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Studies  
on *Massarina* Sacc. and Related Genera

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## Studies on *Massarina* Sacc. and Related Genera

By

S. K. BOSE

*With 26 Figures*

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### A. INTRODUCTION

The Ascomycete fungi belonging to the genera *Massarina* Sacc., *Keissleriella* v. Höhnel and *Herpotrichia* Fuckel, and treated in this paper, have remained obscure for a long time. Recently, MUNK (1956) and HOLM (1957) have given some attention to them and attempted to define the genera by providing adequate descriptions, but as the number of species examined by them is rather small, there still remains some doubt as to the value of their conclusions.

MUNK (1956) has also created a new family, *Massarinaceae*, in which he has included five genera, viz., *Metasphaeria* Sacc. sensu restr., characterized on the basis of *Metasphaeria coccodes* (Karst.) Sacc. (1883), *Massarina* Sacc. (1883), *Keissleriella* v. Höhnel (1919), *Pseudotrichia* Kirschst. (1939), and *Trichometasphaeria* Munk (1953). HOLM (1957) and SCHEINPFLUG (1958) have doubted whether this family is really well defined and could be distinguished from the *Pleosporaceae*, or perhaps from the *Didymosphaeriaceae*, which has also incidentally been created by MUNK (1953) and which is doubtful in some respects too.

Thus the problems related to this paper are:

1. To evaluate and, if possible, to define the above mentioned and related genera.
2. To describe the species on the basis of morphological and biological studies.
3. To determine whether these fungi are related close enough to form an individual family, clearly distinguishable from the others, or not.

## B. HISTORICAL REVIEW AND GENERAL OBSERVATIONS

The genus *Massarina* has been created by SACCARDO (1883) with a view to segregate the fungi with typically hyaline ascospores, which had been previously placed under the genus *Massaria* de Notaris (1844), but the latter is now considered not as closely related to *Massarina*, as supposed before.

SACCARDO (1883) has also created the genus *Metasphaeria* in which he has included the hyaline-spored species of *Leptosphaeria*. Soon after, WINTER (1887) questioned this separation. The species, originally included under *Metasphaeria* by SACCARDO, undoubtedly belong to different genera viz., *Leptosphaeria*, *Massarina* and *Keissleriella*. In fact, many of the species have been removed from *Metasphaeria* and placed under different genera by subsequent authors. MÜLLER (1950) considered *Metasphaeria* synonymous to *Leptosphaeria* Cesati and de Notaris. Unfortunately, as pointed out by MÜLLER (1955), no recognisable type of the genus *Metasphaeria* Sacc. is in existence. *Metasphaeria boemeriæ* (Rabenh.) Sacc. (1883) (= *Sphaerella boemeriæ* Rabenh. [1878]) is the first species described by SACCARDO under the genus *Metasphaeria*. This fungus has been found to be an imperfect fungus with only the pycnidial stage (MÜLLER 1955). The type of the genus designated as *Metasphaeria sepincola* (Fr.) Sacc., by CLEMENTS and SHEAR (1931), is identical with *Pringsheimia sepincola* (Fr.) v. Höhnelt (HOLM 1957), and thus, *Metasphaeria* Sacc. would be synonymous with *Pringsheimia* Schulz (1866). This species has been misinterpreted by PETRAK (1921 a) and his *Sclerodotthis sepincola* (Berk. and Broome) Petrak is identical with *Massarina microcarpa* (Fuckel) Sacc. There is hardly any justification for retaining the genus *Metasphaeria*, which has proved to be a conglomeration of diverse genera and has created much nomenclatural confusion.

MUNK (1953) has described a fungus under the name *Metasphaeria coccodes* (Karst.) Sacc. and has considered it to be the basic type of the family *Massarinaceae* Munk. From its description, the fungus described by MUNK appears to be a *Massarina*.

MUNK (1956) has also described a fungus under the name *Pseudotrichia minor* Munk and has mentioned the presence of a cylindrical tissue, composed of dark brown cells in the porus of the ascocarp. On the basis of this character, he has justified the inclusion of the genus, *Pseudotrichia* Kirschst. (1939), within the family *Massarinaceae* Munk, although

*Pseudotrichia minor* is not the type of the genus. The type species of *Pseudotrichia*, now named *Herpotrichia mutabilis* (Pers.) Winter, had originally been taken as a base for the genus *Khokia*, but later on, KIRSCHSTEIN (1939) has shown some nomenclatural obscurities, so that the genus could be considered doubtful. Accordingly, he renamed it *Pseudotrichia*, which is identical with *Herpotrichia*. Although the fungus described as *Pseudotrichia minor* Munk appears to belong to the genus *Massarina*, it has been considered advisable to include the genus *Herpotrichia* Fuckel (1869) in the present study, to arrive at a better understanding of its relationship.

The genus, *Keissleriella*, has been established by VON HÖHNEL (1919). This genus is characterised by the presence of setae within the porus of the ascocarp. MUNK (1956) has established a strikingly similar genus under the name *Trichometasphaeria*, in which he has included species with more than two-celled ascospores. Except for this difference, the two genera appear to be similar. According to CORBAZ (1957), the genus *Trichometasphaeria* Munk is a synonym of *Keissleriella* v. Höhnel. Examination of the type specimen of *Keissleriella* has shown that the old ascospores of *Keissleriella aesculi* (v. Höhnel) v. Höhnel often become triseptate. In view of these considerations, it is unnecessary to retain *Trichometasphaeria* as a distinct genus.

The five genera, originally included by MUNK under the family *Massarinaceae* Munk, can be merged into two, viz., *Massarina* Sacc. and *Keissleriella* v. Höhnel. These two genera have been taken up for a more detailed study in this paper along with the genus *Herpotrichia* Fuckel, as mentioned above.

### C. MATERIAL AND METHODS

Authentic herbarium material and numerous specimens have constituted the basis of this study. To examine the herbarium material and measure the asci and the ascospores, thin sections have been heated in a drop of lactic acid. A dilute solution of cotton blue in lactic acid has been used to stain the fungi when necessary. Water-mounts of spores have been used for observation of the presence of a mucous sheath around the ascospores. Spore measurements given in this paper, unless otherwise stated, are exclusive of the mucous sheath, the extent of which, when present, has been mentioned separately whereas the measurements of asci, unless otherwise stated, are inclusive of the stipe. Type specimens of the new species, described in this paper, have been deposited in the ETH Herbarium, Zürich.

### D. EXPERIMENTAL PART

#### I. Cultural Studies

Besides the cultures of some of the species already available from the ETH Pure Culture Collection, more isolations have been obtained from fresh specimens by the "spore shooting method". A piece of the matrix,

containing the ascocarps, has been soaked in water for approximately half an hour and then fixed to cotton plugs of 100 ml Erlenmeyer flasks, containing 2% malt extract agar. Spore discharge and subsequent development of mycelium have occurred in all cases, where the fungi have still been viable. The isolations have been maintained on 2% malt extract agar by frequent subcultures.

Experiments have been conducted to induce the fungi to produce their imperfect stages by growing them on BARNES agar (GWYNNE-VAUGHAN and BARNES, 1937) as recommended by RIEDL (1959). Thin twigs of *Fagus sylvatica* L. and *Cornus sanguinea* L. have also been used for this purpose. Small pieces of the twigs, approximately 2.5 cm in length, have been sterilized in propylene oxide as recommended by HANSEN and SNYDER (1947). The sterilized pieces have been placed aseptically in culture tubes (19.5 × 2 cm), containing 5 ml malt extract solution. The tubes, after inoculation, have been stored at various temperatures. Best results have been obtained with *Cornus* twigs, but 2% malt extract agar has also proved satisfactory for this purpose in some cases. The details of the imperfect stages have been described under the morphological studies of the fungi concerned. The form-genera of the imperfect stages are listed in table 1.

Table 1  
Imperfect stages of some species of *Massarina* Sacc.,  
*Keissleriella* v. Höhnel and *Herpotrichia* Fuckel

Fungus	Form-genus of the imperfect stage
<i>Massarina eburnea</i>	<i>Ceratophoma</i> v. Höhnel
<i>Massarina Brunaudi</i>	<i>Microsphaeropsis</i> v. Höhnel
<i>Massarina cisti</i>	<i>Ceratophoma</i> v. Höhnel
<i>Massarina corni</i>	<i>Coniothyrium</i> Corda
<i>Massarina papulosa</i>	<i>Diplodia</i> Fr.
<i>Massarina polymorpha</i>	<i>Dendrophoma</i> Sacc.
<i>Keissleriella alpina</i>	<i>Dendrophoma</i> Sacc.
<i>Keissleriella cladophila</i>	<i>Dendrophoma</i> Sacc.
<i>Keissleriella gallica</i>	<i>Ascochyta</i> Lib.
<i>Herpotrichia diffusa</i>	<i>Pyrenochaeta</i> de Not.
<i>Herpotrichia coulteri</i>	<i>Pyrenochaeta</i> de Not.
<i>Herpotrichia juniperi</i>	<i>Pyrenochaeta</i> de Not.

The imperfect stages of the various species of *Massarina* Sacc., *Keissleriella* v. Höhnel and *Herpotrichia* Fuckel, listed in table 1, belong to the *Sphaeropsidales* and have one- or two-celled, coloured or hyaline pycnidio-spores.

## II. Inoculation Experiments

Since most of the fungi, included in this study, are not strictly limited to specific hosts and have moreover, good growth when artificially cultivated on pieces of *Fagus* and *Cornus* twigs, further experiments have been

conducted to find out whether they can attack various living plants. For this purpose, inoculation experiments have been conducted on one-year-old plants of *Alnus glutinosa* L., *Betula pubescens* L., *Cornus sanguinea* L., *Fagus silvatica* L. and *Fraxinus excelsior* L. In one set of experiments the inoculum has been placed on the uninjured epidermis of the branches, in another, it has been introduced under the tissues of the cortex with a sterilized scalpel and in a third set of experiments, a hot scalpel has been used to injure the tissues of the cortex before introducing the inoculum. In each case, the inoculated part has been covered with a piece of wax tape. The experiments have been conducted during the last week of May 1960.

No infection has been observed where the inoculum has been placed on the uninjured epidermis, or, where it has been introduced in the tissues of the cortex. However, some of the fungi have shown detrimental effects when introduced in the cortical tissues after injuring the latter with a hot scalpel. In such cases, there have been no visible symptoms during the first week. By the end of the second week, the leaves have shown chlorosis and the inoculated branches have started to droop. The affected branches have died after four or five weeks. The fungi that have shown such effects are listed below:

Table 2  
Results of inoculation experiments

Fungus	<i>Alnus glutinosa</i>	<i>Betula pubescens</i>	<i>Cornus sanguinea</i>	<i>Fagus silvatica</i>	<i>Fraxinus excelsior</i>
<i>Keissleriella caudata</i>	—	—	—	+	—
<i>Massarina eburnea</i>	—	—	—	+	—
<i>Massarina maritima</i>	+	—	—	+	—
<i>Massarina Brunaudi</i>	—	+	—	+	—
<i>Massarina cisti</i>	—	+	—	+	—

— = negative; + = positive.

The results indicate that the fungi, *Keissleriella caudata* (Müller) Corbaz, *Massarina eburnea* (Tul.) Sacc., *Massarina maritima* Bose, *Massarina Brunaudi* Bose and *Massarina cisti* Bose, are capable of acting as weak parasites, only in the presence of injured tissues in favourable hosts.

## E. SPECIAL PART

### I. Key to the Genera

- 1 Ascocarps immersed, sometimes erumpent, globose or subglobose. Ascospores hyaline, two- to many-celled ..... 2
- 2 Porus simple or cells lining porus are small and dark coloured, sometimes forming a distinct tissue ..... *Massarina* Sacc.

2\* Porus lined with unicellular setae; setae usually dark brown

*Keissleriella* v. Höhnelt

1\* Ascocarps superficial or embedded at base, beset with long, sparsely branched, brown hyphae. A subiculum of brown hyphae usually present. Ascospores hyaline or mostly coloured, two- to many-celled

*Herpotrichia* Fuckel

## II. *Massarina* Sacc.

### a) Diagnosis of the genus

*Massarina* Sacc. — Syll. Fung. 2: 153 (1883)

Type: *Massarina eburnea* (Tul.) Sacc.

Synonyms:

*Abhapospora* Kirschst. — Ann. Mycol. 37: 97 (1939).

*Amphididymella* Petrak — Engler Bot. Jahrb. 62: 94 (1928); Sydowia 13: 7 (1959).

*Massarinula* Géneau de Lamarlière — Rev. Gen. Bot. 6: 321 (1894).

*Pseudodiaporthe* Speg. — Ann. Mus. Buenos Aires 19: 359 (1909).

*Oraniella* Speg. — l. c. 378 (1909); Chr. emend. PETRAK and SYDOW — Ann. Mycol. 34: 47 (1936).

The spherical or hemispherical ascocarps are scattered irregularly or crowded under the epidermis, usually embedded in the underlying tissues. In some cases, they are erumpent. Sometimes, they originate within the empty ascocarps of other Pyrenomycetes. The wall of the ascocarp is composed of thick-walled, brown, polyhedral cells, which often form a clypeus and the latter may also aggregate into a stromatic tissue between adjoining ascocarps. The ascocarps are unilocular and lined with thin-walled and hyaline cells. Generally, they have a simple porus or this is lined with small, thick-walled, brown cells which often form a dark, conical or cylindrical tissue. In early stages, the porus is filled with a hyaline mass of pseudoparenchymatous tissue, the lower cells of which are attached to the upper ends of the paraphysoids. The asci have a double membrane which is thickened at the apex. They are sessile or shortly stiped, cylindrical, or cylindrical clavate and in some cases broader in the lower region. The ascospores are hyaline, fusiform or fusiform-elliptical, straight or curved, rounded at the ends, two or more celled and often surrounded by a mucous sheath, which is sometimes evanescent. The paraphysoids are numerous, thin, hyaline, filiform and septate. They are attached at both ends in early stages, ultimately becoming free at the apex.

### b) Key to the Species

- |    |  |    |
|----|--|----|
| 1  | Asci cylindrical, cylindrical-clavate, or clavate .....  | 2  |
| 1* | Asci sack-like upon maturity .....   | 18 |
| 2  | Ascospores 3-septate upon maturity .....   | 3  |
| 2* | Ascospores 1-septate .....   | 15 |
| 3  | Ascospores broadly rounded at ends, elliptical-fusiform, cylindrical or cylindrical-fusiform ..... | 4  |



- 3\* Ascospores fusiform ..... 11
- 4 Ascospores usually above 25  $\mu$  in length ..... 5
- 4\* Ascospores usually below 25  $\mu$  in length ..... 8
- 5 Ascospores straight and curved mixed ..... 6
- 5\* Ascospores always straight ..... 7
- 6 On *Fagus*, *Corylus*, *Betula*, imperfect stage *Ceratophoma*  
*Massarina eburnea*
- 6\* On *Cornus*, *Ostrya*, imperfect stage *Coniothyrium* *Massarina corni*
- 7 Ascospores thin-walled, without mucous sheath, on *Cistus*  
*Massarina cisti*
- 7\* Ascospores thick-walled, with a slime sheath, on *Spartium*  
*Massarina Brunaudi*
- 8 Ascospores elliptical-fusiform or elliptical ..... 9
- 8\* Ascospores cylindrical or cylindrical-fusiform ..... 10
- 9 Ascospores thick-walled, elliptical-fusiform, ascocarps immersed  
*Massarina coccifera*
- 9\* Ascospores thin-walled, septa not parallel, ascocarps erumpent  
*Massarina juniperi*
- 10 Ascospores usually cylindrical or oblong-elliptical, 1-septate for a long time, ascocarps immersed, on *Rosa* ..... *Massarina polymorpha*
- 10\* Ascospores oblong-elliptical or oblong-fusoid, ascocarps erumpent, flattened-hemispherical, on *Salix* ..... *Massarina salicinicola*
- 11 Ascocarps with a distinct conical or cylindrical dark tissue lining the porus ..... *Massarina microcarpa*
- 11\* Ascocarp without dark tissue lining the porus ..... 12
- 12 Mucous sheath projecting at the ends of the ascospores  
*Massarina dryopteris*
- 12\* Mucous sheath not projecting at the ends of ascospores ..... 13
- 13 Ascospores above 30  $\mu$  in length, inequilaterally curved on *Coffea*  
*Massarina coffeae*
- 13\* Ascospores under 30  $\mu$  in length ..... 14
- 14 Ascocarp with simple porus ..... *Massarina microspora*
- 14\* Ascocarp with long or conical porus ..... *Massarina coffeicola*
- 15 Ascospores oblong-elliptical or fusiform-elliptical ..... 16
- 15\* Ascospores fusiform ..... 17
- 16 Ascospores oblong-elliptical, straight; ascocarp globose, immersed  
*Massarina maritima*
- 16\* Ascospores fusiform-elliptical, straight or curved, ascocarp hemispherical, with a dark tissue at the base of the porus, erumpent  
*Massarina australis*
- 17 Ascospores with short mucous appendages at the ends *Massarina spiraeae*
- 17\* Ascospores without mucous appendages ..... *Massarina corticola*
- 18 Ascospores not more than 3-septate ..... *Massarina jasminicola*
- 18\* Ascospores more than 3-septate ..... *Massarina papulosa*

## c) Description of the Species

1. *Massarina eburnea* (Tul.) Sacc. — Syll. Fung. 2: 153 (1883)

## Synonyms:

*Massaria eburnea* Tul. — Selecta Fungorum Carpologium 2: 239 (1863).

*Sphaeria pupula* var. *minor* Desm. — Pl. Crypt. du Nord de la France, no. 1764 (1851).

*Cladosphaeria fuscidula* Otth. ap. Trog-Mitt. naturf. Gesells. Bern, no. 658—662. 37—70 (1869).

*Massaria eburnoides* Sacc. — Michelia 1: 41 (1879).

*Massarina eburnoides* (Sacc.) Sacc. — Syll. Fung. 2: 153 (1883).

Matrix: Dead branches of *Fagus silvatica* L., *Corylus avellana* L., *Betula alba* L.

Illustrations: BERLESE, A. N., Icones Fungorum 1: tab. 124, figs. 2—3 (1894). — SACCARDO, P. A., Fungi Italici, fig. 147 (1877).

Material examined: DE THÜMEN, Mycotheca universalis no. 1951 (sub. *Massaria eburnea* Tul.) ex Herb. ETH Zürich, on dead twigs of *Fagus silvatica* L., from Karlsbrunn, Silesia, Austria, during August and September 1880, leg. NIESSL. — WARTMANN and WINTER, Schweizerische Kryptogamen no. 827 (sub. *Massaria eburnea* Tul.) ex Herb.

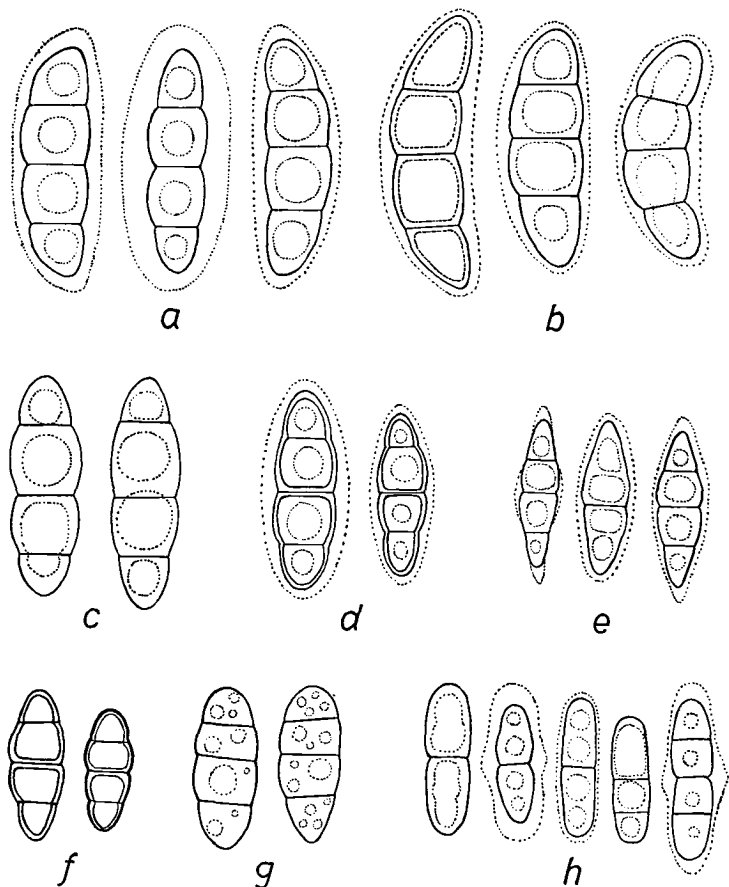


Fig. 1. Ascospores from a) *Massarina eburnea*, b) *Massarina corni*, c) *Massarina cisti*, d) *Massarina Brunaudi*, e) *Massarina microcarpa*, f) *Massarina coccifera*, g) *Massarina juniperi*, h) *Massarina polymorpha*. Magnification 1000×

ETH Zürich, on fallen twigs of *Fagus sylvatica* L., from Bremgarten forest, Bern, Switzerland, during 1880, leg. G. OTTH. — RABENHORST and WINTER, *Fungi europaei* no. 2767 (sub. *Massaria eburnea* Tul.) ex Herb. ETH Zürich, on twigs of *Fagus sylvatica* L., from Königsbrunn, Saxonia, during April 1882, leg. W. KRIEGER. — PETRAK, F., *Mycotheca generalis* no. 451 (sub. *Massarina eburnea* [Tul.] Sacc.) on dead twigs of *Fagus sylvatica* L., from Rotgraben bei Klosterneuburg, Niederdonau, during April 1941, leg. F. PETRAK. — Dead twigs of *Fagus sylvatica* L., from Rehalp forest, Zürich, Switzerland, on 31. 1. 1960, leg. S. K. BOSE (= ETH Pure Culture Collection no. 2945). — Dead twigs of *Corylus avellana* L., near Rumensee, Küssnacht, Switzerland, on 16. 4. 1960, leg. S. K. BOSE (= ETH Pure Culture Collection no. 2980).

The ascocarps occur within the cortex of thin dead branches and are usually crowded. They are 500—700  $\mu$  in diameter and approximately half as high. The upper part of the wall of the ascocarp is often clypeate and

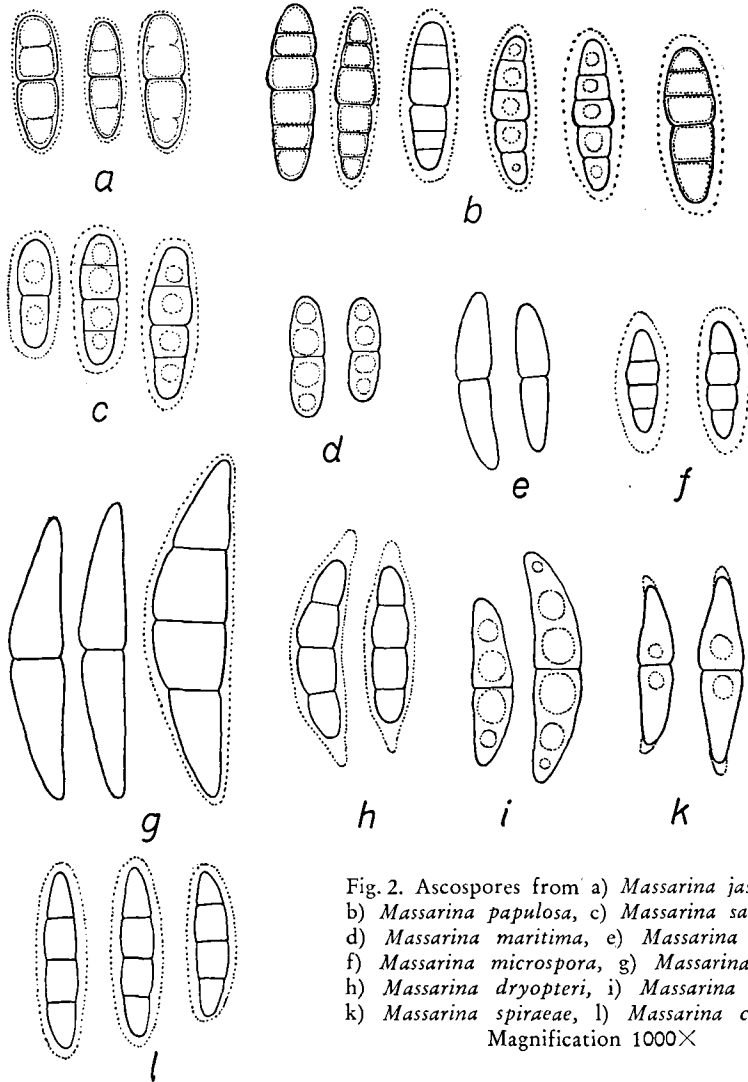


Fig. 2. Ascospores from a) *Massarina jasminicola*, b) *Massarina papulosa*, c) *Massarina salicinicola*, d) *Massarina maritima*, e) *Massarina australis*, f) *Massarina microspora*, g) *Massarina coffeae*, h) *Massarina dryopteris*, i) *Massarina corticola*, k) *Massarina spiraeae*, l) *Massarina coffeicola*.

Magnification 1000 $\times$

extends beneath the raised epidermis. Round the porus it is upto  $50\ \mu$  in thickness and is composed of thick-walled, dark brown cells  $2.5\text{--}6\ \mu$  in diameter. The wall is  $25\text{--}35\ \mu$  in thickness at the sides where it is composed of brown, elongated cells, measuring  $5\text{--}15 \times 3\text{--}6\ \mu$ . The basal part of the ascocarp is composed of binucleate or multinucleate cells derived from the lower cells of the paraphysoids and transverse hyphae, joining these cells. Croziers are formed from these cells and develop into asci (figs. 3 and 4).

