

Ascomycetes on Nordic Lycopods

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The ascomycete flora of some *Lycopodium* species (*L. annotinum*, *L. clavatum*, *L. alpinum*, *L. complanatum* s.lat., *L. selago*) has been investigated, mainly on the basis of Nordic, particularly Swedish, material. These species have proved to harbour a rich mycoflora, largely confined to the club mosses and in many cases even restricted to a certain host species. The lycopods studied differ significantly with regard to their fungi. The origin of this mycoflora is discussed. It is considered to be fairly modern and apparently the lycopods were once colonized by fungi inhabiting other xerophytic plants, like Ericaceae and *Juniperus*.

Twelve Discomycetes and 13 Pyrenomycetes are dealt with and the following new names are published: Discomycetes: *Cryptodiscus anguillosporus* L. & K. Holm, n.sp., *Dasyscyphus inopinatus* (Kirschst.) L. & K. Holm, n.comb., *Hyalopeziza pani* (Vel.) L. & K. Holm, n.comb., *Hyalopeziza rubefaciens* L. & K. Holm, n.sp., ?*Micropeziza diphasii* L. & K. Holm, n.sp., *Pseudopeltis perminuta* L. & K. Holm, n.sp. Pyrenomycetes: *Gibbera lycopodii* L. & K. Holm, n.sp., *Massarina chamaecyparissi* (Rehm) L. & K. Holm, n.comb., *Phaeosphaeria marciensis* (Peck) L. & K. Holm, n.comb., *Venturia lycopodina* L. & K. Holm, n.sp.

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Introduction

Lycopodium s.lat. is a cosmopolitan genus of roughly 400 species. The great majority of them are wholly unexplored with regard to their mycoflora. Actually, our knowledge in this field is almost entirely restricted to a few boreal species but even these have not been much scrutinized for fungi. Some 50 fungal taxa have so far been reported on *Lycopodium*, most of them little known and recorded only once. Few mycologists have paid more than casual attention to these plants; among them particularly C.H. Peck in North America and F. Petrak in Europe.

As a part of our studies of the fungi on pteridophytes, we have also examined the club mosses, which have proved to harbour a rich and highly specific mycoflora. There are in Scandinavia 6 (or 7) species of *Lycopodium*, representing 4 taxonomic groups recently often treated as separate genera in Europe, viz. *Lycopodium* s.str., with *L. annotinum* and *L. clavatum*, *Lepidotis* (*L. inundatum*), *Huperzia* (*L. selago*) and *Diphasium*, with *L. alpinum* and *L. complanatum* (including *L. tristachyum*). Among these species *L. inundatum* stands apart by its ecology, being a semiaquatic plant, confined to margins of lakes and similar wet places. It is comparatively rare in most parts of Scandinavia and we have had little opportunity to study its fungi. It is our impression, however, that *L. inundatum* has little in common with its congeners, as far as fungi are concerned, and it is not dealt with here.

The other Nordic *Lycopodia* generally grow in more or less dry coniferous forests, except *L. alpinum*, which is a plant of alpine and subalpine heaths. *L. annotinum*, too, and particularly *L. selago* reach high up in the mountains. In our experience the latter species is not very attractive to fungi.

The present article is mainly based on our own collections, including those of cooperative friends and relatives. In addition the material in H, S and UPS has been examined; further some specimens, mainly types, have been obtained on loan from B, BP, C, HBG, K, NYS, and PRM. If nothing else is stated, the cited material is collected by us, and preserved in UPS.

The following account is by no means exhaustive. We have seen more species, but as the material of these was inadequate to allow us to get acquainted with them, they are not introduced here, though some of them may be true *Lycopodium* fungi. Nevertheless, we believe that most of the common Nordic Ascomycetes are included, and also that many of these species are fairly coextensive with their hosts.

The Imperfecti are respectfully omitted, owing to our very imperfect knowledge of them. On the whole they are considerably less frequent than the teleomorphs, at least in the lowlands, the main exception being *Ceuthospora lycopodii*, which is one of most common microfungi on lycopods, except on *L. selago*. *Epicoccum* sp. seems to be fairly common, too.

Coniothyrium cf. *lycopodium* and a *Diplodina* have been met with a few times, on *L. annotinum* and *L. clavatum*, and so has *Coleophoma* cf. *empetri* on *L. selago*.

Artificial key

1. Discomycetes 2
- Pyrenomycetes 13
2. Apothecia wholly immersed 3
- Apothecia erumpent or superficial 4
3. Spores vermiform *Cryptodiscus anguillosporus*
- Spores fusiform *Cryptodiscus* sp.
4. Apothecia distinctly hairy 5
- Apothecia glabrous or almost so 8
5. Hair asperulate, brown *Dasyyscyphus inopinatus*
- Hairs smooth, mostly hyaline 6
6. Apothecia brownish, hairs 'glassy', straight
- *Hyalopeziza rubefaciens*
- Apothecia whitish, hairs uncinata 7
7. Hairs thin-walled *Hamatocanthoscypha laricionis*
- Hairs solid *Hyalopeziza pani*
8. Apothecia sessile 9
- Apothecia stipitate 12
9. Scutellum present, excipulum reduced 10
- Scutellum absent, excipulum well developed *Mollisia* sp.
10. Apothecia usually circular in surface view 11
- Apothecia usually elliptic in surface view, opening by a longitudinal slit *Pseudopeltis perminuta*
11. Scutellum subcuticular, shining black, opening with persistent flaps *Phacidina gracilis*
- Scutellum supracuticular, dark brown, disappearing early *Micropeziza diphasii*
12. Spores ellipsoid *Poculopsis ogrensii*
- Spores narrowly fusiform *Cyathicula cyathoidea*
13. Ascocarps setose 14
- Ascocarps glabrous 16
14. Ascocarps superficial 15
- Ascocarps immersed *Venturia lycopodina*
15. Asci unitunicate, spores fusiform *Niesslia haglundii*
- Asci bitunicate, spores ellipsoid *Gibbera lycopodii*
16. Spores with transverse septa only 17
- Spores muriform *Pleospora islandica*
17. Spores 1-septate 18
- Spores with 2 or more septa 22
18. Septum near the base, asci unitunicate *Pseudomassaria lycopodina*
- Septum (sub)median, asci bitunicate 19
19. Spores strongly guttulate, >20 µm long *Massarina chamaecyparissi*
- Spores <15 µm long 20
20. Interascal threads present, spores obtuse *Venturia lycopodina*
- Interascal threads absent 21
21. Ascocarps generally densely grouped, spores pointed
- *Mycosphaella lycopodii-annotini*
- Ascocarps scattered, spores obtuse *Mycosphaerella lycopodii*
22. Spores with (2 or) 3 septa 23
- Spores with 5 or more septa 25
23. Spores long hyaline, fusiform *Massarina chamaecyparissi*
- Spores yellow-brown, ellipsoid 24
24. Ascocarps in the spikes, spores eguttulate
- *Phaeosphaeria lycopodina*
- Ascocarps in the leaves, spores guttulate *Phaeosphaeria marciensis*
25. Spores with 1 inflated, submedian cell *Phaeosphaeria fückelii*
- Spores with 1 inflated, suprmedian cell
- *Phaeosphaeria herpotrichoides*

Discomycetes

Cryptodiscus anguillosporus L. & K. Holm sp.nova

— Figs. 1a, 2, 8

Apothecia immersa, sparsa, orificio fere rotunda 0.2—0.3

mm diam. *Excipulum* vulgo 15—20 µm latum, e cellulis minutis, c. 2 µm diam., pariete hyalino, sat crasso; margo intus filamentis brevibus ad instar periphysium. *Asci* fere cylindracei, 35—45(–50) × 4—5 µm, apice incrassati, octospori, 1-. *Sporae* vermiformes, 20—28 × 1 µm, guttulis paucis. *Paraphyses* filamentosae, c. 1 µm diam., septatae, apice vix incrassatae, 1-.

Habitat in *Lycopodio complanato* emortuo, praecipue in pagina inferiore surculorum.

Typus: Suecia, Uplandia, Dalby pr. Hammarskog, 29.VI.1980 K. & L. Holm 1893a (UPS, holotype).

It is somewhat surprising to come across a *Cryptodiscus* on this type of substratum, as otherwise it is mainly a genus of lignicolous fungi. However, the present species is a perfectly good *Cryptodiscus*, though distinguished by the scoleospores. It is probably not infrequent; besides the type we have 7 collections, all from Sweden:

Upland: Dalby par., pr. Hammarskog, 5.XII.1979, 1767d; 28.VII.1980, 2016d; 16.XI.1980, 2272a. — *Västmanland*: Västerfärnebo, 20.XI.1980 Rosén. — *Dalarna*: Garpenberg, Mt Prästberget, 31.VIII.1974 Lundqvist 8677. Sundborn, pr. Mjölnarvallen, 30.VIII.1980 Rosén. — *Torne Lappmark*: Gällivare, Mt Dundret, VII.1930 Lind.

Cryptodiscus sp.

— Fig. 1b

On an old herbarium sheet of *L. alpinum* (vide infra) we have found a *Cryptodiscus* externally similar to the preceding species but with quite different spores: they are fusiform — somewhat clavate, 8—10 × 1.5 µm, finally with 1—2 (or more?) septa. This collection may represent a species of its own, possibly restricted to *L. alpinum*.

Sweden. *Dalarna*: Idre, Mt Stådjan, 24.II.1893 Helsing.

Cyathicula cyathoidea (Bull. ex Mérat) Thümen

— Figs. 9, 11

Helotium Sommierianum Magnus, N. Giorn. Bot. Ital. 25:108 (1893). — Type: Siberia, pr. Samarova, 'in spica annotina *L. clavati*', 18.VII. 1880 Sommier (HBG!).

Helotium lycopodium Moesz & Smarods in Moesz, Bot. Közlem. 39:188 (1942). — Type: Latvia, Madona, pr. Vestiana, in dead spikes of *L. clavatum*, 10.VIII. 1940 Rasins (BP!).

As far as we know, this common and polyphagous fungus has not been recorded on *Lycopodium*. However, the two taxa cited above in synonymy, obviously belong to this possibly collective species. We have examined the types, which are well developed and seem to match *C. cyathoidea* in every respect. It should be noticed that the original description of *Helotium sommierianum* is erroneous in one essential detail: the spores are said to be cylindraceous ('elongato-baculiformes'), whilst they are actually fusiform. Apparently because of this misleading statement, Moesz did not identify his fungus with that of Magnus, but described it as new. Neither he nor Magnus considered *Cyathicula* in their discussion.

