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A monograph of the genera *Nectriella* Nitschke and *Pronectria* Clements with reference to Charonectria, Cryptonectriella, Hydronectria and Pseudonectria

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City University of New York, 1991

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by

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ABSTRACT

A MONOGRAPH OF THE GENERA NECTRIELLA NITSCHKE AND PRONECTRIA CLEMENTS WITH REFERENCE TO CHARONECTRIA, CRYPTONECTRIELLA, HYDRONECTRIA AND PSEUDONECTRIA

by

ROSALIND LOWEN

Advisor: Dr. Clark T. Rogerson

A monographic revision of the genus Nectriella Nitschke in Fuckel (1870) (non Nectriella Saccardo, 1877); Ascomycetes, Hypocreales, Hypocreaceae is presented. Nectriella Nitschke, typified by N. fuckelii Nitschke is characterized by nonstromatic, often setose ascomata that are immersed to partially erumpent. The ascomata usually occur in dead plant tissue. The asci generally have a nonamyloid apical ring. The ascospores are typically uniseptate, ornamented and partly biseriate. As in the other hypocrealean genera, the known anamorphs are phialidic.

Lichenicolous taxa formerly included in Nectriella have been placed in the genus Pronectria Clements (1931), type species P. robergei (Mont. & Desm.) Clements. Ascomata of species of Pronectria typically remain immersed, are parasitic and have a clypeoid mixture of fungus and host tissues. They generally have redder pigments than those of Nectriella.

Twenty-five species are included in Nectriella Nitschke and 17 species in Pronectria. These species, their known anamorphs and relationships are discussed. New taxa described here are **Charonectria amabilis** Lowen & Hawksworth, **Nectriella dingleyae** Lowen, **N. minuta** Lowen, **N. obscura** Lowen, **N. rubrocapitula** Lowen, **N. utahensis** Lowen & Rogerson, **Pronectria echinulata** Lowen, **P. leptaleae** (Steiner) Lowen var. **tuberculata** Lowen, **P. paucispora** Lowen, and **P. pertusariicola** Lowen. Two new names proposed are **Nectriella crouanii** Lowen and **N. halonata** Lowen. New combinations in the Hypocreales are **Nectria helenae** (Sacc. & Roum.) Lowen, **Nectriella dakotensis** (Seaver) Lowen, **Pseudonectria aurantia** (Penzig & Sacc.) Lowen and **Pseudonectria coronata** (Juel) Lowen. New combinations in the Xylariales are **Charonectria sceptri** (Nyl.) Lowen, **Cryptonectriella geoglossi** (Overeem) Lowen and **Discostroma succinea** (Roberge) Lowen.

Most of the names excluded from Nectriella Nitschke belong in the hypocrealean genera Nectria sensu lato, Hydronectria and Schizoparme. The remaining excluded species are placed in nonhypocrealean genera, such as Charonectria and Cryptonectriella.

A later homonym, Nectriella Saccardo (= Pseudonectria Seaver), was erected for species with superficial ascomata and unicellular ascospores. Nomenclature and brief descriptions of examined specimens are presented for the species originally referred to Nectriella Saccardo.

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INTRODUCTION

The global decline in biological diversity suggests that there is a great need for systematic studies. Enormous numbers of species of organisms yet undescribed are threatened by loss of habitat through pollution or destruction of natural areas.

This work is a monographic revision of the genera <u>Nectriella</u> Nitschke in Fuckel (1870) [non <u>Nectriella</u> Saccardo, 1877] and <u>Pronectria</u> Clements in Clements and Shear (1931); Ascomycetes, Hypocreales, Hypocreaceae. Species of <u>Nectriella</u> are such organisms. The minute, immersed, inconspicuous, pallid ascomata are difficult to locate. Ascomata of <u>Nectriella</u> are found in a variety of substrates including parts of herbaceous and woody phanerogams, rotten rope and paper; <u>Pronectria</u> is found in the thalli of lichens.

The concept of <u>Nectriella</u> is reevaluated, taking into account modern research in the Hypocreaceae by Booth (1959), Rogerson (1970), Rossman (1979) and Samuels (1976). Many new names have been introduced into <u>Nectriella</u> since the genus was monographed by Weese (1914). Although <u>Nectriella</u> is accepted as a genus, some <u>of</u> the species eventually may be better associated with species with superficial ascomata currently classified in <u>Nectria</u> Fr. Subgroupings are being established within the <u>Nectria</u> complex based on the correlation of life cycles with morphological characters of both the anamorph and the teleomorph following Booth (1959), Rossman (1983), Samuels and Rossman (1979) and Samuels and Seifert (1987). When this realignment is achieved, the groups are likely to form the basis for segregate genera and may accommodate some species currently assigned to *Nectriella* and perhaps *Pronectria*.

Of the 171 names considered in *Nectriella*, 25 of the accepted names belong in *Nectriella* Nitschke, 18 in *Pronectria*, three in *Charonectria* Sacc., two in *Cryptonectriella* (Höhnel) Weese, one in *Hydronectria* Kirschst., five in *Pseudonectria* Seaver, 52 in *Nectriella* Sacc. and 20 in *Nectria*. Forty-five of the names are synonyms. One of the taxa studied as *Nectriella* Nitschke is referred to *Discostroma* Clements, Xylariales, Amphisphaeriaceae (*sensu* Barr, 1990). Five others cannot be assigned to genera. New taxa described herein are **Charonectria amabilis** Lowen & Hawksw., **Nectriella dingleyae** Lowen, **N. minuta** Lowen, **N. obscura** Lowen, **N. rubrocapitula** Lowen, **N. utahensis** Lowen & Rogerson, **Pronectria echinulata** Lowen, **P. leptaleae** (Steiner) Lowen var. **tuberculata** Lowen, **P. paucispora** Lowen and **P. pertusariicola** Lowen. Two new names proposed are **Nectriella crouanii** Lowen and **N. halonata** Lowen. New combinations are **Charonectria sceptri** (Karst.) Lowen, **Cryptonectriella geoglossi** (Overeem) Lowen, **Discostroma succinea** (Roberge) Lowen, **Nectria helenae** (Sacc. & Roumeg.) Lowen, **Nectriella dakotensis** (Seaver) Lowen,

Pseudonectria aurantia (Penzig & Sacc.) Lowen and **Pseudonectria coronata** (Juel) Lowen.

Many genera of fungi can be defined by their anamorphs. The establishment of anamorphic connections through the growth of cultures from isolated ascospores is important in the systematics of ascomycetes. The Tulasne brothers (1865), Wollenweber (1926) and Booth (1959) have contributed to our knowledge of the anamorph-teleomorph connection in the Hypocreales. Closely related ascomycetes tend to produce similar conidiogenous cells (Rogers, 1979; Samuels and Seifert, 1987) and anamorphs can be helpful in understanding relationships. Cultures, even if sterile, can provide additional characters such as color, aerial mycelium, or type of margin that are useful for identification of species and for affording the opportunity for experiments such as testing the pigments with thin-layer chromatography (TLC) or the possibility of examining the septa with transmission electron microscopy (TEM).

The location of fresh ascomata of species of Nectriella is difficult because the ascomata are immersed in the substrate with only the papillae visible. Despite the difficulty, thirteen species of Nectriella or Pronectria were collected and isolated into pure culture from ascospores. The colonies grew slowly on various media and produced pale red- to orange-colored cultures. Based on these life history studies, five species of Nectriella were found to be homothallic, i.e., they produce ascomata in colonies derived from single ascospores and do not need differing mating types to form the dicaryon. I have not observed conidia in cultures of the homothallic species. The homothallic species are N. bloxamii (Berk. & Br.) Fuckel, N. guttulata Lowen, N. halonata, N. paludosa Fuckel and N. sambuci (Höhnel) Weese. Anamorphs have been proven for eight species. N. dakotensis, N. minuta, Pronectria anisospora (Lowen) Lowen and Pronectria santessonii (Lowen) Lowen have Acremonium Link anamorphs. Nectriella dingleyae and N. obscura have Fusarium Link anamorphs. N. pironii Alfieri & Samuels is linked to a Kutilakesa Subram. Finally, Pronectria erythrinella (Nyl.) Lowen has a Illosporium Mart. anamorph. A species of Illosporium associated with Pronectria robergei (Mont. & Desmaz.) Lowen is the strongly suspected anamorph but this was not confirmed in culture.

This paper describes species of Nectriella Nitschke, Pronectria, Charonectria, Cryptonectriella, Hydronectria and includes the nomenclature and descriptions of Nectriella Sacc. [= Pseudonectria] where species were studied. Other names are disposed in Allantonectria Earle, Discostroma, Nectria, Neoskofitzia Schulzer, Pycnidiella Höhnel, Schizoparme Shear and Sphaerostilbella (Hennings) Sacc. & D. Sacc.

TAXONOMIC HISTORY AND GENERIC CONCEPTS

Nitschke's description of Nectriella, as published in Fuckel (1870), was for hypocrealean fungi that have solitary, erumpent, nonstromatic, translucent and reddish ascomata and Nectria-like ascospores. In addition to N. fuckelii Nitschke in Fuckel, Fuckel (1870) added four species, N. charticola Fuckel, N. paludosa, N. carnea Fuckel and N. coccinea Fuckel. N. fuckelii was described as having four-celled ascospores. The other species described by Fuckel alone all had two-celled ascospores. Nectriella fuckelii, as the only Nitschke species included in the original treatment, was selected as the lectotype by Seaver (1909: 45). This lectotypification was accepted by most later workers such as Weese (1914: 128), Clements and Shear (1931: 281) and Rogerson (1970: 895). Müller and Arx (1962: 621) selected N. robergei for the lectotype because the type material examined of N. fuckelii was immature. Seaver, however, must be followed as the first author to designate N. fuckelii as the lectotype species of Nectriella.

Weese (1914) in his revision of Nectriella included 15 species. In placing species in Nectriella, Weese emphasized immersed ascomata as an important character. In addition, his concept of Nectriella was of hypocrealean fungi that have two-celled, hyaline ascospores. Weese considered the anatomy of ascomatal wall structure in the determination of species. Because some of the type collections that I examined such as Nectria alpina (Winter) Weese, N. dacrymycella (Nyl.) Rehm and Pharcidia mammillula (Anzi) Vouaux f. tenacis Vouaux were not seen by Weese, some of our generic concepts differ. Also, although a blueing of the ascus apex in the presence of iodine does not occur in the Hypocreaceae, Weese did not test for iodine reactions of the ascus apices. Two of the species accepted by Weese, Nectriella succinea (Rob.) Weese [= Discostroma succinea] and N. fimicola (Höhnel) Weese have asci that blue in iodine and are assigned to the Xylariales (sensu Barr, 1990). Based on my examination of the fifteen species included by Weese in Nectriella, six are retained: N. alpina; N. charticola [= N. funicola (Berk. & Br.) Petch]; N. fuckelii; N. luteola (Rob.) Weese; N. paludosa ; and N. sambuci. Names discussed and synonymized by Weese that are also recognized herein as species are N. bloxamii, N. dacrymycella and Charonectria umbelliferarum Höhnel (as Nectriella halonata).

Species described in Nectriella fall into two assemblages. One, typified by N. fuckelii, has ascomata that are at first immersed, then erumpent, saprophytic and occur mostly on herbaceous substrates. The other assemblage includes species growing in lichens. When Nectriella was published, Fuckel included two lichenicolous species, N. carnea [= N. robergei] and Nectriella coccinea [= N. tincta (Fuckel) Santesson]. Fuckel also introduced the name N. kalchbrennerii Fuckel [=N. erythrinella (Nyl.) Weese] at the end of his description of N. carnea, with the comment that N. kalchbrennerii has larger asci and ascospores than N. carnea. Fuckel did not count N. kalchbrennerii as one of the species of Nectriella. Two additional species were combined by Weese in Nectriella, N. tenacis (Vouaux) Weese and N.

verrucariae (Vouaux) Weese. These five lichenicolous species are now placed in Pronectria because they have ascomata that remain immersed, have a clypeoid mingling of fungus and host tissues at the ascomatal apex and are biotrophic.

Pronectria (Hypocreales, Hypocreaceae) was erected for lichenicolous species of Nectriella (Clements and Shear, 1931). The type species is P. lichenicola (Ces.) Clem. [= Nectriella robergei]. Hawksworth (1983) published a key to the known species of Nectriella on lichens and described new lichenicolous species of Nectriella (Hawksworth, 1978; 1983). Additional species were described by Eriksson (1964), Lowen and Hawksworth (1986), Lowen (1989) and Lowen and Diederich (1990). I follow Clements and Shear (1931) in placing species with immersed ascomata in lichens in the genus Pronectria (Lowen, 1990). Seventeen lichenicolous species, including the five from Weese and the three new species described herein, are now recognized. The known anamorphs belong in Acremonium and Illosporium.

Saccardo (1880) erected Charonectria, type species C. consolationis Sacc., for species that have immersed, solitary ascomata and one-septate, hyaline ascospores. Saccardo was unaware of the genus Nectriella Nitschke and applied the same concept for species of Charonectria. Saccardo had Hyponectria Sacc. differing from Charonectria by the presence of unicellular ascospores.

Saccardo (1883) transferred Sphaeria succinea Rob. [= Discostroma succinea] to Charonectria. This fungus, however, with its ascus pore that blues in iodine belongs in the Xylariales, Amphisphaeriaceae (*sensu* Barr, 1990).

Höhnel placed five additional species in *Charonectria*: *C. biparasitica* Höhnel (1903), *C. fimicola* (Höhnel, 1905), *C. luteola* (Desmaz.) Höhnel (1906), *C. sambuci* Höhnel (1903), and *C. umbelliferarum* Höhnel (1903). Weese (1914) considered *Charonectria* to be a taxonomic synonym of *Nectriella* Nitschke.

Because the eleven names in *Charonectria* were based on the same concept as *Nectriella* Nitschke, most are combined in *Nectriella*, *Pronectria* or other genera. None of the Höhnel names belong in *Charonectria*. Only *C. consolationis*, the type species, and *C. amabilis* and *C. sceptri*, both newly combined in *Charonectria*, are included herein in the genus.

Charonectria consolationis has a hamathecium of apically free paraphyses (fig. 44). Clypeoid tissues at the apex formed from the intermingling of leaf cells with the fungus are inconspicuous but characteristic. The developing asci are at first clavate and the epiplasm in the ascal apex forms a short angular protrusion. The asci become shorter and wider as they mature (fig. 44). Ascospores of species of *Charonectria* are larger than those of species of *Nectriella* (to 30 x 10 μm). Therefore, *Charonectria* is excluded from *Nectriella* and the Hypocreales and is assigned to the Xylariales, Hyponectriaceae (*sensu* Barr, 1990) on the basis of the presence of apically free paraphyses, the immersed ascomata and the clypeoid tissues.

The other four *Nectriella* species of Weese are treated in this paper as excluded species: *N. succinea* (see above), *N. pedicularis* (Tracy & Earle) Seaver [= *Charonectria sceptri*], *N. biparasitica* (Höhnel) Weese [= *Cryptonectriella biparasitica*] Xylariales, Hyponectriaceae (*sensu* Barr, 1990), and *Nectriella fimicola*, which may represent an undescribed genus in the Amphisphaeriaceae (*sensu* Barr, 1990)].

Cryptonectriella was erected as a subgenus of *Nectriella* by Höhnel (1918) for *N. biparasitica*. Höhnel (1903) originally described this fungus as *Charonectria biparasitica*. It has ascomata completely immersed in old ascomata of *Valsa flavovirens* Nitschke. Because of the immersed ascomata, Weese (1914) transferred the species to *Nectriella*. *Cryptonectriella* was elevated to generic status by Weese in 1919 with *C. biparasitica* as the only species. Müller and von Arx (1962) treated *Cryptonectriella* as a synonym of *Nectriella* because they did not consider the fungicolous habit enough to warrant a separate genus. They redescribed *N. biparasitica*. I exclude *Cryptonectriella* from *Nectriella* and the Hypocreales because of the presence of paraphyses with free tips, a character that indicates a nonhypocrealean centrum. The genus is assigned to the Xylariales, Hyponectriaceae (*sensu* Barr, 1990). *Cryptonectriella geoglossi*, another fungicolous fungus with paraphyses, immersed ascomata and 2-celled ascospores is also added.

Saccardo and collaborators (1877, 1878, 1881, 1883, 1891, 1917, Saccardo and Penzig in Saccardo, 1881, Saccardo and Roumeguère 1883, Saccardo and Trotter, 1913 and Penzig and Saccardo, 1897) named or transferred many of the taxa included in this study to Nectriella. Saccardo's classification, based mainly on spore characters, especially pigmentation and septation and on the location of the ascomata in relation to the substrate, is rejected herein in favor of taxonomy based on combinations of characters. Single character taxonomy resulted in the placement of species that we currently consider closely related into diverse hypocrealean genera (Rossman, 1983).

Hyalodothis Patouillard & Hariot (1893), type species H. clavus, was described based on two fungi, a hypocrealean fungus, Nectriella balansiae Arnold, immersed in the stroma of Balansia volkensii (Henn.) Castell. & Cif. Because the protologue describes the asci and ascospores of Nectriella balansiae and Nectriella is the oldest name, Hyalodothis is a synonym of Nectriella.

Nectriella Sacc. (1877), type species Nectriella rousseliana (Mont) Sacc. [= Nectria rousseliana Mont.], a later homonym of Nectriella Nitschke (1870), was erected for species of Nectria-like fungi that have solitary, superficial ascomata and unicellular ascospores. Seaver (1909) replaced Saccardo's homonym with the new name Pseudonectria. He designated Nectria rousseliana as the type species without combining the name in Pseudonectria.

Pseudonectria rousseliana has nonstromatic, superficial ascomata, scattered lanceolate setae, unicellular ascospores and *Volutella buxi* (Corda) Berk. as its anamorph.

Notarisiella, described as a subgenus of *Nectriella* by Saccardo (1883) for species with hirsute ascomata, was later elevated to generic rank by Clements and Shear (1931). *Notarisiella* is a nomenclatural synonym of *Pseudonectria* based on the same type species, *Nectria rousseliana*.

Sporadospora Reinsch (1875) type species *S. jungermanniae* Reinsch, was proposed as a new genus of Hyphomycetes on the liverwort *Plagiochila asplenoides*. *Sporadospora* was said to be a taxonomic synonym of *Pseudonectria* in Hawksworth, et al. (1983). Racovitza (1959) pointed out that *Sporadospora* is not a Hyphomycete but the appressoria of the mycelium similar to those of *Pseudonectria crozalsiana* (Grelet) Racovitza. According to Döbbeler (1978) the appressoria of *Pseudonectria perforata* Döbbeler, *P. hemicrypta* Döbbeler, and *P. suboperculata* Döbbeler & James are morphologically very much alike. Thus *Sporadospora* cannot be assigned to one species of *Pseudonectria*. Because the name is actually based on the mycelium, representing only a part of the holomorph, the genus belongs in Mycelia Sterilia.

The genus *Pseudonectria* is accepted for species originally described in *Nectriella* Saccardo with superficial ascomata and unicellular ascospores.

Hydronectria, type species H. kriegeriana, was introduced by Kirschstein (1925) to accommodate species with pallid, soft-textured ascomata that were immersed-erumpent in the substrate. The fungus had two-celled ascospores and an aquatic habit. Hydronectria was suggested by Hawksworth et al. (1983) to be a taxonomic synonym of Nectriella, presumably because it is a hypocrealean fungus with an immersed habit. The presence of clypeoid tissues, ovoid asci and large, multiseriately arranged ascospores, two distinct layers of the ascomatal wall and the aquatic habitat are characters that justify Hydronectria as a separate genus. One other species, H. tethys introduced by J. and E. Kohlmeyer (1965), was placed in the genus. The absence of apically free paraphyses and the presence of pallid, soft ascomata are characters that indicate that Hydronectria belongs in the Hypocreales.

The history of anamorphic connections in Nectriella follows. Fuckel (1870) attributed species of the genus Illosporium, type species I. roseum Mart. [= I. carneum Fr.], as the anamorphs of the lichenicolous species Nectriella carnea [= Pronectria robergei] and N. coccinea [= Pronectria tincta]. The circumstantial evidence of the close and repeated association of the sporodochia of Illosporium with the ascomata suggests that he was right in the former case. Examination of collections of I. coccineum Fr., however, reveals not the proposed anamorph of Nectriella coccinea, but pink crystalline material as described by

Hawksworth (1979). Thus Fuckel was mistaken in the latter case. Fuckel (1870) stated that the collection of Illosporium in the exsiccati, Rabenhorst 73b, differed from Illosporium carneum that is associated with Nectriella carnea. He observed that the aggregations of conidia were larger but that the individual conidia were smaller. Fuckel discovered ascomata in this collection, named the fungus N. kalchbrennerii Fuckel and clarified the relationship of the Nectriella with Illosporium with the observation that the ascomata originate from beneath the sporodochia of Illosporium. He stated that he had shown that Illosporium is not a part of the lichen. Weese (1914) affirmed the connection and aggreed that the Illosporium associated with Nectriella erythrinella differs from I. carneum Fr. The connection of P. erythrinella with an Illosporium anamorph is proven herein. Because the two species of Pronectria are considered distinct herein, there must be two species of Illosporium involved. Distinguishing the two species may be possible when fresh collections of Pronectria robergei with Illosporium carneum are available to compare with those of P. erythrinella. The color of the Illosporium associated with P. robergei according to descriptions (Fries, 1829; Hawksworth, 1979) should be pink rather than orange and the cultural characteristics might be different.

Höhnel (1904) described Pseudodiplodia umbelliferarum which he recombined as Stylonectriella umbelliferarum (Höhnel) Höhnel (1915), and suggested that this is the pycnidial anamorph of Nectriella halonata. There are brown pycnidia on the type but they do not fit the description of P. umbelliferarum and the connection with an amamorph with dark pycnidia is not likely (Samuels and Seifert, 1987). Sutton (1977) suggested that the Höhnel description of single, short conidiophores were setae and that the pycnidia were actually "effete" ascomata. Sutton's explanation is probable and the anamorph of C. umbelliferarum is still unknown.

Spegazzini (1899) described Diplosporium caudatum Speg. from Ricasolia casarettoana, the same lichen in which he found Nectriella subimperspicua Speg., and said D. caudatum is the conidial state. Because this hyphomycete is pallid and phialidic, it could be the anamorph of N. subimperspicua.

Kutilakesa conidiomata have been connected to Nectriella pironii (Alfieri & Samuels, 1980) both in culture and on the host. Two species, Nectriella obscura and N. dingleyae, are connected with species of Fusarium. The other connections that have been made are with species of Acremonium.

MATERIALS AND METHODS

Over 500 collections were examined. Type specimens of species named in Nectriella Nitschke were studied from squash mounts and sections. Twenty-six type specimens of

Nectriella Sacc. were examined but few were sectioned and the remaining species were not examined. Material was moistened first with deionized water or rehydrated on filter paper in a Petri dish to become more visible. Ascomata were located and observed with a dissecting microscope. Observations made of ascomata include presence of mycelium, relative numbers, position, arrangement and shape, presence of stromata, color, presence of setae, condition of the substrate and presence of an anamorph.

Ascomata were removed from the host with a #11 scalpel blade. Sections 10μm thick were made by immersing the ascomata with a small piece of surrounding host material for a short time in 50% Stevens gum or Lepage glue and 50% water, embedding in 100% glue or Tissue-Tek (Miles) and sectioning either with a Leitz 1320 freezing microtome equipped with a Kryomat 1703 stage or with a Minotome-Cryostat (International Equipment Company). Ascomata were mounted on slides in 3% KOH followed by Melzer's reagent. Other stains used were dilute Quink blue-black ink, KOH-phloxine, erythrosin in ammonia, lactophenol and lactophenol cotton blue (LCB). The cover slips were tacked down with nail polish and the slides were preserved in lactophenol or 50% glycerol infusion after staining. Squash preparations of ascomata were mounted first in water to spread out the asci and to observe the fungus in the most natural state (Baral, 1989), then in the various stains.

Slides were examined using light, phase and differential interference contrast microscopy with Beck Kassel, Zeiss and Olympus microscopes. Although observations initially were made in water, measurements usually were made in cotton blue in lactophenol (LCB). Sections were illustrated using the 20X objective; ascomatal wall structure, asci and ascospores were observed with the 100X objective (oil immersion). Ascomatal wall measurements were from the lateral wall of a median section.

Scanning electron microscope (SEM) studies were conducted at the Commonwealth Agricultural Bureau laboratory in Slough, England. The SEM used was a Cambridge Stereoscan fitted with chambers for freezing, etching, and gold coating. The specimen was frozen in subcooled nitrogen and then transferred in an evacuated chamber to subsequent chambers in which it was irradiated with heat to remove any ice crystals and then sputter coated with gold. This procedure provided the advantage of examination of specimens in the frozen hydrated state, producing a record of the morphology of the fungus as close as possible as that of the natural state. Additionally, cryofixation is much faster than the traditional method of chemical dehydration before gold coating and is likely to produce fewer artifacts (Read et al., 1983).

Ascospores were germinated on agar and isolated manually or with a micromanipulator. Single spore isolations were accomplished manually in the following manner. Two separate drops of sterile distilled water were placed on a slide sterilized by flaming after dipping in alcohol. A few ascomata were rinsed in the first drop of water on the slide and then crushed in the second. The disturbed ascomatal contents were transferred by a sterilized loop to a Petri dish containing a thin layer of tap water agar (TWA), streaked along lines marked on the outside and allowed to incubate at ambient room temperature for one to three days. Germinated ascospores were located using transmitted light with a dissecting microscope at 40X magnification, cut out with a scalpel, checked with a light microscope at low power to insure the location of only one ascospore, transferred to potato carrot agar plus antibiotic (PCA+) or corn meal dextrose agar (CMD, Difco) in 5 or 9 cm diam plastic Petri dishes sealed with PVC electrical tape or Parafilm, incubated under ambient or cool white fluorescent plus near UV alternating on and off at 12 hour intervals at room temperature and examined weekly. Antibiotics were sometimes added to media in order to deter the growth of bacteria. Transfers were made to CMD, oat agar (OA), malt agar (MA, Difco) and to corn meal agar (CMA, Difco). Some cultures were dried after two months; other cultures were maintained for as long as nine months. OA and PCA were prepared according to Smith and Onions (1983).

Two-dimensional thin layer chromatography (tlc) was used (Paterson, 1986). The plates were developed in the first dimension with the solvent, chloroform/acetone/propan-

2-ol (85:15:20, v/v/v) and in the second dimension with the solvent, toluene/ethyl acetate/90% formic acid (5:4:1, v/v/v) and examined under UV light.

Living cultures, kept available for future research, are maintained in the culture collections of Clark T. Rogerson (CTR) (NY) and CAB International Mycological Institute (IMI) and type cultures have also been deposited in the American Type Culture Collection (ATCC).

Abbreviations of herbaria follow Index Herbariorum (Holmgren et al., 1990); abbreviated literature citations follow Botanico-Periodicum-Huntianum, B-P-H (Lawrence et al., 1968) and Taxonomic Literature (Stafleu and Cowan, 1976-1988); other abbreviations used are: ICBN (International Code of Botanical Nomenclature, Greuter et al., 1988); L/W refers to the length to width ratio of the ascospores. Unpublished herbarium names are not included in synonymy unless they have been mentioned in the literature. Generic citations were verified with Farr et al. (1979). An exclamation mark (!) after a specimen citation indicates that the specimen was examined. Accepted names are in capital letters. Descriptive terms referring to shape are taken from Hawksworth et al. (1983) and Radford (1986). Characters of the cultures are after Stalpers (1978). References to color are Kelly (1965) and Kornerup and Wanscher (1978) (K and W). Data from type specimens and some other collections have been translated into English where possible.

Names used herein that have not previously been validly published are intended for future publication only. They are not to be considered as validly published in this document.

DEFINITIONS OF SOME TERMS USED

Clypeoid: a mingling of fungus and host tissues at the ascomatal apex (after J. & E. Kohlmeyer, 1965).

Collapse:

Vertical: nonpapillate ascomata-become a cup shaped.

papillate ascomata-papilla sinks into the lower part of the ascoma, usually remaining erect.

Lateral: the sides of the ascomata pinch in. The papilla may retain a rounded shape or may also pinch in assuming a flat appearance.

Connection between a teleomorph and its anamorph:

Proven: when the anamorph develops in culture from single ascospores.

Circumstantial: When a consistent association is noted between a teleomorphic and an anamorphic state on the substrate.

KOH-: when ascomata do not change color in KOH.

KOH+: when ascomata turn red to purple in KOH and subsequently bright yellow when lactic acid or lactophenol is added.

J+ asci: when the ring or part of the apex turns blue in melzer's solution .

Thick-walled: when the cell wall is more than 1 μm wide.

Stroma: aggregations of vegetative hyphae associated with ascomata.

EVALUATION of MORPHOLOGICAL and ANATOMICAL CHARACTERS

The Hypocreaceae (Hypocreales) includes fungi that are characterized by soft, nearly white to brightly pigmented (red to yellow) to rarely dark perithecial ascomata and a characteristic centrum development involving downward-growing apical paraphyses (Rogerson, 1970). The apical paraphyses usually evanesce at maturity (Rogerson, 1970) sometimes leaving irregular gelatinous strands among the asci. Sometimes a fringe of paraphysis remains (periphysoids of Barr, 1990) is visible in the upper centrum. Apically free paraphyses are not known to occur in the Hypocreales (Hypomyces: Hanlin, 1963b; Samuels, 1973; Nectria: Hanlin, 1961, 1963a, 1971; Hypocrea: Hanlin, 1965). Other hypocrealean characters are nonamyloid asci that have one visible wall layer and variably ornamented ascospores that are hyaline or tints of yellow, brown, green, red or orange. Characters observed will be discussed in my estimation of relative importance.

I follow Weese (1914) and Booth (1959) in considering the construction of the ascoma important, especially the wall structure: the varieties of cells, or layers, in the side walls; and the organization of cells at the apex of the ascoma. Whether the ascomata are superficial or immersed is an important character in the determination of species and a generic character when correlated with other characteristics. Other characters considered are the presence or absence of a stroma, the presence or absence of a papilla, the pattern of collapse of dried ascomata and the pigmentation. The structure of the ascomatal wall dictates the manner of collapse.

Ascomata are separate and nonstromatic or occasionally seated on an inconspicuous stroma in the genus *Pseudonectria*. A true clypeus, defined as a shield-like stromatic growth (Hawksworth et al., 1983), does not occur. Species of *Pronectria* as defined herein, however, have inconspicuous clypeoid mixing of host and fungus tissues at the ascomatal apex.

The apex of the ascomata, as in many species of *Nectria*, always consists of at least some parallel and vertically oriented elongate cells. This hyphal orientation is more developed in species that have a papilla with elongate cells that curve outward. Sometimes the papilla exhibits light sensitivity and is curved presumably toward the source of light as in *P. robergei*.

Uecker (1976) and others have reported that the neck of an ascoma develops from a secondary subapical meristem. I have seen initially globose ascomata in culture subsequently develop a papilla. The parallel hyphal fibers forming the papilla of species of Nectriella and Pronectria may develop from a secondary meristem at the apex of the ascomata.

Further support for a secondary papilla development comes from Read (1983) who reported that the neck developed in Sordaria humana (Fuckel) Winter after an initial bulge containing the major neck peridium precursor cells (the periphyses). The ostiole then became evident. The rest of the neck was derived from the internally formed periphyses which lined the ostiolar canal beneath the pore. Neck extension then involved the growth of periphyses which piled up on top of each other and cohered together to form the cells of the neck peridium.

The ascomata are usually from 150-250(-500) µm in diam and the apex is often truncate. The ascomatal wall in longitudinal section is usually not wider than 30 µm at the vertical mid-point. The widened ostiolar area is always at least partly composed of vertically parallel hyphae.

Most ascomata have a few rows of pallid, compressed, elongate, thin-walled cells lining the centrum. The outer rows of cells are usually wider with more highly pigmented, thicker walls. Although the peridium and centrum are considered to be formed from the dicaryon (Miller, 1928), in a two-layered ascoma the outer layer is likely to be derived from vegetative cells (Hanlin, 1961). Doi (1978) considered that the inner cells represent the true ascomatal wall and the outer cells a stroma in which the ascocarp develops. I follow Barr (1990) in considering the outer cells a layer of the ascomatal wall for convenience and include it when reporting measurements.

Pigments in the ascomata studied range from red, orange, yellow to light brown. Ascomata of some species, such as Nectriella pironii, are nearly white. The pigments can vary with age; ascomata of most species in Nectriella become yellow when they are old. Colors tend to be more pallid in ascomata of Nectriella than in Pronectria.

Although Nectriella or Pronectria are comparable to some species currently placed in the genus Nectria, no species of either genus appears to be closely related to Nectria as defined in the strict sense by Rossman (1989). These genera differ from the core groups of Nectria (type species Nectria cinnabarina (Tode: Fr.) Fr.) which are characterized by superficial clustering on a stroma, the anamorph Tubercularia vulgaris Fr. and the red pigmentation of the ascomata. Nectria sensu lato has few immersed members with an enhanced apical ascomatal structure. Nectriella bloxamii and Nectriella dacrymycella, however, have subglobose, KOH- ascomata with an ascomatal wall structure of thick-walled rounded cells similar to those of arenula-group of Nectria (Booth, 1959; Samuels, 1978).

The red color of the ascomatal wall of N. cinnabarina becomes darker in potassium hydroxide (KOH) and yellow in lactic acid. This pH-dependent KOH reaction has often been used in the classification of other nectrioid fungi (Weese, 1914). The reactive pigment, thought to be skyrin (Carey and Nair, 1975; Rossman, 1983), is in the cell walls of the ascomata. Extracts from cultures grown in the laboratory from fresh collections of Nectriella paludosa, Pronectria anisospora, P. erythrinella. P. santessonii and Illosporium carneum were compared with the lichen Phaeophyscia rubropulchra (Desel.) Essl., known to contain skyrin (R.C. Harris, pers. comm.). None of pigments of these KOH- fungi had the same Rf values as the lichen pigment.

Surface cell arrangements could not always be seen due to the immersed habit, but angular to epidermoid cells were detected in many species. In the light microscope the surface cells often appear to have unevenly thickened walls.

Characters of the ascus such as shape, apical apparatus, and arrangement of the ascospores, are likely to be evolutionarily stable. The ascus of species of Nectriella is usually clavate with a truncate apex and a coronate aspect to the apex of the epiplasm within, undoubtedly governed by the presence of a nonamyloid apical ring or thickening. The visibility, shape and size of the ring varies in different species. The shape of the epiplasm is included in descriptions because it is often easier to see than any structures in the wall of the ascal apex.

In fresh material mounted and observed first in water, a thick apical sheath of the ascus (fig. 42) is sometimes seen that is not visible in older herbarium specimens or in some other mountants. Pascoe (1990) describes the same phenomenon in Plectosphaera eucalypti (Cooke & Massee) Swart (Phyllachoraceae) and concludes that the variability seen by others in the ascus structure could be due to the condition and age of the material and the various mountants used. Because of this variability Pascoe urges caution in the description of the structure of asci.

Asci in the species studied, like those found in Nectria, are the "annellasces" ascus types described by Chadefaud (1958, figs 1-3) and clarified by Bellemere (1975). They are unitunicate. If an apical ring is present, like those of the other species in the Hypocreales, it is nonamyloid. In Nectriella-like fungi there is no uniformity or pattern seen in the type of ring or the manner in which the ascospores are discharged. The ring, difficult to see with light microscopy, is more readily apparent with phase contrast. Even with phase, in mature asci when the apex becomes stretched by the ascospores within, the ring may not be discernible. Sometimes with light microscopy, in Pronectria robergei for example, the ring appears as a cap across the apex of the ascus. Using phase contrast and differential interference microscopy, two round thickenings of the ring are often seen in profile. Occasionally when seen in top view a compete ring with a central opening may be visible. After the ascospores are ejected the empty asci with the ring everted may be visible with phase.

Although a ring or apical thickening occurs in most species of Nectriella, it has not been observed in some, especially those with subglobose ascospores. Rossman (pers. comm.) observed that hypocrealean species with long ascospores also tend not to have apical rings. Even if an apical ring has not been seen using phase microscopy, it might still be observed with different stains or fluorescence microscopy (see Romero and Minter, 1988). Chadefaud (1958) speculated that those species without visible apical apparati exhibit regressive evolution. Harris (1989) uses the possible loss of an apical ascus ring to support a tentative phylogeny within the Pyrenulaceae. Perhaps the presence of subglobose ascospores and the lack of an annulus are derived characters in Nectriella-like fungi.

The asci range from 40 to 100 µm long, rarely smaller or larger. Most species have asci containing eight partially biseriate ascospores with single ascospores at the apex and at the base; this spore number and arrangement is considered the primitive condition in Nectriella and Pronectria herein. A few lichenicolous species have fewer ascospores per ascus.

Few differences in ascal characters exist within the Nectria and Nectriella-like fungi. Aside from the presence or absence of an annulus, I do not have enough data to use the ascus type in the subordinal classification of these fungi. Observations are simply noted.

Ascospores are another important character. The spores can be subglobose, ellipsoid, fusiform, naviculate to ovoid. They are inequilateral in most taxa because of a curvature of one lateral wall while the other lateral wall is straight. One cell of the ascospore is often slightly broader or rounder and the other slightly narrower and pointed. The shape of the ascospores, best expressed as length to width ratio (L/W), ranges from L/W 1.4 (subglobose) to 6.1 (elongate and narrow).

The size is usually 10-25 μm and not longer than 30 μm. The ascospores are two-celled and hyaline, often becoming pale yellow, brown, or orange at maturity. They are occasionally smooth or with the ornamentation of the wall varying from echinulate, strongly tuberculate to striate. Tubercules can measure to 2 μm high, for example, in Pronectria ornamentata (Hawksw.) Lowen. Because ornamentation on ascospores occur throughout the Ascomycetes, their presence is considered to have only specific significance (Booth, 1959).

Although guttules in ascospores are described where they have been observed, their presence does not appear to be a consistent, important character in most species. Droplets appear in young ascospores, often coalesce as the spore is maturing to form one or two rounded bodies per cell, then become amorphous in shape and often disappear in the mature ascospore or upon germination.

Most of the two-celled ascospores in Nectria and Nectriella-like species have a thickening of wall material at the outer edges of the septum with a triangular area that often appears dark in transmitted light. I could not give taxonomic usefulness to this character because a triangular area seemed present in almost all of the two celled ascospores studied. Trinci and Collinge (1974) found this triangular area in arthrospores of Geotrichum candidum Link ex Pers. to contain lytic enzymes that they thought were active in cell division. Bellemere (1975), using the Thiéry test for polysaccharides, found this site nonreactive in species with nonfragmenting ascospores. Hypocrealean fungi with fragmenting ascospores, e.g. species of Hypocrea, may have lytic enzymes. If Bellemere's (1975) findings apply, however, the enzymes are probably absent in the nonfragmenting ascospores seen in this study.

ANAMORPHS

Identification of the anamorph or confirmatiuon of teleomorph-anamorph relationships can be accurately determined by culturing of single ascospores. Single spore cultures are essential to determine whether an isolate is homothallic or heterothallic.

Hypocrealean anamorphs have phialidic conidiogenous cells and are produced in pallid or brightly colored cultures (Samuels and Seifert, 1987). The conidia are usually hyaline. Phialides develop when wall material (periclinal thickening) on the inside of the conidiogenous cell builds up from the release of a basipetal succession of conidia (Cole and Samson, 1979). The anamorphs (except Illosporium) found in the fourteen species in Nectriella and Pronectria that were cultured agree with the brightly colored, phialidic pattern in the Hypocreales. The cultures produced, however, were all slow growing.

Species of Acremonium, the anamorph of four species in this study, have relatively simple, unbranched conidiophores that do not aggregate into more elaborate structures such as pycnidia, sporodochia or synnemata. Conidiogenous cells emerge singly from conidiophores as side and terminal branches. The substrates tend to be ephemeral such as the dead herbaceous stems on which ascomata of Nectriella dakotensis (Seaver) Lowen are found. Anamorphs with simple morphology might be necessary for rapid development when the substrate is transitory (Samuels and Seifert, 1987).

The four Acremonium anamorphs known in Nectriella and Pronectria have conidiophores that do not branch like those of Acremonium sect. Nectrioidea Gams (1971). The conidiophores are solitary and distinct from the subtending vegetative hyphae. The basal wall of the phialide is thickened in Pronectria santessonii and thin in the other three species. The wall of the phialidic tip is thickened but not flared. The conidia are hyaline. Three of the

Acremonium species, connected to *Nectriella dakotensis* and *N. minuta* and *Pronectria santessonii*, have not been described separately because their simple conidiophores and ellipsoid conidia are much like other species of *Acremonium*. *Acremonium pedatum* Lowen, anamorph of *Pronectria anisospora*, has distinctive, elongate conidia with a prominent basal abscission scar.

Illosporium, unlike the anamorphs of other members of the Hypocreaceae, is not phialidic but has a thallic development, whereby cells of the mycelium enlarge and clump together to form dry, dehiscent propagules. Individual cells failed to germinate, but clumps of these progagules produced a pink culture. Developing conidia are illustrated for *Pronectria erythrinella* (fig. 28). A second *Illosporium* species is the probable anamorph of *P. robergei*.

Thallic anamorphs such as *Illosporium* occur in other genera of hypocrealean fungi. Conidia of *Illosporium* are like aleuriospores, dehiscent thallic propagules (Carmichael, 1971), that occur in some species of *Hypomyces* (Rogerson and Samuels, 1989). Chlamydospores are diagnostic at the specific level in *Fusarium*. These are indehiscent, thick-walled propagules of thallic development that consistently occur in fungi including species of *Fusarium* (Booth, 1959). I theorize that the thallic conidia of *Illosporium* states of *Pronectria* are synanamorphs and the phialidic form does not develop either in culture or in nature.

Kutilakesa pironii Alfieri, anamorph of Nectriella pironii, has conidia born on aggregations of phialides forming sporodochia on woody shrubs. Undulate, light brown, ornamented hairs protrude from the sporodochia. Hypocrealean teleomorphs have not been reported for the other two species of Kutilakesa (Alfieri et al., 1979).

The Fusarium anamorphs of Nectriella dingleyae and N. obscura produce slow growing, orange cultures with little aerial mycelium similar to those of Fusarium merismoides Corda. Nectriella dingleyae and N. obscura are the only species in Nectriella connected to Fusarium. They could be placed in Nectria subg. Dialonectria (Samuels et al., 1991) on the basis of the anamorph combined with their warted, pale brown ascospores, but are retained in Nectriella because of the pallid color of the KOH- ascomata combined with the immersed habit and the presence of setae.

Although anamorphs may correlate with and suggest natural relationships of their teleomorphs (Samuels and Seifert, 1987), too few species of Nectriella or Pronectria have been grown in culture to infer relationships.

ECOLOGY

Fungi obtain nutrition either as necrotrophs (obtaining nutrients from dead cells and undoubtedly contributing to the decay and recycling of the organic matter) or biotrophs (obtaining nutrients from living cells and likely to be pathogenic) or both. Most necrotrophs are quite restricted in habitat often to a single host species. Most species of Nectriella appear to be necrotrophs. They are often found in recently dead plant material. J. Hafellner and his students (GRAZ) suggest that lichens may be identified in many cases by the specificity of their lichenicolous fungi (pers. comm.).

The fact that species of Nectriella appear early in the decay cycling of plant debris suggests that the mycelium may be endophytic and the fungus is then ready to develop when the plant dies.

Biotrophic fungi often damage their hosts. Many of the species of Pronectria that exhibit biotrophic nutrition (P. santessonii and P. paucispora, for example) discolor the lichen thallus in areas where the fungus is present. Nectriella pironii, the only biotrophic species of Nectriella, is pathogenic and produces galls on ornamental shrubs in Florida (Alfieri, et al., 1979; Alfieri and Samuels, 1980).

I have observed two means of release of ascospores in hypocrealean fungi, probably dependent on environmental conditions. Forcible ejaculation of ascospores in Nectriella paludosa has been proved by collection on cellophane tape. Mature ascomata grown in culture were tested for forcible ejection of ascospores by attaching cellophane tape to the inside of a Petri dish lid to collect ascospores shot from below. Microscopic examination of the tape showed the presence of many ascospores. Additional evidence of forcible ascospore discharge is that groups of eight ascospores are often found released but still in the biseriate formation found in the ascus. These spore aggregations are held together by the epiplasm from the ascus as described by Pascoe (1990). The forcible ejection is presumably accomplished through a shooting mechanism in the apex of ascospores involving the apical ring. The eversion of the ring supports this idea.

Alternately, ascospores ooze out of ascomata to form globs or tendrils especially when the humidity is continuously high (Snyder and Hansen, 1947). The following observations indicate which factors contribute to the formation of tendrils. Collapsed ascomata, common in some species, are usually turgid upon hydration; ascomatal rehydration seems to produce pressure that squeezes out free ascospores. Often ascospores, sometimes germinating outside the asci, are found inside overmature ascomata. Gelatinous remains of disintegrated asci and apical paraphyses may contribute to increased osmotic potential within the ascomata and a substance which retains the spores in globs or tendrils outside the ascomata. Harris (1989) suggests that ascospores released into the ascomatal chamber by disintegrating asci are forced by hygroscopic changes into the ostiolar canal. Well-developed, gelatinous periphysoidal tissues narrow the canal and are the actual release mechanism. Harris suggests that the ascospores are actively squeezed out of the ostiole by this process.

My theories concerning the ecological significance of the characteristic collapse of dry ascomata and ascospores as protective mechanisms follow. Unlike other rigid, dark-walled pyrenomycetes, many species in the Hypocreaceae, probably as a means of conserving moisture, exhibit various patterns of ascomatal collapse. My observations confirm that those individuals that collapse are more likely to retain asci and ascospores. Another possible survival strategy, observed with freezing SEM in Nectriella guttulata, may be the possession of ornamented ascospores that collapse when dry into a wing-like shape (fig. 52). The shape suggests that they might be wind dispersed in the collapsed condition. Perhaps other species of Nectriella and even Nectria have ascospores that collapse when exposed to the outside environment. That this is a usual type of ascospore collapse is yet to be determined.

Since hypocrealean ascospores are usually hyaline, they are more likely to be vulnerable to damage from desiccation and ultraviolet light than species with melanized ascospores (Pirozynski, pers. comm.). Perhaps collapsible structures and ascospore ornamentation serve the same protective function as rigid walls and melanin.

TAXONOMIC TREATMENT

KEY TO GENERA OF NECTRIELLA-LIKE FUNGI

1. Hamathecium with paraphyses among mature asci.........2
    2. Immersed in other fungi; clypeoid tissues absent ....Cryptonectriella
    2. Immersed in leaves or lichens; clypeoid tissues present...3
        3. Clypeoid tissues not visible on substrate; paraphyses apically free; apical ring in ascus absent or inconspicuous....Charonectria
        3. Clypeoid tissues visible on substrate as translucent area; paraphyses attached at apex of centrum; apical ring in ascus conspicuous.....................Hyponectria
1. Hamathecium with paraphyses absent among mature asci....4
    4. Ascomata superficial; stroma present or lacking; ascomata yellow, orange, or red..................5
        5. Ascospores 1- or sometimes more septate; ascomata non-setose.........................6
            6. Stroma present; ascomata red, KOH+; wall > 20 μm wide..........Nectria s.s.
            6. Stroma absent or inconspicuous; ascomata yellow, KOH-; wall $\leq$ 20 μm wide ....Nectriopsis

5. Ascospores nonseptate; ascomata often setose ....Pseudonectria

4. Ascomata immersed, nonstromatic; ascomata yellow to orange, if red, then KOH -....................7

7. Aquatic ascomata with lateral wall of 2 distinct regions; asci ovoid, > 20 μm wide..............................Hydronectria

7. Terrestrial ascomata with lateral wall, if of 2 regions then intergading; asci clavate, < 20 μm wide................................8

8. Ascomata in lichens or algae, clypeoid, remaining immersed............Pronectria

8. Ascomata in herbaceous materials, occasionally in wood, not clypeoid, usually erumpent..............Nectriella

I. **NECTRIELLA** Nitschke in Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870].

= Hyalodothis Patouillard and Hariot, Patouillard, Bull. Soc. Mycol. France 9: 210. 1893, type species Hyalodothis clavus Pat. & Har.

Type species: NECTRIELLA FUCKELII Nitschke in Fuckel.

Ascomata perithecial, obpyriform, less often subglobose, 100-500 μm diam, immersed-erumpent, scattered or in groups, nonstromatic, translucent, at first nearly white, pale yellow, pale red or pale brown, then often becoming yellow with age, not changing color in 3% KOH or 100% lactic acid or rarely reacting weakly; collapse vertical, by lateral pinching or not collapsing. Setae often present. Cells on the surface of the ascomata often obscured, when seen, usually angular, rarely hyphal. Ascomatal wall 10-30(-40) μm wide, often of two intergrading regions: outer region of thick-walled, angular to rounded cells; inner region of thin-walled, elongate, rectangular cells. Ascomatal apex formed of rows of parallel, vertically elongated cells continuous with the inner region of the ascomatal wall; cells becoming increasingly narrow and merging with the periphyses at the interior and somewhat expanded or clavate at the exterior. Asci unitunicate, clavate, usually not under 45 μm or over 100 μm long and ca. 15 μm wide, 8-spored, apex truncate, usually containing a nonamyloid apical ring, sometimes inconspicuous in mature asci; ascospores usually biseriate in the middle, uniseriate above and below, occasionally entirely uniseriate, filling the ascus. Ascospores fusiform or ellipsoid, rarely subglobose, inequilateral, typically not over 25 μm long and 8 μm wide, 1-septate, hyaline, usually slightly colored in mass especially when fresh, smooth or faintly spinulose or verrucose; guttules usually present in young ascospores, often disappearing at maturity. Paraphyses with discrete apices absent. Gelatinized remains of apical paraphyses sometimes seen.

On dead wood or herbaceous debris, rarely fungicolous or parasitic.

Nomenclature and taxonomic history of Nectriella were discussed in the introduction. For a discussion of Hyalodothis see Nectriella Balansiae.

In determining relationships within Nectriella I follow Booth (1959) in using the structure of the ascomata as a major criterion; whether a fungus is superficial or immersed is considered of less importance. Erumpent ascomata of species of Nectriella have a characteristic collapse when they are dry. In the discussion that follows, the number of regions in the ascomatal lateral wall and the resultant collapse are used to group species.

Within Nectriella twenty-five taxa have been defined which can be subdivided into several species complexes. The characters overlap and assigning individual collections to a species is sometimes difficult even though the species appear distinct according to the original descriptions and type studies. Species typical of the genus will be discussed first.

Nectriella has three basic kinds of ascomatal wall structure. The first kind, represented by Nectriella fuckelii, N. paludosa and N. sambuci, have short, obpyriform ascomata and two regions of cells throughout the ascocarp wall. The papilla, composed of parallel hyphal-like cells flaring out at the apex, has scattered setae. Because the wall structure is uniformly wide and has two regions throughout, the ascoma does not often collapse when dry. The setae, appearing to be secretory at an early stage of development, have thin walls at the apex, are brittle and scattered.

In the second kind, the ascomatal wall comprises two regions of cells that stain differentially in LCB or phloxine. The ascomata are obpyriform with scattered setae on the elongate papilla. This group includes Nectriella funicola, N. guttulata and N. verrucosa Urries. The wall collapses by pinching inward from the sides and the papilla also compresses. In culture developing setae of N. guttulata have liquid drops at the tips; in herbarium specimens deposits of material can be seen on the surface of setae. At maturity the apices are clavate with a thin apical wall. The bases of the setae often narrow where they are inserted (fig. 10).

Ascomata of the third kind have a thin lateral and basal wall and a well-developed, truncate papilla. The outer hyphae of the papilla extend outward forming a circle of setae or a corona around the ostiole. Nectriella alpina, N. dakotensis, N. dingleyae, N. halonata and N. pironii are in this group. In this kind of ascomata the thin lateral wall bows outward when dry causing a vertical collapse with the papilla retaining its shape in the center.

Some atypical species of Nectriella will now be discussed. Nectriella bloxamii, N. dacrymycella, N. galii (Plowright & Harkness) Lowen and N. luteola have affinities to the arenula-group of Nectria (Booth, 1959; Samuels, 1978). Like Nectria arenula, the ascomata (fig. 3) are subovoid and nonpapillate, thick-walled cells form the outer part of the apex whereas the lateral wall is less robust. This anatomy results in a vertical collapse that typically becomes slightly cupulate when the fungus is dry. Setae are usually not formed in this group. Because Nectriella bloxamii produced ascomata when cultured from single ascospores, the species is homothallic. No anamorph was produced.

Two species are found on monocots. Nectriella exigua Dennis found on the grass Ammophila arenaria (L.) Link is non-setose, has a relatively wide ascomatal wall with two regions and an abruptly narrowed, cylindrical papilla that barely penetrates the host. Nectriella lacustris (Kirschst.) Magnes & Hafellner (1991) on Typha and Carex has ascomata with walls of two regions similar to ascomata of N. exigua. These species differ from other species of Nectriella in that they remain immersed in the host tissues.

Nectriella balansiae Arnold, a fungicolous species found in the stroma of Balansia volkensii (Henn.) Castellani & Ciferri, differs from other species of Nectriella because the ascomal wall structure appears nonhyphal at the apex.

Samuels and Rossman (1979) correlated ascomatal structure with ascospores and anamorphs. Fitting the ascomatal structures and asci of Nectriella into their scheme (fig. 50), Nectriella is distinctive: nonstromatic ascomata with a widened apex composed of parallel hyphae and truncate asci with an apical ring. Correlating known anamorphs with this scheme (fig. 51) places Nectriella anamorphs at the base of the figure with Acremonium having the simplest structure. Fusarium, often with Acremonium-like microconidia, is an offshoot of Acremonium and still near the base in this schema. Kutilakesa has more complex structure than any other known anamorphs in Nectriella with sporodochial clustering of conidiophores and undulating, echinulate, pale brown setae. In Kutilakesa pironii the development of more complicated morphology may be correlated with growth on long-lived woody shrubs.

In addition to the idea that complex structures need less ephemeral substrates to allow time for development, the complex morphology of the anamorph could have phylogenetic implications. Figure 51 could be read either from the top downwards suggesting that simpler structures are derived from more complex ones or from the base upwards suggesting that the complex structures are derived from simpler ones. More species need to be cultured to determine the relationships among anamorphs in Nectriella-like fungi.

The known distribution of Nectriella is predominantly temperate: Europe, North America and one species from Chile. Only three species have been found in the tropics, namely Brazil, French Guiana and Venezuela. The paucity of tropical collections could be due to lack of mycological exploration than in Europe in particular and to the difficulty in finding light-colored, immersed fungi.

In conclusion, most of the 25 taxa in Nectriella form a distinct genus. Typically, they are characterized by immersed-erumpent, nonstromatic, pallid, setose ascomata with lateral walls usually not wider than 30 µm, asci with an apical ring and ornamented, uniseptate ascospores. Within the genus three kinds of ascomatal wall structures exist that collapse when dry in characteristic ways.

Nectriella is distinguished from genera with soft pale ascomata in other orders (Charonectria, Cryptonectriella, Hyponectria) by the lack of apically free paraphyses. Within the Hypocreales Nectriella is distinguished from Nectria sensu stricto by the KOH-, nonstromatic ascomata. Nectriella differs from Pseudonectria by the immersed ascomata and uniseptate ascospores. Nectriella is distinct from Hydronectria by the terrestrial habitat, by the lateral wall that is clearly differentiated into two regions, and by the ascospores that are usually less than 30 µm long. Nectriella is distinguished from Nectriopsis Maire, as redescribed by Samuels (1988), by having ascomata with red pigments, setae, a wall often composed of two regions of differing cells and by occurring not in mycelium but immersed in the substrate.

KEY TO SPECIES OF NECTRIELLA

1. Ascomata subglobose when rehydrated, nonpapillate,

non-setose..2

2. Ascospores uniseriate; apical ring in ascus absent 3

3. Ascospores subglobose, 3-4 x 2-3 μm; fungicolous........................20. N. queletii

3. Ascospores ellipsoid, 10-12 x 4-6 μm; on Galium ....11. N. galii

2. Ascospores partially biseriate; apical ring in ascus present....................................4

4. Ascomata remaining immersed, not collapsing; on Rubus..............................4. N. crouanii

4. Ascomata erumpent, collapse vertical; on leaves and petioles of Populus or other herbaceous substrates.............................5

5. On leaves and petioles of Populus; ascomata orange-brown...................15. N. luteola

5. On various herbaceous stems; ascomata yellow-brown or orange.............................6

6. Ascomata yellow-brown, opaque when dry......................3. N. bloxamii

6. Ascomata orange, translucent when dry ....5. N. dacrymycella

1. Ascomata obpyriform when rehydrated, papillate, setose or not..7

7. Ascomata with circle of setae around papilla, collapse vertical with papilla retaining its shape........8

8. Associated with galls on shrubs; anamorph Kutilakesa.........................19. N. pironii

8. On other substrates; anamorph, if known, Fusarium or Acremonium....................................9

9. Ascospores 7-10 x 2-3 μm.........6. N. dakotensis

9. Ascospores averaging ≥ 12 μm long..............10

10. On bark; known from New Zealand; anamorph Fusarium ....7. N. dingleyae

10. On herbaceous substrates; known from Europe or U.S.A.; anamorph Acremonium or unknown....................................11

11. From U.S.A.; ascospore L/W 3.0; ellipsoid structures on substrate ....24. N. utahensis

11. From Europe; ascospore L/W > 3.0; ellipsoid structures absent...........12

12. Ascospores finely striate; L/W 4.3; on Silene ....23. N. silenes-acaulis

12. Ascospores verrucose; L/W 3.7; on other substrates 13

13. Setae thin-walled, 10-18 x 3-5 μm; ascospores 13-18 x 3.5-5.0; on Arabis or Saxifraga.........1. N. alpina

13. Setae thick-walled, 10-80 x 2-5 μm; ascospores 15-20 x 4.0-5.5 μm; on other herbaceous stems

...............13. N. halonata

7. Ascomata, non-setose or if setose, then setae scattered, collapsing by lateral pinching or not collapsing...14

14. Ascomata non-setose, remaining immersed..........15

15. Asci averaging > 45 μm long..................16

16. On leaves of Typha and grass; ascospores 15-25 x 4.0-5.5 μm......14. N. lacustris

16. On bamboo; ascospores (9-)10-12(-14) x 2-3(-4) μm...............16. N. minuta

15. Asci averaging $\leq$ 45 μm long..................17

17. Ascomata pale yellow; fungicolous; ascospores averaging $\geq$ 10 μm long, 9.5-10.5 x 2.5-3.0.......2. N. balansiae

17. Ascomata with red pigments; in herbaceous monocot or woody twigs; ascospores averaging < 10 μm long.....18

18. On Ammophila; ascomata pale red; ascospores 8-10 x 2-3 μm
.......................8. N. exigua

18. On woody twigs; ascomatal apex red; body of ascoma nearly white; ascospores 6-7 x 2 μm..............
21. N. rubrocapitula

14. Ascomata setose, erumpent 19

19. Setae sparse......................................20

20. Papilla conic to rounded; ascomata nearly white; ascospores pale brown, verrucose......................17. _N. obscura_

20. Papilla truncate; ascomata pigmented; ascospores pale orange or pink in mass, echinulate or smooth.......................21

21. Ascospores echinulate, at first hyaline, then pink in mass; L/W 4.1; on _Typha_ ....18. _N. paludosa_

21. Ascospores smooth, at first hyaline, then orange in mass; L/W 3.1; on _Sambucus_.................22. _N. sambuci_

19. Setae numerous.......................................22

22. On wood or herbaceous debris; papilla short; ascospores echinulate.....................23

23. On wood of _Populus_; ascomata yellow; ascospores 14-16 µm long................9. _N. fuckelii_

23. On petioles of _Gunnera_; ascomata orange; ascospores 17-20 µm long ....12. _N. guttulata_

22. On paper or rope; papilla elongate; ascospores verrucose.......................24

24. Ascomatal wall 17-30 µm wide; ascospores 16-24 x 4-8 µm; asci 60-110 x 8-14 µm....10. _N. funicola_

24. Ascomatal wall 20-35 μm wide; ascospores 20-30 x 5-9 μm; asci 80-135 x 10-20 μm..25. N. verrucosa

SYNOPTIC KEY TO SPECIES OF NECTRIELLA

Characters of the ascomata

Shape

Obyriform 1, 2, 6-10, 12-14, 16-19, 21-25

Subglobose 3-5, 11, 15, 20

Wall regions

One 1, 2, 5, 6, 13, 20-22

Two 3, 4, 7-12, 14-19, 23-25

Color

Red 4, 7, 21, 22, 25

Yellow 1, 4, 6, 9, 10, 13, 14, 20, 22, 23, 25

Orange 1, 5-7, 12, 23, 24

Pink 8, 11, 18

Brown 3, 15

Nearly white 2, 16, 17, 19, 21, 23

Collapse

Vertical, papilla intact 1, 6, 7, 13, 19, 23, 24

Vertical, becoming cup-shaped 3, 5, 11, 15

Lateral 10, 12, 16, 22, 23, 25

Not collapsing 2, 4, 8, 9, 14, 18, 20, 21

Setose 6, 7, 9-13, 18, 19, 22-25

Setae arranged in circles on papilla 6, 7, 13, 19, 23, 24

Setae scattered 9-12, 17, 18, 22, 25

Non-setose 2-5, 8, 14-18, 20, 21

Characters of the asci

Size

Length averaging > 50 µm 1, 3, 5, 7, 9-19, 22-25

Length averaging < 50 µm 2, 4, 6, 8, 11, 15, 20, 21, 24

Apical ring

Absent 11

Present 1-10, 12-25

Arrangement of ascospores

Uniseriate 7, 11, 17, 20

Biseriate 1-6, 8-10, 12-16, 18, 19, 21-25

Characters of the ascospores

Size

Averaging < 11 µm long 2, 6, 8, 17, 20, 21

Averaging 11-19 µm long 1, 3, 4, 5, 7, 9, 11, 12, 13-16, 18, 19, 22-24

Averaging 20-30 µm long 10, 25

Shape

Ellipsoid 1-19, 21-25

Fusiform 2, 4-6, 12, 13, 19, 23, 24

Subglobose 20

L/W < 2.0 17, 20

L/W 2.0-3.9 1, 2, 5-11, 13, 15, 21, 22, 24, 25

L/W $\geq$ 4.0 3, 4, 12, 14, 16, 18, 19, 23

Ornamentation

Echinulate 1, 9, 12, 14, 17, 23, 24

Roughened 3, 7, 10, 11, 13, 15, 16, 18, 19, 21, 25

Smooth 2, 4, 5, 6, 8, 20, 22

Striate 19, 23

Verrucose 7, 10, 17, 25

Pigmentation en masse

Pale brown 7, 17

Pale orange to yellow 3, 5, 6, 9, 11-13, 19, 22-24

Pale pink 18

Hyaline 1, 2, 4, 8, 10, 14-16, 20, 21, 25

Anamorphs

Acremonium 6, 16

Fusarium 7, 17

Kutilakesa 19

Unknowm 1-5, 8-15, 18, 20-25

Mating type

Homothallic 3, 12, 13, 18, 22

Heterothallic unknown

Substrates

Monocots 5, 8, 14, 16, 18

Leaves or stems of herbaceous dicots 1, 3, 5, 6, 11-13, 16, 23, 24

Leaves of woody dicots 15

Paper or rope 10, 25

Wood 4, 7, 9, 17, 19, 21, 22

Fungi 2, 20

SPECIES OF NECTRIELLA

1. *N. alpina* (Winter) Weese
2. *N. balansiae* R. Arnold
3. *N. bloxamii* (Berk. & Br.) Fuckel
4. *N. crouanii* (Crouan & Crouan) Lowen
5. *N. dacrymycella* (Nyl.) Rehm
6. *N. dakotensis* (Seaver) Lowen
7. *N. dingleyae* Lowen
8. *N. exigua* Dennis
9. *N. fuckelii* Nitschke
10. *N. funicola* (Berk. & Br.) Petch
11. *N. galii* (Plowr. & Harkn.) Lowen
12. *N. guttulata* Lowen
13. *N. halonata* Lowen
14. *N. lacustris* (Kirschs.) Magnes & Hafellner
15. *N. luteola* (Desm.) Weese
16. *N. minuta* Lowen
17. *N. obscura* Lowen
18. *N. paludosa* Fuckel
19. *N. pironii* Alfieri & Samuels
20. *N. queletii* (Karst.) Karst.
21. *N. rubrocapitula* Lowen
22. *N. sambuci* (Höhnel) Weese

23. N. silenes-acaulis Nograsek

24. N. utahensis Lowen & Rogerson

25. N. verrucosa Urries

1. NECTRIELLA ALPINA (Winter) Weese, Ann. Mycol. 12: 148. 1914 [Ann. Mycol. 8: 464. 1910, comb. invalid, Art. 33.1]. fig. 1

≡ Nectria alpina Winter, Hedwigia 19: 175. 1880.

