

ON THE PROBLEM OF SUBARCTIC BASIDIOLICHENS. II

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In our first investigation dealing with the problem of «subarctic basidiolichens» (HEIKKILÄ & KALLIO 1966) the spatial relationship of certain basidiomycetes and green algae was mainly studied on the basis of material collected in Lapland. It was already then assumed that these organisms are distributed circumpolarly in the arctic and subarctic regions, and the observations made during last two years have confirmed this opinion. In summer 1966, during a Kevo-excursion the authors collected material on the western coast of Spitsbergen, mainly in the mouth of Isfjorden (peninsula west of Grönfjorden), where we were accommodated in Norsk Polarinstitut's cabin at Isfjord Radio. In addition we only very shortly visited Longyearbyen and for two days Ny Ålesund (Kongsfjord). In 1967 an excursion was made to northeastern Canada, in central and northern parts of Labrador-Ungava peninsula. This excursion was financially supported by the National Museum of Canada in Ottawa. The main research area comprised the surroundings of Schefferville, and our excellent accommodation (with the important possibilities to dry plants) was arranged by McGill University Subarctic Research Laboratory. The staff of this laboratory also helped us in many other ways, e.g. in the local transportations, which enabled us to see a large area within a short time. Our shorter northern halt was in Fort Chimo, where we enjoyed great hospitality as guests of the Quebec Government. In addition, the author Kallio had the opportunity to take part in the Middle North Tour (1967) arranged by AINA and could gather some specimens in Frobisher Bay (Baffin Island), Inuvik (Mackenzie River delta, NW-Territories) and Barrow (Alaska).

Some more information was received by studying herbarium specimens from the Botanical Museums in Copenhagen (C, material from Greenland), Oslo (O), Stockholm (S) and Leningrad (LE; material from northern Siberia, from where the authors also have own find having visited Jakutia as guests of the local department of the Acad. of Sci. of the USSR).

The purpose of the present paper is thus to give more information about the distribution of basidiolichens, while our laboratory investigations have not yet given any results for the nearer explanation of the actual nature of the symbiosis. It has not been finally proved that the symbiotic relationship called basidiolichen corresponds to the old concept of a lichen (*Ascolichenes*), and we use the terms *Basidiolichenes*, *Agaricolichenes* etc. knowing well the possible inexactness attached to them.

In this paper we shall concentrate on the group *Agaricolichenes*, and thus on two lichens: *Botrydina vulgaris* and *Coriscium viride*. The agarics associated with them belong in both cases to the genus *Omphalina*, while the phycobionts are green algae of the genus *Coccomyxa*.

Botrydina vulgaris Bréb.

The list of agarics, which we have always observed associated with the primitive lichen *Botrydina*, consists of three *Omphalina* species: *O. ericetorum*, *O. luteovitellina* and *O. velutina*. In every find of these species dark green spherical thalli of *Botrydina* have been found around the base of the fungus — no matter, if its substrate has been barren ground, rotten wood, mosses or old thalli of other lichens.

Omphalina ericetorum (Pers.) M. Lange [= *O. umbellifera* (L.) Quél.]
+ *Botrydina vulgaris* Bréb.

Finland. Very common throughout the whole land. Many finds both in southern and in northern parts.

Spitsbergen 1966. — W. coast: Leinstrand 14. 8., (R. Engstrand. — Longyearbyen: Adventdalen 22. 8., Longyearbyen Aug. (M. Rösler). — Isfjorden: peninsula west of Grönfjorden: Vardåsen 12. 8., Kongressdalen 16. 8., Branzatoppen 19. 8., Festningen 14. 8.; west coast of Grönfjorden, Blendadalen 16. 8.

USA 1967. — Alaska: Barrow 24. 7.

