# A Contribution to the Mycoflora of Pine Forests in the Netherlands

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With 42 figures on plates 50 *(1)* — 57 *(8)*.

Up to the present time the study of the biocoenosis of the forest has dealt mainly with special groups of macro-organisms such as birds, and insects or certain groups of the larger fungi such as the Basidiomycetes. Considerable knowledge of these groups has accumulated since they have received attention for a long time.

The micro-organisms, on the contrary, are not well-known, because investigations on them have only recently begun. In the case of the micro-fauna some intensive research has been lately carried out in the Netherlands, dealing especially with the species occurring in a beech forest floor (VAN DER DRIFT, 1950). The micro-fauna plays an active part in the decomposition of forest litter by constantly mixing, reducing and eating it.

Although considerable information about the micro-fungi of the forest-soil is available, little work has been performed on the species occurring on the forest-floor. These fungi, however, are main agents responsible for the decomposition of the trash and litter.

Investigations into the decay of logs and branches of deciduous trees have been carried out by CHESTERS (1950) who described a number of Ascomycetes and Basidiomycetes as pioneer colonists of the rough material. MANGENOT (1952), also studying the decomposition of deciduous trees such as willow and birch, listed the fungi which he could isolate from the trunks as well as the fruit-bodies occurring on these trunks during the year. KUJALA (1950) made a study of the micro-fungi living on conifers in Finland. Beside a detailed list of these organisms he gave some data on their ecology. The stress, however, is more or less laid upon the parasitic species, whereas in the present contribution the majority of the fungi dealt with are saprophytic.

Forest pathology has contributed a great deal to our knowledge of certain components of this biocoenosis, especially of those fungi para-

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sitizing such parts of the tree as, the needles *(Lophodermium pinastri, Scleroderris lagerbergii),* the trunks *(Crumenula sororia)* and the roots *(Rhizina undulata, Fomes annosus).* Such parasites, however, represent only a small part of the total number of species of fungi living in the forest. Numerous saprophytic species have been neglected since they seemed of little or no importance, although they fulfill a useful task in contributing to the disintegration of the trash and litter. Many are pioneers in the decomposition of the annual debris falling on the soil making it available to succeeding organisms and finally for colonization by characteristic soil inhabitants.

Since they can invade living tissues tree parasites have a start on saprophytes. Pine trees may be attacked by a series of such parasitic-fungi, e. g. by root-fungi such as *Rhizina undulata* or *Fomes annosus,* resulting in the death of the whole tree. Attacked trees are soon colonized by boring insects such as *Blastophagus piniperda* or *Pissodes pini* which penetrate the bark. These bark beetles carry numerous spores of fungi, particularly spores of the so-called „blueing fungi" such as *Ophiostoma,* the mycelium of which develops in the insect galleries. The mycelium of *Ophiostoma pini* may spread into further parts of the stems when they are left unpeeled in the forest (MATHIESEN-KÄÄRIK, 1953). A detailed list of minor fungi occurring on pine and associated with bark beetles, including *Ophiostoma, Cephalosporium, Pullularia* and *Phialophora,* has been given by this Swedish author.

On the outside of these upright dying trees there may occur a number of other fungi among them many Discomycetes such as *Belonium biatorinum, Gorgoniceps aridula* and *Crumenula pinicola.* They live for only a short time on the cortex of the tree and their significance in the biocoenosis is still unclear. Possibly they only decompose the remnants of carbohydrates in this part of the tree.

The needles of trees killed by a root-fungus are often colonized by minute fungi such as *Sclerophoma pityophila,* the spores of which are very common in the air and on the surface of green needles. RISHBETH & MEREDITH (1957) demonstrated the presence of spores of *Sclerophoma pityophila, Ophionectria* and *Fomes annosus* by percolating sterile water on green needles and plating out the suspension. The percentage of spores of *Sclerophoma* appeared to be very high and this combined with the rapid growth of the fungus and its ability to colonize in this microclimate is responsible for the great capacity of the fungus to colonize dead tissue.

Another manner of colonizing by pioneer colonists is by local infection of a stem or branch (causing a canker) e. g. by the facultative parasite *Crumenula sororia.* After this primary attack secondary or-

ganisms may invade the wound and even penetrate the woody part of the tree. Isolations made from such cankers often reveal a variety of fungi with a high proportion of *Sclerophoma* and *Pezicula livida.* Such fungi become established in the tissues and survive for a long time. After the death of the tree or branch they may grow out into the dead parts of the host, often colonizing extensive parts and finally fructifying on them. Mutual competition appears to be very important since a few species are constantly dominant.

Attack of shoots due to fungi e. g. by the rust, *Melampsora pinitorqua,* often results in the killing of 1-year old parts. The dying needles are commonly infected by *Sclerophoma pityophila.* After primary insect damage, e. g. by larvae of *Retinia buoliana,* tips of shoots are killed and often colonized by the same imperfect fungus. This can be demonstrated by isolating from these tissues. Insect damage at the base of the needles ascribed to *Cecidomyia brachyntera,* a gall-midge may give a start to *Cenangium ferruginosum.*

Mechanical damage to trees such as may occur during brashing may cause serious wounds which can be colonized by certain fungi causing decay of the wood after a long period of growth. Resinous wounds may often be inhabited by a characteristic fungus, *Tromera resinae,* seeming to live on the resin.

Living needles are very commonly infected by the ascospores of *Lophodermium pinastri.* After development of the spermogonia and the apothecial-initials the needles are shed and the microclimate alters. On the ground-floor the apothecia mature, but at the same time the needles become accessible to other organisms such as *Trichoderma* which decompose them further.

From these few examples it is clear that parasitic fungi and insects are important pioneers preparing the living tissues for saprophytic species.

Another aspect is the colonization and decomposition of the needles and branches left on the forest floor after a felling or thinning. Gremmen (1957) demonstrated that two successive stages in the disintegration may be distinguished depending on the microclimate. He mentioned a dry form, the *Sclerophoma*-stage of which the dominant fungus is *Sclerophoma pityophila* and a codominant *Cenangium acuum.* These needles are grey, lying in heaps under dry conditions or still attached to a dead tree e. g. after attack by *Fomes annosus.* These heaps may be wetted by rain, but they soon dry out. A second stage was mentioned as the *Desmazierella*-stage, characterized by the dominant species *Desmazierella acicola* and the codominant *Hyalotricha trichodea.* This is a more humid form and here the needles are black,

lying in heaps under wet or very wet conditions, almost in contact with or very near to the forest soil. The stage is more advanced than the former. A third stage may be added and is called the *Trichoderma*-stage characterized by strongly decomposed, fragmentary needles.

Another far more important aspect deals with the annual debris in the forest. The annual leaf fall supplies the raw material necessary for humus formation. This litter often accumulates on the soil since it is decomposed very slowly in pine plantations. For the purpose of studying the disintegration KENDRICK (1958) subdivided the $A_0$ horizon of forest soils in the following way: the L layer = undecomposed litter; the F layer = decomposing, but still recognizable litter and the H layer = amorphous humus. The F layer is moreover subdivided into the $F_1$ layer of which the needles are dark in colour and often still intact and into the $F_2$ layer of which the needles are greyish, fragmentary and compressed. Decomposition of the needles passes through these stages and a number of distinct fungi contribute to the decay. KENDRICK reported *Lophodermium pinastri* from the L layer, *Verticicladium* from the $F_1$ layer and a Basidiomycete mycelium was observed in the $F_2$ layer. By plating out needles he revealed the presence of other fungi which were not seen by a direct observation.

The needles form the most important part of the litter and a minor part consists of branches and cones. The disintegration of this material is considerably slower and takes longer. The flora of it may be very characteristic. On thick branches for example may occur *Therrya fuckelii, Tympanis hypopodia* and *Orbilia luteo - rubella;* on the thinner twigs, *Pezicula livida, Trichoscyphella hahniana* and *Tr. calycina.* The flora of the cones is very scanty. They probably contain little or no substances suitable for the growth of Ascomycetes. A few characteristic species are, however, sometimes found including *Durella suecica* and *Lasiostictis fimbriata.* The relative high quantity of lignin and cellulose may be responsible for it.

Colonization and decomposition of stumps from thinning or felling is a particular interesting field of research since fresh stumps soon become infected by air-borne spores of *Fomes annosus* (RISHBETH, 1951). Beside *Fomes* a number of other fungi, especially Basidiomycetes may also inhabit the stumps and even compete with *Fomes.* The incidence of minor fungi and their ecology, however, is insufficiently investigated, although a list of Hyphomycetes isolated from pine and spruce stumps was recorded (KÄÄRIK & RENNERFELDT, 1957) among which *Trichoderma viridis* was the commonest. *Coryne sarcoides* sometimes occurred on the stumps in our country.

Much investigation is still required, but even this short account may indicate that the micro-fungi are extremely important in the biocoenosis leading to the decay of trash and litter. Study of this biocoenosis is therefore of more than theoretical interest, but is necessary for a better understanding of the fungi-complex and the benefit of a good conversion of the forest trash and litter. The flora of this material is very typical, consisting of some dominating species, often accompanied by many other species seeming to occur more or less incidentally.

The present paper deals with parasitic as well as saprophytic fungi living on trunks, branches, needles and cones of Scots pine *(Pinus sylvestris* L.), austrian pine *(Pinus nigra* ARN. var. *austriaca* ASCH. & GR.) and corsican pine *(Pinus nigra* ARN. var. *corsicana* SCHN.). Since these species are grown on a large scale in the Netherlands, often in pure plantations and since bad growth was frequently observed which may partly be due to foulty decomposition of the litter, study of the organisms responsible was stimulated. The number of species living on the trash of Scots pine is surprisingly abundant in contrast to that on the trash of larch, spruce and douglas fir. This may be due to the fact that Scots pine is a native tree in the Netherlands, whereas the other species are exotics.

So far 45 species, mainly Ascomycetes, have been reported and identified together with their known imperfect forms. This list, however, is far from complete since various other fungi which occur, among them a number of Hyphomycetes, are in need of research. In addition to short descriptions, there are given drawings of the fructifications and spores, which in part are schematic.

Using ascospores or conidia most of the fungi have been isolated and further cultured; only a few could not be cultured. For some of them, new data was obtained on the imperfect stages, which are described in detail. Culture work was carried out on different media, but the briefly summarized descriptions are based on the development on malt agar. This medium was prepared from 100 grammes of barley obtained from the brewery, boiled for about one hour, afterwards adding 20 grammes of dextrose, 1 gramme peptone and 25 grammes of agar, then sterilizing at 0.5 atmosphere pressure for about 20 minutes.

It was found extremely difficult to give good culture-characteristics since they may vary considerably from medium to medium. Good use, however, could be made of our stock-cultures by comparing them with isolates made from the wood or bark. Often, in the case of species which do not produce fructifications in culture, this method was very helpful and simplified the identification.

All species described in this paper were collected in the Netherlands, except a few marked with an asterisk which were found outside the country and which were essential for the study of these pine fungi.

The following fungi are discussed:

*Anthostomella rehmii* (No. 42); *Belonium biatorinum* (No. 28); *Brunchorstia pinea* (No. 22); *Calothyrium pinastri* (No. 43); *Cenangium acuum* (No. 8); *Cenangium ferruginosum* (No. 29); *Ceuthospora pinastri* (No. 10); *Cistella species* (No. 12); *Coryne cylichnium* (No. 15); *Coryne sarcoides* (No. 14); *Corynella atrovirens* (No. 31); *Cryptosporiopsis abietina* (No. 40); *Cytospora pini* (No. 13); *Crumenula pinicola* (No. 20); *Crumenula sororia* (No. 21); *Dasyscyphus pulverulentus* (No. 19); *Desmazierella acicola* (No. 7); *Diaporthe conorum* (No. 2); *Digitosporium piniphilum* (No. 21); *Diplozythia scolecospora* (No. 38); * *Durella suecica* (No. 26); *Encoelia petrakii* (No. 33); *Gorgoniceps aridula* (No. 32); *Hyaloscypha leuconica* (No. 24); *Hyaloscypha stevensonii* (No. 25); *Hyalotricha trichodea* (No. 16); *Lachnellula rehmii* (No. 37); * *Lasiostictis fimbriata* (No. 39); *Lentomita acuum* (No. 9); *Leptostroma pinastri* (No. 1); *Leptostromella species* (No. 4); *Lophodermium pinastri* (No. 1); *Melanospora chionea* (No. 45); *Monilia species* (No. 5); *Naemacyclus niveus* (No. 6); *Ophionectria scolecospora* (No. 38); *Orbilia luteo-rubella* (No. 27); *Pezicula livida* (No. 40); *Phacidiella coniferarum* (No. 35); *Phacidiopycnis pseudotsugae* (No. 35); *Phacidium lacerum* (No. 10); *Phialophora lagerbergii* (No. 12); *Phialea acuum* (No. 5); *Phomopsis occulta* (No. 2); *Pirobasidium sarcoides* (No. 14); *Pleurophomella species* (No. 41); *Pseudohelotium pineti* (No. 4); *Pyrenopeziza pinicola* (No. 11); *Rosellinia thelena* (No. 30); *Scleroderris lagerbergii* (No. 22); *Sclerophoma pityophila* (No. 3); *Sirothyriella pinastri* (No. 43); *Sphaeropsis ellisii* (No. 34); *Therrya fuckelii* (No. 36); *Trichoscyphella calycina* (No. 18); *Trichoscyphella hahniana* (No. 17); *Tromera resinae* (No. 23); *Tympanis hypopodia* (No. 41); *Valsa pini* (No. 13); *Verticicladium trifidum* (No. 7) and *Zythia resinae* (No. 23).

## *Discussion of the fungi*

1. *LOPHODERMIUM PINASTRI* (Schrad. ex Fr.) Chév., Flore gén. env. Paris, *1:* 436, 1826. (Plate 50 (1), fig. 1).

Apothecia (No. 1626): 0.5—2 mm in diam., conchoidal or ellipsoidal, black. At maturity opening by a longitudinal split, disc cream or light-brown. Hymenium colourless. Hypothecium colourless, very thin. Exciple consisting of a dark-brown stratum basalum and stratum tectricum. Asci 120-150 × 10-14 μ, surrounded by colourless, slender,

filiform paraphyses with distinctly thickened tips. Ascospores 100-125 × 1.5-2 μ, colourless, 1-celled, filiform or slightly curved.