Neither of these two *Helotium* 'species' has been recorded since first published and we would hardly have dealt with them here, had we not made the find

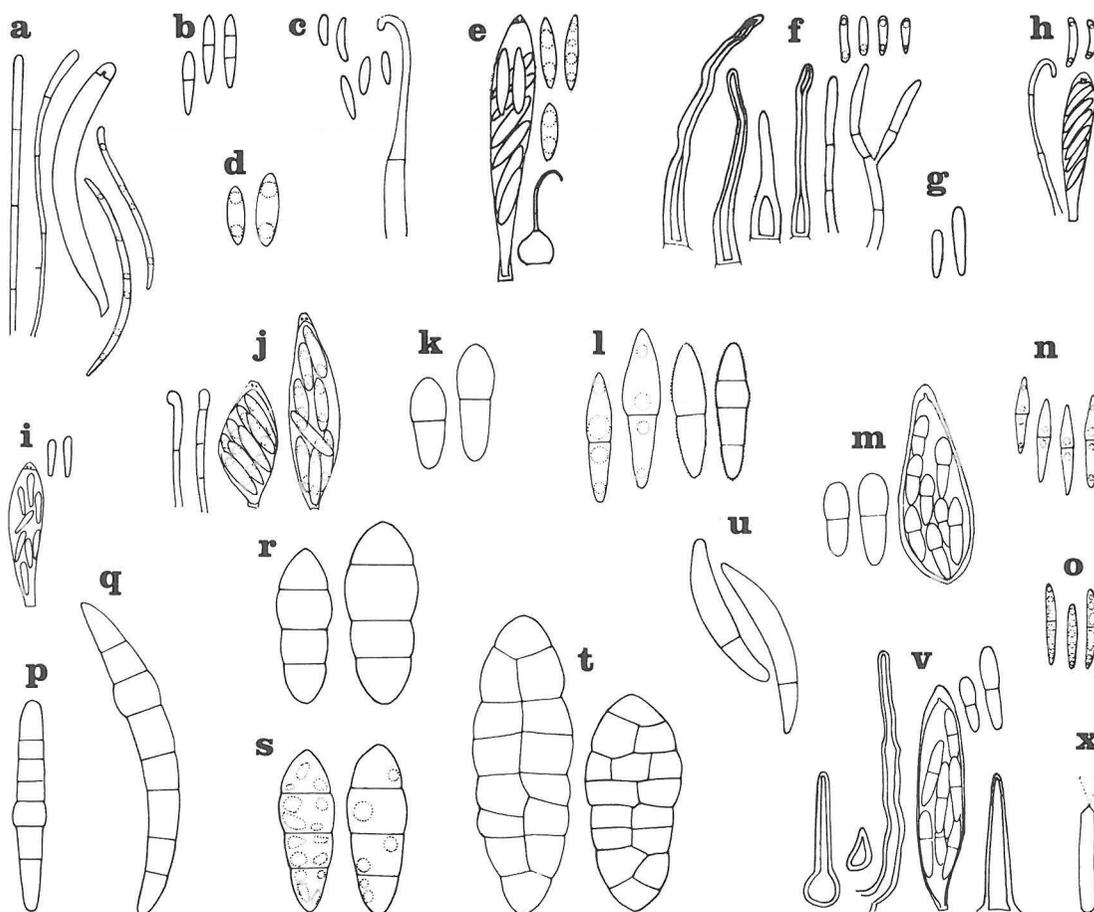


Fig. 1. — a) *Cryptodiscus anguillosporus*: paraphyses, ascus, and spores, b) *Cryptodiscus* sp.: spores, c) *Hamacanthoscypha laricionis*: spores and hair, d) *Dasyscyphus inopinatus*: spores, e) *Hyalopeziza pani*: ascus, spores, and hair, f) *Hyalopeziza rubefaciens*: hairs, paraphyses, and spores, g) *Mollisia* sp.: spores, h) ?*Micropeziza diphasii*: paraphysis, ascus, and spores, i) *Phacidina gracilis*: ascus and spores, j) *Pseudopeltis perminuta*: paraphyses and asci with spores, k) *Gibbera lycopodii*: spores, l) *Massarina chamaecyparissi*: two immature and two fully mature spores, m) *Mycosphaerella lycopodii*: spores and immature ascus, n) *Mycosphaerella lycopodii-annotini*: spores, o) *Niesslia haglundii*: spores, p) *Phaeosphaeria fuckelii*: spore, q) *Phaeosphaeria herpotrichoides*: spore, r) *Phaeosphaeria marcyensis*: spores, s) *Phaeosphaeria lycopodina*: spores, t) *Pleospora islandica*: spores, u) *Pseudomassaria lycopodina*: spores, v) *Venturia lycopodina*: setae, ascus, and spores, x) *Ceuthospora lycopodii*: conidium. — All $\times 1000$.

quoted below. This material is abundant, with the previous year's spikes heavily infested. The apothecia are quite immature but undoubtedly represent the same species as the collections just mentioned. Certainly the repeated occurrence on lycopod spikes is noteworthy and perhaps this is a particular strain, specialized to *L. clavatum*. We leave this question to a future monographer of *Cyathicula*.

Sweden. Upland: Dalby, c. 1 km W of Högby, dead spikes of *L. clavatum*, 27.IV.1975, 474a.

Poculopsis ogrensis Kirschst.

— Figs. 5, 10

Kirschstein, Ann. Mycol. 33:204 (1935). — *Allophylaria ogrensis* (Kirschst.) Dennis, Persoonia 3:57 (1964). — Type: Latvia, Ogre, *L. clavatum*, 3.VIII.1933 Kirulis (B!).

Apothecia scattered, epiphyllous, distinctly stipitate, disc 0.3—0.5 mm wide, yellow when young, darkening with age subgelatinous when wet. *Asci* cylindrico-clavate, 120—130 \times 15 μ m, somewhat narrowed toward the flattened apex, 8-spored; ascus wall considerably thickened at tip, with a minute ring, 1+. *Spores* ellipsoid, 20—25 \times 8—12 μ m, hyaline in ascus with 1 or 2 oil globules, then smoky grey and lastly dark brown, sometimes with a germ pore. 1-celled, or finally 2-celled. *Paraphyses* cylindrical, apically branched, enlarged at the tips to 3 μ m.

Saprophytic in dead *L. annotinum* and *L. clavatum*.

It is particularly noteworthy that the spores eventually turn dark brown and develop a septum. These hitherto overlooked facts indicate the true taxonomic position. The spore type strikingly recalls *Phaeangelina empetri* and there can be no doubt of the affinity. Closely related is also the genus *Chloroscypha*, on

Cupressaceae, which agrees perfectly in most essential characters; the main difference is in the excipular hyphae, which are considerably less gelatinized in *Poclopsis*.

P. ogrensis has to the best of our knowledge been recorded only once since described, viz. from Norway, by Dennis (1964). It is a rather common species, though, and we have found it in 17 samples from Sweden (Uppland, Dalarna, Hälsingland, Härjedalen, Torne Lappmark).

Mollisia sp.

— Figs. 1g, 12

Apothecia scattered — thinly grouped, up to 0.5 mm in diam., externally almost black, hymenium grayish. Asci c. $40 \times 5 \mu\text{m}$, cylindrico-clavate, 8-spored, J+. *Spores* narrowly clavate, $7\text{--}10 \times 1.5\text{--}2 \mu\text{m}$, 1-celled, hyaline. *Paraphyses* thread-like, dissolving early.

Fairly common in withering, grayish parts of *Lycopodium* spp., preferably in spikes and culms.

This species seems to be distinguished by the small, clavate spores and the dark apothecia, but we do not venture to name it, having too much respect for the genus. Possibly it is a true *Lycopodium* fungus. *Mollisia lycopodii* Le Breton & Malbranche (1884:130) is obviously something else, to judge from the description. Our efforts to trace authentic material of that species have unfortunately been without success. According to the kind information of Mr. Michel Lerond, it is not kept in the herbarium of Malbranche and Le Breton in the Muséum de Rouen.

Micropeziza? *diphasii* L. & K. Holm sp.nova

— Figs. 1h, 13

Typus: Suecia, Dalarna, paroecia Folkärna, pr. Korskrögen, *L. complanatum*, 16.X.1980 K. & L. Holm 2216f (UPS, holotype).

Apothecia superficialia, sparsa — laxe gregaria, $80\text{--}100\text{--}120 \mu\text{m}$ diam., primo tecta scutello unistrato e cellulis meandriformibus usque $12 \mu\text{m}$ longis, $2\text{--}4 \mu\text{m}$ latis in seriebus radiatis dispositis, mature centro dehiscenti, reliquiis collum fuscum hymenium cingentem formantibus. *Excipulum* saepe fere nullum, sed interdum basaliter evolutum, ad $25 \mu\text{m}$ altum e cellulis globosis minutis usque $5 \mu\text{m}$, pariete hyalino \pm incrassato, refringente. *Asci* vulgo $20\text{--}25 \times 4\text{--}5 \mu\text{m}$, clavati, apice paulo incrassati, annulo minuto ope lodi et solutione KOH coerulescenti, octospori. *Sporae* suballantoideae, $5\text{--}7 \times 1 \mu\text{m}$, hyalinae, denique guttulateae. *Paraphyses* ascis longiores, filamentosae, leviter flexuosae, septatae, c. $1 \mu\text{m}$ crassae.

In *Lycopodio* (*Diphasio*) *complanato* sicco, praecipue in pagina inferiore surculorum.

We have put a question mark by the generic name above, owing to the great difficulty of disposing correctly of such a strongly reduced fungus. There are, however, good reasons for assigning it to *Micropeziza*, cf. Nannfeldt (1976). The general aspect is indicative; so is the scutellum and the supracuticular habit. A distinctive feature of *Micropeziza* is the excipular structure, composed of cells with thick, hyaline, refractive walls. In *M. diphasii* the excipulum is more or less reduced: the perihymenial part is almost wholly

absent and often the basal excipulum, too. The latter can be present in larger apothecia, though, and is mostly made up of very small thin-walled cells, but interspersed among them are larger cells reminiscent of those found in the true *Micropezizae*. We think that these cells are indicative of the presumed affinity. Anyway we can see nothing that argues against it.

This tiny species often grows intermixed with other dwarfs, like *Phacidina gracilis* and *Pseudopeziza permixta*. It is probably common and widespread, but so far is known only from a few places in Sweden and Finland. Besides the type we have seen the following material:

Sweden. *Uppland*: Dalby, pr. Hammarskog, 19.XI.1979, 1893b and 16.IV.1980, 2016b. Tunaskog, 30.X.1980, 2264c. — *Dalarna*: St. Kopparberg, 26.VIII.1980, 2234a. Mt Krokforsberget, 6.VIII.1974, 326k. Folkärna, pr. Korskrögen, 23.VII.1979, 1822b and 27.VIII.1980, 2235a.

Finland. *Tavastia australis*: Loppi, 26.VIII.1967 Alanko 67-1453d (H).

Dasyscyphus inopinatus (Kirschst.) L. & K. Holm n.comb.