Canada 1967. — NW-Territories: Inuvik 23. 7., Baffin Island: Frobisher Bay 18. 7. — Quebec: Fort Chimo area: 1 mile SE. of Inukshuktuyuk 27. 7., between Inukshuktuyuk and Fort Chimo, 2 miles W. of Koksoak River, NE. of the 564 ft. hill (58° 24'N, 68° 15'W) 28. 7., about 1 mile W. of Whales Head (58° 11'N, 68° 21'W) 29. 7., Stewart Lake, at the seaplane base 3. 8., W. side of Koksoak River, opposite to Old Fort Chimo 29. 7., Old Fort Chimo 31. 7., 0.6 miles E. of Fort Chimo (58° 07'N, 68° 23'W) 25. 7., W. of Fort Chimo (58° 06'N, 68° 27'W) 26. 7., E. shore of Koksoak River, opposite to Big Elbow Island 31. 7., at the lower falls of Highfall Creek (58° 01'N, 68° 29'W) 2. 8. — Schefferville area: Snowy Channel (54° 55'N, 67° 05'W) 15. 7., Schefferville, bog N. of Schefferville airfield 8. 7., 10. 7. — Newfoundland-Labrador: Schefferville area: SW. shore of Attikamagen Lake (54° 54'N, 66° 37'W) 5. 8., E. slope of Ruth Ridge, subalpine and alpine belts 9. 7., W. slope of Ruth Ridge at Ruth Lake 9. 7., upper course of Wishart Creek (54° 44'N, 66° 48'W) 2. 8. Marble Lake: second small island E. of McGill University cabin (54° 30'N, 66° 34'W) 12. 7., between the McGill University cabin and the powerhouse 11. 7., E. shore of Marble Lake (54° 28'N, 66° 31'W) 13. 7., cape in the

SW. shore of Marble Lake (54° 26'N, 66° 27'W) 12. 7. — Esker area: about 1.5 miles NE. of the Tamarack Rived bridge 19.7., shore of Tamarack River, near the bridge 19. 7.

Siberia 1967. — Jakutia: E. of Jakutsk, between the city and the river Kenkäna, bog on the shore of an «alas»-lake 21. 8.

From Spitsbergen *O. ericetorum* has already been recorded by LINDBLOM (1841, 158), KARSTEN (1872, 93), DOBBS (1942, 97—99), HAGEN (1950, 17) and SKIRGIELLO (1961, 291), whereas KOBAYASI & al. (1968, 35, 48, 49) do not mention it. We found it abundantly in moist places, growing on mosses, mostly *Sphagnum*, with large amounts of *Botrydina* on the leaves and stalks of the mosses. This material does not differ from the Lappish specimens, not even in the size of the carpophores (cf. *O. luteovitellina*). Spore size in two dried specimens was in average $7.0 \times 4.5 \mu$ (100 spores) and $7.4 \times 4.9 \mu$ (50 spores).

The samples from northern North America were collected in different kinds of habitats: forest, bog, subalpine and alpine belts of mountains, tundra heath. The substrates were also varying: rotten wood, mosses (often *Sphagnum*), barren ground. The Siberian specimen was found in a bog surrounding an «alas»-lake (caused by permafrost), on a spot of ground with sparse *Polytrichum juniperinum*- and liverwort-vegetation. *Botrydina*-globules were seen on the ground around the fungus on old remains of mosses.

Omphalina luteovitellina (Pilát & Nannf.) M. Lange (= *O. flava* (Cooke) Möller) + *Botrydina vulgaris* Bréb.

Finland. — Utsjoki: East of Nillasvaara 15. 9. 1967, Ailigas 29. 6. 1967, Kotkapahta 20. 6. 1967, Könkäänpahta 27. 6. 1967, SW. of Linkkapahta 19. 7. 1966. — Kusamo: Juuma, Jäkälävuoma 31. 8. 1966 (R. Alava and K. Alho).

Norway. — Finnmark: Varangerbotn palsa bog 18. 7. 1966, 26. 6. 1967, Rastegaissa, alpine belt 18. 7. 1967.

Spitsbergen 1966. — Isfjorden: Peninsula west of Grönfjorden: Linnédalen 13. 8., 20. 8., Kongressdalen 16. 8., Festingsudden 14. 8.

USA. — Alaska: Barrow 24. 7. 1967.

Canada 1967. — Quebec: Fort Chimo area: between Inukshuktuyuk and Fort Chimo: 2 miles W. of Koksoak River, NE. of the 564 ft. hill. (58° 24'N, 68° 15'W) 28. 7., about 1 mile W. of Whales Head (58° 10'N, 68° 21'W) 29. 7.; W. of Fort Chimo (58° 06'N, 68° 27'W) 26. 7. — Schefferville area: Snowy Channel 15. 7. — Newfoundland-Labrador: Schefferville area: Geren Mountain, alpine belt (55° 03'N, 66° 15'W) 15. 7.