Spermogonia (No. 1631): 120-150 μ in diam., linear or oval, laid down between epidermis and hypodermis, irregularly opening at maturity. Spermatia 6-7 × 0.5 μ, colourless, 1-celled, bacilliform. This stage of the fungus is named: *Leptostroma pinastri* DESM. (Ann. Sci. nat. *19:* 338, 1843).

Culture-work (No. 227, 277): Cultures obtained from ascospores develop a colourless or greyish, delicate, slowly growing mycelium, afterwards changing into ochreous, often forming black lines in the medium and alternating zones of white and brown mycelium.

Ecology: *Lophodermium pinastri* is only restricted to species of the genus *Pinus* causing the so-called needle cast. Young seedlings as well as older trees may be attacked, although infection is most serious in nurseries when older pine trees are on a short distance. The disease which prevails throughout North America and Northern Europe and even occurs on the farthest outposts of the Scots pine in Lappland received much attention by forest pathologists. A lot of papers are dealing with the parasite in view of control. From these papers I should like to refer to a special paper of TUBEUF, who reported on its biology and ecology (TUBEUF, 1902).

Beside the incidence of the fungus on the living needles in its spermogonial form, it occurs on the dead needles in the apothecial stage in the L layer of the litter. The fungus was also found on old cones of Scots pine laying on the ground floor. Asci and ascospores of this material ranged from 150-190 × 15.5-20 μ and 105 × 3.5 μ respectively.

2. *Diaporthe conorum* (DESM.) NIESSL, Hedwidia *15:* 2, 1876. (Plate 50 (1), fig. 2.)

Pycnidia (No. 1672): 0.3-0.5 mm in diam., immersed in the host, subglobose or lenticular, with a thick layer of dark-brown hyphae at the top, afterwards rupturing the hypodermis, with or without a definite ostiole. Pycnidial cavity simple or compound, with brown walls. Pycnospores formed on short sporophores of which three types may be distinguished viz. alpha-spores: 8.5-11.5 × 3.5μ, colourless, 1-celled, ellipsoid-oblong, 2-guttulate; bêta-spores: 22-30 × 1 μ, colourless, 1-celled, straight or slightly hooked like a walking-stick; intermediate spores: intergrading between the alpha- and bêta-spores. These forms represent the conidial form of *Diaporthe conorum* and has been described as *Phomopsis occulta* (SACC.) TRAV. [Fl. ital. Crypt. *1* (2): 221, 1906].

Spermatia which have been also observed are 3-4 × 0.4 µ, colourless, 1-celled, bacilliform.

The perithecial stage has been reported from different conifer species a. o. from dead branches of 15-25 year old douglas fir which had been killed by shading (WILSON, 1925). Up till now the perfect form was not collected by the present author.

Culture-work (No. 281): Cultures obtained from pycnospores develop a pure white silky, fairly rapid growing mycelium, afterwards changing into greyish colour. Mature pycnidia were formed with characteristic alpha- and bêta-spores oozed out in yellow spore-horns.

Ecology: Pycnidia of *Diaporthe conorum* were collected on still attached dead needles of *P. sylvestris*, but they may also inhabit other conifer species. *Phomopsis occulta* was a. o. isolated from dying branches of douglas fir probably killed by a heavy frost, seeming to be a harmless organism often penetrating weakened tissues.

3. *SCLEROPHOMA PITYOPHILA* (CORDA) HÖHNEL, Sitz.-ber. Akad. Wiss. Wien, *118:* 1234, 1909. (Plate 50 (1), fig. 3).

Pycnidia (No. 1624): 0.2-0.5 mm in diam., immersed, at maturity rupturing the epidermis, globose, black. Pycnidial walls dark-brown, pseudoparenchymatic. Pycnospores 6-8 × 3.4 µ, colourless, 1-celled, ovoid or ellipsoidal.

The mycelium of the fungus is of the type *Pullularia pullulans* (DE BY.) BERKH., but it must be realised that this name represents a complex species since this type of budding mycelium occurs in many genera like *Dothidea* FR., *Dothidella* SPEG., *Systremma* THEISS. & SYD., etc.

A perfect stage has not been observed by the present author. BENNETT (1928), however, described *Anthostomella pullulans* BENN. as the ascigerous form of *Pullularia pullulans*, but after NANNFELDT Bennett's fungus is not a true *Anthostomella* (MELIN & NANNFELDT, 1934). Although nothing seems to be known with certainty on the perfect stage of *Sclerophoma pityophila*, it is assumed that it must be sought in the group of the Pseudosphaeriales.

Culture-work (No. 283, 289, 298): Cultures obtained from pycnospores initially develop a colourless or greyish, afterwards dark olive-green of blackish, fast growing mycelium. In these cultures greenish brown hyphae are observed producing yeast-like spores by a form of budding process, so that the cultures seem to be contaminated. On sterilized bark mature pycnidia were obtained.

Ecology: *Sclerophoma pityophila* is a pioneer of dead branches as well as needles and one of the commonest inhabitants, often colonizing extensive parts. It occurs everywhere in the forest living also on

the trash of larch, spruce and *Abies*. Colonization often seems to take place after primary damage of the shoots e. g. by *Retinia buoliana* or by the rust *Melampsora pinitorqua*. BATKO, MURRAY & PEACE (1958) reported on *Sclerophoma* associated with damage of the needles by *Cecidomyia baeri*. JAHNEL & JUNGHANS (1957) mentioned the fungus as a parasite of pine needles, but they did not give a definite proof. These authors also found the „disease" associated with the gall-midge *Cecidomyia*.

4. *PSEUDOHELOTIUM PINETI* (BATSCH EX FR.) FUCK., Symb. myc. 298, 1870. (Plate 50 (1), fig. 4).

Apothecia (No. 1610): 0.7-0.9 mm in diam., disc cream, pink, purplish or light-brown, margin often undulate, outside slightly pulvinate, short-stalked. Hymenium colourless. Hypothecium colourless. Exciple light-brown with up to 40 µ, colourless or light-brown, slender cell-excrescences. Asci 60-75 × 7-8 µ, surrounded by colourless, cylindrical paraphyses with slightly thickened tips. Ascospores 31-35 (40) × 2-2.5 µ, colourless, 1- to 4-celled, straight or slightly bent, needle-shaped or somewhat clavate.

*Conidial stage* (No. 1610): A conidial form associated with the apothecial form was observed on the needles. When dry these brown conidial pustules show a tough, resinous consistency, when moist changing into milky-coloured, slimy droplets. Conidia are 75-85 × 1-1.5 µ, colourless, 1- or more-celled, needle-shaped. In specimen 1622 they range, however, from 54--60 × 2 µ.

Since it was possible to obtain the conidial stage in cultures both from ascospores and conidia, the connection between *Pseudohelotium pineti* and this form is well established. It was, however, not possible to trace a name for it, but it may be provisionally placed in the form genus *Leptostromella* SACC.

Culture-work (No. 310, 317): Cultures obtained from ascospores and conidia initially develop small, colourless, slowly growing, yeast-like colonies which soon become brownish forming slimy conidial pustules consisting of numerous needle-shaped conidia. Afterwards these cultures produce a greyish white or cream superficial mycelium with characteristic zones of yellowish green or sulphur-green colour. Conidia from both types of cultures (310) are 25-40 × 1-1.5 µ, colourless, 3-celled, straight or slightly bent. Conidia from isolate 317 range from 40-54 × 2 µ being identical in every respect with isolate 310.

Already BREFELD (1891) cultivated *Niptera tapesioides* (= *Belonium pineti* var. *tapesioides* REHM), which after REHM (1896) is a well-developed specimen of *Belonium pineti*. BREFELD (l. c.) obtained 47-63 ×

2-2,5 μ, colourless, 1- to 8-celled, filiform or needle, shaped, straight or slighty curved conidia.

Ecology: This fungus occurs on dead, discoloured needles of Scots pine left on the ground-floor after a previous year's thinning. From Britain and Finland the organism was recorded from the old cones.

5. *PHIALEA ACUUM* (Alb. & Schw. ex Fr.) Rehm, Rabenh. Krypt. Fl. *1* (3): 717, 1896. (Plate 50 (1), fig. 5).

Apothecia (No. 1592): 0.4-0.5 mm in diam., pure white, cup-shaped, outside with 15-30 μ long, colourless, clavate, minutely granulated cell-excrescences, with a 300-400 μ long stalk. Hymenium, hypothecium and exciple colourless. Asci 35-40 × 4 μ, surrounded by colourless, filiform paraphyses. Ascospores 4-5 × 2 μ, colourless, 1-celled, ovoid or ellipsoidal, often 2-guttulate.

Conidial stage (No. 1619): A conidial stage associated with the ascigerous form has been observed. The conidial cushions consist of long chains of 5.5-9.5 × 2-3 μ, colourless, 1-celled, ellipsoidal or slightly acuminate, 2-guttulate conidia. It was possible to obtain this conidial stage in cultures started from ascospores, so that the connection between the ascocarps and the imperfect stage could be ascertained. This stage is tentavily placed in the form genus *Monilia* Pers. A valid name, however, could not be found for it up to the present. Fuckel (cit. Rehm, 1896) reported a conidial form named *Sphaeridium candidum* Fuck. with spores ranging from 4 × 1 μ, which does not match. Gremmen (1957) assumed a pycnidial fungus connected with *Phialea acuum*, but up till now this could not be confirmed and even seems very doubtful.

Culture-work (No. 248, 306, 314): Cultures obtained from ascospores develop a pure white, powdery, fast growing mycelium, sometimes producing a reddish brown pigment in the medium. The conidial stage always developed abundantly in vitro; sometimes mature apothecia were observed. The conidia are 7.5-15 × 2.5-3 μ colourless, 1-celled, often 2-guttulate, occurring in chains of 10 and more cells.

Ecology: Apothecia occur in great numbers on the dead needles of *P. sylvestris* and *P. nigra* lying on the ground-floor, especially on trash left in the forest after a thinning. The fungus develops well under humid conditions and is often accompanied by the conidial cushions. Its contribution to the decay of this material seems to be locally very important.

6. *NAEMACYCLUS NIVEUS* (Pers.) Sacc., Bot. Centralbl. *18:* 251, 1884. (Plate 50 (1), fig. 6).

Apothecia (No. 1558): About 0.6 mm in diam., scattered, initially immersed in the host, at maturity rupturing the epidermis, with a cream

or pink-coloured disc. Hymenium colourless. Hypothecium colourless, very thin. Exciple absent. Asci 95-115 × 5 µ, surrounded by colourless, filiform paraphyses with thickened globular tips. Ascospores 105 × 3.5-4 µ, colourless, 1- to 4-celled, vermicular, minutely granulated.

Beside the normally developed apothecia some of them were observed lacking the hymenial part, instead of this tissue forming light-brown criss-cross growing hyphae without any indication of spore formation. FUCKEL (cit. REHM, 1896) reported a stage with conidia ranging from 60 × 0.5-1 µ. He assumed this stage to belong in the life-cycle of *Naemacyclus niveus*.

Culture-work (No. 278): Cultures obtained from ascospores orginally develop a white or slightly pink-coloured mycelium, afterwards with cream or yellow patches. Lemon-yellow, mature apothecia abundantly developed after a few months of cultivation. A conidial stage was always lacking.

Ecology: Apothecia of *Naemacyclus niveus* were observed initiating in white spots of dying needles of *Pinus sylvestris*. REHM (1896) mentioned „Ein sehr schöner, vielleicht schon den lebenden Bäumen gefährlicher Pilz". It is, however, open question whether this Ascomycete has killed the needles, although it was not further investigated. Apothecia were also found by PURNELL (1957) on *P. radiata* from needles of trees which suddenly died. She, however, does not believe the fungus to be a parasite.

7. *DESMAZIERELLA ACICOLA* LIB., Ann. Sci. nat. *17:* 83, 1829. (Plate 51 (2), fig. 7, 7a).

Apothecia (No. 1617): 3-6 mm in diam., scattered or in small clusters, disc yellowish brown, with long brown hairs, sessile. Hymenium yellowish brown. Exciple colourless, consisting of loosely interwoven hyphae. Cortex of the exciple with numerous up to 130 µ long light- and dark-brown, septate cell-excrescences and marginally with 1-1.5 mm dark-brown, stiff hairs. Asci 200-250 × 12-14 µ, surrounded by characteristic acuminate paraphyses with a colourless lower part and a brown, ramified upper part, moreover with up to 300 µ long, dark-brown stiff hair-like cells. Ascospores 18-21 × 8-12 µ, colourless, 1-celled, ellipsoidal, often 2-guttulate.

Conidial stage (No. 1617): A hyphomycetous fungus occurring on the dead needles belongs in the life-cycle of this Ascomycete. This form is of common occurrence and may be collected throughout the whole season, whereas the ascigerous stage only develops in early spring. Conidiophores are 300 × 9.5-11-5 µ, dark-brown, thick-walled,

septate, ramifying dichotomally or trichotomally, with 20-40 µ long light-brown or yellowish subulate cells carrying 3-3.5 × 2 µ colourless, pear-shaped conidia.

The connection between both stages has been established by culture-experiments (GREMMEN, 1949) who referred the conidial stage to *Verticicladium acuum* OUD. According to HUGHES (1951) this Hyphomycete is identical with *Verticicladium trifidum* PREUSS [Linnaea *24:* 127, 1851]. A synonym of this fungus seems to be *Acrodesmis secundum* BAT. & VIT. (cf. An. Soc. Biol. Pernambuco *15:* 374, 1957).

Culture-work (No. 56, 59, 81, 254): Cultures obtained from ascospores initially develop a colourless, rapidly growing, delicate mycelium, afterwards forming olive-green patches and 1-1.5 cm black, stromatical structures upon with the conidial stage develops. The culture medium gradually changes into a rather tough mass often producing a curious smell.

Ecology: *Desmazierella acicola* is a rather comman inhabitant in pine woods occurring on the needles of the $F_1$ layer and is often associated with *Hyalotricha trichodea*. The fungus was found both on Scots pine and *P. nigra* sometimes colonizing the needles of whole branches. It seems to prefer a moist microclimate and appears to be an important decomposing organism.

