ISSN 0376-5156
Geophytology 52(1&2): 67–116
November 2022

# Fossil fungal species assigned to extant genera: global records and distribution

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Manuscript received: 20 August 2022
Accepted for publication: 22 September 2022

## ABSTRACT

Saxena R.K. 2022. Fossil fungal species assigned to extant genera: global records and distribution. Geophytology 52(1&2): 67–116.

The paper presents fossil fungal species assigned to extant genera recorded from the world over. Fifty extant genera containing eighty species are recorded with relevant information. For each genus (arranged in alphabetical order), the following information is provided: Index Fungorum Registration Identifier, Synonyms (if any), Type species, Classification, Number of fossil species known and Remarks (if any). For the species (arranged in alphabetical order under each genus), the following information is provided: Index Fungorum Registration Identifier, Synonyms (if any), Original Description, Location, Age and Remarks (if any). Two replacement names, viz. *Brachysporium trivedii* and *Meliola dilcheri* and two new combination, viz. *Brachysporiella doerfeltii* (Sadowski et al.) and *Chaetothyrina antiqua* (Dilcher) are proposed. Taxonomic classification (e.g. Phylum, Class, Order and Family), of all the taxa is also presented. Global distribution of these taxa is discussed.

**Keywords** –Fossil fungal species, extant genera, fungal taxonomy, global diversity, world-wide distribution.

## INTRODUCTION

Fossil fungi are generally described as form taxa (based on morphological characters only) because, in most cases, they cannot be ascribed to extant ones. However, in certain cases, it has been possible to assign them to extant species, e.g. *Annellophora mussaendae* M.B. Ellis., *Entophlyctis lobata* Willoughby & Townley, *Tetraploa aristata* Berk. & Broome, *T. ellisii* Cooke (Gupta 1970) or to extant genera, e.g. *Alternaria* sp. (Rao & Menon 1970, Sharma 1976, Mallesham et al. 1989), *Chaetomium* sp. (Banerjee & Nandi 1992), *Isthmospora* sp. (Ramanujam & Srisailam 1980), *Meliola* sp. (Ramanujam & Rao 1978, Prasad & Ramesh 1983, Varma & Patil 1985, Saxena & Rao 1996) and *Periconia* sp. (Sarkar & Singh 1994, Mandaokar et al. 2008).

In cases, where fossil specimens are placed in extant genus but cannot be placed in any of its known extant species, new species is proposed under the extant genus. Such species is called fossil species because of its type being fossil. The present paper deals with such fossil species described the world over. These days, more and more efforts are being made to establish fossil-extant relationship in fungi. Saxena and Wijayawardene (2022) discussed three cases of fossil-extant relationship, e.g. 1. *Mediaverrunites* Jarzen & Elsik ex Nandi & A. Sinha 2007 vs. *Potamomyces* K.D. Hyde 1995; 2. *Polycellaesporonites* Anil Chandra et al. 1984 vs. *Alternaria* Nees 1816; and 3. *Frasnacritetrus* Taug. 1968 vs. *Tetraploa* Berk. & Broome 1850. Nuñez Otaño et al. (2017) considered *Mediaverrunites* to be a later synonym of *Potamomyces* and transferred seven species of

*Mediaverrunites* to *Potamomyces*. Saxena et al. (2022) considered *Polycellaesporonites* to be a later synonym of *Alternaria* and transferred seven species of *Polycellaesporonites* to *Alternaria*.

In this paper, a brief account of fossil fungal species assigned to extant genera, recorded the world over, is presented. Altogether, fifty extant genera containing eighty species are recorded and described. The genera are arranged in alphabetical order and species are also arranged in alphabetical order, within the genus. For the genus, the following information is provided: Index Fungorum Registration Identifier, Synonyms (if any), Type species, Classification (e.g. Phylum, Class, Order and Family), Number of fossil species known and Remarks (if any). For the species, the following information is provided: Index Fungorum Registration Identifier, Synonyms (if any), Original Description (this includes both, Diagnosis and Description), Location, Age and Remarks (if any). Each species is either provided with a figure or reference to the previously published figure.

## FOSSIL FUNGAL SPECIES ASSIGNED TO EXTANT GENERA

1. Genus: ***Acremonium*** Link

**Index Fungorum Registration Identifier:** 7028.

**Type species:** Not indicated. Lectotype: *Acremonium alternatum* Link (designated by Clements & Shear 1931), Index Fungorum Registration Identifier: 598618.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Hypocreales*, Family: Incertae sedis.

**Number of fossil species known:** One.

1.1. Species: ***Acremonium succineum*** Casp. 1907

**Index Fungorum Registration Identifier:** 107444.

**Figure:** In Caspary 1907: 10, plate 1, figure 5.

**Homotypic synonym:** *Acremonites succineus* (Casp.) Pia 1927, Index Fungorum Registration Identifier: 115027.

**Original Description:** On the leaves and stems of *Widdringtonites oblongifolius* var. *longifolius* Casp. are a few spots that are covered by a dark-brown fungal mycelium, the hyphae of which are about 4.2 µm or a bit more in thickness and adhere closely to the surface. From these arise short, perpendicular threads that terminate in an obovate or subspherical head. In several places similar threads break directly through the epidermal surface of the leaf, where no mycelium can be seen on the surface of the infected organ. In these specimens, the mycelium must be present within the leaf or its stem. The spore-bearing, upright threads are often slightly transparent in their upper part, about 4.2 µm thick and 85–96 µm long. The head is 22.7 µm long and 17 µm thick, often transparent in its basal part. No septa can be observed in the opaque upper part.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

**Remarks:** Pia (1927) erected a new genus *Acremonites* and transferred *Acremonium succineum* Casp. 1907 into the new genus, which is considered here unwarranted.

2. Genus: ***Alternaria*** Nees

**Index Fungorum Registration Identifier:** 7106.

**Type species:** *Alternaria tenuis* Nees, Index Fungorum Registration Identifier: 211928.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Pleosporales*, Family: *Pleosporaceae*.

**Number of fossil species known:** Seven.

2.1. Species: ***Alternaria acuminata*** (Rouse & Mustard) R.K. Saxena et al. 2022

Figure 1

**Index Fungorum Registration Identifier:** 843345.

**Basionym:** *Multicellaesporites acuminatus* Rouse & Mustard, Palynology 21: 208. 1997, Index Fungorum Registration Identifier: 463998.

**Homotypic Synonyms:** *Piriurella acuminata* (Rouse & Mustard) M.G. Parsons & G. Norris 1999, Index Fungorum Registration Identifier: 483924. *Polycellaesporonites acuminatus* (Rouse & Mustard) Kalgutkar & Janson. 2000, Index Fungorum Registration Identifier: 483526.

**Original Diagnosis:** Fusiform fungal spores, consisting of 5–6 thin septa in each half; each septum with a small central pore; septa supporting an inner membranous body that is closely appressed to the outer wall in central regions, but contracted away from the outer wall towards the two pointed extremities; wrinkles occur sporadically on the inner wall that appear as elongate irregular plicae. Dimensions: range of length 62–68 µm; of diameter 17–25 µm.

**Figure 1.** *Alternaria acuminata* (Rouse & Mustard) R.K. Saxena et al. 2022. Scale Bar = 20 µm.

**Location:** Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, Canada and the Northwestern Washington State, U.S.A.

**Age:** Late Palaeocene.

2.2. Species: ***Alternaria alternariata*** (Kalgutkar & Sigler) R.K. Saxena et al. 2022

Figure 2

**Index Fungorum Registration Identifier:** 843343**.**

**Basionym:** *Piriurella alternariata* Kalgutkar & Sigler, Mycological Research 99(5): 518, figure 14. 1995, Index Fungorum Registration Identifier: 413840.

**Homotypic synonym:** *Polycellaesporonites alternariatus* (Kalgutkar & Sigler) Kalgutkar & Janson. 2000, Index Fungorum Registration Identifier: 483527.

**Original Diagnosis:** Conidia arising singly or in clusters; multicellate, muriform, solitary, ovoid to obclavate, rostrate, cicatrized or not, pale brown to brown, smooth. Conidia with a short conical beak and 8–12 transverse and several longitudinal or oblique septa; transverse septa more prominent and thicker than the longitudinal or oblique septa; terminal [apical] conical beak about 9–11 µm broad, with a conspicuous dark thickened tip that probably represents the point of origin (attachment scar) of the next apical spore in the succession of a conidial chain. Conidia, when cicatrized, with a scar at the proximal end at the point of attachment to the conidiophore. Conidia 42–74 µm long, 18–27 µm wide in the broadest part.

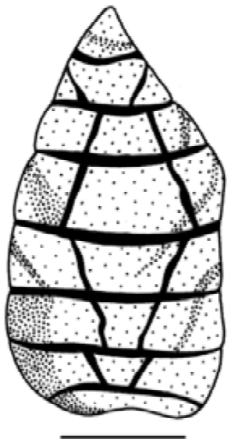

**Figure 2.** *Alternaria alternariata* (Kalgutkar & Sigler) R.K. Saxena et al. 2022. Scale Bar = 15 µm.

**Location:** Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada.

**Age:** Late Palaeocene or Early Eocene (Iceberg Bay Formation).

**Remarks:** This species has also been recorded from the intertrappean beds (Early Palaeocene) exposed at about 5 km west of Naredi, on Naliya–Narayan Sarovar Road, Kutch District, Gujarat, India (Saxena & Ranhotra 2009).

2.3. Species: ***Alternaria bella*** (Anil Chandra et al.) R.K. Saxena et al. 2022
Figure 3

**Index Fungorum Registration Identifier:** 843342.

**Basionym:** *Polycellaesporonites bellus* Anil Chandra et al., Biovigyanam 10(1): 49, plate 2, figure 20. 1984, Index Fungorum Registration Identifier: 107183.

**Original Diagnosis:** Fungal spore with a capsular body and a tube-shaped unicellular appendage emerging from one end; size range 45–68 × 13–15 µm; main body of spore 33–48 × 13–15 µm; tube-like projection hyaline, 12–20 µm long, multicellate individual cells rectangular, not arranged along one axis; inaperturate; spore wall 1–1.5 µm thick, psilate.

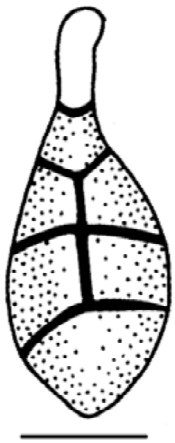

**Figure 3.** *Alternaria bella* (Anil Chandra et al.) R.K. Saxena et al. 2022. Scale Bar = 15 µm.

**Location:** Sediment core no. 1 (Lat. 17°57.92' N: Long. 70°46.02' E), Arabian Sea.

**Age:** Late Quaternary.

**Remarks:** Chandra et al. (1984) suggested possible affinity of this species to *Alternaria* sp.

2.4. Species: ***Alternaria clavellata*** (Z.-C. Song & G.-X. Li in Song et al.) R.K. Saxena et al. 2022
Figure 4

**Index Fungorum Registration Identifier:** 843347.

**Basionym:** *Pluricellaesporites clavellatus* Z.-C. Song & G.-X. Li in Song et al., Early Tertiary Sporo-Pollen Assemblages from the Dongpu Region: 40, plate 2, figure 21. 1989, Index Fungorum Registration Identifier: 485254.

**Homotypic synonym:** *Polycellaesporonites clavellatus* (Z.-C. Song & G.-X. Li in Song et al.) Kalgutkar & Janson. 2000, Index Fungorum Registration Identifier: 483528.

**Original Diagnosis:** Spores clavate with a long stipe and wide middle part, tapering toward both ends; about 100 µm in length, widest part about 18 µm in width. Spores multicellular, cells flat, some middle cells appear to be subdivided [by longitudinal septa]. Septa generally without septal folds and pores. Stipe of one cell, about 30 µm in length, with an attachment scar or pore at the [proximal] end. Spore wall less than 1 µm in thickness, surface smooth.

**Figure 4.** *Alternaria clavellata* (Z.-C. Song & G.-X. Li in Song et al.) R.K. Saxena et al. 2022. Scale Bar = 20 µm.

**Location:** Heze County and Shenxian County of Shandong Province, China.

**Age:** Middle-Late Oligocene (Shahejie and Dongying formations).

2.5. Species: ***Alternaria psilata*** (A. Gupta) R.K. Saxena et al. 2022
Figure 5

**Index Fungorum Registration Identifier:** 843341.

**Basionym:** *Polycellaesporonites psilatus* A. Gupta, Tertiary Research 21(1–4): 146, plate 4, figure 7. 2002, Index Fungorum Registration Identifier: 540760.

**Original Diagnosis:** Spores multicelled, elongate, showing cells arranged in clusters along more than one axis at one end and a tube-like appendage at other, inaperturate, 37–78 µm long, number of cells across its width of cell clusters ranges up to 3 or more, psilate, surface folded.

**Figure 5.** *Alternaria psilata* (A. Gupta) R.K. Saxena et al. 2022. Scale Bar = 10 µm.

**Location:** Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

**Age:** Late Palaeocene to Early Oligocene (Subathu Formation).

**Etymology:** The species was named after its psilate spore wall.

2.6. Species: ***Alternaria saxenae*** **(**A. Gupta) R.K. Saxena et al. 2022

Figure 6

**Index Fungorum Registration Identifier:** 843340.

**Basionym:** *Polycellaesporonites saxenae* A. Gupta, Tertiary Research 21(1–4): 145, plate 4, figure 4, 2002, Index Fungorum Registration Identifier: 540761.

**Original Diagnosis:** Spores multicelled, elongate, showing cells arranged in clusters along more than one axis at one side and a tube-like appendage at other, inaperturate, measuring 35–75 µm long, three or more cells across width, granulate, sculptural elements distinct at cell clusters but indistinct at appendage, surface folded.

**Figure 6.** *Alternaria saxenae* (A. Gupta) R.K. Saxena et al. 2022. Scale Bar = 5 µm.

**Location:** Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

**Age:** Late Palaeocene to Early Oligocene (Subathu Formation).

**Etymology:** The species was named to honour Dr. Ramesh K. Saxena, Birbal Sahni Institute of Palaeosciences, Lucknow, India.

2.7. Species: ***Alternaria sirmaurensis*** **(**A. Gupta) R.K. Saxena et al. 2022

Figure 7

**Index Fungorum Registration Identifier:** 843339.

**Basionym:** *Polycellaesporonites sirmaurensis* A. Gupta, Tertiary Research 21(1–4): 145, plate 4, figure 3. 2002, Index Fungorum Registration Identifier: 540762.

**Original Diagnosis:** Spores multicelled, elongate, showing cells arranged in clusters along more than one axis at one side and a tube-like appendage at other, inaperturate, measuring 26–58 µm long, number of cells across the width of cells cluster ranges up to 2, largely granulate, sculptural elements distinct at cluster but indistinct at appendage, surface folded.

**Figure 7.** *Alternaria sirmaurensis* (A. Gupta) R.K. Saxena et al. 2022. Scale Bar = 15 µm.

**Location:** Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

**Age:** Late Palaeocene to Late Eocene (Subathu Formation).

**Etymology:** The species was named after Sirmaur District in Himachal Pradesh, India where its type locality is situated.

3. Genus: ***Asterina*** Lév.

**Index Fungorum Registration Identifier:** 409.

**Type species:** *Asterina melastomatis* Lév., Index Fungorum Registration Identifier: 218181.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Asterinales*, Family: *Asterinaceae*.

**Number of fossil species known:** Nine.

3.1. Species: ***Asterina eocenica*** Dilcher 1965

Figure 8

**Index Fungorum Registration Identifier:** 326723.

**Original Description:** Fruiting body round, radiate, consists of prosenchymatous cells; small fruiting body 35–45 µm in diameter, large fruiting body 100–225 µm in diameter. Central cells of fruiting body isodiametric, 5–7 µm in diameter. Elongate marginal cells bifurcate frequently, 3–4 × 3.5–7 µm in small fruiting body, 2.5–3.5 × 7.5–12.5 µm in large fruiting body. Fruiting body astomate, splits open radially at maturity, exposing radially arranged ascospores within the large fruiting body. Spores two-celled, echinate, 9–14 × 20–28 µm. The two cells of the spores unequal in size, the larger 9–14 × 12–15 µm and the smaller 8–12 × 10–13 µm. Typical germination of spores occurs from the free end of the smaller cell of the spore. Spores may persist in attachment to the young hyphae produced. Hyphae typically straight, usually branch alternately or unilaterally, may branch oppositely, hyphal cells 3–5 × 6–32 µm. Single-celled hyphopodia produced at more or less regular intervals along the length of the hyphae, often near the distal end of the hyphal cells. Hyphopodia generally alternate, may be unilateral, single-celled, elongate and attenuate at the apex, 3–5 × 9–14 µm at base tapering to about half this width near tip. No haustorial pores present in hyphopodia; no indication of infection of host leaf. Found on lower surface of *Chrysobalanus* sp.

**Figure 8.** *Asterina eocenica* Dilcher 1965. Bar = 50 µm

**Location:** Wilcox Formation, Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Etymology:** The specific epithet indicates age of the is Wilcox Formation from where the species was described.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000), therefore, selected a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), two distinct groups of fruiting bodies may be distinguished on the basis of size. In one group, in which no spores have

been found, the maximum diameter ranges from 35–45 µm; in the other group, in which ascospores have been found, the maximum diameter ranges from 100–225 µm.

3.2. Species: ***Asterina indodeightonii*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559810.

**Figure:** In Vishnu et al. 2017: 152, figure 4A–C.

**Original Description:** (Diagnosis): Appressoria thick-walled, globoid to ovoid, unicellular, curved or bent towards tip, opposite, 19–22 × 11–14 µm. (Description): Colonies amphigenous, epiphyllous; vegetative hyphae flexuous, branched, brown, irregular, loosely reticulate, septate, appressoriate; hyphal cells thick, short, 10–12 × 4–5 µm, cell margin irregular, cylindrical; appresoria unicellular, appeared to be opposite, thick-walled, globoid to ovoid, capitate, entire, rarely uniseptate, constricted, 19–22 × 11–14 µm, curved or bent towards tip; thyriothecia absent; ascospores bi-celled, slightly thick-walled, 30 × 10 µm, ovoid to globose, striate.

**Location:** Road cuttings along the Itanagar-Banderdewa Road in Papumpare District, Arunachal Pradesh, India.

**Age:** Late Pliocene to Early Pleistocene, Upper Siwalik (Kimin Formation).

**Etymology:** The specific epithet is derived by adding the prefix 'indo' to the modern comparable specific epithet *deightonii*.

**Remarks:** *Asterina indodeightonii* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), the species is similar to the extant *Asterina deightonii* Syd., originally described from Sierra Leone on leaves of *Loranthus leonensis* Sprague (*Loranthaceae*) (Sydow 1938).

3.3. Species: ***Asterina kosciuskensis*** Selkirk 1975

**Index Fungorum Registration Identifier:** 309273

**Figure:** In Selkirk 1975: 73, plate 2, figures 1–9, plate 3, figure 7.

**Original Description:** Colonies up to 4 mm diameter, amphigenous. Mycelium dark. Hyphae straight, cells 19–47 µm long and 4.5–10 µm wide, branches at 90 degrees, alternate or unilateral. Hyphopodia one-celled, alternate or unilateral, subglobose to cylindrical with broadly rounded apex, 9–15 µm long and 5–10 µm wide; mostly at right angles to cells bearing them, often slightly antrorse, occasionally reflexed; distinct pore up to 2.5 µm diameter towards distal end, usually surrounded by a thickened rim. Perithecia scattered or crowded, up to 450 µm diameter, composed of radiating hyphae; margin fimbriate, paler than central area. Central portion of wall multi-layered, margin single layered. Spores ovate-elliptical, 1–septate, constricted, cells of unequal length, walls thin, granular. Walls of spore become thick and dark after germination and further septa may develop.

**Location:** Kiandra, New South Wales, Australia.

**Age:** Early Miocene.

3.4. Species: ***Asterina mioconsobrina*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559811.

**Figure:** In Vishnu et al. 2017: 152, figure 4D–G.

**Original Description:** (Diagnosis): Appressoria entire, curved, bottle-shaped, ovoid-elliptical, irregularly crooked, with sinuate margins, alternate, 7–9 × 5–6 µm. (Description): Vegetative hyphae branched, blackish brown, cylindrical, septate, appressoriate; branching unilateral; hyphal cells slender, in diameter, scutellum cells 17.7 × 3.3 µm, slightly undulated; ascospore bi-celled, thick walled, globose, smooth, 8 × 10 µm.