— Figs. 1d, 3, 4, 14—17

Lachnella inopinata Kirschstein, Ann. Mycol. 36:383 (1938). — Type: Austria, Tyrol, St. Anton, *L. annotinum*, 5.VII.1931 Kirschstein (B).

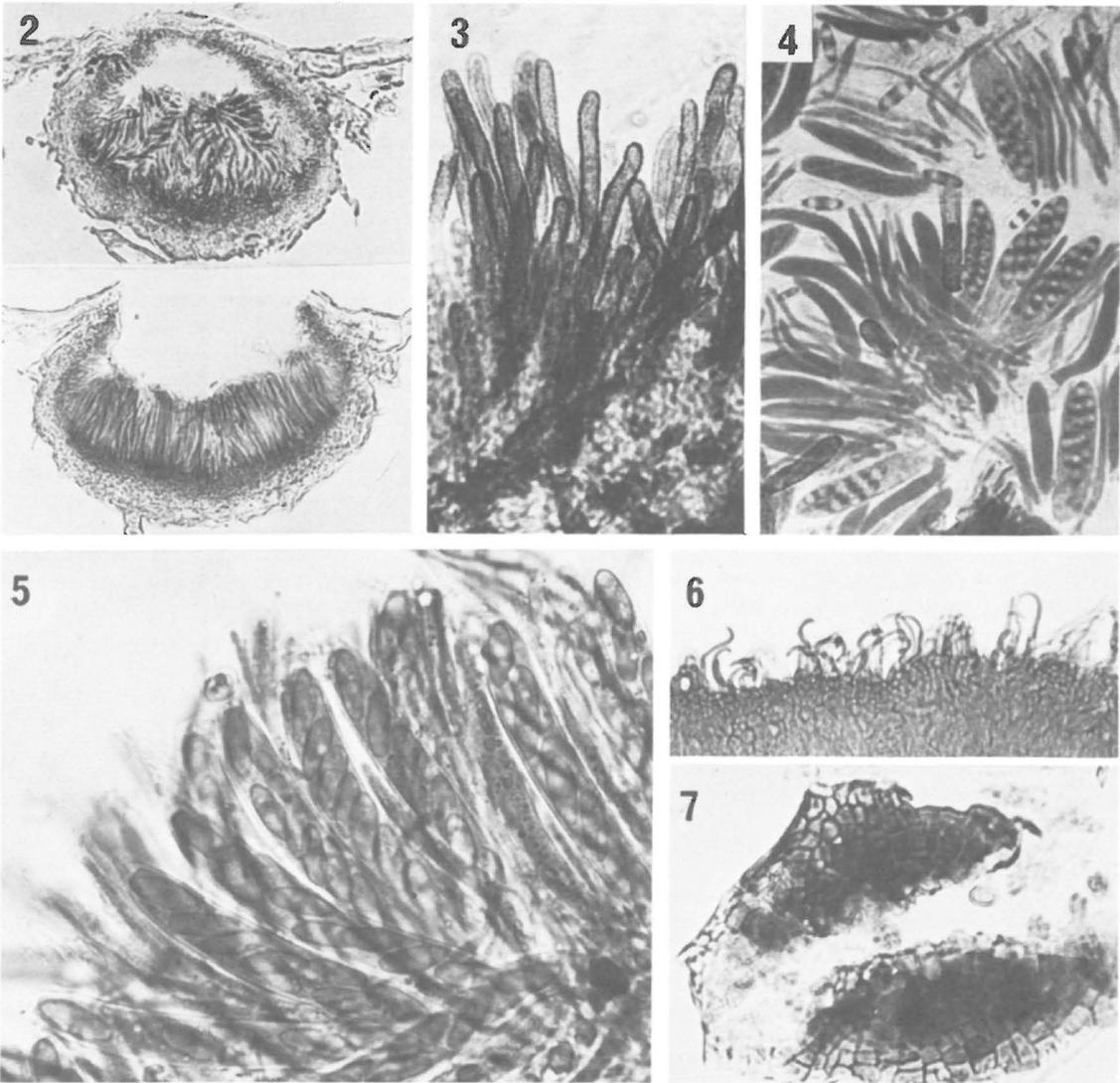
Apothecia scattered, amphigenous, subcuticularly attached, when dry shrivelled up to minute brown, bristly balls, when wet cup-shaped, $0.2\text{--}0.3\text{--}0.4$ mm in diam., with a short but distinct stipe. *Excipulum* of textura angularis, densely clad with numerous brown, cylindrical hairs of varying length, up to $120 \mu\text{m}$, and $5\text{--}8 \mu\text{m}$ in diam., obtuse at apex, densely asperulate, sparingly septate. *Disc* greyish. *Paraphyses* cylindrical, $2\text{--}3 \mu\text{m}$ wide, obtuse at tips, aseptate. *Asci* clavate, $40\text{--}50 \times 8\text{--}10 \mu\text{m}$, with a minute apical ring, 1+, 8-spored. *Spores* narrowly ellipsoid, $8\text{--}10 \times 3\text{--}4 \mu\text{m}$, hyaline, with large oil globules, one-celled (or finally 1-septate?).

On dead *L. annotinum* and *L. clavatum*.

We have examined the type material, obtained on loan from B, but unfortunately without finding anything corresponding to Kirschstein's description. However, there can be no doubt that his species is the one described here; it is true that he gave the spores as 2-celled, whilst we have seen only aseptate spores, but this discrepancy can be explained: the spores may finally develop a septum, or Kirschstein was the victim of an error of observation: the thin median plasma bridge between the oil drops is easily mistaken for a septum.

The aspect of *D. inopinatus* is suggestive of *D. pteridis* (Alb. & Schw. ex Fr.) Masee, on ferns, and particularly of *D. borealis* K. & L. Holm, on juniper. The latter species has narrower spores, and wholly superficial apothecia (Holm & Holm 1977).

D. inopinatus has not been recorded since first described. Nevertheless it is fairly common on *L. annotinum*, and we have seen material from Sweden (Bohuslän, Uppland, Värmland, Dalarna, Hälsingland, Härjedalen, Lule Lappmark, Torne Lappmark), Norway (Sör-Trøndelag) and Iceland.



Figs. 2 — 7. — 2: *Cryptodiscus anguillosporus*, sections of apothecia, closed above, and opened below, Lactic Blue, $\times 210$. — 3-4: *Dasyscyphus inopinatus* (3: hairs; 4: paraphyses, asci, spores in Lactic Blue), $\times 530$. — 5: *Poculopsis ogrensis*, asci with spores and paraphyses, Lactic Blue, $\times 530$. — 6: *Hamacanthoscypha laricionis*, hairs, Lactic Blue, $\times 530$. — 7: *Pseudopeltis perminuta*, shield, $\times 530$.

Hamacanthoscypha cf. laricionis (Vel.) Svrček

— Figs. 1c, 6

Svrček, *Česká Mykol.* 31:11 (Febr. 1977). — *Uncinia laricionis* Velenovský, *Monogr. Disc. Bohem.*: 295 (1934). — *Unciniella laricionis* (Vel.) K. & L. Holm, *Symb. Bot. Upsal.* 21(3):17 (Aug. 1977).

?*Hyaloscypha Lycopodii* Velenovský, *Monogr. Disc. Bohem.*: 282 (1934). — Type: Czechoslovakia, pr. Mnichovice, *L. clavatum*, XI.1929 (PRM, slide 151162!).

Apothecia scattered, c. 0.1—0.3 mm in diam., whitish with a distinct stipe, c. 0.1 mm high, brownish at base. *Hairs* unciniate, generally with 1 septum, up to 40 μm long. *Paraphyses* thread-like, c. 1 μm broad. *Asci* cylindrico-clavate, 25—30 \times 4—5 μm , 8-spored, 1+. *Spores* cylindrical or

slightly fusiform or clavate, 5—6 \times 1—1.5 μm , one-celled, hyaline, eguttulate.

H. laricionis is fairly common on coniferous litter. A very similar and perhaps identical fungus has been encountered a few times on *Lycopodium*. The collections are scanty, the occurrence probably being accidental. *Hyaloscypha lycopodii* Vel. may be conspecific, to judge from a (poor) slide of the type.

Sweden. Uppland: Dalby, pr. Österbergstorpet, *L. complanatum*, 19.XI.1979, 1893j, 16.XI.1980, 2272d. — **Dalarna:** St. Kopparberg, Krokforsberget, 6.VIII.1974, *L. complanatum*, 326h. Garpenberg, Realsbo, *L. clavatum*, 29.VIII.1974,

351d. Folkärna, pr. Korskrogen, *L. complanatum*, 20.X.1980, 2235f.

***Hyalopeziza rubefaciens* L. & K. Holm sp.nova**

— Figs. 1f, 18, 19

Apothecia sparsa, superficialia, sessilia, pilosa, in humido 0.1–0.2 (–0.3) mm diam., discoidea, rufa; in sicco urceolata, fusca, orificio ochraceo. *Excipulum* basi c. 25 μ m latum, lateraliter tenuius, pro parte majore e cellulis brunneis fere isodiametris, 5–12 μ m; extus pilis hyalinis crassitunicatis, saepe nonnihil undulatis, (20–)25–35(–40) μ m longis, basi c. 4 μ m apice c. 2 μ m crassis. *Paraphyses* filamentosae, interdum ramosae, septatae, c. 1.5 μ m crassae. *Asci* cylindrico-clavati, subsessiles, perumque 15–20 \times 4 μ m, octospori, 1-. *Sporae* cylindraceae — subclaviformes, 4–6 \times 1.5 μ m, hyalinae, plerumque guttulis terminalibus instructae.

In pagina inferiore surculorum *Lycopodii* (*Diphasii*) *complanati*. Typus: Suecia: Dalarna, St. Kopparberg, pr. Övre Krokfors, 6.VIII.1974, 326b (UPS, holo).

A beautiful species well characterized by the reddish colour appearing when the apothecia turn moist. The substratum is somewhat reddened, too — the place where an apothecium has fallen is marked by a small reddish spot. The hairs are rather variable, see Fig. 1f. Most of them have a fairly wide lumen, without septa; in others the lumen is very fine save at the apex and base, while some hairs seem to be solid except for the basal part. This variation is noteworthy, particularly in view of the importance attributed to the various hair types in the delimitation of genera in the Hyaloscyphaceae. We therefore concur with Korf and Kohn (1980), who unite most of these taxa in a broadly conceived genus, *Hyalopeziza*. The present species seems best accommodated in the subgenus *Unguicularia*.

Besides the type we have seen the following material:

Sweden. Dalarna: Kopparberg, pr. Övre Krokfors, 26.VIII.1980, 2234f. Folkärna, pr. Korskrogen, 19.VI.1979, 1580b; 23.VII.1979, 1822a; 8.IV.1980, 2008; 16.X.1980, 2216g; 20.X.1980, 2235d.