8. *CENANGIUM ACUUM* COOKE & PECK, Grevillea *7:* 40, 1878. (Plate 51 (2), fig. 8).

Apothecia (No. 1634): 1-2 mm in diam., dark-brown or ochreous, cup-shaped, outside pulvinate, with a broad up to 200 µ long stipe. Hymenium colourless. Hypothecium light-brown. Exciple colourless forming a textura intricata. Cortex of exciple dark-brown with brown, globular cell-excrescenses. Asci 70-96 × 7.5-11 µ, surrounded by colourless, filiform paraphyses with brown club-shaped tips. Ascospores 11.5-19 × 3.5-4 µ, colourless, 1- or 2-celled, fusoid, 1- or 2-guttulate. Spermatia 4-5 × 0.5 µ, colourless, bacilliform. Up till now a conidial stage has not been found.

According to REHM (1896) a difference exists between *Cenangium acuum* COOKE & PECK and *Cenangium acicolum* (FUCK.) REHM based on the size of the fructifications. By comparing american and european collections they proved to be the same.

Culture-work (No. 213): Cultures obtained from ascospores develop a moderately growing mycelium varying from white or cream to yellowish green or yellow-brown in colour. A conidial stage was never observed.

Ecology: This fungus is a rather common inhabitant of pine needles and is often accompanied with *Sclerophoma pityophila*. KUJALA (1950) reported the fungus from *Abies*, but his statement could not be confirmed up to the moment.

9. *LENTOMITA ACUUM* MOUTON, Bull. Soc. Bot. Belge *26:* 173, 1887 (Plate 51 (2), fig. 9.)

Perithecia (No. 1642): 0.15-0.2 mm in diam., crowded, superficially immersed in the host, globular, black, with long 0.6-1.5 mm slender ostiola carrying whorls of colourless, septate cilia at the tips. Asci 46-50 × 15 µ. Ascospores 20-26 × 7.5 µ, colourless, 1-celled, ellipsoidal, 2- or 4-guttulate, afterwards 2-celled, often slightly constricted at the septum.

A conidial stage associated with the ascigerous form was not observed on the material. This fungus is a representative of the Cerastomeae, but according to Dr. J. A. von Arx who investigated the material its taxonomic place is stil uncertain.

Culture-work (No. 307): Cultures obtained from ascospores failed by a heavy bacterial contamination of the ascospores.

Ecology: Perithecia of this Ascomycete developed in great numbers on the dead needles of Scots pine. They are often accompanied by the ascocarps of *Phialea acuum*.

10. *PHACIDIUM LACERUM* FR., Obs. myc. 2: 313, 1818. (Plate 51 (2), fig. 10).

Apothecia (No. 1344): 0.3-0.6 mm in diam., initially immersed in the host, at maturity rupturing the hypodermis, disc dark-brown, surrounded by fragments of host-tissue. Hymenium colourless. Hypothecium indistinct. Exciple consisting of a 75-95 µ thick, dark-brown stratum tectricum and a 20-40 µ thick stratum basalum. Asci 73-85 × 7.5-8.5 µ, surrounded by colourless, filiform paraphyses. Ascospores 9-11.5 × 3-4 µ, colourless, 1-celled, ellipsoidal.

Conidial stage (No. 1670): A conidial form associated with the perfect stage was sometimes observed. The pycnidia contain colourless, 1-celled, bacilliform pycnospores. This stage is recorded as *Ceuthospora pinastri* (FR.) HÖHNEL. [Mitt. Bot. Inst. Techn. Hoch. 2 (4): 99—100, 1925].

*Phacidium lacerum* and its pycnidial stage have been fully described and compared with *Phacidiella coniferarum*, but due to a serious typographical error the description is rather useless (GREMMEN, 1959).

Culture-work (No. 250): Cultures obtained from ascospores initially develop a greyish white, delicate, fast growing mycelium, after-

wards changing into a greenish brown colour forming an abundance of grey aerial mycelium. Mature pycnidia were obtained in vitro, being 0.5-0.7 mm in diam., globular, black, with 1- or more spore-forming cavities. Pycnidial walls 40-60 μ thick, dark-brown, with up to 20 μ long sporophores. Pycnospores 11.5-15.5 × 2-3.5 μ, colourless, 1-celled, rod-like.

Ecology: Both stages were found on decaying needles of Scots pine laying on the forest-floor under rather humid conditions.

11. *PYRENOPEZIZA PINICOLA* REHM, Rabenh. Krypt. Fl. 1 *(3)*: 540, 1896. (Plate 51 (2), fig. 11).

Apothecia (No. 1654): 0.3-0.4 mm in diam., grey or dark-blue, saucer-shaped, formed on a delicate, brown subicular-like mycelium developing on the needle surface. Hymenium colourless. Exciple consisting of a brown textura globulosa. Asci 40-55 × 4-5.5 μ, surrounded by colourless paraphyses with slightly club-shaped tips and filled with an oily substance. Ascospores 8.5-9.5 × 2 μ, colourless, 1-celled, sometimes 2-celled, fusoid. So far a conidial form has not been observed.

*Pyrenopeziza acicola* SACC. & SPEG. seems closely related, but differs in the size of the ascospores.

Culture-work (No. 341): Cultures obtained from ascospores develop a greyish, woolly or floccose, afterwards greyish brown to cinnamon-brown, rapidly growing mycelium.

Ecology: *Pyrenopeziza pinicola* inhabits previous year's trash of pine and occurs on needles as well as branches, often in great abundance.

12. *CISTELLA SPECIES* (Plate 52 (3), fig. 12).

Apothecia (No. 1585): About 0.4 mm in diam., greyish white, cup-shaped, outside slightly pulvinate, sessile. Hymenium colourless. Exciple olive-green, at the base consisting of 3-4 μ in diam., prosenchymatic cells, marginally with colourless, minute cell-excrescences. Asci 30-40 × 5.5 μ, surrounded by colourless, cylindrical, often ramified paraphyses with slightly thickened tips. Ascospores 4.5-6 × 2.5-3 μ, colourless, 1-celled, ovoid.

Conidial stage (No. 1585): In some apothecia spore-producing hyphae were observed which probably function as conidial apparatus.

Re-examination of the material by Dr. R. W. G. DENNIS (Kew) confirmed the identity with the genus *Cistella* QUÉL., but since this group of inoperculate Discomycetes is still insufficiently known a definite name could not be traced for it. The ascocarps of the *Cistella* show great similarities with *Phialea acuum*, but their conidial stages are totally distinct.

Culture-work (No. 293): Cultures obtained from ascospores develop very slowly growing colonies, initially grey-coloured and surrounded by a zone of dark olive-green mycelium, afterwards dark-grey and velvety. In the centre 2-3 μ thick brownish green, septate spore-producing hyphae are observed, representing the so-called phialides which are flask-formed and about 30 μ long. Phialospores are formed endogenous, they are 4 × 2-2.5 μ, colourless, 1-celled, ovoid or fusoid, 2-guttulate, often sticking together to the tip of the phialide. This conidial stage is identical with *Phialophora lagerbergii* (MELIN & NANNF.). CONANT [Mycologia 29: 598, 1937] (= *Cadophora lagerbergii* MELIN & NANNF.). MELIN isolated the fungus as the cause of blue-stain from *P. sylvestris* in Sweden (MELIN & NANNFELDT, 1934). MANGENOT (1952) described the same fungus from *Salix*, forming a member of his *„Phialophora fastigiata"* group which is characteristic for pulpwood. He does not report, however, an Ascomycetous fungus connected with it.

Identification of imperfect fungi of the form genus *Phialophora* is extremely difficult since this type of spore-formation occurs in different groups of Ascomycetes demonstrating great conformity.

BOOTH (1957) reported such a conidial stage in *Chaetosphaeria myriocarpa* (FR.) BOOTH which can be hardly separated from the imperfect fungus isolated from pine. Even his cultures show a great resemblance. His fungus, however, is the imperfect stage of a Pyrenomycete inhabiting alder and birch. May be MANGENOT's *„Phialophora lagerbergii"* is merely the conidial form of this *Chaetosphaeria* and therefore not identical with the fungus orginally described by MELIN & NANNFELDT as *Cadophora lagerbergii.*

Ecology: The ascocarps were collected on a resinous canker brought about by *Crumenula sororia* on a stem of *P. nigra* var. *corsicana.* It probably lives as a secondary organism in the dead tissue.

13. *VALSA PINI* (ALB. & SCHW.) FR., Summa veg. Sc. 412, 1849. (Plate 52 (3), fig. 13, 13a).

Perithecia (No. 1646): 0.2-0.4 mm in diam., in groups of 6 or more immersed in a dark stroma, ostiolate, with dark-brown walls. Asci 35-40 × 5-6 μ. Ascospores 7.5-9.5 × 2 μ, colourless, 1-celled, allantoid.

Conidial stage (No. 1646): The ascigerous form is often associated with pycnidia. They are 0.2-0.3 mm in diam., immersed, with dark-brown walls and 1- or plurilocular spore-forming cavities. Pycnospores 4-5 × 1 μ, colourless, 1-celled, allantoid, formed on short sporophores, often oozed out in yellow spore-horns. This stage of the fungus is recorded as *Cytospora pini* DESM. [Ann. sci. nat. Bot. sér. II, *19:* 362, 1843].

A number of *Valsa* species as well as *Cytospora* species have been described on coniferous hosts. Up to the present, however, our knowledge on them is too scanty to judge whether they are all good species, but it seems very likely that many of them must be reduced to synonymy.

Culture-work (No. 282, 319): Cultures obtained from ascospores develop a quickly growing colourless, delicate mycelium, afterwards forming a greyish colour with a floccose texture. The pycnidial stage was also formed in vitro and the spores are oozed in yellow sporehorns.

Ecology: *Valsa pini* and its imperfect stage is rather common on pine trash, often colonizing whole branches of Scots pine, which may be explained by its rapid growth. Doubtless this organism is an important decomposer of organic debris in the pine forest.

14. *CORYNE SARCOIDES* (JACQ. ex FR.) TUL., Sel. fung. Carp. 3: 190, 1865. (Plate 52 (3), fig. 14).

Apothecia (No. 1551): 2-8 mm in diam., disc violet-coloured, gelatinous, sessile or nearly so. Hymenium colourless. Hypothecium of loosely interwoven hyphae. Exciple dark-brown. Asci 90-100 × 8-10 µ, surrounded by colourless, filiform paraphyses. Ascospores 10-15 × 3-5 µ, colourless, 1- or 2-celled, ellipsoidal, straight or slightly bent.

Conidial stage (No. 1551): A conidial form has been observed on the material and seems to be identical with *Pirobasidium sarcoides* (JACQ.) HÖHNEL [Fragm. z. Myk. in Sitz.-ber. Akad. Wiss. Wien, Math.-Nat. Kl. I, *111, 1902].*

Culture-work (No. 300): Cultures obtained from ascospores develop a colourless, delicate, rather slowly growing mycelium, gradually producing a violet pigment into the medium. Numerous reddish coloured microconidial pustules forming globular microconidia at the tips of sickle-shaped conidiophores, and flattened disc-like structures, were observed.

Ecology: *Coryne sarcoides* does not merely inhabit conifers, but may also occur on broad-leaf trees. MANGENOT (1952) reported *Coryne* and some other fungi as „— agents destructeurs de la cellulose", whereas recently study has been performed in Canada on this organism since it is associated with heart-rot in conifers (ETHERIDGE, 1957).

The apothecia as well as the *Pirobasidium* stage were found on trash of Scots pine, but they were rather uncommon. The fungus was also collected on trunks of *Quercus.*

15. *CORYNE CYLICHNIUM* (TUL.) BOUD., Hist. & Classif. Disc. d'Eur. 97, 1907. (Plate 52. (3), fig. 14).

Apothecia (No. 1563): 2-3 mm in diam., purplish, disc- or urn-shaped very similar to *C. sarcoides*. Asci 150-210 × 8.5-11.5 µ, surrounded by filiform paraphyses. Ascospores 20-30 × 4-6.5 µ, colourless, 1- to 4-celled, fusoid, acuminate, often minutely guttulate, sometimes abstricting spherical secondary spores.

Conidial stage: A conidial stage closely related to or probably identical with *Pirobasidium sarcoides* (JACQ.) HÖHNEL was observed.

Culture-work (No. 273): Cultures obtained from ascospores develop alike as *Coryne sarcoides*. In older cultures characteristic club-shaped excrescences up to 2.5 mm, producing 4 × 1.5 µ colourless, 1-celled, more or less curved conidia, and reddish coloured microconidial pustules, were observed.

Ecology: Apothecia occur on pine stumps of Scots pine, but seems to be rather uncommon. The fungus inhabits far more broad-leaf trees such as *Fagus*.

16. *HYALOTRICHA TRICHODEA* (PHILL. & PLOWR.) DENNIS, Mycol. Pap. *32:* 76, 1949 (Plate 52 (3), fig. 15).

Apothecia (No. 1584): 0.6-1 mm in diam., in small clusters developing on a dark-brown stroma-like tissue, or scattered, light-brown or yellow-brown, cup-shaped, clothed with long yellowish brown hairs, sessile. Hymenium colourless. Hypothecium colourless, filled with lumps of crystals. Exciple pale brown forming a textura prismatica, marginally hairy. Asci 35-38 × 4-5 µ, surrounded by colourless, filiform paraphyses. Ascospores 5-8 × 1.5-2 µ, colourless, 1-celled, cylindrical-fusoid, sometimes 2- or 3-guttulate. Hairs 100-200 × 4-6 µ, colourless or light-brown, cylindrical, thick-walled, aseptate, slightly bent or stiff, with a fine lumen reduced to a narrow canal. A conidial stage has not been observed.

Culture-work (No. 305): Cultures were started from ascospores, but they did not succeed since the ascospores failed to germinate.

Ecology: *Hyalotricha trichodea* is one of the components of the *Desmazierella*-stage of pine litter and occurs in the $F_1$ layer of the $A_0$ horizon.

17. *TRICHOSCYPHELLA HAHNIANA* (SEAVER) MANNERS, Transact. Brit. myc. soc. *36:* 364, 1953 (Plate 53 (4), fig. 16).