**Location:** Road cuttings along the Itanagar-Banderdewa road in Papumpare District, Arunachal Pradesh, India.

**Age:** Late Pliocene to Early Pleistocene, Upper Siwalik (Kimin Formation).

**Etymology:** The specific name is derived by adding the prefix 'mio' to the modern comparable specific epithet *consobrina*.

**Remarks:** *Asterina mioconsobrina* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), this species shows strikingly similar appresorial morphology with the extant *Asterina consobrina* Syd. described on *Solanum* cf. *laurifolium* Mill. (*Solanaceae*) in Costa Rica (Sydow 1927; Hosagoudar & Abraham 2000) and on *Solanum aphyodendron* S. Knapp in Panama (Hofmann & Piepenbring 2007).

3.5. Species: ***Asterina miosphaerelloides*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559812.

**Figure:** In Vishnu et al. 2017: 152, figure 5A–F.

**Original Description:** (Diagnosis): Appressoria ovoid to elongated globoid, unicellular, curved at ends, alternate, 9.5 × 11.5 µm. (Description): Mycelial colony brown; vegetative hyphae septate, branching unilateral or alternate, appressoriate; hyphal cells cylindrical, 8–50 × 4–6 µm, slender, thick walled; appressoria unicellular, alternate, ovoid to elongated globoid, curved at ends, irregularly ellipsoidal to ampuliform, sometimes with one deep lobe at the middle, sessile, 9.5 × 11.5 µm; thyriothecia at different stages of development, dark brown, circular, discoid, margin curved; mature thyriothrcia rupture centrally with a stellate opening, then centre with indistinguishable cellular details, 75–200 µm in diameter; asexual conidiospores unicellular, slightly thick-walled, ovoid to globose, 8 µm in diameter.

**Location:** Road cuttings along the Itanagar-Banderdewa road in Papumpare District, Arunachal Pradesh, India.

**Age:** Late Pliocene to Early Pleistocene, Upper Siwalik (Kimin Formation).

**Remarks:** *Asterina miosphaerelloides* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), *Asterina miosphaerelloides* shows close resemblance with the extant *Asterina sphaerelloides* Speg. recorded from *Ilex* L. (*Aquifoliaceae*), *Clematis* L. (*Ranunculaceae*), *Phoradendron novae-helveticae* Trel. (*Loranthaceae*) (Stevens & Ryan 1939) from Brazil (Theissen 1913) and Panama (Hofmann & Piepenbring 2006). The present fossil fungus shows some similarities with previously described fossil *Asterina*-like genus *Asterinites* Doub. & D. Pons ex Kalgutkar & Jansonius 2000. However, *Asterinites* differs in having much shorter, globose, sessile or bi-celled appressoria in contrast to the much larger, sessile appressoria with a deep lobe in middle portion of the present species *Asterina miosphaerelloides*.

3.6. Species: ***Asterina neocombreticola*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559813.

**Figure:** In Vishnu et al. 2017: 158, figures 6–7.

**Original Description:** (Diagnosis): Appressoria intercalary, ovoid to globose, opposite couplet with a continuous lumen, 20–25 × 15–20 µm; phialide present. (Description): Colony epiphyllous, forming a dense mycelial mat, dark brown, amphigenous; hyphae straight, slender, branching opposite to irregular at acute to wide angles, closely to loosely reticulate, with intercalary

appressoria and phialidic-like structures; hyphal cells 3–5 × 20–30 µm; appressoria intercalary, opposite couplet fused to form swollen, nodular clamp with a lumen, ovoid to globose, entire, 20–25 × 15–20 µm, penetration pore visible at the tip of each nodular clamp; phialide-like structures present, elliptical, ovoid, curved at the tip, 8–12 × 17–20 µm, pores at the apex; thyriothecia scattered, orbicular to oval, smaller ones 30–50 µm in diameter) with entire margins, larger ones 100–300 µm, with marginal hyphae projecting outwards the periphery; scutellum cells rectangular to cylindrical; stellately dehisced in centre; spores not found.

**Location:** Road cuttings to the south of Pinjoli area in West Kameng District, Arunachal Pradesh, India.

**Age:** Middle to Late Miocene, Lower Siwalik (Dafla Formation).

**Etymology:** The fossil form is reported from the compressed leaf remain of *Combretum* Loefl. (*Combretaceae*) from the Neogene and hence receives the epithet '*neocombreticola*'.

**Remarks:** *Asterina neocombreticola* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), the fossil epiphyllous fungus is strikingly similar to species belonging to *Gangamyces* V.B. Hosagoudar (*Asterinaceae*). *Gangamyces* spp. resemble those of *Asterina*, but differ in appressorial features.

3.7. Species: ***Asterina neoelaeocarpi*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559814.

**Figure:** In Vishnu et al. 2017: 161, figure 8A–F.

**Original Description:** (Diagnosis): Appressoria cylindrical, ovoid with pointed tapering ends, unicellular, opposite, 12–18 × 5–8 µm. (Description): Colony dense; vegetative hyphae straight to sub-straight, septate, branched, branching opposite, unilateral, loosely reticulate; hyphal cells cylindrical, little irregular along margin, 5–15 × 4–5 µm; appressoria often opposite, ovoid to broadly ovoid with pointed tapering ends, unicellular, 12–18 × 5–8 µm; young thyriothecia present, cellular details not evident forming a dense brown discoid body with projecting hyphae, margin irregular, almost circular, 80 µm in diameter; conidiospores numerous, scattered on the leaf surface, unicellular, smooth, 4.5 µm in diameter.

**Location:** Road cuttings to the south of Pinjoli area in West Kameng District, Arunachal Pradesh, India.

**Age:** Middle to Late Miocene, Lower Siwalik (Dafla Formation).

**Etymology:** The specific name is derived by adding the prefix 'neo' to the modern comparable specific epithet *elaeocarpi*.

**Remarks:** *Asterina neoelaeocarpi* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), *Asterina neoelaeocarpi* is similar to extant *Asterina elaeocarpi* Syd. & P. Syd., originally reported from *Elaeocarpus* sp. (*Elaeocarpaceae*). Other morphologically similar species are *A. elaeocarpi* Syd. var. *ovalis* A.K. Kar & S.N. Ghosh, *A. elaeocarpi-kobanmochi* Yam. and *A. elaeocarpicola* Hansf., which have been recorded on *Elaeocarpus* from Borneo, China, India, Java and the Philippines (Sydow et al. 1911, Hansford 1954, Yamamoto 1957, Kar & Ghosh 1986).

3.8. Species: ***Asterina nodosaria*** Dilcher 1965

**Index Fungorum Registration Identifier:** 326725.

**Figure:** In Dilcher 1965: 18, plate 9, figure 75.

**Original Description:** No mature fruiting bodies present; only hyphae, setae, and seta bases known. Hyphae spread over upper surface of the host leaf, producing opposite or unilateral branches with frequent node-like or enlarged cells 7 × 12–20 µm with thickened lateral walls. Hyphal cells 3–5 × 7–27 µm. Very young developmental stages of fruiting bodies preserved, produced by node-like cells of the hyphae. Lateral walls of this cell fold outward producing a thin crenulated disk. Setae rarely preserved, 4 µm wide (tapering slightly towards apex) × 15–20 µm long, attached to fimbriate, thickened bases 5–10 µm in diameter. When setae are missing, seta bases have conspicuous pores, 3–6 µm in diameter, in center. Seta bases occur singly or clustered in a group. No spores found. Host leaf *Sapindus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000), therefore, selected a lectotype from the syntypes (resulting from a single collection) figured by Dilcher (1965). According to Dilcher (1965), this fossil form of *Asterina* is similar to *Asterolibertia couepiae* (P. Henn.) Arnaud described by Arnaud (1918) and later put in synonymy with *Asterina* as *Asterina couepiae* Henn. by Clements and Shear (1931).

3.9. Species: ***Asterina presaracae*** Vishnu et al. 2017 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 559815.

**Figure:** In Vishnu et al. 2017: 161, figure 9A–F.

**Original Description:** (Diagnosis): Appressoria unicellular, ampulliform, hook-shaped, alternate, 10–15 × 4–5 µm. (Description): Fungal colonies forming dense, brown, branched mycelial mat on leaf surface; vegetative hyphae septate, straight, branching alternate, opposite to irregular at acute angles; hyphal cells elongated, thick-walled, cylindrical, 10–22 × 4–6 µm; appressoria alternate, some opposite, unicellular, ampulliform, hook-shaped, thick-walled, broad at base, tapering at end, 10–15 × 4–5 µm; young as well as mature thyriothecia present scattered within hyphal mass; dark brown, discoid, margin crenate, radiating hyphae at the periphery, marginal fringes present, 45–150 µm in diameter; young thyriothecia indistinct in cellular details, mature one ruptured at centre; scutellum cells almost square at centre but become elongated towards periphery; conidia round, brown, thick-walled, smooth, 4–6 µm in diameter; scattered on the leaf surface.

**Location:** Road cuttings to the Bhalukpong area in West Kameng District, Arunachal Pradesh, India.

**Age:** Pliocene, Middle Siwalik (Subansiri Formation).

**Remarks:** *Asterina presaracae* was not validly published by Vishnu et al. (2017) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) registered it with Index Fungorum and obtained a unique Registration Identifier which is mentioned above. According to Vishnu et al. (2017), the fossil epiphyllous form shows structural similarity to *A. saracae* Hosag. et al. due to the unicellular, ampulliform appressoria with tapering ends (10–15 × 4–5) and discoid thyriothecia with crenate margin (45–150 µm). This extant species was reported by Hosagoudar et al. (1998) on leaves of *Saraca asoca* (Roxb.) Wilde (*Fabaceae*) from Kerala, India.

4. Genus: ***Botryodiplodia*** Sacc.

**Index Fungorum Registration Identifier:** 7420.

**Type species:** As per Index Fungorum, Saccardo accepted the type of *Diplodia* b *Botryodiplodia* as *Diplodia juglandis* (Fr.) Fr., Index Fungorum Registration Identifier: 214772.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Diaporthales*, Family: Incertae sedis.

**Number of fossil species known:** One.

4.1. Species: ***Botryodiplodia mohgaoensis*** Barlinge & Paradkar 1982

Figure 9

**Index Fungorum Registration Identifier:** 108725.

**Homotypic synonym:** *Diplodites mohgaoensis* (Barlinge & Paradkar) Kalgutkar et al. 1993, Index Fungorum Registration Identifier: 532825.

**Original Description:** Pycnidia 100–114 × 7–80 µm, compact; conidiophores branched; conidia bicelled, dark, 7–8 × 3–3.5 µm, fusiform with striations; hyphae branched, septate.

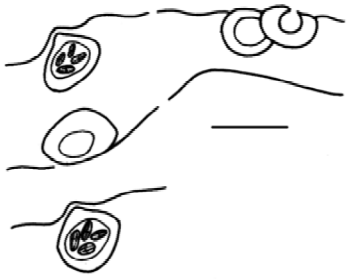

**Figure 9.** *Botryodiplodia mohgaoensis* Barlinge & Paradkar 1982. Bar = 100 µm.

**Location:** Mohgaonkalan, Chhindwara District, Madhya Pradesh, India.

**Age:** Late Cretaceous (Maastrichtian).

**Remarks:** According to Barlinge and Paradkar (1982), the conidia resemble the fossil fungus *Diplodia rodei* described by Mahabalé (1969). There are, however, differences in the size of conidiospores. The conidiospores of *D. rodei* are larger, 17.5–18 × 7.5 µm, purple, and on a monocotyledonous leaf. The present form occurs on a dicotyledonous leaf and has smaller spores that are not purple. In a fossil form, the original natural color of spores may not remain but may be modified to some extent. Kalgutkar and Jansonius (2000) transferred this species to *Diplodites* Teterevn.-Babajan & Tasl. ex Kalgutkar et al. 1993. The present author, however, does not agree with this transfer.

5. Genus: ***Brachysporiella*** Bat. in Batista & Vital

**Index Fungorum Registration Identifier:** 7443.

**Synonym:** *Monotosporella* S. Hughes 1958, Index Fungorum Registration Identifier: 8991 fide Index Fungorum (2022).

**Type species:** *Brachysporiella gayana* Bat., Index Fungorum Registration Identifier: 800370.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Sordariales*, Family: Incertae sedis.

**Number of fossil species known:** One.

5.1. Species: ***Brachysporiella doerfeltii*** (Sadowski et al.) R.K. Saxena, **comb. nov.**

**Index Fungorum Registration Identifier:** 553290.

**Figure:** In Sadowski et al. 2012: 1002, figure 2E.

**Basionym:** *Monotosporella doerfeltii* Sadowski et al., Fungal Biology 116(10): 1002, figure 2E. 2012, Index Fungorum Registration Identifier: 800370.

**Original Description:** (Diagnosis): The amber specimen of *Monotosporella* is distinct from extant species in possessing the combination of short conidiophores and two-septate, pyriform, and relatively small conidia. Although some extant species show one of these characteristics, their combination is unique within the genus *Monotosporella*. (Description): Colonies scattered, dark brown. Mycelium composed of brown to pale brown hyphae, 2–3.5 µm wide. Conidiophores arranged in clusters or singly, straight or arcuate, pale brown to hyaline, sometimes possessing one septum, 15–40 µm (rarely up to 60 µm) long, 2–5 µm wide at apex, 4–5 µm wide at base. Conidiogenous cells monoblastic, terminal. Conidia solitary, dark brown to black with hyaline cells at the base, pyriform, 1–3 septate, usually two septate, 17–28 µm × 10–15 µm, 2–5 µm wide at the base.

**Location:** Tadkeshwar Lignite Mine, Gujarat, India (21°21.400' N latitude, 73°04.532' E longitude).

**Age:** Early Eocene.

**Etymology:** The epithet honours Heinrich Dörfelt, mycologist and ecologist at Friedrich Schiller University Jena (Germany), a pioneer of extensive systematic studies on amber preserved fungi.

**Remarks:** *Monotosporella* S. Hughes 1958 is a later synonym of *Brachysporiella* Bat. in Batista & Vital 1952 (Species Fungorum 2022), hence *Monotosporella doerfeltii* Sadowski et al. 2012 has been transferred to *Brachysporiella* Bat. in Batista & Vital 1952.

6. Genus: ***Brachysporium*** Sacc.

**Index Fungorum Registration Identifier:** 7444.

**Type species:** *Brachysporium obovatum* (Berk.) Sacc., Index Fungorum Registration Identifier: 230865.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Trichosphaeriales*, Family: *Trichosphaeriaceae*.

**Number of fossil species known:** One.

6.1. Species: ***Brachysporium trivedii*** R.K. Saxena, **nom. nov**.

**Index Fungorum Registration Identifier:** 553465.

**Figure:** In Trivedi & Verma 1970: 68, plate 1, figures 3–4.

**Replaced synonym:** *Brachysporium minutum* Trivedi & C.L. Verma, J. Palynology 5(2): 68, plate 1, figures 3–4. 1970, Index Fungorum Registration Identifier: 309934, lectotype designated by Kalgutkar and Jansonius 2000, non *Brachysporium minutum* Bat. & H. Maia (as *minutus*) in Batista et al., Publicacões Inst. Micol. Recife 444: 4. 1965, Index Fungorum Registration Identifier: 309935.

**Homotypic Synonyms:** *Pluricellaesporites minutus* (Trivedi & C.L. Verma) ex Kalgutkar & Janson. 2000.

**Original Description:** Fungal spores two to several celled, upper two cells more dense, basal cell gradually narrower ending into a short stalk, apical cell rounded, cross walls thick, two-lobed, dense, 30 µm in thickness, spore wall 1 µm thick, surface smooth. Length of an individual spore depends on the number of cells that go to compose the spore. Spores 30–40 µm in length, and 15–20 µm in breadth.

**Location:** Near Kuala Lumpur, Malaya.

**Age:** Eocene.

**Remarks:** The species *Brachysporium minutum* Trivedi & C.L. Verma 1970 was not validly published because two elements were included under the designation "Holotype". Kalgutkar and Jansonius (2000) designated figure 4 as lectotype, and assigned the species to *Pluricellaesporites.* The present author, however, does not agree with this transfer.

7. Genus: ***Chaenothecopsis*** Vain.

**Index Fungorum Registration Identifier:** 934.

**Type species:** *Chaenothecopsis rubescens* Vain, Index Fungorum Registration Identifier: 598662.

**Classification:** Phylum: *Ascomycota*, Class: *Eurotiomycetes*, Order: *Mycocaliciales*, Family: *Mycocaliciaceae*.

**Number of fossil species known:** One.

7.1. Species: ***Chaenothecopsis bitterfeldensis*** Rikkinen & Poinar 2000

**Index Fungorum Registration Identifier:** 464310.

**Figure:** In Rikkinen & Poinar 2000: 8, figures 1–22.

**Original Description:** In amber, algae not present in the substrate. Ascomata 0.3– 0.7 mm high, capitulum obconical, later narrowly lenticular, 0.08–0.2 mm wide. Exciple less than 10 µm thick, apparently formed by periclinally arranged hyphae. Stalks erect, 50–75 µm diam.; stalk surface smooth, mainly consisting of interwoven hyphae; stalk base with tufts of anchoring hyphae. Ascospores pale brown, narrowly ellipsoidal to cylindrical, 1–septate, (9–) 10.5–13.5 (–16) × (3–) 3.5–5.5 (–6) µm, smooth under the light microscope.

**Location:** Near Bad Schmiedeberg and Bitterfeld, Central Germany.

**Age:** Near Oligocene-Miocene boundary.

**Etymology:** The specific epithet is after Bitterfeld, the locality of occurrence of the amber specimen from which the fungus has been obtained.

8. Genus: ***Chaetosphaeria*** Tul. & C. Tul.

**Index Fungorum Registration Identifier:** 970.

**Type species:** *Chaetosphaeria innumera* Berk. & Broome ex Tul. & C. Tul., Index Fungorum Registration Identifier: 213365.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Chaetosphaeriales*, Family: *Chaetosphaeriaceae*.

**Number of fossil species known:** One.

8.1. Species: ***Chaetosphaeria elsikii*** M.J. Pound et al. 2018

**Index Fungorum Registration Identifier:** 821981.

**Figure:** In Pound et al. 2018: 603, plate 3, figures 6–9.

**Original Description:** Pentagonal-pyramidal monocellate fungal phialospore with five germinal openings on the proximal face and an attachment scar on the distal face. The dark brown cell wall thins at the germinal openings, producing a near-annulate appearance. Wall is psilate to faintly scabrate and slightly recurved between the openings, producing a near-lobate outline of the proximal face. The proximal face is slightly domed. When viewed proximally or distally, the cell has a star shaped outline, whereas when viewed laterally it has an oval to triangular outline. The cell is 20–24 µm in diameter across the proximal face; the distal pyramidal portion is nearly the same height. Cell walls are 1.5 µm thick at most. A flattened area surrounding the attachment scar has a diameter of 3–4 µm.

**Location:** Bees Nest Clay Pit, Brassington, Derbyshire, U.K.

**Age:** Miocene.

9. Genus: ***Chaetothyrina*** Theiss.

**Index Fungorum Registration Identifier:** 976.

**Synonym:** *Plochmopeltidella* J.M. Mend. in Stevens & Manter 1925, Index Fungorum Registration Identifier: 4256 fide Index Fungorum 2022.

**Type species:** *Chaetothyrina musarum* (Speg.) Theiss., Index Fungorum Registration Identifier: 239828.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Microthyriales*, Family: *Micropeltidaceae*.

**Number of fossil species known:** One.

9.1. Species: ***Chaetothyrina antiqua*** (Dilcher 1965) R.K. Saxena, **comb. nov.**

**Index Fungorum Registration Identifier:** 553355.

**Figure:** In Dilcher 1965: 28, plate 16, figures 129.

**Basionym:** ***Plochmopeltidella antiqua*** Dilcher, Palaeontographica, Abt. B 116: 28, plate 16, figures 129. 1965, lectotype selected by Kalgutkar & Jansonius 2000, Index Fungorum Registration Identifier: 337268.

