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The Swedish Geoporae and their Pyrenomycete Infections

LARS E. KERS

Bergianska trädgården, S-104 05 Stockholm, Sweden

Abstract

The Swedish herbarium material of *Geopora arenicola* (Lév.) Kers comb. nov. (≡*Sepultaria arenicola* (Lév.) Massee) has been revised, especially as to its Pyrenomycete infections. The species was found to be attacked by *Melanospora tulasnei* Udagawa & Cain (eight collections) and by *Melanospora brevirostris* (Fuck.) Tul. (one collection). *Microthecium geoporae* (Obermeyer) Höhnel is reported from Sweden, where it grows on *Geopora cooperi* Harkn. (three collections). The taxonomy and nomenclature of both hosts and parasites are discussed. Their characteristic features have been illustrated.

Introduction

During an excursion in southern Sweden I happened to come across the uncommon Discomycete *Geopora arenicola* (≡*Sepultaria arenicola*). I had long been anxious to find that species because its growth habit was so peculiarly characterized in the literature: the insignificant specimens should merely appear as "holes in the ground". This characteristic was found to be very appropriate, indeed. When the specimens were studied under microscope, their hymenium was found to be infected by a Pyrenomycete (*Melanospora tulasnei*). Studies of the literature dealing with the host and with the parasite made it obvious to me that it could be worthwhile to present a survey of the Swedish *Geopora* material and its Pyrenomycete infections. The herbarium material of *Geopora* is still very sparse. Certainly it gives us a very incomplete information of the frequency and geographical distribution of its two species. It is to be wished that the collecting botanists would pay a more active interest in these fungi, which show such a singular variant of the phenomenon "fungus on fungus".

Geopora arenicola

Taxonomy, nomenclature

Cooke 1879 (1879, p. 251 ff.) subdivided the genus *Peziza* Fries into a number of Sub-Genera. By subsequent authors these Sub-Genera have been considered equivalent to sections. The section *Sepultaria* Cooke comprized twenty species

and included, e.g. *Peziza sepulta* Fr. and *P. arenicola* Lév. In 1885 Boudier raised the section *Sepultaria* Cooke to generic level and he did this without altering its original circumscription (1885, p. 104). The lectotype of the genus *Sepultaria* (Cooke) Boud. is *Peziza sepulta* Fr., designated by Boudier (loc. cit). By modern authorities *Sepultaria sepulta* (Fr.) Boud. has been sunk in the synonymy of *Sepultaria arenicola* (Lév.) Mass. (cp. Seaver 1928, p. 149; Nannfeldt 1941, p. 24).

In a recent paper (1968) Burdsall synonymized *Sepultaria* with *Geopora* Harkness and proved that the latter name has priority over *Sepultaria*. In the same paper (p. 500) the lectotype of *Sepultaria* was transferred to *Geopora* and named *G. sepulta* (Fr.) Korf & Burdsall. The present author regards *Peziza sepulta* Fr. as a synonym of *Peziza arenicola* Lév. As a consequence, the following transfer is proposed:—

Geopora arenicola (Lév.) Kers **comb. nov.**

Basionym: *Peziza arenicola* Lév., Ann. Sci. Nat. sér. 3, 9: 140, 1848.

Synonyms: *Sepultaria arenicola* (Lév.) Massee, Brit. Fungus-Fl. 4: 390, 1895. — *Sarcosphaera arenicola* (Lév.) Lindau in Engler & Prantl, Nat. Pfl. fam. I (i): 182, 1896. — *Scutellinia arenicola* (Lév.) Kuntze, Rev. Gen. Plant. 2: 869, 1891. — *Lachnea arenicola* (Lév.) Quél. Ench. Fung. p. 283, 1886.

Because the author here applies Nannfeldt's concept of this species (1941), the following taxa will also be included in the synonymy:—

Geopora sepulta (Fr.) Korf & Burdsall, Mycologia 60: 500, 1968. — *Peziza sepulta* Fr., Summa Veg. Scand. p. 564, 1849.

Sepultaria arenosa (Fuck.) Boud., Hist. Class. Discomyc. Eur. p. 59, 1907. — *Peziza arenosa* Fuckel, Fungi Rhen. no. 1212, 1865.

Sepultaria Geaster (Berk. & Br.) Boud., Hist. Class. Discomyc. Eur. p. 59, 1907. — *Peziza Geaster* Berk. & Br., Ann. Mag. Nat. Hist. 3 (18): 125, 1886.