Apothecia (No. 1582): 0.1-1 mm in diam., at first cup-shaped afterwards saucer-shaped, disc orange-red clothed with colourless hairs, short-stalked. Hymenium colourless. Exciple forming a colourless tex-

tura intricata. Asci 135-145 × 10-11.5 µ, surrounded by colourless, filiform, often somewhat moniliform, septate paraphyses. Ascospores 19 × 7.5 µ, colourless, 1-celled, ellipsoidal. Hairs colourless, cylindrical, thin-walled, minutely granulated.

Conidial stage: An imperfect form has been never observed, but instead of such a form yellowish microconidial pustules gradually developing into mature ascocarps. The micronidia are 2-5 × 1-2 µ, colourless, elliptical or allantoid, born on subulate sporophores.

Culture-work (No. 74, 295, 303): Cultures obtained from ascospores develop a colourless, rather slowly growing mycelium, afterwards changing into yellow or brown velvety colour. Microconidial pustules are formed in vitro too. They consist of globular microconidia.

Ecology: This fungus is one of the commonest fungi on dead branches of Japanese larch, but it also occurs on Scots pine when growing near the larch.

18. *TRICHOSCYPHELLA CALYCINA* (Schum. ex Fr.) Nannf., Nova Acta Reg. Soc. Sci. Ups. 4, *8* (2): 299, 1932. (Plate 53 (4), fig. 16).

Apothecia (No. 1615): 1-2 mm in diam., initially cup-shaped, afterwards expanding, with orange-yellow disc, clothed with colourless hairs, short-stiped. Asci 75-80 × 4.5-5 µ, surrounded by colourless, filiform paraphyses. Ascospores 6-9 × 2.5-3 µ, colourless, 1-celled, ellipsoidal or fusoid. Hairs colourless, cylindrical, thin-walled, minutely granulated. A conidial form has not been observed.

*Trichoscyphella calycina* is closely related to the above mentioned species, but may be easily distinguished by its ascospore-size.

Culture-work (No. 302, 315): Cultures obtained from ascospores develop a white moderately growing mycelium, afterwards changing into a yellowish colour.

Ecology: This fungus occurs on dead, thin branches of Scots pine.

19. *DASYSCYPHUS PULVERULENTUS* (Lib.) Sacc., Syll. Fung. *8*: 463, 1889 (Plate 53 (4), fig. 17).

Apothecia( No. 1633): 0.6-1 mm in diam., scattered, yellow or yellow-green, cup-shaped or saucer-shaped, hairy, short-stalked. Hymenium yellowish. Exciple yellow. Asci 30-40 × 4 µ, surrounded by colourless, cylindrical paraphyses exceeding the asci. Ascospores 4-6 × 1 µ, colourless, 1-celled, cylindrical or fusoid. Hairs 30-65 × 3-4 µ, colourless of yellowish, finely punctate, septate, club-shaped, tips sometimes with lumps of crystals. When dry the hairs may be sometimes observed with red tips. A conidial stage has been never observed.

Culture-work: (No. 257, 316): Cultures obtained from ascospores develop a greyish white, rather slowly growing mycelium, often showing white patches of woolly hyphae. Yellow-green pustules are sometimes developed forming 2-4 × 1 μ, colourless, bacilliform microconidia.

Ecology: *Dasyscyphus pulverulentus* is a Discomycete living on the trash and occurring on pine needles.

20. *CRUMENULA PINICOLA* (Fr.) Karst., Myc. Fenn. *1*: 210, 1871 (Plate 53 (4) fig. 18).

Apothecia (No. 118): 1.5-2 mm in diam., cup-shaped, dark-brown or red-brown, hairy, stalked. Hymenium beige-coloured. Hypothecium colourless. Exciple reddish brown forming a textura intricata consisting of two definite layers: The first layer, 30-40 μ in thickness with a compact structure; a second layer, 80-120 μ thick with large cavities. Cortex of exciple dark-brown with cell-excrescences, marginally with reddish brown hairs. Asci 75 × 9-11 μ, surrounded by colourless, filiform paraphyses. Ascospores 17-30 × 4-5 μ, colourless, 1- or 2-celled, fusoid, acuminate. In spite of careful search a conidial stage has not been observed.

Detailed information on *Crumenula pinicola* has been recorded by Van Vloten & Gremmen (1953) and Gremmen (1953).

Culture-work (No. 212, 219): Cultures obtained from ascospores develop a grey or greyish brown, moderately growing mycelium, sometimes forming microconidial pustules.

Ecology: This Ascomycete occurs on dead thick branches as well as on the bark of different pine species. In some cases canker-like wounds with apothecia of the fungus were noticed on stems and branches of living trees. Inoculations performed with a pure culture, however, did not succeed, but will be repeated.

21. *CRUMENULA SORORIA* Karst., Myc. Fenn. *1*: 211, 1871 (Plate 53 (4), fig. 19, 19a).

Apothecia (No. 119): 1-2.5 mm in diam., cup- or saucer-shaped, almost black, hairy, stalked. Hymenium yellow-green. Hypothecium yellow-green. Exciple yellow-green forming a textura intricata. Cortex of exciple opaque with irregular cell-excrescences, marginally with up to 100 μ long hair-like cells. Asci 86-114 × 11 μ, surrounded by filiform paraphyses. Ascospores 13-30 × 5.5 μ, colourless, 1- to 4-celled, ellipsoidal. Hairs dark-brown or greenish brown, septate.

Conidial stage (No. 631): The ascigerous form is often associated with 0.4-0.7 mm in diam., pear-shaped or globular, black pycnidia forming colourless or greenish, many-celled, finger-shaped pyc-

nospores. This stage is named *Digitosporium piniphilum* GREMMEN (cf. Acta Bot. Neerl. 2 (2): 233, 1953).

A detailed account on *Crumenula sororia* and its perfect has been published (VAN VLOTEN & GREMMEN, 1953) and (GREMMEN, 1955).

Culture-work (No. 218, 253, 287): Cultures obtained from ascospores as well as from pycnospores develop a slowly growing, greyish, in cushions growing mycelium, gradually changing into greyish green or olive-green colour. A black pigmentation is often observed in the medium. The conidial stage was obtained both from ascospore- and pycnospore-isolates.

Ecology: Apothecia as well as pycnidia occur on branches and stems of different pine species often causing resinous cankers and blue-stain of the wood.

22. *SCLERODERRIS LAGERBERGII* GREMMEN, Sydowia 9: 232, 1955 (Plate 54 (5), fig. 20, 20a).

*Apothecia* (No. 521): About 1 mm in diam., dark-brown, short-stalked. Hymenium subhyaline. Hypothecium colourless. Exciple dark-brown consisting of 6-15 µ in diam., dark-brown, angular, thick-walled cells forming a textura prismatica. Cortex of exciple with irregular cell-excrescences, marginally with scale-like projections instead of hairs. Asci 118-122 × 11.5 µ, surrounded by colourless, filiform paraphyses forming an epithecium. Ascospores 15-16 × 4-5 µ, colourless, 4-celled, ellipsoidal.

Conidial stage (No. 1375): The ascigerous stage is associated with a pycnidial form. Pycnidia 0.4-0.5 mm dark-brown, initially immersed in the substratum, afterwards rupturing the tissue. Pycnospores 25-42 × 3-4 µ, colourless, 1- to 4-celled, sickle-shaped, formed on short sporophores. This stage is recorded as *Brunchorstia pinea* (KARST.) HÖHNEL [Fragm. z. Myk. in Sitz.-ber. K. Akad. Wiss. Wien, Math.-Nat. Kl. 1: *124*, 1915].

Extensive study on this parasitic fungus has been performed by ETTLINGER (1945) and VAN VLOTEN & GREMMEN (1953).

Culture-work (No. 239, 263): Cultures obtained from ascospores as well as from pycnospores develop a moderately growing greyish green mycelium, gradually changing into a yellow-green or green colour. The pycnidial stage was formed in abundance oozing spores in pink-coloured spore-horns.

Ecology: This Ascomycete causes dying of shoots of pine, especially in *P. nigra*. Fructifications and pycnidia are formed at the base of the dead needles. The fungus may, moreover be isolated from the diseased needles. On the dead branches apothecia of *Cenangium ferru-*

*ginosum* may be observed later on. They are easily confused with apothecia of *Scleroderris*. Inoculation experiments with *Cenangium* did not succeed, in contrast, to the those with *Scleroderris*. (VAN VLOTEN & GREMMEN, 1953).

23. *TROMERA RESINAE* (FR.) KÖRBER, Parerg. lich. 453, 1865 (Plate 54 (5), fig. 21).

Apothecia (No. 1576): 0.8-1 mm in diam., yellowish orange, sessile. Hymenium yellow. Exciple yellowish forming a tissue of densely interwoven hyphae, surrounding the hymenial part of the fructification. Asci 90-100 × 18-20 µ, poly-spored and surrounded by paraphyses forming a characteristic, about 20 µ thick epithecium. Ascospores about 3 µ in diam., colourless, 1-celled, globular.

Conidial stage (No. 1577): 0.3-0.4 mm in diam., densely crowded, pear-shaped, amber-coloured. Conidiophores 7-10 µ, subulate. Conidia 3 µ in diam, colourless, 1-celled, globular, oozing in milky droplets. This stage is named *Zythia resinae* (EHRENB.) KARST. [Medd. Soc. Fauna Fl. Fenn. *14:* 104, 1887]. (= *Biatorella resinae* (FR.) MUDD.). According to NANNFELDT (1932) this fungus belongs to the Lecanorales. A characteristic feature is the strong blueish reaction of the ascus-wall with a solution of $KJ_2$.

Culture-work (No. 284): Cultures obtained from pycnospores develop a slowly growing, colourless, delicate mycelium, afterwards changing into a yellow colour. Mature pycnidia were also obtained in vitro. By means of culture experiments the relationship between the apothecia and pycnidia was clearly demonstrated (AYERS, 1941).

Ecology: Apothecia as well as pycnidia occur on different species of conifers inhabiting cankers on trunks or branches showing a resin flow e. g. cankers formed by *Crumenula sororia*. The fungus was often isolated from such cankers. AYERS (1941) isolated the fungus from the inner bark of certain conifers, but he could not demonstrate an assumed parasitical behaviour, since his inoculations failed.

24. *HYALOSCYPHA LEUCONICA* (COOKE) NANNF., Transact. Brit. myc. soc. *20:* 206, 1936 (Plate 54 (5), fig. 22).

Apothecia (No. 1635): 0.2-0.3 mm in diam., crowded, cup-shaped, pure white, with long colourless hairs, sessile. Hymenium colourless. Exciple colourless forming a textura prismatica. Asci 40-45 × 5 µ, surrounded by colourless, filiform paraphyses. Ascospores 8.5-12.5 × 2-2.5 µ, colourless, 1-celled, cylindrical, straight or somewhat bent. Hairs 60-110 µ long, colourless, thin-walled, with an almost cylindrical base, up to 6 µ thick. A conidial stage has not been observed.

A record of *Hyaloscypha hyalina* (PERS. ex FR.) BOUD. from *P. sylvestris* must be rectified since this fungus is only but *H. leuconica* (GREMMEN, 1957).

Culture-work (No. 318): Cultures obtained from ascospores develop a quickly growing grey mycelium, gradually changing into greyish blue or olive-green colour.

Ecology: *Hyaloscypha leuconica* does not only inhabit pine, but also occurs on *Calluna* stems. Material from this host could be studied through the kindness of Mr. W. G. Bramley (Pickering, Yorks.). In general this fungus was collected from decaying branches, pieces of old wood, and old cones of different pine species.

25. *HYALOSCYPHA STEVENSONII* (BERK. & BR.) NANNF., Transact. Brit. myc. soc. *20:* 206, 1936 (Plate 54 (5), fig. 22).

Apothecia (No. 1566): About 0.3 mm in diam., crowded, cup-shaped, white, with colourless, minute short hairs, sessile. Hymenium colourless. Asci 45-55 × 7.5 µ, surrounded by slender, filiform paraphyses. Ascospores 6-10 × 2-2.5 µ, colourless, 1-celled, ellipsoidal. Hairs 20-30 µ long, colourless, thin-walled, without a bulbous base. A conidial stage has not been observed.

The ascocarps of *H. stevensonii* are closely related to *H. leuconica,* making identification only possible by means of the hairs.

Culture-work (No. 285): Cultures obtained from ascospores develop a greyish or greyish green quickly growing floccose mycelium. Its development shows great affinities with the mycelium of *H. leuconica.*

Ecology: This fungus occurs on dead branches, as well as pieces of wood of different pine species.

26. *DURELLA SUECICA* (STARB.) NANNF., Nova Acta Reg. Soc. Sci. Ups. 4, *8* (2): 293, 1932 (Plate 54 (5), fig. 23).

Apothecia (No. 1657): 0.4-0.5 mm in diam., crowded, saucer-shaped, smooth, black. Hymenium colourless. Exciple consisting of brown, cartilaginous, prosenchymatical cells. Asci 45-55 × 7.5 µ, surrounded by colourless, filiform paraphyses with slightly ramified tips forming a pale yellow epithecium. Ascospores 7-10 × 3 µ, colourless, 1- or 2-celled, ovoid or ellipsoidal, often slightly acuminate. A conidial stage connected with the apothecia has not been observed.

Culture-work (No. 344): Cultures obtained from ascospores develop a very slowly growing, greyish white mycelium, afterwards changing into pale yellow.

Ecology: The very minute apothecia occur on old cones of Scots pine.

27. *ORBILIA LUTEO-RUBELLA* (NYL.) KARST., Myc. Fenn. *1:* 101, 1871 (Plate 54 (5), fig. 24).

Apothecia (No. 1653): 1-2.5 mm in diam., yellow-orange, sessile. Hymenium yellow and a subhymenial layer of about 10 μ thick. Hypothecium light-yellow, extensive. Exciple pale-yellow forming a textura prismatica with 4-12 μ in diam., angular or polyhedral cells. Asci 40 × 4 μ, surrounded by colourless paraphyses with up to 4 μ globular tips. Ascospores 6 × 2 μ, colourless, 1-celled, ellipsoidal. A conidial stage was not observed.

This species is closely related to *Orbilia coccinella* (SOMMERF.) KARST. The latter, however, has 3-5 × 2-2.5 μ ovoid or ellipsoid ascospores.

