

Indian Fossil Fungi

R.K. SAXENA AND S.K.M. TRIPATHI

Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India.
Email: rksaxena2207@yahoo.com; suryatripathi.2009@rediffmail.com

(Received 11 May, 2011; revised version accepted 13 June, 2011)

ABSTRACT

Saxena RK & Tripathi SKM 2011. Indian Fossil Fungi. The Palaeobotanist 60(1): 1-208.

The main objective of this publication is to synthesize the available information on Indian fossil fungi published so far. It contains four main parts, Introduction, Terminology, Description and Discussion. The introductory part provides a brief account of diversity of fungal remains through the ages, scope and organization of the publication and classification of fossil fungal spores and fruiting bodies. The Terminology part defines the commonly used terms for describing fungal remains. The Description part provides description of all the fossil fungal taxa known so far from India along with their illustration, locality, age and Indian records. MycoBank number of each genus and species is also provided. Fifteen new species, viz. *Dicellaesporites classicus*, *Dicellaesporites jainii*, *Dicellaesporites singhii*, *Foveoletisporonites keralensis*, *Frasnacritetrus masolensis*, *Fusiformisporites barmerensis*, *Inapertisporites chandreae*, *Inapertisporites karii*, *Inapertisporites sahhii*, *Kutchiathyrites mehrotrae*, *Monoporisporites meghalayaensis*, *Multicellites chandreae*, *Pluricellaesporites himachalensis*, *Pluricellaesporites keralensis* and *Pluricellaesporites mehrotrae* and twelve new combinations, viz. *Kutchiathyrites perfectus* (Kar et al.), *Meliolinites ilangsamensis* (Kar et al.), *Multicellites circularis* (Samant and Tapaswi), *Multicellites himalayaensis* (Gupta), *Multicellites jainii* (Gupta), *Multicellites psilatus* (Saxena), *Multicellites ramanujamii* (Gupta), *Multicellites reticulatus* (Samant and Tapaswi), *Palaeomycites dichotomus* (Kar et al.), *Palaeomycites excellensus* (Kar et al.), *Palaeomycites globatus* (Sharma et al.) and *Palaeomycites minutus* (Kar et al.) have been proposed. This part also records informally published fungal remains along with reference to page of their publication, illustration, horizon and age and location of occurrence. The Discussion part includes diagnostic characteristics of fossil fungal spores and fruiting bodies, general remarks on Indian fossil fungal records and stratigraphic and palaeoclimatic interpretations.

Key-words—Fungal spores, Fungal fruiting bodies, Description, Classification, India.

भारतीय कवक जीवाश्म

आर.के. सक्सेना एवं एस.के.एम. त्रिपाठी

सारांश

इस प्रकाशन का मुख्य उद्देश्य अब तक प्रकाशित भारतीय कवक जीवाश्मों पर उपलब्ध विवरण का समन्वय करना है। इस प्रकाशन के चार मुख्य भाग हैं : प्रस्तावना, शब्दावली, वर्णन एवं विवेचन। प्रस्तावना में कवक जीवाश्मों की विभिन्न कालों में विविधता, प्रकाशन का विषय-क्षेत्र व व्यवस्थापन एवं कवक बीजाणुओं तथा फलन-कायों के वर्गीकरण का संक्षिप्त विवरण उपलब्ध है। अब तक ज्ञात सभी कवक जीवाश्मों का वर्णन, प्राप्त होने का स्थान एवं रेखा-चित्र तीसरे भाग में दिए गए हैं। प्रत्येक कवक के वंश एवं जाति की माइक्रोबैक संख्या भी दी गई है। पंद्रह नवीन जातियां: *डाईसेल्लोस्पोराइटिस क्लैसिकस*, *डाईसेल्लोस्पोराइटिस जैनाई*, *डाईसेल्लोस्पोराइटिस सिंहाई*, *फोवियोल्लीटीस्पोरोनाइटिस केरलेन्सिस*, *फ्रेसनाक्राईटेट्रस मसोलैन्सिस*, *फ्यूजिफार्मिस्पोराइटिस बारमेरेन्सिस*, *इनएपरटिस्पोराइटिस चंद्राई*, *इनएपरटिस्पोराइटिस कराई*, *इनएपरटिस्पोराइटिस साहाई*, *कच्छियाथायराइटिस मेहरोत्राई*, *मोनोपोरिस्पोराइटिस मेघालयेन्सिस*, *मल्टीसेल्लाइटिस चंद्राई*, *प्लुरिसेल्लोस्पोराइटिस हिमाचलेन्सिस*, *प्लुरिसेल्लोस्पोराइटिस केरलेन्सिस* तथा *प्लुरिसेल्लोस्पोराइटिस मेहरोत्राई* एवं बारह नवीन संयोजन: *कच्छियाथायराइटिस परफेक्टस* (कर एवं अन्य) *मीलियोलिनाइटिस लैंगसामेन्सिस* (कर एवं अन्य) *मल्टीसेल्लाइटिस सर्कुलैरिस* (सामंत एवं तपस्वी) *मल्टीसेल्लाइटिस हिमालयेन्सिस* (गुप्ता), *मल्टीसेल्लाइटिस जैनाई* (गुप्ता), *मल्टीसेल्लाइटिस साइलैटस* (सक्सेना), *मल्टीसेल्लाइटिस रामानुजमाई* (गुप्ता), *मल्टीसेल्लाइटिस रेटीकुलाटस* (सामंत एवं तपस्वी), *पैलियोमाइसाइटिस डाईकोटोमस* (कर एवं अन्य), *पैलियोमाइसाइटिस एक्सिलेंसस* (कर एवं अन्य), *पैलियोमाइसाइटिस ग्लोबेटस* (शर्मा एवं अन्य), *पैलियोमाइसाइटिस माइन्यूटस* (कर एवं अन्य) प्रस्तावित किए गए हैं। इस भाग में अनियमित रूप से प्रकाशित कवक अवशेषों का उनके प्रकाशन, रेखा-चित्र, संस्तर-स्थिति व आयु एवं उत्पत्ति के स्थान सहित संदर्भ का अभिलेख है। विवेचन भाग में कवक जीवाश्म बीजाणुओं व फलन-कायों के विभेदक लक्षण, भारतीय कवक जीवाश्म अभिलेख के सामान्य कथन व स्तरिक एवं पुराजलवायवी व्याख्याएं समाविष्ट हैं।

संकेत-शब्द—कवक बीजाणु, कवक फलन-काय, वर्णन, भारत।

INTRODUCTION

Fossil fungi from India are amply diversified. These are reported in the form of spores, mycelia, fructifications and mycorrhiza. Fungal remains, commonly observed in the palynological preparations, have been sporadically recorded since long (Williamson 1878, 1880, Kidston & Lang 1921, Edwards 1922) but their study received more attention with the amplification of palynological studies since the 1950s. A great spurt in the fungal diversity is witnessed in Tertiary Period, suggesting that their proliferation is linked with diversification of angiosperms. As evident by the fossil records, Ascomycetes, the largest and most diversified group of modern fungi, got well established during the Cretaceous Period and became conspicuously abundant in the Tertiary Period (Jain 1974, Jansonius 1976, Jain & Kar 1979, Ramanujam 1982, Kalgutkar & Jansonius 2000, Tripathi 2009). The majority of dispersed fungal spores found in palynological preparations are produced by the Ascomycetes. Ascospores are produced, usually in groups of four or eight, inside a sac (ascus) by the so-called “perfect stage” (teleomorph) of these fungi. The “imperfect stage” (anamorph) may produce several types of asexual spores, named as conidiospores (or conidia). The Deuteromycetes also, comprising a large group of fossil fungi with septate hyphae, reproduce by conidia and other asexual spores. Although their conidia are similar to those met with in the Ascomycetes, the lack of a sexual (perfect) stage prevents their assignment to the latter class. Saprophytic Ascomycetes may produce ascocarps of macroscopic size and definite shape. These fruiting bodies may occur above ground, e.g. the cup fungi, or may remain subterranean, as in truffles.

Fragments of fossil fungi are commonly seen in macerated residues prepared for palynological studies. These are less frequent in samples from Palaeozoic strata but are better represented in preparations of Early Mesozoic sediments. As stated earlier, the fungal diversity increases in the Tertiary Period. Except for some distinctive Tertiary forms, fossil fungal remains cannot be generally ascribed to modern taxa hence their classification with extant fungi is not possible. Fossil fungal remains are, therefore, described as ‘form genera’ under the Artificial System of classification which is based on morphological characters only. Fossil spores are described under ‘Dispersed Spores’ which include detached spores, microscopic sporangia and fragmented mycelia. Based on characters associated with size, symmetry, pores and septa, the spores are described under different morphologic groups. On the other hand, the fructifications of epiphyllous fungi can be compared with extant forms with greater accuracy than the spores. The fructifications or the ascocarps are variously shaped, ostiolate or non-ostiolate bodies made up of radiating rows of mycelia, giving an appearance of tissues arranged in a radiating fashion. The ascocarps contain asci. Fossil epiphyllous fungi are more reliable and advantageous for

palaeoclimatic interpretations. Besides, studies particularly focusing the host-fungus relationship are of great significance in attempting the palaeoenvironmental interpretations.

During the last four decades or so, serious efforts have been made on the study of fossil fungi laying emphasis on their phylogenetic, stratigraphic and environmental aspects. In order to include all records of fossil fungal remains from the Indian Tertiary sediments, published between 1971 and 2005, two catalogues were published (Saxena 1991, 2006). Data generated on fossil fungi are significant but a large number of fossil fungal forms needed taxonomic revision, as these were either not validly published or their diagnoses and status were not properly defined. Hence, many species of different genera needed to be recombined with some other suitable genera. Kalgutkar and Jansonius (2000) took up the mountainous task and tried to streamline the taxonomic status of many fossil fungal genera and species. They described about 950 validly published species, attributed to approximately 300 genera. They proposed twelve new genera and about 350 new combinations. Transfers of species to more appropriate genera resulted in 31 junior homonyms, for which they provided new names. They also validated one genus and several species.

SCOPE AND ORGANIZATION OF THE PUBLICATION

We have documented all published genera and species of fossil fungal remains described so far from India. In addition to these, 15 new species have been proposed. These forms were assigned to different genera by earlier workers without designating them to any known species. Specimens of these forms were restudied and critical observations led to the establishment of new species. The newly proposed species are: *Dicellaesporites classicus*, *Dicellaesporites jainii*, *Dicellaesporites singhii*, *Foveoletisporonites keralensis*, *Frasnacritetrus masolensis*, *Fusiformisporites barmerensis*, *Inapertisporites chandrae*, *Inapertisporites kari*, *Inapertisporites sahi*, *Kutchiathyrites mehrotrae*, *Monoporisporites meghalayaensis*, *Multicellites chandrae*, *Pluricellaesporites himachalensis*, *Pluricellaesporites keralensis* and *Pluricellaesporites mehrotrae*. Twelve new combinations have also been proposed. These are: *Kutchiathyrites perfectus* (Kar *et al.* 2010), *Meliolinites tlangsamensis* (Kar *et al.* 2010), *Multicellites circularis* (Samant & Tapaswi 2000), *Multicellites himalayaensis* (Gupta 2002), *Multicellites jainii* (Gupta 2002), *Multicellites psilatus* (Saxena 2009), *Multicellites ramanujamii* (Gupta 2002), *Multicellites reticulatus* (Samant & Tapaswi 2000), *Palaeomycites dichotomus* (Kar *et al.* 2010), *Palaeomycites excellensus* (Kar *et al.* 2010), *Palaeomycites globatus* (Sharma *et al.* 2005) and *Palaeomycites minutus* (Kar *et al.* 2010). The genera are arranged in alphabetical order with the following details: i. Name of the genus followed by its author(s) and year of publication, ii. MycoBank number, iii. Type species, iv.

Description (including diagnosis and/or description), v. Classification, and vi. Remarks, if any. Similarly, all the species described under each genus are arranged in alphabetical order. Each species is provided with the following information: i. Name of the species followed by its author(s) and year of publication, ii. MycoBank number, iii. Description (including diagnosis and/or description), iv. Locality, v. Age, vi. Indian records, and vii. Remarks, if any. A text figure is provided for each species.

CLASSIFICATION OF FOSSIL FUNGI

Being fragmentary in nature, fossil fungi lack characteristic features that are diagnostic of extant taxa. Except for some distinctive Tertiary forms, most of the fossil fungal remains can seldom be compared with modern taxa hampering their classification under the Natural System. Problems concerning the nomenclature and classification of fossil fungi have been discussed by various workers from time to time. These workers argued that assigning most of the fossil forms to extant taxa names will lead to a taxonomic confusion and it will therefore be more convenient as well as logical to describe the fragmentary fossils as form genera which are described on the basis of morphological characters only. Following the Artificial System of classification, fossil fungal remains are divided into two categories - the **Fungal Spores** and the **Ascocarps** (fruiting bodies of epiphyllous fungi). Details of each category are provided in the Discussion part.

TERMS RELATED TO FOSSIL FUNGI

Acrogenous: Growing at the apex (conidia) of a conidiophore.

Acropetal: Conidia produced in succession forming a chain toward the apex; young conidia occurring at the tip.

Acervulus (pl. acervuli): A mat of hyphae giving rise to short conidiophores grouped together forming a specialized mycelial mass or fructification.

Amb (short for Latin *ambitus*, circuit, orbit): Term used in palynology to refer to the optical section of a spore or pollen grain, or to the outline of such a grain when seen in polar view.

Amerospore: A one-celled spore.

Amphigenous: A mycelium growing on both sides of the host leaf (as in microthyriaceous fungi).

Anamorph: The asexual vegetative form of an ascomycetous fungus.

Apothecium (pl. apothecia): An open ascocarp in which a layer of asci (hymenium) lies exposed on the surface or hollow part of the disc or variously shaped structure.

Arbuscule: Shrub-like growth; as in a tuft of conidiophores, or the haustoria-like intracellular development of mycorrhizal fungi.

Ascocarp (= ascoma, pl. ascomata): Any open or closed fruiting body containing asci of Ascomycetes.

Ascospore: A sexual spore produced as a free cell by meiosis and mitotic processes in an ascus.

Ascostroma (pl. ascostromata): Simple type of ascomycetous fructification consists of an undifferentiated mass of tissue forming a stroma, on or in which the asci are developed.

Ascus (pl. asci): An enlarged sac-like cell containing a specific number of ascospores (often four, typically eight).

Aseptate (= nonseptate): Lacking cross-walls or septa.

Astomate: Without an ostiole.

Basidiocarp: A fruiting body of Basidiomycetes bearing basidia and basidiospores.

Basidiospore: A sexual spore borne externally on a basidium.

Basidium (pl. basidia): A specialized, club-shaped cell bearing four basidiospores.

Basipetal: Conidia produced in succession, or in a chain, from the base (proximal); older conidia occurring at the tip.

Blastospore: A spore formed by budding.

Catenate (or catenulate): Produced in chains.

Chlamyospore: 1. A thick-walled, secondary spore developed from hyphae, usually intercalary that generally functions as a resting spore; 2. An endogenous, multinucleate thick walled spore, variable in volume, commonly found in parasitic fungi.

Cleistocarp: Synonymous with cleistothecium.

Cleistothecium (pl. cleistothecia): A closed ascocarp, from which ascospores are liberated by rupture or decay of the structure.

Coenobium (pl. coenobia): A colony.

Conidiophore: Simple or branched specialized hypha, arising from a vegetative mycelial hypha and bearing, at its tip or side, one or more conidiogenous cells.

Conidium (pl. conidia): A nonmotile exogenous asexual spore.

Dictyospore: Conidium divided into cells by longitudinal and transverse septa.

Didymospore: Monoseptate (dicellate) conidium.

Dimidiate: Appearing to lack one half of the wall of an ascoma, or, having one half very much smaller than the other.

Dolipore: A septum of a dikaryotic basidiomycete hypha which flares out in the middle portion forming a barrel-shaped structure with open ends.

Ectomycorrhiza: A mycorrhiza in which fungal hyphae grow intercellularly in the host tissue.

Endomycorrhiza: A mycorrhiza in which the fungal hyphae penetrate into the cells of the host; also called vesicular-arbuscular mycorrhiza (VAM).

Foliicolous: Growing on leaves.

Fungi Imperfecti: The Ascomycetes are divided into those fungi representing the perfect stage (teleomorphs) in which sexual spores are produced, or those (anamorphs, representing the imperfect stage), in which only

vegetative spores are produced. Holomorphs are those in which both sexual and asexual spores have been observed. The group of anamorph fungi are also referred to as Fungi Imperfecti, or Deuteromycetes.

Fructification: Any (sexual or asexual) structure that contains spores, ascospores, basidiospores or conidia, or asci or basidia.

Helicospore: A coiled or helical conidium.

Heterotroph: Living on food made by other organisms.

Hilum (pl. hila): A mark or scar on spores appearing like a dot, flat spot or pore, indicating the point of attachment of the spore to a conidiophore, conidiogenous cell, hypha or sterigma.

Hypha (pl. hyphae): Basic tubular, septate or aseptate, elements of the fungi that may form a mycelium (thallus).

Hyphomycetous: Relating to the Hyphomycetes; moldlike, cobwebby.

Imperfect stage (anamorph): Asexual stage (conidial) of an ascomycetous fungus.

Intramatrix: Hyphae located within the matrix or substratum.

Macronematous: Refers to any conidiophore that is differentiated from the normal hyphal cells.

Miospore: Collective designation for dispersed small or large spores and pollen grains, as found in palynological preparations, of which it may not be possible to differentiate their biological function of micro- or macrospore (megaspore).

Muriform (of conidia): Being divided by intersecting septa in more than one plane.

Mycelium (pl. mycelia): Collective term for a mass or group of hyphae or fungal filaments (the fungal thallus).

Mycology: The study of fungi.

Mycorrhiza (pl. mycorrhizae): The symbiotic association between certain fungi and the roots of plants.

Ostiole (adj. ostiolate): A pore, often at the end of a neck-like structure, in an ascocarp or a pycnidium.

Perfect stage (teleomorph): The (gametangial) sexual stage of an ascomycetous fungus.

Perithecium (pl. perithecia): A rounded, oval, pyriform or beaked ascocarp (ascoma), characteristic of the Pyrenomycetes, with a pore (ostiole) or slit at the top, and within which asci are borne in a characteristic manner.

Phragmospore: A spore with two or more transverse septa.

Pseudoparenchyma (adj. pseudoparenchymatous): A type of plectenchyma consisting of closely packed, more or less isodiametric or oval cells resembling the parenchyma of vascular plants.

Pycnidiospore: A conidium borne in a pycnidium.

Pycnidium (pl. pycnidia): An asexual hollow fruiting body lined inside with conidiophores bearing conidia. It may be fully enclosed, or have an opening (ostiole).

Saccardoan system: The grouping of conidia (and dispersed ascospores) proposed by Saccardo, mostly of the

Ascomycetes and Deuteromycetes, based on the number of cells and the organization of the septa in each spore, as well as the intensity of the pigmentation. The main groups are: Amerosporae, Didymosporae, Phragmosporae, Dictyosporae, Scolecosporae, Helicosporae and Staurosporae.

Sclerotium (pl. sclerotia): 1. A resting body composed of a hardened mass of hyphae, from which fruiting bodies, stromata or conidiophores may develop; 2. Hardened resting condition of the plasmodium of Myxomycetes.

Scolecospore: An elongated needle- or worm-like spore.

Septate: Provided with (longitudinal or) transverse partitions.

Septum (pl. septa): Internal partition in a hypha or spore.

Sporangiospore: A spore produced in a sporangium.

Sporangium (pl. sporangia): A sac-like structure producing spores endogenously.

Staurospore: stellate conidium.

Stroma (pl. stromata): A compact vegetative tissue of hyphae in which fructifications (ascocarps) are formed.

Teleomorph: Form of an ascomycetous fungus bearing a sexual organ.

Teleutospore: An old term for 'teliospore.'

Teliospore: A thick-walled resting spore of the terminal stage of Uredinales and Ustilaginales (rusts and smuts).

Thallospore: A spore formed on the thallus (mycelium), either singly or in chains within a hypha and liberated by disintegration of the hyphal wall; or terminal, as the swollen end of a hypha (and not a distinct structure). It includes blastospores, arthrospores, Chlamydospores and oidia. In part synonymous with conidia and aleurospores.

Thallus (pl. thalli): General term for the vegetative part of a non-vascular plant, particularly the Thallophytes; of the fungi, the entire assimilative phase of the individual.

Thyriothecium (pl. thyriothecia): Shield-shaped fructification (in Hemisphaerales or Microthyriales) that is oriented not by the mycelium, but by the host, with the generative tissue hanging downward, i.e. inverted. It may be considered as half a perithecium, with the tip lying beneath.

Vesicular-arbuscular mycorrhiza (VAM): A mycorrhiza in which the fungal hyphae penetrate into the cells of the host; also called endomycorrhiza.

Uredium (pl. uredia): The sorus of the Uredinales, bearing the spores.

Zoospore: A motile asexual spore.

Zygospore: Thick-walled resting spore resulting from the conjugation of isogametes (as in Zygomycetes), or the fusion of similar gametangia.

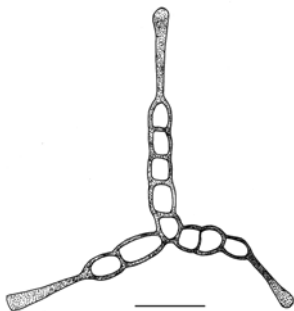
Zygote: A resting spore resulting from the fusion of two sexually dissimilar gametes.

DESCRIPTION OF FOSSIL FUNGI

A

Genus: *Alleppeysporonites* Ramanujam & Rao 1978**Mycobank No.:** MB 21008.**Type species:** *Alleppeysporonites scabratus* Ramanujam & Rao 1978.**Description** (Ramanujam & Rao 1978, p. 299): Spores branched, brownish in colour, multicellular, nonaperturate, septa only transverse, branches one or two per spore, gently curved. Basal and terminal cells each with a conspicuous appendage. Spore wall psilate to scabrate.**Classification:** Fungi Imperfecti, Phragmosporae.**Species: *Alleppeysporonites scabratus* Ramanujam & Rao 1978**

Fig. 1

Mycobank No.: MB 115028.**Description** (Ramanujam & Rao 1978, p. 299): Spores branched, branches one or two per spore, transverse septa 2-5 per branch, cells rectangular, 6-11 x 4-6 µm, basal and terminal cells each with a prominent appendage. Appendages simple, 15-22 µm long. Spore wall thin, scabrate.Fig. 1. *Alleppeysporonites scabratus*. Bar = 20 µm**Locality:** Alleppey, Kerala, India.**Age:** Miocene (Warkalli Beds).**Indian records:** Ramanujam & Rao 1978, p. 299, pl. 3, figs. 40-41, Warkalli Beds (Miocene), Alleppey, Kerala.**Remarks:** Ramanujam & Rao (1978) commented that "The branched nature and the presence of appendages are the important features of this spore type. The fossil taxon shows striking similarity to the dematiaceous fungus *Grallomyces* (Barnett 1956, Ellis 1971, Subramanian 1971). The appendages of the fossil are similar to the stalked attachment organs of *Grallomyces* conidia. The spore wall in *Grallomyces* is minutely verrucate whereas in the fossil spores it is essentially scabrate. *Grallomyces* is common in moist tropics. *Alleppeysporonites* was found occasionally in the Warkalli beds. It was also noticed, although rarely, in the clay samples

of the Padappakkara area." Ramanujam and Rao (1978) illustrated two specimens of this species. Of these, the holotype (pl. 3, fig. 40) complies with the specific diagnosis whereas the other specimen (pl. 3, fig. 41) appears to be different.

Genus: *Alternariaites* Pathak & Banerjee 1984 (nom. inval.)**Type Species:** None designated.**Remarks:** Pathak & Banerjee (1984, p. 250, pl. 2, fig. 22) informally used this generic name (*Alternariaites* sp.) for the fungal forms from the Geabdat Sandstone (Neogene), Darjeeling District, West Bengal. They ascribed the generic name to Chitale (1951) who never published it. Pathak and Banerjee (loc. cit.) neither published a generic diagnosis nor assigned any species to the genus. The genus name is therefore not validly published.**Genus: *Aplanosporites* Kar 1979****Mycobank No.:** MB 24060.**Type Species:** *Aplanosporites robustus* Kar 1979.**Description** (Kar 1979, p. 35): (Diagnosis): Spore generally subcircular, irregularly folded, inaperturate, laevigate. A tail-like appendage present in most specimens. (Description): Fully flattened specimens without folds rare, spores take various shapes due to haphazard foldings, 68-134 µm. Spore coat up to 2 µm thick. Characteristic appendage-like projection probably forms from original hyphae, terminal part of which swollen to form spore (aplanospore). In some specimens (pl. 3, fig. 58) this hypha-like growth seems to originate from other hyphae. Appendage-like structure may be preserved terminally but may also be appressed to body of spores (pl. 3, figs. 61-62).**Classification:** Zygomycetes, Endogonales.**Remarks:** *Aplanosporites* Kar 1979 is a junior synonym of *Palaeomycites* Meschinelli 1902.**Species: *Aplanosporites bharwainensis* Singh & Saxena 1981****Mycobank No.:** MB 483888.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Palaeomycites* Meschinelli 1902 [See: *Palaeomycites bharwainensis* (Singh & Saxena 1981) Kalgutkar & Jansonius 2000].**Species: *Aplanosporites robustus* Kar 1979****Mycobank No.:** MB 483361.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Palaeomycites* Meschinelli 1902 [See: *Palaeomycites robustus* (Kar 1979) Kalgutkar & Jansonius 2000].**Genus: *Appendicisporonites* Saxena & Khare 1992****Mycobank No.:** MB 28636.

Type Species: *Appendicisporonites typicus* Saxena & Khare 1992.

Description (Saxena & Khare 1992, p. 40): Spores subcircular; inaperturate; multicellular, each cell possessing a long process; processes septate or nonseptate, with pointed or blunt tips; wall psilate.

Classification: Ascomycetes, Microthyriales.

Species: *Appendicisporonites typicus* Saxena & Khare 1992
Fig. 2

Mycobank No.: MB 483897.

Description (Saxena & Khare 1992, p. 40): Spores subcircular; size 44–47 x 36–39 μm (excluding appendages); inaperturate; multicellular, each cell possessing a long process; processes nonseptate, 43–45 μm long and 5–6 μm wide with pointed tip, psilate.

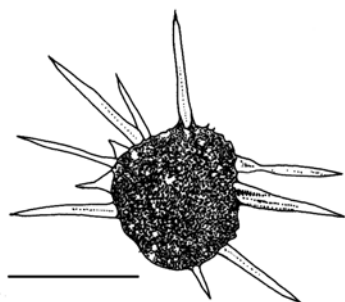


Fig. 2. *Appendicisporonites typicus*. Bar = 50 μm

Locality: Jayamkondacholapuram Well-12, Tiruchirapalli District, Tamil Nadu, India.

Age: Eocene (Neyveli Formation).

Indian records: Saxena & Khare 1992, p. 40, pl. 1, fig. 1, Late Palaeocene–Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala.

Genus: *Arbusculites* Paradkar 1976

Mycobank No.: MB 21013.

Type Species: *Arbusculites dicotylophylli* Paradkar 1976.

Description (Paradkar 1976, p. 120): Saprophytic fungus, septate mycelium, dictyosporites formed on a conidial head.

Classification: Fungi Imperfecti, Dictyosporae.

Remarks: *Arbusculites* Paradkar 1976 is a junior synonym of *Dictyosporites* Felix 1894.

Species: *Arbusculites dicotylophylli* Paradkar 1976

Mycobank No.: MB 483814.

Remarks: Kalgutkar and Jansonius (2000) transferred *Arbusculites dicotylophylli* Paradkar 1976 to *Dictyosporites* Felix 1894 [See: *Dictyosporites dicotylophylli* (Paradkar 1976) Kalgutkar & Jansonius 2000]

Genus: *Archaeoglomus* Sharma *et al.* 2005 (nom. inval.)

Mycobank No.: MB 29093.

Type Species: *Archaeoglomus globatus* Sharma *et al.* 2005 (nom. inval.).

Description (Sharma *et al.* 2005, p. 76): (Diagnosis): Chlamydo-spores subcircular-oval, size range 17–38 μm , borne on terminal end of undifferentiated hyphae, less than 2 μm thick, laevigate. (Description): Chlamydo-spores generally subcircular, sometimes look like inflated balloon, hyphae bearing these structures slightly swollen, interconnected with each other, many chlamydo-spores found together, hyphae narrow, not septate, dichotomously branched.

Classification: Zygomycetes, Endogonales.

Remarks: Sharma *et al.* (2005) proposed the generic name *Archaeoglomus*, but neither mentioned slide number nor repository of the holotype. The generic name, and also the name of its type species (*Archaeoglomus globatus* Sharma *et al.* 2005), are therefore not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006). The genus is, however, identical to *Palaeomycites* Meschinelli 1902 and therefore considered here its junior synonym.

Species: *Archaeoglomus globatus* Sharma *et al.* 2005 (nom. inval.)

Mycobank No.: MB 529470.

Remarks: While proposing the new species *Archaeoglomus globatus*, Sharma *et al.* (2005) made no mention of holotype slide and its repository, hence the species name is not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006). However, since *Archaeoglomus* is considered here a junior synonym of *Palaeomycites*, *Archaeoglomus globatus* is being transferred to *Palaeomycites* Meschinelli 1902 [See: *Palaeomycites globatus* (Sharma *et al.* 2005) comb. nov.]

Species: *Archaeoglomus minutus* Kar *et al.* 2010

Mycobank No.: MB 542206.

Remarks: *Archaeoglomus minutus* Kar *et al.* 2010 is not validly published, as it has been ascribed to a genus that is not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006). However, since *Archaeoglomus* is considered here a junior synonym of *Palaeomycites*, *Archaeoglomus minutus* is being transferred to *Palaeomycites* Meschinelli 1902 [See: *Palaeomycites minutus* (Kar *et al.* 2010) comb. nov.]

Genus: *Ascochyites* Barlinge & Paradkar 1982, non *Temerevnikova-Babajan & Taslahejan* 1973 (nom. inval.)

Mycobank No.: MB 21021.

Type Species: *Ascochyites intertrappeus* Barlinge & Paradkar 1982.

Description (Barlinge & Paradkar 1982, p. 170): Saprophytic sphaeropsidaceous fungus with ostiolate pycnidia; hyphae septate, branched; conidiospores small.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Ascochyites intertrappeus* Barlinge & Paradkar 1982

Fig. 3

Mycobank No.: MB 108705.**Description** (Barlinge & Paradkar 1982, p. 170): Saprophytic sphaeropsidaceous fungus with ostiolate pycnidia; pycnidia 80-100 x 60-65 µm; mycelium 1.5-2 µm broad, branched; conidia 2-celled, elongate, hyaline, 3.5 x 2-1.5 µm.Fig. 3. *Ascochyites intertrappeus*. Bar = 200 µm**Locality:** Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.**Age:** ?Late Cretaceous (Deccan Intertrappean Series).**Indian records:** Barlinge & Paradkar 1982, p. 169, pl. 1, fig. D, text-figs. F-G, Deccan Intertrappean Series (?Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.**Genus:** *Asterina* L veill  1845**Mycobank No.:** MB 409.**Type Species:** *Asterina melastomatis* L veill  1845.**Classification:** Ascomycetes, Microthyriales.**Species:** *Asterina eocenica* Dilcher 1965

Fig. 4

Mycobank No.: MB 326723.**Description** (Dilcher 1965, p. 17): 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 x 3.5-7 µm in small fruiting body, 2.5-3.5 x 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 x 20-28 µm. The two cells of the spores unequal in size, the larger 9-14 x 12-15 µm and the smaller 8-12 x 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 orunilaterally, may branch oppositely, hyphal cells 3-5 x 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 x 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.Fig. 4. *Asterina eocenica*. Bar = 50 µm**Locality:** Lawrence Clay pit of the Spinks Clay Co., Tennessee, U.S.A.**Age:** Early Eocene (Wilcox Formation).**Indian records:** Ramanujam & Rao 1973, p. 206, pl. 3, fig. 21, Warkalli Formation (Miocene), Varkala, Kerala.**Genus:** *Asterothyrites* Cookson 1947 emend. Kalgutkar & Jansonius 2000**Mycobank No.:** MB 21026.**Type Species:** *Asterothyrites minutus* Cookson 1947 (designated by Jansonius & Hills 1976, card 186).*Paramicrothallites* Jain & Gupta 1970.**Description** (Cookson 1947, p. 209): Mycelium superficial, persistent. Ascomata round, flat, radiate. Ascospores unknown.**Emended description** (Kalgutkar & Jansonius 2000, p. 32-33): Ascomata circular with radially arranged hyphae laterally interconnected to form a pseudoparenchymatous tissue. Cells isodiametric, squarish or elongate rectangular. Ascomata ostiolate; ostiole simple, not surrounded by a collar or thickened tissue, small or large, of irregular shape or with a regular outline. Ostiole probably formed by lysogenetic dissolution of central cell(s); small ostioles may result from rupture, or (stellate) fissure in the central part of the pseudoparenchyma.**Classification:** Ascomycetes, Microthyriales.**Species:** *Asterothyrites edvensis* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000

Fig. 5

Mycobank No.: MB 483257.

Paramicrothallites edvensis Rao & Ramanujam, Geophytology 6(1), p. 100, pl. 1, fig. 7. 1976.

Description (Rao & Ramanujam 1976, p. 100): Free mycelium lacking. Ascromata flattened, somewhat circular, margin firm and even, 50-85 µm in diameter; ostiolate, ostiole with no specialized border, rounded to slightly irregular, 7.5-9 µm in diameter; cells of ascromata radially arranged, 3-4.5 µm wide, squarish to rectangular near central region, elongated, 6-9 µm long and thin-walled near margin, margin mostly crenate with local thickenings.

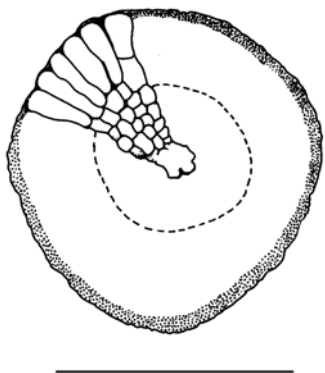


Fig. 5. *Asterothyrites edvensis*. Bar = 50 µm.

Locality: Edavai, Kerala, India.

Age: Miocene (Quilon Beds).

Indian records: Rao & Ramanujam 1976, p. 100, pl. 1, fig. 7, Quilon Beds (Miocene), Edavai, Kerala.

Species: *Asterothyrites keralensis* Rao & Ramanujam 1976

Mycobank No.: MB 309297.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites keralensis* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000].

Species: *Asterothyrites konkanensis* (Saxena & Misra 1990)

Kalgutkar & Jansonius 2000

Fig. 6

Mycobank No.: MB 534430.

Paramicrothallites konkanensis Saxena & Misra, Palaeobotanist 38, p. 270, pl. 2, fig. 9. 1990.

Description (Saxena & Misra 1990, p. 270): Ascstromata subcircular in shape, dark brown, size range 94-103 x 90-98 µm, ostiolate, ostiole subcircular, ca. 7-9 µm in diameter, unthickened, hyphae radiating, forming aporate pseudoparenchymatous cells, central cells squarish, marginal cells rectangular, margin uneven.

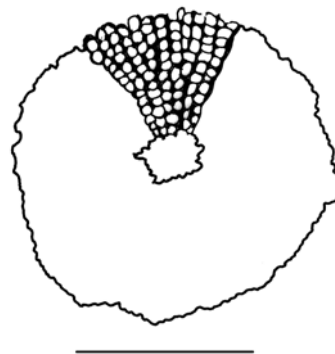


Fig. 6. *Asterothyrites konkanensis*. Bar = 50 µm.

Locality: Amberiwadi Section, Sindhudurg District, Maharashtra, India.

Age: Neogene (Sindhudurg Formation).

Indian records: Saxena & Misra 1990, p. 270, pl. 2, fig. 9, Sindhudurg Formation (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra.

Species: *Asterothyrites menonii* (Jain & Gupta 1970)

Kalgutkar & Jansonius 2000

Fig. 7

Mycobank No.: MB 483260.

Paramicrothallites menonii Jain & Gupta, Palaeobotanist 18(2), p. 179, pl. 1, fig. 10. 1970.

Description (Jain & Gupta 1970, p. 179): Ascromata flattened, circular, ostiolate, 40-60 µm in diameter, solitary, margin entire; hyphae radially arranged, interconnected, forming pseudoparenchymatous cells; central cells squarish, marginal rectangular, walls thin. Ostiole well-defined, 8-10 µm in diameter, centrally placed, not surrounded by any specialized cells, margin lobed. This simple ostiole is formed probably by the dissolution of the central cells of the ascromata. Free hyphae are either truly lacking or not preserved. Ascospore unknown.

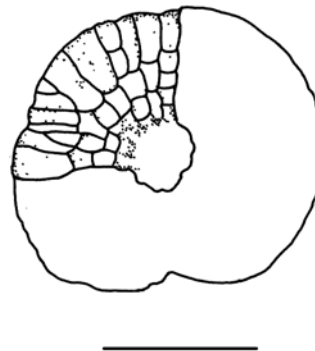


Fig. 7. *Asterothyrites menonii*. Bar = 25 µm.

Locality: Padappakkara, Kollam, Kerala, South India.

Age: Miocene (Quilon Beds).

Indian records: Jain & Gupta 1970, p. 179, pl. 1, fig. 10, Quilon Beds (Early Miocene), Kollam, Kerala; Singh *et al.* 1986, p. 96, pl. 1, fig. 4, Barail and Surma groups (Oligocene-Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rao 1995, p. 233, pl. 1, fig. 2, Tertiary, Alleppey and Kannur districts, Kerala.

Genus: *Axisporonites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28611.

Type Species: *Axisporonites indicus* (Kumar 1990) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 36): Medium-sized, inaperturate, tricellate fungal spores; overall shape more or less elliptical; two polar cells smaller, triangular, with dark pigmentation and thicker wall than large, hyaline central cell; septa thicker than wall of central cell.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Axisporonites indicus* (Kumar 1990) Kalgutkar & Jansonius 2000

Fig. 8

Mycobank No.: MB 483266.

Multicellaesporites indicus Kumar, Review of Palaeobotany and Palynology 63, p. 23, pl. 1, fig. 14. 1990.

Description (Kumar 1990, p. 23): Fungal spores tricellate, elongate, elliptical or spindle-shaped with narrowly rounded to angular ends. Size range 31-38 x 11-18 μm . A longitudinal slit present in hyaline middle region. Spore wall smooth, less than 1 μm thick in central region and ± 2 μm at the terminal and septal regions and differentially coloured or thickened. The middle cell pale to hyaline, 14-19 μm long, the terminal cells comparatively darker and smaller in size (8-9 μm long).



Fig. 8. *Axisporonites indicus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, South India.

Age: Early-Middle Miocene

Indian records: Kumar 1990, p. 23, pl. 1, fig. 14, text-fig. 15, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

B

Genus: *Basidiosporites* Elsik 1968

Mycobank No.: MB 21028.

Type species: *Basidiosporites fournieri* Elsik 1968.

Description (Elsik 1968, p. 273): Monoporate, unicellate, psilate fungal spores with the pore offset from one apex. No basal attachment area evident. Shape variable, generally elongate in some fashion.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Basidiosporites fournieri* Elsik 1968

Fig. 9

Mycobank No.: MB 309461.

Description (Elsik 1968, p. 273): Oval to capsular, monoporate fungal spores, 7 to 10 μm wide and 12-15 μm long. Wall 0.5 μm thick, psilate. Wall thickens inwards slightly at pore. Pore 0.5 μm does not bulge out. Pore is offset, not apical. A basal attachment area is not evident.

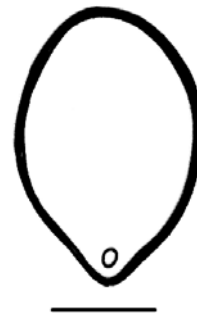


Fig. 9. *Basidiosporites fournieri*. Bar = 5 μm .

Locality: 11 km south-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Saxena & Misra 1990, p. 265, Sindhudurg Formation (Miocene), Amberiwadi Section, Sindhudurg District, Maharashtra.

Species: *Basidiosporites ovalis* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 10

Mycobank No.: MB 483267.

Monoporisporites ovalis Sheffy & Dilcher, Palaeontographica Abt. B 133(1-3), p. 40, pl. 15, fig. 21. 1971.

Description (Sheffy & Dilcher 1971, p. 40): Oval spore, 13.5 x 19.3 μm , psilate, medium pigment. Pore asymmetrical at one end of spore, wall 1.0 μm thick.

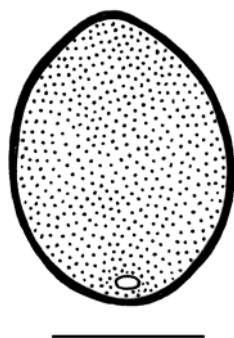


Fig. 10. *Basidiosporites ovalis*. Bar = 10 μ m.

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Ambwani 1982, p. 30, pl. 1, fig. 12, Deccan Intertrappean Series (Early Eocene), Kotta Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Remarks: Since pore is offset from one apex in *Monoporisorites ovalis* Sheffy & Dilcher 1971, it has been transferred to *Basidiosporites*.

Species: *Basidiosporites sadasivanii* Chandra *et al.* 1984

Fig. 11

MycoBank No.: MB 106626.

Description (Chandra *et al.* 1984, p. 51): Biconvex, lanceolate or oval-elliptical fungal spores, size range 33-43 x 20-21 μ m; unicellate; non-septate; monoporate, pore offset from apex being situated in the centre of the longer axis, circular, 1-3 μ m in diameter, pore margin slightly thickened, spore wall 0.5 μ m thick, psilate.

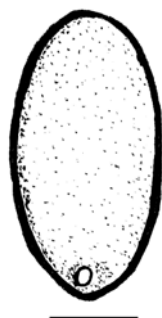


Fig. 11. *Basidiosporites sadasivanii*. Bar = 10 μ m.

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 51, pl. 2, fig. 30, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Genus: *Biporipsilonites* Kalgutkar & Jansonius 2000

MycoBank No.: MB 28612.

Type species: *Biporipsilonites belluloides* (Song 1985) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 37): Generally small to medium-sized unicellate fungal spores of more or less elongate fusiform to barrel-shaped outline; generally with a plane of symmetry through the equator; spore wall generally smooth, occasionally with some subdued sculpture, and of medium thickness; two terminal pores, forming pore chambers subtended by a basal septum, and enclosed by thin wall material that further thins centrifugally; septa, thin or thick, may show a central perforation and/or small septal folds; the terminal pore itself may be closed by very thin wall material, or ruptured to gaping and broad.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Biporipsilonites fusiformis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 12

MycoBank No.: MB 483271.

Diporisorites fusiformis Chandra *et al.*, Biovigyanam 10(1), p. 54, pl. 2, figs. 37-38. 1984.

Description (Chandra *et al.* 1984, p. 54): Fusiform-elliptical fungal spores; size range 35-70 x 16-18 μ m; unicellate; aseptate; diporate, pores on both apices of spore, 4-6 μ m in diameter, pore margin not thickened; spore wall 0.5-1.0 μ m thick, psilate, sometimes dark-pigmented, occasionally slightly folded.

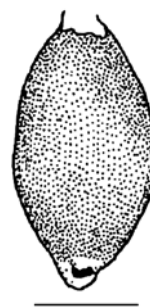


Fig. 12. *Biporipsilonites fusiformis*. Bar = 20 μ m.

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 54, pl. 2, figs. 37-38, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Species: *Biporipylonites kari* (Chandra *et al.* 1984)
Kalgutkar & Jansonius 2000

Fig. 13

MycoBank No.: MB 483272.

Multicellaesporites kari Chandra *et al.*, Biovigyanam 10(1), p. 46-47, pl. 2, fig. 13. 1984.

Description (Chandra *et al.* 1984, p. 46-47): Spindle-shaped fungal spore, size 18 x 17 μm ; tricellate, middle cell much larger than the terminal ones; inaperturate, biseptate, septa slightly thicker than the spore wall; spore wall about 1 μm thick, psilate, pigment light.

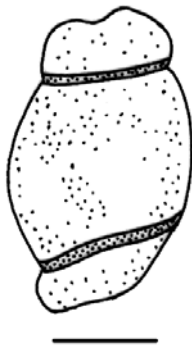


Fig. 13. *Biporipylonites kari*. Bar = 5 μm .

Locality: Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 46-47, pl. 2, fig. 13, Late Quaternary, Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Species: *Biporipylonites krempii* (Varma & Rawat 1963)
Kalgutkar & Jansonius 2000

Fig. 14

MycoBank No.: MB 483273.

Psilodiporites krempii Varma & Rawat, Grana Palynologica 4(1), p. 132, figs. 8-9. 1963.

Diporiporites krempii (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 277. 1968. (nom. inval.).

Description (Varma & Rawat, p. 132): Pollen grains 2-porate, isopolar, bilateral (tapering towards either end), 20-26 x 36-49 x ca. 23 μm . Pore areas about 8.6-10 μm in diameter. They have an opening which is not well defined but presumably circular (fig. 8a), about 2.9-4.3 μm in diameter. Base of the raised structure thickened, whereas the rest of the area is as thin and usually of the same colour as the general body. Exine smooth, less than 1 μm thick. The grains are fragile and provided with numerous, more or less irregular folds.



Fig. 14. *Biporipylonites krempii*. Bar = 20 μm .

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam, India.

Age: Early to Late Eocene.

Indian records: Varma & Rawat 1963, p. 132, fig. 8, Early to Late Eocene, western and eastern India, including oil exploration areas in West Bengal and Assam.

Species: *Biporipylonites padappakkarensis* (Kumar 1990)
Kalgutkar & Jansonius 2000

Fig. 15

MycoBank No.: MB 483277.

Diporicellaesporites padappakkarensis Kumar, Review of Palaeobotany and Palynology 63, p. 24, pl. 1, fig. 25. 1990.

Description (Kumar 1990, p. 24): Fungal spores multicellate and elongated-elliptical in shape. Size 30-35 x 19-22 μm . Cells unequal in size, the central cell large, 19 x 17 μm and terminal cells splitting, resulting in a beak-shaped structure, 4-6 μm long. Both ends with single pore, offset, slit-like and measuring 1-2 x 1-5 μm , partially divided into two pore cells. Septa three, comparatively thicker than the spore wall, \pm 1.6 μm thick, smooth. Wall of central cell dark coloured and terminal cells hyaline.

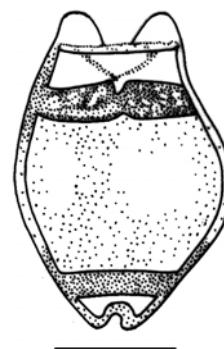


Fig. 15. *Biporipylonites padappakkarensis*. Bar = 20 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 24, pl. 1, fig. 25, text-fig. 18, Quilon Beds (Early-Middle Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Genus: *Bireticulasporis* Potonié & Sah 1960

Mycobank No.: MB 21030.

Type species: *Bireticulasporis communis* Potonié & Sah 1960.

Description (Potonié & Sah 1960, p. 130): Size varies from 77.5-129 μm ; extrema lineamenta circular to irregular, circular or polygonal; outline undulated to irregularly dentate, sometimes \pm straight; the outline may or may not be accompanied by a \pm narrow darker band which apparently results from the folding of the peripheral exine in tangential plane. The exine shows two ornamentations; a finer reticulation in the higher focus and a clear coarse reticulation in the deeper focus; the lumina of the deeper reticulation have a diameter several times as great as the diameter of the reticulation in the higher focus. In the last reticulation the lumina are \pm rounded and sometimes with diameter less than the muri between them. The coarser reticulation shows greater lumina with \pm polygonal shape or sometimes with muri which are a little sinuous. A tetrad mark or another germinal apparatus is not seen.

Classification: Fungi, Incertae sedis.

Species: *Bireticulasporis communis* Potonié & Sah 1960

Fig. 16

Mycobank No.: MB 519765.

Description (Potonié & Sah 1960, p. 131): Size ranges from 36 to 129 μm ; outline irregular circular to roundly polygonal and dentate to faintly sinuate, the extrema lineamenta inside is followed by a dark \pm narrow band; this band is formed by very narrow and dense tangential folds; coarser reticulum not always perfect perhaps as a result of bad preservation; the higher reticulation sometimes seen as sharp white points but in the highest focus as dark points.



Fig. 16. *Bireticulasporis communis*. Bar = 30 μm .

Locality: Kannur District, Kerala, India.

Age: Late Miocene (Cannanore lignite).

Indian records: Potonié & Sah 1960, p. 131, pl. 4, figs. 30-31, Cannanore lignite (Late Miocene), Kannur District, Kerala; Jain & Kar 1979, p. 108, pl. 1, fig. 12, pl. 2, fig. 24, Neogene, around Kollam and Varkala, Kerala.

Species: *Bireticulasporis indicus* Potonié & Sah 1960

Fig. 17

Mycobank No.: MB 519766.

Description (Potonié & Sah 1960, p. 131): Size range from 77.5-129 μm ; outline \pm irregular, circular, partly irregular, dentate if exolamella shrunken or partly disappeared; darker band along the periphery absent; muri of the coarser reticulum sometimes sinuous, mostly straight; lumina \pm polygonal, often having more than ten times the breadth of the muri. The fine reticulation of the higher focus may be faint but often is clear.

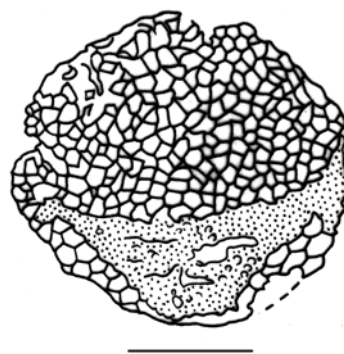


Fig. 17. *Bireticulasporis indicus*. Bar = 30 μm .

Locality: Kannur District, Kerala, India.

Age: Late Miocene (Cannanore lignite).

Indian records: Potonié & Sah 1960, p. 131, pl. 4, figs. 24-25, 30-31, Cannanore lignite (Late Miocene), Kannur District, Kerala; Jain & Kar 1979, p. 108, pl. 1, fig. 12, pl. 2, fig. 24, Neogene, around Kollam and Varkala, Kerala.

Genus: *Botryodiplodia* Saccardo 1884

Mycobank No.: MB 7420.

Type species: *Botryodiplodia mori* Dias & Camara 1954.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Botryodiplodia mohgaensis* Barlinge & Paradkar 1982

Mycobank No.: MB 108725.

Remarks: Kalgutkar *et al.* (1993) transferred this species to *Diplodites* Terevnikova-Babaian & Taslakhchian 1973 ex Kalgutkar *et al.* 1993 [See: *Diplodites mohgaensis* (Barlinge & Paradkar 1982) Kalgutkar *et al.* 1993].

Genus: *Brachysporisporites* Lange & Smith 1971

Mycobank No.: MB 21037.

Type species: *Brachysporisporites pyriformis* Lange & Smith 1971.

Description (Lange & Smith 1971, p. 677): Obovate, turbinate or pyriform, phaeophragmospores of several cells, the cells much broader than long in a sharply graded series of diminishing size from a large domed apical cell to a small hyaline attachment cell, with extremely dark thick bands of septa, similarly graded towards the attachment cell.

Emended Description (Ediger 1981, p. 93): Fungal spores of three or more cells and two or more septa, symmetrical along the long axis; clavate, obovate, pyriform or ovoid shape; cells are arranged in a graded series of diminishing size from a large domed apical cell to a relatively small hyaline or so attachment cell; one or two cells at aporate end usually bigger and making up the bulk of the spore; monoporate, pore is situated on the long axis at the narrower end of the spore; exine thickest on the biggest cell, psilate or scabrate; there may be some pits especially on the biggest cell; thickness of septa variable, there may be at least one opening on septa.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Brachysporisporites catinus* (Elsik & Jansonius 1974) Kalgutkar & Jansonius 2000

Fig. 18

Mycobank No.: MB 483795.

Granatisporites catinus Elsik & Jansonius, Canadian Journal of Botany 52, p. 954, pl. 1, fig. 15. 1974.

Description (Elsik & Jansonius 1974, p. 954): Overall shape of spore like tear-drop; four or five cells; basal cell by far the largest (22 µm long in holotype), occupying more than half of total volume of the whole spore, with thicker wall; septa perforate; in holotype no pore cell, but it may be lacking because of poor preservation; wall psilate. Size of holotype about 40 x 27 µm; basal cell 22 µm high.

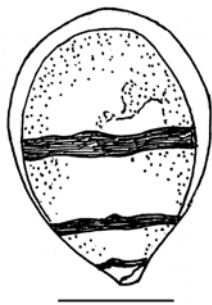


Fig. 18. *Brachysporisporites catinus*. Bar = 20 µm.

Locality: Mackenzie River Delta, North-west Territories., Canada.

Age: Palaeogene.

Indian records: Singh & Tripathi 2010, p. 11, pl. 1, fig. 11, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Brachysporisporites longovatus* Song Zhichen & Cao Liu 1994

Fig. 19

Mycobank No.: MB 483770.

Description (Song Zhichen & Cao Liu 1994, p. 41): Spores elongated ovate or narrowly spoon-shaped in outline, width of spores narrowing from the middle part to both ends, and one end sharper than the other; average size of spores in 10 specimens 50-55 µm in length, 21-24 µm in width; size of holotype 50 µm in length, widest part 24 µm in width; three- to four-celled, basal cell elongated, its length 2/3 as long as long axis of spore, other two or three cells short, small and trapezium-shaped, proximal end flat or pointed, spore probably hilate, contact areas at the septa between cells without distinct indentations; two to three septa, without folds; spore wall thick, about 1.5 µm in thickness, surface smooth, black.

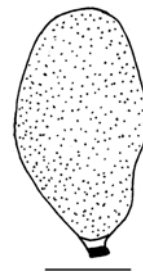


Fig. 19. *Brachysporisporites longovatus*. Bar = 20 µm.

Locality: King George Island, Antarctica.

Age: Late Cretaceous.

Indian records: Singh & Tripathi 2010, p. 10, pl. 1, fig. 4, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Brachysporisporites magnus* Samant in Saxena 2009

Fig. 20

Mycobank No. MB 515015.

Brachysporisporites magnus Samant, Geophytology 28(1-2), p. 11-12, pl. 1, figs. 1-2. 2000. (nom. inval.).

Description (Samant 2000, p. 11): Fungal spores di- or multicellular; balloon shaped; about 59-80 x 43-48 µm in size; cells of unequal size, smaller cell at the apical end, apical cells hyaline and almost opaque, basal cell quite big and balloon

shaped, opaque, about 40–48 μm in diameter; septate, septa 2–3 μm thick; spore wall about 1 μm thick, smooth.