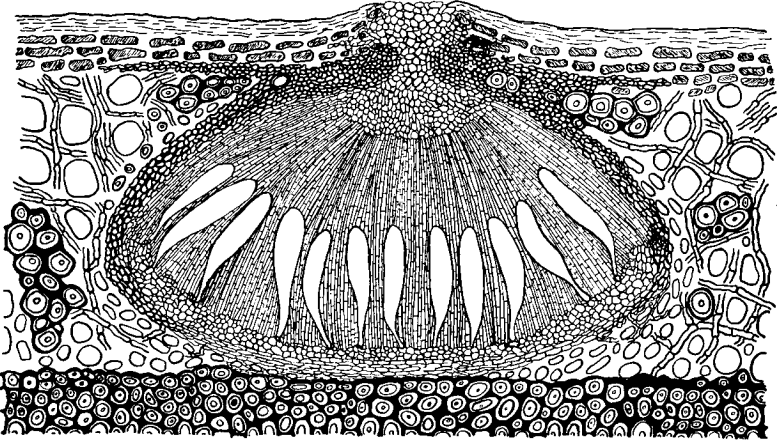


Fig. 3. Section through the ascocarp of *Massarina eburnea*. Magnification  $250\times$

The mature asci are eight-spored, cylindrical-clavate, with a double membrane, which is thickened at the apex, and measure  $90\text{--}170 \times 11$  to  $16\ \mu$ . The ascospores are biseriata in the upper part of the ascus and subseriata below. They are hyaline, oblong-fusiform, broadly rounded at the ends, straight or curved, 3-septate, with four guttulations, constricted at septa,  $27\text{--}32 \times 5\text{--}9\ \mu$  in size and surrounded by a hyaline mucous sheath, which is  $2\text{--}3\ \mu$  in thickness. The paraphysoids are thin, hyaline, septate, filiform and  $2\text{--}2.5\ \mu$  in diameter. These are closely packed between the asci and frequently anastomose, especially in the lower region where the cells are shorter and wider. At the apex, the paraphysoids are attached to a compact mass of hyaline, polyhedral cells, which ultimately disintegrate to form the porus (fig. 1 a).

**Cultural Studies:** On malt extract agar, the fungus forms a white or yellowish-white, cottony colony. After 3–7 days, numerous black pycnidia are formed on the surface. On BARNES medium, the mycelial growth is sparse and the pycnidia few in number. The pycnidia are globular with a papillate or elongated neck, and  $150\text{--}400\ \mu$  in diameter. The ostiole is  $10\text{--}20\ \mu$  in width. The wall is  $24\text{--}40\ \mu$  in thickness and composed of dark brown, thick-walled, elongated or polyhedral cells, measuring  $6\text{--}14 \times 4\text{--}8\ \mu$ . The pycnidial cavity is unilocular, but the brown cells of the perithecial wall often project towards the interior. The cavity is lined with hyaline, septate, unbranched pycnidiophores, measuring  $10\text{--}50 \times 2\text{--}4\ \mu$ .

The hyaline, unicellular, oval pycnospores are formed singly and measure  $2-3 \times 1-1.5 \mu$ .

BERKLEY and BROOME (1861) have described *Septoria princeps*, which has been supposed by TULASNE (1868), to be the imperfect stage of *Massarina eburnea*. Subsequently, BREFELD (1891) has described the pycnospores to be hyaline, ovoid and  $7-10 \mu$  in size. However, cultures obtained from the ascospores of the fungus, have always produced pycnidial stages, belonging to the form-genus *Ceratophoma*, as described above.

The fungus from the dead branches of *Corylus avellana* L., designated in literature as *Massarina eburnoides* (Sacc.) Sacc. is morphologically indistinguishable from *Massarina eburnea* (Tul.) Sacc., except for the apparent absence of the clypeus, but the tendency to form a clypeus has been noticed during the course of this investigation and the clypeus is sometimes present to a lesser extent. The isolates from *Corylus avellana* L. (ETH Pure Culture Collection no. 2980) and *Fagus silvatica* L. (ETH Pure Culture Collection no. 2945), obtained by the ascospore shooting method from unclypeate and clypeate ascocarps respectively, are similar and also produce identical pycnidial stages. This indicates that the fungi on *Fagus* and *Corylus* are indistinguishable and that the variation in the formation of clypeus evidently seems to be due to the influence of the substratum.

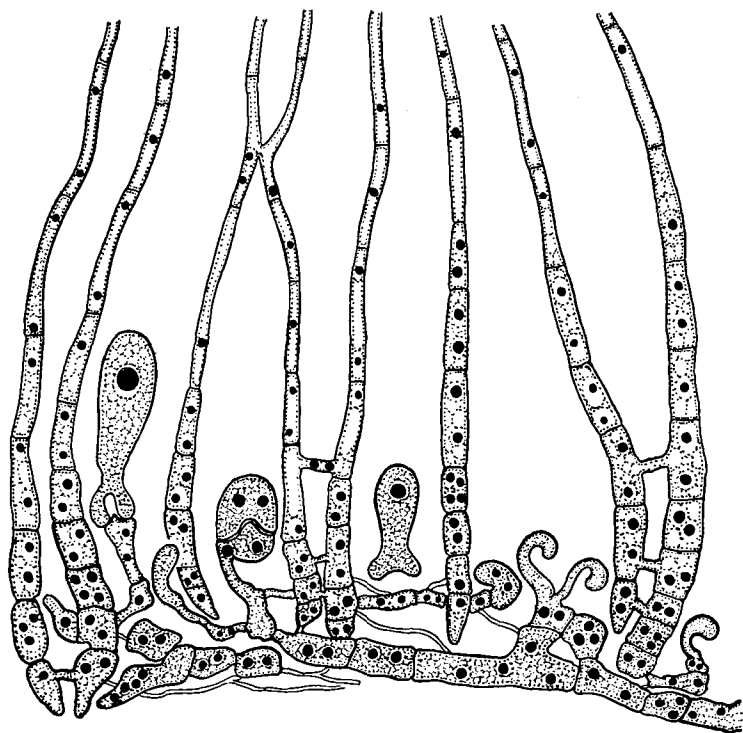


Fig. 4. Initial stages in the formation of asci of *Massarina eburnea*. Magnification 2000X

2. *Massarina corni* (Fuckel) Sacc. — Syll. Fung. 2: 154 (1883)

Synonym: *Massaria corni* Fuckel — Symb. Mycol. Nachtr. 1: 303 (1871).

Matrix: Dead twigs of *Cornus sanguinea* L., *Ostrya carpinifolia* Scop.

Illustration: BERLESE, A. N., Icones Fungorum 1: tab. 124, fig. 1 (1894).

Material examined: Herb. FÜCKEL (sub. *Massaria corni* Fuckel), ex Herb. University of Geneva, on dry twigs of *Cornus sanguinea* L., from Johannisberg, Germany, during autumn 1871, leg. G. WINTER. — JOHANNES KUNZE, Fungi selecti exsiccati no. 338 (sub. *Massaria corni* Fuckel), ex Herb. ETH Zürich, on dry twigs of *Cornus sanguinea* L., from Zürichberg, Zürich, Switzerland, during September 1878, leg. G. WINTER. — REHM, Ascomyceten (sub. *Massaria corni* Fuckel), ex Herb. University of Geneva, on dry twigs of *Cornus sanguinea* L., from Klosterzell bei Nossen, Sachsen, during August 1882, leg. KRIEGER. — KRIEGER, Fungi Saxoni no. 19 (sub. *Massaria corni* Fuckel) ex Herb. University of Geneva, on *Cornus sanguinea* L., during 1885, leg. KRIEGER. — Dry twigs of *Ostrya carpinifolia* Scop., from Meride, Kt. Tessin, Switzerland, on 30. 5. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2935). — Dry twigs of *Cornus sanguinea* L., from Solisbrücke, Alvaschein, Kt. Graubünden, Switzerland, on 2. 8. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2936).

The ascocarps are subcuticular, subepidermal or immersed in the cortex of dead twigs, usually scattered, measuring  $180\text{--}270 \times 100\text{--}150 \mu$ . The wall of the ascocarp is  $15\text{--}50 \mu$  in thickness at the sides and composed of thick-walled, brown, polyhedral cells, measuring  $3\text{--}5 \mu$  in diameter. The inner cells of the wall are hyaline and pseudoparenchymatous. At the top and base of the ascocarps, the outer brown wall is very thin and often absent. The porus is schizogonic and  $25\text{--}65 \mu$  in diameter.

The asci are eight-spored, broadly cylindrical, subsessile, with a double wall which is thickened at the apex, and  $68\text{--}115 \times 16\text{--}23 \mu$  in size. The ascospores are biseriata, hyaline, oblong-fusiform, broadly rounded at the ends, straight or curved, 1-septate with four refractive guttulations, constricted at septa and  $25\text{--}38 \times 7\text{--}11 \mu$  in size, with a hyaline mucous sheath which is  $2\text{--}3 \mu$  in thickness. The paraphysoids are thin, hyaline, septate, filiform and attached at both ends in the beginning, ultimately becoming free at the apex (fig. 1 b).

**Cultural Studies:** The fungus grows well on malt extract agar, forming a greyish or greyish-white colony. After four weeks, numerous dark coloured pycnidia, measuring  $100\text{--}300 \mu$  in diameter appear scattered on the surface. The pycnidial wall is  $15\text{--}30 \mu$  in thickness and composed of brown, polyhedral cells, measuring  $4\text{--}10 \mu$  in diameter. The innermost cells are slightly papillate and give rise to numerous oval or oblong-elliptical, brown pycnosporae, measuring  $3.5\text{--}4.5 \times 2\text{--}2.5 \mu$ . The spores fill the pycnidial cavity in a compact mass. The pycnidial stage belongs to the form-genus *Coniothyrium* Corda (1840; em. SACC. 1880 a; em. PETRAK and SYDOW 1927).

The cultures of the fungus also produce the ascocarps when grown on pieces of *Cornus* and *Fagus* twigs, previously sterilized with propylene oxide. These are formed after six months at room temperature and the structure of the asci and ascospores are similar to those occurring in nature.

3. *Massarina cisti* sp. nov.

Matrix: Dead decorticated twigs of *Cistus albidus* L.

Material examined: Dead decorticated twigs of *Cistus albidus* L., from Plan d'Aups, France, on 6. 6. 1959, leg. R. HÜTTER and W. LOEFFLER (= ETH Pure Culture Collection no. 2937).

Perithecia erumpentia, solitaria vel congregata, hemispherica, 350 to 650 × 300—425  $\mu$ . Asci paraphysati, octo-sporei, cylindranei vel claviformis, breve stipitati, bitunicati, apice crasse tunicati, 50—100 × 14—18.5  $\mu$ . Ascospore biseriata, hyalinae, rectatae, fusiformes, apice rotundatae, 3-septatae, septis, constrictae, guttulate, 25—35 × 9—11  $\mu$ .

Status conidiophorus: *Ceratophoma* v. Höhnel.

Habitat: in emortuis ramis decorticatis *Cisti albidus* L.

Typus: France, Plan d'Aups, June 6, 1959, leg. R. HÜTTER and W. LOEFFLER.

The hemispherical ascocarps occur singly or in groups on the surface of decorticated dead twigs and measure 350—650 × 300—425  $\mu$ . The wall of the ascocarps is 70—130  $\mu$  in thickness at the top and 50—100  $\mu$  at the sides. The outer layers of the wall are composed of thick-walled, dark brown, polyhedral cells, measuring 4—12  $\mu$  in diameter and often form a stromatic tissue between adjoining ascocarps. The inner cells are thin-walled, pale brown, while the innermost cells lining the cavity are hyaline and elongated, measuring 4—10 × 2—4  $\mu$ .

The asci are eight-spored, cylindric-clavate, with a double membrane, which is thickened at the apex, and 50—100 × 14—18.5  $\mu$  in size. The ascospores are biseriata, hyaline, straight, oblong-fusoid, broadly rounded at the ends, 3-septate, constricted at septa, guttulate, 25—35 × 9—11  $\mu$  in size and devoid of mucous sheath. The paraphysoids are thin, filiform, hyaline, septate and 1.5—2  $\mu$  in diameter; the cells towards the base are broader and connected with the subhymenium. At the apex the paraphysoids are attached to a hyaline, pseudoparenchymatous tissue, which disintegrates to form the porus (fig. 1 c).

Cultural Studies: The fungus grows well on malt extract agar, forming a white, cottony mycelium, which soon becomes greyish due to the formation of grey tufts of hyphae, in which the pycnidia are formed after 3—4 weeks. On BARNES agar, the mycelium and pycnidia are sparse. The fungus also produces pycnidia when grown upon *Cornus* and *Fagus* twigs, previously sterilized with propylene oxide. The pycnidia are globose or pyriform, with a papillate or elongated neck and 200—500  $\mu$  in diameter. The pycnidial wall is 20—40  $\mu$  in thickness, composed of dark brown cells, measuring 4—12  $\mu$  in length and 3—8  $\mu$  in diameter. The pycnidia on malt extract agar are unilocular, but on *Fagus* and *Cornus* twigs, the pycnidial cavity is imperfectly chambered. The cavity or chambers are lined with pseudoparenchymatous cells, which give rise to elongated, hyaline pycnidio-phores, measuring 12—25 × 2  $\mu$ . The hyaline, globose-ovoid or oblong, unicellular pycnosporos are formed singly and measure 2—2.5 × 1  $\mu$ . The pycnidia belong to the form-genus *Ceratophoma* v. Höhnel (1918).

4. *Massarina Brunaudi* nom. nov.

Synonym: *Metasphaeria spartii* Brunaud — Journ. d'hist. nat. Bordeaux et du Sud-Ouest 41: 3 (1887).

Matrix: Dead decorticated twigs of *Spartium junceum* L.

Material examined: Dead decorticated twigs of *Spartium junceum* L., from Plan d'Aups, France, on 7. 6. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2939).

The hyphae of the fungus are brown, septate, 2—4  $\mu$  in diameter and penetrate and fill the xylem vessels of dead twigs, ultimately forming ovate ascocarps, 150—250  $\mu$  in diameter, with a papillate or elongated neck of varying length. The porus is 20—50  $\mu$  wide. The wall of the ascocarp is 12—35  $\mu$  in thickness and composed of elongated or polyhedral, brown cells, measuring 6—12  $\times$  2—4  $\mu$ .

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane, which is thickened at the apex, and 60—92  $\times$  14—16  $\mu$  in size. The ascospores are straight, biseriata, hyaline, oblong-fusoid, broadly rounded at the ends, 4-guttulate, 3-septate, constricted at septa and 21—28  $\times$  4.5—8  $\mu$  in size, surrounded by a hyaline mucous sheath which is upto 5  $\mu$  in thickness. The paraphysoids are thin, hyaline, filiform, approximately 1  $\mu$  in diameter, and attached at both ends in the beginning, but ultimately becoming free at the apex (fig. 1 d).

Cultural Studies: On malt extract agar, the fungus forms a fluffy, white, raised colony, on the surface of which scattered or crowded, black pycnidia appear after two weeks. On sterilized *Fagus* twigs, the pycnidia are formed on the surface and resemble those produced on malt extract agar. The pycnidia are oval or pear-shaped and 300—500  $\mu$  in diameter. The wall is 20—30  $\mu$  in thickness, composed of elongated, dark brown cells, measuring 6—12  $\times$  2.5—4  $\mu$ , and the innermost cells are hyaline and pseudoparenchymatous. The pycnidial cavity is lined with septate, branched, hyaline pycnidiophores, measuring 15—30  $\times$  2—4  $\mu$ . The pale brown, oval, unicellular pycnosporos, formed singly, are 2.5—4  $\times$  1.5—2  $\mu$  in size and appear brownish in a mass. The pycnidial stage belongs to the form-genus *Microsphaeropsis* v. Höhnelt (1918).

*Massarina spartii*, described by PASSERINI (1888), is quite different from the fungus described above, in that it has uniseriate coloured spores and may belong to some other genus. The description of *Metasphaeria spartii* Brunaud (1887) closely approximates the fungus under discussion in morphology, locality and substratum. Unfortunately, the type specimen of this apparently synonymous fungus could not be traced for comparison. The present fungus is being treated as *Massarina Brunaudi* nom. nov. with *Metasphaeria spartii* Brunaud as a synonym.

5. *Massarina coccifera* sp. nov.

Matrix: Dry twigs of *Quercus coccifera* L.

Material examined: Dry twigs of *Quercus coccifera* L., from Antibes, France, on 18. 4. 1959, leg. E. MÜLLER.

Perithecia solitaria vel dispersa, ellipsoidea, clypeata, base plana, 200—250  $\times$  100—120  $\mu$ . Paries cellulis crassiter tunicatis, brunneis, polyedricis, 3—6  $\mu$  diam. compositus; paries parte laterale tenuis, base tenuissimus vel



abest. Asci paraphysati, octo-spore, cylindranei, bitunicati, apice crasse tunicati, brevis stipitati,  $70-115 \times 13-18 \mu$ . Ascospore biseriatae, hyalinae, rectae, crassiter tunicatae, ellipsoideae, late rotundatae extremis, 3-septatae, septis constrictis,  $14-23 \times 5-8 \mu$ .

Habitat: Ramis torridis *Querci cocciferae* L.

Typus: France, Antibes, April 18, 1959, leg. E. MÜLLER.

The hemispherical ascocarps are scattered in the cortex of dry twigs,  $200-250 \times 100-120 \mu$  in size and have a schizogonic porus. The wall of the ascocarp is upto  $30 \mu$  in thickness in the upper part, where it is clypeate and composed of thick-walled, brown, polyhedral cells  $3-6 \mu$  in diameter. The wall gradually tapers down towards the sides and is usually very thin at the base.

The asci are eight-spored, shortly stipitate, cylindrical, with a double membrane which is thickened at the apex, and measure  $70-115 \times 13-18 \mu$ . The ascospores are obliquely biseriatae, hyaline, straight, thick-walled, ellipsoid, broadly rounded at the ends, 3-septate, constricted at septa and measure  $14-23 \times 5-8 \mu$ . The paraphysoids are numerous, thin, hyaline, filiform and measure approximately  $1 \mu$  in diameter (fig. 1 f).

#### 6. *Massarina juniperi* sp. nov.

Matrix: Dry twigs of *Juniperus nana* Willd.

Material examined: Partially decorticated twigs of *Juniperus nana* Willd., from Arosa, Isla, Kt. Graubünden, on 14. 7. 1959, leg. E. MÜLLER.

Perithecia hemispherica, partim immersa,  $350-480 \times 250-350 \mu$ . Ostiolum  $30-50 \mu$  diam. Parietis  $50-80 \mu$  crassitudine parte superiore et laterale, base tenuis. Asci octo-spore, paraphysati, bitunicati, cylindranei vel paulum curvati,  $65-115 \times 10-13 \mu$ . Ascospore biseriatae, hyalinae, 3-septatae, septis constrictae, loculi impleti guttulae virides vel gilvi,  $14-21 \times 6.5-9 \mu$ .

Habitat: In ramis partium decorticatis *Juniperi nanae* L.

Typus: Switzerland, Kt. Graubünden, Arosa Isla, July 14, 1959, leg. E. MÜLLER.

The hemispherical ascocarps are partially embedded at the base,  $350$  to  $480 \times 250-350 \mu$  in size and have a unipapillate or slightly depressed porus which is  $30-50 \mu$  in diameter. The wall of the ascocarp is  $50-80 \mu$  in thickness and is composed of dark, thick-walled, irregular cells towards the exterior, succeeded by yellowish-brown, polyhedral cells towards the interior. The cavity of the ascocarp is lined with interwoven or parallel elongated cells. The basal part of the ascocarp is thin and hyaline. The remains of the host tissues are often incorporated in the wall of the ascocarp.

The asci are eight-spored, shortly stipitate, with a double membrane which is thickened at the apex, and measure  $65-115 \times 10-13 \mu$ . The ascospores are obliquely biseriatae, elliptical, hyaline, 3-septate, constricted at septa and measure  $14-21 \times 6.5-9 \mu$ . The ascospores are full of small, yellowish-green guttulations and the septa are usually non parallel. The paraphysoids are numerous, thin, hyaline, filiform and measure approximately  $0.5 \mu$  in diameter (fig. 1 g).

7. *Massarina polymorpha* (Rehm) Sacc. — Syll. Fung. 2: 155 (1883)

Synonyms:

*Massaria polymorpha* Rehm — Ascom. Diagon. no. 242.

*Massarina himalayense* Müller — Sydowia 11: 461 (1957).

Matrix: Dead twigs of *Rosa* sp.

Illustration: MÜLLER, E., Sydowia 11: 462, fig. 5 (1957).

Material examined: Dry twigs of *Rosa* sp., from Klosters, Kt. Graubünden, Switzerland, on 1. 5. 1944, leg. A. VOLKART. — Dry twigs of *Rosa* sp., from Schöni Wollerau, Kr. Zürich, on 10. 2. 1950, leg. E. MÜLLER. — Herb. ETH Zürich, on dry twigs of *Rosa moschata* Müller, from Naini Tal, Kumaon, India, 5. 5. 1957, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2943). — Herb. ETH Zürich (sub. *Massarina himalayense*), on dry twigs of *Rosa* sp., from Bhuna, Nanda-Gini Valley, Eastern Garhwal, India, on 4. 6. 1957, leg. E. MÜLLER. — Dry twigs of *Rosa* sp., from Montagnes de Saou (Drôm), France, on 31. 5. 1959, leg. E. MÜLLER. — Dry twigs of *Rosa pendulina* L., from Ibergereg, on 21. 6. 1960, leg. E. MÜLLER.

The globular, pyriform or hemispherical ascocarps are scattered in the cortex of dead twigs and measure 250—500  $\mu$  in diameter. These are usually unapiculate, but sometimes the ascocarps are deep seated and open by means of a short neck. The wall of the ascocarp is 25—50  $\mu$  in thickness and composed of thick-walled, brown, polyhedral cells, measuring 4—12  $\mu$  in diameter. The flattened base of the hemispherical ascocarps is composed of thin-walled, hyaline and pseudoparenchymatous cells.

The asci are eight-spored, subsessile, cylindrical, with a double membrane which is thickened at the apex, and measure 60—110  $\times$  9—14  $\mu$ . The ascospores are hyaline, cylindrical or oblong-elliptical, rounded at the ends and constricted in the middle. In some cases, the ascospores remain 1-septate and 2—4 guttulate for a long time, occasionally becoming 3-septate. In other cases, on the contrary, the spores become 3-septate earlier. The ascospores are 14—25  $\times$  4—7  $\mu$  in size and usually surrounded by a hyaline mucous sheath, which is upto 2.5  $\mu$  in thickness, but which sometimes appears thicker in the middle. The paraphysoids are thin, hyaline, filiform and approximately 1.5  $\mu$  in diameter (fig. 1 h).

**Cultural Studies:** The fungus grows well on malt extract agar, forming a colony with raised centre and zonate, ash-coloured margin. Numerous black, globular, superficial pycnidia, measuring 70—200  $\mu$  in diameter, are produced after three weeks. The wall of the pycnidia is 10—20  $\mu$  in thickness and composed of brown, polyhedral cells, measuring 4—10  $\mu$  in diameter. The pycnidial cavity is lined with hyaline, branched pycnidio-phores, approximately 1—2  $\mu$  in diameter, which bear hyaline, oval pycnospores, measuring 2—4  $\times$  2  $\mu$ . The pycnidial stage belongs to the form-genus *Dendrophoma* Sacc. (1880 a).

8. *Massarina salicinicola* Rehm — Ann. Mycol. 4: 397 (1906)

Matrix: Dead twigs of *Salix* sp.

Material examined: Dead twigs of *Salix* sp., ex Herb. Hort. Bot. Reg. Kew, from Vardefjell, Neslyen, Buskerud Jylke, Norway, on 7. 8. 1956, leg. R. W. G. DENNIS. — Dead twigs of *Salix* sp., from Arosa, on 18. 7. 1958, leg. E. MÜLLER.

The hemispherical ascocarps are scattered in the cortex of thin, dead branches and measure 250—350  $\times$  135—170  $\mu$ . The wall of the ascocarp is

30—45  $\mu$  in thickness at the apex and composed of dark brown, thick-walled polyhedral cells, upto 4  $\mu$  in diameter, and these also ramify in the adjoining epidermal and subepidermal tissues of the substratum, intercellularly forming a clypeus. Towards the sides, the ascocarps are 15—25  $\mu$  in thickness and composed of light brown, elongated cells. The basal part is hyaline and pseudoparenchymatous. The ostiole is simple, schizogonous and 15—25  $\mu$  in diameter (fig. 5).

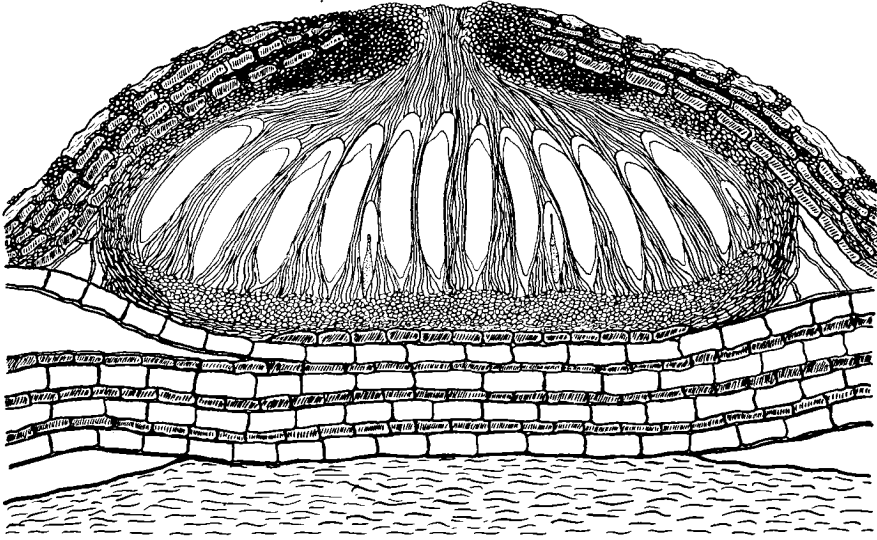


Fig. 5. Section through the ascocarp of *Massarina salicinicola*. Magnification 250 $\times$

The asci are eight-spored, shortly stipitate, cylindrical-clavate, with a double membrane which is thickened at the apex, and measure 60—95  $\times$  12 to 16  $\mu$ . The ascospores are obliquely biseriata, straight, oblong-elliptical or oblong fusoid, at first 1- then 3-septate, 2—4 guttulate, constricted at the middle septum, occasionally constricted at the other two septa, 14—20  $\times$  4.5—6  $\mu$  in size and with a hyaline mucous sheath, which is upto 2  $\mu$  in thickness. The paraphysoids are thin, hyaline, filiform, flexuous and approximately 2  $\mu$  in thickness (fig. 2 c).

9. *Massarina microcarpa* (Fuckel) Sacc. — Syll. Fung. 2: 154 (1883)

Synonyms:

- Massaria microcarpa* Fuckel — Symb. Mycol. p. 154 (1869).
- Massaria coryli* Karst. — Symb. Mycol. Fenn. p. 33 (1870).
- Massarina coryli* (Karst.) Sacc. — Syll. Fung. 2: 154 (1883).
- Massaria rubi* Fuckel — Symb. Mycol. Nachtr. 1: 303 (1871).
- Massarina rubi* (Fuckel) Sacc. — Syll. Fung. 2: 155 (1883).
- Sclerodothis sepincola* (Berk. and Br.) Petrak — Ann. Mycol. 19: 41 (1921 a).