***Hyalopeziza pani* (Vel.) L. & K. Holm comb.nova**

— Figs. 1e, 20–22

Hyaloscypha Pani. Velenovský, Monogr. Disc. Bohem.: 285 (1934). — Type: Czechoslovakia, pr. Jevany, *L. clavatum*, X.1925 (PRM!).

Apothecia scattered or a few together, \pm turbinate, 0.1–0.3 mm in diam., subsessile or with a short stipe up to 0.1 mm, white, densely and minutely hairy. *Excipulum* thin at margin, c. 10 μ m broad, composed of small prismatic cells, towards the base of larger isodiametric cells, up to 15 μ m; outside clothed with 1-celled hairs, globose at base, c. 5 μ m in diam., drawn out above into a solid hair, 10–15 μ m long and 1 μ m thick, hooked at the tip. *Paraphyses* thread-like, c. 1.5 μ m thick, (dissolving? early). *Asci* clavate, 36–45 \times 7–9 μ m, with a minute apical ring, 1+, 8-spored. *Spores* obtusely fusiform — narrowly ellipsoid, 8–10 \times 2–3 μ m, one-celled, hyaline, with two or more oil droplets. On dead *Lycopodium* spp.

The above description is made from our material; the identification with Velenovský's species is based on a slide from the type collection (PRM 149707). As stated under *H. rubefaciens*, we have adopted the wi-

de generic concept advocated by Korf and Kohn (1980) and refer this species also to *Hyalopeziza*. It seems best accommodated in the subgenus *Unguicularia* (as also suggested by Dr. M. Svrček, in litt.) but deviates by the apparent lack of paraphyses with glassy, thickened apex, and cannot be identified with any of the half-dozen species of this group so far known, cf. Raitviir (1970: 37).

This tiny species may be restricted to lycopods, perhaps preferring *L. clavatum* as it is fairly abundant on this host, in nos. 1885 and 2239c. It may occur intermixed with *Hamatocanthoscypha laricionis* but can generally be recognized under the binocular by the more turbinate almost sessile apothecia, with have a 'downy' appearance whilst those of *H. laricionis* look more hairy. We have seen the following Nordic material:

Sweden. On *L. clavatum*: — Uppland: Dalby, Tuna skog, 8.X.1979, 1885. Åland, pr. Rövarkulan, 19.IX.1980, 2239c.

On *L. complanatum*: — Uppland: Dalby, pr. Östbergstorp, 19.XI.1979, 1893h. — Dalarna: Sundborn, pr. Finnbo, 6.VIII.1974, 326n, and c. 1500 m W of Mjölнарvallen, 30.VIII.1980 Rosén.

Finland. *Tavastia australis*: Loppi, Hunsala, *L. complanatum*, 26.VIII.1967 Alanko 67-1453 (H).

***Pseudopeltis perminuta* L. & K. Holm sp.nova**

— Figs. 1j, 7, 24

Typus: Suecia: Dalarna, St. Kopparberg, pr. Övre Krokfors, *L. complanatum*, 19.VI.1979 K. & L. Holm 1731b (UPS, holo).

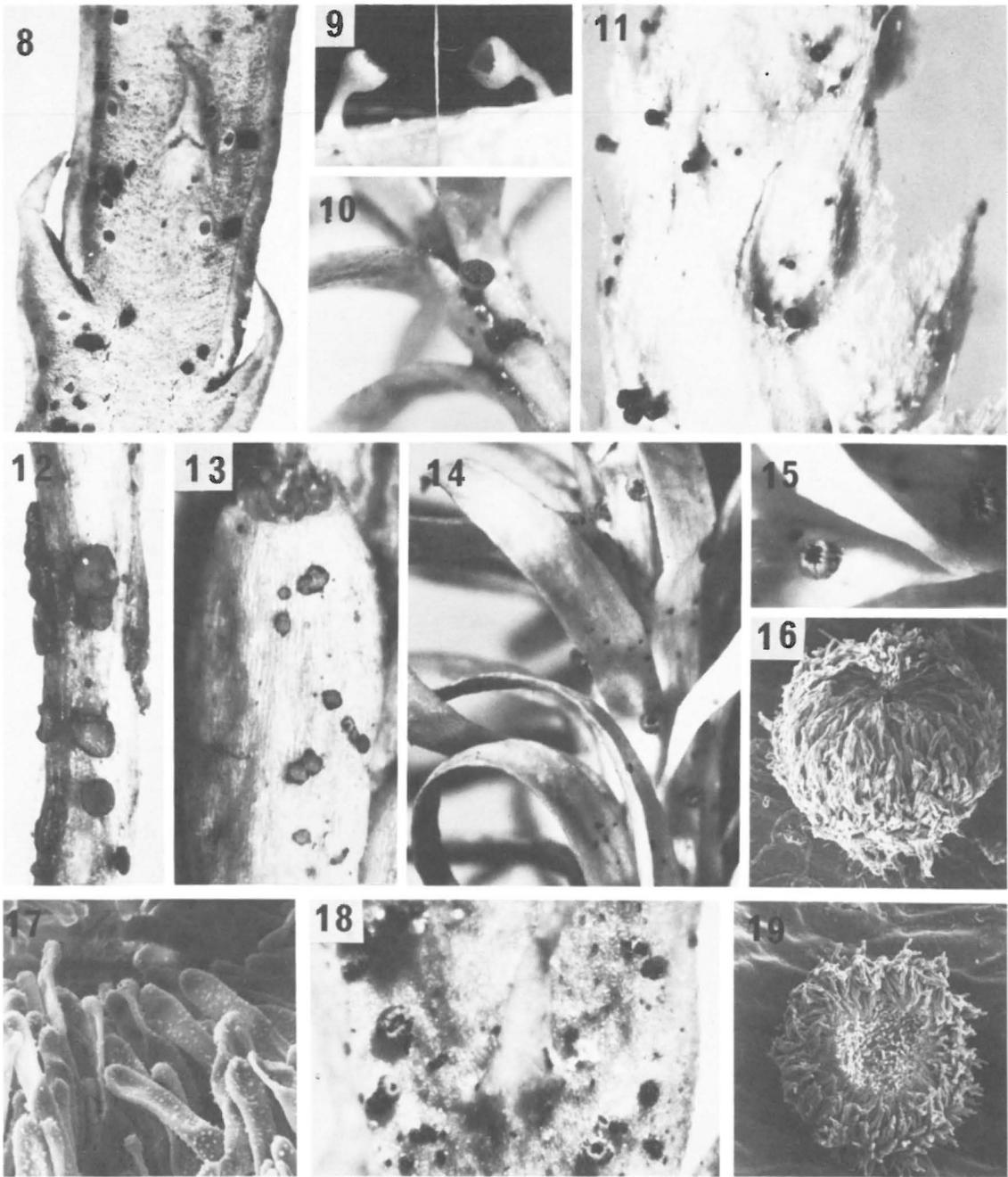
Apothecia amphigena, subcuticularia, vulgo dense sparsa, desuper visa generatim \pm ellipticae interdum circularia, 50–100(–120) μ m longa, 40–60 μ m lata, fissura longitudinali aliquando furcata dehiscentia. *Scutellum* cellulis radiatum dispositis, centro quadratis ad 5 μ m, margine elongatis usque 8 μ m. *Excipulum* fere nullum. *Asci* \pm saccati, subsessiles, 15–27 \times 6–8 μ m, annulo apicali ope lodi et solutione KOH coerulescenti. *Sporae* hyalinae, continuae, anguste ellipsoideae vel subcylindricae, 7–9 \times 2 μ m, plerumque guttulis duobus distinctis. *Paraphyses* ascos subaequantur, septatae, apicem versus leniter incrassatae, c. 2 μ m, diam.

Habitat in surculis emortuis: *Lycopodii complanati*.

A veritable Lilliputian among the many dwarfs on *Lycopodium*! Nevertheless it catches the eye as it often occurs in abundance, more or less covering relatively large areas, 1–2 cm long, on the shoots. It is very characteristic and easily identified by its appearance which recalls a *Leptopeltis*. As it is so strongly reduced, its taxonomic positions is somewhat uncertain but it seems to fit in well in *Pseudopeltis*, a genus recently established for a similar fungus on ferns, *P. filicum* (Holm & Holm 1978). There is close agreement in essential characters, like the structure of the scutellum and asci.

P. perminuta is a true inhabitant of *L. complanatum*, and seemingly restricted to this host. It is certainly much more common and widely distributed than can be inferred from our comparatively few collections, but is possibly a northern species.

Sweden. Dalarna: St. Kopparberg, pr. Övre Krokfors: 6.VIII.1974, 326m; 19.VI.1979, 1731b; 26.VIII.1980, 2234c;



Figs. 8—19. — 8: *Cryptodiscus anguillosporus*, apothecial openings, $\times 14$. — 9: *Cyathicula cyathoidea*, apothecia (type collection of *Helotium lycopodium*), $\times 32$. — 10: *Poculopsis orgensis*, apothecium, $\times 12$. — 11: *Cyathicula cyathoidea*, very young apothecia (Holm 474a), $\times 16$. — 12: *Mollisia* sp., apothecia, $\times 16$. — 13: ?*Micropeziza diphasii*, apothecia, $\times 32$. — 14-17: *Dasyyscyphus inopinatus* (14-16: apothecia, $\times 16$, $\times 32$ and SEM $\times 150$; 17: hairs, SEM $\times 1100$). — 18-19: *Hyalopeziza rubefaciens*, apothecia, $\times 32$ and SEM $\times 250$.

27.VIII.1980, 2235e. Folkärna pr. Korskrogen: 19.VI.1979, 1580d; 23.VII.1979, 1822f; 16.X.1980, 2216a. — *Ångermanland*: Ullånger, Håll, 24.X.1980 Moberg. — *Torne Lappmark*: Jukkasjärvi, Kaisepakte, 28.VII.1939 Alm & Smith. Gällivare, Dundret, VII.1930 Lind. Karesuando, 1833 Laestadius.

***Phacidina gracilis* (Niessl) von Höhnel**

— Figs. 1i, 23

von Höhnel, Ber. Deutsch. Bot. Ges. 35:422 (1917). — *Phacidium gracile* Niessl apud Voss, Österreich. Bot. Zeitschr. 32:357 (1882). — Type: Jugoslavia, Ljubljana (Laibach), *L. complanatum*, VIII.1882 Voss.

Exs.: Rbh., F. eur. 2459 (UPS).

Ascocarps scattered, subcuticular, scutate, (50—) 100—200 μm in diam., 50 μm high. *Shield* pseudoparenchymatous, not radiate, at centre 10—15 μm thick, composed of c. 5 layers of strongly pigmented cells, at margin consisting of 1 layer of hyaline cells; splitting irregularly at maturity and exposing the pale hymenium. *Lateral excipulum* c. 0, *basal layer* weakly developed, composed of 1—2 layers of very small, globose cells, c. 2 μm in diam., with slightly thickened, somewhat refractive walls. *Interascal threads* present, articulate. *Asci* broadly clavate, narrowing upwards, c. 25 \times 5—6 μm , sessile, with a minute apical ring, c. 1 μm in diam., 1+, 8-spored. *Spores* rod-like, thickening slightly upwards, c. 7 \times 1 μm , one-celled, hyaline.