LECTOTYPE, designated herein: SWITZERLAND. Grisons: Rhaetia, Albula near Hospiz, in wilted and dry leaves of Arabidis pumila (= Arabis pumila Jacq.) [Brassicaceae], May 1880, G. Winter (with Pleospora pyrenaica Niessl, NY!).

Anamorph: not known.

Habitat: basal leaves and stems of Arabis, Saxifraga.

Distribution: Austria, Switzerland.

Ascomata obpyriform, 220-260 μm high (Winter: 320 μm high) x 195-250 μm wide, immersed-erumpent in basal leaves and stems, scattered or in groups of 5-6, at first orange-yellow, then yellow with brownish ostiole, not changing color in KOH; papilla truncate, 50 μm high x 100-150 μm wide; apex of papilla of clavate, diverging, thin walled hyphae, 10.0-17.5 x 3-5 μm, 0-2 septate; ends free. Cells on surface consisting of intertwined hyphae. Ascomatal wall 10-12 μm wide, of one region, the outer part of intertwined hyphae that appear in section as ellipsoid cells 5-9 x 1.5-3.5 μm, the inner part of parallel hyphae 0.5-1.5 μm wide;

cells narrower toward the centrum. Asci clavate, 60-89 x 9.0-12.5 μm; apex rounded, containing an inconspicuous apical ring; epiplasm in apex appearing coronate; ascospores biseriate. Ascospores ellipsoid, (12.5-)13.0-17.5(-19.0) x 3.5-5.0(-7.0) μm, L/W 3.7, 1-septate, sometimes slightly constricted, with upper cell often wider than lower cell, hyaline, echinulate.

Additional specimen examined:

AUSTRIA. Steiermark, Eisenerzer Alpen, Reiting W von Trofaiach, NE-Abhang des Greiskogels, ca. 2050 m, Caricetum firmae, on Saxifraga paniculata, 9 Jul 1984, J. Hafellner & A. Nograsek (GZU 140-88).

Discussion: After searching in B and FH-Höhnel, the type of Nectriella alpina was located in NY, from the Ellis herbarium. The Winter herbarium in Berlin was mainly destroyed in World War II (Stafleu and Cowan, 1988). Because no other Winter material was found, I designate the NY collection the lectotype.

Weese (1914) could not locate material of Nectria alpina but combined the species in Nectriella based on the immersed habit described by Winter. The species was recollected and redescribed by Nograsek (1990).

Pleospora pyreniaca was found immersed in the leaves and even attached to Nectriella alpina in the type specimen suggesting a relationship between the two fungi.

Nectriella alpina may be distinguished from other species of Nectriella by the structure of the ascomata. The combination of the lateral wall composed of one region and the ascomatal apex that looks slightly hairy due to the parallel hyphae terminating in free ends is characteristic of ascomata of N. alpina.

2. NECTRIELLA BALANSIAE R. Arnold, Mycologia 59: 248, figs. 1-7. 1967.

LECTOTYPE, designated herein based on the Nectriella part: CENTRAL AFRICAN REPUBLIC ("French Congo"). Kouti Region [near Ndéle], journey II, immersed in the stromata of Balansia volkensii (Henn.) Castellani & Ciferri on high herbs [grass], 15 Nov 1891, J. Dybowski, Patouillard Herb 597 (FH, sheet 6844!; as Hyalodothis clavis).

Anamorph: not known.

Habitat: fungicolous, on stromata of Balansia.

Distribution: known only from the type collection.

Ascomata obpyriform, 110-128 μm high x 70-120 μm wide, immersed in stromata and occasionally in empty ascomata of Balansia, scattered above and between the larger ascomata of Balansia, not visible from exterior, nearly white, not changing color in KOH; papilla 30-66 μm high x 16-30 μm wide, undifferentiated from the lateral wall. Non-setose. Ascomatal wall 12 μm wide, of one region of elongate cells 6 x 2 μm, cell walls 0.8 μm wide; periphyses prominent. Asci clavate, 31.5-40.0 x 5.5 μm; apex truncate, containing an apical ring; epiplasm in apex appearing "u" shaped; base rounded; ascospores biseriate; discharged asci 28-31 x 3.0-

4.2 µm. Ascospores irregularly ellipsoid-fusiform, 9.5-10.5 x 2.5-3.0 µm, L/W 3.5, typically 1-septate, occasional additional septa forming at site of distal guttules, one cell often narrower, hyaline, smooth, two prominent guttules per cell.

Discussion: Nectriella balansiae, not visible from the exterior, is found immersed in curved, black stromata of Balansia volkensii measuring 15-20 x 2-3 mm. Ascomata are under parts of stromata whitened by mycelium or crystalline material (Arnold, 1967, found ascomata beneath the surface of nearly the whole stroma). The smaller ascomata of the Nectriella are visible in cross section lining the interior of the stromata above and between the ascomata of the Balansia.

Specimens of Hyalodothis clavus Patouillard & Hariot (1893), type species of Hyalodothis Pat. & Har. have the appearance of ergot. Because the authors were unable to refer the species to any known genus, they erected Hyalodothis. They thought that the genus had characteristics of the Dothidiaceae and the Hypocreaceae. Müller & von Arx (1962) also considered H. clavus to be a single fungus with a dark outer wall and a colorless inner one. Diehl (1950) reported Hyalodothis clavus to be scarcely different from Balansia volkensii (Henn.) Castell. & Cif. [basionym Epichloë volkensii Henn., Essb. Pilze Ostafr., 32. 1895]. Theissen and Sydow (1914, 1915), Höhnel (1909, 1912) and Arnold (1967), however, found that H. clavus consists of two fungi. Höhnel (1909b) thought that the genus was Botryosphaeria but in 1912 referred Hyalodothis to the Hypocreaceae. Theissen and Sydow (1914, 1915) considered the stromatic part to be Ophiodothis and referred the hymenium to Hyalodothis in 1914 and to Hyponectria in 1915. Erkisson & Hawksworth (1990) without discussion treat Hyalodothis as a rejected name. The generic name Hyalodothis and the species name Hyalodothis clavus were considered illegitimate, nomina ambigua and nomina confusa by Arnold (1967) on the basis of Art. 70 because of the discordant elements: the hymenium of one fungus (Nectriella) and the stromata of another (Balansia). Article 70, however, was deleted by the Leningrad Congress in 1975. The result is that the element corresponding most closely to the original description must be chosen as the lectotype for the name (ICBN, Article 9.2). I follow Theissen and Sydow (1914) in selecting the part dealing with the hymenium as typifying the name Hyalodothis because the size of the asci and ascospores coincide. I agree with Arnold (1967) that the immersed ascomata and hymenium with hyaline, two-celled ascospores are those of Nectriella. Thus Hyalodothis becomes a synonym of Nectriella, the oldest name, and Nectriella balansiae is the correct name for the hypocrealean fungus.

Nectriella balansiae differs from other species of Nectriella by the following. The structure of the wall in the ascus apex causing the "u" shaped epiplasm is unlike others seen in Nectriella. Also, the cells of the papilla are unlike other species of Nectriella where the ascomatal apex is formed of rows of vertically elongated cells that become clavate at the exterior.

Cryptonectriella biparasitica (Höhnel) Weese and C. geoglossi (van Overeem) Lowen are non-hypocrealean fungicolous species previously combined in Nectriella. Nectriella balansiae differs from the two above species in the absence of free paraphyses and by asci that are shorter (40 µm or less) and filled with ascospores to the base. Nectriopsis epichloe (Speg.) Samuels also occurs on a species of Balansia and produces similarly sized and shaped asci and ascospores, but differs from Nectriella balansiae by the yellow, superficial ascomata and ascospores that lack prominent guttules.

3. NECTRIELLA BLOXAMII (Berkeley & Broome) Fuckel, Jahrb. Nassauischen Vereins Naturk. 29-30: 21. 1876-1877 [before 20 Nov 1875].

≡ Nectria bloxamii Berk. & Br., Ann. Mag. Nat. Hist., ser. 2, 13: 467. 1854 "bloxami".

≡ Calonectria bloxamii (Berk. & Br.) Sacc., Atti Soc. Venet.-Trent. Sci. nat. 4(1): 123. Jul 1875.

≡ Dialonectria bloxamii (Berk. & Br.) Cooke, Grevillea 12: 110. 1884.

= Nectria umbelliferarum Crouan & Crouan, Fl. Finestère, p. 37. 1867.

≡ Nectriella umbelliferarum (Crouan & Crouan) Sacc., Michelia 1: 278. 1878.

= Nectria heraclei Crouan & Crouan, Fl. Finistère p. 38. 1867.

= Nectria fuscidula H.Rehm, Hedwigia 21: 119. 1882.

≡ Nectriella fuscidula (Rehm) Weese in Höhnel & Weese, Ann. Mycol. 8: 466. 1910.

= Nectria dacrymycelloides Rehm, Hedwigia 42: 175. 1903.

[≡ Nectriella dacrymycelloides (Rehm) Höhnel & Weese, Ann. Mycol. 8: 465. 1910, comb. invalid, Art. 33.1].

HOLOTYPE: U.K., England. Leistershire: Twycross, on Jerusalem artichokes [Helianthos tuberosus L., Asteraceae], 16 Nov 1855, Rev. A. Bloxam 781. (K!; Isotypes, IMI52290, slides!; K, 3 collections!; K-BM!; PC!, all as Sphaeria (Nectria) bloxami).

Anamorph: not known.

Habitat: on dead stems of herbaceous dicotyledonous plants.

Distribution: Europe, New Zealand; temperate.

Ascomata subglobose, 250-300 μm diam, immersed, becoming erumpent, scattered or in groups of up to 8, pale at first orange-brown, then tan, not changing color in KOH; collapse vertical, shallow. Non-setose. Cells on surface of ascomata angular, 10 μm diam. Ascomatal wall 20 μm wide, of two regions: outer region 12 μm wide of thick-walled, angular to rounded cells, 10 μm diam; inner region 8 μm wide, of thin-walled, elongate, rectangular cells 10 μm long. Asci clavate, 40-70 x 8-9(-12) µm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid, 16-24 x 3-5 µm, L/W 4.6, 1-septate, often slightly constricted, hyaline, pale orange in mass when fresh, smooth to slightly roughened, often many guttules per cell.

CHARACTERISTICS IN CULTURE. Colonies grown in 5 cm Petri dishes, 21°C, 12 h dark/ 12 h light, cool white fluorescent plus near UV; 6 weeks on MA+, OA, OA+, PCA, PSA. Colonies on PCA reaching a maximum of 30 mm; aerial mycelium cottony, zonate, at first peach, then tan; center and reverse brown; margin scalloped; odor strong, sweet. Conidia and conidiophores absent. Aggregations of white hyphae often forming in rings at 4 weeks, ascomata forming at site of hyphal aggregations. Ascomata immersed, most becoming erumpent, maturing in 6 weeks. Colonies on MA+ with aerial mycelium tanish orange; agar becoming dark brown; ascomata forming, asci and ascospores absent. Colonies on CMD (by G.J.Samuels): colonies grown 15-18°C diffuse daylight, reaching 10-15 mm in three weeks; aerial mycelium scant; margin scalloped; tan to brown at inoculation site, rest of colony white.

Additional specimens examined:

AUSTRIA. Tirol: Aeternam Taschach-Gletscher, Gosshard Pass, Piz Alps, valley near glacier, alt. 6,200 ft., on rotting stems of <u>Aconitum napellus</u>, Sep 1891, <u>Rehm 42</u> (isotypes of <u>Nectria fuscidula</u>: FH-Höhnel, slides 3-3, 3-8). FRANCE. location unknown, on Angelica sylvestris, F. Fautrey (K, as Nectria umbelliferarum); Brittany: Finestère, on dead stems of Oenanthe croata, 20 Jun 1864, Crouan & Crouan (LECTOTYPE of Nectria umbelliferarum, designated herein; CO); (syntypes, on dead stems of Urtica, 18 Jun 1864, Crouan & Crouan; on stem of Angelica sylvestris, 29 Apr [year unknown], Crouan & Crouan, drawingss of orange ascomata, no ascomata found; on stem of Umbelliferae [Apiaceae], 30 Jan 1862, Crouan & Crouan; (CO); on the stems of Heracleum sphondylium, 27 Mar 1863, Crouan & Crouan (HOLOTYPE of Nectria heraclei; CO); on stems of Heracleum, 27 Mar 1869, Crouan & Crouan (CO); on Angelica sylvestris, 29 Apr 1863, Crouan & Crouan (CO); on a stem of Umbelliferae [Apiaceae], Jan 1863, Crouan & Crouan (CO). GERMANY. Bavaria: Konigstein, in dry stems of Cirsium arvense, 20 Jul 1899, W. Krieger (S; as Nectriella dacrymycella); Saxony: Uttewalder Grunde, on rotten stems of Senecio fuchsii, 18 Jun 1902, Krieger, Fungi Saxonici 1720 (LECTOTYPE of Nectria dacrymycelloides, packet with n. 8 in corner designated herein: S; isolectotypes, K, 2 collections; S). POLAND. Silesia, near Krummhübel, Riesengebirge, on stems of Mulgedium alpinum [Asteraceae], 4 Aug 1922, H. Sydow, Mycoth. Germ. 2139 (BPI; FH; K; all as Nectriella luteola). NEW ZEALAND. Nelson: Nelson Lakes Natl. Park, Lake Rotoroa, on stem of Composite

[Asteraceae], 25 May 1983, G.J. Samuels 83-101, T. Matsushima, A. Y. Rossman (PDD 46295, includes dry cultures). SWITZERLAND. Grisons: Rhaetia, Albulapass, on rotting stems of Aconitum napellus, Aug 1882, G. Winter, Rabenh.-Winter Fungi Eur. (K; as Nectria fuscidula). U.K., England. location unknown, on Heracleum, with Sphaeria, H. C. Hawley (K; as Calonectria); Lancashire: Gaitbarrows NNR, on Helleborus foetidus [Ranunculaceae], Oct 1985, L. & P. Livermore (IMI, includes dry cultures); Gaitbarrows NNR, on Helleborus foetidus, Nov 1985, L. & P. Livermore (IMI 311204, includes dry cultures); Suffolk: Southwold, on dried stems of Foeniculum vulgare [Apiaceae], 21 Sep 1977, M.B. & J.P. Ellis (IMI 227526); W. Sussex: Bignor Hill, on Urtica dioica, 29 May 1985, M.C. Clark (IMI 295733, dry culture); W. Sussex: Pagham Harbour, on Crambe maritima [Brassicaceae], 30 May 1983, S. Francis (IMI 279454); Worcestershire: Wassall Wood near Bendley, on stems of Digitalis, 7 Aug 1984, M.C. Clark 3109 (IMI, includes dry cultures; as Nectriella digitalicola); Yorkshire: Pickering, Little Park Wood, Footpath from Whitby Rd, on Sonchus oleraceus [Asteraceae], W. Bramley, K/82/4 (K; as Nectria arenula). Illegible location, Paneveggio, on stems of Senecio, Aug 1886, N. Amver (S, Nectriella halonata also present; as Nectria dacrymycelloides).

Discussion: The orthography of Nectria "bloxami," named after Rev. A. Bloxam, and all synonyms are obligately changed to bloxamii. The combination Calonectria bloxamii was published by Saccardo in the fourth of a series of five articles entitled "Fungi Veneti novi vel critici" that appeared in several journals. The earliest publication was in Nuovo Giorn. Bot. Ital. 5: 269-298. 1873. The reference to the publication is often given as the title of the article rather than the journal in which it appeared.

The aromatic, tan to brown cultures produced from single ascospores are consistent and characterstic for this species. Ascomata production was best on PCA and CMD; conidial production never occured. Because ascomata are produced from single ascospores, the species is homothallic.

Weese (1914), without examining the type, listed Nectriella bloxamii as a possible synonym of N. sambuci. Ascomata of Nectriella sambuci, however, unlike those of N. bloxamii, are papillate. Although Booth (1959) and Rossman (1979) considered N. bloxamii a synonym of Nectria arenula, Nectriella bloxamii is a distinct species, distinguished by the erumpent, nonstromatic ascomata and nonstriate ascospores.

Nectriella bloxamii can be confused with N. luteola in macroscopic appearance but is distinguished by the longer ascospores, the difference in substrates (herbaceous stems versus leaf veins and petioles) and the color of the ascomata. Nectriella dacrymycella has orange, translucent ascomata that usually remain under the epidermis of the substrate and that have a more thickened apex due to the globose, thick-walled outer region of cells of the ascomatal wall.

4. NECTRIELLA CROUANII Lowen, nom. nov. Fig. 4

≡ Nectria aurea Crouan & Crouan, Fl. Finistère, p. 37. 1867, non Nectriella aurea Sacc. & Speg. 1878.

≡ Calonectria aurea (Crouan & Crouan) Sacc., Michelia 1: 344. 1878.

HOLOTYPE: FRANCE. Brittany: Tenfeld, on small branches of Rubus, 26 Feb 1863, Crouan & Crouan (CO!).

Anamorph: not known.

Habitat: Rubus, "moulin".

Distribution: France, known only from the two Crouan collections.

Mycelium at first yellow (Crouan & Crouan, 1867), then white. Ascomata subglobose, 100-200 μm diam, immersed, often becoming erumpent, scattered; yellow; ascomatal apex red, becoming darker in KOH, slowly changing to yellow in lactophenol; basal, immersed part of ascomata becoming darker in lactophenol; papilla truncate. Non-setose. Cells on surface obscured. Ascomatal wall 21-23 μm wide, of two regions at the apex and sides and one at the base: outer region 9-13 μm wide; cell walls indistinct; inner region 10-12 μm wide, of thin-walled, elongate, rectangular cells. Asci clavate, 44 x 4-5 μm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid to fusiform, 12 x 3 μm, L/W 4.0, 1-septate, not constricted, hyaline, smooth, two guttules per cell.

Additional specimen examined:

FRANCE. Brittany: Vallon, on white "moulin," 8 March 1866, Crouan & Crouan (CO).

Discussion: Rossman (1979) determined that because Nectriella crouanii has multiguttulate but uniseptate ascospores, the species is unrelated to Calonectria. She retained the species in Nectria, close to the Nectria episphaeria-group of Booth (1959). Ascomata of Nectriella crouanii, however, are immersed-erumpent and do not have roughened, yellow-brown ascopsores. The species fits better in Nectriella.

Nectriella crouanii has similarities to N. exigua. The two species are distinguished from other species of Nectriella by the ascomatal walls that have two regions at the apex and sides and by asci that average less than 45 μm long. Nectriella crouanii differs from N. exigua by the substrate and by the ascomata that are red at the apex and yellowish on the sides and base.

5. NECTRIELLA DACRYMYCELLA (Nylander) Rehm, Ascomyceten 232. 1874. fig. 5

≡ Sphaeria dacrymycella Nyl., Flora 46: 322. 1863.

≡ Nectria dacrymycella (Nyl.) Karst., Fungi Fenn. exs. 667. 1867.

≡ Calonectria dacrymycella (Nyl.) Sacc., Michelia 1: 314. 1878.

HOLOTYPE: FINLAND. Tavastia australis Lempäälä, on stems of Urtica, 9 Sep 1860, P.A. Karsten (H 2236!; isotypes, IMI 52313, slide!; H 2237!).

Anamorph: not known.

Habitat: herbaceous stems.

Distribution: Europe.

Ascomata subglobose, 140-200 μm high x 180-230 μm wide, immersed, scattered or in groups of up to 20, bright orange, remaining covered by the epidermis of the stem, not changing color in KOH; collapse vertical. Non-setose. Cells on surface of ascomata angular, 6-10 μm diam. Ascomatal wall 10 μm wide, widening to 20 μm at apex due to the enhanced development of an outer region of rounded, thick-walled cells; lateral wall of elongate, rectangular cells; ostiolar region of thick-walled, angular to rounded cells, outer cells merging with substrate. Asci clavate, 50-75 x 9-10 μm; apex truncate, containing an inconspicuous apical ring; ascospores biseriate; discharged asci open at apex. Ascospores fusiform-ellipsoid, 13-20 x 4.0-5.5 μm, L/W 3.4, 1-septate, sometimes slightly constricted, appearing curved because of one side being straight, the other side curved, at first hyaline, then pale brown, smooth to slightly roughened, sometimes 2 guttules per cell (seen in lactophenol).

Additional specimens examined:

CZECHOSLOVAKIA. Moravia: Weisskirchen, on _Urtica dioica_, Oct 1926, _F. Petrak_, Mycoth. gen. (C; as _Nectria dacrymycella_). FRANCE. Brittany: on dead stems of _Urtica_, 22 Oct 1869, _Crouan & Crouan_ (CO; as _Nectria dacrymycella_). U.K., England. Bucks: on stems of _Iris pseudacorus_, (IMI 96574); Isle of Lyigha, E. Bay at Tabet, on _Iris pseudacorus_, 12 May 1981, _R.W. Dennis_ (K; as _Nectria arenula_); Norfolk: King's Lynn, on stem of _Urtica dioica_, 26 Jun 1979, _A. Moore_ (K; as _Nectria arenula_); Norfolk: Norwich, on stems of _Iris pseudacorus_, (IMI 70195); WALES. Monmouthshire: Gwernesey, on stems of _Iris pseudacorus_, (IMI 49092); Powys: Forden, _Nectria_ on nettle stems, 27 Sep 1934, _Vize 37_ (K).

Discussion: Weese (1914), without seeing the type of _Nectriella_ , suggested that this species might be a synonym of _N. luteola_. Rossman (1979) also did not see the type specimen. _Nectriella_ is, however, distinct from _N. luteola_.

Nectriella dacrymycella has been confused with several species. The combination _N. dacrymycella_, published in Rehm Ascom. 232, was based on a misidentified collection of _N. dakotensis_. _Charonectria sceptri_ (Nyl.) Lowen is missnamed _Nectriella dacrymycella_ in Rehm ascom. 232b. _Charonectria sceptri_ and _Nectriella dacrymycella_ both have ascomata that look like orange blisters under the epidermis of herbaceous stems. _Nectriella dacrymycella_ usually has smaller, nonpapillate ascomata with a narrower lateral wall, shorter asci and is nonparaphysate. Ascomata of Nectriella *dacrymycella* are found on *Iris pseudacorus* and *Urtica dioica* whereas those of *C. sceptri* are found on species of *Aconitum*, *Pedicularis*, *Sceptrum*, and other dead herbaceous plants. *Nectriella dacrymycella* has ascospores that overlap in size and shape with those of *Nectriella bloxamii* and *N. luteola* but is distinguished from the latter two species by ascomata that have a wider wall at the ascomatal apex and the bright orange pigment. *Nectriella dacrymycella* is illustrated and briefly described by Ellis and Ellis (1985).

6. NECTRIELLA DAKOTENSIS (Seaver) Lowen, comb. nov. fig. 6

≡ *Hyponectria dakotensis* Seaver, Mycologia 1: 20, pl. 2, figs. 1-4. 1909.

= *Nectriella muelleri* Samuels, Rogerson, Rossman & J.D. Smith, Canad. J. Bot. 62: 1899, figs. 7-10. 1984.

HOLOTYPE: U.S.A. North Dakota: Fargo, on herbaceous stems, ?*Ambrosia trifida*, *Seaver* (NY!; isotype, NY!).

Anamorph: *Acremonium* sp., based on *Nectriella muelleri* (Samuels et al., 1984).

Habitat: on dead herbaceous dicotyledonous stems.

Distribution: Alpine, known from Canada, Romania, Sweden, Switzerland, U.S.A.

Ascomata obpyriform, 130-220 high µm x 90-300 µm wide, immersed, singly or in groups of up to 20, raising the epidermis of the herbaceous substrate and becoming erumpent or only the papilla penetrating the epidermis; at first yellow to orange, then yellow-brown, not changing color in KOH; papilla truncate 40 µm high x 80-130 µm wide, sometimes slightly darker than ascomata; collapse vertical with papilla retaining shape or not collapsing. Setae on ascomata clavate, 14-60 x 2.0-4.5 µm; 1-septate, hyaline; tips rounded; walls thin; forming a circle around ostiole, sometimes not easily seen. Cells on surface of ascomata angular, 6-10 µm diam. Ascomatal wall 10-15 µm wide, of one region; of thin-walled, ellipsoid to elongate cells, 3.5-10.0 x 1.5-3.5 µm, cells becoming more narrow toward the centrum. Contents of the centrum pale orange. Asci cylindric-clavate, 30-55 x 4.0-6.5 µm; apex truncate, containing a refractive apical ring; epiplasm in apex appearing coronate; base rounded; originating from the base of the ascomata; ascospores biseriate. Ascospores navicular to ellipsoid-fusiform, 7-10 x 2-4 µm, L/W 3.0, 1-septate, at first hyaline, then slightly brown, smooth, several guttules per cell.

CHARACTERISTICS IN CULTURE. Colonies grown 10°C in the dark, 5 months, on PDA and CMD. Colonies on CMD reaching a maximum of 55 mm; aerial mycelium at first felty of short hyphae, then cottony, formed of longer hyphae, white to pale salmon. Conidiophores forming in scattered tufts, erect, 25-46 µm long, unbranched, 1(-2)-septate. Phialides terminal, 20-25 µm long x 2 µm at the base tapering to 1 µm at the apex, monoblastic, integrated, terminal; collarette thickened, not flared. Conidia subglobose to oblong, 2-5 x

1.5-2.0 μm, unicellular, hyaline, produced in basipetal succession, held in a droplet of hyaline liquid (GJS 78-47).

Additional specimens examined:

Location unknown, Rehm Ascom. 1861 (FH-H, slide 3-1). AUSTRIA. Tirol: Schwofrapass, 1720 m, on stems of Aconitum, Sep 1908, Rehm (S; as Nectria dacrymycella). CANADA. Québec: Lac Cascapedia, on stalks of Epilobium angustifolium, 21 Aug 1957, H.E. & M.E. Bigelow (NY; as Nectria pedicularis); Süd-Tirol: [illegible] inedazzo, on rotten stems of Cirsium spinosissimum, Aug 1882, Dr. Smort (S; as N. tuberculariformis). ROMANIA (Transylvania). Hunedoara "Hunyad": Zenoga, Rhetzat, ca. 6000 ft., on rotted stems of Umbelliferae [Apiaceae], Aug 1873, Lojka, Rehm Ascom. 232 (FH-Höhnel, slides 3-1, K, NY, S; all as Nectriella dacrymycella). SWEDEN. Lycksele Lappmark: Tärna par., roadside ca. 100 m s. of the brook Jirejukke near old Umasjö, on Trollius europaeus, 29 Jun 1985, L. Holm (NY; as Nectriella muelleri); Lycksele Lmk: Tärna par., roadside near Umasjö, alt. ca. 550 m, on Trollius europaeus, 8 Aug 1985, L. Holm (NY; as Nectriella muelleri); Västerbotten: Umeå, Brännland, ditch, on Cirsium arvense, 28 Jul 1977, O. Eriksson (NY). SWITZERLAND. Grisons: Davos, Dischma-Valley, Hillberg, on Adenostyles alliariae (Gouan) Kerner [Asteraceae], 18 Sep 1963, E. Müller [Nectria tuberculariformis also present] (NY); Grisons: Zuoz, elev. 1700 m, on dead stems of *Cirsium spinosissimum*, 20 Jul 1978, Samuels (78-47), Rossman & Müller (ISOTYPE of *Nectriella muelleri*; NY); Unterengadin, Susch, Val Susasca, Röven, 5 Sep 1989, E. Müller (NY!; herb. Müller, not examined).

Discussion: Samuels et al. (1984) described and illustrated *Nectriella dakotensis* as *N. muelleri*. The authors established that *N. dakotensis* grows best in culture at 10°C.

Hyponectria dakotensis along with *H. mohavensis* Bonar and *H. cacti* (Ellis & Everh.) Seaver were excluded from *Hyponectria* by Barr (1977) because these fungi do not have broad paraphyses attached at both the apex and base of the centrum as in the type of *Hyponectria*, *H. buxi* (DC ex Desm.) Sacc.

7. NECTRIELLA DINGLEYAE Lowen, sp. nov. Fig. 7

HOLOTYPE: NEW ZEALAND. Northland: Hokianga County, vic. Mangamuka Bridge, Omahuta State Forest, Omahuta Kauri Sanctuary, 10 May 1981, G.J. Samuels 81-106 & E. Horak (PDD 46011!; IMI 297573, cultures and slides!).

Anamorph: *Fusarium* sp.

Etymology: Named in honor of Joan M. Dingley, for her collection of this fungus and for her work with Hypocrealean fungi.

Habitat: bark.

Distribution: New Zealand (North Island, Northland; South Island, Westland).

Ascomata obpyriform, 175-420 µm high x 175-378 µm wide, immersed, sometimes becoming erumpent, scattered or in groups of up to 20; red-orange, becoming slightly darker red in KOH and pallid in lactophenol, slowly becoming yellow; papilla truncate, 60-120 µm high x 100-130 µm wide; collapse vertical with papilla retaining shape. Setae surrounding ostiole, 14-24 x 5-8 µm; wall thick, 3 µm wide, outline undulate; apex rounded. Cells on surface of ascomata angular, 10-16 µm diam. Ascomatal wall 30-40 µm wide, of two regions: outer region 20-30 µm wide of thick-walled, angular to rounded cells; inner region of thin-walled, elongate, rectangular cells. Asci cylindrical, 76-88 x 5-9 µm; apex truncate, containing an apical ring; base slightly pointed; ascospores uniseriate. Ascospores ellipsoid, 12-18 x 4-8 µm, L/W 2.6, 1-septate, occasionally slightly constricted, at first hyaline, then pale brown, verrucose, several guttules per cell.

CHARACTERISTICS IN CULTURE. Colonies grown 20°C, diffuse daylight, 6 weeks on PCA, PSA. Colonies on PCA reaching a maximum of 20 mm; aerial mycelium cottony, slightly zonate, at first orange, nearly transparent; reverse, slighty darker orange; margin white; then pale brown with diffusing, pale brown pigment. Conidial production beginning in 3 days. Conidiophores arising directly from the surface of the agar and from the aerial mycelium; microconidiophores morphologically distinct from macroconidiophores. Microconidiophores arising from aerial mycelium, 20 μm long, branching irregularly, each branch terminating in a single phialide; phialides cylindrical, 20.0 x ca. 1.5 μm at the base tapering to the apex. Microconidia cylindrical, 4-7 x 1.5-2.0 μm. Macroconidiophores 70-255 μm long, 5-9 μm wide at base, 3.5(-5.0) μm wide at the tip, hyaline, smooth; tip with visible periclinal thickening, not flared. Macroconidia falcate, 40-50 x 4-6 μm, 3-7-septate, smooth, hyaline; foot cell indistinct; held in a hyaline liquid droplet. Chlamydospores not observed.

Additional specimen examined:

NEW ZEALAND. Westland: Waiho, in bark of Olearia avicenniifolia, Jun 1950, J.M.Dingley 12/46 (part of PDD 10507).

Discussion: Nectriella dingleyae is distinguished from N. obscura by the orange ascomata and setae encircling the ostiole and from other species of Nectriella by the elongate asci, relatively wide, roughened, uniseriate ascospores and the Fusarium anamorph.

The species was grown in culture by G.J. Samuels. The Fusarium anamorphs of Nectriella dingleyae and N. obscura are characterized by a slow growing, orange culture with little aerial mycelium similar to Fusarium merismioides Corda. These are the only species in Nectriella connected to Fusarium. They could be placed in Nectria subg. Dialonectria

(Samuels et al., 1991) on the basis of the anamorph combined with their warted, pale brown ascospores, but are retained in Nectriella because of the KOH- ascomata combined with the immersed habit and the presence of setae.

8. NECTRIELLA EXIGUA Dennis, Revista Biol. 12: 22, fig 1B. 1983.

HOLOTYPE: U.K., England. Cornwall: Perranporth, in dead leaves of Psamma arenaria (L.) Roem. & Schult. (= Ammophila arenaria (L.) Link), 9 Feb 1929, F. Rilstone (K!).

Anamorph: not known.

Habitat: graminicolous.

Distribution: known only from the type collection.

Ascomata obpyriform, 100 μm high x 120 μm wide, immersed, scattered, sparse, appearing as tiny blisters on the dead grass; pale pink, not changing color in KOH; papilla rounded, 20 μm diam. Non-setose. Ascomatal wall 34 μm wide, of two regions: outer region 30 μm wide, of thick-walled, angular to rounded cells; inner region 4 μm wide, of thin-walled, elongate, rectangular cells. Asci clavate, 30-45 x 5-8 μm, fragile, evanescent, apex truncate, containing an apical ring; epiplasm in apex appearing coronate; ascospores biseriate. Ascospores ellipsoid, often slightly curved, 8-10 x 2-3 μm, L/W 3.6, 1-septate, one side straight, one side curved, hyaline, smooth, often many guttules per cell.

Discussion: Nectriella exigua is one of the few graminicolous species of Nectriella. The ascomatal wall is wider than any other known species of Nectriella and the ascomata remain immersed. Nectriella exigua is closest to N. lacustris ascomata of which also are found on graminicolous substrates and remain immersed.

9. NECTRIELLA FUCKELII Nitschke in Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870]. fig. 9

≡ Calonectria fuckelii (Nits. in Fuckel) Sacc., Michelia 1: 310. 1878.

LECTOTYPE: GERMANY. Hesse [formerly Nassau]: Rheingau, on fallen but still hard wood of Populus nigra, Spring, Nitschke, Herb. Barbier Boiss. 915 (BPI!; isolectotypes, B!, FH-H!, S!, all as Calonectria fuckelii).

Anamorph: not known.

Habitat: decorticated wood.

Distribution: Europe.

Ascomata obpyriform, 220-400 μm high x 200-340 μm wide, immersed to half erumpent, scattered or in groups of up to 10, at first red, then yellow, not changing color in KOH; papilla rounded, 88-168 μm high x 150-200 μm wide. Setae clavate, 24-64 μm long x 4-5 μm at widest tapering to 3 μm at base; sparingly septate, hyaline, brittle, apex rounded; walls 1.5-2.0 μm thick; deposits of unidentified material on surface seen especially in water mounts; scattered on papilla, arising singly or in groups of 2 or 3. Cells on surface of ascomata obscured. Ascomatal wall 21-28 µm wide, of two regions: outer region 14-18 µm wide of thick-walled, rounded cells 3-7 x 2-8 µm, walls 2 µm, fusing and terminating at upper sides of papilla with openings 1.0-1.5 µm diam separated by 3-6 µm of wall material; inner region 8-10 µm wide, of elongate cells 3.5-10.5 x 0.7-5.0 µm; base of one region; cells similar to inner wall above. Asci clavate, 70-80 x 12-16 µm; apex rounded to truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid, (12-)16-18 x 4-7 µm, L/W 2.3, 1-septate, at first hyaline, then slightly yellowish, echinulate, 1 to several guttules per cell.

Discussion: The isolectotype material at B was probably seen by Nitschke as evidenced by the handwriting on the label. Although it would have probably made the most appropriate lectotype, the specimen selected as lectotype (Rossman, 1979) is identical. Fuckel described ascospores of N. fuckelii as three-septate. This may have been based on the presence of guttules that give the appearance of more than one septum. I agree with Weese (1914) that the ascospores are actually one-septate.

Weese (1914) redescribed N. fuckelii and said that this species conforms well to the concept of Nectriella. Rossman (1979) furnished a short description of N. fuckelii and a discussion of the genus Nectriella.

10. NECTRIELLA FUNICOLA (Berkeley & Broome) Petch, Naturalist 970: 281. 1937. fig. 10

≡ Sphaeria funicola Berk. & Br., Ann. Mag. Nat. Hist., 7: 188. 1851.

≡ Nectria funicola (Berk. & Br.) Berk., Outl. Brit. Fungi. 393. 1860.

≡ Calonectria funicola (Berk. & Br.) Sacc., Michelia 1: 312. 1878.

≡ Lasionectria funicola (Berk. & Br.) Cooke, Grevillea 12: 112. 1884.

= Nectria charticola Fuckel, "chartaecola," Fungi rhenani. 990, fasc. 10. 1864, description on printed label.

≡ Nectriella charticola (Fuckel) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870].

= Nectria fibricola Plowright in Sacc., Michelia 2: 152. 1880.

HOLOTYPE: U.K., England. Northamptonshire: King's Cliffe, on decayed rope, 22 Oct 1841, Berkeley (K!; isotype, IMI 52630, slide!).

Anamorph: not known.

Habitat: rotting rope and paper.

Distribution: Europe.

Ascomata obpyriform, 280-400 μm high x 330-400 μm wide, immersed, to erumpent, scattered or in groups of up to 20; yellow, not changing color in KOH; papilla variable in size, to 140 μm high x 110-140 μm wide; collapsing by lateral pinching. Setae on surface of papilla, scattered, arising singly, sparse, stiff, lanceolate, 35-160 μm long x 4-12 μm at base, tapering to 4 μm at apex; nearly white; apex pointed to rounded; broken in many collections; wall thick 2-3 μm. Cells on surface of ascomata angular, 4-8 μm diam. Ascomatal wall 17-30 μm wide, of two regions: outer region 18 μm wide of thick-walled, angular to rounded cells, 1.5-5.0 x 1-3 μm diam; inner region 10-20 μm wide, of thin-walled, elongate, rectangular cells, 9-12 x 1 μm; ascomatal base of a single region of cells similar to the inner region above. Asci clavate, 60-110 x 8-14 μm; containing an apical ring seldom visible in mature ascus; epiplasm in apex appearing coronate; ascospores biseriate. Ascospores ellipsoid, 16-24 x 4-8 μm, L/W 3.5, 1-septate, rarely 3-septate, hyaline, slightly roughened to verrucose, 2 guttules per cell.

Additional specimens examined:

FRANCE. Brittany: St. Malo, in rotted paper, "m. Mart.," B. de Lesdain (C, IMI 12918, K, all as N. charticola). GERMANY. Rhenish Hesse: near Budenheim, in Pines, in rotted paper lying on the ground, rare, Autumn, Fungi rhenani 990 (HOLOTYPE of N. charticola; G; isotypes, FH-Höhnel, slide 2-24; IMI; K, 2 collections). LUXEMBOURG. Pappendickel, Feltgen, ex Herb Rehm (FH). U.K., England. Norfolk: King's Lynn, in rotted cord, Plowright (HOLOTYPE of Nectria fibricola: K; isotype, FH); S. Yorkshire: Near Cadeby, Melton Wood, on old cardboard, 1901 (IMI 62631, slide; K; all as N. funicola).

Discussion: Fuckel described Nectriella charticola as one of the original members of the genus Nectriella. Nectriella charticola was placed in subg. Cosmospora by Saccardo (1883). Species in the subgenus were characterized by verrucose, rufescent ascospores. Weese (1914) synonymyzed Nectria fibricola with Nectriella charticola and redescribed the species. His illustrations (1914, fig. 2) demonstrated the variability of the ascomata. Booth (1959) recognized the synonymy of N. charticola with N. funicola. He redescribed the species as a member of the Nectria lasionectria-group and illustrated the asci and ascospores (1959, fig. 35, C, D). Rossman (1979) considered Calonectria funicola a species of Nectria. She incorrectly synonymized N. funicola with N. luteofusca Crouan & Crouan (Fl. Finistère, p. 39. 1867). Nectria luteofusca, also on rotten rope and originally described with chestnut brown ascomata, has blackish ascomata, and smooth ascospores measuring 10 x 4 µm. The pallid ascomata and longer, ornamented ascospores of Nectriella funicola are differences that make the two species distinct.

Nectriella funicola is retained in Nectriella because of the erumpent, setose, KOH- ascomata. Nectriella funicola is distinguished from N. verrucosa, which also has setose, variably papillate ascomata that are found on paper, by the smaller asci and ascospores. These fungi are rarely collected, but additional specimens and cultural information may ultimately prove the species to be synonymous.

11. NECTRIELLA GALII (Plowright & Harkness) Lowen, comb. nov.

= Nectria galii Plowr. & Harkn., Bull. Calif. Acad. Sci. 1: 26. 1884.

HOLOTYPE: U.S.A. California: on Galium trifolium (Rubiaceae), H.W. Harkness 3070 (K!).

Anamorph: not known.

Habitat: stems of Galium.

Distribution: known only from the type collection.

Ascomata subglobose, 160 µm high x 220-240 µm wide, immersed, scattered, raising the epidermis of the stem but usually remaining immersed, pale pink, not changing color in KOH; collapse vertical. Setae flexuous, septate, to 200 µm. Cells on surface of ascomata obscured. Ascomatal wall 10 µm wide, of two regions: outer region 8 µm wide of thick-walled, angular to rounded cells; inner region 2 µm wide, of thin-walled, elongate, rectangular cells. Asci cylindrical, 40-60 x 4-8 µm; apex truncate, apical ring absent; thin-walled, and deliquescing early; ascospores overlapping, uniseriate. Ascospores ellipsoid, 10-12 x 4-6 µm, L/W 2.3, 1-septate, some slightly constricted, hyaline, pale yellow in mass, smooth to slightly roughened, one guttule per cell, ascospores occuring in great numbers, filling the centrum.

Discussion: Seaver (1909) treated *Nectria galii* as a doubtful species of *Nectriella* because he did not examine specimens.

The ascomata of *Nectriella galii* can be mistaken for a pycnidium because the fragile asci rupture easily in a squash mount liberating great numbers of ascospores into the centrum.

Nectriella galii has erumpent ascomata with an enlarged apical wall typical of the genus *Nectriella*. *Nectriella galii* is related to *N. bloxami* and *N. luteola*, two other species that have subglobose ascomata. The wall structure of two regions with subglobose, thick-walled cells in the outer apical region leads to a cupulate collapse in these species when they are dry.

12. NECTRIELLA GUTTULATA Lowen, Mem. New York Bot. Gard. 49: 244, figs. 1-3, 1989. figs. 12, 52

HOLOTYPE: CHILE. Región de la Araucania: Cautin, Malleco nr. the entrance to Parque Nac. de Conguillio, on decaying petioles of *Gunnera chilensis* Lam. at riverside, 24 Oct 1985, *P.F. Cannon*, *D.W. Minter & H. Peredo* (IMI 311205!; isotype, NY!).

Anamorph: not known.

Habitat: petioles of *Gunnera*.

Distribution: known only from the type collection.

Ascomata obpyriform, 320 high x 200 µm wide, immersed, scattered or in groups of up to six, bright orange, not changing color in KOH; papilla rounded, 100 µm high x 120 µm wide. Setae cylindrical, to 60 µm long x 8 µm at base tapering to 4 µm, scattered, recurved, on the papilla except at the ostiole, hyaline, smooth, thin-walled, septate, constricted; septa with a pore except terminal septum which completely delimits the apical cell; apex round to pointed. Ascomatal wall 20-24 µm wide, of two regions: outer region 10 µm wide of thick-walled, round to oval cells 2.5-4.0 µm diam; inner region 10-14 µm wide, of thin-walled, elongate, rectangular cells 8-12 x 2 µm, orange oily drops emerging from squashed or sectioned ascomatal wall cells and from centrum. Asci clavate, 60-100 x 8.0-11.5 µm; apex containing an apical ring; ascospores biseriate. Ascospores ellipsoid-fusiform, 17-20 x 3.5-5.5 µm, L/W 4.3, 1-septate, often slightly curved and slightly constricted, hyaline at first, then pale brown as seen in transmitted light, pale peach in mass when oozed out of ascomata, minutely echinulate, spines more prominent at maturity, two orange guttules per cell.

CHARACTERISTICS IN CULTURE. Ascospores germinating from the sides of either or both cells. Colonies grown 12 h dark / 12 h cool white fluorescent plus near UV; 2 months on CMA, OA, OA+, PCA, PSA. Colonies on PCA reaching a maximum of 70 mm; aerial mycelium plumose, bright orange, slightly darker and raised in center; opaque; reverse concolorous; Colonies on PSA becoming furrowed and radially wrinkled. reverse somewhat darker. Conidia not observed on any media. Aggregations of hyphae visible in one week in cultures derived from single or multiple ascospores, scattered; cells inflated, thin-walled, white to pale peach, secreting a clear liquid at the apex. I take these aggregations to be ascomatal initials because the cells become ascomatal setae. Ascomata at first nonpapillate, becoming papillate, with asci and ascospores in one month except on PSA.

Discussion: Nectriella guttulata is homothallic because ascomata developed from single ascospores. No anamorph was produced.

The setae produced in culture preceding ascomatal development exuded a clear watery substance. As the ascomata develop, the tips of the setae assume a rounded or sometimes pointed apex. The terminal cell closes off from the other part of the hair which retains a channel in the center. The significance of this phenomenon seen in other species of Nectriella, N. paludosa for example, is unknown.

SEM (fig. 52) verifies that the uneven appearance of the ascospores seen with oil immersion magnification is due to projections from the spore surface. The collapsed, wing-like appearance of the ascospores is likely to be the state in which these ascospores exist outside the ascomata and may be a survival mechanism. The shapes also suggest that the ascospores might be wind dispersed in the collapsed condition.

The epithet guttulata is descriptive of the orange guttules contained in the ascospores and released from the cells of the ascomatal walls and centrum in fresh squash mounts. Nectriella utahensis also has orange, setose ascomata. Nectriella guttulata is distinguished by ascomata with recurved setae and more narrow ascospores with a L/W of 4.3.

13. NECTRIELLA HALONATA Lowen, nom. nov. Fig. 13

≡ Charonectria umbelliferarum Höhnel, Hedwigia 42: 187. 1903, non Nectriella umbelliferarum Crouan & Crouan, Fl. Finestère, p. 37. 1867.

≡ Calonectria bloxamii (Berk. & Br.) Sacc. var. umbelliferarum Höhnel, Ann. Mycol. 2: 49. 1904.

HOLOTYPE: AUSTRIA. Tirol: Ötzal, Tumpener See, on dry stems of Umbellifer, ? 8/99, 27 Aug 1902, Höhnel (FH!, FH-H slide!, as Charonectria umbelliferarum).

Anamorph: not known.

Etymology: halonata refers to the halo of setae on the papilla.

Habitat: in herbaceous stems of dicotyledonous plants.

Distribution: Europe, U.S.A. (Colorado), temperate.

Ascomata obpyriform, 300-400 µm high x 180-420 µm wide, immersed, scattered or in groups of 20+, nonstromatic, pale yellow, not changing color in KOH; papilla truncate, 60-170 µm high x 80-140 µm wide; collapse vertical with the papilla retaining its shape. Setae clavate, 10-80 x 2-5 µm, longer toward the perimeter, widening to 6 µm at apex; wall 1 µm thick; apex rounded and thin-walled; base sometimes uneven; 0-2 septate, hyaline, more numerous toward perimeter, continuous as outgrowths of the vertically oriented hyphae of the papilla, forming a circle around the ostiole. Cells on the surface of ascomata angular, 8-10 µm diam. Ascomatal wall 14-16 µm wide, of thin-walled, elongate, rectangular cells 8-10 x 2 µm. Contents of centrum pink. Asci clavate, 40-80 x 6-10 µm; apex thickened and rounded in young asci, containing an apical ring; epiplasm in apex appearing coronate; base pedicellate; ascospores biseriate. Ascospores ellipsoid-fusiform, often slightly curved, (10-)15-20(-22) x 4.0-5.5 µm, L/W 3.7, 1-septate, at first hyaline, then brownish-yellow, distinctly verrucose when mature, 1-2 guttules per cell; .

Additional specimens examined:

FRANCE. Côte-d'Or: Morvan plateau, edge of pond of St. Isabelle, on Angelica sylvestris, Aug 1891, F. Fautrey, Roumeguère Fungi Sel. Exs. 6049 [associated with Leptosphaeria conoidea] (K, NY, both as Nectria umbelliferarum (Crouan & Crouan) Sacc.). GERMANY. Bavaria: Hochvogel, Bärgündele-Alpe, (Algäuer Hochalpen), on dry stems of Umbellifer, ca. 1300 m, 1909, Rehm, Ascom. 1867 (FH, K, NY); Bavaria: München, Kiesgrube near Fürstenried, on dry stems of Umbellifer, Oct 1902, Rehm, Rehm Ascom. 1466 (IMI 104344; K; both as Calonectria bloxami). SWEDEN. Uppland: Dalby par., roadside ca. 125 m W of Jerusalem, on Carlina vulgaris [Asteraceae], overwintered stems and leaves, 28 Jun 1988, K. & L. Holm 4941a (NY). U.K., England. Suffolk:

Dunwich Forest, on Angelica sylvestris, 21 Sep 1979, M.B. & P. Ellis (IMI 241564); Yorkshire: Pickering marshes, on Urtica dioica, 21 Jun 1956, W.G. Bramley (K; as Lasionectria). U.S.A. Colorado: location unknown, in herbaceous stems, 1910, Seaver & Bethel, (NY; as Nectriella fuckelii).

Discussion: Although no ascomata remain in the holotype collection, there is a slide in the Höhnel herbarium that serves as the type. The description herein is based on Rehm Ascom. 1867 because the type material was insufficient. The collection of Rehm Ascom. 1867 is considered authentic because it was found in the Höhnel herbarium annotated as Charonectria umbelliferarum. The substrate is also a member of the Apiaceae and the size of the asci and ascospores fit the description of Nectriella umbelliferarum.

Höhnel (1903) described both Charonectria umbelliferarum and C. sambuci with ascomata with hairs. He did not describe a circular arrangement of hairs for either species. Höhnel said that he could not see hairs on C. umbelliferarum but thought that they might be visible on more well-devoloped specimens. Although there was a circle of setae in all three collections of Rehm Ascom. 1876 examined, Weese (1914) did not report them. Weese concluded that Nectriella sambuci and Charonectria umbelliferarum were the same taxa and that N. sambuci was the correct epithet because it appeared first in Höhnel (1903). Median vertical sections of ascomata of these two taxa, however, reveal basic differences in ascomatal wall anatomy (Fig. 13) and there is a ring of setae on N. halonata. The setae when found are scattered in N. sambuci.

Höhnel (1904) described Pseudodiplodia umbelliferarum. Höhnel (1915) suggested this species is the pycnidial anamorph of Nectriella halonata. He recombined the species as Stylonectriella umbelliferarum. There are brown pycnidia on the type material but they do not fit the description of P. umbelliferarum. The connection with an amamorph with dark pycnidia is not likely (Samuels and Seifert, 1987).

Nectriella halonata, like N. dakotensis, has ascomata that have setae encircling the ostioles and that collapse vertically with the papillae retaining their shapes. Nectriella halonata has larger asci and ascospores.

14. NECTRIELLA LACUSTRIS (Kirschstein) Magnes & Hafellner, Biblioth. Mycol. 139: 105. 1991. fig. 14

≡ Calonectria lacustris Kirschst, Ann. Mycol. 34: 186. 1936.

HOLOTYPE: GERMANY. Westhavelland, Klein-behnitzer See, on dry, still standing leaves of Typha latifolia, 5 Nov 1935, W. Kirschstein (B!).

Anamorph: not known.

Habitat: Typha latifolia.

Distribution: Germany, Switzerland.

Ascomata subglobose, 105-114 μm high x 123-149 μm wide, immersed, usually remaining subcuticular, scattered, sparse, pale yellow, not changing color in KOH; papilla inconspicuous, 52 µm wide x 10 µm high; collapse vertical. Non-setose. Cells on surface obscured by cuticle of Typha. Ascomatal wall 12-14 µm wide, of two regions at the upper sides and apex: outer region 4-7 µm wide of fused wall material with sparse, rounded openings, 1.0-1.5 µm diam separated by 3-6 µm of wall material; inner region 7-10 µm wide, of elongate cells 3.5-10.5 x 0.7-5.0 µm. Asci clavate, 48-65 x (8.5-)10.0-16.0 µm; apex rounded to truncate, slightly depressed in center, containing an apical ring; epiplasm in apex appearing coronate; ascospores biseriate. Ascospores ellipsoid, 15-25 x 4.0-5.5 µm, L/W 4.1, 1-septate, occasionally 3-septate, one side straight, the other side curved, one end rounded, the other end tapered, hyaline, sometimes echinulate when mature, 2 guttules per cell.

Additional specimen examined:

AUSTRIA. Steiermark: Niedere Tauern, Südl. Abhänge der Schadminger Tauern, Krakuahintermühlen, Etrachsee, 1372 m, on leaves of Carex rostrata, 19 Jun 1989, J. Hafellner & M. Magnes 136 (NY).

Discussion: Ascomata in the collection on Carex differ from the those of type Nectriella lacustris in having a thinner ascomatal wall and are papillate. The asci and ascospores agree in size and shape. If more collections are made, this may prove to be a separate species.

Nectriella lacustris is similar to, but differs from *N. exigua* on *Amophila* by the thiner ascomatal wall, generally larger ascospores and yellow blister-like appearance of the ascomata when mature and from *N. paludosa*, also on *Typha*, by the color and shape of the ascomata and by the thinner ascomatal wall.

15. NECTRIELLA LUTEOLA (Desmazières) Weese, Ann. Mycol. 12: 131. 1914.

≡ *Sphaeria luteola* Desm., Desmazières Pl. Crypt France, ed. 1, ser. 1, fasc. 42: 2078. 1850, diagnosis with specimen.

≡ *Calonectria luteola* (Desm.) Sacc., Michelia 1: 315. 1878.

≡ *Charonectria luteola* (Desm.) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 115: 1193. 1906.

LECTOTYPE, designated herein: FRANCE. In leaves and petioles of *Populus*, summer, no collector, Pl. Crypt. France 2078 (PC!; isolectotypes, BPI!; FH-Höhnel!; H!; K, 3 collections!; NY!).

Anamorph: not known.

Habitat: Leaf veins and petioles of deciduous trees.

Distribution: Temperate, Europe.

Ascomata subglobose, 300 µm diam, immersed-erumpent, scattered, on veins or petioles of leaves, orange-brown, translucent, not changing color in KOH; collapse vertical.

Non-setose. Cells on surface of ascomata subglobose, 8-12 μm diam., separated. Ascomatal wall 20-30 μm wide, of two regions: outer region 10-15 μm wide of thick-walled, angular to rounded cells 6 μm diam; inner region ?10-15 μm wide, of thin-walled, rectangular cells 10 μm long. Asci clavate, 44-60 x 8-12 μm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores naviculate-ellipsoid, 11-16 x 3-5(-6) μm, L/W 3.4, 1-septate, often slightly constricted, slightly roughened, several small guttules per cell.

Additional specimens examined:

FRANCE. In petioles of Populus and leaves of Fraxinus, summer, no collector, Pl. Crypt. France 2078 (found with the lectotype and isolectotype collections; PC; BPI; FH-Höhnel; H; K, 3 collections; NY). LUXEMBOURG. on petiole of Fraxinus, Apr 1902, J. Feltgen (FH-A2899; as Charonectria luteola). SWITZERLAND. Valais: Aletschwaldreservats, Reidialz, on fallen leaves of Alnus viridis, 9 Sep 1970, R.W.Dennis (K; as Nectria arenula). U.K., England. Devon: Slapton Ley Nature Reserve, on stem of Rubus, 10 Oct 1979, M.C. Clark (IMI 24778; K).

Discussion: The collections of Nectriella luteola on petioles of Populus and leaves of Fraxinus were found in Pl. Crypt. France 2078 with the type collections.

Weese (1914) redescribed Nectriella luteola. Although he synonymyzed Nectria fuscidula and N. dacrymycelloides with Nectriella luteola, the former two species are synonymized with N. bloxamii herein. Weese also thought that Nectria dacrymycella might be a synonym of Nectriella luteola but was not sure because he did not see the type collection. Rossman (1979) accepted the name Nectriella luteola and briefly described the species. I separate N. luteola from N.bloxamii by hosts and color of the ascomata. If N. luteola is refound and can be cultured, these taxa may prove to be synonyms

16. NECTRIELLA MINUTA Lowen, sp. nov. Fig. 16

HOLOTYPE: VENEZUELA. Edo. Merida: La Montaña, El teleferico above Merida, on bamboo, 30 Jul 1971, K.P. Dumont VE 3435 & G.J. Samuels (NY-CTR 71-347!).

Anamorph: Acremonium sp.

Etymology: refers to the small inconspicuous ascomata.

Habitat: culms of bamboo.

Distribution: Andean; known only from the type collection.

Ascomata obpyriform, 160-200 μm high x 130-175 μm wide, immersed with only the papilla emergent or appearing superficial if the epidermis erodes away, then seated on mycelium; hyphae 1-3 μm wide, in dense groups, some ascomata contiguous, sharing lateral wall, nearly white, apex yellow, not changing color in KOH; papilla truncate to acute, 40-50 μm wide; collapsing by lateral pinching. Non-setose. Cells on surface of ascomata obscured. Ascomatal wall 14(-20) μm wide at sides of two regions: outer region of thick-walled, angular to rounded cells 4 x 3 µm; inner region of thin-walled, rectangular cells 5 x 2 µm. Asci clavate, 40-70 x 6-8(-14) µm; apex truncate, containing an apical ring sometimes appearing as two projections from the epiplasm in apex; ascospores biseriate. Ascospores narrowly ellipsoid, (9-)10-12(-14) x 2-3(-4) µm, L/W 4.5, 1-septate, becoming 3-septate, some with one end more pointed, slightly constricted, hyaline, smooth to slightly roughened, two guttules per cell.

CHARACTERISTICS IN CULTURE. Ascospores germinating from both ends. Colonies grown 20°C, diffuse daylight, one month on CMD, PDA. Colonies on CMD 10 mm diam in 7 days, reaching a maximum of 25 mm in 1 month; aerial mycelium felty, opaque; nearly white to pale orange; margin white. Conidial production not observed. Colonies on PDA 15 mm in 7 days, reaching a maximum of 35 mm in 1 month; aerial mycelium densely cottony; center depressed, sometimes developing a faster growing sector, at first white, then pale orange, with areas of salmon slime; surface becoming crustose. Conidiophores on PDA arising from aerial hyphae and from surface of agar, solitary; terminating in a single phialide; phialides tapering. (10-)15-38 x 1.5-3.0 µm at base narrowing to 1.0-1.5 µm at apex. Conidia oblong to ellipsoid, 3.0-5.0(-12.0) x 1.0-1.5(-2.0) µm, unicellular, smooth, hyaline; basal abscission scar protuberant and flattened on ellipsoid conidia, lacking on oblong conidia, held in hyaline liquid.

Discussion: The species was grown in culture from single ascospores by Samuels (pers. comm.) who discovered the _Acremonium_ anamorph.

Nectriella _minuta_ is distinguished from other species of _Nectriella_ by the tropical distribution, bamboo substrate, nearly white ascomata and _Acremonium_ anamorph.

17. NECTRIELLA OBSCURA Lowen, sp. nov. Fig. 17

HOLOTYPE: NEW ZEALAND. Gisborne: Urewera National Park, Lake Waikaremoana, vic. Motor camp, Ngamoko Track, on bark, 30 May 1983, _G.J. Samuels 83-172_, _P.R.Johnston_, _T. Matsushima_ & _A.Y. Rossman_ (PDD 46349!; Isotypes IMI 297574, cultures and slides!).

Anamorph: _Fusarium_ cf. _merismioides_ Corda, Icones fungorum 2: 4. 1838.

Habitat: on bark.

Distribution: French Guiana, New Zealand.

Etymology: refers to the pallid ascomata that are very difficult to see.

Ascomata obpyriform, 150-300 µm high x 100-230 µm wide, immersed to erumpent with only base immersed, separate or in groups of up to 20 at nodes of stem, pale yellowish, hyaline in water, not changing color in KOH; papilla conic, 80 µm high x 60-80 µm wide; collapse vertical. Setae sparse, 20-60 x 4-10 µm, 0-1 septate; apex rounded. Cells on the surface of ascomata angular, 5-10 µm diam. Ascomatal wall 12-20 µm wide, of two regions: outer region 16 µm wide of thick-walled, angular cells with long side perpendicular to the surface; inner region 4 μm wide, of thin-walled, rectangular cells. Asci cylindrical to slightly clavate, 60-110 x 5-8 μm; apex truncate, containing an apical ring; base rounded; ascospores diagonally uniseriate. Ascospores ellipsoid to ovoid, 8-12 x 4-8 μm, L/W 1.8, 1-septate, at first hyaline, then pale brown, verrucose.

CHARACTERISTICS IN CULTURE. Colonies grown 20°C, diffuse daylight; 6 weeks on CMD, OA, and PDA, PSA. Colonies on CMD reaching a maximum of 10-15 mm diam; aerial mycelium absent, a few rope-like strands forming in center, slimy, radially furrowed, zonate, pale salmon to nearly white. Colonies on PSA grown 12 h dark, 12 h cool white fluorescent plus near UV; 6 weeks, reaching a maximum of 30 mm; aerial mycelium lacking, opaque, slimy, orange (Kelly 48); radially furrowed; furrows white; margin white, scalloped; odor strong, sweet. Conidiophores arising as lateral branches directly from the surface of the agar, branching irregularly; each branch terminating in a single phialide; phialides cylindrical, 0-1-septate, hyaline, smooth 13-30 x 2.5-3.0 μm; tip with slight periclinal thickening, not flared. Microconidia not formed. Macroconidia falcate, arcuate; septa difficult to observe, most 3-septate, from 0- to 6-septate: 0-septate 16-26 x 2-3 μm; 1-septate 21-32 x 3-4 μm; 3 septate: 34-48 x 3-5 μm; 4-septate 40-50 x 3-5 μm; 5-6 septate 43-54 x 3.5-5.0 μm; foot cell indistinct. Chlamydospores not observed.

Additional specimens examined:

FRENCH GUIANA. 15 km SW of Saül toward Mt. Galbao, 600-650 m, 14, 18, 29 Jan 1986, G.J. Samuels 2858 & J. Boise (NY); vic. Saül, ca. 7 km SW of Saül toward Mt. Galbao, 450-500 m, 3-16 Feb 1986, G.J. Samuels 2786 & J. Boise [Nectria hematococca Berk. & Br. also present] (NY). NEW ZEALAND. North Canterbury: Arthur's Pass National Park, Cockayne Nature Walk, on bark of Pseudopanax crassifolia [Araliaceae], 20 May 1983, G.J. Samuels 83-153, T. Matusushima, A.Y. Rossman (PDD 46333); Auckland: Waitemata City, Waitakere Ranges, Piha Road, Cowan Track, on bark of Rhipogonum scandens [Liliaceae (liana)] 4 Jun 1983, A.Y. Rossman & G.J. Samuels 83-130 (IMI 297577, culture and slides; PDD 46312).

Discussion: Nectria consors and Volutella sp. are also present in the type collection.

Nectriella obscura was grown in culture from single ascospores by Samuels (pers. comm.) and produced a slow growing, slimy, orange culture with little aerial mycelium similar to Fusarium merismioides Corda. Nectriella dingleyae and N. obscura are the only species in Nectriella connected to Fusarium. They could be placed in Nectria subg. Dialonectria (Samuels et al., 1991) on the basis of the anamorph combined with their warted, pale brown ascospores, but are retained in Nectriella because of the pallid, KOH-ascomata combined with the immersed habit.

Nectriella obscura is distinguished from N. dingleyae by the pale ascomata and the sparse setae and from other species of Nectriella by the inconspicuous ascomata, elongate asci, roughened, uniseriate ascospores and the Fusarium anamorph.

18. NECTRIELLA PALUDOSA Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870]. fig. 18

≡ Nectria paludosa (Fuckel) Sacc., Michelia 1: 289. 1898, non Nectria paludosa Crouan & Crouan 1876 (= Tubeufia paludosa (Crouan & Crouan) Rossm).

[≡ Nectriella diaphana Fuckel & Nitschke in Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870], ICBN, Art. 34.1, name invalid, not accepted by author.]

HOLOTYPE: GERMANY. Hesse: Near Budenheim, on rotting leaves of Typha angustifolia, floating in swamp water, Spring, Fuckel & Nitschke, Fungi rhenani 2048, (G!; isotypes as Herb. Barb. Boiss.: FH-Höhnel, slides 3-13!; IMI!; K, 2 collections!; all as N. diaphana).

