µm, 1-septate.

**Ecology.** On limestone, with *Thelidium pyrenophorum*, *Xanthoria elegans* and *Polyblastia theleodes*.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Van Keylenhavn [Van Keulenhamna], 6.8.1926, B. Lyngé (O); Gipsdalen, Aug. 1987, D.O. Øvstdal (BG).

***Thelidium minimum*** (Massal. in Nyl.) Arnold (1871)

**Thallus** as black granulate areoles 1–2 mm wide. **Perithecia** half immersed in areoles, up to 0.2 mm wide, black. Involucellum in upper half; exciple brown. Ascospores 8 per ascus, 12–15 × 6–7.5 µm, 1-septate.

**Ecology.** On red sandstone, with *Rhizocarpon geminatum*.

**Distribution.** Only known from Recherchefjorden.

**Notes.** This species is recognized by the dark, granulate thallus with semi-immersed perithecia, and the relatively small ascospores. New to Svalbard. World distribution: Europe, Siberia, North America.

**Specimen seen:** E side of Recherchefjorden, 17.7.1926, B. Lyngé (O).

***Thelidium papulare*** (Fr.) Arnold (1855)

Fig. 33 (p. 233).

**Thallus** endolithic. **Perithecia** sessile, 0.3–0.4 mm diam. Involucellum prominent, reaching to base of perithecium. Exciple brown. Ascospores 8 per ascus, 3-septate, 30–34 × 13–15 µm.

**Ecology.** On sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: Europe, North Africa, North America (including Greenland), Australia, New Zealand.

**Specimens seen** (selected): Blix Cape [Blixodden], 10.8.1926, B. Lyngé (O); Calypso Bay [Calypsostranda], 14.7.1926, B. Lyngé (O).

***Thelidium pyrenophorum* (Ach.) Mudd (1861)**

**Thallus** 2–3 cm wide, epilithic, ivory white, thick (0.3–0.4 mm). **Perithecia** mostly almost immersed in thallus, sometimes half emerging, up to 0.5 mm wide. Involucellum reaching halfway down the perithecium; exciple dark in upper 2/3. Ascospores 8 per ascus, 30–34 × 11–13 µm, 1-septate.

**Ecology.** On dry limestone.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen:** Kjærstranda, Ny-Ålesund, Aug. 1973, D.O. Øvstedral (BG); Kongsfjorden, 17.8.1868, Th.M. Fries (O).

**THELIGNYA** Massal. (1855)

**Thallus** squamulose, blackish, gelatinous when wet. Photobiont *Gloeocapsa*. **Apothecia** completely immersed in thallus, originating in hyphal bundles (“Hyphenknaüel”). Asci cylindrical, narrowing towards apex. Ascospores 8–16 per ascus, simple, colourless. Hamathecium paraphyses, anastomosing. Conidia subglobose.

***Thelignya lignyota* (Wahlenb.) P.M. Jørg. & Henssen (1989)**

**Thallus** 1–2 cm wide, fissured-areolate, black; areolae up to 1 mm wide, thick, with scurfous surface. **Apothecia** seen as minute, black, concave discs 0.05 mm diam. Hymenium 75–80 µm high; epithecium with a bluish tinge. Hypothecium pale brown. Upper part of true exciple bluish. Ascospores 8 per ascus, broadly elliptic, 9–11 × 5–7 µm. Paraphyses anastomosing.

**Chemistry.** Negative.

**Ecology.** On weakly acidic sandstone.

**Distribution.** Rare.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimen seen:** Kjellstrømdalen, Aug. 1986, D.O. Øvstedral (BG).

**THELOCARPON** Nyl. (1853)

**Thallus** as raised warts or a thin crust at base of apothecia, usually inconspicuous. Photobiont green algae, in some species absent. **Ascomata** apothecia, perithecium-like with a narrow opening; exciple colourless. Asci 50–300-spored, flask-shaped, thin-walled; tip not or slightly thickened, K/I + blue or K/I -. Ascospores small, simple, colourless. Hamathecium of periphyses, present or absent, simple to branched to anastomosing. Paraphyses present or absent. Condida elongate.

**Note.** Some species are parasitic on other lichens.

***Thelocarpon epibolum*** Nyl. (1866)

**Thallus** as scattered yellow conical warts, up to 0.05 mm wide and high, with dark centre. No algae present. **Apothecia** up to 100 µm diam.; exciple 20–25 µm thick, colourless. Both periphyses and paraphyses present; paraphyses simple. Ascospores >50 per ascus, simple, colourless, elongate, 4–7 × 2–2.5 µm.

**Chemistry.** Vulpinic acid, pulvinic dilactone, pulvinic acid (according to Watson et al. 1992; Svalbard material not studied).

**Ecology.** On decaying lichens, often *Peltigera* spp.

**Distribution.** Rare.

**Note.** World distribution: Europe, Taimyr, North America (including Greenland).

**Specimens seen:** none seen; record based on Olech & Alstrup (1989), who reported specimens from Sørkapp Land.

**THROMBIUM** Wallr. (1831)

**Thallus** crustose, membranous, subgelatinous; photobiont green algae (*Leptosira*). **Ascomata** perithecia, with thalline margin, ostiole black. Involucellum absent. True exciple brownish. Ascii thin-walled, tholus K/I + blue, with narrow cylindrical axial mass, cap K/I + blue. Ascospores 8 in ascii, colourless, simple. Hamathecium of paraphyses, unbranched, thin. Pycnidia not known.

***Thrombium epigaeum*** (Pers.) Wallr. (1831),

**Thallus** very thin, as a grey-green film. **Perithecia** semiglobose, up to 0.7 mm diam., greyish, with a large, sunken, blackish ostiole area. No involucellum. Thalline exciple prominent. True exciple brown, 25–30 µm broad, in upper part enlarged to 120–130 µm broad. Ascospores 6–8 in ascii, simple, uncoloured, broadly elliptic, 30–36 × 20–26 µm. Paraphyses persistent, flexuose.

**Chemistry.** Not tested.

**Ecology.** On soil.

**Distribution.** Only known from Longyearbyen.

**Notes.** New to Svalbard. World distribution: Europe, Taimyr, North America (including Greenland), Chile, New Zealand.

**Specimen seen:** Adventfjorden, Longyearbyen, 5.7.1936, E. Dahl (O).

**TONINIA** Massal. (1852)

**Thallus** squamulose, grey to brown, often with lower cortex. **Ascomata** apothecia, black, sessile, with true exciple only. Ascii with a gelatinous, K/I + blue sheath, and a K/I + blue tholus with a stronger stained tube and an ocular chamber. Hamathecium paraphyses, simple to anastomosing with a swollen end cell with a gelatinous pigmented cap. Conidia bacilliform to thread-like. A small genus growing on soil and rock. See also *Mycobilimbia* and *Stereocaulon*.

Key to *Toninia* on Svalbard:

1	Epithecium grey, K + violet .....	<i>T. sedifolia</i>
1	Epithecium green or brown, K – .....	2
2 (1)	Hypothecium colourless .....	<i>T. squalida</i>
2	Hypothecium red-brown .....	3
3 (2)	Epithecium N + red; thallus with white spots .....	<i>T. aromatica</i>
3	Epithecium N –; thallus without white spots .....	<i>T. verrucarioides</i>

***Toninia aromatica* (Sm.) Massal. (1852)**

**Thallus** squamulose, up to 4 mm diam., grey to brown, flat to somewhat convex, with whitish spots on surface. **Apothecia** black, up to 1.5 mm diam., flat; margin persistent. Hymenium 70–80 µm high; epithecium greenish, K –, N + violet. Hypothecium dark red-brown. Ascospores 8 per ascus, 3-septate, bacilliform, 12–23 × 3–6 µm.

**Chemistry.** Negative.

**Ecology.** On soft rock and consolidated soil.

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by the pale spots on the thallus and the colour of the epithecium. World distribution: Europe, Siberia, North Africa, North America (including Greenland), Australia, New Zealand.

**Specimens seen:** none seen; included on the basis of Timdal (1991), who reported it from Sorgfjorden and Lomfjorden.

***Toninia sedifolia* (Scop.) Timdal (1991)**

**Thallus** squamulose; squamules up to 2 mm diam., convex with crenulated margins, white-blue pruinose. **Apothecia** flat-concave, black, somewhat pruinose, up to 2.5 mm diam.; marg thin. Hymenium 45–50 µm high; epithecium dark grey, K + red. Hypothecium red-brown. Ascospores 8 per ascus, 1-septate, 18–22 × 2.5–3 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous, silty soil, associated with *Protoblastenia terricola* and *Phaeorrhiza nimboosa*.

**Distribution.** Scattered on limestone soil.

**Notes.** The distinctly bluish pruinose squamules and K – reaction of the epithecium characterize this species. World distribution: cosmopolitan.

**Specimens seen** (selected): Moskudalen, Øvstedal 1988 (BG); Wijdefjorden, A. Elvebakk 01:149 (TROM).

***Toninia squalida* (Ach.) Massal. (1852)**

**Thallus** squamulose; squamules brown, up to 2 mm diam., often coalescent. **Apothecia** flat to somewhat convex, up to 1.5 mm diam., black. Hymenium 70–80 µm high; epithecium green, K –, N + red. Hypothecium colourless to pale brown. Ascospores 3–7-septate, acicular, 20–45 × 3–5 µm.

**Chemistry.** Negative.

**Ecology.** On calcareous rock.

**Distribution.** A few scattered localities.

**Notes.** Recognized by its pale hypothecium and 3–7-septate ascospores. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen:** none seen; included on the basis of Timdal (1991), who reported it from Prins Karls Forland.

### *Toninia verrucariooides* (Nyl.) Timdal (1991)

**Thallus** squamulose; squamules grey-brown, up to 2 mm wide. **Apothecia** up to 1 mm wide, flat, black, ± white pruinose; exciple persistent. Hymenium 70–80 µm high; epithecium brownish, K –, N –. Hypothecium dark red-brown. Ascospores 8 per ascus, 3-septate, bacilliform, 10–18 × 4–6 µm.

**Chemistry.** Negative.

**Ecology.** Growing on lichens with cyanobacteria (e.g. *Placynthium* spp.).

**Distribution.** A few scattered occurrences.

**Notes.** Recognized by the colour of its epithecium and lack of white spots on the thallus. World distribution: Europe, Chukotka, North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk F-134 (TROM); Kjellstrømdalen, Aug. 1986, D.O. Øvstedral (BG).

### **TRAPELIA** M. Choisy ( 1929)

**Thallus** squamulose to crustose. Photobiont trebouxioid. **Ascomata** apothecia, usually pinkish but may become almost black, globose when young, then bursting open from thallus tissue at apex. Thalline margin may or may not be persistent, true margin composed of pale hyphae, strongly adglutinated. Ascii with tholus which is laterally amyloid and with an amyloid apical cap. Ascospores 8 in ascii, simple, uncoloured. Hamathecium of paraphyses, branched to anastomosing, very thin, end cell not or little enlarged. Conidia cylindrical to thread-like.

### *Trapelia coarctata* (Sm.) M. Choisy ( 1932)

**Thallus** crustose, thin, pale ochre, with whitish, fluffy dots. **Apothecia** up to 1.1 mm wide, dark brown, often as 2–3 discs interlocked, true margin thin, slightly protruding, thalline margin not visible. Hymenium 130–140 µm high, epithecium pale brown, K + faintly violet. Ascospores 8 per ascus, broadly elliptic, 15–19 × 9–10 µm. Paraphyses thin, 1.5 µm wide, lax.

**Chemistry.** Gyrophoric acid.

**Ecology.** On sandstone.

**Distribution.** Only known from Kapp Laila.

**Notes.** New to Svalbard. World distribution: cosmopolitan.

**Specimen seen:** Kapp Laila, 1986, T. Tønsberg 9836 (BG).

**TREMOLECIA** M. Choisy (1953)

**Thallus** crustose, effuse, areolate, rust-coloured. Photobiont trebouxioid. **Ascomata** apothecia, immersed in thallus, black, with true exciple only. Ascii with non-amylloid tholus. Ascospores 8 per ascus, simple, colourless. Hypothecium dark brown. Hamathecium of paraphyses, branched and anastomosing. Conidia cylindrical.

*Tremolecia atrata* (Ach.) Hertel (1977)

**Thallus** crustose, effuse, to c. 3 cm diam., rust-coloured; prothallus usually conspicuous, black. **Apothecia** immersed, black, to 0.5 mm diam.; margin conspicuous. Hymenium 90–120 µm, uppermost part colourless to green-grey. True exciple brown-black. Hypothecium dark brown. Ascospores ellipsoid, 10–14 × 6–9 µm. Conidia cylindrical, 4 × 1 µm. Medulla K/I –.

**Chemistry.** Negative.

**Ecology.** On Fe-rich, siliceous rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan in cold regions.

**Specimens seen** (selected): Forsbladhamna, 27.7.1926, B. Lyngé (O); Colesbukta, 1.10.1999, S. Spjelkavik (BG).

**TUCKERMANOPSIS** Gyelnik (1933)

**Thallus** foliose or fruticose, brown to greenish, flattened, without pseudocyphellae on lower surface. Cortex one-layered; exiple two-layered. **Ascomata** apothecia. Ascii with no amyloid ring structure in tholus, with broad axial body. Ascospores subglobose or globose. Conidia bifusiform.

*Tuckermanopsis inermis* (Nyl.) Kärnfelt (1993)

**Thallus** fruticose, dichotomously branched, lobes brown, flat to canaliculated, to 3 mm broad, with a few marginal projections present; pseudocyphellae distinct, on outer parts of lower surface.