**Original Description:** Fruiting body 50–75 µm in diameter, more or less round, not radiate, non-ostiolate, lacks well-defined margin, may be setose. Fruiting body composed of interwoven, irregularly lobed, inordinately arranged cells, 1–2.5 × 5–15 µm. Conspicuous free hyphae anastomose over surface of leaf. Free hyphae sinuous, setose; hyphal cells 1.5–3 × 12–25 µm. Setae 1.5–2.5 × 15–85 µm, multicellular (3–5 cells), usually of uniform width. Setae arise directly from free hyphae. Germinating spore 4.5 × 14 µm, 1–septate, fusiform, constricted, psilate, attached to free hyphae. Hyphae produced from ends of both cells of the spore. Found on lower surface of *Sapindus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype and therefore Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figured by Dilcher (1965). Clements and Shear (1931) put *Plochmopeltidella* in synonymy with *Chaetopeltopsis*. However, Batista (1959) revalidated the genus *Plochmopeltidella*, differentiating it from *Chaetopeltopsis* on the basis of the absence of an ostiole and the presence of setae. Thus this fossil form was assigned to the genus *Plochmopeltidella* as

described by Mendoza (Stevens & Manter 1925) and revalidated by Batista (1959). All the same, *Plochmopeltidella* is now in the synonym list of *Chaetothyrina*, *Plochmopeltidella antiqua* Dilcher is therefore transferred to *Chaetothyrina* Theiss.

10. Genus: ***Clasterosporium*** Schwein.

**Index Fungorum Registration Identifier:** 7685.

**Type species:** *Clasterosporium caricinum* Schwein., Index Fungorum Registration Identifier: 197664.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Magnaporthales*, Family: *Magnaporthaceae*.

**Number of fossil species known:** One.

10.1. Species: ***Clasterosporium eocenicum*** Fritel & R. Vig. 1909

**Index Fungorum Registration Identifier:** 198755.

**Figure:** In Fritel & Viguier 1909: 143, figure 1.

**Original Description:** While examining the structure of *Equisetum noviodunense*, we observed abundant evidence of a fungus growing in the cortical spaces of the rhizome. In the transverse section, a very slender mycelium tracks in all directions through the spaces, being particularly concentrated near the cell walls. The mycelium consists of long tubes of 2–3 µm diameter, that branch only occasionally. However, as the mycelial hyphae lining the lacunae run more or less obliquely, they cannot be traced beyond the thickness of the section. The mycelium has a very thin wall; here and there, transverse septa can be discerned, often only with some difficulty. The mycelium carries, at fairly close intervals, spores that are either sessile, or borne at the end of a short, narrow pedicel. These spores are ovoid, elongate, rounded at their distal tips, more or less tapering at their base; they are always pluricellate, the cells arranged in a linear fashion. There are usually some 5–6 cells, never fewer than 3, and occasionally as many as 11–12. A three-celled spore may be some 40 µm long, one having 11 cells may reach 90–95 µm: the cells are usually about 10 µm long. The spores are 10–12 µm in diameter, and their wall is uniformly thin, smooth, homogeneous. The color of the fossil spores cannot be deduced. Also, whether the fungus was parasitic or saprophytic cannot be determined.

**Location:** Brétigny et Muirancourt (Oise), France; as calcareous pseudomorphs in marls underlying lignites.

**Age:** Sparnacian (Early Eocene).

11. Genus: ***Cyathus*** Haller

**Index Fungorum Registration Identifier:** 19085.

**Type species:** *Cyathus striatus* (Huds.) Willd., Index Fungorum Registration Identifier: 211223.

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Agaricales*, Family: *Nidulariaceae*.

**Number of fossil species known:** One.

11.1. Species: ***Cyathus dominicanus*** Poinar 2014 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 807716.

**Figure:** In Poinar 2014: 326, figures 3–5.

**Original Description:** This specimen is described in the genus *Cyathus* because of the three-layered peridial wall and presence of a purse indicating a funicular cord. The peridioles of *Nidula* do not have a funicular cord and the peridium of *Crucibulum* is cup or crucible shaped, composed of a single layer and the peridioles are whitish (Brodie 1975; Miller and Miller 1988). In his key to the species of *Cyathus* (Brodie 1977), *C. dominicanus* comes closest to members of Group ll, the *palidus* group, containing *C. pallidus* Berk. & Curt and *C. julietae* Brodie, both of which occur in the West Indies. This group is characterized by non-plicate, light-colored peridia with fine, matted hairs not flaring out abruptly at the mouth. In their key to the Brazilian species of *Cyathus*, the peridial shape of *C. stercoreus* (Schw.) resembles that of *C. dominicanus*. However, their specimens of *C. stercoreus* ranged from 10–13 mm in length and the peridioles ranged from 1.5–2.0 mm in diameter, which

are much larger values than the corresponding features on the fossil (1.8 mm in length and 265 µm × 180 µm for the peridioles) (Baseia & Milanez 2001). A short basal stipe similar to that on *C. dominicanus* occurs on other members of the genus *Cyathus*, such as *C. triplex* Lloyd, *C. gracilis* Brodie and *C. montagnei* Tul. & C. Tul. (Brodie 1975, Trierveiler-Pereira & Baseia 2013). Only *C. microsporus* Tul. has previously been reported from *Hispaniola* (Brodie & Dennis 1954). This species, which can also have a fawn peridium, is 4–7 mm in length and about 6 mm wide at the mouth, which separates it from *C. dominicanus.* The length of the peridium (under 2 mm), narrow apical opening separates *C. dominicanus* from all extant members of the genus (whose peridia range from 4 mm to 18 mm in length) (Brodie 1975, 1977, 1984; Trierveiler-Pereira & Baseia 2013).

**Location:** Amber from mines in the Cordillera Septentrional, Dominican Republic.

**Age:** Late Eocene to Early Miocene.

**Etymology:** The specific epithet is based on country of origin (Dominican Republic).

**Remarks:** *Cyathus dominicanus* was not validly published by Poinar (2014) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) cited above the Index Fungorum Registration Identifier of the name of this taxon. According to Poinar (2014), the peridium is narrowly obconic, funnel-shaped, not flaring out at mouth, with three-layered non-plicate walls and short slender stipe 320 µm in length; outer peridial wall with outward pointing hairs; length, 1.8 mm, width at mouth, 650 µm; setae absent. The peridiole is brown, oval, surface diameter, 265 µm × 180 µm; thickness, 140 µm; attached to peridial wall by purse, thus implying presence of a funicular cord; basidiospores not visible; remains of at least 5 other torn purses present in basal area of peridium.

12. Genus: ***Desmidiospora*** Thaxt.

**Index Fungorum Registration Identifier:** 7964.

**Type species:** *Desmidiospora myrmecophila* Thaxt., Index Fungorum Registration Identifier: 140388.

**Classification:** *Ascomycota* incertae sedis.

**Number of fossil species known:** One.

**Remarks:** *Desmidiospora* Thaxt. 1891 comprises two species. The type species *D. myrmecophila* Thaxt. 1891 represents living fungi whereas *D. marginiconvoluta* Kalgutkar 1997 represents fossil fungi.

12.1. Species: ***Desmidiospora marginiconvoluta*** Kalgutkar 1997

**Index Fungorum Registration Identifier:** 437899.

**Figure:** In Kalgutkar 1997: 209, plate 2, figure 1.

**Original Description:** Monoporate, flattened, brown to dark brown spores; outline irregularly but distinctly convoluted with broad to narrow inwardly extending marginal invaginations. Spore wall smooth, entire, less than 1 µm thick. Pore more or less centrally located, possibly representing a point of attachment to the hypha; pore with an equatorially thickened annulus. Diameter 12–18 µm.

**Location:** Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada.

**Age:** Late Palaeocene-Early Eocene (Iceberg Bay Formation, Eureka Sound Group).

**Etymology:** The species epithet indicates convoluted spore margin.

**Remarks:** According to Kalgutkar (1997), spores of this species differ from *Desmidiospora willoughbyi* (Bradley 1967) D.L.E. Glass et al. 1986 in being devoid of secondary bilobate invaginations at the periphery.

13. Genus: ***Diplodia*** Fr.

**Index Fungorum Registration Identifier:** 8047.

**Type species:** *Diplodia mutila* (Fr.) Mont., Index Fungorum Registration Identifier: 201741.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Botryosphaeriales*, Family: *Botryosphaeoriaceae.*

**Number of fossil species known:** Two.

13.1. Species: ***Diplodia rodei*** Mahab. 1969
Figure 10

**Index Fungorum Registration Identifier:** 313187.

**Homotypic synonym:** *Diplodites rodei* (Mahab.) Kalgutkar et al. 1993. Index Fungorum Registration Identifier: 532806.

**Original Description:** Well preserved, two-celled, oval-oblong spores, 17.5–18 × 7.5 µm, smooth, thick-walled, purple, placed in a thick-walled pycnidium embedded in decaying tissues of monocotyledonous plants, preserved in a small Intertrappean chert of olivaceous brown color. The mycelium septate, conidium terminal and unbranched.

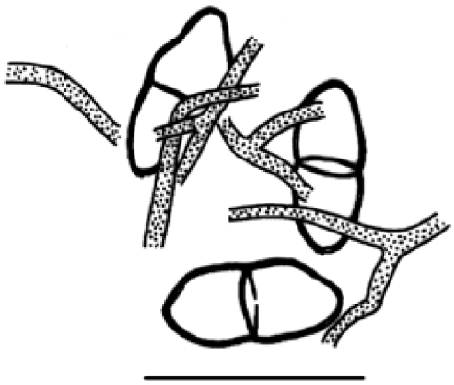

**Figure 10.** *Diplodia rodei* Mahab. 1969. Bar = 20 µm.

**Location:** Mohgaonkalan locality in Chhindwara District, Madhya Pradesh, India.

**Age:** Late Cretaceous (Maastrichtian).

**Etymology:** The species has been named after Professor K.P. Rode of the University of Udaipur, whose discovery of this classical Tertiary locality of India at Mohgaon Kalan (Madhya Pradesh, India) has added materially to our knowledge of the flora of the Deccan Intertrappean Series.

13.2. Species: ***Diplodia sahnii*** Singhai 1974
Figure 11

**Index Fungorum Registration Identifier:** 313191.

**Homotypic synonym:** *Diplodites sahnii* (Singhai) Kalgutkar et al. 1993, Index Fungorum Registration Identifier: 532805.

**Original Description:** Pycnidia spherical. Ostiolate and measuring 100–200 × 100–160 µm; conidia dark brown, 2–celled, ellipsoid or ovoid or oblong [sic], measuring 9–14 × 6–8 µm; conidiophores short and simple, measuring 4 × 2 µm.

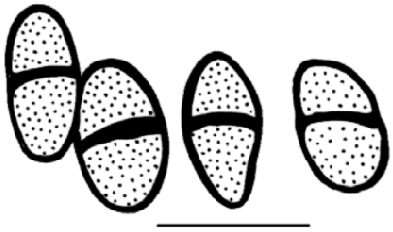

**Figure 11.** *Diplodia sahnii* Singhai 1974. Bar = 10 µm.

**Location:** Mohgaonkalan locality in Chhindwara District, Madhya Pradesh, India.

**Age:** Late Cretaceous (Maastrichtian).

**Etymology:** The specific epithet is after Professor Birbal Sahni F.R.S.

14. Genus: ***Diporotheca*** C.C. Gordon & C.G. Shaw

**Index Fungorum Registration Identifier:** 1635.

**Type species:** *Diporotheca rhizophila* C.C. Gordon & C.G. Shaw, Index Fungorum Registration Identifier: 330113.

**Classification:** Phylum: *Ascomycota*, Class: Incertae sedis, Order: Incertae sedis, Family: *Diporothecaceae*.

**Number of fossil species known:** Two.

14.1. Species: ***Diporotheca doniana*** O'Keefe 2017

**Index Fungorum Registration Identifier:** 821917.

**Figure:** In O'Keefe 2017: 323, plate 3, figures 36–37.

**Original Description:** Spores brown, ovoid to broadly navicular and tapered at the apices. The folded, raised perispore is a distinctive feature of this taxon,

and appears to be a regular network of ridges. In this species, the ridged perispore presents an almost kite-like outline with ridges projecting inwards to form a central diamond near the equator of the grain. Under light microscopy, the underlying spore has slightly curved septae just below the apical pores. Specimens ~38 µm wide × ~51–56 µm high.

**Location:** Tumbes Province, Peru.

**Age:** Miocene (Heath Formation).

**Etymology:** The specific epithet is a feminization of 'Don' in honour of Donald W. Engelhardt, Earth Sciences Resources Institute, University of South Carolina, Columbia, South Carolina, U.S.A.

14.2. Species: ***Diporotheca gorda*** O'Keefe 2017

**Index Fungorum Registration Identifier:** 821918.

**Figure:** In O'Keefe 2017: 323, plate 3, figures 35.

**Original Description:** Spores brown, ovoid to very broadly navicular and tapered at the apices. The folded, raised perispore is a distinctive feature of this taxon, and appears to be a regular network of ridges. In this species, the ridged perispore presents an almost rectilinear pattern of ridges such that six 'windows' encircle the spore around the equator and six triangular 'windows' taper to the pores. Under light microscopy, the underlying spore has slightly curved septae just below the apical pores. Most specimens of this spore were preserved as fragments; when fragmentary or when the crack visible in the lower portion of the type specimen is wider, the bi-septate inner spore appears to be lost, leaving only periderm behind. Specimens ~35 µm wide × ~56 µm high.

**Location:** Quebrada Bocapán, Tumbes Province, Peru.

**Age:** Miocene (Heath Formation).

**Etymology:** The specific epithet is Spanish for 'fat woman', given the very boxy, fat shape of the grain relative to other spores of *Diporotheca.*

15. Genus: ***Entophlyctis*** A. Fisch. in Winter

**Index Fungorum Registration Identifier:** 20222.

**Type species:** *Entophlyctis cienkowskiana* (Zopf) A. Fisch. (Basionym: *Rhizidium cienkowskianum* Zopf 1885, Index Fungorum Registration Identifier: 199977). Lectotype designated by Clements & Shear 1931. Index Fungorum Registration Identifier: 598208.

**Classification:** Phylum: *Chytridiomycota,* Class: *Chytridiomycetes*, Order: *Chytridiales*, Family: *Chytriomycetaceae.*

**Number of fossil species known:** One.

15.1. Species: ***Entophlyctis willoughbyi*** W.H. Bradley 1967
Figure 12

**Index Fungorum Registration Identifier:** 330609.

**Original Description:** Sporangia thick-walled and flattened in the plane of the substratum, circular, 8–22 µm diameter, to irregularly elliptical, up to as much as 22 µm long. Sporangia more or less deeply lobed, the lobes being separated by distinctive narrow invaginations, many of which have a characteristic circular enlargement at the proximal ends. In larger sporangia these invaginations commonly occur in radial sets of two or three lengths, each shorter invagination being between two next longer invaginations. Sporangia smooth or papillate, some having the persistent thickened zoospore cyst, 2.5–3.5 µm diameter, and germ tube. Many have a clearly defined, circular exit pore, 2–2.5 µm diameter. Zoospores and rhizoidal axes unknown.

**Figure 12.** *Entophlyctis willoughbyi* W.H. Bradley 1967, Bar = 8 µm.

**Location** Wyoming, Colorado, U.S.A. (Bradley 1967); East and south-central Texas, U.S.A. (D.L.E. Glass et al. 1986).

**Age:** Eocene (Bradley 1967), Late Eocene (Manning Formation, Jackson group) (Glass et al. 1986).

**Remarks:** According to Bradley (1967), the individual sporangia of *Entophlyctis willoughbyi* are roughly half the size of the living *E. lobata*. *Entophlyctis willoughbyi* differs from *E. lobata* mostly in having generally deeper and more regularly spaced marginal invaginations in the dehisced sporangia.

16. Genus: ***Epicoccum*** Link

**Index Fungorum Registration Identifier:** 8188.

**Type species:** *Epicoccum nigrum* Link, Index Fungorum Registration Identifier: 226758.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Pleosporales*, Family: *Didymellaceae*,

**Number of fossil species known:** One.

16.1. Species: ***Epicoccum deccanense*** R. Srivast. et al. 2009
Figure 13

**Index Fungorum Registration Identifier:** 561524.

**Original Description:** Fungal spores/conidia are profusely found endogenously in the vessels of the fossil wood. Very fine mycelium is also seen at places but it is broken, ill preserved and difficult to reveal structural details. Hyphae septate, frequently branched, fine, 3–5 µm in diameter. In ground section they often appear flat and ribbon-like, but twists in the hyphae at places create the superficial appearance of change in diameter. Hyphal branches are sometimes narrower than the parent filament. Short conidiophores originate from hyphae in the form of clusters, conidiophores give rise to conidia. Conidia (spores) are dark coloured, circular, found as single grained or mostly in clusters, small, 10–30 µm in diameter, young conidia are round, smooth and without septation while mature conidia are multicellular (dictyoconidia), and have a funnel-shaped base and attachment scar that is formed from aggregated conidiophores on sporodochium. Conidial walls rough, verrucose to warty with dark pigmentation. Thinning and degradation of cell walls of fibres and ray cells seen at places.

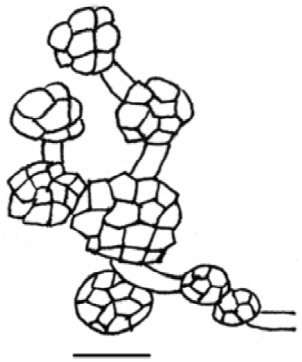

**Figure 13.** *Epicoccum deccanense* R. Srivast. et al. 2009. Bar = 10 µm.

**Location:** Jhargad, near Jhadgaon village, Yavatmal District, Maharashtra, India.

**Age:** Late Maastrichtian-Danian (Deccan Intertrappean Beds).

17. Genus: ***Fomes* (Fr.) Fr.**

**Index Fungorum Registration Identifier:** 17608.

**Type species:** *Polyporus fomentarius* L. ex Fr., Index Fungorum Registration Identifier: 167443.

**Synonym:** *Polyporus* subgen. *Fomes* Fr.

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Polyporales*, Family: *Polyporaceae*.

**Number of fossil species known:** One.

17.1. Species: ***Fomes idahoensis*** R.W. Br. 1940

**Index Fungorum Registration Identifier:** 314176.

**Figure:** In Brown 1940: 422, figures 1–4.

**Original Description:** This specimen is the sporophore or spore-bearing portion of a bracket fungus. It is 13.5 cm long and 4.5 cm thick. The upper surface is, or was, fairly smooth and displays a series of convex-rounded "rings" of growth. The under surface

is flat and porous, the pores numbering about 750 per sq. cm. These are shown in figure 2, magnified four times. Figure 3 is a cross section through the right hand end of figure 4 and illustrates the vesicular corky context separated from the pore area by an irregular dark zone. Microscopic examination reveals no spores or other significant cellular structures.

**Location:** On highway from Bruneau, Idaho to Owyhee, Nevada, U.S.A.

**Age:** Early Pliocene.

**Remarks:** According to Brown (1940), the specimen resembles the living bracket fungus, *Fomes pinicola* (Swartz) Cooke, so closely that no doubt exists as to its affinities. The only difference appears to be in the size of the pores, which are slightly larger in the fossil, thus aggregating only about 750 per sq. cm as compared with about 1,000 in *F. pinicola*.

18. Genus: ***Geastrum*** Pers.

**Index Fungorum Registration Identifier:** 19141.

**Type species:** *Geastrum pectinatum* Pers., Index Fungorum Registration Identifier: 153421

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Geastrales*, Family: *Geastraceae*.

**Number of fossil species known:** One.

18.1. Species: ***Geastrum tepexense*** Magallon-Puebla & Cevallos-Ferriz 1993

**Index Fungorum Registration Identifier:** 659428.

**Figure:** In Magallon-Puebla & Cevallos-Ferriz 1993: 1163, figures 2–6.

**Original Description:** Basidiocarp with open, stellate exoperidium, 2.5 cm in maximum diameter, radially divided into ten rays, each triangular to rectangular in outline, and with the apex curled and folded beneath more proximal parts; some rays with a faint superficial reticulate pattern; endoperidium of circular outline, 1.3 cm in diameter, irrregular surface relief and with a small, eccentric ostiole surrounded by a conical protuberance; associated spores globose, verrucate, from 3.5 to 7.0 µm in diameter.

**Location:** Puebla, Mexico.

**Age:** Cenozoic (Miocene to earliest Pleistocene).

**Remarks:** According to Magallon-Puebla and Cevallos-Ferriz (1993), features of the fossil fungus indicate that it had reached an advanced stage of maturity, as the exoperidium had split into star-like rays and recurved to expose the endoperidium at its center.

19. Genus: ***Hendersonula*** Speg.

**Index Fungorum Registration Identifier:** 8511.

**Type species:** *Hendersonula australis* Speg., Index Fungorum Registration Identifier: 233580.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Botryosphaeriales*, Family: Incertae sedis.