Culture-work (No.338): Cultures obtained from ascospores develop a rather slowly growing floccose, greyish white mycelium.

Ecology: Apothecia were found on rather thick, decaying branches of *P. sylvestris* laying on the ground-floor.

28. *BELONIUM BIATORINUM* REHM, Rabenh. Krypt. F. 1 (*3*): 685, 1896 (Plate. 54 (5), fig. 25).

Apothecia (No. 1323): 0.3-0.6 mm in diam., disc-shaped, white, with up to 100 μ brownish stipe. Hymenium colourless. Exciple brown consisting of more or less angular excipular cells, marginally with brown club-shaped cell-excrescences. Asci 70-80 × 9.5-11.5 μ. Ascospores 8.5-11.5 × 4 μ, colourless, originally 1-celled and ovoid, afterwards definitely 2-celled, ellipsoidal. A conidial stage has not been observed.

*Belonium piceae* HENN. var. *laricinum* VEL. received from Mr. W. G. Bramley (Pickering, Yorks.) is probably the same fungus. DENNIS (1955) investigated the same material and considered this fungus to be a species of the genus *Cistella* NANNF.

Culture-work (No. 292): Cultures obtained from ascospores develop a slowly growing, olive-grey mycelium, afterwards changing into ochreous-brown and developing an abundance of grey aerial hyphae.

Ecology: This fungus inhabits dead stems and branches of different pine species. It was especially abundant on dying trunks of Corsican pine.

29. *CENANGIUM FERRUGINOSUM* FR. ex FR., Syst. myc. 2 (*1*): 187, 1822 (plate 55 (6), fig. 26).

Apothecia (No. 1508): 2-3 mm in diam., in small clusters, cup-shaped, brown, with yellow disc, leathery, sessile. Hymenium colourless. Hypothecium yellow-brown. Exciple colourless forming a textura intricata. Cortex of exciple dark-brown consisting of roundish or angular

cells provided with cell- excrescences. Asci 85-130 × 11.5-13.5 µ, surrounded by colourless, filiform, septate paraphyses with slightly thickened tips. Ascospores 13.5-19 × 5.5-7.5 µ, colourless, 1-celled, ovoid or ellipsoidal, finely guttulate. A conidial stage has not been observed.

In literature much confusion existed on the biology of the fungus since it was assumed that *C. ferruginosum* has two distinct imperfect stages, viz. one with sickle-shaped conidia, which is *Brunchorstia pinea* (KARST.) HÖHNEL and a second with minute, ovoid spores which is *Sclerophoma pityophila* (CORDA) HÖHNEL (= *Dothichiza pityophila* (CORDA) PETR.). Both fungi are described in this paper.

Culture-work (No. 226): Cultures obtained from ascospores develop a slowly growing greyish or greyish white mycelium, afterwards changing into cream, yellowish or light-brown. Later on black-coloured fructifications oozing 3.5-4.5 × 1-1.5 µ, colourless, 1-celled, bacilliform spermatia are formed. A conidial fungus was never obtained in vitro.

Ecology: *Cenangium ferruginosum,* formerly described as *C. abietis* (PERS.) DUBY has a very interesting biology, being a pioneer organism on branches still attached to the tree. It seems adapted to this habitat with its dry microclimate which make competition possible with other micro-organism living on dead branches. In many cases the fungus only seems to inhabit branches suffering from a primary parasitical attack e. g. after damage by *Scleroderris lagerbergii* or after insect damage *(Cecidomyia brachyntera).*

VAN VLOTEN & GREMMEN (1953) demonstrated that this organism is a harmless fungus since inoculation experiments did not succeed. GREMMEN (1958) moreover showed that confusion with other similar Discomycetes has taken place and that *C. ferruginosum* only inhabits pine.

30. *ROSELLINIA THELENA* (FR.) AWD., Hedwigia *4:* 154, 1865 (Plate 55 (6), fig. 27).

Perithecia (No. 1651): 1-1.5 mm in diam., crowded, with papillate ostiola, glabrous, brownish, black, developing on a brown subiculum. Asci 100-160 × 9 µ (after WINTER, 1887). Ascospores 22-31 × 7-8 µ, dark-brown, ellipsoidal, with a colourless, often disappearing 6 x 2 µ spore-appendage. A conidial form has not been observed up till now.

Quoting OUDEMANS (1897): „Le *R. thelena* diffère du *R. aquila* par le subicule beaucoup moins dévéloppé, non floconneux, mais ressemblant plutô à un tissu serré —". The spores are 18-24 × 6.5-7.5 µ, somewhat longer than in *R. aquila* and characterized „par un appendice gélatineux en forme d'épine, atteignant une longeur de 14 µ". In *R. aquila* OUDEMANS mentioned „— appendicule hyalin, à peine perceptible, —".

Culture-work: Since the material was overmature it was not possible to obtain a culture.

Ecology: *Rosellinia thelena* was found in great numbers in heaps of dead branches of Scots pine laying in a rather moist locality. It also inhabits broad-leaf e. g. *Acer* species.

31. *CORYNELLA ATROVIRENS* (PERS. ex FR.) BOUD., Bull. soc. myc., Fr. *1:* 114, 1885. (Plate 55 (6), fig. 28).

Apothecia (No. 1652): 0.5-1.5 mm in diam., lemon-yellow or yellowish green, gelatinous, sessile. Hymenium pale yellow. Hypothecium pale-yellow forming an extensive textura solida, surrounding the hymenial part of the fructification. Exciple lacking. Asci 125-135 × 9.5-11.5 µ, surrounded by colourless, filiform paraphyses and filled with numerous, 1-1.5 µ colourless, globular or ellipsoidal secondary ascospores, often forming typical spore-balls. Primary ascospores colourless, more-celled, but seldom observed. A conidial stage was not found, but MAAS GEESTERANUS (1955) described fasciculate, stipitate, up to 2 mm high coremia among the apothecia. He, on the contrary, did not observe the secondary ascospores, whereas the primary spores in his material were 13.4-20.1 × 4 µ, 4- to 8-celled.

In a young stage the apothecia are yellow-coloured, afterwards becoming dark-brown, so that confusion with *Tympanis hypopodia* is possible. The latter species, however, forms almost black, cartilaginous apothecia which are often associated with black pycnidia of the form genus *Pleurophomella* HÖHNEL.

Culture-work (No. 339): Cultures obtained from the secondary ascospores develop very slowly growing, orange-coloured, yeast-like colonies.

Ecology: This fungus inhabits coniferous as well as broad-leaf trees *(Acer, Fagus, Fraxinus).*

32. *GORGONICEPS ARIDULA* KARST., Myc. Fenn. *1:* 185, 1871 (Plate 55, (6), fig. 29).

Apothecia (No. 1561): 0.3-0.5 mm in diam., disc-shaped, red-brown, sessile. Hymenium and hypothecium colourless. Exciple brown with a prosenchymatical structure. Asci 95-130 × 11-12 µ, surrounded by colourless, filiform paraphyses with slightly thickened tips. Ascospores 55-85 × 2-3.5 µ, colourless, 1-celled, curved, afterwards 14- or 16-celled, one side blunt, the other acuminate. A conidial stage was not observed.

Culture-work (No. 279): Cultures obtained from ascospores develop a greyish, slowly growing mycelium, afterwards changing into dark olive-green provided with fluffy greyish aerial mycelium.

Ecology: Great numbers of ascocarps of *Gorgoniceps* were collected on dying trunks of *Pinus nigra* var. *corsicana* due to a heavy winter frost. They were often accompanied by the apothecia of *Crumenula pinicola* and *Belonium biatorinum*. Apothecia of *Gorgoniceps* occur on dead branches as well as old cones of scots pine.

33. *ENCOELIA PETRAKII* Gremmen, Sydowia Beiheft 181, 1957 (Plate 55 (6), fig. 30).

Apothecia (No. 813): 1.2-1.5 mm in diam., cup-shaped or funnel-shaped, rust-brown or dark-brown, with a crenulate margin. Hymenium colourless or pale brown Hypothecium rust-brown forming a textura intricata. Exciple consisting of a colourless, cartilaginous textura oblita. Cortex of exciple 10-15 µ thick, dark-brown. Asci 95 × 7.5 µ, surrounded by colourless, filiform paraphyses with slightly thickened, pale-brown or dark-brown tips. Ascospores 15-17 × 3.5-4 µ, colourless, 1-celled, fusoid, straight or slightly curved (sometimes 2-celled). A conidial form was not observed.

Culture-work (No. 207): Cultures obtained from ascospores develop a greyish white rather slowly growing mycelium, afterwards changing into cream or brown forming a black stroma on the medium on which microconidial pustules are formed.

Ecology: A very remarkable fungus found one time on pine as well as on dead branches of the douglas fir.

34. *SPHAEROPSIS ELLISII* Sacc., Syll fung., 3: 300, 1884 (Plate 55 (6), fig. 31).

Pycnidia (No. 1612): 0.3-0.4 mm in diam., immersed, rupturing the epidermis at maturity, with 20-40 µ thick, dark brown pycnidial walls. Pycnospores 31-40 × 12-15 µ, dark-brown, 1- or 2-celled, oblong-ellipsoidal or navicular and finely punctate, formed on short sporophores.

Culture-work: Cultures of this organism were not obtained.

Ecology: The pycnidia were collected on dead needles of Scots pine.

35. *PHACIDIELLA CONIFERARUM* Hahn, Mycologia *49*: 227, 1957. (Plate 56 (7), fig. 32).

Apothecia (No. 1524): 0.5-1 mm in diam., immersed in a stroma-like tissue, at maturity rupturing the periderm, the black or olive-brown disc surrounded by 4-6 fragments of host-tissue. Hymenium pale-brown.

Exciple consisting of a 90-160 μ thick, dark-brown stratum tectricum with up to 20 μ long interascicular hyphae. Asci 105-115 (145) × 11-12 μ, surrounded by colourless, filiform paraphyses with slightly swollen tips. Ascospores 13.5-16 × 5.5-6 μ, colourless, 1-celled, ellipsoidal or slightly bent, filled with minute guttulae.

Conidial stage (No. 1526): The ascigerous stage is often associated with a pycnidial form. The pycnidia are 0.3-0.5 mm in diam., immersed, at maturity rupturing the periderm, simple or compound, black, lenticular or subglobose, unilocular or plurilocular with thin yellowish walls. Pycnospores 5.5-7.5 × 3 μ, colourless, 1-celled, ellipsoidal, formed on short sporophores and oozed out in milky-coloured spore-horns. This stage was formerly described as *Phomopsis pseudotsugae* WILS., but since our knowledge of the organism has increased the name has been altered in *Phacidiopycnis pseudotsugae* (WILS.) HAHN. [Mycologia, *49*: 230, 1957].

Culture-work (No. 272): Cultures obtained from ascospores as well as from the pycnospores develop a moderately growing, colourless, afterwards changing into dark-brown or olive-brown, velvety mycelium. Pycnidia are again obtained in vitro.

Ecology: Much knowledge has been accumulated on this parasitic fungus causing the so-called *Phomopsis*-disease of Japanese larch and douglas fir.

Apothecia were only found on dead branches of Scots pine. Inoculations performed with ascospore-cultures again demonstrated its parasitism on Japanese larch. As far as known *Phacidiella coniferarum* is a harmless fungus on Scots pine inhabiting dead branches, but becoming a serious parasite when wounded larches are in the neighbourhood (GREMMEN, 1959).

36. *THERRYA FUCKELII* (REHM) KUJALA, Comm. Inst. For. Fenn. *38* (4): 48, 1950 (Plate 56 (7), fig. 33).

Apothecia (No. 1645): 1-2 mm in diam., immersed, black, at maturity rupturing the periderm longitudinally or irregularly, the yellow disc surrounded by fragments of host-tissue. Hymenium yellow. Hypothecium colourless filled with 10-20 μ in diam. crystals. Exciple dark-brown. Asci 150-165 × 11.5-15.5 μ, club-shaped, surrounded by colourless paraphyses with colourless or dark-brown tips forming a dark-brown epithecium. Ascospores 115-135 × 4-5 μ, colourless, at first 1-celled, afterwards 8- to 12-celled, with long colourless cilia. Up till now a conidial stage was not observed.

REHM (1896) described this fungus as *Coccophacidium pini* var. *fuckelii* separating it from *C. pini*, but it is very doubtful whether there

is a real difference between them. NANNFELDT (1932) referred these fungi to the genus *Therrya* PENZ. & SACC., but up to the present the life-cycle of these fungi is unsufficiently elucidated.

Culture-work (No. 267, 320): Cultures obtained from ascopores develop a slowly growing, floccose, white or cream mycelium. A conidial form was not observed in vitro.

Ecology: Apothecia of the fungus occur on thick, dead branches of Scots pine; they are often associated with *Crumenula pinicola.*

37. *LACHNELLULA REHMII* FERDINANDSEN & JØRGENSEN, in Skovtraeernes Sygdomme, 191, 1938-1939 (Plate 5 6(7), fig. 34).

Apothecia (No. 1389): About 1 mm in diam., saucer-shaped, disc orange-yellow, with white hairs, short-stalked. Hymenium pale-yellow. Hypothecium colourless. Exciple yellow forming a compact interwoven structure. Cortex of exciple with up to 80 μ long, colourless, rough hairs. Asci 40-42 × 4 μ, surrounded by colourless, filiform paraphyses. Ascospores 3-3.5 μ in diam., colourless, 1-celled, globular.

REHM (1896) mentioned three species of the genus *Lachnellula* KARST. occurring on conifers, viz. *L. chrysophthalma* (PERS.) KARST, with ascospores ranging from 4-6 μ; *L. schumannii* REHM with spores about 2 μ in diam. and *L. resinaria* (COOKE & PHILL.) REHM with spores measuring 2.5-3 μ. The mutual differences seem to be insignificant. FERDINANDSEN & JØRGENSEN (l. c.) distinguish *L. resinaria* and *L. rehmii* based on the elliptical form of the ascospores of *L. resinaria* and the globular spores of *L. rehmii.* Further study of this genus seems to be justified since our knowledge of these fungi is very scanty. According to above mentioned danish authors both species are causing cankers on *Picea, Abies* and *Pinus.*

Culture-work: Cultures were not made.

Ecology: Apothecia were collected on dead stems of corsican pine. Observations on a parasitical behaviour, however, were not done.