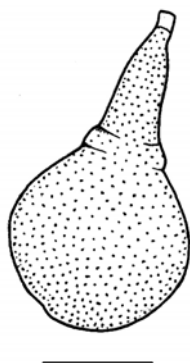


Fig. 20. *Brachysporisporites magnus*. Bar = 30 μm .

Locality: Near Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharsalia Clay Formation).

Indian records: Samant 2000, p. 11, pl. 1, figs. 1–2, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Brachysporisporites pyriformis* Lange & Smith 1971

Fig. 21

Mycobank No.: MB 309928.

Spore Type B. Ramanujam & Rao 1978, p. 296, pl. 1, figs. 18–19.

Description (Lange & Smith 1971, p. 677); Spores pyriform, the distal septum more or less equatorial to the ovoid part of the spore and approaching twice the length of the next septum, the basal part of the spore tapered and the median-width ratio of apical and attachment cells about 3:1, observed spore dimensions about 35–40 x 15–18 μm .

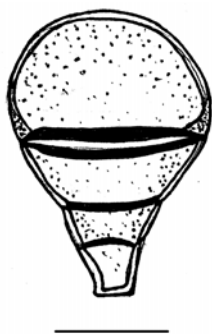


Fig. 21. *Brachysporisporites pyriformis*. Bar = 20 μm .

Locality: Maslin Bay, South Australia.

Age: Early-Middle Eocene.

Indian records: Ramanujam & Srisailam 1980, p. 130, pl. 2, fig. 30, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra. Singh & Tripathi 2010, p. 11, pl. 1, fig. 13, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Remarks: Spore Type B described by Ramanujam and Rao (1978) from Quilon and Warkalli beds (Miocene) of Kerala resembles *Brachysporisporites pyriformis* in possessing similar shape and nature of cells, septa and spore wall.

Species: *Brachysporisporites tenuis* Kumar 1990

Fig. 22

Mycobank No.: 126550.

Didymoporisporonites sp. Varma & Patil, Geophytology 15(2), p. 152, pl. 1, fig. 4. 1985.

Description (Kumar 1990, p. 23): Fungal spores di- or multicellate and balloon shaped. Size 38–43 x 22–30 μm . Cells unequal, small cell hyaline and thin, measuring 4–10 x 3–6 μm broad. Larger apical cell or cells forming a dome shaped, thick and dark coloured to opaque structure, 23–40 x 14–32 μm . Septa 2–3 μm thick, smooth to wedge-shaped.

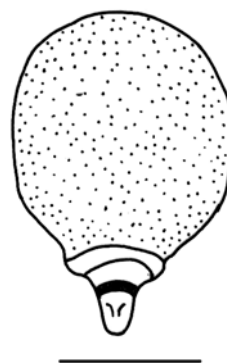


Fig. 22. *Brachysporisporites tenuis* Bar = 20 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Ramanujam & Rao 1978, p. 296, 301, pl. 1, figs. 18–19, Miocene, Kerala; Varma & Patil 1985, p. 152, pl. 1, fig. 4, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Kumar 1990, p. 23–24, pl. 1, fig. 11, text-fig. 16, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Remarks: *Didymoporisporonites* sp. described by Varma and Patil (1985) from the Miocene sediments of Tonakkal area in Thiruvananthapuram District, Kerala resembles *Brachysporisporites tenuis* Kumar (1990) in all morphological features, hence merged to it.

C

Genus: *Callimothallus* Dilcher 1965 ex Jansonius & Hills 1977**Mycobank No.:** MB 21042.**Type species:** *Callimothallus pertusus* Dilcher 1965.*Pseudosphaerialites* Venkatachala & Kar 1969, p. 180**Description** (Dilcher 1965, p. 13): No free hyphae; stroma round, radiate, astomate, no central dehiscence, individual cells may possess single pore; spores undetermined; 50-250 μm .**Classification:** Ascomycetes, Microthyriales.**Species: *Callimothallus assamicus* Kar *et al.* 1972**

Fig. 23

Mycobank No.: MB 310057.**Description** (Kar *et al.* 1972, p. 151): Ascomata flattened, subcircular to circular, non-ostiolate, 50-80 μm . Central cells triangular to polygonal from which radiating rows of cells extend outwards. Central cells porate, pores single, outward cells radially elongated.**Emended description** (Saxena *et al.* 1984, p. 188): Ascstromata subcircular; size ca. 140 x 100 μm . Non-ostiolate, margin wavy, central cells more or less circular in shape, marginal cells bigger in size and rectangular in shape, a small circular pore present in each cell of the central region, margin of the individual cell thickened.Fig. 23. *Callimothallus assamicus*. Bar = 50 μm .**Locality:** Damalgiri, Garo Hills, Meghalaya, India.**Age:** Palaeocene (Tura Formation).**Indian records:** Kar *et al.* 1972, p. 151, pl. 2, figs. 19-20, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Sah & Kar 1974, p. 182, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan; Saxena *et al.* 1984, p. 188, pl. 2, fig. 35,Lower Siwalik (Middle-Late Miocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Singh *et al.* 1985, p. 36, Barail Group (Oligocene), Assam and Meghalaya; Sarkar & Singh 1988, p. 60-61, pl. 6, fig. 22, Subathu Formation (Early Eocene), Banethi-Bagthan area, Sirmour District, Himachal Pradesh; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Saxena & Sarkar 2000, p. 257, Siju Formation (Middle Eocene), Simsang River Section near Siju, South Garo Hills District, Meghalaya.**Species: *Callimothallus dilcheri* Rao & Ramanujam 1976**

Fig. 24

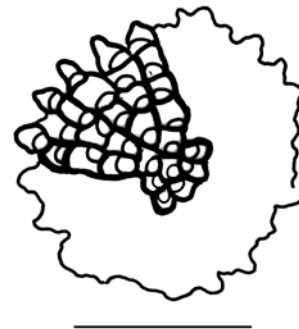
Mycobank No.: MB 310059.**Description** (Rao & Ramanujam 1976, p. 99): Free mycelium lacking; ascomata flattened, \pm circular, margin irregular, 75-120 μm in diameter, non-ostiolate, cells forming the ascomata radiating from angular central cell, cells near central region 5-6 angled and those towards periphery rectangular, 4-5 μm wide and 4-7.5 μm long, marginal cells bottle shaped (phialide-like) with a distinctly constricted neck and porate, pores one per cell, located terminally, 1.5-2.5 μm wide, radial and tangential walls of cells thickened.Fig. 24. *Callimothallus dilcheri*. Bar = 50 μm .**Locality:** Edavai, Kollam District, Kerala, India.**Age:** Miocene (Quilon Formation).**Indian records:** Rao & Ramanujam 1976, p. 99, pl. 2, fig. 13, Quilon and Warkalli Beds (Miocene), Kerala.**Species: *Callimothallus pertusus* Dilcher 1965**

Fig. 25

Mycobank No.: MB 327246.**Description** (Dilcher 1965, p. 13): Stroma round, often somewhat lobed, astomate, multiporous, entire to crenate

margins, lack free hyphae. Stroma 30-250 μm in diameter, consists of radiating rows of cells which increase in number as the diameter of the stroma increases. Centre of the stroma consists of irregularly angled, often isodiametric cells 3-5 μm in diameter. Central cells often much darker than the rest of the stroma, may proliferate to form a mound of several cells "humped up" in the centre. Radiating rows of cells extend outward from central cells. Individual cells in radiating rows 2-8 μm wide x 3-12 μm long, rectangular, often slightly wedge-shaped. Most cells of the stroma have a small pore, 1-2 μm in diameter, in upper surface of the cell. Pores slightly elevated, may be randomly placed, generally limited to extreme proximal end of the cell. No spores found. Host leaves *Sapindus* sp., most frequently occurs on upper surface, occasionally on lower surface.

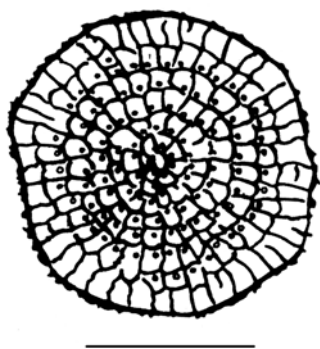


Fig. 25. *Callimothallus pertusus*. Bar = 50 μm .

Locality: Western Tennessee, U.S.A.

Age: Early Eocene.

Indian records: Ramanujam & Rao 1973, p. 205, pl. 2, figs. 15-18, Warkalli Formation (Miocene), Varkala, Kerala; Phadtare & Kulkarni 1980, p. 166, pl. 2, fig. 4, Ratnagiri Beds (Miocene), Ratnagiri-Pawas Road near Third Dharamshala stop 10 km south of Ratnagiri, Ratnagiri District, Maharashtra; Reddy *et al.* 1982, p. 114, pl. 1, figs. 10-11, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Singh & Sarkar 1984b, p. 48-49, pl. 2, fig. 32, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Singh *et al.* 1985, p. 36, Barail Group (Oligocene), Assam and Meghalaya; Varma 1987, p. 167, pl. 1, fig. 8, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Patil & Ramanujam 1988, p. 263, pl. 1, fig. 3, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Mallesham *et al.* 1989, p. 15, pl. 1, fig. 1, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Tripathi 1989, p. 72, pl. 2, fig. 3, pl. 3, fig. 8, Therria and Kopili formations (Palaeocene-Eocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirappalli District, Tamil

Nadu; Tripathi 1995, p. 47, subsurface Palaeocene-Eocene sediments near Kapurdi, Barmer District, Rajasthan; Samant & Phadtare 1997, p. 66, pl. 14, fig. 18, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Samant 2000, p. 16, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Sarkar & Prasad 2000b, p. 147, Subathu Formation (Late Ypresian-Middle Lutetian), west bank of Ghaggar river near Kharak village, Morni Hills, Haryana; Tripathi *et al.* 2000, p. 243, Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya.

Species: *Callimothallus quilonensis* Jain & Gupta 1970

Fig. 26

Mycobank No.: MB 310060.

Description (Jain & Gupta 1970, p. 180): Ascromata flattened, subcircular to circular, non-ostiolate, 35-65 μm in diameter, solitary, margin entire to crenate. Centre cell triangular from which radiating rows of cells extend outward, cells more elongated towards the periphery, peripheral cells porate, pore single, slightly elevated, 1-3 μm wide, placed apically. Cell wall thick. Hyphae absent. Ascospore unknown.



Fig. 26. *Callimothallus quilonensis*. Bar = 50 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early Miocene.

Indian records: Jain & Gupta 1970, p. 180, pl. 1, figs. 15-16, Quilon Beds (Early Miocene) Kollam District, Kerala.

Species: *Callimothallus ramanujamii* (Saxena & Singh 1982a) Kalgutkar & Jansonius 2000

Fig. 27

Mycobank No.: MB 483284.

Sivalikiathyrites ramanujamii Saxena & Singh, Geophytology 12(2), p. 294, pl. 2, fig. 25. 1982a.

Description (Saxena & Singh 1982a, p. 294): Ascstromata subcircular to circular, size range 64-86 μm , no free hyphae observed, dimidiate, non-ostiolate, arrangement of hyphae not radial, divided into central polygonal and outer elongated pseudoparenchymatous cells, cells aporate.

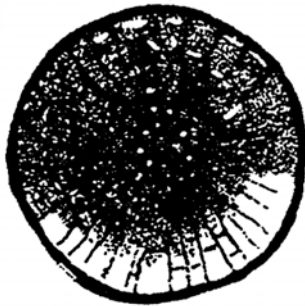


Fig. 27. *Callimothallus ramanujamii*. Bar = 40 μm .

Locality: Hoshiarpur-Una Road Section, near Bankhandi, Hoshiarpur District, Punjab, India.

Age: Miocene-Pliocene.

Indian records: Saxena & Singh 1982a, p. 294, pl. 2, figs. 24-25, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Saxena & Bhattacharyya 1990, p. 112, pl. 2, fig. 4, Dharmasala Group (Oligocene-Early Miocene), Manjhi Khad Section near Dharmasala, Kangra District, Himachal Pradesh.

Species: *Callimothallus raoi* Ramanujam & Rao 1973

Fig. 28

Mycobank No.: MB 283378.

Description (Ramanujam & Rao 1973, p. 205-206): Free mycelium lacking. Ascomata discoid, rounded, margin entire; 55-75 μm in diameter. Central part consists of irregular cavity with ragged margin, 5 or 6 layers of cells around central cavity, smaller, 1.25-3 μm in diameter, darker, thick-walled, irregularly angled than cells of rest of fruit body. Cells nearer periphery in radiating pattern, light-coloured, thinner-walled, slightly larger than former, rectangular, 2.5-6 μm x 2-4 μm . Only few cells in central and peripheral regions porate, pore single, 1-1.5 μm , usually distal in peripheral cells, central to proximal in central thick-walled cells.

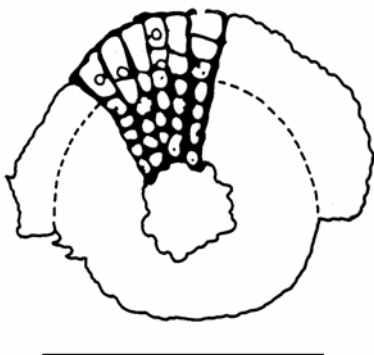


Fig. 28. *Callimothallus raoi*. Bar = 50 μm .

Locality: Warkalli, Kerala, India.

Age: Late Miocene (Warkalli lignite).

Indian records: Ramanujam & Rao 1973, p. 205-206, pl. 3, figs. 19-20, text-fig. 1, Warkalli Formation (Miocene), Varkala, Kerala.

Species: *Callimothallus senii* (Venkatachala & Kar 1969) Kalgutkar & Jansonius 2000

Fig. 29

Mycobank No.: MB 483285.

Pseudosphaerialites senii Venkatachala & Kar, Palaeobotanist 17(2), p. 181, pl. 1, figs. 6-7. 1969.

Description (Venkatachala & Kar 1969, p. 181): Perithecium subcircular, 100-140 μm ; dark brown in colour, one layer thick in most cases. Central part of perithecium darker than neighbouring regions; in the latter each stromatal cavity possesses one hypha. Hyphae radially arranged, pseudoparenchymatous; outer layer thickened and minutely setose. Asci not seen.

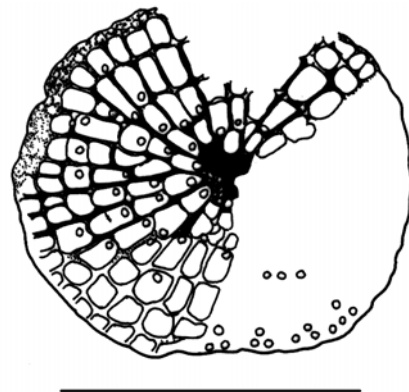


Fig. 29. *Callimothallus senii*. Bar = 100 μm .

Locality: Bore-hole No. 14, Matanomadh, Kutch District, Gujarat, India.

Age: Early Eocene.

Indian records: Venkatachala & Kar 1969, p. 181, pl. 1, figs. 6-7, Naredi Formation (Early Eocene), Matanomadh, Kutch District, Gujarat.

Genus: *Cannanosporonites* Ramanujam & Rao 1978

Mycobank No.: MB 21044.

Type species: *Cannanosporonites raoi* Ramanujam & Rao 1978.

Description (Ramanujam & Rao 1978, p. 299): Spores melanin-coloured, tetracellate, barrel shaped, cells unequal in size, basal and terminal cells smaller than central cells. Cells exhibit differential pigmentation, two central cells dark coloured, basal and terminal cells sub-hyaline to hyaline. Central cells with bulging lateral walls. Septa considerably thickened. Spore

wall psilate. Apical cell conidiogenous, bearing a large simple pore.

Classification: Fungi Imperfecti, Phragmosporae.

Remarks: *Cannanosporonites* Ramanujam & Rao 1978 is a junior synonym of *Chaetosphaerites* Felix 1894.

Species: *Cannanosporonites raoi* Ramanujam & Rao 1978

Mycobank No.: MB 115037.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Chaetosphaerites* Felix 1894 [See: *Chaetosphaerites raoi* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Genus: *Ceratohirudispora* Kar *et al.* 2010

Mycobank No.: MB 541644.

Type species: *Ceratohirudispora miocenica* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 246): Hyphomycetaceous fungi, conidiophore small, growth terminated by production of apical conidium; conidium enlarges laterally in opposite direction to produce two–three arms, conidia 5–10 celled, septa up to 2 μ m thick, with broad base and narrow tip.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Ceratohirudispora miocenica* Kar *et al.* 2010

Fig. 30

Mycobank No.: MB 542233.

Description (Kar *et al.* 2010, p. 246): Conidia of imperfect fungi, two armed, V-shaped, laterally, opposite to each other forming an acute angle, arms more or less equal in size, 24–38 x 5–9 μ m; conidia septate, septa 2 μ m thick, septa 6–8; conidia broader in middle, narrow at base and apex, wall about 1 μ m thick, laevigate.



Fig. 30. *Ceratohirudispora miocenica*. Bar = 10 μ m.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 1, fig. 7, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Ceratohirudispora triradiata* Kar *et al.* 2010

Fig. 31

Mycobank No.: MB 542234.

Description (Kar *et al.* 2010, p. 246): Hyphomycetaceous conidia, three armed providing a triradiate appearance, arms unequal in length and size, septate, septa more or less 1 μ m thick, 4–8 celled, conidia wall 1 μ m thick, laevigate.

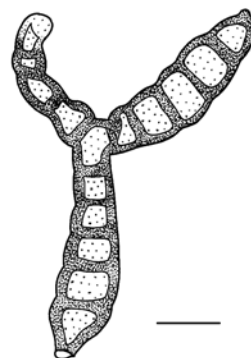


Fig. 31. *Ceratohirudispora triradiata*. Bar = 10 μ m.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 1, fig. 8, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Genus: *Cercosporites* Salmon 1903

Mycobank No.: MB 21048.

Type species: *Cercosporites salmonii* Kalgutkar 1997.

Description (combined description, Jansonius & Hills 1979, card 3541): Mycelium consisting of pale brown, septate, filamentous hyphae that grow individually and have a diameter of 5–8 μ m; at more or less irregular intervals the hyphae may suddenly inflate into larger, more or less globose cells of 15–23 μ m diameter which, when mature, are opaque dark brown and aligned into chains of 3 to 6 cells or rarely into biserial aggregates, and which probably function as sclerotia.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Cercosporites catenatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 32

Mycobank No.: MB 483287.

Pluricellaesporites catenatus Ramanujam & Rao, in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976–77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 298, pl. 3, figs. 34–35. 1978.

Description (Ramanujam & Rao 1978, p. 298): Spores melanin coloured, 4 to 6 celled, 40–65 x 15–21 μ m. Cells more or less rounded imparting a beaded look to the spores; terminal cell

dome-shaped, often darker than others, basal cell sub-hyaline to hyaline, slightly curved. Each transverse septum with two triangular or wedge-shape thickenings towards one side of spore only; thickenings on adjacent septa often face each other. A single pore between thickenings in each septum. Spore wall 1 μm thick, septa slightly thicker, surface psilate to scabrate.



Fig. 32. *Cercosporites catenatus*. Bar = 10 μm .

Locality: Varkala, Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 298, pl. 3, figs. 34-35, Miocene, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Mandaokar 1993, p. 139, Tikak Parbat Formation (Late Oligocene), Dangri Kumari Colliery, Dibrugarh District, Assam.

Genus: *Cervichlamydospora* Kar *et al.* 2010

Mycobank No.: MB 541645.

Type species: *Cervichlamydospora nigra* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 247): Chlamydo-spores sub-circular, dark brown-black, originate from neck of hyphae; solitary, 14-24 x 12-22 μm , many hyphae adhere together at base, branch out laterally at tip; hyphae wall laevigate-granulose, grana up to 1 μm thick, sparsely placed.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Cervichlamydospora nigra* Kar *et al.* 2010

Fig. 33

Mycobank No.: MB 542235.

Description (Kar *et al.* 2010, p. 247): Chlamydo-spore sub-circular, solitary, dark brown-black with a constriction at margin, margin entire like a shield, smooth, 13-23 x 12-21 μm ; arise from neck of hyphal strand, strand composed of 8-13 hyphae, closely adhered at base and region of chlamydo-spore

attachment, separate and loose in rest part, central hypha strongly built, nonseptate or rarely septate; hypha wall about 1 μm thick, generally laevigate, sometimes weakly granulose.

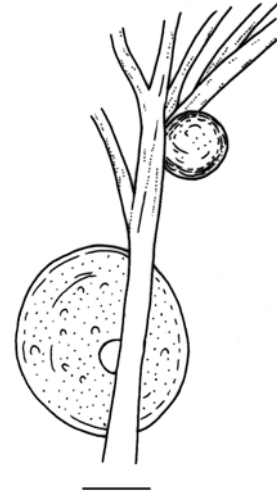


Fig. 33. *Cervichlamydospora nigra*. Bar = 10 μm .

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 247, pl. 2, fig. 5, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Genus: *Chaetosphaerites* Felix 1894

Mycobank No.: MB 21053.

Type species: *Chaetosphaerites bilychnis* Felix 1894.

Cannanorosporonites Ramanujam & Rao 1978.

Description (combined description, Felix 1894, p. 272): Some of the silicified spores are characterized particularly by the two middle cells being dark brown, the two end cells pale brown. Since the boundaries of the respective colours coincide exactly with the sharp delimitations of the individual segments, it is probably not justified to assume that the differences in shade only resulted from the state of preservation. It is unlikely, particularly in view of the minute size of the objects, for differences to occur in the state of preservation of the individual parts; in addition, within the genera *Chaetosphaeria*, *Lophiostoma*, *Massaria* and *Melanomma* there occur many species in which only the middle cells are of darker colour – generally dark brown or blackish-than the end cells which often appear almost colourless. The shape of the sporidia is strongly obtuse spindle-shaped, almost like that of a cylinder with rounded ends. They probably consist of 4 segments, but the midmost septum is not clearly visible on account of the dark colouration of this area. The length is 0.0238 mm (23.8 μm), the width 0.0085 mm (8.5 μm). The two median, dark coloured

cells are larger than the two others; their combined length is 0.0148 mm (14.8 μ m).

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Chaetosphaerites raoi* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 34

Mycobank No.: MB 483286.

Cannanosporonites raoi Ramanujam & Rao, in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 299, pl. 2, fig. 33. 1978.

Description (Ramanujam & Rao 1978, p. 299): Spore 4-celled, 55 x 32 μ m, basal and apical cells about half the size of central cells and more flattened. Transverse septa up to 4 μ m thick; lateral walls of central cells 2.5 μ m thick, of basal and apical cells 1.5 μ m thick, surface psilate.

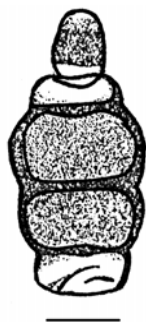


Fig. 34. *Chaetosphaerites raoi*. Bar = 10 μ m.

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 299, pl. 2, fig. 33, Miocene, Kerala.

Genus: *Chlamydospora* Kar *et al.* 2010

Mycobank No.: MB 541646.

Type species: *Chlamydospora dichotoma* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 245): Chlamydospores oval, 12–25 x 10–22 μ m, dark brown, hyphae dichotomously branched to produce two spores, wall up to 2 μ m thick, laevigate, hyphae septate.

Classification: Zygomycetes, Endogonales.

Remarks: Kar *et al.* (2010) proposed the new genus *Chlamydospora*, which is identical to *Palaeomycites* Meschinelli 1902 and therefore considered here its junior synonym.

Species: *Chlamydospora dichotoma* Kar *et al.* 2010

Mycobank No.: MB 542237.

Remarks: Since *Chlamydospora* is considered here a junior synonym of *Palaeomycites*, *Chlamydospora dichotoma* Kar *et al.* 2010 is being transferred to *Palaeomycites* Meschinelli 1902 [See: *Palaeomycites dichotomus* (Kar *et al.* 2010) comb. nov.]

Genus: *Chlamydosporites* Paradkar 1975

Mycobank No.: MB 21054.

Type species: *Chlamydosporites gramineus* Paradkar 1975.

Description (Paradkar 1975, p. 96): Mycelium of septate branched hyphae with haustoria, chlamydospores with thick wall.

Classification: Basidiomycetes, Ustilaginales.

Species: *Chlamydosporites gramineus* Paradkar 1975

Fig. 35

Mycobank No.: MB 311052.

Description (Paradkar 1975, p. 96): Mycelium of profusely branched hyphae, septate, 4–6 μ m broad, with haustoria, chlamydospores 10–12 μ m thick with reticulate exine and thin intine.

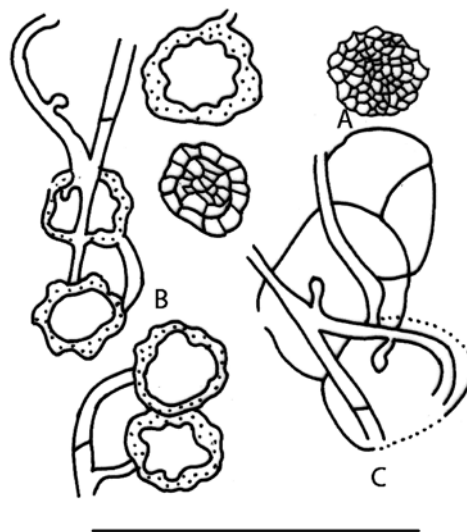


Fig. 35. *Chlamydosporites gramineus*. A. Reticulate chlamydospore; B-C. Mycelium and hyphae with haustoria and chlamydospores. Bar = 50 μ m.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India

Age: ?Late Cretaceous (Deccan Intertrappean Series).

Indian records: Paradkar 1975, p. 96-97, pl. 1, fig. 4, Deccan Intertrappean Series (?Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Circinoconites* Kar *et al.* 2010**Mycobank No.:** MB 541647.**Type species:** *Circinoconites arthrus* Kar *et al.* 2010.**Description** (Kar *et al.* 2010, p. 246): Fungal conidia, conidia acrogenous, strongly spiralled, spirals 30–39 x 25–31 μm ; solitary, coiled, not in chains or slime, 8–14 septate, fist-shaped, dark brown, constricted at septa, cells increasing in diameter from base to apex, dissimilar, spirally arranged.**Classification:** Fungi Imperfecti, Phragmosporae.**Species:** *Circinoconites arthrus* Kar *et al.* 2010

Fig. 36

Mycobank No.: MB 542238.**Description** (Kar *et al.* 2010, p. 246): Conidia arise from tip of conidiophores, helicoid, looking like fist, 42–30 x 23–27 μm made up of 10–16 cells, cells increase in size from base to top, basal cell, rectangular, 6–8 x 4–6 μm 3–4, lower cells straight, rest cells coiled, septate, septa up to 2 μm thick, constriction more marked in middle region, individual cells rectangular–wedge shaped, terminal cell oval–subcircular, 11–18 x 1216 μm ; spore wall about 1 μm thick, mostly laevigate, sometimes weakly intrastructured.Fig. 36. *Circinoconites arthrus*. Bar = 10 μm .**Locality:** Tlamsam, Mizoram, India.**Age:** Miocene (Bhuban Formation).**Indian records:** Kar *et al.* 2010, p. 246, pl. 2, fig. 10, Bhuban Formation (Miocene), Tlamsam, Mizoram.**Genus:** *Colligerites* Jain & Kar 1979**Mycobank No.:** MB 21058.**Type species:** *Colligerites kutchensis* (Kar & Saxena 1976) Jain & Kar 1979.**Description** (Jain & Kar 1979, p. 110): Spores multicellular, coiled, cells generally smaller, rounded in central region and bigger, rectangular in outer region. Spore wall mostly laevigate,

sometimes granulose. Pore may be present or absent in each cell.

Classification: Fungi Imperfecti, Helicosporae.**Species:** *Colligerites chowdhryi* Jain & Kar 1979**Mycobank No.:** MB 112034.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Involutisporonites* Clarke (1965) [See: *Involutisporonites chowdhryi* (Jain & Kar 1979) Kalgutkar & Jansonius 2000].**Species:** *Colligerites kutchensis* (Kar & Saxena 1976) Jain & Kar 1979

Fig. 37

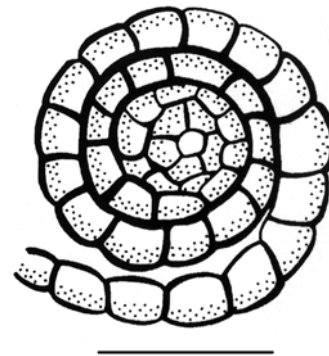
Mycobank No.: MB 112205.*Involutisporonites kutchensis* Kar & Saxena, Palaeobotanist 23(1), p. 12, pl. 3, fig. 37. 1976.**Description** (Kar & Saxena 1976, p. 12): Coiled, laevigate, generally monoporate fungal spores. Cells in central region darker with thicker wall and rhomboid-squarish shape, outer cells thinner but longer, having rectangular shape.Fig. 37. *Colligerites kutchensis*. Bar = 50 μm .**Locality:** Matanomadh Village, Bhuj-Lakhpatt Road, Kutch District, Gujarat, India.**Age:** Palaeocene (Matanomadh Formation).**Indian records:** Kar & Saxena 1976, p. 12, pl. 3, figs. 37–38, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Jain & Kar 1979, p. 110, pl. 2, fig. 29, Miocene, around Kollam and Varkala, Kerala.**Colligerites trochus** Samant in Saxena 2009

Fig. 38

Mycobank No.: MB 515017.*Colligerites trochus* Samant, Geophytology 28, p. 12, pl. 1, fig. 3. 2000. (nom. inval.).**Description** (Samant 2000, p. 12): Fungal spores multicellular; coiled; trochospiral coiling; 47–60 μm in diameter; nonaperturate; first cell smallest, dark in colour and almost indistinct, cells of inner circle dark and fused, cell size gradually

increases from centre to outer region, individual cell rectangular in shape; spore wall smooth.

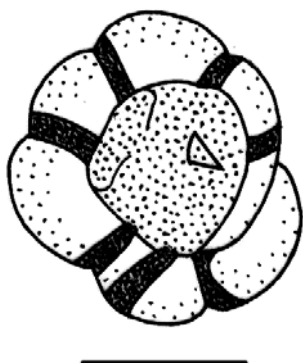


Fig. 38. *Colligerites trochus*. Bar = 30 μ m.

Locality: Near Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharsalia Clay Formation).

Indian records: Samant 2000, p. 12, pl. 1, fig. 3, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Samant & Tapaswi 2000, p. 29, fig. 2.1, Cambay Shale (Early Eocene), Cambay Basin, Gujarat.

Genus: *Cucurbitariaceites* Kar *et al.* 1972

Mycobank No.: MB 21067.

Type species: *Cucurbitariaceites bellus* Kar *et al.* 1972.

Description (Kar *et al.* 1972, p. 148): Pseudoperithecia subcircular to circular, 40-120 μ m, outer region darker than inner, laevigate, Asci 1-20 μ m, equal or unequal in size, cylindrical to somewhat bulging at tips in mature stage. No true paraphysis observed, but in some specimens basal part of asci may join together to form a broad irregular mesh like structure.

Classification: Ascomycetes, Dothideales.

Species: *Cucurbitariaceites bellus* Kar *et al.* 1972

Fig. 39

Mycobank No.: MB 312379.

Description (Kar *et al.* 1972, p. 148): Pseudoperithecia subcircular to circular, 40-120 μ m. Peripheral part dark brown, central part translucent, characterized by presence of a polygonal area formed by the interconnection of basal parts of asci. Asci \pm cylindrical, sometimes swollen tipped, always originate from upper surface of stroma.



Fig. 39. *Cucurbitariaceites bellus*. Bar = 50 μ m.

Locality: Nongwal Bibra, Garo Hills, Meghalaya, India

Age: Tura Formation (Palaeocene).

Indian records: Kar *et al.* 1972, p. 148, pl. 1, figs. 11-15, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Tripathi 1989, p. 73, pl. 2, fig. 8, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Mandaokar 1991, p. 26, Early Miocene, north of Maibong Railway Station, North Cachar Hills District, Assam; Mandaokar 1993, p. 139, Tikak Parbat Formation (Late Oligocene), Dangri Kumari Colliery, Dibrugarh District, Assam; Mandal *et al.* 1996, p. 80, age not mentioned, mud volcano in Baratang Island, Andaman and Nicobar Islands; Saxena *et al.* 1996, p. 21, pl. 3, fig. 13, Tura Formation (Palaeocene), Nongwal Bibra area, East Garo Hills District, Meghalaya; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Mandaokar 2000b, p. 181, pl. 1, figs. 20, 24, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Mandaokar 2000c, p. 38, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte Village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002b, p. 21, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Mandaokar 2003, p. 187, Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhaintuipui District, Mizoram; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Species: *Cucurbitariaceites keralensis* Varma & Patil 1985

Fig. 40

Mycobank No.: MB 133493.

Description (Varma & Patil 1985, p. 155): Pseudoperithecia subcircular to circular, dark-brown, 86-90 μm in diameter. Outer region light-brown, characteristically very wide (about 28-32 μm), uneven, with microreticulate ornamentation, imparting a mesh-like appearance to the peripheral zone. Central part conspicuously small, circular in outline, about 20-26 μm in diameter, with radiating lines of adpressed asci running from the radius to the periphery of the central part. Central part darker than the peripheral region.

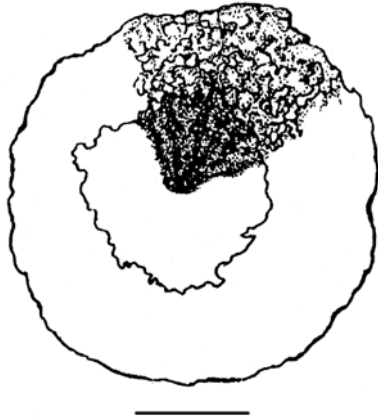


Fig. 40. *Cucurbitariaceites keralensis*. Bar = 50 μm .

Locality: Tonakkal, Thiruvananthapuram District, Kerala, India.

Age: Miocene.

Indian records: Varma & Patil 1985, p. 155, pl. 1, fig. 29, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

D

Genus: *Dactylosporites* Paradkar 1976

Mycobank No.: MB 21070.

Type species: *Dactylosporites dicotylophylli* Paradkar 1976.

Description (Paradkar 1976, p. 120): Fungus saprophytic, mycelium septate, phragmospores smooth.

Classification: Fungi Imperfecti, Dictyosporae.

Remarks: *Dactylosporites* Paradkar 1976 is a junior synonym of *Dictyosporites* Felix 1894.

Species: *Dactylosporites dicotylophylli* Paradkar 1976

Mycobank No.: MB 483815.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dictyosporites* Felix 1894 with a new name [See: *Dictyosporites paradkariae* Kalgutkar & Jansonius 2000]

Genus: *Deccanodia* Singhai 1974

Mycobank No.: MB 21071.

Type species: *Deccanodia eocena* Singhai 1974.

Description (Singhai 1974, p. 100): Pycnidium brown, more or less globose, non-ostiolate, thick-walled; conidia many, faintly to dark brown in a mass, unequally 2-celled, oblong or ellipsoid.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Deccanodia eocena* Singhai 1974

Fig. 41

Mycobank No.: MB 312756.

Description (Singhai 1974, p. 100): Pycnidium brown, more or less globose, 345 x 364 μm in size; conidia faintly brown, unequally 2-celled, oblong or ellipsoid, with their ends pointed or rounded, or one end pointed and the other round, measuring 12-24 x 2-8 μm .

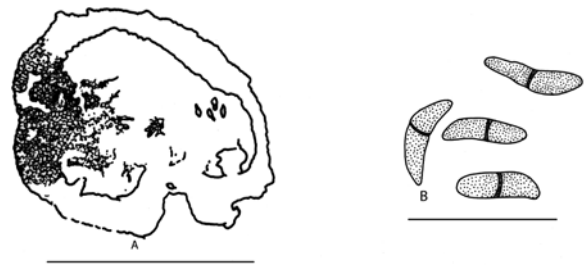


Fig. 41. *Deccanodia eocena*. A. Pycnidium. Bar = 250 μm , B. Pycnidiospores. Bar = 50 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Beds).

Indian records: Singhai 1974, p. 100, pl. 1, figs. 9-10, Deccan Intertrappean Beds (Late Cretaceous, Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Dendromyceliates* Jain & Kar 1979

Mycobank No.: MB 25610.

Type species: *Dendromyceliates splendidus* Jain & Kar 1979.

Description (Jain & Kar 1979, p. 111): Hyphae thick-walled, septate, cylindrical, base swollen, hyphae length divided into several cells by septa, cells with or without pores, generally uniporate. Tip of hyphae dichotomously branched 3-4 times, acutely pointed.

Classification: Fungi Imperfecti, Mycelia sterilia.

Species: *Dendromyceliates rajmahalensis* Tripathi 2001

Fig. 42

Mycobank No.: MB 532865.

Description (Tripathi 2001, p. 570): Fungal hyphae dark brown, 3-3.5 μm wide, < 1 μm thick, smooth, dichotomously branched, rounded tips, septate; septa thin; cells aporate. Free ends of hyphae bear globular, round-headed, smooth structures:

conidia separated by thin septa. In places, hyphae bear small, 0.5 μm long, baculate projections.

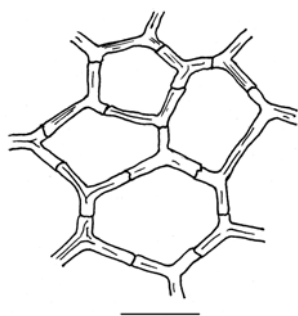


Fig. 42. *Dendromyceliates rajmahalensis*. Bar = 10 μm .

Locality: Borehole RJNE-32, depth 95.50 m, Rajmahal Basin, Bihar, India.

Age: Early Cretaceous (Rajmahal Formation).

Indian records: Tripathi 2001, p. 570, figs. 4F-K, Rajmahal Formation (Early Cretaceous), Borehole RJNE-32, depth 95.50 m, Rajmahal Basin, Bihar.

Species: *Dendromyceliates splendidus* Jain & Kar 1979

Fig. 43

Mycobank No.: MB 112059.

Description (Jain & Kar 1979, p. 112): Fungal hyphae 52-165 μm long, dark brown, thick-walled, septate, cells larger at unbranched region, smaller in upper part, with or without pores. Hyphae dichotomously branched 3-4 times, tips pointed.



Fig. 43. *Dendromyceliates splendidus*. Bar = 50 μm .

Locality: Chanakkodi, Kollam District, Kerala, India.

Age: Miocene.

Indian records: Jain & Kar 1979, p. 112, pl. 3, figs. 45-46, Neogene, around Kollam and Varkala, Kerala; Varma & Patil

1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Genus: *Desmidiospora* Thaxter 1891

Mycobank No.: MB 7964.

Type species: *Desmidiospora myrmecophila* Thaxter 1891.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Desmidiospora willoughbyi* (Bradley 1967) Ethridge Glass *et al.* 1986

Fig. 44

Mycobank No.: MB 357741.

Entophlyctis willoughbyi Bradley, American Journal of Botany 54, p. 579, fig. 6. 1967.

Description (Ethridge Glass *et al.* 1986, p. 408): 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.

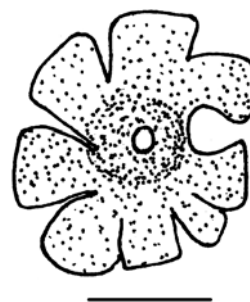


Fig. 44. *Desmidiospora willoughbyi*. Bar = 5 μm .

Locality: Wyoming, Colorado, Texas, U.S.A.

Age: Eocene.

Indian records: Jain & Gupta 1970, p. 180, pl. 1, figs. 3-5, Quilon Beds (Early Miocene), Kollam, Kerala.

Genus: *Dicellaesporites* Elsik 1968**Mycobank No.:** MB 21074.**Type species:** *Dicellaesporites popovii* Elsik 1968.**Description** (Elsik 1968, p. 269): Inaperturate, psilate fungal spores or algal bodies. Two cells, uniseptate. Shape variable.**Emended Description** (Sheffy & Dilcher 1971, p. 41): Inaperturate fungal spores or algal bodies. Two cells, uniseptate, shape variable. Sculpture psilate to scabrate.**Classification:** Fungi Imperfecti, Didymosporae.**Species: *Dicellaesporites aculeolatus* Sheffy & Dilcher 1971**

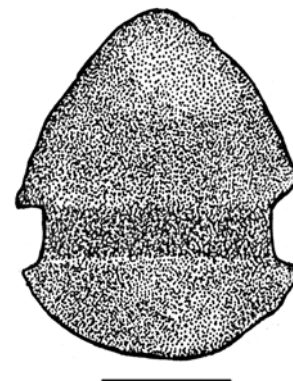
Fig. 45

Mycobank No.: MB 111404.**Description** (Sheffy & Dilcher 1971, p. 41): Dicellate spore, slightly tapered at both ends. Single opaque septum, wall smooth, 0.5-1.0 μm thick with small irregular folds. Size range from 5.8 x 18.4 μm - 6.8 x 21.3 μm .Fig. 45. *Dicellaesporites aculeolatus*. Bar = 5 μm .**Locality:** Puryear clay pit, Tennessee, Henry County, U.S.A.**Age:** Middle Eocene (Claiborne Formation).**Indian records:** Ramanujam & Rao 1978, p. 295, pl. 1, fig. 11, Miocene, Kerala.**Species: *Dicellaesporites classicus* sp. nov.**

Fig. 46

Mycobank No.: MB 561702.*Dicellaesporites* sp. B in Singh *et al.*, Palaeobotanist 35(1), p. 98, pl. 2, fig. 23. 1986.**Description:** Fungal spore elongated, biconvex. Size 110-126 x 34-46 μm . Dicellate. Inaperturate. Uniseptate, septa clearly discernible, thicker than spore wall. Spore wall 0.5-1 μm thick, foveolate, foveola sparsely placed but evenly distributed. Few irregular folds present.Fig. 46. *Dicellaesporites classicus*. Bar = 25 μm .**Holotype:** Singh *et al.* 1986, pl. 2, fig. 23, Slide no. 8122, Birbal Sahni Institute of Palaeobotany, Lucknow.**Locality:** Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam, India.**Age:** Early Miocene (Bhuban Formation).**Indian records:** Singh *et al.* 1986, p. 98, pl. 2, fig. 23, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.**Species: *Dicellaesporites companulatus* Ambwani 1983**

Fig. 47

Mycobank No.: MB 106768.**Description** (Ambwani 1983, p. 148): Inaperturate fungal spore bodies, two cells, uniseriate, dark brown to blackish in colour, size \pm 80 μm , shape ovate, upper cell companulate while basal cell round, two cells separated by a very thick septum, about 12 μm thick. Exine thin and smooth.Fig. 47. *Dicellaesporites companulatus*. Bar = 20 μm .**Locality:** Neyveli, South Arcot District, Tamil Nadu, India.**Age:** Miocene (Neyveli lignite).**Indian records:** Ambwani 1983, p. 148, pl. 1, fig. 1, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Species: *Dicellaesporites constrictus* Sah & Kar 1974

Fig. 48

Mycobank No.: MB 519767.**Description** (Sah & Kar 1974, p. 181): Two celled psilate, inaperturate fungal spores, 89-120 x 40-101 μm , constricted in middle, uniseptate. Individual cells subcircular-oval.Fig. 48. *Dicellaesporites constrictus*. Bar = 20 μm .**Locality:** Palana, Bikaner District, Rajasthan, India.**Age:** Early Eocene (Palana lignite).**Indian records:** Sah & Kar 1974, p. 181, pl. 4, fig. 99, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan.**Species: *Dicellaesporites crassiseptus* Ramanujam & Srisailam 1980****Mycobank No.:** MB 108842.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Hilidicellites* under a new name [See: *Hilidicellites dubius* Kalgutkar & Jansonius 2000]**Species: *Dicellaesporites disphaericus* Sheffy & Dilcher 1971**

Fig. 49

Mycobank No.: MB 111406.**Description** (Sheffy & Dilcher 1971, p. 42): Two celled spore, 16.4 x 26.4 μm , cells spherical, slightly flattened at one end. Dark pigment, wall rough, scabrate, 1.0 μm thick, opaque equatorial septum and pronounced constriction.**Locality:** Puryear clay pit, Tennessee, Henry County, U.S.A.**Age:** Middle Eocene (Claiborne Formation).Fig. 49. *Dicellaesporites disphaericus*. Bar = 10 μm .**Indian records:** Ambwani 1983, p. 149, pl. 1, fig. 2, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.**Species: *Dicellaesporites ellipticus* Jain & Kar 1979**

Fig. 50

Mycobank No.: MB 112269.**Description** (Jain & Kar 1979, p. 110): Spores two celled, elliptical, 45-70 x 30-60 μm in size, inaperturate, septa distinct, straight, cells equal. Spore wall 1-2 μm thick, ornamentation granulose-microverrucose, sculptural elements not more than 1 μm high.Fig. 50. *Dicellaesporites ellipticus*. Bar = 20 μm .**Locality:** Papanasam, Varkala, Kerala, India.**Age:** Miocene.**Indian records:** Jain & Kar 1979, p. 110, pl. 2, figs. 31-32, Neogene, around Kollam and Varkala, Kerala; Saxena & Bhattacharyya 1990, p. 13, Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh.**Species: *Dicellaesporites elongatus* Ramanujam & Rao 1978**

Fig. 51

Mycobank No.: MB 115060.**Description** (Ramanujam & Rao 1978, p. 295): Spores inaperturate, dicellate, melanin-coloured, ellipsoidal to almost oblong, 21-26 x 6-8 μm . Individual cells considerably elongated; spore wall 1 μm thick, transverse septum considerably thicker, often more than twice as thick as the wall, surface psilate.Fig. 51. *Dicellaesporites elongatus*. Bar = 10 μm .

Locality: Quilon and Warkalli beds of Kerala State along the west coast of South India.

Age: Miocene.

Indian records: Ramanujam & Rao 1978, p. 295, pl. 1, figs. 9-10, Miocene, Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 8, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Dicellaesporites elongatus* Kumar 1990 (nom. illeg.)

Mycobank No.: MB 126551.

Remarks: *Dicellaesporites elongatus* Kumar 1990 is illegitimate being a junior homonym of *Dicellaesporites elongatus* Ramanujam & Rao 1978. For this reason, Kalgutkar and Jansonius (2000) proposed a new name, *Dicellaesporites perelongatus*, for *Dicellaesporites elongatus* Kumar 1990, non Ramanujam & Rao 1978 [See: *Dicellaesporites perelongatus* Kalgutkar & Jansonius 2000]

Species: *Dicellaesporites elsikii* Samant in Saxena 2009

Fig. 52

Mycobank No.: MB 515018

Dicellaesporites elsikii Samant, Geophytology 28(1-2), p. 12, pl. 1, fig. 7. 2000. (nom. inval.).

Description (Samant 2000, p. 12): Fungal spores bicellate; 40-45 x 20-26 µm in size; cells of unequal size; first cell almost circular, about 20 µm in diameter, second cell large and elongate, about 26 x 20 µm in size; septate, septa thin or 1 µm; marked constriction between cells; spore wall thin (1 µm), smooth and hyaline.



Fig. 52. *Dicellaesporites elsikii*. Bar = 10 µm.

Locality: Near Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharsalia Clay Formation).

Indian records: Samant 2000, p. 12, pl. 1, fig. 7, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Dicellaesporites fusiformis* Sheffy & Dilcher 1971

Fig. 53

Mycobank No.: MB 111408.

Description (Sheffy & Dilcher 1971, p. 41): Fusiform, fungal spore 8.7 x 17.4 µm psilate, light pigment. Septum disk shaped, wall 1.0 µm thick.



Fig. 53. *Dicellaesporites fusiformis*. Bar = 10 µm.

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Saxena *et al.* 1984, p. 186, pl. 2, fig. 29, Middle Siwalik (Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Singh *et al.* 1986, p. 97, pl. 2, fig. 7, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Mandaokar 2000b, p. 181, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam.

Species: *Dicellaesporites himachalensis* Saxena & Bhattacharyya 1990

Fig. 54

Mycobank No.: MB 519768.

Description (Saxena & Bhattacharyya 1990, p. 113): Dark brown, dicellate, inaperturate, elliptical, fungal spore, distinct septa, folds invariably present, size large, spore wall very thick.



Fig. 54. *Dicellaesporites himachalensis*. Bar = 20 µm.

Locality: Manjhi Khad Section near Dharmsala, Kangra District, Himachal Pradesh, India.

Age: Early Miocene (Lower Dharmsala Group).

Indian records: Saxena & Bhattacharyya 1990, p. 113, pl. 2, fig. 9, Lower Dharmsala Group (Early Miocene), Manjhi Khad Section near Dharmsala, Kangra District, Himachal Pradesh.

Species: *Dicellaesporites himalayaensis* Gupta 2002

Fig. 55

MycoBank No.: MB 540463.

Description (Gupta 2002, p. 131): Spores two celled, uniseptate, inaperturate, $9 \times 6 - 18 \times 14 \mu\text{m}$, cells similar, not constricted where they join, septum transverse, punctate/granulate and irregularly folded, wall $0.5 \mu\text{m}$ thick

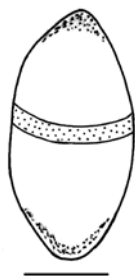


Fig. 55. *Dicellaesporites himalayaensis*. Bar = $7 \mu\text{m}$.

Locality Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 131, pl. 2, fig. 1, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Dicellaesporites inaequalis* (Varma & Patil 1985) Kalgutkar & Jansonius 2000

Fig. 56

MycoBank No.: MB 483293.

Dyadosporonites inaequalis Varma & Patil, Geophytology 15(2), p. 153, pl. 1, fig. 7. 1985.

Description (Varma & Patil 1985, p. 153): Spores dicellate, diporate, fusiform, light brown, $89-92 \times 22-24 \mu\text{m}$ at the septum. Spore wall double-layered, $2 \mu\text{m}$ thick, psilate; inner layer forms double-layered septum of uniform thickness dividing the spore into two unequal halves, septum $2-5 \mu\text{m}$ thick, with 2-pore-like cracks in the middle.



Fig. 56. *Dicellaesporites inaequalis*. Bar = $20 \mu\text{m}$.

Locality: Tonakkal area, Thiruvananthapuram District, Kerala, South India.

Age: Miocene.

Indian records: Varma & Patil 1985, p. 153, pl. 1, fig. 7, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Species: *Dicellaesporites indicus* Gupta 2002

Fig. 57

MycoBank No.: MB 540464.

Description (Gupta 2002, p. 132): Spores two celled, uniseptate, uniseriate, inaperturate, more or less doublet shaped, $9-12 \mu\text{m}$ long, $4-6.5 \mu\text{m}$ broad, variably shortly constricted in middle, transverse septum distinct, loosely ornamented with large but coarse elements, surface folded, wall ca. $1 \mu\text{m}$ thick.

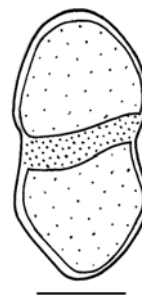


Fig. 57. *Dicellaesporites indicus* Bar = $5 \mu\text{m}$.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 132, pl. 2, fig. 2, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Dicellaesporites jainii* sp. nov.

Fig. 58

Mycobank No.: MB 519938.

Dicellaesporites sp. in Jain *et al.*, Geophytology 3(2), p. 161, pl. 2, fig. 67. 1973.

Dicellaesporites sp. 2 in Chandra *et al.*, Biovigyanam 10(1), p. 46, pl. 2, fig. 12. 1984.

Description: Capsular fungal spores, dicellate, slightly constricted in middle, 17-24 x 9-22 µm, both cells almost equal in size and shape, uniseptate, septa thicker than spore wall, spore wall about 1.0 µm thick, psilate, no aperture observed.

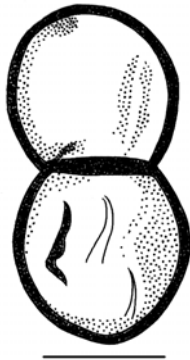


Fig. 58. *Dicellaesporites jainii*. Bar = 10 µm.

Holotype: Jain *et al.* 1973, pl. 2, fig. 67, slide no. 4273/10, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Barmer Hill, Barmer District, Rajasthan, India.

Age: Palaeocene (Barmer Sandstone).

Indian records: Jain *et al.* 1973, p. 161, pl. 2, fig. 67, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Chandra *et al.* 1984, p. 46, pl. 2, fig. 12, Late Quaternary, Core no. 5 (Lat. 24°04.5'N; Long. 69°26.0'E), Arabian Sea.

Species: *Dicellaesporites keralensis* Kumar 1990

Fig. 59

Mycobank No.: MB 126552.

Description (Kumar 1990, p. 20): Spores dicellate, inaperturate and broadly oval in shape. Size 18-22 x 13-16 µm. Broadly rounded at free ends but slightly constricted at the septal regions, cells unequal in size, 10-13 x 11-14 µm. Both septum and spore wall ±1 µm thick and smooth.

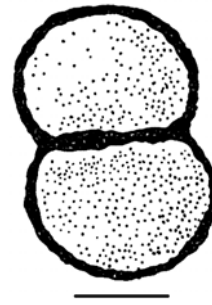


Fig. 59. *Dicellaesporites keralensis*. Bar = 10 µm.

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 20, pl. 1, fig. 12, text-fig. 9, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Samant 2000, p. 16, pl. 1, fig. 6, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Dicellaesporites levis* Sheffy & Dilcher 1971

Fig. 60

Mycobank No.: MB 111410.

Description (Sheffy & Dilcher 1971, p. 41): Dicellate spore, cells unequal in size, rounded at the apices, septum opaque, disk shaped, slight equatorial constriction. Wall psilate, 0.5-1.0 µm thick. Size ranges from 9.7 x 27.1 µm - 9.7 x 27.6 µm.

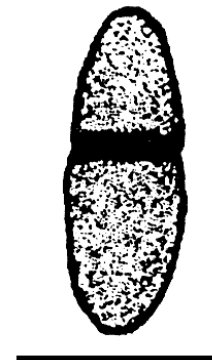


Fig. 60. *Dicellaesporites levis*. Bar = 10 µm.

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.
Age: Middle Eocene (Claiborne Formation).

Indian records: Sarkar & Singh 1988, p. 58-59, pl. 5, fig. 2, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Sarkar & Prasad 2000b, p. 147,

Subathu Formation (Late Ypresian-Middle Lutetian) west bank of Ghagggar river near Kharak village, Morni Hills, Haryana.

Species: *Dicellaesporites minutus* Kar & Saxena 1976

Fig. 61

Mycobank No.: MB 112270.

Description (Kar & Saxena 1976, p. 10): Spores bicellate, septa distinct, oval, 23-33 x 7-12 μm ; inaperturate, septa distinct, individual cells \pm same in size and shape. Spore wall up to 1.5 μm thick, laevigate.