**Number of fossil species known:** One.

19.1. Species: ***Hendersonula mohgaoensis*** R.B. Singh & Patil 1980

Figure 14

**Index Fungorum Registration Identifier:** 108907.

**Original Description:** Pycnidia in chains, embedded in stroma in host tissue, oval or irregular, each 126–145 × 85–140 µm in size, thin-walled; conidiogenous cells 4 µm long; conidia oval, 4 × 1.5 µm, bicelled, thin-walled. Host: dicotyledonous wood.

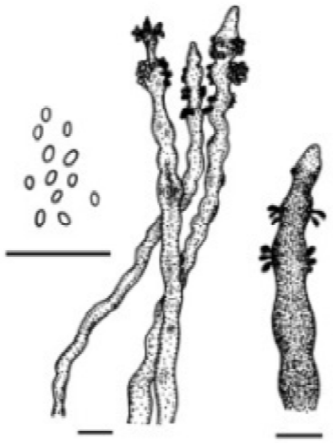

**Figure 14.** *Hendersonula mohgaoensis* R.B. Singh & Patil 1980. A. Arrangement of pycnidia. Bar = 800 µm, B. Host tissue with mycelium. Bar = 50 µm, C. Part of pycnidium wall with dicellate spores and stroma. Bar = 50 µm.

**Location:** Mohgaonkalan, Chhindwara District, Madhya Pradesh, India.

**Age:** Cretaceous (Intertrappean beds).

**Remarks:** According to Singh and Patil (1980), the [silicified] infected wood shows branched septate intercellular hyphae, at places, which form chlamydospores in chains of 2–3. Chlamydospores occur more in number in the region above the secondary xylem where host tissue is disintegrated.

20. Genus: ***Hydnum*** L.

**Index Fungorum Registration Identifier:** 17797.

**Type species:** *Hydnum repandum* L., Index Fungorum Registration Identifier: 225014.

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Cantharellales*, Family: *Hydnaceae*.

**Number of fossil species known:** One.

20.1. Species: ***Hydnum argillae*** R. Ludw. 1859

**Index Fungorum Registration Identifier:** 249648.

**Figure:** In Ludwig 1859: 57, plate 8, figures 1, 1a-1b, 1d-1e.

**Original Description:** Mushroom with a broad, irregularly oval, upwards slightly concave cap, the spore bearing skin spread over narrow spines that taper downward. The stem is in the centre of the cap.

**Location:** Münzenberg Shale, Rheinisch-Wetterauer brown coal; Rhine valley, Germany.

**Age:** Tertiary, Oligocene.

**Remarks:** According to Ludwig (1859), the spinules of the hymenium show as numerous tubules, arranged in concentric circles, as the space between them had become filled up with clay, and the space they occupied remained open after the organic matter decayed.

21. Genus: ***Manginula*** G. Arnaud

**Index Fungorum Registration Identifier:** 8841.

**Type species:** *Manginula perseae* G. Arnaud, Index Fungorum Registration Identifier: 179676.

**Classification:** *Ascomycota* incertae sedis.

**Number of fossil species known:** Two.

21.1. Species: ***Manginula maegdefraui*** Lange 1969

**Index Fungorum Registration Identifier:** 317133.

**Figure:** In Lange 1969: 568, figures 10–15.

**Homotypic synonym:** *Entopeltacites maegdefraui* (Lange) Selkirk 1972. Index Fungorum Registration Identifier: 313891.

**Original Description:** Hyphae with short brown cells and long colorless cells in loose alternation, often short-long-long or short-long alternation, sometimes mixed; color differentiation often lacking, size alternation rarely completely absent; short cells 2–3 × 4.5–7 µm, long cells 2–3 × 10–20 µm, cells <2 × 20 µm are found, and on leaf venation cells may be broader than long; hyphae branching by dichotomy and pseudodichotomy, appearing irregular because hyphae tend to change direction in the length of one cell; 4–way anastomoses common. Successive septa subparallel and may differ in length. Hyphopodia not obvious, but an appressorial pit shows in some cells. Fruit bodies rare, developing from a layer of light-brown pseudoparenchyma and culminating in a circular dimidiate dome 50–60 µm across, with central ostiole and reticulate appearance.

**Location:** South Maslin Sands, South Australia.

**Age:** Eocene.

**Etymology:** This species is named after Professor K. Mägdefrau of Tübingen.

21.2. Species: ***Manginula osbornii*** Lange 1969

**Index Fungorum Registration Identifier:** 317135

**Figure:** In Lange 1969: 568, figures 1-9.

**Homotypic synonym:** *Entopeltacites osbornii* (Lange) Selkirk 1972. Index Fungorum Registration Identifier: 313892.

**Original Description:** Hyphae with disintegrated lateral walls and detectable mostly by persistent septa, cells alternating long and short, the feature expressed with variable precision, no color differentiation, hyphae 2.5–5 µm broad, typically 3.5–4 µm, long cells typically 2–3 × length of short cells and commonly 18–25 µm; branching by dichotomy and pseudodichotomy commonly at an angle of 50–60 degrees, at intervals up to 30 cells; 4–way anastomoses common. Septa are all perforate. Hyphopodia are not obvious but short cells often have dark circular appressorial pit. Fruit bodies of two kinds; one develops to a single brown layer of angular pseudoparenchyma, then matures to circular convex dimidiate ostiolate body 60–150 µm across, semi-reticulate, with basal rim of translucent angular pseudoparenchyma; the other is similar but cells lack individuality, tissue appears amorphous, more translucent, whole structure is rent open usually by large transverse or triangular tear.

**Location:** South Maslin Sands, South Australia.

**Age:** Eocene.

**Etymology:** This species is named after Emeritus Professor T.G.B. Osborn, first Professor of Botany at Adelaide University, Australia.

22. Genus: ***Melanospora*** Corda

**Index Fungorum Registration Identifier:** 3085.

**Type species:** *Melanospora zamiae* Corda, Index Fungorum Registration Identifier: 211586.

**Synonym:** *Gonatobotrys* Corda 1839, Index Fungorum Registration Identifier: 8374.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Melanosporales*, Family: *Ceratostomataceae.*

**Number of fossil species known:** One.

22.1. Species: ***Melanospora primigenia*** (Casp.) R.K. Saxena et al. 2021
Figure 15

**Index Fungorum Registration Identifier:** 556982.

**Basionym:** *Gonatobotrys primigenius* Casp. (as "*primigenia*"), in Klebs, Abh.. preuss. geol. Landesanst. 4(1): 11, taf. 1, figure 6. 1907, Index Fungorum Registration Identifier: 626875.

**Homotypic synonym:** *Gonatobotrytites primigenius* (Casp.) Pia 1927; Index Fungorum Registration Identifier: 115070.

**Original Description:** On the corolla of an unidentified flower occurs a very unusual fungus. It consists of hyphae that are about 74–199 µm long and 4.2–7 µm thick. They stand either perpendicularly or at an angle to their substrate, within which their supporting mycelium must be situated. The individual threads, especially the young ones, are cylindrical, and so transparent that it can be seen that they are not septate. Most threads are brown, and have swellings, that give them the appearance of a rosary, and that in their basal parts make them lean this way or that. The two to three distalmost swellings are on all sides surrounded by numerous thin-walled elliptical spores, that occasionally appear to have a very thin stem and most likely grew from the swellings. The hyphal threads terminate, distally of these spore-bearing swellings, with a transparent, almost colorless, egg-shaped structure that is distally drawn out into a long point; the very tip of this, in turn, may again carry some rows of radially arranged elliptical spores. These spores are about 1.9 µm long and half that in width, but the youngest ones are much smaller. Even the oldest opaque dark-brown hyphal threads do not show any septa.

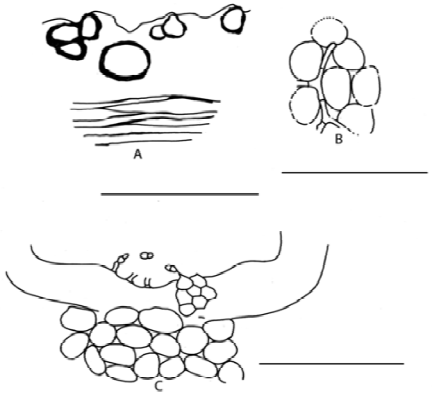


**Figure 15.** *Melanospora primigenia* (Casp.) R.K. Saxena et al. 2021. Bar = 5 µm.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

23. Genus: ***Meliola*** Fr.

**Index Fungorum Registration Identifier:** 3100.

**Type species:** *Meliola nidulans* (Schwein.) Cooke, Index Fungorum Registration Identifier: 230480.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Meliolales*, Family: *Meliolaceae.*

**Number of fossil species known:** Two.

23.1. Species: ***Meliola dilcheri*** R.K. Saxena, **nom. nov.**

Figure 16

**Index Fungorum Registration Identifier:** 553796.

**Replaced synonym:** *Meliola anfracta* Dilcher, Palaeontographica Abt. B 116: 7, plate 2, figures 2, 8. 1965. lectotype selected by Kalgutkar and Jansonius (2000). Index Fungorum Registration Identifier: 484071, non *Meliola anfracta* Cif., Annales Mycologici 36(2/3): 204. 1938.

**Homotypic synonym:** *Meliolinites anfractus* (Dilcher) Kalgutkar & Janson. 2000. Index Fungorum Registration Identifier: 483419

**Original Description:** Colonies 1–3 mm in diameter, subdense to dense. Hyphal cells 4–9 × 14–37 µm. Lateral walls of hyphae sinuous; often the hyphae appear undulating. Capitate hyphopodia 10–15 × 14–28 µm, generally alternate, occasionally unilateral, rarely opposite, may spread straight out from the hyphae but usually stalk cells noticeably bent disposing the hyphopodia distally. Stalk cells 5–11 × 4–11 µm, generally cylindrical with straight or undulating lateral walls, rarely cuneate. Head cells 10–15 × 10–17 µm, rarely entire or angular, most often lobate. Mycelial setae 3–6 µm wide and 300 µm long, absent to moderately abundant, scattered, arise directly from hyphal cells and arch upward, straight to slightly curved, apex not seen. Spores 20 × 50 µm, slightly bent, psilate, 3–septate (4 celled), may produce hyphae from any or all of the 4 cells, 2 central cells largest, 2 smaller end cells have rounded ends. No mucronate hyphopodia or perithecia found. Found only on upper epidermis of *Sapindus* sp.

**Figure 16.** *Meliolinites dilcheri* R.K. Saxena nom. nov. Bar = 10 µm.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Etymology:** The new specific epithet honours Professor David L. Dilcher, Department of Botany, Indiana University, Bloomington, Indiana, U.S.A.

**Remarks:** *Meliola anfracta* Dilcher (1965) is illegitimate (Art. 53.1, Turland et al. 2018) being a later homonym of *Meliola anfracta* Cif. 1938, hence a new replacement name is proposed here.

23.2. Species: ***Meliola spinksii*** Dilcher 1965

Figure 17

**Index Fungorum Registration Identifier:** 334060.

**Homotypic synonym:** *Meliolinites spinksii* (Dilcher) Selkirk 1975, Index Fungorum Registration Identifier: 317538.

**Original Description:** Only young colonies found; mature colonies probably thin. Hyphae straight, branch oppositely to alternately at right angles. Hyphal cells 5–9 × 14–50 µm, produce capitate hyphopodia laterally at distal ends of the cells. Capitate hyphopodia 5–10 × 10–18 µm, opposite or occasionally unilateral, generally antrorse. Stalk cells 4–9 × 2–5 µm, somewhat cuneate to cylindrical. Head cells 5–10 × 8–13 µm, entire, oblong to ovoid. Mucronate hyphopodia 5–7 × 11–18 µm, taper gradually, opposite. Spores 12–15 × 37–43

µm, 4–septate (5–celled), psilate, linearly arranged, middle cell often largest, end cells rounded, hyphae originate from any or all of the 5 cells. Found only on the lower epidermis of *Chrysobalanus* sp.

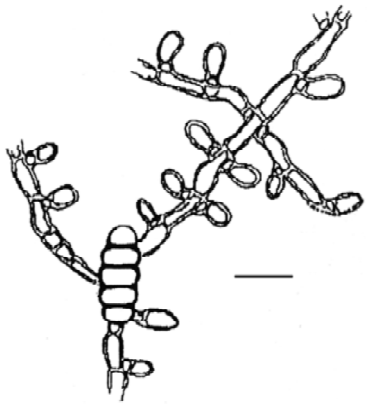

**Figure 17.** *Meliolinites spinksii* Dilcher 1965. Bar = 10 µm.

**Location:** Western Tennessee, U.S.A. (Dilcher 1965); Kiandra, New South Wales, Australia (Selkirk 1975).

**Age:** Early Eocene (Dilcher 1965), Early Miocene (Selkirk 1975).

**Remarks:** Dilcher (1965) did not designate a holotype and therefore Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), no parasitic forms of fungi were found to be intimately associated with *Meliola spinksii*. No mycelial setae were observed on any of the young colonies of *M. spinksii*; however mycelial setae in several modern species are often localized around perithecia, and no perithecia were yet developed by the young colonies of *M. spinksii*.

24. Genus: ***Microthyriella*** Höhn.

**Index Fungorum Registration Identifier:** 3202.

**Type species:** *Microthyriella rickii* (Rehm) Höhn., Index Fungorum Registration Identifier: 185119.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: Incertae sedis, Family: *Schizothyriaceae*.

**Number of fossil species known:** Two.

24.1. Species: ***Microthyriella diporata*** K.P. Rao & Ramanujam 1976

Figure 18

**Index Fungorum Registration Identifier:** 317745.

**Original Description:** Free mycelium lacking. Ascomata flattened, irregular in shape, highly variable in size, ranging between 50–150 µm; cells of the ascomata 5–10 µm in diameter, pentagonal to hexagonal, irregularly arranged and porate, pores mostly two per cell, 2.5–3.5 µm wide, circular and randomly disposed.

**Figure 18.** *Microthyriella diporata* K.P. Rao & Ramanujam 1976. Bar = 30 µm.

**Location:** Lignite from Warkalli, India.

**Age:** Late Miocene.

**Remarks:** According to Rao and Ramanujam 1976, fruit bodies of this type are fairly common and exhibit a wide variation in their shape and size. Since no other dehiscence mechanism was observed in any of the fruit bodies examined, the pores in the cells can be supposed to function as secondary ostioles helping in the release of spores (Dilcher, 1965). *Microthyriella fungosa* Dilcher, 1965 from the Eocene of Tennessee, U.S.A. is distinguishable in the possession of only one pore per cell.

24.2. Species: ***Microthyriella fungosa*** Dilcher 1965

**Index Fungorum Registration Identifier:** 334312.

**Figure:** In Dilcher 1965: 27, plate 15, figure 118.

**Original Description:** Stroma 35–200 µm in diameter, more or less round with irregular margins superficial, consists of irregularly arranged prosenchymatous cells 5–12 µm in diameter. No primary ostioles present; numerous pores observed in all stromata. Pores circular to oval, 2.5–5 µm in diameter, present in many of the individual stroma cells, most often occur near margins of the cells. No free hyphae associated with the stromata. No spores found. Found on the upper epidermis of *Sapindus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype and therefore Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), *Microthyriella fungosa* fits the generic description of *Microthyriella* well; it lacks an ostiole, has no free hyphae, and consists of irregularly arranged pseudoparenchymatous cells.

25. Genus: ***Mundkurella*** Thirum.

**Index Fungorum Registration Identifier**: 16223

**Type species:** *Mundkurella heptapleuri* Thirum., Index Fungorum Registration Identifier: 288459.

**Classification:** Phylum: *Basidiomycota*, Class: *Ustilaginomycetes*, Order: *Urocystidales*, Family: *Urocystidaceae.*

**Number of fossil species known:** One.

25.1. Species: ***Mundkurella mohgaoensis*** Chitaley & Yawale 1978

Figure 19

**Index Fungorum Registration Identifier**: 110825.

**Original Description:** Sori heterosporous, 17 × 44 µm in diameter, containing unicellular and bicellular spores, singly or in groups. Unicellular spores deep brown to pale yellow in color, 8 × 13 µm in diameter. Bicelled spores deep brown with rich granular contents, 11 × 16 µm. Epispore 1 × 2.5 µm thick and smooth.

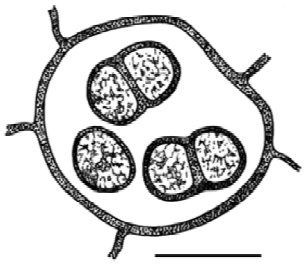

**Figure 19.** *Mundkurella mohgaoensis* Chitaley & Yawale 1978. Bar = 25 µm.

**Location:** Mohgaonkalan, Madhya Pradesh, India.

**Age:** Late Cretaceous-Maastrichtian.

**Remarks:** According to Chitaley & Yawale (1978), the present species shows resemblance to the modern species *Mundkurella heptapleuri* (Thirumalachar 1944) in that: 1. Sori heterosporous in fruits, with completely or partially destroying the endosperm and embryo; 2. Testa remnant intact; 3. Spores held together by pericarp. Nevertheless, it does differ in having smaller spores and unicellular spores being spherical. Also, the epispore is very thick and smooth unlike in *M. heptapleuri*.

26. Genus: ***Muyocopron*** Speg.

**Index Fungorum Registration Identifier:** 3294.

**Type species:** *Muyocopron corrientinum* Speg., Index Fungorum Registration Identifier: 173387.

**Synonym**: *Haplopeltis* Theiss., Index Fungorum Registration Identifier: 2234.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Muyocopronales*, Family: *Muyocopronaceae*.

**Number of fossil species known:** Two.

26.1. Species: ***Muyocopron mucoris*** (Dilcher) Samarak & K.D. Hyde 2019

Figure 20

**Index Fungorum Registration Identifier:** 555736.

**Basionym:** *Haplopeltis mucoris* Dilcher, Palaeontographica, Abt. B 116: 26, plate 15, figure 117. 1965. Index Fungorum Registration Identifier: 331694.

**Original Description:** Fruiting body more or less round, 50–100 µm in diameter, not radiate, conspicuously raised above the surface of the host leaf, ostiolate. Ostioles 7–15 µm in diameter, prominent, central, round, surrounded by a ring of small (3–5 µm in diameter) cells. Fruiting body pseudoparenchymatous, cells 2–8 µm in diameter, margins not radiate, entire. No free hyphae present. No spores known. Found on the upper surface of (leaves of) *Chrysobalanus* sp.

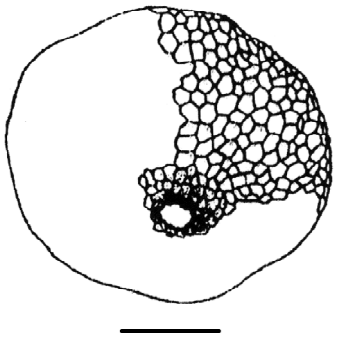

**Figure 20.** *Muyocopron mucoris* (Dilcher) Samarak & K.D. Hyde 2019. Bar = 25 µm.

**Location:** Western Tennessee, U.S.A.

**Age:** Lower Eocene.

26.2. Species: ***Muyocopron neyveliensis*** (Reddy et al.) Samarak & K.D. Hyde 2019

Figure 21

**Index Fungorum Registration Identifier:** 555737.

**Basionym:** *Haplopeltis neyveliensis* Reddy et al., Records of the Geological Survey of India 114(5): 118, plate 2, figure 9. 1982, Index Fungorum Registration Identifier: 519809.

**Original Description:** Ascomata rounded, epiphyllous, brownish, prominently raised above the general surface of leaf, free mycelium lacking, 75–145 µm in diameter, conspicuously ostiolate, ostiole rounded, elevated, 8–15 µm in diameter, centric or slightly eccentric, bordered by 2–4 layers of small, angular, dark brown, thick-walled cells, ostiole border 5–8 µm thick; fruit body pseudoparenchymatous, cells non-radiating, angular, locally of irregular shape, 4.5–12 µm in diameter, thin-walled, margin firm, entire, composed of flattened cells.

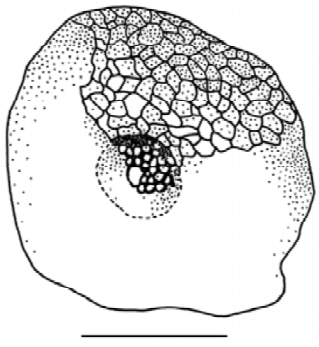

**Figure 21.** *Muyocopron neyveliense* (Reddy et al.) Samarak & K.D. Hyde 2019. Bar = 50 µm.

**Location:** Neyveli, South Arcot District, Tamil Nadu, India.

**Age:** Miocene.

27. Genus: ***Nidula*** V.S. White

**Index Fungorum Registration Identifier:** 19235.

**Type species:** *Nidula candida* (Peck) V.S. White, Index Fungorum Registration Identifier: 207133

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Agaricales*, Family: *Nidulariaceae*.