This is obviously the first time, when *O. luteovitellina* is mentioned from Spitsbergen. All our finds are from tundra heath on barren ground (sometimes with sparse moss vegetation) and have very abundant *Botrydina*-mass around the base. The fungi are in average somewhat smaller than our collections from Lapland, but in other respects similar to the Lappish material from drier places. The spore size of three dried specimens was in average $7.5 \times 4.0 \mu$ (50 spores), $7.9 \times 4.8 \mu$ (50 spores) and $5.8 \times 3.4 \mu$ (100 spores).

The same observations on the macroscopic features and *Botrydina*-mass also suit to the material from arctic North America.

From LE we borrowed six herbarium specimens, all named *Omphalina luteovitellina* (Pilát & Nannf.) M. Lange, collected in northern Siberia. Two of these specimens agree with our concept of *O. luteovitellina*, both collected by B. P. Vassilkov in Tžukotka-peninsula (1964 and 1965); in our opinion the remaining four specimens belong to *O. luteolilacina*.

O. velutina Quél. (= *O. grisella* (Weinm.) Moser.) + *Botrydina vulgaris* Bréb.

Finland. — Utsjoki: Kotkapahta 20. 6. 1967.

Norway. — Troms: Tromsø, Fløitfjellet 28. 8. 1966.

Spitsbergen 1966. — Kongsfjord: Ny Ålesund 24. 8. — Isfjorden: Longyearbyen: meadows in Longyeardalen 22. 8., slopes and meadows east of Funksjonaerbyen 22. 8.; peninsula west of Grönfjorden, Kongressdalen 16. 8.

Canada 1967. — Quebec: Schefferville area, a small bog in the forest N. of Schefferville airfield 4. 8.

This fungus is not earlier mentioned from Spitsbergen, where we found it in similar localities as *O. luteovitellina*: in tundra heaths on spots of barren ground, all the fungi associated with *Botrydina*. — Our only find in Canada was on a small road through a boggy place in a forest. Both these materials fully correspond to the Lappish collections.

The species also occurs in southern Scandinavia; among the herbarium specimens borrowed from O there was one sample of *O. velutina* from southern Norway: «Rogaland, Høle: Høle, Nordland talkbrudd, i marken» (on the ground) 28. 7. 1967. Per Magnus Jørgensen, det. Gro Gulden. — The author Heikkilä had the opportunity to visit Riksmuseet in Stockholm and see the *Omphalina*-specimens in the herbarium. The most important observation was perhaps that Lundell's *Omphalia anthodia* was quite obviously the same fungus that we call *O. velutina*. There was an exsiccate of LUNDELL & NANNFELDT (1949, n:o 1752) named *Omphalia anthodia* (Pers.) Lundell n. comb., with the locality «Amongst *Cladonia* and low *Polytricha* on poor, earthy spots close to boulders, at the margin of disused pasture-land turning into wood. — Småland: Femsjö parish, the E. margin of the pasture close to and just SE. of Källebo. 21. IX 1943. Seth Lundell (no. 3606).» The description agrees well with our opinion of *O. velutina*, and so do the characteristics of the dried specimens, — and they were associated with *Botrydina*! In the herbarium there were also three other samples named *O. anthodia*: «Uppland: Djurö s:n, Munkön, i SÖa delen, i liten ravin invid stranden, på jord (on the ground). 24. VIII. 1949 H. Jahn, G. Haglund, N. Suber.»; «Uppland: Djurö s:n, Runmarö, vid stugan vid Kasvikens östra strand, vid stigen Söderby-Kila, på jord, på kalkhäll (on the ground, on lime boulder). 22. 8. -54 G. Haglund.»; «Uppland: Djurö s:n, Runmarö, Vånö, N intill sågspånshögen vid stigen Vånö-Kila, på jord i hjulspår (on the ground in wheel tracks) 22. 8. -54 G. Haglund.» All the fungi looked like our *O. velutina*, and *Botrydina* was seen on the substrate attached to the foot.

Omphalina luteolilacina (Favre) Henderson. + *Coriscium viride* (Ach.) Vain.