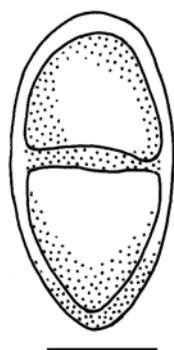


Fig. 61. *Dicellaesporites minutus*. Bar = 10 μm .

Locality: Matanomadh, Kutch District, Gujarat, India.

Age: Palaeocene (Matanomadh Formation).

Indian records: Kar & Saxena 1976, p. 10, pl. 3, fig. 28, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Ramanujam & Rao 1978, p. 295, pl. 1, figs. 9-10, Miocene, Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 8, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Malleshham *et al.* 1989, p. 18, pl. 1, fig. 5, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Tripathi 1989, p. 73, pl. 3, fig. 12, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Ambwani 1993, p. 153, Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Saxena & Rao 1996, p. 46, pl. 3, fig. 17, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Mitra *et al.* 2000, p. 126, pl. 1, fig. 5, Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte Village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002b, p. 21, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Mandaokar 2003, p. 187, Middle Bhuban

Formation (Early Miocene), Lawngtlai, Chhimituipui District, Mizoram; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram.

Species: *Dicellaesporites perelongatus* Kalgutkar & Jansonius 2000

Fig. 62

Mycobank No.: MB 483296.

Dicellaesporites elongatus Kumar, Review of Palaeobotany and Palynology 63, p. 20, pl. 1, fig. 9. 1990, non Ramanujam & Rao 1978

Description (Kumar 1990, p. 20): Spores dicellate, fusiform and inaperturate. Size 41-50 x 14-17 μm . Cells gradually tapering at either end. Both spore wall and septum \pm 1 μm thick. Spore wall smooth, light coloured and folded. Septum centrally porate.



Fig. 62. *Dicellaesporites perelongatus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 20, pl. 1, fig. 9, text-fig. 8, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Tripathi *et al.* 2000, p. 243, Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Species: *Dicellaesporites popovii* Elsik 1968

Fig. 63

Mycobank No.: MB 312948.

Description (Elsik 1968, p. 269): Capsular, inaperturate, dicellate fungal spore ca. 19 x 29 μm . Wall 0.8 μm thick, psilate. Septum 1 μm thick, appears to be of two layers.



Fig. 63. *Dicellaesporites popovii*. Bar = 10 μm .

Locality: 11 km south-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Kar & Saxena 1976, p. 10, pl. 3, fig. 27, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Ramanujam & Rao 1978, p. 295, pl. 1, fig. 8, Miocene, Kerala; Ambwani 1982, p. 30, pl. 1, fig. 10, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh; Tripathi 1989, p. 73, pl. 1, fig. 7, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Samant & Phadtare 1997, p. 66, pl. 15, fig. 6, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan; Singh & Tripathi 2010, p. 11, pl. 1, fig. 12, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Dicellaesporites singhii* sp. nov.

Fig. 64

Mycobank No.: MB 519939.

Dicellaesporites sp. in Saxena & Singh, Geophytology 12(2), p. 294, pl. 2, fig. 26. 1982a.

Dicellaesporites sp. 1 in Chandra *et al.*, Biovigyanam 10(1), p. 46, pl. 2, fig. 11. 1984.

Description: Fungal spore oval-fusiform, size 85-89 x 60-79 μm . Dicellate, cells unequal in size, smaller cells have broadly

rounded end but bigger one has \pm pointed end. Uniseptate, septa 2-2.5 μm thick, dark in colour. Inaperturate. Spore wall 0.5-1.0 μm thick, psilate to weakly structured, having few irregular folds.



Fig. 64. *Dicellaesporites singhii*. Bar = 20 μm .

Holotype: Saxena & Singh 1982a, pl. 2, fig. 26; slide no. 6702a/1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh, India.

Age: Pliocene (Upper Siwalik).

Indian records: Saxena & Singh 1982a, p. 294, pl. 2, fig. 26, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Chandra *et al.* 1984, p. 46, pl. 2, fig. 11, Late Quaternary, Core no. 1 (Lat. 17°57.92 N: Long. 70°46.0'E), Arabian Sea.

Genus: *Dictyomykus* Kar *et al.* 2010

Mycobank No.: MB 541657.

Type species: *Dictyomykus ellipticus* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 247): Conidiophores small, closely placed to form a sporodochium like cluster; conidia elliptical, basal part narrowed than terminal, 30-48 x 7-12 μm , branches 4-8, parallel, develop from a basal cell, laterally fused, multiseptate, septa margin not constricted, incurved at tip, spore wall laevigate.

Classification: Fungi, Incertae sedis.

Species: *Dictyomykus ellipticus* Kar *et al.* 2010

Fig. 65

Mycobank No.: MB 542240.

Description (Kar *et al.* 2010, p. 247): Conidiophores inconspicuous, 4-6 celled, closely adhered to each other; conidia borne singly, elliptical in shape, basal part generally narrower than terminal end, may also be equally broad at two ends, 30-48 x 9-14 μm , branches 5-8, equal in length, fused laterally except at tip, transversely septate, septa 10-18, distinct, parallel to each other, no appreciable constriction at

margin, terminal cell markedly curved, spore wall about 1 μm thick, laevigate.

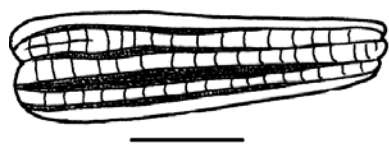


Fig. 65. *Dictyomykus ellipticus*. Bar = 10 μm .

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar et al 2010, p. 247, pl. 2, fig. 2, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.

Genus: *Dictyosporites* Felix 1894

Mycobank No.: MB 21075.

Arbusculites Paradkar 1976.

Dactylosporites Paradkar 1976.

Pleosporonites Lange & Smith 1971.

Ravenelites Ramanujam & Ramachar 1980.

Type species: *Dictyosporites loculatus* Felix 1894.

Description (combined description, Felix 1894, p. 277): The so-called wall-shaped conidia become multicellular by repeated transverse and longitudinal divisions. In addition to large conidia, whose growth can probably be regarded as complete, uni- and bicellular conidia representing the initial developmental stages also occur. They are all of brownish colouration. Their outlines are rather variable, depending on the position of the conidium to the plane of section. Viewed from the top or bottom, they often appear spherical with flatly indented outlines; longitudinal sections are of rather irregular shape; elliptical, pear-shaped or resembling short, corpulent snails (e.g. *Turbo*). The maximum length is 0.0204 mm (20.4 μm), the maximum diameter 0.0153 mm (15.3 μm); the respective dimensions of an only bicellular conidium are 0.0102 and 0.0085 mm (10.2 and 8.5 μm).

Emended description (Kalgutkar & Jansonius 2000, p. 72): Inaperturate, multicellate (apparently by internal septation, of irregular pattern), muriform fungal spores, cells rounded to rounded polygonal. Overall shape rounded, oval/ovoid to elongate; indentations may occur where septa intersect the amb. A hilum cannot be discerned. *Staphlosporonites* differs in showing a distinct hilum, or proximal hilar cell. *Papulosporonites* consists of spore clusters or aggregates, in which there is no suggestion of linear or planar symmetry. **Classification:** Fungi Imperfecti, Dictyosporae.

Species: *Dictyosporites dicotylophylli* (Paradkar 1976) Kalgutkar & Jansonius 2000

Fig. 66

Mycobank No.: MB 483297.

Arbusculites dicotylophylli Paradkar, Journal of Palynology 10(2), p. 119-120, pl. 1, fig. 5, text-fig. 1, 3-4, 7-8. 1976.

Description (Paradkar 1976, p. 119-120): Saprophytic fungus; mycelium of septate hyphae; conidial head with paraphyses; conidia of dictyospore type, irregular in size and shape, 15-22 μm in size each, in simple or branched chains. Host: decaying dicotyledonous leaves. Conidial head 60-65 μm in size; conidia in chains, muriform, compound, dictyospore type, with transverse and vertical septa forming a checkered structure inside the compound spore. Some conidial chains and many conidia are scattered on the leaf peel, as are some septate hyphae and some mycelial projections like paraphyses between the spore chains on the conidial head. Haustoria are absent. The growth of these spores is not acropetal. Conidia are irregular in size and shape. They vary from 15-22 μm in size, and are oval, oblong, squarish or rounded in shape.



Fig. 66. *Dictyosporites dicotylophylli*. Bar = 20 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Series).

Indian records: Paradkar 1976, p. 119-120, pl. 1, fig. 5, text-figs. 1, 3-4, 7-8, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Species: *Dictyosporites paradkariae* Kalgutkar & Jansonius 2000

Fig. 67

Mycobank No.: MB 483305.

Dactylosporites dicotylophylli Paradkar, Journal of Palynology 10(2), p. 120, pl. 1, fig. 2, text-fig. 5. 1976, non *Dictyosporites dicotylophylli* (Paradkar 1976) Kalgutkar & Jansonius 2000

Description (Paradkar 1976, p. 120): Fungus saprophytic, mycelium septate; elongated or oval, smooth phragmospores, 31-40 μm long and 12-18 μm broad, 4- to 9-celled, seen singly and not as groups. Mycelium (observed only in one case), septate.



Fig. 67. *Dictyosporites paradkariae*. Bar = 20 μm .

Locality: Mohgaon Kalan, Chhindwara district, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Series).

Indian records: Paradkar 1976, p. 120, 123, pl. 1, fig. 2, text-fig. 5, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Species: *Dictyosporites tirumalacharii* (Ramanujam & Ramachar) Kalgutkar & Jansonius 2000

Fig. 68

Mycobank No.: MB 483307.

Ravenelites tirumalacharii Ramanujam & Ramachar, Records of the Geological Survey of India 113(5), p. 83, pl. 1, fig. 12. 1980.

Description (Ramanujam & Ramachar 1980, p. 83): Teliospore heads rounded, chestnut-brown, often darkly so, 35-55 μm in diameter, usually 4-8 spores across in each head; configuration and size of spores in each head variable, individual spores 8-11.5 μm , wall up to 2.5 μm thick, smooth or finely flecked; germ pores one in each cell (spore) of telial head, 1.5 μm across, occasionally faint.

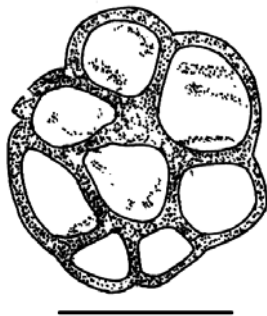


Fig. 68. *Dictyosporites tirumalacharii*. Bar = 20 μm .

Locality: Neyveli, South Arcot District, Tamil Nadu, India.

Age: Miocene (Neyveli lignite).

Indian records: Ramanujam & Ramachar 1980, p. 83, pl. 1, figs. 11-12, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Saxena & Ranhotra 2009, p. 692, figs. 3.27, 35, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Dictyosporites tristratosus* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 69

Mycobank No.: MB 483308.

Staphlosporonites tristratosus Sheffy & Dilcher, Palaeontographica Abt. B 133(1-3), p. 48, pl. 16, fig. 78. 1971.

Description (Sheffy & Dilcher 1971, p. 48): Eight or more irregular cells arranged in an ovate structure 10.6 x 19.3 μm , two to three cells wide. Psilate, light pigment, septa opaque, varying in thickness, continuous with wall, 0.7 μm thick.

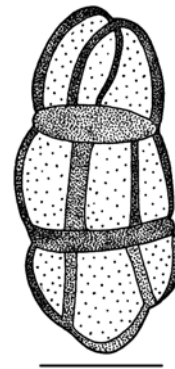


Fig. 69. *Dictyosporites tristratosus*. Bar = 5 μm .

Locality: Puryear clay pit, one-half mile south of Puryear, Henry County, Tennessee, U.S.A.

Age: Middle Eocene.

Indian records: Ambwani 1983, p. 150, pl. 1, fig. 8, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Saxena & Sarkar 2000, p. 257, Siju Formation (Middle Eocene), Simsang River Section near Siju, South Garo Hills District, Meghalaya.

Genus: *Dictyostromata* Kar *et al.* 2010

Mycobank No.: MB 541658.

Type species: *Dictyostromata perfecta* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 247): Stromata fan-shaped except attachment zone; attachment slightly pointed, haustorium hyaline, nonseptate, tubular, 32-49 x 22-38 μm , lateral arms more or less equal, hyphae radially and transversely anastomose to form pseudoreticulation on both sides.

Classification: Fungi Imperfecti, Dictyosporae.

Remarks: Kar *et al.* (2010) proposed the new genus *Dictyostromata*, which is identical to *Kutchiathyrites* Kar 1979 and therefore the former is considered here as junior synonym of the latter.

Species: *Dictyostromata perfecta* Kar *et al.* 2010

Mycobank No.: MB 542241.

Remarks: Since *Dictyostromata* is considered here a junior synonym of *Kutchiathyrites* Kar 1979, *Dictyostromata perfecta* Kar *et al.* 2010 is being transferred to *Kutchiathyrites* Kar 1979 [See: *Kutchiathyrites perfectus* (Kar *et al.* 2010) comb. nov.]

Genus: *Didymoporisporonites* Sheffy & Dilcher 1971

Mycobank No.: MB 21077.

Type species: *Didymoporisporonites psilatus* Sheffy & Dilcher 1971.

Description (Sheffy & Dilcher 1971, p. 42): Spore dicellate, uniseptate, pore at apex of one cell. Sculpture psilate to punctate, variable.

Classification: Fungi Imperfecti, Didymosporae.

Species: *Didymoporisporonites gigas* Kalgutkar & Jansonius 2000

Fig. 70

Mycobank No.: MB 483310.

Lacrimasporonites magnus Saxena & Singh, Geophytology 12(2), p. 295, pl. 2, fig. 27. 1982a, non *Lacrimasporonites magnus* Haseldonckx 1973.

Description (Saxena & Singh 1982a, p. 295): Fungal spore ± elliptical, size 120 x 47 µm, distal end of spore pointed and proximal end broad. Unicellate, aseptate. Monoporate, pore apical, on the broader end, 27 µm in diameter, surrounded by thickening. Spore wall 0.5 µm thick, psilate.

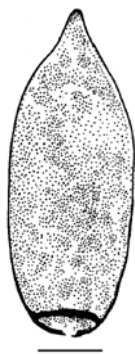


Fig. 70. *Didymoporisporonites gigas*. Bar = 10 µm.

Locality: Hoshiarpur-Una Road Section, near Bankhandi, Hoshiarpur District, Punjab, India.

Age: Miocene-Pliocene.

Indian records: Saxena & Singh 1982a, p. 295, pl. 2, fig. 27, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh.

Species: *Didymoporisporonites indicus* Chandra *et al.* 1984

Mycobank No.: MB 106776.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Hilidicellites* Kalgutkar & Jansonius 2000 [See: *Hilidicellites indicus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Species: *Didymoporisporonites longus* (Kar 1979) Kalgutkar & Jansonius 2000

Fig. 71

Mycobank No.: MB 483311.

Lacrimasporonites longus Kar, Palaeobotanist 26(1), p. 33, pl. 3, fig. 56. 1979.

Description (Kar 1979, p. 33): Spores 67-132 x 32-47 µm, elliptical, carrot-shaped, monoporate; pore circular, distinct, margin slightly thickened, a lid-like projection present above the pore; spore coat laevigate.



Fig. 71. *Didymoporisporonites longus*. Bar = 20 µm.

Locality: Barkhana nala cutting, near Sarangwara Village, Kutch District, Gujarat, India.

Age: Oligocene (Maniyara Fort Formation).

Indian records: Kar 1979, p. 33, pl. 3, fig. 56, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Jain & Kar 1979, p. 112, pl. 3, fig. 47, Neogene, around Kollam and Varkala, Kerala; Kar & Saxena 1981, p. 106, Middle Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Kar 1985, p. 130, Eocene,

bore core no. 27 near Rataria, Kutch District, Gujarat; Ambwani 1993, p. 153, Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram.

Species: *Didymoporisporonites psilatus* Sheffy & Dilcher 1971

Fig. 72

Mycobank No.: MB 111424.

Description (Sheffy & Dilcher 1971, p. 42): Oval, two-celled, psilate fungal spore. Cells unequal in size, single pore in smaller cell, larger cell with darker pigment. Septum opaque, wall 0.5–1.0 μm thick. Size ranges from 6.3 x 10.6 μm – 6.8 x 11.1 μm (two specimens).

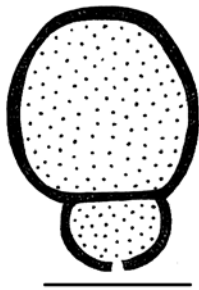


Fig. 72. *Didymoporisporonites psilatus*. Bar = 20 μm .

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.
Age: Middle Eocene (Claiborne Formation).

Indian records: Pathak & Banerjee 1984, p. 248, pl. 1, fig. 7, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal.

Species: *Didymoporisporonites siddiquiei* Chandra *et al.* 1984

Mycobank No.: MB 106777.

Remarks: Kalgutkar & Jansonius (2000) transferred this species to *Hilidicellites* Kalgutkar & Jansonius 2000 [See: *Hilidicellites siddiquiei* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Genus: *Diplodia* Fries 1834

Mycobank No.: MB 8047.

Type species: None designated.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Diplodia rodei* Mahabale 1969.

Mycobank No.: MB 313187.

Remarks: Kalgutkar *et al.* (1993) transferred this species to *Diplodites* Teterevnikova-Babaian & Taslakhchian 1973 ex Kalgutkar *et al.* 1993 [See: *Diplodites rodei* (Mahabale 1969) Kalgutkar *et al.* (1993)].

Species: *Diplodia sahnii* Singhai 1974

Mycobank No.: MB 313191.

Remarks: Kalgutkar *et al.* (1993) transferred this species to *Diplodites* Teterevnikova-Babaian & Taslakhchian 1973 ex Kalgutkar *et al.* 1993 [See: *Diplodites sahnii* (Singhai 1974) Kalgutkar *et al.* (1993)].

Genus: *Diplodites* Teterevnikova-Babaian & Taslakhchian 1973 ex Kalgutkar *et al.* 1993

Mycobank No.: MB 532862.

Palaeodiplodites Watanabe *et al.* 1999.

Type species: *Diplodites sweetii* Kalgutkar *et al.* 1993.

Description (Kalgutkar *et al.* 1993, p. 111): Hyphae intercellular, in the pericarp, septate, branched, smooth, thick-walled. Pycnidia superficial or immersed, with no definite orientation; shape and size variable, globose to subglobose, ovate-oblong or pyriform; dark, thick-walled, wall tissue pseudoparenchymatous. Pycnidia generally ostiolate, astomous when immersed; solitary or aggregated in small groups; a subicle or stroma present. Stroma typically dark brown or black, composed of thick-walled cells, uniloculate. Immature pycnidia filled with thin-walled cells. Conidia 1-septate or aseptate, both kinds occurring in the same pycnidium, size variable, ellipsoidal-oblong to ovate, light to dark brown, septa twice as thick as spore walls; globose conidia 1-celled, lightly coloured; two-celled conidia brown, with striations occasionally present. Conidiophores or their remnants not present.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Diplodites mohgaoensis* (Barlinge & Paradkar 1982) Kalgutkar *et al.* 1993

Fig. 73

Mycobank No.: MB 532825.

Botryodiplodia mohgaoensis Barlinge & Paradkar, Botanique 10(1-4), p. 168-169, pl. 1, fig. G 1982.

Description (Barlinge & Paradkar 1982, p. 168-169): Pycnidia 100–114 x 7–80 μm , compact; conidiophores branched; conidia bicelled, dark, 7–8 x 3–3.5 μm , fusiform with striations; hyphae branched, septate.

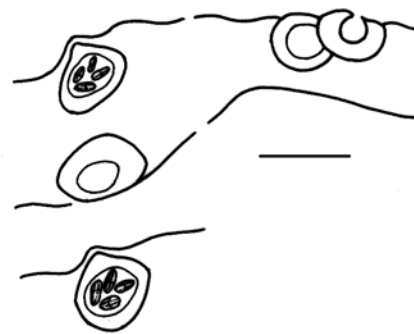


Fig. 73. *Diplodites mohgaoensis*. Bar = 100 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Series).

Indian records: Barlinge & Paradkar 1982, p. 168-169, pl. 1, fig. G, text-figs. A-E, Deccan Intertrappean Series (?Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Species: *Diplodites rodei* (Mahabale 1969) Kalgutkar *et al.* 1993

Fig. 74

Mycobank No.: MB 532806.

Diplodia rodei Mahabale, Palaeobotanist 17(3), p. 295, pl. 1, figs. 1-6. 1969.

Description (Mahabale 1969, p. 295): Well preserved, two-celled, oval-oblong spores, 17.5-18 x 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 colour. Mycelium septate, conidium terminal and unbranched.

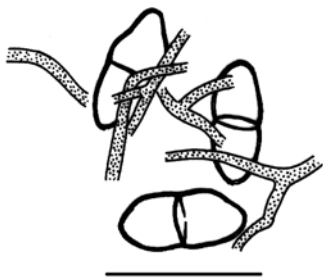


Fig. 74. *Diplodites rodei*. Bar = 20 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Early Tertiary (Deccan Intertrappean Series).

Indian records: Mahabale 1969, p. 295, pl. 1, figs. 1-6, Deccan Intertrappean Series (Early Tertiary), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Species: *Diplodites sahnii* (Singhai 1974) Kalgutkar *et al.* 1993

Fig. 75

Mycobank No.: MB 532805.

Diplodia sahnii Singhai, Journal of Biological Sciences 17, p. 97, pl. 1, figs. 5-8. 1974.

Description (Singhai 1974, p. 97): Pycnidia spherical. Ostiolate and measuring 100-200 x 100-160 μm ; conidia dark brown, 2-celled, ellipsoid or ovoid or oblong, measuring 9-14 x 6-8 μm ; conidiophores short and simple, measuring 4 x 2 μm .

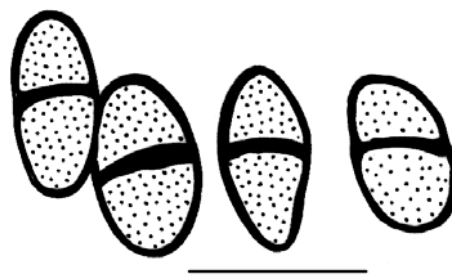


Fig. 75. *Diplodites sahnii*. Bar = 10 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Beds).

Indian records: Singhai 1974, p. 97, pl. 1, figs. 5-8, Deccan Intertrappean Beds (Late Cretaceous, Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Species: *Diplodites sweetii* Kalgutkar *et al.* 1993

Fig. 76

Mycobank No.: MB 533027.

Description (Kalgutkar *et al.* 1993, p. 111): An internal mycelium consisting of branched hyphae ramifies through the tissue of the pericarp. No external or superficial mycelium is present. Internal hyphae are smooth, thick-walled and 3-6 μm in diameter. The ramifying hyphae were seen in close proximity with a row of pycnidia developed within the pericarp tissue. An open and split pycnidium was found on the perianth in three-dimensional view showing pseudoparenchymatous wall tissue, a pycnidial cavity, an ostiole and liberated conidia outside the fruit wall in the vicinity of the pycnidium. Morphology of the pycnidia is variable, showing a wide range of form and size. Pycnidia are globose to subglobose, 68-108 μm in diameter, or ovate-oblong to pyriform with a size range of 79-353 x 54-234 μm . They are thick-walled, dark brown, immersed, erumpent or superficial, ostiolate or astomous when immersed. Pycnidia occur singly or aggregated in small groups with a subicle or a stroma. Stroma typically dark brown to black, thick-walled, uniloculate, and covering a single pycnidium or a group of pycnidia with measured stromatic tissue around 30 μm thick on the side, 72 μm thick at the base and a pedicellate portion 90 x 36 μm . Generally, pycnidium occurs largely surrounded by the stromatic tissue and a fused pycnidial wall. The pycnidium appears raised and erumpent when pedicellate. External pycnidia are generally ostiolate. Presence of seemingly non-ostiolate pycnidia may simply represent non-median sections. Ostioles appear to develop at one end with the widening and separation of some thin-walled cells making a narrow passage to facilitate dispersal of

the conidia. Superficial immature pycnidia in tangential section consist of a pycnidial wall surrounding a central primordial tissue of thin-walled cells. The narrow end of the pycnidium is indicative of the future ostiolar opening, while the central tissue may represent a fertile portion developing eventually into a palisade-like layer of conidiophores that lined the inner wall of the mature fructification. Mature and relatively young pycnidia contain conidia. Conidia are also found in close proximity to solitary and empty pycnidia. Both septate and aseptate conidia seem to occur in the same pycnidium. Conidia are one- or two-celled, of varying shapes and sizes, but distinct size ranges in the 2-celled conidia corresponding to globose and extended pycnidia were not observed. Ellipsoidal-oblong to ovate conidia are present. These are dark brown, 1-septate, obtuse, smooth, with thickened central septum. The septum is nearly twice as thick as the cell wall. Globose conidia are generally 1-celled, somewhat lightly coloured but not hyaline or smooth. The two-celled conidia are between 14-18 x 7-9 μm in size whereas globose conidia are around 7 μm in diameter. No conidiophores or their remnants were recognized in the pycnidia containing conidia, and observed conidia were without appendages. Striations on the conidia are not a common feature; however, a few conidia with longitudinal striae were encountered.

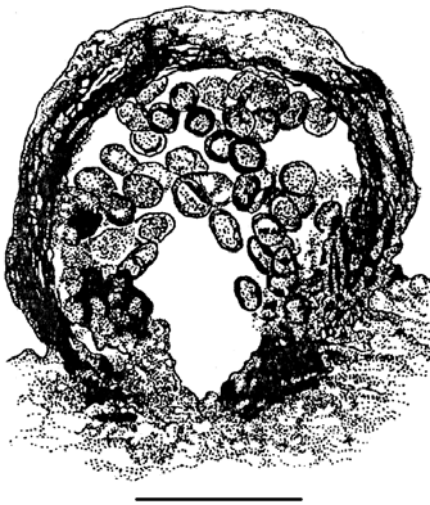


Fig. 76. *Diplodites sweetii*. Bar = 30 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean beds).

Indian records: Kalgutkar *et al.* 1993, p. 111, pl. 1, fig. 3, Deccan Intertrappean beds (Late Cretaceous, Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Diploneurospora* Jain & Gupta 1970

Mycobank No.: MB 21081.

Type species: *Diploneurospora tewarii* Jain & Gupta 1970.

Description (Jain & Gupta 1970, p. 180): Ascospore two celled, uniseriate, elliptical margin uneven; upper cell prominent, dark brown in colour, thick walled, wall sculptured with longitudinal ribs. Lower cell hyaline, appendage like, small in size, rib sculpture faint.

Classification: Ascomycetes, Sphaeriales.

Species: *Diploneurospora tewarii* Jain & Gupta 1970

Fig. 77

Mycobank No.: MB 313231.

Description (Jain & Gupta 1970, p. 180): Ascospores two celled, uniseriate, cells unequal in size, length ratio nearly 3:1, both ends acute, two cells attached at broader base along one side. Larger cell dark brown in colour, elliptical, 50 x 16 μm in size, exine 0.7 μm thick, sculptured, ribs prominent on one side, extending up to margins on the other side, leaving central portion free, ribs longitudinal, dichotomous, 8-10 in number, branched. Smaller cell hyaline, tail like, 10 x 15 μm in size. Exine thin, ribs very faint, 4-5 in number.



Fig. 77. *Diploneurospora tewarii*. Bar = 20 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early Miocene.

Indian records: Jain & Gupta 1970, p. 180, pl. 1, fig. 21, Early Miocene, Padappakkara, Kollam District, Kerala, India.

Genus: *Diporicellaesporites* Elsik 1968

Mycobank No.: MB 21083.

Type species: *Diporicellaesporites stacyi* Elsik 1968.

Description (Elsik 1968, p. 279): Elongate, diporate, multicellate fungal or algal spores. One pore at each end of the spore. Shape and ornamentation variable except never coiled. Two or more septae.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Diporicellaesporites attenuatus* Ramanujam & Srisailam 1980

Mycobank No.: MB 108846.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Quilonia* Jain & Gupta 1970 emend. Kalgutkar & Jansonius 2000 [See: *Quilonia attenuata* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000].

Species: *Diporicellaesporites concavus* Kumar 1990

Fig. 78

Mycobank No.: MB 126553.

Description (Kumar 1990, p. 24): Fungal spores multicellate, diporate and fusiform in shape. Size range 38-42 x 22-24 µm. Spore gradually tapering at both ends. Central cells dark in colour and larger in size (8-13 x 13-21 µm), apical cells smaller, hyaline, porate and delimited by a concave darker outline (septum). Spore wall thickest at the central septal region and smooth. Septum straight or disc-shaped, septum of central cell ± 3 µm thick with a central pore. Terminal pores ± 2 µm wide, pore margin thin and hyaline.



Fig. 78. *Diporicellaesporites concavus*. Bar = 10 µm.

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 24, pl. 1, figs. 15, 21, text-fig. 17, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Species: *Diporicellaesporites dilcheri* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 79

Mycobank No.: MB 483313.

Inapertisporites dilcheri Chandra *et al.*, Biovigyanam 10(1), p. 44, pl. 2, fig. 4. 1984.

Description (Chandra *et al.* 1984, p. 44): Biconvex, lanceolate fungal spores with both apices pointed, size range 33-55 x 17-22 µm; unicellate, inaperturate, spore wall 0.5 µm thick, psilate.



Fig. 79. *Diporicellaesporites dilcheri*. Bar = 10 µm.

Locality: Sediment core no. 1 (Lat. 17°57.92' N; Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 51, pl. 2, fig. 30, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Sediment core no. 2 (Lat. 18°35.2'N; Long. 69°17.2'E), Sediment core no. 3 (Lat. 19°32.8'N; Long. 71°21.5'E), Sediment core no. 5 (Lat. 24°04.5'N; Long. 69°26.0'E), Arabian Sea; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Species: *Diporicellaesporites elsikii* Samant & Tapaswi 2000, non Martínez-Hernández & Tomasini-Ortiz 1989.

Mycobank No.: MB 515004.

Remarks: *Diporicellaesporites elsikii* Samant & Tapaswi 2000 is illegitimate, being junior homonym of *Diporicellaesporites elsikii* Martínez-Hernández & Tomasini-Ortiz 1989. For this reason, Saxena (2009) replaced it with a new name [See: *Diporicellaesporites samantiae* Saxena 2009]

Species: *Diporicellaesporites fusiformis* Ramanujam & Srisailam 1980

Fig. 80

Mycobank No.: MB 108847.

Description (Ramanujam & Srisailam 1980, p. 128): Spore dark brown, 5-celled, fusiform, 49.5-55.6 x 15.6-18.5 µm, central cells 10.2 x 17 µm, terminal cells smaller, conio-truncate, 8.5 x 6.8

μm , diporate, one pore at each end, transverse septa fairly thick and dark, each $1.7 \mu\text{m}$ thick, psilate.



Fig. 80. *Diporicellaesporites fusiformis*. Bar = $10 \mu\text{m}$.

Locality: Palayangadi, Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 128, pl. 2, fig. 22, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Diporicellaesporites multicellatus* Saxena & Khare 1992

Mycobank No.: MB 483893.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Quilonia* Jain & Gupta 1970 emend. Kalgutkar & Jansonius 2000 [See: *Quilonia multicellata* (Saxena & Khare 1992) Kalgutkar & Jansonius 2000].

Species: *Diporicellaesporites padappakkarensis* Kumar 1990

Mycobank No.: MB 126554.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Biporipsilonites* Kalgutkar & Jansonius 2000 [See: *Biporipsilonites padappakkarensis* (Kumar 1990) Kalgutkar & Jansonius 2000].

Species: *Diporicellaesporites pluricellus* Kar & Saxena 1976

Fig. 81

Mycobank No.: MB 112280.

Diporicellaesporites sp. Kar *et al.*, Palaeobotanist 19(2), p. 152, pl. 2, fig. 27. 1972.

Description (Kar & Saxena 1976, p. 11-12): Spores generally eight celled but number may vary from seven to eleven, 67-94

$\times 19-38 \mu\text{m}$, \pm elliptical in shape. One pore at each margin, pore well developed, sometimes may be slightly protruding. Spore wall up to $2.5 \mu\text{m}$ thick, psilate. Septa distinct, straight or slightly curved, cells are bigger in size in middle region.



Fig. 81. *Diporicellaesporites pluricellus*. Bar = $20 \mu\text{m}$.

Locality: Matanomadh, Kutch District, Gujarat, India.

Age: Palaeocene (Matanomadh Formation).

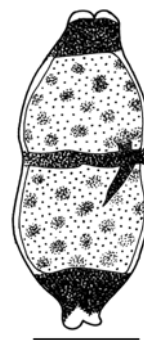
Indian records: Kar & Saxena 1976, p. 11-12, pl. 3, figs. 35-36, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Ramanujam & Rao 1978, p. 297, pl. 2, figs. 22-23, Miocene, Kerala; Jain & Kar 1979, p. 111, Neogene, around Kollam and Varkala, Kerala; Ramanujam & Srisailam 1980, mp. 128, pl. 2, fig. 23, Warkalli Beds (Miocene), Kannur District, Kerala; Pathak & Banerjee 1984, p. 250, pl. 2, fig. 19, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Varma 1987, p. 167, pl. 1, fig. 3, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Malleshram *et al.* 1989, p. 15, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Samant & Phadtare 1997, p. 66, pl. 15, fig. 7, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Samant 2000, p. 16, pl. 1, fig. 19, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Samant & Tapaswi 2000, p. 29, fig. 2.4, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam.

Species: *Diporicellaesporites prakashii* Chandra *et al.* 1984**Mycobank No.:** MB 106780.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Quilonia* Jain & Gupta 1970 emend. Kalgutkar & Jansonius 2000 [See: *Quilonia prakashii* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].**Species: *Diporicellaesporites samantiae* Saxena 2009**

Fig. 82

Mycobank No.: MB 515005.*Diporicellaesporites elsikii* Samant & Tapaswi 2000, Gondwana Geological Magazine 15(2), p. 25–26, fig. 2.2, non Martínez-Hernández & Tomasini-Ortiz 1989.**Description** (Samant & Tapaswi 2000, p. 25-26): Fungal spores curved; four cellate; 52 x 13 µm in size; diporate; pores small; septa thick, without flap like structure; middle cells rectangular; spore wall < 1 µm thick; surface smooth.Fig. 82. *Diporicellaesporites samantiae*. Bar = 10 µm.**Locality:** Near Bhavnagar, Cambay Basin, Gujarat, India.**Age:** Early Eocene (Kharsalia Clay Formation).**Indian records:** Samant & Tapaswi 2000, p. 25-26, fig. 2.2, Kharsalia Clay Formation (Early Eocene), Cambay Basin, Gujarat.**Species: *Diporicellaesporites stacyi* Elsik 1968**

Fig. 83

Mycobank No.: MB 313249.**Description** (Elsik 1968, p. 279): Tetracellate, psilate, diporate fungal spore 11 to 13 µm wide and 23 to 31 µm long. Wall ca. 0.5 µm thick. Inner layer of wall turns inward to form one layer of two layered septae. Septae almost twice as thick as wall. Inner surface of cells granular to punctate. Pores with slit margins due to compression; 2.5 to 4 µm wide. Pore chambers are slightly offset from outline of inner chambers.Fig. 83. *Diporicellaesporites stacyi*. Bar = 10 µm.**Locality:** 11 km south-west of Rockdale, Milam County, Texas, U.S.A.**Age:** Palaeocene (Rockdale lignite).**Indian records:** Jain *et al.* 1973, p. 161, pl. 2, fig. 80, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Kar & Saxena 1976, p. 11, pl. 3, fig. 34, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Mehrotra 1983, p. 17, pl. 3, fig. 17, Mikir Formation (Palaeocene-Early Eocene), Garampani, North Cachar Hills, Assam; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlamsam, Mizoram.**Species: *Diporicellaesporites verrucatus* Singh *et al.* 1986**
Fig. 84**Mycobank No.:** MB 131930.**Description** (Singh *et al.* 1986, p. 101): Fungal spore lanceolate in shape, biconvex. Size 155 x 53 µm. 12-celled, cells wider in the middle and narrower at the ends. Diporate, pores apical, 11 µm in diameter. Septa 2-4 µm thick, dark, complete, thicker than the spore wall. Spore wall 1 µm thick, verrucose, verrucae flat-topped, 5 µm in size.Fig. 84. *Diporicellaesporites verrucatus*. Bar = 50 µm.

Locality: Sonapur-Badarpur road Section, Jaintia Hills District, Meghalaya, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 101, pl. 2, fig. 10, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Species: *Diporicellaesporites wilkinsonii* Saxena & Misra 1990

MycoBank No.: MB 483360.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* van der Hammen 1954a ex Clarke 1965 [See: *Dyadosporites wilkinsonii* (Saxena & Misra 1990) Kalgutkar & Jansonius 2000].

Genus: *Diporisporites* van der Hammen 1954a

MycoBank No.: MB 21084.

Type species: *Diporisporites elongatus* van der Hammen 1954a (designated by van der Hammen 1954b, p. 14).

Description (van der Hammen 1954a, p. 83): Fungal spores “with two small pores” (vide Jansonius & Hills 1976, card 810)

Emended Description (Elsik 1968, p. 277): Diporate fungal spores of one cell. Pores on opposite ends of the grains. Pores may be modified, i.e. with atrium, annulus or septum forming pore chamber. Shape variable. Ornamentation variable.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Diporisporites anklesvarensis* (Varma & Rawat 1963) Elsik 1968 (nom. inval.)

MycoBank No.: MB 313250.

Remarks: See: *Foveodiporites anklesvarensis* Varma & Rawat 1963.

Species: *Diporisporites barrelis* Gupta 2002

Fig. 85

MycoBank No.: MB 540470.

Description (Gupta 2002, p. 130): Fungal spores one celled, nonseptate, diporate, slightly curved, barrel shaped, 25 x 10 - 30 x 14 μm ; pores situated at opposite ends of longest axis, simple; psilate, surface folded, wall <0.5 μm thick.



Fig. 85. *Diporisporites barrelis*. Bar = 20 μm .

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 130, pl. 1, fig. 12, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Diporisporites bhavnagarensis* Saxena 2009

Fig. 86

MycoBank No.: MB 515013.

Diporisporites granulatus Samant, Geophytology 28(1-2), p. 12, 14, pl. 1, fig. 10. 2000. (nom. inval.).

Description (Samant 2000, p. 12): Fungal spores diporate; dark brown; elliptical to elongate; 55-62 x 30-35 μm in size; pore 3-4 μm in diameter, slightly protruding, slightly rimmed to thin margined; spore wall 0.5 to 1 μm thick, distinctly granulate.



Fig. 86. *Diporisporites bhavnagarensis*. Bar = 10 μm .

Locality: Near Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharsalia Clay Formation).

Indian records: Samant 2000, p. 12, 14, pl. 1, fig. 10, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Diporisporites conspicuus* Ramanujam & Rao 1978

MycoBank No.: MB 115062.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Foveodiporites* Varma & Rawat 1963 [See: *Foveodiporites conspicuus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Diporisporites curvatus* Ramanujam & Rao 1978

MycoBank No.: MB 115063.

Remarks: Elsik (1990) transferred this species to *Hypoxylonites* Elsik 1990 [See: *Hypoxylonites curvatus* (Ramanujam & Rao 1978) Elsik 1990].

Species: *Diporisorites elongatus* van der Hammen 1954a

Fig. 87

Mycobank No.: MB 330110.**Description** (van der Hammen 1954a, p. 103): (Fungal spores) psilate, more or less dark (opaque?), with two distinct and relatively large pores; 21.5 x 11.5 µm.Fig. 87. *Diporisorites elongatus*. Bar = 20 µm.**Locality:** Eastern Cordilleras, Colombia.**Age:** Maastrichtian.**Indian records:** Kar & Saxena 1976, p. 11, pl. 3, figs. 31-32, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Jain & Kar 1979, p. 110, pl. 3, fig. 44, Neogene, around Kollam and Varkala, Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, figs. 5-6, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Samant 2000, p. 16, pl. 1, fig. 8, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Samant & Tapaswi 2000, p. 29, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan.**Species:** *Diporisorites elsikii* Saxena 2000

Fig. 88

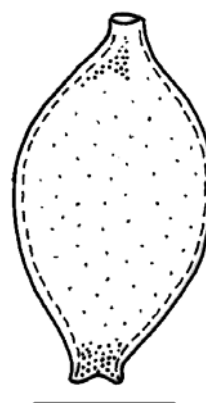
Mycobank No.: MB 519769.**Description** (Saxena 2000, p. 159): Fungal spores spindle shaped, brown in colour. Size range 64-72 x 45-51 µm. Unicellate, Diporate, pores apical 5-9 µm in diameter. Nonseptate. Wall 2.5 µm thick, psilate.Fig. 88. *Diporisorites elsikii*. Bar = 10 µm.**Locality:** Mavli Mine at Redi, Sindhudurg District, Maharashtra, India.**Age:** Miocene (Sindhudurg Formation).**Indian records:** Saxena 2000, p. 159, pl. 2, fig. 18, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.**Species:** *Diporisorites fusiformis* Chandra *et al.* 1984**Mycobank No.:** MB 106781.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Biporipsilonites* Kalgutkar & Jansonius 2000 [See: *Biporipsilonites fusiformis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].**Species:** *Diporisorites giganticus* Kar 1990a (nom. inval.)

Fig. 89

Mycobank No.: MB 519770.**Description** (Kar 1990a, p. 196): Spores oval, 101-130 x 52-65 µm, diporate, pore distinct-indistinct, broad, spore wall laevigate, irregularly folded.Fig. 89. *Diporisorites giganticus*. Bar = 30 µm.**Locality:** Tripura-Assam, North-east India.**Age:** Miocene-Pliocene (Surma and Tipam groups).

Indian records: Kar 1990a, p. 196, pl. 8, figs. 114-115, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura.

Remarks: Kar (1990a) described the new species "*Diporisorites giganticus*" but did not validly publish the name, as he did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Diporisorites granulatus* Samant 2000 (nom. inval.)

MycoBank No.: MB 529671.

Remarks: Samant (2000) described the new species "*Diporisorites granulatus*" but did not validly publish the name as she did not state where the type is stored (McNeill *et al.* 2006: Art. 37.7). The species was later validated by Saxena (2009) by adding the holotype location, obtained from personal communication with Dr. Bandana Samant. Samant's epithet "*granulatus*" could not be used because of the existence of *Diporisorites granulatus* Ke & Shi 1978 and therefore Saxena (2009) published it as a new species, *Diporisorites bhavnagarensis* Saxena 2009.

Species: *Diporisorites gunniae* (Varma & Rawat 1963) Elsik 1968

MycoBank No.: MB 313253.

Basionym: *Psilodiporites gunniae* Varma & Rawat, Grana Palynologica 4(1), p. 132, fig. 6. 1963.

Remarks: See: *Foveodiporites gunniae* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Species: *Diporisorites hammenii* Elsik 1968

Fig. 90

MycoBank No.: MB 313254.

Description (Elsik 1968, p. 278): Elongate, diporate psilate fungal spores 6 to 8 μm wide and 11 to 14 μm long. Wall 0.5 μm thick. Pores 0.5 μm wide. Wall characteristically bulge out parallel to long axis of the spore at the pores, forming a short neck. Wall does not thicken at the pores.

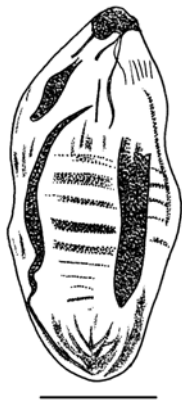


Fig. 90. *Diporisorites hammenii*. Bar = 35 μm .

Locality: 11 km. South-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Saxena *et al.* 1984, p. 187, pl. 2, fig. 28, Lower-Upper Siwalik (Middle Miocene-Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Samant & Phadtare 1997, p. 67, pl. 15, fig. 8, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat.

Diporisorites harrisii (Varma & Rawat 1963) Elsik 1968 (nom. inval.)

MycoBank No.: MB 313255.

Punctodiporites harrisii Varma & Rawat, Grana Palynologica 4(1), p. 136, figs. 16-19. 1963.

Remarks: See: *Foveodiporites harrisii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Species: *Diporisorites krempii* (Varma & Rawat 1963) Elsik 1968 (nom. inval.).

MycoBank No.: MB 313256.

Psilodiporites krempii Varma & Rawat, Grana Palynologica 4(1), p. 132, figs. 8-9. 1963.

Remarks: See: *Biporipsilonites krempii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000.

Species: *Diporisorites major* Chandra *et al.* 1984

Fig. 91

MycoBank No.: MB 106782.

Description (Chandra *et al.* 1984, p. 52): Tube-shaped fungal spore; size 62 x 25 μm ; unicellate, nonseptate; diporate, pores on both ends, circular, 7 μm in diameter, pore margin not thickened; spore wall about 1 μm thick, laevigate.

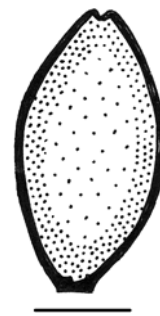


Fig. 91. *Diporisorites major*. Bar = 10 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 52, pl. 2, fig. 30, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Species: *Diporisorites piercei* (Varma & Rawat 1963) **Elsik 1968 (nom. inval.)**

Mycobank No.: MB 313257.

Granodiporites piercei Varma & Rawat, Grana Palynologica 4(1), p. 135, fig. 14. 1963.

Remarks: See: *Foveodiporites piercei* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000.

Species: *Diporisorites psilatus* **Kumar 1990**

Fig. 92

Mycobank No.: MB 126555.

Description (Kumar 1990, p. 18): Fungal spores unicellate, elongate, fusiform and diporate. Size 19–40 x 10–22 μm . Pore at each end of the spore, simple, slightly sunken and $\pm 2 \mu\text{m}$ wide. Spore wall smooth, 1 μm thick.

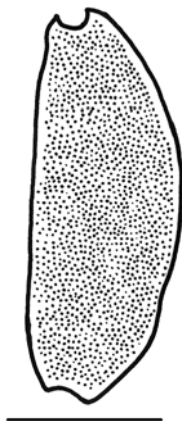


Fig. 92. *Diporisorites psilatus*. Bar = 20 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 17–18, pl. 1, fig. 18, text-fig. 4, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram.

Species: *Diporisorites reticulatus* (Varma & Rawat 1963) **Elsik 1968 (nom. inval.)**

Mycobank No.: MB 313258.

Striadiporites reticulatus Varma & Rawat, Grana Palynologica 4(1), p. 137, fig. 21. 1963.

Remarks: See: *Striadiporites reticulatus* Varma & Rawat 1963.

Species: *Diporisorites sirmaurensis* **Gupta 2002**

Fig. 93

Mycobank No.: MB 540471.

Description (Gupta 2002, p. 130): Fungal spores one celled, nonseptate, porate, globose, \pm subcircular, 11.6 x 9 μm , pores situated at opposite ends, simple; psilate, wall ca. 1 μm thick.

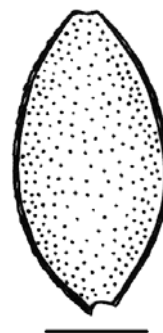


Fig. 93. *Diporisorites sirmaurensis*. Bar = 10 μm .

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 130, pl. 1, fig. 13, text-fig. 2b, Subathu and Dagshai formations (Late Palaeocene to Early Oligocene), Dadahu and Jantah Road sections, Sirmaur District, Himachal Pradesh.

Species: *Diporisorites varius* (Mathur 1966) **Kalgutkar & Jansonius 2000**

Fig. 94

Mycobank No.: MB 483325.

Scabradiporites varius Mathur, Quarterly Journal of the Geological, Mining and Metallurgical Society of India 38, p. 43, pl. 2, fig. 28. 1966.

Description (Mathur 1966, p. 43): Amb elliptical, 42 x 14 μm in size, diporate, pores elliptical, larger axis 4 μm . Exine less than 1 μm thick, scabrate, brown.

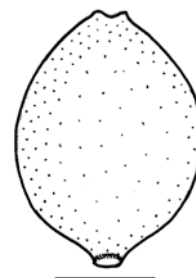


Fig. 94. *Diporisorites varius*. Bar = 5 μm .

Locality: Matanomadh, western Kutch, Gujarat, India.

Age: Palaeocene (Supratrappeans).

Indian records: Mathur 1966, p. 43, pl. 2, fig. 28, Supratrappeans (Palaeocene), Matanomadh, western Kutch, Gujarat, India.

Genus: *Diporopollis* Dutta & Sah 1970 emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 30408.

Type species: *Diporopollis assamicus* Dutta & Sah 1970.

Description (Dutta & Sah 1970, p. 45): Diporate; amb more or less globular to sub-spheroidal; small to medium in size; pores placed one over the other, circular in shape, and encircled by one or more thickened rims; exine thin, surface sculpture psilate to scabrate or finely granulate.

Emended Description (Kalgutkar & Jansonius 2000, p. 90): Small to medium sized, tri- to tetracellate conidia, of which the distal cell is very much larger than the other cells. Although the basic structure can be compared to that of *Brachysporisporites*, here the distal cell is so inflated, that it is spherical, or its width even larger than its length, commonly causing the spores to be (proximo-distally) compressed in the equatorial plane. This in turn causes the two or three proximal-most cells to collapse into each other. Spore wall thin to very thin, and prone to concentric folding, in the distal cell; septa thin, with distinct rimmed pores, anchored by thick, opaque septal bases, that in proximo-distal compression form concentric rings. When the compression is somewhat oblique, the proximal cells show that they are forming a short, more or less tapering tube, the end of which has a small, imperceptible pore, indicating that it is functionally a hilum.

Classification: Fungi Imperfecti, Phragmosporae.

Remarks: Dutta and Sah (1970), though proposed *Diporopollis* as a pollen genus, compared it with fungal spore genera, viz. *Diporisporites* van der Hammen (1954a, p. 103, pl. 20), *Diporites* van der Hammen (1954, pl. 6). They also differentiated this genus from pollen genera, viz. *Banksiaeidites* Cookson (1950, p. 169, pl. 1, fig. 9) and *Graminidites* Cookson (1947, p. 134, pl. 15, figs. 41-42). Kalgutkar and Jansonius (2000, p. 90) considered it as 'Fungi Imperfecti, Phragmosporae'.

Species: *Diporopollis assamicus* Dutta & Sah 1970

Fig. 95

Mycobank No.: MB 519812.

Description (Dutta & Sah 1970, p. 45): Size range 42-57 μm ; holotype 43 μm ; amb globular to sub-spheroidal; 2-porate, pores placed on either side, superimposed over one another, circular in shape, encircled by pronounced annular thickenings, usually two sometimes three in number; pore

apertures small, up to 1.5 μm across, placed one below the other so that one pore is distinct in high focus while the other pore becomes clear only in low focus. Equatorial outline originally globular but assuming various shapes owing to rather thin exine; exine thin, surface sculpture psilate.



Fig. 95. *Diporopollis assamicus*. Bar = 5 μm .

Locality: Umstew, South Shillong Plateau, Meghalaya, India.

Age: Early Eocene (Cherra Formation).

Indian records: Dutta & Sah 1970, p. 46, pl. 8, figs. 21-24, Cherra Formation (Palaeocene), Umstew, Shillong Plateau, Meghalaya; Kar *et al.* 1994, p. 186, Tertiary, subsurface sediments in Upper Assam; Mandaokar 2000c, p. 38, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh; Kapoor *et al.* 2003, p. 183, Dharmsala and Siwalik (Oligocene-Neogene), Dharmsala and Nurpur areas, Kangra District, Himachal Pradesh.

Remarks: Dutta and Sah (1970) mentioned that "pollen grains of *Diporopollis assamicus* are not comparable to any of the fossil species known so far. Although the present pollen grains from Assam show striking resemblance to pollen within the family Gramineae, their affinity with the family Gramineae remains questionable owing to number, position and nature of the apertures".

Genus: *Dyadosporites* van der Hammen 1954b ex Clarke 1965

Mycobank No.: MB 483335.

Dyadosporonites Elsik 1968.

Psidimobipiospora Salard-Cheboldaeff & Locquin 1980.

Type species: *Dyadosporites ellipsus* Clarke 1965 (by monotypy).

Description (van der Hammen 1954b, p. 15): Fungal spores "two spores (cellules) united."

Restated Description (Clarke 1965, p. 90): Fungal spores bilocular (didymosporous), elliptical, central septum simple, cell wall psilate to finely punctate, pore at apex of each cell. (vide Jansonius & Hills 1976, card 882)

Description (here emended): Fungal spores of various shapes, dicellate, uniseptate. Diporate, with a single pore at each end of the spore. Spore wall psilate to variously sculptured.

Classification: Fungi Imperfecti, Didymosporae.

Remarks: *Dyadosporites* was established by van der Hammen (1954, p. 15) with *D. umeriensis* as its type. The diagnosis for *D. umeriensis* has never been published and therefore the publication of genus was not valid. Clarke (1965, p. 90) considered *Dyadosporites* as validly published and described under it a single species *D. ellipsus*. Clarke (1965) also provided a restated diagnosis for *Dyadosporites*. The genus *Dyadosporites* is therefore considered here as being validly published by Clarke (1965) by the principle of monotypy (ICBN Art. 42, McNeill 2006). Elsik (1968) did not consider *Dyadosporites* as validly published and proposed another genus *Dyadosporonites* with the following diagnosis "Diporate, uniseptate fungal spores. Shape and ornamentation variable. Single pore at each end of the spore. Pore may be modified, i.e. atrium, annulus or pore chamber formed by thin septum across end of spore." Since *Dyadosporites* and *Dyadosporonites* completely overlap each other the latter is considered here the junior synonym of the former.

Species: *Dyadosporites bhardwaji* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Fig. 96

Mycobank No.: MB 483331.

Psilodiporites bhardwaji Varma & Rawat, Grana Palynologica 4(1), p. 133, fig. 10. 1963.

Dyadosporonites bhardwaji (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 278. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 133): Grains 2-porate, isopolar, bilateral, somewhat barrel-shaped (about 40 x 61 x 40 µm), slightly constricted in the middle, dark brown. Pores at the lateral ends, circular (about 7.1 µm). The sexine forms a hemispherical to cone-like structure around the pore areas. It is provided with a circular outer opening communicating with the inner part of the aperture. Exine psilate, about 1 µm thick, consisting of sexine and nexine. In the middle of the grain is a septum traversing the whole width of the grain. It shows two triangular flanges, generally directed towards one of the sides of the grain (perhaps due to greater pressure in one direction during preservation). The bases of the flanges are approximately of the same size. They meet near the middle septum, as can be seen in pollen grains in lateral view. These triangular outgrowths may or may not be always equal and similar in shape. Numerous irregular folds are present on the general body of the grain.