**Number of fossil species known:** One.

27.1. Species: ***Nidula baltica*** Poinar 2014 ex R.K. Saxena & P.M. Kirk 2022

**Index Fungorum Registration Identifier:** 807714.

**Figure:** In Poinar 2014: 326, figures 1–2.

**Original Description:** This specimen is placed in the genus *Nidula* V.S. White because of its uniform, two-layered peridial wall, the absence of a funicular cord attaching the peridioles to the peridial wall and a gelatinous deposit surrounding the peridiole. Except for the apical rim surrounded by exposed scales, the shape of the fossil is similar to that of the Chilean species, *N. macrocarpa*. However the latter species is much larger than *N. baltica*, has a homogenous peridial wall and lacks the apical rim of exposed scales (Brodie 1975;

Diehl 2000). The small size and apical rim of scales distinguishes *N. baltica* from other members of the genus (Brodie 1975, 1977).

**Type locality:** Amber from the Kaliningrad region of northern Europe.

**Age:** Late Eocene to Early Miocene.

**Etymology:** The specific epithet is based on area of origin (Baltic region).

**Remarks:** *Nidula baltica* was not validly published by Poinar (2014) because it was not registered with any recognized nomenclatural repository, which is a mandatory requirement for valid publication of a fungal taxon (Article F.5.1, Turland et al. 2018). In order to validate this name, Saxena and Kirk (2022) cited the Index Fungorum Registration Identifier of the name of this taxon.

28. Genus: ***Patouillardiella*** Speg.

**Index Fungorum Registration Identifier:** 9237.

**Type species:** *Patouillardiella guaranitica* (Speg.) Speg., Index Fungorum Registration Identifier: 186768.

**Synonym:** *Auerswaldiopsis* Henn. 1904. Index Fungorum Registration Identifier: 7294.

**Classification:** *Ascomycota* incertae sedis.

**Number of fossil species known:** One.

28.1. Species: ***Patouillardiella imbricata*** Dilcher 1965

**Index Fungorum Registration Identifier:** 335662.

**Figure:** In Dilcher 1965: 34, plate 22, figure 172.

**Original Description:** Fruiting body 50–90 µm in diameter, more or less hemispherical, superficial, composed of compact mass of conidiospores. Conidiospores radiate out from center of conidial mass. Conidiospores closely packed, imbricate, 3.5– 4.5 × 13–19 µm, 1–septate (2–celled), fusoid. Hyphae and conidiophores poorly developed, inconspicuous or possibly obsolete. Found on the upper epidermis of *Chrysobalanus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000), therefore, selected a lectotype from the syntypes figured in Dilcher (1965). According to Dilcher (1965), this species is characterized by a fruiting body which is composed of compact mass of conidiospores that radiate out from the centre of the conidial mass.

29. Genus: ***Penicillium*** Link

**Index Fungorum Registration Identifier:** 9257.

**Type species:** *Penicillium crustaceum* Link ex Fries, Index Fungorum Registration Identifier: 497352.

**Classification:** Phylum: *Ascomycota*, Class: *Eurotiomycetes*, Order: *Eurotiales*, Family: *Aspergillaceae*.

**Number of fossil species known:** One.

29.1. Species: ***Penicillium curtipes*** Berk. 1848

**Index Fungorum Registration Identifier:** 156419.

**Figure:** In Berkeley 1848: 381, plate 11, figure 1.

**Original Description:** Hyphasma shining white, sparing, loosely branched and mostly at right angles, giving off extremely short flocci, consisting of from three to four articulations which are slightly constricted at the dissepiments, and divided above into two or three threads which are again loosely branched; lower articulations oblong-elliptic, larger, the upper ones gradually smaller, but always elliptic and quite smooth. (Meschinelli 1892, p. 789). Mycelium shining white, sparing; growing subhorizontally, loosely branched, hyphae divided and consisting of 4 articulations or joints. Conidia elliptical, 2.5–2 µm [sic].

**Location:** East Prussia (Berkeley 1848), Europe (Meschinelli 1892).

**Age:** Eocene (Berkeley 1848), Oligocene (Meschinelli 1892).

30. Genus: ***Peziza*** Dill. ex Fr.

**Index Fungorum Registration Identifier:** 3859.

**Type species:** *Peziza vesiculosa* Bull. ex Fries (lectotype), Index Fungorum Registration Identifier: 194560.

**Classification:** Phylum: *Ascomycota*, Class: *Pezizomycetes*, Order: *Pezizales*, Family: *Pezizaceae*.

**Number of fossil species known:** One.

30.1. Species: ***Peziza sylvatica*** R. Ludwig 1859

**Index Fungorum Registration Identifier:** 484057.

**Figure:** In Ludwig 1859: 57, plate 8, figures 12, 12a, 12b.

**Original Description:** Saucer-shaped, round, thick-walled fungi [apothecia], without a stalk, measuring 0.75–1 mm in diameter, arranged in close groups on a decaying substrate, but without touching each other.

**Location:** Salzhausen, Rheinisch-Wetterauer brown coal; Rhine valley, Germany.

**Age:** Tertiary, Oligocene.

31. Genus: ***Potamomyces*** K.D. Hyde

**Index Fungorum Registration Identifier:** 27626.

**Type species:** *Potamomyces armatisporus* K.D. Hyde. Index Fungorum Registration Identifier: 413894.

**Synonym:** *Mediaverrunites* Nandi & A. Sinha 2007 fide Nuñez Otaño et al. 2017, Index Fungorum Registration Identifier: 548478.

**Classification:** *Ascomycota* incertae sedis.

**Number of fossil species known:** Seven.

31.1. Species: ***Potamomyces batii*** (Sancay) ex Nuñez Otaño et al. 2017

Figure 22

**Index Fungorum Registration Identifier:** 814793.

**Basionym.** *Mediaverrunites batii* Sancay, Palynology 38: 35, plate 1, figures 1–9. 2014.

**Original Description:** Spores monocellate, monoporate, pore situated at one end of the spore, dark brown in color, wall thin, smooth and two layered, layers seen as separate, overall outline is oval to oval-elongate, gradually narrowing at both ends, equatorial knobs or verrucae are low, three or four in number, 7.3–10.1 µm wide and 0.7–1 µm high, overall size based on seven specimens is 32.2–41.3 × 53.1–64.4 µm, equatorial shadow-like rim is distinct.

**Figure 22.** *Potamomyces batii* (Sancay) ex Nuñez Otaño et al. 2017. Scale Bar = 20 µm.

**Location:** Black Sea, Turkey.

**Age:** Late Miocene.

**Etymology:** The specific epithet honours Dr Z. Batý.

**Remarks:** According to Sancay (2014), *Potamomyces batii* is distinguished from most other species of this genus in having a reduced number (three or four) of knobs/verrucae.

31.2. Species: ***Potamomyces elsikii*** (Nandi & A. Sinha) Nuñez Otaño et al. 2017

Figure 23

**Index Fungorum Registration Identifier:** 814695.

**Basionym.** *Mediaverrunites elsikii* Nandi & A. Sinha, Palynology 31: 99, plate 1, figures 7, 10–20, text-figure 2B. 2007.

**Original Description:** Spores monocellate, elliptical, apices narrowly to broadly rounded, monoaperturate, size range 25–45 × 40–55 µm; dark brown in color, pore at one end of the spore, thin (Plate 1, figures 14,15) or with slightly thickened wall (Plate 1, figures 10, 13, 20), verrucae arranged along the equatorial region; six to eight small verrucae present (Plate l, figures 17, 18), sometimes more (Plate l, figures 11,14,19), the verrucae are free, rounded, or conical, 4–6 µm in diameter, 1–2 µm high, the equatorial shallow band is mostly indistinct (Plate 1, figures 14,18,19), exceptionally prominent or thick and dark (Plate 1, figure 11), spore wall thin, psilate to finely ornamented.

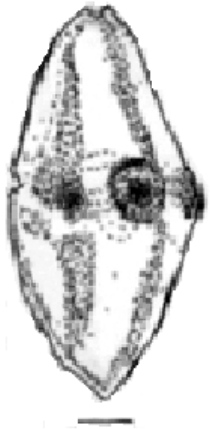

**Figure 23.** *Potamomyces elsikii* (Nandi & A. Sinha) Nuñez Otaño et al. 2017. Scale Bar = 10 µm.

**Location:** Rengtekawn-Sherlui Road Traverse, Mizoram, India.

**Age:** Neogene.

**Etymology.** The epithet honours eminent palaeomycologist Dr. William C. Elsik.

**Remarks.** *Potamomyces elsikii* is distinguished from *Potamomyces mulleri* Nandi & A. Sinha 2007 by its smaller size, having smaller verrucae at the equator, and the relatively thin-walled pore.

31.3. Species: ***Potamomyces fournieri*** (Elsik & Jarzen) Nuñez Otaño et al. 2017

Figure 24

**Index Fungorum Registration Identifier:** 814696.

**Basionym:** *Mediaverrunites fournierii* Elsik & Jarzen, Palynology 31: 102, plate 1, figures 1–5. 2009.

**Original Description:** Monoporate; area of thinned spore wall around apical pore; occasionally entire apical area tom and lost. Pore diameter 0 .5 µm or larger. Overall spore outline oval to oval-elongate. Overall size based on 10 specimens is 27–37 × 42–52 µm, spore wall ca. 0.5 µm thick. Equatorial knobs or verrucae generally 5 or 6 in number, 5–7 µm wide, 1.5–3.0 µm high.

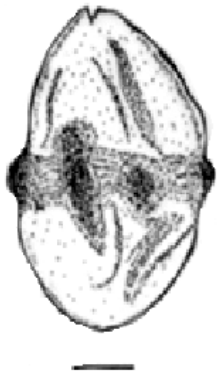

**Figure 24.** *Potamomyces fournieri* (Elsik & Jarzen) Nuñez Otaño et al. 2017. Scale Bar = 10 µm.

**Location:** Colombia, South America.

**Age:** Early Miocene.

**Etymology:** The epithet honours Dr. George R. Fournier.

31.4. Species: ***Potamomyces invaginatus*** (Elsik & Jarzen) Nuñez Otaño et al. 2017

Figure 25

**Index Fungorum Registration Identifier:** 814698.

**Basionym:** *Mediaverrunites invaginatus* Elsik & Jarzen, Palynology 33: 102, plate 2, figures 1–5. 2009.

**Original Description:** Overall size of holotype ca. 28 × 46 µm. Spore wall thickness ca. 0 .25 µm at end opposite pore to ca. 0 .5 µm at porate end; spore wall turns inward at the pore and forms inverted, interior cone 1–2 µm long around pore. Overall outline oval elongate to rounded fusiform; more·pointed at porate end. Equatorial knobs 3–5, usually 4; ca. 10–12 µm in diameter.

**Figure 25.** *Potamomyces invaginatus* (Elsik & Jarzen) Nuñez Otaño et al. 2017. Scale Bar = 10 µm.

**Figure 26.** *Potamomyces magnus* (Elsik & Jarzen) Nuñez Otaño et al. 2017. Scale Bar = 10 µm.

**Location:** Gulf of Mexico, offshore Louisiana.

**Age:** Early Miocene, Pliocene and Early Pleistocene.

**Etymology:** Derivation of Name. Named for the invaginate pore.

**Remarks:** The invaginate pore distinguishes *Potamomyces invaginatus* from all other described species of *Potamomyces.* The invaginate pore is also seen in a few other undescribed genera of fungal spores. This distinctive feature resembles an inverted funnel.

31.5. Species: ***Potamomyces magnus***
(Elsik & Jarzen) Nuñez Otaño et al. 2017

Figure 26

**Index Fungorum Registration Identifier:** 814697.

**Basionym:** *Mediaverrunites magnus* Elsik & Jarzen, Palynology 33: 102, plate 1, figures 6–8. 2009.

**Original Description:** Overall size of holotype 46 × 78 µm; spore wall ca. 1.5 µm thick, thickening equatorially to 2.5 µm, psilate except for 7 to 8 low equatorial verrucae that are 8–10 µm wide and 1.5 to 2 µm high. Apical pore ca. 1.5 µm in diameter; very thin inner layer of spore wall forms atrium or vacuolar chamber ca. 8 µm wide. Outer wall layer also characteristically thinned in median band, ca. a few µm wide around apical pore.

**Location:** Colombia, South America.

**Age:** Early Miocene.

**Etymology: The epithet indicates** overall large size of the specimens.

**Remarks:** According to Elsik and Jarzen (2009), *Potamomyces magnus* is almost twice as large as other species of the genus. The row of low knobs is obscured by the equatorial band of thickened spore wall.

31.6. Species: ***Potamomyces mulleri***
(Nandi & A. Sinha) Nuñez Otaño et al. 2017

Figure 27

**Index Fungorum Registration Identifier:** 814692.

**Basionym:** *Mediaverrunites mulleri* Nandi & A. Sinha, Palynology 31: 98, plate 1, figures 1–6, 8–9, text-figure 2A. 2007.

**Original Description:** Spores amerosporous, ellipsoidal, gradually narrowing at both ends, apices narrowly rounded, size range 70–85 × 35–45 µm, monoaperturate, pore at one end, with a thickened wall, four or over eight verrucae present, the verrucae are large and are arranged in a ring within a thin equatorial, shadow-like, rim or band (Plate 1, figures 2, 5), the verrucae are rounded, 8–10 um in diameter and 2–6 µm high, spore wall thin, psilate to finely ornamented. Occasionally pole to pole folds are present, and these may pass through the verrucae.

**Figure 27.** *Potamomyces mulleri* (Nandi & A. Sinha) Nuñez Otaño et al. 2017. Scale Bar = 10 µm.

**Location:** Rengtekawn-Sherlui Road Traverse, Mizoram, India.

**Age:** Neogene.

**Etymology.** The epithet honours Professor Jan Müller, who first recorded this kind of spores.

31.7. Species: ***Potamomyces pontidiensis*** (Sancay) ex Nuñez Otaño et al. 2017

Figure 28

**Index Fungorum Registration Identifier:** 814794.

**Basionym:** *Mediaverrunites pontidiensis* Sancay, Palynology 38: 35, plate 2, figures 1–10. 2014.

**Original Description:** Spores monocellate, monoporate, pore situated at one end of the spore, dark brown in color, wall thin, smooth and two-layered, overall outline is oval to oval-elliptical, gradually narrowing at both ends, equatorial knobs or verrucae are distinct and high, three or four in number, 7.1–11.8 µm wide and 2.3–3 µm high, overall size based on seven specimens is 25.2–37.2 × 40.9–59.6 µm, equatorial shadow-like rim is mostly distinct.

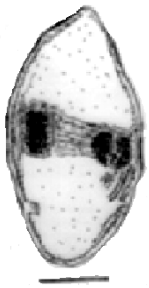

**Figure 28.** *Potamomyces pontidiensis* (Sancay) ex Nuñez Otaño et al. 2017. Bar = 20 µm.

**Location:** Black Sea, Turkey.

**Age:** Late Miocene.

**Etymology.** The epithet is after the locality Pontides, which is an orogenic belt extending from Thrace to Georgia forming the northern coast of Turkey, where the first specimens were identified.

32 Genus: ***Ramularia*** Unger

**Index Fungorum Registration Identifier:** 9691.

**Type species:** *Ramularia pusilla* Unger, Index Fungorum Registration Identifier: 228980.

**Classification:** Phylum: *Ascomycota,* Class: *Dothideomycetes*, Order: *Mycosphaerellales*, Family: *Mycosphaerellaceae*.

**Number of fossil species known:** One.

32.1. Species: ***Ramularia oblongispora*** Casp. 1907

**Index Fungorum Registration Identifier:** 107522.

**Figure:** In Caspary 1907: 15, plate 1, figures 11a, b.

**Original Description:** On the tip of a slender stylus surmounting a small fruit, grows a fungus that extrudes from the inner parts of the infected organ. It consists of nearly cylindrical threads that are articulated and at their tips branch into 1–4 branches, and that are nearly colorless except for a tinge of a brown hue. The cells in the hyphae are commonly somewhat convex, somewhat roller- or barrel-shaped. Near its apex, the hyphae branch and segregate ovoid or elliptical spores, a number of which became detached and fell around the hyphal base. The fungus is 45.4–51.1 µm long and 1.8–4.2 µm wide; the fallen spores are 2.8 µm wide and twice or three times that in length.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

33. Genus: ***Rhexoampullifera*** P.M. Kirk

**Index Fungorum Registration Identifier:** 9717.

**Type species:** *Rhexoampullifera fagi* (M.B. Ellis) P.M. Kirk & C.M. Kirk, Index Fungorum Registration Identifier: 110996.

**Classification:** *Ascomycota* incertae sedis.

**Number of fossil species known:** Two.

33.1. Species: ***Rhexoampullifera stogieana*** M.J. Pound et al. 2018

**Index Fungorum Registration Identifier:** 821979.

**Figure:** In Pound et al. 2018: 3, plate 1, figures 1–6; Plate 3, figures 1–3.

**Original Description:** Fungal conidia, 10.9–12.7 µm wide and 65–71.6 µm long; wall 1–2 µm thick. The conidium is generally straight, but may be slightly bowed. It has four cells arranged semi-symmetrically around a central septum, which is somewhat obscured by darkening of the conidial wall. The central septum is 5.9–7.7 µm wide. Cells on either side of the central septum are 14–15 µm long, and may be cylindrical to slightly doliform. Septae on the far wall of these cells are approximately 5.9–7.4 µm wide. The cells beyond these septae are shorter than the central two, approximately 3–7 µm long and tapers slightly to the next septum, which 5–6 µm thick and 6–7 µm wide. While the majority of the conidia is highly melanised, the apical cell is both hyaline and torn. Where present in any significant length, this apical cell flares and has a slightly 'frilly' aspect, giving it a collarette-like appearance. It is 6 µm wide at the septum and flares to 7 µm at the edge. The wall thins from 2 µm to less than 1 µm at the edge. Where truncated, the polar cell may appear cup-like, with short extensions of the cell wall extending from the basal septum.

**Location:** Bees Nest Pit, Brassington, Derbyshire, U.K.

**Age:** Miocene.

33.2. Species: ***Rhexoampullifera sufflata*** M.J. Pound et al. 2018

**Index Fungorum Registration Identifier:** 821980.

**Figure:** In Pound et al. 2018: 7, plate 1, figures 7–12; Plate 3, figures 4–5.

**Original Description:** Fungal conidia, 58.4 to 66 µm long and 13.1–15.6 µm wide at the widest point; wall ranges from 1.6 to 0.8 µm thick. Septae are broad, 4.2 to 6.9 µm in thickness, and somewhat obscured by wall darkening across the septal area. Conidia are somewhat constricted at the septae. Conidia are less symmetrical than those of *R. stogieana* and have a pronounced doliform to globose cell on one side of the central septum. This inflated cell is longer 19–21.8 µm than the slightly doliform cell 10.2–15.7 µm on the other side of the septum. Conidia is strongly melanised, however the apical cells are hyaline and torn. The apical cell on the bulging half of the conidium is has a slightly 'frilly' aspect, giving it a collarette like appearance. The apical cell on the non-bulging half of the conidium is truncated and appears cup-like, with a flattened bottom and short extensions of the cell wall extending from the basal septum.

**Location:** Bees Nest Pit, Brassington, Derbyshire, U.K.

**Age:** Miocene.

34 Genus: ***Rhizophagus*** P.A. Dang

**Index Fungorum Registration Identifier:** 20482.

**Type species:** *Rhizophagus populinus* P.A. Dang, Index Fungorum Registration Identifier: 218112.

**Classification:** Phylum: *Glomeromycota,* Class: *Glomeromycetes*, Order: *Glomerales*, Family: *Glomeraceae*.

**Number of fossil species known:** One.

34.1. Species: ***Rhizophagus fasciculatus*** (Thaxt.) C. Walker & A. Schüßler in A. Schüßler & C. Walker

**Index Fungorum Registration Identifier:** 542909.

**Figure:** In Thaxter 1922: 308, figures 21–28.

**Basionym:** *Endogone fasciculata* Thaxt. 1922. Index Fungorum Registration Identifier: 264677.

**Homotypic synonym:** *Endogone fasciculata* Thaxt., Proc. Amer. Acad. Arts & Sci. 57: 308. 1922; *Glomus fasciculatum* (Thaxt.) Gerd. & Trappe [as *'fasciculatus'*], Mycol. Mem. 5: 51. 1974.

**Original Description:** Glomoid spores formed singly, in loose clusters, tight clusters (fascicles) in the substrate and in the roots or rhizoids of host plants. Forming arbuscular mycorrhizas.