Anamorph: not known.

Habitat: stems of Typha and Iris.

Distribution: Europe, U.S.A., temperate.

Ascomata obpyriform, 190-290 µm high x 230-430 µm wide, often remaining immersed, sometimes erumpent, scattered or in groups of up to 5, often only the papilla showing through the epidermis, at first pale pink, then yellow, nearly white in water, not changing color in KOH; papilla truncate; collapse vertical or not collapsing. Setae on papilla, clavate, 8 x 2 μm, 2-septate, sparse. Cells on surface of ascomata angular, cells 8 μm diam. Ascomatal wall 20-24 μm wide, of two regions: outer region of thick-walled, angular to rounded cells; inner region of thin-walled, rectangular cells. Asci clavate, 68-85 x 7.5-10.0 μm; apex truncate, containing an apical ring; epiplasm in apex appearing coronate; ascospores biseriate. Ascospores ellipsoid, (12-)14-23 x 4-5 μm, L/W 4.1, 1-septate, often slightly constricted, hyaline, pale pink in mass, echinulate, 2 guttules per cell.

CHARACTERISTICS IN CULTURE. Ascospores germinating in 24 h from both ends, occasionally becoming 4-celled. Colonies grown 20°C, diffuse daylight, 7 days, on CMD, OA, PCA, TWA. Colonies on OA 17-18 mm diam in 14 days reaching a maximum 28 mm, in 1 month; aerial mycelium at first plumose, then cottony, zonate; with spreading, pink to orange pigment; reverse K and W 8A, 3-4; at first white, then pink to orange (K and W 10 A, 2-3); odor strong, sweet; conidial production absent. Ascomatal production beginning as clear drops of fluid, becoming surrounded by white mycelium, on the surface of the agar, maturing in 2 weeks; ascospores discharged forcibly. Ascomatal production most prolific on OA. Chlamydospores forming on PDA.

Additional specimens examined:

CZECHOSLOVAKIA. Moravia: Mähr.-Weisskirchen, Thein, on Typha latifolia, Sep 1927, F. Petrak (C); Moravia: M. Weisskirchen, on T. latifolia, Sep 1927, F. Petrak (IMI); Lipnik, Thrin (?ir), on T. latifolia (IMI 9446). GERMANY. on Iris pseudacorus, Aug 1904, Krieger, Fungi Sax. 1769 (FH-Höhnel, slide 3-13, A2880; K); on Typha latifolia, Petrak 456 (K); Petrak 2488 (K). (IMI 202253; as N. dacrymycella). U.K., England. West Sussex: Loder Valley Nature Reserve, on T. latifolia floating in pond, 26 Oct 1986, R. Lowen 232 (IMI 348647). U.S.A. Maine: Sagadahoc County, Merrymeeting Bay, ca. 6 mi N of Woolwich, highway 128, across road from R.P.T. Coffin Wild flower Sanctuary, 44° 01′ N, 69° 48′ W, on damp, dead stems of Typha latifolia, 19 Sep 1987, C.T. Rogerson & R. Lowen 356-87 (NY).

Discussion: The papilla of Nectriella paludosa sometimes appears dark due to the presence of algae on the surface of the substrate.

In the pink cultures produced from single ascospores no anamorph formed. Because the ascomata developed from single ascospores, the species is homothallic. The forcible discharge of the ascospores was proven by collecting discharged ascospores on the lid of Petri dish on cellophane tape.

Fuckel (1870) changed the name from Nectriella diaphana to N. paludosa when he decided that all of the species in the genus had translucent ascomata.

The description of Nectriella paludosa herein essentially agrees with the Weese redescription (1914) except that he gives the width of the wall of the ascomata as 45 µm whereas the maximum seen in this study was 24 µm. I suggest that his section could have been on an angle making the wall appear wider.

19. NECTRIELLA PIRONII Alfieri & Samuels, Mycologia 71: 1181, figs. 1-9. 1979 [20 Feb 1980]; [Plant Disease Reporter 63: 1016. 1979, nomen nudum]. fig. 19

HOLOTYPE: U.S.A. Florida: Gainesville, artificial inoculation of stems of Aphelandra squarrosa Nees [zebra plant], Mar 1978, S.A. Alfieri, Jr. (NY, GJS 78-24!).

Anamorph: Kutilakesa pironii Alfieri, Mycotaxon 10: 217. 1979.

Habitat: pathogenic; forming galls on stems and leaves of woody plants.

Distribution: Florida.

Ascomata obpyriform, 165-235 µm high x 115-200 µm wide, immersed to erumpent, scattered or in groups up to 30, yellowish to nearly white, not changing color in KOH; papilla truncate to slightly rounded, 80 µm high x 140 µm wide; collapsing by lateral or vertical pinching of the basal part of the ascomata with the papilla staying intact. Setae forming a circle of white around the ostiolar opening, disc 75-100 µm diam, clavate, 10-20 x 4 µm long; walls 1.0-

1.5 thick, very thin at apex; pore seen in one. Cells on surface of ascomata angular, 7-10 µm diam. Ascomatal wall 15-20 µm wide, of two regions: outer region 10-15 µm wide of angular-rectangular cells 5-7 x 2 µm, walls 0.5 µm thick; inner region 5 µm wide, of thin-walled, rectangular cells. Asci clavate, 50-70 x 6.5-10.0 µm; apex truncate, sometimes rounded, containing an apical ring; ascospores biseriate. Ascospores ellipsoid-fusiform, (11.5-)12.5-16.0(-19.0) x 2.5-4.5 µm, L/W 4.3, 1-septate, often slightly constricted, pale orange, finely striate, one large and one small guttule per cell.

Anamorph on substrate: Mycelium white, arachnoid, spreading over the surface of galls, producing an Acremonium-like stage. Conidiomata sporodochial, setose, erumpent through fissures in gall, and on stems, irregularly rounded, 250-750 µm diam to elongate, up to 1.5 x 0.5 mm; cells of base pseudoparenchymatous, 7-10 µm long x 3-5 µm wide. Phialides 7-12 µm long, tapering from 1.5-2.5 µm wide at the base to 1.5 µm wide at the apex, arising on penicillate whorls of two to four phialides at tips of conidiophores or along the length of the conidiophore. Conidia in bright orange slimy masses that dry to pale peach crust, ellipsoid, 6-9 x 2.0-2.5 µm, unicellular, smooth, pale orange with two or more amorphous guttules. Setae cylindrical, undulating, 50-150 x 4-5 µm; septate, apex rounded, at first white, then yellow brown, echinulate; wall 0.5- 1.0 µm wide; spines needle-like ca. 1.5 µm long.

CHARACTERISTICS IN CULTURE. Ascospores germinating within 12 h at 18°C, producing one to four branching germ tubes. Colonies grown 18-21°C, diffuse daylight, 10 days, on CMD, PDA, and V-8. Colonies on PDA reaching 15-20 mm diam; aerial mycelium pink with a white margin; reverse ivory to pale orange. Conidiomata sporodochial, discrete or forming flat masses of orange slime, setose, arising on the surface of agar in the center of colony and in concentric zones; conidiophores densely compacted; base pseudoparenchymatous. Conidiophores 25-55 μm long, branching, terminating in a single whorl of 2 to 4 phialides at the tip of each branch. Phialides 7.5-28.0 μm long, tapering gradually from 2 μm at base to 1.5 μm at apex. Conidia 4-8(-13) x 1.5-2.5 μm, otherwise the same as produced on substrate. Setae arising from sporodochia, up to 200 μm long x 4 μm wide, otherwise the same as those produced on the substrate. _Acremonium_-like state also produced. Conidiophores (30-)40-65(-75) x 2.0-2.5 μm at the base tapering to 1.5-2.0 μm at apex, 1-2 septate, rarely branched. Conidia identical to those from sporodochia. Colonies on CMD with aerial mycelium white, scanty, flat, translucent; conidiomata absent.

Additional specimens examined, U.S.A. (Florida):

Location unknown, on _Codiaeum variegatum_, date unknown, _S.A. Alfieri, Jr. 069-110_ (NY, Samuels 69-13); location unknown, on stem cankers of _Pittosporum tobira_, date unknown, _S.A. Alfieri, Jr. 069-3148_ (NY, Samuels 70-1); location unknown, on cankers of _Clerodendrum bungei_, date unknown, S.A. Alfieri, Jr. 069-802 (NY). Alachua County: Gainesville, on stems of Codiaeum variegatum Blume [croton], Mar 1978, S. A. Alfieri, Jr. 078-1809 (NY, GJS 78-27); Gainesville, on stems of Leucophyllum frutescens (Berl.) Johnston (texas sage), 21 May 1977, S. A. Alfieri, Jr. 077-1360 (NY, GJS 78-32 [part of this collection in PDD & ZT]); Gainesville, on stems of L. frutescens, 3755 NW 7th Pl., no date, S.A. Alfieri, Jr. (FLAS F51285); Gainesville, 3755 NW 7th Place, on L. frutescens, causing moderate leaf spot, 5 Oct 1979, S.A. Alfieri, Jr. 079-4621 (ascomata not present) (FLAS F52099; as Kutilakesa pironii); Dade County: Opa Locka, South Florida Nurseries, on croton, 28 Oct 1977, M. Corman, (FLAS F51282); same location, on Codiaeum variegatum, 28 Oct 1977, M. Corman (FLAS F51281; as Kutilakesa "madreeya" & Nectria sp.); Hillsboro County: Tampa, Petti-John Nurseries, 6509 N. Hines Ave., on croton, Oct 1977, S.A. Alfieri Jr. (FLAS F51283); Lake County: Groveland, Nichols Nursery, on Clerodendrum bungei Steud., 3 June 1977, S.A. Alfieri, Jr. & C.P. Seymour (FLAS F51284; as Kutilakesa "madreeya" & Nectria sp.); Orange County: Apopka, Green Thumb Company, on Codiaeum variegatum (plant originally from Guatemala), 7 Jul 1978, D. Remington & F.L. Ware (no ascomata present) (FLAS F51831; as K. "madraeya"); Apopka, O.F. Nelson's Nursery, on Aphelandra squarrosa, 23 Aug 1977, S.A. Alfieri, Jr. & C.P. Seymour (FLAS

F51629; as Nectria sp. & Kutilakesa "madraeya"); Apopka, on stems of Aphelandra squarrosa, 28 Jun 1978, J.F. Knauss (NY, Samuels 78-40); Volusia County: Mt. Dora, Wilson's Wholesale Nursery, Blk 3, Rt 2, Box 675, on Pittosporum tobira, 29 Dec 1977, S.A. Alfieri Jr. & C.P. Seymour (FLAS F51632; as Nectria); same collection information (FLAS F51630; as Nectria sp.); same collection information, (no ascomata present) (FLAS F51633; as K. madryttya).

Discussion: Although the description by Alfieri and Samuels (1979) was intended to contain the first publication of Nectriella pironii, the paper by Alfieri (1979) was actually published earlier creating a nomen nudum. The Latin description was in the later publication.

Ascomata are difficult to find in dried material because they are easily damaged and also tend to fall out leaving empty, rounded depressions. The sporodochia are more conspicuous than the ascomata. Both stages may be found on the substrate at the same time. According to Sutton (1981), Kutilakesa is a synonym of Sarcopodium Ehrenb. ex Schlecht.

Nectriella pironii is one of the few biotrophic species of Nectriella. The anamorph is reported to be a pathogen that forms galls and cankers on stems of various ornamental shrubs and herbaceous plants in Florida. Alfieri (1979) and Sinclair et al. (1987) report other substrates. Additional substrates reported in Farr et al. (1989), all from Florida, are: Albizia, Barleria, Bauhinia, Callistemon, Chrysanthemum, Cuphea, Cyphomandra, Dieffenbachia, Dombeya, Dracaena, Eupatorium, Euphorbia, Fatsia, Ficus, Forsythia, Gelsemium, Hedera, Hydrangea, Jasminum, Lansium, Leea, Ligustrum, Ludwigia, Lysiloma, Mahonia, Melia, Osmanthus, Parkinsonia, Philodendron, Plumbago, Polyscias, Psychotria, Saliz, Salvia, Sambucus, Solenostemon, Trevesia, Ulmus.

20. NECTRIELLA QUELETII (Karsten) Karsten, Acta Soc. Fauna Fl. Fenn. 2(6): 15. 1885.

≡ Hyponectria queletii Karsten, Hedwigia 21: 34,35. 1882.

Type: FINLAND. Near Mustalia, in hymenium of Stereum subcostatum Karst., on fallen stems of Betula in shady places, Oct 1881 (?H, not examined).

Anamorph: not known.

Habitat: fungicolous, Stereum on stems of Betula.

Distribution: Finland.

Ascomata subglobose, 60-78 x 75-82 µm, immersed in Stereum, gregarious, nonstromatic, apex acute, yellow, not changing color in KOH. Non-setose. Ascomatal wall 5-7 µm thick at side, only 3-5 rows of cells at base. Asci cylindrical, 21-32 x 3.5 µm, containing an obscure apical ring; ascospores mostly diagonally uniseriate. Ascospores globose to ellipsoid, 3-4 x 2-3 µm, L/W 1.4, 1-septate, hyaline, smooth, collapsing.

Additional specimens examined:

FINLAND. Mustiala, in stems of Betula, Oct 1887, P.A. Karsten. (Topotype, S; as Stereum subcostatum & Nectriella queletii).

Discussion: Karsten described Hyponectria queletii with unicellular ascospores. He transferred the species to Nectriella sensu Saccardo. The septum in the ascospores is difficult to see, especially in polar view. Although the gregarious ascomata and the subglobose, uniseriately arranged ascospores are unusual characters for Nectriella, the soft, yellow, immersed ascomata, the two-celled ascospores, and the lack of paraphyses are all characters that place Nectriella queletii in Nectriella Nits.

21. NECTRIELLA RUBROCAPITULA Lowen, sp.nov. Fig. 21

HOLOTYPE: BRAZIL. Amazonas: Plateau of Serra Araca, N side of N Mountain, 1250 m, 00°57'N,63°21'W, cloud forest, on twig, 17-22 Feb 1984, G.J. Samuels 481a, G.T.Prance & J. Pipoly (INPA, not seen; Isotype NY!).

Anamorph: not known.

Etymology: refers to the red apex (or head) of the ascomata.

Habitat: woody twig.

Distribution: known only from the type collection.

Ascomata obpyriform, 80 μm high x 100 μm wide, immersed, scattered or in groups of up to 10, strongly adherent to the substrate and difficult to remove, red at ascomatal apex, immersed part of wall yellowish, not changing color in KOH; papilla truncate, 50 µm wide. Non-setose. Ascomatal wall 14 µm wide, of one region, cells 2.0-8.0 x 0.5 µm, thick-walled, elongate. Asci clavate, (29-)35-45 x 4.5-5.5(-6.5) µm; apex truncate, containing an apical ring; epiplasm in apex appearing coronate; base pedicellate; ascospores biseriate. Ascospores ellipsoid, 6-7.5 x 2.0 µm, L/W 3.7, 1-septate, often slightly constricted, hyaline, smooth, inconspicuously guttulate.

Discussion: Nectriella rubrocapitula is distinguished from other species of Nectriella by the adherence of the ascomata to the woody substrate, the pigmented apex of the ascomata, and by asci less than 46 µm long and ascospores 7.5 µm or less in length.

22. NECTRIELLA SAMBUCI (Höhnel) Weese, Ann. Mycol. 12: 150. 1914. fig. 22

≡ Charonectria sambuci Höhnel, Hedwigia 42: 187. 1903.

HOLOTYPE: YUGOSLAVIA. Herzegovina, Jablanica, on thin, dry stems of Sambucus nigra, Apr 1903, Höhnel (FH-Höhnel!)

Anamorph: not known.

Habitat: stems of woody plants.

Distribution: Europe.

Ascomata obpyriform, 100-300 µm high x 220 µm wide, immersed, sometimes erumpent, scattered or in groups of up to 30, some contiguous, at first reddish yellow, then yellow, not changing color in KOH; papilla truncate, 60-140 µm high x 120-160 µm wide. Setae clavate, 40 x 4 µm (not seen in type). Cells on surface of ascomata angular, 5-10 μm diam. Ascomatal wall 20-30 μm wide of two regions: outer region of rectangular to ellipsoid cells, 6-10 x 2-3 μm, walls 2 μm thick; cells of inner region containing granular epiplasm, walls 1 μm thick. Contents of centrum pink. Asci clavate when young, 50-68 x 6-8 μm, apex truncate, containing an apical ring, deliquescing at maturity; ascospores biseriate. Ascospores ellipsoid, 14-16 x 3-4(-6) μm, L/W 3.1, typically 1-septate, occasionally 3-septate, often slightly constricted, many curved, at first hyaline, then slightly brown, smooth, often several guttules per cell.

CHARACTERISTICS IN CULTURE. Colonies grown 20°C 12 h dark/ 12 h light, cool white fluorescent plus near UV, to 2 1/3 months, on MA, OA, PCA, PSA. Colonies on PCA with aerial mycelium cottony; margin appressed, scalloped; surface lacunose, zonate, at first white, then pale brown; reverse brown-yellow; odor strong, sweet. Conidia and conidiophores absent. Erect hyphae forming singly or in aggregations, droplets of clear fluid exuded from apex dissolving in lactophenol; ascomata forming at site of hyphal aggregations.

Additional specimens examined:

U.K., England. N. Yorkshire: Levisham, Hagg Wood Marsh NR, BW,C-73-4, on <u>Filipendula ulmaria</u> [Rosaceae], 1 Jul 1973, collector unknown (IMI 177564, dry culture on OA; as <u>Nectria arenula</u>).

Discussion: Nectriella sambuci has an ascomatal wall with two regions that stain differentially in blue-black ink. The outer cells are darker staining. There were ascospores, but no asci in the type collection and setae were not seen.

The culture grown from single ascospores by Booth (IMI 241564) produced ascomata and is thus homothallic. Conidia were not observed. The ascomata had scattered setae that appeared to be secretory at an early stage.

Höhnel (1903) described ascomata of Charonectria sambuci with with short, stiff, hyaline, sometimes branched hairs mostly on the margin of the papilla. He said the ascomata were either not ripe or the asci had gelatinized and germinating ascospores were found in the centrum.

Weese (1914) redescribed Nectriella sambuci. He thought that the fungus may have been described earlier as Nectria dacrymycella, Calonectria bloxamii or C. xantholeuca. He did not, however, see the types of these species. The first two species are discussed in this paper under their respective names. Calonectria xantholeuca was never combined in Nectriella. Because the type only contains a pycnidial fungus the name C. xantholeuca cannot be characterized.

Weese (1914) found the type of Nectriella sambuci to be in poor condition. He did not see the described hairs. He thought the ascomata of N. sambuci and N. umbelliferarum corresponded and that those of Rehm Ascom. 1867 agreed in structure, form, and size with N. sambuci even though he could not observe the crown under the disk in the Rehm collection. I do not agree. A crown of hairs was obvious in the ascomata of Rehm Ascom. 1867 and represents my concept of *N. halonata* (= *Charonectria umbelliferarum*). The two species differ.

The concept of *Nectriella sambuci* presented here is of a papillate ascomata with scattered hairs and a wall with two regions. Like the related species, *N. fuckelii* and *N. paludosa*, the ascomata have scattered secretory setae and do not usually collapse when they are dry.

23. NECTRIELLA SILENES-ACAULIS Nograsek, Biblioth. Mycol. 133: 69. 1990.

HOLOTYPE: AUSTRIA. Steiermark: Hochschwabgebiet, Hochschwab, Graf Meransteig, ca. 1800 m, on *Silene acaulis*, 7 Sep 1985, *E. Hierzer* (GZU!).

Anamorph: not know.

Habitat: dead leaves of *Silene acaulis*.

Distribution: Austria, altitude over 1500 m.

Ascomata obpyriform, 165-400 μm high x 115-200 μm wide, immersed to erumpent, scattered or in groups up to 30, yellow orange when fresh, yellowish to nearly white when dry, not changing color in KOH; papilla truncate to slightly rounded, 75-100 μm wide; collapsing by lateral or vertical pinching of the basal part of the ascomata with the papilla remaining intact. Setae forming a circle of white around the ostiolar opening, clavate, 10-60 x 4 μm long, septate, very thin at apex; walls 1-1.5 thick; pore seen in one; base narrowing and extending 10 μm or more between hyphae of papilla. Cells on surface of ascomata angular, 7-10 μm diam. Ascomatal wall 15-20 μm wide, of two regions: outer region 10-15 μm wide of rectangular cells 5-7 x 2 μm; walls 0.5 μm thick; inner region 5 μm wide, of thin-walled, rectangular cells. Asci clavate, 50-70 x 6.5-10.0 μm; apex truncate, sometimes rounded, containing an apical ring; epiplasm in apex appearing coronate; ascospores biseriate, many asci floating free in a squash mount. Ascospores ellipsoid-fusiform, (11.5-)12.5-16.0(-20.0) x 2.5-4.5(-7.0) μm, L/W 4.3, 1-septate, often slightly constricted, pale orange, echinulate and finely striate, one large and one small guttule per cell.

Additional specimens examined:

AUSTRIA. Steiermark: Dachsteinmassiv, Weg of the Oberst-Klinke-Hütte from the Admonter Kalbling, ca. 1500 m, on Silene acaulis, 11 Aug 1985, C. Scheuer (GZU); Steiermark: Dachsteinmassiv, Stoderzinken, NE-exponierte Hänge am Gipfel, ca. 2040 m, on Silene acaulis, 23 Jul 1985, J. Hafellner & A. Nograsek (GZU).

Discussion: Nectriella silenes-acaulis is distinguished from other species of Nectriella by its yellowish setose ascomata that become nearly white when dry, the finely striate ascospores, and the habitat from high altitude in the Austrian alps.

24. NECTRIELLA UTAHENSIS Lowen & Rogerson, sp. nov. Fig. 24

HOLOTYPE: U.S.A. Utah: Weber County, north of N. Ogden Divide, Wasatch Crest trail, on decaying leaves of Swertia radiata (Kellog) Kuntze, 19 Aug 1987, C.T. Rogerson (NY!).

Anamorph: not known.

Etymology: describes the location of the type collection, the favorite locale of the collector.

Habitat: dead leaves of Swertia radiata.

Distribution: known only from the type collection.

Ascomata obpyriform, 238-342 µm high x 255-300 µm wide, immersed to erumpent, scattered or in groups up to 10, yellowish orange, not changing color in KOH; papilla truncate, 62-100 µm high x 123-176 µm wide; collapsing by lateral or vertical pinching of the basal part of the ascomata with the papilla staying intact. Setae forming a circle around the ostiolar opening, cylindrical, 7-21 x 3.5-5.0 µm; walls 0.3 µm thick; apex rounded; base extending ca. 17 µm into papilla tapering to 1.5 µm wide. Cells on surface of ascomata irregular, walls obscured. Ascomatal wall uneven, 18-35 µm wide, of two regions: outer region 7-18 µm wide of ellipsoid, fused cells 3.5-7.0 x 1.5-4.5 µm; inner region 11-18 µm wide, of thin-walled, rectangular cells 7-15 x 0.5-2.0 µm. Asci clavate, 40-56 x 5.5-8.5 µm; apex truncate, containing an apical ring; ring often pushed to one side in mature asci; ascospores biseriate. Ascospores ellipsoid-fusiform, 14.0-17.5 x 4.0-6.5 µm, L/W 3.0, 1-

septate, pale orange in mass, echinulate when mature, several orange guttules per cell.

Structures in substrate ellipsoid, (3.5-)6.0-9.0 x 9-14 μm, thick-walled, hyaline, containing orange drops, developing from outgrowths of hyphae 2-5 μm wide.

Discussion: Nectriella utahensis can be distinguished from Hyponectria sceptri by the paler color, obpyriform-papillate shape, setae on the papilla and wider, ornamented ascospores. The ellipsoid structures in the substrate have not been noted in other species of Nectriella and their function is unknown.

Several collections obtained in Switzerland in late 1990 contained orange setose ascomata similar to Nectriella utahensis and have given a Stachybotrys Corda anamorph in culture. There were no ellipsoid structures on the substrates. The information was obtained was too late for consideration in this paper. Further study may show these collections to be Nectriella utahensis.

25. NECTRIELLA VERRUCOSA de Urries, An. Jard. Bot. Madrid 1: 67. 1941. fig. 25

HOLOTYPE: SPAIN. near Matriti, in rotting paper, 14 Jan 1940, Urries (MA!).

Habitat: rotting paper.

Distribution: known only from the type collection.

Ascomata obpyriform, 313-387 μm high x 176-317 μm wide, immersed, scattered or in groups of up to 20, at first reddish, then yellow, not changing color in KOH; papilla truncate, 282-310 µm high x 132-308 µm wide. Setae broken, largest 66 x 5 µm, base tapered to 2 µm, hyaline, septate; wall ca. 1 µm wide. Cells on surface of ascomata obscured. Ascomatal wall 20-35 µm wide, of two regions: outer region 12-26 µm wide of thicker-walled, wider, more disorganized cells; inner region 7-9 µm wide, of thin-walled, parallel, more densely packed cells. Asci clavate, (70-)80-135 x 10-20 µm; apical ring inconspicuous; ascospores biseriate in the middle; base clavate, lower 1/4 occasionally empty. Ascospores narrowly ellipsoid, one side often curved, the other side straight, (20.5-)22.0-28.0(-30.0) x (5-)6-8(-9) µm, L/W 3.6, 1-septate, septum inconspicuous in mature ascospores, hyaline, verrucose at maturity, often many guttules per cell, tending to disappear at maturity.

Discussion: The two regions of the ascomatal wall are demonstrated by differential staining in phloxine. The inner cells stain substantially darker than the outer cells. *Nectriella verrucosa* is related to *N. funicola* but distinguished by the larger, more ornamented ascospores, more elongate, thin ascomatal wall cells and angular apex of the ascus. The two taxa are represented by only a few collections. If specimens with intermediate characters are found, the taxa may prove synonymous.

II. **PRONECTRIA** Clements in Clements & Shear, Genera of Fungi 282. 1931.

Type species: P. lichenicola (Ces.) Clements in Clements & Shear.

Clypeoid tissues hyaline, inconspicuous, subcuticular, radiating from ascomatal apex into the substrate. Ascomata subglobose to obpyriform, 100-500 μm diam, immersed, scattered or in groups, nonstromatic, orange to red, rarely yellow, not changing color in 3% KOH or 100% lactic acid or rarely reacting. Setae rarely present. Cells on the surface of the ascomata usually angular. Ascomatal wall 10-40 μm wide, often of two regions; outer region thick-walled angular to rounded cells; inner region of thin-walled elongate rectangular cells. Ascomatal apex of rows of parallel, vertically elongated cells continuous with the inner region of the ascomatal wall; cells becoming increasingly narrow and merging with the periphyses on the interior and somewhat expanded or clavate at the exterior surface. Asci clavate, usually not over 100 μm long or 15 μm wide, 2-8-spored, unitunicate; apex truncate, usually containing a nonamyloid apical ring, sometimes difficult to see in mature ascus; ascospores biseriate in the middle, uniseriate above and below, or rarely uniseriate, filling the ascus. Ascospores fusiform, ovoid or ellipsoid, typically not over 25 μm long and 8 μm wide, 1-septate, inequilateral, at first hyaline, then usually slightly colored in mass especially when fresh, smooth to echinulate to tuberculate, guttules usually present in young ascospores, often disappearing at maturity. Paraphyses with discrete apices absent.

Lichenicolous, algicolous.

Lichenicolous fungi occur in many orders of fungi. Pyrenomycetous species occurring in the Dothidiales and Verrucariales (_sensu_ Hawksw. et al., 1983) have bitunicate asci. Species with unitunicate asci occur in the Phyllachorales and Sordariales (_sensu_ Hawksw. et al., 1983). There are numerous unrelated lichenicolous species in the Hypocreales. Species of _Nectria_ occurring on lichens, _N. rubefaciens_ Ellis and Ev. and _N. lecanodes_ Ces. for example, often have setose ascomata. _Trichonectria hirta_ (Bloxam) Petch (Hypocreales) is also setose. Only one species of _Pronectria_ is setose. _Paranectria_ Sacc., another lichenicolous hypocrealean genus has ascomata with ciliate muriform ascospores.

Ascomata of species of _Pronectria_ differ from those of other lichenicolous hypocrealean fungi mainly by the immersed ascomata. Ascomata of species of _Pronectria_ differ from the immersed ascomata of species of _Nectriella_ mainly by their occurrence in lichens. The lichenicolous species, formerly in _Nectriella_ Nits., were segregated (Lowen, 1990) into the genus _Pronectria_, type species _P. lichenicola_, on the basis of the following additional morphological and anatomical differences, none of which are mutually exclusive.

In general the wall of species of _Pronectria_ consists of only one region and in many of these species, for example, _P. erythrinella_, the wall has cellular differentiation only at the apex. In contrast the ascomata of most species of _Nectriella_ have two regions of cells in the ascomatal wall,

The ascomata of _Pronectria_ remain immersed; cells at the apex are clypeoid and mingle with the host. In _P. robergei_ cells of the papilla mix with the epithelial cells of the lichen. In _P. xanthoriae_ mycelium from the ascomata extend as much as 60 μm into the lichen.

In _Pronectria_ pigmentation of the ascomata is usually more vivid than in _Nectriella_. The species of _Pronectria_ range from orange to dark red; such pigmentation also occurs in other hypocrealean fungi. The pigments are in the liquid of the centrum and in the wall cells of recently collected ascomata forming water repellent droplets in a squash mount and in the guttules of the ascospores. These droplets are not as apparent in old collections. Such droplets can be found in other species such as in _Nectria_ _calami_ (Hennings & Nyman) Rossman. Most species exhibit a KOH- reaction but the entire wall in _Pronectria ornamentata_ and the outer red wall in _P. subimperspicua_ are KOH+. I cannot explain this anomaly.

Three species of *Pronectria* have less than eight ascospores per ascus. Reduction in the number of ascospores per ascus occurs in other unrelated ascomycetes. For example *Polycoccum crassum* Vezda and *Actinopeltis peltigericola* Hawksw. are among six unrelated fungi with 4-spored asci occurring on *Peltigera* Willd. (Hawksworth, 1983). Thus this character is considered to have significance only at the specific level.

Another characteristic of several species of *Pronectria* is that asci continue to emerge from squashed ascomata mounted in water for several minutes. This is an indication of a difference in osmotic potential within the ascomata as compared to the mounting medium.

Illosporium anamorphs occur in *Pronectria robergei* and *P. erythrinella*. Species of *Illosporium* are not connected to any other genus and may prove characteristic of *Pronectria*.

The lichenicolous habit, often a 3-membered relationship, is another reason to separate *Pronectria* from *Nectriella*. Ascomata of several lichenicolous species of *Pronectria* are surrounded by necrotic areas of the lichen thallus, suggesting biotrophic nutrition. Proof of nutritive means cannot be established at this time because possible mechanisms such as the existence of haustoria within host cells, the dissolution of walls of host cells or the existence of specialized contact cells at the tips of mycoparasitic hyphae have not been observed.

Many species of Pronectria occur in small populations. Eight of the species are known only from the type collection. Just two species, P. robergei and P. erythrinella, are represented by many collections. The harsh environment of a lichen host may lead to isolation of the fungi. Species on rocks or sand are subjected to extreme fluctuations in moisture. In low moisture conditions many lichens such as Peltigera spp. curl up. Low light levels occur during the summer when the leaves expand in tree bark habitats with species such as Physcia stellata (L.) Nyl.

Pronectria anisospora has been found in the United States (Maine) and in the United Kingdom (western isles) on the same host (Hypogymnia physodes (L.) Nyl.). Because fresh collections of Pronectria are often undescribed species, it is likely that many more species of the genus remain undescribed.

Because lichens are evolutionarily old plants (Hawksworth, 1983), the lichenicolous habit may be an old association. The fungi could be coevolving with the lichens. The coevolution of host and lichenicolous fungus could involve increased specialization of the fungus in order to adapt to the host defenses; the chemical defenses of the lichens, for example, would have to be overcome in order for the host and parasite to coexist.

If the lichens were related, then the lichenicolous fungi could be related (J. Hafellner, pers. comm.). The lichens that host species of Pronectria, however, are in four orders, the Peltigerales, Lecanorales, Teloschistales and Verrucariales. These lichens involve different algal partners and produce different sugar alcohols. The Peltigerales are generally considered to be the oldest; many species exist on all major land masses and must have evolved before the breakup of Pangea (Hawksworth, 1982). Indeed Peltigera is the host genus of four species. According to Hawksworth (1983) species of Peltigera have substances such as tenuiorin that provide a poor defense against lichenicolous fungi. Two factors that may enable survival of species of Peltigera from an invasion of lichenicolous fungi are the possession of a nitrogen-fixing photobiont and a large thallus (Hawksworth, 1982).

The algicolous Pronectria laminariae (Eriks.) Lowen, as pointed out by Hawksworth (1983), belongs in Pronectria because of its immersed, soft, red ascomata and two-celled ascospores. Ascomata also are expanded at the apex where the cells of the fungus mix with those of the alga.

I have attempted to group the species of Pronectria. Of the four species that occur in Peltigera three appear related. Pronectria robergei and P. erythrinella are related because of their red ascomatal pigments, thin wall structure, truncate asci with an apical ring and Illosporium anamorph. Pronectria tenuispora (Hawksw.) Lowen has a wider ascomatal wall consisting of two regions of cells but otherwise could be placed with these species because it has an apical ring in the ascus and red pigments in the apex of the ascomata. Pronectria ornamentata with its wall structure of one region and KOH+ reaction stands by itself.

Pronectria anisospora and P. paucispora appear related. The side and basal walls of the ascomata consist of one region, the ascospores are unequally-celled with rounded ends and both species are found on members of the Parmeliaceae. Members of the Parmeliaceae contain many active chemical compounds. Because many of these compounds have been shown to be antibiotic (Harris, pers. com.), they may deter invading organisms. Pronectria anisospora and P. paucispora appear to have overcome these defenses. The anamorph of P. anisospora is Acremonium pedatum. The anamorph of P. paucispora has not been determined. An argument against the close relationship of these two species is that the ascomata of P. anisospora are ornamented by recurved setae. The presence of setae is a character that has been used at the generic level in other pyrenomycetes such as Chaetomium Kunze and Trichonectria Kirschst. The relationship of P. anisospora and P. paucispora may be better resolved if an anamorph of P. paucispora can be determined.

The remaining nine species do not form any pattern within Pronectria but are included in the genus because of the hosts and the clypeoid ascomatal apices. The immersed ascomata with expanded apices and red pigments may be the result of convergent evolution. Fresh material is needed for more culture work to help determine relationships.

As with other fungi the known distribution of *Pronectria* reflects the location of mycologists interested in lichenicolous fungi. Most species have been found in northern Europe.

Pronectria is separated from *Nectriella* by host, immersed, typically nonerumpent, generally red to orange ascomata, clypeoid ascomatal apical wall structure that mingles with tissues of the host and potential toward parasitism (see Table 2). The genus is useful for segregating the lichenicolous and algicolous species. *Pronectria* is similar to some species of *Nectria*-like fungi that have separate, nonstromatic, yellow to orange ascomata (Samuels, 1988) and is close to *Nectriella* Nitschke.

KEY TO SPECIES OF PRONECTRIA

1. Ascomata becoming darker in KOH and yellow in lactophenol; ascospores uniseriate....................2
    2. Asci 70-100 x 7-13 μm; ascospores ellipsoid, (18-)25-31 x 7-9(-10) μm; immersed in the thallus of *Peltigera* sp..........6. *P. ornamentata*
    2. Asci 40-50 x 6.5-7.5 μm; ascospores subglobose, 6.5-8.0 x 5-6 μm; immersed in the thallus of *Punctelia* sp......11. *P. subimperspicua*
1. Ascomata not changing color in KOH or in lactophenol; ascospores biseriate.................................3
    3. Ascomatal apex and lateral wall not concolorous.......4

4. Algicolous; ascomata immersed in stipe of *Laminaria* sp.; ostiolar area red; ascospores 13-20 x 7-9 µm ....4. *P. laminariae*

4. Lichenicolous; ascomata immersed in thallus or apothecia of *Collema* sp.; ostiolar area purple-red; ascospores 10-16 x 5-6 µm; ....12. *P. tenacis*

3. Ascomatal apex and lateral wall concolorous...........5

5. Ascomata subglobose; ascospores smooth..............6

6. Ascomata setose, orange, immersed in thallus of *Hypogymnia physodes*........1. *P. anisospora*

6. Ascomata non-setose, shade of red, immersed in thallus of other lichens..................7

7. Ascomata dark red; asci 32-40 x 6.5-10.0 µm.............7. *P. paucispora*

7. Ascomata pale red; asci 60-70 x 8-10 µm ....14. *P. terrestris*

5. Ascomata obpyriform; ascospores usually ornamented..8

8. Ascomata brownish, wall 8 µm wide; ascospores broadly ellipsoid, L/W 2.0; immersed in thallus of *Physcia aipolia*...2. *P. echinulata*

8. Ascomata pallid, wall 10 µm wide or greater; ascospores ellipsoid to fusiform, L/W > 2.0; immersed in thalli of other lichens...............................9

9. Ascomata immersed in thallus of *Peltigera* sp...................................10

10. Ascospore L/W $\geq$ 5; ascomata red only at the apex, mostly orange; anamorph not known..............13. _P. tenuispora_

10. Ascospore L/W < 5; ascomata at first red, then turning yellow; anamorph _Illosporium_............................11

11. Asci 72-90 μm long; ascospores (17-)18-20(-30) x (4.0-)5.5-6.0 (-8.0) μm........3. _P. erythrinella_

11. Asci 40-70 μm long; ascospores 8-16 x (3-)4-8 μm..... 9. _P. robergei_

9. Ascomata immersed in other lichens.......12

12. Apical ring in ascus lacking.........13

13. Ascospores subglobose; ascomata immersed in apothecia and thallus of _Physcia_ spp...................14

14. Ascospores hyaline, smooth ....5. _P. leptaleeae_

14. Ascospores pale brown, tuberculate............... .5a _P. leptaleeae_ var. _tuberculata_

13. Ascospores fusiform to ellipsoid; immersed in parts of other lichens.........................15

15. Ascomata immersed in thalline exciple of _Anaptychia_

ciliaris; papilla rounded; ascospores fusiform, 17-22 x 4.0-5.5 μm......15. *P. tincta*

15. Ascomata immersed in thallus of *Pertusaria* sp.; papilla truncate; ascospores ovoid, 9-12 x 4.5-5.0 μm ....8. *P. pertusariicola*

12. Apical ring in ascus present........16

16. Ascospores ovoid, averaging > 6 μm wide; ascomata dark red, immersed in thallus of *Anaptychia runcinata*........10. *P. santessonii*

16. Ascospores fusiform, averaging < 6 μm wide; ascomata orange, immersed in parts of other lichens..........................17

17. Ascospores 5-7 μm wide; ascomata immersed in perithecia of *Verrucaria* ....16. *P. verrucariae*

17. Ascospores 4-5 μm wide; ascomata immersed in thallus and apothecia of *Xanthoria*....17. *P. xanthoriae*

SYNOPTIC KEY TO SPECIES OF PRONECTRIA

Characters of the ascomata

- Shape
    - Subglobose 1, 7, 13, 14
    - Obpyriform 2-6, 8-12, 14-17
- Wall regions
    - One 2, 3, 6, 12, 14-17
    - Two 1, 4, 5, 7-11, 13
- Color
    - Red 4-7, 9, 10, 12-14
    - Orange 1-3, 11, 12, 16, 17
    - Yellow 8, 15
    - Pigmented at apex only; base nearly white 4, 12
- Setose 1
- Setae lacking 2-17

Characters of the asci

- Size
    - Length averaging > 60 μm 3-6, 8, 13-15, 17
    - Length averaging $\leq$ 60 μm 1, 2, 7, 9-12, 16
- Apical ring
    - Absent 2, 5-8, 11, 15
    - Present 1, 3, 4, 9, 10, 12-14, 16, 17
- Arrangement of ascospores
    - Uniseriate 6, 11, 16
    - Biseriate 1-5, 7-10, 12-15, 17

Characters of the ascospores

- Size

Averaging < 12 μm long 5, 8, 11,

Averaging 12-22 μm long 1-4, 7, 9, 10, 12, 14-16

Averaging > 22 μm long 6, 13, 17

Shape

Ellipsoid 1-7, 9, 10, 12, 14, 16, 17

Fusiform 3, 4, 13, 15-17

Ovoid 2, 8-10, 12, 14, 16

Subglobose 5, 5a, 11

L/W < 2 5, 11

L/W 2-2.9 1, 2, 4, 8-10, 12, 14

L/W 3-3.9 3, 6, 7, 16

L/W 4-5 15, 17

L/W > 6 13

Ornamentation

Echinulate 2, 8, 10

Slightly roughened 9

Smooth 1, 5, 7, 9, 13, 14

Tuberculate 5a, 6

Verruculose 3, 4, 11, 12, 15-17

Pigmentation

Pale brown 2, 5a, 6

Pale yellow to orange 1, 3-5a, 10, 12, 14, 16, 17

Remaining hyaline 7-9, 11, 13, 15

Anamorphs

Acremonium 1, 10

Illosporium 3, 9

Substrates

Lichens 1-3, 5-17

Algae 4

SPECIES OF PRONECTRIA

1. *P. anisospora* (Lowen) Lowen
2. *P. echinulata* Lowen
3. *P. erythrinella* (Nyl.) Lowen
4. *P. laminariae* (O. Eriksson) Lowen
5. *P. leptaleae* (Steiner) Lowen
    5a. *P. leptaleae* var. *tuberculata* Lowen
6. *P. ornamentata* (Hawksw.) Lowen
7. *P. paucispora* Lowen
8. *P. pertusariicola* Lowen
9. *P. robergei* (Mont. & Desm.) Lowen
10. *P. santessonii* (Lowen & Hawksw.) Lowen
11. *P. subimperspicua* (Speg.) Lowen
12. *P. tenacis* (Vouaux) Lowen
13. *P. tenuispora* (Hawksw.) Lowen
14. *P. terrestris* Lowen & Diederich
15. *P. tincta* (Fuckel) Lowen
16. *P. verrucariae* (Vouaux) Lowen
17. *P. xanthoriae* Lowen & Diederich

1. PRONECTRIA ANISOSPORA (Lowen) Lowen, Mycotaxon 39: 461. 1990. Fig. 26

≡ *Nectriella anisospora* Lowen, Mem. New York Bot. Gard. 49: 248, figs. 4, 5. 1989.

HOLOTYPE: U.S.A. Maine: Sagadahoc County, Bates-Morse Mountain Coastal Research Area, nr. Phippsburg, nr. road past crest of hill descending to ocean, immersed in thallus of Hypogymnia physodes (L.) Nyl. on dead branch still on tree, 19 Sep 1987, R. Lowen 358-87 (NY!; cultures deposited NY, ATCC 64701, IMI).

ANAMORPH: Acremonium pedatum Lowen, Mem. New York Bot. Gard. 49: 248. 1989.

Habitat: corticolous lichen.

Distribution: cool temperate, U.S.A., U.K.

Ascomata subglobose, 140-260 µm diam, immersed, scattered or in groups of up to 4, raising the epidermis of the lichen and visible through star-like cracks in the epidermis, bright orange (K & W: 8A8; Kelly: 34 v.r. orange) to yellow, not changing color in KOH; sometimes collapsing vertically. Setae 10-32 x 3.5-5.5 µm, recurved, inconspicuous, nearly white, 0-1-septate; apex rounded; scattered or in groups of up to four, on upper surface of ascomata. Cells on surface of indefinite outline with unevenly thickened walls, to 12 µm diam. Ascomatal wall 16-20 µm wide; cells 8-16 x 5-6 µm becoming rounder and thicker-walled, ca. 4-6 µm diam, toward the outside of the ascomata. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 40 x 8-9(-20) µm; apex truncate, containing an inconspicuous apical ring, deliquescing at maturity; ascospores biseriate. Ascospores unequally ellipsoid, 12-17 x 4-6 µm, L/W 2.9, 1-septate, constricted, one cell subglobose, the other cell subcylindrical and longer and narrower, at first hyaline, then pale orange, smooth, many guttules per cell.

CHARACTERISTICS IN CULTURE. Ascospores germinating laterally from one or both cells. Colonies grown 20°C in diffuse daylight for 3 months on CMD and OA. Colonies on CMD reaching a maximum diameter of 30-40 mm in three months; aerial mycelium lacking, flat with a raised central knob, opaque, hyphae barely penetrating the agar, zonate; margin scalloped, pink (K & W: 8A5; Kelly: 26 s.y. pink); center brownish; reverse darker; conidia forming abundantly within 17 days. Conidiophores continuous with subtending hypha, 12-22 x 1.5-2.0 μm, abruptly widened to 3-5 μm at the base, smooth, nonseptate, straight, hyaline, terminating in a single phialid. Phialides 12-22 μm, tip with periclinal thickening, not flared. Conidia cylindrical, 12-24 x 4 μm, unicellular, thick-walled, smooth, hyaline, often narrowing in the middle or at the base, often containing several oily drops; basal abscission scar protuberant, flat, 2.5-3.5 μm wide; held in an aggregation in a drop of liquid at the tip of the conidiophore.

Additional specimens examined:

U.K., Isle of Argyll: Ca. 1 km S of Bernice, Benmore Forest, W side of Loch Ech Wood, on Hypogymnia physodes, 23 Sep 1988, B.J. Coppins 12846 & R. K. Brinklow (Herb Diederich); Isle of Raasay (E Isle of Skye): S. Fearns, (NG 58;35), on H. physodes, 25 May

1987, P. Diederich 8770 (LG); Isle of Skye: SW Broadford, Drinan, (NG55,15), on H. physodes, on Corylus & Betula, 25 May 1987, P. Diederich 8215 (LG); Isle of Skye: NE Carbost, Fernilea, NG 36,34, on Hypogymnia physodes, on Betula, Corylus or on rock, 26 May 1987, P. Diederich 8244; Isle of Skye: S. Kyle of Lochalsh, S. Loch Na Béiste, on Hypogymnia physodes, on Quercus, Betula, Ilex, 31 May 1987, P. Diederich 8821 (LG).

Discussion: Acremonium pedatum developed in culture but was not seen in nature. The anamorph is allied to Acremonium sect. Nectroidea W. Gams (1971) because of the unbranched conidiophores. The elongate conidia are distinguished from those of A. lichenicola W. Gams by remaining unicellular and their prominent, protuberant basal abscission scars.

Pronectria anisospora is similar to P. paucispora because both species have subglobose ascomata and smooth, ellipsoid ascospores. The two species are distinguished by the color of the ascomata, different lichen hosts and the recurved setae of P. anisospora.

2. PRONECTRIA ECHINULATA Lowen, sp. nov. Fig. 27

HOLOTYPE: IRELAND. Gortnaskehy (H10), in Physcia aipolia on Salix, 30 Aug 1985, R.D. Seaward (IMI 105139!).

Etymology: The specific epithet refers to the echinulate ascospores.

Anamorph: not known.

Habitat: corticolous lichen.

Distribution: Ireland; known only from type.

Ascomata obpyriform, 120-140 high x 100-130 µm wide, immersed in thallus, in groups of up to 20, orangish brown, becoming darker in KOH, not changing color in lactic acid; papilla truncate. Non-setose. Cells on surface angular, 7.0-9.5 x 8.5-12.0 µm; wall outlines prominent. Ascomatal wall 8 µm wide, of one region of 3 rows of thin-walled angular cells. Asci clavate, 52 x 12 µm; apical ring not seen, ascospores biseriate. Ascospores ellipsoid-ovoid, 12-14(-18) x 5.5-8.0(-10.0) µm, L/W 2.0, 1-septate, sometimes slightly constricted, thin-walled, hyaline, echinulate, one guttule per cell.

Additional specimen examined:

U.S.A. Idaho: Lochsu River near Howell, on lichen on stick, 29 Jun 1989, Katia Rodrigues (NY).

Discussion: Ascospores of *Pronectria echinulata* from Idaho did not germinate when isolation was attempted.

Pronectria echinulata is distinguished from other species of *Pronectria* by its thin lateral ascomatal wall of brownish cells and by its obviously echinulate, ellipsoid ascospores with fragile walls that fracture easily with pressure.

3. PRONECTRIA ERYTHRINELLA (Nylander) Lowen, Mycotaxon 39: 461. 1990. Fig. 28

≡ Sphaeria erythrinella Nyl., Not. Sällsk. Fauna Fl. Fenn. Fung. rh. II, 1: 125. 1859.

≡ Nectria erythrinella (Nyl.) Tulasne & Tulasne, Selecta Fungi Carpologia 3: 95. 1865.

≡ Charonectria erythrinella O. Jaap, Verh. Bot. Vereins Prov. Brandenberg 52: 133. 1910.

≡ Nectriella erythrinella (Nyl.) Höhnel & Weese, Ann. Mycol. 8: 466. 1910.

= Nectriella kalchbrennerii Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 177. 1869 [1870] "kalchbrenneri" (name invalidly published, Art. 34.1, not accepted by author).

HOLOTYPE: FINLAND. Nylandia: Helsinki (Helsingfors), Grid 27|E, on Peltigera sp., Nov 1858, W. Nylander (H!; Isotype, IMI 211135, slide!, as Sphaeria erythrinella).

ANAMORPH: Illosporium sp.

Habitat: Peltigera spp.

Distribution: cool temperate.

Ascomata obpyriform, 280-320 high x 240-340 µm wide, immersed, scattered or in groups of up to six, at first red to orange (K & W 10, 8C; 9, 8C; Kelly 36), then fading to yellow, not changing color in KOH; papilla truncate occasionally with hyphal ends free at edges, averaging 80 µm high x 160 µm wide. Non-setose. Cells on surface angular to irregularly rectangular, mostly 10 x 5 µm. Ascomatal wall 20 µm wide, of one region, of thin-walled rectangular cells 5-12 x 2.5-3.5 µm diam, widening to two regions in upper quarter; outer cells thick-walled, subglobose; periphyses at base of papilla directed downward into centrum, often emergent in squash mounts. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 72-90 x 10-14 µm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid-fusiform, (17-)18-20(-26-30) x (4.0-)5.5-6.0(-8.0) µm, L/W 3.5, 1-septate, septa often jagged, at first hyaline to pale yellow, then pale orange, verruculose, guttules often present in immature ascospores.

CHARACTERISTICS IN CULTURE. Ascospores germinating from the sides of either or both cells. Colonies grown in diffuse daylight for 3 months on CMD, OA. Colonies on CMD reaching a maximum diam of 7 mm in 2 months; aerial mycelium plumose, surface opaque, pink to orange (K & W 8,5A to 8,8A; center Kelly 26) center 4 mm, slightly darker and raised; reverse concolorous. Hyphal cells enlarging, becoming wider and rounder aggregating into subglobose, dry, dehiscent groups of conidia 20-50 µm diam. Cells of aggregates developing into individual conidia, rounded to angular, 5-10(-20) µm, surface slightly roughened.

Anamorph on host: Sporodochia ca. 250 µm round, reddish orange (K & W 7,8A; Kelly 48), erumpent, scattered or in groups on lichen thallus, sometimes contiguous with ascomata. Conidia germinating from groups of cells, not from single cells.

Selected specimens examined:

CANADA. Alberta: SW of Calgary, Eau Claire campground, 1400m (4600'), on Peltigera rufescens [= P. leptophora], on rock outcrops, lower subalpine, 19 Jul 1981, R. Rosentreter 2198 (Illosporium sp. also present; IMI 269698). CZECHOSLOVAKIA. Near Spis-Olaszi, in Peltigera canina, Jun 1860, Kalchbrenner, Rabenh. Fungi eur. 73b (ISOTYPE of Nectriella kalchbrennerii; NY; as I. carneum). FINLAND. Pp: Ii: Iin aseman ratapihan N-pää, sillanpiel en ratavallin W-rinne, grid 27|E, on Peltigera didactyla (With.) Laundon, 21 Jul 1964, J. Suominen (H; as Nectriella robergei; Illosporium sp. also present); Pp: Rovaniemi, Muurolasta, 1.5 km S, Harjulle mousevan hiekkaisen ratavallin SE-rinne, grid 27°E, on Peltigera didactyla, 27 Jul 1964, J. Suominen (H); KemL: Kolari: Äkäsjokisuu, campground, on P. didactyla, sandy soil, grid 27°E: 748: 35, UTM: FVI, 13 Aug 1970, T. Ahti 27194 (H); Mustiala, Haarankorpi, on Peltigera, 16 Sep 1869, P.A. Karsten 1584 (H; as Sphaeria (Nectria) erythrinella); Myllyperä, on Peltigera, äng, May 1866, Karsten Fungi Fenn. 475 (K; as S. erythrinella). RUSSIA. Bologoye: prov. Nangorva, 29 Aug, 10 Sep 1897, W. Trampchel (S). SWEDEN. location unknown, 16 Aug 1974, R. Santesson (UPS; as N. robergei); Gotland: Tårä, NW orn Holnuddendynsauka, an fa Strauddyneu, liter Anenophila huille, N sida doende Peltigera "erumpens," 11 Sep 1953, B. Pettersson 1/306 (UPS; as

I. carneum); Härjedalen: Tännäs par., valley of River Ljunan, ca. 1 km SE of Hotel Ramunberget, 62° 42'N, 12° 24'E. 700m, on a road cutting, on thallus of P. didactyla, 1 Aug 1987, R. Santesson 31869 (IMI330721); Jämtland: Hammerdal par., ca. 5 km N of Hammerdal, on a road cutting, on P. didactyla, 31 Aug 1979, R. Santsson 29916 (IMI 314288); Jämtland: Årn s:n, Storlien, Vid vägen ca. 1 km OSO om järnvägsstationen, Gamma, brandplats, ca. 600 m, 6 Aug 1948, R. Santesson (UPS; as Nectriella robergei); Södermanland: Nacka s:n, Vungsborg (vid Skurnsundetrs norra mynning,) shig, on Peltigera polydactyla, 25 Jun 1944, R. Santesson (UPS; as Nectriella robergei); Torne Lappmark: Jukkasjärvi s:n, Abisko Naturvetenskapliga Stationen 350-380 m, subalpine region, 17 Aug 1947, R. Santesson (UPS; as Illosporium carneum); Torne Lappmark: Torneträsk area, Abisko, on the railway cut SW of Naturvetenskapliga Stationen, subalpine region, alt 380 m, 28 Aug 1959, R. Santesson 13404f (with Illosporium sp., UPS); Torne Lappmark: Karesuando sn, öv. Soppero, bar jord bland videsnår vid landsvägskanten, on Peltigera leucophlebia, 23 Jul 1948, T.E. Hasselrot (UPS; as Nectriella robergei); Torne Lappmark: Kiruna, vattenledningsverket, bar jord nära stranden av Luossajärvi, on Peltigera spuria, 26 Jul 1947, L.E. Hasselrot (UPS); Uppland: Almunge par., 0.5 km SE of Ekdalen, at Lake Lötsjön, on an esker, on thallus of P.

polydactyla, 26 Oct 1941, E. Aberg (IMI 292398, UPS); Värmland: Sunnemo s:n, berg 295 vid Skärjen, Lodyta, on P. polydactyla, 23 Oct 1951, L. Hedlund (with Illosporium sp.; UPS); Vestiuauuia (Fuscia): Ramsberg, in Peltigera, 19 Aug 1921, E. Haglund (FH; as Nectria lichenicola). U.S.A. Idaho: Lemhi County, Gilmore Summit, Lemhi-Birch creek valley T13N, R27E, 7500′, 20 Jun 1987, R. Rosentreter 4243, culture as R. Lowen 359a-87 (NY, herb. Rosentr.); New Hampshire: Coos County, Shelburne, Sep 1891, W.G. Farlow 406 (Illosporium sp. also present; FH, S).

Discussion: Fuckel (1870) mentioned Nectriella kalchbrennerii in his discussion of N. carneum. He noted that the former species has larger asci and ascospores. Fuckel did not mention N. erythrinella and may not have been aware of the species. Unable to obtain a collection of N. kalchbrennerii in Rabenh. 73b, Weese (1914) discussed this name but did not synonymize it with N. erythrinella.

The ascomatal papilla of Nectriella erythrinella is barely visible through cracks in the thallus of the host, or can become emergent and is then surrounded by a ring of epidermis of the lichen. In some collections the papilla is bent, appearing to be oriented toward the sky. The ascomatal apex is composed almost entirely of parallel hyphae.

Weese (1914) noted the difficulty in distinguishing Nectriella erythrinella from N. robergei. Ascomata of N. erythrinella are brighter in color than those of N. robergei at first, but in the herbarium where the colors usually fade the species cannot be distinguished macroscopically. *Nectriella robergei* has smaller more ellipsoid ascospores, shorter asci, and a two-region lateral ascomatal wall. *Nectriella robergei* is usually found on *Peltigera* cf. *canina* whereas N. erythrinella is usually found on *P. didactyla*.

Fuckel reported that he had clarified the relationship of *Nectriella* with *Illosporium*. He observed that the ascomata of *N. kalchbrennerii* originate from beneath the sporodochia of *Illosporium* and concluded that *Illosporium* is not a part of the lichen but is associated with the *Nectriella*. Fuckel observed that the aggregations of conidia of *Illosporium* are larger but the individual conidia are smaller than those associated with *Nectriella carneum*. Weese (1914) affirmed the connection and agreed that the *Illosporium* associated with *Nectriella erythrinella* differs from *I. carneum* Fr.

I obtained an *Illosporium* anamorph in colonies derived from single ascospores of *N. erythrinella*. *Nectriella erythrinella* and *N. robergei* both have been found associated with what appears to be *I. carneum*; sometimes ascomata are found directly in the *Illosporium* lesions on the *Peltigera*. Because I also consider the two species of *Pronectria* distinct, there must be two species of *Illosporium* involved, but I have been unable to make a distinction. The color of the *Illosporium* sporodochium associated with *Pronectria robergei* according to the description should be pink rather than orange and the cultural characteristics might be different. When fresh material of Nectriella robergei becomes available, comparison of the original colors and the growth of cultures to compare development is likely to reveal two species of Illosporium.

The thallic development of the conidia of Illosporium carneum as described above is termed holoarthric by Cole and Samson (1979). Although most anamorphic development is enteroblastic-phialidic in the Hypocreales, thallic development is known. Aleuriospores, synanamorphs of species of Hypomyces, and chlamydospores in species of Fusarium are thallic. The conidia of Illosporium are another example of thallic development of conidia of hypocrealean anamorphs. I suggest that the phialidic form of the anamorph either has not yet been found or has been lost.

4. PRONECTRIA LAMINARIAE (O. Eriksson) Lowen, Mycotaxon 39: 461. 1990. Fig. 29

≡ Nectriella laminariae O. Erikss., Svensk Bot. Tidskr. 58: 233, figs. 1, 2. 1964.

HOLOTYPE: NORWAY. Rogalands fylke: Jaeren, Orre parish, 3.5 km SSE of "Jaerens (Jaederens) rev," sandy beach, in old stipes of Laminaria sp., 18 May 1963, B. & O. Eriksson 1963a (UPS!; ISOTYPES, BPI!, DAOM, K!, L, O, S!).

Anamorph: not known.

Habitat: marine alga, Laminaria sp.

Distribution: Norway.

Ascomata obpyriform, 243 high x 200 µm wide, immersed, in large groups of up to 100, side walls and base nearly white, not changing color in KOH; papilla truncate, 60 µm high x 90 µm wide, red, becoming darker in KOH. Non-setose. Ascomatal wall 26 µm wide, of two regions; outer region 13 µm wide of thick-walled round to oval cells 5-7 x 2-4 µm; inner region 13 µm wide, of thin-walled rectangular cells 5-9 x 1 µm. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 44-80 x 7-12 µm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid-fusiform, 13-20 x 7-9 µm, L/W 2.0, 1-septate, at first hyaline, then pale brown, verruculose, verrucae more prominent at maturity, two orange guttules per cell.

Additional specimens examined:

NORWAY. Rogalands fylke: Jaeren, Orre parish, 3.5 km SSE of "Jaerens (Jaederens) rev," sandy beach, in old stipes of _Laminaria_ sp., 18 May 1963, _B. & O. Eriksson 1963c_ (UPS; as _Coniothyrium_); Rogalands fylke: Karmöy, Kopervik Parish, "Åkrasanden," rocks, 20 May 1963, _B. & O. Eriksson 1979a_(OE) (paratype, UPS).

Discussion: _Nectriella_ _laminariae_ was accepted in _Nectriella_ by Hawksworth (1983) because of the immersed, soft, red ascomata and two-celled ascospores. The species is placed in _Pronectria_ herein because the ascomata are expanded at the apex where the cells of the fungus mix with those of the alga.

Eriksson (1964) reported that a hyphomycete having phialospores was also found on the stipes of *Laminaria* at the type location. Because the hyphomycete was not directly associated with *Pronectria laminariae*, the anamorph remains unknown. Eriksson also reported that the ascospores divide into two separate halves on germinating. He did not, however, describe cultures.

Pronectria laminariae when described by Eriksson (1964) was compared to *Nectriella santessonii* as (*N. tincta*). *Pronectria laminariae* like *P. santessonii* and *P. tenuispora*, has ascomata with red pigments, a lateral wall with two regions and asci with an apical ring. *Pronectria laminariae* may be distinguished from the latter two species by the algicolous host and the two-colored ascomata.

5. PRONECTRIA LEPTALEAE (Steiner) Lowen, Mycotaxon 39: 462. 1990. Fig. 30

≡ *Pharcidia leptaleae* Steiner in Fritsch, Akad. Wiss. Wien, Math.-Naturwiss. Kl., Denkschr. 68: 238, fig. 13. 1900.

≡ *Nectriella leptaleae* (Steiner) R. Sant., Publ. Herb. Univ. Uppsala13: 11. 1984.

HOLOTYPE: TURKEY. Belgrade woods, Umpelung von Konstantino pel, on the apothecial disc of *Physcia leptaleae*, 1896/97, *J. Nemetz 2957* (WU!).

Anamorph: not known.

Habitat: *Physcia* spp.

Distribution: temperate; Europe, U.S.A.

Ascomata obpyriform, 130-200 high x 150-225 μm wide, immersed in apothecia of lichen, in groups of six to 10, pale orange, upper third red, becoming pale brown in KOH and yellow in lactic acid; papilla truncate, 40 μm wide. Non-setose. Cells on surface angular, cells 10-14 x 8-10 μm. Ascomatal wall 20 μm wide, of two regions; outer region 10 μm wide of cells 6 x 1 μm; inner region 10 μm wide, of 3 rows of thin-walled elongate rectangular cells. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 60-100 x 8.0-11.5 μm; apical ring not seen; epiplasm in apex appearing coronate; ascospores 8, diagonally uniseriate to partially biseriate, not filling the base of the ascus. Ascospores ellipsoid to subglobose, 9-11 x 6.5-8.0 μm, L/W 1.4, 1-septate, at first hyaline, then pale orange.

Additional specimens examined:

AUSTRIA. Steiermark: Hochschwab-Gruppe, an der Strasse von Thörl zum "Ghf" Bodenbauer, kurz vor dem Moarhaus ca. 2,5 km NW von Innerzwain, ca. 840 m, am Straßenrand, on *Physcia stellaris*, on *Tilia*, 21 June 1985, *J. Hafellner 13266* (GZU); Steiermark: Eisenerzer Alpen, Gössgraben NW von Trofaiach, an Alleebäumen ca. 2 km taleinwärts von Oberdorf, ca. 800 m, on *Physcia stellaris* on *Quercus rubra* (cult.), 1 Apr. 1984, *J.*

Hafellner 11148 (GZU); Steiermark: Gesäuse-Gebiet, Johnsbach, ca. 0.5 km E des Gasthofs Kölbl, ca. 875 m, Grundfeld 8453/4, on *Physcia aipolia*, on *Fraxinus exelsior*, 20 May 1988, J. Hafellner 20289 & E. Schreiner (GZU). SWEDEN. Jämtland: Branflopar., Torvalla, on *Physcia stellaris*, on twigs of *Salix caprea* in a *Populus* grove, 18 Aug 1948, R. Santesson 48502 (S; IMI 292399).