Matrix: Dead twigs of *Carpinus betulus* L., *Corylus avellana* L., *Crataegus oxyacantha* L., *Juglans regia* L., *Kerria japonica* DC., *Rubus fruticosus* L.

Illustrations: BERLESE, A. N., Icones Fungorum 1: tab. 123, fig. 1 (1894). — FÜCKEL, L., Symb. Mycol. tab. 6, fig. 37 (1869). — MÖLLER, F. H., Fungi of Faröes, 2: 75 (1958).

Material examined: Herb. FÜCKEL (sub. *Massaria microcarpa* Fuckel) ex Herb. ETH Zürich, on dry twigs of *Carpinus betulus* L., from Oestricher Wald, Rheinland, during spring 1894, leg. L. FÜCKEL. — Herb. FÜCKEL (sub. *Massaria rubi* Fuckel), ex Herb. University of Geneva, on dry twigs of *Rubus fruticosus* L., from the south slope of the Boss bei Eberbach, Germany, during autumn 1894, leg. L. FÜCKEL. — PETRAK, Flora Moravica (sub. *Metasphaeria sepincola* [Berk. and Broome] Sacc.), ex Herb. ETH Zürich, on dry twigs of *Crataegus oxyacantha* L., from Weisskirchen, Czechoslovakia, during April 1916, leg. F. PETRAK. — PETRAK, Flora Moravica (sub. *Metasphaeria sepincola* [Berk. and Broome] Sacc.), ex Herb. ETH Zürich, on dry twigs of *Corylus avellana* L., from Weisskirchen, Czechoslovakia, during November 1925, leg. F. PETRAK. — In empty ascocarps of another Pyrenomycete on dry twigs of *Kerria japonica* DC., from Zollikon, Zürich, Switzerland, on 15. 4. 1951, leg. E. MÜLLER. — On dead twigs of *Juglans regia* L., from Forstgarten, Brione-Verzasca, Switzerland, 28. 3. 1955, leg. JOTTERAND (= ETH Pure Culture Collection no. 2944).

The hemispherical or pear-shaped ascocarps are scattered or crowded in the cortex of the dead twigs, sometimes also occurring within empty ascocarps of other Pyrenomycetes, and are 150—350  $\mu$  in diameter. The wall of the ascocarp is 15—50  $\mu$  in thickness and composed of brown, thick-walled, polyhedral cells, measuring upto 10  $\mu$  in diameter. The porus is conical or cylindrical, 30—100  $\mu$  in length, 20—50  $\mu$  in diameter and lined with an opaque, black, conical or cylindrical tissue, which is upto 15  $\mu$  in thickness and composed of thick-walled, dark brown cells, measuring 2—5  $\mu$  in diameter (fig. 6).

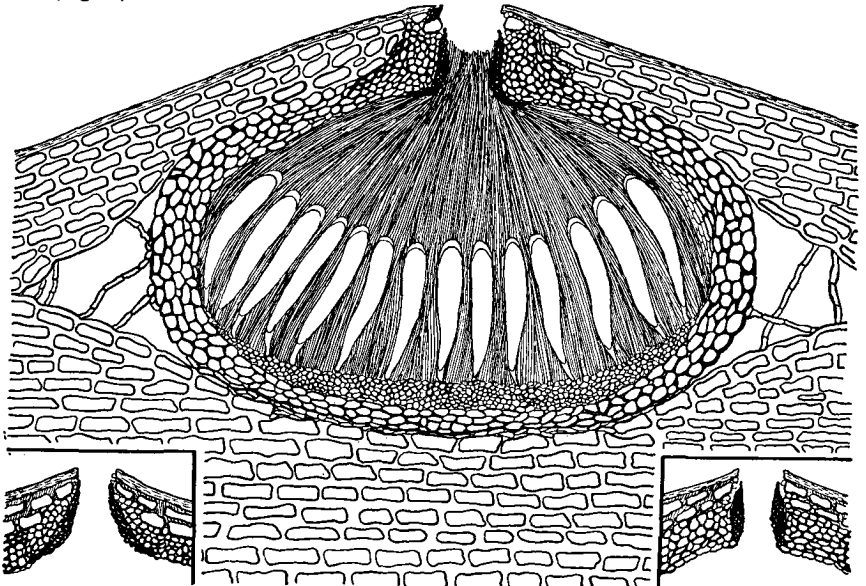


Fig. 6. Section through the ascocarp of *Massarina microcarpa*; inset-variations in the structure of the porus. Magnification 250 $\times$

The asci are eight-spored, cylindrical, with a double membrane which is thickened at the apex, and measure 50—100  $\times$  8—14  $\mu$ . The ascospores are hyaline, straight or slightly curved, fusiform, at first 1-septate in the middle,

ultimately 3-septate, constricted at the septa, measuring  $16-26 \times 4.5-7 \mu$ , surrounded by a hyaline mucous sheath, which is upto  $3 \mu$  in width and rounded or tapering at the tips. The paraphysoids are thin, hyaline, filiform and  $1-1.5 \mu$  in diameter (fig. 1 e).

**Cultural Studies:** The fungus grows well on malt extract agar, producing a fluffy, greyish-white, raised colony. On BARNES agar, the mycelium is appressed to the substratum and the growth is slow.

Examination of the type specimens of *Massarina microcarpa* (Fuckel) Sacc. and *Massarina rubi* (Fuckel) Sacc. has shown that the two specimens have similar fruit bodies and the structures of the ostiole, asci and ascospores approximate closely. It is, therefore, proposed to treat *Massarina rubi* (Fuckel) Sacc. as a synonym of the earlier described fungus *Massarina microcarpa* (Fuckel) Sacc.

*Massarina coryli* (Karst.) Sacc. has been indicated by SACCARDO (1883) to have affinity with *Massarina microcarpa* (Fuckel) Sacc. Subsequently, REHM (1906) has treated the former as a synonym.

#### 10. *Massarina dryopteri* sp. nov.

Matrix: Dry leaves of *Dryopteris filix mas* L.

Material examined: Dry leaves of *Dryopteris filix mas* L., from Burvagn, Oberhalbstein, Kt. Graubünden, on 12. 6. 1955, leg. E. MÜLLER.

Perithecia solitaria, immersa, globosa,  $100-150 \mu$  diam. Paries  $8-12 \mu$  crassitudine, asci paraphysati, cylindranei, bitunicati, crasse tunicati, octospori,  $70-80 \times 12-14 \mu$ . Ascosporae biseriatae, rectae vel curvatae, hyalinae, fusiformes vel ellipsoideae, 3-septatae, septis constrictae,  $22-28 \times 5-7 \mu$ , bituitosae, in extremis appendices  $5-7 \mu$  longitudine.

Habitat: In foliis aridis *Dryopteris filix mas*.

Typus: Switzerland, Kt. Graubünden, Oberhalbstein, Burvagn, June 12, 1955, leg. E. MÜLLER.

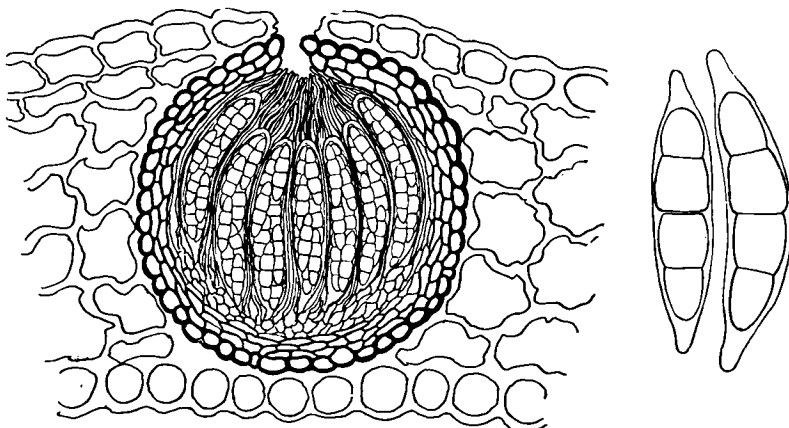


Fig. 7. Section through the ascocarp of *Massarina dryopteri*;  
Magnification  $330\times$ ; ascospores (right)  $1300\times$

The spherical ascocarps are scattered and immersed in the tissues of the dry leaves and measure 100—150  $\mu$  in diameter. The wall of the ascocarp is composed of brown, polyhedral cells, measuring 4—7  $\mu$  in diameter. The cavity of the ascocarp is lined with two or three layers of thin-walled, elongated cells (fig. 7).

The asci are eight-spored, shortly stipitate, cylindrical, with a double membrane which is thick-walled at the apex, and measure 70—80  $\times$  12—14  $\mu$ . The ascospores are biseriata, hyaline, fusiform, 3-septate, constricted at septa and measure 22—28  $\times$  5—7  $\mu$ . The cell above the middle septum is broadest. There is a thin mucous sheath which projects out at both ends to the extent of 5—7  $\mu$ . The paraphysoids are thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 2 h).

**Cultural Studies:** The fungus forms a greyish-white, slow growing colony on malt extract agar. The mycelium is appressed at first, later on forming numerous, scattered, dark-coloured, conical hyphal structures, measuring 2—5  $\mu$  in diameter. On BARNES agar and on inoculated wood of *Fagus* and *Cornus*, the growth is very slow. No ascocarp or imperfect stage has been observed in any of the various substrata.

#### 11. *Massarina coffeae* (Speg.) comb. nov.

Synonym: *Pseudodiaporthe coffeae* Speg. — Anal. Mus. Nac. Buenos Aires 19, 359 (1909).

Matrix: Dry twigs of *Coffea arabica* L.

Illustration: SPEGAZZINI, C., l. c. 359, fig. 14 (1909).

Material examined: SPEGAZZINI no. 2459, ex Herb. University of La Plata, on dead twigs of *Coffea arabica* L., from Jujuy, Oran, during March 1905, leg. SPEGAZZINI.

The flask-shaped ascocarps, measuring 450—750  $\mu$  in diameter, occur scattered or in groups embedded in the wood and open to the surface by means of a long neck, measuring 200—600  $\mu$  in length and 95—200  $\mu$  in diameter. The neck is usually formed at the apex of the ascocarp, but sometimes, it arises somewhat obliquely. The wall of the fruit body is 50 to 90  $\mu$  thick at the sides but thinner at the neck and base, where it is only 20—30  $\mu$  in thickness, and is composed of small, polyhedral, brown cells measuring 5—7  $\mu$  in diameter. From the surface of the ascocarp, numerous brown, thick-walled, septate hyphae ramify in the substratum and measure 2.5—3  $\mu$  in diameter (fig. 8).

The asci are eight-spored, clavate, with a double membrane which is thickened at the apex, and measure 90—150  $\times$  16—19  $\mu$ . The ascospores are biseriata, irregularly biseriata or crowded, hyaline, fusiform, tapering at ends, 1-septate for a long time, ultimately becoming 3-septate, constricted at septa, 32—45  $\times$  6—10  $\mu$  in size and sometimes surrounded by a thin mucous sheath. The paraphysoids are thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 2 g).

This fungus had been originally placed in the monotypic genus *Pseudodiaporthe* by SPEGAZZINI (1909). However, the characters being similar to those of the Genus *Massarina* Sacc., the fungus is now treated as *Massarina coffeae* (Speg.) comb. nov.

12. *Massarina microspora* Pass. — Rend. R. Acad. Lincei Roma, 4 ser. 7: 45 (1891)

Matrix: Dry twigs of *Bupleurum fructigenum* L., *Coriaria myrtifolia* L., *Lavendula stoechas* L.  
 Illustration: BERLESE, A. N., *Icones Fungorum* 1: tab. 122, fig. 2 (1894).

Material examined: Dry twigs of *Lavendula stoechas* L., from Biot, Alpes Maritimes, France, on 23. 4. 1959, leg. E. MÜLLER. — Dry twigs of *Coriaria myrtifolia* L., from Biot, Alpes Maritimes, France, on 25. 4. 1959, leg. E. MÜLLER. — Dry twigs of *Bupleurum fructigenum* L., from St. Guilhem-le-Desert, Hérault, France, on 26. 5. 1960, leg. E. MÜLLER.

The globose or subglobose ascocarps are scattered in the cortex of the dead branches and measure 90—160  $\mu$  in diameter. The wall of the ascocarp is 16—35  $\mu$  in thickness and composed of small, thick-walled, brown, polyhedral cells, measuring 2.5—5  $\mu$  in diameter. The upper part of the ascocarp often extends on either side like a clypeus and is composed of a net-work of dark brown, interwoven hyphae. The porus is simple and 10—20  $\mu$  in diameter.

The asci are eight-spored, shortly stipitate, cylindrical, with a double membrane which is thickened at the apex, and measure 45—92  $\times$  9.5—14  $\mu$ . The ascospores are obliquely biseriate, straight, fusoid, hyaline, 3-septate, constricted at septa, 13—16.5  $\times$  4—5  $\mu$ , with a hyaline mucous sheath, which is upto 2  $\mu$  in thickness. The paraphysoids are thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 2 f).

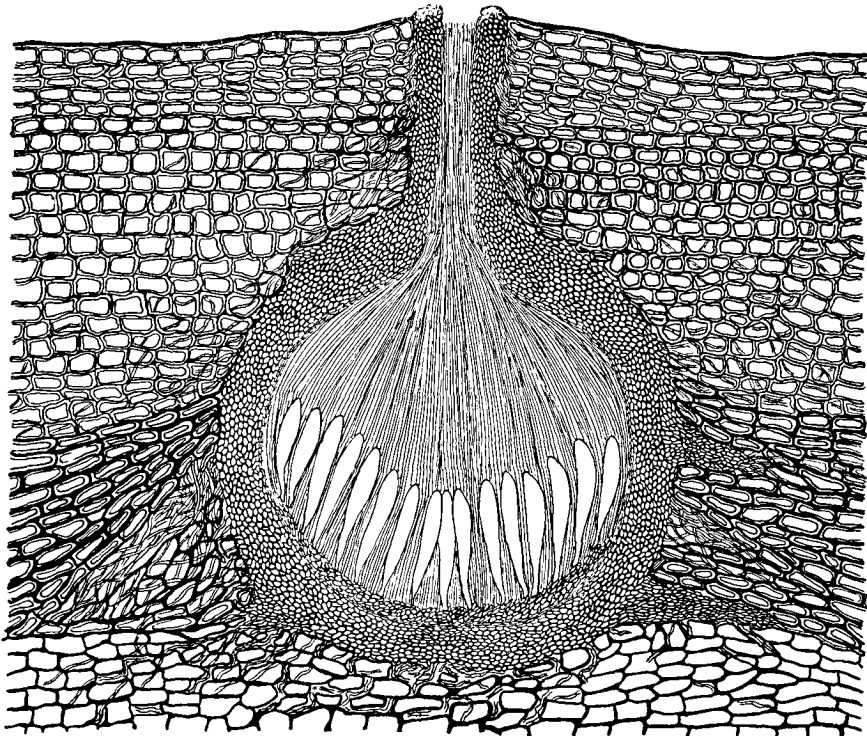


Fig. 8. Section through the ascocarp of *Massarina coffeae*. Magnification 250 $\times$

**Cultural Studies:** On malt extract agar, the fungus produces a grey or a greyish-white, slow growing, conical or hemispherical sclerotial colony. On BARNES agar, the mycelium is very slow growing, sparse and appressed.

13. *Massarina coffeicola* (Speg.) comb. nov.

Synonym: *Oraniella coffeicola* Speg. — Anal. Mus. Nac. Buenos Aires, 19: 378 (1909); chr. emend. PETRAK — Ann. Mycol. 34: 47 (1936).

Matrix: Dead twigs of *Coffea arabica* L.

Illustration: SPEGAZZINI, C., Anal. Muc. Buenos Aires, 19: 378, fig. 17 (1909).

Material examined: Herb. ETH Zürich, on dry twigs of *Coffea arabica* L., from Columbia, on 20. 7. 1959, received from Dr. VON ARX (= ETH Pure Culture Collection no. 2940).

The pear-shaped or flask-shaped ascocarps are scattered in the cortex of dead twigs and also occur in old, empty fruit bodies belonging to the same fungus. These are 100—280  $\mu$  in diameter and open to the surface of the substratum by means of a conical or elongated neck, which is upto 200  $\mu$  in length and 50—90  $\mu$  in diameter. The ascocarp wall is 10—25  $\mu$  in thickness and composed of thick-walled, polyhedral or elongated, brown cells, measuring 3—8  $\mu$  in diameter. The basal part of the neck and the porus is lined by thin-walled, elongated, light brown or hyaline cells to which the upper ends of the paraphysoids are attached in the beginning.

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex, and measure 70—95  $\times$  9 to 12  $\mu$  in size. The ascospores are biseriata, hyaline, fusiform, straight or inequilaterally curved, 3-septate, constricted at septa, measuring 21—28  $\times$  9—12  $\mu$ , with a thin hyaline mucous sheath which is often evanescent. The paraphysoids are thin, hyaline, filiform, approximately 2 $\mu$  in diameter, and attached at both ends in the beginning, ultimately becoming free at the apical end (fig. 2 l).

**Cultural Studies:** On BARNES agar, the fungus forms a slow growing white colony which gradually turns grey in the centre. On malt extract agar, the colony is brownish-white and raised. No fructifications are formed on any of these two media. However, on sterilized *Fagus* twigs, the ascocarps are formed on the surface in small numbers after about five months at room temperature. These are globose, 250—300  $\mu$  in diameter, with a wall 25—30  $\mu$  in thickness, which is composed of dark brown, elongated or polyhedral cells, measuring 3—5  $\mu$  in diameter. The ascocarps are covered with encrusted or warty, brown, hyphae, measuring 4—5  $\mu$  in diameter. The asci and ascospores are similar to those formed in nature. The variation in the shape of the ascocarp, especially the presence or absence of the neck, is evidently due to the influence of the substratum and the position of the fruit body. When the latter is formed superficially, as in the case on inoculated *Fagus* twigs, the neck is completely absent, whereas on dead twigs of *Coffea arabica* the ascocarps are embedded in the substratum and the length of the neck is dependent upon the depth at which the ascocarps are formed.



14. *Massarina maritima* sp. nov.

Matrix: Dead twigs of *Spartium junceum* L.

Material examined: Dead twigs of *Spartium junceum* L., from Ste. Maymes, Antibes, Alpes Maritimes, France, on 24. 4. 1959, leg. E. MÜLLER (= ETH Pure Culture no. 2933).

Perithecia cortice immersa vel in peritheciis vacuis alterarum pyrenomycetum, globosa vel subglobosa, 170—350  $\mu$  diam. Paries 15—40  $\mu$  crassitudine, cellulis crasse tunicati, atro-fuscis, 3—9  $\mu$  diam. Ostiolum 15—50  $\mu$  diam. Asci paraphysati, octo-spori, bitunicati, crasse tunicati apice, cylindraceuti, breve stipitati, 65—85  $\times$  11—14  $\mu$ . Ascosporae biseriatae, hyalinae, rectae, ellipsoideae vel cylindraceutae, in medio constrictae, bicellulatae, 4-guttulatae, 14—20  $\times$  4.5—7  $\mu$ .

Habitat: In torridis ramis *Spartii juncei* L.

Typus: Alpes Maritimes, Antibes, Ste. Maymes, France, April 24, 1959, leg. E. MÜLLER.

The globose or subglobose ascocarps are scattered in the cortex and also occur in old empty ascocarps of another Pyrenomycete. These are 170—350  $\mu$  in diameter. The wall of the ascocarp is 15—40  $\mu$  in thickness and composed of thick-walled brown polyhedral cells, measuring 3—9  $\mu$  in diameter. From the outer cells, light brown to dark brown, septate, encrusted or warty hyphae are given out. The porus is simple, on level with the substratum or slightly papillate, and 15—50  $\mu$  wide.

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex and 65—85  $\times$  11—14  $\mu$  in size. The ascospores are obliquely biseriatae, hyaline, straight, oblong-elliptical, 1-septate, constricted in the middle, 2—4 guttulate and measure 14—20  $\times$  4.5—7  $\mu$ . The Paraphysoids are thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 2 d).

Cultural Studies: The fungus forms a brownish very slow growing colony on BARNES agar. On malt extract agar, the colony is white or greyish-white, appressed to the substratum and becomes greyish at the margin when old.

15. *Massarina australis* sp. nov.

Matrix: Dead twigs of a deciduous plant.

Material examined: Dead twigs of a deciduous plant, from Garden Route (10 miles west of Knysna), Cape Province, South Africa, on 31. 10. 1959 (collection no. 72), leg. H. SCHÜEPP.

Perithecia hemispherica, base substrato immersa, 400—650  $\times$  200 to 300  $\mu$  Paries 35—75  $\mu$  crassitudine, clypeatus, cellulis brunneis 5—12  $\mu$  diam., compositus. Ostiolum 20—35  $\mu$  diam., pars basilis pori circumdata texta umbrina cellulis parvis, umbrinis, polyedricis. Asci paraphysati, octo-spori, bitunicati, cylindraceuto-clavati, apice crassetunicati, 80—100  $\times$  10—12  $\mu$ . Ascosporae biseriatae, rectae vel leniter tunicatae, cylindraceuto-fusifformes, hyalinae, bicellulatae, medio leniter constrictae, 20—25  $\times$  4.5—5.5  $\mu$ .

Habitat: Ramis torridis.

Typus: South Africa, Cape Province, Garden Route (10 miles west of Knysna), October 31, 1959, leg. H. SCHÜEPF.

The ascocarps are clypeate, hemispherical, flattened and their base is embedded in the woody substratum. These are  $400-650 \times 200-300 \mu$  in size. The wall of the ascocarp is  $35-70 \mu$  in thickness and composed of brown, polyhedral cells, measuring  $5-12 \mu$  in diameter. Disintegrated cells of the substratum are often incorporated in the wall. The porus is simple, unapiculate,  $20-35 \mu$  in diameter and lined at the base with a dark tissue composed of small, dark brown, polyhedral cells, upto  $6 \mu$  in diameter. The base of the ascocarp is composed of thin hyaline cells (fig. 9).

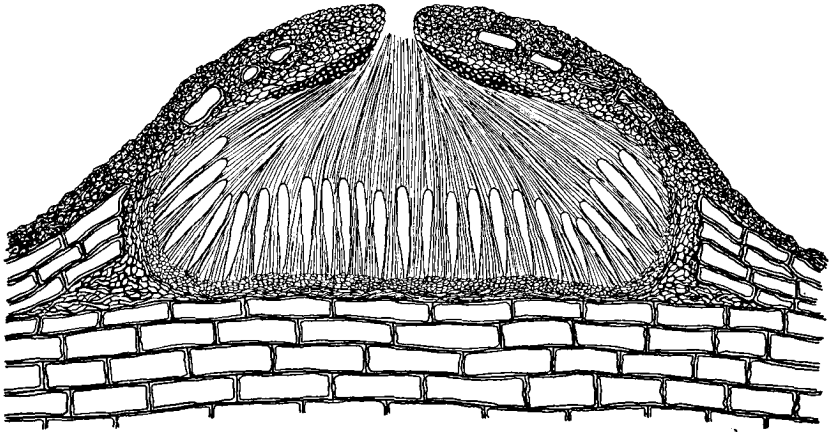


Fig. 9. Section through the ascocarp of *Massarina australis*. Magnification  $125\times$

The asci are eight-spored, clavate-cylindrical, with a double membrane which is thickened at the apex, and measure  $80-100 \times 10-12 \mu$  in size. The ascospores are obliquely biseriate, straight or slightly curved, fusiform-elliptical, 1-septate, constricted in the middle, and  $20-25 \times 4.5-5.5 \mu$  in size. When freshly ejected, the ascospores often have a long thread-like mucous appendage at both ends, but these disappear after a short time. The paraphysoids are thin, hyaline, filiform and approximately  $0.5 \mu$  in diameter (fig. 2 e).

#### 16. *Massarina spiraeae* sp. nov.

Matrix: Dead twigs of *Spiraea salicifolia* L.

Material examined: PETRAK, Flora Moravica (sub. *Metasphaeria sepincola* [Berk. and Broome] Sacc.) ex Herb. ETH Zürich, on dead twigs of *Spiraea salicifolia* L., collected from Weisskirchen, Czechoslovakia, during June 1923, leg. F. PETRAK.

Perithecia solitaria, subcorticea, globosa vel subglobosa,  $135-200 \times 100-150 \mu$ . Paries  $15-35$  crassitudine, brunneis, cellulis tenuites tunicatis,  $4-10 \mu$  diam. Ostiolum simplex, ad  $25 \mu$  diam. Asci paraphysati, cylindracei, bitunicati, crasse tunicati apice, parte inferiore latiores,  $50-65 \times 16-19 \mu$ . Ascospores biseriatas, hyalinae, fusiformes, extremis rotundatae,

bicellulatae, in medico constrictae, hyalino appendice pituitoso, ad  $2\ \mu$  longitudine. Spore appendicesque  $22\text{--}28 \times 4.5\text{--}8\ \mu$ .

Habitat: In ramis aridis *Spiraeae salicifoliae* L.

Typus: Weißkirchen, June 1923, leg. F. PETRAK.

The slightly clypeate or unclypeate, globose or subglobose ascocarps occur scattered in the cortex of the dead twigs and measure  $135\text{--}200 \times 100\text{--}150\ \mu$ . The wall of the ascocarp is  $15\text{--}35\ \mu$  in thickness and composed of polyhedral, brown cells, measuring  $4\text{--}10\ \mu$  in diameter. The porus is simple and  $15\text{--}25\ \mu$  in width.

The asci are eight-spored, broadly-cylindrical, sessile or shortly stipitate, with a double membrane which is thickened at the apex, and measure  $50\text{--}65 \times 16\text{--}19\ \mu$ . The ascospores are biserial, fusiform, straight or inequilaterally curved, 1-septate, constricted in the middle, with short, hyaline appendages at the ends, extending upto  $2\ \mu$  in length, and measure  $22\text{--}28 \times 4.5\text{--}8\ \mu$  in size, inclusive of the appendages. The paraphysoids are hyaline, filiform, septate, approximately  $1.5\ \mu$  in diameter, and attached at both ends in the beginning, but ultimately becoming free at the apex (fig. 2 k).

17. *Massarina corticola* (Fuckel) Holm — Symb. Bot. Upsal. 14: 147 (1957)

Synonyms:

*Trematosphaeria corticola* Fuckel — Symb. Mycol. 162 (1869).

*Zygnocella corticola* Sacc. — Michelia 1: 346 (1878).