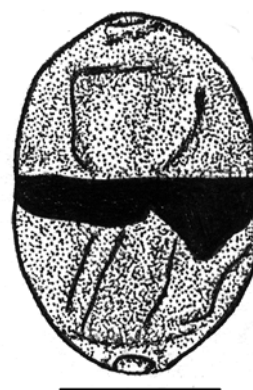


Fig. 96. *Dyadosporites bhardwaji*. Bar = 20 µm.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam.

Age: Eocene-Miocene.

Indian records: Varma & Rawat 1963, p. 133, fig. 10, Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam.

Species: *Dyadosporites kannanorensis* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 97

Mycobank No.: MB 483332.

Dyadosporonites kannanorensis Ramanujam & Rao in Bharadwaj, D. C. et al. (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 295-296, pl. 1, fig. 13. 1978.

Description (Ramanujam & Rao 1978, p. 295-296): Spores dicellate, diporate, darkish brown, 25-35 x 10-13 µm, ellipsoidal to faintly fusiform, slightly asymmetrical. A prominent pore at each end of spore slightly off its long axis. Pore 2-4 µm in diam., pouting, margins thickened, atrium present. Transverse septum up to 2 µm thick, two layered. Spore wall two-layered, 1-1.5 µm thick, surface psilate.

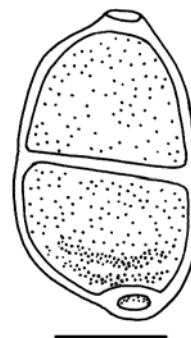


Fig. 97. *Dyadosporites kannanorensis*. Bar = 10 µm.

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 295-296, pl. 1, fig. 13, Miocene, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Malleshham *et al.* 1989, p. 15, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Species: *Dyadosporites denticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 98

MycoBank No.: MB 483334.

Dyadosporonites denticulatus Ramanujam & Rao in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 296, pl. 1, fig. 14. 1978.

Description (Ramanujam & Rao 1978, p. 296):

Spores dicellate, diporate, melanin-coloured, fusiform to barrel-shaped, 38-45 x 20-28 μm . A conspicuous pore at each end of the spore along its long axis, pores 3-5 μm in diam., with prominent annulus up to 3 μm thick. Transverse septum with conspicuous, usually two, denticulate or wedge-shaped thickenings on one side. Spore wall thin, less than 1 μm , folded irregularly, surface psilate.

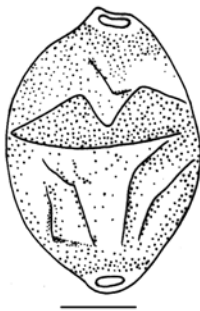


Fig. 98. *Dyadosporites denticulatus*. Bar = 10 μm .

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 296, pl. 1, fig. 14, Miocene, Kerala; Pathak & Banerjee 1984, p. 249, pl. 1, fig. 12, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Dyadosporites dubius* Kumar 1990

Fig. 99

MycoBank No.: MB 126556.

Description (Kumar 1990, p. 22): Fungal spores diporate, dicellate and broadly oval or bracket-shaped (outline). Size 15-18 x 12-13 μm . Pores 4-6 μm wide, simple, one at either end. Spore wall \pm 1.6 μm thick, smooth, gradually thinning outwards the pore. Septum \pm 2 μm thick, opaque.

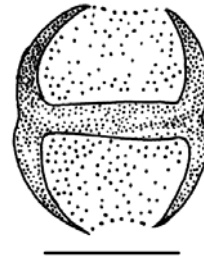


Fig. 99. *Dyadosporites dubius*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 22, pl. 1, fig. 19, text-fig. 13, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Species: *Dyadosporites ellipsus* Clarke 1965

Fig. 100

MycoBank No.: MB 330252.

Description (Clarke 1965, p. 90): Fungal spores bilocular (didymosporous), elliptical, apical pores circular, 4-5 μm diameter, central septum simple, 2-3 μm thick, cell wall psilate to finely punctate, 1-2 μm thick, overall dimensions 23-27 x 38-55 μm .



Fig. 100. *Dyadosporites ellipsus*. Bar = 10 μm .

Locality: Canon City Coalfield, Fremont County, Colorado, U.S.A.

Age: Late Cretaceous.

Indian records: Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram.

Species: *Dyadosporites grandiporus* (Singh *et al.* 1986) Kalgutkar & Jansonius 2000

Fig. 101

Mycobank No.: MB 483339.

Dyadosporonites grandiporus Singh *et al.*, Palaeobotanist 35(1), p. 100, pl. 2, fig. 6. 1986.

Description (Singh *et al.* 1986, p. 100): Fungal spores cylindrical in shape. Size range 95 x 34 μm . Dicellate, both cells equal in size and shape. Diporate, pore 14-16 μm in diameter, pore margin very much thickened. Uniseptate, septa 2 μm thick, complete. Spore wall less than 1 μm thick, laevigate, slightly folded.

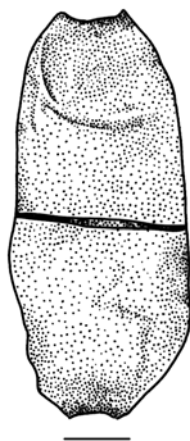


Fig. 101. *Dyadosporites grandiporus*. Bar = 10 μm .

Locality: Sonapur-Badarpur Road Section, Jaintia Hills District, Meghalaya, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 100, pl. 2, figs. 6, 22, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Species: *Dyadosporites novus* Kumar 1990

Fig. 102

Mycobank No.: MB 126557.

Description (Kumar 1990, p. 21): Fungal spores dicellate and diporate. Size 28-32 x 13-16 μm . Cells fusiform and gradually taper towards ends. Apical pore 0.5 μm and simple. Septum 2-3 μm thick, wedge-shaped or denticulate with a central pore, dark and opaque. Spore wall 1.6 μm thick, smooth, slightly constricted at septal region and showing a brief collar at one end (probably basal end) of the spore.

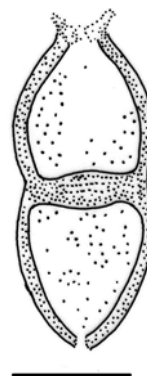


Fig. 102. *Dyadosporites novus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 21, pl. 1, fig. 16, text-fig. 12, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Species: *Dyadosporites reticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 103

Mycobank No.: MB 483346.

Dyadosporonites reticulatus Ramanujam & Rao in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 295, pl. 1, fig. 12. 1978.

Description (Ramanujam & Rao 1978, p. 295): Spores dicellate, diporate, melanin-coloured, more or less barrel-shaped, 22-30 x 8-15 μm . A single pore at each flattened or truncate end of spore along its long axis. Pore simple, up to 3.5 μm in diameter. Spore wall less than 1 μm thick, transverse septum slightly thicker; surface reticulate; muri of low height, meshes polygonal, lumina irregular, smooth.

Locality: Kannur, Kerala, India.

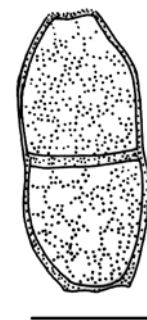


Fig. 103. *Dyadosporites reticulatus*. Bar = 10 μm .

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 295, pl. 1, fig. 12, Quilon and Warkalli beds (Miocene), Kerala; Ramanujam & Srisailam 1980, p. 126, pl. 2, fig. 18, Warkalli Beds (Miocene), Kannur District, Kerala; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya.

Species: *Dyadosporites sahnii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Fig. 104

MycoBank No.: MB 483347.

Granodiporites sahnii Varma & Rawat, Grana Palynologica 4(1), p. 136, fig. 15. 1963.

Dyadosporites sahnii (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 278. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 136): Grain 2-porate, bilateral, iso- to paraisopolar, somewhat barrel shaped (21 x 30 x 21 μm), with constrictions in the middle where a septum runs entire width of the grain. Ledges on both sides of the median line of the septum are presumably due to the obliquely pressed septum wall of the septum. Pores at each end of the longest axis of the grain presumably circular (about 8.6 μm). Pore area covered by a dome shaped sexinous fragile membrane, opening irregularly or by a central pore. Exine granulate (1st order), less than 1.4 μm thick.

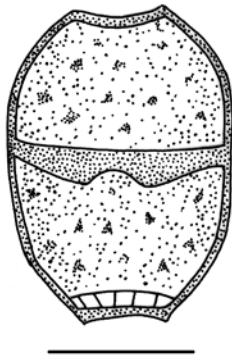


Fig. 104. *Dyadosporites sahnii*. Bar = 10 μm .

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam.

Age: Eocene-Miocene.

Indian records: Varma & Rawat 1963, p. 136, fig. 15, Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam.

Species: *Dyadosporites scabratus* (Kumar 1990) Kalgutkar & Jansonius 2000

Fig. 105

MycoBank No.: MB 483348.

Psidimobipiospora scabratus Kumar, Review of Palaeobotany and Palynology 63, p. 22, pl. 1, fig. 10. 1990.

Description (Kumar 1990, p. 22): Fungal spores cylindrical, dicellate and diporate. Size range 35-45 x 13-16 μm . Cells rectangular in shape, each cell 19 x 13-14 μm , \pm equal in size with a pore at free end. Pore 4-6 μm wide, simple and slightly sunken. Septum \pm 3 μm thick, opaque and simple. Spore wall \pm 2 μm thick, thinner around pore, surface smooth to finely scabrate or echinate, slightly constricted at septal region.

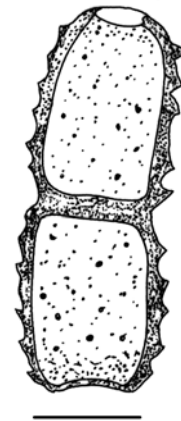


Fig. 105. *Dyadosporites scabratus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 22, pl. 1, fig. 10, text-fig. 14, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Species: *Dyadosporites schwabii* (Elsik 1968) Kalgutkar & Jansonius 2000

Fig. 106

MycoBank No.: MB 126573.

Dyadosporonites schwabii Elsik, Pollen Spores 10(2), p. 279, pl. 2, fig. 30. 1968.

Description (Elsik 1968, p. 279): Fusiform, slightly asymmetrical, psilate, dicellate, diporate fungal spore; 9 x 20 μm . Pores about 1 μm wide, bulge out slightly, located somewhat off the long axis of the grain. Spore wall very thin, two layered. Inner wall turns in at junction of two cells to form two layered septum. Septum about 0.5 μm thick.

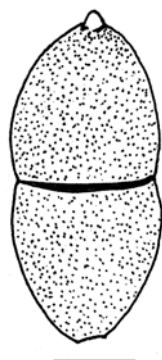


Fig. 106. *Dyadosporites schwabii*. Bar = 5 μ m.

Locality: 11 km south-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Jain & Kar 1979, p. 111, pl. 2, fig. 35, Neogene, around Kollam and Varkala, Kerala; Pathak & Banerjee 1984, p. 249, pl. 1, fig. 11, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Chandra & Kumar 1998, p. 62, pl. 1, fig. 10, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Species: *Dyadosporites udarii* (Gupta 1984) Kalgutkar & Jansonius 2000

Fig. 107

Mycobank No.: MB 483351.

Dyadosporonites constrictus Kar, Palaeobotanist 26(1), p. 33, pl. 3, figs. 54-55. 1979, non Mathur & Mathur 1969.

Dyadosporonites udarii Gupta, Geophytology 14(2), p. 248. 1984.

Description (Kar 1979, p. 33): Spore diporate, 65-89 x 31-39 μ m, uniseptate. Pores distinct, circular, margin thickened, spore coat laevigate, generally constricted in middle.



Fig. 107. *Dyadosporites udarii*. Bar = 10 μ m.

Locality: Barkhana nala cutting, Sarangwara, Kutch District, Gujarat, India.

Age: Oligocene (Maniyara Fort Formation).

Indian records: Kar 1979, p. 33, pl. 3, figs. 54-55, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Kar & Saxena 1981, p. 106, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Kar 1985, p. 130, Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram.

Species: *Dyadosporites verrucatus* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000

Fig. 108

Mycobank No.: MB 483352.

Dyadosporonites verrucatus Ramanujam & Srisailam, Botanique 9(1-4), p. 126-127, pl. 2, fig. 19. 1980.

Description (Ramanujam & Srisailam 1980, p. 126): Spores brown to light brown, dicellate, oblong, 22.1-25.5 x 8.0-9.5 μ m, one conspicuous pore at each truncate end, pore up to 4 μ m in diameter, transverse septum prominent, in the form of dark band, spore wall 1.7 μ m thick, slightly constricted at the septum, surface densely studded with verrucae; verrucae of low height, locally fusing to form sinuous ridges.

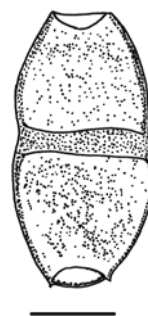


Fig. 108. *Dyadosporites verrucatus*. Bar = 10 μ m.

Locality: Palayangadi, Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 126, pl. 2, fig. 19, Warkalli Beds (Miocene), Kannur District, Kerala.

Species: *Dyadosporites wilkinsonii* (Saxena & Misra 1990) Kalgutkar & Jansonius 2000

Fig. 109

Mycobank No.: MB 483353.

Diporicellaesporites wilkinsonii Saxena & Misra, Palaeobotanist 38, p. 272, pl. 3, fig. 13. 1990.

Description (Saxena & Misra 1990, p. 272): Fungal spores capsular in shape, size range 98-126 x 36-40 μ m; tetracellate, middle septum complete, 2.5-3 μ m thick, whereas other two septa incomplete, not covering full width of spore; diporate,

pores apical, situated on protuberances, sometimes slightly offset; wall up to 1 µm thick, psilate.

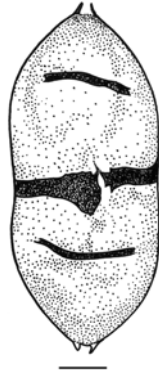


Fig. 109. *Dyadosporites wilkinsonii*. Bar = 10 µm.

Locality: Amberiwadi Section, Sindhudurg District, Maharashtra, India.

Age: Miocene (Sindhudurg Formation).

Indian records: Saxena & Misra 1990, p. 272, pl. 3, fig. 13, Sindhudurg Formation (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra.

Genus: *Dyadosporonites* Elsik 1968

Mycobank No.: MB 21092.

Type species: *Dyadosporonites schwabii* Elsik 1968.

Description (Elsik 1968, p. 278): Diporate, uniseptate fungal spores. Shape and ornamentation variable. Single pore at each end of the spore. Pore may be modified, i.e., atrium, annulus or pore chamber formed by thin septum across end of spore.

Classification: Fungi Imperfecti, Didymosporae.

Remarks: *Dyadosporonites* Elsik 1968 is a junior synonym of *Dyadosporites* van der Hammen 1954b ex Clarke 1965

Species: *Dyadosporonites kannanorensis* Ramanujam & Rao 1978

Mycobank No.: MB 124439.

Remarks: Since *Dyadosporonites* Elsik (1968) is a junior synonym of *Dyadosporites* Van der Hammen 1954b ex Clarke 1965, Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* [See: *Dyadosporites kannanorensis* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites constrictus* Mathur & Mathur 1969

Mycobank No.: MB 483857.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Hilidicellites* Kalgutkar & Jansonius 2000 [See: *Hilidicellites constrictus* (Mathur & Mathur 1969) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites constrictus* Kar 1979

Mycobank No.: MB 112282.

Dyadosporonites udarii Gupta 1984 (= nom. nov. pro *Dyadosporonites constrictus* Kar, non *Dyadosporonites constrictus* Mathur & Mathur 1969).

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites udarii* (Gupta 1984) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites denticulatus* Ramanujam & Rao 1978

Mycobank No.: MB 115064.

Remarks: Since *Dyadosporonites* Elsik (1968) is a junior synonym of *Dyadosporites* Van der Hammen 1954b ex Clarke 1965, Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* [See: *Dyadosporites denticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites grandiporus* Singh *et al.* 1986

Mycobank No.: MB 131931.

Remarks: Since *Dyadosporonites* Elsik 1968 is a junior synonym of *Dyadosporites* Van der Hammen 1954b ex Clarke 1965, Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* [See: *Dyadosporites grandiporus* (Singh *et al.* 1986) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites inaequalis* Varma & Patil 1985

Mycobank No.: MB 133494.

Remarks: Kalgutkar and Jansonius (2000) transferred *Dyadosporonites inaequalis* Varma & Patil 1985 to *Dicellaesporites* Elsik (1968) [See: *Dicellaesporites inaequalis* (Varma & Patil 1985) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites reticulatus* Ramanujam & Rao 1978

Mycobank No.: MB 115065.

Remarks: Since *Dyadosporonites* Elsik (1968) is a junior synonym of *Dyadosporites* Van der Hammen 1954b ex Clarke 1965, Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* [See: *Dyadosporites reticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites schwabii* Elsik 1968

Mycobank No.: MB 313436.

Remarks: Kalgutkar and Jansonius (2000) transferred *Dyadosporonites schwabii* Elsik 1968 to *Dyadosporites* Van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites schwabii* (Elsik 1968) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites udarii* Gupta 1984

Mycobank No.: MB 483858.

Dyadosporonites constrictus Kar, Palaeobotanist 26(1), p. 33, pl. 3, figs. 54-55. 1979, non Mathur & Mathur 1969.

Remarks: Kalgutkar and Jansonius (2000) transferred *Dyadosporonites udarii* Gupta 1984 to *Dyadosporites* Van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites udarii* (Gupta 1984) Kalgutkar & Jansonius 2000].

Species: *Dyadosporonites verrucatus* Ramanujam & Srisailam 1980

Mycobank No.: MB 108852.

Remarks: Kalgutkar and Jansonius (2000) transferred *Dyadosporonites verrucatus* Ramanujam & Srisailam 1980 to *Dyadosporites* Van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites verrucatus* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000].

E

Genus: *Elsikisporonites* Kumar 1990

Mycobank No.: MB 25441.

Type species: *Elsikisporonites tubulatus* Kumar 1990.

Description (Kumar 1990, p. 18): Fungal spores monoporate, nonseptate, tubular and coiled. Pore at outer end, nozzle-like. Spore wall smooth and hyaline.

Classification: Fungi Imperfecti, Helicosporae.

Species: *Elsikisporonites tubulatus* Kumar 1990

Fig. 110

Mycobank No.: MB 126558.

Description (Kumar 1990, p. 18): Fungal spores monoporate, nonseptate, tubular in shape and coiled. Cell broadest in the middle region, 10-12 μm wide, gradually tapering towards the ends. Pore at free outer end, small, nozzle-like, 1.5 μm wide. Spore wall 1 μm thick, smooth, slightly folded, hyaline.

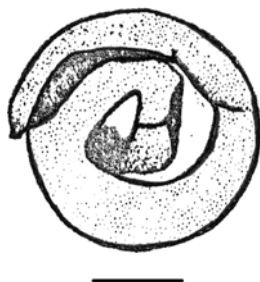


Fig. 110. *Elsikisporonites tubulatus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 18, pl. 1, figs. 7-8, text-fig. 5, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Genus: *Epicoccum* Link 1815

Mycobank No.: MB 8188.

Type species: *Epicoccum nigrum* Link 1815.

Classification: Ascomycetes.

Species: *Epicoccum deccanense* Srivastava *et al.* 2009

Fig. 111

Mycobank No.: MB 561524.

Description (Srivastava *et al.* 2009, p. 16): 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.

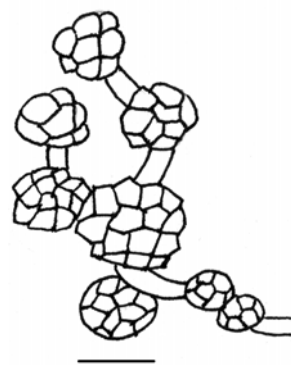


Fig. 111. *Epicoccum deccanense*. Bar = 10 μm .

Locality: Jhargad, near Jhadgaon village, Yavatmal District, Maharashtra, India.

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

Indian records: Srivastava *et al.* 2009, p. 16, pl. 1, figs. 1-6, pl. 2, figs. 1-7, Deccan Intertrappean Beds (Late Maastrichtian-Danian), Jhargad, near Jhadgaon village, Yavatmal District, Maharashtra, India.

Genus: *Euthythyrites* Cookson 1947**Mycobank No.:** MB 21098.**Type species:** *Euthythyrites oleinites* Cookson 1947.**Description** (Cookson 1947, p. 210): Mycelium superficial; ascomata linear, radiate. Characters of spores unknown.**Classification:** Ascomycetes, Microthyriales.**Species: *Euthythyrites bifidus* Kar *et al.* 2010**

Fig. 112

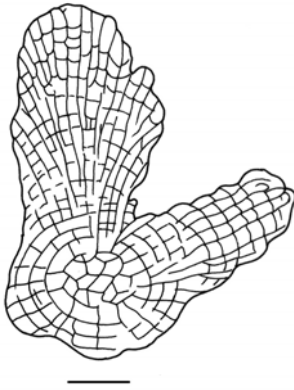
Mycobank No.: MB 542245.**Description** (Kar *et al.* 2010, p. 247): Ascstromate, 51–60 x 30–45 µm, dimidiate, nonostiolate, dark brown, generally one celled thick, darker in central region, hyphae radially arranged, anastomose to form square–rectangular pseudoparenchymatous cells, branches semicircular at ends, generally divided into two, sometimes an incipient third also visible, mycelia absent.Fig. 112. *Euthythyrites bifidus*. Bar = 10 µm.**Locality:** Tlamsam, Mizoram, India.**Age:** Miocene (Bhuban Formation).**Indian records:** Kar *et al.* 2010, p. 247, pl. 2, fig. 8, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.**Species: *Euthythyrites keralensis* Ramanujam & Rao 1973**

Fig. 113

Mycobank No.: MB 314011.*Thyriothecium* Type-3 in Ramanujam, Current Science 32, p. 328, fig. 3. 1963a.**Description** (Ramanujam & Rao 1973, p. 207): Mycelium superficial, ascomata linear, elliptical to oblong, ends rounded or flattened, lateral margins uneven. Ascomata 125–350 µm x 60–100 µm, dehiscing by a longitudinal slit (7–13 µm broad); cells radiating from mid-vertical line, square to rectangular, 2.5–8 µm x 2.5–3.75 µm, thick-walled, brownish to dark-brown. Mycelial hyphae radiating mostly from lateral marginal cells, usually flexuous, 2.5–3.75 µm thick, hyphopodiate, hyphopodia small, peg-like.Fig. 113. *Euthythyrites keralensis*. Bar = 100 µm.**Locality:** Varkala, Kerala, India.**Age:** Upper Miocene (Warkalli lignite).**Indian records:** Ramanujam & Rao 1973, p. 207, pl. 1, figs. 10–11, pl. 2, figs. 12–14, Warkalli Formation (Miocene), Varkala, Kerala; Phadtare & Kulkarni 1980, p. 167, pl. 1, fig. 3, Ratnagiri Beds (Miocene), Ratnagiri-Pawas Road near Third Dharamshala stop, 10 km south of Ratnagiri, Ratnagiri District, Maharashtra.**Species: *Euthythyrites morenoinitis* Selkirk 1975**

Fig. 114

Mycobank No.: MB 314012.**Description** (Selkirk 1975, p. 76): Free mycelium sparse. Hyphae straight, branched, without hyphopodia, arising from marginal cells of the fructification. Fructifications linear when mature, dehiscing by a longitudinal slit. Wall of fructification composed of radiating, dichotomously branched hyphae; cells square to rectangular, 1.5–6.5 µm long and 1–3.5 µm wide, walls 0.5 µm thick. Spores two celled, smooth, almost colourless.Fig. 114. *Euthythyrites morenoinitis*. Bar = 30 µm.

Locality: Kiandra, New South Wales, Australia.

Age: Early Miocene.

Indian records: Reddy *et al.* 1982, p. 117, pl. 2, figs. 2-4, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Varma 1987, p. 167, pl. 1, fig. 7, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Patil & Ramanujam 1988, p. 264, pl. 2, fig. 7, Miocene, Tonakkal, Thiruvananthapuram District, Kerala.

Genus: *Exesisporites* **Elsik 1969**

Mycobank No.: MB 21100.

Type species: *Exesisporites neogenicus* **Elsik 1969**.

Description (Elsik 1969, p. 516): Unicellular, aseptate, psilate, monoporate fungal spores of circular outline with lenticular to spherical? shape. The centrally located pore in most specimens is surrounded by a dark circular patch which is interpreted as a thickened wall. This polar area is occasionally found free of the spore.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Exesisporites neogenicus* **Elsik 1969**

Fig. 115

Mycobank No.: MB 107966.

Description (Elsik 1969, p. 517): Monoporate, unicellular, psilate fungal spores 15-20 μm in diameter. Wall thickness ca. 0.5 μm . Circular outline, oriented in polar view. Apparently lenticular in cross section as the pore (hilum?) is nearly always oriented in the centre of the spore. A somewhat thickened polar area around the minute pore is evidenced by darker colouration and tendency of the polar area to break free in heavily oxidized or degraded specimens. This polar thickening is not evident in the darker coloured specimens. The circular outline may be modified by folding in the polar area. Monolinear and Y-shaped folds across the polar area are also encountered.

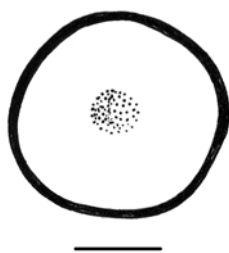


Fig. 115. *Exesisporites neogenicus*. Bar = 5 μm .

Locality: Northern Gulf of Mexico.

Age: Miocene-Pleistocene.

Indian records: Bera & Banerjee 1995, p. 150, Bengal lignite (Middle-Late Eocene), Panagarh-Domra Sector, Burdwan District, West Bengal; Gupta 2002, p. 128, pl. 1, fig. 6, Subathu Formation (Late Palaeocene to Late Eocene), Dadahu and Jantah Road sections, Sirmaur District, Himachal Pradesh;

Mandaokar 2002c, p. 79, Keifang Formation (Early Miocene), eastern flank of Aizawl Hills, Mizoram.

Species: *Exesisporites psilatus* **Saxena 2000**

Fig. 116

Mycobank No.: MB 519806.

Description (Saxena 2000, p. 159): Fungal spores subcircular. Size range 50-82 x 50-71 μm . Unicellate. Monoporate, pore circular, 5-8 μm in diameter, centrally placed, pore margin thickened. Wall 2.5 - 5.5 μm thick, psilate, folded.

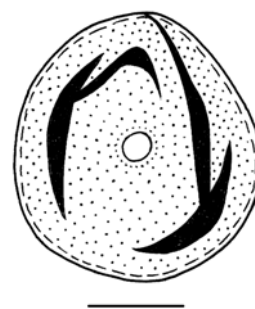


Fig. 116. *Exesisporites psilatus*. Bar = 20 μm .

Locality: Mavli Mine at Redi, Sindhudurg District, Maharashtra, India.

Age: Miocene (Sindhudurg Formation).

Indian records: Saxena 2000, p. 159, pl. 1, fig. 20, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Species: *Exesisporites verrucatus* **Kumar 1990**

Fig. 117

Mycobank No.: MB 126559.

Description (Kumar 1990, p. 15): Fungal spores lenticular in shape and unicellate. Size 25-27 x 28-30 μm . Monoporate, pore ± 1 μm in diameter surrounded by ± 1.6 μm thick, diffuse margin. Spore wall two layered ± 2 μm thick, outer layer forming 16-18 hyaline, hollow, rounded verrucae-like sculptures at peripheral margin of spore, measuring 2 - 2.5 μm high and 1.6 - 2.5 μm broad at base, rather evenly placed, imparting angularity to the ambitus.

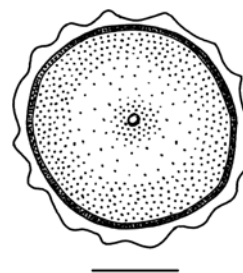


Fig. 117. *Exesisporites verrucatus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 15, pl. 1, fig. 4, text-fig. 2, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram.

F

Genus: *Foveodiporites* Varma & Rawat 1963

Mycobank No.: MB 21105.

Type species: *Foveodiporites anklesvarensis* Varma & Rawat 1963.

Punctodiporites Varma & Rawat 1963.

Description (Varma & Rawat 1963, p. 133): Pollen grains diporate. Exine foveolate.

Emended Description (Kalgutkar & Jansonius 2000, p. 112): Monocellate diporate fungal spores of mostly medium (ca 15–60 µm) size; overall shape fusiform to elliptic, but characteristically somewhat lob-sided, with one side of the outline more convex than the other; spore wall relatively thin, externally essentially smooth, internally smooth, or with punctate, granulate, foveolate or similar sculpture; pores terminal, complex, consisting of a thin collar and separated from the spore interior by one or two septa (the latter forming a pore chamber); pore regions often with darker pigmentation.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Although originally described as pollen, these forms are now generally recognized as fungal spores. *Punctodiporites* is a junior synonym of *Foveodiporites* as emended by Kalgutkar and Jansonius (2000).

Species: *Foveodiporites anklesvarensis* Varma & Rawat 1963

Fig. 118

Mycobank No.: MB 105891.

Diporisorites anklesvarensis (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 263. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 133): Pollen grains 2-porate, bilateral, isopolar, somewhat elongated (usually 27 x 67 x 30 µm). Pores at the lateral ends about 8.6 µm in diameter at the base, elevated from the general body by a collar about 4.3 µm high. Pore opening small, about 2.9 µm in diameter. General surface of the grain often slightly (irregularly) folded. Exine foveolate, less than 1.4 µm thick.



Fig. 118. *Foveodiporites anklesvarensis*. Bar = 10 µm.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam, India.

Age: Early-Middle Eocene, Late Eocene-Oligocene, Early Miocene.

Indian records: Varma & Rawat 1963, p. 133, fig. 11, Early-Middle Eocene, Late Eocene-Oligocene, Early Miocene, Western and eastern India, including oil exploration areas in West Bengal and Assam; Venkatachala & Rawat 1973, p. 258, pl. 1, fig. 8, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Kar & Saxena 1976, p. 11, pl. 3, fig. 33, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Jain & Kar 1979, p. 111, pl. 3, figs. 42–43, Neogene, around Kollam and Varkala, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Varma 1987, 167, pl. 1, fig. 2, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Kar 1990b, p. 232, Disang Formation (Palaeocene-Eocene), Silchar-Haflong Road Section, Assam; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya.

Species: *Foveodiporites conspicuus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 119

Mycobank No.: MB 483364.

Diporisorites conspicuus Ramanujam & Rao, in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976–77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 295, pl. 1, fig. 7. 1978.

Description (Ramanujam & Rao 1978, p. 295): Spores diporate, light brown, elliptical, 58.5 x 37.5 µm. A single conspicuous pore at each end of the spore along its vertical axis, pores with thickened margins and distinct atria, 2.5–4 µm in diameter. Spore wall thin, less than 1 µm, variously folded, surface psilate.

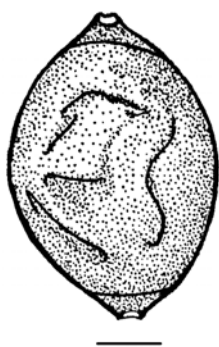


Fig. 119. *Foveodiporites conspicuus*. Bar = 10 μ m.

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 295, pl. 1, fig. 7, Miocene, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Mallesham *et al.* 1989, p. 15, pl. 1, fig. 6, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Species: *Foveodiporites gunniae* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Fig. 120

MycoBank No.: MB 483369.

Psilodiporites gunniae Varma & Rawat, Grana Palynologica 4(1), p. 132, fig. 6. 1963.

Diporisporites gunniae (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 277. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 132): Pollen grains 2-porate, isopolar, bilateral (21.5 x 40 x 21.5 μ m). Pores projecting at both ends of the longest axis of the grains, circular (about 7.1 μ m in diameter), with an outer opening (diameter about 4.3 μ m) elevated by a collar about 1.5-2 μ m high (the collar of the left, i.e. the smaller, pore, shows some darker areas towards the lumen of the grains; these do not, however, seem to indicate a morphological feature). A few folds may be present on the thin-walled body of the grain. Exine psilate, less than 1.4 μ m thick.

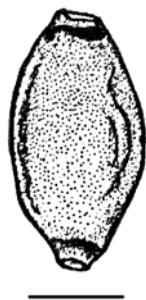


Fig. 120. *Foveodiporites gunniae*. Bar = 10 μ m.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam, India.

Age: Middle-Late Eocene.

Indian records: Varma & Rawat 1963, p. 132, fig. 6, Middle-Late Eocene, western and eastern India, including oil exploration areas in West Bengal and Assam.

Species: *Foveodiporites harrisii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Fig. 121

MycoBank No.: MB 483370]

Punctodiporites harrisii Varma & Rawat, Grana Palynologica 4(1), p. 136, fig. 16. 1963.

Diporisporites harrisii (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 277. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 136): Pollen grains 2-porate, bilateral, isopolar, elongated, with narrowly ending lateral sides (21-36 x 42-72 x 21-36 μ m), generally 28.5 x 57 x 28.5 μ m. Pores 4-8.6 μ m in diameter, at each end of the long axis. Pore (outer) opening presumably circular (diameter 2.9-5 μ m), elevated by a collar about 2.9-8.6 μ m high (usually 5-6 μ m). Occasionally there are two unequal thickenings on the basal part of the collar leaving a slit-like space traversing the centre of the collar (16a-b). A thin sexinous extension above the pore opening is sometimes present but in most cases it breaks irregularly. General body of the grain usually fragile, provided with irregular folds. Exine punctate, less than 1.4 μ m thick. Sexine and nexine indistinguishable.



Fig. 121. *Foveodiporites harrisii*. Bar = 10 μ m.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam, India.

Age: Early Eocene-Early Oligocene.

Indian records: Varma & Rawat 1963, fig. 16, Early Eocene-Early Oligocene, Western and eastern India, including oil exploration areas in West Bengal and Assam; Venkatachala & Rawat 1972, p. 327-328, pl. 5, fig. 19, Palaeocene-Eocene, Cauvery Basin, Tamil Nadu.

Species: *Foveodiporites piercei* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000

Fig. 122

Mycobank No.: MB 483372.

Granodiporites piercei Varma & Rawat, Grana Palynologica 4(1), p. 135, fig. 14. 1963.

Diporisporites piercei (Varma & Rawat 1963) Elsik, Pollen Spores 10(2), p. 277. 1968. (nom. inval.).

Description (Varma & Rawat 1963, p. 135): Pollen grains 2-porate, bilateral, isopolar, somewhat barrel-shaped (36 x 51 x 36 µm). Pores slightly bulging, provided with a thickened collar. Pore opening presumably circular, about 11.5 µm in diameter. Exine granulate (first order), about 1 µm thick. Sexine and nexine distinguished with difficulty.

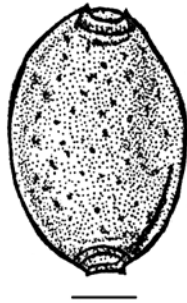


Fig. 122. *Foveodiporites piercei*. Bar = 10 µm.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam.

Age: Middle-Late Eocene.

Indian records: Varma & Rawat 1963, p. 135, fig. 14, Middle-Late Eocene, western and eastern India, including oil exploration areas in West Bengal and Assam; Venkatachala & Rawat 1973, p. 258, pl. 1, fig. 7, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Samant 2000, p. 16, pl. 1, fig. 9, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Genus: *Foveoletisporonites* Ramanujam & Rao 1978

Mycobank No.: MB 21102.

Type species: *Foveoletisporonites miocenicus* Ramanujam & Rao 1978.

Description (Ramanujam & Rao 1978, p. 299): Spores simple, light to dark brown, multicellate, inaperturate. Spore wall two-layered, inner layer forming transverse septa, surface conspicuously foveolate.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Foveoletisporonites indicus* Ramanujam & Srisailam 1980

Fig. 123

Mycobank No.: MB 108883.

Description (Ramanujam & Srisailam 1980, p. 123-124): Spores elongated, light to dark brown, 5-septate, 68-74.8 x 15-20 µm, slightly constricted at central part, central two cells large, elongated, 20.4 x 17 µm, end cells small relatively, 10.2 x 5.1 µm, cells in between of medium size, 17 x 10.2 µm, septa thick, conspicuous, spore wall 1.7 µm thick, no vertical septa in terminal cells, surface conspicuously foveolate, foveolae irregularly aligned, larger, 2.5 µm in diam. in central cells, slightly smaller in the end cells.



Fig. 123. *Foveoletisporonites indicus*. Bar = 20 µm.

Locality: Palayangadi and Cheruvattur (southern side of Karingottu River), Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 123-124, pl. 1, fig. 11, Warkalli Beds (Miocene), Kannur District, Kerala; Rao 1995, p. 233, pl. 1, fig. 5, Tertiary, Alleppey and Kannur districts, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Species: *Foveoletisporonites keralensis* sp. nov.

Fig. 124

Mycobank No.: MB 519940.

Diporicellaesporites sp. B in Jain & Kar, Palaeobotanist 26(2), p. 111, pl. 3, fig. 49. 1979.

Description: Spore nine celled, 76-84 x 21-25 µm in size; septa distinct, thickened, straight. Inaperturate. Spore wall less than 1 µm thick, foveolate, foveolae appear as white specks in surface view.

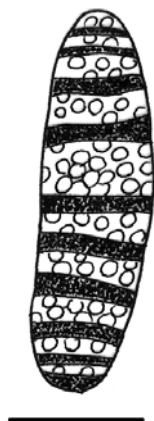


Fig. 124. *Foveoletisporonites keralensis*. Bar = 30 μm .

Holotype: Jain & Kar 1979, pl. 3, figs. 49; slide no. 5423/1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Around Kollam and Varkala, Kerala, India.

Age: Miocene.

Indian records: Jain & Kar 1979, p. 111, pl. 3, fig. 49, Miocene, around Kollam and Varkala, Kerala.

Species: *Foveoletisporonites miocenicus* Ramanujam & Rao 1978

Fig. 125

Mycobank No.: MB 115066.

Description (Ramanujam & Rao 1978, p. 299): Spores multiseptate, 100-120 μm long, 18-25 μm broad, transverse septa up to ten, apical cell deltoid with one or two vertical septa. Spore wall conspicuously foveolate, foveolae 1.5 to 3.5 μm in diameter, aligned in two or three horizontal rows in each cell.

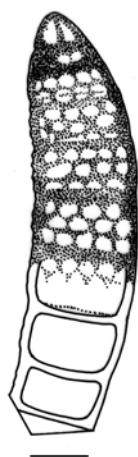


Fig. 125. *Foveoletisporonites miocenicus*. Bar = 10 μm .

Locality: Varkala, Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli Beds).

Indian records: Ramanujam & Rao 1978, p. 299, pl. 3, fig. 36, Miocene, Kerala; Ramanujam & Srisailam 1980, p. 124, pl. 1, fig. 12, Warkalli Beds (Miocene), Kannur District, Kerala; Rao 1995, p. 233, pl. 1, fig. 11, Tertiary, Alleppey and Kannur districts, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Genus: *Frasnacritetrus* Taugourdeau 1968

Mycobank No.: MB 519771.

Type species: *Frasnacritetrus josettae* Taugourdeau 1968.

Description (Taugourdeau 1968, p. 3): Organic-walled microorganism, generally of cylindrical shape tending to a rounded slightly bell-shaped parallelepiped, in transversal section nearly circular at one pole, becoming rectangular with rounded corner at the opposite pole which carries four hollow horns (or "processes") that extend the ribs of the body.

Emended Description (Saxena & Sarkar 1986, p. 212): (Emended diagnosis): Microfossils having two to four processes. Body subrectangular, unicellular or divided into chambers by septa, smooth or variously sculptured. Processes mostly smooth but may also be sculptured, unicellular or septate. (Emended description): Main body of the microfossils generally rectangular-subrectangular but variously shaped; either unicellular or divided into longitudinal chambers by vertical septa or multichambered, being divided by both vertical and transverse septa; septa may be complete or incomplete, sometimes septa faintly developed; body either smooth or ornamented with grana, verrucae or coni, etc., sculpturing elements may be closely or sparsely or evenly distributed. Two to four processes arising from one end of the body (although in *Frasnacritetrus* sp. 4, three processes are attached at the end of the body while the fourth one comes out from the middle of the body); generally broader at the base and tapering towards the apices; cylindrical or ribbon-like; either aseptate-unicellular or septate, septa one to many in each process; apex of processes pointed or blunt. *Frasnacritetrus* is not comparable to any of the known fossil palynogenera.

Classification: Fungi Imperfecti, Staurosporae.

Species: *Frasnacritetrus conatus* Saxena & Sarkar 1986

Fig. 126

Mycobank No.: MB 519773.

Description (Saxena & Sarkar 1986, p. 215-216): Fungal conidia with four processes. Main body rectangular in shape, dark brown in colour, unicellular, surface closely beset with small sized coni. Processes arise from one end of the body, tubular, wider at the base and gradually taper towards the apices, nonseptate; wall of processes smooth.

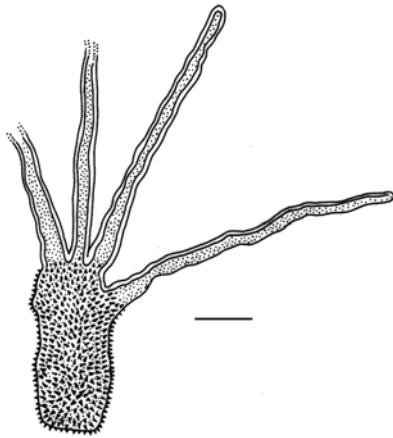


Fig. 126. *Frasnacritetrus conatus*. Bar = 10 μm .

Dimensions: Length of the conidia: 98 μm ; size of the body: 25-38 x 18-20 μm ; size of the processes: 62-84 x 2-6 μm .

Locality: Nalagarh-Ramshahr Road Section, Solan District, Himachal Pradesh, India.

Age: Middle-Upper Miocene (Lower Siwalik).

Indian records: Saxena & Sarkar 1986, p. 215-216, pl. 1, figs. 4-5, text-fig. 3, Kasauli Formation and Lower Siwalik (Miocene), near Banethi, Sirmaur District, Himachal Pradesh, and Nalagarh-Ramshahr Road Section, Solan District, Himachal Pradesh; Sarkar 1997, p. 102, 104, 108, Subathu Formation (Eocene), 20 km south-east of Bilaspur on Shimla-Bilaspur Highway, Bilaspur District, Himachal Pradesh; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Saxena & Ranhotra 2009, p. 692, fig. 3.18, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Frasnacritetrus indicus* Saxena & Khare 1992

Fig. 127

Mycobank No.: MB 483898.

Description (Saxena & Khare 1992, p. 42): Fungal conidia with four processes. Main body rectangular to oval, 23-28 x 13-17 μm , multicellular, being divided by longitudinal and transverse ridges/furrows, spore wall up to 1 μm thick, conate, coni uniformly distributed. Processes septate, 35-117 μm long and 3-4.5 μm wide, number of septa in each process 2-5, psilate.

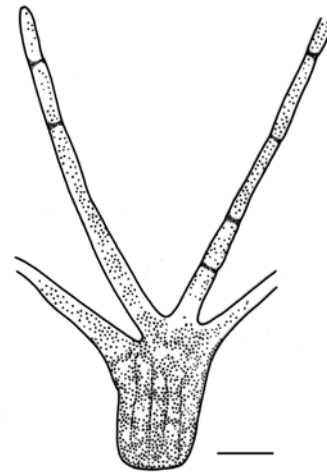


Fig. 127. *Frasnacritetrus indicus*. Bar = 10 μm .

Locality: Jayamkondacholapuram well-12 (depth 128.0 m), Tiruchirapalli District, Tamil Nadu, India.

Age: Eocene (Neyveli Formation).

Indian records: Saxena & Khare 1992, p. 42, pl. 1, fig. 17, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Saxena & Ranhotra 2009, p. 692, fig. 3.23, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Frasnacritetrus jamtahensis* Gupta 2002

Fig. 128

Mycobank No.: MB 540509.

Description (Gupta 2002, p. 148): Conidia with 4 processes, main body multicellular containing longitudinal as well as transverse septa, subverrucose, processes psilate to ornamented, aseptate or septate, fully developed or reduced. (Dimensions: Conidia 41-101 μm long, body 26-33 x 9-17 μm , processes 1.5-3 μm broad).



Fig. 128. *Frasnacritetrus jamthaensis*. Bar = 15 μm .

Locality: Jantah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Late Palaeocene-Early Oligocene (Subathu and Dagshai formations).

Indian records: Gupta 2002, p. 148, pl. 5, figs. 1-3, Subathu and Dagshai formations (Late Palaeocene-Early Oligocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Frasnacritetrus masolensis* sp. nov.

Fig. 129

Mycobank No.: MB 519941.

Frasnacritetrus sp. in Saxena *et al.*, Geophytology 17(2), p. 278, pl. 2, fig. 34. 1988.

Description: Fungal conidia with four processes. Main body rectangular in shape, smooth, divided by vertical septa into four chambers, each terminating into a process. Processes tubular, broader at the base and taper towards the apices, septate, laevigate. (Dimensions: Length of the conidia: 65-100 μm ; size of the body: 20-30 μm ; size of the processes: 30-70 μm).

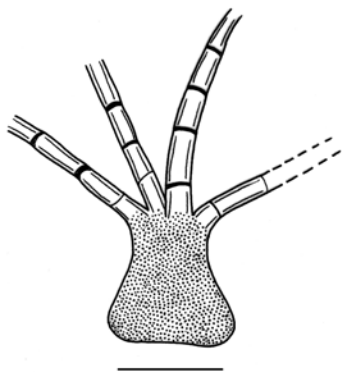


Fig. 129. *Frasnacritetrus masolensis*. Bar = 20 μm .

Holotype: Saxena *et al.* 1988, pl. 2, fig. 34; slide no. 9577, coordinates 28.5 x 113.5, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Masol-Kiratpur Section, Ambala District, Haryana, India.

Age: Pliocene (Tatrot and Pinjor Formations).

Indian records: Saxena *et al.* 1988, p. 278, pl. 2, fig. 34, Tatrot and Pinjor Formations (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana.

Species: *Frasnacritetrus siwalikus* Saxena *et al.* 1988

Fig. 130

Mycobank No.: MB 519774.

Description (Saxena *et al.* 1988, p. 277): Fungal conidia with four processes. Main body oval in shape, dark brown in colour, ornamented with sparsely placed coni and grana, divided into 4 columns, each column terminates into a process. Processes tubular, wide at the base and gradually taper at the apices, nonseptate, smooth. (Dimensions: Length of conidia: 50-60 μm ; size of the body: 25-35 μm ; size of the processes: 32-45 μm).

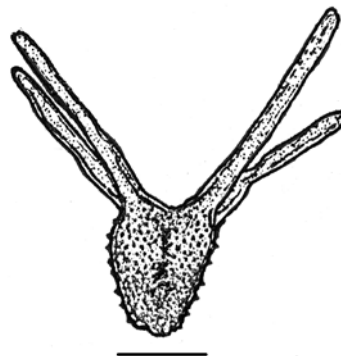


Fig. 130. *Frasnacritetrus siwalikus*. Bar = 10 μm .

Locality: Masol, Ambala District, Haryana, India.

Age: Pliocene (Tatrot Formation, Upper Siwalik).

Indian records: Saxena *et al.* 1988, p. 277, pl. 2, figs. 31-33, Tatrot and Pinjor Formations (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Kumar & Takahashi 1991, p. 609, pl. 7, fig. 6, pl. 16, fig. 11, Lower Bhuban and Bokabil formations (Early-Middle Miocene), Silchar-Haflong Road Section, Assam; Kumar 1994, p. 55, pl. 27, fig. 6, Lower Bhuban Formation (Early Miocene), Silchar-Haflong Road Section, Assam; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Frasnacritetrus taugourdeau* Saxena & Sarkar 1986

Fig. 131

Mycobank No.: MB 519775.

Frasnacritetrus sp. Sarkar & Singh 1988, p. 61, pl. 5, fig. 21; pl. 6, fig. 18.

Description (Saxena & Sarkar 1986, p. 213-215): Fungal conidia with four processes. Main body biconvex, spindle shaped, unicellular, surface granulose; grana small in size, closely placed and evenly distributed throughout the surface. Processes arise out from one end of the body, tubular, slightly wider at the base; all processes uniform in shape; wall of processes smooth; septa present in the basal part of few processes. (Dimensions: Length of the conidia: 66-112 μm ; size of the body: 30-35 x 15-20 μm ; size of the processes: 35-75 x 2-5 μm).

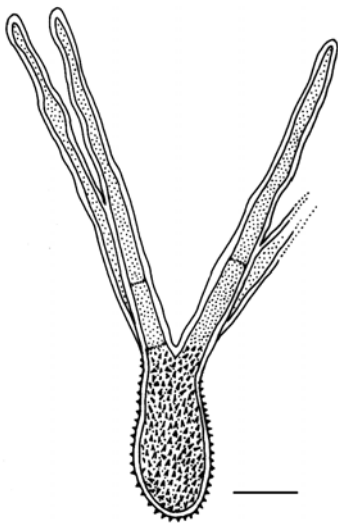


Fig. 131. *Frasnacritetrus taugourdeaui*. Bar = 10 μm .

Locality: Near Banethi, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Saxena & Sarkar 1986, p. 213-215, pl. 1, figs. 1-3, text-fig. 2, Kasauli Formation and Lower Siwalik (Miocene), near Banethi, Sirmaur District, Himachal Pradesh and Ramshahr Well no.1, Solan District, Himachal Pradesh.

Genus: *Fusiformisporites* Rouse 1962

Mycobank No.: MB 21113.

Type species: *Fusiformisporites crabbii* Rouse 1962.

Description (Rouse 1962, p. 210): Spores (?) very distinctly fusiform in outline. The unit is split into equal halves by an equatorial wall that appears to be continuous, thus completely dividing the unit. Longitudinal grooves spread out along the wall from either pole like a spindle; some reach the equator, others stop short of it. Only occasionally is a groove continuous across the dividing wall. The wall is moderately

thick, about 3 μm . Ornamentation laevigate. Size range 20-100 μm .

Emended description (Elsik 1968, p. 269): Inaperturate, dicellate fungal spores bearing characteristic elongate striae, ribs, ridges or costae oriented parallel to the long axis of the spore. Wall of one or more layers. Inner surface of wall psilate to punctate or scabrate. Equatorial septum of two layers. Equatorial constriction of wall may or may not be present.

Classification: Fungi Imperfecti, Didymosporae.

Species: *Fusiformisporites acutus* Kumar 1990

Fig. 132

Mycobank No.: MB 126560.

Description (Kumar 1990, p. 21): Fungal spores dicellate, inaperturate and elongated-fusiform. Size range 90-102 μm , generally tapering towards acute ends. Septum ± 1 μm thick. Spore wall 1-1.6 μm thick and ribbed. Ribs ± 1 μm wide, wider 1.6-2.5 μm at septal region, closely spaced, alternate or continuously running end to end, sometimes bifurcating and converging at the ends, furrows narrow.



Fig. 132. *Fusiformisporites acutus*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Lower-Middle Miocene (Quilon beds).

Indian records: Kumar 1990, p. 21, pl. 1, fig. 22, text-fig. 11, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram.

Species: *Fusiformisporites barmerensis* sp. nov.

Fig. 133

Mycobank No.: MB 519942

Fusiformisporites sp. in Jain *et al.*, Geophytology 3(2), p. 161, pl. 2, fig. 77. 1973.

cf. *Fusiformisporites* sp. in Mukherjee & Chakraborty in Badve R. M. *et al.* (Editors) - Proceedings of the 10th Indian Colloquium on Micropalaeontology and Stratigraphy, Pune,

1982. Maharashtra Association for the Cultivation of Science, Pune, p. 506, pl. 1, fig. 2. 1984.

Description: Fusiform, inaperturate, dicellate fungal spores, 68-76 x 32-40 μm , wall 0.5 μm thick, striations thin, occasionally open, apices thickened, smooth, septum two layered.

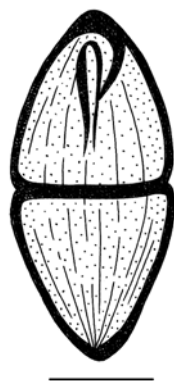


Fig. 133. *Fusiformisporites barmerensis*. Bar = 20 μm .

Holotype: Jain *et al.* 1973, pl. 2, fig. 77; slide no. 4285/1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Barmer Hills, Barmer District, Rajasthan, India.

Age: Palaeocene (Barmer Sandstone).

Indian records: Jain *et al.* 1973, p. 161, pl. 2, fig. 77, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan.

Species: *Fusiformisporites crabbii* Rouse 1962

Fig. 134

Mycobank No.: MB 109769.

Description (Rouse 1962, p. 210-212): As for the genus, with following additions: There are typically five grooves exposed on each flattened sector. Also, the equatorial plate appears to be slightly inset from the body wall, giving appearance of constriction. Size range 45-52 μm .



Fig. 134. *Fusiformisporites crabbii*. Bar = 10 μm .

Locality: Terminal Dock, Vancouver, British Columbia, Canada.

Age: Late Cretaceous- Middle Eocene (Burrard Formation).

Indian records: Ramanujam & Srisailam 1980, p. 123, pl. 1, figs. 8-9, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Malleshram *et al.* 1989, p. 15, pl. 1, figs. 15-16, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh; Rao *et al.* 1995, p. 374, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala; Samant & Phadtare 1997, p. 67, pl. 15, fig. 9, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002c, p. 79, Keifang Formation (Early Miocene), eastern flank of Aizawl Hills, Mizoram; Mandaokar 2003, 187, Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhimtui District, Mizoram; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Species: *Fusiformisporites elongatus* Ramanujam & Rao 1978

Fig. 135

Mycobank No.: MB 115067.

Description (Ramanujam & Rao 1978, p. 300-301): Spores light brown, inaperturate, prominently elongated, dicellate, 35-38.5 x 8-12 μm . Ends blunt, transverse septum up to 2.5 μm thick, spore wall 1 μm thick, finely striate; striae longitudinal or obliquely aligned, numerous, often converging at the ends, ridges as thick as grooves.

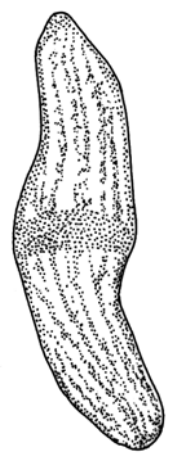


Fig. 135. *Fusiformisporites elongatus*. Bar = 10 μm .

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 300-301, pl. 3, figs. 46-48, Miocene, Kerala; Pathak & Banerjee 1984, p. 248-249, pl. 1, fig. 10, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal.

Species: *Fusiformisporites foedus* Salujha *et al.* 1974

Fig. 136

MycoBank No.: MB 519807.

Fusiformisporites sp. Ramanujam & Rao in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 300, pl. 3, fig. 44. 1978.