By some authorities the genus *Geopora* (s. orig.) has been placed in the *Tuberales*, while by others in the *Pezizales*. Although most authors have regarded it as a truffle, they have pointed out its anomalous position in that fungus group (cp. Fischer 1897, p. 288, note; Nannfeldt 1946, p. 185 ff.; Kimbrough 1970, p. 145). Burdsall emended *Geopora* so as to include *Sepultaria* and he placed the emended genus under *Pezizales* (Burdsall 1968).

Description (Swedish material)

Ascocarps, solitary or gregarious, immersed in the ground except for the apical portion, spherical to depressed spherical, hollow with one single cavity, 2–30 mm i diam.; apical area rupturing into a number of broad, triangular lobes, which become vertically directed or reflexed. In aged or dried out ascocarps the apical lobes are incurved and much shrivelled at their tips. Outer surface of the ascocarp covered with a loose layer of brown, flexuous, branched hairs, which are interwoven

with the soil particles surrounding the ascocarp and consolidate the soil to a loose earth case. Hymenium cream coloured. When infected by *Melanospora* the hymenium turns dark brown to black, due to the ripe perithecia and the cover of ascospores from the parasite. Paraphyses equalling the asci in height or slightly overtopping them, hyaline, very slender and thin, with a few septa, sometimes broadening at apex. Asci cylindrical, hyaline, 200–265×16–20 μ, 8-spored, tapering into a stipe. Ascospores obliquely uniseriate, hyaline, smooth, ellipsoidal, symmetric, 18–25×9–14 μ, with one, seldom two, large oil drops.

Illustrations

Fig. I A, B, D, E; Cooke 1875, Plates 29, 30 (ut *Peziza* spp.); Rehm 1887–1896, p. 1046 (ut *Sepultaria arenicola* et *S. arenosa*); Seaver 1942, Pl. 51 and p. 312 (ut *Sepultaria arenicola*); Dennis 1968, Pl. V F & Fig. 5 G (ut *Sepultaria arenosa*); Burdsall 1968, p. 500 (ut *Geopora sepulta*, growth habit).

Distribution

The total distribution comprises North America, Europe and North Africa. In Scandinavia the species is known from Sweden, Denmark and Norway (Lange & Hansen 1950, pp. 63, 64; Eckblad 1956, pp. 227, 228; Eckblad 1968, p. 63; Nannfeldt 1949, p. 317). In Sweden most collections come from the southern part of the country. An isolated northern find has been made in Lapland (Abisko, lat. 68°20′).

Ecology

The only record of the species in Scandinavian ecological literature seems to be that of O. Andersson (1950). In his treatment of the Scandinavian sand fungi, Andersson briefly mentioned this species (pp. 6, 22), which he classed as a "facultative sand-fungus". In Swedish floras, the habitats of *Geopora arenicola* are characterized as "sandy garden paths and gravelly foot pavements etc." (Nannfeldt 1949, p. 317). Although most frequently collected from such habitats, the species is reported from many different habitats and soil types. It has been found on pure sedimentary sand, on silty sand and gravelly—sandy moraine and even on glacial clay. What seems to be characteristic for the habitats is less the mere soil type than the open and bare condition of the soil surface. The geographical pattern of the Swedish finds also makes it possible that this species is a calciphilous fungus.

In most cases the collectors' notes give us fairly scant information about the habitats ("open, sandy soil" etc.). It is to be noted that "open soil" will result either from human agencies (e.g. as garden paths) or from natural agencies (e.g. by wind, solifluction etc.). When a species like *G. arenicola* repeatedly has been found on man-made places only, it is of particular interest to trace whether or not there exist some "natural" habitats for the species. I have found that a number

of gatherings undoubtedly come from habitats, where the ground is kept open due to natural agencies. In the following these habitats are classified into a few groups.

My own collection (from Västergötland) comes from a thin layer of silty-sandy soil (1–3 dm thick), which covered an almost plane bedrock surface (limestone). Apart from a few small moss colonies, the ground was almost devoid of a vegetation cover. Certainly this peculiarity is here a result of the same natural agencies which give rise to similar bare ground on our well-known "alvar" areas. The agencies are dryness of the thin soil in summer as well as frost upheavals and movements of the soil layers during the cold and wet seasons. Only two more finds have apparently occurred on this type of open soil (samples from Östergötland and Gotland).