*Melomastia corticola* Schroet. — Die Pilze Schles. 2: 321 (1894).

Matrix: Dead twigs of *Aesculus*, *Juglans*, *Populus*, *Rhamnus*, *Quercus*, *Salix*, *Spartium*, *Tilia*, *Ulmus* spp.

Illustrations: BERLESE, A. N., Icones Fungorum 1: tab. 95, fig. e (1894). — HOLM, L., Symb. Bot. Upsal. 14: 175, fig. 4 j (1957).

Material examined: Dead twigs of *Spartium junceum* L., from Gréolières, le Foulons, Alpes Maritimes, France, on 21. 6. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2933).

The hemispherical ascocarps, occurring scattered in the cortex of the dead twigs, are  $300\text{--}500\ \mu$  in diameter and somewhat less in height. The wall of the ascocarp is  $70\text{--}90\ \mu$  in thickness in the upper part, becoming thinner at the sides where it is  $25\text{--}50\ \mu$  in thickness and is composed of elongated or irregular polyhedral, brown cells, measuring  $4\text{--}10\ \mu$  in diameter. Groups of thick-walled cells occur scattered in the wall of the ascocarp, especially in the outer layers. The porus is simple and  $10\text{--}35\ \mu$  in width.

The asci are eight-spored, clavate, tapering in the lower part, with a double membrane which is thickened at the apex, and measure  $60\text{--}100 \times 10\text{--}14\ \mu$ . The ascospores are biserial in the upper part of the ascus, getting subserial below, and are fusiform, curved, 1-septate, constricted in the middle,  $4\text{--}6$  guttulate, measuring  $23\text{--}34 \times 4\text{--}5\ \mu$ . The paraphysoids are densely packed, thin, hyaline, filiform and approximately  $1\ \mu$  in diameter (fig. 2 i).

Cultural Studies: On BARNES agar, the fungus forms a slow growing, light brown, feathery, appressed colony. On malt extract agar,

the colony is white and appressed, forming pycnidial initials which do not mature.

18. *Massarina jasminicola* Viswanathan — Mycopathologia et Mycologia Applicata  
13: 239 (1960)

Matrix: Dry twigs of *Jasminum malabaricum* Wall.

Illustration: VISWANATHAN, T. S., and S. T. TILAK, Mycopathologia et Mycologia Applicata  
13: 239, fig. 3 (1960).

Material examined: Herb. ETH Zürich, on dry twigs of *Jasminum malabaricum* Wall., from  
Poona, India, on 9. 2. 1959, leg. T. S. VISWANATHAN (= ETH Pure Culture Collection  
no. 2942).

The globose or subglobose, papillate ascocarps, immersed in the cortex of the dead twigs, measure 150—250  $\mu$  in diameter. The wall of the ascocarp is 12—35  $\mu$  in thickness and is composed of thick-walled, polyhedral, brown cells, measuring 3—9  $\mu$  in diameter. The porus is 20—30  $\mu$  in diameter and approximately the same in height.

The asci are eight-spored, at first cylindrical, becoming sack-like when mature, with a double membrane which is thickened at the apex, shortly stipitate, and 60—85  $\times$  11.5—18.5  $\mu$  in size. The ascospores are biseriata or crowded, hyaline, straight, cylindrical-fusoid or oblong-elliptical, at first 1-septate, later 3-septate, constricted in the middle, 2—4 guttulate, and 14.5—19  $\times$  6.5—6  $\mu$  in size, with a hyaline mucous sheath which is upto 2  $\mu$  in thickness. The paraphysoids are crowded, thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 2 a).

**Cultu r a l S t u d i e s :** The fungus produces a slow growing, greyish-white, appressed colony on BARNES agar. On malt extract agar, the colony is dark grey, compact or raised in the centre, producing fruit bodies after about five months at room temperature. The asci degenerate early and the ascospores too usually appear degenerate, brownish and 3-septate.

19. *Massarina papulosa* (Dur. et Mont.) comb. nov.

Synonyms:

*Sphaeria papulosa* Dur. et Mont. — Flore d'Algérie 1: 536 (1846—1849).

*Metasphaeria papulosa* (Dur. et Mont.) Sacc. — Syll. Fung. 2: 168 (1883).

*Metasphaeria algeriensis* Sacc. et Berl. — Rev. Myc. 8: 34 (1886).

*Sphaeria anisometra* Cooke et Harkn. — Grev. 9: 86 (1881).

*Metasphaeria papulosa* f. *anisometra* (Cooke et Harkn.) Sacc. — Syll. Fung. 2: 163 (1883).

*Endophaea anisometra* (Cooke et Harkn.) Cooke — Grevillea 17: 89 (1889).

*Sphaeria calamina* Dur. et Mont. — Flore d'Algérie 1: 532 (1846—1849).

*Metasphaeria papulosa* f. *calamina* (Dur. et Mont.) Sacc. — Syll. Fung. 2: 173 (1883).

*Sphaeria californica* Cooke et Harkn. — Grevillea 13: 20 (1884).

*Leptosphaeria californica* Berl. et Vogl. — Addit. Vol. I—IV von Saccardo Sylloge Fungorum. 137 (1886).

*Leptosphaeria debeauxii* Sacc. et Roum. — Michelia 2: 318 (1882).

*Metasphaeria papulosa* f. *debeauxii* (Sacc. et Roum.) Sacc. — Syll. Fung. 2: 182 (1883).

*Sphaeria epiteridis* Cooke et Harkn. — Grevillea 9: 8 (1880).

*Metasphaeria papulosa* f. *epiteridis* (Cooke et Harkn.) Sacc. — 2: 183 (1883).

*Metasphaeria ferulae* Bacc. et Avetta — Annuario del. R. Istit. bot. di Roma, 1: 13 (1885).

*Metasphaeria janiculi* Pass. — Diagn. F. N. I. no. 58; Sacc. — Syll. Fung. 9: 838 (1891).  
*Massaria marcucciana* Auersw. et Rabenhorst — Fungi Eur. no. 2665 (absque diagnosi),  
 in Un. itin. crypt. (1866).

*Massarina marcucciana* (Auersw. et Rabenh.) Sacc. — Syll. Fung. 2: 155 (1883).

*Metasphaeria papulosa* f. *marcucciana* (Auersw. et Rabenh.) Berl. — Icones Fungorum  
 1: 140 (1894).

*Sphaeria peruviana* Cooke — Grevillea 8: 35 (1879).

*Metasphaeria peruviana* (Cooke) Sacc. — Syll. Fung. 2: 164 (1883).

*Leptosphaeria pinnarum* Pass. — Rev. Mycol. 2: 34 (1880).

*Metasphaeria pinnarum* (Pass.) Sacc. — Syll. Fung. 2: 179 (1883).

*Leptosphaeria spatharum* Ces. — ap. Rabenh. F. Eur. no. 2530 (absque diagnosi).

*Metasphaeria spatharum* (Ces.) Sacc. — Syll. Fung. 2: 179 (1883).

*Metasphaeria viridarii* Sacc. — Syll. Fung. 9: 838 (1891).

*Metasphaeria Wheeleri* Linder — Mycologia 30: 665 (1938).

Matrix: Dead twigs or leaves of *Ampelodesmus tenax* Lk., *Araucaria Bidwellii* Hook.,  
*Araucaria imbricata* Pav., *Arceuthobium campylopodium* A. Gray, *Athansia dentata*  
 L., *Chamaerops excelsa* Boj., *Chamaerops humilis* L., *Cirsium giganteum* Spreng.,  
*Citrus aurantium* Risso., *Cupressus macrocarpa* Hartw., *Dracaena* sp., *Eucalyptus*  
*globosus* Labill., *Evonymus* sp., *Hedera helix* L., *Helichrysum martinum* Less., *Jas-*  
*minum fruticans* L., *Linum thesoides* Bartl., *Lonicera involucreta* Banks., *Menispermum*  
*canadense* L., *Mesembryanthemum edule* L., *Mimulus glutinosus* Wendl., *Phoenix*  
*dactylifera* L., *Pinus canariensis* Smith, *Pteris aquilina* L., *Robinia* sp., *Rhododendron*  
 sp., *Rubus* sp., *Sarothamnus* sp., *Smilax mauritanica* Poir., *Ulmus carpiniifolia* Ehrh.

Illustrations: BERLESE, A. N., Icones Fungorum 1: tab. 154, fig. 3; tab. 155, figs. 1—3;  
 tab. 156, figs. 1—3 (1894). — LINDER, D. H., Mycologia 30: 666, fig. 1 (1938). —  
 SACCARDO, P. A., and A. N. BERLESE, Rev. Mycol. 8: tab. 57, figs. 3—4 (1886).

Material examined: RABENHORST-WINTER, Fungi europaei no. 2655, ex Herb. ETH Zürich  
 (sub. *Massaria marcucciana* Auersw. and Rabenh.), on dry culms of *Ampelodesmus*  
*tenax* Lk., from Sardinia during June 1866, leg. MARCUCCI. — Dry twigs of *Jas-*  
*minum fruticans* L., from Piméau, Antibes, Alpes Maritimes, France, on 18. 4. 1959,  
 leg. E. MÜLLER (= ETH Pure Culture Collection no. 2932). — Dry leaves of *Hedera*  
*helix* L., from Antibes, France, on 18. 4. 1959, leg. E. MÜLLER. — Dry leaves of  
*Araucaria Bidwellii* Hook., from Villa Thuret, Antibes, Alpes Maritimes, France, on  
 22. 4. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2931). — Dry twigs  
 of *Ulmus carpiniifolia* Ehrh., from Biot, Alpes Maritimes, France, on 24. 4. 1959,  
 leg. E. MÜLLER (= ETH Pure Culture Collection no. 2938). — Dry needles of *Pinus*  
*canariensis* Smith with old empty fruit bodies of a diatrypoid fungus, from Antibes,  
 France, on 22. 4. 1959, leg. E. MÜLLER. — Dry twigs of *Helichrysum martinum* Less.,  
 from Noordhoek Peak, Hout Bay, Cape Peninsula, South Africa, on 12. 11. 1959  
 (collection no. 85), leg. H. SCHÜEPP. — Dry or dying plants of *Linum thesoides* Bartl.,  
 from Chapman's Peak, Hout Bay, Cape Peninsula, South Africa, on 15. 11. 1959,  
 collection nos. 38 and 97, leg. H. SCHÜEPP.

The globose, subglobose, or conical ascocarps occur scattered or in  
 stromatic groups under the cuticle or immersed in the underlying tissues and  
 are sometimes also formed within empty ascocarps of other Pyrenomycetes  
 mostly as a saprophyte, but in some instances as a parasite. The ascocarps  
 are 100—230  $\mu$  in diameter and almost as much in height. The wall of the  
 ascocarp is 12—35  $\mu$  in thickness and composed of thick-walled, polyhedral,  
 brown cells, measuring 5—12  $\mu$  in diameter. A stromatic tissue is sometimes  
 formed between the upper parts of adjoining fructifications. The base of the  
 ascocarps is often thin and hyaline. The porus is 10—20  $\mu$  in diameter. The  
 host cells are usually discoloured and permeated by brown, septate, smooth  
 or warty hyphae, measuring 1.5—2.5  $\mu$  in diameter (fig. 10).

The asci are eight-spored, sessile or shortly stipitate, cylindrical or cylindrical-clavate at first, becoming sack-like upon maturity, with a double membrane which is much thickened at the apex, and measure  $50-85 \times 14-22 \mu$ . The ascospores are biseriata or crowded, hyaline, usually straight, but sometimes inequilaterally curved, generally rounded at ends, in some cases tapered or pointed, 3-6 septate, constricted at septa, with the lower two or three cells usually cylindrical and thinner than the cells immediately above, and measure  $14-26 \times 5-7 \mu$  in size. They are surrounded by a thin, hyaline mucous sheath, which is sometimes evanescent. The paraphysoids are thin, septate, hyaline, filiform and approximately  $2 \mu$  in diameter, the lower cells in the region of the subhymenium being shorter, broader and upto  $5 \mu$  in diameter (fig. 2 b).

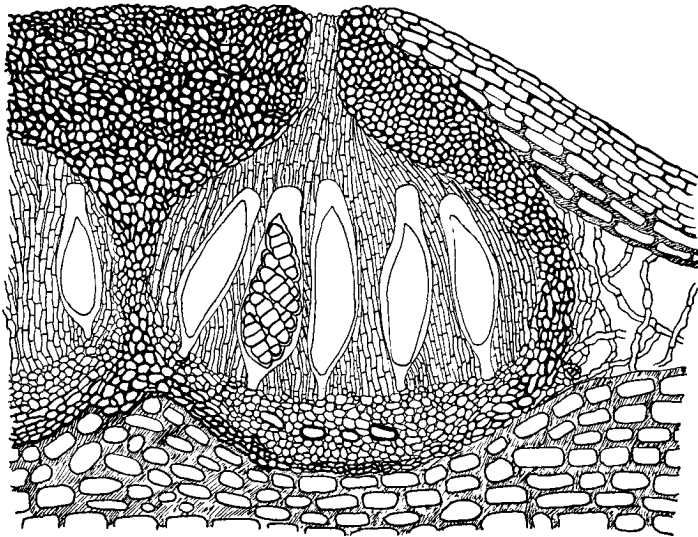


Fig. 10. Section through the ascocarp of *Massarina papulosa*. Magnification  $500\times$

**Cultural Studies:** The fungus forms a greenish-grey colony on malt extract agar. On BARNES agar, the growth is slower. After repeated subcultures, the colonies appear smoky or brownish-grey. All the cultures produce identical pycnidial stage when inoculated on sterilized pieces of *Cornus* twigs, after approximately five months at room temperature. The pycnidia are superficial, scattered or in groups, globose or pear-shaped and  $90-200 \mu$  in diameter. The pycnidial wall is  $20-35 \mu$  in thickness and composed of dark brown, polyhedral cells, upto  $5 \mu$  in diameter. The pycnidial cavity is lined with hyaline, branched or usually unbranched pycnidio-phores, measuring  $5-12 \times 2-3 \mu$ . The pycnidia are produced singly, hyaline at first, gradually turning brown, septate in the middle, pyriform, clavate, or elliptical, and  $7-16 \times 2.5-5 \mu$  in size. The pycnidial stage belongs to the form genus *Diplodia* Fr.

III. *Keissleriella* v. Höhnel

## a) Diagnosis of the Genus

*Keissleriella* v. Höhnel — Sitzber. Ak. Wien Math.-naturw. Kl. 128<sup>1</sup>: 592 (1919)

Type: *Keissleriella aesculi* (v. Höhn.) v. Höhnel.

## Synonyms:

*Coenosphaeria* Munk — Dansk Bot. Arkiv. 15<sup>2</sup>: 133 (1953).

*Trichometasphaeria* Munk — l. c. 135 (1953).

*Zopfinula* Kirschst. — Ann. Mycol. 37: 98 (1939).

The spherical or hemispherical ascocarps are scattered irregularly under the epidermis, usually embedded in the underlying tissues and sometimes covered by a stromatic clypeus, but in some cases they are erumpent or originate within the empty ascocarps of other Pyrenomycetes. The wall of the ascocarps is composed of thin- or thick-walled, brown, polyhedral cells, the innermost cells being thin-walled and hyaline. Apically the ascocarps are bored by a porus, which is lined with unicellular, dark brown or sometimes thin-walled, light brown or hyaline setae. These often crown the apex of the ascocarps. The asci are cylindrical, cylindrical-clavate or clavate, sometimes saccate, and have a double membrane, which is thickened at the apex. The ascospores are hyaline, fusiform, fusiform-elliptical or oval, two- or more-celled and often surrounded by a mucous sheath. The paraphysoids are thin, hyaline and attached in early stages at both ends but ultimately become free at the apex.

## b) Key to the Species

- |    |  |                                   |
|----|--|-----------------------------------|
| 1  | Ascospore 1-septate .....  | 2                                 |
| 1* | Ascospores more than 1-septate or 1-septate and more than 1-septate mixed .....                  | 4                                 |
| 2  | Ascospores tapering at ends, fusiform-elliptical ..  | <i>Keissleriella caudata</i>      |
| 2* | Ascospores broadly rounded at ends .....   | 3                                 |
| 3  | Ascospores oblong-elliptical, asci sack-like, ascocarps erumpent, hemispherical, flattened ..... | <i>Keissleriella subalpina</i>    |
| 3* | Ascospores oval, ascocarps immersed, asci cylindrical  | <i>Keissleriella mediterranea</i> |
| 4  | Ascospores 2-septate, ascocarps erumpent .....   | <i>Keissleriella ocellata</i>     |
| 4* | Ascospores more than 2-septate or 1- and more-septate spores mixed                               | 5                                 |
| 5  | Ascospores 3- or 3-many septate .....  | 6                                 |
| 5* | Ascospores 1- and 3-septate mixed .....  | 10                                |
| 6  | Ascospores 3-septate .....   | 7                                 |
| 6* | Ascospores 3-many septate .....  | 9                                 |
| 7  | Ascocarps formed within empty fruit bodies of another Pyrenomycetes, Ascospores fusiform .....   | <i>Keissleriella alpina</i>       |
| 7* | Ascocarps not formed on another fungus; immersed within plant tissues .....                      | 8                                 |
| 8  | Ascospores clypeate .....  | <i>Keissleriella gallica</i>      |
| 8* | Ascocarps unclypeate .....   | <i>Keissleriella culmifida</i>    |

- 9 Ascospores fusiform, 4—5 septate, surrounded by a mucous sheath  
*Keissleriella taminensis*
- 9\* Ascospores fusiform-elliptical, 4—6 septate, without mucous sheath  
*Keissleriella gloeospora*
- 10 Ascocarps immersed, clypeate, ascospores ellipsoid-biconical, 1-septate for a long time becoming 3-septate, 3-septate spores often appearing degenerate ..... *Keissleriella cladophila*
- 10\* Ascocarps erumpent, ascospores fusiform-elliptical or elliptical, 1—3 septate mixed ..... *Keissleriella emergens*

### c) Description of the Species

#### 1. *Keissleriella cladophila* (Niessl) Corbaz — *Phytopath. Zeitschr.* 28: 410 (1956)

##### Synonyms:

*Didymosphaeria cladophila* Niessl — *Oesterr. Bot. Zeitschr.* 25: 199 (1875).

*Didymella cladophila* (Niessl) Sacc. — *Syll. Fung.* 1: 545 (1882).

*Trichometasphaeria cladophila* (Niessl) Holm — *Symb. Bot. Upsal.* 14<sup>3</sup>: 140 (1957).

*Othiella aesculi* v. Höhnelt — *Sitzber. Akad. Wiss. Wien, Math.-naturw. Kl.* 126<sup>1</sup>: 377 (1917).

*Keissleriella aesculi* (v. Höhnelt) v. Höhnelt — *Sitzber. Akad. Wiss. Wien, Math.-naturw. Kl.* 128<sup>1</sup>: 582 (1919).

*Amphididymella Ahmadi* Müller and Corbaz — *Sydowia* 9: 256 (1955).

*Coenosphaeria diaporthoides* Munk — *Dansk. Bot. Arkiv.* 15<sup>2</sup>: 133 (1953).

*Didymella sambucina* Rehm — *Ann. Mycol.* 5: 538 (1907).

*Keissleriella sambuci* (Rehm) v. Höhnelt — *Sitzber. Akad. Wiss. Wien, Math.-naturw. Kl.* 128<sup>1</sup>: 582 (1919).

*Zopfinula sambucina* Kirschst. — *Ann. Mycol.* 37: 98 (1939).

Matrix: Dry twigs of *Aesculus hippocastanum* L., *Berberis* sp., *Genista tinctoria* L., *Kerria japonica* DC., *Salix* sp., *Sarothamnus scoparia* Koch.

Illustrations: MÜLLER, E., and R. CORBAZ, *Sydowia* 9: 256, figs. 1—2 (1955). — MUNK, A., *Dansk Bot. Arkiv.* 17<sup>1</sup>: 449, fig. 186 (1957).

Material examined: Herb. PETRAK (sub. *Melanopsamma salicaria* [Karst.] Sacc.), ex Herb. ETH Zürich, on dead twigs of *Salix* sp., collected in Kulm, N.-Dacota, USA, during June 1913, leg. G. F. BRENKLE. — Herb. VON HÖHNEL (sub. *Othiella aesculi* v. Höhnelt), ex Herb. University of Harvard, USA, on dry twigs of *Aesculus hippocastanum* L., from Bremenmeistal, Wienerwald, during the summer of 1916, leg. VON HÖHNEL. — Herb. PETRAK (sub. *Didymella cladophila* [Niessl] Sacc.), ex Herb. ETH Zürich, on dead twigs of *Kerria japonica* DC., from Stryj (Galizien), during March 1918, leg. F. PETRAK. — Herb. PETRAK (sub. *Didymella cladophila* [Niessl] Sacc.), ex Herb. ETH Zürich, on dead twigs of *Genista tinctoria* L., from Nannyst, Naloncorn, Czechoslovakia, during July 1928, leg. D. G. HRUBY. — Herb. ETH Zürich (sub. *Amphididymella Ahmadi* Müller and Corbaz), on dead twigs of *Berberis* sp., from Rawalpindi, West Pakistan (collection no. 11 083), on 6. 8. 1954, leg. SULTAN AHMAD (= ETH Pure Culture Collection no. 550). — Herb. ETH Zürich (sub. *Amphididymella Ahmadi* Müller and Corbaz), on dead twigs of *Smilax parvifolia* Wall., from Murree, West Pakistan (collection no. 11 016), on 10. 8. 1954, leg. SULTAN AHMAD (= ETH Pure Culture Collection no. 552).

The globose, subglobose or hemispherical ascocarps are scattered and immersed in the cortex, and measure 300—500  $\mu$  in diameter. The wall of the ascocarp is 30—45  $\mu$  in thickness and composed of light brown, polyhedral cells, measuring 9—12  $\mu$  in diameter. The upper part of the wall is clypeate and composed of smaller and darker cells. The porus is slightly



papillate or unapillate and lined with dark brown, unseptate, straight or somewhat flexuous bristles, measuring  $30-45 \times 3-4.5 \mu$  in size (fig. 12).

The asci are eight-spored, cylindrical-clavate, tapering in the lower part, with a double membrane which is thickened at the apex, and  $70-125 \times 9-12 \mu$  in size. The ascospores are  $10-16 \times 4-6 \mu$  in dimensions and obliquely biseriata in the upper part of the ascus, becoming uniseriate below, hyaline, ellipsoid-biconical, 1-septate and constricted in the middle for a long time. The older spores often become upto 3-septate, but such spores usually appear to be degenerating. The paraphysoids are densely packed, thin, hyaline, filiform and approximately  $1 \mu$  in diameter (fig. 11 e).

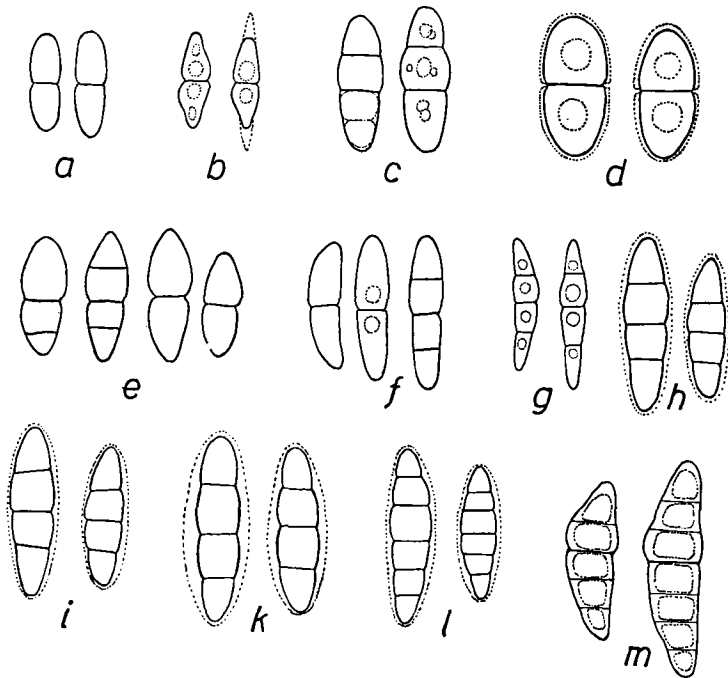


Fig. 11. Ascospores from a) *Keissleriella subalpina*, b) *Keissleriella caudata*, c) *Keissleriella ocellata*, d) *Keissleriella mediterranea*, e) *Keissleriella cladophila*, f) *Keissleriella emergens*, g) *Keissleriella alpina*, h—i) *Keissleriella gallica*, k) *Keissleriella culmifida*, l) *Keissleriella taminensis*, m) *Keissleriella gloeospora*. Magnification 1000×

VON HÖHNEL (1917) has described the imperfect stage of this fungus as *Pyrenochaeta aesculi* v. Höhnel. Examination of his specimen (sub. *Otthiella aesculi* von Höhnel) has shown the presence of a *Dendrophoma* associated with the ascocarps. However, no definite conclusions could be drawn about their relationships as both these stages have been found together with a third fungus, *Massarina microcarpa* Fuckel, also present in the matrix. The specimens collected in Pakistan on Berberis and Smilax twigs have also the *Dendrophoma* type of the imperfect stage, with globose pycnidia, measuring  $80-150 \mu$  in diameter, and composed of several layers of light brown

polyhedral cells, 8—12  $\mu$  in diameter. The cells towards the apex of the pycnidium are thicker and clypeate. The cavity of the pycnidium is lined with thin, hyaline, once or twice branched conidiophores, measuring 10—40  $\times$  2—2.5  $\mu$ . The conidia are formed singly at the apex and are hyaline, unicellular and oblong, measuring 5—7  $\times$  2—2.5  $\mu$ .

**Cultural Studies:** The fungus forms a white, cottony colony on malt extract agar and pycnidia belonging to the form-genus *Dendrophoma* are produced after about two months. These are similar to those formed in nature but remain unclypeate.