Though the species has a distinctive appearance, the subcuticular ascocarps looking like shining black dots, its true taxonomic positions is a difficult problem, and has been understood in various ways. Originally described as a *Phacidium*, it was still regarded as such by Rehm (1888). Von Höhnel (1917) ranged it among the Leptopeltidaceae, and Nannfeldt (1932) considered it to be ascolocular. Von Arx and Müller (1954) treated it thoroughly, concluding that it was closely akin to *Phacidium*. According to them the ascocarps are stromatic with interthelial threads attached above as well as below: "Zwischen Basal- und Deckschicht sind die Zellen hyalin und in senkrechter Richtung fadenförmig gestreckt: nach dem Heranwachsen der Asci lösen sie sich oben los und werden dann zu 'Paraphysen'." We agree with this interpretation: We have studied the ascocarp structure on ultratome sections, 1 μm thick, and as far as we can see the interascal threads are not true paraphyses but pseudo-paraphyses; these are outgrowths from the shield, directed downwards, and the shield is the part of the ascocarp that is formed first. But it is another question whether this type of development is found in *Phacidium*, which rather has true paraphyses. We are not convinced that these genera are related, but we have no better place for *Phacidina*, which seems to be very isolated.

An anamorph has been attributed to *Phacidina gracilis*, viz. *Ceuthospora lycopodii* Lind, by Kendrick & DiCosmo (1980), on the basis of a vague supposition by von Höhnel (1925). There is no evidence for such a connection, which seems highly improbable.

Phacidina gracilis is very common on *L. complanatum* and perhaps co-extensive with this plant. It is particularly abundant in the margins of the undersi-

de. It is also found on *L. alpinum* (recorded already by Lind 1934); more surprising is its rather frequent occurrence on *L. clavatum*.

Pyrenomyces unitunicati

Niesslia haglundii Starb.

— Figs. 1o, 25, 35

Starbäck, Bih. K. Sv. Vet.-Akad. Handl. 14(3:5):9 (1889). — *Venturia Haglundii* (Starb.) Saccardo, Syll. Fung. 9:694 (1891). — Type: Sweden, Östergötland, Simonstorp, *L. complanatum*, E. Haglund (S?).

Exs.: (Petr., Fl. Bohem. Mor. 11:1 no. 1246b, intermixed).

This fungus can hardly be distinguished from the plurivorous *Niesslia exilis* on morphological grounds, nor did Starbäck indicate any differences. But for the time being we prefer to keep it as a separate taxon since it is probably biologically distinct. *N. haglundii* is apparently not plurivorous, as we have found it exclusively on the two members of the subgenus *Diphysium*, i.e. *L. alpinum* and *L. complanatum*. For a description of *N. exilis*, see e.g. Müller and von Arx (1962:576).

N. haglundii is similar to *Gibbera lycopodii* in gross appearance, but can generally be recognized under the binocular by the still more collapsed ascocarps with shorter bristles and without subiculum. Spores 9—11 \times 1.5 μm , with several distinct oil droplets. The species seems to be fairly common on *L. complanatum*, particularly on the underside of younger branches. It can also infest *L. alpinum*: We have found it once on this host, on an old herbarium sheet:

Norway: *Finnmark*: Varanger, 8.IX.1851 Chr. Sommerfelt (UPS).

***Pseudomassaria lycopodina* (Karst.) von Arx**

— Figs. 1u, 27, 28, 33, 34

von Arx, Beitr. Kryptog.-Fl. Schweiz 11(2):686 (1962). — *Shaeella lycopodina* Karsten, F. fenn. exs. 596 (1866). — Type: Finland, Mustiala, *L. complanatum* (UPS, iso).

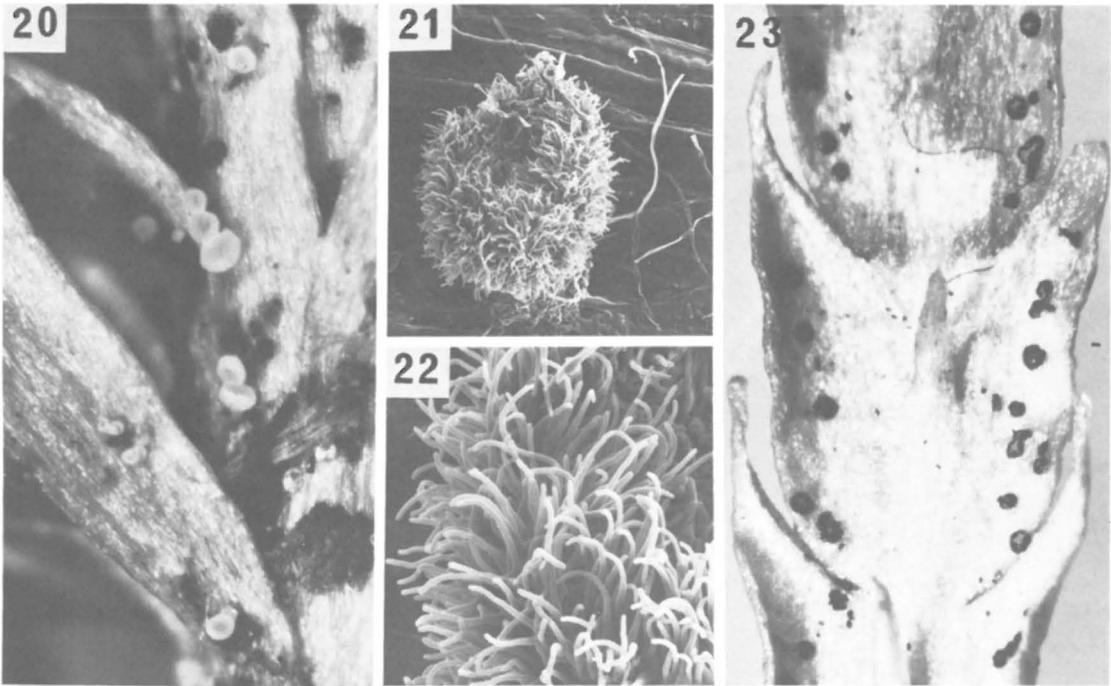
?*Metasphaeria lycopodii* (Berk. & Curt.) Sacc., Syll. 2:183 (1883). — *Sphaeria Lycopodii* Berkeley & Curtis, Grevillea 4:155 (1876). — Type: 'U.S.A., New Jersey, on *Lycopodium*, No. 4686' (K!).

Exs.: Karst., F. Fenn. 569 (UPS). — Lund. & Nannf., F. succ. 2292 (UPS). — Rbh., F. eur. 1154 ('*Gnomonia Niessli*') (UPS). — Rehm, Asc. 1392 (UPS) (Roum., F. sel. 4653). — Syd., Myc. germ. 582, 1233, 2694 (UPS); Myc. march. 2132 (UPS). — Thüm., myc. univ. 1848 ('*Leptosphaeria microsticta*') (UPS).

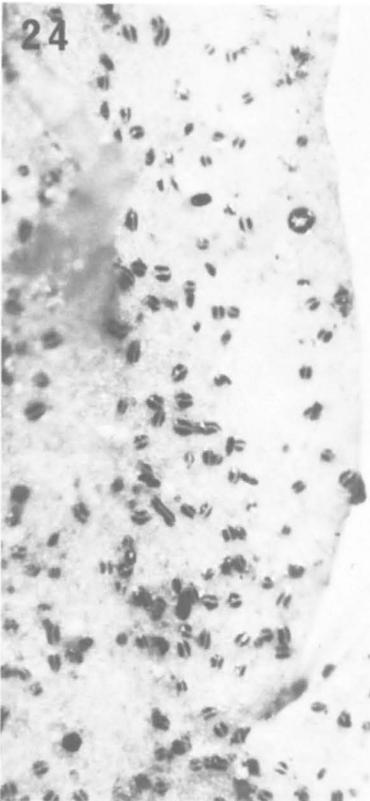
Perithecia \pm thickly scattered, mainly in the upper leafside, immersed, depressed, c. 150 μm in diam., with a minute papilla, sometimes slightly clypeate. *Peridium* often double, consisting of a primary inner wall, fairly rather light brown, c. 5 μm thick, composed of 1—2 layers of strongly compressed cells, rather large, up to 15 μm , and a secondary outer wall, about as thick, composed of coarse, interwoven darkening hyphae. *Asci* numerous, \pm cylindrical, 60—80 \times 8—10 μm with a minute apical ring, 1+, 8-spored. *Spores* rather variable in size and shape, \pm 'banana-shaped' 14—24 \times 4—5 μm , hyaline with large \pm diffuse oil drops, finally with a septum near the base (sometimes lacking?); nuclei often stained by Cotton Blue.

In *L. annotinum* and *L. complanatum*.

Perhaps the most common of all the microfungi on



Figs. 20—24. — 20–22: *Hyalopeziza pani* (20–21: apothecia, $\times 32$ and SEM $\times 250$; 22: apothecial hairs, SEM $\times 900$). — 23: *Phacidina gracilis*, apothecia, $\times 16$. — 24: *Pseudopeziza perminuta*, apothecia, $\times 32$.



Lycopodium, and at least sometimes a true parasite, infesting green leaves (e.g. in Lundell & Nannf., F. suc. no. 2292). It is noteworthy because of the peculiar peridium structure (first pointed out by Barr 1964): the perithecial wall often consists of two clearly different layers: apparently the outer layer is often lacking (the reverse condition perhaps sometimes prevails?). The outer wall layer may develop into a slight clypeus.

The species has been described several times; a detailed synonymy was published by Barr (1964). We can add one further probable synonym, viz. *Metasphaeria lycopodii*. There are two packets at K under his name, very probably parts of the same collection: 1) Ex herb. Berkeley no. 4686 — a very small specimen with empty perithecia. 2) A fragment from herb. Ravenel, with the annotated locality 'New Jersey, Laning' and with plenty of perithecia of *Pseudomasaria lycopodina*. The host in both packets is *L. complanatum* coll. We would have no hesitation in identifying *Sphaeria Lycopodii* with the *Pseudomasaria*, had not Berkeley stated in the original (poor) description that the spores are 'biseptate'. However, we are inclined to believe that this is an error for 'bicellular'. As far as we know, no other find of *Sphaeria lycopodii* has ever been recorded.