Open, bare soil will also arise along streams and rivers due to water sedimentation and erosion. Two finds originate from that type of habitat (samples from Lapland and Uppland).

Sand dunes might be expected to present suitable habitats for this species. No Swedish find, however, comes from sand dunes, although the species has been reported from such habitat in Norway (Eckblad 1956, p. 228). It is true that one gathering originates from a sand dune complex (on Gotska Sandön in the Baltic), but there the species was found in a deep depression among the dunes, not on the actual dunes. The bottom of this depression is periodically wet. It is occupied by a scant vegetation of marsh phanerogams (*Primula farinosa, Epipactis palustris*, etc.).

The examples of natural habitats listed above may give indications for the field botanists, where they have to search for the species. Most collections have been made from August until November. Two samples were gathered in June. Certainly this species has been much overlooked, especially due to its minute size and its hidden, buried fruit-bodies. The specimens are most easily observed in damp weather and when the ascocarps have just ruptured. Dried out specimens, shrivelled and dusted with soil particles are extremely difficult to catch sight of. Such specimens, in particular, are merely traceable as minute "holes in the ground".

Pyrenomycete Infections

Two Pyrenomycetes were encountered in the studied material of *G. arenicola: Melanospora tulasnei* and *M. brevirostris*. I have not found both of them on one and the same ascocarp, nor growing separately on ascocarps, forming an integral part of one collection. *M. tulasnei* seems to be more frequent than *M. brevirostris*. Both species grow as parasites in (or on) the hymenium of the host. It may even be justified to regard them as commensals on *Geopora* (cp. Doguet 1955, p. 227). The two *Melanospora* species will be treated in the following text.

The presentation is followed up by a report of *Microthecium geoporae* (Oberm.) Höhnel, which was found on the hymenium of *Geopora cooperi* Harkn. All Pyrenomycetes dealt with here have been much confused in the past. Our knowledge of them has recently been cleared up considerably through the works of Doguet (1955) and Udagawa & Cain (1969).

The following key includes only the species treated in the present paper.

Key to Pyrenomycetes Found on Geopora

Perithecia ostiolate; on *Geopora arenicola*

Perithecia pyriform, with well marked neck; ascospores symmetric, 18–24 μ long *Melanospora tulasnei*

Perithecia spherical with a short neck; ascospores asymmetric, 25–31 μ long *Melanospora brevirostris*

Perithecia cleistocarpic, spherical; ascospores symmetric, 28–30 μ long; on *Geopora cooperi* *Microthecium geoporae*

Melanospora tulasnei Udagawa & Cain (Fig. 1 D, G, K)

This species was found on samples of *Geopora arenicola*, which had been collected in the provinces of Västergötland, Södermanland and in Uppsala.

Perithecia (with ripe spores) flask-shaped to onion-shaped, 150–320 μ broad, 150–350 μ in height (incl. neck), the lower 2/3–1/2 immersed in the hymenium of the host; neck ca. 1/5–1/6 of the total perithecium height; crowned by a tuft of erect, stiff, hyaline hyphae (setae). Asci claviform, soon evanescent, 8-spored, erectly fascicled in the lower 2/3 of the perithecium. Ascospores 18–24×10–15 μ, equilateral, smooth, spindle-shaped with blunt ends, dark brown (seen through microscope) or black (with the naked eye).

M. tulasnei is characterized by the flask-shaped perithecia and smooth, symmetric ascospores. (Compare *Melanospora brevirostris* p. 350.)

In my own collection, every ascocarp of *Geopora arenicola* was infected by *M. tulasnei*. In other samples, some ascocarps were infected while others were not. An infection is usually easy to detect already with a hand-lens. The hymenium is normally cream coloured, but appears black when infected due to the ripe perithecia and the dense cover of ascospores. As a rule an infected *Geopora* ascocarp is very rich in *Melanospora* perithecia. These tend to grow densely clustered and often cover the greater portion of the hymenium layer. Perithecia of different age occur close to each other. Young perithecia are pale brown, deeply sunk into the hymenium layer and have short necks with poorly developed setae. The mature fruit-bodies are semi-immersed with distinct, setose necks. When ripe, the dark brown spores are visible through the translucent peridium. They emerge as a viscid mass through the ostiolum, remaining attached like a droplet. If the hymenium is then moistened, although very slightly, the ascospores instantly de-