**Chemistry.** Lichesterinic and protolichesterinic acids.

**Ecology.** On acidic soil.

**Distribution.** Only known from Sjuøyane.

**Notes.** A high-arctic species; in Europe only known from Svalbard (Tønsberg & Elvebakk 1993). World distribution: Europe, Asia, North America.

**Specimen seen:** Sjuøyane, 1936, E. Dahl (O).

**UMBILICARIA** Hoffm. (1789)

**Thallus** foliose, umbilicate, corticate on both sides. Upper side smooth or wrinkled. Lower side either smooth, or with rhizines or ridges, in many species with thallospores. Photobiont green algae. **Ascomata** apothecia, laminal, without thalline exciple, black, lecideine, gyrose or umbonate. Ascii with apical, K/I + blue dome. Ascospores 8 per ascus, simple or muriform, colourless or brownish. Hamathecium of paraphyses, simple or branched. Conidia cylindrical. Thallospores simple or multicellular. All species are restricted to acidic rocks.

Key to *Umbilicaria* on Svalbard:

- |         |  |                             |
|---------|--|-----------------------------|
| 1       | Thallus with isidia .....  | <i>U. deusta</i>            |
| 1       | Thallus without isidia .....                                       | 2                           |
| 2 (1)   | Thallus sorediate at margins .....                                 | <i>U. hirsuta</i>           |
| 2       | Thallus not sorediate .....  | 3                           |
| 3 (2)   | Thallus with rhizines on lower surface .....                       | 4                           |
| 3       | Thallus without rhizines on lower surface .....                    | 8                           |
| 4 (3)   | Thalli mostly single-lobed; apothecia common, umbonate .....       | 5                           |
| 4       | Thalli multi-lobed; sterile or with gyrose apothecia .....         | 6                           |
| 5 (4)   | Upper surface strongly wrinkled; apothecia stipitate .....         | <i>U. virginis</i>          |
| 5       | Upper surface smooth or with few wrinkles; apothecia sessile ..... | <i>U. crustulosa</i>        |
| 6 (4)   | With abundant marginal cilia .....                                 | <i>U. cylindrica</i>        |
| 6       | Without marginal cilia .....                                       | 7                           |
| 7 (6)   | Thallus small; some rhizines pale .....                            | <i>U. aprina</i>            |
| 7       | Thallus large; all rhizines dark .....                             | <i>U. vellea</i>            |
| 8 (3)   | Upper surface brown, not pruinose .....                            | 9                           |
| 8       | Upper surface grey to black, pruinose towards centre .....         | 14                          |
| 9 (8)   | Perforate or lacerate towards margin .....                         | <i>U. torrefacta</i>        |
| 9       | Not perforate or lacerate towards margin .....                     | 10                          |
| 10 (9)  | Thallus multi-lobed; upper side smooth .....                       | <i>U. polypylla</i>         |
| 10      | Thallus single-lobed; upper side areolate or ridged .....          | 11                          |
| 11 (10) | Lower side coal black .....  | <i>U. nylanderiana</i>      |
| 11      | Lower side brownish or grey .....                                  | 12                          |
| 12 (11) | Lower side with black spot around umbo .....                       | <i>U. hyperborea</i>        |
| 12      | Lower side without black spot around umbo .....                    | 13                          |
| 13 (12) | Thallus thick; apothecia gyrose; thallospores 5 µm .....           | <i>U. arctica</i>           |
| 13      | Thallus thin; apothecia umbonate; thallospores 10 µm .....         | <i>U. krascheninnikovii</i> |
| 14 (8)  | Lower side grey to grey-brown .....                                | <i>U. proboscidea</i>       |
| 14      | Lower side black .....   | 15                          |

- 15 (14) Upper side with sharp ridges; apothecia umbonate; gyrophoric acid present .....  
..... *U. decussata*
- 15 Upper side with low ridges; apothecia leiodisc; gyrophoric acid absent ..... *U. lyngei*

***Umbilicaria aprina* Nyl. (1863)**

**Thallus** monophyllus, up to 2 cm diam. Upper side dark grey, wrinkled and pruinose towards umbo. Margin strongly laciniate when young, when old with cylindric extensions. Lower side black, with numerous black to pale grey rhizinae. Thallospores unicellular, 6–8 µm diam. **Apothecia** very rare, at first omphalodisc, later gyrodisc and convex, up to 2 mm diam. Ascospores 8 per ascus, narrowly elliptic, simple, 11–13 × 5–7 µm.

**Chemistry.** Gyrophoric acid.

**Ecology.** On siliceous rock, not ornithocoprophilous.

**Distribution.** Scattered, see map by Elvebakk & Tønsberg (1992).

**Notes.** This species was described from the mountains of Africa (Abyssinia) by Nylander, who did not see fertile material. The first record of apothecia was by Frey (1936), who found both omphalodisc and gyrodisc ones in his material. The species is common in Antarctica (Øvstdal & Lewis Smith 2001), but has never been found fertile there. One of the few fertile specimens known from Svalbard (Elvebakk 86:236) shows that the apothecia at first are omphalodisc, later the sterile umbo expands and deforms and the apothecium becomes much larger, convex and gyrodisc. On Svalbard, young thalli have distinctly laciniate margins, and in this respect they differ from Antarctic ones which have a smooth margin, otherwise they are similar. World distribution: Europe, North America (including Greenland), Africa, Antarctica.

**Specimens seen** (selected): Van Mijenfjorden, 13.7.1986, A. Elvebakk 86:236 (TROM; fertile); Nordenskiöld Land, Reindalen, 1986, T. Tønsberg 9853b & Elvebakk (BG).

***Umbilicaria arctica* (Ach.) Nyl. (1859)**

**Thallus** monophyllous to polyphyllous, up to 5 cm wide. Upper side brown, with small ridges and buckles. Lower side smooth, pale brown, black around umbo. **Apothecia** gyrose. Thallospores only in black area around umbo, unicellular, 5 µm diam.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Bockfjorden, 12.8.1974, A.A. Frisvoll (TRH); Hinlopenstredet [Hinlopenstretet], Store Russeoya, 22.8.1936, E. Dahl (O).

***Umbilicaria crustulosa* (Ach.) Frey (1936)**

**Thallus** polyphyllus, growing in cushions, up to 2 cm diam. Upper surface brown-grey, smooth, slightly pruinose. Margin with cilia. Lower side pink, without rhizines except in outermost part. No thallospores. **Apothecia** omphalodisc.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** Rare.

**Note.** World distribution: Europe, Siberia, North America.

**Specimen seen:** Kong Karls Land, Hårfagrenuten, 11.8.1936, E. Dahl (O).

### *Umbilicaria cylindrica* (L.) Delise (1830)

**Thallus** polyphyllus, 1–8 cm wide. Upper side grey, smooth; margin with cilia. Lower side pink to ochraceous, with pale dendroid rhizines towards margin. No thallospores. **Apothecia** gyrodisc.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimens seen** (selected): Nordaustlandet, Brennevinsfjorden, 21.8.1936, E. Dahl (O); Bockfjorden, summit of Trolltindane, 1973, A.A. Frisvoll (TRH).

### *Umbilicaria decussata* (Vill.) Frey (1936)

**Thallus** monophyllus, up to 7 cm wide. Upper side grey, with a network of sharp ridges. Lower side smooth, black, without rhizines. Thallospores unicellular, 6–7 µm diam. **Apothecia** omphalodisc.

**Chemistry.** Gyrophoric acid, ± norstictic acid.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimen seen** (selected): Nordaustlandet, Wahlenberg Bay [Wahlenbergfjorden], 2.7.1931, P.F. Scholander (TRH).

### *Umbilicaria deusta* (L.) Baumg. (1790)

**Thallus** monophyllus or polyphyllus, up to 3 cm diam. Upper side brown, isidiate. Lower side black, without rhizinae. A few unicellular thallospores seen, 5 µm diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Bockfjorden, Germaniahøgdene, 12.8.1974, A.A. Frisvoll (TRH); Nordaustlandet, Rijpfjorden, 14.8.1936, E. Dahl (O).

### *Umbilicaria hirsuta* (Sw. ex Westr.) Ach. (1794)

**Thallus** monophyllus, up to 5 cm diam., sorediate. Upper side grey, smooth, sorediate towards margins. Lower side pale brown, scabrose, with numerous pale rhizines. Thallospores not seen. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On hard rock.

**Distribution.** Only known from Bockfjorden.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland), Argentina, Australia.

**Specimen seen:** Bockfjorden, summit of Trolltindane, 16.8.1974, A.A. Frisvoll (TRH).

#### *Umbilicaria hyperborea* (Ach.) Hoffm (1800)

**Thallus** monophyllus, thin, up to 5 cm diam. Upper side brown, rugulose towards umbo, areolate towards margin. Lower side brown, smooth. Thallospores produced in low quantities, unicellular, 4–5 µm diam. **Apothecia** gyrodisc.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** Common and widespread.

**Note.** World distribution: almost cosmopolitan.

**Specimens seen** (selected): Sydkapp land [Sørkapp Land], 3.8.1920, J. Lid (TRH); Phippsøya, 18.8.1936, E. Dahl (O).

#### *Umbilicaria krascheninnikovii* (Sav.) Zahlbr. (1939)

**Thallus** 1(–3) cm, monophyllus. Upper side grey-brown, rugulose, somewhat pruinose. Lower side smooth, black around umbilicus, otherwise pale ochre. Thallospores unicellular, 9–10 µm diam.

**Apothecia** with plane disc, regular margin and sterile button.

**Chemistry.** Negative.

**Ecology.** On rock.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), New Zealand, Antarctica.

**Specimens seen** (selected): Edgeøya, S of Habenichtbukta, 7.8.1936, E. Dahl (O); Hinlopenstredet [Hinlopenstretet], Store Russeøya, 22.8.1936, E. Dahl (O).

#### *Umbilicaria lyngei* Scholander (1934)

**Thallus** monophyllus, up to 4 cm wide, Upper side grey, with very low ridges, pruinose. Lower side black, without rhizines. Thallospores unicellular, 5–7 µm diam. **Apothecia** leiodisc.

**Chemistry.** ± Norstictic acid.

**Ecology.** On hard rock.

**Distribution.** Widespread and common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Hårfagrehaugen, 1936, E. Dahl (O); Lomfjorden, 1931, P.F. Scholander (TRH).

*Umbilicaria nylanderiana* (Zahlbr.) H. Magn. (1937)

**Thallus** monophyllus, up to 2 cm diam. Upper side dark brown, rugulose to ridged. Lower side without rhizines, smooth, coal black. Thallospores unicellular, 7–8 µm diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** A few scattered localities.

**Notes.** New to Svalbard. World distribution: Europe, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimen seen** (selected): Longyearbyen, 22.7.1936, E. Dahl (O).

*Umbilicaria polyphylla* (L.) Baumg. (1790)

**Thallus** polyphyllus, up to 3 cm diam. Upper side brown, smooth. Margin laciniate. Lower side black, without rhizines. Thallospores multicellular, 12–14 µm diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric acid.

**Ecology.** On hard rock.

**Distribution.** Only known from Longyearbyen.

**Note.** World distribution: Europe, Asia, North America (including Greenland), South America, Australia, New Zealand, Antarctica.

**Specimen seen:** Longyearbyen, 18.7.1981, A. Elvebakk 81:414 (TROM).

*Umbilicaria proboscidea* (L.) Schrad. (1794)

**Thallus** monophyllus, up to 5 cm diam. Upper side grey, wrinkled and pruinose towards umbo. Lower side grey to grey-brown, paler towards umbo, usually with a few rhizines. Thallospores not seen. **Apothecia** gyrodisc.

**Chemistry.** Gyrophoric acid.

**Ecology.** On hard rock.

**Distribution.** Common and widespread.

**Notes.** In a few specimens the thallus was broken and split close to margins; otherwise they were similar to the main form. World distribution: Europe, Asia, North America (including Greenland), Argentina, Australia.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O); Nordaustlandet, Duvefjorden, 16.8.1936, E. Dahl (O).

*Umbilicaria torrefacta* (Lightf.) Schrad. (1794)

**Thallus** monophyllus, 1–2 cm diam. Upper side dark brown, areolate and fenestrated. Lower side dark brown, with tubercles. A few unicellular thallospores seen, 4–6 µm diam. **Apothecia** common, gyrodisc.

**Chemistry.** Gyrophoric acid.

**Ecology.** On rock.

**Distribution.** Common.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Kongsfjorden, Blomstrandhalvøya, 17.7.1974, A.A. Frisvoll (TRH); Red Bay [Raudfjorden], 22.7.1928, O.A. Høeg (TRH).

### *Umbilicaria vellea* (L.) Ach. (1794)

**Thallus** monophyllus, up to 15 cm diam. Upper side grey, smooth, white-pruinose. Lower side black, with lamellae, scattered rhizines and numerous low papillae. Thallospores variable, from unicellular (6 µm diam.) to multicellular (10–15 µm diam.). **Apothecia** not seen in Svalbard material.

**Chemistry.** Gyrophoric (major), and lecanoric acids.

**Ecology.** On hard rock.

**Distribution.** Common and widespread.

**Note.** World distribution: cosmopolitan.

**Specimens seen** (selected): Bockfjorden, Germaniahøgdene, 12.8.1974, A.A. Frisvoll (TRH); Phippsøya, 18.8.1936, E. Dahl (O).

### *Umbilicaria virginis* Schaerer (1841)

**Thallus** monophyllus, up to 10 cm diam. Upper side usually with ridges, pale grey. Lower side rose-coloured with numerous pale rhizines. Thallospores not present. **Apothecia** actinogyrose.