Discussion: When Steiner (in Fritsch, 1900) described *Pronectria leptaleae* in *Pharcidia*, he suggested that the species needed a different generic position. Santesson (1984) placed the species in *Nectriella* and said that *N. leptaleae* is closest to *N. subimperspicua*. As stated by Santesson (1984) *Pronectria leptaleae* is distinguished from *P. subimperspicua* by the larger ascomata and ascospores and the different substrate. Santesson also reported the species to be found in *Physconia pulverulacea* from Sweden.

5a. PRONECTRIA LEPTALEAE (Steiner) Lowen var. TUBERCULATA Lowen, var. nov. Fig. 30a

HOLOTYPE: AUSTRIA. Steiermark: Hochschwab-Gruppe, an der Strasse von Thröl zum Ghf Bodenbauer, kurz vor dem Moarhaus ca. 2,5 km NW von Innerzwain, ca. 840 m, an Strassenrand, on *Phaeophyscia orbicularis*, on *Fraxinus*, 20 Jun 1985, J. Hafellner 13320 (GZU!; Isotype, IMI!).

Ascomata obpyriform, 200-240 μm high by 200-336 wide, immersed, becoming erumpent, red, turning black when dry; papilla to 130 μm wide, of obvious parallel hyphae; ostiole sometimes appearing open. Asci containing 3-8 ascospores. Ascospores subglobose to ellipsoid, 8-12 μm diam, pale orange, prominently tuberculate.

Additional specimens examined:

AUSTRIA. Steiermark: Hochschwab-Gruppe, Umgebung von Tragößß, Jollingergraben an der Straße von Pichl-Großdorf auf das Hieslegg, 860 m, Grundfeld 8456/3, on Physconia distorta, on Fraxinus excelsior, 3 Apr 1988, J. Hafellner 20705 (Herb J. Hafellner); same collection information, J. Hafellner 20708 (Herb J. Hafellner). U.K., Isle of Skye: SW Broadford, Coille Gaireallach, NG 60;20, on Pannaria rubiginosa on Corylus & Betula, 22 May 1987, P. Diederich 8124 (LG); Isle of Skye: SW Broadford, Coille Gaireallach, NG 60;20, on Parmeliella plumbea on Corylus & Betula, 22 May 1987, P. Diederich 8125 (LG). U.S.A. Oklahoma: Cherokee County, along Terapin Creek, ca. 6 mi N of St. Rd. 82, on St. Rd. 100, T 14 N, R22W, sect. 24, oak-hickory forest, on and a little above flood plain, with dolomite, on Physcia caesia (Hoffm.) Fürnr., 23 Apr 1988, R.C. Harris 21337 (NY, slide).

Discussion: Pronectria leptaleae var. tuberculata from Austria, United Kingdom, and the United States, is also found in the apothecia and thallus of Physcia stellaris. The new variety differs from typical <u>Pronectria leptaleae</u> mainly in the brown, warted ascospores. Eight ascospores are formed, but three to five fail to enlarge and remain hyaline. The ascomata are larger and often appear erumpent as the lichen surface erodes.

6. PRONECTRIA ORNAMENTATA (Hawksworth) Lowen, Mycotaxon 39: 462. 1990. Fig. 31

≡ <u>Nectriella ornamentata</u> Hawksworth, Nova Hedwigia 35: 756, figs. 1A-H, 2A. 1982 [1983].

HOLOTYPE: ICELAND. Jokuldalur, in thallus of <u>Peltigera</u>, 26 Jun 1970, <u>P.B. Topham</u> (IMI 247733!).

Anamorph: not known.

Habitat: <u>Peltigera</u>.

Distribution: Cool temperate; Europe, Greenland, Iceland.

Ascomata obpyriform, 290-360 high x 290-320 μm wide, immersed, scattered or in groups of up to 50, visible through star-like cracks in the epidermis, dark red, sometimes black when dry, becoming darker red in KOH, then yellow when treated with lactic acid; papilla truncate, averaging 60-84 μm high x 103-120 μm wide, ostiole sometimes appearing open. Non-setose. Ascomatal wall 10 μm wide, of one region of thick-walled angular to rounded cells. Asci clavate, 70-100 x 7-13 μm; usually containing 4 mature ascospores and 4 hyaline, deteriorated ascospores; apex truncate, not containing an apical ring; ascospores uniseriate, filling the ascus. Ascospores ellipsoid, (18-)25-31 x 7-9(-10) μm, L/W 3.4, 1-septate, slightly constricted, at first hyaline, then pale brown, thin-walled, tuberculate, tubercules 1.0-1.5 µm x 1-2 µm; 2 guttules per cell, prominent when immature.

Lichen thallus appearing dead where infected by the fungus; upper cortex appearing discolored and whitish.

Additional specimens examined:

AUSTRIA. LUXEMBOURG. Gutland: Between Dudelange and Kayl, Haardt (M8.54.23), on iron minerals, on Peltigera, mosses or vegetable debris, 24 Feb 1989, P. Diederich 9009 & C. Roux, (LG). SWITZERLAND. Valais: Aletschwald between Großem Aletschgletscher and Riederalp oberhalb Mörel, (Brig im Rhonetal), 1840 m, on Peltigera, 20 Sep 1973, P. Döbbeler 560 (GZU). SWEDEN. Jämtland: Åre s:n, Handölsfallen. På öppen grusmark vid nedre fallet På östra sidan, ca. 550 m ö.h., På P. lepidophora, 4 Aug 1948, R. Santesson 48.182 (herb. R. Sant.); Jämtland: Åre s:n, Handölsfallen. På öppen grusmark vid nedre fallet På östra sidan, ca. 550 m ö.h., På P. spuria, 4 Aug 1948, R. Santesson 48.182 (herb. R. Sant.); Jämtland: Åre s:n, Handölsfallen. På öppen grusmark vid nedre fallet På östra sidan, ca. 550 m .ö.h., På P. spuria, 4 Aug 1948, R. Santesson 48.186 (herb. R. Sant.).

Discussion: Pronectria ornamentata differs from all other species of Pronectria by the KOH+ ascomata. The tuberculate, pale brown ascospores are larger than but most like those of P.leptaleae var. tuberculata.

7. PRONECTRIA PAUCISPORA Lowen, sp. nov. Fig. 32

HOLOTYPE: U.S.A. Connecticut: Litchfield County, 5 mi S of Canaan, on Parmelia rudecta Ach. [= Punctelia rudecta (Ach.) Kroy], on moss covered rock in woods, 2 Nov 1959, C.T. Rogerson 59-53 (NY!).

Etymology: The specific epithet refers to the reduced number of ascospores in the ascus.

Anamorph: not known.

Habitat: Punctelia.

Distribution: U.S.A. (Connecticut).

Ascomata subglobose, 100-200 μm diam, immersed in thallus, scattered or in groups of up to 20, dark red, not changing color in KOH. Non-setose. Cells on surface epidermoid, 8 μm diam. Ascomatal wall 20 μm wide, of thick-walled angular to rounded cells; inner region 10 μm wide, of thin-walled elongate rectangular cells. Asci clavate, 32-40 x 6.5-10.0 μm; apical ring not seen; ascospores biseriate. Ascospores ellipsoid, 14-20 x 4-6 μm, L/W 3.4, 1-septate, septum submedial, one cell slightly wider, curved, hyaline, smooth, 2-5 maturing per ascus.

Lichen thallus darker and discolored in presence of ascomata.

CHARACTERISTICS IN CULTURE. Colony white to orange. Conidia absent (Rogerson, field notebook).

Discussion: Several collections made by R. Santesson from Sweden resemble P. paucispora when they are immature. The ascospores, however, become inflated and eventually disarticulate at the septum. These collections need further study.

Pronectria paucispora is distinguished from other species of *Pronectria* by the subglobose ascomata and the narrowly ellipsoid, curved ascospores. The ascospores are most like those of *P. anisospora*, but the ascomata differ in color and those of *P. paucispora* do not have setae.

8. PRONECTRIA PERTUSARIICOLA Lowen, sp. nov. Fig. 33

HOLOTYPE: FRANCE. Brittany: Finistère, Coatadon, [on *Pertusaria* sp.] on bark of elm, 18 Oct 1868, *Crouan & Crouan* (CO!).

Etymology: The specific epithet is based on the host lichen *Pertusaria*.

Anamorph: not known.

Habitat: *Pertusaria* sp.

Distribution: France, known only from the type locality.

Ascomata obpyriform to subglobose, 220-300 high x 150-220 µm wide, immersed, scattered or in groups of up to 20, yellow, not changing color in KOH; papilla truncate, 100-110 µm wide. Non-setose. Ascomatal wall 17-20 µm wide, of two regions; outer region 9-13 µm wide, of thick-walled angular to rounded cells, 2.0-3.5 x 1.0-1.5 µm; inner region 7-8 µm wide, of thin-walled elongate rectangular cells, 2.0-8.5 x 0.5 µm. Asci clavate, 60-80 x 7-8 µm; apex truncate; apical ring not seen; ascospores irregularly uniseriate to biseriate. Ascospores ovoid, 9-12 x 4.5-5.0 µm, L/W 2.3, 1-septate, slightly constricted; hyaline, echinulate, often many guttules per cell.

Additional specimen examined:

FRANCE. Brittany: Finistère, Coatadon, on *Pertusaria pertusa* (as *P. communis*), 18 Jun 1870, *Crouan & Crouan* (CO).

Discussion: The collections of *Pronectria pertusariiicola* were found in the Crouan herbarium with the same species epithet under the generic name *Nectria*. The name was never published.

Pronectria pertusariiicola and *P. robergei* can be confused. They differ most conspicuously by the host. Furthermore *P. pertusariiicola* has different ascomatal wall anatomy, asci lacking an apical ring and ascospores that are more ornamented than those of *P. robergei*.

9. PRONECTRIA ROBERGEI (Montagne & Desmazières) Lowen, Mycotaxon 39: 462. 1990. Fig. 34

≡ *Nectria robergei* Mont. & Desm., Pl. Crypt. France, ed. 3, fasc. 8: 374. 1856, description on printed label.

≡ *Nectriella robergei* (Mont. & Desm.) Weese in Höhnel & Weese, Ann. Mycol. 8: 467. 1910.

= *Cryptodiscus lichenicola* Cesati, Rabenh. Herb. Mycol. ed. 2, fasc. 6: 523. 1857, description on printed label..

≡ Nectria lichenicola (Ces.) Sacc., Michelia 1: 289. 1878.

≡ Calonectria lichenicola (Ces.) Rehm, Ascom. Lojka 44. 1882.

≡ Nectriella lichenicola (Ces.) Höhnel & Weese, Ann. Mycol. 8: 466. 1910.

≡ Pronectria lichenicola (Ces.) Clements in Clements & Shear, Genera of Fungi 282. 1931, non Nectria lichenicola Crouan & Crouan, Fl. Finistère. 256. 1867.

= Nectriella carnea Fuckel, Jarb. Nassauischen Vereins Naturk. 23-24: 176. 1869 [1870].

= Nectria peltigerae Phillips & Plowright, Grevillea 4: 123 ["223"]. 1876.

LECTOTYPE, packet with 374 written on it designated herein: FRANCE. Normandy: Lébisey park, on thallus of Peltigera canina, on old elm, Apr 1843, Roberge; later Calavados: below Colleville-sur-Mêr, on dunes, and Ouistreham, Oct 1852, Pl. Crypt. France, ed. 3, fasc. 8: 374, 1856 (PC!; ISOLECTOTYPES, FH-Höhnel, slides 3-1!, 3-15!; H, Herb. W. Nylander!; IMI 52717, slide!; K!; PC!).

ANAMORPH: Illosporium carneum Fr., Syst. Mycol. 3: 259. 1829.

Habitat: Peltigera spp.

Distribution: temperate; Chile, Europe, U.S.A.

Ascomata obpyriform, 240-340 high x 250-320 μm wide, immersed, scattered or in groups of up to 20, closely adherent and raising the epidermis of the lichen or visible through star-like cracks in the epidermis, pale red to orange, yellow when dry, not changing color in KOH; papilla truncate, 60-130 μm wide; ostiolar area sometimes depressed and hyaline. Ascomatal wall ca. 35 μm wide, of one region at the base, 18 μm wide; of two regions at the sides: outer region 17 μm wide, of thick walled globose cells 3.5 μm diam to ellipsoid cells 5.0 x 3.5 μm; inner region 18 μm wide of thin-walled elongate cells 3.5-10.5 x 2-3 μm; periphyses at base of papilla directed downward into centrum, often emergent in squash mounts. Asci clavate, 40-70 x 8-9(-14) μm; apex truncate, containing an apical ring; epiplasm in apex appearing coronate, asci often floating out separately in water mounts; ascospores biseriate. Ascospores ellipsoid to ovoid, 8-16 x (3-)4-8 μm, L/W 2.2, 1-septate, sometimes slightly constricted; hyaline, smooth to slightly roughened, often many guttules per cell.

Often damaging thallus of the lichen causing discolored areas delimited by a dark line from the inner layers, leaving smooth craters where ascomata have fallen out.

Selected additional specimens examined (all on thallus of Peltigera canina unless otherwise noted):

BELGIUM. Bruxelles, in P. polydactyla, winter, collector unknown (IMI 52776, slide; K; as Sphaeria sanguineo-punicea Lib.); near Malmédy, in thallus of

Peltigera polydactyla, winter, collector unknown, Roumeg. Fungi Selecti Gallici, Relique Libertianae, (FH Höhnel slide 3-8; K). CHILE. Magallanes, Isla Riesco, Mina Elna, on *Peltigera spuria* [as *P. erumpens*] on ground in burned place in *Nothofagus betuloides* rain forest, alt < 10 m, 30 Apr 1940, R. Santesson Sx (UPS). FINLAND. Ks: Kuusamo, (USSR) Kk: Kirkon luona Kedolla, paljastuneella maalla st cp, grid 27°E: 7320:599, UTM: pp 2, 10 Aug 1965, T. Ahti 20863 (*Illosporium carneum* also present; H). FRANCE. No further information, Herb. W. Nylander (H); Roumeg. Fungi Selecti Gallici 664 (FH-Höhnel, slide 3-8; as *Nectriella erythrinella*). GERMANY. location unknown, Sydow Mycoth. March. 345 (K; as *Cryptodiscus lichenicola*); Sydow 4028 (FH-Höhnel, slide 3-8; as *Nectriella erythrinella*); Bavaria: München, Schöngeising gegen Jexhof, auf pettig ranine am Wald sacem, on *Peltigera spuria* (Ach.)DC, 8 May 1894, Arnold (H; as *Nectria lichenicola*); München, between Schöngeising and Jexhof, Saume des Buchenwalds, on *Peltigera spuria*, 23 Jun 1894, Arnold 373, Lich. Monacenses (H; as *Nectria lichenicola*); Freienweinheim, Kiefernwald [pine wood], in thallus of *Peltigera canina*, spring, Kalchbrenner, Fungi rhenani exsiccati 1835 (HOLOTYPE of *Nectriella carnea*, G; Isotypes, FH-Höhnel, slide 3-1,2; IMI; K; S). ITALY. Piedmont: Maggio, Biella district, on withering lichen thallus, Aug 1860, Cesati, Erbar Crittogam. Ital. Ser. 1, n. 492 (K; S; as Cryptodiscus lichenicola). Piedmont: Near Viverone at the SW limit of Bugellensis, Bertignano mountain, around a depression, alternately on thallus of Peltigera canina Oct-Nov 1856, V. Cesati, Rabenh. Herb. mycol., ed. 2, ser. 1, cent. 6, 523 (ISOTYPES of Cryptodiscus lichenicola: IMI, K, S). LUXEMBOURG. Gutland: Esch-sur-Alzette, Lallingerberg, on Peltigera rufescens, 10 Jul 1986, P. Diederich 7834 (LG). RUMANIA. No collection information, 1877, Lojka (FH-Höhnel, slide 3-1; K; as Cryptodiscus lichenicola). SWEDEN. Dalarne: Mora s:n, på stenslänten vid brofästet vid Sandängarna, på P. spuria, 25 Jul 1939, G.A. Sjödahl (S); Jämtland: Undersóker s:n, Sylarna, Knippens V-sluttning, Reg. alp. inf., ca. 1180 m, 1 Aug, 1950, R. Santesson (UPS); Jämtland: Åre s:n, Handölsfallen pó öppen grusmark vid nedre fallet pó östra sidan, on P. spuria, 4 Aug 1948, R. Santesson 48.184a (with Illosporium carneum; UPS); Lapponia inarensis: Inari (= nare) par., Kaamanen, on Peltigera spuria on burned wood, 24 Jul 1961, J. A. Nannfeldt (with I. carneum; UPS); Lycksele Lappmark: Stensele sin, holmen SE om Luspholmen i S. Enden av Storuman, Strandbrinken, 25 Jul 1970, O. Eriksson, Umeå Universität (Illosporium carneum also present; IMI 307998); Torne Lappmark: Torneträsk-omràdet, invid stigen fràn Abisko Ö, till Nissonjokks mynning, ganska nära Nissonjokk. Brandfläck i björkskogen, ca. 450 m, 23 Aug 1953, R. Santesson (with I. carneum; UPS); Torne Lappmark: Jukkasjärvi s:n, Abisko Turiststation. Pó Järnvägsbanken, 385 m, 16 Aug 1947, R. Santesson (with Illosporium carneum; UPS); Uppland: Estuna parish, 1/2 km W if Kullsta, in Peltigera spuria on bare sand on roadside, 7 Jul, 1960, R. Santesson 13763 (with I. carneum; UPS); Uppland: Läby s:n, sekt 2, Läbyvad, SO om landsvägsbron över Hågaån, grusgrop i dalsidan, on P. spuria [as P. erumpens], 16 Sep 1945, T.E. Hasselrot (S); Uppland: Gamla Uppsala s:n, Röbo, grustag i åsen strax Nom Röbo Tegelbruk, on P. spuria, 22 Jun 1945, T.E. Hasselrot (as Illosporium carneum which is also present; S); Uppland. :ena s:n, Vattholma å stig till gamla Kalkstensbrott I barrskog ca. 1 km x SO om bruket, 26 Jun 1945, T.E. Hasselrot (Illosporium carneum also present; S). Västergötland: Gärdhem, s:n, nära Altorpet, på öppen hällmark i blandskog. on Peltigera polydactyla, 26 Jun 1947, R. Santesson (UPS); (S; as Nectriella erythrinella); U.K., England. location unknown, on Peltigera canina, 1882, C.B. Plowright, Vize, Microfungi Brit. 4, no. 388 (K; as Nectriella carnea); Norfolk: Castle Rising [as "Lynn,"] Nov 1875, collector unknown (ISOTYPES of Nectria peltigerae: E!, FH-Höhnel, slide 3-1!); Norfolk: N. Wootton, Plowr. Sphaeriae Brit. Cent. 3, no. 13, 13 Nov 1873, Plowright (K); SCOTLAND. West

Sutherland: Kinlochbervie, Oldshoremore, VC L08, 29/20.58(-9), on Peltigera canina, 23 Aug 1983, B.J. Coppins 9975 (Illosporium carneum also present; E); West Sutherland: Kinlochbervie, Oldshoremore, VC L08, 29/20.58(-9), 23 Aug 1983, B.J. Coppins 9973 (E). U.S.A. Montana: Ravelli County, R. Rosentreter 3286 (herb. Rosentr.); 20 mi south of Missoula, alt 3500′, on Peltigera spuria, 23 Oct 1986, R. Rosentreter 3286 (Herb. Christiansen 3398); New Hampshire: Coos County, Shelburne, on P. cf. polydactyla, Sep 1891, W.G. Farlow (FH; as Nectria erythrinella with I. carneum); Shelburne, on Peltigera cf. polydactyla, Sep 1891, W.G. Farlow (FH; as Nectria erythrinella); New York: Erie County: Buffalo, G.W. Clinton (NY; as Illosporium carneum).

Discussion: Pronectria robergei and P. kalchbrenneri have been confused. The species can be most readily distinguished by the size of the ascospores. Winter (1872), assuming the small ascospores to be immature, synonymized the species. Additional redescriptions of N. robergei by Keissler (1930), Petch (1938) and Müller and Arx (1962) followed. Only Petch had the correct spore dimensions because he did not include N. erythrinella (= . kalchbrenneri) in the synonymy.

Müller and Arx (1962) and Petch (1938) gave Illosporium carneum as the anamorph of N. robergei. The connection with an Illosporium anamorph is circumstantial; it is deduced by close and repeated association on the host, but is not proven in culture. The apparent lack of distinction between the I. carneum anamorphs of Pronectria robergei and P. erythrinella was discussed under the latter taxon.

The Roberge collections all represent Pronectria robergei but are actually a composite of three syntypes that cannot be separated. One of the packets in PC was selected as the lectotype.

Pronectria robergei (= P. lichenicola) and P. eythrinella form a complex of species with similar characters making them undistinguishable in the herbarium without microscopic examination. According to the protologue, ascomata of P. robergei are pale red at first whereas those of P. erythrinella are bright scarlet to orange. Since P. eythrinella has consistently larger asci and ascospores, it can be distinguished microscopically from the other two taxa. The type collection of Pronectria lichenicola has features that might separate it from P. robergei: 1. ascomata smaller (200 μm diam with papilla 60 μm wide); 2. ascospores ovoid and ascospores and asci intermediate in size between P. robergei and P. erythrinella; 3. ascomatal lateral wall section narrower, 16 μm wide, of cells of one kind; and 4. not raising thallus of the lichen around the papilla but simply visible through cracks in the epidermis of the lichen. Some collections have these characters that could set them apart as P. lichenicola; however, the features overlap with the other two taxa. There is not enough evidence to consider *P. lichenicola* a distinct species.

Although *Pronectria robergei* is represented in herbaria by more than any species of *Pronectria*, the species is not often found. Most collections are from Scandinavia and Europe. In addition to the collections listed, *P. robergei* has also been found in New Zealand and British Columbia.

10. PRONECTRIA SANTESSONII (Lowen & Hawksworth) Lowen, Mycotaxon 39: 462. 1990. Fig. 35

≡ *Nectriella santessonii* Lowen & Hawksw., Lichenologist 18: 322, figs. 1-3. 1986.

ANAMORPH: *Acremonium* sp.

HOLOTYPE: U.K., England. Devon: Dartmouth, Warren Cove below Combe Point, in thallus of *Anaptychia runcinata* (With.) Laundon (= *A. fusca* (Huds.) Vainio) on rocks facing the sea, 5 August 1985, *D. L. Hawksworth* & *R. Lowen 141* (IMI 305040!; ISOTYPES, UPS!, NY!) [cultures: IMI 305040, ATCC 62532, NY (RL 141)].

Habitat: *Anaptychia runcinata* on rocks near the sea.

Distribution: Ireland, Sweden, U.K.

Ascomata obovoid, 200-235 high x 190-250 µm wide, immersed in thallus and apothecia, scattered or in groups of up to 100, nonstromatic, visible through star-like cracks in the epidermis, dark red, turning black with age, not changing color in KOH; apex pointed to truncate; ostiolar area sometimes white. Non-setose. Cells on surface appearing incomplete with walls of varying thickness, ca. 15 μm diam. Ascomatal wall at the apex of the ascomata 40 μm, of three regions: inner and outer regions hyaline; center with red pigment in cell walls; outer hyaline cells at the apex merging with lichen cells just below the epidermis of the lichen. Lateral ascomatal wall 20 μm wide, of two regions; outer region 10 μm wide of cells ellipsoid to globose, 3-8 x 3-4 μm, thick-walled; inner region 10 μm wide; cells rectangular, 8-12 x 2-3 μm, thin-walled, hyaline. Asci clavate, 50-70 x 8-12 μm; apex truncate, containing an apical ring; base rounded; ascus wall deliquescing with age; asci originating from the base and sides of the centrum; ascospores biseriate. Ascospores ovoid to ellipsoid, (10-)12-18 x 4.5-8.0 μm, L/W 2.4, 1-septate, often slightly constricted; at first hyaline, then pale orange, slightly echinulate, 1-2 guttules per cell.

CHARACTERISTICS IN CULTURE. Ascospores germinating from the ends of one or both cells. Colonies grown at 20°C 12 h dark/ 12 h light, cool white fluorescent plus near UV light; for 2 months, on CMA, MA, OA, and PCA+; then in the dark at 4°C for 7 additional months. Colonies on PCA+ reaching 7-10 mm diam in 2 months and a maximum of 20 mm in 9 months; aerial mycelium sparse, at first pastel red (K & W 8,4A; Kelly 28, light yellow pink), then brownish red on all media (K & W 8,7C; Kelly 37, medium red orange), ultimately whitish, black pigment diffusing into medium; reverse dark. Conidiophores arising perpendicularly from aerial hyphae, (16-)28-36(-80) μm long x 4 μm wide at the base, tapering to 2 μm at tip, unbranched, 0-3-septate; walls often slightly dark, especially at the base, often unevenly verrucose and wavy in outline, terminating in a single phialide. Phialide with inconspicuous periclinal thickening, not flared. Conidia ellipsoid with with a flat, 1 μm wide, protuberant, abscission scar, 4-8 x 2.5-4.0 μm, mostly unicellular, occasionally 1-septate, hyaline, terminal, cohering in a clear droplet; conidial production sparse, best on CMA. Chlamydospores common on all media, enlarged intercalary hyphal cells often in chains; cells angular to oval, 5-11 μm diam, thick-walled.

Additional specimens examined (all on Anaptychia runcinata):

IRELAND. County Kerry: Hänge, Felsrücken near Sybil Point, Aug. 1978, J. Poelt (GZU 554-78, IMI 326720, S, UPS, all as Nectriella tincta); SWEDEN. Västergötland: par. Styrsö, Vrångö, on rock by cove, 20 Jun 1950, A.H. Magnusson (UPS 21981; as Pharcidia); Västergötland: par. Styrsö, Vråangö, on boulder on shore, 20 Jun 1950, A.H. Magnusson Lichenes selecti Scand. 376 (UPS; as Nectriella coccinea). U.K., England. S. Devon: Prawle, Prawle Point, 24 Aug 1980, D.L. Hawksworth 5030 (IMI 251251; as N. tincta); S. Devon: Dartmouth, Warren Cove below Combe Point, 5 Aug 1984, D.L. Hawksworth 5504 (IMI 228173; as N. tincta); Pembrokeshire: Manorbier, Priest's Nose, on A. runcinata, 28 Aug 1988, D.L. Hawksworth 5330 (IMI 328707).

Discussion: The fungus appears to be biotrophic in Anaptychia runcinata causing the thallus to become bleached, to develop extensive circular lesions as large as eight cm diam, and eventually to break away from the substrate.

Many of the collections had ascospores germinating in the centrum. This shows that not all ascospores are forcibly expelled and that dispersal is passive as well.

Pronectria santessonii is the only species of Pronectria found on Anaptychia runcinata. The red ascomata and damaged lichen are characteristic.

11. PRONECTRIA SUBIMPERSPICUA (Spegazzini) Lowen, Mycotaxon 39: 462. 1990. Fig. 36

≡ Nectria subimperspicua Spegazzini, Anal. Mus. Nac. Hist. Nat. Buenos Aires 6: 290. 4 Jan 1899.

≡ Nectriella subimperspicua (Speg.) R. Sant., Publ. Herb. Univ. Uppsala 13: 11. 1984.

HOLOTYPE: ARGENTINA. Buenos Aires: La Plata, in park, on the wilting thallus of Punctelia constantimontium [as Ricasolia casarettoana (Nyl.) Sacc. & P. Sydow], 1 Apr 1890, Spegazzini 1618 (LPS!).

Anamorph: Diplosporium caudatum Speg. (not proven in culture).

Habitat: immersed in thallus of Punctelia.

Distribution: known only from type.

Ascomata obpyriform, 120-240 high x 120-240 μm wide, immersed, scattered or in groups of up to 30, pale orange, outer wall region becoming red (K & W 8,8A; Kelly 35) in KOH and changing to yellow in lactic acid; papilla conic to truncate, 60 μm diam, slightly paler than side and base walls. Non-setose. Ascomatal wall 10 μm wide, of two regions; outer region 5 μm wide of thick-walled round to oval cells; inner region 5 μm wide, of thick-walled elongate rectangular cells. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 40-50 x 6.5-7.5 μm; apex rounded, apical ring not seen; asci in fascicles; ascospores diagonally uniseriate, filling the ascus. Ascospores subglobose, 6.5-8.0 x 5-6 μm, L/W 1.3, 1-septate, slightly constricted, at first hyaline, then pale orange, verruculose.

Discussion: Spegazzini (1899) in the protologue of Diplosporium caudatum said that the teleomorph is Pronectria subimperspicua. Although the two fungi were found on the same host, no hyphomycete was seen on the holotype collection of P. subimperspicua. According to Hawksworth (pers. comm.) the holotype of Diplosporium caudatum was not found at LPS. Because Diplosporium is phialidic and has hyaline conidia, like other hypocrealean anamorphs, the connection is possible, but not proven.

The KOH reaction of the outer wall of the ascomata of Pronectria subimperspicua differs from that of other species of Pronectria which are KOH-. Pronectria paucispora is also found on Punctelia, but has subglobose ascomata and longer and narrower ascospores. Pronectria leptaleae also has subglobose ascospores, but has much longer asci and is found in Europe.

12. PRONECTRIA TENACIS (Vouaux) Lowen, Mycotaxon 39: 462. 1990. Fig. 37

≡ Pharcidia mammillula (Anzi) Vouaux f. tenacis Vouaux in Bouly de Lesdain, Rech. lich. Dunkerque. 273. 1910.

≡ Nectria tenacis (Vouaux) Vouaux, Bull. Soc. Mycol. France 28: 184. 1912.

≡ Nectriella tenacis (Vouaux) Weese, Ann. Mycol. 12: 156. 1914.

NEOTYPE, designated herein: U.K., England. N. Devon: Braunton Barrows NNR, on Collema tenax on dunes, 16 Apr 1988, D.L. Hawksworth 5314 (IMI 327003!).

Anamorph: not known.

Habitat: sand dunes, on Collema tenax.

Distribution: U.K. and France.

Ascomata obpyriform, 240 high x 200 μm wide, immersed in thallus and apothecia, scattered or in groups of up to six, orange, turning yellow with age, not changing color in KOH; papilla conic to truncate, redder than walls. Non-setose. Cells on surface angular. Ascomatal wall 17-22 μm wide, of one region of thin-walled rounded to angular cells 3 μm diam, cells becoming longer and thinner toward the centrum. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 50-70 x 8-14

μm, containing an apical ring; ascospores biseriate. Ascospores ellipsoid-ovoid, 10-16 x 5-6 μm, L/W 2.3, 1-septate, at first hyaline, then pale orange, verruculose.

Discussion: Weese (1914) and Keissler (1930) did not see the type collection but described Nectriella tenacis based on the protologue. Weese (1914) made the combination in Nectriella because of the immersed perithecia.

Along with the loss of the Vouaux herbarium during WW II, was the loss of the type of Pharcidia mammillula f. tenacis (FRANCE. Nord: Bray-Dunes, on the thallus and sometimes in the apothecia of Collema tenax, Bouly de Lesdain). The Hawksworth collection agrees well with the protologue; as the only known extant collection of Pronectria tenacis, I have designated it the neotype. The sand dune habitat is like the original locality.

I attempted to culture the Hawksworth collection but the ascospores did not germinate on CMD at 20°C after 14 days. Bouly de Lesdain (1910) suggested that a species of Pyrenochaeta de Not. is the anamorph of Pronectria tenacis because he observed the development of ascomata adjacent to the pycnidia on the host. There is no proof; this connection is unlikely because the dark pycnidia of Pyrenochaeta are unlike the pale colored anamorphs found in the Hypocreales (Samuels and Seifert, 1987). The known teleomorphs of Pyrenochaeta are in the bitunicate genera Cucurbitaria and Herpotrichia (Kendrick et al., 1979).

Pronectria tenacis is distinguished from other speces of _Pronectria_ by the host lichen and the ascomata each with purple-red papilla.

13. PRONECTRIA TENUISPORA (Hawksworth) Lowen, Mycotaxon 39: 462. 1990. Fig. 38

≡ _Nectriella tenuispora_ Hawksw., Notes Roy. Bot. Gard. Edinburgh 36: 187, figs. 3A, B. 1978.

HOLOTYPE: U.K., SCOTLAND. Midlothian: near West Calder, vc 83 36/007630, 160 m, roadside, on steep, north-facing slope of coal mine slag heap, in thallus of _Peltigera polydactyla_ (Neck.) Hoffm., 15 May 1976, _D.G. Long & D.F. Chamberlain_ (E!, slide IMI 209761!).

Anamorph: not known.

Habitat: _Peltigera_ on coal mine slag heap.

Distribution: Europe.

Ascomata subglobose, 200-420 high x 150-378 μm wide, immersed in thallus to erumpent through cracks or raising surface of lichen, scattered or in groups of up to six, orange, red around ostiole, drying yellow with translucent ostiole, not changing color in KOH; papilla truncate. Cells on surface appearing to have incomplete walls, oval, 8-10 μm diam. Ascomatal wall 20-40 μm wide, of two regions; outer region 9 μm wide of rectangular cells perpendicular to ascomatal surface at the apex and parallel toward base, 2 x 4 μm; inner region 22 μm wide, of about 7 rows of thin-walled elongate rectangular cells 11 x 3 μm. Asci clavate, 60-90 x (6-)7-9(-10) µm; apex truncate, containing an apical ring and epiplasm in apex appearing coronate; ascospores biseriate. Ascospores fusiform, 22-28(-33) x 3.5-5.0 µm, L/W 6.1, 1-septate, often slightly curved; hyaline, smooth, two guttules per cell.

Thallus of lichen discolored in presence of ascomata.

Additional specimen examined:

GERMANY. Triglitz, on Peltigera, 20 Apr 1905, O. Jaap (FH-Höhnel, slide 3-8).

Discussion: Pronectria tenuispora is distinguished from other species of Pronectria by the long narrow ascospores that have the highest L/W ratio known in the genus.

14. PRONECTRIA TERRESTRIS Lowen & Diederich, Mycologia 82: 790. 1990. Fig. 39

HOLOTYPE: LUXEMBOURG. City of Luxembourg, W Zwickau (M8.25.42), between railroad tracks, soil covered with algae, bryophytes, and lichens, on Thrombium epigaeum (Pers.) Wallr., 5 Aug 1987, P. Diederich 8362 & G. Marson (NY!; isotype, Herb. Diederich!).

Anamorph: not known.

Habitat: Thrombium, on soil.

Distribution: known only from the type.

Ascomata subglobose to obpyriform, 210-260 µm diam, immersed, scattered or in groups 3-5, very pale red to yellowish, not changing color in KOH; papilla truncate to slightly rounded, 60 µm wide. Cells on surface indistinct, angular, 10 µm diam. Ascomatal wall 20 µm wide, delicate, of one region; cells elongate to angular, 10-15 x 2-4 µm near the centrum, becoming rounder, 6-10 µm diam toward the outside. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, 60-70 x 8-10 µm; apex truncate, containing an apical ring; ascospores biseriate. Ascospores ellipsoid to ovoid, 12-17 x 5.5-7.0 µm, L/W 2.3, 1-septate, sometimes slightly constricted, hyaline, smooth, often 1-2 orange guttules per cell.

Discussion: The fact that ascospores sometimes are found germinating in the centrum is support for the observation that the ascospores are also passively dispersed. Ascomata of *Pronectria terrestris* are easily seen as red spots when moist, but they are extremely difficult to find when dry. This is the only *Pronectria* found on *Thrombium*. *Pronectria terrestris* has subglobose ascomata similarly structured to those of *Nectriella anisospora*, from which it may be distinguished by its pallid ascomata that lack setae and the smooth, equally celled, ellipsoid to ovoid ascospores.

15. PRONECTRIA TINCTA (Fuckel) Lowen, Mycotaxon 39: 462. 1990. Fig. 40

≡ *Cryptodiscus tinctus* Fuckel, Fungi rhenani exsiccati, fasc. 4: 1836. 1867, description on printed label.

≡ *Calonectria tincta* (Fuckel) Rehm, Ann. Mycol. 8: 302. 1910.

≡ Nectriella tincta (Fuckel) R. Sant. in Eriksson, Sv. Bot. Tidskr. 58: 235. 1964.

≡ Nectriella coccinea Fuckel, Jarb. Nassauischen Vereins Naturk. 23-24: 177, pl. 4, fig. 20. 1869 [1870].

≡ Nectria fuckelii Sacc., Michelia 1: 289. 1878, nom. nov., non N. coccinea (Pers.: Fr.) Fr., Summa Veg. Scand. 2: 388. 1849.

≡ Calonectria fuckelii (Sacc.) Rehm, Transchel & Serebrianikow, Mycotheca Rossica fasc. 2: 68. 1910, non C. fuckelii (Nitschke) Sacc., Michelia 1: 310. 1878.

= Calonectria fuckelii (Sacc.) Rehm f. everniae Rehm in Motouschek, Centralbl. Bakteriol., 2 Abth. 42: 105. 1915.

Anamorph: not known.

HOLOTYPE: SWITZERLAND. Neuchâtel: near Neuchâtel, in Jura, on thallus and apothecia of Anaptychia ciliaris, [as Hagenium ciliarum], P. Morthier, Fungi rhenani exsiccati 1836, spring, 1870, (G!; ISOTYPES, Herb. Barb. Boiss., FH-Höhnel, slide 3-8!; G!; IMI!; K!, as Cryptodiscus tinctus).

Anamorph: not known.

Habitat: Anaptychia ciliaris (L.) Körb.

Distribution: Europe.

Ascomata obpyriform, 170-220 high x 170-230 μm wide, immersed in ectal excipulum and thallus, scattered or in groups of up to 15, at first pale red (according to the original description), then pale yellow, not changing color in KOH; papilla conic, 75-80 μm high x 100-120 μm wide. Non-setose. Cell walls on surface appearing incomplete, mostly 6 μm diam; wall of varying thickness. Ascomatal wall 10-16 μm wide, of one region consisting of 5-6 rows of thin-walled rectangular cells 6 x 3 μm. Asci clavate, 60-80 x 9-11 μm; apex rounded; apical ring not seen; originating from a layer of cells lining the base and sides of the ascomatal wall; ascospores biseriate. Ascospores fusiform, 17-22 x 4.0-5.5 μm, L/W 4.1, 1-septate; cells inequal, one cell is wider than the other, hyaline, verruculose, one to many guttules per cell.

Additional specimens examined (all in Anaptychia ciliaris unless otherwise noted):

FINLAND. Tavastia australis: Tammela, Mustiala, 13 Oct 1888, P.A. Karsten 2740 (H; as Nectria fuckelii); Tavastia australis: Tammela, Mustiala, on Physcia stellaris, 4 Oct 1888, P.A. Karsten 2739 (H; as Nectria fuckelii); Tavastia australis: Tammela, Mustiala, on Physcia stellaris, Oct 1888, P.A. Karsten 2738 (H; as Nectria fuckelii). USSR. Prov. Kursk: Schebekino, in thallus of "Evernia prunastri" Ach., 15 Jul 1908, Serebrianikow, Tranzschel & Serebrianikow, Mycoth. Ross. fasc. 2: 68 (ISOTYPES, BPI, FH K, S, all as Calonectria fuckelii f. everniae); K, as C. tincta); Prov. Kursk: Schebekino, in thallus, Aug 1908, Serebrianikow, Rehm Ascom., fasc. 46: 1897 (FH-Höhnel, slide 2-24, K, S, all as Calonectria tincta).

Discussion: Fuckel published the name Cryptodiscus tincta in Fungi rhenani exsiccati 1836 before publishing the superfluous name Nectriella coccinea as a replacement. Fuckel may have changed the epithet from tincta to coccinea when he thought it was associated with Illosporium coccineum Fr., Syst. Mycol. 3: 259. 1829. Because Nectria coccinea was already occupied, N. fuckelii is a new name introduced by Saccardo also based on the type of Nectriella tincta.

Rehm transferred Nectria fuckelii to Calonectria where this epithet was already occupied. Mycothecia Rossica 68 was issued both as C. tincta and as C. fuckelii f. everniae. Calonectria fuckelii f. everniae is based on the collections in Mycoth. Ross. 68 on Anapytchia ciliaris. The new form, C. fuckelii f. everniae, is based on Rehm's misidentification of the host as Evernia prunastri Ach. Rossman (1979) speculated that Rehm may have realized this error only after some of the labels had been printed. He then reidentified the exsiccata as Calonectria tincta on Anaptychia ciliaris. Weese (1914) and Keissler (1930) redescribed the species as Nectriella coccinea. The combination N. tincta was erroneously based on a misidentification of Pronectria santessonii. The nomenclature, however, is valid and must apply to the fungus with the basionym tincta.

Weese (1914) and Rossman (1979) synonymized Calonectria fuckelii with Nectriella tincta. Although I follow the synonymy because Calonectria fuckelii has the same wall structure, it may be a different fungus distinguished by ascomata aging orange-yellow instead of translucent yellow, longer asci (80-100 x 11.5-14.0 μm), wider ascospores (5-7 μm), and a cespitose habit.

Weese (1914) could not distinguish between Nectriella coccinea and N. erythrinella. Although the two species have ascospores with overlapping sizes, N. coccinea is readily distinguishable by the different hosts, ascomata with rounded apex, and differing ascomatal wall anatomy.

Illosporium coccineum was suggested by Fuckel in the original description to be the anamorph of Nectriella coccinea. Hawksworth (1979) examined three Fries collections (S) of Illosporium coccineum and found vivid pink granules on Phlyctis argena (Spreng.) Flot. to be structureless crystalline masses dissolving in KOH that he concluded were excrescences of norstictic acid. Hawksworth therefore considered I. coccineum to be a lichen, a synonym of a morph of Phlyctis argena. Two other collections examined (FRANCE. "occidentalis," in the lichen Leprosis crustaceis, Roumeguère 321 (NY); location unknown, on Physcia adscendens (Fr.) H. Olivier and Xanthotria parietina (L.) Th. Fr., autumn, 1863, Fungi rhenani exsiccati 240, fasc. 3 (IMI)) contained bright pink material on a white crustose lichen that was non-cellular and nonfungal. Thus, I agree with Hawksworth (1979) that Illosporium coccinium is not a fungus. Diederich (pers. comm.) points out, however, that because *I. coccineum* represents only the crystals and not a living organism, the name must be rejected.

The correct name of the fungus based on the earliest epithet is *Pronectria tincta*. *Pronectria tincta* is distinguished from other species of *Pronectria* by the host and the inequal, fusiform ascospores with a L/W of 4.1.

16. PRONECTRIA VERRUCARIAE (Vouaux) Lowen, Mycotaxon 39: 462. 1990. Fig. 41

≡ *Nectria verrucariae* Vouaux, Bull. Soc. Mycol. France 28(2): 186. 1912.

≡ *Nectriella verrucariae* (Vouaux) Weese, Ann. Mycol. 12: 154. Apr 1914.

HOLOTYPE: FRANCE. Nord: Dunkirk, on dunes near the lighthouse, in thallus of *Verrucaria integra* on calcarous rocks, 20 May 1904, *B. de Lesdain* (Herb. Vouaux!; ISOTYPE, FH-Höhnel slide 3-1!).

Anamorph: not known.

Habitat: *Verrucaria*.

Distribution: France, U.S.A. (New York).

Ascomata obpyriform, 180-320 high x 150-280 μm wide, immersed in ascomata of lichen, visible as black or sometimes orange spots due to the barely visible papilla, scattered or in groups of up to 6, pale orange (K & W: 6, B6; Kelly: 52), falling out when old leaving orange, circular craters, not changing color in KOH; papilla truncate, 60 μm wide. Non-setose. Ascomatal wall 16-20 μm wide, of one region, mostly of thin-walled rectangular cells 4-10 x 2 μm. Centrum contents pale orange. Asci clavate, 44-70 x 8-12 μm, containing 2-4 spores; apex truncate, containing a ring at apex of epiplasm, visible only in young asci; ascospores uniseriate. Ascospores ovoid to ellipsoid-fusiform, 16-21 x 5-7 μm, L/W 3.1, often slightly constricted, 1-septate; the end of one cell often pointed; the other end rounded; at first hyaline, then pale orange, smooth to slightly roughened; 1 to several guttules per cell.

Additional specimen exmined:

U.S.A. New York: Niagara County, Goat Island, near shore, north slope on retaining wall, in ascomata of Verrucaria muralis Ach. associated with Caloplaca feraeissima Magn., 1 Nov 1989, R.C. Harris 22856A (NY).

Discussion: Weese (1914) redescribed Nectriella verrucariae and combined his description with that of Vouaux (1912) because completely ripe ascospores were not observed. Weese combined the species in Nectriella on the basis of the immersed ascomata.

Pronectria verrucariae is distinguished from other species of Pronectria by the ascomata immersed in ascomata of the Verrucaria host.

17. PRONECTRIA XANTHORIAE Lowen & Diederich, Mycologia 82: 788. 1990. Fig. 42

HOLOTYPE: U.K., England. Derbyshire: Bakewell, Over Haddon, 43/2?6, in apothecia and thallus of <u>Xanthoria parietina</u> on limestone wall, 13 Apr 1985, <u>D.L. Hawksworth 5513</u> (IMI 294074!).

Anamorph: Not known.

Habitat: On saxicolous and corticolous <u>Xanthoria parietina.</u>

Distribution: Europe (U.K., Luxembourg).

Ascomata obpyriform, 150-300(-400) μm high x 140-250(-400) μm wide, immersed in the apothecia and sometimes the thallus of the lichen, scattered or in groups of up to six; raising the surface of the lichen in rounded mounds or as cylindrical projections with a translucent dark orange center, bright orange, not changing color in KOH; papilla truncate, 60-120 μm high x 200 μm wide; hyphae 1.4-2.0 μm wide extending from the top and sides of papilla up to 60 μm into the lichen. Non-setose. Cells on surface angular to epidermoid, ca. 8 x 4-8 μm. Ascomatal wall 15-20 μm wide, of one region, cells of thin-walled elongate rectangular, 9-12 x 2-4 μm, typically of 6 rows; periphyses 1.0-1.5 μm wide. Centrum contents pale orange; orange oily drops emerging from crushed ascomata. Asci clavate, (50-)64-80 x 6-13 μm; apex truncate, containing an inconspicuous apical ring; sometimes enclosed in a sheath, ascospores biseriate. Ascospores ellipsoid-fusiform, 17-24 x 4-5 μm, L/W 4.5, 1-septate, at first hyaline, then pale orange, verruculose, one to three guttules per cell.

Additional specimen examined:

LUXEMBOURG. NE Bergem, Schéierboesch (M8.44.12), on <u>Xanthoria parietina</u> on <u>Populus</u>, 26 Aug 1987, <u>P. Diederich</u> 8511 (Herb. Diederich; NY).

Discussion: The apothecia of the <u>Xanthoria</u> appear to be brighter orange when infected by <u>P. xanthoriae</u>. Pycnidia of <u>Xanthoria parietina</u> are often present in the thallus but may be distinguished from ascomata of <u>Pronectria</u> <u>xanthoriae</u> by their orange color producing diffuse spots as distinguished from the translucent dark orange projections of the ascomatal papillae.

Specimens of <u>Nectriella</u> on <u>Xanthoria parietina</u> have also been reported from Czechoslovakia as <u>N. coccinea</u> (Vezda, 1970: 224) and from Denmark as <u>N</u>. <u>tincta</u> by Keissler, 1930: 286) and as <u>Nectria fuckelii</u> by Ferdinansen and Winge, 1909; Lind, 1913, also in Rostrup herbarium n. 655). These collections (not examined) are likely to be <u>Pronectria</u> <u>xanthoriae</u> and would extend the known distribution.

<u>Pronectria</u> <u>xanthoriae</u> is distinguished from other species of <u>Pronectria</u> by its bright orange ascomata, elongate, ornamented ascospores and substrate of <u>Xanthoria parietina</u>. <u>Pronectria tenuispora</u> is the only species of <u>Pronectria</u> known to have spores with a larger L/W ratio.

III. **CHARONECTRIA** Saccardo, Michelia 2: 72. 1880.

Type species: Charonectria consolationis Sacc.

Clypeoid tissues hyaline, inconspicuous, subcuticular, radiating from ascomatal apex into the substrate. Ascomata subglobose, immersed, scattered or in groups, nonpapillate, pallid, orange to yellow, not changing color in KOH. Ascomatal wall to 10 μm wide, of one region. Ascomatal apex typically of rows of parallel, vertically elongated cells that are continuous with the inner region of the ascomatal wall; cells becoming increasingly narrow and merging with the periphyses and somewhat expanded or clavate where they terminate at the exterior. Asci clavate at first, usually 8-spored, unitunicate; apex rounded, apical ring absent; ascospores multiseriate. Ascospores ellipsoid, typically over 16 μm long and 5 μm wide, 1-septate, hyaline, spinulose, guttules often present. Paraphyses with free apices present.

Inhabiting herbaceous debris or lichens.

Charonectria was erected by Saccardo (1880) for species that have immersed, solitary ascomata and uniseptate ascospores. Saccardo was unaware of the genus Nectriella Nits. and applied the same concept for species of Charonectria. Saccardo had Hyponectria Sacc. differing from Charonectria by the presence of unicellular ascospores.

Ascomata of Hyponectria, from my examination of a fresh collection from Denmark of the type species, H. buxi (DC)

Sacc., have septate paraphyses attached both apically and basally, asci each with a J- apical ring shaped like an inverted letter v, and unicellular ascospores. My findings agree with the descripton of the species by Barr (1977). Barr (1977) accepts species in Hyponectria with either chitinoid or amyloid rings in the asci. The species described in Charonectria all have nonamyloid asci.

Three species are included in the genus herein, Charonectria consolationis, C. amabilis, and C. sceptri. Charonectria sasae Hara, also treated although it was never combined in Nectriella, is not likely to be a species of Charonectria. The protologue describes a stromatic fungus; stromata are not a characteristic of Charonectria. Proper taxonomic placement of C. australis Speg. (never combined in Nectriella and not examined) and C. sasae will be determined when the species are examined. A specimen of Sphaerella patouillardii Sacc., Syll. Add. 1-4: 407. 1886, annotated as Charonectria by Höhnel, was examined from the Höhnel herbarium at FH. The combination was never published. S. patouillardii is bitunicate, aparaphysate and is a member of the Dothidiales (sensu Eriksson and Hawksworth, 1990; Barr, 1990).

Charonectria is easily confused with Nectriella because of the superficial characters of fleshy, light-colored ascomata and hyaline ascospores in unitunicate asci. The most conspicuous difference from Nectriella, the presence of apically free paraphyses, while significant, is not easily seen (fig. 44). Another difference is the inconspicuous but characteristic clypeoid tissues at the apex formed from the intermingling of leaf cells with the fungus. On the basis of these characters, Charonectria is excluded from Nectriella and the Hypocreales. Charonectria is assigned to the Xylariales, Hyponectriaceae (sensu Barr, 1990) because of the presence of paraphyses, immersed ascomata, hyaline ascospores and clypeoid tissues.

Charonectria is distinguished from Cryptonectriella by the inconspicuous clypeoid tissues, the habit in leaves or stems of higher plants or in lichens and the lack of a conspicuous apical ring in the asci. Charonectria is distinguished from Hyponectria by the apically free paraphyses and the lack of a conspicuous apical ring in the asci.

1. CHARONECTRIA AMABILIS Lowen & Hawksworth, sp. nov., Fig. 43

HOLOTYPE: CANADA. Alberta: Jasper Park, Parker Ridge, by old Columbian ice field, 1980 m, on Phaeorhiza sphaerocarea (Th. Fr.) Sheard [as Rinodina cf. cinnamomea (Th. Fr.) Räs.], on alpine sod, 21 Jul 1981, R. Rosentreter 2150 (IMI 290622!).

Anamorph: not known.

Habitat: lichenicolous.

Distribution: Canada (Alberta); known only from type.

Ascomata obpyriform, 200-390 μm high x 200-300 μm wide, immersed, scattered, orange, not changing color in KOH; papilla truncate, 120 μm wide. Cells on surface of ascomata angular. Ascomatal wall 20 μm wide, of one region; cells rectangular 5-15 x 3-6 μm, forming 4-5 rows. Asci clavate, 65-88 x 9-12 μm; apex rounded, containing an apical ring; ascospores uniseriate to partially biseriate. Ascospores subglobose to ellipsoid, 9.5-11.0 x 5.5-8.0 μm, L/W 1.5, 1-septate, hyaline, sparsely echinulate, several small guttules per cell. Paraphyses 2 μm wide, unbranched.

Lichenicolous; lichen not damaged.

Discussion: Charonectria amabilis is the only known lichenicolous species that has orange, immersed ascomata with a hamathecium of persistent, apically free paraphyses.

2. CHARONECTRIA CONSOLATIONIS Saccardo, Michelia 2: 72. 1880. fig. 44

≡ Nectriella consolationis (Saccardo) Müller in Müller & Arx, Beitr. Kryptogamenfl. Schweiz 11: 642. 1962.

HOLOTYPE: FRANCE. On upper side of leaf of Laurus nobilis, Jun, Brunaud 45 (PAD!).

Anamorph: not known.

Habitat: leaves of Laurus nobilis.

Distribution: Europe.

Ascomata subglobose, 160 μm high x 180 μm wide, remaining immersed, scattered, pale orange; papilla rounded, protruding through cracks in leaf epidermis; clypeoid tissues inconspicuous. Cells on surface of ascomata obscured. Ascomatal wall 8-10 µm wide, of one layer of interwined hyphae; individual cells obscured; hyphae of wall especially at apex mingling with leaf cells. Asci clavate when young, 50-90(-160) x 12 µm, ellipsoid at maturity, 40-55 x 16-25 µm, floating free; apical ring or thickening not observed and the protrusion of epiplasm in the apex appearing angular; ascospores crowded in upper part, biseriate, becoming multiseriate. Ascospores cylindrical to ellipsoid, 16-30 x 5-10 µm, often constricted, 1-septate, hyaline, verruculose, guttules often present. Paraphyses apically free, 2 µm wide, 3 µm wide at apex, septate, unbranched, becoming gelatinized.

Additional specimens examined:

U.K., England. Cornwall: St. Minver, on leaf litter of *Laurus nobilis*, 16 Jun 1980, *P.M. Kirk 640* (IMI 249613); W. Sussex, Arundel Castle, on bottom of leaf of *Laurus nobilis*, 13 Jul 1983, *R.W.G. Dennis* (IMI 279333).

Discussion: *Charonectria consolationis* has been redescribed twice since being introduced by Saccardo. Müller in Müller and Arx (1962) combined the species in *Nectriella*. Kirk (1981, fig. 9A) redescribed and illustrated *N. consolationis* as a part of his study of fungi on *Laurus nobilis* litter. Kirk did not describe the paraphyses.

The wall of the ascomata of *Charonectria consolationis* fragments easily when sectioned because of the narrow width, interwined cells, and intermixing with the leaf cells.

3. CHARONECTRIA SCEPTRI (Karsten) Lowen, comb. nov. fig.45.

≡ *Nectria sceptri* Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 8: 213. 1866.

≡ *Nectria dacrymycella* (Nyl.) Karst. var. *sceptri* (Karst.) Karst., Fung. Fenn. exs. 667. 1866, description on label.

≡ *Calonectria sceptri* (Karst.) Sacc., Michelia 1: 314. 1878.

≡ *Nectriella sceptri* (Karst.) Rossman, Mycotaxon 8: 542. 1979.

≡ *Hyponectria* sceptri (Karst.) Samuels, Rogerson, Rossman & Smith, Canad. J. Bot. 62: 1902, figs. 14-22. 1984.

= *Nectria dacrymycella* (Nyl.) Sacc. f. *aconiti* Sacc., Syll. Fung. 2: 490. 1883.

≡ *Calonectria dacrymycella* (Nyl.) Sacc. f. *aconiti* Sacc., Syll. Fung. 2: 490. 1883.

= *Peziza oleosa* Ellis, Bull. Torrey Bot. Club 10: 52. 1883.

≡ *Calloria oleosa* (Ellis) Sacc., Syll. Fung. 8: 639. 1889.

= *Charonectria pedicularis* Tracy & Earle in Greene, Pl. Baker. 1: 26. 1901.

≡ Nectriella pedicularis (Tracy & Earle) Seaver, Mycologia 1: 46. 1909.

≡ Nectria pedicularis (Tracy & Earle) Petrak, Hedwigia 68: 230. 1928.

HOLOTYPE: USSR. Murmansk Region: Lapponia, Tulomensis, Subovi, on dead stems of Sceptrum carolinum, 11 Jul 1861, P.A. Karsten, (H, as Peziza sceptri!).

Anamorph: not known.

Habitat: dead stems of herbaceous plants, in 24 genera in the following families: Caprifoliaceae, Compositae, Cyperaceae, Gramineae, Labiatae, Leguminosae, Oleaceae, Ranunculaceae, Rosaceae, Scrophulariaceae, Umbelliferae.

Distribution: high altitude or latitude: Alps (Italy, Switzerland), western U.S.A., USSR.

Ascomata subglobose, 300-375 high x (295-)320-500 µm wide, immersed-erumpent but remaining under the raised cuticle of host, scattered or in groups of up to 20, nonstromatic, brownish yellow to orange to red orange, not changing color in KOH; papilla inconspicuous, 40-60 µm high x 80-120 µm wide; collapse vertical with papilla retaining shape, becoming ring-like with a central depression and a raised margin. Ascomata when squashed extruding periphyses, 40 x 0.5 µm, and yellow or orange droplets. Cells on surface of ascomata angular. Ascomatal wall (25-)32-50 µm wide, of two regions; inner region 20-30 µm wide, of thin-walled rectangular to ellipsoid cells 10-15 µm long x 4-6 µm wide;

outer region 10-20 μm wide of thick-walled, angular, rounded, fused cells, with hyphal characters, extending growth into the substrate at apex and base. Asci clavate, (48-)80-130 x (8-)10-15 μm; apex truncate to slightly rounded, containing a minute nonamyloid apical ring; ring cap-like or seen as two thickenings with phase contrast microscopy; protrusion of epiplasm in apex appearing angular; base pedicellate; ascospores biseriate in the middle, uniseriate above and below, occupying the upper 2/3 of the ascus. Ascospores, ellipsoid-fusiform, (16-)18-24 x 3.5-5.5 μm, 1-septate, hyaline, pale orange in mass, spinulose, several pale orange to yellow guttules per cell. Paraphyses apically free, 4-5 μm wide, sparse, septate, occasionally branched.

Additional Specimens examined:

AUSTRIA. Tirol: location unknown, on dead stems of _Aconitum_, Sep 1909, collector unknown, (IMI 52314, slide); Tirol: location unknown, on _Aconitum variegatum_, Jul 1878, _Brotzel_ (IMI 52311, slide ex S, as _Nectriella dacrymycella_); Tirol: St. Leonard in Pitztal, Taschrader Gletscher, ca. 6800′, under the epidermis of diverse dry stems and leaves, 18 Aug 1875, _Rehm_, Ascom. 232b, Thümen Mycoth. Univers. 1064 (FH-Höhnel, slides 3-1, 3-5; K; NY; S; all as _Nectriella dacrymycella_). GERMANY. Bavaria: Hochvogel, Bägündele-Alpe (Algäuer Hochalpen) ca. 1300 m, on dry stems of _Aconitum napellus_ 1909, _Rehm_, Ascom. 1868 (IMI, slide ex S; K; NY; S; all as _Calonectria dacrymycella_ f. _aconiti_). ITALY. Vette di Feltre Mountains, in stems of _Aconitum napellus_ associated with _Leptosphaeria modesta_, _Bizzozero_ (Type of _Nectria dacrymycella_ f. _aconiti_; IMI 52312, slide). SWITZERLAND. Grisons: Klosters, Mönchalptal, 2400 m, on _Cirsium spinossisimum_ (L.) Scop., 1 Sep 1987, _G.J. Samuels & E. Müller_ (NY; ZT, not examined); Grisons: Albula pass, below Murtel digl Crap alv., on _Peucedanum ostruthium_ (L.) Koch, 5 Sep 1987, _E. Müller_ (NY); Grisons: Albula pass, Westseite, westlich des Weges von Weissenstein zur Fuorcla Crap alv., on _Peucedanum ostruthium_, 5 sep 1978, _E. Müller, O. Petrini, & G. J. Samuels_ (NY). U.S.A. Colorado: Boulder County, near Mitchell Lake, 10,703 ft., Roosevelt National Forest, on dead stems of herbaceous plant, 27 Aug 1964, _C.T. Rogerson_ (NY); Boulder County, trail to Mitchell Lake, Roosevelt National Forest, on dead stems of umbelliferous plant, 27 Aug 1964, _C.T. Rogerson_ (NY); Boulder County, Fourth of July Campground, 8 m NW of Nederland, (ca. 40°N; 105°38′ W.), alt. 10,250 ft., along north fork of Middle Boulder Creek, on dead stems of _Heracleum lanatum_, 21 Aug 1964, _C.T. Rogerson_ (NY); Middle Boulder, on _Heracleum lanatum_ Michx. [cow parsnip], 24 Jul 1929, _F.J. Seaver & P.F. Shope_ (BPI; as _Nectriella_ with epithet _macrospora_, unpublished herbarium name); Grand County, Church Park, Arapaho National Forest, 9900 ft, T1S R77W S28, W of Fraser, on dead stems of Pedicularis groenlandica Retz., 23 Aug 1983, C.T. Rogerson (NY); Larimer County, vicinity of Cameron Pass Campground, Roosevelt National Forest, headwaters of Cache La Poudre River, 10,276 ft, on dead overwintered stems of Pedicularis racemosa Douglas, 4 Aug 1984, C.T. Rogerson (NY); same location, on dead overwintered stems of Pedicularis bracteata Bentham var. paysoniana (Pennell) Cronquist, 4 Aug 1984, C.T. Rogerson (NY); same location, on dead overwintered stems of Penstemon virgatum Gray var alpinum Torrey, 4 Aug 1984, C.T. Rogerson (NY); Larimer County, Trail Ridge Road, between Rainbow Curve and Forest Canyon Overlook, Rocky Mountain National Park, 11,000 ft, on dead stems of Senecio serra Hooker, 7 Aug 1984, C.T. Rogerson (NY); Rabbit Ears Pass, on dead stems of composite, M. & H. Flemming (C.T. Rogerson 66-70), 4 Sep 1966 (NY); La Plata mountains, Bear Creek Divide, 11,000 ft., on dead stems of Pedicularis crenulata [Scrophulariaceae], 29 Jun 1898, C.F. Baker, F.S. Earle, & S.M. Tracy, 230 (HOLOTYPE of Charonectria pedicularis, NY; isotypes: FH; BPI; K); Harkness 1033 (K); Utah: 49 collections by C.T. Rogerson were examined from the following counties: Box Elder (12), Cache (4), Duchesne (5), Iron (1), Rich (6), Sanpete, Summit (7), Wasatch (1), Weber (2), on the following host genera: Aconitum, Actaea, Agastache, Aquilegia, Bromus, Carex, Castilleja, Cirsium, Delphinium, Geum, Helenium, Helianthella, Lathyrus, Lomatum, Ligustrum, Osmorhiza, Pedicularis, Potentilla, Rudbeckia, Sambucus, Sceptrum, Scrophularia, Senecio, Thalictrum; Carbon County, Pleasant Valley near Schofield, 7000 ft., on dead herbaceous stems, Feb 1882, S.J. Harkness (HOLOTYPE: Peziza oleosa, NY). USSR. Murmansk region: Lapponia, Tulomensis, Subovi, på torra stjelkarai Sceptrum carolinum, 11 Jul 1861, P.A. Karsten, Fung. Fenn. 8: 667. 1861 (FH-Höhnel [asci immature], K, S, as Nectria dacrymycella var sceptri).

Discussion: Cultures described from Samuels et. al (1984) were derived from ascospores germinated in cold conditions (0-15°). The above authors reported that in cultures derived from single ascospores conidia were not observed but ascomata formation occurred in colonies derived from several (not from single) ascospores grown in darkness. Ascomata formation in cultures derived from mass ascospores which ascomata developed occurred herein also. The difference is that in addition to cold temperature, contamination by another fungus apparently is another stimulus of ascomatal formation.

Ascomata of the type specimen of Nectria sceptri f. aconiti are papillate and the asci and ascospores are shorter than those of the type specimen of Charonectria sceptri but can be included in the latter taxon because the forma falls within the range of variation of C. sceptri.

Charonectria sceptri differs from Hyponectria buxi by the sparse, septate, apically free paraphyses, asci with an inconspicuous, J- apical ring and by epiplasm that appears angular at the apex.