Opinions vary regarding the true taxonomic position of the species. It has repeatedly been regarded as

sphaerellaceous, even by as late an author as Kirschstein (1938), though Auerswald (1869) had a better idea of it, many years earlier, referring it to *Gnomonia*. We have some hesitation in following the current practice of placing it in *Pseudomassaria*. It is obviously related to this genus but it is hardly closely akin to the type species, *P. chondrospora* (Ces.) Jacz., on twigs of *Tilia*. On the other hand, it seems very close to some *Physalospora* species on Ericaceae, like *P. clarae-bonae* (Speg.) Theiss. and *P. empetri* Rostr. The present circumscription of *Pseudomassaria* is probably rather schematic.

P. lycopodina is common and generally abundant on *L. annotinum* and *L. complanatum*, but curiously enough not found on *L. clavatum*. We have seen Swedish material from the provinces of Skåne, Östergötland, Uppland, Dalarna, and Hälsingland, and one collection from Finland, Tavastland.

Pyrenomycetes bitunicati

Gibbera lycopodii L. & K. Holm sp.nova

— Figs. 1k, 29, 30, 40

Ascocarpia superficialia, globosa vel in sicco depressa, 80—100 μm diam., sursum setulis brunneis rigidis non septatis ad 175 \times 5 μm , basi hyphis numerosis \pm brunneis. *Peridium* e textura angulari, cellulis ad 12 μm . *Asci* subsaccati, 45—55 \times 12—15 μm , brevissime stipitati, octospori. Sporae 12—15(—18) \times 4—5 μm , dilute virides, postremo pallido brunneae, cellula superiore saepe paulo latiore. Ad folia sicca vel viva *Lycopodii* spp.

Typus: Suecia, Härjedalen, par. Tännäs, Fjällnäs, c. 800 m, *L. annotinum*, 26.VI.1975 Holm 599b (UPS, holo).

This species seems well characterized by the very long bristles and the often profuse subiculum. It is a *Protoventuria* in Barr's classification. Besides the type we have five collections:

Sweden. Dalarna: Idre, pr. Mt Nipfjället, *L. annotinum*, 26.VI.1975, 598a. — Härjedalen. Tännäs. Mt Hamrafjället, r. alp., *L. alpinum*, 27.VI.1975, 620c. — Lycksele Lappmark. Tärna, Mt Ryfjället, *L. alpinum*, 27.VII.1928 Lindström.

Norway. Nordland: Örtfjellmoen, *L. annotinum*, 11.IX.1976 Lundqvist 10518a.

Iceland. Eyjafjarðarsýsla, Olafsfjardarmúli, *L. alpinum*, 1.VIII.1971, 13b—71.

Venturia lycopodii L. & K. Holm sp.nova

— Figs. 1v, 32, 44, 45

Typus: Suecia, pr. Gävle, in silva Tolfforsskogen, *L. annotinum*, 15.VIII.1950 J. A. Nannfeldt 11357b (UPS, holo).

Exs.: Petr., Fl.Bohem. Mor. exs. 11:1 no. 1246 (*'Mycosphaerella lycopodina'*) (S1).

Ascocarpia solitaria, sparsa, amphigena, immersa, papilla minuta erumpentia, fere globosa, vulgo 50—80 μm diam., sat pallide brunnea autem circa ostiolum plerumque annulata nigra, interdum setis paucis fuscis ad 30 μm longis apica instructa. *Peridium* tenue, c. 6 μm latum, e textura angulari, cellulis vulgo 5—10 μm , circa ostiolum minoribus. *Asci* sat numerosi, subsaccati, sessilia, 24—30 \times 5—6 μm , octospori. Sporae oblongae, 7—12 \times 2—2.5 μm , terminaliter obtusae, medio septatae, hyalinae, indistinctae guttulate. *Filamenta interthecialia* mature dissolutae. In foliis caulibusque siccis *Lycopodii annotini*.

This species has puzzled us a great deal, but with

some experience it can generally be recognized by sight in the binocular; it is fairly well distinguished by the small ascocarps, which when moist are light brown except for a dark annular zone around the ostiole. It is often intermixed with other pyrenomycetes and can easily be confused with solitary fruit bodies of *Mycosphaerella lycopodii-annotini*. Moreover, it greatly resembles a *Mycosphaerella* in the hyaline spores, and it should be noted that *apical setae are mostly lacking*. However, the presence of interthecial threads at a young stage clearly indicates *Venturia*. Though certainly a common fungus, it has hitherto been almost completely overlooked. The sole exception may be Petrak's abovementioned exsiccata. It is labelled '*Mycosphaerella lycopodina* (Karst.)', which name apparently refers to *Venturia lycopodii*, which is fairly abundant in this sample. Petrak certainly did not have the true Karstenian fungus in mind (i.e. *Pseudomassaria lycopodina*), as he knew that species under another name, viz. *Pseudapiospora necans* (Rehm) Petr. The exsiccata in question merits some further comments. The host is stated in sched. to be *L. clavatum*, but is actually *L. annotinum*, at least in the copy at S. Still more confusion was introduced by Petrak (1920:12) when he reported that the host of no. 1246 is *L. complanatum*! In fact, there is also a no. 1246b, likewise labelled '*M. lycopodina* (Karst.)', the host of which is *L. complanatum*; the copy at S of this b-collection contains no fungus but *Phacidina gracilis*. Beside the type we can cite the following collections:

Sweden. Bohuslän: Lindome, Greggered, 8.IX.1979 and 1.I.1981 Bengtsson. — Uppland: Uppsala-Näs, pr. Dalkarlskärret, 4.X.1980 Stendahl. Väddö, 2.X.1980 Stendahl. — Dalarna: Sundborn, Övertjärn, 18.VII.1974, 310e. Garpenberg, 29.VIII.1974, 353b. Folkärna, pr. Korskrogen, 23.VII.1979, 1823c. — Hälsingland: Segersta, Digerberget, 26.VII.1963 Nannfeldt 17977a.

Norway. Nordland: Örtfjellmoen, 11.IX.1976 Lundqvist 10518b.

Iceland. Barðastrandarsýsla, pr. Vatnsfjörður, 23.VII.1962 Nannfeldt 17576e.

Czechoslovakia. Moravia, Weisskirchen, 27.VIII.1914 Petrak (S).

Massarina chamaecyparissi (Rehm) L. & K. Holm comb.nova

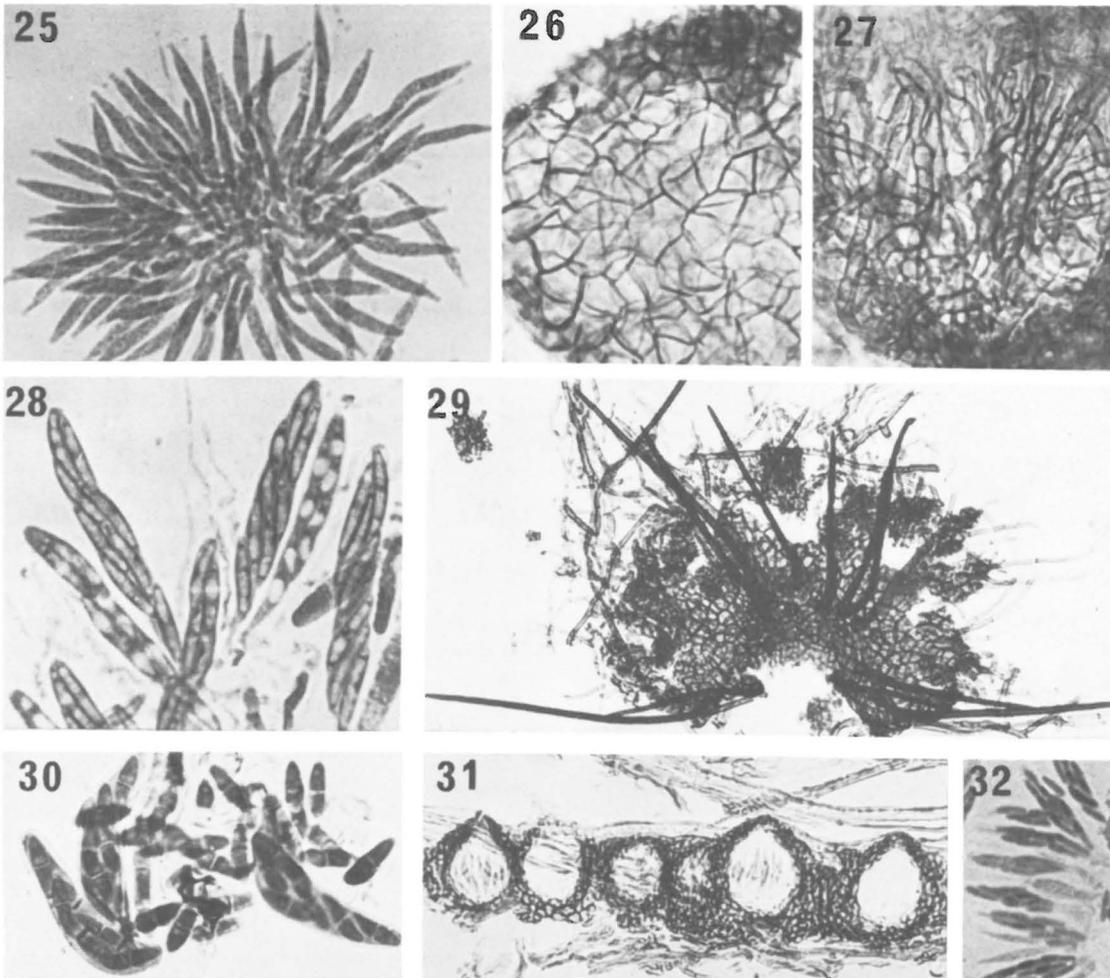
— Figs. 11, 36

Didymella Chamaecyparissi Rehm in Voss, Verhandl. Zool.-Bot. Ges. Wien 34:10 (1884). — Type: Jugoslavia, Ljubljana, *L. complanatum* ssp. *chamaecyparissus*, VIII.1883 Voss, (S1).

Metasphaeria lycopodina Petrak, Ann. Mycol. 32:426 (1934). — Type: Czechoslovakia, Weisskirchen, *L. annotinum*, IX.1928 (n.v.).

Exs.: Petr., Fl. Bohem. Mor. 11:1 no. 2485 (S) — Syd., Myc. germ. 1092 (S, UPS).

Ascocarps mostly epiphyllous, \pm densely scattered, immersed, depressed, 150—200 μm in diam., epapillate, with a thin peridium, light brown when young, darkening with age. *Asci* clavate, 55—60(—65) \times 8—10 μm , 8-spored. Spores fusiform, hyaline when young with numerous very distinct oil globules, bicellular, somewhat inflated above the septum,



Figs. 25—32. — 25: *Niesslia haglundii*, asci in Lactic Blue, $\times 530$. — 26–28: *Pseudomassaria lycopodina* (26: texture of primary perithecial wall; 27: texture of outer wall; 28: asci with spores in Lactic Blue), $\times 530$. — 29–30: *Gibbera lycopodii* (29: crushed ascocarp with setae and subiculum, $\times 210$; 30: asci and spores in Lactic Blue, $\times 530$). — 31: *Mycosphaerella lycopodii-annotini*, section of grouped ascocarps, asci coloured with Lactic Blue, $\times 210$. — 32: *Venturia lycopodina*, asci in Lactic Blue, $\times 530$.