**Chemistry.** Gyroporic acid.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Common and widespread

**Note.** World distribution: Europe, North America (including Greenland), New Zealand.

**Specimens seen** (selected): Sabineodden, 12.7.1928, O.A. Høeg (TRH); Kong Karls Land, Hårfagrehaugen, 11.8.1936, E. Dahl (O).

### *USNEA* Dill ex Adans. (1763)

**Thallus** fruticose, greenish-yellow, erect to decumbent, with a compact holdfast. Branches corticated, medulla lax or dense, central axis cartilaginous. Photobiont trebouxioid. **Ascomata** apothecia, lateral or terminal, with thalline margin. Ascii of *Lecanora*-type. Ascospores 8 per ascus, simple, colourless. Conidia bacilliform.

### *Usnea sphacelata* R. Br. (1823)

Fig. 34 (p. 234).

**Thallus** fruticose, up to 5 cm high, yellow-green, with black annulations, often blackened in exposed sites, growing from a delimited to a proliferating holdfast, erect, mostly richly branched above. Fibrils absent. Branches terete. Surface subnitid or matt, scabrid with minute papillae. Axis less than 50 % of branch width. Soralia usually only on ultimate branches. **Apothecia** unknown.

**Chemistry.** Usnic acid.

**Ecology.** On stone.

**Distribution.** Common and widespread.

**Notes.** Previously often treated in *Neuropogon*, but position within *Usnea* supported by Wirtz et al. (2006). World distribution: northernmost Europe, arctic Siberia, North America (including Greenland), South America, New Zealand, Antarctica.

**Specimens seen** (selected): Wijdefjorden, just N of the mouth of Reinsbukkdalen, 2002, T. Tønsberg 31198 (BG); Reindalen, A. Elvebakk 86:493 (TROM).

## VARICELLARIA Nyl. (1861)

**Thallus** crustose, effuse, white. Photobiont trebouxioid. **Ascomata** apothecia, with thin thalline exciple. True exciple thin. Ascii of *Pertusaria* (?) type. Ascospores 1 per ascus, uncoloured, 1-septate, with thick wall. Hamathecium paraphyses, thin, anastomosing.

### *Varicellaria rhodocarpa* (Körb.) Th. Fr. (1871)

**Thallus** white, effuse, 3–4 cm wide, granular-areolate, sorediate. Soralia coarse, concolorous with thallus, delimited to effuse. **Apothecia** rare, half to fully immersed in thallus, with a thin, white thalline margin. Disc flat to slightly convex, pink to orange-pink, often 2–3 together, up to 0.7 mm diam., sometimes white-pruinose. Hymenium 330–350 µm high, uppermost part yellowish. Ascospores 1 per ascus, 140–150 × 60–75 µm, uncoloured, 1-septate, with very thick wall.

**Chemistry.** Lecanoric acid, lichenanthrone.

**Ecology.** On organic material.

**Distribution.** Rare.

**Notes.** It is with some doubt we include this species, which was reported from Svalbard by Körber (1875), as we have not seen any material (not found in L). The description above is based on a specimen from Finnmark (BG), where it is very common. World distribution: Circumpolar arctic-boreal, Argentina.

**Specimens seen:** none seen; record based on Körber (1875), who cited specimens from Hornsund.

## VERRUCARIA Schrad. (1794)

**Thallus** crustose to effigurate, rimose to smooth. Photobiont various green algae. **Ascomata** perithecia, immersed or emergent. Involucellum mostly present. True exciple colourless to brown. Ascii 8-spored. Ascospores simple, colourless. Hamathecium of pseudoparaphyses which dissolve early, and periphyses below the ostiole.

**Notes.** A cosmopolitan genus, with most species being maritime (littoral to supralittoral) or lacustrine.

Key to *Verrucaria* on Svalbard:

1	Marine species .....	2
1	Non-marine species .....	7
2 (1)	Thallus with black dots or ridges .....	3
2	Thallus without black dots or ridges .....	4
3 (2)	Thallus with minute black dots .....	<i>V. maura</i>
3	Thallus with elongate black ridges .....	<i>V. degelii</i>
4 (2)	Perithecia covered by thalline tissue .....	5
4	Perithecia not covered by thalline tissue .....	6
5 (4)	Perithecia semiglobose .....	<i>V. halophiloides</i>
5	Perithecia completely immersed .....	<i>V. mucosa</i>
6 (4)	Thallus strongly rimose, thick, extensive .....	<i>V. ceutocarpa</i>
6	Thallus not rimose, thin, 2–3 mm wide .....	<i>V. halizoa</i>
7 (1)	On bone .....	<i>V. sp.</i>
7	On rock .....	8
8 (7)	On limestone .....	9
8	On other types of rock .....	19
9 (8)	Perithecia immersed in pits .....	<i>V. deversa</i>
9	Perithecia not immersed in pits .....	10
10 (9)	Thallus endolithic .....	<i>V. devergens</i>
10	Thallus epilithic .....	11
11 (10)	Thallus as discrete, thick areolae .....	<i>V. wilzeckii</i>
11	Thallus coherent .....	12
12 (11)	Thallus thick .....	13
12	Thallus thin .....	18
13 (12)	Thallus bullate; perithecia immersed in areolae .....	<i>V. bullata</i>
13	Thallus flat; perithecia not immersed in areolae .....	14
14 (13)	Ascospores less than 20 µm long .....	15
14	Ascospores more than 20 µm long .....	16
15 (14)	Ascospores less than 14 µm long .....	<i>V. caerulea</i>
15	Ascospores 16–18 µm long .....	<i>V. pinguiscula</i>
16 (14)	Ascospores 22–26 µm long .....	17
16	Ascospores 30 µm long .....	<i>V. glaucina</i>
17 (14)	Perithecia to 0.4 mm diam., involucellum reaching to base .....	<i>V. dufourii</i>
17	Perithecia to 0.2 mm diam., involucellum only in upper part .....	<i>V. muralis</i>
18 (12)	Thallus brown, granulose; ascospores 17–30 µm long .....	<i>V. obsoleta</i>
18	Thallus pale brown, gelatinous; ascospores 15–20 µm long .....	<i>V. rejecta</i>

19 (8)	Perithecia covered by thalline tissue .....	20
19	Perithecia not covered by thalline tissue .....	21
20 (19)	Ascospores 20–35 µm long .....	<i>V. margacea</i>
20	Ascospores 14–27 µm long .....	<i>V. aethiobola</i>
21 (19)	Ascospores 10 µm long .....	22
21	Ascospores more than 15 µm long .....	24
22 (21)	Thallus pale grey-brown .....	<i>V. cf. bulgarica</i>
22	Thallus brown or black .....	23
23 (22)	Perithecia constricted below; ascospores 5–6 µm broad .....	<i>V. acrotella</i>
23	Perithecia not constricted below; ascospores 7–8 µm broad .....	<i>V. arctica</i>
24 (21)	Growing in dry places .....	25
24	Growing in wet places .....	26
25 (24)	Thallus brown-black; surface smooth; ascospores up to 17 µm .....	<i>V. nigrescens</i>
25	Thallus black; surface scabrous; ascospores 18–22 µm long .....	<i>V. extrema</i>
26 (24)	Carbonized basal layer present; angle between involucellum and excipulum darkened .....	<i>V. funckii</i>
26	Carbonized basal layer not present; angle between involucellum and excipulum clear .....	<i>V. hydrella</i>

***Verrucaria acrotella* Ach. (1803)**

Fig. 35 (p. 235).

**Thallus** coal black, thin, with a rough surface, up to 4–5 cm wide, but often broken up on coarse-grained rock. **Perithecia** sessile, constricted below, 0.2 mm diam.; surface rough. Involucellum well-developed, extending to base of perithecia. Excipulum pale brown. Ascospores 10–13 × 5–6 µm.

**Ecology.** On various kinds of rock, but avoiding pure limestone, ± dry.

**Distribution.** Common and widespread..

**Notes.** Recognized by its dull coal black thallus and small perithecia with constricted base. New to Svalbard. World distribution: Europe, Siberia, North America.

**Specimens seen** (selected): Litledalen, 17.8.1926, B. Lynge (O); Ahlstrandodden, 20.7.1926, B. Lynge (O).

***Verrucaria aethiobola* Wahlenb. (1803)**

Fig. 36 (p. 235).

**Thallus** thick, grey-brown to reddish-brown, rimose, several cm diam. **Perithecia** up to 0.4 mm broad, covered up to 2/3 by thalline tissue. Involucellum in upper part only, spotlike darkened. Angle tissue between involucellum and excipulum unclear. Excipulum pale brown. Ascospores 16–22 × 7–12 µm.

**Ecology.** Upper amphibian zone in brooks and on wet, non-calcareous cliffs.

**Distribution.** Widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, Antarctica.

**Specimens seen** (selected): Mitterhuken [Midterhuken], 5.8.1926, B. Lynge; Forsbladhamna, 29.7.1926, B. Lynge (O).

### *Verrucaria arctica* Lynge (1928)

Lectotype: Novaya Zemlya, Matotchkin Shar, east of Cap Youravlev, 14.7.1921, B. Lynge (O; selected here).

Fig. 37 (p. 235).

**Thallus** as 0.2–0.4 mm wide, dark brown, round, convex areolae, dispersed but sometimes coalescing to larger thalli. **Perithecia** half covered by thallus, 0.1–0.2 mm wide; ostiole black, shiny. Involucellum reaching down 2/3–3/4 of the perithecium. Exciple pale brown. Ascospores subglobose, 9–11 × 7–7.5 µm.

**Ecology.** On weakly acidic shales.

**Distribution.** Common and widespread.

**Notes.** New to Svalbard. World distribution: Europe, Asia, arctic North America (including Greenland).

**Specimens seen** (selected): Kjellstrømdalen, Aug. 1987, D.O. Øvstdal (BG); Forsbladhamna, 31.7.1936, B. Lynge (O).

### *Verrucaria* cf. *bulgarica* Szatala (1930).

Fig. 38 (p. 236).

**Thallus** pale grey-brown, 3–4 cm wide, thin, strongly rimose. **Perithecia** sessile, semiglobose, up to 0.4 mm diam., sometimes 2–3 merging together. Involucellum in upper part only; exciple brown. Ascospores 8–10 × 5–6 µm.

**Ecology.** On dry, weakly acidic sandstone.

**Distribution.** Only known from Bromelldalen.

**Notes.** The Svalbard specimen keys out as *V. bulgarica* in Hawksworth et al. (1992), but differs in somewhat larger perithecia. Among the two other species on dry rock with small perithecia and ascospores, *V. arctica* differs in its small, non-rimose, dark brown thalli, whereas *V. acrotella* has a rough, coal-black, non-rimose thallus and perithecia which are constricted below. New to Svalbard. World distribution: Europe, Antarctica.

**Specimen seen:** Bromelldalen, 9.8.1926, B. Lynge (O).

### *Verrucaria bullata* Lynge (1940)

Fig. 39 (p. 236).

Thallus 2 cm wide, composed by round, convex, dark green-brown areolae which are somewhat elongate at margin. Prothallus between areolae, thin, pale ochre. **Perithecia** generally one per areola, but up to three in marginal ones, completely immersed in areolae except for the black ostiole. Involucellum minute, in uppermost part only. Exciple brown. Ascospores 16–18 × 5–7 µm.

**Ecology.** On limestone, with *Endocarpon pulvinatum*.

**Distribution.** Only known from Dicksonfjorden.

**Notes.** Recognized by its discrete, convex areolae and perithecia which are completely immersed in the areolae. New to Svalbard. World distribution: arctic Europe.

**Specimen seen:** Dicksonfjorden, 1926, B. Lynge (O).

*Verrucaria caerulea* DC (1805)

Fig. 40 (p. 236).

**Thallus** thick, bluish-white, rimose, 5–10 mm wide; rimae pale; prothallus absent. **Perithecia**  $\frac{3}{4}$  sessile, up to 0.3 mm diam. Involucellum prominent, expanded in lower part. Exciple dark brown. Ascospores  $11\text{--}14 \times 5\text{--}6 \mu\text{m}$ .

**Ecology.** On dry limestone.

**Distribution.** Only known from one site.

**Notes.** The specimens conform with material from Öland, Sweden, treated by Fröberg (1989), except that perithecia are almost immersed in thallus in material of the latter. Perhaps this is an adaptation to light conditions. In the high-radiation climate of Öland the lichen will protect its reproductive organs from excessive temperatures by immersing them into the grey thallus, while in Svalbard, with low-radiation conditions, the black perithecia protrude to absorb as much radiation as possible to enhance the temperature. New to Svalbard. World distribution: Europe, North America.

**Specimen seen:** Kings Bay [Kongsfjorden], 17.8.1868, Th.M. Fries (O; two collections).

*Verrucaria ceutocarpa* Wahlenb. (1803)

**Thallus** several cm wide, black, areolated by fissures; areolae mostly 0.2–0.3 mm wide. Fissures apparently same colour as thallus but when wet they appear darker. **Perithecia** almost immersed in areolae; ostiole black, protruding. Involucellum only in upper part; exciple colourless. Ascospores  $9\text{--}12 \times 6\text{--}7 \mu\text{m}$ .

**Ecology.** Intertidal rocks.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Siberia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimen seen (selected):** Virgohamna, 7.7.1928, O.A. Høeg (TRH).

*Verrucaria degelii* R. Sant. (1939)

**Thallus** crustose, olivaceous, strongly rimose-areolate, rimae black. Areolae up to 0.5 mm wide, irregular, with low elongate black ridges. **Perithecia** black,  $\frac{1}{3}$  sessile, 0.1–0.15 mm wide. Involucellum thin, in upper part only, exciple pale brown to colourless. Mature ascospores not seen.