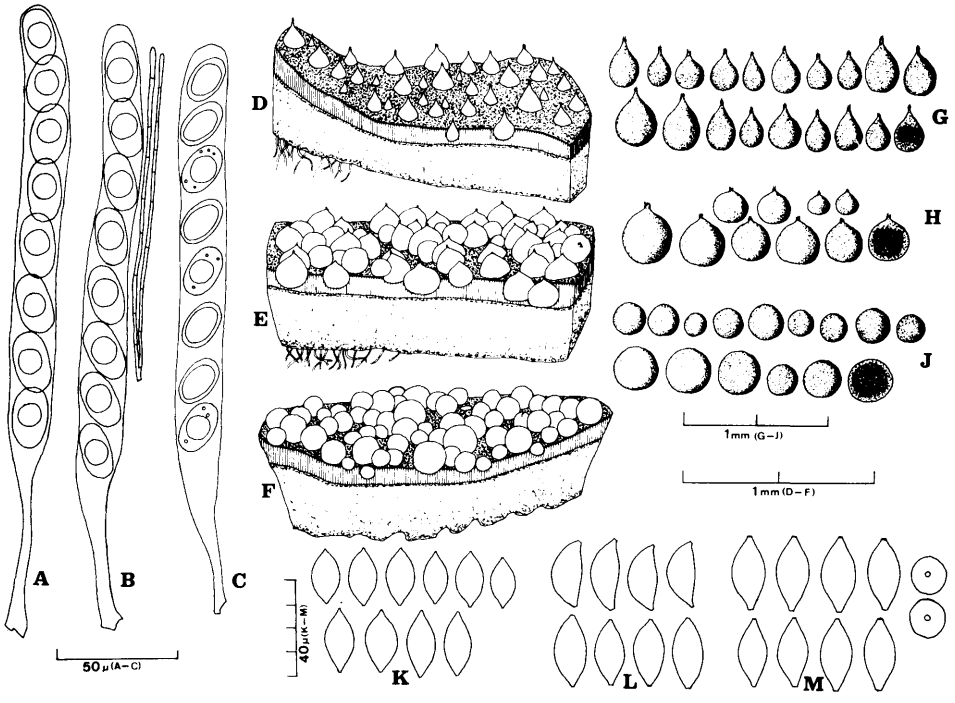

Fig. 1. (*A, B*) Asci of *Geopora arenicola*. One with upper portions of paraphyses. (*C*) Ascus of *Geopora cooperi*. (*D*) Portion of ascocarp wall of *Geopora arenicola* with *Melanospora tulasnei*. (*E*) Same with *Melanospora brevirostris*. (*F*) Ascocarp wall of *Geopora cooperi* with *Microthecium geoporae*. (*G*) Perithecia of *Melanospora tulasnei* (one with the ascospores indicated). (*H*) Perithecia of *Melanospora brevirostris* (one with the ascospores indicated). (*J*) Perithecia of *Microthecium geoporae* (one with the ascospores indicated). (*K*) Ascospores of *Melanospora tulasnei*. (*L*) Ascospores of *Melanospora brevirostris*, seen from two different views. (*M*) Ascospores of *Microthecium geoporae*. Polar view to the right. (*A*) Romell (S); *B, D, G, K* upper row: Kers (S); *C, F, J, M:* Eriksson (UPS); *E, H, L:* Sandberg (UPS); *K* lower row: Bruun (UPS).

tach themselves from each other and spread as a thin layer upon the water surface.

Although the ascospores have here been characterized as symmetric, a small number of them might show a slight asymmetric outline. This aberration is rare among fresh spores observed in water. It grows in quantity after the spores have been treated with embedding liquids (alcohol, xylol, etc.). I consider these aberrations to be partly artefacts, partly occasional abnormalities.