Ascomata of Charonectria sceptri and C. consolationis both are orange, have apically free paraphyses and a similar ascal apex and bicellular ascospores. Thus, I have no doubt that the two are congeneric.

CHARONECTRIA, EXCLUDED SPECIES

Charonectria sasae Hara, Trans. Mycol. Soc. Japan 4: 3. 1957, name invalid (Art. 36.1, no latin, no reference to previous latin description or basionym).

≡ Calonectria sasae Hara, Bot. Mag. Tokyo 27: 247. 1913.

Type: JAPAN. Gifu Pref.: Kawakami, Mino River, parasitic on the leaf sheath of Sasa albo-marginata [Gramineae], Feb 1912, Hara (not examined).

Habitat: leaf sheath of bamboo.

Distribution: Japan.

Stromata immersed at first, then erumpent, in groups, shape irregular, massive, soft, fleshy, orange-yellow, surface granular, roughened. Ascomata globose, 250-300 µm wide, buried in the stromata; wall fleshy, orange-yellow. Papilla, pear shaped; ostiole slender and slightly protruding; periphyses present. Asci cylindrical to broad, swelling, 90-110 x 12-16 μm, apex pointed or truncate, middle sometimes depressed, containing a disk, ascospores uniseriate to diagonally uniseriate. Ascospores ellipsoid, 13-16 x 8-10 μm, single celled; contents granular at first, then 1-septate, often slightly constricted, hyaline to pale yellow, one guttule per cell. Paraphyses needle-shaped, to 2 μm wide, hyaline, equalling the length of the ascus.

Differs from *Calonectria balanseana* Berl. in the color of the stromata and the shape of the spores.

Discussion: The above description was taken from Hara (1913, 1957). Hara published this species, with the same type specimen, twice in different genera, *Calonectria* (1913) and *Charonectria* (1957). *Charonectria sasae* was proposed without a latin description and without reference to the earlier description. Because the concept of *Calonectria* current in 1913 included elongate phragmospores and this concept does not agree with the description of 1-septate ascospores for *Calonectria sasae* (1913), it is likely that "*Calonectria*" was a misprint for "*Charonectria*." Since Hara (1957) in attempting to correct the error, did not cite the basionym and did not provide a latin description, *Calonectria sasae* is the only valid name available.

Rossman (1979) said that the type collection of *Calonectria sasae* was not found at TNS.

From the published description, I exclude *Calonectria sasae* from *Nectriella* because of the presence of stromata and apically free paraphyses. The presence of paraphyses also excludes C. sasae from the Hypocreales and a new disposition is likely when the collection is examined.

IV. **CRYPTONECTRIELLA** (Höhnel) Weese, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1 (2). 128: 715. 1919.

≡ Nectriella Nitschke sect. Cryptonectriella Höhnel, Ann. Mycol. 16: 36. 1918.

Type species: Cryptonectriella biparasitica (Höhnel) Weese.

Ascomata obpyriform to subglobose, 75-500 μm diam, immersed, scattered or in groups, nonstromatic, yellow, not changing color in KOH. Ascomatal wall of one region, 7 to 25 μm wide. Ascomatal apex of rows of parallel, vertically elongated cells that are continuous with the inner region of the ascomatal wall; cells becoming increasingly narrow and merging with the periphyses and somewhat expanded or clavate where they terminate at the exterior. Asci clavate, usually not over 100 μm long or 15 μm wide, 8-spored, unitunicate, apex simple or containing a nonamyloid apical ring; ascospores uniseriate or biseriate, not filling the base of the ascus. Ascospores ellipsoid, typically not over 15 μm long and 8 μm wide, 1-septate, hyaline, smooth, guttules present. Paraphyses apically free, to 2 μm wide, septate. Fungicolous.

Discussion: The genus Cryptonectriella includes species that are nonstromatic, immersed in other ascomycetes, have stipitate asci, discrete, apically free paraphyses and are otherwise similar to Nectriella. The presence of apically free paraphyses is not known in the Hypocreales (Rogerson, 1970). The genus is assigned to the Xylariales, Hyponectriaceae (sensu Barr, 1990) on the basis of the KOH- ascomata and hamathecium. The two species follow.

1. CRYPTONECTRIELLA BIPARASITICA (Höhnel) Weese, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1 (2), 128: 715. 1919.

fig. 46

≡ Charonectria biparasitica Höhnel, Ann. Mycol. 1: 395. 1903.

≡ Nectriella biparasitica (Höhnel) Weese, Ann. Mycol. 12: 152. 1914.

HOLOTYPE: CZECHOSLOVAKIA. Bohemia: Kubany, Urwald, Böhmerwald, in old, empty ascomata of Valsa flavovirens [Nitschke], in branch of Fagus, 6 Jun 1903, Höhnel (FH-Höhnel!, Höhnel slides 3-20!).

Anamorph: not known.

Habitat: fungicolous; in old ascomata of Valsa.

Distribution: known only from the type.

Ascomata obpyriform, 336 high x 378 µm wide, immersed singly in empty, separate ascomata of Valsa flavovirens, nonstromatic, papillate, yellow, not changing color in KOH; papilla conical, 50 µm high x 42 µm wide. Ascomatal wall 25 µm wide, of thick-walled elongate cells, 3.5-7.0 x 2 µm.

Asci clavate, 80-100 x 8-10 μm; apex rounded, containing a nonamyloid apical ring; epiplasm in apex appearing coronate; ascospores obliquely uniseriate (occasionally biseriate) in the upper two thirds of the ascus; base empty and attenuated. Ascospores ellipsoid, 10-12 x 6-8 μm, L/W 1.6, 1-septate, hyaline, smooth to irregularly pitted, at first multiguttulate, later with one guttule per cell. Paraphyses apically free, 80 x 0.5-2.0 μm, septate, rounded.

Discussion: Although the species Cryptonectriella biparasitica and Cryptonectriopsis biparasitica (Höhnel) Weese, type, Rehm Ascomyceten 1523, share epithets and authorities, they are unrelated. Cryptonectriopsis biparasitica was first described by Höhnel (1918) in Hyponectria as a parasite in old ascomata of Leptosphaeria dolioloides (as Phomatospora ovalis (Passerini) Sacc.). Arx and Müller (1954) included P. ovalis in the synonymy of Heteropera borealis (Sacc.) Theissen [= Physalospora borealis Sacc., 1904). Arx and Müller (1954) interpreted the thick ascomatal wall as a stroma and determined that Cryptonectriopsis biparasitica is a synonym of Heteropera borealis (Sacc.) Theissen (Diaporthales). They surmised that Höhnel erroneously thought that the pale colored part was hyperparastic in the dark ascomatal wall. Arx and Müller (fig. 109: 360, 1954) concluded that only one fungus is involved. Subsequent authors agreed with Höhnel. Petrak (1960) recognized that Heteropera borealis is based in a fungus identical with Cryptonectriopsis biparasitica. Barr

(1978) considers Rehm Ascomyceten 1523 from the description to be a species of Phomatospora and that Cryptonectriopsis is congeneric with Phomatospora. Barr (1978) declared the name Heteropera, based on a combination of characteristics of Cryptonectriopsis biparasitica, invalid. I follow Höhnel, Petrak and Barr in concluding that the ascomata of C. biparasitica are immersed in empty pleosporaceous ascomata. Because Barr (1990) placed Phomatospora in the Amphisphaeriaceae, there is no relationship to Cryptonectriella biparasitica.

Charonectria biparasitica was redescribed by Müller and von Arx (1962, as Nectriella). The description herein, based on a squash mount from the type collection, has ascospores shorter than those in the protologue. The type material was too sparse to make sections.

2. CRYPTONECTRIELLA GEOGLOSSI (van Overeem) Lowen, comb. nov. fig. 47

≡ Nectriella geoglossi van Overeem, Bull. Jard. Bot. Buitenzorg III, 5: 249, pl. 2. 1923.

HOLOTYPE: INDONESIA. Java: Buitenzorg, Bogor, botanical garden, in Bambusa shrub, parasitic in hymenium of Geoglossum walteri Berk., Mar 1921, C. & D. van Overeem-de Haas 600 (BO 09773!, Isotype slides NY!).

Anamorph: not known.

Habitat: fungicolous; hymenium of Trichoglossum.

Distribution: known only from the type

Ascomata subglobose to ellipsoid, 77-144 high x 35-90 µm wide, crowded at the surface of the stromata of the *Trichoglossum*, completely immersed, barely visible through the hymenium, separated by the asci and paraphyses of the *Trichoglossum*, nonstromatic, hyaline. Ascomatal wall 7-10 µm wide, of fused hyphae. Periphyses present. Asci clavate, 70 x 4.5-6.5 µm; spore bearing part 25-30; base long and thin; apex rounded, slightly thickened; apex of epiplasm depressed in center; ascospores biseriate in the middle, uniseriate above and below, not filling the base. Ascospores ellipsoid, variable, one end often slightly attenuated, 6-9(-14) x 2.0-3.5 µm, 1-septate, often slightly curved, hyaline, smooth; guttules occasionally present. Paraphyses apically free, narrowly filamentous, 0.5-1.0 µm wide.

Additional specimens examined:

INDONESIA. Java: Buitenzorg, Bogor botanical garden, parasitic in hymenium of *Geoglossum walteri* Berk., Mar 1931, collector unknown (BO 12195); Same location and host, Apr 1931, collector unknown (BO 12358).

Discussion: *Cryptonectriella geoglossi*, known from only three collections from the Bogor botanical garden, is found in moist places among mosses and is rare (van Overeem, in herb.). Because, as indicated by the original description, the host fungus does not appear to be damaged, *C. geoglossi* must have been found accidentally. Rifai, while annotating specimens of *Cryptonectriella geoglossi*, redetermined the host as *Trichoglossum hirsutum* (Pers: Fr.) Boud.).

Because of the long empty base of the ascus, the presence of apically free paraphyses, the pallid KOH- ascomata, the rounded ascal apex and fungicolous habit, I place this species along with C. biparasitica in Cryptonectriella.

V. **HYDRONECTRIA** Kirschstein, Verh. Bot. Vereins Prov. Brandenburg 67: 87. 1925.

Type species: H. kriegeriana Kirsch.

Clypeoid tissues hyaline, inconspicuous. Ascomata obpyriform, immersed-erumpent, scattered or in groups, nonstromatic, orange, not changing color in KOH. Ascomatal wall of two regions at apex and sides, to 30 µm wide, one region at base: outer region of thick-walled rounded cells containing oily orange pigment; inner region of hyaline cells. Ascomatal apex typically of rows of cells that are continuous with the inner region of the ascomatal wall. Asci ovoid, usually not over 100 µm long, to 30 µm wide, 8-spored, unitunicate; apex truncate; apical ring absent; ascospores multiseriate, filling the ascus. Ascospores fusiform to ellipsoid, inequilateral, typically not over 25 µm long and 8 µm wide, 1-septate, hyaline, smooth. Paraphyses with free apices absent. Aquatic on rocks associated with algae or marine on driftwood.

Rogerson (1970) accepted Hydronectria in the Hypocreales. J. and E. Kohlmeyer (1979) briefly redescribed

Hydronectria as a member of the Hypocreales along with their description of H. tethys J. & E. Kohlmeyer, a species that they considered secondarily marine. Müller and Arx (1962) redescribed the genus along with their description of H. kriegeriana. On the basis of his examination H. kriegeriana, Reidl (1987) determined that Hydronectria is lichenized. He found a thread-like species of the alga Trentepolia inside the substrate. Trentepolia was not seen herein.

Hydronectria is referable to the Hypocreales because of the pallid, soft-textured ascomata with the absence of apically free paraphyses in the hamathecium. The presence of clypeoid tissues, the separable ascomatal wall layers, the ovoid asci, large, multiseriately arranged ascospores, and aquatic habitat separate Hydronectria from Nectriella. There is one other species in Hydronectria, H. tethys, described by J. Kohlmeyer (1965, 1984) and J. & E. Kohlmeyer (1979). H. tethys, found in driftwood from pantropical marine waters, has pinkish, immersed ascomata with clavate asci, 90-105 x 15-23 μm and ascospores that are 17-26 x 9-13 μm, striate (IMI 103837!) to smooth (in var. glabra Kohlm.) .

1. HYDRONECTRIA KRIEGERIANA Kirschstein, Verh. Bot. Vereins Prov. Brandenburg 67: 87. 1925. fig. 48.

HOLOTYPE: GERMANY. Brandenburg, North Küstrinchen, Küstrinchener stream, on rocks on lichen, 3 Oct 1923, Krieger and 2 Oct 1924, Krieger & Hillmann, (B!).

Habitat: red algae (<u>Hildenbrandia</u> Liebm.) J. Agardh; in fresh water on rocks.

Distribution: known only from the type.

Anamorph: not known.

Ascomata obpyriform, 300 high x 400 µm wide, immersed in purple colored alga on rocks, becoming partly erumpent, scattered, brownish orange, not changing color in KOH; collapse vertical. Ascomatal wall of two regions; outer region orange, of thick-walled ellipsoid to globose cells 16 µm diam; inner region separable from outer, hyaline, of thick-walled ellipsoid to globose cells 4 µm diam; ascomatal apex of rows of vertically elongated cells continuous with the inner region of the ascomatal wall. Asci ovoid, 60-92 x 20-32 µm; apical ring absent; ascospores multiseriate, filling the ascus. Ascospores ellipsoid-fusiform, 35-38 x 10-13 µm, constricted, 1-septate, hyaline, smooth.

Discussion: Although the protologue cites one collection, the data with the type of <u>Hydronectria kriegeriana</u> indicates that the material consisting of several rocks is derived from two gatherings that have been combined. The complete collection is taken as the holotype.

Müller and Arx (1962) redescribed and illustrated <u>Hydronectria kriegeriana</u>.

VI. **NECTRIA** Fr.

Type species: <u>N. cinnabarina</u> (Tode: Fr.) Fr.

Ascomata obpyriform, conical or subglobose, 100-700 µm diam, superficial or immersed in stroma, scattered or in groups, stromatic or nonstromatic, colors variable, yellows to red to pale brown, KOH+ or KOH-. Setae present in some species. Cells on surface of ascomata variable. Ascomatal wall 10-40 µm or more wide, one or more regions. Asci cylindrical to clavate, usually 8-spored, usually not over 100 µm long or 15 µm wide, apex truncate; nonamyloid apical ring present or absent; ascospores uniseriate to biseriate. Ascospores fusiform to ellipsoid, typically not over 25 µm long and 8 µm wide, sometimes constricted, 1-multiseptate, hyaline to yellow-brown, rarely red, green, or yellow, smooth spinulose to tuberculate, striate, guttules present or not. Paraphyses with free apices absent.

Fungicolous, herbicolous, licheincolous, lignicolous, corticolous.

Anamorphs: Many genera including Acremonium, Cylindrocarpon Wollenw., Dendrodochium Bon., Fusarium, Tubercularia and Verticillium (see Samuels and Seifert, 1987).

1. NECTRIA AUREOLA Winter, Hedwigia 24: 261. 1885.

= Nectriella aureola (Winter) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 118: 820. 1909.

= Lasionectria aureola (Winter) Petch, Trans. Brit. Mycol. Soc. 21: 267. 1938.

Type: GERMANY. Leipzig, 1885, G. Winter, Rabenh. Fungi eur. et extraeur., Cent. 33 & 34 (not examined).

Anamorph: not known.

Habitat: fungicolous; mycelium of *Meliola*.

Distribution: Europe.

Discussion:

Höhnel (1909a) in discussing *Nectria* on *Meliola*, inadvertently combined *Nectria aureola* in *Nectriella*.

Booth (1959) considered *Nectria aureola* a member of the *N. lasiosphaeria*-Group because of the setose ascomata.

2. NECTRIA BAMBUSAE Berk. & Br., J. Linn. Soc. Bot. 14: 115. 1873.

≡ *Nectriella bambusae* (Berk. & Br.) Saccardo, Michelia 1: 279. 1878.

≡ *Pseudonectria bambusae* (Berk. & Br.) Höhnel in Höhnel & Weese, Ann. Mycol. 8: 464. 1910.

HOLOTYPE: Ceylon (SRI LANKA). on bamboo, n. 1015 (K!; Isotype: FH- Höhnel slide 3-20!).

Anamorph: not known.

Habitat: bamboo.

Distribution: Sri Lanka, tropical.

Ascomata subglobose, superficial, red; apex flattened with a tiny, conical central papilla. Ascospores ellipsoid, 8-10 x 3 μm, 1-septate.

Discussion: Pseudonectria bambusina H. & P. Sydow (Ann. Mycol. 15: 214. 1917) on bamboo from the Philippine Islands could be the same fungus but the type was not examined.

Nectria bambusae belongs in Nectria because of sthe superficial, red ascomata and bicellular ascospores. The subglobose ascomata with the flattened apices are similar to N. discophora (Mont.) Mont. but may be distinguished by the smaller ascospores.

3. Nectriella callorioides Rehm, Hedwigia 37: 189, pl. 8, fig. 1. 1898.

≡ Pseudonectria callorioides (Rehm) Höhnel in Höhnel & Weese, Ann. Mycol. 8: 468. 1910.

= Pseudonectria tornata Höhnel, Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. 1, 118: 1470. 1909 [fide Höhnel, 1912].

= NECTRIA OCHROLEUCA (Schw.) Berk., Grevillea 4: 16. 1875.

HOLOTYPE: BRAZIL. Santa Catarina: Blumenau, on leaves of ?Agave [identified as Pandanus by Höhnel, 1912], Sep 1888, Ule 999 (isotypes FH-Höhnel, 3-20!, K!).

Anamorph: not known.

Habitat: leaves.

Distribution: Subtropical.

Stromatic base inconspicuous. Ascomata subglobose, 360 high x 320 μm wide, superficial, scattered or in groups, nonpapillate, not changing color in KOH. Cells on surface rectangular, 8 x 12-14 μm, smooth or roughened. Ascomatal wall 10 µm wide. Asci 30-40 x 6-8 µm; containing an apical ring; ascospores biseriate. Ascospores cylindrical to ellipsoid, slightly curved, 10-13 x 2-2.5 µm, 1-septate; septum difficult to see, hyaline, smooth, 2 guttules per cell.

Additional specimen examined:

BRAZIL. Santa Catarina: Blumenau, on fallen parts "cineritriodes," Sep 1908, (NY). INDONESIA. Java: Tjibodas, on leaf of Pandanus Bl., 1907-1908, Höhnel (FH-Höhnel, slide 3-1).

Discussion: The type examined by Samuels at K had ascomata of Nectria ochroleuca but none remained on the part at B (pers. comm.).

Nectria ochroleuca is the basis of the N. ochroleuca-Group (Samuels, 1976). The group is characterized by superficial, orange, KOH-, often stromatic ascomata. The walls are frequently tuberculate and the ascomata are found on herbaceous debris or on wood. The known anamorphs are species of Clonostachys Corda, Dendrodochium Bonorden, Myrothecium Tode, and Sesquicillium Gams.

4. NECTRIA CARNEA Desmazières, Bull. Soc. Bot. France 4: 998. 1857, "carneum."

= Nectriella carnea (Desm.) Sacc., Michelia 1: 278. 1878, non N. carnea Fuckel, 1870.

LECTOTYPE, part on Carex leaves designated herein: FRANCE. on dry leaves of Luzula (as Caricis) and Buxus, Summer, Desm., Pl. Crypt. France, ed. 1, ser. 2, fasc. 8: 373 (PC!).

Discussion: The syntype material at PC of Nectria carnea on leaves of Buxus sempervirens is a mixture of Pseudonectria rousseliana and P. coronata.

5. NECTRIA CHLORINA Crouan & Crouan, Fl. Finistère, p. 37. 1867.

≡ Nectriella chlorina (Crouan & Crouan) Saccardo, Michelia 1: 278. 1878.

LECTOTYPE, designated herein: FRANCE. Brittany: Finistère, at the base of a dead branch of Angelica sylvestris, 20 May 1857, labeled "Nectria chlorina olim, Sphaeria citrina Wallr., N. chlorina Fr. Summa." Crouan & Crouan (CO!; isotype: packet with picture labeled "la theque ne present pas...d'un fluid du lactique, grosse 40 fois", CO!).

Anamorph: not known.

Ascomata obpyriform, 220 µm high x 190 µm wide, superficial, scattered or in groups of 3, nonstromatic, translucent red (bright yellow at first, then yellow-brown when dry according to the protologue), becoming darker red in KOH, and slowly yellow in lactophenol; papilla conical. Surface covered with hyphae, 1-2 µm wide. Asci cylindrical, 35-40 x 4-5 µm; apex truncate, containing a ring; ascospores uniseriate. Ascospores ellipsoid, 5.5-7.0 x 2.5-3.0 µm; 1-

septate, hyaline, smooth to slightly striate, often one guttule per cell.

Discussion: Although the drawing on the packet and the original description of Nectria chlorina describe bright yellow ascomata, the ascomata examined were translucent red but otherwise fit the original description. The fungus is best placed in Nectria subg. Dialonectria (Sacc.) Cooke (1884). Species of Nectria subg. Dialonectria were formerly placed in N. episphaeria-Group of Booth (1959) and Samuels et al. (1991). The species are characterized by superficial, nonstromatic, KOH+ ascomata that are usually associated with other fungi, asci often with a ring, and ascospores that are smooth to ornamented and colorless to yellow-brown. The anamorphs are described in Acremonium, Chaetopsina Rambelli, Fusarium, Cylindrocladiella Boesew., Verticillium, and Volutella.

6. NECTRIA CHRYSITES (Wallroth) Rabenhorst, Bot. Zeitung (Berlin) 9: 180. 1851.

≡ Sphaeria chrysites Wallr., Fl. crypt. Germ. 2: 841. 1833.

≡ Hypoxylon chrysites (Wallr.) Westendorp, Herb. crypt., fasc. 8: 365, 1, 3. 1849, description on label (K!).

≡ Nectriella chrysites (Wallr.) Sacc., Michelia 1.: 278. 1878, as N. chrysites Crouan & Crouan.

HOLOTYPE: GERMANY: Saxony: Thüringia, on dry branches of Ribes nigrum, Wallr. Sched. Crit. Pl., 1822 (not examined).

Anamorph: not known.

Habitat: dead wood.

Distribution: Europe.

Stromata erumpent through bark, bright yellow. Ascomata turbinate, 300 x 250 µm wide, umbilicate, superficial, grouped on stromata, bright yellow, turning red in KOH and yellow in lactophenol; collapse vertical. Cells on surface roughened. Ascus 60-70 x 8 µm; ascospores uniseriate to biseriate. Ascospores ellipsoid, 8 x 4 µm, 2-celled; septum often difficult to see.

Specimens examined:

FRANCE. Brittany: on dead bark of broom and gorse, 24 Feb 1864, Crouan & Crouan (CO; as Nectria chrysites Wallr.); on the bark of Ulex europaea (gorse), Feb 1851, Crouan & Crouan (CO; as Nectria ochracea (Grev.) Fr., Summa). GERMANY. Saxony: Hermsdorf, Königstein, in dry branches of Ulmus campestris L., Rabenh. Herb. mycol., ed. 2: 632. 1858, ed. 1: 1444, Jun 1857 [Tubercularia cf. vulgaris also present] (K; IMI; both as Nectria chrysites).

Discussion: The nomenclature is confused because of incorrect author citations. Wallroth appears to be the earliest author. Saccardo incorrectly attributed the name Nectria chrysites to Crouan; The Crouans, however, cited

Wallroth. Saccardo's combination in Nectriella was based on incorrect descriptions of unicellular ascospores by the Crouans. Although the type was not examined, the specimens that were examined herein, agree with the original description. The ascomata of Nectria chrysites are yellow and stromatic much like those of N. cinnabarina except for the color.

7. NECTRIA CITRUM (Wallr.) Fr., Summa veg. Scand., sect. post., 388. 1849, as N. "citrina."

≡ Sphaeria Citrum Wallr., Fl. crypt. Germ. 2: 788. 1833, non Sphaeria citrina Pers., Syn. Meth. Fung. 1: 18. 1801 [= Hypocrea citrina (Pers.: Fr.) Fr.].

≡ Nectriella citrum (Wallroth) Saccardo, Michelia 1: 278. 1878, as N. "citrina."

HOLOTYPE: GERMANY: Thüringia, on trunks of rotten alder, Wallroth (not examined).

Anamorph: Tubercularia ciliata Ditmar, Deutschl. Fl. 3 (1): 29. 1817 (according to Smyk, 1975).

Ascomata superficial, solitary to gregarious in groups of a few, red-orange, translucent, orange in KOH, then dark red in lactophenol. Asci cylindrical; apex truncate, containing a ring. Ascospores naviculate, 5-11 x 2.5-4.0 μm, often slightly constricted, 1-septate, one cell ovate; one cell deltoid, hyaline, becoming pale brown, spinulose to striate, containing one guttule per cell.

Additional specimen examined:

FRANCE. Brittany: Finistère, on the dead stems of Daucus carrota, Crouan & Crouan (CO; as Nectria citrina).

Discussion: The epithet Citrum was capitalized by Wallroth (1833) while he used lower case for other epithets on the page; this was clearly used not an adjective but as a noun. Citrum is Latin for citron, a small tree, and thus as a noun in apposition carries its own gender. Fries (1849) incorectly changed the orthography, so the correct epithet is citrum. Saccardo followed Fries in making the epithet an adjective.

The combination Nectriella citrina was incorrectly attributed to Crouan & Crouan by Saccardo even though the Crouans (1876: 37) gave the species as N. citrum (Wallr.) Fr. The nomenclature is confused with Sphaeria citrina Pers. (= Hypocrea citrina).

The work by Smyk (1975) illustrates a stromatic nonpapillate fungus. Smyk obtained the anamorph Tubercularia ciliata in cultures derived from ascospores. These characters suggest that Nectria citrum has affinities to the N. cinnabarina-Group as defined by Seifert (1985) and Rossman (1989).

In contrast, Nectria citrum, based on the Crouan collection, is a Nectria with nonstromatic ascomata and in spite of the unusual KOH reaction, is closest to Nectria subgenus Dialonectria. The type must be studied to determine which species concept is correct.

8. NECTRIA CONSORS (Ellis & Everh.) Seaver, Mycologia 1: 61. 1909.

≡ Dialonectria (Nectriella) consors Ellis & Everh., J. Mycol. 4 (12): 122. 1888.

≡ Nectriella consors (Ellis & Everhart) Saccardo, Syll. fung. 9: 941: 15 1891.

= Nectria ignia Höhnel, Sitzungber. Kaisrl. Akad. Wiss. Math.-Naturwiss. Kl., Abt. 1, 118: 1475. 1909 [fide Samuels, 1977; Samuels, et al., 1990].

HOLOTYPE: U.S.A. Louisiana: St. Martinsville, on dead stems of Polygonum acre, 3 Sep 1888, Langlois, Flora Ludoviciana 1485 (NY!).

Anamorph: Volutella minima Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 118: 1543. 1909 (Samuels, et al., 1990).

Habitat: on dead herbaceous debris and on wood.

Distribution: New Zealand, Indonesia (Java, North Sulawesi), Colombia, Panama, Southern U.S.A., pantropical and subtropical.

Illustrations: Samuels (1977: 258, 259).

Ascomata obpyriform, 210-270 high x 150-220 μm wide, superficial, scattered or in groups of up to 6, often seated on sporodichium of Volutella with setae appearing to project from base of ascomata, red-orange; becoming deeper red in

KOH and yellow in lactic acid; papilla conical. Setae slightly clavate, 10-50 x 5 µm, scattered, red. Ascomatal wall 15-25 µm wide. Asci clavate, 40-65 x 6 µm, containing an apical ring; ascospores diagonally uniseriate to biseriate, filling the ascus. Ascospores fusiform, (9-)10-15 x 3-4 µm, 1-septate, hyaline, becoming pale brown, smooth, 1-2 guttules per cell that often disappear in mature ascospores.

CHARACTERISTICS IN CULTURE (condensed from Samuels, 1977). Colonies grown on CMD, OA, V-8,and PSA at room temperature and ambient light. Colonies on CMD reaching 20-50 mm in 2 wks; aerial mycelium scanty, zonate, white; margin undulate. Sporodochia forming concentric rings, on CMD, V-8, and PSA; abundant, scattered on OA, 50-100 high x 80-185 µm wide, stipitate; stipe 30-50 wide, white; setae lanceolate, 250-400 x 8-10 µm, colorless, thick-walled, septate; conidial mass conical. Conidiophores cylindrical, 25-30 x 2-3 µm at the base; closely aggregated, branching once or twice; phialides cylindrical, 10-15 x 2-3 µm, narrowing abruptly; collarette widely flared. Conidia ellipsoid, (4.5)5.0-7.0(-13.0) x 1.5-2.5(-3.0) µm, colorless, unicellular, 0-2 guttules, with a protuberant flattened basal abscission scar.

Additional specimens examined:

NEW ZEALAND. North Canterbury: Arthur's Pass National Park, Cockayne Nature Walk, on bark of <u>Pseudopanax crassifolia</u> [Araliaceae], 20 May 1983, <u>G.J. Samuels 83-</u>

153, T. Matusushima, A.Y. Rossman (PDD 46333; with and filed as *Nectriella obscura*); Auckland: Waitemata City, Waitakere Ranges, Piha Road, Cowan Track, on bark of *Ripogonum scandens* Foster & Foster [Liliaceae (liana)] 4 Jun 1983, A.Y. Rossman & G.J. Samuels 83-130 (PDD 46312; with and filed as *Nectriella obscura*).

Discussion: *Nectria consors* is a species of *Nectria* subg. *Dialonectria* because of the following characters: ascomata solitary, KOH+; ascomatal wall thin, red. The anamorph, *Volutella minima* can usually be found on the substrate and *N. consors* is often found with other fungi such as *Nectriella obscura*. See Samuels (1977) and Samuels et al. (1991) for redescriptions.

9. NECTRIA DIGITALICOLA Crouan & Crouan, Fl. Finistère, p. 37. 1867.

≡ *Nectriella digitalicola* (Crouan & Crouan) Saccardo, Michelia 1: 278. 1878.

HOLOTYPE: FRANCE. Brittany: in marshy places, on branches of *Digitalis*, 12 Oct 1863, Crouan & Crouan (CO!).

Anamorph: not known.

Ascomata obpyriform, 220 µm high x 190 µm wide, superficial, scattered or in groups up to 3, nonstromatic, red orange, becoming red in KOH and pallid in lactophenol; apex of papilla rounded; collapse vertical. Cells on surface of ascomata epidermoid, 8-12 in widest dimension, smooth. Asci clavate, 36-40 x 4.0-6.5 µm; apex rounded; apical ring

not visible; protrusion of epiplasm in the apex appearing angular; ascospores uniseriate with overlapping ends or irregularly biseriate, filling the ascus. Ascospores cylindrical, 11-12 x 3-4 μm, slightly constricted, 1-septate; septum difficult to see, hyaline, smooth.
Discussion: Ascomata on the type collection are sparse. Nectria digitalicola belongs in Nectria subg. Dialonectria because of the solitary, KOH+ ascomata with epidermoid surface cells.

10. Nectriella farinosa (Hennings) Möller, Bot. Mitt. Tropen 9: 296. 1901.

≡ Nectria farinosa Henn., Hedwigia 36: 219. 1897.

= NECTRIA BYSSICOLA Berk. & Br., J. Linn. Soc. Bot. 14: 116. 1873. [fide Samuels et al., 1991].

HOLOTYPE: SRI LANKA (Ceylon). Locality and date unknown, Thwaites 173d (not examined).

Anamorph: Dendrodochium sp. (Samuels et al., 1991).

Discussion: The holotype of Nectria farinosa (BRAZIL. Santa Catarina, Blumenau, on wood, A. Möller 181) was not examined.

Nectria byssicola was redescribed by Samuels et al. (1991) and placed in the N. ochroleuca-Group. Nectria byssicola, characterized by superficial, orange, tuberculate, stromatic ascomata found on the bark of recently dead wood, fits well in the group. The Dendrodochium anamorph is also consistent with the group.

This fungus is referred to the Nectria ochroleuca-Group because of the KOH-, stromatic ascomata. See Samuels et al. (1991) for a redescription and illustration of N. byssicola.

11. NECTRIA FLOCCULENTA (Hennings & Nyman) Höhnel, Kaiserl. Sitzungsber. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 121: 360, fig. 20. 1912.

≡ Nectriella flocculenta P. Hennings & E. Nyman in O. Warburg, Monsunia 1: 160, pl. 5, fig. 6. 1900 [1899].

= Nectria tjibodensis Penz. & Sacc. var. crebrior Sacc., Syll. Fung. 14: 636. 1899 [fide Samuels et al., 1991].

= Nectria bainii Massee var. hypoleuca Sacc., Nuovo Giorn. Bot. Ital. n.s., 23: 205. 1916 [fide Samuels et al., 1991].

= Nectria vanillae Zimmermann, Centralbl. Bakteriol. II, 8: 473. 1902 [fide Samuels et al., 1991].

HOLOTYPE: INDONESIA. Java: Bogor botanical garden, On dead herbaceous branches with Nectriella setulosa, Aug 1898, E. Nyman (isotype FH, herb. Theissen!).

Anamorph: Kutilakesopsis macalpinae Agnihothrudu & Barua, J. Indian Bot. Soc. 36: 309. 1957, (Samuels et al., 1991).

Habitat: on recently dead woody twigs, stromata of pyrenomycetes, herbaceous debris.

Distribution: Pantropical.

Stromata erumpent. Ascomata globose, superficial in groups, orange-reddish, not changing color in KOH, becoming yellow in lactic acid; papilla conical, darker red. Setae spinulose, to 70 µm, thin-walled, septate, unbranched, golden. Cells of surface of ascomata angular, 10 µm diam. Asci narrowly clavate (32-)42-63(-75) x (6.5-)7.5-10.0(-12.0 µm), containing an ring; ascospores partly biseriate. Ascospores ellipsoid to fusiform, 10-13(-17) x (2.5-)3.0-4.5(-6.0) µm, hyaline to pale brown, striate.

Discussion: Nectria flocculenta, fully described, including references to illustrations, by Samuels et al. (1990, fig. 19 D-F), belongs in the N. flavolanata-Group as defined by Samuels et al. (1991). The N. flavolanata-Group consists of species that have KOH+ ascomata with walls of angular cells that are ornamented with spinulose hairs, have colorless, striate ascospores and are found on recently dead twigs. The known anamorphs are Actinostilbe Petch and Kutilakesopsis Agnihothrudu & Barua.

12. NECTRIA GRAMINICOLA Berkeley & Broome, Ann. Mag. Nat. Hist. ser. 3, 2: 21, pl. 11, f.40. 1859, non Nectria graminicola Krieger = Nectria pseudograminicola Weese.

≡ Nectriella graminicola (Berk. & Br.) Niessl in Rabenh., Fung. eur., ed 3, 1652. 1873.

≡ Dialonectria graminicola (Berk. & Br.) Cooke, Grevillea 12: 110. 1884.

≡ Calonectria graminicola (Berk. & Br.) Wollenw., Phytopathology 3: 34. 1913.

Isotypes: U.K., England. Norfolk: Batheaston, Sphaeria on grass (Aira caespitosa), 15 Jan 1850, C.E. Broome, Brit. Fung. 897 (FH-Höhnel, slides 3-9!; K, 3 collections!).

Anamorph: not known.

Habitat: graminicolous.

Distribution: Europe.

Ascomata subglobose, 295-380 µm diam, superficial and easily dislodged, scattered, nonstromatic, brown, not changing color in KOH; collapse vertical, becoming deeply cupulate. Cells on surface angular, to 10-12 µm diam. Ascomatal wall 20-30 µm wide, of two regions; inner region 10 µm wide, of thin-walled elongate rectangular cells; outer region 10 µm wide of thick-walled angular rounded cells. Asci clavate, 40-68 x 8-12 µm; apex truncate, containing an apical ring; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores fusiform, 17-21 x 4 µm, 1-septate, hyaline, smooth to spinulose, 2 guttules per cell.

Additional Specimens examined:

AUSTRIA. Near Graz, in dry leaves of grass, autumn, Niessl 897, Rabenh. fung. eur. 1652 (K: 3 collections, S). U.K., SCOTLAND. Argyll: southeast corner of Kintyre, road across Achinhoan Head, on Juncus, 22 Sep 1980, R.W. Dennis (K).

Discussion: Ascomata of Nectria graminicola are loosely attached to the grass. Few ascomata remain in any of the isotype collections. Because of the sparse material, Booth (1959) considered Nectria graminicola a nomen dubium or as a probable synonym of Nectria arenula. The species can, however, be adequately described even though the material is sparse. The ascomata of Nectria arenula, seated on small stromata, collapse slightly when dry becoming shallowly cupulate. The ascospores are striate. Nectria arenula is distinct from N. graminicola.

Nectria graminicola belongs in the N. peziza-Group of Booth (1959). The KOH- ascomata with round cells in the outer region of ascomatal wall and the cupulate collapse are typical of the group.

13. NECTRIA HELENAE (Sacc. & Roum.) Lowen, comb. nov.

≡ Nectriella helenae Saccardo & Roumeguère, Rev. Mycol. (Paris) 5: 238, pl. 41, fig. 20. 1883.

Type: BELGIUM. Malmédy, on rotten stems of Brassica. 1883 Roum., Fung. Gall. exs. 2669 (isotypes: FH-Höhnel!; PC, 2 collections!; K!; NY!)

Anamorph: not known.

Habitat: Brassica.

Distribution: Europe.

Stromata red-brown. Ascomata ellipsoid, 190-240 high x 110-250 μm wide, superficial but surrounded with stromatic cells, clustered in groups of up to 20, nonpapillate, red-brown, not changing color in KOH; apex truncate; ostiolar area nipple-like; collapse lateral. Cells on surface epidermoid. Ascomatal wall 12-15 µm wide; cells thick-walled, rounded toward the outside, thinner and longer toward the interior. Asci clavate, 36-50 x 5 µm; apex truncate, containing an apical ring; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ellipsoid, 10-12 x 4 µm, 1-septate, hyaline, smooth.

Discussion: A note by Roumeguère on the packet stated that Nectriella helenae is named in memory of his friend Saccardo's daughter, Helenae--an angel in the sky--and that Saccardo was inconsolable when his daughter died.

If there is no material of Nectriella helenae in PAD, then the collection in PC labeled "Sur les tiges pourissants. In charu...199-4" should be designated the lectotype.

Nectria helenae differs from species of the Nectria subg. Dialonectria by the clustered, stromatic, KOH- ascomata and the smooth, hyaline ascospores. The N. ochroleuca-Group includes species with KOH-, stromatic ascomata but N. helenae differs by the brick red color of the ascomata and the narrower ascomatal walls. Grouping within the genus Nectria remains to be determined.

14. Nectria microspora Cooke & Ellis, Grevillea 5: 53, pl. 80, fig. 8. 1876, non Nectria microspora (Rehm) Weese.

≡ Nectriella microspora (Cooke & Ellis) Saccardo, Michelia 1: 279. 1878.

= NECTRIA PURTONII (Greville) Berk. [synonmy proposed by Samuels, et al., 1991].

HOLOTYPE: U.S.A. New Jersey: Newfield, on bark of Magnolia, J.B. Ellis (NY!, isotype FH!).

Anamorph: Fusarium aquaeductuum (Radlk. & Rabenh.) Lagerheim, Zentralbl. Bakteriol. 2 Abt., 9: 655. 1891.

Habitat: bark, possibly fungicolous.

Distribution: Canada (Newfoundland, Ontario), U.S.A. (New Jersey).

Ascomata immersed in rifts in bark in groups of up to 20, red, becoming darker red in KOH and yellow in lactophenol; collapse lateral. Cells on surface of ascomata angular, 5-10 µm diam. Ascomatal wall 18 µm wide. Asci cylindrical, 40-70 x 4-6 µm, containing a ring, base rounded; ascospores diagonally uniseriate. Ascospores ellipsoid, 7-10 x 3-5 µm, 1-septate, hyaline, containing several small guttules per cell.

Additional Specimens examined:

CANADA. Ontario: London, on bark of a dead standing beech tree, Sep 1895, J. Dearness (FH); same location, on bark of Ostrya virginica Willd, 5 May 1893 (FH); same location, on erect beech, 23 1895, J. Dearness (FH). Newfoundland: Middle Arm, on dead Birch, 16 Apr 1826, A. Waghorne (Ellis & E.; FH; as var. congesta).

Discussion: Nectria microspora was synonymized by Samuels et al. 1991 with N. purtonii as a member of Nectria subg. Dialonectria. The Fusarium anamorph is consistent with the species of Dialonectria.

15. NECTRIA MYRIADEA Ces., Atti Accad. Sci. Fis. 8 (3): 15. 1879.

≡ Nectriella myriadea (Cesati) Saccardo, Syll. fung. 2: 450. 1883.

HOLOTYPE: SRI LANKA. On bare wood, Beccari (K!).

Anamorph: not known.

Ascomata superficial, nonstromatic. Asci 90-110 x 8-10 µm; ascospores uniseriate in ascus. Ascospores ellipsoid, 10-16 x 6-8 µm, 1-septate, pale brown, striate.

Discussion: Petch (1920) stated that Nectriella myriadea belongs in the genus Cosmospora Rabenh. Rogerson (1970) considers Cosmospora a synonym of Nectria. The type species of Cosmospora, C. coccinea Rabenh. 1862, is synonymous with Nectria cosmariospora Ces. & de Not. 1863 (Rossm., pers. comm.). Ascomata of Nectria myriadea have superficial, nonstromatic ascomata and roughened, pale brown ascospores. Therefore, N. myriadea can be referred to Nectria subg. Dialonectria Samuels et al. (1991).

16. NECTRIA PEPONUM Berkeley & Curtis in Berkeley, Grevillea 4: 16. 1875.

≡ Nectriella peponum (Berk. & Curt.) Seaver, Mycologia 1: 46. 1909.

= Nectriella peponum Berk. & Curt. var aurelia Berk.& Curt., Grevillea 4: 16. 1875.

= Nectria brassicae Ellis & Sacc., Michelia 2: 374. 1881.

≡ Dialonectria brassicae (Ellis & Sacc.) Cooke, Grevillea 12: 110. 1884.

≡ Cucurbitaria brassicae (Ellis & Sacc.) Kuntze, Revis. Gen. Pl. 32: 460. 1898.

LECTOTYPE, designated herein: U.S.A. South Carolina: Aiken County, on dead gourds, date unknown, H.W. Ravenel 2384 (in red folder marked Herb. Berk. 1879; K!); SYNTYPES: Aiken, in Cucurbit virrum, date unknown, H.W. Ravenel 2230; on Solanum lycopersicum (tomato), date unknown, H.W. Ravenel 2124; Calhoun County: Santee Canal, on gourd, date unknown, H.W. Ravenel 1786 [2 collections] (all at K!).

Anamorph: not known.

Habitat: stems and fruit of Cucurbita, Solanum.

Distribution: Eastern U.S.A.

Ascomata obpyriform, 100-210 high x 130-200 μm wide, superficial; base firmly attached, scattered or in groups of up to 20, nonstromatic, bright orange-red, becoming darker red in KOH and slowly yellow in lactophenol; papilla acute, paler at site of ostiole and darker around perimeter; collapse lateral. Cells on surface of ascomata angular, 10-12 x 8 μm; walls distinct. Ascomatal wall 14-20 μm wide, of two regions; cells of inner region nonpigmented, 4-8 μm wide, of thin-walled elongate cells, 5-10 x 1-2 μm; outer region 10-12 μm wide of three rows of thick-walled, rounded cells 6-10 x 4-6 μm. Asci clavate, 40-56 x 8-12 μm; apex truncate; apical ring visible in young asci, conspicuously pedicellate; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ovoid to ellipsoid, 8-14(-20) x 4-6 μm, often slightly constricted, 1-septate, hyaline, becoming slightly brown, spinulose, sometimes striate.

Additional Specimens examined:

U.S.A. New Jersey: Newfield, on dead stems of _Solanum tuberosum_, lying on the ground, Sep 1883, _Ellis_, N. Amer. Fungi 572b (K, 2 collections; NY; as _Nectria brassicae_); on old stalks of _Brassica oleracea_, of the previous year, Jul 1880, _Ellis_, N. Amer. Fungi 572 (LECTOTYPE of _Nectria brassicae_, designated herein: NY; Isolectotypes: FH; K). S. Carolina: Aiken County, Aiken, in _Cucurbita_, _H. W. Ravenel, 1393_ (HOLOTYPE of _Nectriella peponum_ var _aurelia_, K, as _Sphaeria_); Aiken County: Aiken, in _Cucurbita_ fruit; _H. W. Ravenel_ Fung. Amer. exs. 338 (K, 2 collections); Aiken, on old gourd, May 1881, _H. W. Ravenel_ (K); _H. W. Ravenel 1831_ (K); Aiken, on putrid squash, Aug 1869, _H. W. Ravenel 2141_ (K); Aiken, on fruit of _Cucurbita_, _H. W. Ravenel 2313_ (another collection marked on old gourd) (K); Aiken, on aged fruit of _Cucurbita_, 1855, _H. W._

Ravenel, Fung. Caroliniani Exs. 4: 51 (K); Chesterfield County, Society Hill, in Cucurbita melopepa, H. W.Ravenel (K). District of Columbia, Washington, on old stems of Solanum tuberosum, Oct 1902, J.B. Rorer (K, as N. brassicae).

Discussion: The best collection was chosen for the lectotype from the four Ravenel gatherings mentioned in the protologue.

Phomopsis brassicae Sacc. & Roum. was reported as the anamorph of Nectria brassicae by Uecker (1988). Booth (1959) found the perithecia of N. brassicae associated with pionnotes covered with Fusarium macroconidia. He did not, however, grow the species. Fusarium is a more likely anamorph for N. peponum.

Berkeley and Curtis proposed the new variety aurelia for specimens of Nectriella peponum with unicellular ascospores. Examination of the holotype of the N. peponum var. aurelia, however, revealed that the ascospores have a septum and that the variety aurelia cannot be distinguished from variety peponum.

Stevenson (1971) noted that when Ravenel collections do not cite the collector or locality, Ravenel himself is the is presumed collector and the locality is inferred to be his farm in Aiken, South Carolina. This information is added to the specimens examined herein.

Nectria peponum is placed in Nectria subg. Dialonectria (see Samuels et al., 1991) because of the nonstromatic, KOH+

ascomata, the asci with a ring and the ornamented, pale brown ascospores.

17. NECTRIA THUJANA Saccardo, Michelia 1: 295. 1878

[Nectriella thujana Rehm, Ascom. 338. 1875, nomen nudum, Art. 32.1].

HOLOTYPE: U.S.A. New Jersey: Newfield, with Pithya cupressina (Batsch: Fr.) Fuckel, on dead foliage of Cupressus thyoides L. [= Chameacyparis thyoides (L.) B.S.P.] (white cedar) Nov 1875, J.B. Ellis (S!, handwritten packet; ISOTYPES: NY!; K, 2 collections!; S!; as Rehm ascom. 338; on dead foliage of white cedar cut about one year ago, Nov 1887, Ellis, [Pythia cupressina also present] [one packet from K labeled "with Venturia cupressina Rehm (= Asterina cupressina Cooke), on dried up foliage of Cupressus thyoides"], K, 5 collections; NY; some packets as N. thujina, all as N. Amer. Fungi 160; in dry, still attached foliage and branches of Cupressus thyoides, associated with Pythia cupressina, winter 1875, J.B. Ellis, K!; NY, 3 collections!; S!; all as Nectria thujina in de Thümen Mycoth. Univers. 972).

Anamorph: not known.

Habitat: Chameacyparis.

Distribution: known only from type collection.

Mycelium white, sparse. Ascomata obpyriform, 190-200 μm high x 140-150 μm wide, superficial, easily removed from host, scattered to groups of 4-5, in leaf axils, pale red to orange, becoming darker red in KOH and yellow in lactophenol; papilla conical, pallid; collapse lateral. Cells on surface of ascomata angular, to 10 μm diam; walls distinct. Asci clavate, 60-80 x 12 μm, not containing an apical ring; base pedicellate; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ellipsoid, 8-15 x 7-8 μm, often slightly constricted, 1-septate, hyaline, becoming pale brown, smooth to spinulose, 1 large guttule per cell. Paraphyses not seen. Discussion: Although Stevenson (1971) lists the type of Nectria thujana as de Thümen Mycoth. Univers. 972, the packet in S is a handwritten packet, labeled original. Unlike most of the types of the Ellis collections which are in NY, the S collection is the holotype of Nectria thujana.

Even though the printed labels differ, I follow Stevenson (1971) in giving the exsiccati collections, Rehm Ascomyceten 338, Ellis North American fungi 160 and de Thümen Mycotheca universalis 972, all as isotype collections.

Rehm did the taxonomic work on this fungus but did not publish it validly in Rehm Ascomyceten 338. Stevenson (1971) gives a Rehm citation of 1881 for the original publication. Saccardo (1878), however, is the first author.

Few ascomata remain in any of the collections of Nectria thujana.

The papillae originally described as purplish-red are now faded and often lighter than the rest of the surface of the ascomata.

Nectria thujana belongs in Nectria subg. Dialonectria because of the separate, red, KOH+ ascomata and pale brown, ornamented ascospores.

18. NECTRIA VULPINA (Cooke) Ellis, North Amer. Fungi 774. 13 1882.

≡ Peziza vulpina Cooke, Hedwigia 14: 82. 1875.

≡ Dialonectria vulpina (Cooke) Cooke, Grevillea 12: 83. 1884.

≡ Nectriella vulpina (Cooke) Ellis, Berlese & Vogl., Syll. Fung. Add. Vol 1-4: 194. 1886.

= Nectria incrustans Weese, Z. Gärungsphysiol. 1: 144. 1912 [fide Samuels, 1976].

LECTOTYPE: U.S.A. New Jersey: Newfield, on maple wood, 6 Dec 1874 J.B. Ellis (NY!; designated by Samuels, 1976: 45); isolectotypes: labeled "Dasy. sessiles," J.B. Ellis; labeled "specimen showing both the young & old state;" labeled "on rotten wood," and an annotation by J.B.E. "This is a Nectria," (all at K! as Peziza vulpina).

Anamorph: not known.

Habitat: rotted wood.

Distribution: Eastern U.S.A.

Ascomata subglobose, 190-240(-340) high x 240-295(-320) µm wide, superficial, grouped, attached firmly to the substrate, orange-yellow, not changing color in KOH; papilla lacking or inconspicuous; collapse vertical, deeply cupulate. Setae on ascomata 16-24 x 2-3 µm, apex rounded (Samuels: orange, 10-50 x 3-5 µm). Surface hyphal. Asci clavate, 40-70 x 8-9(-14) µm; apex truncate, containing an apical ring; ascospores uniseriate to irregularly biseriate, filling the ascus. Ascospores ellipsoid, 9-12 x 4-6 µm, slightly constricted, 1-septate, hyaline, striate, containing small guttules.

Additional Specimens examined:

U.S.A. Pennsylvania: West Chester, on rotten wood, Everhart, Haines, Jeffries & Gray, Ellis, N. Amer. Fungi 774 (FH, K, NY).

Discussion: Two collections of Peziza vulpina were located at K from Cooke's herbarium. Because the specimens were in the author's herbarium and the labels were handwritten, these collections contained the material originally studied by Cooke. The substrate was incorrectly cited as apple wood but is maple wood on the original label. Samuels (1976) did not examine the Cooke material, but it is identical to the Ellis portion in NY.

Samuels (pers. comm., 1991) suggests that N. vulpina may have affinities to the N. subfalcata-Group as defined by Samuels (1976). The species of Nectria in this group have superficial, nonstromatic, gregarious ascomata immersed in hyphae. The orange, KOH- ascomata have walls greater than 20 μm wide, colorless, smooth to striate ascospores and are found on herbaceous debris. The known anamorphs are Acremonium sp.

19. Nectriella wainioi Karsten, Hedwigia 28: 192. 1889 ["N. vainioi"].
= NECTRIA OCHROLEUCA (Schw.) Berk., Grevillea 4: 16. 1875.

HOLOTYPE: BRAZIL. Minas Gerais: Sitio, on bark of a leafy tree, 1885, E. Wainio (Herb. Karsten 1392, H, not examined).

Discussion: The holotype of Nectriella wainioi was examined by Samuels (pers. comm.). The ascomata are superficial, grouped on erumpent stromata and the ascospores are 2-celled. These characters place the species in the Nectria ochroleuca-Group.

NECTRIELLA Fuckel, TAXA THAT ARE ASSIGNED TO OTHER GENERA OR CANNOT BE ASSIGNED TO GENUS

1. Nectriella erysiphioides (Saccardo & P. Sydow) Theissen, Verh. Zool. Bot. Ges. Wien 24. 1919 [not validly pub., ICBN, Art. 33.1, combination not actually made].
= Stigmatula erysiphioides Sacc. & P. Syd., Bull. Herb. Boissier 77. 1901.

Type: BRAZIL. S. Francisco, in living leaves of Achyroclines saturejoides, Ule (isotype FH!).

Ascomata cleistothecial, ellipsoid to globose, 84 x 120 µm or 130-160 µm diam, superficial, crowded, yellow-brown; outer covering brown. Asci clavate-cylindrical, 48-54 x 11-14 µm, bitunicate, obliquely uniseriate. Ascospores ellipsoid to naviculate, 9-13 x 8 µm, unicellular, inequilateral, hyaline.

Discussion: *Nectriella erysiphoides* is not a member of the genus *Nectriella* because of the biotrophic habit on leaves and cleistothecial ascomata. The bitunicate asci exclude *N. erysiphoides* from the Hypocreales and indicate that the species is a Loculoascomycete. The lack of paraphyses indicate Dothidiales (*sensu* Hawksw. et al., 1983). More study is needed for better placement.

2. *Nectriella fimicola* (Höhnel) Weese, Ann. Mycol. 12: 153. 1914, non *Nectria fimicola* Fuckel.

≡ *Charonectria fimicola* Höhnel, Österr. Bot. Z., p. 22. 1905.

HOLOTYPE: AUSTRIA. Vienna woods, Sparbacher zoo, in dung, incubated under glass, Apr 1904, *Höhnel*, Rehm Ascom. 1587 (FH!, isotype: FH!, K!).

Anamorph: not known.

Habitat: dung.

Distribution: known only from the type collection.

Ascomata obpyriform, 228-300 x 164-200 µm, immersed, hyaline to yellowish, not changing color in KOH; papilla 80-90 µm high x 140-160 µm wide; apex rounded to almost pointed. Cells on surface angular, 5-9 µm wide x 5-16 µm long. Ascomatal wall 20 µm wide, of 2 regions; inner region 16 µm of thin rectangular cells 14 x 2 µm; outer region of thick-walled rounded cells, 10-14 x 5-8 µm. Asci 70-90 x 5-6 µm wide; apex containing a small J+ (iodine) ring; ascospores uniseriate, often only 4-5 maturing. Ascospores ellipsoid, 10.0-12.5 x 5-6 µm, often constricted, 1-septate, hyaline, becoming pale brown, verrucose to striate with verrucae arranged in rows, in end view round with edges roughened from verrucae; 1-3 round to irregular guttules per cell. Paraphyses apically free, 1-2 µm wide, unbranched; septa not seen.

Discussion: This fungus developed on deer dung pellets placed in moist chamber in the laboratory. The iodine positive apical ring of the ascus and thin paraphyses place this species in the Amphisphaeriaceae, but the absence of clypeoid tissues, the dung substrate and the prominently tuberculate, striate ascospores indicate that another genus is needed for proper placement.

3. <u>Nectriella</u> <u>moravica</u> (Petrak) Petrak, Ann. Mycol. 17: 78. 1919 [1920].

= <u>Stigmatea moravica</u> Petrak, Ann. Mycol. 12: 473. 1914.

= <u>Lejosphaerella</u> <u>moravica</u> (Petrak) Petrak, Sydowia 15: 209. 1961.

LECTOTYPE (designated herein): CZECHOSLOVAKIA. Moravia orientalis: near Hrabuvka, Moravian-Weisskirchen, margin of woods, in dry stems of Rosa canina, Apr 1912, F. Petrak (W 09773!; as "Leiosphaerella" moravica).

Anamorph: unknown.

Habitat: dead stems of Rosa, Amelanchier.

Distribution: Austria, Czechoslovakia, Sweden, Canada (British Columbia).

Ascomata ellipsoid, 180-200 x 180-280 μm, completely immersed, scattered, nonstromatic, dark or brownish, not changing color in KOH; papilla truncate, 26 μm high x 68 μm wide, of elongated hyphae, closely adherent and raising but barely protruding through the host. Cell walls on surface of ascomata indistinct. Ascomatal wall 7-10 μm wide, of two region; outer region 3-6 μm wide of fused intertwined hyphae 1.5-3.5 μm diam; inner region 3.5-5.0 μm wide, of thick-walled rounded or elongate cells 2.5-6.0 x 1.5-3.5 μm; ascomatal apex of parallel hyphal-like cells. Periphyses present. Asci clavate, 45-84 x 6.0-10.5 μm; apex truncate, J-, containing a slight apical thickening; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores fusiform, often slightly curved, 12-23 x 3.5(-5.5) μm, including clear sheath 0.5 μm wide, 1-septate, hyaline, smooth. Paraphyses not seen. Hyphae from fungus seen mixing with host cells.

Additional specimens examined:

CANADA. British Columbia: Sidney, beach off Braemar Ave., on old Dothidiaceous stromata, on twig of Amelanchier, 16 Sep 1990, M.E. Barr 7303 (NY). CZECHOSLOVAKIA. Moravia: Mährisch-Weisskirchen, [2 notes inside packet: Luchena stream, on R. dumitorum, 8 Jan 1919, and on dry stems of Rosa sp., 17 Jan 1920], F. Petrak (W 14514, as "Leiosphaerella" moravica); Toward Bölten, near the North railroad station, at the forest edge, on Rosa canina, 5 Feb 1913, F. Petrak (W 14871, as "Leiosphaerella" moravica). SWEDEN. Uppland: Bromma sin Stockholm, Drottiningholmsvägen, on Rosa canina, 5 Dec 1920, T. Vestergren (det. F. Petrak, 1951) (S).

Discussion: Lejosphaerella moravica is difficult to find because the ascomata are totally immersed and other dark fungi are present.

Lejosphaerella moravica differs from species of Nectriella in the elongate ascospores, and the dark color. Although the ascospores of Lejosphaerella moravica typical of the genus Lejosphaerella, the asci are J- and there are no paraphyses. The proper generic position remains to be determined.

4. Nectria obvoluta Karsten, Mycol. Fennica 2: 217. 1871.

≡ Calonectria obvoluta (Karst.) Sacc., Michelia 1: 316. 1878.

≡ Nectriella obvoluta (Karst.) Rossman, Mycotaxon 8: 532. 1979.

HOLOTYPE: FINLAND. Mustiala reperta, on leaves of Calamagrostis arida, Oct. (H!).

Anamorph: not known.

Habitat: leaves of Calamogrostis.

Distribution: Finland.

Ascomata superficial, pale yellow, not changing color in KOH; collapse vertical; hyphae covering lower surface, ≤ 4 μm thick with walls 0.8 μm wide, contorted, white. Ascomatal wall 20 μm wide, of interwoven hyphae. Asci clavate, 44-50 x 6-7 μm; apex truncate, containing an apical ring. Ascospores fusiform, 8-12 x 1.5-2.0(-4.0) μm, 1-septate, spinulose.

Discussion: The ascomatal wall of interwoven hypae and the superficial habit suggest perhaps Nectriopsis Maire (Samuels, 1988) or more likely Peristomialis (Boud.) Boud. (Samuels, 1988).

5. Nectriella rhizogena (Berkeley) Theissen, Ann. Mycol. 14: 335. 1916.

≡ Sphaeria rhizogena Berk., J. Bot. 4: 312. 1845.

≡ Botryosphaeria rhizogena (Berk.) Sacc., Syll. Fung. 1: 462. 1882.

= Melogramma rhizogenum Berk., Grevillea 4: 98. 1876. [Carol. Sup. 1788].

Type: U.S.A. Ohio: on roots of Gleditschia triacanthos washed bare by Ohio freshets, date unknown, T.G. Lea 188 (K (not examined); isotypes: FH!).

Anamorph: not known.

Habitat: roots of Gleditschia.

Distribution: U.S.A. (Ohio).

Stromata erumpent through bark, yellow. Ascomata subglobose, superficial, clustered, pale brown. Asci clavate, 44-56 x 6.5-10.5 μm, unitunicate, containing an inconspicuous nonamyloid apical ring, seen only in immature asci; protrusion of epiplasm in the apex appearing angular; ascospores diagonally uniseriate to biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores subglobose to ellipsoid, 5-8 x 4-7 μm, 1-septate; septum inconspicuous; hyaline, smooth. Paraphyses apically free, 80 x 2.5-4.0 μm, septate.

Discussion: Ascomata of this species superficially resemble those of species of Nectria, but a hamathecium with apically free paraphyses is not known in the Hypocreales. More research is needed to place this species.

6. Nectriella succinea (Roberge) Weese, Ann. Mycol. 12: 130. 1914.

≡ Sphaeria succinea Rob. in Desm., Ann. Sci. Nat. Bot., sér. 3, 10: 354. 1848.

≡ Charonectria succinea (Rob.) Sacc., Syll. Fung. addenda 2: 68. 1883.

≡ _Paradidymella succinea_ (Rob.) Petrak, Ann. Mycol. 25: 239. 1927.

≡ _Lejosphaerella succinea_ (Rob.) Müller in Müller & Arx, Beitr. Kryptogamenfl. Schweiz 11(2): 673. 1962.

≡ _Amphisphaeria succinea_ (Rob.) Krug, Sydowia 30: 130. 1977 (1978).

≡ DISCOSTROMA SUCCINEA (Rob.) Lowen, comb. nov.

= _Sphaeria succinea_ Rob. var. _epiphylla_ G. Kunze & Schmidt, Mycol. I: 107. 1817.

?= _Charonectria succinea_ (Rob.) Sacc. var. _bractearum_ Sacc., Ann. Mycol. 6: 559. 1908.

LECTOTYPE, designated herein: FRANCE. Normandy: Caen, on inferior face of dry leaves of _Quercus_ still holding to the branch, spring and summer, _Roberge_, Desm. Pl. Crypt. France, ed. 1, fasc. 36: 1794, 1849, (PC!; isolectotypes: K, 3 collections!; UPS-Fries!; ed. 2, fasc. 29: 1444, 1848, K!; PC!)

Anamorph: not known.

Habitat: dead leaves of _Quercus_.

Distribution: France, Italy.

Ascomata subglobose, 220-400 high x 200-340 µm wide, immersed in leaf, lifting flaps of the epidermis, in groups, honey-color, becoming paler in water, not changing color in KOH. Asci clavate, 56-68 x 8-10 µm; apex rounded to truncate; apical ring J+; epiplasm in apex appearing coronate; base rounded; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ellipsoid to ovate, 9-11 x 4.0-5.5 μm, 1-septate, hyaline, smooth, 1 to several guttules per cell. Paraphyses not seen.

Specimens examined (all on dead Quercus leaves):

FRANCE. Normandy: near Caen, Park de Lébisey, May 1845, Roberge (FH 919); collection data unknown, Desm. Pl. Crypt. France 1797 (FH-Höhnel, slide 3). ITALY. near Florence, Jul 1860, L. Caldesi, Rabenh. F. Eur. 326 (FH-Höhnel; K, 2 collections).

Discussion: Although the ascomata and hyaline 2-celled ascospores are similar to the ascospores of Nectriella, the amyloid apical ring in the ascus, the presence of clypeoid tissues, and the habitat on leaves place this species in Discostroma Clements (Xylariales, Amphisphaeriaceae, sensu Barr, 1990) but differing from the species discussed by Brockmann (1974/1975).

Krug (1978) synonymyzed Paradidymella succinea with Sphaeria cupula Ellis (1883). Sphaeria cupula was subsequently transferred by Müller (in Müller and von Arx, 1962) to Cainia. I do not accept Krug's synonymy because the ascospores of P. succinea are hyaline whereas those of Cainia are brown with elongate germ slits appearing as longitudinal ridges.

VII. **PSEUDONECTRIA** Seaver, Mycologia 1: 48. 1909.

Type species Pseudonectria rousseliana (Montagne) Wollenweber; designated by Seaver, Mycologia 1: 48. 1909 (as Nectria rousseliana Mont.).