Description (Salujha *et al.* 1974, p. 281): Brown, oval with pointed ends, size 43.2-46.4 x 24.5-27.2 μm ; on the equator a wide disc with a wavy margin present, exine $\pm 1.2 \mu\text{m}$ thick, ridged, ridges 10 in number, $\pm 1.5 \mu\text{m}$ wide, running from one pole to the other.

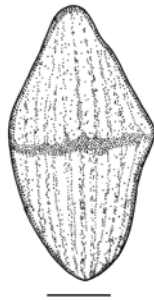


Fig. 136. *Fusiformisporites foedus*. Bar = 10 μm .

Locality: Bali-Chara Nadi Traverse; Khasi and Jaintia Hills, Meghalaya, India.

Age: Palaeocene (Disang Formation).

Indian records: Salujha *et al.* 1974, p. 281, pl. 3, figs. 98-99, Palaeocene, Khasi and Jaintia Hills, Meghalaya; Ramanujam & Rao 1978, p. 300, pl. 3, fig. 42, Quilon and Warkalli beds (Miocene), Kollam District, Kerala; Tripathi *et al.* 2000, p. 243, Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya.

Species: *Fusiformisporites keralensis* Ramanujam & Rao 1978

Fig. 137

MycoBank No.: MB 115068.

Description (Ramanujam & Rao 1978, p. 300): Spores dark brown to light brown, large, inaperturate, fusiform to rhomboidal, 51-56 x 32-36 μm , dicellate, ends truncate to broadly arched. Transverse septum conspicuous, two layered up to 4 μm thick. Spore wall 1.5 μm thick, much thicker at each end along the long axis, prominently striate; striae numerous, longitudinal, seen on either side of septum, ridges slightly broader than grooves.



Fig. 137. *Fusiformisporites keralensis*. Bar = 10 μm .

Locality: Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 300, pl. 3, fig. 42, Quilon and Warkalli beds (Miocene), Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 9, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Fusiformisporites lineolatus* Sheffy & Dilcher 1971

Fig. 138

MycoBank No.: MB 111493.

Description (Sheffy & Dilcher 1971, p. 48): Fusiform fungal spore 18.4 x 33.8 μm , inaperturate bearing 6-7 conspicuous longitudinal ribs. Two cells separated by an opaque septum 1.0 μm thick.



Fig. 138. *Fusiformisporites lineolatus*. Bar = 10 μm .

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.
Age: Middle Eocene (Caliborne Formation).

Indian records: Ramanujam & Srisailam 1980, p. 123, pl. 1, fig. 10, Warkalli Beds (Miocene), Kannur District, Kerala; Mallesham *et al.* 1989, p. 15, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Samant 2000, p. 16, pl. 1, fig. 11, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Fusiformisporites minutus* Phadtare & Kulkarni 1984 (nom. inval.)

Remarks: This species name was not validly published by Phadtare and Kulkarni [1984, p. 528, pl. 1, figs. 1-2, Ratnagiri Beds (Miocene), well at Golap on Ratnagiri-Pawas Road, Ratnagiri District, Maharashtra], as they did not publish description of the species.

Species: *Fusiformisporites pseudocrabbii* Elsik 1968

Fig. 139

MycoBank No.: MB 314248.

Description (Elsik 1968, p. 270-272): Fusiform, inaperturate fungal bodies bearing broad longitudinal ribs or folds. Fine inner striae made up of rows of punctae, punctae parallel to the coarse ribs. Width of spores ca. 25 µm, length 40-45 µm. Wall of two layers: inner 0.5 µm thick, outer 0.5 to 1.5 µm at apices. Apices 1.5 to 2 µm, psilate. Equatorial septum 2 µm thick, of two layers. Slight constriction of spore wall equatorially. Spore wall occasionally split between ribs.

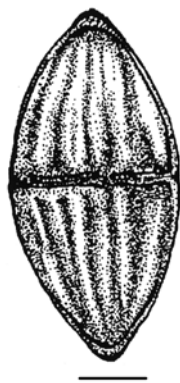


Fig. 139. *Fusiformisporites pseudocrabbii*. Bar = 10 µm.

Locality: 11 km south-east of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Venkatachala & Rawat 1973, p. 257-258, pl. 1, fig. 4, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Rawat *et al.* 1977, p. 187, Kadi Formation (Early Eocene), Cambay Basin, Gujarat; Kar *et al.* 1994, p. 187, subsurface Tertiary sediments in Upper Assam; Mandaokar 2000c, p. 38, Tikak

Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh.

Species: *Fusiformisporites tonakkalensis* Varma & Patil 1985

MycoBank No.: MB 133495.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Varmasporites* Kalgutkar & Jansonius 2000 [See: *Varmasporites tonakkalensis* (Varma & Patil 1985) Kalgutkar & Jansonius 2000].

G

Genus: *Granodiporites* Varma & Rawat 1963

MycoBank No.: MB 30409.

Type species: *Granodiporites erdtmanii* Varma & Rawat 1963.

Description (Varma & Rawat 1963, p. 135): Diporate pollen grains with granular exine.

Classification: Angiospermae.

Remarks: Kalgutkar and Jansonius (2000) transferred the type species *Granodiporites erdtmanii* Varma & Rawat 1963, to pollen genus *Banksieaeidites* Cookson 1950. The genus *Granodiporites* therefore became a junior synonym of *Banksieaeidites* Cookson 1950. Surprisingly, even after its transfer to pollen genus, they classified it under "Fungi Imperfecti, Amerosporae".

Species: *Granodiporites erdtmanii* Varma & Rawat 1963

Remarks: Kalgutkar and Jansonius (2000) transferred this species to pollen genus *Banksieaeidites* Cookson (1950)

Species: *Granodiporites piercei* Varma & Rawat 1963

MycoBank No.: MB 483374.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Foveodiporites* Varma & Rawat (1963) [See: *Foveodiporites piercei* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

Species: *Granodiporites sahnii* Varma & Rawat 1963

MycoBank No.: MB 483375.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* van der Hammen (1954) [See: *Dyadosporites sahnii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

H

Genus: *Hapalophragmites* Ramanujam & Ramachar 1980

MycoBank No.: MB 28629.

Type species: *Hapalophragmites cumminsii* Ramanujam & Ramachar 1980.

Description (Ramanujam & Ramachar 1980, p. 82): Teliospores triquetrously three-celled, pedicellate, odd cell terminal, the

two basal cells borne on a common stalk; wall cinnamon-brown; one germ pore in each cell.

Classification: Basidiomycetes, Uredinales.

Species: *Hapalophragmites cumminsii* Ramanujam & Ramachar 1980

Fig. 140

Mycobank No.: MB 483758.

Description (Ramanujam & Ramachar 1980, P. 82): Teliospores triquetrously three-celled, pedicellate, more or less rounded triangular to rounded, 30-42 x 30-39 μm , cinnamon-brown, wall up to 3 μm thick, smooth; pedicel up to 8 μm long; one germ pore per cell, faint, up to 2 μm in diameter.

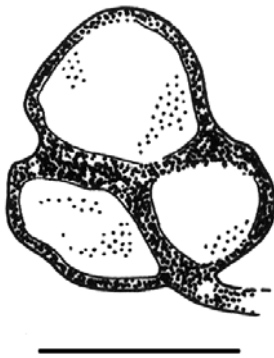


Fig. 140. *Hapalophragmites cumminsii*. Bar = 20 μm .

Locality: Neyveli, South Arcot District, Tamil Nadu, India.

Age: Miocene (Neyveli lignite).

Indian records: Ramanujam & Ramachar 1980, p. 82-83, pl. 1, figs. 7-9, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Genus: *Haplopeltis* Theissen 1914

Mycobank No.: MB 2234.

Type species: *Haplopeltis bakeriana* (Rehm) Theissen 1914.

Classification: Ascomycetes, Microthyriales.

Species: *Haplopeltis mucoris* Dilcher 1965

Fig. 141

Mycobank No.: MB 331694.

Description (Dilcher 1965, p. 26): 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.

Locality: Western Tennessee, U.S.A.

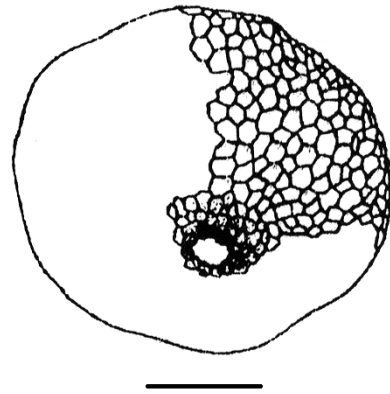


Fig. 141. *Haplopeltis mucoris*. Bar = 25 μm .

Age: Early Eocene.

Indian records: Rao & Ramanujam 1976, p. 102, pl. 1, fig. 6, Quilon and Warkalli Beds (Miocene), Kerala.

Species: *Haplopeltis neyveliense* Reddy *et al.* 1982

Fig. 142

Mycobank No.: MB 519809.

Description (Reddy *et al.* 1982, p. 118): 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.

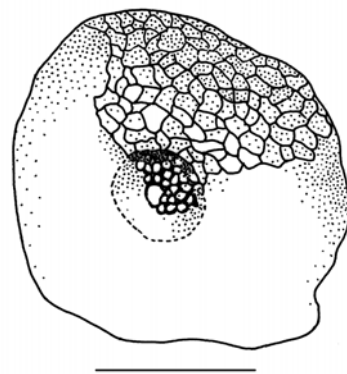


Fig. 142. *Haplopeltis neyveliense*. Bar = 50 μm .

Locality: Neyveli, South Arcot District, Tamil Nadu, India.

Age: Miocene.

Indian records: Reddy *et al.* 1982, p. 118, pl. 2, figs. 7-9, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Genus: *Helicominites* Barlinge & Paradkar 1982

Mycobank No.: MB 21126.

Type species: *Helicominites salvinites* Barlinge & Paradkar 1982.

Description (Barlinge & Paradkar 1982, p. 167): Fungus saprophytic; mycelium septate, branched, hyphae faint in colour; pycnidium and acervulus absent; conidia coiled in loose spirals and narrow at both ends.

Classification: Fungi Imperfecti, Helicosporae.

Species: *Helicominites salvinites* Barlinge & Paradkar 1982

Fig. 143

Mycobank No.: MB 108905.

Description (Barlinge & Paradkar 1982, p. 166): Saprophytic fungus found inside *Salvinia intertrappea* megaspores, in space usually occupied by female gametophyte; mycelium 5-6 μm in breadth; conidia loosely, spirally coiled, 21-32 x 20-30 μm , narrow at both ends.

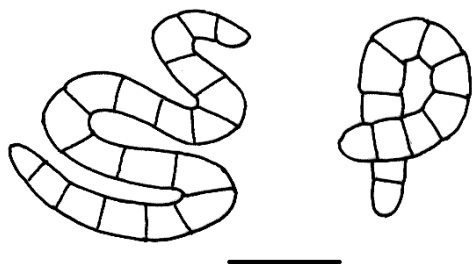


Fig. 143. *Helicominites salvinites*. Bar = 10 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Cretaceous – Maastrichtian (Deccan Intertrappean Series).

Indian records: Barlinge & Paradkar 1982, p. 166-167, text-figs. T-V, Deccan Intertrappean Series (?Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Helminthosporites* Chitaley & Sheikh 1971 (nom. inval.)

Mycobank No.: MB 21128.

Type species: *Helminthosporites mohgaoensis* Chitaley & Sheikh 1971 (nom. inval.).

Description: As for the type species (combined description).

Classification: Hyphomycetes.

Remarks: No illustration of this taxon was published. However, the authors illustrated their taxonomic concept with photographs of extant *Helminthosporium*. This generic name (and also the species *Helminthosporites mohgaoensis* Chitaley & Sheikh 1971) is therefore not validly published.

Species: *Helminthosporites mohgaoensis* Chitaley & Sheikh 1971 (nom. inval.)

Mycobank No.: MB 106175.

Description (combined description, Chitaley and Sheikh 1971, p. 138): Mycelium of short, branched, septate hyphae with multicellular 1- to 4-celled spores of dark colour. Sexual reproduction not known.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian.

Indian records: Chitaley & Sheikh 1971, p. 138, fig. 4, Deccan Intertrappean Series (?Palaeocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Remarks: Chitaley and Sheikh (1971) stated that the present fungus does not show any sexual reproductive stage and thus is difficult to assign to a definite fungal order. However, the septate shortly branched condition of the hyphae with multicellular spores suggests its identity with the existing *Helminthosporium* group (Alexopoulos 1958, Wolf & Wolf 1949). Fungi from this group are imperfect ones and are normally found infecting cereals. They therefore included it in the group *Helminthosporium* under the new name *Helminthosporites mohgaoensis*. No illustration of this taxon was published by Chitaley and Sheikh (1971). However, they illustrated their taxonomic concept with photographs of extant *Helminthosporium*. This generic name, and also the name of the species, is therefore considered as not validly published.

Genus: *Hendersonula* Spegazzini 1880

Mycobank No.: MB 8511.

Type species: *Hendersonula australis* Spegazzini 1880.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Hendersonula mohgaoensis* Singh & Patil 1980

Fig. 144

Mycobank No.: MB 108907.

Description (Singh & Patil 1980, p. 18): Pycnidia in chains, embedded in stroma in host tissue, oval or irregular, each 126-145 x 85-140 μm in size, thin-walled; conidiogenous cells 4 μm long; conidia oval, 4 x 1.5 μm , bicelled, thin-walled. Host: dicotyledonous wood.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Cretaceous (Deccan Intertrappean beds).

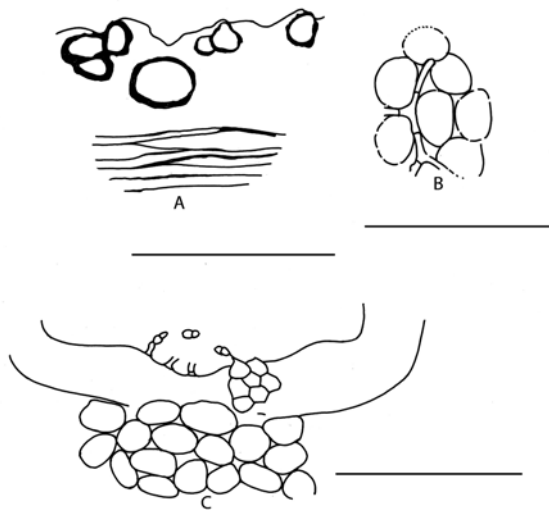


Fig. 144. *Hendersonula mohgaensis*. A. Arrangement of pycnidia. Bar = 800 μ m, B. Host tissue with mycelium. Bar = 50 μ m, C. Part of pycnidium wall with dicellate spores and stroma. Bar = 50 μ m.

Indian records: Singh & Patil 1980, p. 18, pl. 1, figs. 3-4, text-figs. 5-6, Deccan Intertrappean Series (Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Hilidicellites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28618.

Type species: *Hilidicellites appendiculatus* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 133): Small to medium-sized dicellate fungal spores, with the proximal end flattened or truncate, due to the presence of a hilum or pore-like structure; the two cells generally of comparable size; spore wall thin or of medium thickness, smooth or with subdued sculpture, generally thinner than the septal base.

Classification: Fungi Imperfecti, Didymosporae.

Remarks: *Didymoporisporonites* differs in having proximal cell, much smaller than the distal cell. *Dicellaesporites* lacks a hilum or pore.

Species: *Hilidicellites constrictus* (Mathur & Mathur 1969) Kalgutkar & Jansonius 2000

Fig. 145

Mycobank No.: MB 519830.

Dyadosporonites constrictus Mathur & Mathur, Bulletin of the Geological, Mining and Metallurgical Society of India 42, p. 3, pl. 1, fig. 3. 1969.

Description (Mathur & Mathur 1969, p. 3): Surface view. Spores bilocular, horizontally septate, strongly constricted at the septum, individual cells 12 x 9.8 μ m in size, two-layered, psilate, brown.

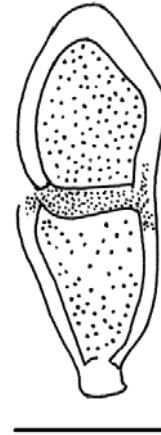


Fig. 145. *Hilidicellites constrictus*. Bar = 10 μ m.

Locality: Naera and Baraia area, Kutch District, Gujarat, India.

Age: Pliocene.

Indian records: Mathur & Mathur 1969, p. 3, pl. 1, fig. 3, Pliocene, Naera and Baraia area, Kutch District, Gujarat; Kar 1985, p. 159, pl. 37, fig. 3, Pliocene, Naera, Kutch District, Gujarat; Malleshham *et al.* 1989, p. 15, pl. 1, fig. 8, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Kar *et al.* 1994, p. 187, pl. 2, fig. 30, subsurface Tertiary sediments in Upper Assam; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Mandaokar 2000c, p. 38, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh.

Remarks: Mathur and Mathur incorrectly cited the generic name as "*Dyadosporonites* van der Hammen 1954". This error in bibliographic citation does not, however, invalidate the publication of the species name. The photograph of the type specimen shows a distinct hilum and subtending hyphal fragment; it probably is a teleutospore.

Species: *Hilidicellites dubius* Kalgutkar & Jansonius 2000 Fig. 146

Mycobank No.: MB 483384.

Dicellaesporites crassiseptus Ramanujam & Srisailam, Botanique 9(1-4), p. 127, pl. 2, fig. 20. 1980, non *Hilidicellites crassiseptus* (Salard-Cheboldaeff & Locquin) Kalgutkar & Jansonius 2000

Description (Ramanujam & Srisailam 1980, p. 127): Spores dark brown, dicellate, elliptical, 15.5-20.4 x 7-8.5 μ m,

inaperturate, upper cell more acutely tapering than the lower cell, base slightly protruding, frilled, transverse septum dark, opaque, in the form of a conspicuously thick (6.8 μm) band; spore wall up to 2.2 μm thick, psilate to finely granular.

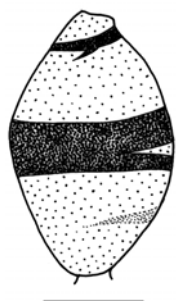


Fig. 146. *Hilidicellites dubius*. Bar = 20 μm .

Locality: Kannur beach area, Palayangadi and Cheruvattur (southern side of Karingottu River), Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 127, pl. 2, fig. 20, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Mallesham *et al.* 1989, p. 15, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Species: *Hilidicellites indicus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 147

Mycobank No.: MB 483386.

Didymoporisporonites indicus Chandra *et al.*, Biovigyanam 10(1), p. 51, pl. 2, fig. 31. 1984.

Description (Chandra *et al.* 1984, p. 51): Spindle-shaped fungal spore, size 35 x 15 μm ; dicellate, both cells almost equal in size, uniseptate; monoporate, pore on the apex of one cell, pore margin not thickened, wall 0.5 μm thick, punctate.



Fig. 147. *Hilidicellites indicus*. Bar = 10 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 51, pl. 2, fig. 31, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Species: *Hilidicellites siddiquiei* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 148

Mycobank No.: MB 483394.

Didymoporisporonites siddiquiei Chandra *et al.*, Biovigyanam 10(1), p. 51, pl. 2, fig. 32. 1984.

Description (Chandra *et al.* 1984, p. 51): Oval fungal spores, size 38 x 21 μm , dicellate, closed apex of the spore rounded while the other one conical; uniseptate, septum faint but complete, about 1 μm thick; monoporate, pore margin not thickened, spore wall very thin, hyaline, psilate, finely folded.



Fig. 148. *Hilidicellites siddiquiei*. Bar = 10 μm .

Locality: Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°12.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 51, pl. 2, fig. 32, Late Quaternary, Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°12.9'E), Arabian Sea.

Genus: *Hypoxylonites* Elsik 1990

Mycobank No.: MB 25556.

Hypoxylonsporites Kumar 1990 (May), non *Hypoxylonites* Salard-Chebaldæff & Locquin 1980 (nom. inval.; lacking a diagnosis).

Type species: *Hypoxylonites brazosensis* Elsik 1990.

Description (Elsik 1990, p. 143): Oval to elongate, aseptate, bilateral, psilate fungal spores bearing an elongate scar, slit or furrow. At the level of transmitted light microscopy, at least one species is faintly sculptured. The elongate furrow is parallel to the axis and can be of various lengths. Apices rounded to pointed; usually of similar shape but some species

have an attachment scar at one end; apices can also be thickened or otherwise modified. The spore wall in most specimens is generally rigid.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Kumar (1990, p. 18-19) instituted *Hypoxylonsporites* (Type species: *H. miocenicus*) with the following diagnosis “Fungal spores unicellular, oval to ellipsoidal in shape with acutely rounded ends. A longitudinal slit like aperture may be running end to end. Spore wall single layered, smooth and may be differentially coloured.” It is evident that *Hypoxylonites* Elsik (March 1990) and *Hypoxylonsporites* Kumar (May 1990) are identical in all essential characters and are therefore synonyms. Both of these genera have affinity with the extant genus *Hypoxylon* of the family Xylariaceae. Above observation was made by Saxena (1992). Since *Hypoxylonites* has nomenclatural priority over *Hypoxylonsporites*, Saxena (1992) transferred the species described under latter to the former.

Species: *Hypoxylonites ater* (Kumar 1990) Saxena 1992

Fig. 149

Mycobank No.: MB 483400.

Hypoxylonsporites ater Kumar, Review of Palaeobotany and Palynology 63, p. 19, pl. 1 fig. 13. 1990.

Hypoxylonites ater (Kumar 1990) Kalgutkar & Jansonius, AASP Contribution Series 39, p. 137, pl. 4, fig. 29. 2000.

Description (Kumar 1990, p. 19): Fungal spores unicellular, broadly oval in shape, ends tapered. Size 25-30 x 18-20 μm . Longitudinal slit runs from end to end. Spore wall single layered, $\pm 1.6 \mu\text{m}$ thick and smooth.

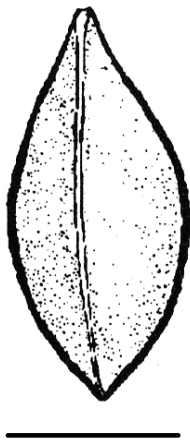


Fig. 149. *Hypoxylonites ater*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 19, pl. 1 fig. 13, Quilon Beds (Early-Middle Miocene), Padappakkara, Kollam District, Kerala, India.

Species: *Hypoxylonites bhubanensis* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 150

Mycobank No.: MB 519748.

Description (Nandi *et al.* 2003, p. 58): Amerospores bilateral, elliptical, elongated, generally with rounded to obtuse distal and basal ends, sides straight to slightly convex, furrow long, situated at straight side. Spore wall 2 μm thick, surface smooth. Spore size ranges from 30 μm – 45 μm x 12 μm – 15 μm .

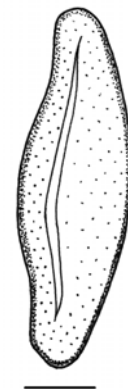


Fig. 150. *Hypoxylonites bhubanensis*. Bar = 5 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Neogene (Bhuban, Bokabil Tipam and Dupitila formations).

Indian records: Nandi *et al.* 2003, p. 58, pl. 1, figs. 1-2, text-fig. 3.1, Bhuban, Bokabil Tipam and Dupitila formations (Neogene), North-eastern India.

Remarks: Nandi and Banerjee in Nandi *et al.* (2003) described the new species “*Hypoxylonites bhubanensis*” but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites chaiffetzii* Elsik 1990

Fig. 151

Mycobank No.: MB 130350.

Description (Elsik 1990, p. 147): Bilateral, aseptate, reniform, psilate fungal spores with a longitudinal furrow about 3/4 of the length of the spore. Outline of the spore is almost straight along the furrow; the ends of the spore are narrowly rounded. Overall size ca. 11-13 x 29 μm . The spore wall is rigid, 0.5 μm or less thick, and can be very slightly thickened at the subrounded apices.

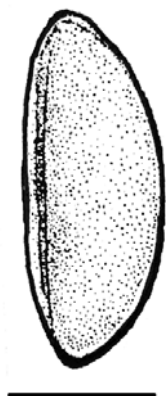


Fig. 151. *Hypoxylonites chaiffetzii*. Bar = 10 μ m.

Locality: Gulf Coast.

Age: Neogene.

Indian records: Nandi *et al.* 2003, p. 58, pl. 1, fig. 3, Siju, Kherapara, Bhuban, Bokabil, Tipam and Dupitila formations (Tertiary), North-eastern India.

Species: *Hypoxylonites curvatus* (Ramanujam & Rao 1978) **Elsik 1990**

Fig. 152

Mycobank No.: MB 130343.

Diporisorites curvatus Ramanujam & Rao in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 294, pl. 1, fig. 6. 1978.

Description (Ramanujam & Rao 1978, p. 294): Spores diporate, darkish brown, elliptical to slightly elongated and curved, 14 x 7.5 μ m. A single pore on opposite ends of spore along its vertical axis, pore rounded, simple, not pouting; spore wall two layered up to 1.5 μ m thick, surface psilate.



Fig. 152. *Hypoxylonites curvatus*. Bar = 5 μ m.

Locality: Alleppey, Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 294, pl. 1, fig. 6, Miocene, Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 4, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte Village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002c, p. 79, Keifang Formation (Early Miocene), eastern flank of Aizawl Hills, Mizoram.

Species: *Hypoxylonites elsikii* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 153

Mycobank No.: MB 519749.

Description (Nandi *et al.* 2003, p. 58): Amerospores bilateral, boat shaped to elliptical to cylindrical ellipsoid with narrowly protruded apiculi at both ends, sides convex. Single longitudinal furrow straight, narrow, extended to the ends. Spore wall 2 μ m thick, thicker towards the poles but thinner at the far ends of the spores and around the furrow. Spore size ranges from 5 μ m-15 μ m x 10 μ m-25 μ m.

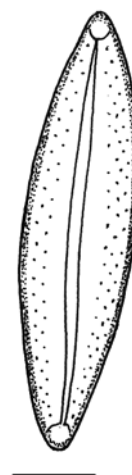


Fig. 153. *Hypoxylonites elsikii*. Bar = 5 μ m.

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Siju, Kherapara, Bhuban, Bokabil and Dihing formations),

Indian records: Nandi *et al.* 2003, p. 58, pl. 1, figs. 5, 9, 16, 17, text-fig. 3.3, Siju, Kherapara, Bhuban, Bokabil and Dihing formations (Tertiary), North-eastern India.

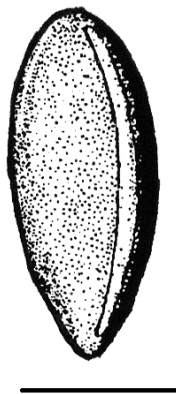
Remarks: Nandi and Banerjee in Nandi *et al.* (2003) described the new species "*Hypoxylonites elsikii*" but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites eocenicus* Elsik 1990

Fig. 154

MycoBank No.: MB 130355.

Description (Elsik 1990, p. 149): Aseptate, psilate fungal spores ca. 10 x 25 μm overall. Outline narrowly elliptical in a fusiform manner with subpointed ends. Furrow straight and parallel to the length of the spore. The furrow almost completely encircles the spore; the more or less equal halves of the spore remain attached to one end which is very slightly less narrowly rounded. Thickness of the spore wall is ca. 0.5 μm or less, generally ca. 0.25 μm .

Fig. 154. *Hypoxylonites eocenicus*. Bar = 10 μm .**Locality:** The Green River Section, Washington, U.S.A.**Age:** Late Eocene.

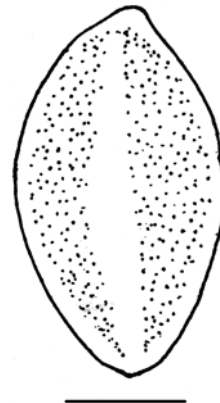
Indian records: Nandi *et al.* 2003, p. 58, pl. 1, figs. 18, 20, pl. 2, fig. 19, Siju, Kherapara, Bhuban and Bokabil formations (Tertiary), North-eastern India.

Species: *Hypoxylonites felixii* Elsik 1990

Fig. 155

MycoBank No.: MB 130357.

Description (Elsik 1990, p. 150): Aseptate, psilate fungal spores ca. 14 x 23 μm overall. Spore wall ca. 0.5 μm , thickened to ca. 1 μm over the protruding ends of the spore. Outline elliptical in top view, with narrowly rounded ends. The furrow reaches within 2 μm of the ends of the spore; it is straight and parallel to the length of the spore. Outline in side view not seen. The furrow in oblique views is seen to traverse a convex surface of the spore.

Fig. 155. *Hypoxylonites felixii*. Bar = 5 μm .**Locality:** Mid Creek Section, Bristol Bay, Alaska.**Age:** Miocene.

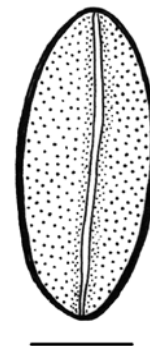
Indian records: Singh & Tripathi 2010, p. 11, pl. 1, fig. 18, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Hypoxylonites fusiformis* Elsik 1990

Fig. 156

MycoBank No.: MB 130359.

Description (Elsik 1990, p. 150): Aseptate, psilate fungal spores ca. 8 x 20 μm overall. The spore wall is very thin, uniformly ca. 0.25 μm . Outline elliptical or narrowly elliptical with pointed or subpointed ends in an overall fusiform shape. The longitudinal furrow reaches the ends of the spore. The outline in side view was not seen.

Fig. 156. *Hypoxylonites fusiformis*. Bar = 5 μm .

Locality: The Gulf Coast.

Age: Neogene.

Indian records: Nandi *et al.* 2003, p. 59, pl. 1, figs. 4, 8, Bhuban, Bokabil, Tipam and Dupitila formations (Neogene), North-eastern India.

Species: *Hypoxylonites gulfensis* Elsik 1990

Fig. 157

MycoBank No.: MB 130360.

Description (Elsik 1990, p. 150): Bilateral, reniform, aseptate, psilate fungal spores with a longitudinal furrow generally 1/2 or less of the length of the straight or concave side of the spore. Overall size 7-10 x 25-32 μm . Spore wall 0.25-0.5 μm or slightly thicker, thickening to a maximum of 1.5 μm over the ends of the spore in a few specimens; not thickened in other specimens. Aperture a narrow furrow with rounded ends. Ends of spore subpointed or narrowly rounded.

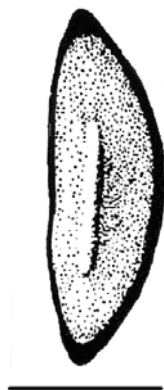


Fig. 157. *Hypoxylonites gulfensis*. Bar = 10 μm .

Locality: The Gulf Coast.

Age: Neogene.

Indian records: Nandi *et al.* 2003, p. 59, pl. 1, fig. 7, Bhuban, Bokabil, Tipam and Dupitila formations (Neogene), North-eastern India.

Species: *Hypoxylonites kumarii* Kalgutkar & Jansonius 2000

Fig. 158

MycoBank No.: MB 483402.

Hypoxylosporites miocenicus Kumar, Review of Palaeobotany and Palynology 63, p. 19, pl. 1 fig. 23. 1990 (May), non Elsik 1990 (March).

Hypoxylonites miocenicus (Kumar 1990) Saxena, Geophytology 21, p. 211. 1992.

Description (Kumar 1990, p. 19): Fungal spores unicellular, elliptic to spindle-shaped with narrowly rounded ends. Size 21-55 x 9-26 μm . A longitudinal slit extends from one end to the other. Spore wall single layered, \pm 1.6 μm thick and smooth.



Fig. 158. *Hypoxylonites kumarii*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Lower-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 19, pl. 1, fig. 23, text-fig. 6, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Species: *Hypoxylonites magnus* Elsik 1990

Fig. 159

MycoBank No.: MB 130364.

Description (Elsik 1990, p. 152): Aseptate, psilate fungal spores ca. 15 x 44 μm overall in side view. Outline in top view narrowly elliptical; in side view narrowly reniform. Longitudinal, straight furrow reaches to about 5-6 μm from each end of the spore along the straight to very slightly convex side. Spore wall 0.25-0.5 μm , thickening to 1 μm towards the ends and to 1.0-2.0 μm over the ends.

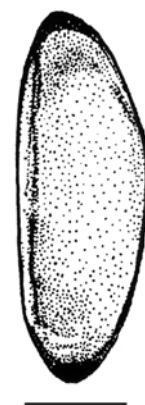


Fig. 159. *Hypoxylonites magnus*. Bar = 10 μm .

Locality: Socony-Vacuum Borehole no. 2, Isla de Cubagua, Venezuela.

Age: Middle Miocene.

Indian records: Singh & Tripathi 2010, p. 11, pl. 1, fig. 14, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Hypoxylonites minimus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 160

Mycobank No.: MB 519750.

Description (Nandi *et al.* 2003, p. 59): Spores elliptic, sides convex, apex rounded, furrow long, crossed one end and almost encircle the spore throughout its polar axis. Spore exine thick, thinner around the aperture, surface smooth. Spore size ranges from 5-7 μm x 10-12 μm .

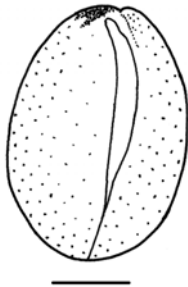


Fig. 160. *Hypoxylonites minimus*. Bar = 3 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Siju, Bhuban, Bokabil, Tipam and Dupitila formations).

Indian records: Nandi *et al.* 2003, p. 59, pl. 1, figs. 12, 21, text-fig. 3.5, Siju, Bhuban, Bokabil, Tipam and Dupitila formations (Tertiary), North-eastern India.

Remarks: Nandi & Banerjee in Nandi *et al.* (2003) described the new species "*Hypoxylonites minimus*" but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites miocenicus* Elsik 1990

Fig. 161

Mycobank No.: MB 130367.

Description (Elsik 1990, p. 153): Aseptate, aporate, psilate fungal spores bearing a single linear furrow. Outline elliptical with sharply rounded ends; the shape is robustly uniform. The furrow extends to the ends, or almost to the ends, of the spore. Overall size is ca. 12-13 x 20-22 μm . The spore wall is ca. 0.8 μm ; it is 0.5 μm or thinner over the surface around the furrow, and thickened to ca. 1 μm at the ends of the spore.

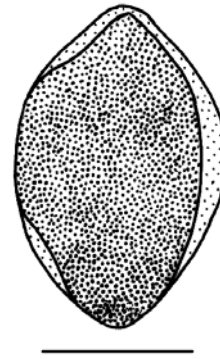


Fig. 161. *Hypoxylonites miocenicus*. Bar = 10 μm .

Locality: The Gulf Coast.

Age: Late Miocene.

Indian records: Nandi *et al.* 2003, p. 59, pl. 1, figs. 6, 10, Mahadeo, Langpar, Cherra Sandstone, Kherapara, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations (Late Cretaceous-Tertiary), North-eastern India.

Species: *Hypoxylonites neogenicus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 162

Mycobank No.: MB 519753.

Description (Nandi *et al.* 2003, p. 59): Spores broadly elliptical to barrel shaped, equator much broader than the apices, apices bluntly rounded. Furrow long, broader at the middle and extended up to the apices dividing the spore almost into two equal boat shaped halves. Spore wall 1.5 μm thick, surface smooth. Size ranges from 80 μm - 90 μm x 15 μm - 25 μm .



Fig. 162. *Hypoxylonites neogenicus*. Bar = 5 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Neogene (Bhuban, Bokabil, Tipam, Dupitila and Dihing formations).

Indian records: Nandi *et al.* 2003, p. 59, pl. 1, figs. 13-14, text-fig. 3.2, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations (Neogene), Northeastern India.

Remarks: Nandi and Banerjee in Nandi *et al.* (2003) described the new species "*Hypoxylonites neogenicus*" but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites ovalis* Elsik 1990

Fig. 163

MycoBank No.: MB 130369.

Description (Elsik 1990, p. 153): Reniform to oval, bilateral, aseptate, psilate fungal spores with a longitudinal furrow nearly the full length of the spore on the somewhat straighter face. One side of the furrow is generally folded. Overall size 7-8 x 16-17 μm ; spore wall ca. 0.75 μm .

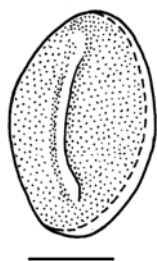


Fig. 163. *Hypoxylonites ovalis*. Bar = 5 μm .

Locality: The Green River Section, Washington, U.S.A.

Age: Eocene.

Indian records: Nandi *et al.* 2003, p. 60, pl. 1, fig. 22, Kherapara, Bhuban, Bokabil, Tipam and Dupitila formations (Tertiary), Northeastern India.

Species: *Hypoxylonites subrotundus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 164

MycoBank No.: MB 519752.

Description (Nandi *et al.* 2003, p. 60): Spores oval to spherical in shape with rounded apices. Furrow long, reaching the apices and sometimes dividing the spores into two boat shaped halves. Spore wall thin to thick. Size ranges from 15 μm x 20 μm – 30 μm .

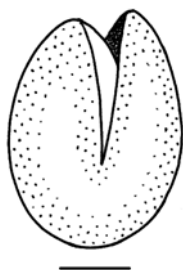


Fig. 164. *Hypoxylonites subrotundus*. Bar = 5 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Siju, Bhuban, Bokabil, Tipam and Dupitila formations).

Indian records: Nandi *et al.* 2003, p. 60, pl. 1, fig. 19, text-fig. 3.4, Siju, Bhuban, Bokabil, Tipam and Dupitila formations (Tertiary), North-eastern India.

Remarks: Nandi and Banerjee in Nandi *et al.* (2003) described the new species "*Hypoxylonites subrotundus*" but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites subuliformis* Elsik 1990

Fig. 165

MycoBank No.: MB 130375.

Description (Elsik 1990, p. 156): Awl-shaped fungal spores, psilate with elongate furrow about 1/4 or less of the spore length on the straight side of the spore. Outline very narrowly elliptical in top view. Overall size ca. 7 x 56 μm . The wall is 0.5-1 μm thick and can be slightly thickened at the apices.



Fig. 165. *Hypoxylonites subuliformis*. Bar = 10 μm .

Locality: Strata in the Socony-Vacuum Borehole No. 2, Isla de Cubagua, Venezuela.

Age: Miocene.

Indian records: Nandi *et al.* 2003, p. 60, pl. 2, figs. 1-2, Siju, Bhuban, Bokabil, Tipam and Dupitila formations (Tertiary), North-eastern India.

Species: *Hypoxylonites sulekii* Elsik 1990

Fig. 166

MycoBank No.: MB 130376.

Description (Elsik 1990, p. 156): Aseptate, psilate fungal spores ca. 10-14 x 34-44 μm overall. The spore outline in top view is narrowly elliptical, with the rounded to narrowly rounded ends slightly or markedly protruded. The longitudinal furrow is a narrow slit or can be gaping with rounded ends, 1/2 to 3/4 the length of the flatter surface of the spore. Outline in side view reniform or boat shaped, asymmetrical; the furrow generally slightly raised, i.e. ends of the spore to the furrow are convex, then straight to concave along the furrow; opposite side low rounded and convex. Spore wall ca. 0.5-1.0 μm , thickening to 1.5-2.5 μm at the ends.

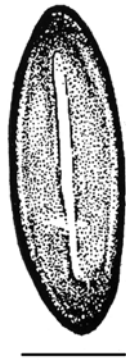


Fig. 166. *Hypoxylonites sulekii*. Bar = 10 μm .

Locality: Socony-Vacuum Borehole no. 2, Isla de Cubagua, Venezuela; the Gulf Coast; the Pacific Coast.

Age: Middle Miocene strata in Venezuela; Neogene of the Gulf Coast; Neogene of the Pacific Coast, from northern California to offshore Baja California.

Indian records: Nandi *et al.* 2003, p. 60, pl. 1, figs. 11, 15, Bhuban and Bokabil formations (Miocene), North-eastern India; Singh & Tripathi 2010, p. 11, pl. 1, fig. 6, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Hypoxylonites thindii* Nandi & Sinha in Nandi *et al.* 2003 (nom. inval.)

Fig. 167

Mycobank No.: MB 519751.

Description Spores rectangular in shape with bluntly straight to slightly convex apices, sides straight to slightly convex. Furrow long and situated at the straight side of the spore, very thin. Spore wall thin, smooth. Size ranges 10 μm -15 μm x 19 μm -21 μm .

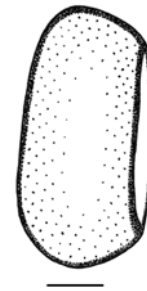


Fig. 167. *Hypoxylonites thindii*. Bar = 5 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Siju, Kherapara, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations).

Indian records: Nandi *et al.* 2003, p. 60, pl. 2, figs. 13-15, text-fig. 3.6, Siju, Kherapara, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations (Tertiary), North-eastern India.

Remarks: Nandi and Banerjee in Nandi *et al.* (2003) described the new species "*Hypoxylonites thindii*" but did not validly publish the name, as they did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Hypoxylonites vittatoides* Elsik 1990

Fig. 168

Mycobank No.: MB 130380.

Description (Elsik 1990, p. 158): Aseptate, psilate fungal spores ca. 12-14 x 24-26 μm overall. Outline elliptical in a fusiform fashion due to the pointed to sharply rounded ends. The furrow is schizoid, almost completely traversing the spore except for one end. The spore wall is 0.5-0.75 μm thick.

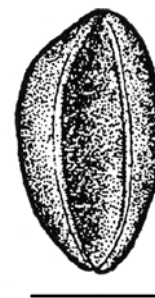


Fig. 168. *Hypoxylonites vittatoides*. Bar = 10 μm .

Locality: Imperial Nuktak C-22 well, Mackenzie River delta, Mackenzie District, Northwest Territories, Canada.

Age: Eocene.

Indian records: Singh & Tripathi 2010, p. 11, pl. 1, fig. 9, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Genus *Hypoxylonsporites* Kumar 1990 (May)

Mycobank No.: MB 25448.

Type species: *Hypoxylonsporites miocenicus* Kumar 1990 (May)

Description (Kumar 1990, p. 18): Fungal spores unicellular, oval to elliptical in shape with acutely rounded ends. A longitudinal slit-like aperture may be running end to end. Spore wall single-layered, smooth, and may be differentially coloured.

Remarks: The genus *Hypoxylonsporites* shows close affinity with the extant genus *Hypoxylon* (Miller 1961). Specimens of *Hypoxylonsporites* also show resemblance with Recent *Endocalyx*. Elsik (1990) placed fungal amero-spores having a single furrow into two genera, *Hypoxylonites* and *Spirotremesporites*. He reviewed their relationship to modern genera such as *Arthrimum*, *Hypoxylon* and *Xylaria*, which are known to produce spores similar to these two morphotypes. *Hypoxylonites* was established for the fossil fungal spores that have one longitudinal furrow parallel to the long axis of the spores; *Spirotremesporites* Dueñas-Jimenez 1979 was emended to include those fossil fungal spores with only one straight, sigmoidal or spiralling furrow that is oblique to the long axis of the spore. Elsik's (March 1990) paper has priority over that of Kumar (May 1990), and hence *Hypoxylonsporites* is a junior taxonomic synonym of *Hypoxylonites*.

Species: *Hypoxylonsporites ater* Kumar 1990 (May)

Mycobank No.: MB 126561.

Remarks: Since *Hypoxylonsporites* Kumar (May 1990) is a junior taxonomic synonym of *Hypoxylonites* Elsik (March 1990), Saxena (1992) transferred this species to *Hypoxylonites* [See: *Hypoxylonites ater* (Kumar 1990) Saxena 1992].

Species: *Hypoxylonsporites miocenicus* Kumar 1990 (May)

Mycobank No.: MB 126562.

Hypoxylonites miocenicus (Kumar) Saxena 1992, p. 211, non *Hypoxylonites miocenicus* Elsik 1990 (March).

Remarks: Since *Hypoxylonsporites* Kumar (May 1990) is a junior taxonomic synonym of *Hypoxylonites* Elsik (March 1990), *Hypoxylonsporites miocenicus* Kumar 1990 was required to be transferred to *Hypoxylonites* Elsik (1990). However, such transfer would have made this species a junior synonym of *Hypoxylonites miocenicus* Elsik 1990. Kalgutkar and Jansonius therefore proposed a new name for this species [See: *Hypoxylonites kumarii* Kalgutkar & Jansonius 2000].

I

Genus: *Imprimospora* Norris 1986

Mycobank No.: MB 25449.

Type species: *Imprimospora tankensis* Norris 1986.

Description (Norris 1986, p. 22): Unicellate, ovoidal, equilateral, isopolar fungal spores with a central region of parallel striae or fissures parallel to the apical line. Pore or furrow present near one end of spore.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: *Imprimospora* is identical to *Palaeoamphisphaerella* Ramanujam & Srisailam 1980, hence Kalgutkar and Jansonius (2000) considered *Imprimospora* a junior synonym of *Palaeoamphisphaerella*.

Species: *Imprimospora ramanujamii* Kumar 1990

Mycobank No.: MB 126563.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Kumarisporites* [See: *Kumarisporites ramanujamii* (Kumar 1990) Kalgutkar & Jansonius 2000]

Genus: *Inapertisporites* van der Hammen 1954a

Mycobank No.: MB 21139.

Type species: *Inapertisporites variabilis* van der Hammen 1954a (designated by van der Hammen 1954b, p. 14).

Description (van der Hammen 1954a, p. 83): Fungal spores without performed aperture.

Emended Description (Elsik 1968, p. 268): Inaperturate, psilate, fungal spores. One cell, no septa. Shape variable.

Emended Description (Sheffy & Dilcher 1971, p. 37): Fungal or algal spores unicellate, nonseptate, and inaperturate. Shape globular or non globular; outline smooth or often uneven because of wrinkles or folds. Ornamentation variable. Size range 5-11 µm.

Emended Description (Saxena & Bhattacharyya 1987, p. 193): Inaperturate algal or fungal spores, unicellate, nonseptate. Shape and size variable, outline smooth or often uneven because of wrinkles or folds. Spore wall ornamentation variable.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Inapertisporites cephalus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 169

Mycobank No.: MB 106915.

Inapertisporites cephalus Chandra *et al.*, Biovigyanam 10(1), p. 44, pl. 2, fig. 2. 1984.

Description (Chandra *et al.* 1984, p. 44): Spherical to oval fungal spores; size range 24-57 x 23-55 µm; unicellate, inaperturate; spore wall up to 1.0 µm thick, psilate, ± intrapunctate, pigment light.

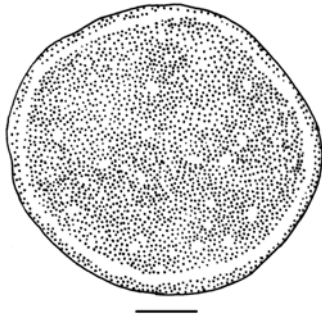


Fig. 169. *Inapertisporites cephalus*. Bar = 10 μ m.

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 44, pl. 2, fig. 2, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Species: *Inapertisporites chandrae* sp. nov.

Fig. 170

Mycobank No.: MB 519898.

Inapertisporites sp. cf. *I. nodulus* Sheffy & Dilcher in Chandra *et al.*, Biovigyanam 10(1), p. 45, pl. 2, fig. 9. 1984.

Description: Circular fungal spore with \pm wavy margin and a small, about 2 μ m long protuberance, main body of the spore 6-11 μ m in diameter (excluding protuberance), unicellate, inaperturate, spore wall psilate, pigment solid, dark.

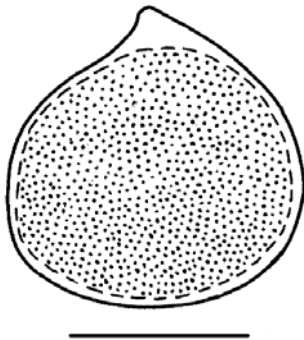


Fig. 170. *Inapertisporites chandrae*. Bar = 5 μ m.

Holotype: Chandra *et al.* 1984, p. 45, pl. 2, fig. 9; slide no. 6337, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Inapertisporites circularis* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 171

Mycobank No.: MB 111543.

Inapertisporites circularis Sheffy & Dilcher, Palaeontographica Abt. B 133(1-3), p. 38, pl. 15, fig. 2. 1971.

Description (Sheffy & Dilcher 1971, p. 38): Spherical fungal spores, unicellular, inaperturate, psilate; wall distinct, 1.0 μ m thick. Diameter ranges from 9.7-11.6 μ m (three specimens).

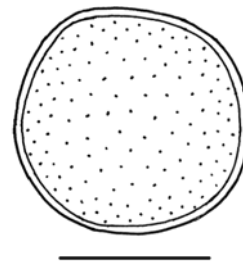


Fig. 171. *Inapertisporites circularis*. Bar = 7 μ m.

Locality: Puryear clay pit, Tennessee, Henry County, Texas, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Singh & Sarkar 1984b, p. 47-48, pl. 2, fig. 21, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena *et al.* 1984, p. 185, pl. 2, fig. 25, Middle-Upper Siwalik (Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Sarkar 1991, p. 3, Kakara Series (Early Eocene), near Kakara-Chapla group of villages, north of Gambhar River, Shimla District, Himachal Pradesh; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Samant & Tapaswi 2000, p. 29, fig. 2.13, Cambay Shale (Early Eocene), Cambay Basin, Gujarat.

Species: *Inapertisporites crenulatus* Kumar 1990

Fig. 172

Mycobank No.: MB 126564.

Description (Kumar 1990, p. 14): Fungal spores unicellular, inaperturate, lenticular in shape, size 17-25 x 25-28 μ m in diameter. Spore wall differentially thickened, \pm 2 μ m thick, equatorial margin wavy simulating crested outline, crests \pm 2 μ m high \pm 3 μ m broad in optical section. Both the surfaces smooth. A polar thinner area, 9-10 μ m in diameter.

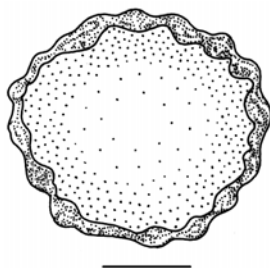


Fig. 172. *Inapertisporites crenulatus*. Bar = 10 μ m.

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Kumar 1990, p. 14-15, pl. 1, figs. 1-2, text-fig. 1, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala; Samant & Tapaswi 2000, p. 29, fig. 2.9, Cambay Shale (Early Eocene), Cambay Basin, Gujarat.

Species: *Inapertisporites cystoides* (Ambwani 1982) Kalgutkar & Jansonius 2000

Fig. 173

MycoBank No.: MB 483900.

Inapertisporites cystoides Ambwani, Palaeobotanist 30(1), p. 29, pl. 1, figs. 3-4. 1982.

Description (Ambwani 1982, p. 29): Fungal body/cyst dark brown, non-aperturate, circular to oval in shape, size 66-60 μ m in diameter, spore wall very thick, \pm 4.5 μ m, laevigate or punctate.



Fig. 173. *Inapertisporites cystoides*. Bar = 10 μ m.

Locality: Kotta-Bommuru, near Rajahmundry, East Godavari District, Andhra Pradesh, India.

Age: Early Eocene (Deccan Intertrappean Series).

Indian records: Ambwani 1982, p. 29, pl. 1, figs. 3-4, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh.

Species: *Inapertisporites deccani* (Chitale & Yawale 1978) Kalgutkar & Jansonius 2000

Fig. 174

MycoBank No.: MB 483407.

Ustilago deccanii Chitale & Yawale, Botanique 7(4), p. 192, pl. 1, figs. 3-4. 1978.

Description (Chitale & Yawale 1978, p. 192): (Diagnosis): Spores spherical, subspherical, sometimes elongate, 7 x 15 μ m in diameter with granular contents. Epispore moderately thick. Some spores with depression on one side, deep brown to pale. (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 colour, with granular content and a mean diameter of 11 μ m, and are found mostly singly, or occasionally in loose groups. Spores two-layered, epispore smooth, 0.4-1.5 μ m thick. Many spores show folding and a depression on one side. No associated mycelium or sori observed.

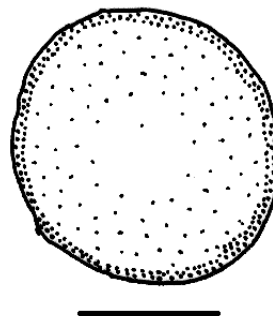


Fig. 174. *Inapertisporites deccani*. Bar = 10 μ m.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian (Deccan Intertrappean Series).

Indian records: Chitale & Yawale 1978, p. 191-192, pl. 1, figs. 3-4, Deccan Intertrappean Series (Latest Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Species: *Inapertisporites dilcheri* Chandra *et al.* 1984

MycoBank No.: MB 106916.

Remarks: Kalgutkar & Jansonius (2000) transferred this species to *Diporicellaesporites* Elsik 1968 [See: *Diporicellaesporites dilcheri* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Species: *Inapertisporites edigeri* Kalgutkar & Jansonius 2000

Fig. 175

Mycobank No.: MB 483408.

Inapertisporites rotundus Ediger, Palaeontographica Abt. B 179, p. 89, pl. 1, fig. 1. 1981, non *Inapertisporites rotundus* Ke & Shi 1978.

Description (Ediger 1981, p. 89): Unicellular, aseptate, spherical to subspherical fungal spore; usually compressed from one side; more than two grains usually clustered irregularly; medium to dark melanin colour, inaperturate; exine 1-2 μm thick and usually pitted. Contact areas are darker due to folding. Size 14-17 x 21-26 μm .

Emended description (Ediger & Alisan 1981, p. 141): Unicellular, aseptate, inaperturate, circular to oval fungal spores. More than two grains are usually clustered irregularly. Exine is 1-2 μm thick, commonly folded, pitted, medium dark to melanin dark. Contact areas are dark due to folding. Size 14-32 x 21-51 μm .



Fig. 175. *Inapertisporites edigeri*. Bar = 10 μm .

Locality: Thrace Basin, Turkey.

Age: Late Eocene-Oligocene, Miocene-Pliocene.

Indian records: Singh & Tripathi 2010, p. 10, pl. 1, fig. 7, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Inapertisporites ellipticus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 176

Mycobank No.: MB 106917.

Inapertisporites ellipticus Chandra *et al.*, Biovigyanam 10(1), p. 44, pl. 2, fig. 1. 1984.

Description (Chandra *et al.* 1984, p. 44): Oval-elliptical fungal spores, size range 27-127 x 17-98 μm , unicellate, inaperturate; spore wall psilate, up to 1.5 μm thick, irregularly folded.

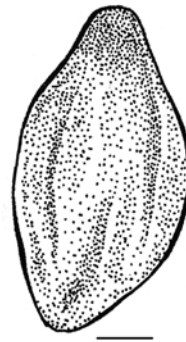


Fig. 176. *Inapertisporites ellipticus*. Bar = 20 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 44, pl. 2, fig. 1, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Sediment core no. 3 (Lat. 19°32.8'N: Long. 71°21.5'E), Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea; Saxena & Singh 1982a, p. 294, pl. 1, fig. 17, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Saxena & Bhattacharyya 1990, p. 112-113, Dharmasala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmasala, Kangra District, Himachal Pradesh.