**Ecology.** On maritime rocks, associated with *V. maura*.

**Distribution.** Only known from Indre Norskøya.

**Notes.** The Svalbard specimen differs from European mainland ones in its thicker thallus, less abundant black ridges and more protrudent perithecia, but we believe that this is within the variation of the species. The other species with black ridges found along northern oceans, *V. striatula*, is very different, with a subgelatinous, non-rimose thallus, and somewhat irregular, sessile apothecia. New to Svalbard. World distribution: Europe, Greenland.

**Specimen seen:** Store Norskøy [Indre Norskøya], 19.7.1928, O. A. Høeg (O).

*Verrucaria devergens* Nyl. (1876)

Fig. 41 (p. 237).

**Thallus** endolithic, as a pale spot on surface of rock. **Perithecia** black, 0.2–0.4 mm wide, not in pits, ostiole part depressed. Involucellum prominent, spreading to lower part of perithecium; exciple dark brown. Ascospores  $28\text{--}30 \times 10\text{--}12 \mu\text{m}$ .

**Ecology.** On limestone.

**Distribution.** Rare.

**Notes.** Close to *V. deversa*, which has perithecia immersed in pits, and smaller ascospores. However, Lynge (1926) reported specimens from Bjørnøya with intermediate ascospores, and apparently considered the possibility that these two taxa are conspecific. World distribution: circumarctic.

**Specimen seen:** Klovningen, 9.7.1928, O.A. Høeg (O).

*Verrucaria deversa* Vainio (1921)

**Thallus** thin, whitish, as a decolouration of the rock. **Perithecia** immersed in pits, black, 0.2–0.3 mm broad. Involucellum in upper part only; exciple brown. Ascospores  $15\text{--}25 \times 7\text{--}10 \mu\text{m}$ .

**Ecology.** On limestone and weakly acidic sandstones

**Distribution.** A few scattered occurrences.

**Notes.** In Svalbard previously only reported from Bjørnøya. World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Bromelldalen, 9.8.1926, B. Lynge (O); Hopen, Lynges Fjell [Lyngefjellet], 19.9.1930, D.S."Sotra" (O).

*Verrucaria dufourii* DC. (1805)

**Thallus** thin, non-gelatinous, as elongate, irregular areolae. **Perithecia** sessile, up to 0.4 mm diam., black, ostiole part deeply impressed. Involucellum prominent, reaching to base of perithecium. Exciple uncoloured to pale brown. Ascospores 8 in ascii,  $23\text{--}27 \times 12\text{--}13 \mu\text{m}$ , mostly simple but a few 1-septate.

**Ecology.** On limestone.

**Notes.** New to Svalbard. Differs from the somewhat similar *V. pinguicula* in the much thinner and paler thallus, and the larger ascospores. Distribution: Europe, Australia, New Zealand.

**Specimen seen:** Hinlopenstredet [Hinlopenstretet], Store Russeøya, 22.8.1935, E. Dahl (O).

*Verrucaria extrema* Th. Fr. (1867)

Type: Kobbefjorden, Malmgren (UPS!).

Fig. 42 (p. 237).

**Thallus** 1–2 cm wide, thick, black; surface rugulose-scabrose. **Perithecia** half immersed in thallus, up to 0.3 mm wide. Involucellum prominent, reaching to base of perithecia and spreading. Exciple brown in upper part, pale in lower. Ascospores  $19\text{--}21 \times 5\text{--}7 \mu\text{m}$ .

**Ecology.** On limestone and weakly acidic sandstones.

**Distribution.** Endemic, scattered.

**Note.** World distribution: Svalbard.

**Specimens seen** (selected): Calypsostranda [Calypsostranda] 18.7.1926, B. Lynge (O); Nordaustlandet, S. Korsøy [S. Krossøya], 6.7.1937, P.F. Scholander (O).

***Verrucaria funckii*** (Spreng.) Zahlbr. (1921)

**Thallus** 3–4 cm wide, black-brown to beige, non-rimose, often subgelatinous, thin to thick. **Perithecia** up to 0.3 mm diam., protruding part variable, at most one half. Carbonized basal layer often present. Involucellum extensive, reaching down to carbonized basal layer. Exciple dark; angle between involucellum and exciple net-like darkened (“netzachtig verdunkelt”). Ascospores 16–20 × 7–10 µm. Photobiont *Dilabifilum incrustans*.

**Ecology.** On periodically submerged acidic rock.

**Distribution.** A few scattered occurrences.

**Notes.** Among the *Verrucaria* species growing in wet, non-marine habitats, *V. funckii* is characterised by intermediate-sized ascospores, a non-rimose, subgelatinous thallus and the net-like darkened angle between involucellum and exciple (see Thüs 2002). New to Svalbard. World distribution: Europe, North America, Australia.

**Specimens seen** (selected): Berzeliusfjellet, 21.7.1926, B. Lynge (O); Calypso-sletten [Calypsostranda], 15.7.1926, B. Lynge (O).

***Verrucaria glaucina*** auct. non Ach.

Fig. 43 (p. 237).

**Thallus** 3–4 mm wide, growing with adjacent thalli to form composite thalli 1–2 cm wide, with dark demarcation lines between the individual thalli, yellow-white. Medulla white. No black hypothallus. **Perithecia**  $\frac{3}{4}$  immersed in thallus, 0.1–0.2 mm wide. Involucellum only in upper part. Exciple dark brown. Ascospores 28–32 × 9–11 µm.

**Ecology.** On dry limestone.

**Distribution.** Only known from Prins Karls Forland.

**Notes.** Externally similar to *Polyblastia* cf. *fuscoargillacea*. New to Svalbard. World distribution: possibly cosmopolitan.

**Specimens seen:** Prins Karls Forland, 15.8.1868, Th.M. Fries (O; several specimens); Bergmannfjellet, 8.8.1926, B. Lynge (O).

***Verrucaria halizoa*** Leighton (1871)

Fig. 44 (p. 238).

**Thallus** very thin, brown-green, smooth but sometimes secondary cracked, up to 3–4 cm diam.; rarely only as a narrow rim around perithecia. **Perithecia** emergent, smooth, black, to 0.2 mm diam. Involucellum reaching down to base, exciple brown. Ascospores ellipsoid, 7–12 × 4–5 µm.

**Ecology.** On intertidal rocks.

**Distribution.** A few scattered occurrences.

**Notes.** New to Svalbard. World distribution: probably cosmopolitan.

**Specimen seen** (selected): Virgohamna, 7.7.1928, O.A. Høeg (TRH).

*Verrucaria halophilooides* Vainio (1909)

**Thallus** continuous, smooth, subgelatinous, brownish black, several cm wide. **Perithecia** semiglobose, up to 0.3 mm wide, with thalline margin with algae. No involucellum; exciple brown. Ascospores  $6-11 \times 4-7 \mu\text{m}$ .

**Ecology.** On intertidal rocks.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Norway (Finnmark), Svalbard, Novaya Zemlya, East Siberia.

**Specimen seen (selected):** Depotøya, 1861, A.J. Malmgren (TRH).

*Verrucaria hydrela* Ach. (1814)

Fig. 45 (p. 238).

**Thallus** several cm wide, thin, non-rimose, subgelatinous, green-black. **Perithecia** flattened semi-globose, with protruding ostiole, 0.2–0.3 mm wide. Involucellum in upper part, spreading laterally; exciple brown. Angle between involucellum and exciple uncoloured. Ascospores  $18-22 \times 9-11 \mu\text{m}$ .

**Ecology.** On wet schist.

**Distribution.** Rare.

**Notes.** Recognized by its smooth, subgelatinous thallus, uncoloured tissue in angle between involucellum and exciple, and ascospore size. New to Svalbard. World distribution: scattered, possibly cosmopolitan.

**Specimen seen:** Wijdefjorden, S of the mouth of Ringhorndalen, 2002, T. Tønsberg 31273 (BG).

*Verrucaria margacea* (Wahlenb.) Wahlenb. (1812)

Fig. 46 (p. 238).

**Thallus** thick, rimose, grey-brown; areolae conical, with peritheciatum in middle. **Perithecia** 0.3–0.4 mm wide, only ostiole protruding. Involucellum spreading, prominent. Exciple brown. Ascospores  $24-30 \times 10-12 \mu\text{m}$ .

**Ecology.** On hard rock in wet places.

**Distribution.** Rare.

**Note.** World distribution: cosmopolitan.

**Specimen seen:** Kobbfjorden [Kobbefjorden], Th.M. Fries (O).

*Verrucaria maura* Wahlenb. (1803)

**Thallus** 3–4 cm wide, black, rimose; cracks concolorous with thallus; areolae to 1 mm diam., with small black dots. **Perithecia** 0.6–0.9 mm diam., varying from being in level with thallus to protruding with a conical shape. Involucellum entire, black. Exciple colourless. Ascospores  $16-19 \times 8-13 \mu\text{m}$ .

**Ecology.** On intertidal and supralittoral rocks.

**Distribution.** A few scattered occurrences.

**Note.** World distribution: Europe, Asia, North America (including Greenland), southern South America, Australia, New Zealand, Antarctica.

**Specimen seen (selected):** Ahlstrands Odde [Ahlstrandodden], 20.7.1926, B. Lynge (O).

*Verrucaria mucosa* Wahlenb. (1803)

**Thallus** continuous, dark olive-green, subgelatinous, 2–3 cm wide. **Perithecia** completely immersed, 0.2–0.3 mm diam.; involucellum only in uppermost part; exciple colourless. Ascospores, elliptic, 11–13 × 7–8 µm.

**Ecology.** On intertidal rock.

**Distribution.** Only found once.

**Notes.** New to Svalbard. World Distribution: Europe, Siberia, North America (including Greenland), southern South America, New Zealand, Antarctica.

**Specimen seen:** Ytre Norskøya, 1928, O.A. Høeg (O).

*Verrucaria muralis* Ach. (1803)

Fig. 47 (p. 239).

**Thallus** medium thick, rimose, grey with a brownish tinge; areolae 2–3 mm wide. **Perithecia** up to 0.2 mm wide, 1/2–1/3 emergent; ostiole part depressed. Involucellum only in uppermost part; exciple brown. Ascospores 22–26 × 9–10 µm.

**Ecology.** On dry limestone, mortar etc.

**Distribution.** Rare.

**Notes.** New to Svalbard. World distribution: cosmopolitan.

**Specimen seen:** Bellsund, 29.7.1926, B. Lynge (O).

*Verrucaria nigrescens* Pers. (1795)

Fig. 48 (p. 239).

**Thallus** 3–4 cm wide, brown-black, rimose-fissured, thick; medulla dark brown. **Perithecia** ¾ immersed in thallus to completely covered with only ostiole protruding; internal diameter 150–200 µm. Involucellum strongly developed, extending below lower part of perithecium. Exciple brown. Ascospores 16–18 × 8–10 µm.

**Ecology.** On dry limestone and weakly acidic sandstone.

**Distribution.** A few scattered occurrences.

**Notes.** In Svalbard previously only known from Bjørnøya. World distribution: cosmopolitan.

**Specimens seen** (selected): Berzeliusfjellet, 21.7.1926, B. Lynge (O); Mitterhuken [Midterhuken], 8.8.1926, B. Lynge (O).

*Verrucaria obsoleta* Lynge (1928)

Fig. 49 (p. 239).

**Thallus** pale ochre, continuous to rimose, thin, up to 4–5 cm wide, rarely endolithic. **Perithecia** 0.1–0.4 mm wide, sessile, not constricted below; ostiole not depressed. Involucellum prominent, extending to base of perithecia. Exciple pale. Ascospores 17–30 × 8–12 µm.

**Ecology.** On dry sandstone.

**Distribution.** Common and widespread.

**Notes.** We have compared the specimens to specimens (herb. O, det. Lynge) from Novaya Zemlja from where the species was described, and found them to be similar in all essential details.

New to Svalbard. World distribution: Europe, North America.

**Specimens seen** (selected): Forsbladhamna, 29.7.1926, B. Lyngé (O); Blix Cap [Blixodden], 12.8.1926, B. Lyngé (O).

### *Verrucaria pinguicula* A. Massal. (1856)

Syn. *V. integra* (Nyl.) Nyl. (1861).

**Thallus** crustose, thick, rimose-cracked, up to 10 mm wide, green-grey in protected areas, brown-black in exposed ones. **Perithecia** 0.2–0.25 mm wide, semiglobose, subsessile; ostiole area depressed. Involucellum prominent, reaching to base of perithecium. Exciple dark brown. Ascospores narrowly elliptic, 13–15 × 6–7 µm.

**Ecology.** In dry crevices in limestone.

**Distribution.** Only known from Kongsfjorden and Lomfjorden.

**Note.** World distribution: Europe, North America.

**Specimen seen:** Kongsfjorden, 1 km SE of Gluudneset, A. Elvebakk 03:139 (TROM).

### *Verrucaria rejecta* Th. Fr. (1867)

Type: Lågøya, 1863, Malmgren (UPS!).

Fig. 50 (p. 240).

**Thallus** brown, thin, uneven, broken up in subgelatinous patches. **Perithecia** 0.1–0.2 mm diam., sessile. Involucellum and exciple merged together, entire, brown-black. Ascospores 15–20 × 9–10 µm.

**Ecology.** On dry limestone and weakly acidic sandstones.

**Distribution.** A few scattered occurrences.

**Notes.** Characterised by its thin, brown thallus, sessile perithecia with involucellum and exciple merged together, and fairly broad ascospores. World distribution: Europe.