From Sweden this species was previously known by a single find (leg. Nannfeldt no. 9959, In hymenio *Lachnea* spec., Uppsala, Carolinaparken 1948). The material was first studied by Doguet (1955, p. 109), who classified it to *Melanospora zobelii* (Corda) Fuck. It is to be noted that Doguet did not accept the genus *Microthecium* Corda, which he included in *Melanospora*. In their monograph of

Microthecium, Udagawa & Cain (1969) express the opinion that *Microthecium* is most conveniently distinguished from *Melanospora* by its cleistocarpy. The type of *Microthecium* is *Microthecium zobelii* Corda (≡*Melanospora zobelii* (Corda) Fuck., pro parte). According to Udagawa & Cain *M. zobelii* is known solely from the original collection. Other samples, previously treated under this name, were classed by them as a new species, named *Melanospora tulasnei* Udag. & Cain (*op. cit.* 1969, p. 500). The above-mentioned collection from Uppsala (Nannfeldt no. 9959) belongs to the material of *M. tulasnei* cited by Udagawa and Cain. My own material, as well as a number of other Swedish collections, also fit well with the description of this species. A list of the studied material will be found at the end of this paper.

Melanospora tulasnei (ut *Mel. zobelii*) has been reported to grow on *Geopora arenicola* (ut *Sepultaria a.*), *Lachnea* spec., "truffles" and on *Hydnocystis arenaria* Tul. (Doguet 1955, pp. 106–107; Petch 1938, p. 254; Udagawa & Cain 1969, p. 1932). The latter species has been regarded as a truffle by most authors. According to Burdsall, *Hydnocystis* Tul. & Tul. is monotypic and belongs to the *Tuberales*. On the other hand, *Hydnocystis arenaria* Tul. was transferred by Burdsall (1968, p. 507) to *Geopora*, where he listed the species in the synonymy of *Geopora clausa* (Tul. & Tul.) Burdsall. Considering the current re-classification of the anomalous members of *Tuberales* to *Pezizales*, it seems doubtful whether *M. tulasnei* (and *M. brevirostris*) really attacks any true truffle.

M. tulasnei is only known from Europe (cf. Udagawa & Cain 1969, p. 1932). Some other Scandinavian records have been reported from Denmark (Lange & Hansen 1950, p. 64; Munk 1957, p. 81; Udagawa & Cain 1969, p. 1932).

Melanospora brevirostris (Fuck.) Tul. (Fig. 1 E, H, L)

From Sweden I know this species from a single find, made in the coastal region of northern Uppland. The host species is also here *Geopora arenicola*.

Perithecia spherical with a setose insignificant neck, 150–300 μ in diam., brown, immersed into the hymenium of the host or often superficial. Ascospores spindle-shaped, inequilateral, 25–31×13–17 μ (en face)×12–14 μ (lateral view), smooth, dark brown (seen through microscope) or black (with the naked eye).

The species differs from *M. tulasnei* by the larger, asymmetric ascospores, the minute neck, and also by its growth habit. The two species are readily distinguished already when observed in situ and with the aid of a binocular. *M. tulasnei* is then characterized by its buried perithecia with projecting necks. *M. brevirostris*, on the other hand, has more or less free and rounded perithecia, which form a covering upon the hymenium. Therefore, an infected area gives the impression of having been spread with a layer of spawn. The material has previously been correctly determined to *M. brevirostris* by Dr N. Lundqvist, Uppsala.

A detailed comparison of the morphology of *M. brevirostris* and "*Melanospora zobelii*" (sensu Doguet) has been carried out by Doguet (*op. cit.* 1955, pp. 103 ff.). He pointed out that the two species are separated principally by their different ascospores.

This species has been recorded from Germany, France and England (Doguet 1955, p. 109; Dennis 1968, p. 264). It has not previously been reported from Scandinavia.

Microthecium geoporae (Obermeyer) Höhn. (Fig. 1 F, J, M)

This Pyrenomycete was found on three samples of *Geopora cooperi* Harkn. The material was collected in the island of Gotland in the Baltic.

Perithecia spherical, non-ostiolate, hyaline when young, dark brown when ripe, 150–320 μ in diam., immersed into the hymenium of the host or superficial. Asci clavate, 8-spored. Ascospores 28–30×13–16 μ, symmetric, spindle-shaped with blunt ends, smooth, dark brown (through microscope) or black (with the naked eye).

The material fits well with the description of *Microthecium geoporae* contributed by Udagawa & Cain (1969). The species comes close to *M. zobelii* Corda and *M. epimyces* (Höhn.) Höhn., but differs from them by its larger and otherwise coloured ascospores (Udagawa & Cain 1969, pp. 1917, 1920–21). *M. geoporae* shows a superficial resemblance to *Melanospora brevirostris*. The similarity is mainly caused by the growth habit: the more or less free perithecia form a dense cover upon the hymenium of the host. It differs from *M. brevirostris* by its symmetric ascospores and cleistothecia.