38. *OPHIONECTRIA SCOLECOSPORA* BREF. & TAV., Unters. Gesammt. Myk. *10:* 178, 1891 (Plate 56 (7), fig. 35, 35a).

Perithecia (No. 1627): 0.4-0.5 mm in diam., red or orange-red, globular, grouped on a dark-brown stroma, with dark-brown walls. Asci 100-120 × 5-11 μ, filled with 3-4 × 1μ, colourless, 1-celled, bacilliform or slightly bent secondary ascospores. Primary ascospores are 30-50 × 2.5-3.5 μ, colourless, many -celled, but seldom observed.

Conidial stage (No. 1625): Pycnidia are found to be associated with the perithecial stage. They are orange-red, pear-shaped or globular

and develop on a dark-brown stroma. Pycnospores are 2-3 × 1 μ, colourless, 1-celled, bacilliform, formed on short sporophores. This stage is described as *Diplozythia scolecospora* Búb. [Ann. Myc. 2: 399, 1904].

Recent investigations have shown that this fungus must be renamed as *Scoleconectria cucurbitula* (Booth, unpubl.)

Culture-work (No. 247): Cultures obtained from the pycnospores develop a very quickly growing white, floccose mycelium, afterwards forming yellow or orange-yellow patches. Mature pycnidia were again obtained in vitro.

Ecology: Perithecia as well as pycnidia occur on dead branches and needles of Scots pine and appear to be rather common.

39. *LASIOSTICTIS FIMBRIATA* (Schw.) Bäumler, Beitr. Crypt. flor. Preszburg 3: 39, 1897 (Plate 56 (7), fig. 36).

Apothecia (No. 1656): 0.3-0.8 mm in diam., immersed, at maturity rupturing and the light-brown disc surrounded by host-tissue. Hymenium colourless. Hypothecium colourless, very thin. Exciple consisting of a dark-brown stratum tectricum carrying colourless, interascicular hyphae. Asci 70-95 × 8-10 μ. Ascospores 77-88 × 3 μ, colourless, 1-celled, vermicular (cf. Addendum).

This fungus was not found in the Netherlands up till now, but it was desirable to study this species in order to compare it with *Naemacyclus niveus*, since Petrak (1947) assumed *Lasiostictis fimbriata* and *Naemacyclus niveus* to be identical. Material was collected by the present author in the Swiss alps, whereas Scottish material could be investigated through the kindness of Mr. W. D. Graddon (Congleton, Ches.).

Culture-work (No. 342): Cultures obtained from ascospores develop a slowly growing, pure white mycelium, afterwards changing into slight yellowish.

Ecology: Apothecia occur on old cones of Scots pine.

40. *PEZICULA LIVIDA* (Berk. & Br.) Rehm, 26e Ber. nat. ver. Augsb. 112, 1881 (Plate 57 (8), fig. 37).

Apothecia (No. 1486): 0.5-2 mm in diam., disc-shaped, orange or yellowish brown with a 60-150 μ long stipe or nearly sessile. Hymenium yellowish. Exciple yellow-brown forming a thick densely interwoven structure. Asci 75-95 × 13.5 μ surrounded by colourless or yellowish paraphyses with brown swollen tips, forming a brownish epithecium. Ascospores 25-30 × 6-7 μ, colourless, with age yellow-brown, 1-celled, later up to 4-celled, ovoid or ellipsoidal, straight or slightly bent.

Conidial stage: Up till now a conidial form could not be found on the natural substratum.

A detailed information dealing with variation within the species, and parasitism has been given by GREGOR-WILSON. It has been assumed by various authors that this fungus is a parasite of douglas fir, sitka spruce and larch. GREGOR-WILSON (1931) carried out experiments with different forms, but could not obtain a positive result.

Culture-work (No. 275): Cultures obtained from ascospores develop a greyish, rather quickly growing mycelium, afterwards changing into reddish brown, dark-green or olive-green colour. In these cultures the ascigerous form; the conidial form as well as the spermogonial form developed. The conidial stage represents spore-pustules consisting of 26-38 × 6-8 µ, colourless or yellow-brown, 1- to 6-celled, cylindrical, straight or slightly bent conidia. It has been recorded as *Cryptosporiopsis abietina* PETR. [Ann. Myc. *23:* 125, 1925]. The spermogonia produce 5-8 × 1 µ, colourless, 1-celled, bacilliform spermatia.

Ecology: This fungus is a very polyphagous one; it has been collected on a number of different hosts such as *Pinus,* larch, *Thuja,* douglas fir and occurs on dead branches, stems as well as on old cones.

41. *TYMPANIS HYPOPODIA* NYL., Obs. Pez. Fenn. 72, 1868 (Plate 57 (8), fig. 38).

Apothecia (No. 738): 0.5-1.5 mm in diam., disc-shaped, cartilaginous, black, short-stalked, or sessile. Hymenium colourless with subhymenial layer up to 20 µ thick and brown. Hypothecium up to 500 µ, light-brown forming a densely interwoven structure. Exciple dark-brown, consisting of dark-brown thick-walled cells Asci 70-110 × 9-12 µ, surrounded by colourless, filiform paraphyses forming a brownish epithecium and filled with 2-3 × 1 µ, colourless, cylindrical or allantoid secondary ascospores. Primary ascospores 6-10 × 2-4 µ, colourless, 1- or 2-celled, fusiform, but rarely observed in the ascus.

Conidial form (No. 738): Pycnidia 0.1-0.3 mm in diam., globular or pear-shaped, black. Pycnospores 2-4 × 1 µ, colourless, 1-celled, cylindrical or allantoid formed on short sporophores. This stage belongs in the form genus *Pleurophomella* HÖHNEL.

Extensive study on the genus *Tympanis* TODE ex FR. has been performed by the canadian mycologist GROVES. He distinguished a number of species occuring on broad-leaf trees as well as on conifers. On *Pinus* he described *T. confusa* NYL., *T. pithya* (KARST.) KARST. and *T. hypopodia* NYL. (GROVES, 1952).

Culture-work (No. 178): Cultures obtained from the secondary ascospores as well as from the pycnospores develop a moderately growing greyish white, very delicate superficial, yeast-like growing mycelium.

Afterwards minute, black fruit-bodies are formed containing colourless, bacilliform spores representing the *Pleurophomella*-stage.

Ecology: The ascigerous form as well as the pycnidial stage are found on thick, dead branches of *P. sylvestris*.

42. *ANTHOSTOMELLA REHMII* (THÜM.) REHM, Krypt. Fl. 1 (2): 561, 1887 (Plate 57 (8), fig. 39).

Perithecia (No. 1665): 0.3-0.4 mm in diam., remaining immersed, at maturity rupturing the hypodermis, spherical, with brown perithecial walls. Asci difficult to observe. Ascospores 11-14 × 6 µ, dark-brown, oblong, one end blunt, with a short up to 2 µ long, colourless appendage. A conidial stage was not observed. A remarkable fact of this fungus are heaps of ascospores at the top of the perithecium on the epidermis giving the fungus a short-necked appearance. This providing a simple manner to localise the always immersed fructifications.

Culture work (No. 345): Cultures obtained from the perithecia developed a slowly growing, white mycelium.

Ecology: This most interesting organism was found in abundance inhabiting the dead needles of austrian pine.

43. *CALOTHYRIUM PINASTRI* (FUCK.) THEISS., Österr. bot. Zeitschrift *62*: 219, 1912 (Plate 57 (8), fig. 40).

Thyriothecia (No. 1666): 0.08 - 0.13 mm in diam., scattered, round, brown, with a pore about 10 µ in diam., the upper wall composed of brown radiating hyphae. Asci 30-40 × 7.5-9.5 µ, clavate, short. Ascospores 11-15 × 2 µ, colourless, 1- or 2-celled, fusoid, with some guttulae.

Conidial stage: Shield-like fructifications were observed looking like the thyriothecia but producing minute 6-7 × 1.5 µ, colourless, 1-celled, rod-like spores being very similar to *Leptostroma pinastri* DESM. This form may be the same as *Sirothyriella pinastri* (KARST.) HÖHNEL [Fragm. z. Myk. no. 518, or 924, 1910].

Ecology: This fungus occurs on decaying needles of austrian pine.

44. *LOPHIOSTOMA PINASTRI* NIESSL, Verh. Naturf. Ver. Brünn 14: 209. 1875 (Plate 57 (8), fig. 41).

Perithecia (No. 1668): About 0.1 mm in diam., superficial, globular or somewhat pear-shaped, slightly truncate, black. Asci 75 × 30 µ, clavate. Ascospores 34 × 8 µ, olive-brownish or greenish brown, almost 6-celled, sometimes 7-celled, fusoid.

Culture-work: Cultures of this extremely minute fungus could not be obtained.

Ecology: This Ascomycete was found on decaying needles of different pine species; its perithecia are very inconspicuous and nearly always escape observation.

45. *MELANOSPORA CHIONEA* (Fr.) Corda, Icon. Fung. *1:* 24, 1837 (Plate 57 (8), fig. 42).

Perithecia (No. 1674): 0.3-0.4 mm in diam. superficially developing in a dense colourless or light yellowish subicular mycelium, with long up to 300 μ brownish ostiola, at the tips with whorls of colourless cilia. Asci difficult to define, but after Von Arx & Müller (1954): 35-45 × 14-18 μ. Ascospores 13.5 × 11.5 × 5 μ, dark-brown, 1-celled, ellipsoidal, flattened.

According to the above mentioned authors many species of the genus *Melanospora* Corda are associated with hyphomycetous fungi.

Culture-work: Culture were not obtained.

Ecology: *Melanospora chionea* occurs on decaying needles of Scots pine, but it seems to be very rare in the Netherlands.

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During the work valuable information was obtained on certain species. Dr. J. A. von Arx (Phytopathologisch Laboratorium, Baarn) identified *Lentomita acuum* Mouton; Dr. R. W. G. Dennis (Royal Botanic Gardens, Kew) investigated the material of *Cistella species* and gave some essential citations; Mr. W. G. Bramley (Pickering) and Mr. W. D. Graddon (Congleton) sent some herbarium specimens for study. Mr. J. S. Murray (Farnham) critically revised a part of the manuscript. I am very indebted to all gentlemen for their kind help.

## *ADDENDUM*

Since the above paper was submitted the conidial stage of *Lasiostictis fimbriata* (Schw.) Bäumler was obtained in pure culture from Dutch material. It proved to be identical with *Eriosporopsis albida* Petrak. A detailed report is in preparation.

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Tab. 50 (1): Fig. 1. *Lophodermium pinastri* (SCHRAD. ex FR.) CHÉV.

A, Apothecium from *P. sylvestris* (No. 1626); B, Ascospores from apothecium (No. 1626); C, Spermogonia from *P. nigra* (No. 1631); D, Spermatia from spermogonium (No. 1631).

Fig. 2. *Diaporthe conorum* (DESM.) NIESSL
A, Pycnidium from *P. sylvestris* (No. 1672); $B_1$, Alpha-spores from pure culture (No. 281); $B_2$, Bêta-spores from pure culture (No. 281).

Fig. 3. *Sclerophoma pityophila* (CORDA) HÖHNEL
A, pycnidium from *P. sylvestris* (No. 1624); B, Pycnospores from pycnidium (No. 1624).

Fig. 4. *Pseudohelotium pineti* (BATSCH ex FR.) FUCKEL
A, Apothecium from *P. sylvestris* (No. 1610); B, Ascospores from apothecium (No. 1610); C, Conidia from P. sylvestris (No. 1610); D, Conidia from ascospore culture (No. 310 b); E, Conidia from pycnospore culture (No. 310a).

Fig. 5. *Phialea acuum* (ALB. & SCHW. ex FR.) REHM
A, Apothecium from *P. sylvestris* (No. 1592); B, Ascospores from apothecium (No. 1592); C, Conidia from ascospore culture (No. 248).

Fig. 6. *Naemacyclus niveus* (PERS.) SACC.
A, Apothecium from *P. sylvestris* (No. 1558); B, Ascospores from apothecium (No. 1558).

Tab. 51 (2): Fig. 7, 7a. *Desmazierella acicola* LIB.

Apothecium from *P. nigra* var. *austriaca* (No. 1617); B, Ascospores from apothecium (No. 1617); C ,Conidial stage from ascospore culture (No. 56).

Fig. 8. *Cenangium acuum* COOKE & PECK
A, Apothecium from *P. sylvestris* (No. 1634); B, Ascospores from apothecium (No. 1634).

Fig. 9. *Lentomita acuum* MOUTON
A, Perithecium from *P. sylvestris* (No. 1642); B, Ascospores from perithecium (No. 1642).

Fig. 10. *Phacidium lacerum* FR.
A, Apothecium from *P. sylvestris* (No. 1344); B, Ascospores from apothecium (No. 1344); C, Pycnidium from pure culture (No. 250); D, Pycnospores from pure culture (No. 250).

Fig. 11. *Pyrenopeziza pinicola* REHM
A, Apothecium from *P. nigra* var. *austriaca* (No. 1654); B, Ascospores from apothecium (No. 1654).

Tab. 52 (3): Fig. 12. *Cistella species*

A, Apothecium from *P. nigra* var. *corsicana* (No. 1585); B, Ascospores from apothecium (No. 1585); C, Phialides and phialospores from pure culture (No. 293).

Fig. 13, 13a. *Valsa pini* (Alb. & Schw.) Fr.
A, Perithecia from *P. sylvestris* (No. 1646); B, Ascospores from perithecium (No. 1646); C, Immature pycnidia from *P. sylvestris* (No. 1646); D, Pycnospores from mature pycnidium (No. 1646).

Fig. 14. *Coryne species*
A, Apothecium from *C. sarcoides* (Jacq. ex Fr.) Tul, from *Quercus* (No. 1551); B, Ascospores from *C. sarcoides* (No. 1551); $B_2$, Ascospores from *Coryne cylichnium* (Tul.) Boud. from *P. sylvestris* (No. 1563).

Fig. 15. *Hyalotricha trichodea* (Phill. & Plowr.) Dennis
A, Apothecium from *P. sylvestris* (No. 1584); B, Ascospores from apothecium (No. 1584); C, Hair from apothecium (No. 1584).