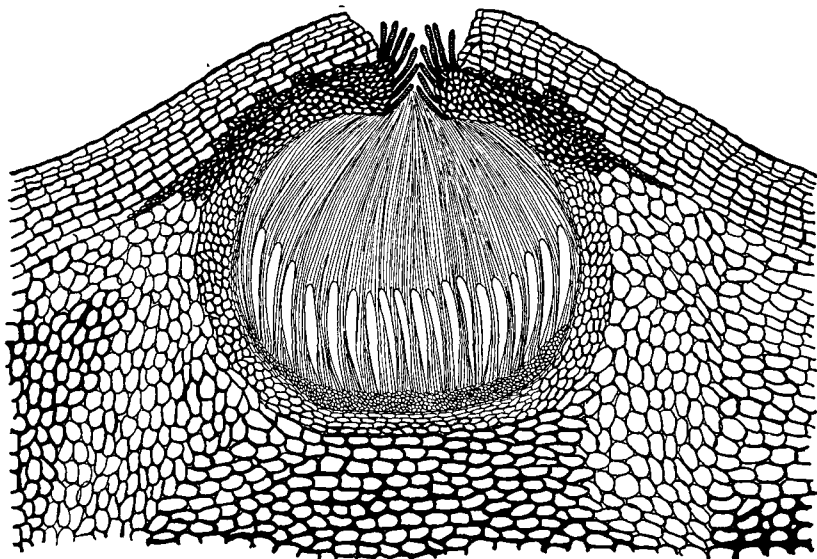


Fig. 12. Section through the ascocarp of *Keissleriella cladophila*. Magnification 125 $\times$

2. *Keissleriella caudata* (Müller) Corbaz — *Phytopath. Zeitschr.* 28: 411 (1957)

Synonym: *Didymella caudata* Müller — *Phytopath. Zeitschr.* 19: 405 (1952).

Matrix: Wheat straw.

Illustration: MÜLLER, E., *Phytopath. Zeitschr.* 19: 406, fig. 2 (1952).

Material examined: Herb. ETH Zürich, on straw of *Triticum vulgare* L., from Oerlikon, Zürich, on 8. 2. 1952 and 26. 2. 1952, leg. E. MÜLLER (= ETH Pure Culture Collection no. 443).

The flask-shaped ascocarps are immersed in the substratum, 80—230  $\mu$  in diameter, and open to the surface by an elongated neck, which projects above the epidermis. The wall of the ascocarp is 5—15  $\mu$  in thickness and composed of several layers of elongated, brown cells, measuring 5—12  $\mu$  in length. The porus is 25—40  $\mu$  wide and lined on the inner surface and at the apex with light brown setae, which are approximately 5  $\mu$  in diameter.

The asci are eight-spored, clavate, with a double membrane which is thickened at the apex, and 55—70  $\times$  8—12  $\mu$  in size. The ascospores are obliquely biseriata, hyaline, fusiform-elliptical, 1-septate, constricted in the

middle, measuring  $10.5\text{--}13 \times 4\text{--}4.5 \mu$ , and usually with a tapering, hyaline, mucous appendage at both ends, which is  $3\text{--}4 \mu$  in length. The paraphysoids are thin, hyaline, septate, filiform and approximately  $1 \mu$  in diameter (fig. 11 b).

**Cultural Studies:** The fungus grows slowly on malt extract agar forming a white, appressed colony, which becomes raised and bordered by a greenish margin in the central part. On BARNES agar, the growth is very slow and diffused and after about six months numerous, scattered, white, pellicular tufts are formed on the surface.

### 3. *Keissleriella subalpina* (Rehm) comb. nov.

Synonyms:

*Massarinula Barbieri* (West) Rehm f. *subalpina* Rehm — Ann. Mycol. 2: 520 (1904).  
*Massarinula analepta* (Ach.) var. *minor* Chentais — Bull. Soc. Mycol. France 35: 67 (1919).

Material examined: REHM, Ascomyceten no. 1570 (sub. *Massarinula Barbieri* [West] Rehm f. *subalpina* Rehm), ex Herb. ETH Zürich, on dry branches of *Erica carnea* L., from Valepp (bayr. Voralpen, 800 m), Germany, during June 1904, leg. Dr. REHM.

The hemispherical ascocarps are flattened at the top, embedded at the base and measure  $120\text{--}165 \times 100\text{--}120 \mu$ . The wall of the ascocarp is  $12\text{--}18 \mu$  in thickness and composed of dark brown, thick-walled, polyhedral cells, which are  $2\text{--}5 \mu$  in diameter. The cells towards the interior and at the base are hyaline and pseudoparenchymatous. The porus is  $10\text{--}18 \mu$  in width and is lined with unicellular, brown setae, measuring  $3\text{--}7 \times 1\text{--}2 \mu$  in size. When viewed from the top, the setae appear as converging teeth within the porus.

The asci are eight-spored, cylindric-pyriform, sack-like, sessile, with a double membrane which is thickened at the apex, and are  $35\text{--}52 \times 12\text{--}17 \mu$  in size. The ascospores are oblong-elliptical, crowded or irregularly arranged, hyaline, septate, and slightly constricted in the middle, with the upper cell slightly broader than the lower, and measure  $12\text{--}15 \times 4\text{--}4.5 \mu$ . The paraphysoids are thin, hyaline, filiform and are practically obliterated by the crowded growth of the maturing asci (fig. 11 a).

### 4. *Keissleriella mediterranea* sp. nov.

Matrix: Decorticated twigs of *Juniperus phoenicea* L.

Material examined: Herb. PETRAK (sub. *Amphididymella adeana* Petrak), ex Herb. ETH Zürich, on dry decorticated twigs of *Juniperus phoenicea* L., from Krete, on 13. 5. 1942, leg. K. H. RECHINGER.

*Perithecia* hemispherica, dispersa vel ordinibus, immersa,  $250\text{--}350 \times 170\text{--}200 \mu$ . Parietes  $25\text{--}35 \mu$  crassitudine, compositus cellulis brunneis, elongatis,  $5\text{--}12 \times 2\text{--}3 \mu$ . Pari circumdati et coronati setis atris et unicellulatis,  $20\text{--}30 \times 2.5\text{--}3.5 \mu$ . Asci octo-sporei, paraphysati, cylindranei, breves stipitati, bitunicati, apice rotundati et crassiores,  $70\text{--}115 \times 18\text{--}23 \mu$ . Ascosporeae biseriatae, hyalinae, ellipsoideae, bicellulatae, biguttulatae,  $15\text{--}23 \times 7\text{--}9.5 \mu$ , circumdatae vagina mucosa  $0.5\text{--}1.0 \mu$  crassitudine et fissis circum septos.

Habitat: In ramis decorticatis *Juniperi phoeniceae* L.

Typus: Kreta, 13. 5. 1942, leg. H. H. RECHINGER.

The hemispherical ascocarps are scattered or in linear groups, immersed in the substratum, and  $250-350 \times 170-200 \mu$  in size. The wall of the ascocarp is  $25-35 \mu$  in thickness and is composed of light brown, elongated cells, measuring  $5-15 \times 2-3 \mu$ . The porus is papillate or conical, lined within and crowned at the top with dark brown, unicellular setae, which are  $20-30 \times 2.5-3.5 \mu$  in size (fig. 13).

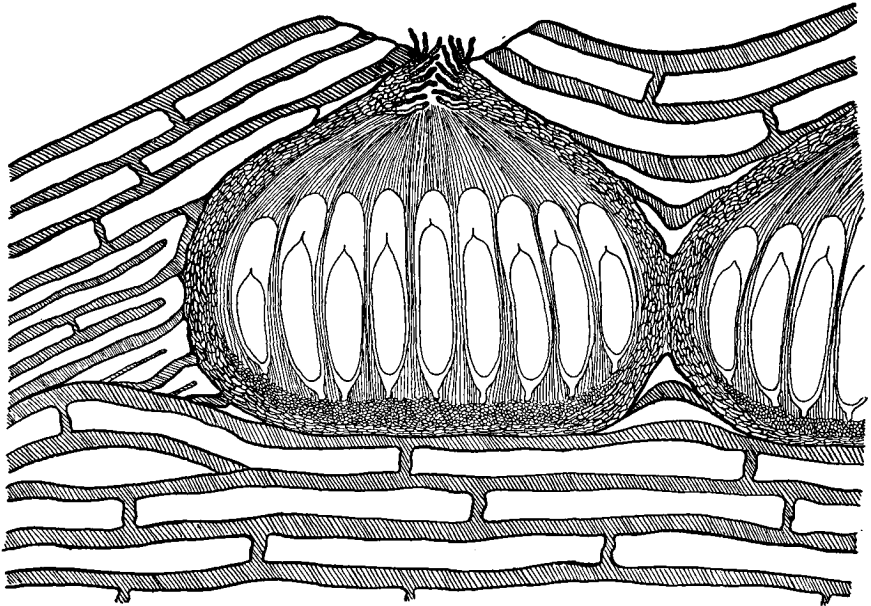


Fig. 13. Section through the ascocarp of *Keissleriella mediterranea*. Magnification  $250\times$

The asci are eight-spored, cylindrical, shortly stipitate, with a double membrane which is much thickened at the apex, and measure  $70-115 \times 18-23 \mu$ . The ascospores are obliquely biseriata, hyaline, oval, 1-septate, slightly constricted in the middle, biguttulate,  $15-23 \times 7-9.5 \mu$  in size, with a thin, hyaline mucous sheath which is  $0.5-1 \mu$  in thickness except in front of the septum, where there is a thin gap in the sheath. The paraphysoids are thin, hyaline, filiform, crowded and approximately  $1 \mu$  in diameter (fig. 11 d).

##### 5. *Keissleriella ocellata* (Niessl) comb. nov.

###### Synonyms:

*Leptosphaeria ocellata* Niessl ex Kunze — F. sel. exs. no. 334 (1878).

*Metasphaeria ocellata* (Niessl) Sacc. — Syll. Fung. 2: 157 (1883).

*Trichometasphaeria ocellata* (Niessl) Holm — Symb. Bot. Upsal. 14<sup>3</sup>: 143 (1957).

*Sphaeria hyperici* Schweinitz — Trans. Amer. Phil. Soc. Ser. 2, 4: 205 (1880).

*Sphaeria* (*Clypeosphaeria*) *hyperici* Phill. and Plowr. — Grevillea 8: 108 (1880).

*Clypeosphaeria hyperici* Sacc. — Syll. Fung. 2: 92 (1883).

*Metasphaeria hyperici* Grove — Journ. Bot. 68: 98 (1930).

Matrix: Dry twigs of *Hypericum calycinum* L., *Hypericum hirsutum* L., *Hypericum maculatum* L., *Hypericum perforatum* L., *Hypericum quadrangulum* L.

Illustrations: BERLESE, A. N., *Icones Fungorum* 1: tab. 136, fig. 2 (1894). — HOLM, L., *Symb. Bot. Upsal.* 14<sup>3</sup>: 175, fig. 4 f (1957). — MOUTON, V., *Bull. Roy. Soc. Bot. Belgique* 26: 186 pl. 1, fig. 9 (1887). — MÜLLER, E., *Sydowia* 4: 235, fig. 14 u (1950).

Material examined: JOHANNES KUNZE, *Fungi Selecti exc. Fungi Helvetici* no. 34 (sub. 334 *Leptosphaeria ocellata* Niessl), ex Herb. ETH Zürich, on dry twigs of *Hypericum perforatum* L., from Zürichberg, Zürich, Switzerland, during August 1878, leg. G. WINTER. — SYDOW, *Mycotheca germanica* no. 588 (sub. *Metasphaeria ocellata* [Niessl] Sacc.), ex Herb. ETH Zürich, on dry twigs of *Hypericum perforatum* L., from province Brandenburg, bei Tamsel, on 22. 2. 1907, leg. P. VOGEL. — PETRAK, F., *Flora Moravica* (sub. *Metasphaeria ocellata* [Niessl] Sacc.), ex Herb. ETH Zürich, on dry twigs of *Hypericum hirsutum* L., from Weisskirchen, Czechoslovakia, during May 1916, leg. F. PETRAK. — Herb. ETH Zürich (sub. *Metasphaeria ocellata* [Niessl] Sacc.), on dry twigs of *Hypericum quadrangulum* L., from Obened near Bâclad Scanice, Sweden, leg. A. G. ELIASSON. — PETRAK, F., *Mycotheca generalis* no. 1847 (sub. *Metasphaeria ocellata* [Niessl] Sacc.), ex Herb. ETH Zürich, on dry twigs of *Hypericum perforatum* L., from province Brandenburg, Tamsel, during March 1929, leg. P. VOGEL.

The ascocarps are formed under the blackened epidermis, becoming hemispherical, erumpent, partially embedded at the base in the substratum on maturity and are  $150\text{--}250 \times 130\text{--}200 \mu$  in size. The wall of the ascocarp is  $15\text{--}30 \mu$  in thickness, and composed of brown, thick-walled, polyhedral cells, which are  $4\text{--}12 \mu$  in diameter. At the base the wall is thin and composed of hyaline cells. The porus is lined with unicellular, hyaline cells, measuring  $10\text{--}15 \times 2 \mu$ . When viewed from the top, these appear to form a converging cone of projecting filaments (fig. 14).

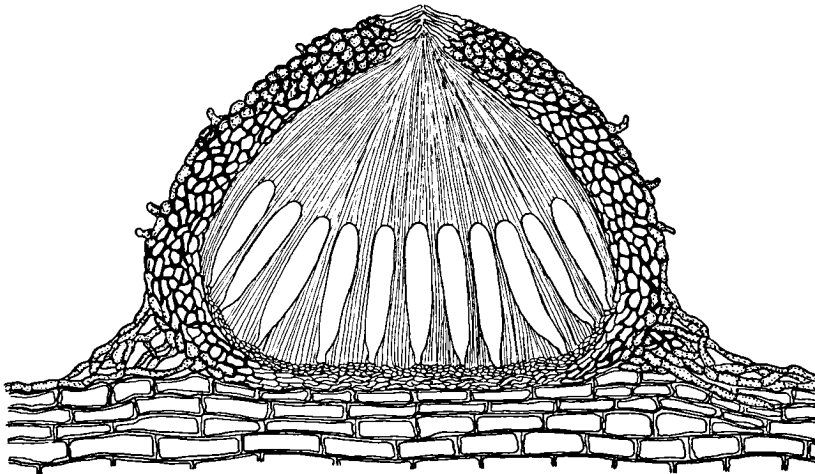


Fig. 14. Section through the ascocarp of *Keissleriella ocellata*. Magnification  $250\times$

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex, and  $50\text{--}80 \times 10\text{--}12 \mu$  in size. The ascospores are biseriate, hyaline, oblong-spindle-shaped and 2-septate, with one of the septa in the middle and the other dividing the upper segment transversely. The lower segment appears very faintly septate

in rare cases. The ascospores are  $14-22 \times 6-7 \mu$  in size and devoid of mucous sheath. The paraphysoids are numerous, hyaline, filiform and approximately  $2 \mu$  in diameter (fig. 11 c).

6. *Keissleriella alpina* sp. nov.

Material examined: Dry twigs of *Acer pseudoplatanus* L., from Arosa near Hotel Tschuggen, Kt. Graubünden, Switzerland, on 20. 7. 1959, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2941).

Perithecia solitaria vel congregata vel in stroma inane alterarum Pyrenomycetum, globosa vel subglobosa,  $150-300 \times 180-250 \mu$ . Ostiolum planum vel metae simile, saetis brunneis, unicellulatis, od  $75 \mu$  longitudine et  $2.5-6 \mu$  diam. Asci paraphysati, octospori, bitunicati, clavati,  $55-85 \times 7-9 \mu$ . Ascosporae hyalinae, biseriatae, fusiformes, rectae vel curvatae, 3-septatae, constrictae in medio,  $4-6$  guttulate,  $17-21 \times 3.5-4 \mu$ . Status conidiophorus *Dendrophoma* Sacc.

Habitat: In ramis *Aceris pseudoplatani* L.

Typus: Switzerland, Kt. Graubünden, Arosa (near Hotel Tschuggen), 27. 7. 1959, leg. E. MÜLLER.

The globose or subglobose ascocarps are formed singly or in groups, on or within the empty fruit-body of another Pyrenomycete and measure  $150-300 \times 180-250 \mu$ . The wall of the ascocarp is  $25-50 \mu$  in thickness and is composed of thick-walled, dark brown, polyhedral cells which are  $3-5 \mu$  in diameter, the inner cells being thinner and lighter in colour. The upper part of the ascocarp is somewhat thicker and bored by a porus, which is lined with a number of unicellular, dark brown, thick-walled, wavy and obtusely pointed bristles, which are upto  $75 \mu$  in length and  $2.5-6 \mu$  in diameter. These also crown the upper part of the fruit body (fig. 15).

The asci are eight-spored, clavate, tapering at base, with a double membrane which is thickened at the apex, and  $55-85 \times 7-9 \mu$  in size. The ascospores are obliquely biseriate in the upper part of the ascus, becoming subseriate below. These are hyaline, fusiform, tapering at ends, straight or curved, 3-septate, constricted in middle,  $4-6$  guttulate and  $17-21 \times 3.5-4 \mu$  in size. The paraphysoids are numerous, thin, hyaline, filiform and approximately  $1.5 \mu$  in diameter (fig. 11 g).

Cultural Studies: On BARNES agar, the fungus forms a very slow growing, white colony. On malt extract agar, the colony is light grey, raised and fluffy, giving rise to numerous white tufts scattered on the surface, in which the pycnidia are formed after six months at room temperature. On *Fagus* wood extract agar supplemented with 1% malt extract, the colony is black in colour and forms pycnidia only when kept outside during winter. On sterilized pieces of *Cornus* and *Fagus* wood, the pycnidia are formed at room temperature after about five months. On malt extract agar, the pycnidia are  $150-200 \mu$  in diameter, with a long, branched or unbranched neck of varying length, measuring  $40-60 \mu$  in diameter. However, the pycnidia formed on inoculated wood of *Fagus* and *Cornus* are only slightly papillate at the apex. The wall of the pycnidium is  $16-40 \mu$

in thickness and is composed of dark brown, polyhedral cells, measuring  $2-5 \mu$  in diameter. The pycnidial cavity is lined with hyaline, branched, septate conidiophores, which are upto  $60 \mu$  in length and approximately  $2 \mu$  in diameter. The conidia are produced singly, are hyaline, oblong or sub-cylindrical and measure  $3-4.5 \times 1-1.5 \mu$ . The imperfect stage belongs to the form-genus *Dendrophoma* Sacc. (1880 a).

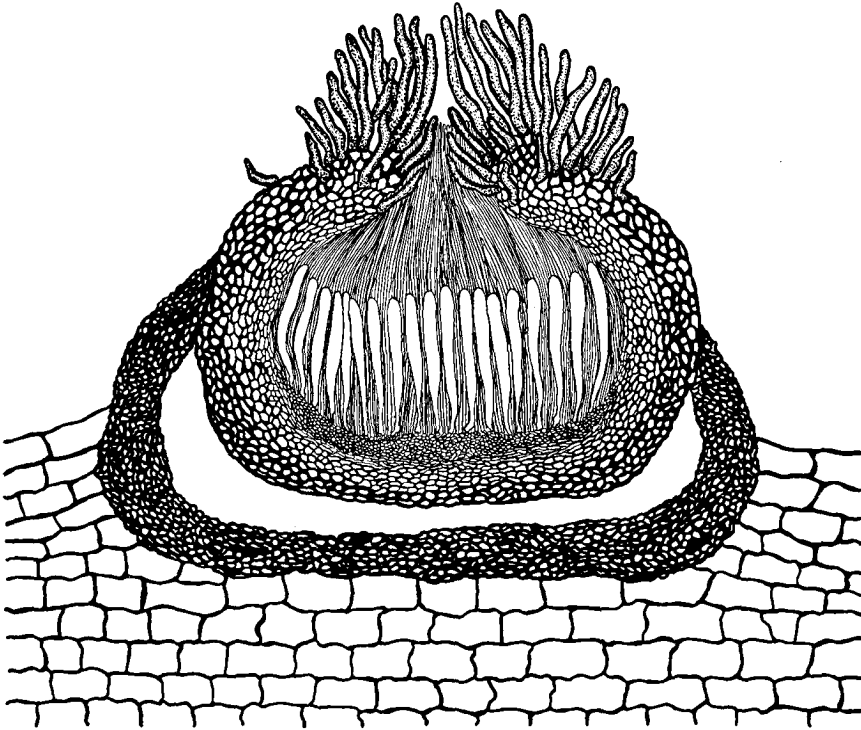


Fig. 15. Section through the ascocarp of *Keissleriella alpina*. Magnification  $125\times$

7. *Keissleriella gallica* (Müller) comb. nov.

Synonym: *Trichometasphaeria gallica* Müller — Journ. Madras Univ. 27: 29 (1957).

Matrix: Living branches of *Spartium junceum* L.

Illustration: MÜLLER, E., l. c. 30, fig. 3 a—d (1957).

Material examined: Herb. ETH Zürich (sub. *Trichometasphaeria gallica* Müller), on twigs of *Spartium junceum* L., from Fontan, Alpes Maritimes, France, on 30. 7. 1955 and 31. 7. 1955, leg. E. MÜLLER. — Herb. ETH Zürich (sub. *Trichometasphaeria gallica* Müller), on twigs of *Spartium junceum* L., from le Foulon, Gréolières, Alpes Maritimes, France, on 21. 6. 1956, leg. E. MÜLLER (= ETH Pure Culture Collection no. 2658).

The fungus is a parasite on living twigs and produces the ascocarps and pycnidia on the dying branches. The globose or pear-shaped ascocarps are immersed in the substratum and measure  $160-350 \times 150-250 \mu$  in size. The wall of the ascocarp is  $12-16 \mu$  in thickness, slightly thicker at the top,

and is composed of thick-walled, elongated, brown cells which are 5—10  $\mu$  in length, extending on either side of the porus and forming a clypeus within and between the epidermal cells of the host. The porus is lined with a number of thick-walled, dark brown, unseptate setae, measuring 30—50  $\times$  4—7  $\mu$ . These are tightly packed in a vertical or conical bundle within the porus in early stages, but on maturity, the porus becomes wider and the setae spread out.

The asci are eight-spored, clavate-cylindrical, shortly stipitate, with a double membrane which is thickened at the apex, and are 80—100  $\times$  10—12  $\mu$  in size. The ascospores are obliquely biseriate, hyaline, straight, fusiform, 3-septate, constricted at septa, the septa are sometimes non parallel, and 16—25  $\times$  5—6  $\mu$  size, surrounded by a thin hyaline mucous sheath. The paraphysoids are thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 11 h—i).

The imperfect stage of the fungus appears on the branches of the host in the form of globose pycnidia, 80—220  $\mu$  in diameter, occurring in groups or growing together stromatically. The pycnidial wall is clypeate at the apex and is composed of thick-walled, brown cells. The wall is thinner at the sides and at the base and is composed of thinner and lighter coloured cells. Short, hyaline, peg-like, pointed pycnidiophores line the pycnidial cavity and bear hyaline, fusiform, 1—2 celled pycnidiospores, measuring 15—18  $\times$  4—4.5  $\mu$ . The imperfect stage belongs to the form-genus *Ascochyta* Lib.

**Cultural Studies:** On BARNES agar, the fungus forms a slow growing, diffused, salmon coloured mycelium, which remains sterile. On malt extract agar, the mycelium is slow-growing, light salmon-coloured and appressed to the substratum, and forms numerous reddish-brown or dark brown pycnidia scattered on the surface after six months at room temperature. The pycnidia are unclypeate and the wall which is upto 40  $\mu$  in thickness is composed of light brown or brown, polyhedral cells, measuring 6—10  $\mu$  in diameter. The pycnidiophores are short, peg-like and bear hyaline, fusiform, 1—2 celled pycnidiospores, which are similar to those formed in nature and measure 13—18  $\times$  3—4.5  $\mu$ .

#### 8. *Keissleriella culmifida* (Karst.) comb. nov.

Synonyms:

*Leptosphaeria culmifida* Karst. — *Mycologia Fennica* 2: 103 (1873).

*Metasphaeria culmifida* (Karst.) Sacc. — *Syll. Fung.* 2: 174 (1883).

*Trichometasphaeria culmifida* (Karst.) Holm — *Symb. Bot. Upsal.* 14: 140 (1957).

*Leptosphaeria poae* Niessl — *Hedwigia* 13: 83 (1882).

*Metasphaeria poae* (Niessl) Sacc. — *Syll. Fung.* 2: 175 (1883).

Matrix: Dead culms of *Agrostis* sp., *Calamagrostis arundinacea* (L.) Roth., *Elymus arenarius* L., *Juncus conglomeratus* L., *Nardus stricta* L., *Phleum pratense* L., *Poa compressa* L., *Poa normalis* L., *Poa pratensis* L., *Triticum* sp., *Typha latifolia* L.

Illustrations: HOLM, L., *Symb. Bot. Upsal.* 14: 175, fig. 4 c (1957). — MÜLLER, E., *Sydowia* 4: 274, fig. 26 a (1950).

Material examined: RABENHORST-WINTER, *Fungi europaei* no. 2854 (sub. *Leptosphaeria poae* Niessl), ex Herb. ETH Zürich, on dead culms of *Poa* sp., from Brünn, Moravia, during September 1881, leg. G. DE NIESSL. — Herb. ETH Zürich (sub. *Leptosphaeria poae* Niessl), on dead culms of a grass, from Felben, Kt. Thurgau, Switzerland, on



6. 10. 1895, leg. H. WEGELIN. — PETRAK, F., Flora Moravica (sub. *Metasphaeria trichostoma* [Pass.] Sacc.), on dead culms of *Poa compressa* L., from Weisskirchen, during August 1923 and 1925; on *Typha latifolia* L., from Weisskirchen, Czechoslovakia, during September 1927, leg. F. PETRAK. — PETRAK, F., Mycotheca Generalis no. 1247 (sub. *Metasphaeria trichostoma* [Pass.] Sacc.), on dead culms of *Typha latifolia* L., from Thein bei Mähr.-Weisskirchen, during September 1927, leg. F. PETRAK.

The globose or pear-shaped ascocarps are scattered, immersed in the substratum and measure  $140\text{--}250 \times 115\text{--}200 \mu$ . The wall of the ascocarp is  $3\text{--}12 \mu$  in thickness at the base,  $15\text{--}20 \mu$  at the sides and upto  $30 \mu$  at the top and is composed of brown, polyhedral cells, measuring  $5\text{--}10 \mu$  in diameter. The porus is conical,  $20\text{--}30 \mu$  in width and lined and crowned with stiff, thick-walled, dark brown, bluntly pointed, unicellular bristles, measuring  $20\text{--}40 \times 3\text{--}4 \mu$  (fig. 16).