Finland. — Utsjoki: Ailigas 23. 7. 1966, E. of Nillasvaara 15. 9. 1967, N. of Kaurulvaara 14. 9. 1967, Juovuskalluvaara 15. 7. 1966, Kevonniemi 17. 6. 1966, bog S. of Njallajärvi 13. 9. 1967, Tievjaoaivi 13. 9. 1967. — Kuusamo: Juuma, Jäkälävuoma 31. 8. 1966 (R. Alava and K. Alho).

Norway. — Finnmark: Varangerbotn palsa bog 18. 7. 1966, 26. 6. 1967, Rastegaissa, alpine region 18. 7. 1967, Neijden, 3 km E. of the Finnish boundary, old road 19. 7. 1967 (L. Hakala). — Troms: Tromsø, Fløitfjellet 28. 8. 1966.

USA. — Alaska: Barrow 24. 7. 1967.

Canada 1967. — NW-Territories: Inuvik 23. 7., Baffin Island, Frobisher Bay 19. 7. — Quebec: Fort Chimo area: between Inukshuktuyuk and Fort Chimo: 1 mile SE. of Inukshuktuyuk 27. 7., NW. of The Narrows, W. of Koksoak River 27. 7., 2 miles W. of the 564 ft. hill (58° 24'N, 68° 15'W) 28. 7., about 1 mile W. of Whales Head 29. 7.; W. of Fort Chimo 26. 7., at the lower falls of Highfall Creek (58° 01'N, 68° 29'W) 2. 8. — Schefferville area: Snowy Channel 15. 7., 23. 7., burnt ridge W. of Schefferville 4. 8. — Newfoundland-Labrador: Schefferville area: Irony Mountain 16. 7., W. slope of Ruth Ridge at Ruth Lake 9. 7. — Marble Lake: cape in the SW. shore of Marble Lake (54° 26'N, 66° 27'W) 12. 7. — Esker area: 3049 ft. mountain (E. of Esker) (53° 51'N, 66° 04'W) 21. 7.

In Spitsbergen we could not find this basidiolichen in spite of careful seeking. Our research area was very small, but even LYNCE (1938), who had lichen collections from different parts of Spitsbergen and North-East Land does not report *Coriscium viride*.

This basidiolichen occurs in Greenland: *Coriscium viride* has been dated by DAHL (1950, 32), and in C there are specimens from Greenland corresponding to our concept of *O. luteolilacina*. We have seen three of the specimens collected by M. Lange and listed by him (M. LANGE 1955, 25: specimens ML 7, 18, 86) as *Omphalina flava* (Cooke) n. comb. (= *O. luteovitellina* (Pilát & Nannf.) M. Lange; LANGE 1957, 63), and most of these fungi represent very typically the species we call *O. luteolilacina* (HENDERSON 1958, 595). This opinion can only be based on the habitus of the fungi, because there are no clear microscopic differences between these two yellow *Omphalinas*, but, having seen a great material, the typical specimens can be easily distinguished also dried. In these herbarium samples *Coriscium* was also observed.

Our material from North America was also in all respects typical and similar to the Lappish specimens. The finds in NE-Canada, Baffin Island, Inuvik and Barrow probably mean that the distribution area of this basidiolichen covers the whole arctic and subarctic region of North America.

KOBAYASI & al. (1967, 79—80) mention in the genus *Omphalina* in Alaska only *O. umbratilis* var. *minor* and two *Omphalina* spp., but the fungus they call *Hygrophorus vitellinus* (76) seems to correspond to our *Omphalina luteolilacina*. The description suits very well, and especially the mention «without clamp connections» confirms our opinion; *Hygrophorus vitellinus* Fr. sensu Møller has

clamp connections according to M. LANGE (1955, 17). The first impulse for our «suspicion», however, was the coloured picture (Plate 3 A), which represents a fungus very similar to *O. luteolilacina* — and a green lichen mass, which most likely is *Coriscium*, is seen round the bases of the fungi. In the picture on Plate 9 B the cup-shaped lichen thalli are also observed at the foot of the fungus.