Tab. 53 (4): Fig. 16. *Trichoscyphella species*
A, Apothecium from *Trichoscyphella hahniana* (Seaver) Manners, from *P. sylvestris* (No. 1582); $B_1$, Ascospores from apothecium (No. 1582); $B_2$, Ascospores from *Trichoscyphella calycina* (Schum. ex Fr.) Nannf. (No. 1615).

Fig. 17. *Dasyscyphus pulverulentus* (Lib.) Sacc.
A, Apothecium from *P. sylvestris* (No. 1633); B, Ascospores from apothecium (No. 1633); C, Hair from apothecium (No. 1633).

Fig. 18. *Crumenula pinicola* (Fr.) Karst.
A, Apothecium from *P. nigra* var. *austriaca* (No. 118); B, Ascospores from apothecium (No. 118).

Fig. 19, 19a. *Crumenula sororia* Karst.
A, Apothecium from *P. sylvestris* (No. 119); B, Ascospores from apothecium (No. 119); C, Pycnospores from ascospore culture (No. 287).

Tab. 54 (5): Fig. 20, 20a. *Scleroderris lagerbergii* Gremmen
A, Apothecium from *P. nigra* var. *austriaca* (No. 521); B, Ascospores from apothecium (No. 521); C, Pycnidium from *P. nigra* var. *austriaca* (No. 1375); D, Pycnospores from pycnidium (No. 1375).

Fig. 21. *Tromera resinae* (Fr.) Körber
A, Apothecium from *P. nigra* var. *corsicana* (No. 1576); B, Pycnospores from pycnidium (No. 1577).

Fig. 22. *Hyaloscypha species*
1 a, Apothecium from *H. leuconica* (Cooke) Nannf. from *P. sylvestris* (No. 1635); 1 b, Ascospores from apothecium (No. 1635); 1 c, hairs from apothecium (No. 1635); 2 a, Apothecium from *H. stevensonii* (Berk. & Br.) Nannf. from *P. sylvestris* (No. 1566); 2 b, Ascospores from apothecium (No. 1566); 2 c, Hairs from apothecium (No. 1566).

Fig. 23. *Durella suecica* (Starb.) Nannf.
A, Apothecium from *P. sylvestris* (No. 1657); B, Ascospores from apothecium (No. 1657).

Fig. 24. *Orbilia luteo-rubella* (Nyl.) Karst.
A, Apothecium from *P. sylvestris* (No. 1653); B, Ascospores from apothecium (No. 1653); C, Ascus and paraphysis from apothecium (No. 1653).

Fig. 25. *Belonium biatorinum* Rehm
A, Apothecium from *P. nigra* var. *corsicana* (No. 1323); B, Ascospores from apothecium (No. 1323).

Tab. 55 (6): Fig. 26. *Cenangium ferruginosum* Fr. ex Fr.
A, Apothecium from *P. sylvestris* (No. 1508); B, Ascospores from apothecium (No. 1508); C, Microconidia from pure culture (No. 226).

Fig. 27. *Rosellinia thelena* (Fr.) Awd.
A, Outline of perithecium from *P. sylvestris* (No. 1651); B, Ascospores from perithecium (No. 1651).

Fig. 28. *Corynella atrovirens* (Pers. ex Fr.) Boud.
A, Apothecium from *P. sylvestris* (No. 1652); B, Secondary ascospores from apothecium (No. 1652); C, Ascus with spore-balls of secondary ascospores (No. 1652).

Fig. 29. *Gorgoniceps aridula* Karst.
A, Apothecium from *P. nigra* var. *corsicana* (No. 1561); B, Ascospores from apothecium (No. 1561).

Fig. 30. *Encoelia petrakii* Gremmen
A, Apothecium from *P. sylvestris* (No. 813); B, Ascospores from apothecium (No. 813).

Fig. 31. *Sphaeropsis ellisii* Sacc.
A, Pycnidium from *P. sylvestris* (No. 1612); B, Pycnospores from pycnidium (No. 1612).

Tab. 56 (7): Fig. 32. *Phacidiella coniferarum* Hahn
A, Apothecium from *P. sylvestris* (No. 1524); B, Ascospores from apothecium (No. 1524); C, Pycnidia from *P. sylvestris* (No. 1526); D, Pycnospores from pycnidium (No. 1526).

Fig. 33. *Therrya fuckelii* (Rehm) Kujala
A, Apothecium from *P. sylvestris* (No. 1645); B, Ascospores from apothecium (No. 1645).

Fig. 34. *Lachnellula rehmii* Ferdinandsen & Jørgensen
A, Apothecium from *P. nigra* var. *corsicana* (No. 1389); B, Ascospores from apothecium (No. 1389).

Fig. 35, 35a. *Ophionectria scolecospora* Bref. & Tav.
A, Perithecia from *P. sylvestris* (No. 1627); B, Secondary ascospores from perithecium (No. 1627); C, Pycnidium from *P. sylvestris* (No. 1625); D, Pycnospores from pycnidium (No. 1625).

Fig. 36. *Lasiostictis fimbriata* (Schw.) Bäumler
A, Closed apothecium from *P. sylvestris* (No. 1386); B, Mature apothecium (No. 1386); C, Ascospores from apothecium (No. 1656).

Tab. 57 (8): Fig. 37. *Pezicula livida* (Berk. & Br.) Rehm
A, Apothecium from *P. sylvestris* (No. 1486); B, Ascospores from apothecium (No. 1486); C, Spermatia from pure culture (No. 275); D, Conidia from pure culture (No. 275).

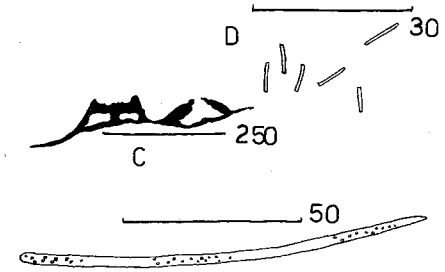
Fig. 38. *Tympanis hypopodia* Nyl.
A, Apothecium from *P. sylvestris* (No. 738); B, Asci with ascospores (No. 738).

Fig. 39. *Anthostomella rehmii* (Thüm.) Rehm
A, Perithecium from *P. nigra* var. *austriaca* (No. 1665); B, Ascospores from perithecium (No. 1665).

Fig. 40. *Calothyrium pinastri* (Fuck.) Theiss.
$A_1$, Thyriothecium from *P. nigra* var. *austriaca* (No. 1666); $A_2$, Transverse section of thyriothecium (No. 1666); B, Ascospores from thyriothecium (No. 1666).

Fig. 41. *Lophiostoma pinastri* Niessl
A, Perithecium from *P. sylvestris* (No. 1669); B, Perithecium with ascospores (No. 1669).

Fig. 42. *Melanospora chionea* (Fr.) Corda
A, Perithecium from *P. sylvestris* (No. 1674); B, Ascospores from perithecium (No. 1674).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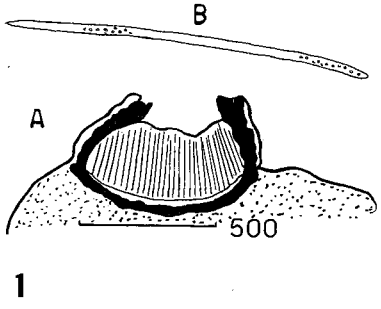
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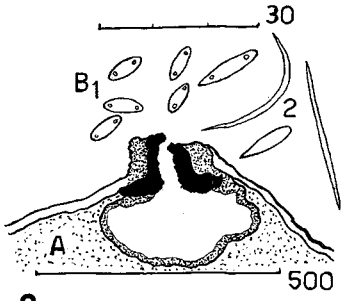
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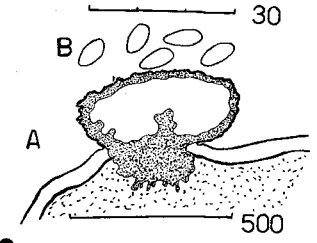
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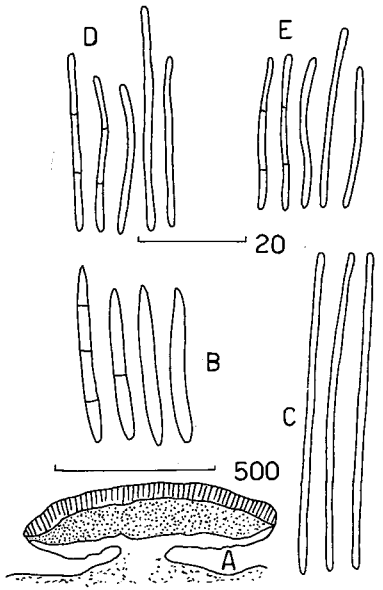
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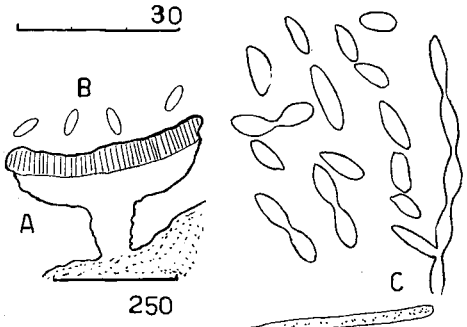
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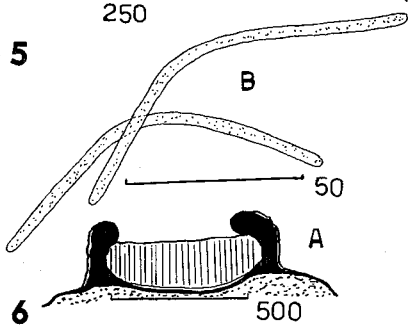
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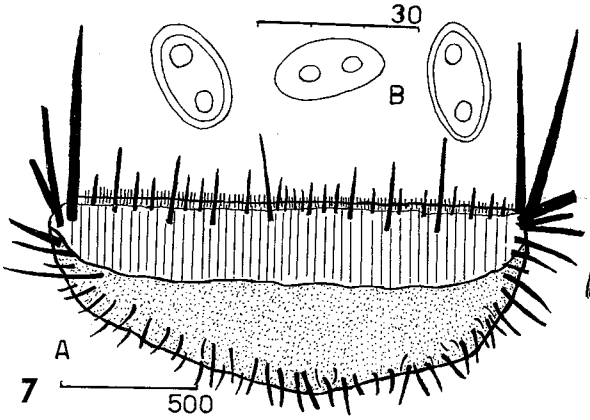


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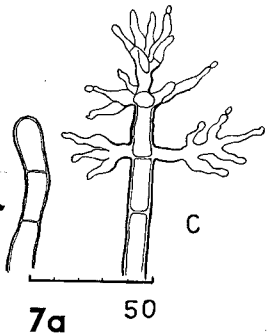


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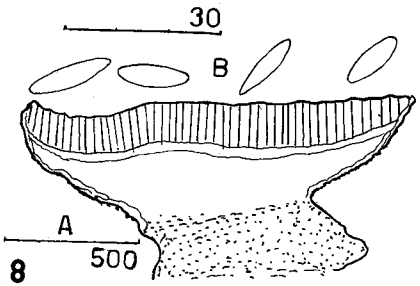


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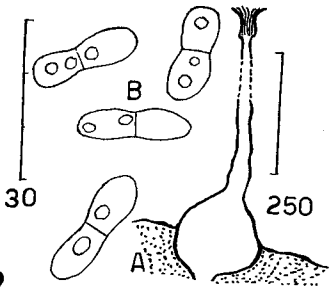


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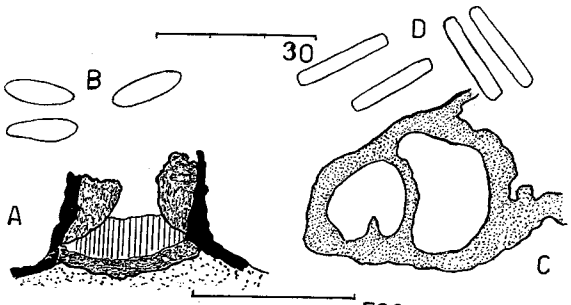


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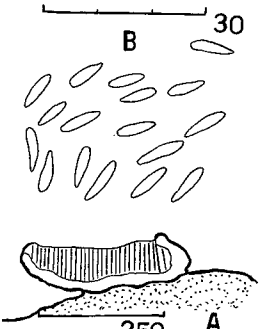


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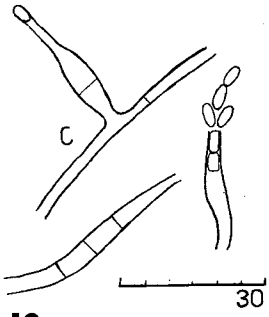


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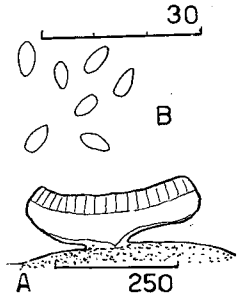


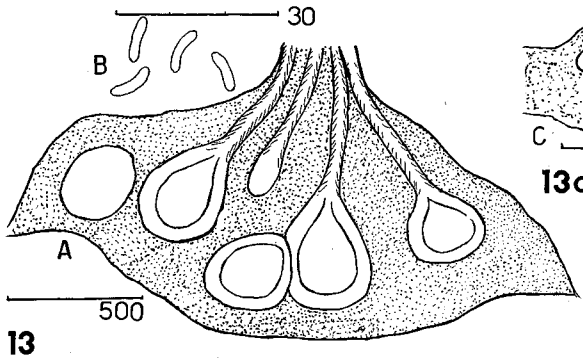


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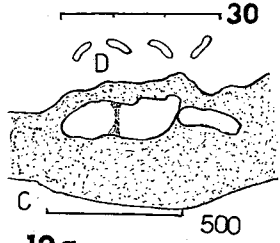


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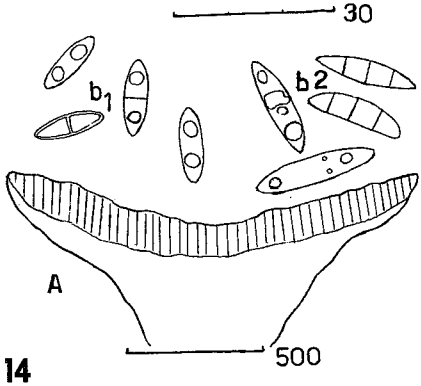