**Specimen seen** (selected): Edgeøya, 6.8.1936, E. Dahl (O).

### *Verrucaria wilczekii* Körber (1875)

Holotype: Hornsund 1872, Höfer (L!).

Fig. 51 (p. 240).

**Thallus** as discrete, round, flat, subsquamulose lobes, up to 0.5 mm across, pale greenish to green-brown. In vertical section there is a 15–20 µm high colorless cortex with isodiametric thin-walled cells, 5–6 µm diam., a 60–65 µm high medulla, densely packed with green algae, a hypothallus-like tissue, 130–150 µm high, with parties of melanized cells; lower cortex indistinct or absent. **Perithecia** rare, on margin of areolae, black, half emergent, up to 0.2 mm diam. Involucellum present, spreading laterally and partly below the centre. Exciple dark brown. Central cavity 110–120 µm diam. Ascospores 10–12 × 5–7 µm.

**Ecology.** On calcareous rock, no other species present.

**Distribution.** Only known from Hornsund and Hinlopenstretet.

**Notes.** Characterised by its dispersed, rounded, flat areolae with perithecia at margin, and small ascospores. It may be confused with *V. macrostoma* which also may have dispersed areolae, but the

latter species has much larger ascospores. World distribution: endemic to Svalbard.

**Specimen seen:** Hinlopenstredet [Hinlopenstretet], Store Russeøya, 22.8.1936, E. Dahl (O).

***Verrucaria* sp.**

**Thallus** 1 cm wide, broken into many sections due to features of the substrate, thick, dark brown, rugulose. Photobiont more yellow than in other *Verrucaria* species (indicated as “*Trentepohlia* ?” by Lynge). **Perithecia** 0.2 mm diam., semiglobose. Involucellum entire, spreading massively below perithecium. Exciple colourless. Ascospores 8 per ascus, 13–15 × 9–11 µm.

**Ecology.** On old bone.

**Distribution.** Only known from Calypsostranda.

**Note.** It has some resemblance to *V. arctica*, but the thallus is larger and its involucellum is much better developed than in *V. arctica*.

**Specimen seen:** Calypso Bay [Calypsostranda], 14.7.1926, B. Lynge (O).

**VESTERGRENOPSIS** Gyelnik (1940)

**Thallus** foliose; lobes small, radiating, greyish to brownish. Photobiont *Scytonema*. **Ascomata** apothecia, with thalline margin. Ascospores 12–16 per ascus, simple, uncoloured, ellipsoid. Hamathecium paraphyses, little branched.

Key to *Vestergrenopsis* on Svalbard:

1	Thallus with isidia .....	<i>V. isidiata</i>
1	Thallus without isidia .....	<i>V. elaeina</i>

***Vestergrenopsis elaeina* (Wahlenb.) Gyelnik (1940)**

**Thallus** foliose; lobes radiating, olive brown, longitudinally striated, 0.2–0.4 mm broad; tips cuneate, up to 2 mm broad. Lower side pale, with scattered rhizinae. **Apothecia** up to 1.5 mm diam., with thalline margin; disc flat, dark brown. Hymenium 80–120 µm high; epithecium brown. Ascospores 12–15 per ascus, 8–10 × 4–5 µm.

**Chemistry.** Negative.

**Ecology.** On weakly acidic rock.

**Distribution.** Common and widespread.

**Note.** World distribution: Europe, Asia, North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk 81:1036 (TROM).

***Vestergrenopsis isidiata* (Degelius) Dahl (1950)**

**Thallus** foliose; lobes radiating, to 0.5 mm broad, longitudinally striated, isidiate. Isidia cylindrical or globose, often becoming flattened. Lower side pale, with scattered rhizinae. **Apothecia** rare,

similar to those of *V. elaeina*.

**Chemistry.** Negative.

**Ecology.** On weakly acidic rock.

**Distribution.** Widespread.

**Note.** World distribution: Europe, North America (including Greenland).

**Specimens seen** (selected): Liefdefjorden, A. Elvebakk 81:1279 (TROM), Bockfjorden, Sverrefjellet, A. Elvebakk 81:1036 (TROM).

## XANTHOMENDOZA S. Kondr. & Kärnefelt (1997)

**Thallus** fruticose, orange, with cortex on both sides. **Ascomata** apothecia, with thalline exciple. Ascii of *Teloschistes*-type. Ascospores 8 per ascus, polarilocular, colourless. Hamathecium of paraphyses, little ramified; end cell enlarged. Conidia bacilliform. Rhizines simple.

### *Xanthomendoza borealis* (Poelt & R. Sant.) Søchting, Kärnefelt & S. Kondr. (2002)

Syn. *Xanthoria mawsonii* auct. non C.W. Dodge (1948).

**Thallus** fruticose, orange, growing in small cushions. Lobes ascending, 7–8 mm long, 1–3 mm wide; tip laciniate, sorediate on margins and lower surface. Pycnidia prominent; conidia 3–4 × 1 µm, bacilliform. **Apothecia** not seen in Svalbard material.

**Chemistry.** Anthraquinones.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Probably common.

**Note.** World distribution: Europe, Asia, North America (including Greenland), Antarctica.

**Specimens seen** (selected): Sabine Kap [Sabineodden], 12.7.1928, O.A. Høeg (O; det. L. Lindblom 2004); Wijdefjorden, 23.8.1936, E. Dahl (O).

## XANTHORIA (Fr.) Th. Fr. ( 1860)

**Thallus** foliose to fruticose, with cortex on both sides, orange. **Ascomata** apothecia, laminal, with thalline exciple. Ascii of *Teloschistes*-type. Ascospores 8 per ascus, polarilocular, colourless. Hamathecium of paraphyses, little ramified; end cell enlarged. Conidia ellipsoid. Hapters confluent, penicillate rhizines present; simple rhizines absent.

Key to *Xanthoria* on Svalbard:

1	Thallus foliose .....	2
1	Thallus fruticose .....	3
2 (1)	With soralia or isidia .....	<i>X. sorediata</i>
2	Without soralia or isidia .....	<i>X. elegans</i>

3 (1)	Without soralia .....	<i>X. subfruticulosa</i>
3	With soralia .....	<i>X. candelaria</i>

*Xanthoria candelaria* (L.) Th. Fr. (1860)

**Thallus** as pulvinate clusters, orange. Lobes ascending, to 10 mm high and 1.5 mm wide; tips irregularly divided, thin, sorediate. Pyrenidia rare, inconspicuous, conidia 2 × 1 µm. **Apothecia** not seen in Svalbard material.

**Chemistry.** Anthraquinones.

**Ecology.** On rock, ornithocoprophilous.

**Distribution.** Common and widespread.

**Note.** World distribution: probably cosmopolitan.

**Specimens seen** (selected): Amsterdamøya, 26.8.1936, E. Dahl (O), Brøggerhalvøya, 1973, D.O. Øvstedal (BG).

*Xanthoria elegans* Link) Th. Fr. (1860)

**Thallus** foliose, growing in rosettes, orange. Lobes radiating, convex, to 1 mm broad, with cortex on both sides. **Apothecia** common, up to 1 mm diam., flat, with narrow thalline margin. Ascospores 8 per ascus, 13–16 × 7–8 µm.

**Chemistry.** Anthraquinones.

**Ecology.** On rock; ornithocoprophilous.

**Distribution.** Common and widespread.

**Note.** World distribution: almost cosmopolitan.

**Specimen seen** (selected): Cap Hesselman [Kapp Hesselman], 22.7.1926, B. Lyngé (O).

*Xanthoria soreciata* (Vain.) Poelt (1954)

**Thallus** foliose, 2–3 cm wide, with radiating, flat, irregularly to dichotomously divided lobes, 0.2–0.3 mm wide, orange, sorediate (very rarely isidiate). Soralia laminal, in inner parts of thallus. Isidia 0.05–0.1 mm diam. **Apothecia** not seen in Svalbard material.

**Chemistry.** Anthraquinones.

**Ecology.** On calcareous rock; ornithocoprophilous.

**Distribution.** Common.

**Note.** World distribution: Europe, North America (including Greenland), Argentina (Calvelo & Liberatore 2002).

**Specimens seen** (selected): Nordkysten [Nord-Spitsbergen], Velkomstpynten, 1936, E. Dahl (O); Gipsdal, A. Elvebakk 85:525 (TROM).

*Xanthoria subfruticulosa* (Elenkin) Piin (1979)

**Thallus** fruticose, orange, up to 10 mm high, growing in wide entangled mats. In sections: cortex uneven, up to 40 µm thick, pseudoparenchymateous. **Apothecia** not seen.

**Chemistry.** Anthraquinones.

**Ecology.** Growing in weak snowbed depressions, on calcareous soil.

**Distribution.** Only known from Gipsdalen and Wijdefjorden.

**Notes.** New to Svalbard. World distribution: circum-arctic (Europe, Asia, North America).

**Specimens seen:** Gipsdalen, 1985, A. Elvebakk 85:747 (TROM); Wijdefjorden, 2002, A. Elvebakk (TROM).

## REJECTED TAXA

Generally we follow Elvebakk & Hertel (1996) as to rejected species, with the following exceptions:

Species rejected by Elvebakk & Hertel, but accepted by us:

*Candelariella dispersa*, *Cetraria ericetorum*, *Cornicularia racemosa* (sub *Cetraria racemosa*), *Lecanora albescens*, *Lecidea cavatula*, *Rhizocarpon occidentale*, and *R. petraeum*.

Included by Elvebakk & Hertel (1996) but rejected by us:

*Aspicilia obscurascens* (H. Magn.) Clauzade & Rondon: reported by Nowak (1965); material not found in KRAM.

*A. obscurata* (Fr.) Arnold: reported by Nowak (1965); material not found in KRAM.

*A. pleiocarpa* (H. Magn.) Oxner: reported by Nowak (1965); material not found in KRAM.

*A. polychroma* Anzi: reported by Nowak (1965); specimen determined by us to *A. sublapponica*.

*Buellia disciformis* (Fr.) Mudd: recorded from driftwood in Longyeardalen by Lynge (1924), but no specimens in O; *B. disciformis* var. *muscorum* is *B. insignis*.

*Caloplaca consiliascens* (Nyl.) Zahlbr.: reported by Wunder (1974), but no material available.

*C. scotoplaca* (Nyl.) H. Magn.: reported by Fries (1867), but no material in UPS.

*Cladonia cervicornis* (Ach.) Flotow: reported by Lynge (1938) from Brennevinsfjorden. The podetia of *C. cervicornis* are like a smaller version of those of *C. verticillata* (Ahti 1980, Carlin 1981), but the main difference from *C. verticillata* lies in the basal squamules which in *C. verticillata* are small with a white lower surface, and in *C. cervicornis* much larger and which are tinged pink to bluish grey below (Ahti 1980). There are some specimens in O labelled *C. cervicornis*, but none of these fit the description of the species, thus it has been rejected from the Svalbard flora.

*C. ecmocyna* Leight.: reported by various authors, but no specimens in O, candidates mainly determined as *C. macroceras*.

*Collema undulatum* Laur. ex Flot.: doubtful record (see Elvebakk & Hertel 1996).

*Dermatocarpon intestiniforme* (Körber) Hasse: specimens redetermined to *D. polyphyllum*.

*D. rivulorum* (Arnold) Dalla Torre & Sarnth.: we have seen one specimen from Sørkapp (leg. & det. Olech), in our opinion a young specimen of *D. polyphyllum*.

*D. spitsbergense* Lynge = *D. polyphyllum* (Heiðmarsson 2000).

*Fuscopannaria leucophaea* (Vahl) P.M. Jørg.: reported from Fosterøyene by Fries (1868), but no specimen in UPS.

*Hymenelia ceracea* (Arnold) Poelt & Vězda: reported by Nowak (1965) from Hornsund; specimen redetermined by us to *Ionaspis lacustris*.

*Hymenelia haematina* (Körb.) Lutzoni. Reported by Elvebakk & Hertel (1996), on the basis of *Ionaspis spitsbergensis* H. Magn. ad int. (O). We have seen the specimen, and in our opinion it belongs in *H. heteromorpha*.

*Ionaspis odora* (Ach.) Th.Fr. ex Stein: Aptroot & Alstrup (1991); specimen determined by us to *I. lacustris*.

*Lecania nylanderiana* A. Massal.: reported by Wulff (1902); no specimens available in UPS.

*Lecanora argopholis* (Ach.) Ach.: reported from Spitsbergen by Hue in Hariot (1893), but no material found in PC. Not included from Svalbard by Vänskä (1984).

*Lecanora flotoviana*: the species does not occur in the Arctic (Sliwa 2007); the report of this species refers to either *L. zosterae*, *L. dispersa* s.str. or *L. semipallida*.

*Lecanora leptacina* Sommerf.: reported from Hornsund by Körber (1875), but no specimen in L; a specimen from Sørkapp (leg. & det. Olech) contained xanthones and belongs to another species; no specimen in O.

*Lecanora cf. leucophaeoides* Nyl.: Hertel & Ullrich (1976); no material available.

*L. leucococca* Sommerf.: reported from Svalbard by Fries (1867) and Lynge (1940a); in our opinion a form of *L. polytropa*.

*L. muralis* (Schreb.) Rabenh.: reported from Edgeøya by Aptroot & Alstrup (1991); the specimen is *Squamaria poeltii*.

*L. polytropella* Nyl.: reported from Chermsideøya by Paulson (1927); the material not found in BM.

*Lecidea cf. panaensis* Nyl.: reported from Bockfjorden (Hafellner 1982); the specimen is *Miriquidica lulensis* (det. M. Andreev 2005).

*Lecidella bullata* Körber = *Lecanora formosa* (Svalbard material).