Species: *Inapertisporites giganteus* Song Zhichen 1985

Fig. 177

Mycobank No.: MB 519814.

Description (Song Zhichen 1985, p. 42): Spore ovate, holotype 60 x 44 μm . Spore wall about 1 μm in thickness, layers of spore wall indistinct; surface scabrate or smooth, without distinct ornamentation. Spore wall easily fractured, usually with several fractures. Spore brownish black.



Fig. 177. *Inapertisporites giganteus*. Bar = 10 μm .

Locality: Dafengshan, Qaidam Basin, Qinghai Province, China.
Age: Middle - Late Miocene.

Indian records: Singh & Tripathi 2010, p. 10, pl. 1, fig. 1, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Inapertisporites globatus* Sah & Kar 1974

Fig. 178

Mycobank No.: MB 519813.

Description (Sah & Kar 1974, p. 181): Spores subcircular, inaperturate, 34-50 x 32-47 μm . wall 3-6 μm thick, not folded.

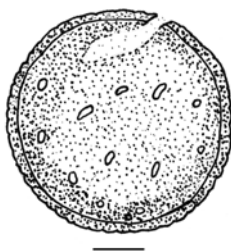


Fig. 178. *Inapertisporites globatus*. Bar = 10 μm .

Locality: Palana, Bikaner District, Rajasthan, India.

Age: Early Eocene (Palana lignite).

Indian records: Sah & Kar 1974, p. 181, pl. 4, fig. 97, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan.

Species: *Inapertisporites granulatus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 179

Mycobank No.: MB 106918.

Inapertisporites granulatus Chandra *et al.*, Biovigyanam 10(1), p. 45, pl. 2, fig. 8. 1984.

Description (Chandra *et al.* 1984, p. 45): Oval fungal spores; size range 20-39 x 14-29 μm ; unicellate, inaperturate; spore wall up to 1 μm thick, occasionally slightly folded, granulate, grana prominent, 1 μm in size, sometimes large, imparting a verrucose appearance, uniformly distributed.

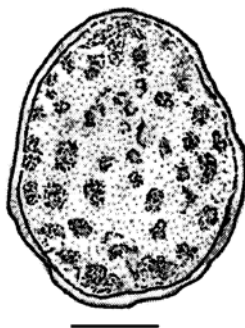


Fig. 179. *Inapertisporites granulatus*. Bar = 10 μm .

Locality: Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 45, pl. 2, fig. 8, Late Quaternary, Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Species: *Inapertisporites hammenii* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 180

Mycobank No.: MB 106919.

Inapertisporites hammenii Chandra *et al.*, Biovigyanam 10(1), p. 45, pl. 2, fig. 6. 1984.

Description (Chandra *et al.* 1984, p. 45): Oval fungal spores; size range 13-18 x 9-16 μm ; unicellate, inaperturate, spore wall about 1 μm thick, ornamented with very fine reticulum.

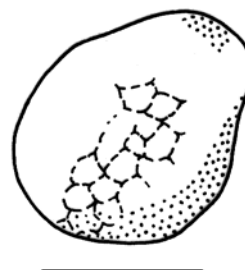


Fig. 180. *Inapertisporites hammenii*. Bar = 20 μm .

Locality: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 45, pl. 2, figs. 6-7, Late Quaternary, Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Inapertisporites indicus* Gupta 2002

Fig. 181

Mycobank No.: MB 540593.

Description (Gupta 2002, p. 128): Spores one celled, nonseptate, inaperturate, variously subcircular, 6 x 4.5-6 (7 x 5) μm , psilate wall 0.5 μm thick.

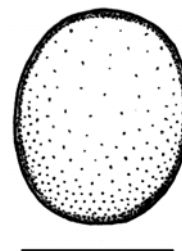


Fig. 181. *Inapertisporites indicus*. Bar = 5 μm .

Locality: Dadahu Road Section (left bank of Giri River), Sirmaur District, Himachal Pradesh, India.

Age: Early Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 128, pl. 1, fig. 4, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Inapertisporites kariii* sp. nov.

Fig. 182

MycoBank No.: MB 519943.

Inapertisporites sp. in Chandra *et al.*, Biovigyanam 10(1), p. 46, pl. 2, fig. 10. 1984.

Description: Triangularly oval fungal spores with two protuberances, main body of the spore 21-28 x 16-19 μm in size, outgrowths each 5 μm long and 2.5 μm wide; unicellate, inaperturate. Spore wall 1.5 μm thick, psilate.



Fig. 182. *Inapertisporites kariii*. Bar = 20 μm .

Holotype: Chandra *et al.* 1984, pl. 2, fig. 10; slide no. 6304/11, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary

Indian records: Chandra *et al.* 1984, p. 46, pl. 2, fig. 10, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Species: *Inapertisporites kedvesii* Elsik 1968

Fig. 183

MycoBank No.: MB 315797.

Description (Elsik 1968, p. 268): Spherical, psilate, inaperturate grains 28-38 μm , larger in expanded state (seen in water mounts of residue). Wall is very thin, ca. 0.2 μm . Characteristically folded several times in dry mounts.

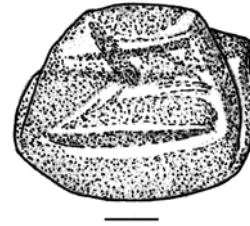


Fig. 183. *Inapertisporites kedvesii*. Bar = 10 μm .

Locality: 11 km south-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Sah & Kar 1974, p. 181, pl. 4, fig. 96, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan; Kar & Saxena 1976, p. 10, pl. 3, fig. 23, pl. 4, fig. 47, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Kar 1979, p. 32, pl. 3, fig. 57, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Jain & Kar 1979, p. 109, pl. 2, fig. 33, Neogene, around Kollam and Varkala, Kerala; Dutta 1980, p. 13, pl. 1, figs. 10-11, Siwalik equivalent (Middle Miocene), Misamari Road Section, Kameng District, Arunachal Pradesh; Kar & Saxena 1981, p. 106, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Mehrotra 1983, p. 17, pl. 5, fig. 6, Mikir Formation (Palaeocene-Early Eocene), Garampani, North Cachar Hills, Assam; Singh & Sarkar 1984a, p. 98, pl. 2, fig. 36, Miocene, Ramshahr Well-1, Solan District, Himachal Pradesh; Singh & Saxena 1984, p. 624, pl. 2, figs. 34-35, Girujan Clay, Namsang and Dhekiajuli Formations (Neogene), Jorajan Well-3, Assam; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Kar 1985, p. 130, Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Saxena *et al.* 1988, p. 276, pl. 2, fig. 24, Tatrot and Pinjor Formations (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Bhattacharya 1987, p. 120, Early Eocene, Rajpardi, Broach District, Gujarat; Saxena & Bhattacharyya 1987, p. 189, Lower Siwalik-Nahan and Upper Siwalik (Middle Miocene-Pliocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh; Sarkar & Singh 1988, p. 58, pl. 5, fig. 9, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Rajendran *et al.* 1989, p. 41, 42, 43, 44, pl. 1, fig. 14, Miocene, Tonakkal, Kundra, Padappakkara, Varkala, Edavai, Paravur, Kannur, Palayangadi, Kerala; Tripathi 1989, p. 74, pl. 2, fig. 7, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Kar 1990a, p. 178, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p.

232, 233, 236, 238, Disang, Laisong, Jenam and Renji formations (Palaeocene-Oligocene), Silchar-Haflong Road Section, Assam; Saxena & Bhattacharyya 1990, p. 112, Dharmasala Group (Oligocene-Early Miocene), Churan Khad and Manjhi Khad sections near Dharmasala, Kangra District, Himachal Pradesh; Saxena & Misra 1990, p. 270, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Singh 1990, p. 224, Tura Formation (Palaeocene), Langrin Coalfield, Khasi Hills, Meghalaya; Kar & Bhattacharya 1992, p. 251, 252, Early Eocene, Rajpardi lignite, Bharuch District and Gujra Dam Section and Akri lignite, Kutch District, Gujarat; Saxena & Khare 1992, p. 37, pl. 1, fig. 15, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Kar *et al.* 1994, p. 187, Tertiary, subsurface sediments in Upper Assam; Rao 1995, p. 233, pl. 1, fig. 7, Tertiary, Alleppey and Kannur districts, Kerala; Kumar 1996, p. 114, Tarkeshwar Formation (Early Eocene), Rajpardi, Bharuch District, Gujarat; Saxena *et al.* 1996, mp. 21, pl. 3, figs. 14-15, Tura Formation (Palaeocene), Nongwal Bibra area, East Garo Hills District, Meghalaya; Chandra and Kumar 1998, p. 62, pl. 3, fig. 1, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Mandaokar 1999, p. 241, Disang Group (Late Eocene), Tirap River Section, Tinsukia District, Assam; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Mandaokar 2000b, p. 181, pl. 1, fig. 16, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Mandaokar 2000c, p. 38, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002b, p. 21, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Mandaokar 2002c, p. 79, Keifang Formation (Early Miocene), eastern flank of Aizawl Hills, Mizoram; Singh & Kar 2002, p. 214, Deccan Intertrappean Beds (Palaeocene), 3 km northeast of Papro village, Lalitpur District, Uttar Pradesh; Mandaokar 2003, p. 187, Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhimgtuipui District, Mizoram; Singh & Kar 2003, p. 219, Deccan Intertrappean Beds (Palaeocene), northeast of Papro, Lalitpur District, Uttar Pradesh; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam;

Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram; Rao 2004, p. 124, pl. 3, fig. 6, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam; Singh & Tripathi 2010, p. 10, pl. 1, figs. 3, 8, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Inapertisporites maximus* (Singh & Saxena 1981) Kalgutkar & Jansonius 2000

Fig. 184

Mycobank No.: MB 483889.

Inapertisporites maximus Singh & Saxena, Geophytology 11(2), p. 176, pl. 1, fig. 19. 1981.

Inapertisporites sp. Singh *et al.* 1986, p. 97, pl. 2, fig. 3, Sonapur-Badarpur Road Section, Meghalaya, India; Bhuban Formation; Early Miocene.

Description (Singh & Saxena 1981, p. 176): Spores subcircular-elliptical, sometime attain irregular shape due to folding, unicellate, nonseptate; wall up to 1 μm thick, psilate, irregularly folded.



Fig. 184. *Inapertisporites maximus*. Bar = 20 μm .

Locality: Gagret-Bharwain Road Section, Una District, Himachal Pradesh, India.

Age: Pliocene-Pleistocene (Upper Siwalik).

Indian records: Singh & Saxena 1981, p. 176, pl. 1, fig. 19, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Saxena & Bhattacharyya 1987, p. 189, Upper Siwalik (Pliocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh.

Species: *Inapertisporites minutus* van der Hammen 1954a

Fig. 185

Mycobank No.: MB 332523.

Description (van der Hammen 1954a, p. 104): Spores 14 μm ; minutely verrucose, scabrate or gemmate.

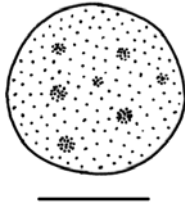


Fig. 185. *Inapertisporites minutus*. Bar = 5 μ m.

Locality: Magdalena Valley, Eastern Cordellera, Colombia, South America.

Age: Maastrichtian.

Indian records: Saxena *et al.* 1984, p. 185, pl. 2, fig. 22, Middle Siwalik (Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh.

Species: *Inapertisporites miocenicus* Singh *et al.* 1986

Mycobank No.: MB 131932.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Quilonia* Jain & Gupta 1970 emend. Kalgutkar & Jansonius 2000 [See: *Quilonia miocenica* (Singh *et al.* 1986) Kalgutkar & Jansonius 2000]

Species: *Inapertisporites novus* Gupta 2002

Fig. 186

Mycobank No.: MB 540594.

Description (Gupta 2002, p. 128): Spores one celled, nonseptate, inaperturate, variously subcircular to nearly circular 65 x 49 to 100 x 81 μ m, minutely punctate, surface folded, wall up to 1 μ m thick.

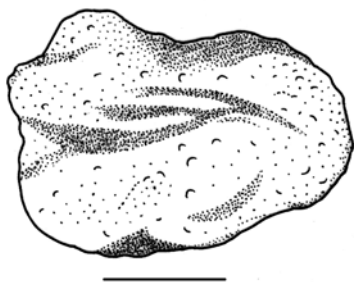


Fig. 186. *Inapertisporites novus*. Bar = 25 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Early Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 128, pl. 1, fig. 5, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Inapertisporites ovalis* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 187

Mycobank No.: MB 111548.

Inapertisporites ovalis Sheffy & Dilcher, Palaeontographica Abt. B 133(1-3), p. 38, pl. 15, fig. 3. 1971.

Description (Sheffy & Dilcher 1971, p. 38): Oval psilate fungal spore, nonseptate, wall smooth 1.0 μ m thick. Size range 4.8 x 10.2 μ m - 7.7 x 14.5 μ m (two specimens).

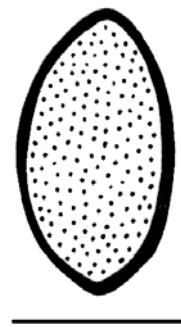


Fig. 187. *Inapertisporites ovalis*. Bar = 7 μ m.

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Singh & Sarkar 1984b, p. 48, pl. 2, fig. 20, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena *et al.* 1984, p. 185, pl. 2, fig. 26, Lower-Upper Siwalik (Middle Miocene-Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Singh *et al.* 1986, p. 97, pl. 2, fig. 14, Lubha Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena & Bhattacharyya 1990, p. 112, pl. 1, fig. 19, Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh; Sarkar 1991, p. 3, Kakara Series (Early Eocene), near Kakara-Chapla group of villages, north of Gambhar River, Shimla District, Himachal Pradesh; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Saxena & Ranhotra 2009, p. 692, fig. 3.36, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Inapertisporites punctatus* Chandra *et al.* 1984, non Rouse 1959

Mycobank No.: MB 106569.

Remarks: *Inapertisporites punctatus* Chandra *et al.* 1984 is illegitimate, being a junior homonym of *Inapertisporites punctatus* Rouse 1959, hence Gupta (1985) renamed it as *Inapertisporites udarii* Gupta 1985.

Species: *Inapertisporites quadrangularis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 188

Mycobank No.: MB 106920.

Inapertisporites quadrangularis Chandra *et al.*, Biovigyanam 10(1), p. 45, pl. 2, fig. 5. 1984.

Description (Chandra *et al.* 1984, p. 45): Quadrangular fungal spores, size 10 µm, unicellate, inaperturate; spore wall psilate, pigment medium to light.

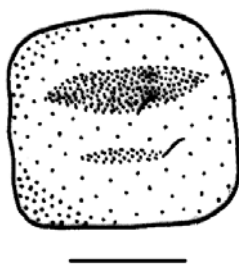


Fig. 188. *Inapertisporites quadrangularis*. Bar = 5 µm.

Locality: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 45, pl. 2, fig. 5, Late Quaternary, Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Inapertisporites sahilii* sp. nov.

Fig. 189

Mycobank No.: MB 519944

Inapertisporites sp. in Sah & Kar, Palaeobotanist 21(2), p. 181, pl. 4, fig. 98. 1974.

Inapertisporites cf. *kedvesii* Elsik 1968 in Pathak & Banerjee in Badve R. M. *et al.* (Editors) – Proceedings of the 10th Indian Colloquium on Micropalaeontology and Stratigraphy, Pune, 1982, Maharashtra Association for the Cultivation of Science, Pune, 247-248, pl. 1, fig. 1. 1984.

Description: Fungal spores subcircular, 51-60-78-90 µm, unicellate, inaperturate. Wall 1-2 µm thick, not much folded.

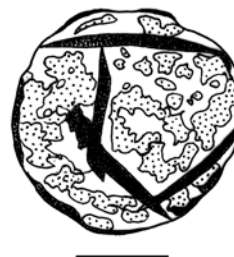


Fig. 189. *Inapertisporites sahilii*. Bar = 30 µm.

Holotype: Sah & Kar 1974, pl. 4, fig. 98; slide no. 4366/13, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Palana, Bikaner District, Rajasthan, India.

Age: Early Eocene (Palana lignite).

Indian records: Sah & Kar 1974, p. 181, pl. 4, fig. 98, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan; Pathak & Banerjee 1984, p. 247-248, pl. 1, fig. 1, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal.

Species: *Inapertisporites sinhae* Gupta 2002

Fig. 190

Mycobank No.: MB 540595.

Description (Gupta 2002, p. 126): Spores one celled, nonseptate, inaperturate, disc-shaped, 6 x 9-10 x 14 µm, largely granulate to sub-verrucose, wall < 0.5 µm thick.

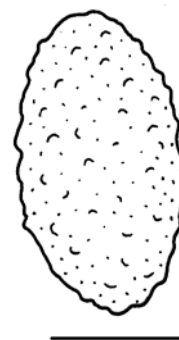


Fig. 190. *Inapertisporites sinhae*. Bar = 5 µm.

Locality: Dadahu Road Section, Sirmour District, Himachal Pradesh, India.

Age: Early Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 126, pl. 1, fig. 1, Subathu Formation (Eocene), Dadahu Road Section, Sirmour District, Himachal Pradesh.

Species: *Inapertisporites subcapsularis* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 191

Mycobank No.: MB 111555.

Inapertisporites subcapsularis Sheffy & Dilcher, *Palaeontographica* Abt. B 133(1-3), p. 38, pl. 15, fig. 4. 1971.

Description (Sheffy & Dilcher 1971, p. 38): Capsilate, psilate, unicellular spore, inaperturate slightly constricted along one side. Size ranges from 11.6 x 17.4 μm - 17 x 26.6 μm (three specimens).

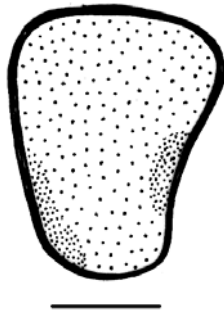


Fig. 191. *Inapertisporites subcapsularis*. Bar = 5 μm .

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.
Age: Middle Eocene (Claiborne Formation).

Indian records: Singh & Saxena 1980, p. 278, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Singh & Saxena 1981, p. 176, pl. 1, fig. 7, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh.

Species: *Inapertisporites subovoideus* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 192

Mycobank No.: MB 111557.

Inapertisporites subovoideus Sheffy & Dilcher, *Palaeontographica* Abt. B 133(1-3), p. 38, pl. 15, fig. 7. 1971

Description (Sheffy & Dilcher 1971, 38): Egg-shaped unicellular with flattened apex. Psilate, inaperturate, wall 0.5-1.0 μm thick. Size ranges from 4.8 x 9.2 μm - 14.5 x 19.3 μm (three specimens).

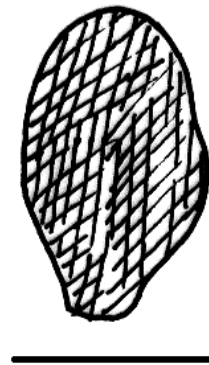


Fig. 192. *Inapertisporites subovoideus*. Bar = 5 μm .

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Singh & Sarkar 1984b, p. 48, pl. 2, fig. 22, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Miocene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena & Khare 1992, p. 37, pl. 1, fig. 7, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Inapertisporites subverrucatus* Gupta 2002

Fig. 193

Mycobank No.: MB 540596.

Description (Gupta 2002, p. 126): Spores one celled, nonseptate, inaperturate, Subcircular, 14.5 x 13-21 x 19 μm , subverrucose and folded, folds irregular, wall ca. 0.5 μm thick.

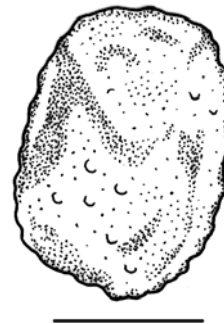


Fig. 193. *Inapertisporites subverrucatus*. Bar = 10 μm .

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Early Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 126, 128, pl. 1, fig. 3, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Inapertisporites tiwarii* Gupta 2002

Fig. 194

Mycobank No.: MB 540597.

Description (Gupta 2002, p. 126): Spores one celled, nonseptate, inaperturate. Circular-subcircular, 19.5 x 7.4-22 μm , verrucose to pseudoreticulate, wall 1.5 μm thick, The bases of the verrucae tend to unite with neighbouring ones to give a reticulate appearance, lumina 2.5-4 μm .

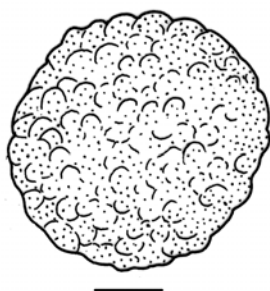


Fig. 194. *Inapertisporites tiwarii*. Bar = 5 μ m.

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Early Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 126, pl. 1, fig. 2, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Inapertisporites trivedii* (Ambwani 1982) Kalgutkar & Jansonius 2000

Fig. 195

Mycobank No.: MB 483899.

Inapertisporites trivedii Ambwani, Palaeobotanist 31(2), p. 29, pl. 1, fig. 1. 1982.

Description (Ambwani 1982, p. 29): Grains non-aperturate, golden yellow in colour; shape oval to elongated, size 125 x 65 - 64 x 55 μ m; spore wall folded, punctate, discontinuous striations present.

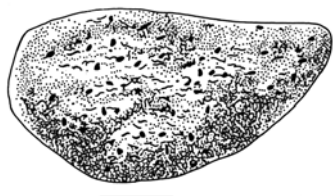


Fig. 195. *Inapertisporites trivedii*. Bar = 20 μ m.

Locality: Kotta-Bommuru, near Rajahmundry, East Godavari District, Andhra Pradesh, India.

Age: Early Eocene (Deccan Intertrappean Series).

Indian records: Ambwani 1982, p. 29, pl. 1, figs. 1-2, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh.

Species: *Inapertisporites udarii* Gupta 1985

Fig. 196

Mycobank No.: MB 133492.

Inapertisporites punctatus Chandra *et al.*, Biovigyanam 10(1), p. 44, pl. 2, fig. 3. 1984, non *Inapertisporites punctatus* Rouse 1959.

Inapertisporites udarii Gupta, Geophytology 15(2), 226. 1985.

Description (Chandra *et al.* 1984, p. 44): Subspherical to oval fungal spores; size range 21-90 x 21-76 μ m; unicellate, inaperturate; spore wall 0.5 μ m thick, punctate, puncta fine, closely placed and uniformly distributed all over the spore wall, irregularly folded.



Fig. 196. *Inapertisporites udarii*. Bar = 20 μ m.

Locality: Sediment core no. 3 (Lat. 19°32.8'N: Long. 71°21.5'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 44, pl. 2, fig. 3, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Sediment core no. 3 (Lat. 19°32.8'N: Long. 71°21.5'E), Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea; Gupta 1985, p. 226; Saxena & Bhattacharyya 1987, p. 189, Lower Siwalik-Nahan (Middle-Late Miocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh; Saxena *et al.* 1988, p. 276, pl. 2, fig. 28, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Saxena & Bhattacharyya 1990, p. 113, Dharmasala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmasala, Kangra District, Himachal Pradesh; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Remarks: The original binomial for this species (*Inapertisporites punctatus* Chandra *et al.* 1984) is a junior homonym of *Inapertisporites punctatus* Rouse 1959, and therefore Gupta (1985, p. 226) proposed the new name, *Inapertisporites udarii*.

Species: *Inapertisporites variabilis* van der Hammen 1954a Fig. 197

Mycobank No.: MB 332525.

Description (van der Hammen 1954a, p. 104): Spores 17.5 x 31 μ m; psilate; in some parts much darker than in others.

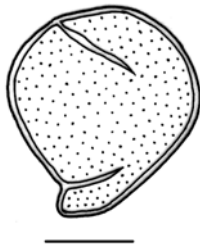


Fig. 197. *Inapertisporites variabilis*. Bar = 5 μ m.

Location: Magdalena Valley, Eastern Cordillera, Colombia, South America.

Age: Maastrichtian.

Indian records: Chandra & Kumar 1998, p. 56, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Mandaokar 2004, p. 146, Upper Bhuban Formation (Miocene), Champhai area, Eastern Mizo Hills, Mizoram.

Species: *Inapertisporites vulgaris* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000

Fig. 198

Mycobank No.: MB 111559.

Inapertisporites vulgaris Sheffy & Dilcher, *Palaeontographica* Abt. B 133(1-3), p. 37, pl. 15, fig. 1. 1971.

Description (Sheffy & Dilcher 1971, p. 37-38): Spherical spore, unicellular, inaperturate, pigment solid, medium to dark; diameter ranges from 6.8-14.5 μ m (ten specimens).

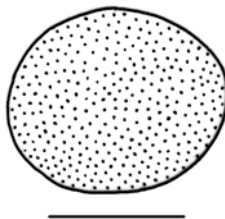


Fig. 198. *Inapertisporites vulgaris*. Bar = 7 μ m.

Locality: Puryear clay pit, Tennessee, Henry County, U.S.A.

Age: Middle Eocene (Claiborne Formation).

Indian records: Saxena & Singh 1980, p. 480, Pinjor Formation (Late Pliocene), near Chandigarh; Singh & Saxena 1980, p. 278, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Singh & Saxena 1981, p. 176, pl. 1, fig. 11, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Saxena & Singh 1982b, p. 330, pl. 1, fig. 14, Pinjor Formation (Late Pliocene), near Chandigarh; Singh & Saxena 1984, p. 624, Girujan Clay and Namsang Formations (Neogene), Jorajan

Well-3, Assam; Saxena *et al.* 1984, p. 185, pl. 2, figs. 23-24, Lower and Upper Siwalik (Middle Miocene-Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Samant & Tapaswi 2000, p. 29, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Gupta 2002, p. 128, Dagshai Formation (Late Eocene-Early Oligocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Genus: *Involutisporonites* Clarke 1965

Mycobank No.: MB 21142.

Type species: *Involutisporonites foraminus* Clarke 1965.

Description (Clarke 1965, p. 91): Fungal spores planispiral, individual cells lobate, septa simple with an opening through each septum.

Emended Description (Elsik 1968, p. 276-277): Monoporate, psilate, multiseptate, coiled fungal spores.

Emended Description (here proposed): Fungal spores coiled, transversely septate, multicellate, individual cells of variable shapes, septal pores may or may not be present. Terminal cell, if present, may have a single pore. Spore wall generally psilate to variously ornamented.

Classification: Fungi Imperfecti, Helicosporae.

Species: *Involutisporonites chowdhryi* (Jain & Kar 1979) Kalgutkar & Jansonius 2000

Fig. 199

Mycobank No.: MB 483410.

Colligerites chowdhryi Jain & Kar, *Palaeobotanist* 26(2), p. 110, pl. 2, fig. 30. 1979.

Description (Jain & Kar 1979, p. 110): Spores multicellular, coiled once in the centre, generally keeping a hollow space. Cells smaller in centre and bigger in outer region. Spore wall granulate. Pores present or absent in cells.

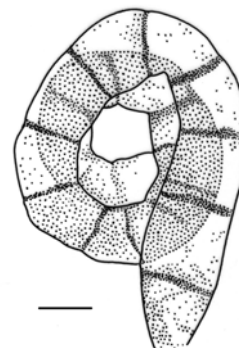


Fig. 199. *Involutisporonites chowdhryi*. Bar = 10 μ m.

Locality: Papanasam, Varkala District, Kerala, India.

Age: Miocene.

Species: *Involutisporonites kutchensis* Kar & Saxena 1976

Mycobank No.: MB 112379.

Remarks: Jain and Kar (1979) transferred this species to *Colligerites* Jain & Kar 1979 [See: *Colligerites kutchensis* (Kar & Saxena 1976) Jain & Kar 1979].

Species: *Involutisporonites wilcoxii* Elsik 1968

Mycobank No.: MB 315918.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Paleoslimacomycetes* Kalgutkar & Sigler 1995 [See: *Paleoslimacomycetes wilcoxii* (Elsik 1968) Kalgutkar & Jansonius 2000].

K

Genus: *Kalviwadithyrites* Rao 2003 (nom. inval.)

Mycobank No.: MB 519802.

Type species: *Kalviwadithyrites saxenae* Rao 2003 (nom. inval.).

Description (Rao 2003, p. 118): Cleistothecium subcircular to circular in shape, dimidiate, non-ostiolate. Two types of cells present, pores absent. No hyphae present. Marginal cells rectangular to polygonal in shape, larger in size, covers outer part; central cells thickness 2 or 3 layered, squarish and isodiametric.

Classification: Ascomycetes, Microthyriales.

Remarks: Rao (2003) did not validly publish the generic name *Kalviwadithyrites* as he did not cite information on where the holotype of its type species is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Kalviwadithyrites saxenae* Rao 2003 (nom. inval.)

Fig. 200

Mycobank No.: MB 519803.

Description (Rao 2003, p. 118): Cleistothecium circular- subcircular. Size range 105-115 x 95-110 μm . Dimidiate, non-ostiolate, No free hyphae. Fruiting body made up of two sets of cells, pores absent. Marginal cells rectangular to polygonal in shape, 9-12 x 10-17 μm in diameter, light brown in colour. Central cells thickness 2 or 3 layered, squarish and isodiametric, 4-10 μm in diameter, darker in colour.

Locality: Kalviwadi, Sindhudurg District, Maharashtra, India.

Age: Miocene (Sindhudurg Formation).

Indian records: Rao 2003, p. 118, pl. 1, figs. 1-3, text-fig. 2, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Rao 2004, p. 124, pl. 2, figs. 11-12, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.

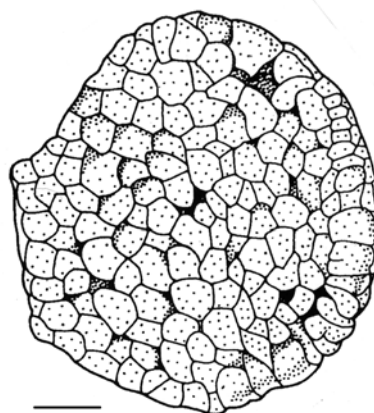


Fig. 200. *Kalviwadithyrites saxenae*. Bar = 25 μm .

Remarks: Rao (2003) did not validly publish *Kalviwadithyrites saxenae* as he did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Genus: *Koshalia* Sarkar & Prasad 2003

Mycobank No.: MB 519804.

Type species: *Koshalia enigmata* Sarkar & Prasad 2003.

Description (Sarkar & Prasad 2003, p. 114): (Diagnosis): Thyriothecia subspherical, multilayered, 90-150 μm in diameter, 9-10 cells arranged in compact rings around an ostiole, marginal cells extremely large, Size 35-45 x 65-85 μm , inner cells small, subcircular, size 8-15 x 10-20 μm . (Description): Thyriothecia subspherical, multicellular, multilayered, cells arranged in compact rings, number of rings three, ostiolate, ostiole centric, circular, 6-10 μm in diameter, 3-4 dark coloured cells present around the ostiole, individual cells radially arranged, interconnected to form a shield-shaped body, marginal cells extremely large, broader than long, cell wall thickened on the ventral surface, cell wall scabrate to infrapunctate. Perforation in individual cells absent.

Classification: Ascomycetes, Microthyriales.

Species: *Koshalia enigmata* Sarkar & Prasad 2003

Fig. 201

Mycobank No.: MB 519805.

Description (Sarkar & Prasad 2003, p. 114): (Diagnosis): Thyriothecia subspherical, multicellular, multilayered, 9-10 cells arranged in compact rings, 3-4 cells in each layer, ostiolate, marginal cells extremely large, overall size range 90-150 μm in diameter. (Description): Thyriothecia subspherical, multilayered, overall size range 90-150 μm in diameter, multicellular, 9-10 cells arranged in compact rings to form a shield-shaped body, 3-4 cells arranged radially around an ostiole in each layer, ostiole centric, 6-10/-1m in diameter,

margin thickened, inner cells subcircular, small, thick walled, marginal cells extremely large, cell wall thin, scabrate to infrapunctate. Perforation absent in individual cells.

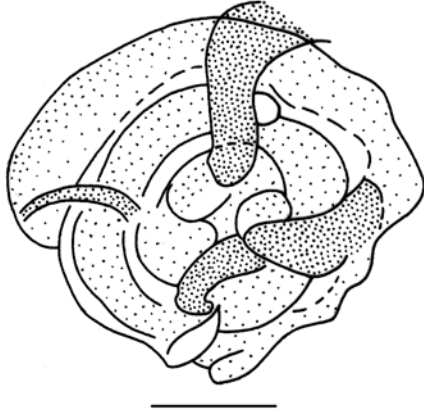


Fig. 201. *Koshalia enigmata*. Bar = 20 μ m.

Locality: Koshalia Nala near Koti, Shimla Hills, Himachal Pradesh, India.

Age: Late Ypresian (Subathu Formation).

Indian records: Sarkar & Prasad 2003, p. 114-115, pl. 1, figs. 1-4, Subathu Formation (Late Ypresian), Koshalia Nala near Koti, Shimla Hills, Himachal Pradesh.

Genus: *Kumarisporites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28619'

Type species: *Kumarisporites ramanujamii* (Kumar 1990) Kalgutkar & Jansonius 2000.

Description (Kumar 1990, p. 20): Small to medium-sized tricellate, inaperturate fungal spores; central cell may be larger than the tapering terminal cells; septa (or septal bases) thicker than spore wall; spore wall ornamented by longitudinal ribs running full length of the spore, tapering towards the poles.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Kumarisporites ramanujamii* (Kumar 1990) Kalgutkar & Jansonius 2000

Fig. 202

Mycobank No.: MB 483411.

Imprimospora ramanujamii Kumar, Review of Palaeobotany and Palynology 63, p. 20, pl. 1, fig. 5. 1990.

Description: Fungal spores tricellate, inaperturate and fusiform. Size 32-40 x 18-21 μ m. Septa 1.6-2 μ m thick, with or without a central pore. Central cell large, 11-13 x 16-19 μ m, terminal cells smaller, 9-10 μ m long, with narrowly rounded ends. Spore wall \pm 1.5 μ m thick and ornamented with longitudinal ribs (about 2 μ m wide) that run full length but are more pronounced on central cell. Furrows 1-2 μ m wide.

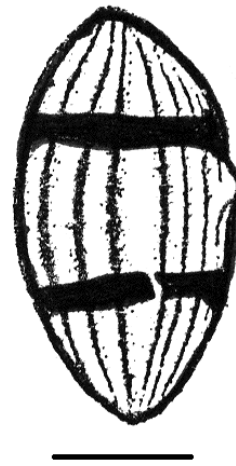


Fig. 202. *Kumarisporites ramanujamii*. Bar = 10 μ m.

Locality: Clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene (Quilon Beds).

Indian records: Ramanujam & Srisailam 1980, p. 131, pl. 2, fig. 28, Warkalli Beds (Miocene), Kannur District, Kerala; Kumar 1990, p. 20-21, pl. 1, fig. 5, text-fig. 10, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala.

Genus: *Kutchiathyrites* Kar 1979

Mycobank No.: MB 21145.

Type species: *Kutchiathyrites eccentricus* Kar 1979.

Description (Kar 1979, p. 32): (Diagnosis): Ascstromata eccentric in development, no free hyphae present, dimidiate, nonostiolate, radially arranged hyphae thick, dark, diverging from one another, transverse hyphae comparatively thinner, \pm translucent, interconnecting radial ones to form squarish, pseudoparenchymatous cells without any pore. (Description): Microthyriaceous ascstromata of approximately semicircular shape in most specimens, in others they look like fish scales, size range 64-110 x 41-73 μ m. Upper surface of ascstromata darker than inner one; radial hyphae also well pronounced in former. Radial hyphae look like dark strands; transverse hyphae ill-developed, sometimes hardly discernable at places. **Emended Description** (Kalgutkar & Jansonius 2000, p. 157): Hilate conidia, fan shaped, formed by numerous linear filaments radiating out from the hilum; conidia may be flattened (i.e. two-) or three dimensional; filaments may be joined to their neighbours, or partially free, and may branch towards the periphery; hilum may or may not show the stipe from which it developed.

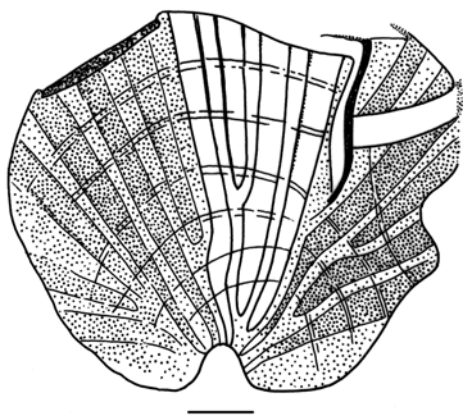
Classification: Fungi Imperfecti, Dictyosporae.

Species: *Kutchiathyrites eccentricus* Kar 1979

Fig. 203

Mycobank No.: MB 112385.

Description (Kar 1979, p. 32): Microthyriaceous ascostromata eccentrically developed, 64-110 x 41-73 μm . Stromata dimidiolate, nonostiolate; radial hyphae diverging, dark, better-developed than transverse ones; hyphae interconnecting each other to form squarish, nonporate, pseudoparenchymatous cells.

Fig. 203. *Kutchiathyrites eccentricus*. Bar = 10 μm .

Locality: Barkhana nala cutting, Sarangwara; Kutch District, Gujarat, India.

Age: Oligocene (Maniyara Fort Formation).

Indian records: Kar 1979, p. 32, pl. 3, figs. 49-52, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Jain & Kar 1979, p. 107, pl. 1, fig. 15, pl. 2, fig. 23, Neogene, around Kollam and Varkala, Kerala; Kar & Saxena 1981, p. 115, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Pathak & Banerjee 1984, p. 250, 254, pl. 2, fig. 25, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Kar 1985, p. 130, Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Bhattacharya 1987, p. 120, Early Eocene, Rajpardi, Broach District, Gujarat; Patil & Ramanujam 1988, p. 266, pl. 2, fig. 11, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Rajendran *et al.* 1989, p. 41, 42, 43, pl. 1, fig. 17, Miocene, Tonakkal, Padappakkara, Edavai, Kerala; Kar 1990a, p. 179, pl. 8, fig. 121, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 238, Renji Formation (Late Oligocene), Silchar-Haflong Road Section, Assam; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Kar & Bhattacharya 1992, p. 251, pl. 2, fig. 37, Rajpardi lignite (Early Eocene), Bharuch District, Gujarat; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirappalli District, Tamil Nadu; Kar *et al.* 1994, p.

187, Tertiary, subsurface sediments in Upper Assam; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Rao 1995, p. 233, Tertiary, Alleppey and Kannur districts, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Rao 2000, p. 295, Kherapara Formation (Oligocene), Tura-Dalu Road Section near Kherapara, West Garo Hills District, Meghalaya; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Rao 2004, p. 124, pl. 3, fig. 15, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.

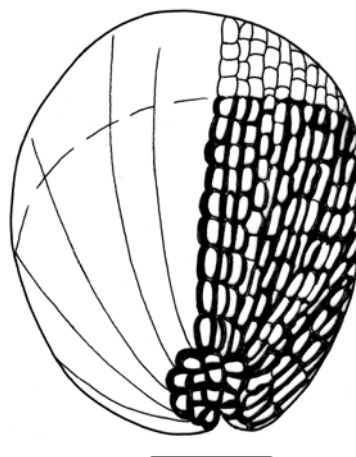
Species: *Kutchiathyrites mehrotrae* sp. nov.

Fig. 204

Mycobank No.: MB 519945.

Kutchiathyrites sp. in Singh *et al.*, Palaeobotanist 35(1), p. 97, pl. 1, figs. 11-12. 1986.

Description: Ascromata \pm semicircular in shape, some specimens look like fish scales, eccentric in development. Size range 88-110 x 67-75 μm . Nonostiolate. No free hyphae present, dimidiolate. Radially arranged hyphae thick, dark, diverging from one another; transverse hyphae comparatively thinner, interconnecting radial ones forming squarish, pseudoparenchymatous cells without having any pore. Some specimens exhibit development of spines from the marginal cells.

Fig. 204. *Kutchiathyrites mehrotrae*. Bar = 40 μm .

Holotype: Singh *et al.* 1986, pl. 1, fig. 11; slide no. 8110, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 97, pl. 1, figs. 11-12, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Species: *Kutchiathyrites perfectus* (Kar *et al.* 2010) **comb. nov.**

Fig. 205

Mycobank No.: MB 519897.

Dictyostromata perfecta Kar *et al.*, Review of Palaeobotany and Palynology 158, p. 247, pl. 2, fig. 6. 2010.

Description (Kar *et al.* 2010, p. 247): Stromata with two lateral sides divergent from each other, outer margin convex, slightly undulated due to pseudoreticulation, $35 \square -42 \times 23 \square -37 \mu\text{m}$; haustorium present or absent, $4-7 \times 2 \square -3 \mu\text{m}$, hyaline, no septa observed, stromata generally conical at attachment zone; radial hyphae stronger than transverse hyphae, anastomose to develop pseudoreticulation, meshes square \square -rectangular; faint at basal region.



Fig. 205. *Kutchiathyrites perfectus*. Bar = 10 μm .

Locality: Tlansam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 247, pl. 2, fig. 6, Bhuban Formation (Miocene), Tlansam, Mizoram, India.

L

Genus: *Lacrimasporonites* Clarke 1965

Mycobank No.: MB 21146.

Type species: *Lacrimasporonites levis* Clarke 1965.

Description (Clarke 1965, p. 87): Fungal spores unicellular (amerspores), elliptical (tear-shaped), hilate or monoporate, cell wall psilate.

Emended Description (Elsik 1968, p. 273): Monoporate, nonseptate, psilate fungal spores. Spatulate to elliptical. Pore apical.

Emended Description (Kalgutkar & Jansonius 2000, p. 161): Unicellate, mostly medium-sized, spatulate to lacrimate, rarely approaching elliptical, smooth-walled fungal spores; with a

flat hilar scar at one end, and a round pore at the opposite end of the spore.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Lacrimasporonites basidii* Elsik 1968

Mycobank No.: MB 316200.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Monoporisorites* van der Hammen 1954a [See: *Monoporisorites basidii* (Elsik 1968) Kalgutkar & Jansonius 2000].

Species: *Lacrimasporonites bellus* Chandra *et al.* 1984

Mycobank No.: MB 106961.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Monoporisorites* van der Hammen 1954a [See: *Monoporisorites bellus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Species: *Lacrimasporonites levis* Clarke 1965

Fig. 206

Mycobank No.: MB 332866.

Description (Clarke 1965, p. 87): Fungal spores unicellular (amersporous), elliptical, hilate or monoporate, "pore" diameter 1-2 μm , cell wall psilate, 1 μm thick, overall dimensions 12-15 x 20-27 μm .



Fig. 206. *Lacrimasporonites levis*. Bar = 5 μm .

Locality: Canon City Coalfield, Fremont County, Colorado, U.S.A.

Age: Late Cretaceous.

Indian records: Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram.

Species: *Lacrimasporonites longus* Kar 1979

Mycobank No.: MB 112387.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Didymoporisoronites* Sheffy & Dilcher 1971 [See:

Didymoporisporonites longus (Kar 1979) Kalgutkar & Jansonius 2000].

Species: *Lacrimasporonites magnus* Saxena & Singh 1982
Mycobank No.: MB 485266.

Remarks: *Lacrimasporonites magnus* Saxena & Singh 1982 is illegitimate, being a junior homonym of *Lacrimasporonites magnus* Haseldonckx 1973. Kalgutkar and Jansonius (2000) transferred this species to *Didymoporisporonites* Sheffy & Dilcher 1971 with a new specific epithet (See: *Didymoporisporonites gigas* Kalgutkar & Jansonius 2000).

Species: *Lacrimasporonites niger* Kumar 1990
Mycobank No.: MB 126565.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Monoporisporites* van der Hammen 1954a [See: *Monoporisporites niger* (Kumar 1990) Kalgutkar & Jansonius 2000].

Species: *Lacrimasporonites ovaliformis* Chandra *et al.* 1984
Mycobank No.: MB 106962.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Monoporisporites* van der Hammen (1954) [See: *Monoporisporites ovaliformis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Genus: *Lirasporis* Potonié & Sah 1960
Mycobank No.: MB 21154.

Type Species: *Lirasporis intergranifer* Potonié & Sah 1960.
Description (Potonié & Sah 1960, p. 132): Size varies from 69 x 103 µm to 116 x 134 µm; outline oval, longitudinal ends of oval broadly rounded or somewhat tapering, sometimes showing irregular protuberances which form a jumbled mass; extrema lineamenta somewhat smooth except the longitudinal ends which are always nearly notched; following the longer axis exist perhaps 20-30 parallel but narrow ribs showing between them spaced grana.

Emended Description (Jain & Kar 1979, p. 108): Fungal bodies oval-elliptical with equal or unequal, broad, generally notched ends. Mycelia, long, septate, ± parallel to one another, extending from one end to other; wall generally laevigate, sometimes granulose.

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Lirasporis elongatus* Kar 1990 (nom. inval.)

Fig. 207

Mycobank No.: MB 519798.

Description (Kar 1990, p. 196): Fungal bodies oval with elongated ends, 135 x 60 µm, broader in the middle and tapering at lateral sides. Mycelia longitudinally and transversally septate, spore wall laevigate.



Fig. 207. *Lirasporis elongatus*. Bar = 35 µm.

Locality: Rokhia borehole; Tripura, North-east India.

Age: Miocene.

Indian records: Kar 1990, p. 196, pl. 8, figs. 116-117, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Chandra & Kumar 1998, p. 58, 60, pl. 1, figs. 11, 15, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Remarks: Kar (1990) did not validly publish "*Lirasporis elongatus*" as he did not cite information on where its type is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Lirasporis intergranifer* Potonié & Sah 1960

Fig. 208

Mycobank No.: MB 519797.

Description (Potonié & Sah 1960, p. 132): Ribs much more narrow than the canals between them; in the canals sparse grana more or less regularly distributed in distances, perhaps a little greater than the breadth of the canals and always only a single granum between the two adjoining ribs; about 10-20 grana in each canal along the longer axis. Holotype: 82 x 109 µm; perhaps 20 ribs on the exposed surface; 16-20 grana in an entire canal; chiefly at one of the longitudinal ends the exine is jumbled to form irregular rounded protuberances (such as illustrated by Samoilovich 1953, pl. 9, fig. 4a, in *Vittatina subsaccata*; and Bolkhovitina 1953, pl. 9, fig. 18, in *Welwitschiapites magniolobatus*; and as has been observed in *Ephedra*).

Emended Description (Jain & Kar 1979, p. 108): Oval-elliptical fungal bodies, 112-154 x 65-113 µm; ends equally or unequally broad, generally notched at one or both ends. Mycelia distinct, run from end to end, septate; wall mostly smooth.



Fig. 208. *Lirasporis intergranifer*. Bar = 10 μ m.

Locality: Kannur District, Kerala, India.

Age: Late Miocene to Pliocene.

Indian records: Potonié & Sah 1960, p. 131-132, pl. 4, figs. 32-33, Cannanore lignite (Late Miocene), Kannur District, Kerala; Jain & Kar 1979, p. 108, pl. 2, fig. 25, pl. 3, fig. 50, Neogene, around Kollam and Varkala, Kerala; Pathak & Banerjee 1984, p. 250, pl. 2, fig. 23, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Singh *et al.* 1986, p. 97, pl. 1, fig. 13, Lubha Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rajendran *et al.* 1989, p. 44, pl. 1, figs. 5, 12, Miocene, Palayangadi, Kerala; Rao 1990, p. 248, pl. 3, fig. 14, Eocene-Early Miocene, Arthungal Borehole, Alleppey District, Kerala; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Rao 1995, p. 233, Tertiary, Alleppey and Kannur districts, Kerala; Rao 1996, p. 156, Early Miocene, Turavur Borehole near Panchayat L.P. School, west of N.H. 47 between 380 and 381 km, Alleppey District, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Rao 2004, p. 124, pl. 3, fig. 12, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District.

Genus: *Lithomucorites* Kar *et al.* 2010

Mycobank No.: MB 541689.

Type species: *Lithomucorites miocenicus* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 245): Fungal sporangia, apophysate, flask shaped, subcircular–circular in shape, size range 25–52 x 22–49 μ m, sometimes with sporangiophore. Wall about 1 μ m thick, closely ornamented with bacula–pila and verrucae, translucent–light brown, some could be made up of calcium oxalate, 2–5 μ m in length, closely placed on both sides to provide negative reticulum on surface view; no slit on sporangia observed.

Classification: Zygomycetes.

Species: *Lithomucorites miocenicus* Kar *et al.* 2010

Fig. 209

Mycobank No.: MB 542279.

Description (Kar *et al.* 2010, p. 245): Sporangia subcircular with serrated margin due to heavy ornamentation, mostly occur in dispersed condition, 32–28 x 26–40 μ m, flask shaped, sporangia wall about 1 μ m thick, ornamented with bacula–pila, and verrucae, pila–bacula 3–5 μ m height, closely placed to form pseudoreticulate structure.

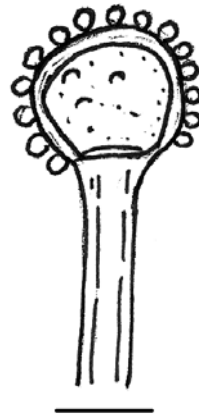


Fig. 209. *Lithomucorites miocenicus*. Bar = 10 μ m.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 245, pl. 1, fig. 1, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Genus: *Lithopolyporales* Kar *et al.* 2003 (nom. inval.).

Mycobank No.: MB 28754.

Type species: *Lithopolyporales zeerabadensis* Kar *et al.* 2003 (by monotypy).

Description (Kar *et al.* 2003, p. 37-38): The fruiting body is macroscopic, conspicuous, shelf-like and effused reflexed. The texture appears to be tough and leathery. The fruiting basidiocarp or 'conks' as they are occasionally called are

perennial as evidenced by the presence of zonation in the section. They were sessile. In the section, minute hyphal strands forming the network could be seen; scattered between were found tiny dot-like spores - presumably the basidiospores.

Classification: Aphyllophorales Polyporaceae.

Remarks: This genus is not validly published, as the only species assigned to it is not validly published.

Species: *Lithopolyporales zeerabadensis* Kar *et al.* 2003 (nom. inval.).

Fig. 210

Mycobank No.: MB 484156.

Description (Kar *et al.* 2003, p. 37-38): As for the genus (combined description).



Fig. 210. *Lithopolyporales zeerabadensis*. Bar = 25 μ m.

Locality: Zeerabad, Dhar District, Madhya Pradesh, India.

Age: Maastrichtian (Lameta Formation).

Indian records: Kar *et al.* 2003, p. 37-38, figs. 3-5, Lameta Formation (Maastrichtian), Zeerabad, Dhar District, Madhya Pradesh.

Remarks: This species is not validly published, as neither its type is indicated nor slide numbers and repository of the figured specimens are mentioned. This species is found in association with angiospermic fossil-woods and is comparable to the fossil forms, viz. *Fomes idahoensis* Brown, reported from the late Tertiary of south-western Idaho, U.S.A.

Genus: *Lithosporocarpia* Kar *et al.* 2010

Mycobank No.: MB 541690.

Type species: *Lithosporocarpia cephalata* Kar *et al.* 2010.

Generic Description (Kar *et al.* 2010, p. 245): Sporocarps subcircular-circular, 22-48 x 20-45 μ m, often with chlamydospores, chlamydospores stalked, subcircular;

sporocarp wall up to 2 μ m thick, hyphae forming reticulation on both sides.

Classification: Fungi, Incertae sedis.

Species: *Lithosporocarpia cephalata* Kar *et al.* 2010

Fig. 211

Mycobank No.: MB 542280.

Description (Kar *et al.* 2010, p. 245): Sporocarps generally subcircular with uneven margin due to projection of hyphae, 28-30 x 26-32 μ m, hyphae forms regular reticulation on both surfaces, meshes mostly square in shape, sometimes rectangular. Chlamydospore present, one chlamydospore found on each sporocarp, chlamydospore subcircular, 10-22 x 8-20 μ m, dark brown, laevigate, with a small stalk and globular head.

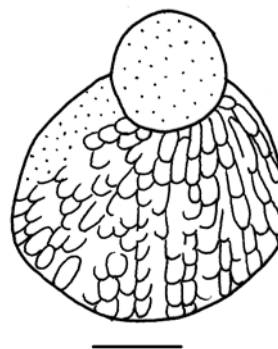


Fig. 211. *Lithosporocarpia cephalata*. Bar = 10 μ m.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 245, pl. 1, fig. 6, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.

Genus: *Lithouncinula* Sharma *et al.* 2005 (nom. inval.)

Mycobank No.: MB 29098.

Type species: *Lithouncinula lametaensis* Sharma *et al.* 2005 (nom. inval.).

Description (Sharma *et al.* 2005, p. 75): (Diagnosis): Cleistotheca subcircular-circular, size range 51-87 μ m, reticulate, dark, with appendages of various sizes, appendages invariably circinate, rarely septate. (Description): Cleistotheca generally very dark obscuring reticulate structure; appendages robust, 18-20 in number. About half have double the length of the rest, coiled at tip, rarely 1-2 septate.

Remarks: Sharma *et al.* (2005) proposed the generic name *Lithouncinula*, but neither mentioned slide number nor repository of the holotype. The generic name, and also the name of its type species (*Lithouncinula lametaensis* Sharma *et al.* 2005), are therefore not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006).

Species: *Lithoucinula lametaensis* Sharma *et al.* 2005 (nom. inval.)

Fig. 212

Mycobank No.: MB 529806.

Description (Sharma *et al.* 2005, p. 76): Cleistotheca subcircular, dense, ornamentation not seen. Appendages of different sizes, 15-20 in number, conspicuous, circinoid, generally not septate.

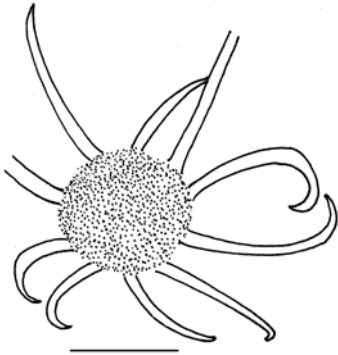


Fig. 212. *Lithoucinula lametaensis*. Bar = 20 μm .

Locality: Pisdura, Maharashtra, India.

Age: Maastrichtian (Lameta Formation).

Indian records: Sharma *et al.* 2005, p. 76, pl. 2, fig. 2, Lameta Formation (Maastrichtian), Pisdura, Maharashtra, India.

Remarks: While proposing the new species, *Lithoucinula lametaensis*, Sharma *et al.* (2005) made no mention of holotype slide and its repository, hence the species name is not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006).

M

Genus: *Mathurisorites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28620.

Type Species: *Mathurisorites ellipticus* (Mathur & Mathur 1969) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 166): Medium-sized hilate spores, generally consisting of a darker central part with 2-4(-6) cells, and proximal and distal parts of a single to few hyaline cells. No distal pore. Septa distinct, as thick as, or thicker than, the spore wall. Differs from *Pluricellaesporites* in the swollen dark central cells.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Mathurisorites ellipticus* (Mathur & Mathur 1969) Kalgutkar & Jansonius 2000

Fig. 213

Mycobank No.: MB 483417.