One of the three samples has previously been determined to *Melanospora zobelii*. This is quite logical, if one follows Doguet's treatment of this species (1955, p. 103 ff.). It is to be remembered that he did not recognize the genus *Microthecium*, which he included in *Melanospora*. By Doguet, *M. geoporae* (ut *Guttularia geoporae* Oberm.) is listed in the synonymy of *Melanospora setchellii* (Harkn.) Sacc. & Sydow (*op. cit.* 1955, p. 124). The history of this old confusion has been elucidated by Udagawa & Cain (*op. cit.* 1955, p. 1931–32). North American material of *M. geoporae* was thus wrongly identified with *M. setchellii* (Harkn.) Höhnel (≡*Sphaeria s., Melanospora s., Nigrosphaeria s.*). This misidentification, once made, obscured the true identity of the original material for subsequent authors. From the original description of *Sphaeria setchellii* Harkn. it is evident that the type material is neither a *Microthecium* nor a *Melanospora* (Udagawa & Cain 1969, p. 1931). As a consequence North American herbarium material of "*Microthecium setchellii*" will include samples of *M. geoporae*.

M. geoporae is known from Europe and North America (Udagawa & Cain 1969, p. 1920). It has not previously been recorded from Scandinavia.

The Swedish host fungus is *Geopora cooperi* Hark. This is a rare species in

Scandinavia, from where it is known by a few finds made on Gotland and in northern Uppland. The specimens are stated to grow immersed in sandy soil next to the sea-shore. The plant association is dominated by scattered *Pinus* and *Juniperus*. Only the specimens from Gotland were found to be infected by *Microthecium*.

A detailed discussion of this species, based on material from Uppland, was contributed by Nannfeldt (Nannfeldt 1946, ut *Geopora schackii* P. Henn.). *G. harknessii* Fischer and *G. graveolens* Obermeyer are two other species recorded to be hosts for *M. geoporae* (Udagawa & Cain 1969, p. 1920). According to Burdsall also these are conspecific with *G. cooperi* (Burdsall 1968, p. 513). *M. geoporae* is thus known from North America and from Europe and its host fungus is one and the same on both continents.

Acknowledgements

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Material Studied

Geopora arenicola

Skåne: G. Degelius, 25.VIII.1945, Västra Klagstorp parish, Klagshamn, at the cement factory. Abundant on bare chalk soil (UPS); G. A. Svensson, 9.VI.1938, Lomma parish, Alnarp, The National Swedish Institute for Seed-control, Alnarp branch. In the garden, below a group of birches and beeches (UPS).

Västergötland: L. E. Kers No. 3983, 29.IX.1973, Sjögestad parish, 1.5 km S of Skultorp railway station, at Nolgården. Old, abandoned limestone quarry along the main road (S).

Östergötland: J. A. Nannfeldt No. 10062, 17.VII.1948, Gryt parish, Säterön, about 1 km SSE of the parish church. Amongst small mosses (UPS); E. Rådström, 2.IX.1967, Krokek parish, Marmorbruket, on cliffs facing Bråviken. Immersed among mosses on shallow soil upon limestone bedrock (UPS).

Gotland: E. Th. Fries, 18.X.1950, Vesterheijde parish, Siegreifs (UPS); B. Pettersson, No. 4514, 12.X.1953, Sundre parish, SE of Muskmyr, on the "alvar" area. *Festuca ovina*, shallow soil on the bedrock (UPS); B. Pettersson, 9.VIII.1958, Gotska Sandön National Park, Tärnudden. Depression among the dunes (UPS); Sernander's excursion, 12.VI.1924, Martebo parish. Dried up peripheral part ("lagg") of a fen (UPS).

Södermanland: H. G. Bruun, 25.VIII.1953, Strängnäs, the military training ground. Below scattered birches (UPS); R. Rydberg, 22.IX.1946, Trosa-Vagnhärad parish, Vagnhärad. Sandy roadside (UPS).