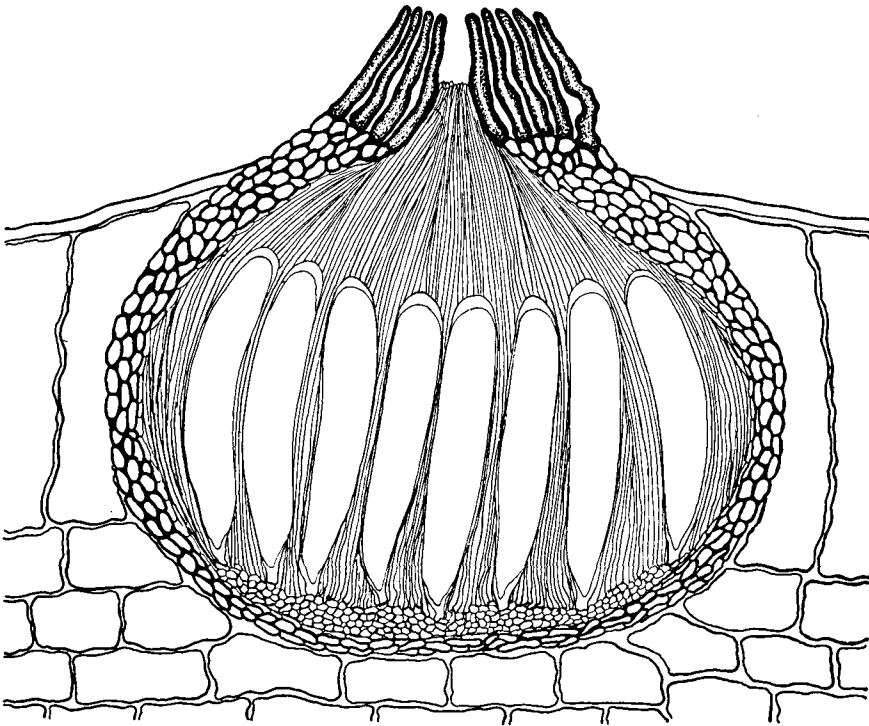


Fig. 16. Section through the ascocarp of *Keissleriella culmifida*. Magnification  $500\times$

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex, and  $65\text{--}80 \times 12\text{--}14 \mu$  in size. The ascospores are biseriata, hyaline, fusiform, mostly straight, 3-septate, constricted at septa, measuring  $10\text{--}25 \times 4.5\text{--}6 \mu$ , and surrounded by a mucous sheath which is upto  $2 \mu$  in thickness. The paraphysoids are thin, hyaline, filiform and approximately  $1 \mu$  in diameter (fig. 11 k).

9. *Keissleriella taminensis* (Wegelin) comb. nov.

## Synonyms:

*Leptosphaeria taminensis* Wegelin — Mitteil. Thurgau. Naturf. Ges. 12: 173 (1896).

*Trichometasphaeria taminensis* (Wegelin) Holm — Symb. Bot. Upsal. 14<sup>3</sup>: 142 (1957).

Matrix: Dead culms of *Agropyron repens* P. B., *Bromus inermis* Leys., *Festuca* sp., *Poa nemoralis* L.

Illustrations: HOLM, L., Symb. Bot. Upsal. 14<sup>3</sup>: 174, fig. 4 d (1957). — MÜLLER, E., Sydowia 4: 264, figs. 23 a, 26 a (1950). — WEGELIN, H., Mitteil. Thurgau. Naturf. Ges. 12: 173, tab. 2, figs. 6—7 (1896).

Material examined: Herb. ETH Zürich (sub. *Leptosphaeria taminensis* Wegelin), on dry culms of *Festuca* sp., from the banks of Tamina, St. Galler Oberland, Switzerland, on 5. 7. 1891, leg. H. WEGELIN (type material). — Fungi Suecici, Upsala Botanical Museum (sub. *Leptosphaeria taminensis* Wegelin), ex Herb. ETH Zürich, on dead culms of *Agropyron repens* (L.) Beauv., from Öland, Borgholm, Sweden, on 30. 8. 1928, leg. A. G. ELIASSON.

The globose or pear-shaped ascocarps are crowded and immersed in the substratum, which is discoloured brown, and measure  $180\text{--}300 \times 150\text{--}200 \mu$ . The wall of the ascocarp is  $25\text{--}35 \mu$  in thickness at the top, gradually tapering downwards and is composed of thick-walled, brown, polyhedral cells, measuring  $5\text{--}9 \mu$  in diameter. The cells at the base are pale brown or hyaline and thin-walled. The porus is  $20\text{--}35 \mu$  wide, lined and crowned with thick-walled, dark brown, unicellular, stiff and bluntly pointed bristles, which are  $20\text{--}30 \times 3.5\text{--}5.5 \mu$  in size.

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex, and measure  $80\text{--}115 \times 11\text{--}14 \mu$  in size. The ascospores are biseriate, hyaline, fusiform, 4- or 5-septate, constricted at septa, and  $18\text{--}23 \times 4.5\text{--}5 \mu$  in size, surrounded by a thin, hyaline mucous sheath. The paraphysoids are thin, hyaline, filiform and approximately  $1 \mu$  in diameter (fig. 11 l).

10. *Keissleriella gloeospora* (Berk. et Curt.) comb. nov.

## Synonyms:

*Sphaeria gloeospora* Berk. et Curt. — Ann. Mag. Nat. Hist. ser. 3, 7: 454 (1861).

*Leptosphaeria gloeospora* (Berk. et Curt.) Sacc. — Syll. Fung. 2: 25 (1883).

*Trichometasphaeria gloeospora* (Berk. et Curt.) Holm — Symb. Bot. Upsal. 14: 144 (1957).

*Leptosphaeria eburnea* Niessl — Hedwigia 20: 98 (1881).

*Metasphaeria eburnea* (Niessl) Sacc. — Syll. Fung. 2: 162 (1883).

*Sphaeria comatella* Cooke et Ellis — Grevillea 5: 52 (1876).

*Leptosphaeria comatella* (Cooke et Ellis) Sacc. — Syll. Fung. 2: 32 (1883).

*Metasphaeria dianthi* Rostr. — Bot. Tidsskr. 26: 311 (1905).

*Trichometasphaeria dianthi* (Rostr.) Munk — Dansk. Bot. Arkiv. 15<sup>2</sup>: 135 (1953).

*Leptosphaeria stichostoma* Berk. et Curt. — Grevillea 4: 151 (1876).

*Sphaeria stichostoma* (Berk. et Curt.) Sacc. — Syll. Fung. 2: 84 (1883).

*Leptosphaeria trichostoma* Pass. — in Thümen Myc. Univ. no. 1455 (1879).

*Metasphaeria trichostoma* (Pass.) Sacc. — Syll. Fung. 2: 158 (1883).

*Metasphaeria xerophila* Sacc. et Malbr. — Atti. R. Istit. Veneco Sci. Lett. ed. arti. 61: 2166 (1883); Hedwigia 23: 14 (1884).

*Metasphaeria trichostoma* var. *xerophila* (Sacc.) Berlese — Icones Fungorum 1: 143 (1894).

Matrix: Dead culms of *Anchusa arvensis* M. B., *Artemisia absinthium* L., *Asparagus* sp., *Chondrilla juncea* L., *Chrysopsis graminifolia* Ell., *Daucus carota* L., *Desmodium*

*nudiflorum* DC., *Erigeron strigosus* Muhl., *Lactuca saligna* L., *Lactuca scariola* L., *Phaseolus* sp., *Phlox paniculata* L., *Silene otites* L., dead culms of an unidentified grass.

Illustrations: BERKLEY, J. M., and C. E. BROOME, Ann. and Mag. Nat. Hist. 3 ser. 7: tab. 17, fig. 33 (1861). — BERLESE, A. N., Icones Fungorum 1: tabs. 63, fig. 3; 152, figs. 1—3 (1894). — COOKE, M. C., and J. B. ELLIS, Grevillea 5: tab. 80, fig. 9 (1876). — HOLM, L., Symb. Bot. Upsal. 14<sup>3</sup>: 175, fig. 4 g (1957). — MÜLLER, E., Sydowia 4: 284, fig. 31 f (1950).

Material examined: Herb. ETH Zürich (sub. *Leptosphaeria scirpina* Wint.), on dead culms of grass collected in Frauenfeld, Switzerland, on 27. 10. 1892, leg. H. WEGELIN.

The globose or pear-shaped ascocarps are scattered, immersed in substratum and measure 200—300  $\mu$  in diameter. The wall of the ascocarp is 10—20  $\mu$  in thickness at the sides and is composed of thick-walled, brown, elongated cells, measuring 4—8  $\mu$  in diameter. Towards the base, the wall is thinner and composed of thick-walled, brown, elongated cells, while towards the apex the wall is thicker, somewhat clypeate and composed of thick-walled, dark brown cells. The porus is conical or cylindrical, 60—90  $\mu$  in width and length and lined with unicellular, thick-walled, dark brown, bluntly pointed, straight or somewhat wavy bristles, which are 25—50  $\times$  3—4  $\mu$  in size.

The asci are eight-spored, cylindrical-clavate, with a double membrane which is thickened at the apex, and 80—115  $\times$  10—16  $\mu$  in size. The ascospores are biserial in the upper part of the ascus becoming subseriate below, hyaline, fusiform, elliptical, straight or curved, 4—6 septate, slightly constricted at septa, with a thickened, hyaline epispore, and measure 23—33  $\times$  6—8  $\mu$ . The paraphysoids are densely packed, thin, hyaline and approximately 1  $\mu$  in diameter (fig. 11 m).

#### 11. *Keissleriella emergens* (Karst.) comb. nov.

Synonyms:

*Sphaeria emergens* Karst. — Bidr. t. Kännedom. af Finlands Natur och Folk 2: 93 (1873).

*Zignoella emergens* (Karst.) Sacc. — Michelia 1: 346 (1878).

*Massarina emergens* (Karst.) Holm — Symb. Bot. Upsal. 14: 149 (1957).

Material examined: KARSTEN, Fungi fenn. exs. no. 853 (sub. *Sphaeria emergens* Karst.), ex Herb. Upsala University, on twigs of *Populus tremula* L., from Mustiala, Finland, on 14. 4. 1869, leg. F. KARSTEN (type material).

The pear-shaped ascocarps are scattered on the surface of the decorticated twigs, partially embedded at the base and measure 300—450  $\mu$  in diameter. The wall of the ascocarp is 40—70  $\mu$  in thickness and is composed of thick-walled, brown, polyhedral cells, 3—8  $\mu$  in diameter. The porus is papillate and lined and crowned with wavy, dark brown, unicellular bristles, measuring 25—60  $\times$  2—3  $\mu$ .

The asci are eight-spored, cylindrical-clavate, tapering in the lower part, with a double membrane which is thickened at the apex, and measure 80—115  $\times$  10—12  $\mu$ . The ascospores are biserial in the upper part of the ascus, becoming uniseriate below. They are hyaline, fusiform-elliptical or elliptical, straight or curved, constricted in the middle, 1—3 septate, 2—4 guttulate, and 17—23  $\times$  4—5.5  $\mu$  in size (fig. 11 f).

IV. *Herpotrichia* Fuckel

## a) Diagnosis of the Genus

*Herpotrichia* Fuckel — Symb. Mycol. 146 (1869)

Type: *Herpotrichia rhenana* Fuckel.

Synonyms:

*Didymotrichia* Berlese — Atti. Congr. Bot. Genova p. 572 (1893).

*Enchmosphaeria* Fuckel — Symb. Mycol. 146 (1869).

*Khekia* Petrak — Hedwigia 62: 284 (1921 b).

*Lojkania* Rehm — Növénytani Közlemények 4: 2 (1905).

*Neopeckia* Sacc. ap. Peck, C. H. — Bull. Torr. Bot. Club. 10: 127 (1883).

*Pseudotrichia* Kirschst. — Ann. Mycol. 37: 125 (1939).

*Sydowina* Petrak — Ann. Mycol. 21: 182 (1923).

*Xenonectria* v. Höhnel — Fragmente zur Mykologie 24: 12 (1920).

The spherical, sometimes hemispherical or flask-shaped ascocarps are scattered irregularly or crowded on the surface of the substratum and are superficial or partially embedded in the underlying tissues. A subiculum of brown, septate hyphae is usually present. The ascocarps are beset with long, sparsely branched, brown hyphae. The outer cells of the ascocarp are composed of thin- or thick-walled, brown, polyhedral cells, the inner cells being hyaline and pseudoparenchymatous or elongated in appearance. The apical part of the ascocarp around the porus may be glabrous or hairy. The porus is simple or lined with short, hyaline hyphae; in some cases, the porus is like a triangular chamber filled with long, branched, hyaline hyphae. The asci are cylindrical, cylindrical-clavate, or clavate, with a double membrane which is thickened at the apex, shortly stipitate or with a long, thin and flexuous stipe. The ascospores are biseriata, subseriate or obliquely uniseriate, usually brown or light brown, often darker at the tips, in some cases hyaline, fusiform, fusiform-elliptical, biconic or oval, two- or more-celled, and sometimes surrounded by a mucous sheath. The paraphysoids are thin, hyaline and attached at both ends in the beginning, but ultimately become free at the apex.

## b) Key to the Species

- |    |   |                                 |
|----|---|---------------------------------|
| 1  | Ascospore 1-septate .....                                   | 2                               |
| 1* | Ascospores 1—3 septate .....                                | 7                               |
| 2  | Ascospores oblong-elliptical, broadly rounded at ends ..... | 3                               |
| 2* | Ascospores biconical or fusoid .....                        | 4                               |
| 3  | Ascospores 20—28 $\mu$ in length .....                      | <i>Herpotrichia coulteri</i>    |
| 3* | Ascospores 17—21 $\mu$ in length .....                      | <i>Herpotrichia rhodosticta</i> |
| 4  | Ascospores fusoid .....                                     | <i>Herpotrichia diffusa</i>     |
| 4* | Ascospores biconic .....                                    | 5                               |
| 5  | Ascospores deeply constricted at septum .....               | <i>Herpotrichia Petrakiana</i>  |
| 5* | Ascospores lightly constricted at septum .....              | 6                               |
| 6  | Ascospores 18—23 $\mu$ in length .....                      | <i>Herpotrichia australis</i>   |
| 6* | Ascospores 22—30 $\mu$ in length .....                      | <i>Herpotrichia lignicola</i>   |



97—165  $\times$  12—15  $\mu$  in size. The ascospores are obliquely biseriate in the upper part of the ascus, becoming uniseriate below. These are hyaline at first, becoming brown when mature, 1—3 septate, constricted in the middle and measure 18—25  $\times$  5—8  $\mu$ . The ascospores are surrounded by a hyaline mucous sheath, which tapers and projects out at each end. The paraphysoids are numerous, thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 17 a).

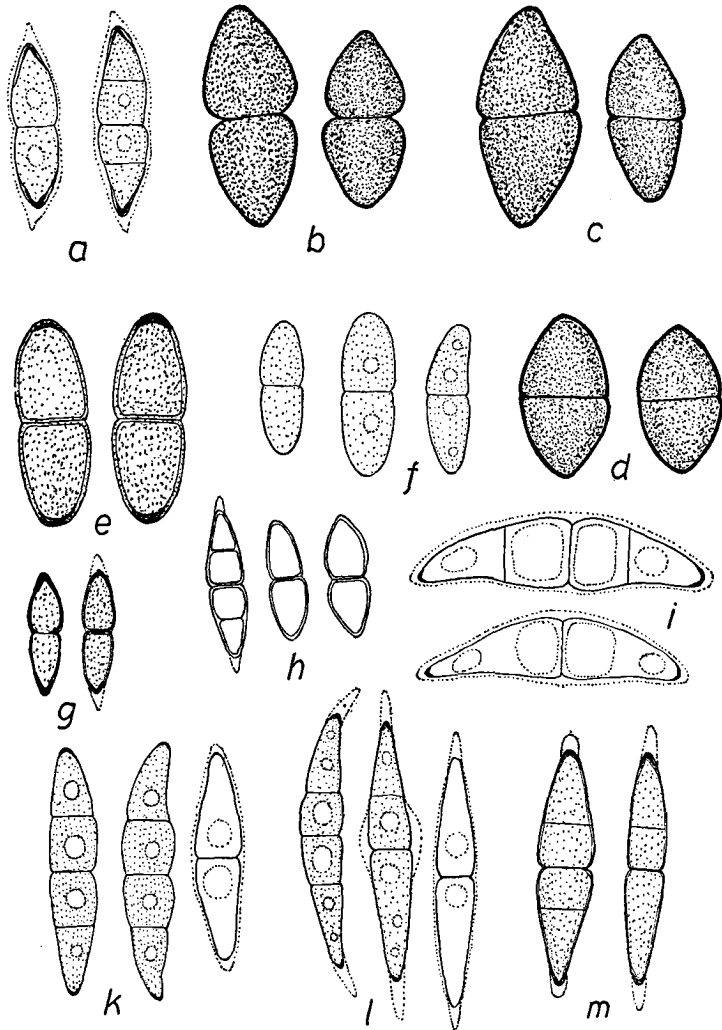


Fig. 17. Ascospores from a) *Herpotrichia rhenana*, b) *Herpotrichia Petrakiana*, c) *Herpotrichia lignicola*, d) *Herpotrichia australis*, e) *Herpotrichia Coulteri*, f) *Herpotrichia rhodosticta*, g) *Herpotrichia diffusa*, h) *Herpotrichia Pandei*, i) *Herpotrichia mutabilis*, k) *Herpotrichia juniperi*, l) *Herpotrichia callimorpha*, m) *Herpotrichia Schiedermayeriana*.  
Magnification 1000 $\times$

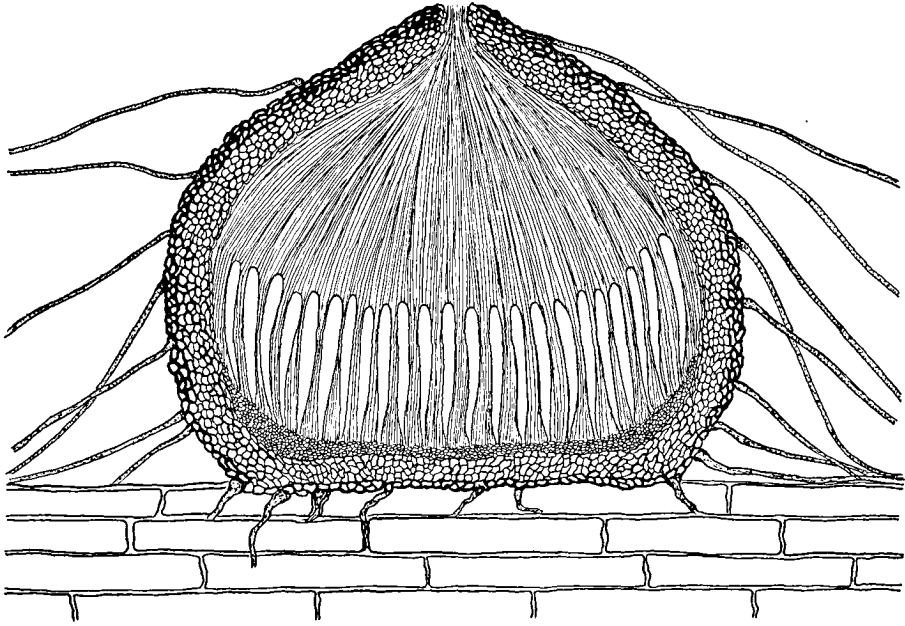


Fig. 18. Section through the ascocarp of *Herpotrichia rhenana*. Magnification 125 $\times$

## 2. *Herpotrichia Coulteri* (Peck) comb. nov.

### Synonyms:

- Sphaeria Coulteri* Peck — in Hayden's U. S. Geol. Survey p. 792 (1872).  
*Enchonosphaeria Coulteri* (Peck) Sacc. — Syll. Fung. 2: 207 (1883).  
*Neopeckia Coulteri* (Peck) Sacc. ap. Peck — Bull. Torrey Bot. Club 10: 127 (1883).  
*Lasio-sphaeria Coulteri* (Peck) Ellis et Everh. — North Am. Pyren. p. 147 (1892).  
*Lasio-sphaeria acicola* Cooke — Grevillea 8: 87 (1880).  
*Amphisphaeria acicola* (Cooke) — Syll. Fung. 1: 727 (1882).

Matrix: Living and dead needles and branches of *Pinus* spp.

Illustrations: STURGISS, W. C., Phytopath. 3: 158, plates 12—13 (1913). — SAVULESCU, MM. TR., and T. RAYSS, Annales des Epiphyties 14: 322—353, plates I—II, figs. 1—20 (1928).

Material examined: Herb. ETH Zürich (sub. *Neopeckia Coulteri* [Peck] Sacc.), on leaves of *Pinus montana* Mill., collected from National Park, Kt. Graubünden, Switzerland, on 15. 7. 1959, leg. E. MÜLLER. — Herb. ETH Zürich (sub. *Neopeckia Coulteri* [Peck] Sacc.), on leaves of *Pinus montana* Mill., collected from Val Chamuera, Switzerland, on 16. 7. 1959, leg. G. BAZZIGHER.

The hyphae of the fungus are brown, septate, 2.5—5  $\mu$  in diameter, forming a matted layer of mycelium on the surface of the matrix, often filling the stomatal cavities of the needles with stromatic tissues and also penetrate the intercellular tissues between the underlying cells. The needles are killed and matted together by the felt-like, brown mycelium. The ascocarps are globose, formed on the surface of the needles, sometimes partially immersed in the subiculum, and measure 250—500  $\mu$  in diameter. The wall of the ascocarp is 30—40  $\mu$  in thickness and is composed of brown, polyhedral cells, measuring 5—11  $\mu$  in diameter. Numerous long, smooth-walled,

brown, septate hyphae arise from the outermost layer of the ascocarp and are  $2.5-4\ \mu$  in diameter, usually unbranched or branched at considerable intervals and sometimes also anastomose with adjoining hyphae, by means of short, lateral fusion branches. The ascocarp is bored at the apex by a porus, which is simple, schizogonic and upto  $80\ \mu$  in diameter (fig. 19).

The asci are eight spored, cylindrical-clavate, truncate at base, with a double membrane which is thickened at the apex, and  $140-200 \times 14-20\ \mu$  in size. The ascospores are obliquely biseriata in the upper part of the ascus, becoming uniseriate below, and are brown, oblong-elliptical, bicelled, constricted in the middle, measuring  $20-28 \times 7-10\ \mu$ . The episporium is darker and thicker at the ends. The paraphysoids are thin, hyaline, filiform, thickly crowded and approximately  $1\ \mu$  in diameter (fig. 17 e).

**Cultural Studies:** The fungus grows well on malt extract agar, forming dark grey or brownish-grey, cottony mycelium and produces globose, brown pycnidia, measuring  $100-200\ \mu$  in diameter, on the surface of the substratum after about six months at  $4\ ^\circ\text{C}$ . The pycnidial wall is  $15-35\ \mu$  in thickness and is composed of thin-walled, brown, polyhedral cells, measuring  $4-16\ \mu$  in diameter. From the surface cells, short or long hyphal appendages are given out. The cells lining the cavity are smaller, papillate or conical, and give rise to hyaline, filiform, usually unbranched pycnidio-phores, which are  $10-20 \times 2\ \mu$  in size and bear unicellular, hyaline, oval pycnosporae, measuring  $2.5-4 \times 1.5-2\ \mu$ . The pycnidial stage belongs to the form-genus *Pyrenochaeta* de Notaris.

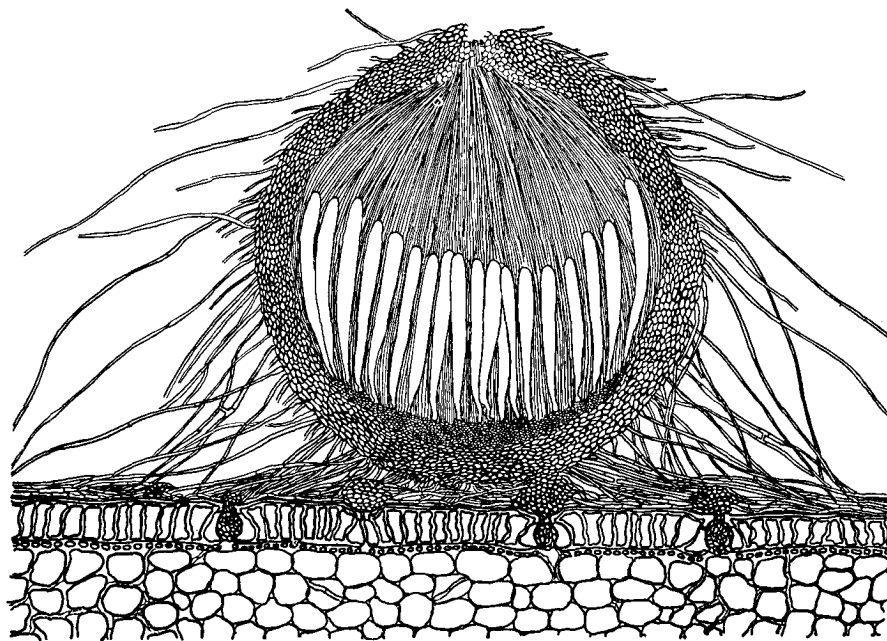


Fig. 19. Section through the ascocarp of *Herpotrichia Coulteri*. Magnification  $125\times$



3. *Herpotrichia rhodosticta* (Berk. et Broome) Sacc. — Syll. Fung. 2: 213 (1883)

## Synonyms:

*Sphaeria rhodosticta* Berk. et Broome — Journ. Linn. Soc., London 14: 126 (1873).

*Didymotrichia rhodosticta* (Berk. et Broome) Berl. — Atti. Congr. Bot. Intern. Genova p. 592 (1894).

*Neopeckia rhodosticta* (Berk. et Broome) Sacc. — Syll. Fung. 11: 137 (1895).

*Herpotrichia rhodospiloides* Peck — Bull. Torrey Bot. Club 36: 154 (1909).

*Amphisphaeria subiculosa* Ellis et Everh. — Journ. Mycol. 2: 103 (1886).

Matrix: Dead twigs; decorticated wood of *Populus* spp.

Illustrations: ELLIS, J. B., and B. M. EVERHART, North Am. Pyren. plate 23, figs. 1—6 (under *Herpotrichia diffusa*) (1892). — BERLESE, A. N., Atti. Congr. Bot. Internaz. Genova, tab. 22, fig. 3 (1893). — REHM, H., Hedwigia 40: tab. 5, fig. 2 (under *Herpotrichia diffusa*) (1901).

Material examined: ELLIS, J. B., and B. M. EVERHART, Fungi Columbiani (by E. BARTHELOMEW) no. 3632 (sub. *Herpotrichia diffusa* [Schw.] Ellis et Everh.), ex Herb. University of Geneva, on decorticated wood of *Populus occidentalis* (Ryd.) E. B., from Louisville, Kansas, USA, on 19. 10. 1911, leg. ELLIS and EVERHART.