**Location:** Bronson, southeastern Kittson County, Minnesota, U.S.A.

**Age:** Late Pleistocene.

35 Genus: ***Sarcophoma*** Höhn.

**Index Fungorum Registration Identifier:** 9787.

**Type species:** *Sarcophoma endogenospora* Höhn., Index Fungorum Registration Identifier: 432071.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: *Dothideales*, Family: *Dothioraceae*.

**Number of fossil species known:** One.

35.1. Species: ***Sarcophoma deccani*** R.B. Singh & G.V. Patil 1980

Figure 29

**Index Fungorum Registration Identifier:** 109235.

**Original Description:** Pycnidium immersed in stroma, ostiolate, spherical to oval, 170–200 × 110–150 µm in size, wall thin, pseudoparenchymatous; conidiophore branched, septate, 1–celled or in chains of 3–4 or more.

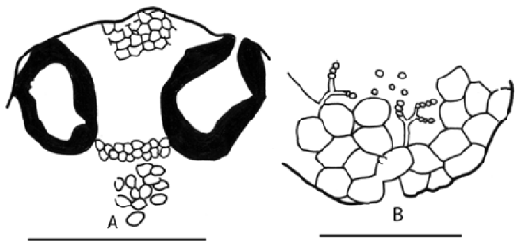


**Figure 29.** *Sarcophoma deccanii* R.B. Singh & G.V. Patil 1980. A. Pycnidium and stroma. Bar = 250 µm, B. Wall of pycnidium, conidiophores and spores. Bar = 50 µm.

**Location:** Mohgaonkalan, Chhindwara District, Madhya Pradesh, India.

**Age:** Cretaceous, Intertrappean beds.

**Remarks:** According to Singh and Patil (1980), the silicified fruiting body, the pycnidium, is spherical to oval in shape, with a distinct pseudoparenchymatous wall. They occur singly and are partly embedded in the host tissue. In some cases a distinct ostiole is present. Conidiophores are distinct, branched, and occur on the inner wall of the pycnidium. The conidia are oval to spherical, 1–celled, and are produced in chains on the tip of branched conidiophores. It was placed under extant genus *Sarcophoma*, with which it shares having immersed thin-walled ostiolate pycnidia, branched conidiophores, and oval, non-septate conidia.

36. Genus: ***Scleroderma*** Pers.

**Index Fungorum Registration Identifier:** 19309.

**Type species:** *Scleroderma verrucosum* (Bull.) ex Pers., Index Fungorum Registration Identifier: 211519.

**Classification:** Phylum: *Basidiomycota*, Class: *Agaricomycetes*, Order: *Boletales*, Family: *Sclerodermataceae*.

**Number of fossil species known:** One.

36.1. Species: ***Scleroderma echinosporites*** Rouse 1962

**Index Fungorum Registration Identifier:** 110078.

**Figure:** In Rouse 1962: 196, plate 5, figure 22.

**Original Description:** Spores small, circular in outline, with no obvious openings or pores in the wall. Ornamentation consists of fine spines radiating out from the wall. These cover the spore except at one place, which presumably was the place of attachment of the sterigma. The wall also seems coarsely punctate, with thin(?) areas more or less scattered on the surface. Size range 11–15 µm.

**Location:** South shore of Burrard Inlet, British Columbia, Canada. Location: South shore of Burrard Inlet, British Columbia, Canada.

**Age:** (Middle?) Eocene (but possibly as old as Late Cetaceous?).

**Remarks:** According to Rouse (1962), the spores are identical to modern puffball spores of the genus *Scleroderma*, and also agree with them in their size range. They were found in only one sample.

37. Genus: ***Sphaerophorus*** Pers.

**Index Fungorum Registration Identifier:** 5112.

**Type species:** *Sphaerophorus coralloides* Pers., Index Fungorum Registration Identifier: 405431

**Classification:** Phylum: *Ascomycota*, Class: *Lecanoromycetes*, Order: *Lecanorales*, Family: *Sphaerophoraceae*.

**Number of fossil species known:** One.

37.1. Species: ***Sphaerophorus moniliformis*** Menge 1858

**Index Fungorum Registration Identifier:** 628321.

**Figure:** In Menge 1858: 9, figure 2.

**Original Description:** Thallus fruiting, of articulate hyphae consisting of appressed globules; branched, branches furcate, diverging, and tapering toward their ends. The minute, brown, encrusting organism covering the terminal leaflets at the tips of twigs of *Thuia occidentalis* like a miniature lawn (vide Kalgutkar & Jansonius 2000, p. 272).

**Location:** Baltic area.

**Age:** Early Tertiary (Oligocene?).

38. Genus: ***Sporidesmium*** Link

**Index Fungorum Registration Identifier:** 10024.

**Type species:** Not indicated.

**Classification:** Phylum: *Ascomycota,* Class: *Dothideomycetes*, Order: Incertae sedis, Family: Incertae sedis.

**Number of fossil species known:** One.

38.1. Species: ***Sporidesmium henryense*** Dilcher 1965

**Index Fungorum Registration Identifier:** 339523.

**Figure:** In Dilcher 1965: 35, plate 23, figures 176–181.

**Original Description:** Hyphae superficial, straight, may branch oppositely, alternately, or unilaterally. Hyphal cells 3–6 × 20–35 µm. Single-celled hyphopodia 6–9 × 5–10 µm, alternate, unilateral, or opposite, located near the distal end of hyphal cells, occur at more or less regular intervals along the length of the hypha. Hyphopodia subhemispherical, rounded at apex. Prominent pores 1–1.5 µm in diameter present in lower surface of hyphopodia and incomplete septations evident in lateral walls where hyphopodia are attached. Conidiophores are abundant, arise singly, 0.5–1 µm wide at point of attachment on hyphae enlarging to 1.5–2 µm wide at point of attachment of conidiospores, by 4–15 µm long. Conidiospores 2–3 septate, 4–6 × 11–14 µm, dark, borne terminally on a single conidiophore. Conidiospores linearly arranged, elliptical, end rounded to more or less flat. Found on lower epidermis of *Chrysobalanus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figures by Dilcher (1965). According to Dilcher (1965), the hyphopodia have pores on the surface adjacent to the lower epidermis of the host leaf *Chrysobalanus* sp.

39. Genus: ***Stagonospora*** (Sacc.) Sacc.

**Index Fungorum Registration Identifier:** 10056.

**Type species:** *Stagonospora paludosa* (Sacc. et Speg.) Sacc. (*Hendersonia paludosa* Sacc. et Speg.). Index Fungorum Registration Identifier: 202117.

**Classification:** Phylum: *Ascomycota,* Class: *Dothideomycetes*, Order: *Pleosporales*, Family: *Phaeosphaeriaceae*.

**Number of fossil species known:** One.

39.1. Species: ***Stagonospora intertrappea*** Trivedi & C.L. Verma 1973

**Index Fungorum Registration Identifier:** 660928.

**Figure:** In Trivedi & Verma 1973: 71, plate 1, figure 1–5.

**Original Description:** (Diagnosis): Pycnidia without stroma, 0.2–0.25 mm long and 0.10–0.15 mm broad; pycnidial wall parenchymatous, single–celled. Spores oblong, linear fuscoid or ellipsoidal, 20–23 × 7–10 µm with 1–3 transverse septa, middle septa dark, without septal opening; mycelium septate and branched. (Description): Five pycnidia are seen in cross section, they are well preserved, three have spores within them while the remaining two, probably immature, are without spores. Pycnidia are 0.2–0.25 mm long and 0.10–0.15 mm broad, somewhat pyriform, pycnidial pores are not clearly visible. Pycnidial wall is parenchymatous, single cell layer thick, its cells are broader than long. Near apex of pycnidium the cells of the wall have dark contents. Host tissue has almost completely decayed but at the base of the pycnidia, parenchymatous cells are still preserved. In close association with the pycnidia, branched septate hyaline hyphae can be seen. Numerous 2– to 4–celled, well preserved spores are enclosed within the pycnidium. They are longer than broad, oblong linear, fusoid, or ellipsoid in shape, 20–23 × 7–10 µm in size when mature. They have 1–3 septa, spore wall is smooth and quite firm. Middle septum of the spore is darker in color and is without any opening.

**Location:** Mohgaonkalan, Chhindwara District, Madhya Pradesh, India.

**Age:** Late Cretaceous (Maastrichtian).

**Etymology:** The specific epithet refers to the intertrappean sediments from where it was recovered.

**Remarks:** *Stagonospora intertrappea* does not resemble any fossil fungus reported so far. *Diplodia rodei* Mahab. 1969 shows only a remote resemblance with it. However, the two differ in many characters.

40. Genus: ***Stigmatomyces*** H. Karst.

**Index Fungorum Registration Identifier:** 5253.

**Type species:** *Stigmatomyces muscae* (Peyr.) H. Karst., Index Fungorum Registration Identifier: 184086.

**Classification:** Phylum: *Ascomycota,* Class: *Laboulbeniomycetes*, Order: *Laboulbeniales*, Family: *Laboulbeniaceae*,

**Number of fossil species known:** One.

40.1. Species: ***Stigmatomyces succini*** W. Rossi et al. 2005

**Index Fungorum Registration Identifier:** 336545.

**Figure:** In Rossi et al. 2005: 272, figures 1–2.

**Original Description:** Thalli about 0.3 mm long, nearly straight, the neck lightly curved outward, the appendage divergent and curved upward. Receptacle slender. Basal and supra-basal cells almost equal in length. Stalk cells of the appendage slender and elongate, the two upper cells of the appendage large and stout, the terminal one bearing two antheridia whose necks are slightly curved, divergent and unusually long, while the subterminal one bears a single antheridium. The presence of a sterile basal cell is supposed, but cannot be clearly seen. Septa dividing stalk and basal cells of perithecium not visible, but these cells form a relatively elongate region, above which the perithecial venter is distinguished only by a slight elevation. Perithecial venter, together with the cells below it, almost elliptical, about three and a half times longer than broad, distinguished by a slight elevation from the large base of the neck; the latter relatively short, with a stout. slightly tapering lower portion and with an upper portion narrow and elongate: the tip slightly enlarged. but details of the lip are not visible.

**Location:** Bitterfeld deposit, Germany

**Age:** Early Miocene

41. Genus: ***Stilbum*** Tode

**Index Fungorum Registration Identifier:** 18601.

**Type species:** *Stilbum vulgare* Tode, Index Fungorum Registration Identifier: 166124.

**Classification:** Phylum: *Basidiomycota,* Class: *Agaricostilbomycetes*, Order: *Agaricostilbales*,

Family: *Chionosphaeraceae*,

**Number of fossil species known:** One.

41.1. Species: ***Stilbum succini*** Casp. 1907

**Index Fungorum Registration Identifier:** 107596.

**Figure:** In Caspary 1907: 16, figures 13a-d.

**Original Description:** On a loose piece of porous, irregularly broken, indeterminate organic material – probably bird feces, but definitely not rotting wood – stands a fungal fruiting body that apparently produced a rich amount of spores. It is 0.51 mm long, and its head measures 0.216 mm across, while the stem [synnema] is 0.102 mm in its middle part. The stem is smooth, cylindrical, flaring somewhat near its bottom and top. It may have been somewhat sticky, as its head is covered by a large number of spores; possibly the spores were sticky. The head is twice as broad as the middle of the stem, and is light yellow in color, making a striking contrast with the deep red-brown spores adhering to it. The spores are elliptic, smooth, 4.6–6.6 × 6.6–7.9 µm in size.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene).

**Etymology:** The species epithet is derived from Latin *succinum* = amber.

42. Genus: ***Stomiopeltis*** Theiss.

**Index Fungorum Registration Identifier:** 5274.

**Type species:** *Stomiopeltis aspersa* (Berk.) Theiss., Index Fungorum Registration Identifier: 221479.

**Classification:** Phylum: *Ascomycota,* Class: *Dothideomycetes*, Order: *Microthyriales*, Family: *Micropeltidaceae.*

**Number of fossil species known:** One.

42.1. Species: ***Stomiopeltis plectilis*** Dilcher 1965

**Index Fungorum Registration Identifier:** 339759.

**Figure:** In Dilcher 1965: 27, plate 16, figure 125.

**Homotypic synonym:** *Stomiopeltites plectilis* (Dilcher) Kalgutkar & Janson. 2000.

**Original Description:** Mature fruiting body 100–210 µm in diameter, more or less round, not radiate. Irregular central ostiole present. Fruiting body composed of several layers of hyphae resulting in a slightly convex overall shape. Hyphae of the fruiting body produce inordinately arranged plectenchyma of sinuous, irregularly lobed cells. Lower layers of hyphae and marginal hyphae also plectenchymatous. Hyphal cells in the fruiting body 1.5–3 × 4–25 µm. Margins generally not entire. Free hyphae somewhat sinuous, loosely reticulate, extending out from the margin of the fruiting body; free hyphal cells 1.5–3 × 15–30 µm. No asci or spores found. Free hyphae and fruiting bodies limited to lower epidermis of the host leaf. Central portion of fruiting body frequently flakes away from the host leaf after maturity, leaving the marginal portion and free hyphae attached to the leaf. There is no evidence of parasitic action by this form on host leaf, *Sapindus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), no ascospores or pycnidiospores have been found associated with any of the fruiting bodies of *S. plectilis*. As there is large variation in the size of the fruiting bodies of *S. plectilis* (100–210 µm) it cannot be determined whether all forms represent developmental stages of ascocarps or whether the smaller forms are pycnidia and the larger forms ascocarps. However, since the smaller fruiting bodies are flat (lack hymenial development), only loosely formed, and lacking ostioles, they appear to be immature and it is more probable that they are immature ascocarps than diminutive pycnidia. Kalgutkar and Jansonius (2000) transferred this species to *Stomiopeltites* Alvin & Muir 1970. The author is of the opinion that this transfer was unwarranted.

43. Genus: ***Tetracoccosporium*** Szabó

**Index Fungorum Registration Identifier:** 10192.

**Type species:** *Tetracoccosporium paxianum* Szabó, Index Fungorum Registration Identifier: 243388.

**Classification:** *Ascomycota* incertae sedis (Wijayawardene et al. 2022)

**Number of fossil species known:** One.

43.1. Species: ***Tetracoccosporium eocenum*** Biradar & Mahab. 1974

Figure 30

**Index Fungorum Registration Identifier:** 519781.

**Original Description:** Hyphae septate, thin walled to moderately thick-walled, hyaline, profusely branched; individual cell measuring 9.4 × 5 µm. Conidia 13 × 18 µm, thick-walled, smooth, dark brown to blackish brown, 4–celled, variously shaped, viz. cruciate or horizontally linear, T-shaped or nearly spherical. A single cell of conidia measures 8.4 × 9 µm. Conidiophores very short, 6 × 7 µm.

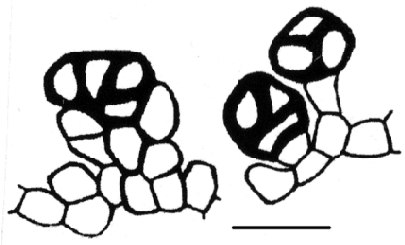

**Figure 30.** *Tetracoccosporium eocenum* Biradar & Mahab. 1974, Bar = 20 µm.

**Location:** Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

**Age:** Maastrichtian (Deccan Intertrappean Series).

44. Genus: ***Thecaphora*** Fingerh.

**Index Fungorum Registration Identifier:** 16347.

**Type species:** *Thecaphora hyalina* Fingerh., Index Fungorum Registration Identifier: 140482.

**Synonym:** *Sorosporium* F. Rudolphi fide Index Fungorum, Index Fungorum Registration Identifier: 16318.

**Classification:** Phylum: *Basidiomycota*, Class: *Ustilaginomycetes*, Order: *Urocystidales*, Family: *Glomosporiaceae*.

**Number of fossil species known:** One.

44.1. Species: ***Thecaphora mohgaoense*** (Chitaley & Yawale) R.K. Saxena et al. 2021

Figure 31

**Index Fungorum Registration Identifier:** 556983.

**Basionym**: *Sorosporium mohgaoense* Chitaley & Yawale, Botanique 7(4): 190, plate 1, figure 1. 1978; Index Fungorum Registration Identifier: 111035.

**Homotypic synonym:** *Papulosporonites mohgaoensis* (Chitaley & Yawale) Kalgutkar & Janson. 2000. Index Fungorum Registration Identifier: 483503.

**Original Description:** The spore balls are deeply buried in the host tissue and look reddish brown to pale yellow. They are egg-shaped consisting of 5 to 25 spores. The spores are more or less permanently united and the balls are not covered by a sterile sheath or any pseudomembrane. No sterile cells are present inside the spore balls. Size of spore balls varies from 17–21 × 35–46 µm. Individual spores are globose in shape but because of compression they look polyhedral. Germ pores are observed in many of them. However, the mycelium is not seen. Spores are 5.3 to 10.6 µm with an average of 8 µm in diameter, globose to ovoid, polyhedral in balls, without any contents, epispore smooth, 0.3–0.7 µm.

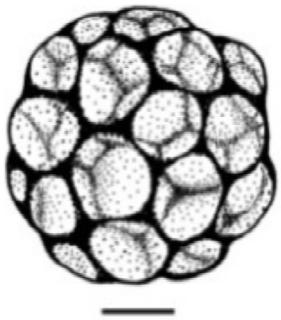

**Figure 31.** *Thecaphora mohgaoensis* (Chitaley & Yawale) R.K. Saxena et al. 2021. Bar = 10 µm.

**Location:** Mohgaonkalan, Chhindwara District, Madhya Pradesh, India.

**Age**: Late Cretaceous-Maastrichtian.

**Remarks:** Kalgutkar & Jansonius (2000) transferred *Sorosporium mohgaoense* to fossil fungal spore genus *Papulosporonites* [as *Papulosporonites mohgaoensis* (Chitaley & Yawale) Kalgutkar & Janson. 2000] without providing any convincing reason for the same. We, therefore, do not accept this transfer. The specific epithet is after the type locality of the species.

45. Genus: ***Torula*** Pers.

**Index Fungorum Registration Identifier:** 10248.

**Type species:** *Torula monilis* Pers., Index Fungorum Registration Identifier: 496602.

**Classification:** Phylum: *Ascomycota,* Class: *Dothideomycetes*, Order: *Pleosporales*, Family: *Torulaceae*,

**Number of fossil species known:** Three.

45.1. Species: ***Torula globulifera*** Casp. 1907

**Index Fungorum Registration Identifier:** 107604.

**Figure:** In Caspary 1907: 12, plate 1, figures. 7, 8a, b.

**Original Description:** A large mass of fungal hyphae occur with a *Frullania* in the same piece of amber [from which also *Gonatobotrys primigenius* Casp. 1907 was described; l.c., p. 11]. A part of these hyphae ["threads"] consist of almost oblong, bright brown cells, rarely wider than long, that are strung together almost as beads in a rosary. These threads are curved in an irregular manner, and have multiple branches, most of which are inserted at a right angle. The cells are 5.7–8.5 µm in length and width; rarely thinner. Between these rosary-like threads often further threads occur (but not connected to them), that are very thin and linear, and also show branching, and that show distinct septa.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

45.2. Species: ***Torula heteromorpha*** Casp. 1907

**Index Fungorum Registration Identifier:** 105832.

**Figure:** In Caspary 1907: 14, plate 1, figures 10a-f.

**Original Description:** This fungus occurs in the amber as numerous free-lying, scattered shreds; here and there those may be concentrated as thick balls that resolve under the microscope into an intricate mass of hyphal threads. Rarely, these branched threads consist of nearly spherical, brown, closely appressed spores with a diameter of 5.7–7.1 µm. Mostly, though (figures 10a–f), these dark brown spore-bearing threads pass at one, or both, ends into light brown ciliate or whip-like extensions that generally show no segmentation, and that may be 170–306 µm long and 1.1–1.4 µm wide.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

45.3. Species: ***Torula mengeana*** Casp. & R. Klebs in Casp. 1907

**Index Fungorum Registration Identifier:** 634247.

**Figure:** In Caspary 1907: 13-14, plate 1, figure 9.

**Original Description:** This elegant fungus forms a locally thick covering over a twig of *Thuites*, particularly so along the edges of the leaves. The branching threads are closely appressed to the leaf surface, and consist of dark brown cells, spherical or slightly flattened, with a diameter of 8.5 to 11.4 µm. From many of these cells arise perpendicular threads consisting of 3–9 cells that gradually decrease in diameter in distal direction. These upright threads are 11.4 µm (three cells) to 51.1 µm (nine cells) long.