FORSGRÉN (1966, 440) has published her observations on the combination of *Coriscium* and *Omphalina* in palsa bogs in N. Sweden. According to her the *Omphalina*-species would be *O. luteovitellina*. On account of the picture (Fig. 1, especially A) we are led to believe that this is the same species which we call *O. luteolilacina*. Later on, in her letter to the author Kallio, Britt Forsgren has also used the name *O. luteolilacina* of the fungus associated with *Coriscium*.

LANGE & SKIFTE (1967, 18—19) mention the fungus from northern Norway (Karasjok, Lakselv and Laevvajokka).

We have seen four herbarium specimens from northern Siberia (LE), named *O. luteovitellina*, but in our opinion representing *O. luteolilacina*; *Coriscium* also was observed on the substrate. Three of the specimens were collected by B. P. Vassilkov in Tžukotka peninsula (1964 and -65) and one by V. A. Troitski in Taimyr peninsula (1966).

The author Kallio collected *O. luteolilacina* + *Coriscium* in 1967 (3. 11.) in northern England: Cumberland, Moor House, where this double organism was growing very abundantly on the eroded hummocks of a blanket bog. — Dr. E. Schofield (The Ohio State University, Dept. of Botany, Columbus, Ohio) has very kindly sent us a specimen collected by him in Scotland: «Perth, SW-slopes of Beinn Ghlas, Ben Lawers Trust. 9. 8. -64» and one from USA: «New Hampshire, Coos County, White Mountain National Forest, on soil of SE-facing slope, The Alpine Garden, Mount Washington, (ca. 5200 ft. elevation) 19. 6. -65.» Both samples were supplied with transparencies of fresh material, and represent *O. luteolilacina* + *Coriscium*.

All these finds suit well to the mainly arctic-alpine picture of the total distribution of this basidiolichen.

Omphalina sp. on *Blasia pusilla*

Outside the basidiolichens, but closely related to this symbiotic problem, we mentioned in our previous investigation (HEIKKILÄ & KALLIO 1966, 70 and Plate 1) the case of *Omphalina* sp. growing on *Blasia pusilla*. The following new finds have been made:

Finland. — Utsjoki: W. shore of Pulmankijärvi, mouth of Kaldaushjoki river 15. 9. 1967. — Saarijärvi: Kalmari, Heikinmäki, NW. side of Valkeisjärvi, wet shore meadow at the Nevanlinna's villa 22. 6. 1967 (Y. Mäkinen 67—197). — Oulu: Sänginjoki, Isokankaanjärvi, at the town-owned cabin, by a muddy bog ditch 13. 8. 1967 (Y. Mäkinen 67—1593).

Norway. — Finnmark: Polmak, N. of Polmakvatn, shore of Polmakelven and roadside 16. 9. 1967.

Canada 1967. — Quebec: Fort Chimo area; between Inukshuktuyuk and Fort Chimo, shore of Koksoak River, SW. of Whales Head 29. 7., Stewart Lake, at the seaplane base, roadside 25. 7., at the lower falls of Highfall Creek 2. 8. — Newfoundland-Labrador: Wabush, clayey roadside S. of the airfield 7. 8. (Y. Mäkinen 67—1489).

LANGE & SKIFTE (1967, 18—19) have recorded a fungus on *Blasia* under the name *Omphalina demissella* M. Lange from Karasjok in northern Norway.

The authors are greatly indebted to all the numerous kind persons, who have contributed to the field work, enabled us to work in different countries, and given material at our disposal.

SUMMARY

Information is given about the new finds of the basidiolichens *Botrydina vulgaris* and *Coriscium viride*. On the western coast of Spitsbergen (1966) — in addition to the combination *Omphalina ericetorum* + *Botrydina vulgaris* — also *O. luteovitellina* + *Botrydina* and *O. velutina* + *Botrydina* were found, which have not earlier been mentioned from Spitsbergen. In northern North America the authors have collected (1967) all these three *Botrydina-Omphalina*-combinations, and *Omphalina luteoilacina* associated with *Coriscium viride*. The last mentioned double organism and *Botrydina* + *O. luteovitellina* as well as *Botrydina* + *O. ericetorum* have also been found in northern Siberia (herbarium specimens in LE by B. P. Vassilkov and V. A. Troitski; also own observation), which confirms the assumed circumpolar distribution of these basidiolichens in arctic and subarctic regions.

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