[≡ Nectriella Saccardo, Michelia 1: 51. 1877, non Nectriella Nitschke 1870; type species: Nectriella rousseliana (Montagne) Saccardo.]

≡ Nectriella subg. Notarisiella Saccardo, Syll. Fung. 2: 452. 1883; type species Nectriella rousseliana (Mont.) Saccardo.

≡ Notarisiella (Saccardo) Clements & Shear, Genera of Fungi, p. 280. 1931; type species Notarisiella rousseliana (Mont.) Clements & Shear.

Known anamorph: Volutella sp.

Mycelium sometimes occurring at base of ascomata. Ascomata ovoid, 100-500 µm diam, superficial, scattered or in groups, nonstromatic or seated on inconspicuous stromata, pallid, yellow to red, changing or not changing color in KOH. Setae often present. Cells on the surface of the ascomata with well defined angular walls. Ascomatal apex of rows of parallel, vertically elongated cells continuous with the inner region of the ascomatal wall; cells becoming increasingly narrow and merging with the periphyses on the interior and somewhat expanded or clavate at the exterior termination. Asci clavate, usually not over 100 µm long or 15 µm wide, 8-spored, unitunicate; apex truncate, usually containing a nonamyloid apical ring, sometimes difficult to see in mature ascus. Ascospores fusiform to ellipsoid, inequilateral, typically not over 25 μm long and 8 μm wide, unicellular, hyaline, smooth to echinulate; guttules usually present in young ascospores. Paraphyses with free apices absent.

Discussion: Many species have been included in Pseudonectria by various authors. The genus was briefly described by Wollenweber (1931), Racovitza (1959), and Döbbeler (1978). Döbbeler (1978) provided a key to the bryophilous species.

Pseudonectria presently contains several diverse elements. The type species P. rousseliana has superficial, yellow, KOH- ascomata that occur separately on an inconspicuous stroma. The ascomata have colorless setae, unitunicate asci and 1-celled ascospores. The anamorph of P. rousseliana, Volutella buxi (DC) Berkeley, produces pink, slimy, one-septate conidia from phialides. These features are all consistent in the Hypocreales.

Sporadospora Reinsch (Contr. Algol. & Fungol. 1: 95, pl. 3, fig. 1. 1875) is a synonym of Pseudonectria (Hawksworth, et al., 1983). Sporadospora was proposed as a genus of Hyphomycetes. The type species, S. jungermanniae Reinsch is actually the appressoria of a species of Pseudonectria (Racovitza, 1959). The ovoid, unicellular, hyaline, 23 x 14 μm appressoria were originally mistaken for conidia. On the basis of the appressoria alone, Döbbeler (1978) could not distinguish the appressoria of Sporadospora jungermanniae from those of species of Pseudonectria. Hawksworth et al. (1983) were in error in synonymizing Sporadospora, a genus based only on vegetative structures, with Pseudonectria, a teleomorphic genus.

A complete revision of Pseudonectria is planned for a later date. Most of the species of Nectriella Sacc. are excluded from Pseudonectria. Of those examined, only P. coronata Juel, P. furfurella (Berk. & Br.) Petch, P. metzgeriae, P. rousseliana and Nectriella aurantia Penzig & Sacc. belong in Pseudonectria. Species described in Pseudonectria but never combined in Nectriella, Pseudonectria pachysandricola Dodge and P. clusae Samuels & Rogerson, for example, are not included in this paper.

1. PSEUDONECTRIA AURANTIA (Penzig & Saccardo) Lowen, comb. nov.

≡ Nectriella aurantia Penz. & Sacc., Malpighia 11: 506, pl. 26, fig. 3. 1897.

HOLOTYPE: INDONESIA. Java: Tjibodas, in dry, small branches, 7 Mar 1897, Penzig 447 (subaffinis Nectria resinae) (Isotype: (FH-Höhnel ex Herb. Sacc.!).

Anamorph: not known.

Habitat: twigs.

Distribution: Indonesia, New Zealand.

Mycelium at base of ascomata, white, loose. Ascomata ovoid to subglobose, 70-112 μm diam, superficial, in groups of 10, pale red to yellow-orange, not changing color in KOH;

apex conic. Surface of ascomata of distinctly angular cells 6-8 μm diam. Ascomatal wall 20 μm wide, cell forming about 10 rows, inner two rows compressed; walls 1.5 μm thick. Asci clavate, 30 x 4 μm; apex truncate to depressed, containing a nonamyloid apical ring; base pedicellate; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ellipsoid, 8-10 x 3-4 μm, unicellular, hyaline, smooth, surrounded by a clear sheath.

Additional specimen examined:

NEW ZEALAND. North Island, Northland: Hobson County, Waipoūa Forest Sanctuary, vic. Te Matua Ngahere and Four Sisters Kauri Trees, on Agathis australis, 23 Nov 1973, G.J. Samuels 73-269, J.M. Dingley, W.B. & S. Kendrick (PDD 32486).

Discussion: Nectriella aurantia is associated with other fungi. The type specimen contained bases of broken black fungi. The New Zealand specimen conforms to the type except for having ascomata with a KOH positive reaction.

2. PSEUDONECTRIA CORONATA (Juel) Lowen, comb. nov.

≡ Nectriella coronata Juel, Ark. Bot. 19(20): 4, text fig. b, p. 4; pl. 1, fig. 2; pl. 2, fig. 3. 1925.

HOLOTYPE: SWEDEN. Uppsala, botanical garden, on leaves of Buxus sempervirens L., 10 Oct 1924, O. Juel (S!; Isotype: BPI!).

Anamorph: Not proven.

Habitat: On leaves of Buxus, usually with other fungi.

Distribution: Europe, U.S.A.

Ascomata subglobose, 150-200 μm diam, superficial, scattered or in groups of 2 to 3, pale red to orange, not changing color in KOH, collapsing by lateral pinching. Setae undulating, 20-30 x 3-4 μm, septate; apex rounded, in circle around apex of ascomata. Ascomatal wall 10 μm wide, of thin-walled elongate rectangular cells. Asci clavate, 40-50 x 6-8 μm; apex rounded; apical ring lacking, ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores ellipsoid-fusiform, 12-15 x 4 μm, unicellular, rarely 1-septate, hyaline, 2-3 guttules per cell.

Additional specimens examined (all on leaves of Buxus sempervirens):

BELGIUM. Roche à Lomme, between Nismes & Fagnolle, on living leaves of Buxus sempervirens, 30 Sep 1984, H.A. van der Aa 9305 (NY ex CBS 3631). ITALY. Meloduno, 23 Sep 1850, Roussel (with lectotype of Nectriella rousseliana, PC). U.S.A. New York: Shelter Island, 10 Oct 1910, W.G. Farlow (FH; as Nectriella rousseliana).

Discussion: Sesquicillium buxi (Schmidt in Link) K.W. Gams is usually found on leaves with the ascomata of Pseudonectria coronata. The conidia are fusiform, 7-8 x 2.5-3.5 μm and unicellular. The anamorphic association has not been proven in pure culture (see Dodge, 1944). Juel (1925) claimed that immature ascomata of P. coronata developed in cultures of conidia of Sesquicilium buxi. Bezzera (1963) reported the anamorph to be S. buxi, but he did not culture single ascospores. Samuels (1989) doubted the connection because several species of Sesquicilium, including S. buxi, are anamorphs of species of Nectria and unrelated to Pseudonectria. Samuels suggested that if Juel's cultures had been allowed to mature, different teleomorphs would have developed.

Other fungi found with Pseudonectria coronata on the specimens examined include P. rousseliana, Volutella sp., and immersed Dothiorella-like acervuli.

Pseudonectria coronata may be distinguished from P. rousseliana by the circle of undulating setae surrounding the ostiole.

3. PSEUDONECTRIA FURFURELLA (Berkeley & Broome) Petch, Trans. Brit. Mycol. Soc. 21: 249. 1937 [1938].

≡ Nectria furfurella Berk. & Br., Ann. Mag. Nat. Hist. Ser. 4,7: 435, pl. 20, fig 22. 1871.

≡ Nectriella furfurella (Berk. & Br.) Saccardo, Michelia 1: 279. 1878.

= Nectria keithii Berk. & Br., Ann. Mag. Nat. Hist. ser. 4, 17: 144. 1876 [fide J. Ehrlich archives, IMI, based on drawings and original description].

≡ Nectriella keithii (Berkeley & Broome) Saccardo, Michelia 1: 279. 1878.

HOLOTYPE: U.K., England. Norfolk: Batheaston, on cabbage stalks, Feb 1869 (K!; Isotype: slide IMI 52755!).

Anamorph: Gliocladium sp. (Booth, 1959).

Hasbitat: stems of Brassica.

Distribution: United Kingdom.

Ascomata subglobose, pale yellow, translucent. Asci clavate, 70 x 12 μm, containing a nonamyloid apical ring; ascospores biseriate. Ascospores ellipsoid, 5 x 3 μm (measured in the ascus), unicellular, smooth.

Specimen examined:

U.K., SCOTLAND. Moray: Forres, on cabbage stalks, date unknown, J. Keith (HOLOTYPE of Nectria keithii, K).

Discussion: Although the material in the holotype collection of Nectria furfurella was sparse, the ascoma examined was sufficient to determine that this is a species of Pseudonectria with superficial ascomata and unicellular ascospores. The holotype material of Nectria keithii is also on cabbage stalks from the United Kingdom and is identical.

Nectriella keithii is not a synonym of Nectria subquaternata as suggested by Petch (1936). The ascomata of N. subquaternata, unlike Nectriella keithii, have a flat disk at the apex that terminates in wart-like processes. Petch examined the type of N. Keithii at K and noted that the many ascomata present were immature. According to descriptions of Nectria subquarternata (Samuels, 1976; 1988), ascospores are 15-18 x 6-8 μm and striate whereas ascospores in the type collection of Nectria keithii are much smaller (5 x 3 μm) and smooth. For further description of Nectria keithii see Booth (1959).

According to Uecker (1988) Saccardo and Roumeguère considered Phomopsis brassicae Sacc. & Roum. to be the anamorph of Nectriella keithii (= Zythia brassicae (Sacc. & Roum.) Sacc. & Roum. There is no evidence of this association.

Booth (1959) found a species of Gliocladium closely associated with Nectria keithii. The connection was not proven in culture.

4. PSEUDONECTRIA METZGERIAE Ade & Höhnel in Ade, Ann. Mycol. 17: 117. 1919 [20 Jun 1920].

HOLOTYPE: GERMANY. Rhön: between Brückenau and Mitgenfeld, on the surface of the thallus of Metzgeria furcata, on small mosses, Dec 1916, Ade (Isotype: FH-Höhnel, slide 3-20!; S!).

Anamorph: not known.

Habitat: Metzgeria.

Distribution: Europe.

Ascomata pyriform, 120 µm diam, immersed, scattered, pallid. Ascomatal surface of angular cells, 5-8 µm diam. Ascomatal wall 10-12 µm; cells elongate, 6.5-12.0 µm long. Asci clavate, (26-)30-48 x 3-4 µm; apical ring not observed; base stalked, ascospores biseriate. Ascospores fusiform, 5-7 x 1.5-2.5 µm, unicellular, hyaline, with a single, large, central guttule.

Additional specimen examined:

GERMANY. Rhön: near Mitgenfeld, toward Brückenau Gitte, on small "mosses", Radula complanata (L.) Dum. and Metzgeria furcata (L.) Dum. on Quercus robur, 6 Dec 1915, (annotated Nectriella with the epithet epibrya by Rehm, herbarium name, S).

Discussion: Brypohilous species other than Pseudonectria metzgeriae originally treated as Nectriella do not belong in the Hypocreales and are treated separately (see below). Racovitza (1959) stated that P. metzgeriae causes the death of the hepatic thallus. Racovitza considered that Pseudonectria casaresii is related to but distinct from P. metzgeriae because of the ellispoid ascospores of the former and the fusoid ascospores of the latter.

Döbbeler (1978) synonymized Pseudonectria casaresii with P. metzgeriae. Döbbeler reported that the fungus is also found in Austria and Yugoslavia.

5. PSEUDONECTRIA ROUSSELIANA (Montagne in Castagne) Wollenweber, Z. Parasitenk. (Berlin) 3: 489. May 1931.

≡ Nectria rousseliana Mont. in Cast., Cat. pl. Marseille Suppl., 44. 1851.

≡ Stigmatea rousseliana (Mont. in Cast.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 97. 1869 (1870). Fungi rhenani 207, 217.

≡ Nectriella rousseliana (Mont. in Cast.) Sacc., Michelia 1: 51. 1877.

= Notarisiella rousseliana (Mont. in Cast.) Clements & Shear, 280. Jun-Jul 1931.

= Nectria rousseliana Mont. in Cast. var. viridis Berk. & Br., Ann. Mag. Nat. Hist. ser. 3, 3: 21. 1859.

LECTOTYPE, designated herein: ITALY. Meloduno, in leaves of Buxus sempervirens, 23 Sep 1850, Roussel 1624, (PC!).

Anamorph: Volutella buxi (DC) Berk., Outl. Brit. fungol. 340. 1860.

Habitat: Abaxial sides of leaves of Buxus sempervirens.

Distribution: Europe.

Ascomata subglobose, 225-300 μm high x 160-220 μm wide, superficial, scattered or in groups of up to 50, pale yellow to dark green, not changing color in KOH; apex conic, collapsing laterally. Setae lanceolate, to 160 x 6-7 μm at the base, tapering to 3.5 μm at the apex, septate; apex rounded to subacute, scattered on peridium, producing red droplets at the apex when young. Surface of angular cells 7-14 μm diam; cells connected by pores. Wall 10.5 μm wide, of one region of elongate cells, 3.5-10.5 x 2 μm. Asci clavate, 40 x 8 μm; apex truncate, containing a nonamyloid apical ring; base rounded; ascospores biseriate in the middle, uniseriate above and below, filling the ascus. Ascospores fusiform with ± truncate ends, 9-16 x 4-6 μm, inequilateral, unicellular, hyaline, smooth to spinulose, 2-3 guttules per cell. Inflated sterile filaments with ellipsoid cells, 15 x 12 μm, seen with phase contrast microscopy.

CHARACTERISTICS IN CULTURE. Colonies grown 20°C, diffuse daylight on CMA, CMD, OA, PCA+. Colonies on CMD reaching a maximum of 30 mm in 10 weeks; aerial mycelium cottony, slightly zonate, pale orange; margin white; odor sweet. Sporodochia forming as aggregations of white mycelium, immersed to sessile to shortly stipitate; setae lanceolate, to 210 x 5 μm, septate, hyaline, scattered; originating at base; producing red droplets from apex. Conidiophores branched; branches 3-4, in whorls, monophialidic. Phialides cylindrical, 9-12 x ca. 2.5 μm; tip with visible periclinal thickening, not flared. Conidia fusiod, 8-11 x 1.5-2.5 μm, unicellular, smooth, hyaline, orange in mass, eventually covering the sporodochium and beyond with pale orange slime. Sclerotia forming occasionally, immersed, becoming erumpent, reddish orange; cells thick-walled, intertwining, emitting orange droplets when squashed. Ascomata forming in some cultures derived from multiple ascospores.

Selected specimens examined (all on leaves of <u>Buxus sempervirens</u>):

AUSTRIA. Location and date unknown, Thümen, Fungi Austria 1155 (K). GERMANY. Location unknown, Rabenh. Fung. Eur. 922, 1856, <u>Rhynms</u> (FH-Höhnel; K); location unknown, Krieger Fungi Sax. 427, Dec 1888 (FH-Höhnel; K); Sonntagsberg, Nov 1904, <u>Shuner</u> (BPI). SPAIN: Catalunya: Espinelves, Oct 1985, <u>R. Lowen S158-85</u> (IMI 311212); Catalunya: Olesa de Bonesvalls, <u>R. Lowen</u>

S169-85 (IMI 311152); Aragon: near Viella, on road to Jaca, 11 Oct 1988, S. Sheine (R. Lowen 643-88 and 646-88, NY). U.K., England. Norfolk: Batheaston, on under side of leaves, E.C. Broome (HOLOTYPE N. rousseliana var. viridis, K); Shropshire: Forden, Plowr. Sphaer. Brit. 2, n. 8, Nov 1879, J.E. Vize (K).

Discussion: Seaver (1909) did not actually make the combination Pseudonectria rousseliana because he did not print the specific epithet with the generic name. Wollenweber (1931) was the first to publish the name. Clements and Shear (1931) incorrectly attributed the combination P. rousseliana (Mont.) to Seaver.

The part of the original material on Ruscus aculeatus L. is a different taxon because of the reddish, KOH+ ascomata and the two-celled, 12-15 x 3.5-4.0 μm ascospores. The fungus looks superficially like Pseudonectria rousseliana with ovoid ascomata, an acutely pointed papilla and hyaline, lanceolate setae. The fungus on Ruscus is an unnamed species of Trichonectria sensu Samuels (1988).

The connection of Pseudonectria rousseliana with Volutella buxi has been proven in pure culture from shooting ascospores from an ascomata on the lid of a Petri dish by Bezerra (1963) and from single ascospores by Lowen. V. buxi is known to be the cause of a disease of Buxus (Samuels, 1977; Farr et al., 1989).

Ascomata of Nectria rousseliana var. viridis are a form of P. rousseliana with green ascomata. The green form was grown in pure culture from single ascospores and produced a pale orange-colored culture and Volutella that was indistinguishable from V. buxi. The cultures are deposited as IMI 311212 and IMI 311214.

Pseudonectria rousseliana is usually associated with other fungi. The holotype collection also has Pseudonectria coronata, Nectria desmazierii Becc. & de Not., and Sesquicillium buxi (J.C. Schmidt in Link) W. Gams present. Other fungi commonly seen are Volutella buxi and Hyponectria buxi (DC) Sacc.

EXCLUDED OR DOUBTFUL TAXA OF **NECTRIELLA Saccardo**

This part of the Nectriella study presents nomenclature based on original literature for each species that has been placed in Nectriella Saccardo. Most of the following species were described as having superficial ascomata with unicellular ascospores. Some of the unexamined species may prove to be members of Pseudonectria. Others are referred to diverse genera in the discussions that follow. A short description is provided where specimens have been examined.

1. Nectriella acrosperma Kirschstein, Hedwigia 80: 120. 1942.

HOLOTYPE: GERMANY. Westphalen: Stark Buberg near Siegen, on Cytisus scoparius (as Sarothamnus scoparius), 4 Nov 1937, A. Ludwig (not examined).

Anamorph: found with Verticillium candelabrum Bonorden (circumstantial).

2. Nectriella artemisiae Fautrey in Roumeguère et al., Rev. Mycol. 13: 125. 1891.

Type: FRANCE. Côte d'Or: Noidan, on branches of Anthemis vulgaris, summer, 1890, F. Fautrey, Roum. Fungi selecti gallici, Cent. 58: 5717 (not examined).

Anamorph: not known.

3. Nectriella aurea Saccardo & Spegazzini in Saccardo, Michelia 1: 409. 1878, non Nectria aurea Crouan & Crouan, Fl. Finistère, p. 37. 1867.

HOLOTYPE: ITALY. Venetia: Conegliano, in dry bark of Ulmus campestris L., spring, 1878 (not examined).

Anamorph: not known.

4. Nectriella bacillispora Traverso & Spessa, Bol. Soc. Brot. 25: 172, pl. 1, fig. 5. 1910.

HOLOTYPE: PORTUGAL. "Lusitania," Coimbra Botanical garden, in leaves of Fouquieria gigantea, 1906, A. Möller (not examined).

Anamorph: not known.

5. Nectriella chamaropsis Oudemans, Contr. fl. mycol. Pays-Bas, contrib. 11, sér. 2,4: 524. 1886. [reprint: Ned. Kriudk. Arch. ser. 2, 4: 524. 1886.]

HOLOTYPE: NETHERLANDS. Amsterdam, botanical garden, in the greenhouses, on the branches of inflorescence of Chamaerops (Palmae), Dec 1885, P. van Balen (chief gardener) (not examined).

Anamorph: not known.

6. Nectriella coruscans (Fries) Saccardo, Syll. fung. 2: 450. 1883.

≡ Nectria coruscans Fr., Nova Acta Regiae Soc. Sci. Upsal., er. 3, 3, 1: 131. 1851. (N. "corruscans").

HOLOTYPE: SIERRA LEONE. (Guinea): on rotten trunk, Afzelius, ill.: Reliq. Afzel. pl. 12, fig. 31. Dec 1860 or 1861, not examined.

Anamorph: not known.

7. Nectriella cucumeris J. Hanzawa, Z. Pflanzenkrankh. 23(2): 71, figs. 2, 3; pl. 1, 2. 1913.

HOLOTYPE: GERMANY. Lower Saxony: Hanover, university washouse, parasitic in cultivated, warm roots and stems of Cucumeris (Cucurbitaceae), Hanzawa (not examined).

Anamorph: unnamed hyphomycete (Hanzawa, 1913).

Discussion: The anamorph of Nectriella cucumeris is described as a white hyphomycete that produces ellipsoid, 2-3-celled conidia on unbranched conidiophores. Chlamydospores are also produced (Hanzawa, 1913).

The subglobose, ornamented, thick-walled, unicellular ascospores do not indicate Pseudonectria. The species may be a species of Neocosmospora but examination of the type of N. cucumeris is required to be certain.

8. Nectriella fusarioides (Berkeley) Saccardo, Syll. fung. 2: 450. 1883.

≡ Nectria fusarioides Berk. in J.D. Hook,, Fl. Tasman. 2: 279. 1860 [1859].

HOLOTYPE: AUSTRALIA. Tasmania: on dead bark, Archer (not examined).

Anamorph: not known.

9. Nectriella gigaspora (Cooke & Massee) Saccardo, Syll. fung. 9: 942. 1891.

≡ Dialonectria gigaspora Cooke & Massee, Grevillea 17: 42. 1888.

≡ Pseudonectria gigaspora (Cooke & Massee) Petch, Ann. Roy. Bot. Gard. (Peradeniya) 7: 122. 1920.

HOLOTYPE: SRI LANKA. Habgalla, on Botryosphaeria inflata, Berkeley 542 (not examined).

Anamorph: not known.

Discussion: Petch (1920) found specimens of Nectriella gigaspora in Herb. Peradeniya collected by Thwaites 1107 as Nectria suffulta. According to Petch N. gigaspora occurs on an erumpent stroma and has roughened, unicellular ascospores, 30-33 x 10 μm, that resemble those of Neocosmospora.

10. <u>Nectriella jaczewskii</u> Girzitska, Mater. Mikol. Fitopatol. 8: 101. 1929.

Type: USSR. Kiovia: in botanical garden, in living seeds and stems of <u>Sabal blacksbartiana</u> [Palmae], 4 Aug 1928, not examined.

Anamorph: not known.

Habitat: living seeds and stems of <u>Sabal</u>.

Distribution: known only from the type.

Published description:

From the Latin: Ascomata globose, 200-300 μm diam, for the most part cespitose in groups of 6-8, erumpent through epidermis, yellow-orange; ostiole umbilicate. Asci cylindrical, 60-80 x 8-12 μm; apex obtuse; ascospores obliquely biseriate. Ascospores ellipsoid-elongate, 14-16 x 4.5-5 μm, yellow.

From the Russian: In the year 1928 in the greenhouse of the Kiev Botanical Garden a dying seedling of Sabal palm was observed (seed was received from Benari company of Erfurt). Investigation shows that the cause of the dead plant appeared to be the fungus <u>Nectriella</u>; stromatal formation of that fungus upon maturity appeared with ascomata forming a solid annulus surrounding the stalk, breaking through the cuticle, or tall clusters on seed coats, each seed permeated by mycelium, seedlings of species other than Sabal palm growing in the same greenhouse not affected.

Discussion: Most of the original description of Nectriella jaczewski is in Russian. Because the journal is not readily available, the translation is published herein.

Nectriella jaczewskii should be excluded from Pseudonectria because of the biotrophic habit, stromatic formation and clustered ascomata as described in the protologue. Proper generic placement must await examination of the type collection.

11. Nectriella jucunda (Durieu & Montagne) Saccardo, Michelia 1: 278. 1878.

≡ Sphaeria jucunda Durieu & Mont. in Durieu, Expl. Sci. Algérie, Bot. 1: 478. 1849.

≡ Nectria jucunda (Durieu & Mont.) Mont., Syll. Gen. Sp. Crypt., p. 225. 1856.

≡ Hyponectria jucunda (Durieu & Mont.) Weese in Höhnel & Weese, Ann. Mycol. 8: 466. 1910.

= Nectriella cacti Ell. & Everh., J. Mycol. 8: 66. 1902.

≡ Hyponectria cacti (Ell. & Ev.) Seaver, Mycologia 1: 20. 1909.

LECTOTYPE, designated herein: ALGERIA. Hill over Bab-Azoun, in stems of Opuntia, 22 Feb 1840, M. C. Durieu de Maisonnneuve (PC-Mont. Herb.!, as Hypocrea jucunda; Isotypes: PC!, 2 as Sphaeria jucunda).

Anamorph: Leptodermella opuntiae Dodge (circumstantial).

Habitat: Stems of Opuntia.

Distribution: Algeria, U.S.A. (Alabama).

Ascomata subglobose, 360 µm high x 250-300 µm wide, immersed, scattered or in groups of up to 20, nonstromatic, pale red or orange to yellow, not changing color in KOH; apex truncate, ostiolar area sometimes darker. Surface cells of the ascomata epidermoid to angular, 5-10 µm in longest dimension. Asci clavate, 42-70 x 3-4 µm; apex truncate; apical ring not observed; ascospores irregularly uniseriate to biseriate in the middle, uniseriate above and below, filling upper two thirds of the ascus. Ascospores cylindrical to allantoid, 5.5 x 1.5 µm, unicellular, hyaline, smooth. Paraphyses not seen.

Additional specimen examined:

U.S.A. Alabama: Tuskegee, on *Opuntia ficus-indica*, *Carver 584* (HOLOTYPE of *Nectriella cacti*; NY).

Discussion: The pink pycnidia of *Leptodermella opuntiae* were also present on the type of *Nectriella cacti* (Dodge, 1938) but the association with *H. cacti* is not proven.

Because *Nectriella jucunda* lacks apically free paraphyses, I agree with Barr (1977) in excluding *Hyponectria cacti* and *H. jucunda* from *Hyponectria* and in referring the species to the Hypocreales. Barr did not suggest a genus. *Hyponectria jucunda* (= *H. cacti*) might be placed in *Pseudonectria* because of the unicellular ascospores. The immersed ascomata and small, allantoid ascospores, however, are different from those in accepted species of *Pseudonectria*. As the earliest epithet for this species *jucunda* is correct. A generic determination, however, has not been made and a new genus may be required to accomodate _N. jucunda_.

12. _Nectriella jucundula_ Saccardo & Spegazzini in Saccardo, Michelia 1: 409. 15 Nov 1878.

HOLOTYPE: ITALY. Conegliano, in decaying culms of _Arundo donax_ L. (Mediterranean Graminae), Jun 1878 (not examined).

Anamorph: not known.

13. _Nectriella lusitanica_ González Fragoso, Bol. Soc. Brot. ser. 2, 2: 30. 1924.

HOLOTYPE: PORTUGAL "Lusitania." Toboaco, in aged bark of _Cupressus glaucus_, Nov 1922, _J. Macedo Pinto_ (not examined).

Anamorph: not known.

14. _Nectriella maquilingica_ Saccardo, Notae Mycol. ser. 23: 69. 1917.

HOLOTYPE: PHILIPPINE ISLANDS. Luzon: Mt. Maquiling, in dead branches of _Leucaena glauca_ (Leguminosae), Dec 1915, collector unknown _3928_ (not examined).

Anamorph: not known.

15. _Nectriella maydis_ Delacroix, Bull. Soc. Mycol. Fr. 7: 105. 1891.

HOLOTYPE: FRANCE. Saône-et-Loire: Rigny-sur Arroux, in culms of dry specimens of _Zea mays_ L., 1891, _Flageolet_ (not examined).

Anamorph: not known.

16. _Nectriella_ _miltina_ (Montagne) Saccardo, Michelia 1: 278. 1878.

≡ _Sphaeria miltina_ Mont. in Durieu, Expl. Sci. Algérie, Bot. 1: 477. 1848 [1849].

≡ _Nectria_ _miltina_ (Mont.) Mont., Syll. Gen. Sp. Crypt., p. 225. 1856.

≡ ALLANTONECTRIA MILTINA (Mont.) Weese in Höhnel & Weese, Ann. Mycol. 8: 467. 1910.

= _Allantonectria yuccae_ Earle in Greene, Pl. Baker. 2: 11. 25 Mar 1901.

LECTOTYPE, designated herein as the lower left packet on the herbarium sheet containing two pieces of _Agave_: ALGERIA. Near Mustapha, in dead leaves of _Agave_, 22 Dec 1829, _Durieu_ (PC-Montagne; 2 syntypes!).

Anamorph: _Tubercularia_ sp.

Illustration: Clements and Shear (1931, Pl. 15, 6a-d).

Habitat: dead leaves of _Agave_, _Yucca_.

Distribution: Algeria, Europe, Panama, western U.S.A.

Stromata erumpent, brick red to orange, not changing color in KOH; cells globose to rectangular, in regular rows, 9-14 x 7.0-10.5 μm. Ascomata superficial on stromata, in groups of up to 25, subglobose, brick red, not changing color or becoming slightly darker in KOH and sometimes becoming yellow in lactophenol; apex truncate, 210-220 µm diam, collapsing vertically, becoming umbilicate. Surface of ascomata of globose cells, 5-6 µm diam. Ascomatal wall 35-38 µm wide, of two regions: outer region 25 µm wide of globose thick-walled cells 5-9 µm diam, walls 2-4 µm thick; inner region 10 µm wide, of thin-walled elongate cells 8.5-10.5 x 3.0 µm. Asci clavate, 24-33 x 2.5-3.0 µm; apex rounded, containing a nonamyloid apical ring; ascospores biseriate in the middle, uniseriate above and below, occupying the upper 2/3 of the ascus. Ascospores allantoid, 4.5-6.0 x 1-2 µm, unicellular, smooth.

CHARACTERISTICS IN CULTURE. Cultures grown 20°C, 12 h dark/ 12 h light, cool white flourescent plus near UV; 6 weeks on CMD, OA, ME. Colonies on CMD slimy, radially furrowed, orange. Conidiophores 2 µm wide; apex sterile. Phialides lateral, collarette not flared. Conidia ellipsoid, 3-5 x 1-3 µm.

Additional specimens examined:

ALGERIA. in Agave, Durieu, 27 (PC, as Sphaeria jucunda, (Hypocrea)); on Agave americana (PC, as Nectriella miltina); Fragruns, on decomposed leaves of Agave americana 21 Dec 1829, Durieu (PC, as Sphaeria miltina); On leaves "juties" of Agave, 15 Jan 1840 (PC); on old leaves of Agave, 22 Oct 1829 (PC, as Sphaeria miltina). AUSTRIA. S. Tirol: Arco-Meran, Dittrich-Kalkhoff, on dead leaves of Agave americana, 1911, Wolff (NY, Rehm ascom. 1962). GREECE. Corfu "Korfu," Mon repos, in leaves of Agave americana, Apr 1912, Rechinger, (FH; NY, Rehm Ascom. 1962b; all as Nectriella miltina). ITALY. Naples, botanical garden, on withering leaves of Agave, on the top surface but fairly frequently forming on both sides, Cesati (with Tubercularia concentrica); Rabenh. F. Eur. 1828, (FH-Höhnel A5373; NY, as Nectria miltina); Rome: Villa Pamphili, in leaves of Agave americana, March 1902, D. Saccardo 866 (NY). FRANCE. Golfe Juan, Château Robert, on dead leaves of Agave americana, Dec 1894, L. Rolland (NY, Roum. 6860). PANAMA. Chiriqui: Leanos del Volcan, 1250-1300 m, 14 Jul 1935, G.W. Martin 2815c (NY, as Allantonectria yuccae). U.S.A. California: Camp Kearney, on Yucca sp., Apr 1935, O.A. Plunkett (NY, as Allantonectria yuccae); Riverside County, Soboba Hot Springs, near San Jacinto, on Yucca schidigera Roezl ex Ortigies, 6 Mar 1955, H.E. Parks 9007, California Fungi 1127 (NY, as Allantonectria yuccae); Riverside County, 3 mi S of Beaumont, east side of Rt. 79, chaparral, on dead, fire-scorched leaves of Yucca schidigera, 29 Aug 1970, H.K. Goree 2765 (NY, as Allantonectria yuccae). Colorado: San Juan County, Hermosa, on Yucca, Apr 1899, C.F. Baker 12 (TYPE of A. yuccae; NY); same location, on dead withered leaves of Yucca, 28 Mar 1899, C.T. Baker 38 (NY, as Allantonectria yuccae); Denver, on leaves of Yucca glauca Nutt., 28 Mar 1910,

E. Bethel, Fungi Columbiani 3204 (NY, as Allantonectria yuccae); Denver, on Yucca glauca, 2 Feb 1910, F.J. Seaver & E. Bethel (NY, as Allantonectria yuccae); Leyden, no host or date, F.J. Seaver & E. Bethel (NY, as Allantonectria yuccae); Leyden, on Yucca glauca, 5 Feb 1910, E. Bethel (NY, as Allantonectria yuccae); Montezuma County, Mesa Verde, 2400 m, saprophytic on dead leaves of Yucca harrimaniae with xerophilic Pinus-Juniperus, 6 Jul 1907, F.E. & E.S. Clements 460 (NY, as Allantonectria yuccae); Trimble Hot Springs, on Yucca baccata Torr., 23 Jun 1918, E. Bethel & Humbt. (NY, as Allantonectria yuccae). Utah: Washington County, Snow Canyon NW of St. George, on Yucca brevifolia Engelm., May 1988, C.T. Rogerson 88-87 (incubated in lab) (NY, as Allantonectria yuccae); Washington County, vicinity of Shivwits Campground, Snow Canyon State Park, north of Santa Clara, on dead leaves of Yucca baccata, 6 May 1988, C.T. Rogerson 88-5 (NY, as Allantonectria yuccae).

Discussion: The type of Allantonectria yuccae (NY) is labeled "number 12" as cited in the protologue, but the date of April on the packet conflicts with the published date of 28 March. This may be the holotype, but I did not search other herbaria for possible additional material.

The description of the characteristics in culture was based on the two 1988 Rogerson collections.

Allantonectria miltina looks superficially like and is related to *Nectria cinnabarina* because the ascomata are grouped on erumpent stromata, collapse vertically with an umbillicus, and produce a similar anamorph. Although the ascomata of the lectotype do not appreciably change color in KOH or lactic acid, some collections do have KOH+ ascomata (Rossman, pers. comm.). *Alantonectria* is retained as a distinct genus because of the unicellular, allantoid ascospores and the lack of a consistent KOH + reaction of the ascomata of *A. miltina*.

Allantonectria Earle was erected for *A. yuccae*. Höhnel and Weese (1910) recognized the synonymy of *A. yuccae* with *A. miltina*. Based on the Höhnel and Weese synonymy, Clements and Shear (1931) cited *A. miltina* as the type species of *Allantonectria*.

17. *Nectriella miniata* Hennings, Hedwigia 36: 219. 1897.

≡ *Nectria miniata* (Henn.) Möller, Bot. Mitt. Tropen 9: 296. 1901.

HOLOTYPE: BRAZIL. Santa Catarina: Blumenau, on tree bark, *Möller 96* (not examined).

Anamorph: not known.

Discussion: According to Theissen (1911), the specimen is on palm wood.

18. *Nectriella mölleri* Hennings, Hedwigia 36: 219, pl. 5. 1897.

≡ <u>Nectria mölleri</u> (Henn.) Möller, Bot. Mitt. Tropen 9: 296. 1901.

HOLOTYPE: BRAZIL. Santa Catarina: Blumenau, on tree bark, <u>Möller 278</u> (not examined).

Anamorph: not known.

Discussion: An isotype collection in the Höhnel herbarium in FH has no <u>Nectria</u> according to Samuels (pers. comm).

19. <u>Nectriella</u> <u>monilifera</u> (Berkeley & Broome) Saccardo, Michelia 1: 279. 1878.

≡ <u>Nectria monilifera</u> Berk. & Br., J. Linn. Soc., Bot. 14: 114. 1873.

≡ <u>Neoskofitzia monilifera</u> (Berk. & Br.) Höhnel in Höhnel & Weese, Ann. Mycol. 8: 467. 1910.

≡ <u>Dialonectria</u> <u>(Eu-dialonectria) monilifera</u> (Berk. & Br.) Cooke, Grevillea 12: 110. 1884, name invalid; Art. 33.1; combination not made.

Type: SRI LANKA. Peradeniya, on rotten wood or soil, 1870, <u>Berkeley 1105</u> (K!).

Anamorph: not known.

Habitat: rotten wood or soil.

Distribution: Sri Lanka.

Ascomata globose, 400 μm, superficial, scattered to clustered, red to orange, turning darker red in KOH and yellow in lactophenol. Ascomatal wall 40 μm wide; cells almost rectangular, to 20 μm long, containing pigment. Asci cylindrical, to 140 μm long; ascospores uniseriate.

Ascospores cylindrical to elliptical, 6 x 3.0-3.5 µm, 1-septate, greenish to pale brown, roughened, disarticulating in the ascus; part-spores discoid, 3.0-3.5 µm diam, walls 1 µm thick.

Discussion: Nectriella monilifera can be readily excluded from Pseudonectria because of the ascospores, which are described as disarticulating into part-spores while still in the ascus. Disarticulation of ascospores into 16 part spores is a characteristic of the hypocrealean genera Hypocrea and Neoskofitzia. Although Rogerson (1970) accepted Neoskofitzia, Rossman (1991, pers. Comm.) was unable to locate material of the lectotype species, N. pallida Schulzer, and the original descriptions of Neoskofitzia and its lectotype are not illuminating. Nectriella monilifera differs from typical Hypocrea in having discrete, superficial, nonstromatic KOH + ascomata.

Neoskofitzia termitum Höhnel (Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 117: 998. 1908) on pieces of a termite comb lying on the ground, was found in Java. Although Höhnel (1912a) disagreed, Petch (1913, 1920) synonymized N. termitum with N. monilifera. Petch stated (1913) that even though N. monilifera was described from sandy soil, there may have been an association with a termite nest. The asci of N. termitum, described as 44 x 4 µm, are smaller than those of specimen examined herein. The type collection of N. termitum must be examined to verify the possible synonymy.

20. Nectriella musicola (Spegazzini) Saccardo & Trotter, Syll. fung. 22: 446. 1913.

≡ Notarisiella musicola Speg., Anal. Mus. Nac. Buenos Aires 19, ser. 8, 12: 404. 1909.

HOLOTYPE: ARGENTINA. Near Tucumán, on semiburned, decaying stems of Musa paradisiaca L., Apr 1906. Mycetes Argentinenses, Ser. 4, n. 675 (not examined).

Anamorph: not known.

21. Nectriella mycetophila (Peck) Saccardo, Syll. fung. 2: 449. 1883.

≡ Nectria mycetophila Peck, Bull. Buffalo Soc. Nat. Sci. 1: 71. 1874

= SPHAEROSTILBELLA AUREONITENS (Tulasne & Tulasne) Seifert, Samuels & W. Gams [fide Seifert, 1985].

HOLOTYPE: U.S.A. New York: Albany County, New Scotland, on decaying fungi, Oct 1872 C.H. Peck 104,(not examined).

Anamorph: Gliocladium penicillioides Corda, Ic. Fung. 4: 31. 1840.

Habitat: fungicolous, especially Stereum spp. (Siefert, 1985).

Distribution: as Nectria mycetophila, New York, as Sphaerostilbella aureonitens, widely distributed.

Discussion: The holotype was examined and described by Samuels (pers. comm.) as follows. Mycelium not obvious.

Ascomata on gill of agaric, solitary to gregarious, obpyriform, 465 x 370-430 µm, yellow, not changing color in KOH, collapsing by lateral pinching. Ascomatal wall 30-40 µm, asci 60-120 µm. Ascospores (8.5-)10.0-14.0 x 3.0-3.5 (-4.0) µm, slightly constricted, 1-septate, smooth.

Seifert (1985) redescribed Gliocladium penicillioides, anamorph of Sphaerostilbella aureonitens, type species of the genus Gliocladium. He did not observe the teleomorph, but referred readers to Samuels (1976).

22. Nectriella nigroviridis (Crouan & Crouan) Saccardo, Michelia 1: 278. 1878.

≡ Nectria nigroviridis Crouan & Crouan, Fl. Finestère 37. 1867.

HOLOTYPE: FRANCE. Brittany: Finestère, in cavities of dead bark of stems of Privet (Ligustrum), spring, Crouan & Crouan (CO!).

Anamorph: not known.

Habitat: Ligustrum.

Distribution: known only from the type.

Ascomata in groups erumpent through bark, obpyriform, appearing black, turning yellow in KOH, not collapsing or collapsing laterally or vertically. Setae on apex of ascomata black-walled. Cells on surface epidermoid. Asci clavate; ascospores diagonally uniseriate. Ascospores ellipsoid, 8 x 4 µm, 1-septate, smooth, one guttule per cell.

Discussion: Nectria nigroviridis was placed in Nectriella by Saccardo based on the Crouan description of unicellular ascospores. There is, however one septum.

Although the dark, soft ascomata and dark-walled setae place this species closest to Niesslia, Niessliaceae, Hypocreales (sensu Barr, 1990), the ascomata are erumpent instead of superficial. A generic determination remains to be made.

23. Nectriella offuscata (Berkeley & Curtis) Saccardo, Michelia 1: 279. 1878.

≡ Nectria offuscata Berk. & Curt., Grevillea 4: 45. 1875.

HOLOTYPE: U.S.A. S. Carolina: on Hibiscus syriacus L., collector unknown, Car. Inf. 2865 (not examined).

Anamorph: not known.

24. Nectriella oryzae Hara, Diseases of the Rice Plant (Japan), p. 130. 1918.

HOLOTYPE: JAPAN. Prov. Mino: Kawaue, on Oryza sativa L., 2 Feb 1918 (not examined).

Anamorph: not known.

Ascomata subglobose, 200-250 μm diam, superficial, scattered or in groups of 3 to 5, seated on a white subiculum, orange yellow, becoming red; ostiole papillate, collapsing vertically. Ascomatal wall containing oil drops. Asci cylindric-clavate, 50-70 x 5-6 μm, 8-spored, unitunicate; apex obtuse; stipitate, crowded; ascospores diagonally uniseriate to biseriate in the ascus. Ascospores fusiform, 7.5-10 x 2-3 μm, unicellular, hyaline, smooth, released easily in water, three guttules in middle of spore. Bakanae colonizes first on dead stems in field. Then _Nectriella_ produces some fruiting bodies on the _Giberella_.

Discussion: The above description is translated from the Japanese protologue. Bakanae refers to a disease of rice characterized by abnormal growth. The symptoms are caused by giberellin produced by _Giberella_ _fujikuroi_ (Sawada) Ito (anamorph _Fusarium moniliforme_ Sheldon, see Booth, 1971). The above description of _Nectriella_ _oryzae_ does not report abnormal growth of the rice.

The type must be examined to determine proper generic placement.

25. _Nectriella_ _pallidula_ Penzig & Saccardo, Malpighia 11: 507, pl. 26, fig. 4. 1898, non _Nectria pallidula_ Cooke 1888.

SYNTYPES: INDONESIA. Java: Tjibodas, in and near ascomata of _Melchioria leucomelaena_ Penz. & Sacc., on rotting stems of _Elettaria_ sp., 6 & 12 Feb 1897, _E. Nyman 142, 441, 865B_ (not examined).

Anamorph: not known.

Discussion: There are two collections in the Höhnel herbarium in FH labeled 12 Feb 1897, _Penzig 1907, 1908_ from the Saccardo herbarium that are probably type material and another specimen from Java, Salak, Urwald, 11 Sep 1897, all not examined.

26. Nectriella papyrogena Saccardo & Penzig, Michelia 2: 608. 1882.

HOLOTYPE: in moist herbarium blotting paper, associated with pink Sporotrichum, Therry 6291 (not examined).

Anamorph: not known.

27. Nectriella perpusilla (Montagne) Saccardo, Michelia 1: 278. 1878 [Michelia 1: 51. 1877, combination not actually made].

≡ Hypocrea perpusilla Mont. in de la Sagra, Hist. phys. Cuba, Bot. Pl. Cell. 335. 1842.

≡ Nectria perpusilla (Mont.) Mont., Syll. gen. spec. Crypt. 225. 1856, non Nectria perpusilla Saccardo, 1918.

≡ NECTRIOPSIS PERPUSILLA (Mont.) Samuels, Mem. New York Bot. Gard. 48: 28, figs. 8A,B. 1988.

= Lisea parasitica Rick, Broteria 5: 41. 1906 [fide Samuels, 1988].

HOLOTYPE: CUBA. [Parasitic in clavate Hypoxylon] Montagne 335 (PC-general collection !).

Anamorph: not known.

Habitat: on perithecia of Hypoxylon, Nectria and Xylaria.

Known distribution: Brazil, Colombia, Cuba, New Zealand, Venezuela.

Ascomata subglobose, 100 x 120 to 169 µm diam, scattered, superficial, yellow, small, not changing color in KOH; papilla conic, collapsing laterally or vertically. Setae hyphal, on apex of ascomata. Surface cells 5-10 µm diam. Ascomatal wall 10 µm wide. Asci clavate, 30-35 x 5-8; apical ring not obvious; ascospores partially biseriate. Ascospores ellipsoid, 7-10 x 2.5-3.5, often constricted, 1-septate, hyaline, one guttule per cell.

Additional specimen examined:

MEXICO. Campechi: "El Tormento" For. Exp. Sta., on stromata of Xylaria maitlandii (Denn.) Hawksw., 9 Nov 1988, San Martín 1201B (NY).

28. Nectriella philippina Rehm, Leafl. Philipp. Bot. 6: 1935. 25 Jun 1913.

HOLOTYPE: PHILIPPINE ISLANDS. Luzon: Prov. Laguna, Los Baños, on dead stems of Passiflora quadrangularis, Dec 1912, C.F. Baker 40c (S!).

Anamorph: not known.

Pseudothecia superficial and easily removed, covered with yellow granules. Asci ellipsoid, 50-70 x 20-24 µm, bitunicate, separated by many sterile filaments. Ascospores ellipsoid, 16-20 x 10 µm, 1-cell, smooth.

Discussion: This fungus differs from Microdothella culmicola H. Sydow (= Phaeopolystomella Batista & Maia) in the lack of hypostroma, larger ascoma, and longer asci.

29. Nectriella ptychospermatis Rehm, Leafl. Philipp. Bot. 6: 2275. 1914.

= ?DISCOCHORA Höhnel [= Guignardia Viala & Ravaz].

HOLOTYPE: PHILIPPINE ISLANDS. Luzon: Prov. Laguna, Los Baños, on Ptychosperma macarthurii (Palmae), 5 Aug 1913, S.A. Reyes (comm. C.F. Baker 1439) (S!).

Anamorph: not known.

Pseudothecia globose, 180-240 μm diam, immersed in leaf, abundant, appearing as translucent yellow spots. Ascomatal wall consisting of two regions; the outer 40 μm wide; the inner 20 μm wide, of flattened thinner-walled cells. Asci clavate, 50-80 x 10-14 μm, bitunicate, with an elongate empty base. Ascospores obovoid, 14-16 x 6-8 μm, unicellular, hyaline. Pseudoparaphyses septate, sparse.

Discussion: Nectriella ptychospermatis belongs in the Pleosporales, Botryosphaeraceae, close to Discochora Höhnel (see Barr, 1987).

30. Nectriella resinae (Fries: Fries) Saccardo, Syll. fung. 2: 451. 1883.

≡ Sphaeria resinae Fr.: Fr., Observ. Mycol. 1: 180. 1815.

≡ Cytispora resinae (Fr.: Fr.) Erenb., Silv. Mycol. Berol., 15, 1818 ("Cytospora").

≡ Nectria resinae (Fr.: Fr.) Fr., Summa veg. Scand., sect. post. 388. 1849.

≡ Tubercularia resinae (Fr.: Fr.) Thümen, Fung. Austr. 79. 1871.

≡ Zythia resinae (Fr.: Fr.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 14: 104. 1887.

≡ PYCNIDIELLA RESINAE (Fr.: Fr.) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 124: 91. 1915.

Teleomorph: SAREA RESINAE (Fr.: Fr.) Kuntze, Revis. Gen. Pl. 3: 515. 1898.

LECTOTYPE (Hawksworth and Sherwood, 1981): SWEDEN. In resin of Pinus abietis Swartz [=Picea], Fries, Scler. Suec. 37, 1825 (UPS; Isotypes: A; B; K; L; STR, not examined).

Habitat: on resin of pines.

Distribution: Europe.

Additional specimen examined:

U.K., SCOTLAND. Dumfries and Galloway: Raider's Road, NX 547 753, 27 May 1986, H. Hodgson, RL 187, (IMI 130486).

Discussion: Hawksworth and Sherwood (1981) conclude that N. resinae is a pycnidial anamorph and that the teleomorph is Sarea resinae, a discomycete referable, to Lecanorales, Agyriaceae Corda.

31. Nectriella rufo-fusca Penzig & Saccardo, Malpighia 11: 507. 1897.

HOLOTYPE: INDONESIA. Java: Tjibodas, in dead branches of *Elettaria*, 6 Feb 1897, collector not identified *436 p.p.* (not examined).

Anamorph: not known.

32. *Nectriella* (*Notarisiella*) *setulosa* Penzig & Saccardo, Malpighia 11: 507, pl. 27, fig. 1. 1897.

HOLOTYPE: INDONESIA. Java: Tjibodas, in rotting branches of *Elettaria*, 1 Mar 1897, *Penzig 191* [with *Nectriella flocculenta*] (not examined).

Anamorph: not known.

33. SCHIZOPARME STRAMINEA Shear, Mycologia 15: 121, pl. 13, figs. 1, 2. 1923.

HOLOTYPE: U.S.A. Virginia: Arlington, farm rose garden, on old fallen leaves of *Rosa rugosa prostrata*, 6 Sep 1920, *C.L. Shear 3568* (BPI).

Anamorph: *Coniella castaneicola* (Ell. & Ev.) Sutton, Coelomycetes, 420. 1980 [proven by Nag Raj, pers. comm.].

Habitat: dead leaves of Eucalyptus, Rosaceae, Fagaceae, Vitaceae.

Distribution: Cuba, Italy, U.S.A. (Virginia).

Epistroma of subglobose cells above ascomata. Ascomata subglobose, 100-500 μm diam, erumpent, scattered to gregarious. Surface cells large, thick-walled. Asci clavate, 45-50 x 8-10 μm, containing a massive nonamyloid ring, appearing as two large bodies, J-; ascospores biseriate. Ascospores ellipsoid, 11-13 x 3-4 µm, unicellular; appendages filmy, emerging from both ends.

Discussion: The placement of Schizoparme straminea has been controversial. The species was listed as Pseudonectria in Eriksson and Hawksworth (1987), suggested to be Nectriella by Dodge (1936: 95), and included as a member of the Sphaeriaceae by Clements and Shear (1931: 261). I believe the correct genus to be Schizoparme because of the epistroma, ascospores with appendages, and black pycnidial anamorph. Many characters of S. straminea suggest the Hypocreales (reddish ascomata, apparent lack of sterile tissue among the asci, hyaline ascospores, phialidic anamorph) but production of yellow pigment when treated with KOH and the proven association with a black pycnidial anamorph (Nag Raj, pers. comm.) would be unusual in that order.

Schizoparme straminea was synonymized with Nectriella versoniana by Dodge (1936). The two taxa share characters of nonsepate, ellipsoid ascospores, asci with two large bodies in the apex, and Coniella anamorphs. Schizoparme straminea differs from S. versoniana in having smaller ascospores, erumpent ascomata and the Coniella castaneicola anamorph.

34. Nectriella thelopsidioides (Crouan & Crouan) Saccardo, Michelia 1: 279. 1878.

≡ Nectria thelopsidioides Crouan & Crouan, Fl Finistère, p. 256. 1867.

HOLOTYPE: FRANCE. Brittany: Coatadon, on dead bark of willow (Salix), 23 Apr 1867, Crouan & Crouan (CO!).

Anamorph: not known.

Habitat: bark of Salix.

Distribution: known only from the type.

Pseudothecia subglobose, erumpent through bark, reddish, not changing color in KOH. Asci clavate, bitunicate, ascospores biseriate. Ascospores fusiform, elongate. Paraphyses apically free, capitate.

Discussion: The holotype packet of Nectria thelopsioides bearing the inscription "theques d'hisente à huit spores comme ce dessous" has an illustration of a muriform, apiculate spore. This drawing does not illustrate the described fungus. Another accompanying illustration, labeled "Nectria thelopsioides Crouan, nov. sp., on willow, 93," depicts two clavate asci and single-celled, fusiform ascospores. This drawing is diagnostic of the species.

The combination of bitunicate asci and apically free paraphyses excludes this taxon from the Hypocreales.

35. Nectriella tracheiphila E.F. Smith, Proc. Amer. Assoc. Advancem. Sci. 44: 190. 1895 (nom. inval., Arts. 32, 34 (N. "trocheiphila").

≡ NEOCOSMOSPORA VASINFECTA E.F. Smith, U.S.D.A. Bull. 17: 45. 1899.

= Neocosmospora vasinfecta E.F. Smith var. tracheiphila E.F. Smith, U.S.D.A. Bull. 17: 45. 1899.

= Nectriella vasinfecta E.F. Smith var. nivea E.F. Smith, U.S.D.A. Bull. 17: 45. 1899.

?= Pseudonectria ornata Batista & Maia, Anais Soc. Biol. Pernambuco 13: 74. 1955 [fide Cannon and Hawksworth, 1984].

= Neocosmospora vasinfecta E.F. Smith var. major Rama Rao, Mycopath. Mycol. Appl. 21: 218. 1963.

= Neocosmospora ornamentata Barbosa, Garcia de Orto 13: 17. 1965, nom. inval., Art. 37.1, holotype not cited.

NEOTYPE, designated by Cannon and Hawksworth (1984): U.S.A. South Carolina: Cameron, on Gossypium herbaceum, Oct 1902, 'W.A.O.' (not examined).

Anamorph: Acremonium sp. (Cannon and Hawksworth, 1984).

Habitat: roots and soil usually associated with leguminous crops as well as a variety of other vascular plants.

Distribution: tropics and warm temperate regions.

Mycelium basal, sparse, white. Ascomata subglobose to short pyriform, (200-)300-500 µm high x (170-)280-480 µm wide, superfical, scattered or in groups of up to 20, nonstromatic, orange brown to red, becoming darker in KOH and yellow in lactic acid; papilla short, truncate. Surface of distinct angular cells, 8-15 µm diam. Periphyses present. Asci cylindrical, 80-100 x 10.5-15.0(-16.0) µm; apex truncate; apical ring absent; ascospores uniseriate, basal 8-15 µm devoid of ascospores. Ascospores globose to ellipsoid, (9.0-)10.0-15.5 x (7.0-)7.5-12.0 µm, unicellular, yellow, buff to salmon pink in mass, roughened with irregularly thickened wall.

Additional specimens examined:

COLOMBIA. Dec 1895, Fungi Columbiani 1434b (isosyntype: K). NETHERLANDS. Baarn, ex stored peanuts, de F. Barbosa (IMI 251387, as Neocosmospora ornamentata Barbosa). JAPAN. National Inst. Hygenic Sci. Comm., ex sewage sludge, 12 May 1983, Udagawa NHL 2911 (IMI 277708, as Neocosmospora teniucristata Veda & Udagawa). U.S.A. Aug 1899, E.F. Smith 1434a (NY).

Discussion: Pseudonectria ornata Batista & Maia in Batista et al. (1955) is a probable synonym of Neocosmospora vasinfecta. Cannon and Hawksworth (1984) suggested the synonmy because Illustrations and descriptions from the protologue coincide with the fungus described herein, but the types must be examined to confirm that the fungi are identical.

36. Nectriella versoniana Saccardo & Penzig, Michelia 2: 256. 1881.

≡ SCHIZOPARME

HOLOTYPE: SPAIN: Granada, Torreglia, Euganei, in immature, rotting fruits of Punicia granatum Sokotra [as "granati"], associated with Phoma versoniana Sacc., in viridarium [garden], Nov 1880, Penzig & Verson, Mycoth. Veneta 1484 (PAD!; Isotypes: BPI!, K!, NY!).

Anamorph: Coniella granati (Sacc.) Petrak & H. Sydow, Repert. Spec. Nov. Regni Veg. Beih. 42: 461. 1927 (= Phoma versoniana) (Dodge, 1936).

Epistroma of subglobose cells above ascomata. Ascomata subglobose, 280-440 µm diam, superficial; bases firmly attached to substrate, gregarious, nonpapillate, black when dry, becoming brown and releasing yellow-brown pigment in KOH, collapsing vertically, becoming deeply cupulate. Surface cells angular to rounded, 16 µm diam; walls 1.5-2.0 µm wide. Ascomatal wall ca. 15 µm wide. Asci clavate, 45-50(-60) x 8-10(-11) µm, containing a massive nonamyloid ring, appearing as two large bodies; ascospores biseriate in ascus. Ascospores ellipsoid, 12-20 x 6-7 µm, unicellular, smooth, surrounded by clear sheath; appendages at each end, rounded, filmy. Paraphyses not observed.

Anamorph in nature: Conidiomata pycnidial, similar to teleomorph but smaller, 70 µm high x 120-140 µm wide, black; collapsing vertically, becoming deeply cupulate. Surface cells angular, 8-10 µm diam. Conidiogenous cells phialidic. Conidia irregularly ellipsoid, 14-21 x 4.0-4.5 µm, unicellular, pale brown, inconspicuous slit sometimes observed; developing on a lenticular cushion of cells proliferating from the base of the pycnidium.

Additional specimen examined:

CYPRUS. Roselle, on fruit of Punicia granatum, 1961, N.A. Burges (IMI, culture collection 90 700).

Discussion: I agree with Nag Raj (pers. comm.) that Nectriella versoniana should be recombined in Schizoparme (Hypocreales) because the asci have a large apical ring, the presence of appendaged ascospores, and a Coniella anamorph. Schizoparme versoniana differs from S. straminea in the substrate (pomegranate), the larger ascospores and the Coniella granati anamorph.

37. Nectriella villosula Spegazzini, Michelia 1: 463. 1879.

HOLOTYPE: ITALY. Venetia: Cera near Belluno, in dead branches of Rosa alpina, Oct 1878, rare (not examined).

Anamorph: not known.

38. Nectriella zingiberis F.L. Stevens & Atienza, Philipp. Agric. 20: 176, fig. 4b. 1931 (N. "zingiberi").

HOLOTYPE: PHILIPPINE ISLANDS. Luzon: Laguna, agricultural college, on rhizomes of cultivated ginger, Zingiber officinale, 18 Nov 1930, F.L. Stevens 1126 (not examined).

Anamorph: not known.

39. Nectriella zingiberis F.L. Stevens & Atienza var. pallida Stevens & Atienza, Philipp. Agric. 20: 176. 1931.

HOLOTYPE: PHILIPPINE ISLANDS. Luzon: Laguna, agricultural college, on rhizomes of cultivated ginger, Zingiber officinale, 18 Nov 1930, F.L. Stevens 1128 (not examined).

Anamorph: not known.

BRYOPHILOUS TAXA DESCRIBED IN **NECTRIELLA Saccardo** THAT ARE EXCLUDED FROM PSEUDONECTRIA

Although the species treated herein are all found on liverworts, I continue to use the traditional designation of "bryophilous fungi" used by Racovitza (1959) and Döbbeler (1978).

Several species that occur on living thalli of liverworts have, at one time, been included in Nectriella Saccardo by the above authors. These species have several characters in common with the genus Pseudonectria, namely superficial, pallid ascomata and unicellular ascospores with walls thickened at the ends.

Although four of these taxa are today accepted as distinct species, they are not related. Pseudonectria metzgeriae is treated herein as a member of Pseudonectria. Pseudonectria brongniartii is retained in the Hypocreales but is not treated as Pseudonectria because of the unusually shaped ascospores and the presence of haustoria. Nectriella erythrostigma and Pseudonectria jungermanniarum, with hamathecia of apically free paraphyses, are excluded from the Hypocreales.

There are no reports of anamorphs of the bryophilous species. Proper taxonomic placement of these species must await a comprehensive study of _Pseudonectria_.

1. _Pseudonectria_ _brongniartii_ (Crouan & Crouan) Döbbeler, Mit. Bot. Staatssamml. München 14: 98, pl. 13. 1978.

≡ _Nectria brongniartii_ Crouan & Crouan, Fl. Finistère, p. 37, suppl. pl. 1867.

≡ _Calonectria brongniartii_ (Crouan & Crouan) Sacc., Michelia 1: 314. 1878.

?= _Nectriella_ _casaresii_ González Fragoso, Mem. Real Soc. España Hist. Nat. 11: 109, pl. 11. 1918 [1919].

≡ _Pseudonectria casaresii_ (G.Frag.) Racovitza ("_Casaresi_"), Mém. Mus. Natl. Hist. Nat., Sér. B, Bot. 10: 20. 1959.

HOLOTYPE: FRANCE. Coatadon, on _Frullania "tamarisci,"_ 18 Jun 1870 (CO; according to Döbbeler, 1978; not examined); on _Frullania dilata_ on an old Holly, Autumn, _Crouan & Crouan_ (CO!).

Anamorph: not known.

Habitat: living leaves of _Frullania_ sp.

Distribution: France, Spain.

Mycelium white, basal. Ascomata subglobose, 300 µm diam, on the ventral side of leaf, red-orange. Asci cylindrical, 50 x 5-6 µm; apex rounded. Ascospores cylindrical, 6-7 x 1.5 µm; ends thickened, pale orange; guttules in ends, 1 µm diam. Paraphyses not seen.

Discussion: The ascospores of this species appear three celled because of the guttule in each thickened end. An isotype collection mentioned by Rossman (1979) was not found at CO.

Racovitza (1959) did not study specimens of Pseudonectria brongniartii but followed Saccardo in treating the species in Calonectria. Racovitza described the ascospores as subcylindric with four hyaline guttules and as having indistinct septa. Racovitza also described and illustrated subglobose haustoria extending from the mycelium of Pseudonectria brongniartii.

Döbbeler (1978) did not examine the type of Pseudonectria casaresii (SPAIN. Pontevedra, near Arosa, on living leaves of Frullania dilatata (L.) Dum. (Hepaticae), A. Casares) but synonymized the species with P. brongniartii on the basis of the close morphological agreement with the description of G. Fragoso (1919).

The synonymy of Pseudonectria casaresii with P. brongniartii must be confirmed by comparing their types. The lack of persistent paraphyses and the pallid, soft ascomata place Pseudonectria brongniartii in the Hypocreales. The unusually shaped ascospores with the thickened ends and the presence of haustoria prevent me from accepting the species in Pseudonectria at this time. The position of this species may be clarified when a comprehensive study of Pseudonectria is undertaken.

2. Nectriella erythrostigma (Montagne) Saccardo, Syll. fung. 9: 942. 1891.

≡ Peziza erythrostigma Mont., Syll. Gen. Sp. Crypt., p. 186. 1856.

≡ Orbilia erythrostigma (Mont.) Sacc., Syll. fung. 8: 632. 1889.

≡ Nectria erythrostigma (Mont.) L.R. Tul. & C. Tul., Select. fung. carpol. 3: 196. 1865, not validly published, Art. 33.1.

HOLOTYPE: FRANCE. Seine-et-Oise: Chennevières-sur-Marne, on surface of Frullania dilatata, Sep 1846, Montagne (PC-herb. Mont. ex herb. Durieu de Maisonnneuve!).

Anamorph: not known.

Ascomata subglobose, pale yellow. Setae 40 x 6 μm, scattered. Asci clavate, 80-120 x 14-18 μm; apical ring absent; ascospores biseriate. Ascospores ellipsoid, 25-34 x 8 μm, 1-celled; ends thickened; projection from lower end, 6-7 μm long, stiff. Paraphyses filiform, 2 μm wide, apically free, abundant.