**Location:** Baltic area, Poland.

**Age:** Tertiary (Oligocene?).

46. Genus: ***Trichopeltina*** Theiss.

**Index Fungorum Registration Identifier:** 5566.

**Type species:** *Trichopeltina labecula* (Mont.)

Theiss., Index Fungorum Registration Identifier: 220570.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: Incertae sedis, Family: *Trichopeltinaceae*.

**Number of fossil species known:** One.

46.1. Species: ***Trichopeltina exporrecta*** Dilcher 1965

**Index Fungorum Registration Identifier:** 340372.

**Figure:** In Dilcher 1965: 23, plate 13, figure 100.

**Original Description:** Stroma small, sterile, associated with conspicuous free hyphae. Stroma 30–75 × 42–140 µm, consists of rectangular to elongate cells 1.5–4 × 3.5–10 µm, united laterally, dichotomizing marginally, or a sheet of randomly orientated irregularly shaped cells 2–4 × 3–8 µm. Stroma margins entire to lobed. Setae sometimes present, 2 µm tapering to 1.5 × 25 µm. Free hyphae attached to stromata, more or less sinuous, anastomose freely over the upper and lower surfaces of the host leaf. Hyphal cells 1.5–4 × 5–30 µm. Two-celled (1–septate) germinating spores attached to free hyphae. Spores 3.5–5 × 12–17 µm, germinate terminally or laterally. Host leaf *Sapindus* sp.

**Location:** Western Tennessee, U.S.A.

**Age:** Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Kalgutkar and Jansonius (2000) selected a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), only linear and radiate sterile stromata, free hyphae, and germinating spores are known for this fossil form. It unquestionably belongs in the *Trichopelteae* because its stroma consists of a radiate prosenchymatous membrane. This fossil material was placed in the genus *Trichopeltina* (Clements & Shear 1931) on the basis of the 2–celled (1–septate) hyaline germinating spores which were found still attached to the free hyphae produced.

47. Genus: ***Trimmatostroma*** Corda

**Index Fungorum Registration Identifier:** 10312.

**Type species:** *Trimmatostroma salicis* Corda, Index Fungorum Registration Identifier: 204246.

**Classification:** Phylum: *Ascomycota*, Class: *Leotiomycetes*, Order: *Helotiales*, Family: *Mollisiaceae*.

**Number of fossil species known:** One.

47.1. Species: ***Trimmatostroma intertrappeanum*** K.S. Patil & Datar 2002

Figure 32

**Index Fungorum Registration Identifier:** 580628.

**Original Description:** (Diagnosis): Mycelium septate, branched, thin walled, hyaline, individual cells circular to oval, thin walled, 4–12 µm in length and 4–8 µm in breadth, dark brown coloured, quadrate conidia on short conidiophores, terminal, 16–24 µm × 8–16 µm and an individual spore in the quadrate conidium 1–5 µm in diameter. Conidiophore 8 µm long and 8 µm in breadth. Conidia kidney shaped and many celled. (Description): A well preserved septate mycelium has been found in a fossil dicot wood measuring 7.5 cm × 5.8 cm. While examining the tangential longitudinal section of the wood, it was observed that its ray tissue and adjoining tissues were heavily infected by an endogenous well preserved fungus. Same type of fungal infection is seen in the fruit wall of a fossil fruit. Mycelium is septate, thin to thick-walled, hyaline to yellowish and branched. Individual cells of the mycelium are circular to oval in shape 4–12 µm in length and 4–8 µm in breadth. Cells are thickened and sometimes these thick walled cells contain dark, black, coloured granular contents. Stroma is well preserved. At many places the mycelium shows dark brown to black coloured conidia. Conidia are sessile or having very short stalk. The conidiophores measure 8 µm in diameter. The conidia are variously arranged in groups of 2–4. Conidia form kidney shaped structures and this arrangement seems to be very typical of this fungus. These quadrate conidia measure 16–24 µm × 8–16 µm in diameter. Conidia are thick walled, smooth, brown to black. They are often very dark at their tips or along the edge. An individual cell in the quadrate of a conidium measures 1.5 µm.

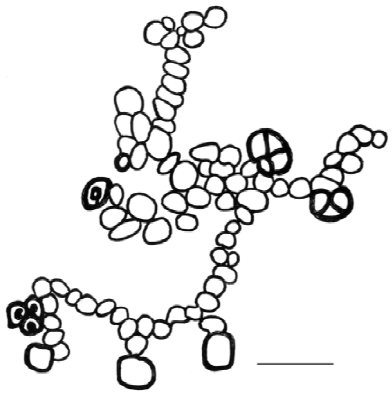

**Figure 32.** *Trimmatostroma intertrappea* K.S. Patil & Datar 2002. Bar = 10 µm.

**Location:** Nawargaon-Maragsur area, Wardha District, Maharashtra, India.

**Age:** Late Cretaceous-Palaeocene (Deccan Intertrappean Beds).

48. Genus: ***Ustilago*** (Pers.) Roussel

**Index Fungorum Registration Identifier:** 16391.

**Type species:** *Ustilago hordei* (Pers.) Lagerh., Index Fungorum Registration Identifier: 244519.

**Classification:** Phylum: *Basidiomycota*, Class: *Ustilaginomycetes*, Order: *Ustilaginales*, Family: *Ustilaginaceae*.

**Number of fossil species known:** One.

48.1. Species: ***Ustilago deccanii*** Chitaley & Yawale 1978

Figure 33

**Index Fungorum Registration Identifier:** 111080.

**Synonym:** *Inapertisporites deccanii* (Chitaley & Yawale) Kalgutkar & Janson. 2000.

**Original Description:** (Diagnosis): Spores spherical, subspherical, sometimes elongate, 7 × 15 µm in diameter with granular contents. Epispore moderately thick. Some spores with depression on one side, deep brown to pale. (Shortened description): A spore mass without definite margin, not covered by a pseudo-membrane, and not forming spore balls, occurs in obscure rotted plant tissue (in a thin section of dark chert); the same type of fungal spores are also scattered over the decaying plant tissue. The spores are deep brown to pale in color, with granular content and a mean diameter of 11 µm, and are found mostly singly, or occasionally in loose groups. Spores two-layered, epispore smooth, 0.4–1.5 µm thick. Many spores show folding and a depression on one side. No associated mycelium or sori observed.

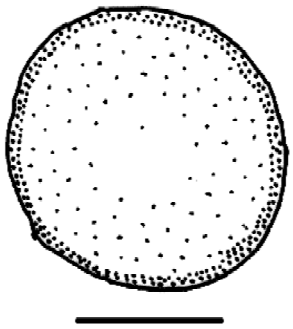

**Figure 33.** ***Ustilago deccanii*** Chitaley & Yawale 1978. Bar=10 µm.

**Location:** Mohgaonkalan, Madhya Pradesh, India.

**Age:** Late Cretaceous-Maastrichtian.

**Remarks:** Chitaley & Yawale (1978) stated that the characters present in these spores lead to its placement under the smut family *Ustilaginaceae*.

49. Genus: ***Vizella*** Sacc.

**Index Fungorum Registration Identifier:** 5747.

**Synonym:** *Shortensis* Dilcher 1965. Index Fungorum Registration Identifier: 21300

**Type species:** *Vizella conferta* (Cooke) Sacc., Index Fungorum Registration Identifier: 207415.

**Classification:** Phylum: *Ascomycota*, Class: *Dothideomycetes*, Order: Incertae sedis, Family: *Vizellaceae*.

**Number of fossil species known:** Two.

49.1. Species: ***Vizella discontinua*** Selkirk 1972

**Index Fungorum Registration Identifier:** 325512

**Figure:** In Selkirk 1972: 142, plate 3, figure 7.

**Original Description:** Colonies up to 5 mm diameter. Mycelium intracuticular, composed of alternating long and short cells; long cells colorless, 13–37 µm long, short cells brown, 4–10 × 4–8 µm, square to rectangular. Main hyphae dichotomously or pseudodichotomously branched at an acute angle; lateral branches opposite (occasionally alternate), arising from long cells only, rarely dichotomously branched, at 90 degrees to main hyphae. Perithecia intracuticular, 85–125 µm diameter when mature, outer wall pseudoparenchymatous, ostiolate. Ostiole ca. 20 µm diameter, not surrounded by specialized cells. Ascospores ovate-elliptical, 9–15 × 3–6 µm, 1–septate, composed of large cell 7–11 × 3–6 µm and a small cell 2–4 × 2–4 µm. Hyaline band ca. 1.5 µm wide present in large cell.

**Location:** Homeward Bound Claim, New Chum Hill, Kiandra, New South Wales, Australia.

**Age:** Early Miocene.

49.2. Species: ***Vizella memorabilis*** (Dilcher) Selkirk 1972

**Index Fungorum Registration Identifier:** 325514.

**Figure:** In Dilcher 1965: 30, plate 17, figures 135–137; plate 20, figures. 157–159; plate 21, figures 160–161.

**Synonyms:** *Shortensis memorabilis* Dilcher 1965. Index Fungorum Registration Identifier: 339265. *Manginula memorabilis* (Dilcher 1965) Lange 1969, p. 565. Index Fungorum Registration Identifier: 317134.

**Original Description:** Epicuticular colonies 90–450 µm in diameter, may originate from germination of 2–celled spore. Initial hyphal cell produces hyphae in two opposite directions. Hyphae dichotomize at short intervals, forming an anastomosing network. Angles of dichotomies become progressively narrower distally in the colonies. Hyphal cells 3–6 × 6–24 µm. Lateral hyphal walls thin, slightly sinuous; end walls markedly thickened. Incomplete septations apparent in end walls. Lateral walls often disintegrate leaving persistent, conspicuous end walls. Hyphopodium-like lateral branches most often unicellular, occasionally multicellular, arise medially from hyphal cells, may be unilateral, alternate or opposite. Evidence of haustorial penetration of the host leaf present in several of the hyphopodium-like branches. Hyphal cells occasionally parasitize host leaf directly. Reproductive multicellular lateral branches also produced by hyphal cells. Both hyphopodium-like and reproductive lateral branches consist of cells shorter and wider than the hyphal cells, 6–17 × 5–15 µm. Fruiting body formed by irregular proliferation of cells from short reproductive lateral branch or, rarely, by medial hyphal cell. Mature fruiting body composed of dense mass of randomly oriented hyphal cells, often hyphae radiate out in all directions from margin. At maturity the center of the fruiting body arches away from the host leaf and a distinct ostiole develops. Two types of fruiting bodies occur: 1) Large fruiting body (ascocarp) 88–150 µm in diameter in which 2–celled spores occur. Spores are 5–10 × 11–14 µm composed of two unequal cells, a smaller hyaline cell 2.5–3.5 × 2.5–3.5 µm and a larger brown cell 6–8 × 8–12 µm often encircled by a conspicuous hyaline band. 2) Smaller fruiting body (pycnidium) 48–110 µm in diameter, in which single-celled spores occur. Spores are 2–3 × 6–7 µm, brown with no hyaline band evident. Found on upper and lower surface of leaves of *Sapindus* sp. and *Chrysobalanus* sp.

**Location** (Dilcher): Western Tennessee, U.S.A.

**Age** (Dilcher): Early Eocene.

**Remarks:** Dilcher (1965) did not designate a holotype. Selkirk (1972), non Jansonius and Hills (1976, card no. 2592) designated a lectotype from the syntypes figured by Dilcher (1965). According to Dilcher (1965), the modern form *Manginula perseae* and this fossil species are similar in general habitat, in appearance, and in pycnidial and mycelial characteristics

50. Genus: ***Zopfiella*** G. Winter

**Index Fungorum Registration Identifier:** 5876.

**Synonyms:** *Ariefia* Jacz. 1922. Index Fungorum Registration Identifier: 307. *Tripterospora* Cain 1956. Index Fungorum Registration Identifier: 5610.

**Type species:** *Zopfiella tabulata* (Zopf) G. Winter, Index Fungorum Registration Identifier: 209499.

**Classification:** Phylum: *Ascomycota*, Class: *Sordariomycetes*, Order: *Sordariales*, Family: *Lasiosphaeriaceae*.

**Number of fossil species known:** One.

50.1. Species: ***Zopfiella neogenica*** O'Keefe 2017

**Index Fungorum Registration Identifier:** 821916.

**Figure:** In O'Keefe 2017: plate 4, figures 6–11.

**Original Description:** Spores roughly equilaterally triangular cushions with one pore on an apex and hyaline thinning of the wall around the midline of the spore. Pore slightly annulate. Walls may be slightly incurved. Spores range from 30 to 40 µm from any apex to the opposite side.

**Location:** Quebrada Bocapán, Tumbes Province, Peru.

**Age:** Miocene (Heath Formation).

**Etymology:** The specific epithet refers to the age of the specimen.

## SYSTEMATIC POSITION

The taxa presented above were placed in their respective phylum, class, order and family. It has been observed that maximum genera belonged to *Ascomycota* (38 genera, 68 species), followed by *Basidiomycota* (10 genera, 10 species), *Chytridiomycota* (1 genus, 1 species) and *Glomeromycota* (1 genus, 1 species). Taxonomic position of all the extant genera and fossil species assigned to them is summarized in Table 1.

**Table 1.** Taxonomic position of extant fungal genera to which fossil species have been assigned.

| Phylum | Class | Order | Family | Modern genera | Fossil species |
|---|---|---|---|---|---|
| *Ascomycota* Caval.-Sm. | *Dothideomycetes* O.E. Erikss & Winka | *Asterinales* M.E. Barr ex D. Hawksw. & O.E. Erikss. | *Asterinaceae* Hansf. | *Asterina* Lév. | *A. eocenica* Dilcher 1965 |
| | | | | | *A. indodeightonii* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | | *A. kosciuskensis* Selkirk 1975 |
| | | | | | *A. mioconsobrina* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | | *A. miosphaerelloides* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | | *A. neocombreticola* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | | *A. neoelaeocarpi* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | | *A. nodosaria* Dilcher 1965 |
| | | | | | *A. presaracae* Vishnu et al. ex R.K. Saxena & P.M. Kirk 2022 |
| | | *Botryosphaeriales* C.L. Schoch. | *Botryosphaeriacea e* Theiss. & Syd. | *Diplodia* Fr. | *D. rodei* Mahab. 1969 |
| | | | | | *D. sahnii* Singhai 1974 |
| | | | Incertae sedis. | *Hendersonula* Speg. | *H. mohgaoensis* R.B. Singh & G.V. Patil 1980 |
| | | *Capnodiales* Woron. | *Mycosphaerellace ae* Lindau | *Ramularia* Sacc. | *R. oblongispora* Casp. 1907 |
| | | *Dothideales* Lindau | *Dothioraceae* Theiss. & Syd. | *Sarcophoma* Höhn. | *S. deccani* R.B. Singh & G.V. Patil 1980 |
| | | *Microthyriales* G. Arnaud | *Micropeltidaceae* Clem. & Shear | *Chaetothyrina* Theiss. | *C. antiqua* (Dilcher 1965) R.K. Saxena comb. nov. |
| | | | | *Stomiopeltis* Theiss. | *S. plectilis* Dilcher 1965 |

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| | | *Microthyriaceae* Sacc. | *Trichopeltina* Theiss. | *T. exporrecta* Dilcher 1965 |
| | *Muyocopronales* Mapook et al. | *Muyocopronaceae* K.D. Hyde | *Muyocopron* Speg. | *M. mucoris* (Dilcher) Samarak & K.D. Hyde 2019 |
| | | | | *M. neyveliensis* (Reddy et al.) Samarak & K.D. Hyde 2019 |
| | *Pleosporales* Luttr. ex M.E. Barr. | *Didymellaceae* Gruyter et al. | *Epicoccum* Link | *E. deccanense* R. Srivast. 2009 |
| | | *Phaeosphaeriaceae* M.E. Barr | *Stagonospora* (Sacc.) Sacc. | *S. intertrappea* Trivedi & C.L. Verma 1973 |
| | | *Pleosporaceae* Nitschke | *Alternaria* Nees ex Fr. | *A. acuminata* (Rouse & Mustard) R.K. Saxena et al. 2022 |
| | | | | *A. alternariata* (Kalgutkar & Sigler) R.K. Saxena et al. 2022 |
| | | | | *A. bella* (Anil Chandra et al.) R.K. Saxena et al. 2022 |
| | | | | *A. clavellata* (Z.-C. Song & G.-X. Li in Song et al.) R.K. Saxena et al. 2022 |
| | | | | *A. psilata* (A. Gupta) R.K. Saxena et al. 2022 |
| | | | | *A. saxenae* (A. Gupta) R.K. Saxena et al. 2022 |
| | | | | *A. sirmaurensis* (A. Gupta) R.K. Saxena et al. 2022 |
| | | *Torulaceae* Corda | *Torula* Pers. ex Fr. | *T. globulifera* Casp. 1907 |
| | | | | *T. heteromorpha* Casp. 1907 |
| | | | | *T. mengeana* Casp. & R. Klebs 1907 |
| | *Sporidesmiales* Crous | *Sporidesmiaceae Fr.* | *Sporidesmium* Link ex Fr. | *S. henryense* Dilcher 1965 |
| | Incertae sedis | *Schizothyriaceae* Höhn. ex Trotter | *Microthyriella* Höhn. | *M. diporata* K.P. Rao & Ramanujam 1976 |
| | | | | *M. fungosa* Dilcher 1965 |
| | | *Vizellaceae* H.J. Swart | *Vizella* Sacc. | *V. discontinua* Selkirk 1972 |
| | | | | *V. memorabilis* (Dilcher) Selkirk 1972 |
| *Eurotiomycetes* O.E. Erikss & Winka | *Eurotiales* G.W. Martin ex Benny & Kimbr. | *Aspergillaceae* Link | *Penicillium* Link | *P. curtipes* Berk. 1848 |
| | *Mycocaliciales* Tibell & Wedin | *Mycocaliciaceae* A.F.W. Schmidt | *Chaenothecopsis* Vain. | *C. bitterfeldensis* Rikkinen & Poinar 2000 |
| *Laboulbeniomycetes* Engl. | *Laboulbeniales* Lindau | *Laboulbeniaceae* G. Winter | *Stigmatomyces* H. Karst. | *S. succini* W. Rossi et al. 2005 |
| *Lecanoromycetes* O.E. Erikss & Winka | *Lecanorales* Nannf. | *Sphaerophoraceae* Fr. | *Sphaerophorus* Pers. | *S. moniliformis* Menge 1858 |
| *Leotiomycetes* O.E. Erikss & Winka | *Helotiales* Nannf. | *Mollisiaceae* Rehm | *Trimmatostroma* Corda. | *T. intertrappea* K.S. Patil & Datar 2002 |
| *Pezizomycetes* O.E. Erikss & Winka | *Pezizales* J. Schröt. | *Pezizaceae* Dumort. | *Peziza* Dill. ex Fr. | *P. sylvatica* R. Ludwig 1859 |
| *Sordariomycetes* O.E. Erikss & Winka | *Chaetosphaeriales* Huhndorf | *Chaetosphaeriaceae* Réblová et al. | *Chaetosphaeria* Tul. & C. Tul. | *C. elsikii* M.J. Pound et al. 2018 |
| | *Diaporthales* Nannf. | Incertae sedis | *Botryodiplodia* Sacc. | *B. mohgaoensis* Barlinge & Paradkar 1982 |
| | *Hypocreales* Lindau | Incertae sedis | *Acremonium* Link | *A. succineum* Casp. 1907 |