*Lecidella euphorea* (Flörke) Hertel: reported from Adventdalen (Lynge 1940a), but no specimens present in O; it should probably be synonymised with *L. elaeochroma*.

*Leptogium subtile* (Schrad.) Torss.: reported from Hornsund by Nowak (1965); specimen not available.

*L. tenuissimum* (Dicks.) Körber: reported from several localities by Fries (1867); but no specimen found in UPS.

*Ophioparma lapponica* (Räsänen) Hafellner & Rogers: all material is *O. ventosa*.

*Parmeliella triptophylla* (Ach.) Müll. Arg: reported from Sørkapp by Olech (1990) and Olech & Alstrup (1989); the specimen is a *Placynthium* sp. (P.M. Jørgensen, det. 2004).

*Peltigera membranacea* (Ach.) Nyl.: not accepted from Svalbard by Vitikainen (1994); no material in O.

*Peltigera praetextata* (Flörke ex Sommerf.) Zopf: reported from Sørkapp by Olech (1990). We examined five specimens (leg. & det. Olech, KRA-L) from Sørkapp. Neither of the specimens showed the schistidia and low veins darkened in inner part which is characteristic of this species, and we believe that they all belong in *P. canina* or *P. rufescens*.

*Pertusaria dactylina* (Ach.) Nyl.: reported by Paulson (1928); no material in BM.

*P. panyrga* (Ach) A. Massal.: reported by Eurola (1968); no specimen available.

*Placynthium tantaleum* (Hepp) Hue: reported by Elvebakk & Hertel (1996); material determined by us to *P. nigrum*.

*Porpidia cinereoatra* (Ach.) Hertel & Knoph: reported from Sørkapp by Olech (1990); no material available.

*P. crustulata* (Ach.) Hertel & Knoph: reported from Sørkapp by Olech (1990); no material available.

*P. glaucophaea* (Körber) Hertel & Knoph: reported from Sørkapp by Olech (1990) and from Hornsund by Nowak (1965); no material available.

*Rhizocarpon macrosporum* Räsänen: reported by Werner (1990); no material available

*Rinodina bischoffii* (Hepp) A. Massal.: reported from Hinlopenstretet by Paulson (1928); Paulson material not found in BM.

*R. tephraspis* (Tuck.) Herre: reported from Hornsund by Körber (1875); no material in Körber's herbarium (L).

*Stereocaulon arenarium* (Savicz) Lamb: reported from Sørkapp by Olech (1990) and Olech & Alstrup (1989); but no material available.

*S. condensatum* Hoffm.: no material in L, material from Sørkapp (Olech 1990) seen, but not possible to determine.

*Strigula sychnogonoides* (Nitschke) R.C. Harris: the Svalbard material determined to *Cercidospora decolorella*.

*Umbilicaria rigida* (DR) Frey: the collection reported by Aptroot & Alstrup (1981) from Edgeøya belongs to other species. Also reported from Edgeøya by Elenkin & Savicz (1912), but there is no specimen from Svalbard in LE (M. Andreev pers. comm. 2005).

**SPECIES ACCEPTED FROM BJØRNØYA BY ELVEBAKK & HERTEL (1996)**

[Not critically studied by us.]

- Acarospora scabrida* Hedl. Ex H. Magn.  
*Amygdalaria consentiens* (Nyl.) Hertel, Brodo & Mas. Inoue  
*Baeomyces placophyllus* Ach.  
*Buellia malmei* Lynge  
*Caloplaca concilians* (Nyl.) H. Olivier  
*C. diphyoides* (Nyl.) Jatta  
*Cladonia maxima* (Asahina) Ahti  
*Gyalecta geoica* (Wahlenb. ex Ach.) Ach.  
*Lecanora actophila* Wedd.  
*Lecidea epiphaea* Nyl.  
*L. minutissima* Lynge  
*L. miseriae* Lynge  
*L. praenubila* Nyl.  
*L. septentrionalis* Th. Fr.  
*Miriquidica leucophaea* (Flörke ex Rabenh.) Hertel & Rambold  
*Polyblastia cruenta* (Körb.) P. James & Swinscow  
*Verrucaria cataleptoides* (Nyl.) Nyl.

## ACKNOWLEDGEMENTS

We thank the curators of the cited herbaria for loan of material. We are greatly indebted to the following experts for determination of or comments to specimens: Dr. T. Ahti, Helsinki (*Cladonia*), Dr. U. Arup, Lund (*Caloplaca*), Dr. M. Andreev, St. Petersburg (*Lecanora*, *Lecidea*, *Miriquidica*), Cand. real. A. Botnen, Bergen (*Staurothele*), Dr. O. Breuss, Wien (*Polyblastia*), Dr. E. S. Hansen, Copenhagen (*Lecanora*), Dr. S. Ekman, Uppsala (*Bacidia*, *Bacidina*, *Lecania*), Dr. A. Fryday, East Lansing (*Cercidospora*, *Lecidea*, *Porpidia*, *Rhizocarpon*, *Thelenella*), Dr. P. G. Ihlen, Bergen (*Rhizocarpon*), Dr. P. M. Jørgensen, Bergen (*Fuscopannaria*, *Leptogium*, *Placynthium*), Dr. M. P. Zhurbenko, St. Petersburg (*Agonimia*), Dr. L. Lindblom, Bergen (*Xanthomendoza*, *Xanthoria*), Dr. J. Miadlikowska, Durham (*Peltigera*), Dr. H. Mayrhofer, Graz (*Rinodina*), Dr. A. Orange, Cardiff (*Polyblastia*, *Verrucaria*, *Catapyrenium*), Dr. C. Printzen, Frankfurt (*Biatora*, *Lecidea*, *Mycobilimbia*), Dr. E. Serusiaux, Liège (*Byssoloma*), Dr. L. Sliwa, Krakow (*Lecanora*), Dr. U. Søchting, Copenhagen (*Caloplaca*), Dr. A. Thell & Dr. M. Westman, Lund (*Melanelia*), Dr. E. Timdal, Oslo (*Squamaria*, *Lecanora*), F. N. Urbanavichene and G. I. Urbanavichus, Apatiti (*Absconditella*), and Dr. O. Vitikainen, Helsinki (*Peltigera*).

Dr. J. A. Elix, Canberra, kindly determined some lichen products. Dr. P. M. Jørgensen, revised the Latin diagnoses. Mr. J. Berge and Mrs B. Helle, both Bergen, made most of the photos and the figure design. Cand. real. A. Botnen greatly helped with word-processing. A special thank to Drs. E. S. Hansen and E. Timdal for valuable comments on the manuscript. D. O. Øvstedral wants to thank Professor Y. T. Gjessing, Longyearbyen/Bergen, who introduced him to the nature of Svalbard.

Thanks are due to the Olaf Grolle Olsens fund, University of Bergen, for financial support toward printing costs.

## REFERENCES

- Ahti, T. 1980. Nomenclatural notes on *Cladonia* species. – Lichenologist 12: 125–133.
- Ahti, T. 1998. A revision of *Cladonia stricta*. – Folia Cryptog. Estonica 32: 5–8.
- Almborn, O. 1948. Distribution and ecology of some south Scandinavian lichens. – Bot. Not. Suppl. 1: 2: 1–254.
- Alsos, I.G., Eidesen, P.B., Ehrich, D., Skrede, I., Westergaard, K., Jacobsen, G.H., Landvik, J.Y., Teberlet, P. & Brochmann, C. 2007. Frequent long-distance plant colonization in the changing Arctic. – Science 316: 1606–1609.
- Alsos, I.G., Westergaard, K., Lund, L. & Sandbakk, B.F. 2004. Floraen i Colesdalen, Svalbard. – Blyttia 62: 142–150.
- Alstrup, A. & Elvebakk, A. 1996. Lichenicolous fungi. – Norsk Polarinst. Skr. 198: 259–270.
- & Hawksworth, D.L. 1990. The lichenicolous fungi of Greenland. – Medd. Grønl. Biosci. 31: 1–90.
- Anonymous. 2003. The place names of Svalbard. – Norsk Polarinstitutt Rapportserie 122.
- Andreev, M., Kotlov, Y. & Makarova, I. 1996. Checklist of lichens and lichenicolous fungi of the Russian Arctic. – Bryologist 99: 137–169.
- Aptroot, A. & Alstrup, V. 1991. Lichens from Edgeøya, Svalbard. – Graphis Scripta 3: 73–75.
- Baruffo, L., Zedda, L., Elix, J.A. & Tretiach, M. 2006. A revision of the lichen genus *Lepraria* s. lat. in Italy. – Nova Hedwigia 83: 387–429.
- Birks, H.H. 1991. Holocene vegetation history and climatic change in west Spitsbergen – plant macrofossils from Skardtjonna, an Arctic lake. – Holocene 1: 209–218.
- Birks, H.J.B., Jones, V.J. & Rose, N.L. 2004. Recent environmental change and atmospheric contamination on Svalbard as recorded in lake sediments – synthesis and general conclusions. – J. Palaeolimn. 31: 531–546.
- Breuss, O. 1996. Eine gefeinerte Gliederung für *Catapyrenium* (lichenisierter Ascomyceten, Verrucariaceae) mit einem Schlüssel für die bisher bekannten Arten. – Ann. Naturhist. Mus. Wien 98B Suppl.: 35–50.
- & Hansen, E.S. 1988. The lichen genera *Catapyrenium* and *Placiopsis* in Greenland. – Pl. Syst. Evol. 159: 95–105.
- Brodo, I.M. 1988. Studies for the lichen genus *Ochrolechia*. 1. A new classification for *Pertusaria subplicans* and *P. rhodoleuca*. – Can. J. Bot. 66: 1264–1269.
- , Sharnoff, S.D. & Sharnoff, S. 2001. Lichens of North America. – Yale University Press, New Haven.
- Buschart, A. 1979. Zur Flechtenflora der inneralpinen Trochentäler. – Biblthca lichenol. 10: 1–419.
- Calvelo, S. & Liberatore, S. 2002. Catálogo de los líquenes de la Argentina. – Kurtziana 29: 2: 1–173.
- Carlin, G. 1981. De svenska bågarlavarna (*Cladonia* undersläktet *Cladonia*). – Svensk Bot. Tidskr. 75: 361–396.
- & Carlin-Silväng, U. 1982. De svenska *Stereocaulon*-arterna (påskrislavar). – Svensk bot. Tidskr. 76: 289–307.
- Coppins, B.J. 1992. *Biatora* Fr. (1817). – In: Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M.(eds.), The lichen flora of Great Britain and Ireland. Natural History Museum Publications/The British Lichen Society, London, pp. 118–121.
- Culberson, C.F. 1972. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. – J. Chromatogr. 72: 113–125.

- & Johnson, A. 1982. Substitution of methyl tert.-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. – *J. Chromatogr.* 238: 483–487.
- & Kristinsson, H. 1970. A standardized method for the identification of lichen products. – *J. Chromatogr.* 46: 85–93.
- Dahl, E. 1950. Studies in the macrolichen flora of South East Greenland. – *Medd. Grønl.* 150: 2: 1–176.
- Dalland, W.K. & Y. Ohta. 2002. Bedrock map of Svalbard and Jan Mayen 1: 750 000, enlarged key areas 1: 250 000, several thematic overview maps 1: 3 000 000. – Norsk Polarinst. Temakart 33.
- Dibben, M.J. 1980. The chemosystematics of the lichen genus *Pertusaria* in North America north of Mexico. – *Publ. Biol. Grol. Milwaukee Publ. Mus.* 5: 1–162.
- Diederich, P. & Zhurbenko, M. 1997. *Taeniolella rolfii* sp. nov., a new lichenicolous hyphomycete from the Siberian Arctic. – *Symb. bot. ups.* 32: 11–16.
- & Zhurbenko, M. 2001. Nomenclatural notes on *Taeniolella rolfii* Diederich & Zhurb. – *Graphis Scr.* 12: 37–40.
- Du Rietz, G.E. 1940. Problems of bipolar plant distribution. – *Acta phytogeogr. suec.* 13: 215–282.
- Ekman, S. & Tønsberg, T. 2002. Most species of *Lepraria* and *Leproloma* form a monophyletic group related to *Stereocaulon*. – *Mycol. Res.* 106: 1262–1276.
- Elenkin, A.A. & Savicz, V.P. 1912. Lisainiki sobrannie I.V. Palibinym v plavanie Ledokla "Ermak" v Severnom ledovitom Okean 1901 (Lichenes in Reginoibus arcticis Oceanii Glacialis a I.V. Palibin anni 1901 collecti). – *Acta Horti Petropol.* 32: 94–97.
- Elix, J.A. 1999. Detection and identification of secondary lichen substances: Contributions by the Uppsala school of lichen chemistry. – *Symb. bot. ups.* 32: 2: 103–121.
- , Wardlaw, J.H. & Søchting, U. 2000. Two new anthraquinones from the lichen *Caloplaca spitsbergensis*. – *Herzogia* 14: 27–30.
- Elvebakk, A. 1984. Vegetation pattern and ecology of siliceous boulder snow beds on Svalbard. – *Polarforschung* 54: 9–20.
- 1985. Higher phytosociological syntaxa on Svalbard and their use in subdivision of the Arctic. – *Nord. J. Bot.* 5: 273–284.
- 1989. Biogeographical zones of Svalbard and adjacent areas based on botanical criteria. – Dr. scient. thesis (unpubl.), Univ. Tromsø, Tromsø (unpubl.).
- 1994. A survey of plant associations and alliances from Svalbard. – *J. Veg. Sci.* 5: 791–802.
- 2005. A vegetation map of Svalbard on the scale 1: 3.5 mill. – *Phytocoenologia* 35: 951–967.
- & Hertel, H. 1996. Lichens. – *Norsk Polarinst. Skr.* 198: 271–359.
- & Moberg, R. 2002. Foliose and placodiod species of the lichen family Physciaceae in southernmost Chile. – *Lichenologist* 34: 311–320.
- & Nilsen, L. 2002. Indre Wijdefjorden med sidefjordar: eit botanisk unikt steppeområde. – *Rapport til Sysselmannen på Svalbard*. – Univ. i Tromsø, Tromsø.
- & Prestrud, P. (Eds). 1996. A Catalogue of Svalbard plants, fungi, algae and cyanobacteria. – *Norsk Polarinst. Skr.* 198: 1–395.
- & Spjelkavik, S. 1995. The ecology and distribution of *Empetrum nigrum* ssp. *hermaphroditum* on Svalbard and Jan Mayen. – *Nord. J. Bot.* 15: 541–552.
- & Tønsberg, T. 1992. Additions to the lichen flora of Svalbard. – *Graphis Scr.* 3: 140–147.
- & Øvstedral, D. O. 2009. *Caloplaca trachyphylla* new to Europe from high- arctic steppes of Svalbard. – *Graphis Scripta* 21 (in press).
- Esslinger, T. 1977. A chemosystematic review of the brown *Parmeliae*. – *J. Hattori bot. Lab.* 42: 1–211.