23—25 $\times 4 \mu\text{m}$; when maturing apparently shrinking somewhat in size, 18—20 $\times 3\text{--}4 \mu\text{m}$, the wall turning brownish and verruculose. 1 or 2 additional septa are sometimes formed.

Petrak (1934) published a detailed description, but he obviously never observed fully mature spores — as a matter of fact they are only rarely seen, as is often the case with the so-called *Metasphaeriae*. It is thus quite comprehensible that Rehm mistook the fungus for a *Didymella*. It seems to fit in well in *Massarina* and the spores recall e.g. *M. corticola* (Fckl.) L. Holm. Its gross appearance is suggestive of *Pseudomassaria lycopodina*, and the two species can hardly be safely differentiated without the compound microscope.

Massarina chamaecyparissi is no common species and it has been but little noticed. It is not mentioned

in Corbaz' (1956) study of *Didymella*. Besides the type and the exsiccata cited we have seen the following material:

Sweden. *Uppland*: Bälinge, pr. Piparröningen, *L. annotinum*, 13.X.1968 Nannfeldt 20464. Dalby, pr. Östbergstorpet, *L. clavatum*, 12.VII.1979, 1791a. Tunaskog, *L. complanatum*, 30.X.1980, 2264b. Ekeby, *L. annotinum*, 10.VII.1974, 266a. Forsmark, Granskär, *L. annotinum*, 26.IX.1962 Eriksson 1757 (UME 26798). — *Västmanland*, Västerfärnebo, *L. complanatum*, 20.IX.1980 Rosén. — *Dalarna*: Garpenberg, *L. annotinum*, 29.VIII.1974, 348a. St.Kopparberg, Mt Krokforsberget, *L. complanatum*, 6.VIII.1974, 326d.

Jugoslavia. Ljubljana, *L. complanatum* spp. *cham.*, VII.1886 Voss (S).

Phaeosphaeria fuckelii (Niessl) L. Holm

— Fig. 1p
L. Holm, Symb. Bot. Upsal. 14(3):123 (1957). — *Lepto-*

sphaeria Fuckelii Niessl apud Voss, Oesterr. Bot. Zeitschr. 32:357 (1882). — Type: Jugoslavia, Ljubljana (Laibach), *Calamagrostis arundinacea*, 13.VIII.1882 Voss (S!).

Leptosphaeria lycopodiicola Peck, Ann. Rep. New York State Mus. 38:105 (1885). — Type: USA, N. Y., Adirondack Mts, *L. clavatum*, Peck (NYS!).

Exs.: vide L. Holm 1957:123.

This is a common species on various grasses, but it is also found on other hosts, especially on *Equisetum*. L. Holm (1957) recorded it on *Lycopodium clavatum*, on the basis of the type collection of *Leptosphaeria lycopodiicola*, which he identified with *P. fuckelii*. Generally this species has 5-septate spores according to the formula 3—1—2 (cf. L. Holm 1957:92, 123), but considerable variation in spore septation often occurs, as O. Eriksson (1967b) has demonstrated. Possibly *P. fuckelii* is a collective species. As a matter of fact, the cited type of *Leptosphaeria lycopodiicola* has predominantly 6-septate spores, of the formula 4—1—2. It is truly remarkable that the same condition prevails in a second collection on *Lycopodium*, viz. Holm 348j, cf. below. This material is not too scanty, and there is possibly a particular form of the *fuckelii* complex infesting *Lycopodium*.

Sweden. Dalarna: Garpenberg, *L. annotinum*, 29.VIII.1974 Holm 348j.

Phaeosphaeria herpotrichoides (De Not.) L. Holm

— Fig. 1q

This apparently 'collective' species is widespread and common on numerous grasses; its many forms have been treated in detail by O. Eriksson (1967b). It is known to occur on other monocots, too, particularly on *Carex*, but has not been reported earlier on *Lycopodium*. We have found it once, in the spikes of *L. clavatum*, on an old herbarium sheet, vide infra. The infection is heavy, recalling *Ph. lycopodina*. Dr. Eriksson has kindly examined the fungus, and informs us (in litt.) that it perfectly matches his Form 5a (Eriksson 1967b:423), which is very frequent in the Scandinavian mountains.

Norway. Finnmark: Karasjokk, Mt Dafteroive, *L. clavatum* v. *lagopus*, sine dato, J.M. Norman.

Phaeosphaeria lycopodina (Mont.) Hedjaroude

— Figs. 1s, 43

Hedjaroude, Sydowia 22:78 (1969). — *Sphaeria lycopodina* Montagne, Ann. Sci. Nat. Bot.(ser. 3) 12:313 (1849). — *Leptosphaeria lycopodina* (Mont.) Sacc., Syll. 2:81 (1883). — Type: Canada, Newfoundland, *L. annotinum*, La Pylaie (PC!).

Exs.: vide L. Holm (1957:70)

The most conspicuous of all the lycopodiicolous fungi, distinguished by its peculiar biology: it is confined to the spikes, which are discoloured and finally almost blackened. The ascocarps are formed in the

bracts, and are surrounded by a rather profuse tomentum. Detailed descriptions and a full synonymy have been published by L. Holm (1957) and Hedjaroude (1969). The generic affinity has been rather doubtful; the assignment to *Phaeosphaeria* is reasonable, and at least nothing argues against it.

This common and widespread species has been distributed in several exsiccata, which were listed by L. Holm (1957). We have seen it on *Lycopodium alpinum*, *L. annotinum*, and *L. clavatum*.

Phaeosphaeria marciensis (Peck) L. & K. Holm comb. nova

— Figs. 1r, 42

Sphaeria Marciensis Peck, Ann. Rep. New York State Mus. 31:51 (1879). — *Leptosphaeria marcyensis* (Peck) Saccardo, Syll. Fung. 2:80 (1883). — Type: U. S. A., New York, Mt Marcy, *L. annotinum*, VIII. 1877 Peck (NYS!).

One of the most common pyrenomycetes on *L. annotinum*. The ascocarps are generally scattered, immersed in the leaves, particularly in the margins, and can as a rule be identified by the rather prominent papilla. We have seen one collection from Swedish Lapland, though, with caulicolous, crowded ascocarps. For a detailed description, the reader is referred to Holm (1957), and Lucas and Webster (1967). The latter authors cultured the species and obtained a *Diplodina* stage. It can be mentioned that we have occasionally come across a *Diplodina* on *L. annotinum*.

Ph. marciensis seems to be comparatively rare on other hosts than *L. annotinum* and the few finds of that sort are listed below. It is remarkable that we have seen it only once on *L. clavatum*; Lucas and Webster (1967) reported a British find on this plant.

On *L. clavatum*: Sweden. Uppland: Åland par., Rövarkulan, 22.VIII.1979, 1854f.

On *L. alpinum*: Sweden. Pite Lappmark: Arvidsjaur, Vittjokk, 12.VIII. 1943 Nannfeldt 6974b.

On *L. selago*: Sweden. Härjedalen: Vemdalen, Mt Högfjället, 28.VIII.1915 Nordström. Finland. Kuusamo: Korojoki, 16.VI.1911, Pl. Finl. exs. 1014.

Pleospora islandica Johanson

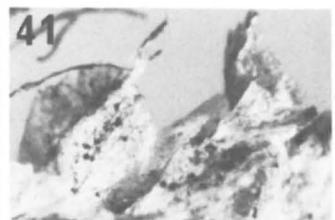
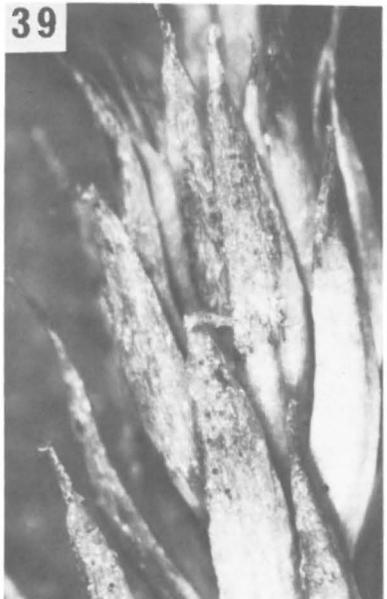
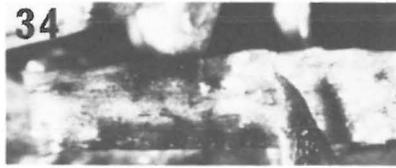
— Fig. 1t

Johanson, Öfvers. K. Sv. Vet.-Akad. Förhandl. 1884(9):170 (1884). — Type: Iceland, Hólar, *Poa glauca*, 22.VII.1883 H. Strömfeldt (UPS!).

?*Pleospora lycopodiicola* Lind, K. Danske Vid. Selsk., Biol. Meddel. 11(2):34 (1934). — Type: not indicated.

Pleospora islandica is very common on grasses in northern regions, and is also known from *Carex*. It is characterized well by the spores with light end cells; there are 7 transverse and 1 or 2 longitudinal septa. For a full description, the reader is referred to Eriksson (1967a).

Figs. 33—41. Ascocarps in surface view. — 33-34: *Pseudomassaria lycopodina* (34: clypeate ascocarps), both $\times 16$. — 35: *Niesslia haglundii*, $\times 32$. — 36: *Massarina chamaecyparissi*, $\times 8$. — 37-38: *Mycosphaerella lycopodii-annotini*, $\times 16$ and $\times 32$. — 39: *Mycosphaerella lycopodii*, $\times 16$. — 40: *Gibbera lycopodii*, $\times 32$. — *Mycosphaerella lycopodii* on spherophylls (type collection), $\times 16$.



It appears that the species can also (incidentally?) infest *Lycopodium*. In two collections, mentioned below, we have found a sparsely occurring fungus, which agrees morphologically with *P. islandica*. *P. lycopodiicola* Lind is very probably the same fungus. Lind based his description on 3 collections from Swedish Lapland, on *Lycopodium alpinum*, *L. annotinum*, and *L. clavatum*, respectively. (He reported it from Denmark, too.) Wehmeyer (1961:85) examined one of the syntypes (Sweden, Karesuando?, *L. annotinum*, Laestadius, C) and found a *Pleospora*, apparently *P. lycopodiicola*. He emphasized that it was close to '*P. heleocharidis*' (= *P. islandica*), though possibly representing a somewhat deviating form.

Sweden. *Lycksele Lappmark*: Tärna, N. Storfjället, 800 m.s.m., 19.IX. 1953 Norrman.

Finland. *Lapponia kemensis*: Muonio, Kätkäsvanto, *L. annotinum*, 27.VIII.1915 Montell.