Uppland: G. E. Du Rietz, 10.IX.1957, Uppsala, at the Institute of Ecological Botany. Sandy garden path (UPS); E. P. Fries, VIII.1853, Uppsala, Carolinaparken (S, UPS); G. Fårhæus, 26.VIII.1945, Uppsala (Bondkyrka parish) Kronoparken (UPS); C. G. von Hofsten, IX.1938, Uppsala, Jumkilsgatan. Sandy foot pavement (UPS); E. Julin, 26.IX.1930,

Uppsala, Villavägen, near the Zoological Institute (UPS); M. A. Lindblad, 1856, Uppsala (S); S. Lundell & H. Smith, 10.X.1938, Uppsala, at SW corner of the Chemical Institute. Lundell & Nannfeldt: Fungi Exs. Suec. 958 (S); N. Lundqvist No. 4765, 27.IX.1965, Ärentuna parish. Storvreta, in gravel behind the furniture factory (UPS); J. A. Nannfeldt, 31.VIII.1928, Uppsala, Kåbo, at C. Wiman's villa. Immersed in the foot pavement (UPS); J. A. Nannfeldt, 10.IX.1928, Uppsala, near the Botanical Garden. J. Weese: Eumyc. Sel. Exs. 522. (UPS); J. A. Nannfeldt no. 4072, 21.VIII.1930. Uppsala, Carolinaparken, beside the old Chemical Institute (UPS); J. A. Nannfeldt No. 21981, 3.X.1971, Lena parish, Hummeltorp. Roadside (UPS); K. G. Ridelius, 14.VIII.1930, Djursholm, Villa Sörsta. Garden path (UPS); L. Romell No. 16407, 15.IX.1885, Uppsala, Slottsbacken (S); G. Sandberg, 1929, Älvkarleby parish, Billudden (UPS); G. Sandberg, 1.XI.1953, Älvkarleby parish, Brämsand (UPS); R. Santesson, 19.IX.1938, Uppsala-Näs parish, just S of Lurbo, on clay slope along Håga river (S); H. Smith, 19.VIII.1942, Uppsala, S. Rudbäcksgatan 16. Foot pavement, in sand (UPS).

Lappland: L. Holm No. 414, VIII.1946, Torne Lappmark, Jukkasjärvi parish, Abisko, on the eastern bank of Abisko river, near the river-mouth. Bare soil surface (UPS).

Geopora cooperi

Gotland: G. Eriksson, 2.VIII.1962, Norrlanda parish, in pine forest, about 100 m from the sea-shore (UPS); G. Eriksson, 20.IX.1962, Norrlanda parish, along the sea-shore (UPS); G. Eriksson, 22.IX.1962. Gothem parish, Tjelders, in sand along the sea-shore (UPS); G. Eriksson, 19.VIII,1965, Norrlanda parish (UPS); G. Eriksson, II.IX.1965, Gothem parish. Sandy sea-shore (UPS).

Uppland: G. Sandberg, 10.IX.1945, Älvkarleby parish. Billudden, eastern part, along the sea-shore. Growing below one of the outermost *Juniperus* shrubs; immersed in the ground (UPS); G. Sandberg, 29.IX.1946, Älvkarleby parish, Billudden, N of Källvik, along the east facing sea-shore. Growing below *Juniperus* shrubs on same locality as for *Geaster minimus* (UPS).

Melanospora tulasnei (on *Geopora arenicola* and *"Lachnea"* sp.)

Västergötland: L. E. Kers No. 3983 (S).

Södermanland: H. G. Bruun, 25.VIII.1953 (UPS).

Uppland: G. E. Du Rietz, 10.IX.1957 (UPS); E. Julin, 16.IX.1930 (UPS); S. Lundell & H. Smith in Lundell & Nannfeldt: Fungi Suec. Exs. 958 (S); J. A. Nannfeldt, 31.VIII.1928 (UPS); J. A. Nannfeldt in J. Weese: Eumyc. Sel. Exs. 522 (UPS); J. A. Nannfeldt No. 4072 (UPS); J. A. Nannfeldt No. 9959, 9.VII.1948, Uppsala, Carolinaparken. "In hymenio Lachneo n. 9958" (UPS); H. Smith, 19.VIII.1942 (UPS).

Melanospora brevirostris (on *Geopora arenicola*)

Uppland: G. Sandberg, 1.XI.1953 (UPS, two samples).

Microthecium geoporae (on *Geopora cooperi*)

Gotland: G. Eriksson, 2.VIII.1962 (UPS), 19.VIII.1965 (UPS), 11.IX.1965 (UPS).

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