- 2008. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: <http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm> (First Posted 1 December 1997, Most Recent Version (#14) 8 October 2008), Fargo, North Dakota.
- Eurola, S. 1968. Über die Fjeldheidevegetation in den Gebieten von Isfjorden und Hornsund in Westspitzbergen. – *Aquilo ser. Bot.* 7: 1–56.
- Flatberg, K.I. & Thinggaard, K. 2004. Taxonomy and Geography of *Sphagnum tundrae* with a Description of *S. mirum*, sp. nov. (*Sphagnaceae*, sect. *Squarrosa*). – *The Bryologist* 106: 501–515.
- Frey, E. 1936. Die geographische Verbreitung der Umbilicariaceen und einiger alpiner Flechten. – *Ber. schweiz. bot. Gesellsch.* 46: 412–444.
- Fries, T.M. 1860. Lichenes Arctoi. – *Reg. Soc. Scient. Ups. Ser. III* 2: 103–398.
- 1867. Lichenes Spitsbergenses. – *K. svenska Vet.-Akad. Handl.* 72: 1–53.
- 1877. Polyblastiae Scandinavicae. – *Reg. Soc. Scient. Upsal. Trad.*: 1–28.
- Fryday, A. 2005. The genus *Porpidia* in northern and western Europe, with special emphasis on collections from the British Isles. – *Lichenologist* 37: 1–35.
- & Coppins, B. 1997. Keys to sterile, crustose saxicolous and terricolous lichens occurring in the British Isles. – *Lichenologist* 294: 301–332.
- Fröberg, L. 1989. The Calcicolous Lichens of the Great Alvar of Öland, Sweden. – *Inst. för syst. bot.*, Lunds Univ., Lund.
- Førland, E.J., Hanssen-Bauer, I. & Nordli, P.Ø. 1997. Climate statistics and Long-Term series of temperature and precipitation at Svalbard and Jan Mayen. – *Det Norske Meteorol. Inst., Rapp. Klima* 21: 1–72.
- Galloway, D.J. 2007. Flora of New Zealand lichens. Revised second edition including lichen-forming and lichenicolous fungi. Vol. I–II. Manaaki Whenua Press, Lincoln, New Zealand.
- & Quilhot, W. 1998. Checklist of Chilean lichen-forming and lichenicolous fungi. – *Gayana Bot.* 55: 111–185.
- Gjessing, Y.T. & Øvstdal, D.O. 1975. Energy budget and ecology of two vegetation types in Svalbard. – *Astarte* 8: 83–92.
- Hafellner, J. 1982. Flechtenfunde am Bockfjord, Spitzbergen. Ergebnisse der österreichischen Spitzbergen-Expedition 1979, I. – *Phyton* 22: 23–50.
- & Türk, R. 2001. Die lichenisierten Pilze Österreichs – eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungssangaben. – *Stapfia* 76: 1–167.
- Hansen, E.S., Poelt, J. & Søchting, U. 1987. Die Flechtengattung *Caloplaca* in Grönland. – *Medd. Grønl. Biosci.* 25: 1–52.
- Haugan, R. & Timdal, E. 1992. A new *Squamaria* from Norway. – *Nord. J. Bot.* 12: 357–360.
- & Timdal, E. 1994. *Tephromela perlata* and *T. talayana*, with notes on the *T. aglaea*-complex. – *Graphis Scr.* 6: 17–26.
- Hariot, M. 1893. Note sur les collections cryptogamiques rapportées à la Manche. III. Spitzberg. Lichenes (determines par M l'abbé Hue). – *Nouv. Arch. Miss. Sci.* 5: 241–257.
- Haworth, D.L. & Dalby, K. 1992. *Lecanora* Ach. (1810). – In: Purvis O.W., Coppins B.J., Hawksworth D.L., James P.W. & Moore, D.M. (eds), The lichen flora of Great Britain and Ireland. Natural History Museum Publications/The British Lichen Society, London, pp. 292–318.
- McCarthy, P.M. & Fletcher, A. 1992. *Verrucaria* Schrader (1794). – In Purvis O.W., Coppins B.J., Hawksworth D.L., James P.W. & Moore D.M. (eds), The lichen flora of Great Britain and Ireland. Natural History Museum Publications/The British Lichen Society, London, pp. 630–642.
- Heiðmarsson, S. 2001. *Dermatocarpon* (Verrucariales, lichenized Ascomycotina) in the Nordic

- countries. – Nord. J. Bot. 21: 605–639.
- Henssen, A. 1995. Studies on the biology and structure of *Dacampia* (Dothideales), a genus with lichenized and lichenicolous species. – Crypt. Bot. 5: 149–158.
- Hertel, H. 1977. Bemerkenswerte Flechtenfunde aus dem Gebiet des Kongsfjordes und des Isfjordes Spitzbergen. – Herzogia 4: 367–401.
- 1981. *Lecidea* in der Arktis II. – Mitt. bot. München 17: 171–184.
  - 1985. New, or little-known New Zealand lecideoid lichens. – Mitt. bot. München 21: 301–337.
  - 1991. *Lecidea* in der Arktis III (lecideoide Flechten, Lecanorales). – Mitt. bot. München 30: 297–333.
  - 1995. Schlüssel für die Arten der Flechtenfamilie Lecideaceae in Europa. – Biblthca lichenol. 58: 137–180.
  - & Rambold, G. 1985. *Lecidea* sect. Armeniacae: lecideoide Arten der der Flechtengattungen *Lecanora* und *Tephromela* (Lecanorales). – Bot. Jahrb. Syst. 107: 469–501.
  - & Rambold, G. 1990. Zur Kenntnis der Familie Rimulariaceae Lecanorales. – Biblthca lichenol. 38: 145–189.
  - & Ullrich, H. 1976. Flechten von Amsterdamsøya (Svalbard). – Mitt. bot. München 12: 417–512.
- Hjelle, A. & Lauritzen, Ø. 1982. Geological map of Svalbard 1: 500 000. Sheet 3G Spitsbergen, northern part. – Norsk Polarinstitutt Skr. 154 C: 1–15.
- Høiland, K. 1987. The basidiolichens of Norway and Svalbard. – Graphis Scr. 1: 81–90.
- Hyvärinen, H. 1972. Pollen analytical evidence for Flandrian climatic change in Svalbard. – Acta Univ. Oulu A3 Geol. 1: 225–237.
- Ihlen, P. G. 2004. Taxonomy of the non-yellow species of *Rhizocarpon* (Rhizocarpaceae, lichenized Ascomycota) in the Nordic countries, with hyaline and muriform ascospores. – Mycol. Res. 108: 533–570.
- James, P.W. & White, J.F. 1987. Studies on the genus *Nephroma* 1. The European and Macaronesian species. – Lichenologist 19: 215–268.
- Jones, V.J. & Birks, H.J.B. 2004. Lake-sediment records of recent environmental change on Svalbard: results of diatom analysis. – J. Palaeolimn. 31: 445–466.
- Kärnefelt, I. 1979. The brown fruticose species of *Cetraria*. – Op. bot. 46: 1–150.
- 1986. The genera *Bryocaulon*, *Coelocaulon* and *Cornicularia* and formerly associated taxa. – Op. bot. 86: 1–90.
- Knoph, J.-G. & Leuckert, C. 1994. Chemotaxonomic studies in the saxicolous species of the lichen genus *Lecidella* (Lecanorales, Lecanoraceae) in America. – Nova Hedwigia 59(3–4): 455–508.
- & Leuckert, C. 2000. Chemotaxonomische Studien in der Gattung *Lecidella* (Lecanorales, Lecanoraceae) III. Die gesteinbewohnenden Arten mit farblosem Hypothecium unter besonderer Berücksichtigung von europäischem Material. – Herzogia 14: 1–26.
- Kristinsson, H. 1974. Two new *Cladonia* and one new *Cetraria* species from Iceland. – Lichenologist 6: 141–145.
- , Hansen, E.S. & Zhurbenko, M. 2006. Panarctic lichen checklist. [http://archive.arcticportal.org/276/01/Panarctic\\_lichen\\_checklist.pdf](http://archive.arcticportal.org/276/01/Panarctic_lichen_checklist.pdf). Version of 22 Dec. 2006.
- Körber, G.W. 1875. Lichenes Spitzbergens und Novaja-Zemlja's auf der Graf Wilczek'schen Expedition 1872. Gesammelt von Prof. Höfer in Klagenfurt. Sitzungsber. – Akad. Wiss. Wien, Mat.-Nat Cl. 71: 520–526.
- Krog, H., Østhagen, H. & Tønsberg, T. 1994. Lavflora. Norske busk- og blad-lav. – Universitetsforlaget, Oslo.
- Lamb, I. M. 1977. A conspectus of the lichen genus *Stereocaulon* (Schreb.) Hoffm. – J. Hattori bot.

- Lab. 43: 191–355.
- 1978. Keys to the species of the lichen genus *Stereocaulon* (Schreb.) Hoffm. – J. Hattori bot. Lab. 44: 209–250.
  - Landvik, J.Y., Mangerud, J. & Salvigsen, O. 1987. The Late-Weichselian and Holocene shoreline displacement on the west-central coast of Svalbard. – Polar Research 5: 29–44.
  - , Brook, E.J., Gualtieri, L., Raisbeck, G. Salvigsen, O. & Yiou, F. 2003. Northwest Svalbard during the last glaciation: ice free areas existed. – Geology 31: 905–909.
  - Lerfall, E. 2001. *Ophioparma* på Svalbard og i Norge. – Cand. scient. thesis. University of Tromsø, Tromsø, unpubl.
  - Leuckert, C., Knoph, J.-G. & Hertel, H. 1992. Chemotaxonomische Studien in der Gattung *Lecidella* (Lecanorales, Lecanoraceae) II. Europäische Arten der *Lecidella asema*-Gruppe. – Herzogia 9: 1–17.
  - , Kümmerling, H. & Wirth, V. 1995. Chemotaxonomy of *Lepraria* Ach. and *Leprolooma* Nyl. ex Crombie, with particular reference to Central Europe. – Biblthca lichenol. 58: 245–259.
  - Lien, L., Henriksen, A. & Traaen, T. S. 1993. Critical loads of acidity to surface waters on Svalbard. – Norsk Inst. Vannforsk. Rep. O-90102: 1–19.
  - Lindblom, L. & Søchting, U. 2008. Taxonomic revision of *Xanthomendoza borealis* and *Xanthoria mawsonii* (Lecanoromycetes, Ascomycota). – Lichenologist 40: 399–409.
  - Lynge, B. 1924. Lichens from Spitzbergen I. – Result. norske Statsunderst. Spitsbergeneksp. 15: 1–21.
  - 1926. Lichens from Bear Island Bjørnøya collected by Norwegian and Swedish expeditions, chiefly by Th. M. Fries during the Swedish polar expedition of 1868. – Result. norske Statsunderst. Spitsbergeneksp. 19: 1–78.
  - 1928. Lichens from Novaya Zemlya excl. of *Acarospora* and *Lecanora*. – Rep. sci. Res. norw. Exped. Novaya Zemlya 1921: 43: 1–299.
  - 1933. On *Duroorea* and *Dactylina* – three arctic lichens. – Skr. Svalbard Ishavet 59: 1–62.
  - 1936. The lichen genus *Rhizocarpon* on the west and north coast of Spitsbergen and Nordostlandet (The North East Land). – Svensk bot. Tidsskr. 30: 307–323.
  - 1938. Lichens from the west and north coasts of Spitsbergen and the north-East Land collected by numerous expeditions. I. The macrolichens. – Skr. Norske Vidensk.-Akad. Oslo. I. Mat.-Nat. vitensk. Klasse 1938: 6: 1–136.
  - 1939. A small contribution to the lichen flora of the eastern Svalbard islands. – Medd. Norges Svalbard-IshavsUnders. 44: 1–12.
  - 1940a. Et bidrag til Spitsbergens lavflora. Laver samlet av Emil Hadac, fortrinsvis i Sassenområdet, sommeren 1939. – Skr. Svalbard Ishavet 79: 1–22.
  - 1940b. Lichens from North East Greenland collected on the Norwegian scientific expeditions in 1929 and 1930. – Skr. Svalbard Ishavet 81: 1–143.
  - Magnusson, A. H. 1929. A monograph of the genus *Acarospora*. – K. svenska Vet.-Akad. Handl. Ser. 3, 7: 4: 1–400.
  - 1935. The lichen genus *Acarospora* in Greenland and Spitsbergen. – Nyt Mag. NatVitensk. 75: 221–241.
  - 1939. Studies in species of *Lecanora*. Mainly the *Aspicilia gibbosa* group. – K. Svenska Vet.-Akad. Handl. Ser. 3, 17: 5: 1–182.
  - 1947. Studies in non-saxicolous species of *Rinodina*. – Medd. Göteborg bot. Trädg. 17: 191–338.
  - Martinez, I. & Burgaz, A.R. 1998. Revision of the genus *Solorina* (Lichenes) in Europe based on spore size variation. – Annls bot. fenn. 35: 137–142.
  - Matthiessen, P. 2003. End of the earth—voyages to the white continent. – National Geographic.