The black, globose ascocarps are crowded together on an effused, thin, black tomentum and sometimes immersed at the base in the substratum. The apex is reddish, subradiate-sulcate, flattened, sometimes slightly depressed, and pierced by the porus when mature. The lower part of the ascocarp is beset with brown, thick-walled, septate hyphae, which form a thin subiculum on the surface of the matrix and also penetrate into the woody substratum, especially beneath the ascocarp. The wall of the ascocarp is composed of thick-walled, brown, polyhedral cells, upto  $9\ \mu$  in diameter. The apical part of the wall is composed of brownish-yellow or pale yellow, pseudoparenchymatous cells, upto  $3\ \mu$  in diameter, appearing reddish in a mass. The porus is formed schizogonously within this tissue.

The asci are eight-spored, cylindrical-clavate, tapering at the base, with a double membrane which is thickened at the apex, and measure  $17\text{--}21 \times 5.5\text{--}7\ \mu$ . The ascospores are biseriate in the upper part of the ascus, becoming uniseriate below. They are pale brown, straight or slightly curved, oblong-elliptical, broadly rounded at the ends, 1-septate, lightly constricted at the septum and  $17\text{--}21 \times 5.5\text{--}7\ \mu$  in size. The paraphysoids are abundant, thin, hyaline and filiform (fig. 17 f).

ELLIS and EVERHART (1886) have described this fungus as *Amphisphaeria subiculosa* Ellis and Everh. Subsequently, these authors (ELLIS and EVERH. 1892) have united this species with *Herpotrichia diffusa* (Schw.) Ellis and Everh. Soon after, STARBÄCK (1894) observed that the fungi described as *Sphaeria diffusa* Schw. and *Amphisphaeria subiculosa* Ellis and Everh. are different. According to the present study, the name *Herpotrichia diffusa* (Schw.) Ellis and Everh. has to be restricted to species with fusoid pointed ascospores and the species with oblong-elliptical, broadly rounded ascospores have to be named *Herpotrichia rhodosticta* (Berk. and Broome) Sacc. with *Amphisphaeria subiculosa* Ellis and Everh. as one of the synonyms.

4. *Herpotrichia diffusa* (Schw.) Ellis et Everh. — North Am. Pyren. 158 (1892)

## Synonyms:

*Sphaeria diffusa* Schw. — Trans. Am. Phil. Soc. 2: 210 (1832).

*Bassosphaeria diffusa* (Schw.) Cooke — Grevillea 15: 81 (1887).

*Neopeckia diffusa* (Schw.) Starb. — Bihang Till. K. Svenska Vet.-Akad. s Handl. 19: AFD III, 30 (1894).

*Sphaeria rhodomphala* Berk. — Hooker's London Journ. Bot. 4: 313 (1845).

*Herpotrichia rhodomphala* (Berk.) Sacc. — Syll. Fung. 2: 212 (1883).

*Herpotrichia diffusa* (Schw.) Ellis et Everh. var. *rhodomphala* (Berk.) Ellis et Everh. — Proc. Nat. Sci. Phil. 47: 21 (1895).

Matrix: Dry twigs of *Juglans cinerea* L., *Quercus incana* Roxb., rotting twigs.

Illustrations: STARBÄCK, K., Bihang Till. K. Svenska vet.-Akad. s Handl. 19: AFD III, tab. 2, figs. 17 a—e (1894). — PENZIG, O., and P. A. SACCARDO, Icones Fungorum Javanicum, tab. 8, fig. 4 (1904). — SEAVER, F. J., Mycologia 14: 235, plate 19, fig. 1 (1922).

Material examined: Herb. ETH Zürich, on dry twigs of *Quercus incana* Roxb., from Cherry Block, Government Gardens, Chaubattia, Ranikhet, Distt. Almora, U. P., India, 19. 10. 1959, leg. M. C. PANDE (= ETH Pure Culture Collection no. 2946). — Herb. ETH Zürich, on dry twigs collected in *Citrus* Estate, Letaba, Tzaneen, Transvaal, South Africa, on 16. 3. 1960, collection no. 157, leg. H. SCHÜEPF.

The black, globose or pear-shaped ascocarps are scattered or densely crowded, slightly embedded at the base in the substratum, 200—400  $\mu$  in diameter and with a flat, whitish, disc-like apex, which ultimately becomes slightly depressed in the centre and pierced by a schizogonic porus. The wall of the ascocarp is composed of thick-walled, brown, polyhedral cells, measuring 4—10  $\mu$  in diameter. The cells lining the cavity are thin-walled, elongated and upto 16  $\mu$  in length. The whitish disc at the apex is composed of colourless pseudoparenchymatous cells. The ascocarps are clothed, except at the apical disc, with lax radiating, smooth, thick-walled, long, flexuous, brown, septate hyphae, measuring 4—6  $\mu$  in diameter. These are usually unbranched and limited round the ascocarps, or form a thin subiculum on the surface of the substratum (fig. 20).

The asci are eight-spored, clavate, tapering to a long, thin, flexuous stipe, with a double membrane which is thickened at the apex, and measure 70—100  $\times$  10—20  $\mu$ . The ascospores are biseriate or crowded in the upper part of the ascus, becoming subserrate below. These are straight or slightly curved, brown, appearing darker at the tips, fusoid, septate and constricted in the middle, and measure 16—18  $\times$  4—5  $\mu$ . There is a hyaline mucous appendage, projecting 2—3  $\mu$  beyond each end of the ascospores. In old spores, the appendages are often evanescent. The paraphysoids are thin, hyaline, filiform, approximately 1  $\mu$  in diameter and attached at both ends in early stages, but ultimately become free at the apex (fig. 17 g).

Cultural Studies: The fungus forms a slow growing, white colony on BARNES agar and produces a few pycnidia scattered on the surface. On malt extract agar, the colony is faster in growth, white at first, gradually becoming light grey in the centre and produces numerous black pycnidia scattered on the surface. The pycnidia are pear-shaped, papillate or with a long neck and 250—400  $\mu$  in diameter. The wall is 12—40  $\mu$  in thickness and

is composed of dark brown, polyhedral cells, 5–12  $\mu$  in diameter on the outside and hyaline pseudoparenchymatous cells towards the interior. The outermost cells are beset with light brown, septate, branched or unbranched hyphal appendages, measuring 4–6  $\mu$  in diameter. The pycnidial cavity is lined with closely packed, branched or unbranched, septate pycnidioophores, measuring 5–12  $\times$  1.5–2.5  $\mu$ . The pycnospores are formed singly at the tip and are hyaline, unseptate, oval, measuring 2–3  $\times$  1–1.5  $\mu$ . The pycnidial stage belongs to the forms-genus *Pyrenochaeta* de Notaris.

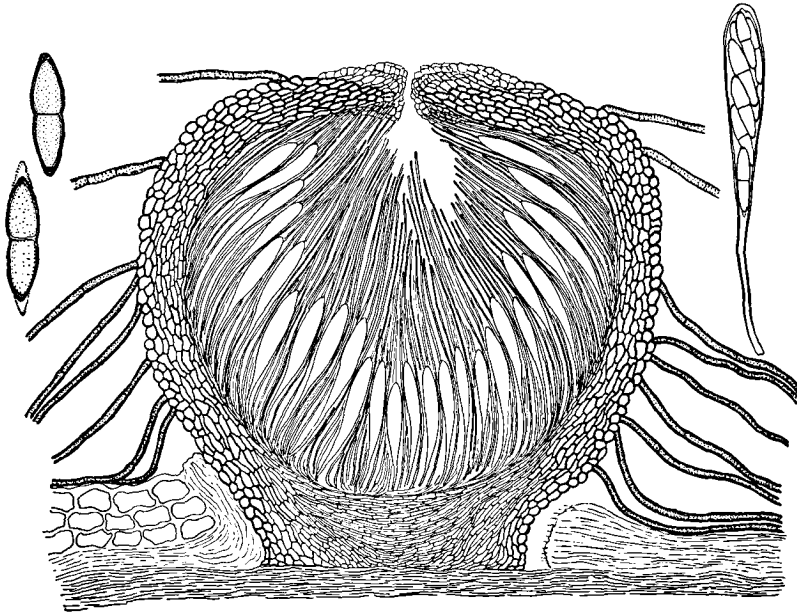


Fig. 20. Section through the ascocarp of *Herpotrichia diffusa*. Magnification 250 $\times$ ; ascus (right) 500 $\times$ ; ascospores (left) 1000 $\times$

##### 5. *Herpotrichia Petrakiana* nom. nov.

Synonym: *Sydowina moravica* Petrak — Ann. Mycol. 23: 95 (1925).

Matrix: Dead wood of *Fagus silvatica* L., and other deciduous trees.

Illustrations: SCHEINPFLUG, H., Ber. Schweiz. Bot. Ges. 68: 379, fig. 201; 380, fig. 211 (1958).

Material examined: AHMAD, S., Fungi of Pakistan no. 14 006 (sub. *Sydowina moravica* Petrak), ex Herb. ETH Zürich, on dead wood, from Lun Bagla, West Pakistan, during September 1955, leg. S. AHMAD.

The pear-shaped ascocarps, measuring 500–900  $\mu$  in diameter, are scattered or crowded on blue stained portions of dead wood. These are at first immersed in the substratum, but become nearly free upon maturity and have a bluntly conical apex with a depressed porus. The wall of the ascocarps is 40–50  $\mu$  in thickness and is composed of thick-walled, brown, polyhedral cells, measuring upto 10  $\mu$  in diameter. The cells towards the base are lighter in colour. The outermost cells of the wall are beset with numerous, olive-brown, thin-walled, septate hyphae, measuring 2–4  $\mu$

in diameter. These form a dense, dark network round the ascocarps but weather away to some extent in older specimens. The porus is lined with septate, hyaline and branched hyphae which are 1—2  $\mu$  in diameter.

The asci are eight-spored, cylindrical, with a double membrane which is thickened at the apex, and measure 130—200  $\times$  12—16  $\mu$ . The ascospores are obliquely uniseriate, biconic, dark brown, septate and deeply constricted in the middle with one or two guttulations in each cell, and measure 24—30  $\times$  11—13  $\mu$  (fig. 17 b).

This fungus has been described by PETRAK (1925) as *Sydowina moravica* Petrak. The genus *Sydowina* does not significantly differ from the earlier described genus *Herpotrichia*. *Sydowina moravica* Petrak, therefore, is being designated as *Herpotrichia Petrakiana* nom. nov. The change in the specific epithet has been found necessary due to the fact that PETRAK (1915) has already described a fungus under the name *Herpotrichia moravica*, which differs from the fungus under discussion.

#### 6. *Herpotrichia australis* sp. nov.

Matrix: Woody remains of *Sclerocarya caffra* Sond., embedded in soil.

Material examined: Woody remains of *Sclerocarya caffra* Sond., mixed with soil, from Pretoriuskop Rest Camp, Krüger National Park, Transvaal, South Africa, on 16. 3. 1960, collection no. 111, leg. H. SCHÜEPP (= ETH Pure Culture Collection no. 3000).

Perithecia singularia vel congregata, erumpentia vel substrato immersa, piriformes, atra 350—600  $\times$  250—400  $\mu$ . Apice ostiolum cylindraceum, hyphibus brunneis, ornatum septatis, flexuosis, 30—80  $\times$  2—2.5  $\mu$  longitudine. Porus occupatus tenuibus, hyalinis, hyphibus septatis ramosis ca. 2  $\mu$  diam., apice clavatus ca. 2.5  $\mu$  diam. Parietes perithecorum 30—40  $\mu$  crassitudine hyphibus numerosis, brunneis ornatis septatis reticulum formantibus super substratum, cellulis parte exteriori crasse tunicatis, hyalinibus. Asci paraphysati, octo-sporei, bitunicati, cylindracei, truncati, apice crasse tunicati, 115—145  $\times$  12—16  $\mu$ . Ascosporeae uniseriatae, astro-fuscae, ellipsoideae vel fusiformes, septatae, in medio paulum constrictae, 18—23  $\times$  11—12  $\mu$ .

Habitat: In ligno *Sclerocaryae caffrae* Sond.

Typus: Pretoriuskop Rest Camp, Krüger National Park, Transvaal, South Africa, March 16, 1960, leg. H. SCHÜEPP.

The black, pear-shaped or flask-shaped ascocarps are scattered or crowded, superficial or embedded in soil or woody substratum, and measure 350—600  $\times$  250—400  $\mu$ . The apex of the ascocarp is bluntly conical or cylindrical and usually crowned with a tuft of flexuous hyphae, measuring 30—80  $\times$  2—2.5  $\mu$ . The wall of the ascocarp is 30—40  $\mu$  in thickness and is composed of a thin outer layer of thick-walled, brown cells, 4—10  $\mu$  in diameter, beset with numerous, brown, septate, sparsely branched hyphae, measuring 2.5—3  $\mu$  in diameter, which ramify in the substratum and also from a diffused network on the surface of the substratum. The inner layers of the wall are composed of hyaline, thin-walled, pseudoparenchymatous cells, measuring 4—12  $\mu$  in diameter, and form a slight bulge at the basal region of the porus. The elongated porus is lined with hyaline, thin-walled,

septate and branched hyphae, measuring approximately  $2\ \mu$  in diameter. The apical parts of these hyphae are usually broader, approximately  $2.5\ \mu$  in diameter and contain thick, deep-staining cytoplasm (fig. 21).

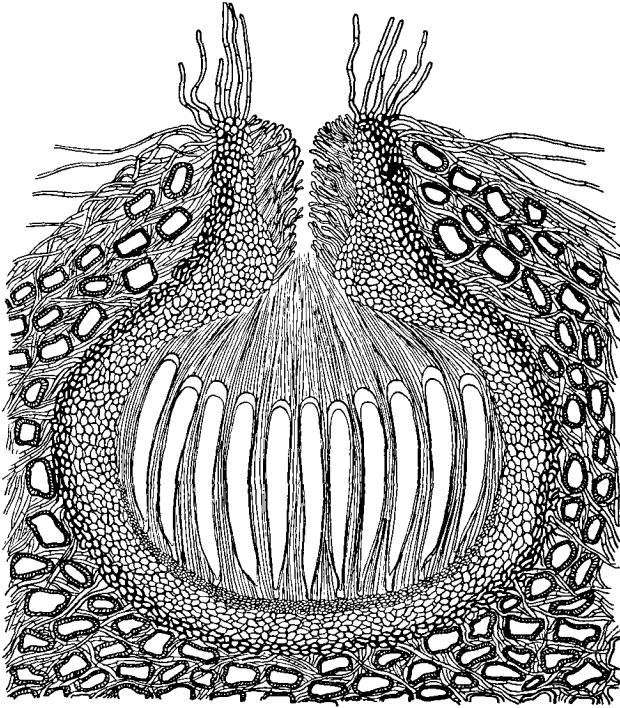


Fig. 21. Section through the ascocarp of *Herpotrichia australis*. Magnification  $200\times$

The asci are cylindrical, truncate at the base, with a double membrane which is thickened at the apex, and measure  $115\text{--}145 \times 12\text{--}16\ \mu$  in size. The ascospores are obliquely uniseriate, dark brown, biconic, 1-septate, indistinctly constricted in the middle, and  $18\text{--}23 \times 11\text{--}12\ \mu$  in size. The paraphysoids are numerous, thin, hyaline, filiform and approximately  $1\ \mu$  in diameter (fig. 17 d).

**Cultural Studies:** The fungus grows well on malt extract agar and forms a greenish-grey, raised colony. The colour gradually turns smoky-grey with age.

#### 7. *Herpotrichia lignicola* (Mout.) comb. nov.

Synonyms:

*Delitschia lignicola* Mout. — Bull. Soc. Roy. Bot. Belg. 25<sup>1</sup>: 151 (1886).

*Sydowina lignicola* (Mout.) Petrak — Ann. Mycol. 23: 96 (1925).

*Lojkania hungarensis* Rehm — Növenytani Közlemények 4: 2 (1905).

*Rhynchostoma julii* Fabre f. *vestitum* Rehm — Hedwigia 30: 256 (1891).

*Sydowina vestita* (Rehm) Petrak — Ann. Mycol. 21: 182 (1923).

Matrix: Moist planks of *Abies alba* Mill. and other conifers.

Illustrations: MOUTON, V., Bull. Soc. Roy. Bot. Belg. 25<sup>1</sup>: 151, tab. 4, fig. 7 (1886). — SCHEINPFLUG, H., Ber. Schweiz. Bot. Ges. 68: 378, figs. 19, 20 k (1958).

Material examined: Herb. ETH Zürich (sub. *Rhynchostoma julii* Fabre f. *vestitum* Rehm), on wet planks of *Abies alba* Mill., from Heimswil, Switzerland, during October 1887, leg. WEGELIN. — REHM, Ascomyceten no. 1030 (sub. *Rhynchostoma julii* Fabre f. *vestitum* Rehm), on wet coniferous planks, from Burgdorf, Switzerland, on 10. 11. 1888, leg. WEGELIN.

This fungus forms a greyish-brown subiculum, composed of dark brown, fluffy hyphae on the surface of the substratum, producing scattered or crowded, flask-shaped ascocarps; which are partially embedded at the base, and measure 400—700  $\mu$  in diameter. The wall of the ascocarp is 40—50  $\mu$  in thickness, and is composed of elongated, thick-walled, polyhedral cells, upto 10  $\mu$  in diameter, which ramify within the substratum and form a thick network round the ascocarp. The cavity of the ascocarp is lined with hyaline, pseudoparenchymatous cells, which form a slight bulge in the basal region of the porus. The elongated porus is lined with numerous, branched, thin hyaline and septate hyphae, measuring approximately 1.5  $\mu$  in diameter.

The asci are eight-spored, cylindrical-clavate, tapering to a thin stipe, with a double membrane which is thickened at the apex, and measure 130 to 200  $\times$  12—16  $\mu$ . The ascospores are 22—30  $\times$  10—14  $\mu$  in size, obliquely uniseriate in the ascus, brown or dark brown, biconic, bicelled, biguttulate and constricted at the septum which is distinctly oblique. The paraphysoids are numerous, thin, hyaline, filiform and approximately 1  $\mu$  in diameter (fig. 17 c).

Dr. EMIL MÜLLER has called my attention to the fact that the type specimen of *Lojkania hungarensis* Rehm, which he had occasion to examine, is identical with the fungus under discussion.

#### 8. *Herpotrichia callimorpha* Winter — Hedwigia 23: 99 (1885)

##### Synonyms:

*Venturia callimorpha* Auersw. — Bot. Tausch-Verein 1867—1868.

*Enchnoa callimorpha* (Auersw.) Winter — in Rabenh. Fungi Europaei no. 1238.

*Herpotrichia callimorpha* (Auersw.) Winter — Hedwigia 23: 99 (1885).

Matrix: Decaying twigs of *Arundo donax* L., *Cornus capitata* Wall., *Lindera pulcherrima* Benth., *Myrica nagi* Thunb., *Rhus semi-alata* Murr., *Rubus* spp., *Saccharum spontaneum* L., *Smilax* sp., *Spiraea corymbosa* Roxb.

Material examined: RABENHORST, Fungi Europaei no. 1238 (sub. *Enchnoa callimorpha* [Mont.] Auersw.), ex Herb. ETH Zürich and ex Herb. University of Geneva, on decaying twigs of *Rubus* sp., from Breitenfelder forest near Leipzig, during August 1866, leg. AUERSWALD. — Herb. University of Geneva (sub. *Venturia callimorpha* Auersw.), on decaying twigs of *Rubus* sp., from Leipzig, leg. AUERSWALD. — Herb. ETH Zürich (sub. *Herpotrichia pinetorum* [Fuckel] Winter), on old twigs of *Rubus lasiocarpus* Sm., from Tiffintop, Naini Tal, Kumoan, India, on 7. 5. 1957, leg. E. MÜLLER. — Herb. ETH Zürich, on decaying twigs of *Cornus capitata* Wall., from Dhobighat, Ranikhet, Distt. Almora, U. P., India, on 19. 10. 1955, leg. M. C. PANDE (= ETH Pure Culture collection no. 2948). — Herb. ETH Zürich, on decaying culms of *Arundo donax* L., from Chaubattia, Ranikhet, Distt. Almora, U. P., India, on 21. 10. 1959, leg. M. C. PANDE (= ETH Pure Culture Collection no. 2947). — Herb. ETH Zürich, on decaying twigs of *Lindera pulcherrima* Benth., from Dhobighat, Ranikhet, Distt. Almora, U. P., India, on 28. 12. 1959, leg. M. C. PANDE (= ETH Pure Culture no. 4531). — Herb. ETH Zürich, on decaying twigs of *Smilax* sp., from Government Hill Fruit Research Station, Chaubattia, Ranikhet, Distt. Almora, U. P., India, on 28. 12. 1959,

leg. M. C. PANDE (= ETH Pure Culture Collection no. 4532). — Herb. ETH Zürich, on decaying twigs of *Myrica nagi* Thunb., *Myrsine africana* L., *Rubus paniculatus* Moon., *Rhus semi-alata* Murr., *Saccharum spontaneum* L. and *Spiraea corymbosa* Roxb., from Chaubattia and Ranikhet, India, between October 1959 and June 1960, leg. M. C. PANDE.

The fungus forms a dense subiculum, composed of dark brown, septate hyphae, on the surface of the substratum. The black, globose or pear-shaped, scattered or crowded ascocarps are partially involved in the subiculum and measure 350—450  $\mu$  in diameter. The wall of the ascocarps is 40—55  $\mu$  in thickness and is composed of brown, pseudoparenchymatous cells, measuring 6—15  $\mu$  in diameter. The outermost cells are somewhat darker and thicker and give rise to numerous brown, septate hyphae, which ramify in all directions. The basal part of the ascocarp is composed of elongated, parallel cells arranged in tiers. The inner layers of the wall project horizontally at the base of the porus, which, consequently, has the appearance of a triangular chamber and is filled with numerous, hyaline, septate and branched hyphae, arising from the cells lining the triangular ostiolar cavity (fig. 22).

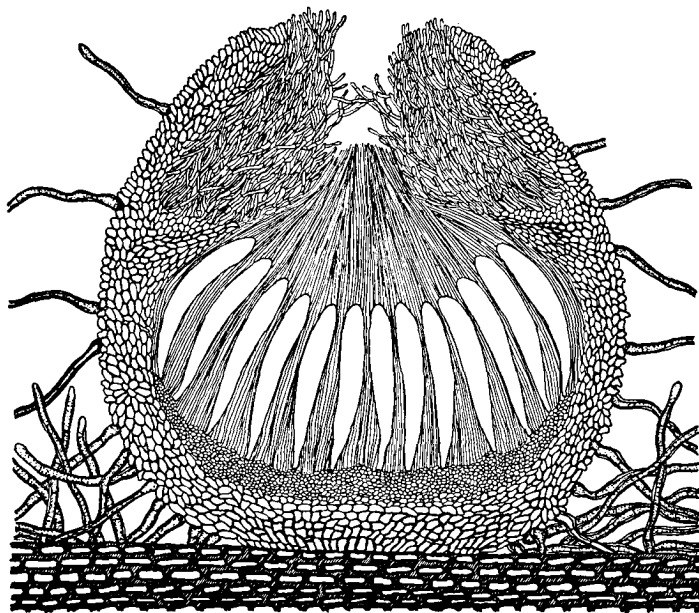


Fig. 22. Section through the ascocarp of *Herpotrichia callimorpha*. Magnification 200 $\times$

The asci are eight-spored, cylindrical-clavate, shortly stipitate, with a double membrane which is thickened at the apex, and measure 90—115  $\times$  11—16  $\mu$ . The ascospores are hyaline at first, ultimately becoming light brown, straight or curved, fusiform, tapering at ends, 1—3 septate, constricted at septa, 4—6 guttulate, and 32—42  $\times$  4.5—7  $\mu$  in size. A thin, hyaline layer of mucous is usually present round the spores and projects into tapering appendages at the ends to the extent of 2—3  $\mu$ . The paraphysoids are numerous, thin, hyaline and filiform (fig. 17 l).

**Cultural Studies:** The fungus grows well on malt extract agar and forms a greenish-grey or smoky-grey, raised colony. On BARNES agar, the growth is slow and the mycelium is thin and light brown.

This fungus has been originally collected by AUERSWALD during the year 1866 and distributed under the name *Venturia callimorpha* (Mont.) Auersw., with *Sphaeria callimorpha* Mont. reduced to a synonym. Subsequently, in Rabenhorst's *Fungi europaei* no. 1238, it has been designated as *Enchmoa callimorpha* (Mont.) Auersw. *Sphaeria callimorpha* described by MONTAGNE (1834) has been, subsequently, renamed *Chaetosphaeria callimorpha* (Mont.) Sacc. by SACCARDO (1883) and has been recently studied in detail by BOOTH (1957). The fungus collected by AUERSWALD has been described again by WINTER (1885) as *Herpotrichia callimorpha* (Auersw.) Winter. Later on, WINTER (1887), apparently unaware of Saccardo's observation, once again described *Sphaeria callimorpha* Mont. as *Chaetosphaeria callimorpha* (Auersw.) Winter, declaring it to be distinct from *Herpotrichia callimorpha* (Auersw.) Winter. In view of the above history, the latter should be named as *Herpotrichia callimorpha* Winter.

9. *Herpotrichia Schiedermayeriana* Fuckel — Symb. Mycol. Zweit. Nachtr. 27 (1873)

Synonyms:

*Sphaeria (Bassisedae) albidostoma* Peck — Ann. Rep. New York State Museum 32: 51 (1879).

*Herpotrichia albidostoma* (Peck) Sacc. — Syll. Fung. 9: 875 (1891).

*Herpotrichia incisa* Ell. et Everh. — Proc. Acad. Sci. Phil. 45: 130 (1893).

*Herpotrichia Schiedermayeriana* Fuckel var. *caldariorum* P. Henn. — Hedwigia 34: (Repertorium no. 2) 102 (1895).

*Xenonectria caldariorum* (P. Henn.) v. Höhnelt — Sitz. Kaiser Akad. Wissensch. Wien, Math.-naturw. Kl. 129: 12 (1920).

*Herpotrichia sabalicola* P. Henn. — Verh. Bot. Ver. Prov. Brandbg. 40: 154 (1898).

Matrix: Decaying twigs and wood of *Arundo donax* L., *Bougainvillea* sp., *Crataegus crenulata* Roxb., *Lonicera quinquelocularis* Hardw., *Pinus* sp., *Prunus cerasoides* D. Don, *Rubus biflorus* Buch., *Rubus fasciculatus* Duthie, *Sambucus nigra* L.

Illustrations: BERLESE, A. N., *Icones Fungorum* 1: tab. 104, fig. 1 (1894). — SACCARDO, P. A., *Fungi Italici*, tab. 143 (1877—1886).