Discussion: Racovitza (1959) considered Nectriella erythrostigma of uncertain taxonomic position. He was unable to recollect this species or to see the Montagne material. He compared N. erythrostigma to Eleutheromyces Fuckel because of the ciliate ascospores. Eleutheromyces, however, is a Coelomycete. Paranectria Sacc., one of the few genera in the Hypocreales with ciliate ascospores, differs because the ascospores are phragmosporous to muriform. Nectriella erysthrostigma, because of the abundant apically free paraphyses, is not hypocrealean. Because of the sparse material, sections could not be made. The stiff projection from the lower end of the ascospore is unusual. With the combination of characters found in this species, N. erysthrostigma cannot be adequately placed.

3. Pseudonectria jungermanniarum (Crouan & Crouan) Döbbeler, Mit. Bot. Staatssamml. München 14: 103, pl. 15. 1978.

≡ Nectria jungermanniarum Crouan & Crouan, Fl. Finistère, p. 37, Suppl. pl. 1867.

≡ Lasionectria jungermanniarum (Crouan & Crouan) Cooke, Grevillea 12: 112. 1884.

= Nectriella lophocoleae C. Massalongo, Mem. Accad. Sci. Med. Nat. Ferrara, figs. 5-8. 1895 [fide Döbbeler, 1978].

≡ Pseudonectria lophocoleae (Massal.) Racovitza ("lophocolea"), Mém. Mus. Natl. Hist. Nat., Sér. B, Bot. 10: 20. 1959.

= Neotiella crozalsiana Grelet, Bull. Soc. Mycol. France 41: 83, fig. 1. 1925 [fide Döbbeler, 1978].

≡ Pseudonectria crozalsiana (Grelet) Racovitza, Bull. Sci. Acad. Roumania 29: 72. 1946.

LECTOTYPE, designated by Döbbeler (1978): FRANCE. Brittany: Finistère, on Jungermania bidentata and Jungermania tamarisci, 1860, Crouan & Crouan (CO!).

Anamorph: not known.

Mycelium pallid. Ascomata perithecioid, subglobose to ovoid, 375-475 high x 250-350 µm wide, superficial, pale yellow to slightly pink, hyphae at sides and base hyaline, becoming slightly red in KOH and yellow in lactic acid. Setae on ascomata obtuse, 50-150 x 8-10 µm, walls thick. Surface cells epidermoid. Asci clavate, 100-124 x 20 µm, operculate, (opening by a slit according to Corner, 1953), J-; ascospores biseriate to triseriate. Ascospores ellipsoid, 30-40 x 10-14 µm, 1-celled, hyaline, end walls thickened, 3 guttules per cell. Paraphyses filiform, 200 x 2 µm, 100 µm longer than asci, branched. Appressoria ellipsoid, often with free end pointed, 20 x 10 µm, forming on side branch of hyphae, arising at a right angle, single subtending cell, thick-walled, 8 µm wide, septate.

Additional specimens examined:

IRELAND. Dargle near Dublin, on Lophocolea bidentata, Mar 1929, Buchanan (K). U.K., SCOTLAND. Mid-Hebrides: Mull, Quinish, on Lophocolea sp. (Hepaticae), 12 Jun 1979, M.C. Clark (IMI 239713).

Discussion: Pseudonectria jungermanniarum, a fungus with apically free paraphyses is not hypocrealean. Grelet (1925) described Neotiella crozalsiana as a discomycete and reported ascomata were at first subglobose and then became applanate. Corner (1929, 1935) studied N. crozalsiana and concluded that the fungus is a discomycete even though the ascomata that he studied maintained a perithecioid shape. He placed N. crozalsiana in the Humariaceae because of the presence of carotin in the paraphyses and the operculate ascus. Corner explained the perithecioid form of ascomata by theorizing that the angiocarpic development was arrested at a juvenile stage. He suggested that a xerophytic environment contributed to the arrested development and the failure to expose the disc.

Racovitza (1946, 1959) disputed Corner's explanation because the collection of Pseudonectria crozalsiana that he studied was on a liverwort found in a very damp, not a dry environment. In addition, he pointed out that carotenes occur in other groups of fungi such as the Hypocreales and Uredinales. He found the fructification to be a true pyrenomycete and based his classification on the form of the ascomata which he considered more important than the operculate ascus. Döbbeler (1978), also, following other authors, treated the fungus in Pseudonectria for the time being. He stated that the synonymy with Neotiella crozalsiana must be regarded as doubtful.

Racovitza (1959) did not study Pseudonectria jungemanniarum. He considered P. crozalsiana and P. lophocoleae to be distinct because of the smaller ascomata and ascospores of P. lophocoleae.

Racovitza reported that he was unsuccessful in germinating ascospores of Neotiella crozalsiana. Corner sucessfully germinated ascospores of N. crozalsiana. He described the development of appressoria. No conidia were produced.

Whether the ascomata of Pseudonectria jungermanniarum are pyrenomycetes or discomycetes needs to be determined. Examples of perithecioid discomycetes exist in the genera Obtectodiscus Müller, Petrini, & Samuels (Müller et al., 1979) and Loramyces Weston, (Digby and Goos, 1988). The asci of these genera are inoperculate whereas the asci of Pseudonectria jungermanniarum are operculate. Operculate asci occur in discomycetes in the Pezizales. I do not know of any pyrenomycetous genera with operculate asci.

Pseudonectria jungermanniarum must be studied further to determine the nature of the ascomata and the asci and to verify the synonymies. The ellipsoid ascospores with thickened end walls, the bryophilous habit, and the appressoria also should be considered in the reclassification.

TABLE 1

NECTRIELLA GENERIC CONCEPTS*

Immersed ascomata, 2-celled ascospores

NECTRIELLA Nitschke in Fuckel, 1870 (Hypocreales)**
Lectotype, N. fuckelii Nits. by Seaver, 1909, Clements and Shear, 1931

CRYPTONECTRIELLA (Höhnel) Weese, 1919 (Xylariales)
(Subgenus Höhnel, 1918)
Type species, C. biparasitica (Höhnel) Weese [Charonectria biparasitica Höhnel, 1903]

PRONECTRIA Clements in Clements & Shear, 1931
Type species, P. lichenicola (Ces.) Clements in Clements & Shear [Cryptodiscus lichenicola Ces., 1857] (= Nectriella robergei Mont. & Desm., 1856) (Hypocreales)

CHARONECTRIA Sacc., 1880 (Xylariales)
Type species, C. consolationis Sacc.

HYDRONECTRIA Kirschstein, 1925 (Hypocreales)
Type species, H. kriegeriana Kirschst.

Superficial ascomata, 1-celled ascospores

PSEUDONECTRIA Seaver, 1909 [new name for Nectriella Sacc.]
Type species, P. rousseliana (Mont.) Wollenw., Oct.1931 (Hypocreales)

Nectriella Sacc., 1877 (non Nectriella Nits., 1870)
Type species, N. rousseliana (Mont.) Sacc., June-July 1931 (Hypocreales)

Notarisiella (Sacc.) Clements and Shear, Jun-Jul 1931
(subgenus Sacc., 1883)
Type species, N. rousseliana (Mont.) Clements & Shear (Hypocreales)

Immersed ascomata, 1-celled ascospores

HYPONECTRIA Sacc., 1878 (Seaver concept, 1909) [emended by Samuels, et al. (1984) to include species with 2-celled ascospores] (Xylariales)
Type species, H. buxi (DC) Sacc. [Sphaeria buxi DC]

*Accepted genera capitalized
**Orders sensu Barr (1990)

Table 2

Comparison of the type species of Nectriella and Pronectria

NECTRIELLA FUCKELII		PRONECTRIA LICHENICOLA
	Host	
dead wood (Populus) saprophytic		living lichen (Peltigera) parasitic, thallus damaged
	Habit	
immersed-erumpent		immersed
Not clypeoid		clypeoid
Nonstromatic		nonstromatic
	Ascomata	
yellow		orange to red
KOH-		KOH-
diam 200-340 μm		diam 250-320 μm
gregarious, discrete		gregarious, discrete
papillate		papillate
setose		nonsetose
wall 2-layer		wall 1-layer
ostiole surrounded by vertical parallel hyphae		ostiole surrounded by vertical parallel hyphae
apex widened		apex widened
apical hyphae not entering host		apical hyphae penetrating lichen
	Asci	
clavate, 60-80 x 10-15 μm		clavate, 62-72 x 9-14 μm
apex rounded		apex truncate
apical apparatus 2 subapical dots		apical apparatus cap-like
ascospores partly biseriate		ascospores partly biseriate
	Ascospores	
ellipsoid,		ellipsoid-ovoid,
12-20 x 5-7 μm		14-17 x 6-7 μm
pallid, 2-celled		pallid, 2-celled
verruculose		verruculose
	Anamorph	
unknown		Illosporium (circumstantial)

TABLE 3
Anamorphic connections of species of *Pronectria* and *Nectriella* (all proven from single ascospore isolations unless otherwise noted)

Name	**Anamorph**	**Reference**
Pronectria anisospora	*Acremonium pedatum*	Lowen, 1989
Pronectria erythrinella	*Illosporium carneum*	Lowen in 1988
Pronectria robergei	*Illosporium carneum*	repeated association
Pronectria santessonii	*Acremonium*	Lowen & Hawksw., 1986
Pronectria subimperspicua	*Diplosporium caudatum*	associated on host
Nectriella dingleyae	*Fusarium*	published herein
Nectriella minuta	*Acremonium*	published herein
Nectriella muelleri	*Acremonium*	Samuels, et al. 1984.
Nectriella obscura	*Fusarium*	published herein
Nectriella pironii	*Kutilakesa pironii*	Alfieri & Samuels, 1979.

Name	**Compatibility**	**Reference**
Nectriella bloxamii	homothallic	Booth in 1984; Lowen in 1985
Nectriella sambuci	homothallic	Culture by Booth in 1973
Nectriella guttulata	homothallic	Lowen, 1989
Nectriella paludosa	homothallic	Lowen in 1986, 1988

Table 4

LICHENICOLOUS SPECIES OF PRONECTRIA ARRANGED BY HOST

PELTIGERALES, Peltigeraceae (all on ground)
- Peltigera
  - P. erythrinella
  - P. robergei
    - N. carnea
    - P. lichenicola
    - N. peltigerae
  - P. tenuispora
  - P. ornamentata

LECANORALES
- Collemataceae
  - Collema, P. tenacis (ground)
- Physciaceae
  - Anaptychia
    - P. santessonii (rock)
    - P. tincta (tree)
  - Physcia
    - P. leptaleae (tree)
    - P. echinulata (tree)
  - Phaeophyscia
    - P. leptalea var. tuberculata (tree)
- Parmeliaceae
  - Punctelia
    - P. paucispora (rock)
    - P. subimperspicua (tree)
  - Hypogymnia
    - P. anisospora (tree)

PERTUSARIALES, Pertusariaceae
- Pertusaria, P. pertusariicola (tree)

TELOSCHISTALES, Xanthoraceae
- Xanthoria, P. xanthoriae (rock, tree)

VERRUCARIALES, Verrucariaceae
- Verrucaria
  - P. verrucariae (rock)
- Thrombium
  - P. terrestris (ground)

FIGURES

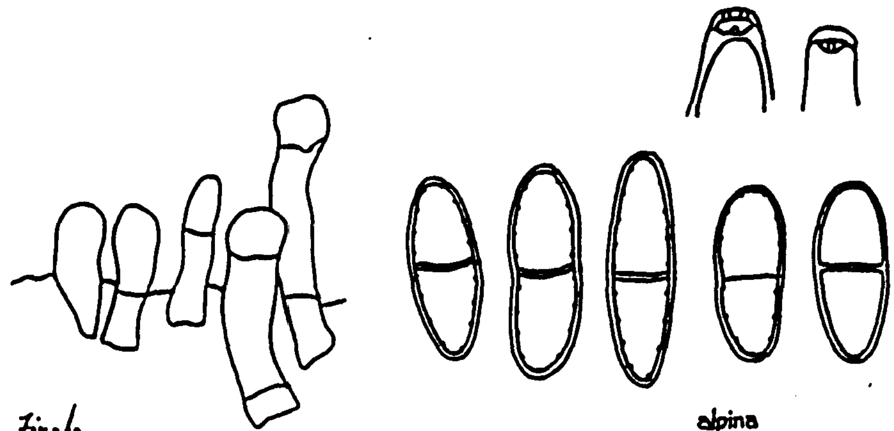


Fig. 1

alpina

crouanii

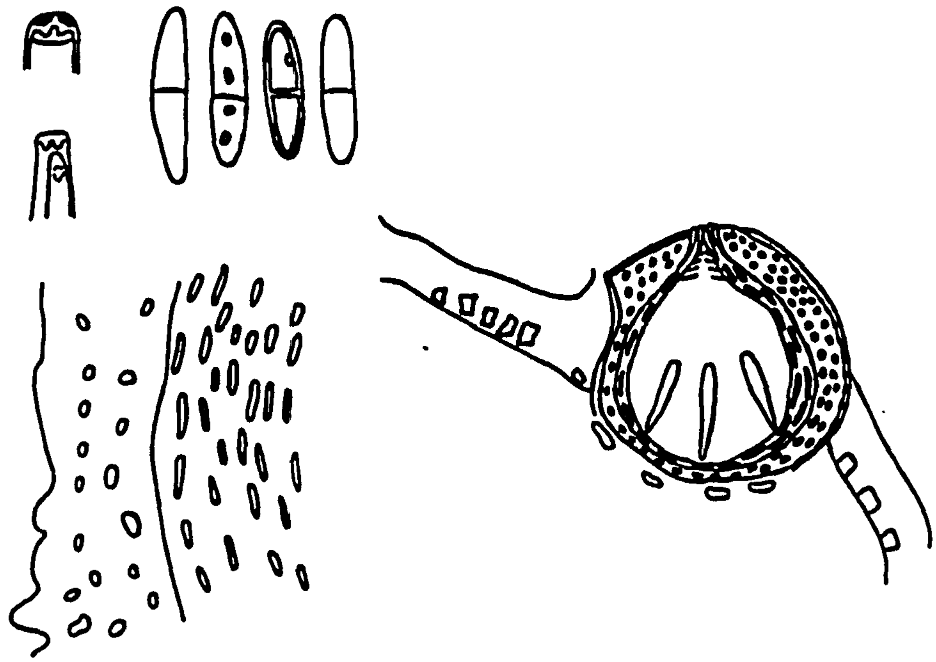


Fig. 4

1. Nectriella alpina. Ascus apex, ascospores, setae (holotype, NY).
4. Nectriella crouanii. Sections of ascoma, lateral wall. Ascus apex, ascospores (holotype, CO).

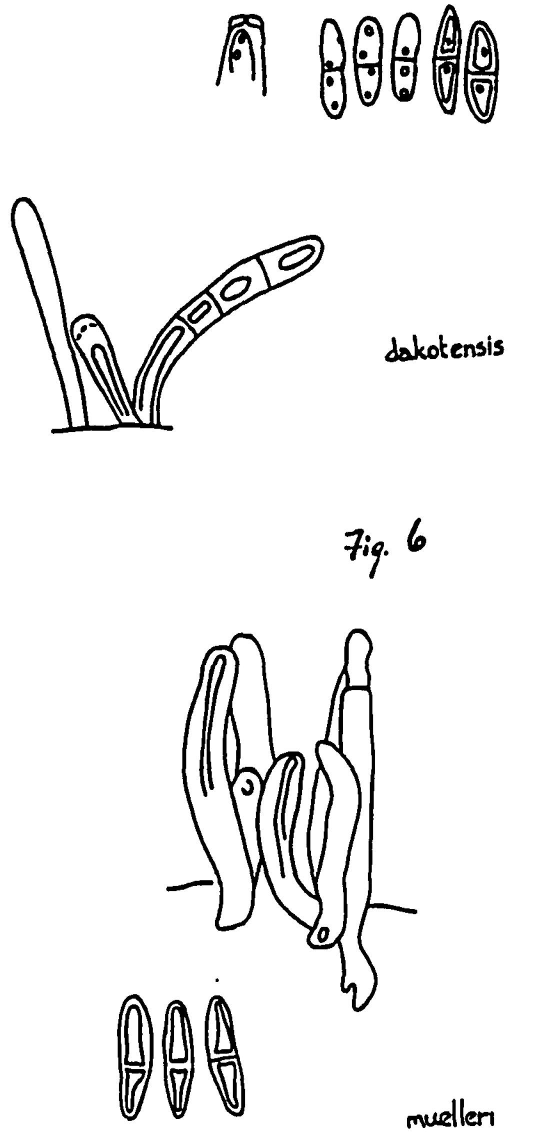


Fig. 6

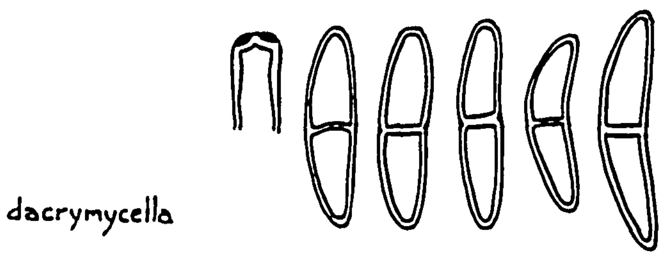
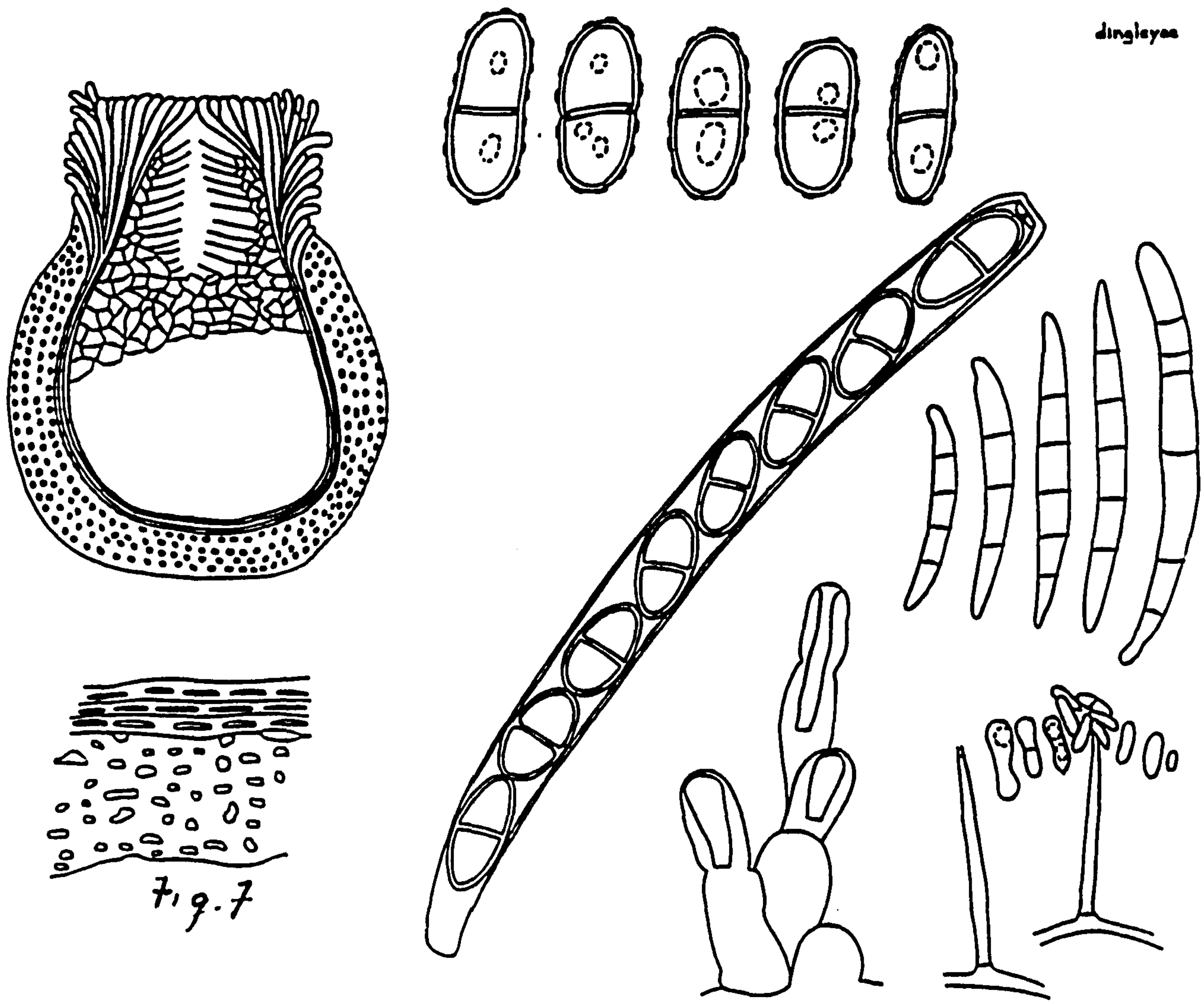


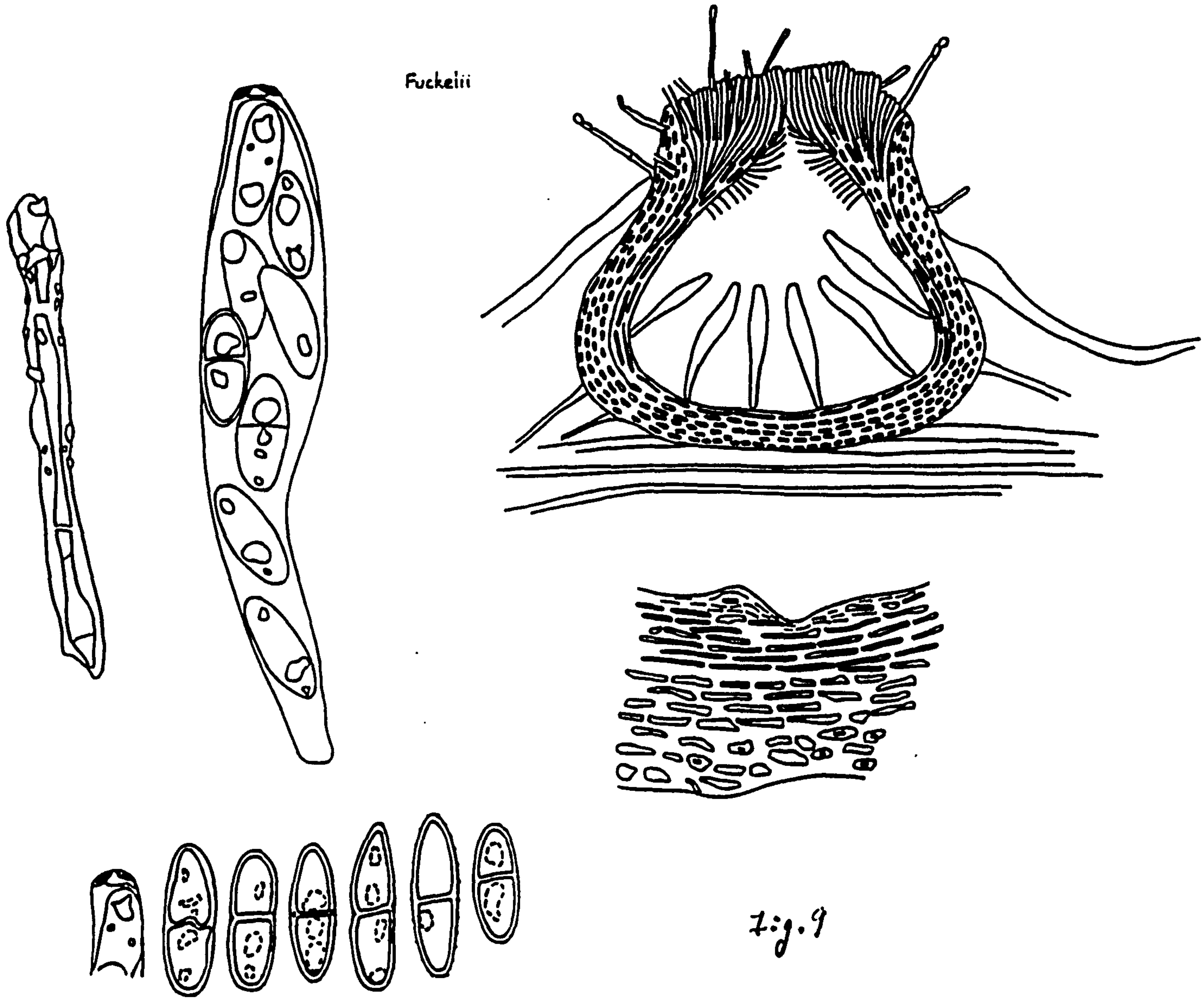
Fig. 5

5. Nectriella dacrymycella. Ascus apex, ascospores (holotype, H).

6. Nectriella dakotensis. Ascus apex, ascospores, setae (holotype, NY). Ascospores, setae (NY, as Nectriella muelleri).



7. Nectriella dingleyae. Sections of ascoma, lateral wall. Ascus, ascospores, seta, microconidiophores, microconidia, macroconidia (holotype, PDD; anamorph Samuels 81-106).



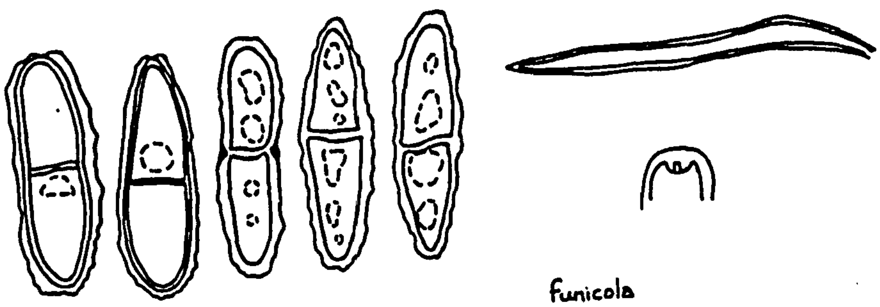
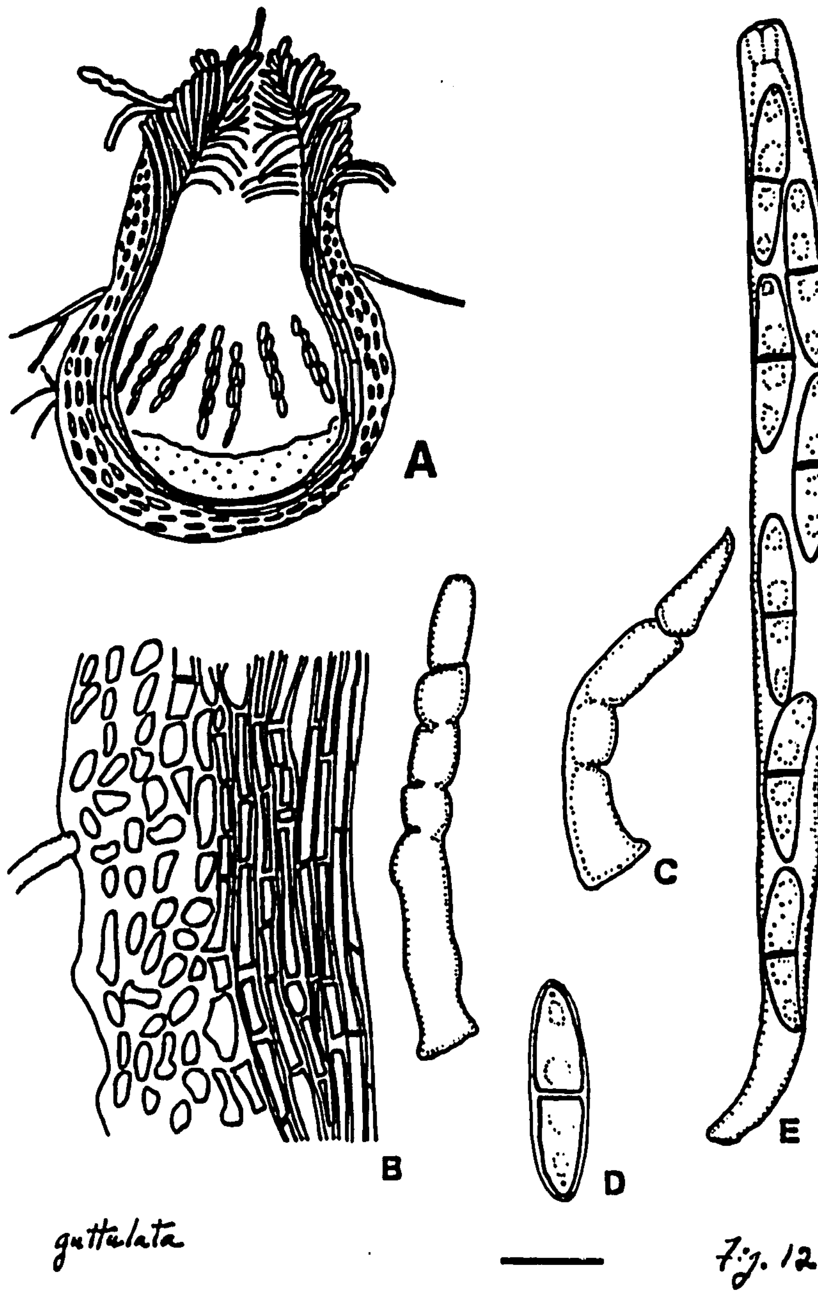


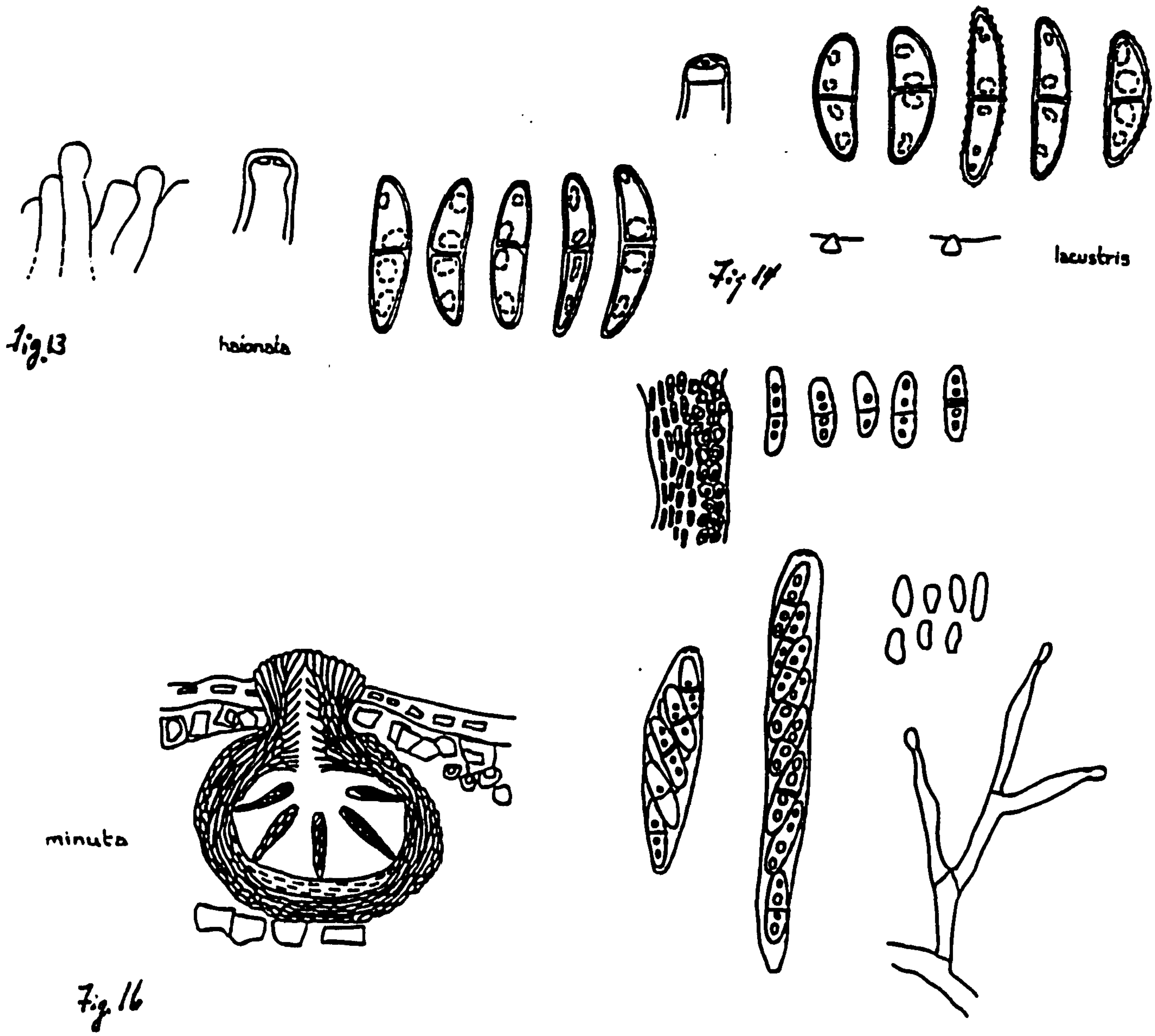
Fig. 10

9. <u>Nectriella</u> <u>fuckelii</u>. Sections of ascoma, lateral wall. Ascus, ascus apex, ascospores, seta (holotype, B).

10. <u>Nectriella</u> <u>funicola</u>. Ascus apex, ascospores, seta (Fungi rhenani 990, IMI, as Nectriella charticola).



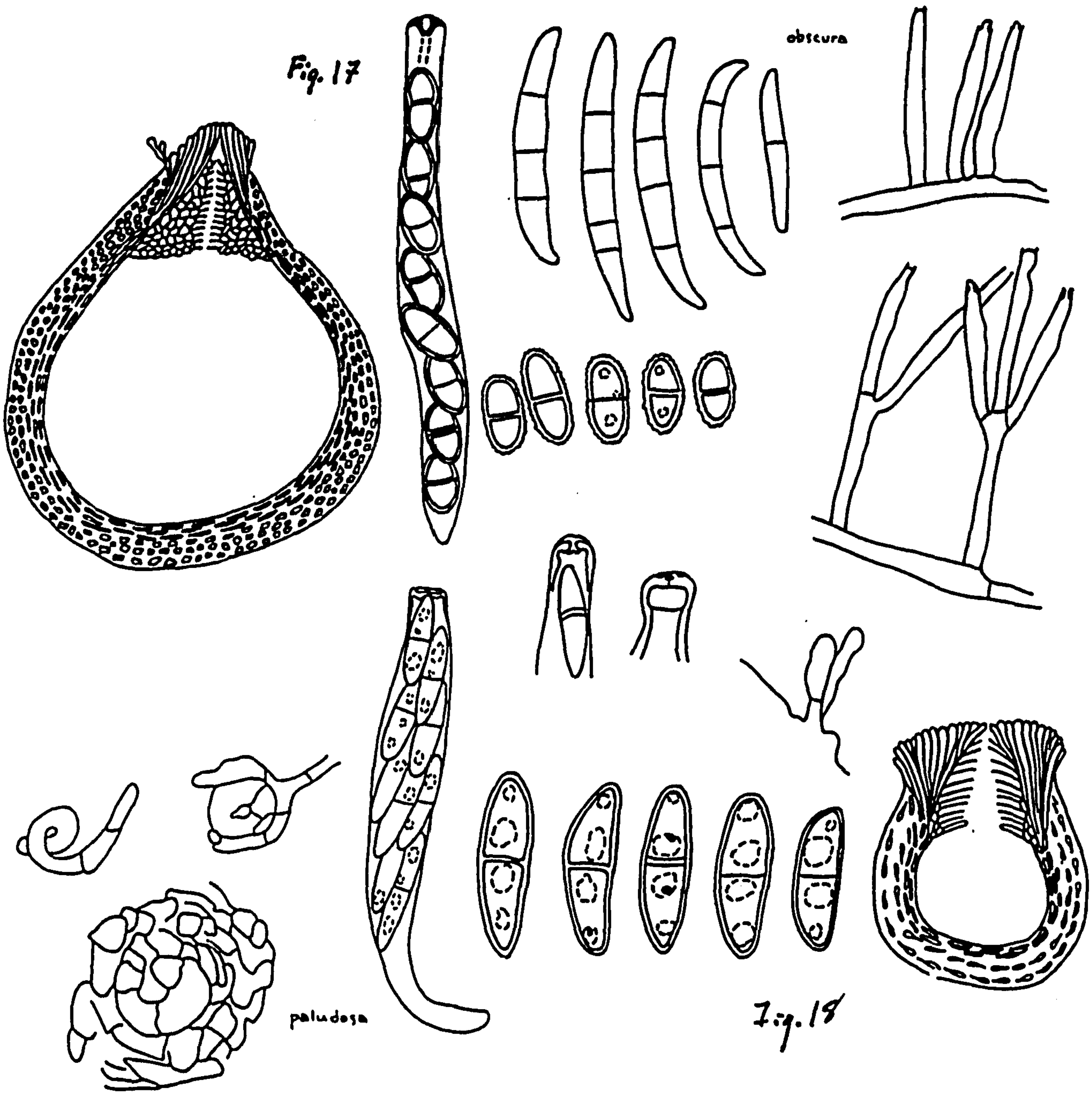
12. Nectriella guttulata. Sections of ascoma, lateral wall. Ascus, ascospore, setae (isotype, NY).



13. Nectriella halonata. Ascospores (holotype, FH); ascus apex, setae (Rehm 1876, FH).

14. Nectriella lacustris. Ascus apex, ascospores, habit sketch (holotype, W).

16. Nectriella minuta. Sections of ascoma, lateral wall. Asci, ascospores, conidiophores, conidia (holotype, NY; anamorph Samuels 71-347).



17. Nectriella obscura. Section of ascoma. Ascus, ascospores, macroconidiophores, macroconidia (holotype, PDD 46349; anamorph Samuels 83-172).

18. Nectriella paludosa. Section of ascoma. Ascus, ascus apex, ascospores, left spore and ascus apex from holotype, G), ascogonial coils from culture (IMI 348647); setae (Fungi rhenani 2048, G, as Nectriella diaphana).

Fig. 19

pironii

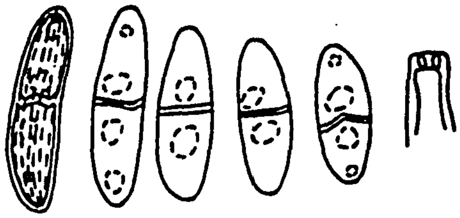
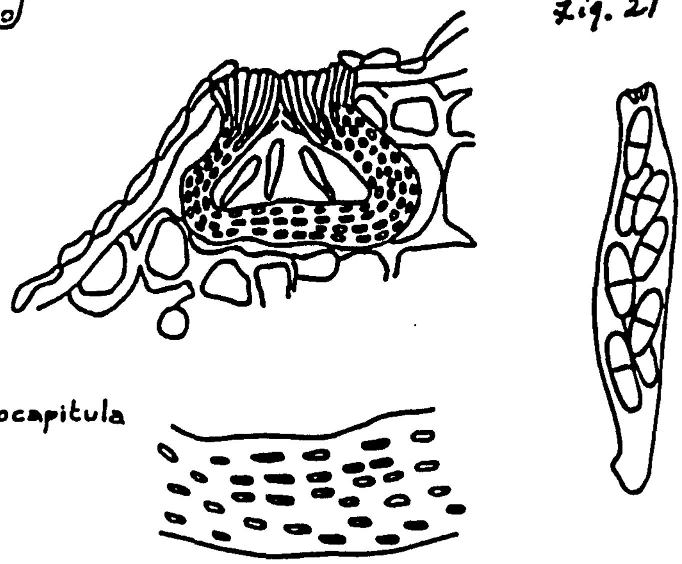
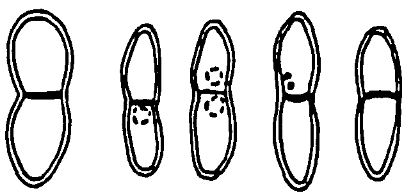


Fig. 21

rubrocapitula



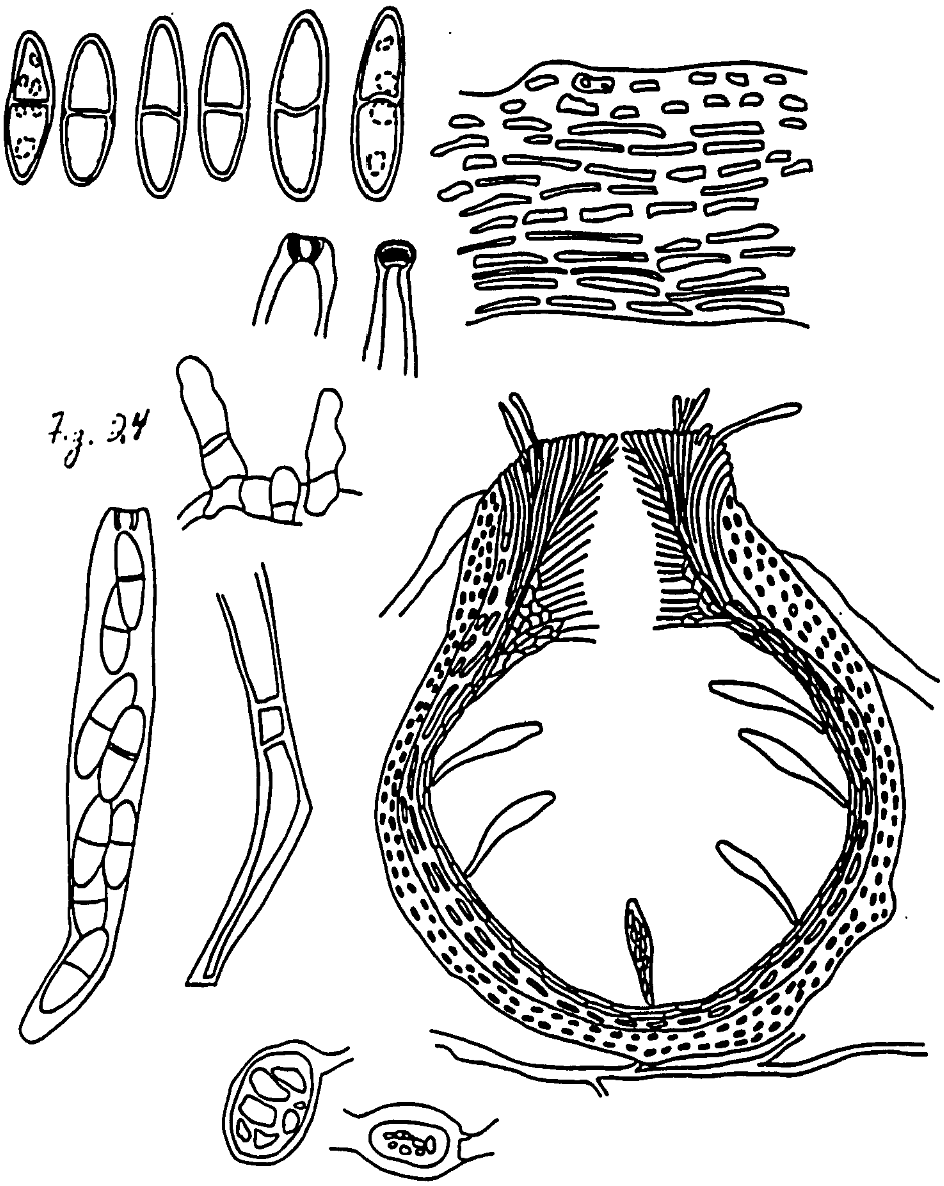


Sambuci Fig. 22

19. Nectriella pironii. Ascus apex, ascospores (holotype, NY).

21. Nectriella rubrocapitula. Section of ascoma, lateral wall. Ascus (isotype, NY).

22. Nectriella sambuci. Ascospores (holotype, FH).



Utahensis

24. Nectriella utahensis. Sections of ascoma, lateral wall. Ascus, ascus apex, ascospores, setae, base of seta, ellipsoid structures on substrate (holotype, NY).

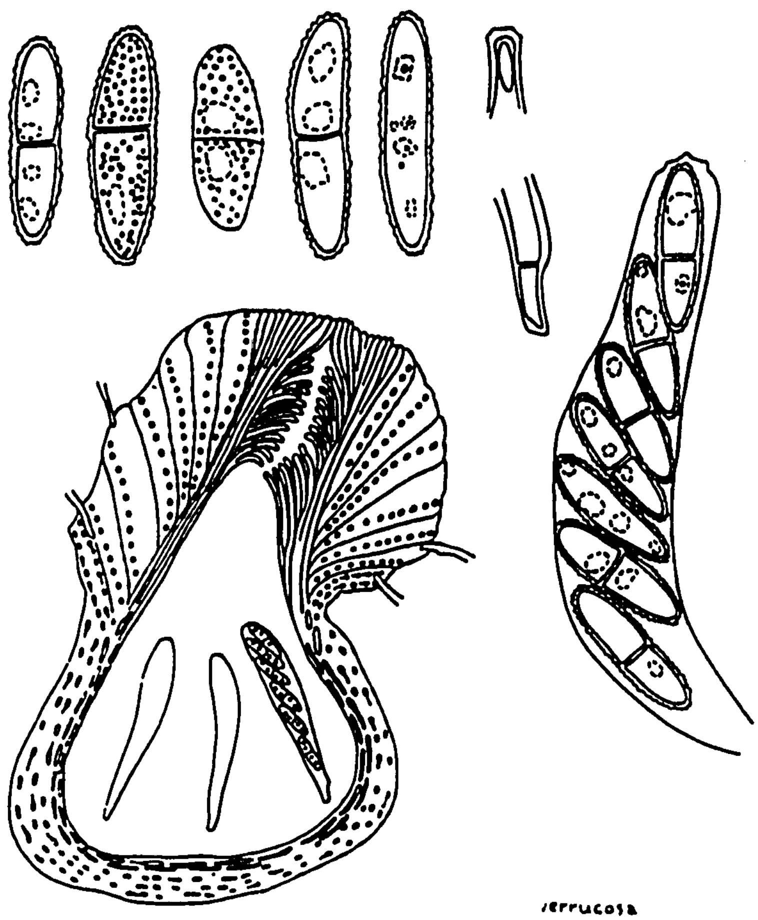
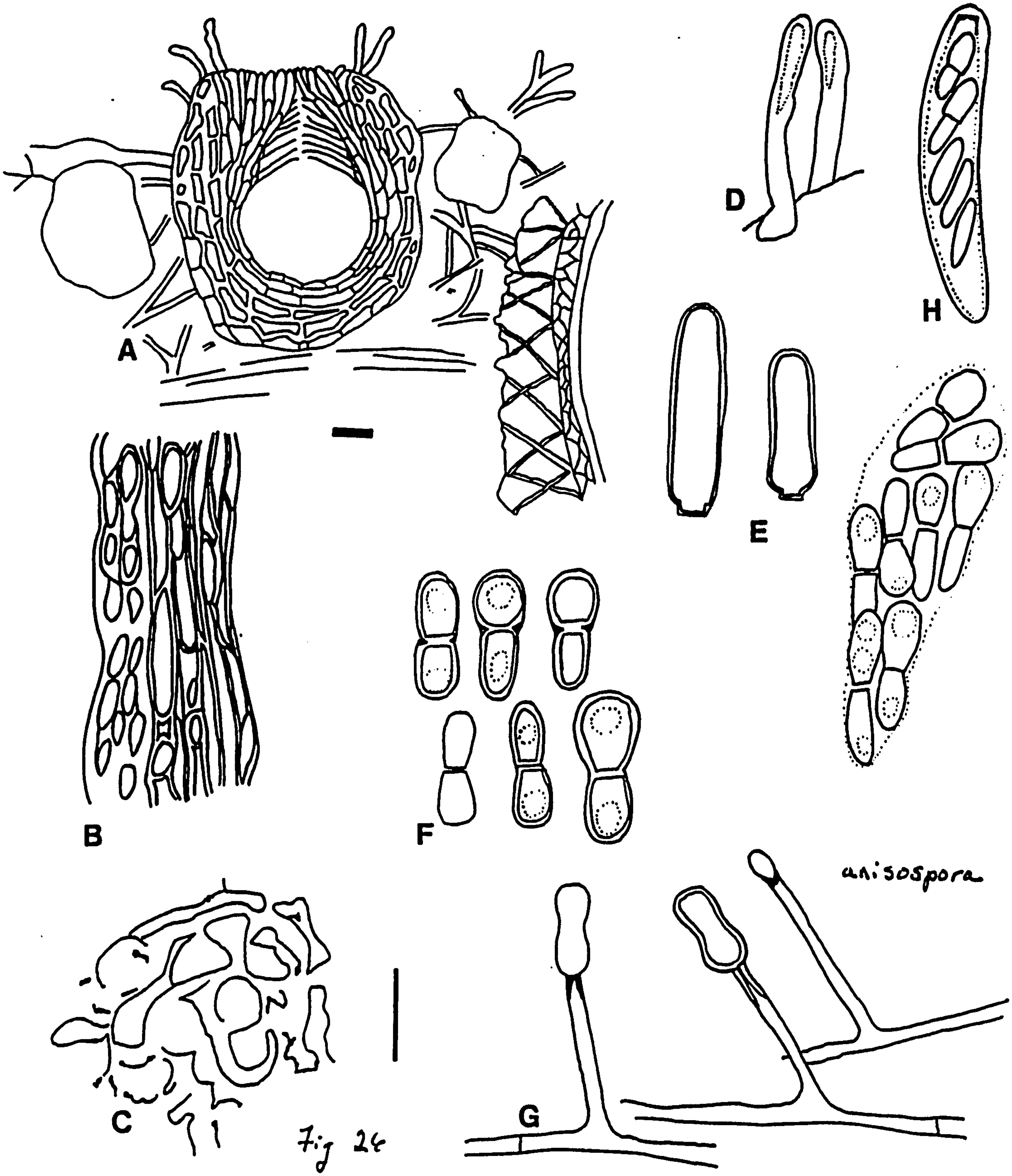
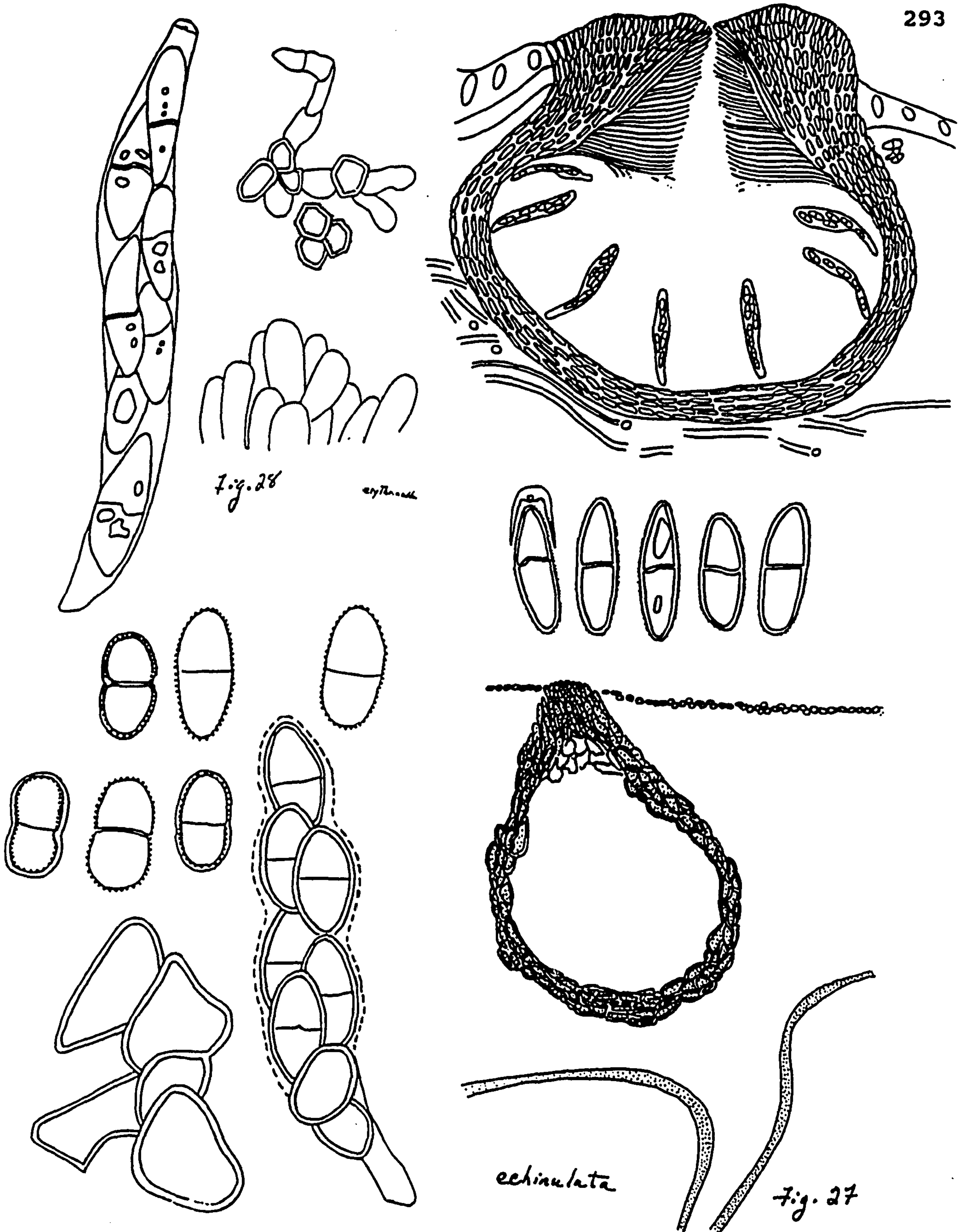


Fig. 25

25. Nectriella verrucosa. Section of ascoma. Ascus, ascus apex, ascospores, base of seta (holotype, MA).



26. Pronectria anisospora. Sections of ascoma, lateral wall. Asci, ascospores, ascomatal surface, setae, conidia conidiophores (holotype, NY).



27. Pronectria echinulata. Section of ascoma. Asci, ascospores, ascomatal surface (holotype, IMI 10539).

28. Pronectria erythrinella. Section of ascoma. Ascus, ascus apex, ascospores, setae, conidia (holotype, H).

Fig. 30

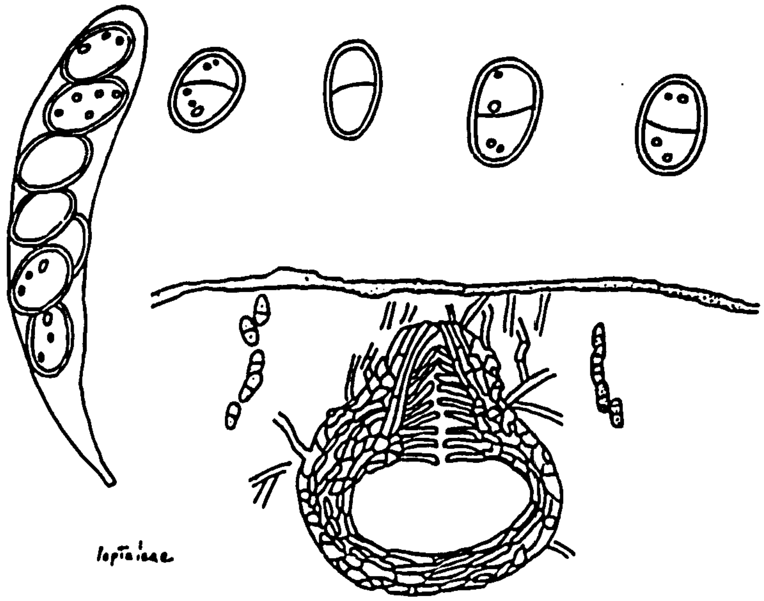
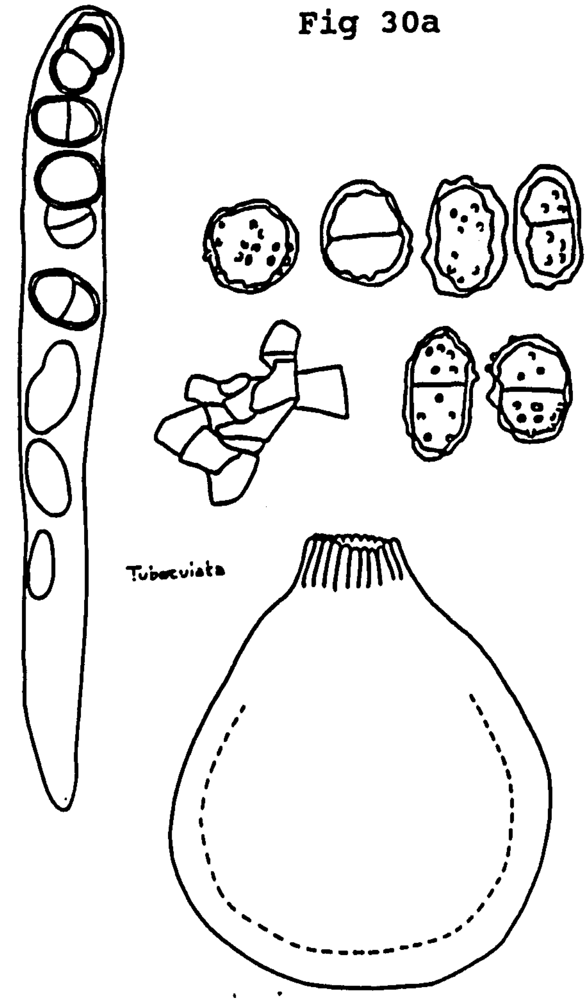


Fig 30a



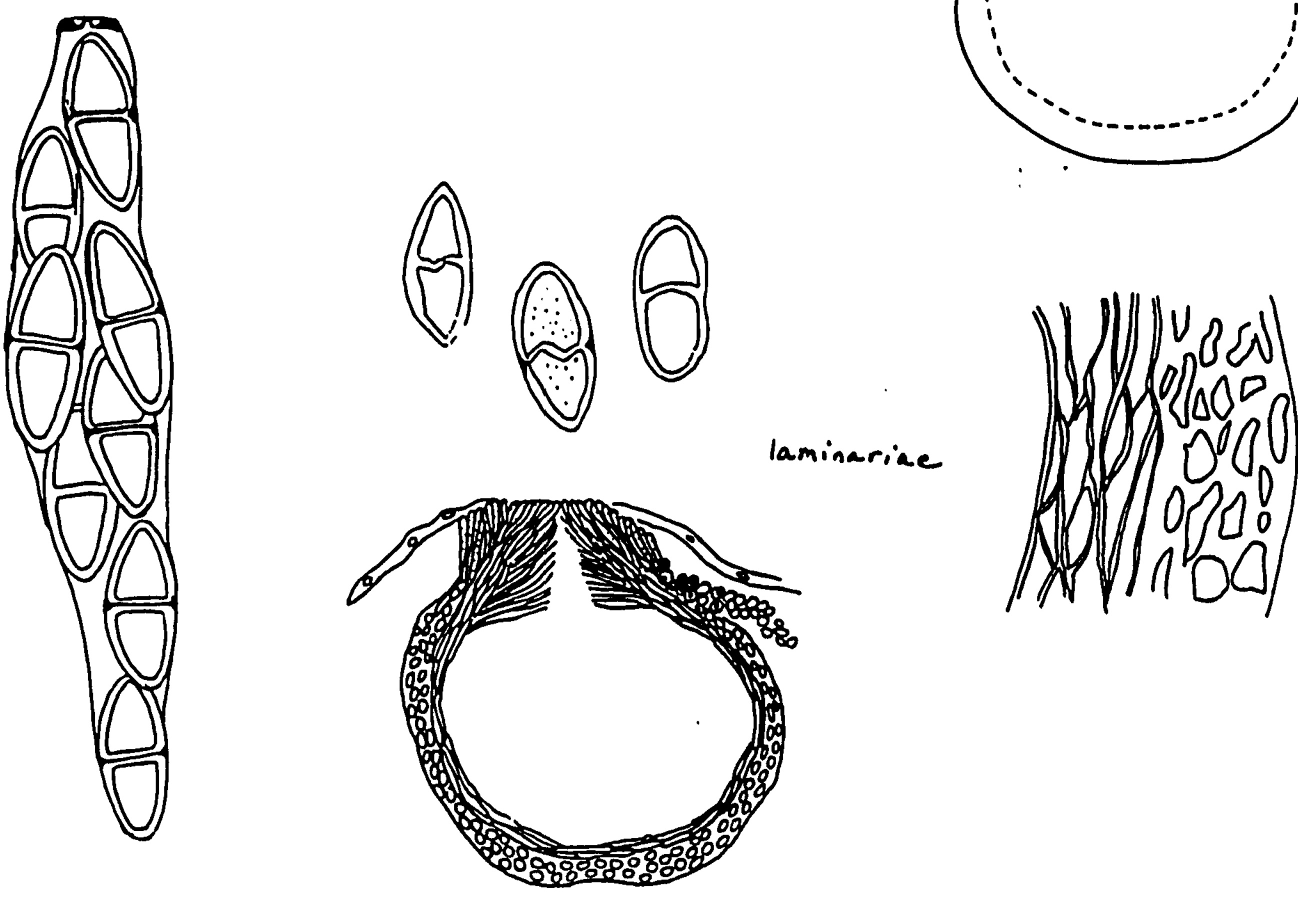


Fig. 29

29. Pronectria laminariae. Sections of ascoma, lateral wall, ascus, (isotype, BPI). Ascospores (holotype, UPS).

30. Pronectria leptaleae. Section of ascoma. Ascus, ascospores (holotype, WU).

30a. Pronectria leptaleae var. tuberculata. Squash mount of ascoma. Ascus, ascospores, ascomatal surface (holotype, Hafellner 13320, GZU).

31. Pronectria ornamentata. Ascospores (holotype, IMI 247733). Section of ascoma, walls, surface cells and asci (from Hawksworth, 1983).