Pluricellaesporites ellipticus Mathur & Mathur, Bulletin of the Geological, Mining and Metallurgical Society of India 42, p. 3, pl. 1, fig. 2. 1969.

Description (Mathur & Mathur 1969, p. 3): Surface view. Spores four celled, stalked, broadly elliptical in shape. 39.5 x 19.6 μm , central cells bigger than end ones. Exine ca. 1 μm thick, brown.

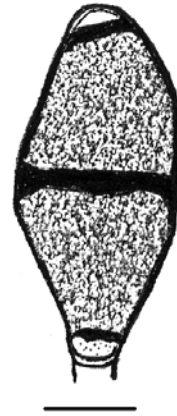


Fig. 213. *Mathurisorites ellipticus*. Bar = 10 μm .

Locality: Naera and Baraia, Kutch District, Gujarat, India.

Age: Pliocene.

Indian records: Mathur & Mathur 1969, p. 3, pl. 1, fig. 2, Pliocene, Naera and Baraia, Kutch District, Gujarat; Kar *et al.* 1994, p. 187, Tertiary, subsurface sediments in Upper Assam; Mandaokar 2000c, p. 38, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh.

Genus: *Meliola* Fries 1825

Mycobank No.: MB 3100.

Type Species: *Meliola nidulans* (Schweinitz ex Fries) Cooke 1882.

Classification: Ascomycetes, Erysiphales.

Species: *Meliola anfracta* Dilcher 1965

Mycobank No.: MB 484071.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Meliolinites* Selkirk 1975 [See: *Meliolinites anfractus* (Dilcher 1965) Kalgutkar & Jansonius 2000].

Genus: *Meliolinites* Selkirk 1975

Mycobank No.: MB 21162.

Type Species: *Meliolinites spinksii* (Dilcher 1965) Selkirk 1975.

Description (Selkirk 1975, p. 70): Fossil fungal colonies. Mycelium and spores with general characteristics of members of Meliolaceae. Mycelial setae absent. Information regarding perithecial structure and nature of perithecial appendages uncertain or lacking.

Classification: Ascomycetes, Erysiphales.

Species: *Meliolinites anfractus* (Dilcher 1965) Kalgutkar & Jansonius 2000

Fig. 214

Mycobank No.: MB 483419.

Meliola anfracta Dilcher, *Palaeontographica* Abt. B. 116, p. 7, pl. 2, fig. 2, 8. 1965.

Description (Dilcher 1965, p. 7): Colonies 1-3 mm in diameter, subdense to dense. Hyphal cells 4-9 x 14-37 μm . Lateral walls of hyphae sinuous; often the hyphae appear undulating. Capitulate hyphopodia 10-15 x 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 x 4-11 μm , generally cylindrical with straight or undulating lateral walls, rarely cuneate. Head cells 10-15 x 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 x 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.



Fig. 214. *Meliolinites anfractus*. Bar = 10 μm .

Indian records: Jain & Kar 1979, p. 109, pl. 3, fig. 51, Neogene, around Kollam and Varkala, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Meliolinites nivalis* Selkirk 1975

Fig. 215

Mycobank No.: MB 317537.

Description (Selkirk 1975, p. 71): Colonies up to 3 mm across. Hyphae straight, branches alternate (unilateral where crowded), antrorse, forming dense reticulum. Hyphal cells 19-34 μm long and 7-11 μm wide. Capitulate hyphopodia alternate, unilateral where crowded, antrorse at ca. 60° to

hyphae or widely spreading, 22-39 μm long. Stalk cells cylindrical, often slightly expanded distally, rarely almost cuneate, 5-15.5 μm long and 6-11 μm wide; head cells irregularly globose, 14-26 μm long and 11-23 μm wide. Spores smooth, straight, oblong with rounded ends, 3-septate, slightly constricted, 62-72.5 μm long and ca. 18 μm wide. Hyphal walls 1.5-2.5 μm thick, cross-septa have a distinct pore of 2-2.5 μm in diameter. About half of the distal ends of hyphal cells bear capitulate hyphopodia. Most head cells globose, but their wall often sinuate, at times even lobate; pore present between head and stalk cells; no mucronate hyphopodia. Head cells show distinct pore in lower surfaces, from which a hyaline (haustorial) tube extends through the cuticle.

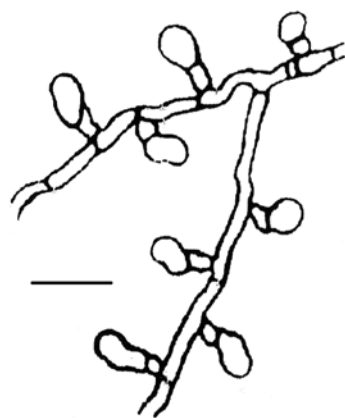


Fig. 215. *Meliolinites nivalis*. Bar = 10 μm .

Indian records: Reddy *et al.* 1982, p. 112, pl. 1, figs. 1-3, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Patil & Ramanujam 1988, p. 262, pl. 1, fig. 1, Miocene, Tonakkal, Thiruvananthapuram District, Kerala.

Species: *Meliolinites spinksii* (Dilcher 1965) Selkirk 1975

Fig. 216

Mycobank No.: MB 317538.

Meliolinites spinksii Dilcher, *Palaeontographica* Abt. B., 116,

p. 8, pl. 3, fig. 12. 1965.

Description (Dilcher 1965, p. 8): Only young colonies found; mature colonies probably thin. Hyphae straight, branch oppositely to alternately at right angles. Hyphal cells 5-9 x 14-50 μm , produce capitulate hyphopodia laterally at distal ends of the cells. Capitulate hyphopodia 5-10 x 10-18 μm , opposite or occasionally unilateral, generally antrorse. Stalk cells 4-9 x 2-5 μm , somewhat cuneate to cylindrical. Head cells 5-10 x 8-13 μm , entire, oblong to ovoid. Mucronate hyphopodia 5-7 x 11-18 μm , taper gradually, opposite. Spores 12-15 x 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.

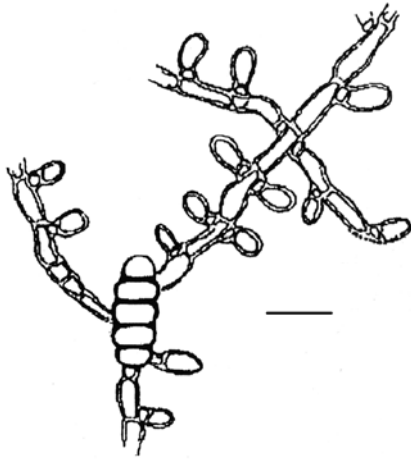


Fig. 216. *Meliolinites spinksii*. Bar = 10 μ m.

Indian records: Chandra & Kumar 1998, p. 60, pl. 1, fig. 7, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Species: *Meliolinites tlangsamensis* (Kar *et al.* 2010) **comb. nov.**

Fig. 217

Mycobank No.: MB 519899.

Meliostroma tlangsamensis Kar *et al.*, Review of Palaeobotany and Palynology 158, p. 246, pl. 1, figs. 10-11. 2010.

Description (Kar *et al.* 2010, p. 246): Fungal stromata subcircular-circular, 26-36 x 24-32 μ m, generally with hyphae of two types \square -two celled, globular, capitate hyphopodia and one celled, bottle shaped mucronate hyphopodia. Stromata reticulate on both sides forming square-rectangular meshes.

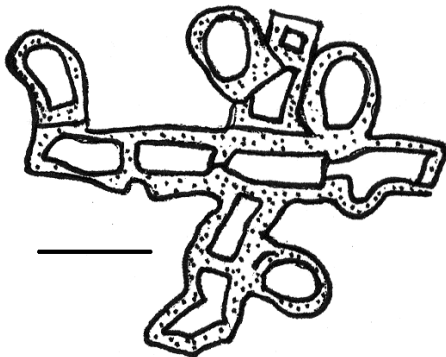


Fig. 217. *Meliolinites tlangsamensis*. Bar = 10 μ m.

Type locality: Tlangsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 1, figs. 10-11, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Genus: *Meliostroma* Kar *et al.* 2010

Mycobank No.: MB 541693.

Type species: *Meliostroma tlangsamensis* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 246): Fungal stromata with mycelia, 25-38 x 22-36 μ m, subcircular \square -circular in shape, dark brown, hyphae forming reticulation on both sides, stromata bear capitate and mucronate hyphopodia.

Classification: Ascomycetes, Erysiphales.

Remarks: Kar *et al.* (2010) proposed the new genus *Meliostroma*, which is identical to *Meliolinites* Selkirk 1975 and therefore considered here its junior synonym.

Species: *Meliostroma tlangsamensis* Kar *et al.* 2010

Mycobank No.: MB 542282.

Remarks: Since *Meliostroma* is considered here a junior synonym of *Meliolinites* Selkirk 1975, *Meliostroma tlangsamensis* Kar *et al.* 2010 is being transferred to *Meliolinites* Selkirk 1975 [See: *Meliolinites tlangsamensis* (Kar *et al.* 2010) **comb. nov.**]

Genus: *Microthallites* Dilcher 1965

Mycobank No.: MB 21165.

Type Species: *Microthallites lutosus* Dilcher 1965.

Description (Dilcher 1965, p. 16): Stroma radiate, more or less round, lacks free hyphae, ostiolate or non-ostiolate. Spores unknown.

Classification: Ascomycetes, Microthyriales.

Remarks: *Microthallites* Dilcher 1965 is a junior synonym of *Phragmothyrites* Edwards 1922 (Kalgutkar & Jansonius 2000).

Species: *Microthallites cooksoniae* Rao & Ramanujam 1976

Mycobank No.: MB 317729.

Remarks: Since *Microthallites* Dilcher 1965 is a junior synonym of *Phragmothyrites* Edwards 1922, Kalgutkar and Jansonius (2000) transferred this species to *Phragmothyrites* [See: *Phragmothyrites cooksoniae* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000].

Species: *Microthallites lutosus* Dilcher 1965

Mycobank No.: MB 334294.

Remarks: Kar and Saxena (1976) transferred *Microthallites lutosus* Dilcher 1965 to *Phragmothyrites* Edwards 1922 [See: *Phragmothyrites lutosus* (Dilcher 1965) Kar & Saxena 1976].

Species: *Microthallites spinulatus* Dilcher 1965

Mycobank No.: MB 334295.

Remarks: Kalgutkar and Jansonius (2000) transferred *Microthallites spinulatus* Dilcher 1965 to *Asterothyrites* Cookson 1947 [See: *Asterothyrites spinulatus* (Dilcher 1965) Kalgutkar & Jansonius 2000].

Genus: *Microthyriacites* Cookson 1947

Mycobank No.: MB 21166.

Type Species: *Microthyriacites grandis* Cookson 1947.

Description (Cookson 1947, p. 210): Ascomata radiate and dimidiate. Information regarding the presence of a free mycelium either uncertain or wanting; ascospores unknown.

Emended Description (Kalgutkar & Jansonius 2000, p. 170): Astomate ascomata composed of two parts: a central part of more or less equidimensional squarish to hexagonal cells with little or no radial pattern, that tend to have thick walls; surrounded by a broad zone of hyphae composed of more elongate cells that are interconnected to form a pseudoparenchymatous fabric with a distinct radial pattern. *Phragmothyrites* may have one or only a few squarish to hexagonal central cells, from which radial hyphae extend.

Classification: Ascomycetes, Microthyriales.

Species: *Microthyriacites cooksoniae* Rao 1958

Fig. 218

Mycobank No.: MB 317739.

Description (Rao 1958, p. 45): Thyriothecia flat, slightly dimidiate and orbicular or shield-shaped, 145-245 μm in diameter, central region of thick-walled compact cells, outer region of elongated, thin-walled cells.

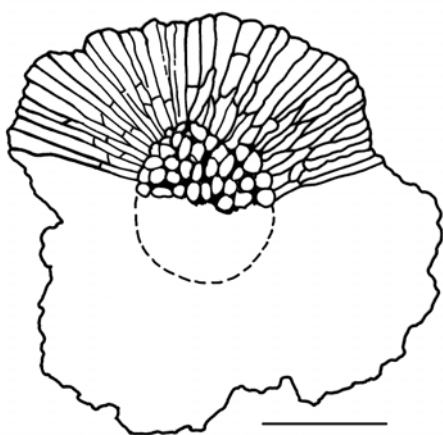


Fig. 218. *Microthyriacites cooksoniae*. Bar = 50 μm .

Locality: Palana lignite, Palana, Bikaner District, Rajasthan, India; Warkalli lignite, Warkalli, Thiruvananthapuram District, Kerala, India.

Age: Early Eocene and Miocene respectively.

Indian records: Rao 1958, p. 45, pl. 1, figs. 12-13, Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan; Warkalli lignite (Miocene), Warkalli, Thiruvananthapuram District, Kerala.

Species: *Microthyriacites edwardsii* Rao 1958

Mycobank No.: MB 317741.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Phragmothyrites* Edwards 1922 [See: *Phragmothyrites edwardsii* (Rao 1958) Kalgutkar & Jansonius 2000].

Species: *Microthyriacites ramanujamii* Saxena & Misra 1990

Fig. 219

Mycobank No.: MB 483355.

Description (Saxena & Misra 1990, p. 268): Ascostromata circular to subcircular, non-ostiolate, size range 110-126 x 90-95 μm , hyphae radiating, forming pseudoparenchymatous, small thickened central cells and larger, rectangular to squarish outer cells, cells aporate, margin thin and wavy.



Fig. 219. *Microthyriacites ramanujamii*

Locality: Amberiwadi, Sindhudurg District, Maharashtra, India.

Age: Miocene (Ratnagiri Beds)

Indian records: Saxena & Misra 1990, p. 268, pl. 2, fig. 13, Miocene, Amberiwadi Section, Sindhudurg District, Maharashtra; Rao 2004, p. 124, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.

Species: *Microthyriacites sahnii* Rao 1958

Fig. 220

Mycobank No.: MB 317743.

Description (Rao 1958, p. 43-44): Thyriothecia flat, superficial, dimidiate, up to 250 μm in diameter, with radially arranged squarish or rectangular cells, peripheral cells smaller, cells with one or more small aperture-like areas. No mycelia or ostiole clearly seen.



Fig. 220. *Microthyriacites sahnii*. Bar = 50 μ m.

Locality: Palana, Bikaner District, Rajasthan, India.

Age: Eocene

Indian records: Rao 1958, p. 44, pl. 1, figs. 3-6, Palana Lignite (Early Eocene), Palana, Bikaner District, Rajasthan

Genus: *Microthyriella* Höhnelt 1909

Mycobank No.: MB 3202.

Type Species: *Microthyriella rickii* (Rehm) Höhnelt 1909.

Classification: Ascomycetes, Microthyriales.

Species: *Microthyriella diporata* Rao & Ramanujam 1976

Fig. 221

Mycobank No.: MB 317745.

Description (Rao & Ramanujam 1976, p. 101): Free mycelium lacking. Ascomata flattened, irregular in shape, highly variable in size, ranging between 50-150 μ m; cells of the ascomata 5-10 μ m in diameter, pentagonal to hexagonal, irregularly arranged and porate, pores mostly two per cell, 2.5-3.5 μ m wide, circular and randomly disposed.



Fig. 221. *Microthyriella diporate*. Bar = 30 μ m.

Locality: Warkalli, Kerala, India.

Age: Late Miocene (Quilon and Warkalli Beds)

Indian records: Rao & Ramanujam 1976, p. 101-102, pl. 2, fig. 15, Quilon and Warkalli Beds (Late Miocene), Warkalli, Kerala.

Genus: *Milesites* Ramanujam & Ramachar 1980

Mycobank No.: MB 28627.

Type Species: *Milesites irregularis* Ramanujam & Ramachar 1980.

Description (Ramanujam & Ramachar 1980, p. 81): Urediniospores obscurely pedicellate, obovoid, lanceolate or of irregular configuration; wall thin, hyaline or very light coloured, smooth or finely sculptured, germ pores few, faint.

Classification: Basidiomycetes, Uredinales.

Species: *Milesites irregularis* Ramanujam & Ramachar 1980

Fig. 222

Mycobank No.: MB 483755.

Description (Ramanujam & Ramachar 1980, p. 81): Urediniospores lanceolate, or irregularly shaped, 30-45 x 12-20 μ m; wall up to 1.5 μ m thick, smooth or finely flecked, almost hyaline; germ pores few, indistinct. Holotype 45 x 13 μ m.



Fig. 222. *Milesites irregularis*. Bar = 10 μ m.

Locality: Neyveli lignite, Tamil Nadu, India.

Age: Miocene.

Indian records: Ramanujam & Ramachar 1980, p. 81, pl. 1, figs. 1-2, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Genus: *Mohgaonidium* Singhai 1974

Mycobank No.: MB 21168.

Type Species: *Mohgaonidium deccanii* Singhai 1974.

Description (Singhai 1974, p. 95): Pycnidia small, brown, thick walled, ostiolate, oval or more or less globose; conidia faintly brown, 1-celled, ovoid or ellipsoidal; conidiophores short and simple.

Classification: Fungi Imperfecti, Sphaeropsidales

Species: *Mohgaonidium deccani* Singhai 1974

Fig. 223

Mycobank No.: MB 317788.

Description (Singhai 1974, p. 97): Pycnidia ostiolate, small, oval or globose, brown, 56-96 x 52-72 μm in size. Conidiophores short (5-8 μm), simple; conidia small, faintly brown, one-celled, ovoid or ellipsoid, measuring 3-4 x 5-6 μm , thin walled, smooth.

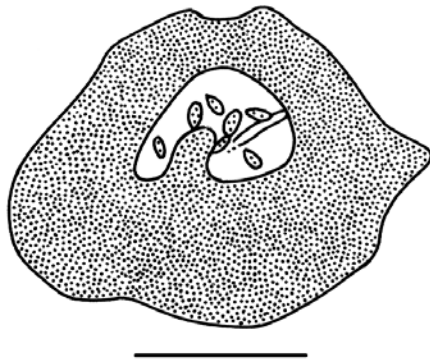


Fig. 223. *Mohgaonidium deccani*. Bar = 50 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian.

Indian records: Singhai 1974, p. 97, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Monodictyites* Barlinge & Paradkar 1982 (nom. inval.)

Mycobank No.: MB 21173.

Type Species: *Monodictyites intertrappea* Barlinge & Paradkar 1982.

Classification: Moniliales.

Species: *Monodictyites intertrappea* Barlinge & Paradkar 1982

Mycobank No.: MB 109515.

Description (Barlinge & Paradkar 1982, p. 168): Fungus saprophytic; hyphae septate, branched; conidiospores with thick stalks; conidia multicellular, dictyosporous and medium-thick walled, 12-40 x 16-28 μm ; found in decaying tissue of the host.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: ? Late Cretaceous (Deccan Intertrappean Series).

Indian records: Barlinge & Paradkar 1982, p. 168, pl. 1, figs. F, H, text-figs. H, N-O, Deccan Intertrappean Series (?Late

Cretaceous)), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Remarks: The species is not validly published, because no illustration of the fossil form was provided. The authors illustrated, on their plate 1, figs. F, H, and in the text-figs. H-O, spores and mycelium of (extant) *Monodictys*.

Genus: *Monoporisorites* van der Hammen 1954a emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21174.

Type Species: *Monoporisorites minutus* van der Hammen 1954a (designated by van der Hammen 1954b, p. 14).

Ornatisporites Parsons & Norris 1999

Polyporisorites van der Hammen 1954a

Psiammopomopiospora Salard-Chebodaeff & Locquin 1980

Psiamspora Salard-Chebodaeff & Locquin 1980

Reticulatisporonites Elsik 1968

Description (van der Hammen 1954a, p. 83, 103): (Fungal) spore with one small, [round (van der Hammen 1954b)] pore (Jansonius & Hills 1976, card no. 1704.)

Emended Description (Elsik 1968, p. 272): Monoporate, nonseptate, psilate fungal or algal spores. Shape spherical to subspherical.

Emended Description (Sheffy & Dilcher 1971, p. 40): Monoporate, aseptate, psilate to finely punctate fungal or algal spores. Shapes spherical to subspherical, hilate or monoporate.

Emended Description (Kalgutkar & Jansonius 2000, p. 175): Monohilate (or monoporate), unicellate, generally small to medium-sized, round, oval or elongate elliptical fungal spores. Wall generally smooth, but ornamented forms are included.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Clarke (1965) published a restated description, as follows: Fungal spores unicellular (amerosporous), spherical to subspherical, hilate or monoporate, cell wall psilate to finely punctate.

Species: *Monoporisorites annulatus* van der Hammen 1954a

Fig. 224

Mycobank No.: MB 334446.

Description (van der Hammen 1954a, p. 103): Spores 13 μm ; psilate, with dark annulus.

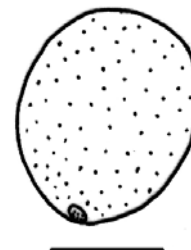


Fig. 224. *Monoporisorites annulatus*. Bar = 5 μm .

Locality: Megdalena Valley, Eastern Cordellera, Colombia, South America.

Age: Maastrichtian.

Indian records: Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Monoporisorites basidii* (Elsik 1968) Kalgutkar & Jansonius 2000

Fig. 225

Mycobank No.: MB 483422.

Lacrimasporonites basidii Elsik, Pollen Spores 10(2), p. 273. pl. 2, fig. 17. 1968.

Description (Elsik 1968, p. 273): Spatulate, apically monoporate, psilate spores 6 to 8 μm wide and 9 to 14 μm long. Wall smooth on both inner and outer surfaces. Wall of two layers of equal thickness. Both layers thin and bulge out somewhat at the pore. Apical pore very small, ca. 0.5 μm . No evidence of basal attachment area.

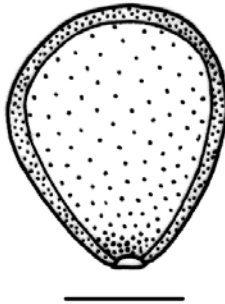


Fig. 225. *Monoporisorites basidii*. Bar = 5 μm .

Locality: Strip mine, Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene.

Indian records: Ramanujam & Srisailam 1980, p. 126, pl. 2, fig. 17, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil, 1985. P. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Sarkar & Singh 1988, p. 59, pl. 5, fig. 1, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Samant & Tapaswi 2000, p. 29, fig. 2.8, Cambay Shale (Early Eocene), Cambay Basin, Gujarat.

Species: *Monoporisorites bellus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 226

Mycobank No.: MB 483424.

Lacrimasporonites bellus Chandra *et al.*, Biovigyanam 10(1), p. 50, pl. 2, fig. 28. 1984.

Description (Chandra *et al.* 1984, p. 50): Oval fungal spore, size 70 x 42 μm ; unicellate, aseptate, monoporate, pore apical; spore wall up to 1 μm thick, psilate, irregularly folded.

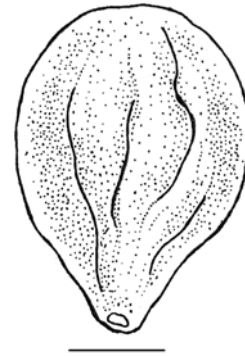


Fig. 226. *Monoporisorites bellus*. Bar = 20 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 50, pl. 2, figs. 28, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Species: *Monoporisorites circularis* Saxena 2009

Fig. 227

Mycobank No.: MB 515007.

Monoporisorites hammenii Samant & Tapaswi, Gondwana Geological Magazine 15(2), p. 28, fig. 2.5. 2000, non Martínez-Hernández & Tomasini-Ortiz 1989.

Description (Samant & Tapaswi 2000, p. 28): Fungal spores circular in shape; 46-48 μm in diameter, opaque, monoporate; pore centrally placed, pore wall thick and even, pore about 6 μm in diameter; spore wall smooth.

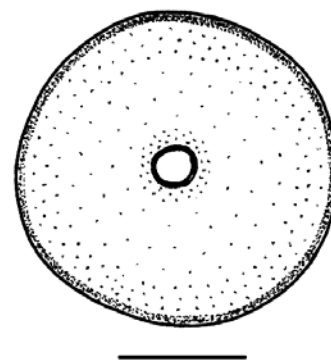


Fig. 227. *Monoporisorites circularis*. Bar = 10 μm .

Locality: Cambay Basin, Surat District, Gujarat, India.

Age: Early Eocene (Cambay Shale).

Indian records: Samant & Tapaswi 2000, p. 28, fig. 2.5, Cambay Shale (Early Eocene), Cambay Basin, Surat District, Gujarat.

Species: *Monoporisorites hammenii* Samant & Tapaswi 2000, non Martínez-Hernández & Tomasini-Ortiz 1989.

Mycobank No.: MB 515006.

Remarks: *Monoporisorites hammenii* Samant & Tapaswi 2000 is illegitimate, being junior homonym of *Monoporisorites hammenii* Martínez-Hernández & Tomasini-Ortiz 1989. For this reason, Saxena (2009) replaced it with a new name [See: *Monoporisorites circularis* Saxena 2009]

Species: *Monoporisorites keralensis* Ramanujam & Rao 1978

Fig. 228

Mycobank No.: MB 115076.

Description (Ramanujam & Rao 1978, p. 294): Spores spheroidal, 22-30 μm in diameter, unicellular, light brown in colour, a single pore towards one side, pore 2 μm in diameter, simple, flush with general surface of spore, spore wall two-layered, outer layer slightly thicker, surface psilate to locally finely flecked.

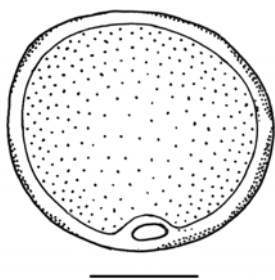


Fig. 228. *Monoporisorites keralensis*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 294, pl. 1, fig. 5, Miocene, Kerala; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 3, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Samant 2000, p. 16, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Monoporisorites koenigii* Elsik 1968

Fig. 229

Mycobank No.: MB 317864.

Description (Elsik 1968, p. 272): Subspherical to pear shaped, psilate, monoporate fungal spores. Size 20 to 22 μm wide and 24 to 30 μm long. Spore wall generally darkly pigmented, 1.5 μm thick. Inner layer of wall twice as thick as outer layer. An outer, very thin third layer may be present. Apical pore 0.5 μm , bulges out slightly without thickening of the spore wall. Wall turned into the pore.

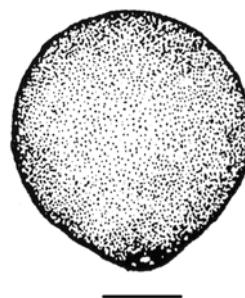


Fig. 229. *Monoporisorites koenigii*. Bar = 10 μm .

Locality: Strip mine, Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene.

Indian records: Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Samant & Tapaswi 2000, p. 29, pl. 2, fig. 6, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Singh & Chauhan 2008, p. 76, pl. 2, fig. 11, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Species: *Monoporisorites meghalayaensis* sp. nov.

Fig. 230

Mycobank No.: MB 519946.

Monoporisorites sp. in Singh *et al.*, Palaeobotanist 35(1), p. 100, pl. 2, fig. 2. 1986.

Description: Fungal spore spherical in shape, size 77-86 μm . Monoporate, pore circular, 7-8 μm in diameter, centrally located. Spore wall 1.5 μm thick, laevigate.

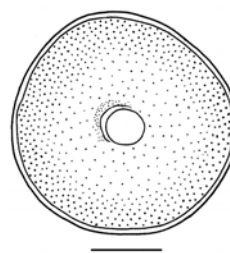


Fig. 230. *Monoporisorites meghalayaensis*. Bar = 20 μm .

Holotype: Singh *et al.* 1986, pl. 2, fig. 2; slide no. 8128, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam, India.

Age: Miocene (Bokabil Formation).

Indian records: Singh *et al.* 1986, p. 100, pl. 2, fig. 2, Bokabil Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Species: *Monoporisorites minutus* van der Hammen 1954a

Fig. 231

Mycobank No.: MB 334450.

Description (van der Hammen 1954a, p. 103): Spores 14 μm (11.5–18 μm); psilate-scabrate; dark colour, pore round, very small.

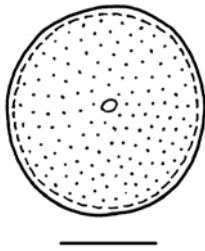


Fig. 231. *Monoporisorites minutus*. Bar = 5 μm .

Locality: Magdalena Valley, Eastern Cordillera, Colombia, South America.

Age: Maastrichtian.

Indian records: Saxena & Singh 1980, p. 480, Pinjor Formation (Late Pliocene), near Chandigarh; Singh & Saxena 1980, p. 278, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Singh & Saxena 1981, p. 177, pl. 1, fig. 12, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Saxena & Singh 1982b, p. 330, pl. 1, fig. 15, Pinjor Formation (Late Pliocene), near Chandigarh.

Species: *Monoporisorites neyveliensis* Ramanujam & Ramachar 1980

Fig. 232

Mycobank No.: MB 483756.

Description (Ramanujam & Ramachar 1980, p. 81): Spores unicellular, globose, 25–30 μm in diameter; wall chestnut-brown, smooth, up to 2.5 μm thick; germ pore one, rather faint, up to 2 μm in diameter, flush with general surface of spore.



Fig. 232. *Monoporisorites neyveliensis*. Bar = 5 μm .

Remarks: Authors considered these spores to be teliospores (Uredinales, Pucciniaceae) resembling those of *Uromyces*. Although none of the spores possessed a pedicel, the flattening of one side of the spore wall in most specimens indicates the original position where a pedicel was attached. *Uromyces* is parasitic on various members of the Leguminosae, Euphorbiaceae and Gramineae. Pollen of these groups occur in the lignite residues.

Locality: Neyveli, South Arcot District, Tamil Nadu, India.

Age: Miocene (Neyveli lignite).

Indian records: Ramanujam & Ramachar 1980, p. 81–82, pl. 1, fig. 3, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Species: *Monoporisorites niger* (Kumar 1990) Kalgutkar & Jansonius 2000

Fig. 233

Mycobank No.: MB 483433.

Lacrimasporonites niger Kumar, Review of Palaeobotany and Palynology 63, p. 15, pl. 1, fig. 6. 1990.

Description (Kumar 1990, p. 15): Fungal spore unicellular, monoporate and elliptical with acutely rounded ends. Size 30–35 x 13–15 μm . Single pore at one end. Spore wall smooth, \pm 0.75 μm thick, slightly thicker around the pore.

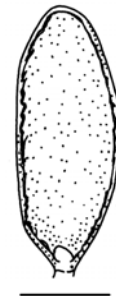


Fig. 233. *Monoporisorites niger*. Bar = 10 μm .

Locality: Padappakkara, Kollam District, Kerala, India.

Age: Early-Middle Miocene.

Indian records: Kumar 1990, p. 15, 17, pl. 1, fig. 6, Early-Middle Miocene, Padappakkara, Kollam District, Kerala.

Species: *Monoporisorites novus* Chandra *et al.* 1984

Fig. 234

Mycobank No.: MB 107032.

Description (Chandra *et al.* 1984, p. 49): Spherical to oval fungal spores; size range 10–19 μm , unicellate, aseptate;

monoporate, pore small, ca. 0.5-1.5 μm in diameter, circular, without any distinct annulus; spore wall up to 1 μm thick, psilate, single-layered, pigment medium to dark, area around the pore darker than rest of the spore.

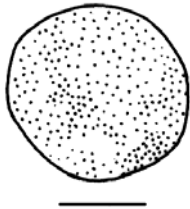


Fig. 234. *Monoporisorites novus*. Bar = 10 μm .

Locality: Sediment core no. 4 (Lat. 21°10.02' N; Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 49, pl. 2, figs. 23-24, Late Quaternary, Sediment core no. 2 (Lat. 18°35.2'N; Long. 69°17.2'E), Sediment core no. 3 (Lat. 19°32.8'N; Long. 71°21.5'E), Sediment core no. 4 (Lat. 21°10.0'N; Long. 70°26.9'E), Sediment core no. 5 (Lat. 24°04.5'N; Long. 69°26.0'E), Arabian Sea.

Species: *Monoporisorites ovaliformis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 235

Mycobank No.: MB 483434.

Lacrimasporonites ovaliformis Chandra *et al.*, Biovigyanam 10(1), p. 50, pl. 2, fig. 29. 1984.

Description (Chandra, *et al.* 1984, p. 50): Subspherical to oval fungal spores; size range 42-55 x 32-41 μm ; unicellate, aseptate; monoporate, pore apical, 6-13 μm in diameter, pore margin faintly thickened; spore wall 0.5 μm thick, psilate to somewhat intrapunctate.

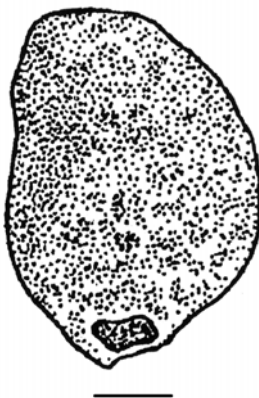


Fig. 235. *Monoporisorites ovaliformis*. Bar = 10 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 50, pl. 2, fig. 29, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Sediment core no. 5 (Lat. 24°04.5'N; Long. 69°26.0'E), Arabian Sea.

Species: *Monoporisorites ovalis* Sheffy & Dilcher 1971

Mycobank No.: MB 111660.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Basidiosporites* Elsik 1968 [See: *Basidiosporites ovalis* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000].

Species: *Monoporisorites psilatus* Chandra *et al.* 1984

Fig. 236

Mycobank No.: MB 107033.

Description (Chandra *et al.* 1984, p. 49): Spherical fungal spore, size 62 x 55 μm ; unicellate, aseptate, monoporate, pore circular, 4.5 μm in diameter, surrounded by a prominent thickening, darker than the rest of the body; spore wall 2 μm thick, psilate.

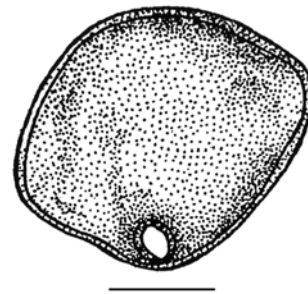


Fig. 236. *Monoporisorites psilatus*. Bar = 20 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 49, pl. 2, fig. 22, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N; Long. 70°46.0'E), Arabian Sea.

Species: *Monoporisorites sheffyi* Chandra *et al.* 1984

Fig. 237

Mycobank No.: MB 107034.

Description (Chandra *et al.* 1984, p. 50): Spherical-sub spherical fungal spores; unicellular, monoporate, size range 15-17 x 13-15 μm , pore ca. 3 μm , wide; spore wall 2-layered, 1.5 μm thick, psilate.

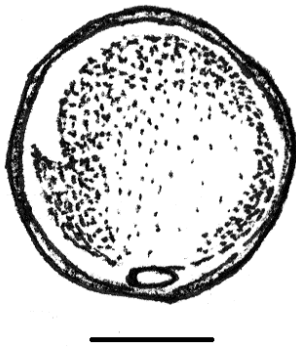


Fig. 237. *Monoporisporites sheffyi*. Bar = 10 μ m.

Locality: Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 50, pl. 2, fig. 25, Late Quaternary, Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Species: *Monoporisporites singhii* Gupta 2002

Fig. 238

Mycobank No.: MB 540671.

Description (Gupta 2002, p. 129): Spores one celled, nonseptate, monoporate, subcircular, 17 x 14.5–26 x 22 μ m, pore \pm circular, simple, situated variously in middle; verrucate with verrucae varying in size and shape, surface folded.



Fig. 238. *Monoporisporites singhii*. Bar = 10 μ m.

Locality: Jantah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 129, pl. 1, fig. 7, Subathu Formation (Eocene), Jantah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Monoporisporites stoveri* Elsik 1968

Fig. 239

Mycobank No.: MB 317866.

Description (Elsik 1968, p. 272): Spherical or disc-shaped, monoporate, psilate fungal spores, 13 to 20 μ m in diameter. Spore wall ca. 0.5 μ m. Pore less than 0.5 μ m, bulges ca. 1 μ m beyond spore outline.

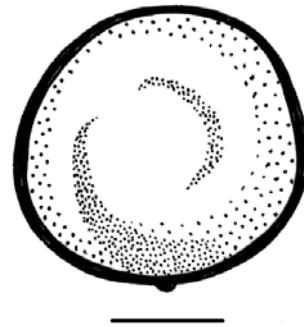


Fig. 239. *Monoporisporites stoveri*. Bar = 5 μ m.

Locality: Strip mine, Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene.

Indian records: Kar & Saxena 1976, p. 11, pl. 4, fig. 51, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Ambwani 1982, p. 30, pl. 1, fig. 13, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam.

Genus: *Multicellaesporites* Elsik 1968

Mycobank No.: MB 21181.

Type Species: *Multicellaesporites nortonii* Elsik 1968.

Warkallisporonites Ramanujam & Rao 1978

Description (Elsik 1968, p. 269): Inaperturate, psilate fungal spores of three or more cells; two or more septa. Shape variable around a long axis.

Emended Description (Sheffy & Dilcher 1971, p. 269): Inaperturate, psilate to scabrate fungal spores or algal bodies of three or more cells; two or more septa. Shape variable around a long axis.

Emended Description (Kumar 1990, p. 22): Fungal spores multicellate, elongate. A longitudinal slit or furrow present. Spore wall smooth or ornamented or differentially coloured or thickened.

Remarks: Kalgutkar & Jansonius (2000) adopted the emended diagnosis of Kumar (1990) but paraphrased the same as follows: "Fungal spores, generally of three to five cells; overall

shape fusiform to elliptical, commonly with a slight curvature in the long axis; generally, the equatorial section is a plane of symmetry; commonly with a subtle, but distinct, longitudinal furrow, crease, thinning or rupture of the wall on the concave side of the spore, that may be expressed in only the terminal cells, or along the whole spore; spore wall smooth or with minute sculpturing; septa distinct or thin, commonly with a perforation or septal folds.”

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Multicellaesporites circularis* Samant & Tapaswi 2000

Mycobank No.: MB 519787.

Remarks: This species does not possess a longitudinal furrow, an essential character of *Multicellaesporites* (sensu Kalgutkar & Jansonius 2000) and therefore is being transferred to *Multicellites* Kalgutkar & Jansonius 2000. [See: *Multicellites circularis* (Samant & Tapaswi 2000) comb. nov.].

Species: *Multicellaesporites confusus* Chandra *et al.* 1984

Mycobank No.: MB 107038.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Multicellites* Kalgutkar & Jansonius 2000 [See: *Multicellites confusus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Species: *Multicellaesporites curvatus* Ambwani 1983

Mycobank No.: MB 107039.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Reduviasporonites* Wilson 1962 [See: *Reduviasporonites curvatus* (Ambwani 1983) Kalgutkar & Jansonius 2000].

Species: *Multicellaesporites denticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 240

Mycobank No.: MB 483445.

Warkallisporonites denticulatus Ramanujam & Rao, in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 298, pl. 2, fig. 27. 1978.

Description (Ramanujam & Rao 1978, p. 298): Spores uniseriate, multicellular, fusiform, 80-102 x 15-18 μm . Transverse septa 4 to 7 in number. Spore constricted at the central septum. Cells broadest in the centre, prominently tapered at each end. Two denticulate or wedge-shaped

thickenings on some septa on either side of a slit-like pore. No thickenings on central septum. Spore wall up to 1.5 μm thick, finely granular to locally almost psilate.

Locality: Kannur District, Kerala South India.

Age: Miocene (Quilon and Warkalli beds).



Fig. 240. *Multicellaesporites denticulatus*. Bar = 20 μm .

Indian records: Ramanujam & Rao 1978, p. 298, pl. 2, figs. 27-28, Miocene, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Multicellaesporites differentialis* Ramanujam & Srisailam 1980

Mycobank No.: MB 109089.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Ramasricellites* Kalgutkar & Jansonius 2000 [See: *Ramasricellites differentialis* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000]

Species: *Multicellaesporites dilcheri* Samant in Saxena 2009

Fig. 241

Mycobank No.: MB 515016.

Multicellaesporites dilcheri Samant, Geophytology 28, p. 14, pl. 1, fig. 12. 2000 (nom. inval.).

Description (Samant 2000 p. 14): Fungal spores oval in shape; tetracellate, about 30-32 x 14-20 μm in size; terminal cell longer than the middle cells, about 10 x 12 μm , middle cells about 12 x 14 μm ; longitudinal slit in the middle region; no constriction of cell wall between the cells; septate, septa about 2 μm thick, porate; cell wall about 1 μm thick, psilate and hyaline.



Fig. 241. *Multicellaesporites dilcheri*. Bar = 5 μ m.

Locality: Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharasalia Clay Formation).

Indian records: Samant 2000, p. 14, pl. 1, fig. 12, Bhavnagar, Cambay Basin (Kharasalia Clay Formation), Gujarat.

Remarks: Samant (2000) described the new species “*Multicellaesporites dilcheri*” but did not validly publish the name, as she did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7). The species was validated by Saxena (2009) by providing holotype location, obtained from personal communication with Dr. Bandana Samant.

Species: *Multicellaesporites elongatus* B. Samant 2000 (nom. inval.)

Mycobank No.: MB 529875.

Remarks: Samant (2000) described the new species “*Multicellaesporites elongatus*” but did not validly publish the name, as she did not cite where the type is stored (McNeill *et al.* 2006: Art. 37.7). The species was validated by Saxena (2009) by providing holotype location, obtained from personal communication with Dr. Bandana Samant. Further, the epithet “*elongatus*” cannot be used because of the existence of *Multicellaesporites elongatus* Sheffy & Dilcher 1971. Saxena (2009) therefore proposed a new name *Multicellaesporites psilatus*. Kalgutkar and Jansonius (2000), however, redefined *Multicellaesporites* and restricted this genus only for spores having a distinct longitudinal furrow. They transferred all the species of this genus, which lack longitudinal furrow, under a new genus *Multicellites*. This species also is therefore transferred to *Multicellites* Kalgutkar & Jansonius 2000 [See: *Multicellites psilatus* (Saxena 2009) comb. nov.].

Species: *Multicellaesporites elsikii* Kar & Saxena 1976

Mycobank No.: MB 112453.

Remarks: Kalgutkar & Jansonius (2000) transferred this species to *Multicellites* Kalgutkar and Jansonius 2000 [See: *Multicellites elsikii* (Kar & Saxena 1976) Kalgutkar & Jansonius 2000]

Species: *Multicellaesporites elsikii* (Ramanujam & Srisailam 1980) Kumar 1990

Mycobank No.: MB 126566.

Staphlosporonites elsikii Ramanujam & Srisailam, Botanique 9(1-4), p. 122, pl. 1, figs. 6-7. 1980.

Remarks: See: *Staphlosporonites elsikii* Ramanujam & Srisailam 1980.

Species: *Multicellaesporites himalayaensis* Gupta 2002

Mycobank No.: MB 540672.

Remarks: This species does not possess a longitudinal furrow, an essential character of *Multicellaesporites* (sensu Kalgutkar & Jansonius 2000) and therefore is being transferred to *Multicellites* Kalgutkar & Jansonius 2000. [See: *Multicellites himalayaensis* (Gupta 2002) comb. nov.].

Species: *Multicellaesporites indicus* Kumar 1990

Mycobank No.: MB 126567.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Axisporonites* Kalgutkar & Jansonius 2000 [See: *Axisporonites indicus* (Kumar 1990) Kalgutkar & Jansonius 2000].

Species: *Multicellaesporites jainii* Gupta 2002

Mycobank No.: MB 540673.

Remarks: This species does not possess a longitudinal furrow, an essential character of *Multicellaesporites* (sensu Kalgutkar & Jansonius 2000) and therefore is being transferred to *Multicellites* Kalgutkar & Jansonius 2000 [See: *Multicellites jainii* (Gupta 2002) comb. nov.].

Species: *Multicellaesporites kariii* Chandra *et al.* 1984

Mycobank No.: MB 106573.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Biporipsilonites* Kalgutkar & Jansonius 2000 [See: *Biporipsilonites kariii* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Species: *Multicellaesporites kumarii* Saxena 2009

Mycobank No.: MB 515008.

Remarks: *Multicellaesporites kumarii* Saxena 2009 is a replacement name of *Multicellaesporites elsikii* (Ramanujam & Srisailam 1980) Kumar 1990, non Kar & Saxena 1976 (= *Staphlosporonites elsikii* Ramanujam & Srisailam 1980). [See: *Staphlosporonites elsikii* Ramanujam & Srisailam 1980].

Species: *Multicellaesporites nortonii* Elsik 1968

Fig. 242

Mycobank No.: MB 317946.

Description (Elsik 1968, p. 269): Fusiform, inaperturate, pentacellate fungal or algal spores, 15 x 39 μ m. Outer surface smooth to slightly punctate or scabrate, which may be a

preservational feature. Inner surface of wall smooth to scabrate. Wall ca. 0.5 μm thick, apparently one layer. The grain has been split longitudinally.



Fig. 242. *Multicellaesporites nortonii*. Bar = 10 μm .

Locality: Strip mine approximately 7 miles southwest of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale Lignite).

Indian records: Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlansam, Mizoram.

Species: *Multicellaesporites prakashii* Ambwani 1983

Mycobank No.: MB 483901.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Reduviasporonites* Kalgutkar & Jansonius 2000 [See: *Reduviasporonites prakashii* (Ambwani 1983) Kalgutkar & Jansonius 2000]

Species: *Multicellaesporites psilatus* Saxena 2009

Mycobank No.: MB 515014.

Multicellaesporites elongatus Samant, Geophytology 28(1-2), p. 14, pl. 1, fig. 14. 2000. (nom. inval.).

Remarks: Since this species lacks a longitudinal furrow, it is being transferred to *Multicellites* Kalgutkar & Jansonius 2000 [See: *Multicellites psilatus* (Saxena 2009) comb. nov.].

Species: *Multicellaesporites ramanujamii* Gupta 2002

Mycobank No.: MB 540674.

Remarks: This species does not possess a longitudinal furrow, an essential character of *Multicellaesporites* (sensu Kalgutkar & Jansonius 2000) and therefore is being transferred to *Multicellites* Kalgutkar & Jansonius 2000. [See: *Multicellites ramanujamii* (Gupta 2002) comb. nov.].

Species: *Multicellaesporites reticulatus* Samant & Tapaswi 2000

Mycobank No.: MB 519788.

Remarks: This species does not possess a longitudinal furrow, an essential character of *Multicellaesporites* (sensu Kalgutkar & Jansonius 2000) and therefore is being transferred to *Multicellites* Kalgutkar & Jansonius 2000. [See: *Multicellites reticulatus* (Samant & Tapaswi 2000) comb. nov.].

Species: *Multicellaesporites tricellatus* Chandra *et al.* 1984

Mycobank No.: MB 107040.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Pluricellaesporites* van der Hammen 1954a [See: *Pluricellaesporites tricellatus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000].

Genus: *Multicellites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28622.

Type Species: *Multicellites tener* (Ke & Shi 1978) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 188): Multicellate, uniseriate, inaperturate fungal spores; number of cells three to many, terminal cells usually rounded; spore wall usually smooth, of medium thickness, usually thinner than the septa (or septal bases); septa generally perforate, or with septal folds.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Multicellites chandrae* sp. nov.

Fig. 243

Mycobank No.: MB 519947.

Multicellaesporites sp. in Chandra *et al.*, Biovigyanam 10(1), p. 47, pl. 2, fig. 16. 1984.

Description: Elliptical fungal spores, size 28-37 x 9-10 μm ; tetracellate, triseptate, inaperturate; spore wall about 1 μm thick, psilate.



Fig. 243. *Multicellites chandrae*. Bar = 10 μm .

Holotype: Chandra *et al.* 1984, pl. 2, fig. 16; slide no. 6299/1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 47, pl. 2, fig. 16, Late Quaternary, Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Species: *Multicellites circularis* (Samant & Tapaswi 2000) **comb. nov.**

Fig. 244

Mycobank No.: MB 519935.

Multicellaesporites circularis Samant & Tapaswi, Gondwana Geological Magazine 15(2), p. 28, fig. 2.11. 2000

Description (Samant & Tapaswi 2000, p. 28): Fungal spores oval in shape; generally dicellate rarely tricellate, 15-17 x 18-21 µm in size, both the cells equal in size, individual cell circular and about 9 µm in diameter, cells slightly overlapping each other and hyaline; spore wall <1 µm thick; smooth.

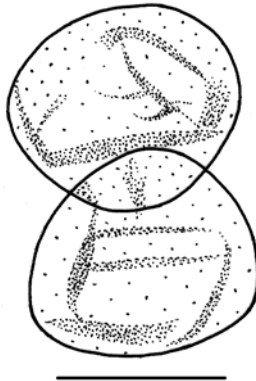


Fig. 244. *Multicellites circularis*. Bar = 10 µm.

Locality: Cambay Basin Gujarat, India.

Age: Early Eocene (Cambay Shale).

Indian records: Samant & Tapaswi 2000, p. 28, fig. 2.11, Cambay Shale (Early Eocene), Surat District, Cambay Basin, Gujarat.

Species: *Multicellites confusus* (Chandra *et al.* 1984) **Kalgutkar & Jansonius 2000**

Fig. 245

Mycobank No.: MB 483453.

Multicellaesporites confusus Chandra *et al.*, Biovigyanam 10(1), p. 47, pl. 2, fig. 14. 1984.

Description (Chandra *et al.* 1984, p. 47): Ribbon-shaped fungal spore, size 88 x 15 µm, multicellate, number of cells nine, all cells more or less equal in shape and size, individual cells squarish-elongate; inaperturate, 8 septa present, septa up to 2 µm thick, sometimes incomplete or broken; spore wall less than 1 µm thick, psilate.

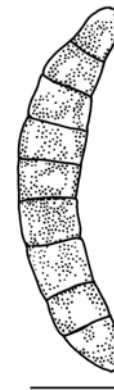


Fig. 245. *Multicellites confusus*. Bar = 20 µm.

Locality: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 47, pl.2, fig. 14, Late Quaternary, Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Multicellites crassisporus* (Salard-Cheboldaeff & Locquin 1980) **Kalgutkar & Jansonius 2000**

Fig. 246

Mycobank No.: MB 483455.

Multicellaesporites crassisporus Salard-Cheboldaeff & Locquin, 105e Congrès National des Sociétés savantes, Caen, Sciences, fascicule 1, p. 189, pl. 3, fig. 4. 1980.

Description (Salard-Cheboldaeff & Locquin 1980, p. 189): Phragmospore inaperturate but with secondary fissures at extremities, septa thickened around the central perforations, spore wall thin, smooth, 3 cells, 40 x 20 µm.



Fig. 246. *Multicellites crassisporus*. Bar = 20 µm.

Locality: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa.

Age: Late Eocene-Oligocene.

Indian records: Singh & Tripathi 2010, p. 12, pl. 1, fig. 17, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Remarks: According to Kalgutkar and Jansonius (2000), the holotype has 4 cells.

Species: *Multicellites elsikii* (Kar & Saxena 1976) Kalgutkar & Jansonius 2000

Fig. 247

MycoBank No.: MB 483460.

Multicellaesporites elsikii Kar & Saxena, Palaeobotanist 23(1), 11, pl. 3, fig. 29. 1976.

Description (Kar & Saxena 1976, p. 11): Spores somewhat elliptical, generally pentacellate but may vary from tetra- to hexacellate, 49-68 x 16-27 μm ; inaperturate, septa clear, individual cells \pm of same size, spore wall up to 1 μm thick, psilate.



Fig. 247. *Multicellites elsikii*. Bar = 15 μm .

Locality: Bhuj-Lakhpur Road, Matanomadh, Kutch District, Gujarat, India.

Age: Palaeocene (Matanomadh Formation).

Indian records: Kar & Saxena 1976, p. 11, pl. 3, fig. 29, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Singh & Chauhan 2008, p. 76, pl. 2, fig. 8, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 198, pl. 1, figs. 3-4, Late Holocene, Demagiri, Mizoram.

Species: *Multicellites himalayaensis* (Gupta 2002) comb. nov.

Fig. 248

MycoBank No.: MB 519900.

Multicellaesporites himalayaensis Gupta, Tertiary Research 21(1-4), p. 136, pl. 2, fig. 16. 2002.

Description (Gupta 2002, p. 136): Spores three to five celled, 2-4 septate, uniseriate, inaperturate elongate, particularly extended at one side with a tube like appendage at other, 31 - 45 μm long, 8-13 μm broad granulate-punctuate, sculpturing distinct at wider part but indistinct at appendage, surface folded, wall < 0.5 μm thick.



Fig. 248. *Multicellites himalayaensis*. Bar = 10 μm .

Locality: Dadahu Road Section, Sirmour District, Himachal Pradesh, India.

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

Indian records: Gupta 2002, p. 136, pl. 2, fig. 16, Subathu and Dagshai formations (Late Palaeocene to Early Oligocene), Dadahu and Jantah Road sections, Sirmour District, Himachal Pradesh.

Species: *Multicellites jainii* (Gupta 2002) comb. nov.

Fig. 249

MycoBank No.: MB 519901.

Multicellaesporites jainii Gupta, Tertiary Research 21(1-4), p. 136, pl. 2, figs. 13, 14. 2002.

Description (Gupta 2002, p. 136): Spores four celled, triseptate, uniseriate, inaperturate, elongate, straight, 19-26 μm broad, subverrucose-granulate, surface folded.



Fig. 249. *Multicellites jainii*. Bar = 5 μm .

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

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

Indian records: Gupta 2002, p. 136, pl. 2, figs. 13, 14, Subathu and Dagshai formations (Late Palaeocene to Early Oligocene, Dadahu and Jantah Road sections, Sirmaur District, Himachal Pradesh).

Species: *Multicellites psilatus* (Saxena 2009) comb. nov.

Fig. 250

MycoBank No.: MB 519903.

Multicellaesporites elongatus Samant, Geophytology 28(1-2), p. 14, pl. 1, fig. 14. 2000. (nom. inval.), non Sheffy & Dilcher 1971.

Multicellaesporites psilatus Saxena, Mycotaxon 110, p. 49. 2009.

Description (Samant 2000, p. 14): Fungal spores rectangular in shape; tricellate; all cells of similar shape and size; about 100-109 μm long; individual cell rectangular in shape, about 23-25 x 14-16 μm in size, marked constriction between the cells; septate, septa about 1-1.5 μm thick; spore wall about 1 μm thick, psilate and hyaline.



Fig. 250. *Multicellites psilatus*. Bar = 5 μm .

Locality: Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharasalia Clay Formation).

Indian records: Samant 2000, p. 14, pl. 1, fig. 14, Kharasalia Clay Formation (Early Eocene), Bhavnagar, Cambay Basin Gujarat.

Species: *Multicellites ramanujamii* (Gupta 2002) comb. nov.