Mycosphaerella lycopodii (Peck) House

— Figs. 1m, 39, 41

House, Bull. New York State Mus. 233—234:28 (1921). — *Sphaerella Lycopodii* Peck, Rep. New York State Mus. 39:51 (1886). — Type: U. S. A., N. Y., Adirondack Mts., Essex County, in spikes of *L. clavatum*, Peck (NYS!).

Ascocarps ± crowded, globose, 40—80 μm, immersed — erumpent, seated on a generally profuse, subcuticular mycelium of coarse, dark hyphae. *Asci* pyriform — saccate, 20—30 × 8—12 μm, 8-spored. *Spores* obovate-oblong, hyaline, straight, with a median or often slightly suprmedian septum and small indistinct guttules, 8—12(—14) × 2.5—4(—5) μm.

In dead and dying leaves and sporophylls of *Lycopodium* spp.

To the slight extent that this species has been noted so far, it has been recorded from sporophylls only. However, a similar and obviously identical fungus grows in vegetative leaves, particularly in the apices. As pointed out by Barr (1959:18), *M. lycopodii* 'is closely related to *M. minor* and is distinguished chiefly by the substrate'. It is perhaps best regarded as a biological 'race' of *M. minor* (Karst.) Joh., specialized to *Lycopodium*. It seems to be weakly parasitic, often being found in moribund leaves. These are characteristically discoloured: they look grayish owing to the raised cuticle, and are darkened by the mycelium and ascocarps.

M. lycopodii is probably a northern and alpine-subalpine species. It is very common in the Scandinavian mountains, especially in vegetative leaves of *L. alpinum*, *L. annotinum*, *L. clavatum* and *L. selago*.

Mycosphaerella lycopodii-annotini Petr.

— Figs. 1n, 31, 37, 38

Petrak, Krypt. Forsch. 2:167 (1931). — Type: Germany, Schwaben, Seilachmoor, *L. annotinum*, 23.VI.1928 Ade (n.v.).

?*Mycosphaerella lycopodiicola* Moesz & Smarods, Bot. Közlem. 34:60 (1937). — Type: Latvia, pr. Riga, *L. annotinum* (n.v.).

Ascocarps immersed, mainly in the upper leaf side and in the margins, subglobose, 50—80 μm, with a short but distinct papilla, solitary, or generally crowded, a few to many,

in dense groups. *Asci* numerous in a fascicle, subsaccate, sessile, mostly 30—35 × 7—8 μm, 8-spored. *Spores* fusiform with ± pointed ends and a median septum, 10—12(—15) × 2.5—3 μm, hyaline with indistinct guttules.

A conspicuous fungus, distinguished by the crowded ascocarps, which are either immediately adjacent to each other or united by intermediate stromatic tissue. Solitary ascocarps are also ± surrounded by such tissue, because of which they look very dark. A lengthy description was given by Petrak (1931). It is a common species but so far known from *Lycopodium annotinum* only. *M. lycopodiicola* is very probably a synonym.

The species resembles *M. juniperina* (Ell.) Tomilin (cf. Holm & Holm 1977) and they are certainly related.

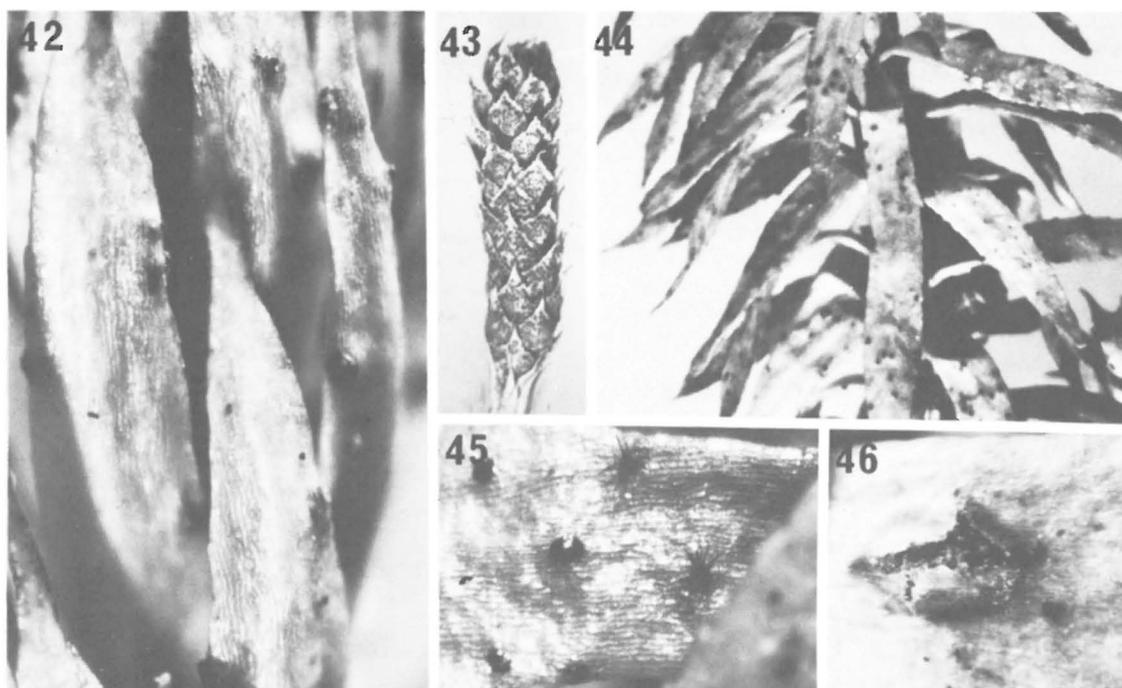
Review and conclusions

A survey of the present fungi and their frequency on the different hosts is given in Table 1. In spite of its modest size, the material seems sufficient to allow of some inferences. It is above all obvious that the lycopods differ considerably *inter se* with regard to their mycoflora. It is noteworthy that none of the fungi is common to all five hosts. *Mycosphaerella lycopodii* is the most general of them, missing only on *L. complanatum*, and this absence may of course merely be due to the limited material. But polyphagy is certainly not the rule among these fungi.

L. complanatum deserves an honourable mention as particularly mycophilous, with half a dozen species of its own. A peculiar fungal community is found on this plant, consisting mainly of some strongly reduced superficial or subcuticular discomycetes, like *Hyalopeziza rubefaciens*, *Micropeziza? diphasii*, *Phacidina gracilis*, and *Pseudopeltis perminuta*. *Niesslia haglundii* also belongs to this society. Not unexpectedly, a certain resemblance can be found to the mycoflora on *L. alpinum* (*Cryptodiscus* spp., *Phacidina gracilis*, *Niesslia haglundii*). More surprising is the indubitable difference between *L. annotinum* and *L. clavatum*. It is remarkable that species like *Mycosphaerella lycopodii-annotini* and *Venturia lycopodina*, which are very frequent on *L. annotinum*, seem to be rare on *L. clavatum*. This difference can hardly be due only to the higher number of *annotinum* samples.

A remarkable phenomenon is the predilection for sporophylls manifest in some species. This particular substrate is obviously rich in nutrients. The very common *Phaeosphaeria lycopodina* is evidently restricted to the spikes; so are, at least in the few samples at hand, *Cyathicula cyathoidea* and *Phaeosphaeria herpotrichoides*. *Mycosphaerella lycopodii* is noteworthy as occurring in sporophylls as well as in vegetative leaves.

Our main impressions of this mycoflora can be summarized in two points: 1) It is highly specific, i.e.



Figs. 42—46. Fruit bodies in surface view. — 42: *Phaeosphaeria marcyensis*, $\times 32$. — 43: *Phaeosphaeria lycopodina*, $\times 3$. — 44-45: *Venturia lycopodina* (45: glabrous and setose ascocarps), $\times 8$ and $\times 32$. — 46: *Ceuthospora lycopodii*, $\times 32$.

Table 1. Number of finds on the different hosts (included are also some finds which are not listed in the text as the material was too scanty to preserve).

	<i>annotinum</i>	<i>clavatum</i>	<i>Lycopodium complanatum</i>	<i>alpinum</i>	<i>selago</i>
Discomycetes					
<i>Cryptodiscus anguillosporus</i>			8		
<i>Cryptodiscus</i> sp.				1	
<i>Cyathicula cyathoidea</i>		3			
<i>Poculopsis ogrensis</i>	10	7			
<i>Mollisia</i> sp.	1	5			
<i>Micropeziza?</i> <i>diphazii</i>			12		
<i>Dasyscyphus inopinatus</i>	30	3			
<i>Hamacanthoscypha laricionis</i>		1	4		
<i>Hyalopeziza rubefaciens</i>			13		
<i>H. pani</i>		2	4		
<i>Phacidina gracilis</i>		10	14	1	
<i>Pseudopeltis perminuta</i>			11		
Pyrenomycetes					
<i>Niesslia haglundii</i>			19	1	
<i>Pseudomassaria lycopodina</i>	23		7		
<i>Gibbera lycopodii</i>	4			3	
<i>Venturia lycopodina</i>	12				
<i>Massarina chamaecyparissi</i>	6	1	5		
<i>Phaeosphaeria fockelii</i>	1	1			
<i>P. herpotrichoides</i>		1			
<i>P. lycopodina</i>	28	6			
<i>P. marciensis</i>	17	1		1	2
<i>Pleospora islandica</i>	1			1	
<i>Mycosphaerella lycopodii</i>	4	3		3	5
<i>M. lycopodii-annotini</i>	25	1			
Deuteromycetes					
<i>Ceuthospora lycopodii</i>	6	6	10	2	

the large majority of these fungi are evidently confined to *Lycopodium*. 2) It is not a radically different flora — most of these species have close relatives on phanerogamous hosts. In some cases direct connections can be traced, e.g. between *Mycosphaerella lycopodii-annotini* and *M. juniperina*, and between *Pseudomassaria lycopodina* and *Physalospora* spp. on Ericaceae. It is a striking fact that the host plants involved — *Lycopodium*, *Juniperus*, *Vaccinium*, and *Empetrum* — have a similar xerophytic leaf structure and inhabit the same biotopes.

Two monotypic genera, *Poculopsis* and *Phacidina*, are confined to *Lycopodium*. *Poculopsis ogrensis* is closely akin to *Chloroscypha sabiniae* on *Juniperus* and to *Phaengellina empetri*, on crowberry, thus following the same pattern as the species just mentioned. *Phacidina gracilis*, on the other hand, is taxonomically isolated in contrast to all the other species treated here, but it is obviously a strongly reduced form.

It is no exaggeration to say that the mycoflora on *Lycopodium*, as represented in Scandinavia, gives the impression of being fairly modern, derived from rather recent colonizers, which took the leap from other plants of the same community, not relatives but neighbours.

There are, as far as known, no primitive fungi on *Lycopodium* — perhaps the Ascomycetes did not yet exist at the time of the major lycopod evolution.

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