Material examined: Herb. FÜCKEL no. 129, ex Herb. University of Geneva, on decaying twigs of *Sambucus nigra* L., from Kirchdorf, Austria, during 1869, leg. F. FÜCKEL (type specimen). — RABENHORST-WINTER, *Pazschke Fungi europaei* no. 4060 (sub. *Herpotrichia Schiedermayeriana* Fuckel var. *caldariorum* P. Henn.), ex Herb. University of Geneva, on pine wood baskets in the orchid house of Botanical Gardens, Berlin, collected during November 1893 and February 1894, leg. P. HENN. — ELLIS and EVERHART, *Fungi Columbiani* no. 1035 (sub. *Herpotrichia diffusa* Schw. var. *Rhodomphala* Berk.) on hard wood in damp situations, from Martinville, La., USA, during February 1896, leg. ELLIS and EVERHART. — Herb. ETH Zürich, on decaying twigs of *Arundo donax* L., *Bougainvillea* sp., *Crataegus crenulata* Roxb., *Lonicera quinquelocularis* Hardw., *Prunus cerasoides* D. Don, *Rubus biflorus* Buch., *Rubus fasciculatus* Duthie, from Chaubattia and Ranikhet, U. P., India, between October 1959 and December 1960, leg. M. C. PANDE.

The fungus forms a dark subiculum, composed of brown, septate hyphae, 4—7  $\mu$  in diameter, on the surface of the substratum. The dark brown, globose or subglobose ascocarps are superficial, scattered or crowded, par-



tially involved in the substratum and 0.5—1 mm. in diameter. The apex of the ascocarp is flat, disc-like, naked, reddish or sometimes whitish and composed of pseudoparenchymatous cells, measuring 4—8  $\mu$  in diameter, which ultimately disintegrate in the centre to form the porus. The wall of the ascocarp is 40—60  $\mu$  in thickness and composed of dark brown, thick-walled, polyhedral cells, measuring 4—10  $\mu$  in diameter. The surface cells give rise to numerous, brown, septate, thick-walled hyphae, which are 4—6  $\mu$  in diameter and similar to the hyphae forming the subiculum with which they intermingle. The basal part of the ascocarp is composed of vertically elongated, parallel cells, arranged in tiers. The cells lining the cavity of the ascocarp are hyaline and pseudoparenchymatous (fig. 23).

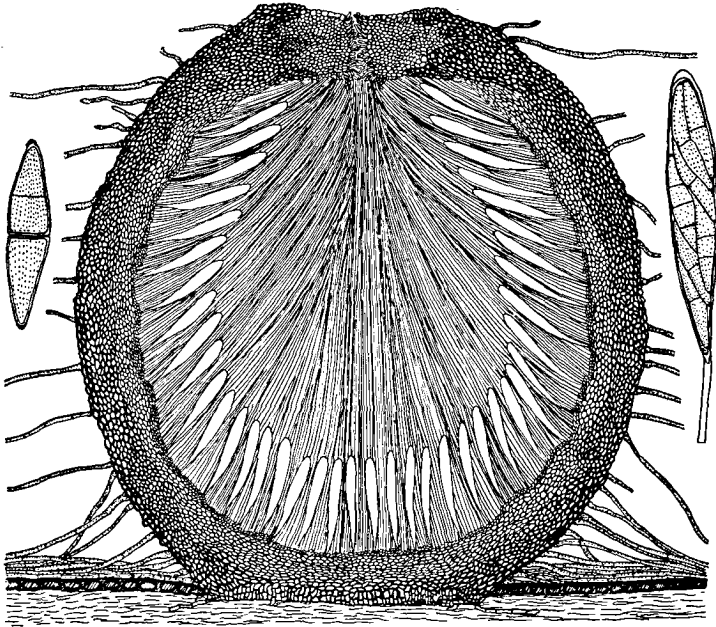


Fig. 23. Section through the ascocarp of *Herpotrichia Schiedermayeriana*.  
Magnification 200 $\times$ ; ascus (right) 400 $\times$ ; ascospore (left) 800 $\times$

The asci are eight-spored, cylindrical-clavate, tapering to a long stipe at the base, with a double membrane which is thickened at the apex, and measure 100—120  $\times$  11—16  $\mu$ . The hymenial layer extends right upto the base of the porus and the asci appear to line the entire surface of the cavity of the fruit body. The ascospores are biseriata in the upper part of the ascus, becoming uniseriate below, light brown, straight or slightly curved, fusiform, 1—3 septate, constricted in the middle, and 25—42  $\times$  4.7—7  $\mu$  in size. There is a hemispherical to tapering appendage at each end projecting out to the extent of 2—4  $\mu$ . The paraphysoids are thin, hyaline, filiform, approximately 1  $\mu$  in diameter and attached at both ends in the beginning, ultimately becoming free at the apex (fig. 17 m).

10. *Herpotrichia juniperi* (Duby) Petrak — Ann. Mycol. 23: 43 (1925)

## Synonyms:

- Sphaeria juniperi* Duby — Klotz. Herb. Myc. no. 1833.  
*Laestadia juniperi* (Duby) Sacc. — Syll. Fung. 9: 585 (1891).  
*Herpotrichia mucilaginoso* Starb. — Bot. Notis. p. 8 (1887).  
*Herpotrichia nigra* Hartig — Allg. Forst. Jagd. Zeit. 64: 15 (1888).  
*Enchnosphaeria nigra* (Hartig) Berl. — Icon. Fung. 1: 105 (1894).  
*Enchnosphaeria passicrinis* Sacc. — Syll. Fung. 2: 206 (1883).  
*Sphaeria pinetorum* Fuckel — Hedwigia 7: 14 (1868).  
*Enchnosphaeria pinetorum* (Fuckel) Fuckel — Symb. Mycol. 147 (1869).  
*Herpotrichia pinetorum* (Fuckel) Winter — Die Pilze 2: 208 (1887).  
*Ozonium plica* Kalchbr. — Math. és Termész. Közlem. p. 159 (1862).  
*Bertia querceti* Rehm — Ascom. no. 43 (1870); in Sacc. — Syll. Fung. 1: 583 (1882).  
*Enchnosphaeria santonensis* Sacc. — Michelia 2: 66 (1880 b).  
*Lasiosphaeria scabra* Auersw. — Fungi europaei no. 1245; in Sacc. — Syll. Fung. 2: 202 (1883).  
*Racodium Therryanum* Thüm. — Rev. Myc. 2: 87 (1880).

Matrix: Needles of various conifers viz., *Abies*, *Chamaecyparis*, *Juniperus*, *Libocedrus*, *Picea*, *Pinus*, *Pseudotsuga*, *Phyllodoce*, *Taxus*, *Thuja*, *Tsuga* spp., and decaying twigs and leaves of deciduous plants in coniferous forests.

Illustrations: BERLESE, A. N., *Icones Fungorum* 1: tab. 102, fig. 2; tab. 103, fig. 1 (1894). — GÄUMANN, E., C. ROTH and J. ANLIKER, *Zeitsch. Pflanzenkrank. und Pflanzenschutz* 44: 97, figs. 1—4 (1934). — HARTIG, R., *Allg. Forst. und Jagd-Zeit.* 64: 17 (1888). — STURGISS, W. C., *Phytopath.* 3: 158, plates 12—13 (1913). — WINTER, G., *Die Pilze* 2: 194, figs. 5—7 (1887).

Material examined: Herb. FÜCKEL, Nassau's Flora, F. rh. no. 1797 (sub. *Sphaeria pinetorum* Fuckel), ex Herb. University of Geneva, on rotting pine needles and deciduous leaves, lying on ground in a pine forest, from Hallgarten, during spring, leg. L. FÜCKEL. — ROUMÉGUÈRE, C., *Fungi selecti exsiccati*, Herb. Boissier no. 4957 (sub. *Enchnosphaeria pinetorum* Fuckel), ex Herb. University of Geneva, on fallen branches and needles of pine, from Janneyrias (Isère) Hiver, France, leg. R. THERRYANAE. — REHM, *Ascomyceten* no. 996 b (sub. *Enchnosphaeria nigra* [Hartig] Berl.), ex Herb. University of Geneva, on needles of *Pinus pumila* Haenke, from Tirol, during August 1905, leg. Dr. REHM. — BARTHOLOMEW, E., *Fungi Columbiani* no. 4634 (sub. *Herpotrichia nigra* Hartig), ex Herb. University of Geneva, on needles of *Picea engelmanni* (Parry) Engel., from Silverlake, Colorado, on 5. 5. 1914, leg. BARTHOLOMEW and BETHET. — SIEMASZKO, W., *Fungi Barlowenses Exsiccati* (sub. *Herpotrichia pinetorum* [Fuckel] Winter), ex Herb. University of Geneva, on needles of *Picea excelsa* Lik., from Pusyeya Biatowieska, Poland, on 18. 9. 1923, leg. W. SIEMASZKO. — Herb. ETH Zürich, on decaying twigs of *Rhododendron ferruginum* L., from Vallouise/Hautes Alpes, France, on 22. 6. 1958, leg. E. MÜLLER.

The fungus forms a dark, felt-like covering on the needles of conifers, which become matted and also fills the sunken spaces above the stomata with brown stromatic cells. The globose or subglobose ascocarps are scattered, superficial or slightly embedded in the substratum and are 200—350  $\mu$  in diameter. The wall of the ascocarp is 20—40  $\mu$  in thickness and is composed of thin-walled brown cells, measuring 2—12  $\mu$  in diameter. The innermost cells are elongated and hyaline, while the outermost ones are thicker, darker and beset with numerous, long, brown, septate hyphae, 4—6  $\mu$  in diameter, which sometimes fuse laterally by means of short lateral branches, arising at right angles (fig. 24).

The asci are eight-spored, cylindrical, shortly stipitate, with a double membrane which is thickened at the apex, and measure  $75-115 \times 12-16 \mu$ . The ascospores are obliquely biseriate, hyaline at first, light brown when mature, straight or curved, fusiform, 1-3 septate, 2-4 guttulate, constricted at septa, and  $22-35 \times 5-7.5 \mu$  in size. The spores are sometimes surrounded by a thin, hyaline, mucous sheath. The paraphysoids are numerous, hyaline, filiform and attached at both ends at first, but ultimately become free at the apex (fig. 17 k).

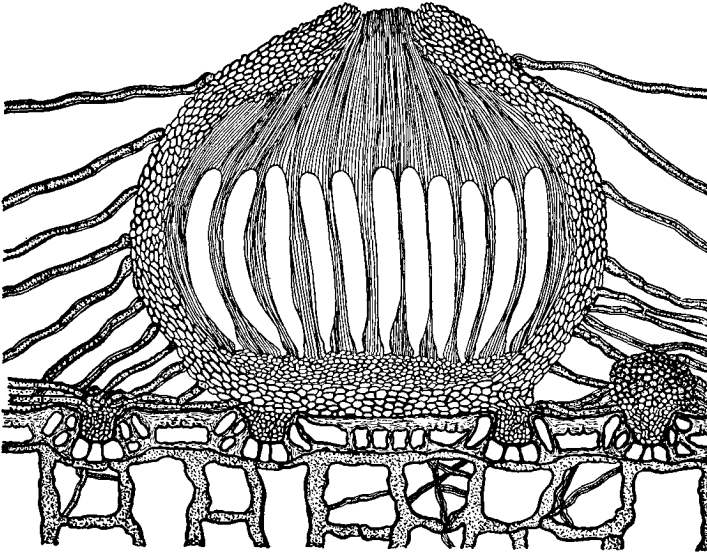


Fig. 24. Section through the ascocarp of *Herpotrichia juniperi*. Magnification  $200\times$

**Cultural Studies:** On Barnes agar, the fungus produces a brownish-grey, slow growing, fluffy colony, which remains sterile. On malt extract agar, the colonies are raised and dark grey, greenish-grey or smoky-grey in colour. At  $4^{\circ}\text{C}$ , numerous intercalar or terminal chlamydospores are formed. The terminal chlamydospores are spore-like, but vary greatly in shape and size. The pycnidia sometimes appear on old cultures and are superficial, globose or pear-shaped, beset with short, light brown appendages, often with a short neck, and measure  $80-200 \mu$  in diameter. The pycnidial wall is composed of 2-3 layers of brown, polyhedral cells, measuring 4 to  $12 \mu$  in diameter. The cavity is lined with short, branched or unbranched pycnidioophores, measuring  $4-10 \times 1.5-2 \mu$ , which bear hyaline unicellular, oval pycnospores, measuring  $1.5-2.5 \times 1-2 \mu$ . The pycnidial stage belongs to the form-genus *Pyrenochaeta* de Notaris.

#### 11. *Herpotrichia Pandei* sp. nov.

Matrix: Decaying culms of *Saccharum spontaneum* L.

Material examined: Decaying culms of *Saccharum spontaneum* L., from Chaubattia, District Almora, U. P., India, on 20. 11. 1959, leg. M. C. PANDE.

Subiculum brunneum, perithecia atra solitaria vel congregata, hemisphaerica, base immersa,  $500-650 \times 450-550 \mu$ . Parietis  $40-70 \mu$  crassitudine, cellulis congregatis brunneis, crasse tunicatis,  $6-10 \mu$  diam., interstrata cellularum parallelum, hyalinarium, parietibus tenuibus, hyphibus ornati brunneis, brevibus vel perpentibus, septatis singillatim vel coniuncte orientibus. Ostiolum hyphibus hyalinis ornatum, septatis, ramosis. Asci 8-sporei, cylindracei, bitunicati,  $120-160 \times 9-11 \mu$ . Ascosporeae occulte biseriatae vel subseriatae, hyalinae, fusiformes vel ellipsoideae, 1-3 septatae, 2-4 guttulate, medio constrictae,  $14-23 \times 4-6 \mu$ , in extremis appendices ad  $4.5 \mu$  longitudine.

Habitat: In culmis morentibus *Saccharum spontanei* L.

Typus: Chaubattia, Dist. Almora, U. P., India, October 20, 1959, leg. M. C. PANDE.

The fungus forms a diffused subiculum composed of dark brown, fluffy hyphae on the surface of the substratum, forming scattered or crowded, hemispherical ascocarps, which are embedded at the base and measure  $500$  to  $650 \times 450-550 \mu$  in size. The wall of the ascocarp is  $40-70 \mu$  in thickness with irregular, thick-walled brown cells towards the exterior and an inner tissue composed of groups of thick-walled, brown cells,  $6-10 \mu$  in diameter, irregularly interspersed by layers of hyaline, thin-walled, elongated and parallel cells, measuring  $16-25 \times 3-6 \mu$ . The wall is beset with numerous, stiff, thick-walled, brown, septate hyphae, measuring  $5-8 \mu$  in diameter. Some of these are shorter, subhyaline or hyaline at the apex, upto  $200 \mu$  in length and usually arise in groups, while the others are longer, unbranched or sparsely branched, trailing, and mingle with similar hyphae of the subiculum. The porus is filled with thin, hyaline, septate and branched hyphae (fig. 25).

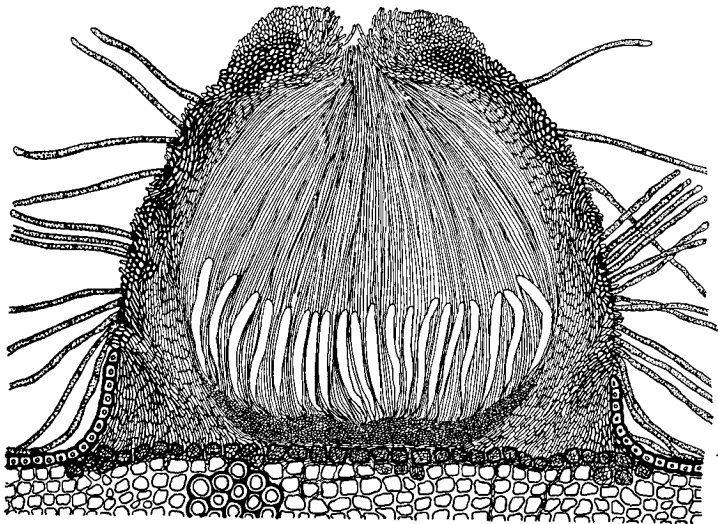


Fig. 25. Section through the ascocarp of *Herpotrichia Pandei*. Magnification  $100\times$

The asci are eight-spored, cylindrical-clavate, tapering to a thin stipe, with a double membrane which is thickened at the apex, and measure  $120-160 \times 9-11 \mu$ . The ascospores are obliquely biseriata in the upper part of the ascus, becoming subseriate or uniseriate below. They are hyaline, straight, biconic or fusiform, 1-3 septate, 2-4 guttulate, constricted in the middle, and are  $14-23 \times 4-6 \mu$  in size. There is a tapering, hyaline, mucous appendage at the tips projecting out to the extent of  $4.5 \mu$ . In older spores, the mucous sheath is usually limited to a short conical projection. The paraphysoids are numerous, thin hyaline, filiform and attached at both ends in the beginning, but ultimately become free at the apex (fig. 17 h).

This fungus has been named after Shri M. C. PANDE, Mycological Assistant, Government Hill Fruit Research Station, Chaubattia, Dist. Almora, U. P., India, whose numerous collections, including the fungus under reference, have been of great help to me.

12. *Herpotrichia mutabilis* (Pees. ex Fr.) Wint. — in Rabenh. Kryptogamenfl. 1<sup>2</sup>: 209 (1887)

Synonyms:

*Sphaeria mutabilis* Pers. — Ic. et descr. Fung. Fasc. 1: 24 (1798); Meth. Fung. p. 72 (1801); and Fries — Syst. Myc. 2: 447 (1822).

*Lasiosphaeria mutabilis* (Pers.) Fuckel — Symb. Mycol. Nachtr. 1: 14 (1871).

*Khokia mutabilis* (Pers.) Petrak — Ann. Mycol. 38: 203 (1940).

*Pseudotrichia mutabilis* (Pers.) Wehm. — The Fungi of New Brunswick, Nova Scotia and Prince Edward Island, Ottawa, p. 35 (1950).

*Khokia ambigua* Petrak, non *Khokia ambigua* (Pass.) Petrak — Hedwigia 62: 284 (1921 b).

*Thyridaria aurata* Rehm — Ann. Mycol. 10: 392 (1912).

*Pseudotrichia aurata* (Rehm) Wehm. — Mycologia 33: 60 (1941).

*Stuartella formosa* Bres. non Fabre — Ann. Mycol. 9: 80 (1911); teste v. Höhncl — Sitzber. Ak. Wiss. Wien, Math.-naturw. Kl. 123<sup>1</sup>: 53 (1914).

*Pseudotrichia stromatophila* Kirschst. — Ann. Mycol. 37: 125 (1939).

*Sphaeria viridicoma* Cooke et Peck — 29 Rep. New York State Mus. p. 64 (1876).

*Lasiosphaeria viridicoma* (Cooke et Peck) Wehm. — The Fungi of New Brunsw. etc., Ottawa, p. 35 (1950).

*Zygoella ybbsitziensis* Strass. — Ann. Mycol. 9: 82 (1911).

*Melogramma ybbsitziensis* (Strass.) v. Höhncl — Sitzber. Ak. Wiss. Wien, Math.-naturw. Kl. 123<sup>1</sup>: 55 (1914).

Matrix: Empty stroma of a Pyrenomycete.

Illustration: PERSOON, C. H., Ic. et descr. Fung. Fasc. 1: tab. 7, fig. 6 (1798).

The globose ascocarps are usually formed within empty stroma of another Pyrenomycete and measure  $500-800 \mu$  in diameter. The wall of the ascocarp is  $40-60 \mu$  in thickness and is composed of laterally flattened, more or less parallel, light brown cells, measuring  $8-12 \times 4-6 \mu$ . The empty older stroma surrounding these ascocarps are composed of hexagonal cells,  $3-5 \mu$  in diameter, and beset with short, stiff, brown hyphae,  $2-4 \mu$  in diameter. Sometimes this covering is incomplete and in such cases the bristle-like appendages arise directly from the wall of the ascocarp (fig. 26).

The asci are eight-spored, cylindric-clavate, tapering at the base, with a double membrane which is thickened at the apex, and measure  $120-180 \times 12-18 \mu$ . The ascospores are biseriata in the upper part of the ascus, becoming uniseriate below. They are hyaline, fusiform, 3-septate, constricted in the middle, 4-guttulate, and measure  $30-39 \times 8-11 \mu$ . There is a thin, hyaline, mucous sheath round the spores. The paraphysoids are numerous, thin, hyaline, filiform and attached at both ends in the beginning, ultimately becoming free at the apex (fig. 17 i).

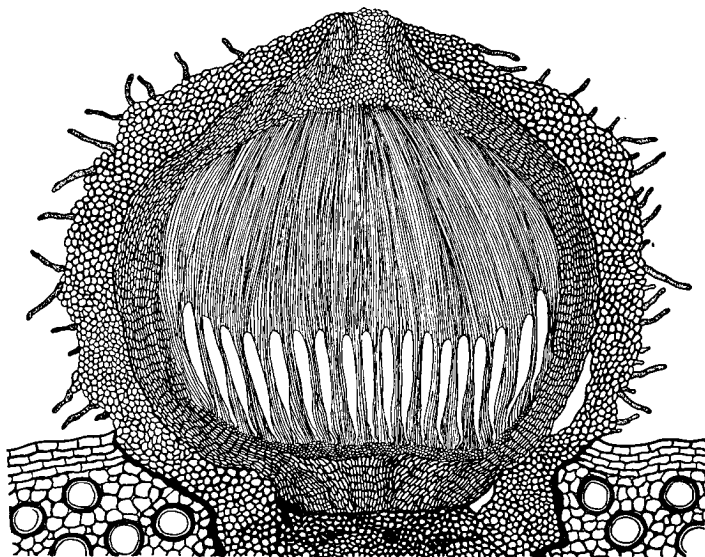


Fig. 26. Section through the ascocarp of *Herpotrichia mutabilis*. Magnification  $100\times$

#### F. DISCUSSION

The genera *Massarina* Sacc., *Keissleriella* v. Höhnel, and *Herpotrichia* Fuckel treated in the foregoing chapters, are distinguishable from one another on the basis of the structure of the fruit body, especially the absence and presence of setae within the porus in *Massarina* and *Keissleriella* respectively, and the presence of a hairy subiculum and covering around the ascocarp in *Herpotrichia*. The presence of a dark tissue lining the porus, emphasised as a generic character by MUNK (1956), is not universal in *Massarina*. These generic characters, as expected, are not characters common to all the three genera. A consideration of these and other features indicates that the genera *Massarina* Sacc., *Keissleriella* v. Höhnel and *Herpotrichia* Fuckel, belonging to the *Bitunicatae* in the order *Pseudosphaeriales* should, for the time being, remain in the family *Ploesporaceae* as there are no striking characters to justify the creation of a new family. The family *Massarinaceae* proposed by MUNK (1956) is based upon characters that cannot be treated as distinct from those present in *Ploesporaceae* and should, therefore, be discontinued.

### Summary

The taxonomy of the genera *Massarina* Sacc., *Keissleriella* v. Höhnelt and *Herpotrichia* Fuckel, together with their synonyms, is treated in this paper.

During the course of this investigation, 19 species of *Massarina*, including 7 new species, 11 of *Keissleriella*, including 2 new species, and 12 of *Herpotrichia* including 2 new species have been studied. The species are distinguishable in ascospore characteristics and also in the structure of the ascocarps, especially in the region of the porus. Keys have been provided for this purpose. In cultural experiments, a large number of the species have been found to be capable of producing their imperfect stages, all of them, so far discovered, belong to the *Sphaeropsidales*.

Although the three genera form a natural group, there is not enough justification for the creation of a new family as they can be easily grouped within the family *Pleosporaceae*. The family *Massarinaceae* proposed by MUNK (1956) is based upon characters that cannot be treated as distinct from those present in *Pleosporaceae*.

### Zusammenfassung

In der vorliegenden Arbeit werden die Ergebnisse einer systematischen Untersuchung der Ascomycetengattungen *Massarina* Sacc., *Keissleriella* v. Höhnelt und *Herpotrichia* Fuckel mit ihren Synonymen dargestellt. Es wurden dabei 19 Arten von *Massarina*, darunter 7 neue, 11 Arten von *Keissleriella*, darunter 2 neue, 12 Arten von *Herpotrichia*, darunter 2 neue, erfaßt. Alle diese Arten lassen sich auf Grund ihrer Ascosporen unterscheiden, und darüber hinaus zeigen sie vielfach auch charakteristische Unterschiede im Fruchtkörperbau, besonders im Bereich der Mündungen. Bestimmungsschlüssel erleichtern das Auffinden der unterschiedenen Arten. An Hand von Kulturversuchen konnten von einer größeren Zahl von Arten sphaeropsidale Nebenfruchtformen nachgewiesen werden.

Obwohl die drei Gattungen eine natürliche Gruppe bilden, lassen sie sich zwanglos in die Familie der *Pleosporaceae* einordnen. Eine Familie der *Massarinaceae*, wie sie von MUNK (1956) vorgeschlagen worden ist, ließe sich nicht genügend von den *Pleosporaceae* trennen.

This work has been carried out at the Institute of Special Botany of the Swiss Federal Institute of Technology, Zürich, under the guidance of Professor Dr. E. GÄUMANN, to whom I wish to express my grateful thanks. I am deeply indebted to Dr. EMIL MÜLLER, who supervised the work, for his unfailing help, numerous suggestions and criticisms. I am exceedingly grateful to Dr. H. SCHÜEPP and Dr. R. HÜTTER for the Latin translation of the diagnosis. I also wish to express my cordial thanks to Miss ARNAVAZ DUBASH for her great help in the preparation of the manuscript.

To all my friends and brethren in Switzerland and Netherlands, I express my sincere thanks for their encouragement and help in many ways.

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## Curriculum vitae

Born on 7. 8. 1922 in Ghazipur, U.P., India. High School from the Government Jubilee High School, Gorakhpur, in 1937. Intermediate in Science from the St. Andrew's College, Gorakhpur, in 1939. Bachelor of Science with Honours in 1942 and Master of Science in 1943, from the University of Allahabad. Demonstrator in Botany and Plant Pathology and subsequently Lecturer in Plant Pathology at the Government Agriculture College, Kanpur, 1943—1950. Mycologist (Uttar Pradesh Agricultural Service), Government Hill Fruit Research Station, Chaubattia, District Almora, U.P., India, since 1950. Studied Food Processing, with special reference to fruits and vegetables, in various countries in Europe, during 1956, under a Fellowship awarded by the Food and Agriculture Organisation of the United Nations. Research Fellow at the Department of Special Botany of the Swiss Federal Institute of Technology in Zürich, Switzerland, under the guidance of Prof. Dr. E. GÄUMANN, 1959—1961.