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| | | *Magnaporthales* Thongk. et al. | *Magnaporthaceae* P.F. Cannon | *Clasterosporium* Schwein. | *C. eocenicum* Fritel & R. Vig. 1909 |
| | | *Melanosporales* N. Zhang & M. Blackw. | *Ceratostomataceae* G. Winter | *Melanospora* Corda | *M. primigenia* (Casp.) R.K. Saxena et al. 2021 |
| | | *Meliolales* Gäum. ex D. Hawksw. & O.E. Erikss. | *Meliolaceae* G.W. Martin ex Hansf. | *Meliola* Fr. | *M. dilcheri* R.K. Saxena nom. nov. |
| | | *Sordariales* Chadef. ex D. Hawksw. & O.E. Erikss. | *Lasiosphaeriaceae* Nannf. | *Zopfiella* G. Winter | *Z. neogenica* O'Keefe 2017 |
| | | | Incertae sedis | *Brachysporiella* Bat. | *B. doerfeltii* (Sadowski et al.) R.K. Saxena comb. nov. |
| | | *Trichosphaeriales* M.E. Barr | *Trichosphaeriaceae* G. Winter | *Brachysporium* Sacc. | *B. trivedii* R.K. Saxena nom. nov. |
| | Incertae sedis | Incertae sedis | *Diporothecaceae* Mibey & D. Hawksw. | *Diporotheca* C.C. Gordon & C.G. Shaw | *D. doniana* O'Keefe 2017 |
| | | | | | *D. gorda* O'Keefe 2017 |
| | | | Incertae sedis | *Desmidiospora* Thaxt. | *D. marginiconvoluta* Kalgutkar 1997 |
| | | | | *Manginula* G. Arnaud | *M. maegdefraui* Lange 1969 |
| | | | | | *M. osbornii* Lange 1969 |
| | | | | *Patouillardiella* Speg. | *P. imbricata* Dilcher 1965 |
| | | | | *Potamomyces* K.D. Hyde | *P. batii* (Sancay) ex Nuñez Otaño et al. 2017 |
| | | | | | *P. elsikii* (Nandi & A. Sinha) Nuñez Otaño et al. 2017 |
| | | | | | *P. fournieri* (Elsik & Jarzen) Nuñez Otaño et al. 2017 |
| | | | | | *P. invaginatus* (Elsik & Jarzen) Nuñez Otaño et al. 2017 |
| | | | | | *P. magnus* (Elsik & Jarzen) Nuñez Otaño et al. 2017 |
| | | | | | *P. mulleri* (Nandi & A. Sinha) Nuñez Otaño et al. 2017 |
| | | | | | *P. pontidiensis* (Sancay) ex Nuñez Otaño et al. 2017 |
| | | | | *Rhexoampullifera* P.M. Kirk | *R. stogieana* M.J. Pound et al. 2018 |
| | | | | | *R. sufflata* M.J. Pound et al. 2018 |
| | | | | *Tetracoccosporium* Szabó | *T. eocenum* Biradar & Mahab. 1974 |
| *Basidiomycota* R.T. Moore | *Agaricomycetes* Doweld | *Agaricales* Underw. | *Nidulariaceae* Dumort. | *Cyathus* Haller | *C. dominicanus* Poinar ex R.K. Saxena & P.M. Kirk 2022 |
| | | | | *Nidula* V.S. White | *N. baltica* Poinar ex R.K. Saxena & P.M. Kirk 2022 |
| | | *Boletales* E.-J. Gilbert | *Sclerodermataceae* Corda | *Scleroderma* Pers. | *S. echinosporites* Rouse 1962 |
| | | *Cantharellales* Gäum. | *Hydnaceae* Chevall | *Hydnum* L. ex Fr. | *H. argillae* R. Ludw. 1859 |
| | | *Geastrales* K. Hosaka & Castellano | *Geastraceae* Corda | *Geastrum* Pers. | *G. tepexense* Magallon-Puebla & Cevallos-Ferriz 1993 |

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| | | *Polyporales* Gäum. | *Polyporaceae* Fr. ex Corda | *Fomes* (Fr.) Fr. | *F. idahoensis* R.W. Br. 1940 |
| | *Agaricostilbomycetes* R. Bauer et al. | *Agaricostilbales* Oberw. & Bauer | *Chionosphaeraceae* Oberw. & Bandoni | *Stilbum* Tode ex Fr. | *S. succini* Casp. 1907 |
| | *Ustilaginomycetes* Warm. | *Urocystidales* R. Bauer & Oberw. | *Glomosporiaceae* Cif. | *Thecaphora* Fingerh | *T. mohgaoensis* (Chitaley & Yawale) R.K. Saxena et al. 2021 |
| | | | *Urocystidaceae* Begerow. et al. | *Mundkurella* Thirum. | *M. mohgaoensis* Chitaley & Yawale 1978 |
| | | *Ustilaginales* G. Winter | *Ustilaginaceae* Tul. & C. Tul. | *Ustilago* (Pers.) Roussel | *U. deccani* Chitaley & Yawale 1978 |
| *Chytridiomycota* Doweld | *Chytridiomycetes* M. Möbius | *Chytridiales* Cohn | *Chytriomycetacea e* Letcher | *Entophlyctis* A. Fisch. | *E. willoughbyi* W.H. Bradley 1967 |
| *Glomeromycota* C. Walker & A. Schüßler | *Glomeromycetes* Caval.-Sm. | *Glomerales* J.B. Morton & Benny | *Glomeraceae* Piroz. & Dalpé | *Rhizophagus* P.A. Dang | *R. fasciculatus* (Thaxt.) C. Walker & A. Schüßler in A. Schüßler & C. Walker 2010 |

## GEOGRAPHIC DISTRIBUTION

A country-wise list of fossil species assigned to extant genera, e.g. in Australia, Canada, China, Colombia, Dominican Republic, France, Germany, India, Malaysia, Mexico, Peru, Poland, Russia (East Prussia and Kaliningrad), Turkey, U.K. and U.S.A., along with relevant references of publications has been presented here (Table 2). Indian records of such species are presented in Table 3.

**Table 2.** Global distribution of fossil fungal species assigned to extant genera.

| Location | Fossil species assigned to extant genera | Original publication reference |
|---|---|---|
| Australia | *Asterina kosciuskensis* Selkirk | Selkirk 1975 |
| | *Manginula maegdefraui* Lange | Lange 1969 |
| | *Manginula osbornii* Lange | Lange 1969 |
| | *Meliola spinksii* Dilcher | Dilcher 1965 |
| | *Vizella discontinua* Selkirk | Selkirk 1972 |
| Canada | *Alternaria acuminata* (Rouse & Mustard) R.K. Saxena et al. | Rouse & Mustard 1997 |
| | *Alternaria alternariata* (Kalgutkar & Sigler) R.K. Saxena et al. | Kalgutkar & Sigler 1995 |
| | *Desmidiospora marginiconvoluta* Kalgutkar | Kalgutkar 1997 |
| | *Scleroderma echinosporites* Rouse | Rouse 1962 |
| China. | *Alternaria clavellata* (Z.-C. Song & G.-X. Li) R.K. Saxena et al. | Song et al. 1989 |
| Colombia | *Potamomyces fournieri* (Elsik & Jarzen) Nuñez Otaño et al. | Elsik & Jarzen 2009 |
| | *Potamomyces invaginatus* (Elsik & Jarzen) Nuñez Otaño et al. | Elsik & Jarzen 2009 |
| | *Potamomyces magnus* (Elsik & Jarzen) Nuñez Otaño et al. | Elsik & Jarzen 2009 |
| Dominican Republic | *Cyathus dominicanus* Poinar ex R.K. Saxena & P.M. Kirk | Poinar 2014 |
| France | *Clasterosporium eocenicum* Fritel & R. Vig. | Fritel & Viguier 1909 |
| Germany | *Chaenothecopsis bitterfeldensis* Rikkinen & Poinar | Rikkinen & Poinar 2000 |
| | *Hydnum argillae* R. Ludw. | Ludwig 1859 |
| | *Peziza sylvatica* R. Ludw. | Ludwig 1859 |
| | *Stigmatomyces succini* W. Rossi et al. | Rossi et al. 2005 |
| India | *Alternaria psilata* (A. Gupta) R.K. Saxena et al. | Gupta 2002 |
| | *Alternaria saxenae* (A. Gupta) R.K. Saxena et al. | Gupta 2002 |
| | *Alternaria sirmaurensis* (A. Gupta) R.K. Saxena et al. | Gupta 2002 |
| | *Asterina indodeightonii* Vishnu et al. ex R.K. Saxena & P.M. Kirk | Vishnu et al. 2017 |
| | *Asterina mioconsobrina* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017 |
| | *Asterina miosphaerelloides* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017 |
| | *Asterina neocombreticola* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017 |
| | *Asterina neoelaeocarpi* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017 |
| | *Asterina presaracae* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017 |
| | *Botryodiplodia mohgaoensis* Barlinge & Paradkar | Barlinge & Paradkar 1982 |

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| | *Brachysporiella doerfeltii* (Sadowski et al.) R.K. Saxena comb. nov. | Sadowski et al. 2012 |
| | *Diplodia rodei* Mahab. | Mahabale 1969 |
| | *Diplodia sahnii* Singhai | Singhai 1974 |
| | *Epicoccum deccanense* R. Srivast. et al. | Srivastava et al. 2009 |
| | *Hendersonula mohgaoensis* R.B. Singh & G.V. Patil | Singh & Patil 1980 |
| | *Microthyriella diporata* K.P. Rao & Ramanujam | Rao & Ramanujam 1976 |
| | *Mundkurella mohgaoensis* Chitaley & Yawale | Chitaley & Yawale 1978 |
| | *Muyocopron mucoris* (Dilcher) Samarak & K.D. Hyde | Samarakoon et al. 2019 |
| | *Muyocopron neyveliensis* (Reddy et al.) Samarak & K.D. Hyde | Samarakoon et al. 2019 |
| | *Potamomyces elsikii* (Nandi & A. Sinha) Nuñez Otaño et al. | Nandi & Sinha 2007 |
| | *Potamomyces mulleri* (Nandi & A. Sinha) Nuñez Otaño et al. | Nandi & Sinha 2007 |
| | *Sarcophoma deccani* R.B. Singh & G.V. Patil | Singh & Patil 1980 |
| | *Stagonospora intertrappea* Trivedi & C.L. Verma | Trivedi & Verma 1973 |
| | *Tetracoccosporium eocenum* Biradar & Mahab. | Biradar & Mahabale 1974 |
| | *Thecaphora mohgaoense* (Chitaley & Yawale) R.K. Saxena et al. | Chitaley & Yawale 1978 |
| | *Trimmatostroma intertrappeanum* K.S. Patil & Datar | Patil & Datar 2002 |
| | *Ustilago deccanii* Chitaley & Yawale | Chitaley & Yawale 1978 |
| | *Alternaria bella* (Anil Chandra et al.) R.K. Saxena et al. | Chandra et al. 1984 |
| Malaysia | *Brachysporium trivedii* R.K. Saxena nom. nov. | Trivedi & Verma 1970 |
| Mexico | *Geastrum tepexense* Magallon-Puebla & Cevallos-Ferriz | Magallon-Puebla & Cevallos-Ferriz 1993 |
| Peru | *Zopfiella neogenica* O'Keefe | O'Keefe 2017 |
| | *Diporotheca doniana* O'Keefe | O'Keefe 2017 |
| | *Diporotheca gorda* O'Keefe | O'Keefe 2017 |
| Poland | *Acremonium succineum* Casp. | Caspary 1907 |
| | *Melanospora primigenia* (Casp.) R.K. Saxena et al. | Caspary 1907 |
| | *Ramularia oblongispora* Casp. | Caspary 1907 |
| | *Sphaerophorus moniliformis* Menge | Menge 1858 |
| | *Stilbum succini* Casp. | Caspary 1907 |
| | *Torula globulifera* Casp. | Caspary 1907 |
| | *Torula heteromorpha* Casp. | Caspary 1907 |
| | *Torula mengeana* Casp. & R. Klebs | Caspary 1907 |
| Russia (East Prussia) | *Penicillium curtipes* Berk. | Berkeley 1848 |
| Russia (Kaliningrad) | *Nidula baltica* Poinar ex R.K. Saxena & P.M. Kirk | Poinar 2014 |
| Turkey | *Potamomyces batii* (Sancay) ex Nuñez Otaño et al. | Sancay 2014 |
| | *Potamomyces pontidiensis* (Sancay) ex Nuñez Otaño et al. | Sancay 2014 |
| U.K. | *Chaetosphaeria elsikii* M.J. Pound et al. | Pound et al. 2018 |
| | *Rhexoampullifera stogieana* M.J. Pound et al. | Pound et al. 2018 |
| | *Rhexoampullifera sufflata* M.J. Pound et al. | Pound et al. 2018 |
| U.S.A. | *Rhizophagus fasciculatus* (Thaxt.) C. Walker & A. Schüßler | Thaxter 1922 |
| | *Chaetothyrina antiqua* (Dilcher) R.K. Saxena comb. nov. | Dilcher 1965 |
| | *Meliola dilcheri* R.K. Saxena nom. nov. | Dilcher 1965 |
| | *Entophlyctis willoughbyi* W.H. Bradley | Bradley 1967 |
| | *Fomes idahoensis* R.W. Br. | Brown 1940 |
| | *Asterina eocenica* Dilcher | Dilcher 1965 |
| | *Asterina nodosaria* Dilcher | Dilcher 1965 |
| | *Alternaria acuminata* (Rouse & Mustard) R.K. Saxena et al. | Rouse & Mustard 1997 |
| | *Meliola spinksii* Dilcher | Dilcher 1965 |
| | *Microthyriella fungosa* Dilcher | Dilcher 1965 |
| | *Sporidesmium henryense* Dilcher | Dilcher 1965 |
| | *Stomiopeltis plectilis* Dilcher | Dilcher 1965 |
| | *Trichopeltina exporrecta* Dilcher | Dilcher 1965 |
| | *Vizella memorabilis* (Dilcher) Selkirk | Dilcher 1965 |
| | *Patouillardiella imbricata* Dilcher | Dilcher 1965 |

**Table 3.** Indian records of fossil fungal species assigned to extant genera.

| Genus | Species | Indian records: |
|---|---|---|
| *Alternaria* Nees | *A. alternariata* (Kalgutkar & Sigler) R.K. Saxena et al. 2021 | Saxena & Ranhotra 2009: 692, figure 3.30, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat. |
| | *Alternaria bella* (Anil Chandra et al.) R.K. Saxena et al. 2022 | Chandra et al. 1984: 49, plate 2, figures 20–21, text-figure 2, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea; Saxena *et al.* 1988: 277, plate 2, figure 30, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Saxena & Bhattacharyya 1987: 189, Lower Siwalik-Nahan and Upper Siwalik (Middle Miocene-Pliocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh; Saxena & Bhattacharyya 1990: 113, Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh; Saxena & Ranhotra 2009: 692, figure 3.31–32, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat. |
| | *Alternaria psilata* (A. Gupta) R.K. Saxena et al. | Gupta 2002: 146, plate 4, figure 7, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh. |
| | *Alternaria saxenae* (A. Gupta) R.K. Saxena et al. | Gupta 2002: 145, plate 4, figure 4, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh. |
| | *Alternaria sirmaurensis* (A. Gupta) R.K. Saxena et al. | Gupta 2002: 145, plate 4, figure 3, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh. |
| *Asterina* Lév. | *Asterina indodeightonii* Vishnu et al. ex R.K. Saxena & P.M. Kirk | Vishnu et al. 2017: 152, figure 4A−C, Upper Siwalik (Kimin Formation, Late Pliocene to Early Pleistocene), Road cuttings along the Itanagar-Banderdewa road in Papumpare district, Arunachal Pradesh. |
| | *Asterina mioconsobrina* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017: 152, figure 4D−G, Upper Siwalik (Kimin Formation, Late Pliocene to Early Pleistocene), Road cuttings along the Itanagar-Banderdewa road in Papumpare district, Arunachal Pradesh. |
| | *Asterina miosphaerelloides* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017: 155, figures 5A−F, Upper Siwalik (Kimin Formation, Late Pliocene to Early Pleistocene), Road cuttings along the Itanagar-Banderdewa road in Papumpare district, Arunachal Pradesh. |
| | *Asterina neocombreticola* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017: 158, figures 6−7, Lower Siwalik (Dafla Formation, Middle to Late Miocene), Road cuttings to the south of Pinjoli area in West Kameng district, Arunachal Pradesh |
| | *Asterina neoelaeocarpi* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017: 161, figures 8A−F, Lower Siwalik (Dafla Formation, Middle to Late Miocene), Road cuttings to the south of Pinjoli area in West Kameng district, Arunachal Pradesh |
| | *Asterina presaracae* Vishnu et al. ex R.K. Saxena ex P.M. Kirk | Vishnu et al. 2017: 161, figures 9A−F, Middle Siwalik (Subansiri Formation, Pliocene), Road cuttings to the Bhalukpong area in West Kameng district, Arunachal Pradesh. |
| *Botryodiplodia* Sacc. | *Botryodiplodia mohgaoensis* Barlinge & Paradkar | Barlinge & Paradkar 1982: 168–169, plate 1, figure G, text-figures A–E, Deccan Intertrappean Series (?Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Brachysporiella* Bat. in Batista & Vital | *Brachysporiella doerfeltii* (Sadowski et al.) R.K. Saxena comb. nov. | Sadowski et al. 2012: 1102, figure 3E, on degraded thallus of cladoniform lichen in amber from Eocene sediments. |
| *Diplodia* Fr. | *Diplodia rodei* Mahab. | Mahabale 1969: 295, plate 1, figures 1–6, Deccan Intertrappean Series (Early Tertiary), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| | *Diplodia sahnii* Singhai | Singhai 1974: 97, plate 1, figures 5–8, Deccan Intertrappean Beds (Late Cretaceous, Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Epicoccum* Link | *Epicoccum deccanense* R. Srivast. et al. | Srivastava *et al.* 2009: 16, plate 1, figures 1–6, plate 2, figures 1–7, Deccan Intertrappean Beds (Late Maastrichtian-Danian), Jhargad, near Jhadgaon village, Yavatmal District, Maharashtra. |
| *Hendersonula* Speg. | *Hendersonula mohgaoensis* R.B. Singh & G.V. Patil | Singh & Patil 1980: 18, plate 1, figures 3–4, text-figures 5–6, Deccan Intertrappean Series (Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Microthyriella* Höhn. | *Microthyriella diporata* K.P. Rao & Ramanujam | Rao & Ramanujam 1976: 101–102, plate 2, figure 15, Quilon and Warkalli Beds (Late Miocene), Warkalli, Kerala. |

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|---|---|---|
| *Mundkurella* Thirum. | *Mundkurella mohgaoensis* Chitaley & Yawale | Chitaley & Yawale 1978: 193, plate 1, figures 5–6, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Muyocopron* Speg. | *Muyocopron mucoris* (Dilcher) Samarak & K.D. Hyde | Rao & Ramanujam 1976: 102, plate 1, figure 6, Quilon and Warkalli Beds (Miocene)), Kerala. |
| | *Muyocopron neyveliensis* (Reddy et al.) Samarak & K.D. Hyde | Reddy *et al.* 1982: 118, plate 2, figures 7–9, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu. |
| *Potamomyces* K.D. Hyde | *Potamomyces elsikii* (Nandi & A. Sinha) Nuñez Otaño et al. | Nandi and A. Sinha 2007: 99, plate 1, figure 7, text-figure 2B, Neogene, Rengtekawn-Sherlui Road Traverse, Mizoram. |
| | *Potamomyces mulleri* (Nandi & A. Sinha) Nuñez Otaño et al. | Nandi and Sinha 2007: 98, plate 1, figures 1−6, 8, 9, text-figure 2A, Neogene, Rengtekawn-Sherlui Road Traverse, Mizoram. |
| *Sarcophoma* Höhn. | *Sarcophoma deccani* R.B. Singh & G.V. Patil | Singh & Patil 1980: 17–18, plate 1, figures 6–7, text-figures 9–10, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Stagonospora* (Sacc.) Sacc. | *Stagonospora intertrappea* Trivedi & C.L. Verma | Trivedi & Verma 1973: 71, plate 1, figure 1–5, Late Cretaceous (Maastrichtian), Mohgaonkalan, Chhindwara District, Madhya Pradesh. |
| *Tetracoccosporium* Szabó | *Tetracoccosporium eocenum* Biradar & Mahab. | Biradar & Mahabale 1974: 223–226, plate 1, figures 1–4, text-figures 1–4, Deccan Intertrappean Series (Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |
| *Thecaphora* Fingerh. | *T. mohgaoense* (Chitaley & Yawale) R.K. Saxena et al. | Chitaley & Yawale 1978: 190, plate 1, figure 1, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh; Saxena & Ranhotra 2009: 692, figure 3.33, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat. |
| *Trimmatostroma* Corda | *T. intertrappeanum* K.S. Patil & Datar | Patil & Datar 2002: 32–34, plate 1, figures 1–4, text-figures 1–8, Deccan Intertrappean Beds (Late Cretaceous-Palaeocene), Nawargaon-Maragsur area, Wardha District, Maharashtra. |
| *Ustilago* (Pers.) Roussel | *U. deccanii* Chitaley & Yawale | Chitaley & Yawale 1978: 191–192, plate 1, figures 3–4, Deccan Intertrappean Series (Latest Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh. |

## ACKNOWLEDGEMENTS

The author is grateful to Professor Paul M. Kirk, Royal Botanic Gardens, Kew, Surrey, U.K. for his advice on nomenclatural matters. Sincere gratitude is expressed to the authorities of the Birbal Sahni Institute of Palaeosciences, Lucknow, India for library facilities.

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