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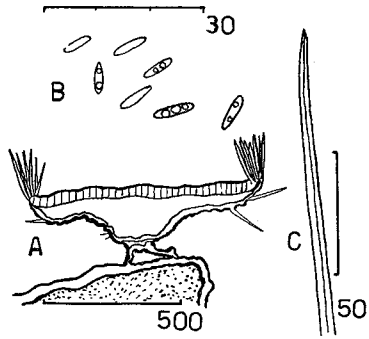


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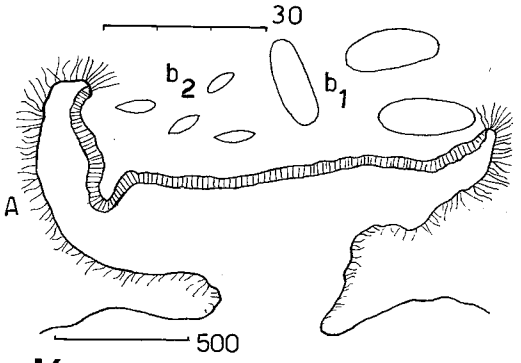


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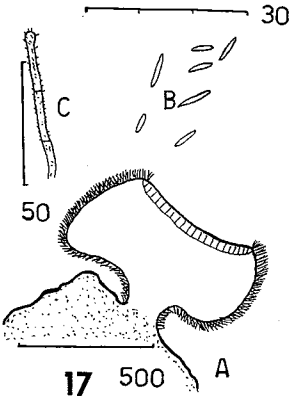


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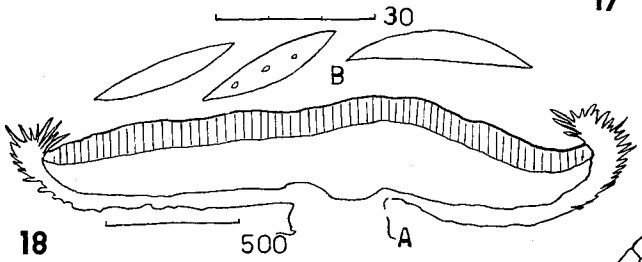


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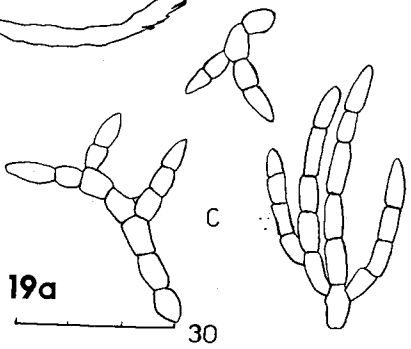


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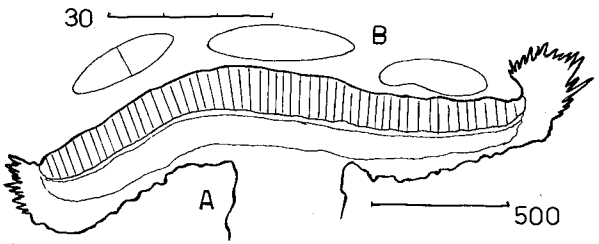


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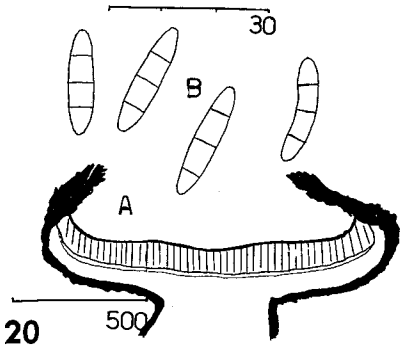


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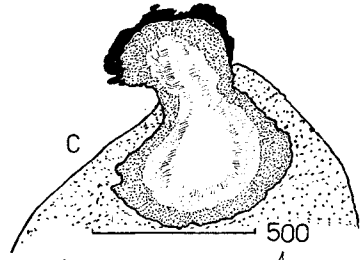


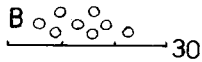


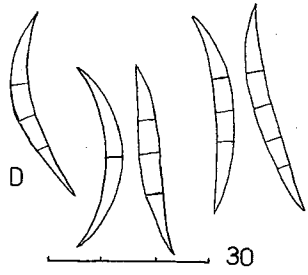


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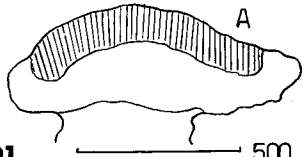


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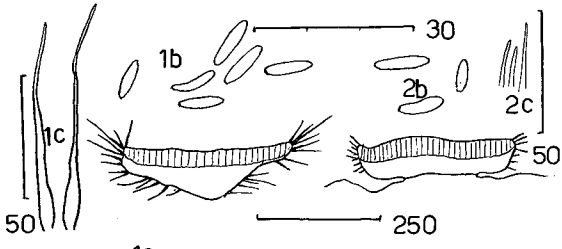


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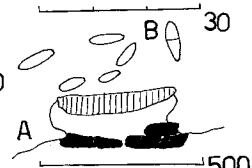


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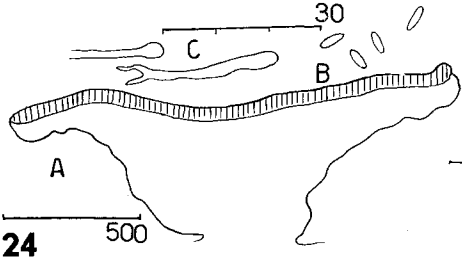


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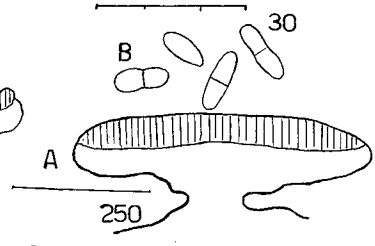


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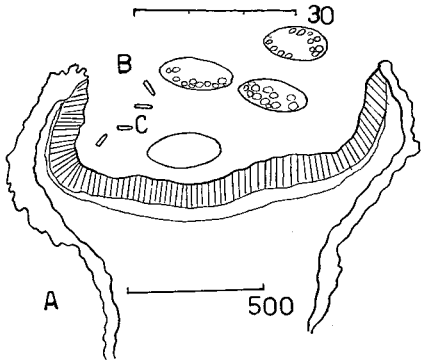


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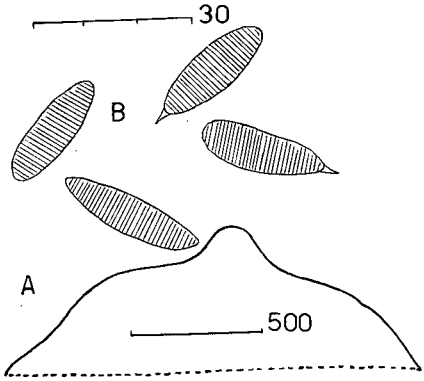


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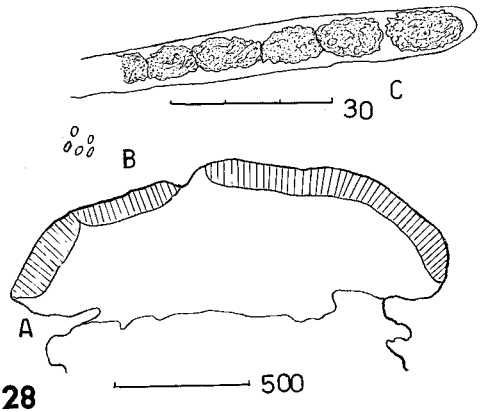


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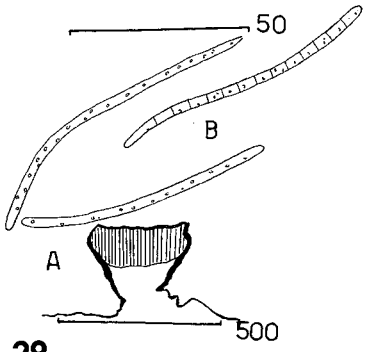


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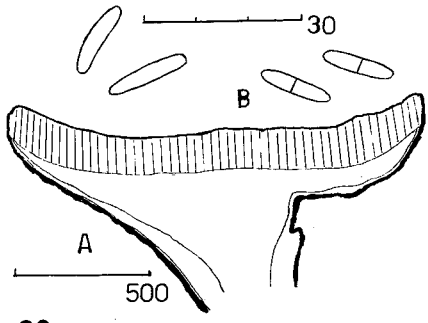


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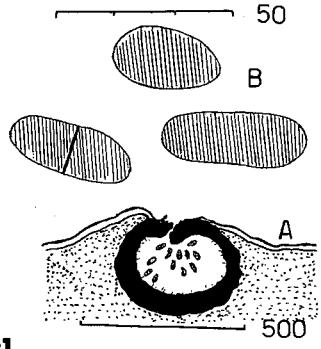


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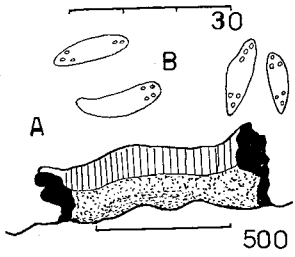


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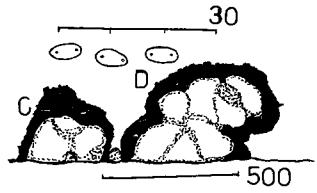


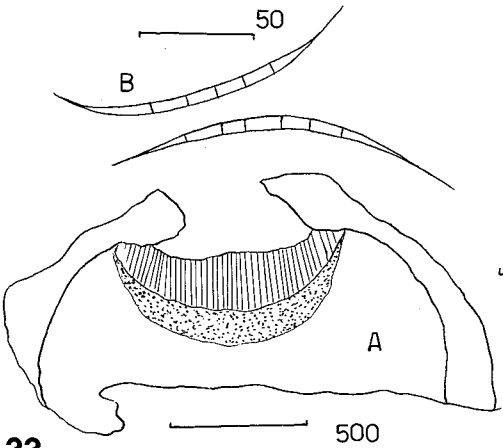


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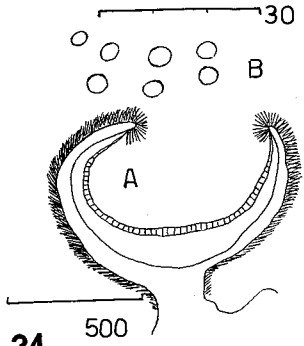


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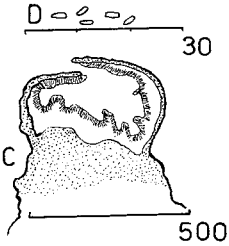


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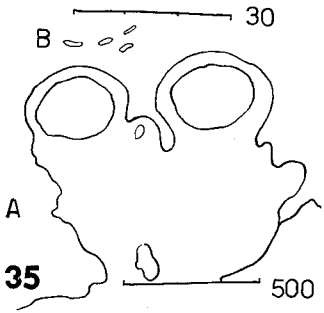


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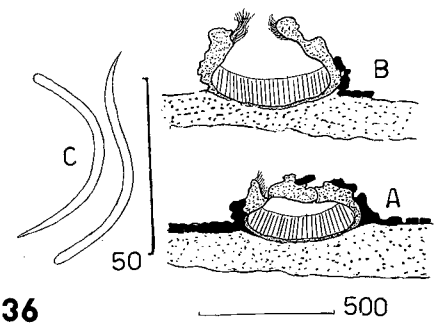


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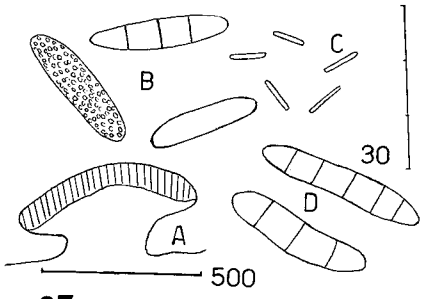


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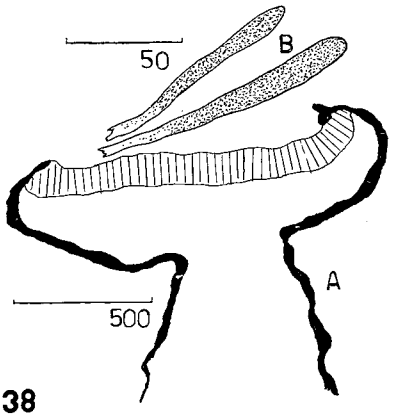


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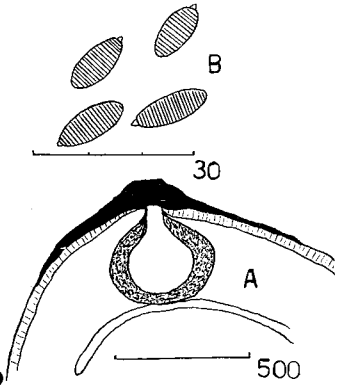


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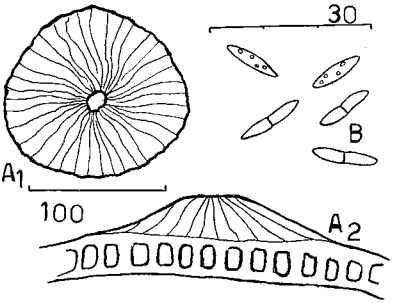


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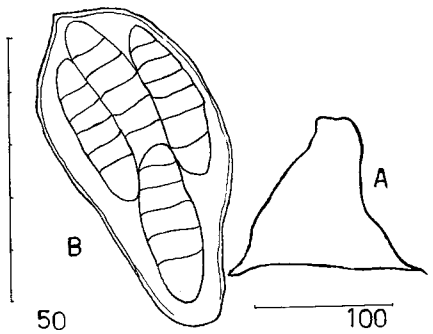


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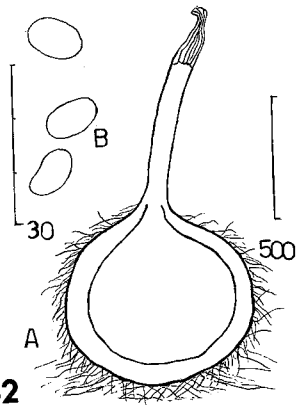


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