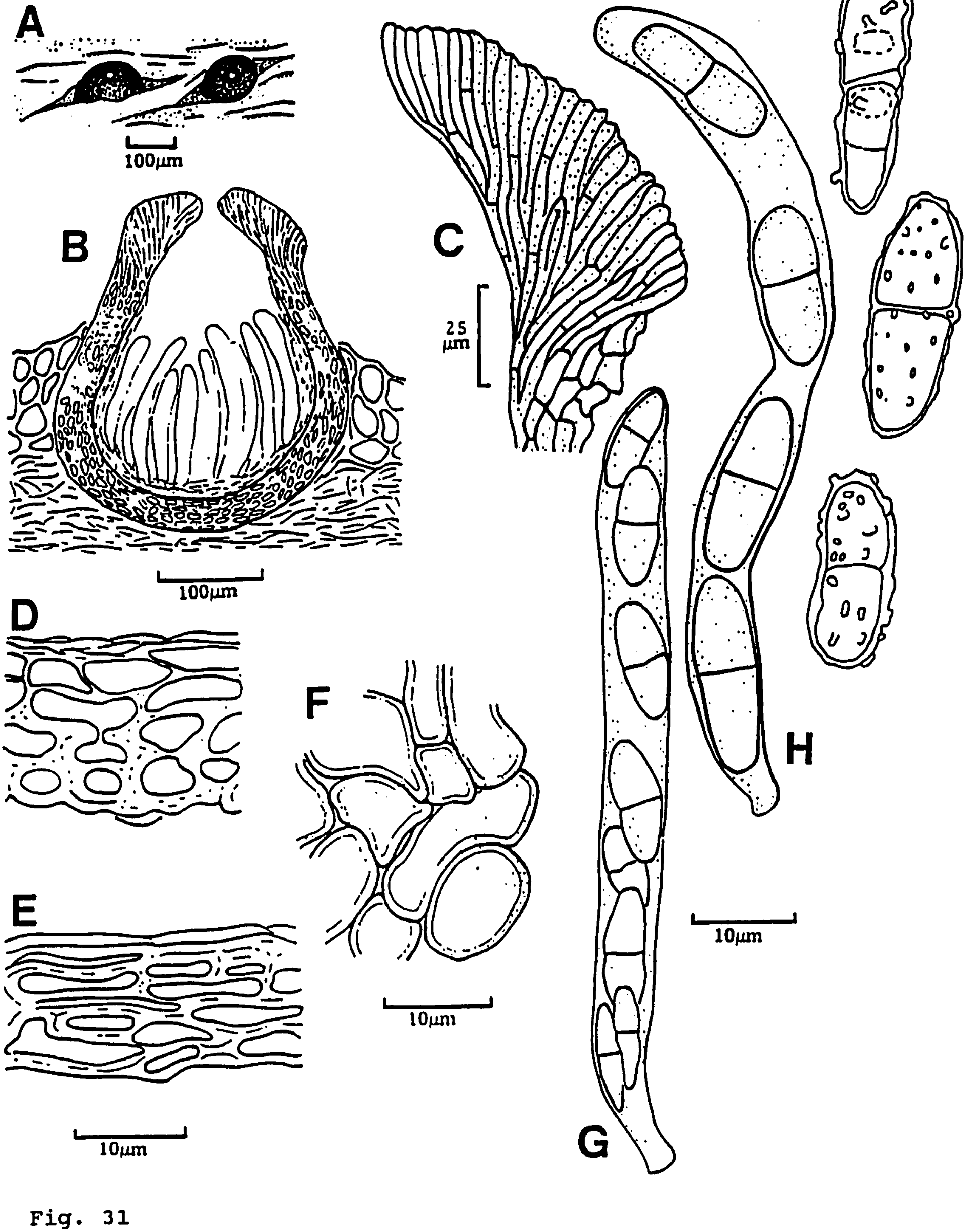
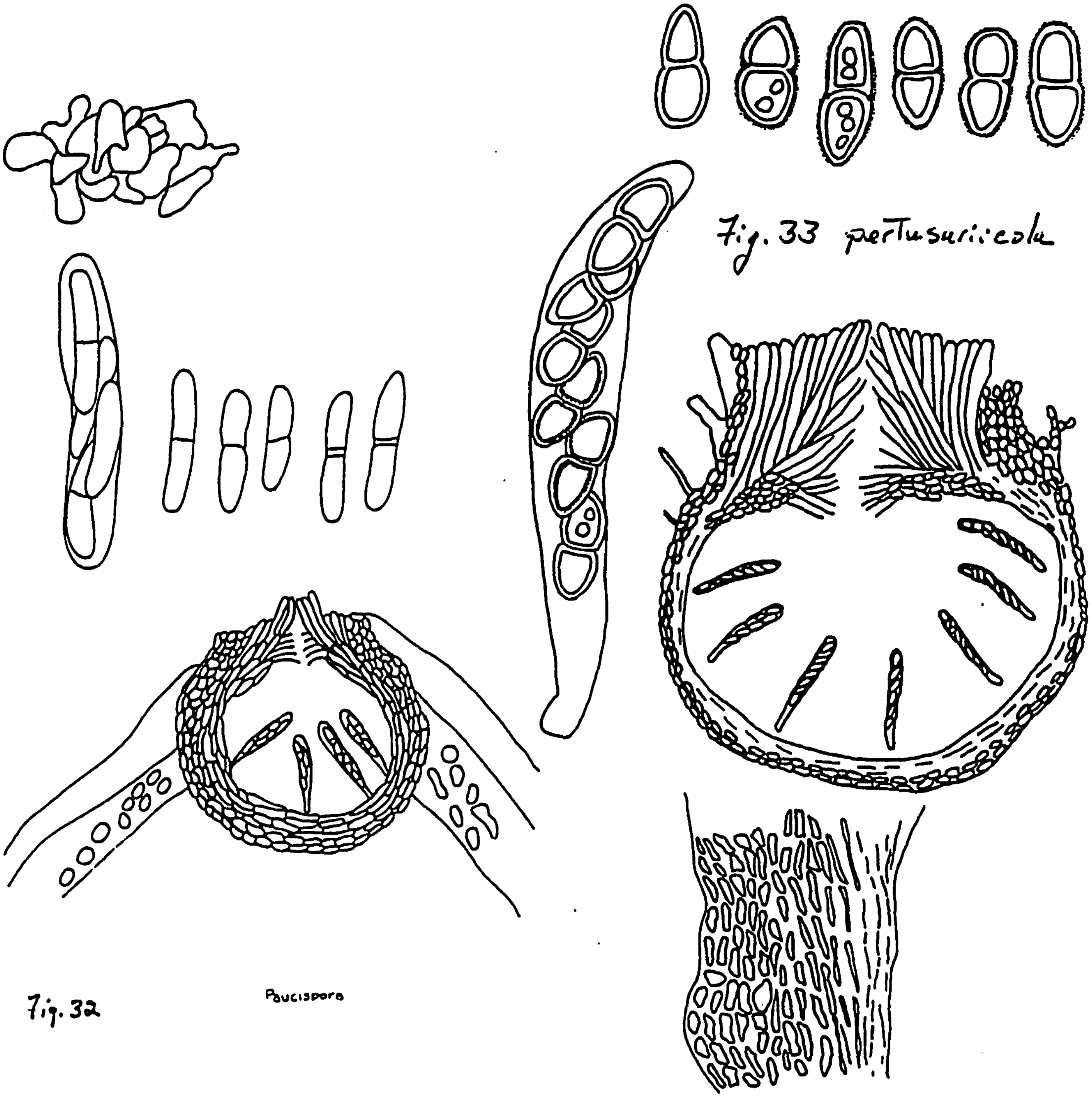


Fig. 31



32. Pronectria paucispora. Section of ascoma. Ascus, ascospores, cells of ascomatal surface (holotype, NY).

33. Pronectria pertusariicola. Sections of ascoma, lateral wall. Ascus, ascospores (holotype, CO).

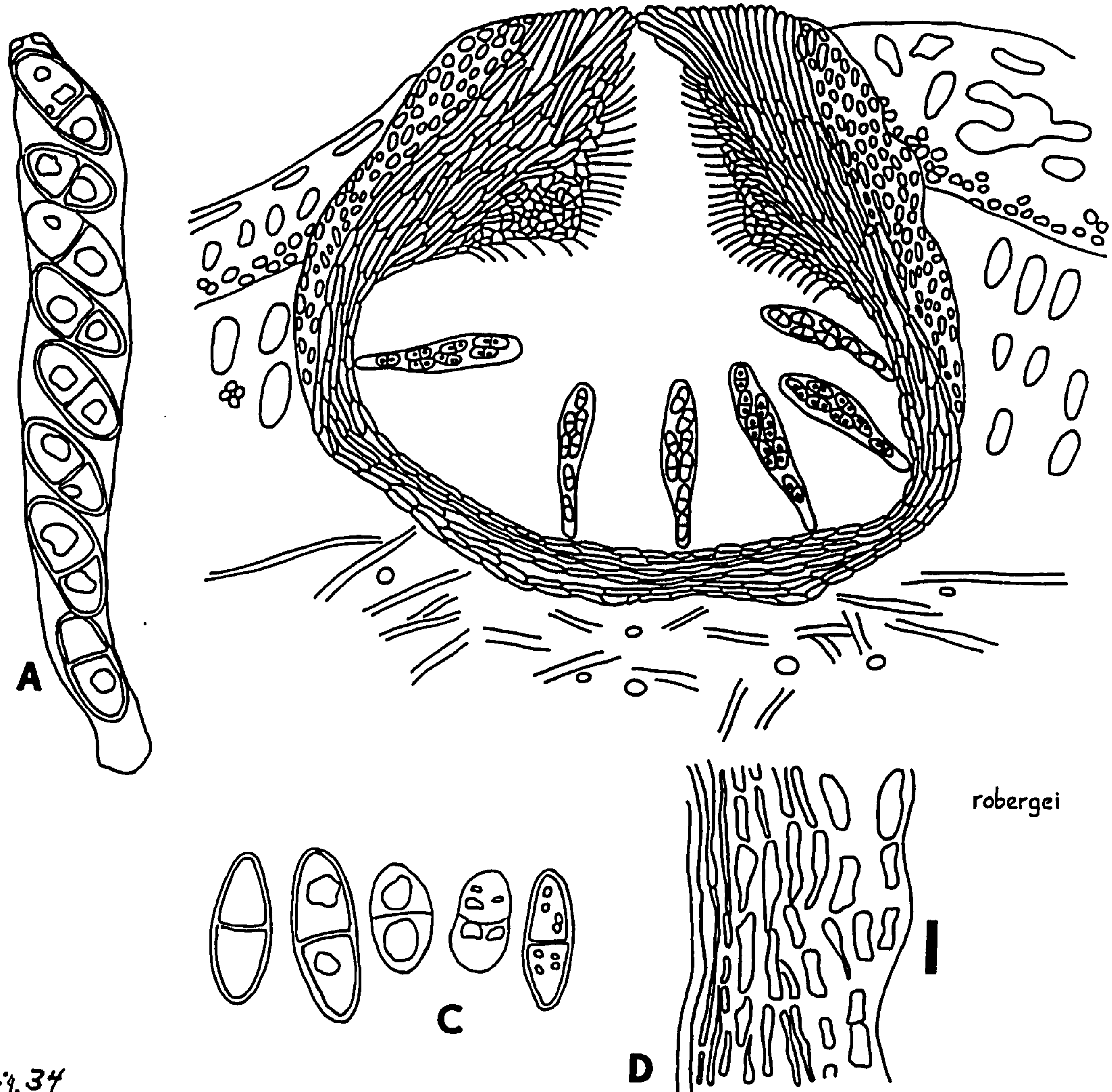
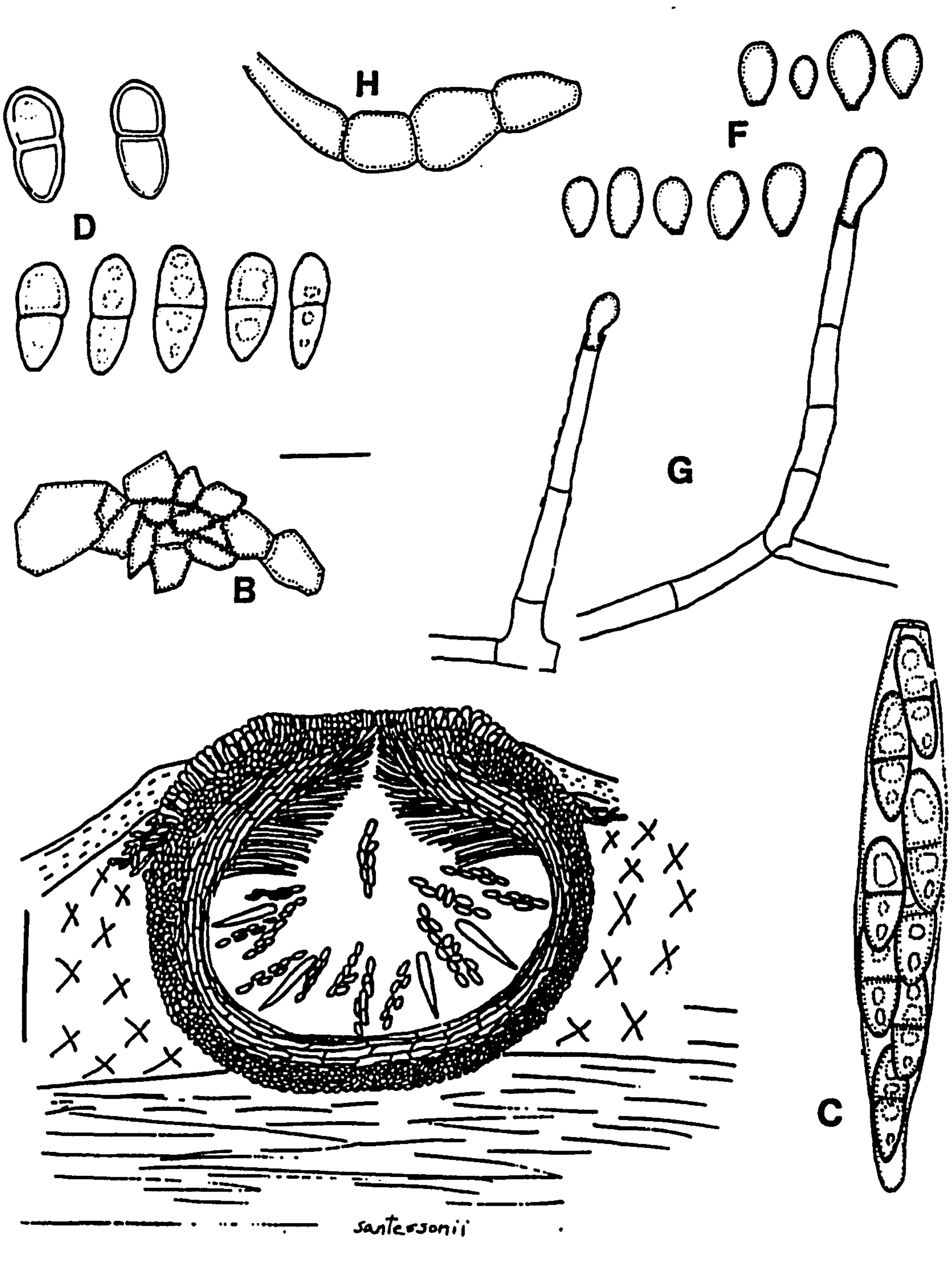
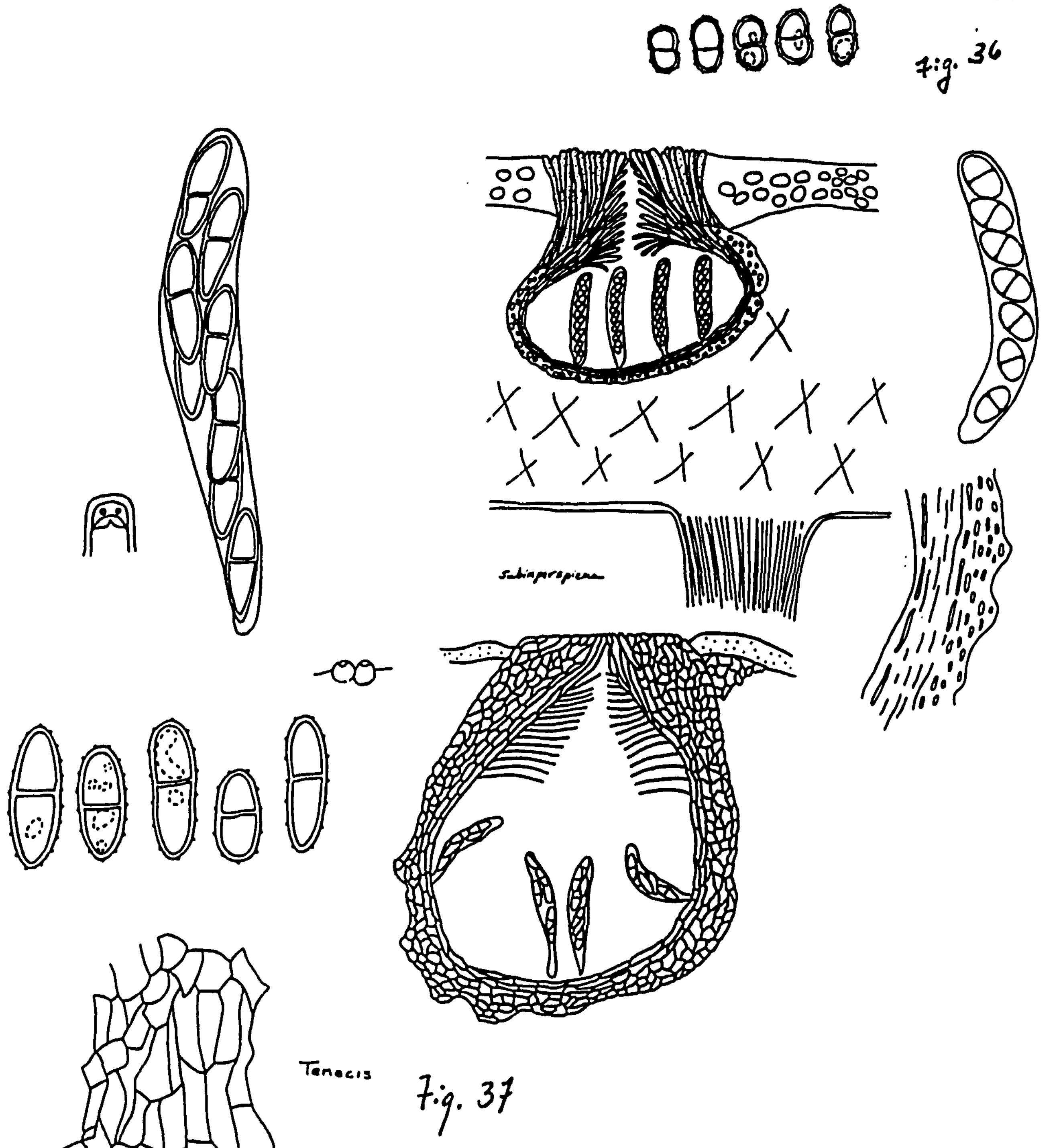


fig.34

34. Pronectria robergei. Sections of ascoma, lateral wall. Ascus, ascospores. Ascospores as Nectriella lichenicola (holotype, PC).

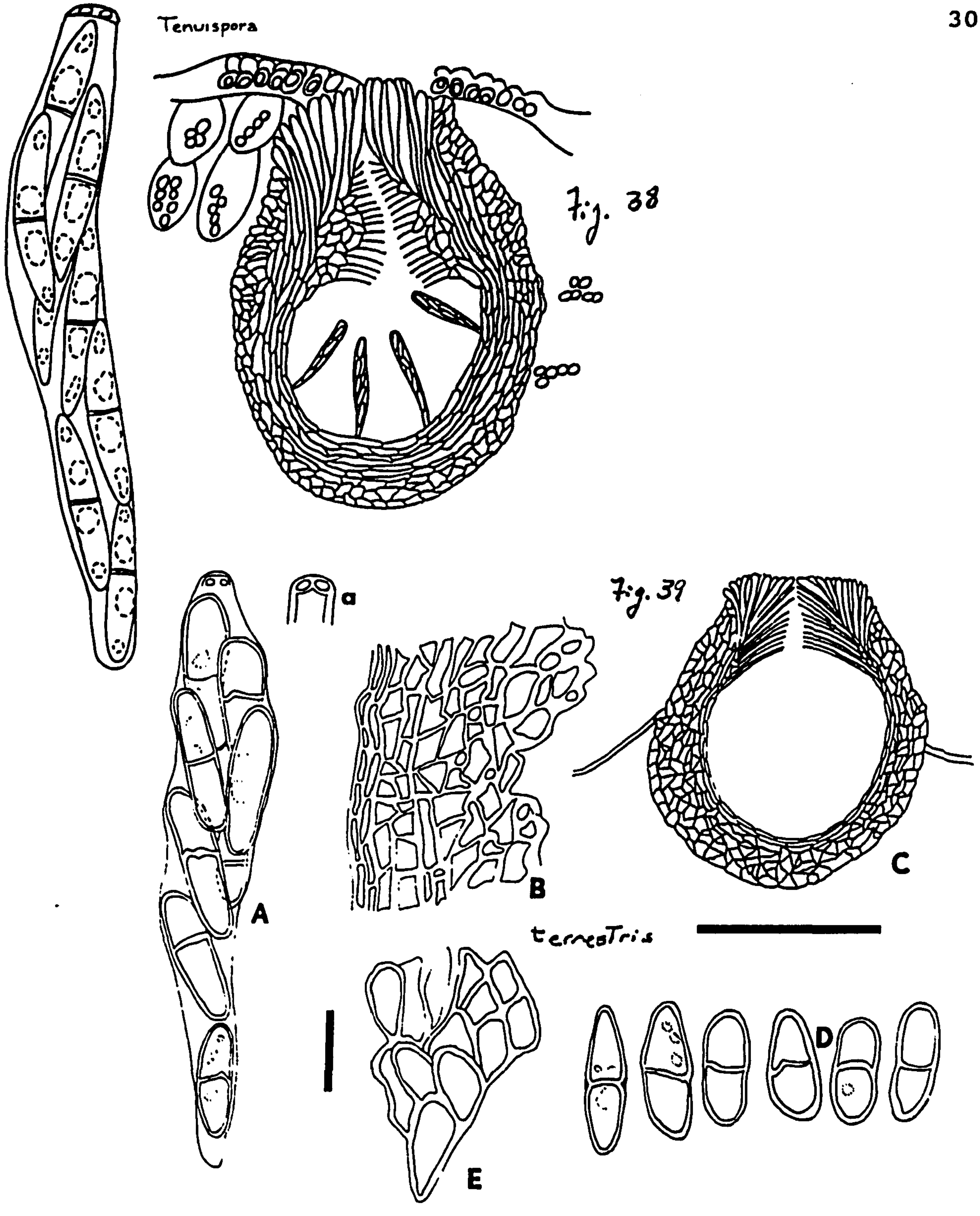


35. Pronectria santessonii. Section of ascoma. Ascus, ascospores, cells of ascomatal surface, conidia, conidiophores, chlaymdospores (holotype, IMI 305040).



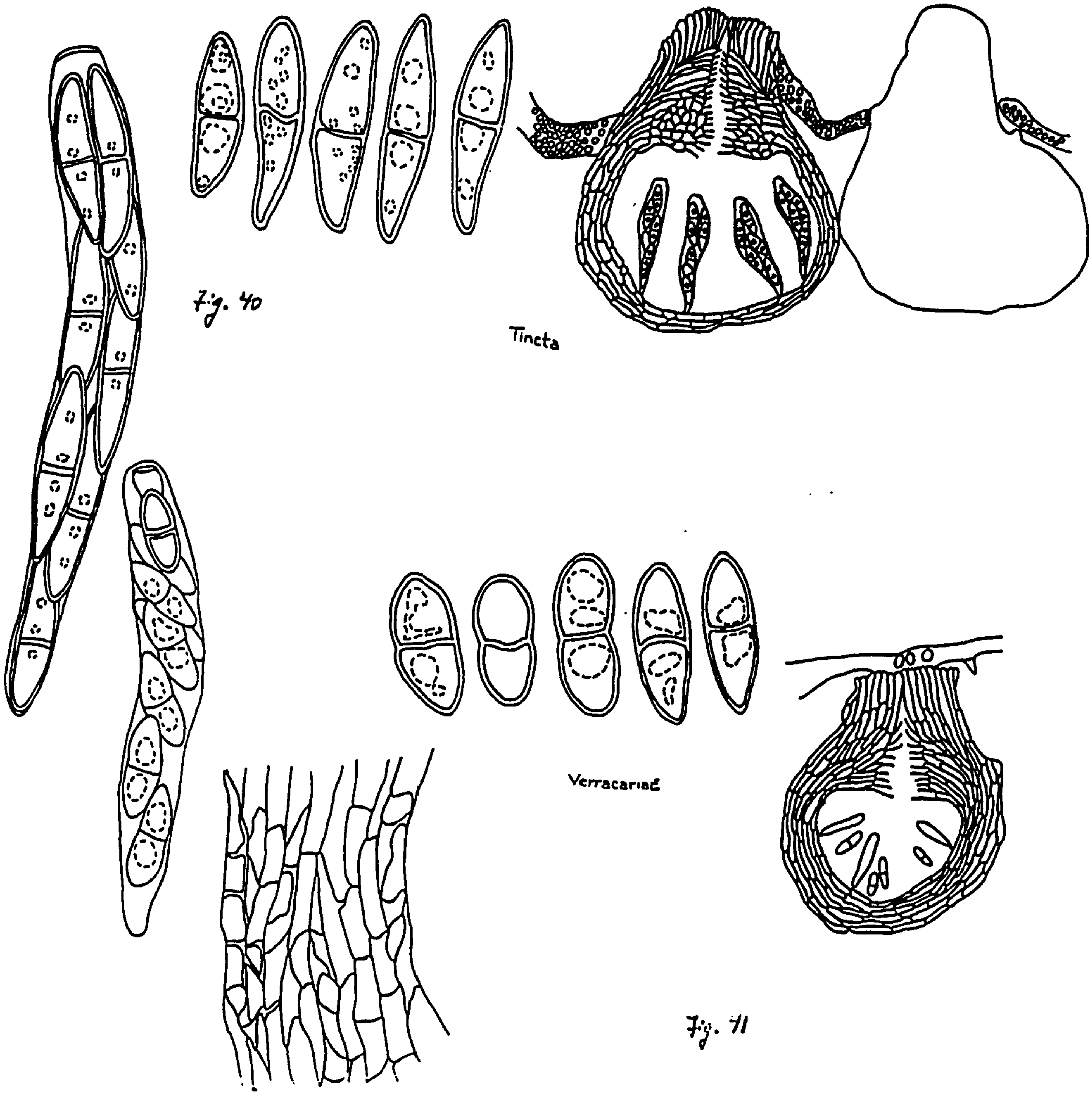
36. Pronectria subimperspicua. Sections of ascoma, lateral wall. Ascus, ascospores (holotype, LPS).

37. Pronectria tenacis. Section of ascoma. Ascus, ascus apex, ascospores, cells of ascomatal surface (neotype, IMI 327003).



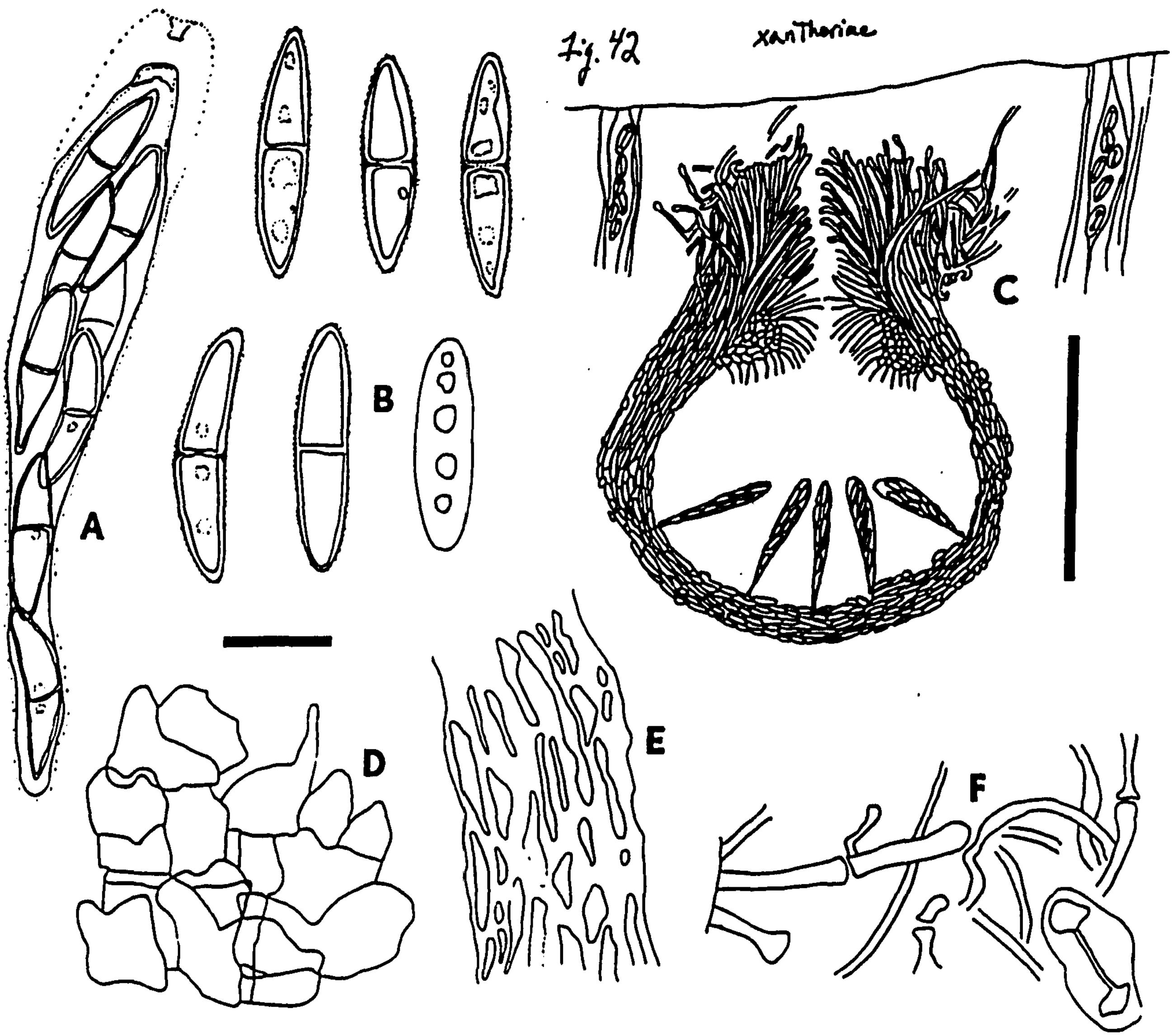
38. Pronectria tenuispora. Section of ascoma. Ascus (holotype, E).

39. Pronectria terrestris. Sections of ascoma, lateral wall. Ascus, ascus apex, ascospores, cells of ascomatal surface (holotype, NY).

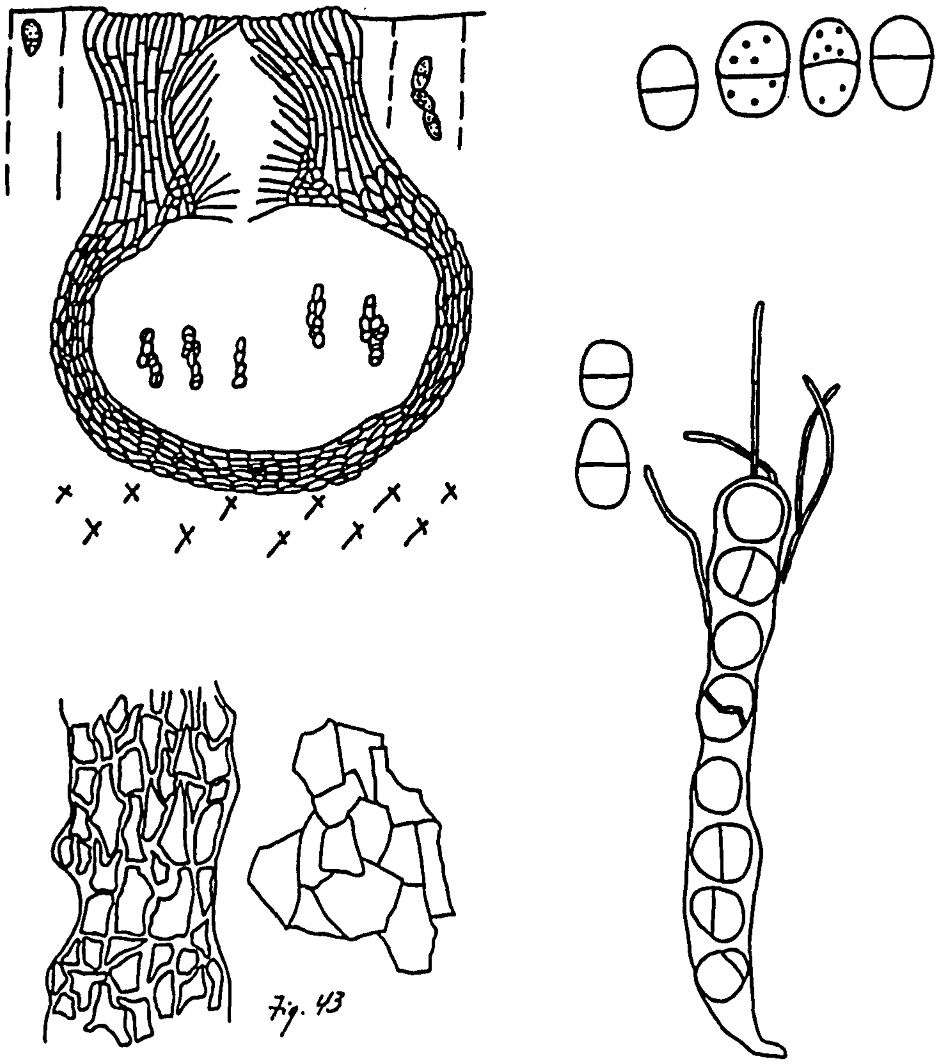


40. <u>Pronectria tincta</u>. Sections of ascomata. Ascus, ascospores (holotype, fungi rhenani 1836, G, as <u>Nectriella</u> <u>coccinea</u>).

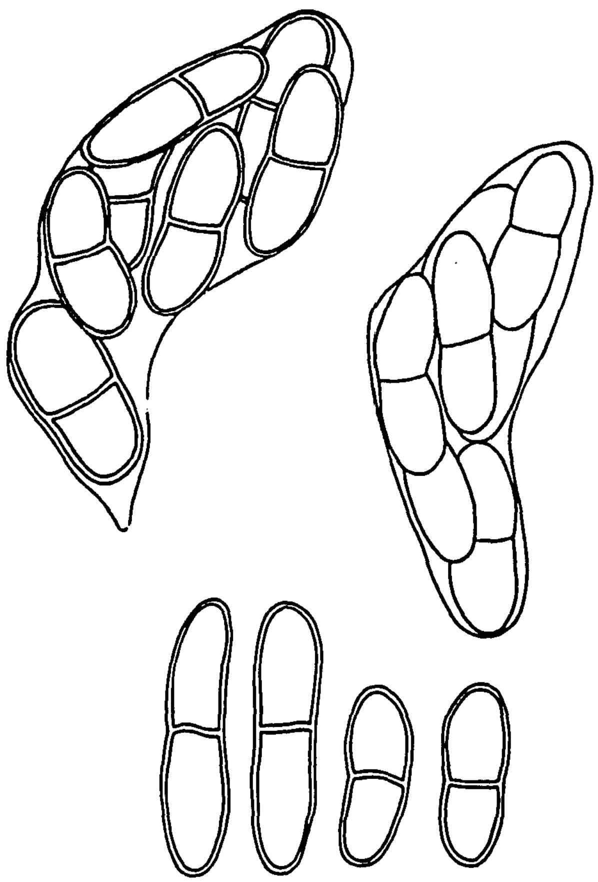
41. <u>Pronectria verrucariae</u>. Sections of ascoma, lateral wall. Ascus, ascospores (holotype, herb. Vouaux).

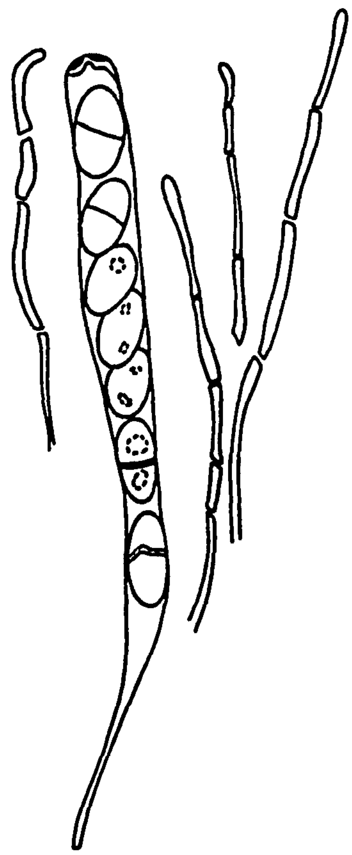


42. <u>Pronectria xanthoriae</u>. Section of ascoma, lateral wall. Ascus, ascospores, cells of ascomata surface, hyphae in lichen extending from ascomatal apex (holotype, IMI 294074).



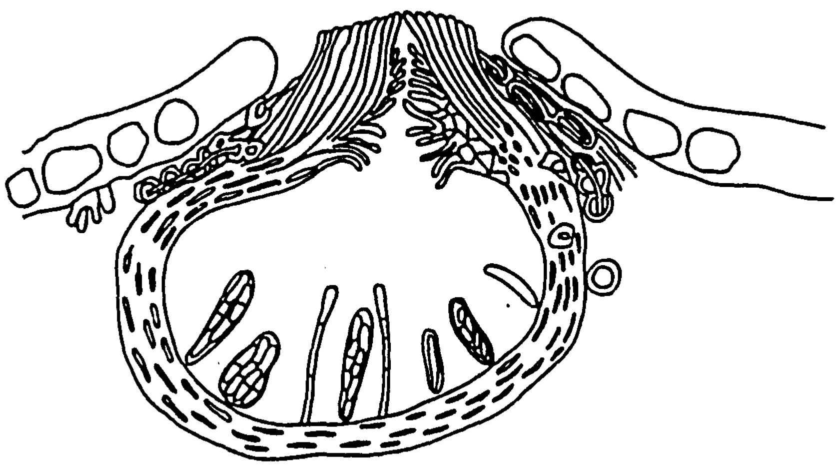
43. Charonectria amabilis. Section of ascoma, lateral wall. Ascus with paraphyses, ascospores, cells of ascomata surface (holotype, IMI 296022).





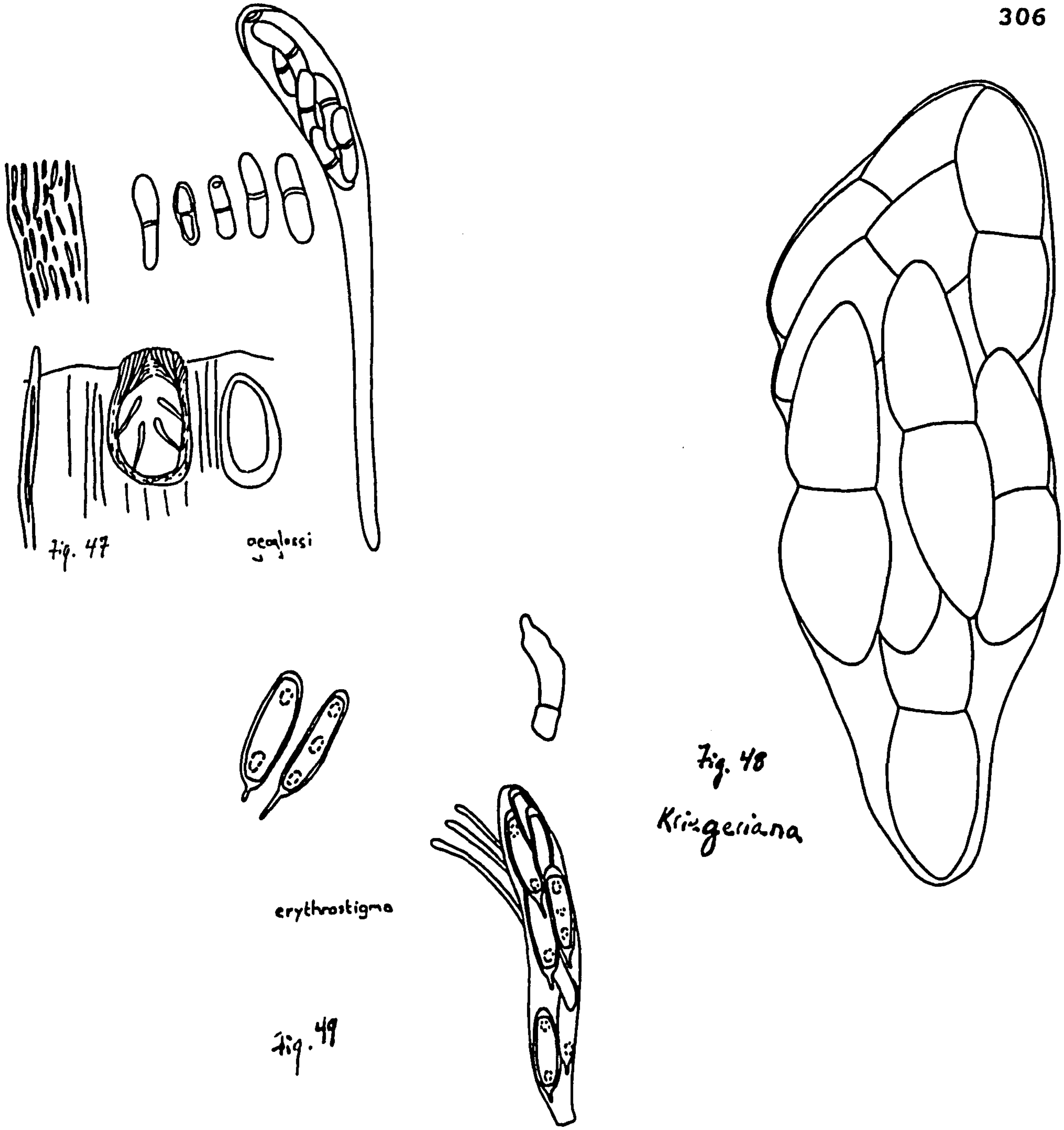
biparasitica

consolationis



44. Charonectria consolationis. Section of ascoma. Asci, ascospores (holotype, PAD).

46. Cryptonectriella biparasitica. Asci, paraphyses (holotype, FH).



47. Cryptonectriella geoglossi. Section of ascomata, lateral wall, seta of Trichoglossum. Ascus, ascospores (holotype, BO).

48. Hydronectria kriegeriana. Ascus (holotype, B).

49. Nectriella erythrostigma. Ascus, ascospores, paraphyses, seta (holotype, PC).

50. From Samuels and Rossman (1979) fig. 11.2 showing basic types of ascomata found in the nectrioid fungi and the range in ascus amd ascospore morphology. Three kinds of ascomata and their asci from Nectriella are added.
51. From Samuels and Rossman (1979) showing the major types of anamorphs in the nectrioid fungi.

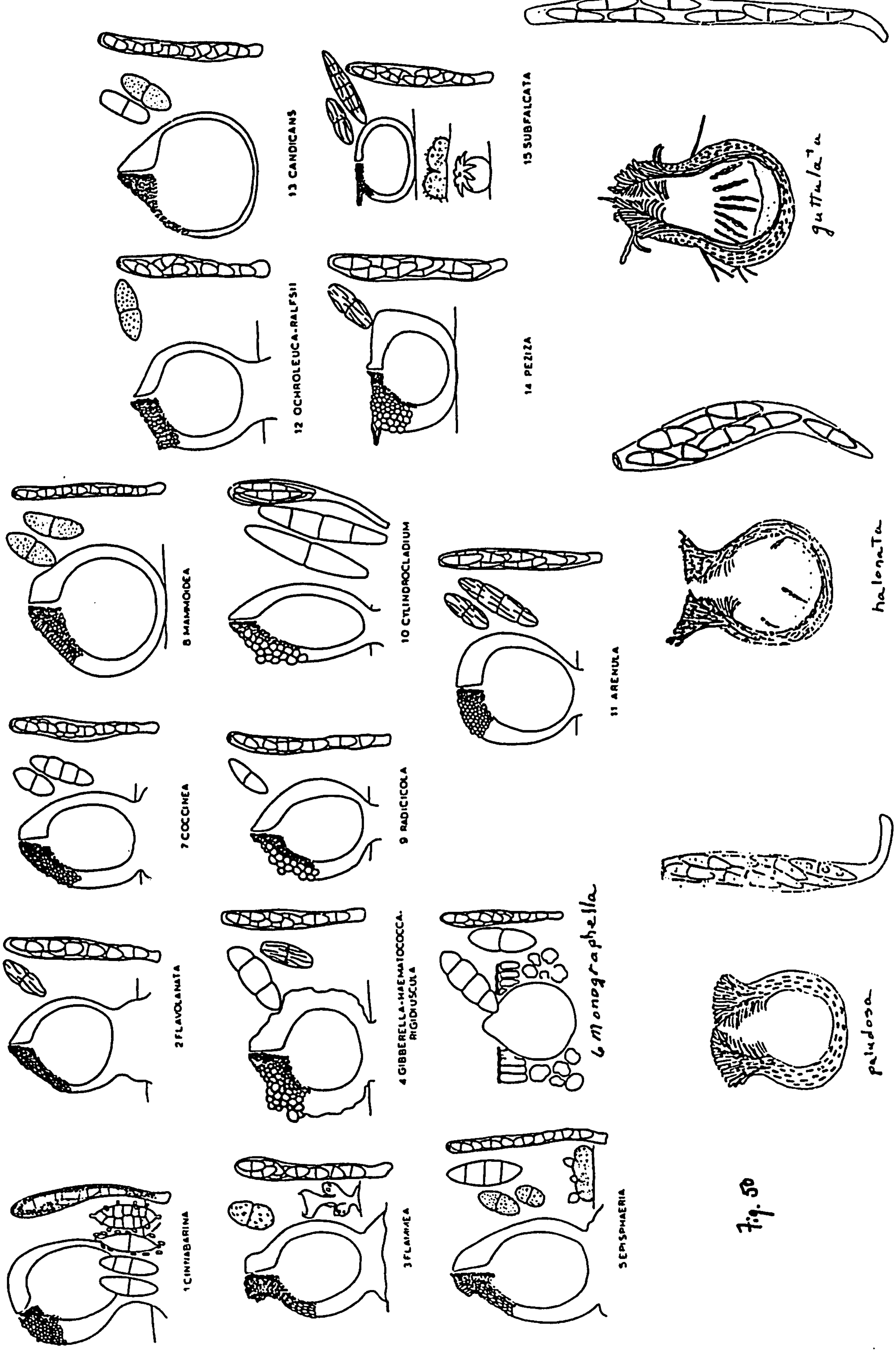


Fig. 50
1 CINNABARINA
2 FLAVOLANATA
3 FLAMMEA
4 GIBBERELLA-HAEMATOCOCCA-RIGIDIUSCULA
SEPISPHAERIA
6 Monographella
7 COCCINEA
8 MAMMOIDEA
9 RADICICOLA
10 CYLINDROCLADIUM
11 ARENULA
12 OCHROLEUCA-RALFSII
13 CANDICANS
14 PEZIZA
15 SUBFALCATA
paludosa
halonata
guttulata

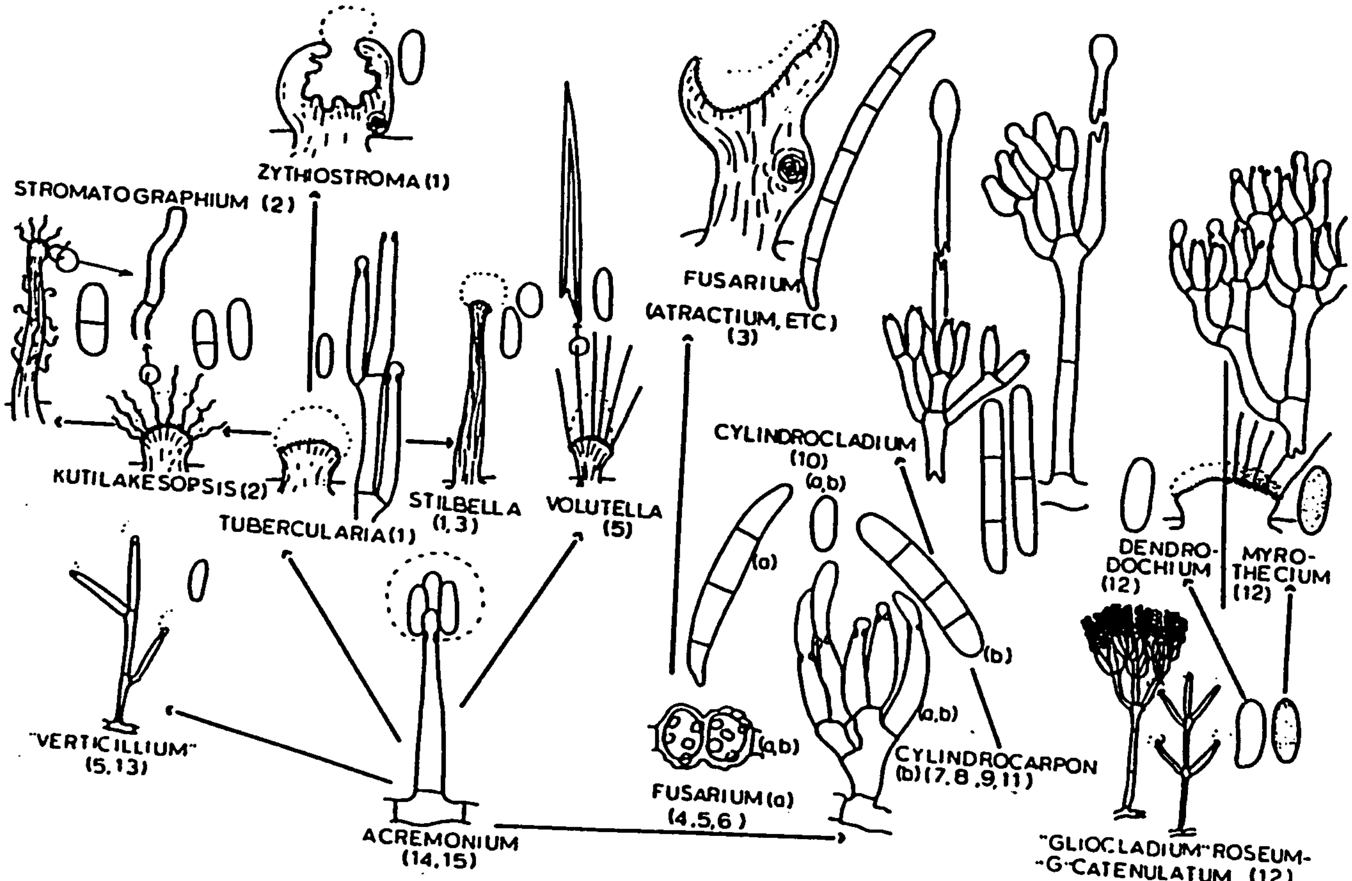
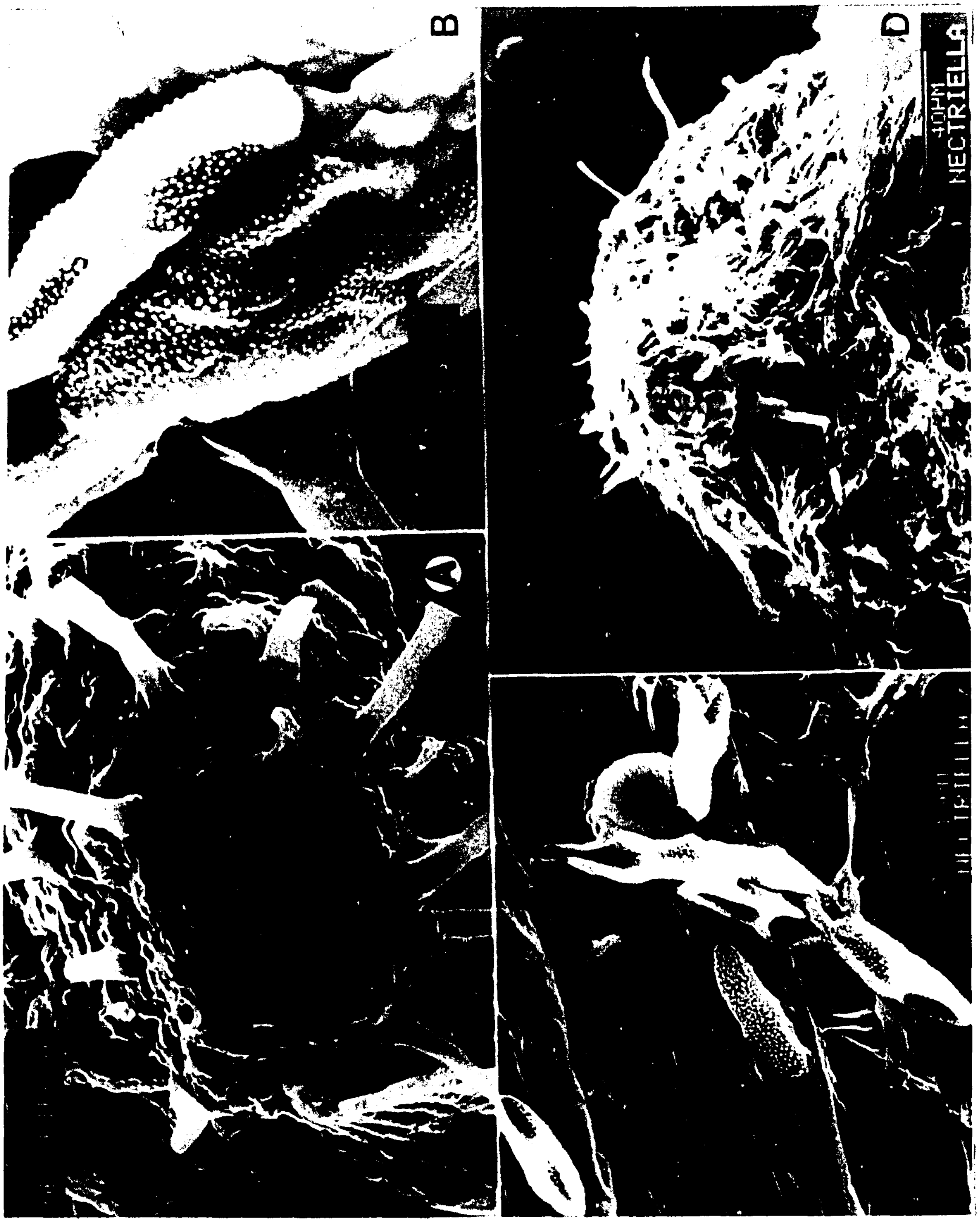
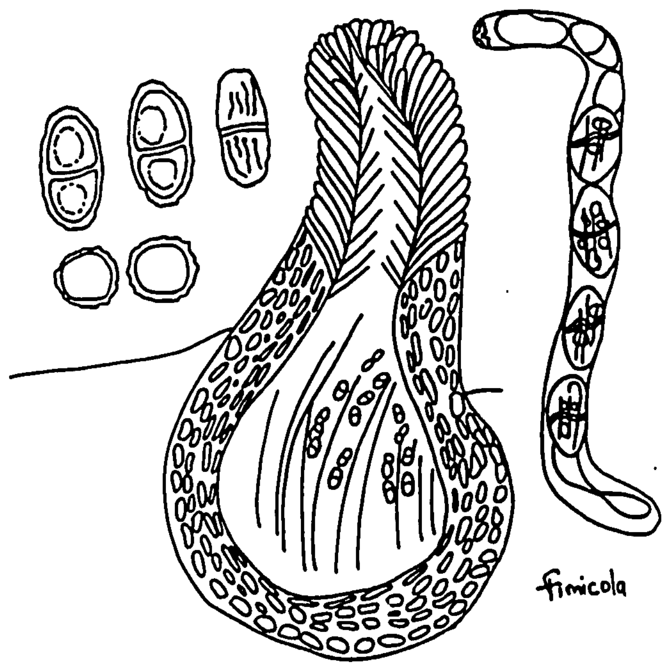

ZYTHIOSTROMA (1)
STROMATOGRAPHIUM (2)
KUTILAKESOPSIS (2)
TUBERCULARIA (1)
STILBELLA (1,3)
VOLUTELLA (5)
FUSARIUM (ATRACTIUM, ETC) (3)
CYLINDROCLADIUM (10)
(a,b)
(a)
(b)
(a,b)
(a,b)
"VERTICILLIUM" (5,13)
ACREMONIUM (14,15)
FUSARIUM (a) (4,5,6)
CYLINDROCARPON (b) (7,8,9,11)
DENDRO-DOCHIUM (12)
MYRO-THECIUM (12)
"GLIOCLADIUM" ROSEUM-"G" CATENULATUM (12)

Fig. 51



52. <u>Nectriella guttulata</u>. (SEM photographs). A. Perithecial apex, showing ostiole and hairs. B.,C. Ascospores, note verrucae and collapse. D. Perithecium, showing position on substrate (isotype, NY).



53. Nectriella fimicola. Section of ascoma, paraphyses.
Ascus, ascospores (holotype, Rehm 1587, FH).

LIST OF SPECIES

I. NECTRIELLA

1. N. alpina (Winter) Weese
2. N. balansiae Arnold
3. N. bloxamii (Berkeley & Broome) Fuckel
   = Nectria umbelliferarum Crouan & Crouan
   = Nectria heraclei Crouan & Crouan
   = Nectria fuscidula Rehm
   = Nectria dacrymycelloides Rehm
4. N. crouanii Lowen
5. N. dacrymycella (Nylander) Rehm
6. N. dakotensis (Seaver) Lowen
   = Nectriella muelleri Samuels, Rogerson, Rossman & J.D. Smith
7. N. dingleyae Lowen
8. N. exigua Dennis
9. N. fuckelii Nitschke
10. N. funicola (Berkeley & Broome) Petch
    = Nectria charticola Fuckel
    = Nectria fibricola Plowright
11. N. galii (Plowright & Harkness) Lowen
12. N. guttulata Lowen
13. N. halonata Lowen
    = Calonectria bloxamii (Berkeley & Broome) Saccardo var. umbelliferarum Höhnel
14. N. lacustris (Kirschstein) Magnes & Hafellner

15. N. luteola (Desmazières) Weese
16. N. minuta Lowen
17. N. obscura Lowen
18. N. paludosa Fuckel
    = Nectriella diaphana Fuckel & Nitschke
19. N. pironii Alfieri & Samuels
20. N. queletii (Karsten) Karsten
21. N. rubrocapitula Lowen
22. N. sambuci (Höhnel) Weese
23. N. silenes-acaulis Nograsek
24. N. utahensis Lowen & Rogerson
25. N. verrucosa Urries

II. PRONECTRIA

1. P. anisospora (Lowen) Lowen
2. P. echinulata Lowen
3. P. erythrinella (Nylander) Lowen
4. P. laminariae (O. Eriksson) Lowen
    = Nectriella kalchbrenneri Fuckel
5. P. leptaleae (Steiner) Lowen
    5a. P. leptaleae (Steiner) Lowen var. tuberculata Lowen
6. P. ornamentata (Hawksworth) Lowen
7. P. paucispora Lowen
8. P. pertusariicola Lowen
9. P. robergei (Montagne & Desmazières) Lowen
    = Cryptodiscus lichenicola Cesati
    = Nectriella carnea Fuckel

= Nectria peltigerae Phillips & Plowright

10. P. santessonii (Lowen & Hawksworth) Lowen

11. P. subimperspicua (Spegazzini) Lowen

12. P. tenacis (Vouaux) Lowen

= Pharcidia mammillula (Anzi) Vouaux f. tenacis Vouaux

13. P. tenuispora (Hawksworth) Lowen

14. P. terrestris Lowen & Diederich

15. P. tincta (Fuckel) Lowen

= Nectriella coccinea Fuckel

= Nectria fuckelii Saccardo

= Calonectria fuckelii (Saccardo) Rehm f. everniae Rehm

16. P. verrucariae (Vouaux) Lowen

17. P. xanthoriae Lowen & Diederich

III. CHARONECTRIA

1. C. amabilis Lowen & Hawksworth

2. C. consolationis Saccardo

3. C. sceptri (Karsten) Lowen

= Nectria sceptri (Karsten) Lowen

= Nectria dacrymycella (Nylander) Saccardo f. aconiti Saccardo

= Peziza oleosa Ellis

= Charonectria pedicularis Tracy & Earle

EXCLUDED from CHARONECTRIA

1. C. sasae Hara

IV. CRYPTONECTRIELLA

1. C. biparasitica (Höhnel) Weese
2. C. geoglossi (van Overeem) Lowen

V. HYDRONECTRIA

1. H. kriegeriana Kirschstein

VI. NECTRIA

1. N. aureola Winter
2. N. bambusae Berkeley & Broome
3. N. callorioides Rehm
   = Pseudonectria tornata Höhnel
   = NECTRIA OCHROLEUCA (Schweinitz) Berkeley
4. N. carnea Desmazières
5. N. chlorina Crouan & Crouan
6. N. chrysites (Wallroth) Rabenhorst
7. N. citrum (Wallroth) Fr. (N. "citrina")
8. N. consors (Ellis & Everhart) Seaver
   = N. ignia Höhnel
9. N. digitalicola Crouan & Crouan
10. N. farinosa Hennings
    = N. byssicola Berkeley & Broome
11. N. flocculenta (Hennings & Nyman) Höhnel
    = N. tjiobodensis Penzig & Saccardo var. crebrior Saccardo
    = N. bainii Massee var. hypoleuca Saccardo
    = N. vanillae Zimmerman

12. *N. graminicola* Berkeley & Broome

13. *N. helenae* (Saccardo & Roumeguère) Lowen

14. *N. microspora* Cooke & Ellis

    = *N. purtonii* (Greville) Berkeley

15. *N. myriadea* Cesati

16. *N. peponum* Berkeley & Curtis

    = *Nectriella peponum* Berkeley & Curtis var. *aurelia* Berkeley & Curtis

17. *N. thujana* Saccardo

18. *N. vulpina* (Cooke) Ellis

    = *N. incrustans* Weese

19. *N. wainioi* Karsten

    = N. OCHROLEUCA (Schweinitz) Berkeley

NECTRIELLA FUCKEL, TAXA THAT ARE ASSIGNED TO OTHER GENERA OR CANNOT BE ASSIGNED TO GENUS

VII. PSEUDONECTRIA

1. *P. aurantia* (Penzig & Saccardo) Lowen

2. *P. coronata* (Juel) Lowen

3. *P. furfurella* (Berkeley & Broome) Petch

    = *Nectria keithii* Berkeley & Broome

4. *P. metzgeriae* Ade & Höhnel

5. *P. rousseliana* (Montagne) Wollenweber

EXCLUDED OR DOUBTFUL TAXA OF **NECTRIELLA SACCARDO**

1. *N. acrosperma* Kirschstein

2. *N. artemisiae* Fautrey.

3. <u>N.</u> <u>aurea</u> Saccardo & Spegazzini

4. <u>N.</u> <u>bacillispora</u> Traverso & Spessa

5. <u>N.</u> <u>chamaropsis</u> Oudemans

6. <u>N.</u> <u>coruscans</u> (Fries) Saccardo

7. <u>N.</u> <u>cucumeris</u> J. Hanzawa

8. <u>N.</u> <u>fusarioides</u> (Berkeley) Saccardo

9. <u>N.</u> <u>gigaspora</u> (Cooke & Massee) Saccardo

10. <u>N.</u> <u>jaczewskii</u> Girzitska

11. <u>N.</u> <u>jucunda</u> (Durieu & Montagne) Saccardo

    = <u>N. cacti</u> Ellis & Everhart

12. <u>N.</u> <u>jucundula</u> Saccardo & Spegazzini

13. <u>N.</u> <u>lusitanica</u> González Fragoso

14. <u>N.</u> <u>maquilingica</u> Saccardo

15. <u>N.</u> <u>maydis</u> Delacroix

16. <u>N.</u> <u>miltina</u> (Montagne) Saccardo

    ≡ ALLANTONECTRIA MILTINA (Mont.) Weese

    = <u>Allantonectria yuccae</u> Earle

17. <u>N.</u> <u>miniata</u> Hennings

18. <u>N.</u> <u>mölleri</u> Hennings

19. <u>N.</u> <u>monilifera</u> (Berkeley & Broome) Saccardo

20. <u>N.</u> <u>musicola</u> (Spegazzini) Saccardo & Trotter

21. <u>N.</u> <u>mycetophila</u> (Peck) Saccardo

    = SPHAEROSTILBELLA AUREO-NITENS (Tulasne & Tulasne) Seifert

22. <u>N.</u> <u>nigroviridis</u> (Crouan & Crouan) Saccardo

23. <u>N.</u> <u>offuscata</u> (Berkeley & Curtis) Saccardo

24. <u>N.</u> <u>oryzae</u> Hara

25. *N. pallidula* Penzig & Saccardo

26. *N. papyrogena* Saccardo & Penzig

27. *N. perpusilla* (Montagne) Saccardo

≡ NECTRIOPSIS PERPUSILLA (Mont.) Samuels

= *Lisea parasitica* Rick

28. *N. philippina* Rehm

29. *N. ptychospermatis* Rehm

30. *N. resinae* (Fries: Fries) Saccardo

≡ PYCNIDIELLA RESINAE (Fr.: Fr.) Höhnel

31. *N. rufo-fusca* Penzig & Saccardo

32. *N. setulosa* Penzig & Saccardo

33. SCHIZOPARME STRAMINEA Shear

34. *N. thelopsidioides* (Crouan & Crouan) Saccardo

35. *N. tracheiphila* E.F. Smith

≡ NEOCOSMOSPORA VASINFECTA E.F. Smith

= *N. vasinfecta* E.F. Smith var. *nivea* E.F. Smith

?= *Psuedonectria ornata* Batista & Maoa

= *Neocosmospora vasinfecta* E.F. Smith var. *major* Rama Rao

= *N. ornamentata* Barbosa

36. *N. versoniana* Saccardo & Penzig

≡ SCHIZOPARME

37. *N. villosula* Spegazzini

38. *N. zingiberis* F.L. Stevens & Atienza

39. *N. zingiberis* F.L. Stevens & Atienza var. *pallida* Stevens & Atienza

BRYOPHILOUS TAXA DESCRIBED IN **NECTRIELLA SACCARDO** THAT ARE EXCLUDED FROM PSEUDONECTRIA

1. *P. brongniartii* (Crouan & Crouan) Döbbeler

   ?= *Nectriella casaresii* González Fragoso

2. *P. erythrostigma* (Montagne) Saccardo

3. *P. jungermanniarum* (Crouan & Crouan) Döbbeler

   = *Nectriella lophocoleae* C. Massalongo

   = *Neotiella crozalsiana* Grelet

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