- Washington DC, 211 pp.
- Mayrhofer, M. 1988. Studien über die saxicolen Arten der Flechtengattung *Lecania* in Europa II. *Lecania* s. str. – Biblthca lichenol. 28: 1–133.
- McCarthy, P.M. 2008. Checklist of the Lichens of Australia and its Island Territories. Australian Biological Resources Study, Canberra. Version 3 December 2008. <http://www.anbg.gov.au/abrs/lichenlist/introduction.html>.
- Menlove, J.E. 1974. Thin-layer chromatography for the identification of lichen products. – Bull. br.Lich. Soc. 3: 3–5.
- Meyer, B. & Printzen, C. 2000. Proposal for a standardized nomenclature and characterization of insoluble lichen pigments. – Lichenologist 32: 571–583.
- Moberg, R. 1977. The lichen genus *Physcia* and allied genera in Fennoscandia. – Symb. bot. ups. 22: 1–108.
- Nordin, A. 1996. *Buellia* species (Physciaceae) with pluriseptate spores in Norden. – Symb. bot. ups. 31: 327–354.
- Nowak, J. 1965. The lichens from Hornsund S.W.-Spitzbergen collected during the Polish polar expeditions in 1957 and 1958. – Fragm. florist. geobot. 11: 171–190.
- Obermayer, W. & Poelt, J. 1994. *Lecanora leptacinella*, *Lecidea polytrichina* und *Lecidea polytrichinella* spec. nova, drei an acidophile Moose gebundene Flechten von arktisch-alpiner Verbreitung. – Acta bot. fenn. 150: 131–142.
- Ochyra, R. & Buch, W.R. 2004. *Arctoa fulvella*, new to Tierra del Fuego, with notes on trans-American bipolar bryogeography. – Bryologist 106: 532–538.
- O'Donnell, K., Ward, T. J., Geiser, D. M., Kistler, H. C. & Aoti, T. 2004. Geneological concordance between the mating type locus and seven other nuclear genes supports formal recognition of nine phylogenetically distinct species within the *Fusarium graminearum* clade. – Fungal Gen. Biol. 41: 602–623.
- Olech, M. 1987. Materials to the lichen flora of Hornsund (SW Spitsbergen). – Zesz. Nauk. Univ. Jagiell. Prace Bot. 15: 165–168.
- 1990. Lichens of the NW Sörkapp Land (Spitsbergen). – Zesz. Nauk. Univ. Jagiell. Prace Bot. 21: 197–210.
- & Alstrup, V. 1989. Lichens new to Spitsbergen. – Graphis Scr. 2: 146–148.
- Orange, A. 1997. Chemical variation in *Lepraria eburnea*. – Lichenologist 29: 9–13.
- 1999. *Lepraria eburnea* Laundon. – In: Seaward M.R.D. (ed.), Lichen atlas of the British isles, British Lichen Society, London, p. 1712.
- Osyczka, P. 2005. A note about new and rarely recorded taxa of the genus *Cladonia* from the arctic island Spitsbergen (Svalbard). – Acta Soc. bot. poloniae 74: 243–246.
- Øvstedal, D.O. & Gremmen, N.J.M. 2006. Lichens of sub-Antarctic Heard Island. – S. Afr. J. Bot. 72: 353–366.
- & Lewis Smith, R.I. 2001. The lichens of Antarctica and South Georgia. – Cambridge Univ. Press, Cambridge.
- Paulson, R. 1923. Spitsbergen lichens. – J. Bot. 6 : 77–81.
- 1928. Lichens of Spitsbergen and North-East Land. – J. Bot. 66: 249–253.
- Poelt, J. 1969. Bestimmungsschlüssel europäischer Flechten. – Kramer, Vaduz.
- 1990. Parasitische Arten der Flechtengattung *Rhizocarpon*: eine weitere Übersicht. – Mitt. bot. München 29: 515–538.
- & Mayrhofer, M. 1988. Über Cyanotrophie bei Flechten. – Pl. Syst. Evol. 158: 265–281.
- Purvis, O.W. 1992. *Alectoria* Ach. (1810). – In: Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M. (eds.), The lichen flora of Great Britain and Ireland. Natural History Museum Publications/The British Lichen Society, London, pp. 67–69.

- & James, P.W. 1992. *Acarospora* Massal. (1852). – In: Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M. (eds.), *The lichen flora of Great Britain and Ireland*. Natural History Museum Publications/The British Lichen Society, London, pp. 58–63.
- Rambold, G. 1989. A monograph of the saxicolous lecideoid lichens of Australia (excl. Tasmania). – *Bibliotheca lichenol.* 34: 1–345.
- Rose, N.L., Rose, C.L., Boyle, J.F. & Appleby, P.G. 2004. Lake sediment evidence for local and remote sources of atmospherically deposited pollutants on Svalbard. – *J. Palaeolimn.* 31: 499–513.
- Saag, L., Hansen, E.S., Saag, A. & Randlane, T. 2007. Survey of *Lepraria* and *Leprocaulon* in Greenland. – *Mycotaxon* 102: 57–90.
- Salvigsen, O., Forman, S.L. & Miller, G.H. 1992. Thermophilous molluscs on Svalbard during the Holocene and their paleoclimatic implications. – *Polar Research* 11: 1–10.
- Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. 2004. Lichen-forming and lichenicolous fungi of Fennoscandia. – Museum of Evolution, Uppsala University, Uppsala.
- Savić, S. & Tibell, L. 2008. *Atla*, a new genus in the Verrucariaceae (Verrucariales). – *Lichenologist* 40: 269–282.
- & Tibell, L. 2009. Taxonomy and species delimitation in *Sporodictyon* (Verrucariaceae) in Northern Europe and the adjacent Arctic – reconciling molecular and morphological data. – *Taxon* 58: 585–605.
- Scheidegger, C. 1993. A revision of European saxicolous species of the genus *Buellia* de Not. and formerly included genera. – *Lichenologist* 25: 315–364.
- Sérusiaux, E. 1998. Deux nouvelles espèces de *Byssoloma* Trev. (Lichenes, Pilocarpaceae) d'Europe occidentale et de Macaronesie. – *Cryptogamie, Bryol. Lichenol.* 19: 197–209.
- Slavíková-Bayerová, Š. & Fehrer, J. 2007. New species of the *Lepraria neglecta* group (Stereocaulaceae, Ascomycota) from Europe. – *Lichenologist* 39: 319–327.
- & Orange, A. 2006. Three new species of *Lepraria* (Ascomycota, Stereocaulaceae) containing fatty acids and atranorin. – *Lichenologist* 38: 503–513.
- Sliwa, L. 2007. A revision of the *Lecanora dispersa* complex in North America. – *Pol. bot. J.* 52: 1–70.
- Søchting, U. 1989. Lignicolous species of the lichen genus *Caloplaca* from Svalbard. – *Op. bot.* 100: 241–257.
- , Balschmidt Lorentsen, L. & Arup, U. 2008. The lichen genus *Caloplaca* (Ascomycota, Leccanomycetes) on Svalbard. Notes and additions. – *Nova Hedwigia* 87: 69–96.
- & Olech, M. 1995. The lichen genus *Caloplaca* in polar regions. – *Lichenologist* 27: 463–471.
- & Tønsberg, T. 1997. *Caloplaca xanthostigmoidea* (Räs.) Zahlbr., a common lichen species in cold regions of the Northern Hemisphere. – *Symb. bot. ups.* 32: 247–253.
- Steffensen, E.L. 1982. The climate at Norwegian Arctic stations. – *Klima* 5: 1–44.
- Stenroos, S. 1990. *Cladonia luteoalba* – an enigmatic *Cladonia*. – *Karstenia* 30: 27–32.
- Summerhayes, V.S. & Elton, C.S. 1923. Contributions to the ecology of Spitsbergen and Bear Island. – *J. Ecol.* 11: 214–286.
- & Elton, C.S. 1928. Further contributions to the ecology of Spitsbergen. – *J. Ecol.* 16: 193–268.
- Svendsen, J.I. & Mangerud, J. 1992. Paleoclimatic inferences from glacial fluctuations on Svalbard during the last 20 000 years. – *Clim. Dyn.* 6: 213–220.
- Tarussov, A. 1992. The Arctic from Svalbard to Severnaya Zemlya: climatic reconstruction from ice cores. – In: Bradley R.S. & Jones P.D. (eds), *Climate since AD 1500*, Routledge, London, pp. 505–516.
- Thomson, J.W. 1984. American arctic lichens. 1. The Macrolichens. – Columbia Univ. Press, New

- York.
- 1997. American arctic lichens. 2. The Microlichens. – University of Wisconsin Press, Wisconsin.
- Thüs, H. 2002. Taxonomie, Verbreitung und Ökologie silikoler Süßwasser- Flechten in Ausseralpinen Mitteleuropa. – Biblthca lichenol. 83: 1–214.
- Tibell, L. 1999. Caliciales. – Nord. Lichen Flora 1: 20–71.
- Timdal, E. 1987. Notes on some parasitic *Rhizocarpon* species. – Lichenologist 193: 335–338.
- 1991. A monograph of the genus *Toninia* (Lecideaceae, Ascomycetes). – Op. bot. 110: 1–137.
  - 2004. *Dactylina ramulosa* new to Norway. – Graphis Scr. 16: 33–36.
  - & Holtan-Hartwig, J. 1988. A preliminary key to *Rhizocarpon* in Scandinavia. – Graphis Scr. 2: 41–54.
- Tønsberg T. 1992. The sorediate and isidiate, corticolous, crustose lichens in Norway. – Sommerfeltia 14: 1–331.
- 2004. *Lepraria*. In: Nash III T.H., Ryan B.D., Diederich P., Gries C. & Bungartz F. (eds), Lichen Flora of the Greater Sonoran Desert Region Vol. II, Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 322–329.
  - & Elvebakk, A. 1993. *Cetraria inermis* new to Europe. – Graphis Scr. 5: 73–74.
  - & Holtan-Hartwig, J. 1983. Phycotype pairs in *Nephroma*, *Peltigera* and *Lobaria* in Norway. – Nord. J. Bot. 3: 681–688.
  - & Zhurbenko, M.P. 2006. *Lepraria gelida*, a new lichen species from the Arctic. – Graphis Scr. 18: 64.
- Urbanavichene, I.N. & Koroleva, N.E. 2008. Lichens. In: Koroleva, N.E., Konstantinova, N.A., Belkina, O.A., Davydov, D.A., Likhachev, A. J., Savchenko, A.N. & Urbanavichene, I.N. (eds). Flora and vegetation of Grønfjord area (Spitsbergen archipelago). Russian Academy of Sciences, Kola Science Centre, N.A. Avrorin Polar-Alpine Botanical Garden Institute, Apatity, pp. 81–92.
- Van der Wal, R., Brooker, R., Cooper, E. & Langvatn, R. 2001. Differential effects of reindeer on high Arctic lichens. – J. Veg. Sci. 12: 705–712.
- Vänskä, H. 1984. The identity of the lichens *Lecanora frustulosa* and *L. argopholis*. – Annls bot. fenn. 21: 391–402.
- Veldkamp, J.F. 2004. *Bilimbia* (Lichenes) resurrected. – Lichenologist 36: 191–195
- Vězda, A. 1966. Flechtersystematische Studien IV. Die Gattung *Gyalidea* Lett. – Folia geobot. phytotax. 1: 311–340.
- Vitikainen, O. 1994. Taxonomic revision of *Peltigera* (lichenized Ascomycotina) in Europe. – Annls bot. fenn. 152: 1–96.
- Werner, A. 1990. Lichen growth rates for the northwest coast of Spitsbergen. Arct. alp. Res. 22: 129–140.
- Winsnes, T.S. 1988. Bedrock map of Svalbard and Jan Mayen. Geological map 1: 1 000 000. – Norsk Polarinstit. Temakart 3: 1–12.
- Wirtz, N., Printzen, C., Sancho, L.G., Lumbsch, H.T. 2006. The phylogeny and classification of *Neuropogon* and *Usnea* (Parmeliaceae, Ascomycota) revisited. – Taxon 55: 367–376.
- Wulff, V. 1902. Botanische Beobachtungen aus Spitzbergen. – Akademische Abhandlung, Lund.
- Wunder, H. 1974. Schwarzfrüchtige, saxicole sippen der Gattung *Caloplaca* (Lichenes, Teloschistceae) in Mitteleuropa, dem Mittelmeergebiet und Vorderasien. – Bibl. Lichenol. 3: 1–186.
- Zahlbrückner, A. 1928. Die Gattung *Lecanora*. – Rep. Sci. Results norw. Exped. Novaya Zemlja Bot. 1921 44: 1–32.
- Zschacke, H. 1934. Epigloeaceae, Verrucariaceae und Dermatocarpaceae. – Leipzig.