Fig. 251

MycoBank No.: MB 519902.

Multicellaesporites ramanujamii Gupta, Tertiary Research 21(1-4), p. 136, pl. 2, fig. 15. 2002.

Description (Gupta 2002, p. 136): Spores four celled, triseptate, uniseriate, inaperturate, variously curved, elongate, 17-35 μm long, 8-12.5 μm broad, psilate-granulate, surface folded, wall 0.5 μm thick.

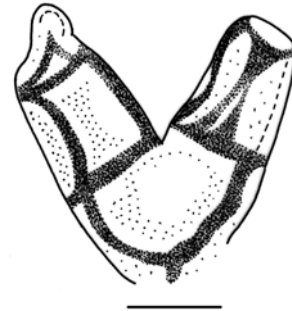


Fig. 251. *Multicellites ramanujamii*. Bar = 10 μm .

Locality: Jamath Road Section, Sirmaur District, Himachal Pradesh, India.

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

Indian records: Gupta 2002, p. 136, pl. 2, figs. 15, Subathu Formation (Late Palaeocene to Late Eocene), Dadahu and Jantah Road sections, Sirmaur District, Himachal Pradesh.

Species: *Multicellites reticulatus* (Samant & Tapaswi 2000) comb. nov.

Fig. 252

MycoBank No.: MB 519936.

Multicellaesporites Samant & Tapaswi, Gondwana Geological Magazine 15(2), p. 28, fig. 2.10. 2000.

Description (Samant & Tapaswi 2000, p. 28): Fungal spores conical in shape; dicellate; 30-32 x 20-21 μm in size, cells overlapping each other, first cell conical and about 10-12 μm in size, second cell circular and about 21 μm in diameter; septate, septa thick, thicker than spore wall, contact between septa and spore wall curved; spore wall about 1.5 μm thick; reticulate.

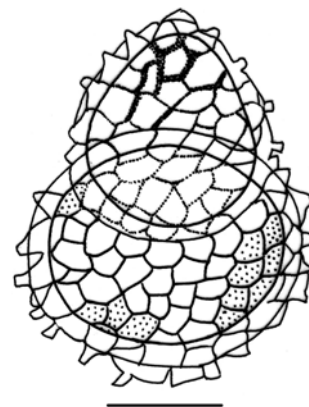


Fig. 252. *Multicellites reticulatus*. Bar = 5 μm .

Locality: Surat District, Gujarat, India.

Age: Early Eocene

Indian records: Samant & Tapaswi 2000, p. 28, fig. 2.10, Early Eocene, Surat District, Gujarat.

Genus: *Mundkurella* Thirumalachar 1944

Mycobank No.: MB 16223.

Type Species: *Mundkurella heptapleuri* Thirumalachar 1944.

Classification: Basidiomycetes, Ustilaginales.

Species: *Mundkurella mohgaoensis* Chitale & Yawale 1978

Fig. 253

Mycobank No.: MB 110825.

Description (Chitale & Yawale 1978, p. 193): Sori heterosporous, 17 x 44 µm in diameter, containing unicellular and bicellular spores, singly or in groups. Unicellular spores deep brown to pale yellow in colour, 8 x 13 µm in diameter. Bicelled spores deep brown with rich granular contents, 11 x 16 µm. Epispore 1 x 2.5 µm thick and smooth.

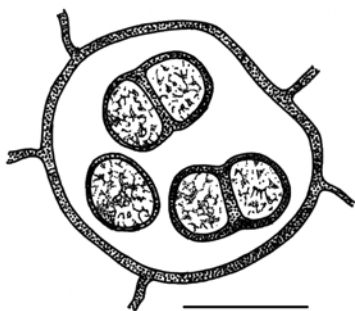


Fig. 253. *Mundkurella mohgaoensis*. Bar = 25 µm.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian.

Indian records: Chitale & Yawale 1978, p. 193, pl. 1, figs. 5-6, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Mycozygosporangia* Kar *et al.* 2010

Mycobank No.: MB 541699.

Type species: *Mycozygosporangia laevigata* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 245): Zygosporangia light-dark brown, 22-48 x 20-46 µm, subcircular-circular in shape, often attached with two opposite hyphae, sporangia wall 2-4 µm thick, laevigate.

Classification: Fungi, Incertae sedis.

Species: *Mycozygosporangia laevigata* Kar *et al.* 2010

Fig. 254

Mycobank No.: MB 542299.

Description (Kar *et al.* 2010, p. 246): Zygosporangium subcircular in shape, 23-48 x 21-46 µm, two hyphae often attached opposite to each other, look like ordinary mycelia, tubular. Spore wall 2-4 µm thick, psilate, often weakly intrastuctured.



Fig. 254. *Mycozygosporangia laevigata*. Bar = 15 µm.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 1, fig. 5, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.

N

Genus: *Netothyrites* Misra *et al.* 1996

Mycobank No.: MB 519790.

Type Species: *Netothyrites vertistriatus* Misra *et al.* 1996.

Description (Misra *et al.* 1996, p. 17-18): Microfossil fungal fruit bodies, pitcher shape with distinct collar, hollow neck and main body with closed reticulated bottom, fly catcher's net like in gross appearance. Proximal opening (? ostiole) distinct, bordered with dark, multicellular cells, form a distinct collar (rim) around subcircular to oval proximal opening. Main body hangs down from the collar, with a distinct neck in between. The side walls of the neck and main body bear number of longitudinal ribs which run down parallel or anastomose to form reticulum. Bottoms of main body densely reticulated and closed.

Classification: Fungi, Incertae sedis.

Species: *Netothyrites paleocenicus* Misra *et al.* 1996

Fig. 255

Mycobank No.: MB 519792.

Description (Misra *et al.* 1996, p. 19): Fruit bodies flask shaped, longitudinally oval, measuring 40-61 µm in longitudinal axis, 22-54 µm in transverse axis; proximal opening (?ostiole) big, subcircular to oval measuring 22-51 µm at transverse axis, bordered with uniserial multicellular peripheral rim (collar), cells of peripheral rim rectangular, with thickened surface, neck in between the proximal opening and main body distinct, broad, maintain almost same diameter as main body.

The side walls of main body bear a number of ribs/striations which emerge out from in between the peripheral cells and run down; striation often dichotomise and anastomose to form reticulate net along side walls as well as at the bottom of main body size of the meshes up to $2.4\ \mu\text{m} \times 3.6\ \mu\text{m}$; reticulation at the bottom very closely placed with thickened and narrow meshes.

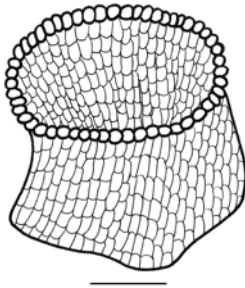


Fig. 255. *Notothyrites palaeocenicus*. Bar = 20 μm .

Locality: Razole well no. A, 3360-3365 m, Krishna-Godavari Basin, Andhra Pradesh, India.

Age: Palaeocene.

Indian records: Misra *et al.* 1996, p. 19, pl. 1, figs. 14-15, text-fig. 1B, Palaeocene, Boreholes EM-A, SM-79-A, B-66-A, B-163-A in Bombay Offshore, Boreholes Palakollu-Am, Modi-A, Razole-A, Elamanchalli-A, Peddapelam-A in Krishna-Godavari Basin and Boreholes An-42-A in Andaman Basin.

Species: *Notothyrites vertistriatus* Misra *et al.* 1996

Fig. 256

Mycobank No.: MB 519791.

Description (Misra *et al.* 1996, p. 18-19): Fungal fruit bodies fly catcher's net shaped, longitudinally oval to elongate, measure 36-64 μm at longitudinal axis, 24-62 μm at transverse axis. Proximal opening (?ostiole) distinct, big, transversely subcircular to oval, approx. 28-65 μm at transverse diameter, opening bordered by a distinct, relatively dark, uni- or biserial multicellular peripheral rim. Cells of peripheral rim hard, rectangular, 2-3 \times 3-6 μm in size: neck in between the main body and proximal opening narrow. Main body hang down from the peripheral rim, side walls bear number of unbranched, parallel running longitudinal ribs; ribs emerge out from the junctions of peripheral cells. Longitudinal ribs 2.5-4 μm away from each other, joined by thin membranous film. The bottom of main body wall closely reticulated with thick mesh.

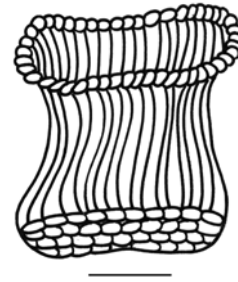


Fig. 256. *Notothyrites vertistriatus*. Bar = 20 μm .

Locality: An-42-A well 1500-1505 m, Andaman Basin, India.

Age: Palaeocene.

Indian records: Misra *et al.* 1996, p. 18-19, pl. 1, figs. 1-13, text-fig. 1A, Palaeocene, Boreholes EM-A, SM-79-A, B-66-A, B-163-A in Bombay Offshore, Boreholes Palakollu-Am, Modi-A, Razole-A, Elamanchalli-A, Peddapelam-A in Krishna-Godavari Basin and Boreholes An-42-A in Andaman Basin.

Genus: *Notothyrites* Cookson 1947

Mycobank No.: MB 21193.

Type Species: *Notothyrites setifer* Cookson 1947.

Description (Cookson 1947, 208): Ascomata without free mycelium, superficial, rounded, radiate, ostiolate. Ostiole prominent, bordered by three to five layers of dark brown, thick walled cells. Ascospores unknown.

Classification: Ascomycetes, Microthyriales.

Remarks: Specimens assigned to *Notothyrites* correspond to *Trichothyrites* Rosendahl 1943 in all respects, including the occasional presence of setae around the ostiole (Elsik 1978). This genus is, therefore, treated a junior synonym of *Trichothyrites* Rosendahl 1943.

Species: *Notothyrites amorphus* Kar & Saxena 1976

Mycobank No.: MB 112479.

Remarks: Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, Saxena & Misra (1990) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites amorphus* (Kar & Saxena 1976) Saxena & Misra 1990].

Species: *Notothyrites denticulatus* Ramanujam & Rao 1973

Mycobank No.: MB 318738.

Remarks: Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, Kalgutkar and Jansonius (2000) transferred this species to *Trichothyrites*

Rosendahl 1943 [See: *Trichothyrites denticulatus* (Ramanujam & Rao 1973) Kalgutkar & Jansonius 2000].

Species: *Notothyrites echinatus* Rao & Ramanujam 1976

Mycobank No.: MB 318739.

Remarks: Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, Kalgutkar and Jansonius (2000) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites echinatus* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000].

Species: *Notothyrites kiandrensis* Selkirk 1975

Mycobank No.: MB 318740.

Remarks: Kalgutkar and Jansonius (2000, p. 197-198) mentioned the status of this species as "Now: *Asterothyrites kiandrensis* (Selkirk) comb. nov.". However, on p. 303 they formally published it as a new combination under *Trichothyrites* Rosendahl 1943. Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, we accept transfer of this species to *Trichothyrites*. "*Asterothyrites kiandrensis* (Selkirk) comb. nov." (Kalgutkar & Jansonius 2000, p. 197-198) is therefore considered here as an inadvertent error and must be ignored.

Species: *Notothyrites neyvelii* Ramanujam 1963b (nom. inval.)

Remarks: Ramanujam (1963b) published the name *Notothyrites neyvelii* in Abstract of a paper, but the name "*N. neyvelii*" was never validly published.

Species: *Notothyrites padappakkarensis* Jain & Gupta 1970

Mycobank No.: MB 318741.

Remarks: Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, Kalgutkar and Jansonius (2000) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites padappakkarensis* (Jain & Gupta 1970) Kalgutkar & Jansonius 2000].

Species: *Notothyrites setifer* Cookson 1947

Mycobank No.: MB 335220.

Remarks: Since *Notothyrites* Cookson 1947 is a junior synonym of *Trichothyrites* Rosendahl 1943, Saxena & Misra (1990, p. 270) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites setifer* (Cookson 1947) Saxena & Misra 1990].

O

Genus: *Ornasporonites* Ramanujam & Rao 1978

Mycobank No.: MB 21200.

Type Species: *Ornasporonites inaequalis* Ramanujam & Rao 1978.

Description (Ramanujam & Rao 1978, p. 298): Spores brownish yellow to pale yellow, 4-celled, fusiform, diporate, cells unequal in size, basal and apical cells much smaller than two central cells; transverse septa three, central septum straight, other two septa curved. One simple pore at each end of spore along its long axis. Spore wall rugulate-reticuloid.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Ornasporonites inaequalis* Ramanujam & Rao 1978

Fig. 257

Mycobank No.: MB 115078.

Description (Ramanujam & Rao 1978, p. 298): Spores fusiform to barrel shaped, tetracellate, 45-63 x 35-42 μm , cells unequal, basal and apical cells much smaller, less than half the size of central cells, one simple pore in basal and apical cells. Spore wall less than 1 μm thick, surface rugulate-reticuloid, muri flat, meshes irregular, often incomplete, lumina irregular, smooth.



Fig. 257. *Ornasporonites inaequalis*. Bar = 10 μm .

Locality: Alleppey, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 298, pl. 2, figs. 31-32, Quilon and Warkalli beds (Miocene), Alleppey District, Kerala; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

P

Genus: *Palaeoamphisphaerella* Ramanujam & Srisailam 1980

Mycobank No.: MB 21204.

Type Species: *Palaeoamphisphaerella pirozynskii* Ramanujam & Srisailam 1980.

Imprimospora Norris 1986

Description (Ramanujam & Srisailam 1980, p. 128): Spores brownish to dark brown, aseptate, elliptical, oblong or somewhat rhomboidal, with more or less rounded ends; with

equatorial pores, placed equidistantly; surface psilate to scabrate.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Kalgutkar and Jansonius (2000) opined that *Imprimospora* Norris 1986 morphologically resembles *Palaeoamphisphaerella*, as described by Ramanujam and Srisailam (1980), hence it is considered a junior synonym of *Palaeoamphisphaerella*.

Species: *Palaeoamphisphaerella keralensis* Ramanujam & Srisailam 1980

Fig. 258

Mycobank No.: MB 109135.

Description (Ramanujam & Srisailam 1980, p. 129): Spores dark brown, aseptate, elliptical to somewhat rhomboidal, 25.5-30.6 x 8.5-15.3 μm , multiporate, 3-6 equatorial pores, not always equidistant, often showing zig-zag alignment, rounded to slightly ovoid or even transversely elongated, 3 μm in diameter, pore margin prominently thickened (2.2 μm), spore wall 1.7 μm thick, surface scabrate, locally coarsely so.

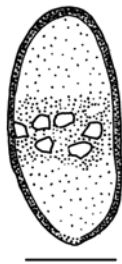


Fig. 258. *Palaeoamphisphaerella keralensis*. Bar = 10 μm .

Locality: Kannur, Palayangadi and Cheruvattur, Kerala, India.

Age: Miocene.

Indian records: Ramanujam & Srisailam 1980, p. 129-130, pl. 2, figs. 26-27, Warkalli Beds (Miocene), Kannur District, Kerala; Mallesham *et al.* 1989, p. 15, pl. 1, fig. 9, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Rao *et al.* 1995, p. 374, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala.

Species: *Palaeoamphisphaerella pirozynskii* Ramanujam & Srisailam 1980

Fig. 259

Mycobank No.: MB 109136.

Description (Ramanujam & Srisailam 1980, p. 128): Spores brownish to dark brown, aseptate, oblong with more or less rounded ends, 28.9-34 x 10.2-15.3 μm , multiporate, pores 8-10,

equatorial, equidistant, 4 or 5 seen on the exposed surface, oval, 3.4-5.1 μm in diameter, pore margin prominently thickened (2.2 μm), spore wall 1.7 μm thick, surface psilate.



Fig. 259. *Palaeoamphisphaerella pirozynskii*. Bar = 10 μm .

Locality: Kannur, Palayangadi and Cheruvattur, Kerala, India.

Age: Miocene.

Indian records: Ramanujam & Srisailam 1980, p. 129, pl. 2, figs. 24-25, Warkalli Beds (Miocene), Kannur District, Kerala; Mallesham *et al.* 1989, p. 15, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Genus: *Palaeocercospora* Mitra & Banerjee 2000

Mycobank No.: MB 28426.

Type Species: *Palaeocercospora siwalikensis* Mitra & Banerjee 2000.

Description (Mitra & Banerjee 2000, p. 8): Stroma compact, with groups of well developed hyphal cells, conidiophores occur singly or in fascicles of 2-7, elongated, divergent, septate, conidial scar present at the point of geniculation.

Classification: Dematiaceous Hyphomycetes.

Species: *Palaeocercospora siwalikensis* Mitra & Banerjee 2000

Fig. 260

Mycobank No.: MB 464780.

Description (Mitra & Banerjee 2000, p. 8): (Diagnosis): Stroma distinct, circular with undulated outline; fascicles of conidiophores ranging 7-20 in number emerge from peripheral zone of stroma. Conidiophores simple, thick walled, smooth, pluriseptate with conidial scar on each cell. (Description): The hyphomycetous epiphyllous fungi showing distinct, well developed stroma; stroma circular, 16.8 to 37.8 μm in diameter, consists of deep brown compactly arranged hyphal cells; conidiophores fasciculate, in fascicles of 7-20 divergent stalks emerging from the stroma. Light brown to dark brown in colour, straight to flexuous, simple, slightly thick walled, smooth,

pluriseptate (5-7 septa), spore scar present and conspicuous, lying at the point of geniculations of the conidiophore, conidiophores long (42-92.4 μm) and slender (width 4.2-6.3 μm), tip somewhat pointed. Conidia absent.

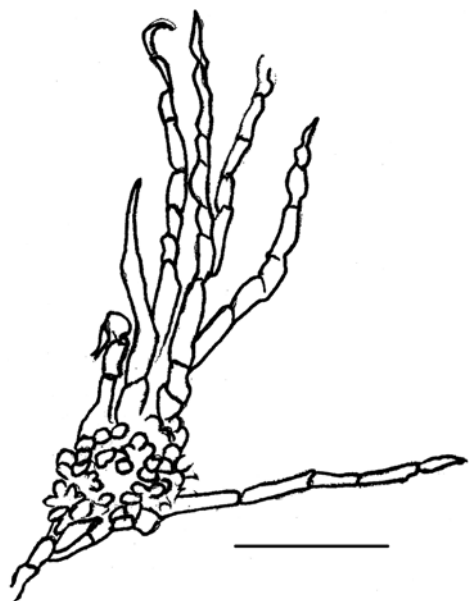


Fig. 260. *Palaeocercospora siwalikensis*. Bar = 20 μm .

Locality: National Highway 31 Road Section, Darjeeling Foothills, Eastern Himalaya.

Age: Middle Miocene (Geabdat Sandstone Formation).

Indian records: Mitra & Banerjee 2000, p. 8, figs. 1-5, text-fig. 2, Geabdat Sandstone Formation (Middle Miocene), N.H. 31 Road Section, Darjeeling Foothills, Eastern Himalaya.

Genus: *Palaeocirrenalia* Ramanujam & Srisailam 1980

Mycobank No.: MB 21205.

Type species - *Palaeocirrenalia elegans* Ramanujam & Srisailam 1980.

Description (Ramanujam & Srisailam 1980, p. 124): Spores light brown to reddish brown, inaperturate, helicoid, 1 to 1¼ times loosely coiled, multicellular, 2 to 6 septate, septa transverse, prominent, as thick and dark bands, cells of unequal size, terminal cell dome-shaped and broader, basal cell usually cuneate, pale-coloured, surface psilate.

Classification: Fungi Imperfecti, Helicosporae.

Species: *Palaeocirrenalia elegans* Ramanujam & Srisailam 1980

Fig. 261

Mycobank No.: MB 109520.

Description (Ramanujam & Srisailam 1980, p. 125): Spores light brown to reddish brown, inaperturate, helicoid, 1 to 1¼ times loosely coiled, 4 to 6 septate, maximum width 34-49.3 μm , basal cell cuneate to elongated-cuneate, 10 x 8.5 μm , pale-coloured to almost hyaline, terminal cell dome-shaped, 15.3 x 17 μm in diameter, septa prominent to form thick dark bands up to 5 μm thick, spore wall up to 1.7 μm thick, surface psilate.

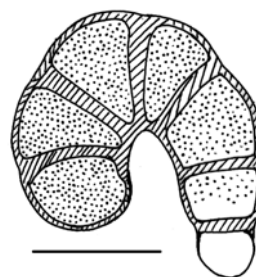


Fig. 261. *Palaeocirrenalia elegans*. Bar = 20 μm .

Locality: Kannur, Palayangadi and Cheruvattur, Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 125, pl. 1, figs. 13-14, pl. 2, fig. 15, Warkalli Beds (Miocene), Kannur District, Kerala; Phadtare & Kulkarni 1984, p. 517, pl. 1, fig. 5, Ratnagiri Beds (Miocene), well at Golap on Ratnagiri-Pawas Road, Ratnagiri District, Maharashtra; Mallesham *et al.* 1989, p. 15, pl. 1, figs. 10-12, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Rao *et al.* 1995, p. 374, fig. 4, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala; Rao 1995, p. 233, Tertiary, Alleppey & Kannur districts, Kerala; Samant & Phadtare 1997, p. 68, pl. 15, fig. 13, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Samant 2000, p. 16, pl. 1, fig. 27, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Samant & Tapaswi 2000, p. 29, Cambay Shale Early (Eocene), Cambay Basin, Gujarat.

Species: *Palaeocirrenalia oligoseptata* Ramanujam & Srisailam 1980

Fig. 262

Mycobank No.: MB 109521.

Description (Ramanujam & Srisailam 1980, p. 125): Spores light brown to light yellowish, inaperturate, helicoid or only partially curved, 2 or 3 septate, maximum width 23.8 x 68 μm , basal cell smaller than, or of same size as terminal cell, elongated-cuneate, pale-coloured, central cells larger than others, 34 x 23.8 μm , septa as prominent dark bands, up to 6.1 μm thick; spore wall 1.7 μm thick, surface psilate.

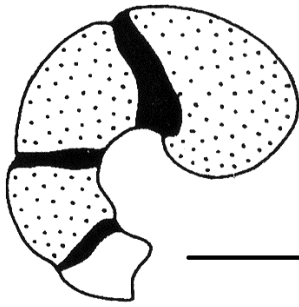


Fig. 262. *Palaeocirrenalia oligoseptata*. Bar = 20 μ m.

Locality: Kannur, Palayangadi and Cheruvattur, Kannur District, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 125, pl. 2, fig. 16, Warkalli Beds (Miocene), Kannur District, Kerala.

Genus: *Palaeocolletotrichum* Mitra & Banerjee 2000

Mycobank No.: MB 28427.

Type Species: *Palaeocolletotrichum graminoides* Mitra & Banerjee 2000.

Description (Mitra & Banerjee 2000, p. 10): Subdermal acervuli indistinct, long, narrow, stiff, pointed setae emerging from the acervular surface.

Classification: Coelomycetes, Melanconiaceae.

Species: *Palaeocolletotrichum graminoides* Mitra & Banerjee 2000

Fig. 263

Mycobank No.: MB 464781.

Description (Mitra & Banerjee 2000, p. 10): (Diagnosis): Setae isolated or in cluster of 3-6, long, base bulbous, pointed at the tip, septate, smooth. (Description): The coelomycetous epiphyllous fungi remains occurring on cuticular layers show numerous setae scattered singly or in groups of 3-6 both on veins and interveinal regions. Faint outline of hyphal mass of acervular structure observed in the subepidermal position. Individual setae 84-126 μ m long, stiff, pointed, moderately thick (4 μ m - 5.5 μ m), dark brown in colour, projected out from the leaf surfaces. The projected setae with a bulbous base of 7-8.4 μ m in diameter, septate, number of septa varies from 5-8.

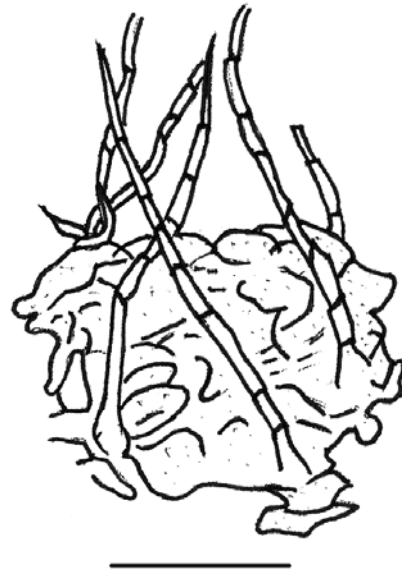


Fig. 263. *Palaeocolletotrichum graminoides*. Bar = 25 μ m.

Locality: National Highway 31 Road Section, Darjeeling Foothills, Eastern Himalaya.

Age: Middle Miocene (Geabdat Sandstone Formation).

Indian records: Mitra & Banerjee 2000, p. 8, figs. 6-9, text-fig. 3, Geabdat Sandstone Formation (Middle Miocene), N.H. 31 Road Section, Darjeeling Foothills, Eastern Himalaya.

Genus: *Palaeocytophaera* Singh & Patil 1980

Mycobank No.: MB 21206.

Type Species: *Palaeocytophaera intertrappeana* Singh & Patil 1980.

Description (Singh & Patil 1980, p. 17): Pycnidia in row, ostiolate, immersed, pseudoparenchymatous, black, spherical to oval; conidia single or in chains, oval to spherical, thin-walled.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Palaeocytophaera intertrappeana* Singh & Patil 1980

Fig. 264

Mycobank No.: MB 109137.

Description (Singh & Patil 1980, p. 17): Pycnidia 5-7 in row, black, ostiolate, spherical-oval, immersed, 110-165 x 70-90 μ m in size; wall pseudoparenchymatous, 3-4 cells thick; conidiophores unbranched, 4 μ m long; conidia oval-spherical, 2-3 μ m in size, one-celled, single or in chains of 2-3; mycelium branched, septate, intercellular. Host: dicotyledonous wood.

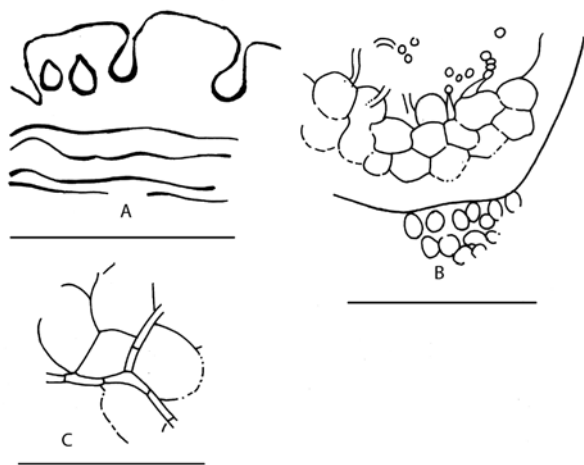


Fig. 264. *Palaeocytophaera intertrappeana*. A. Host and mycelium. Bar = 800 μm , B. Part of wall of pycnidium with conidiophores and spores. Bar = 50 μm , C. Intercellular septate mycelium. Bar = 50 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous (Deccan Intertrappean beds).

Indian records: Singh & Patil 1980, p. 17, pl. 1, figs. 1-2, text-figs. 1-4, Deccan Intertrappean beds (Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Palaeogigaspora* Kar *et al.* 2010

Mycobank No.: MB 541709.

Type species: *Palaeogigaspora excellensa* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 245): Chlamydospores solitary, grow at tip of hyphae, oval, 30-51 x 28-47 μm , dark brown, wall about 2 μm thick, laevigate. Hyphae tubular, nonseptate, hyaline.

Classification: Zygomycetes, Endogonales.

Remarks: Kar *et al.* (2010) proposed the new genus *Palaeogigaspora*, which is identical to *Palaeomycites* Meschinelli 1902 emend. Kalgutkar & Jansonius 2000 and therefore considered here its junior synonym.

Species: *Palaeogigaspora excellensa* Kar *et al.* 2010

Mycobank No.: MB 542305.

Remarks: Since *Palaeogigaspora* is considered here a junior synonym of *Palaeomycites* Meschinelli 1902 emend. Kalgutkar & Jansonius 2000, *Palaeogigaspora excellensa* Kar *et al.* 2010 is being transferred to *Palaeomycites* Meschinelli 1902 emend. Kalgutkar & Jansonius 2000 [See: *Palaeomycites excellensa* (Kar *et al.* 2010) comb. nov.]

Genus: *Palaeoleptosphaeria* Barlinge & Paradkar 1982

Mycobank No.: MB 21207.

Type Species: *Palaeoleptosphaeria intertrappeana* Barlinge & Paradkar 1982.

Description (Barlinge & Paradkar 1982, p. 166): Fungus saprophytic; mycelium branched, septate; asci in pycnidia forming acervulus; ascospores cylindrical, thick-walled, elongate, slightly curved with end cells pale and central 1 or 2 cells enlarged.

Classification: Ascomycetes, Dothideales.

Species: *Palaeoleptosphaeria intertrappeana* Barlinge & Paradkar 1982

Fig. 265

Mycobank No.: MB 109522.

Description (Barlinge & Paradkar 1982, p. 166): Asci 110-114 x 22 μm ; ascospores 8, cylindrical, thick-walled, brown, elongated, slightly curved and 25-35 x 9.5-11.5 μm , end cells pale, central 1 or 2 cells enlarged. Host, decaying plant remains of *Salvinia intertrappea*.



Fig. 265. *Palaeoleptosphaeria intertrappeana*.
Bar = 25 μm .

Locality: Mohgaon Kalan, Chhindwara, Madhya Pradesh, India.

Age: Late Cretaceous

Indian records: Barlinge & Paradkar 1982, p. 166, pl. 1, fig. I, Late Cretaceous, Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Palaeomycites* Meschinelli 1902 emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21210.

Type Species: None designated.

Phycomycites Ellis 1915.

Palaeomyces Renault ex Kidston & Lang 1921.

Rhizophagites Rosendahl 1943.

Propyrium Elias 1966.

Aplanosporites Kar 1979.

Archaeoglomus Sharma *et al.* 2005 (nom. inval.).

Chlamydospora Kar *et al.* 2010.

Palaeogigaspora Kar *et al.* 2010.

Description (Meschinelli 1902, p. 9): Mycelium branched, interwoven, dichotomous, cylindrical or flat (like small tapeworms), 3–4 μm in diameter, often verrucose, with indistinct septa.

Emended Description (Kalgutkar & Jansonius 2000, p. 207): Mycelium of branched, more or less interwoven hyphae, generally lacking septa; hyphae commonly terminating in large round to ovoid sporangia, that rarely show any contained spores; sporangia singly, or grouped into clusters; sporangia closed by a septum, or in open connection with the hypha; sporangia may be developed as a swelling in a hypha.

Classification: Zygomycetes, Endogonales.

Species: *Palaeomycites acinus* (Srivastava 1968) Kalgutkar & Jansonius 2000

Fig. 266

Mycobank No.: MB 483486.

Rhizophagites acinus Srivastava, Canadian Journal of Botany 46, p. 1117, pl. 1, figs. 9–10. 1968.

Description (Srivastava 1968, p. 1117): Mycelia subdichotomously branched, many unilateral projections, tortuous, aseptate, uniform in thickness except at the base of vesicles and at the branching areas, diameter 4–8 μm ; mycelia wall smooth, hyaline, single-layered, thickness irregular, thicker at the base of vesicles and at branching areas, thickness varies from 0.8 to 4 μm . Vesicles spherical to subspherical, sometimes pyriform; usually darker than mycelia; mycelia at the base of vesicles form its stalk, stalk diameter uniform, stalk wall thickens at the base of vesicles; vesicle wall about 3.5–4 μm thick, double-layered; outer layer smooth, continuous with the stalk wall, denser than stalk wall and mycelium, about 1.5–2 μm thick, inner layer 1.5–2 μm thick, baculate, continuous all around inside the vesicle, forms a plug-like structure at the contact of vesicle with the stalk; surface ornamentation infrareticulate, reticulum size less than 1 μm . Size range: Vesicle size 50–80 μm .

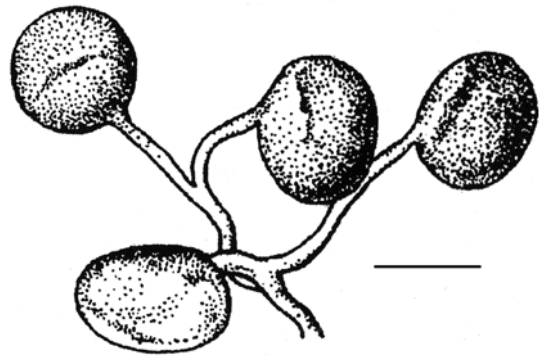


Fig. 266. *Palaeomycites acinus*. Bar = 30 μm .

Locality: Cypress Hills, Alberta, Canada.

Age: Maastrichtian.

Indian records: Saxena & Ranhotra 2009, p. 692, fig. 3.20, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Palaeomycites bharwainensis* (Singh & Saxena 1981) Kalgutkar & Jansonius 2000

Fig. 267

Mycobank No.: MB 483250.

Aplanosporites bharwainensis Singh & Saxena, Geophytology 11(2), p. 175, pl. 1, fig. 17. 1981.

Description (Singh & Saxena 1981, p. 175): Subcircular-oval, 55–66 x 48–52 μm (excluding appendage). Germinal mark absent. Exine up to 0.5 μm thick, laevigate. A long, about 1.5 μm thick, hair-like appendage present, being occasionally branched.



Fig. 267. *Palaeomycites bharwainensis*. Bar = 20 μm .

Locality: Gagret-Bharwain Road Section, Una District, Himachal Pradesh, India.

Age: Miocene-Pliocene.

Indian records: Singh & Saxena 1981, p. 175, pl. 1, figs. 17-18, Upper Siwalik (Plio-Pleistocene), Gagret - Bharwain Road Section, Una District, Himachal Pradesh; Saxena & Singh 1982a, p. 292, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh.

Species: *Palaeomyces butleri* (Rosendahl 1943) Kalgutkar & Jansonius 2000

Fig. 268

Mycobank No.: MB 483489.

Rhizophagites butleri Rosendahl, Bulletin of Torrey Botanical Club 70, p. 131, fig. 2. 1943.

Description (Rosendahl 1943, p. 131): Hyphae moderately tortuous, with numerous unilateral projections and occasional diverticula, pale yellow, 9-11 μm in diameter and uniform in thickness except where the branching occurs, stalks of the vesicles about the same diameter as the rest of the hyphae, vesicles chestnut-brown, oval to subspherical, varying in size from 75 x 79 to 103-124 μm , average size 89 x 98 μm , walls at the base of mature vesicles and walls of the neck of the stalks much thickened.

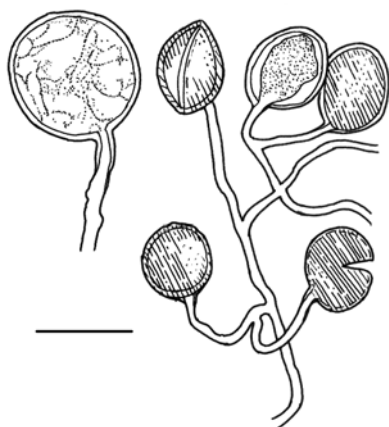


Fig. 268. *Palaeomyces butleri*. Bar = 50 μm .

Locality: Bronson, south-eastern Kittson County, Minnesota, U.S.A.

Age: Late Pleistocene.

Indian records: Saxena & Ranhotra 2009, p. 691, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Palaeomyces dichotomus* (Kar *et al.* 2010) **comb. nov.**

Fig. 269

Mycobank No.: MB 519904.

Chlamydospora dichotoma Kar *et al.*, Review of Palaeobotany and Palynology 158, p. 245, pl. 1, fig. 9. 2010.

Description (Kar *et al.* 2010, p. 245): Chlamydospores oval, 16-28 x 12-24 μm , found in pairs due to dichotomous division of hyphae, spores in terminal position, equal in size and shape, spore wall robustly built, about 2 μm thick, thicker at basal end, psilate, sometimes intrastructured.

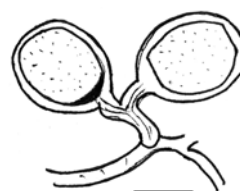


Fig. 269. *Palaeomyces dichotomus*. Bar = 10 μm .

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 245, pl. 1, fig. 9, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Palaeomyces excellens* (Kar *et al.* 2010) **comb. nov.**

Fig. 270

Mycobank No.: MB 519905.

Palaeogigaspora excellens Kar *et al.*, Review of Palaeobotany and Palynology 158, p. 245, pl. 1, fig. 4. 2010.

Description (Kar *et al.* 2010, p. 245): Chlamydospores generally oval with equally broad lateral ends, sometimes subcircular, 31-45 x 28-42 μm ; spore wall up to 2 μm thick, laevigate; mycelia nonseptate, hyaline, laterally branched.



Fig. 270. *Palaeomyces excellens*. Bar = 10 μm .

Type locality: Tlangsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 245, pl. 1, fig. 4, Bhuban Formation (Miocene), Tlangsam, Mizoram, India.

Species: *Palaeomycites globatus* (Sharma *et al.* 2005) **comb. nov.**

Fig. 271

Mycobank No.: MB 519906.

Archaeoglomus globatus Sharma *et al.*, Micropaleontology 51(1), p. 76, pl. 2, fig. 5. 2005.

Description (Sharma *et al.* 2005, p. 76): Chlamydospores light to dark brown, develop at terminal end of hyphae, generally subcircular, sometimes irregularly folded; hyphae translucent, dichotomously branched, often jumbled together.

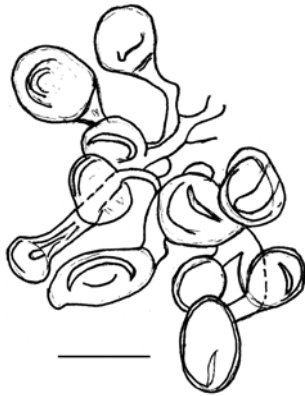


Fig. 271. *Palaeomycites globatus*. Bar = 20 μ m.

Lectotype (here designated): Kar *et al.* 2010, pl. 1, fig. 2, slide no. BSIP 13349 (Q42), Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Tlangsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Sharma *et al.* 2005, p. 76, pl. 2, fig. 5, Lameta Formation (Maastrichtian), Pisdura, Maharashtra; Kar *et al.* 2010, p. 245, pl. 1, fig. 2, Bhuban Formation (Miocene), Tlangsam, Mizoram.

Species: *Palaeomycites horneae* (Kidston & Lang 1921) **Kalgutkar & Jansonius 2000**

Fig. 272

Mycobank No.: MB 483495.

Palaeomycites horneae Kidston & Lang, Trans. Royal Soc. Edinburgh 52, p. 869, pl. 3, figs. 29-35. 1921.

Description (Kidston & Lang 1921, p. 869): Aseptate, branched hyphae often with brown walls, attaining a diameter of 10-15 μ m; present in the intercellular spaces of the tissues and also in the adjoining matrix, from which entering hyphae may be traced. Spherical or oval resting-spores; about 100 μ m in diameter; with, at maturity, moderately thick, brown walls not differentiated into layers. Occurs in relation to the surface, and in between the cells, of some rhizomes and the basal regions of stems of *Hornea lignieri*.

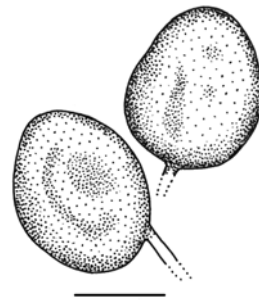


Fig. 272. *Palaeomycites horneae*. Bar = 50 μ m.

Locality: Muir of Rhynie, Aberdeenshire, Scotland.

Age: Early Devonian.

Indian records: Saxena & Ranhotra 2009, p. 692, fig. 3.25, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Palaeomycites minnesotensis* (Rosendahl 1943) **Kalgutkar & Jansonius 2000**

Fig. 273

Mycobank No.: MB 483496.

Rhizophagites minnesotensis Rosendahl, Bulletin of Torrey Botanical Club 70, p. 131, fig. 5. 1943.

Description (Rosendahl 1943, p. 131): Hyphae very tortuous and with few unilateral projections, yellowish brown, uneven in thickness, varying from 6.2 to 20.7 μ m in diameter, stalks of the vesicles thin and mostly elongated, vesicles dark brown, short pyriform to nearly spherical, varying in size from 42 x 46 to 68 x 61 μ m, average size 48 x 53 μ m, walls of mature vesicles not perceptibly thicker at the base.

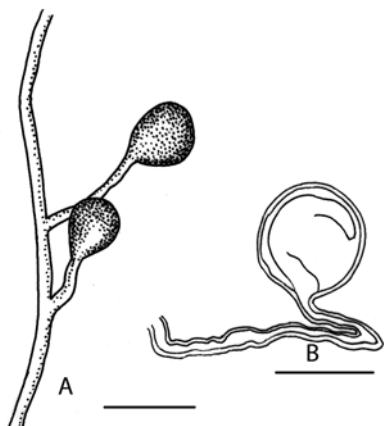


Fig. 273. *Palaeomycites minnesotensis*. A. Holotype. Bar = 100 μ m, B. Detail of wall structure. Bar = 50 μ m.

Locality: Springfield, Minnesota, U.S.A.

Age: Early Pleistocene.

Indian records: Saxena & Ranhotra 2009, p. 692, fig. 3.17, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Palaeomycites minutus* (Kar *et al.* 2010) *comb. nov.*

Fig. 274

Mycobank No.: MB 519907.

Archaeoglomus minutus Kar *et al.*, Review of Palaeobotany and Palynology 158, p. 245, pl. 1, fig. 3. 2010.

Description (Kar *et al.* 2010, p. 245): Auxiliary cells develop at terminal ends of hyphae, hyphae laterally branched, bear one cell at each end, 10-12 x 8-20 μ m, wall about 1 μ m thick, psilate.



Fig. 274. *Palaeomycites minutus*. Bar = 10 μ m.

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 245, pl. 1, fig. 3, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Palaeomycites robustus* (Kar 1979) Kalgutkar & Jansonius 2000

Fig. 275

Mycobank No.: MB 483251.

Aplanosporites robustus Kar, Palaeobotanist 26(1), p. 36, pl. 3, fig. 58. 1979.

Description (Kar 1979, p. 36): Spores originally subcircular but due to irregular folds take various shapes, 68-127 μ m. Spore coat up to 2 μ m thick, laevigate. A tail-like appendage which seems to be remnant of hyphae present in most specimens.



Fig. 275. *Palaeomycites robustus*. Bar = 50 μ m.

Locality: Barkhana, nala cutting, Ber Mota, Kutch District, Gujarat, India.

Age: Oligocene (Maniyara Fort Formation).

Indian records: Kar 1979, p. 36, pl. 3, figs. 58-62, Maniyara Fort Formation (Oligocene), nala cutting near Ber Mota, Kutch District, Gujarat; Singh & Saxena 1980, p. 278, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Singh & Saxena 1981, p. 175, pl. 1, fig. 3, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Saxena *et al.* 1984, p. 188-189, pl. 2, fig. 40, Lower-Middle Siwalik (Middle Miocene-Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Kar 1985, p. 201, Maniyara Fort Formation (Oligocene), near Ber Mota, Kutch District, Gujarat; Kar 1990a, p. 204, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura.

Genus: *Palaeophoma* Singhai 1974

Mycobank No.: MB 21213.

Type Species: *Palaeophoma intertrappea* Singhai 1974.

Description (Singhai 1974, p. 94): Pycnidium brown, more or less spherical; conidia 1-celled, hyaline, bent or curved or lunate or spherical, thick-walled; pycnidium pseudoparenchymatous, ostiole not seen.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Palaeophoma intertrappea* Singhai 1974

Fig. 276

Mycobank No.: MB 319131.

Description (Singhai 1974, p. 94): Pycnidium brown and spherical, measuring 224 x 200 μm , thick-walled (12-32 μm) and pseudoparenchymatous; ostiole not seen. Conidia 1-celled, hyaline, bent or curved or lunate or spherical, thin walled and smooth, measuring 5-8 x 2-4 μm .

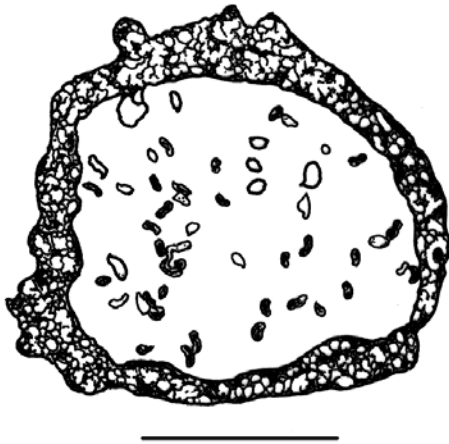


Fig. 276. *Palaeophoma intertrappea*. Bar = 100 μm .

Locality: Mohgaon Kalan, Chhindwara, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian.

Indian records: Singhai 1974, p. 94, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Palaeophthora* Singhai 1978

Mycobank No.: MB 21214.

Type Species: *Palaeophthora mohgaonensis* Singhai 1978.

Description (Singhai 1978, p. 483): Mycelium intracellular, branched, aseptate, sporangia either isolate or in organic connection at the tip of the mycelium, rounded or elongated, columella not present; sexual reproduction heterogamous, represented by rounded oogonia and narrow tube-like antheridia; oogonium having sac-like bodies on its wall; oospore (zygospore) with thick and rough outer wall.

Classification: Phycomyces, Peronosporales.

Species: *Palaeophthora mohgaonensis* Singhai 1978

Fig. 277

Mycobank No.: MB 113297.

Description (Singhai 1978, p. 483): Mycelium intracellular, 2.5-5 μm broad, aseptate, branched; detached sporangia 12-25 μm long and 5-10 μm broad, sporangia in organic connection at the tip of the mycelium 7.6 μm in diameter, columella absent, spores present only in the detached sporangia; narrow elongated antheridia 14 x 5 μm ; oogonium spherical 12 x 11 μm ; oospore (zygospore) rounded, with rough and thick outer wall, 11 μm in diameter.

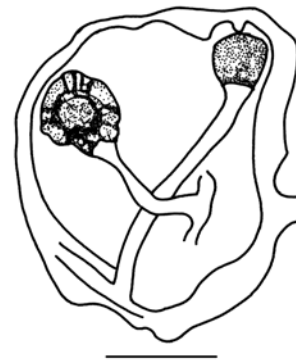


Fig. 277. *Palaeophthora mohgaonensis*. Bar = 25 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian.

Indian records: Singhai 1978, p. 483, pl. 1, figs. 1-5, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Remarks: The holotype is represented by three slides in author's collection, nos. 41, 64 and 80.

Genus: *Palaeosordaria* Sahni & Rao 1943

Mycobank No.: MB 21216.

Type Species: *Palaeosordaria lagena* Sahni & Rao 1943.

Description (Sahni & Rao 1943, p. 46): Fossil fungi referable to the Sordariaceae. Perithecia free, flask-shaped, attached to a septate mycelium.

Classification: Pyrenomycetes, Sphaeriales, Sordariaceae.

Species: *Palaeosordaria lagena* Sahni & Rao 1943

Fig. 278

Mycobank No.: MB 319133.

Description (Sahni & Rao 1943, p. 46): Perithecia black, flask-shaped; body smooth and spherical, about 140 μm in diameter, external surface reticulate; neck tapering, about 180 μm long, with traces of short hairs round the tip. The wall is composed of one layer of cells. Mycelium septate.



Fig. 278. *Palaeosordaria lagena*. Bar = 20 μ m.

Locality: Sausar, Chhindwara District, Madhya Pradesh, India.

Age: Early Tertiary (Deccan Intertrappean Series).

Indian records: Sahni & Rao 1943, p. 46, pl. 2, fig. 13, pl. 3, figs. 22-23, text-fig. 5, Deccan Intertrappean Series (Early Tertiary), Sausar, Chhindwara District, Madhya Pradesh.

Genus: *Paleoslimacomycetes* Kalgutkar & Sigler 1995

Mycobank No.: MB 27617.

Type species: *Paleoslimacomycetes canadensis* Kalgutkar & Sigler 1995.

Description (Kalgutkar & Sigler 1995, p. 521): Conidia simple, solitary, helicoid, curved to hemi-circinate, brown to fuscous, smooth. Conidia 2-3 septate; septa dark, often thick; conidial filaments short, made up of 3-4 broadly curved cells; cells, except the apical cell, darkly-pigmented; apical cell hyaline to pale brown.

Classification: Fungi Imperfecti, Helicosporae.

Species: *Paleoslimacomycetes wilcoxii* (Elsik 1968) Kalgutkar & Jansonius 2000

Fig. 279

Mycobank No.: MB 483500.

Involutisporonites wilcoxii Elsik, Pollen Spores 10(2), p. 277, pl. 3, fig. 7. 1968.

Description (Elsik 1968, p. 277): Coiled, psilate, monoporate fungal spores of 6 cells. Maximum dimension 26 μ m. Wall 0.5 μ m thick except apical chamber, which has walls about 0.2 μ m thick. Wall darkly pigmented except for apical chamber, which is much lighter. Septa twice as thick as wall, two layered. Pore ca. 1 μ m in diameter.



Fig. 279. *Paleoslimacomycetes wilcoxii*. Bar = 10 μ m.

Locality: 11 km south-west of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene (Rockdale lignite).

Indian records: Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhurg District, Maharashtra.

Genus: *Papulosporonites* Schmiedeknecht & Schwab 1964

Mycobank No.: MB 21220.

Type Species: *Papulosporonites sphaeromorphus* Schmiedeknecht & Schwab 1964.

Description (Schmiedeknecht & Schwab 1964, p. 686): Fungal remains of globular to elongate shape, consisting of numerous more or less polygonal cells that are firmly fused into mulberry-shaped aggregates. Cells without any regular order, or concentrically arranged. No differentiation of an outer wall layer; however, one to three of the innermost cells commonly much larger. Occasionally individual aggregates fused together. (Jansonius & Hills 1977, card no. 3379).

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Papulosporonites mohgaensis* (Chitaley & Yawale 1978) Kalgutkar & Jansonius 2000

Fig. 280

Mycobank No.: MB 483503.

Sorosporium mohgaense Chitaley & Yawale, Botanique 7(4), p. 190, pl. 1, fig. 1. 1978.

Description (Chitaley & Yawale 1978, p. 190): 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 x 35-46 μ m. 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 μ m with an average of 8 μ m in diameter, globose to ovoid,

polyhedral in balls, without any contents, episporium smooth, 0.3-0.7 μm .

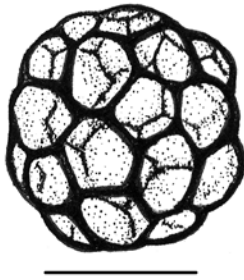


Fig. 280. *Papulosporonites mohgaensis*. Bar = 20 μm .

Locality: Mohgaon Kalan, Chhindwara District Madhya Pradesh, India.

Age: Late Cretaceous, Maastrichtian

Indian records: Chitale & Yawale 1978, p. 190, pl. 1, fig. 1, Late Cretaceous, Maastrichtian, Mohgaon Kalan, Chhindwara District, Madhya Pradesh; Saxena & Ranhotra 2009, p. 692, fig. 3.33, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Papulosporonites multicellatus* (Saxena & Singh 1982a) Kalgutkar & Jansonius 2000

Fig. 281

MycoBank No.: MB 483504.

Staphlosporonites multicellatus Saxena & Singh, Geophytology 12(2), p. 295, pl. 2, fig. 28. 1982a.

Description (Saxena & Singh 1982, p. 295): Fungal spores circular to subcircular, size range 58-80 x 40-80 μm . Multicellate, number of cells more than 25 in each spore, individual cell polygonal in shape and about 5-8 μm in size. Inaperturate. Septa very thin. Spore wall up to 2 μm thick, psilate, sometimes weakly granulose.



Fig. 281. *Papulosporonites multicellatus*. Bar = 20 μm .

Locality: Hoshiarpur-Una Road Section, near Bankhandi, Hoshiarpur District, Punjab, India.

Age: Pliocene (Upper Siwalik).

Indian records: Saxena & Singh 1982a, p. 295, pl. 2, figs. 28-29, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Saxena *et al.* 1988, p. 277, pl. 2, figs. 23, 27, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Saxena & Sarkar 2000, p. 257, Siju Formation (Middle Eocene), Simsang River Section near Siju, South Garo Hills District, Meghalaya; Saxena & Ranhotra 2009, p. 691, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Papulosporonites siwalikus* (Saxena & Bhattacharyya 1987) Kalgutkar & Jansonius 2000

Fig. 282

MycoBank No.: MB 483506.

Staphlosporonites siwalikus Saxena & Bhattacharyya, Palaeobotanist 35(2), p. 193, pl. 1, fig. 12. 1987.

Description (Saxena & Bhattacharyya 1987, p. 193): Fungal spores subcircular in shape, size range 61-77 x 52-70 μm . Multicellate, septa very thick, thicker than spore wall, individual cells circular-polygonal, small in size. Spore wall psilate.

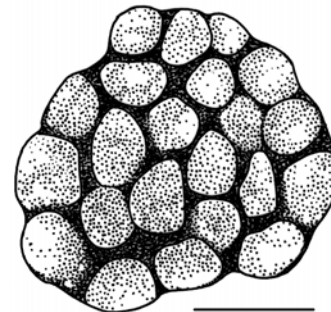


Fig. 282. *Papulosporonites siwalikus*. Bar = 20 μm .

Locality: Kala Amb-Nahan area, Sirmour District, Himachal Pradesh, India.

Age: Miocene (Lower Siwalik-Nahan).

Indian records: Saxena & Bhattacharyya 1987, p. 193, pl. 1, figs. 12, 14, Lower Siwalik-Nahan and Upper Siwalik (Middle Miocene-Pliocene), Kala Amb-Nahan Section, Sirmour District, Himachal Pradesh.

Species: *Papulosporonites subcircularis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 283

MycoBank No.: MB 483507.

Staphlosporonites subcircularis Chandra *et al.*, Biovigyanam 10(1), p. 48, pl. 2, fig. 17-18. 1984.

Description (Chandra *et al.* 1984, p. 48): Subcircular to oval fungal spores having eight or more, polygonal, irregularly arranged cells; size range 15-42 x 13-30 µm; inaperturate; septa thicker than spore wall; spore wall 1 µm thick; psilate, pigment medium to dark.

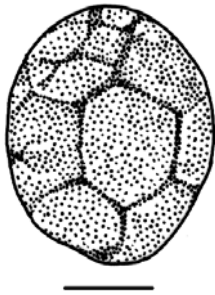


Fig. 283. *Papulosporonites subcircularis*. Bar = 10 µm.

Locality: Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 48, pl. 2, fig. 17-18, Late Quaternary, Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Arabian Sea.

Genus: *Paramicrothallites* Jain & Gupta 1970

Mycobank No.: MB 21221.

Type Species: *Paramicrothallites spinulatus* (Dilcher 1965) Jain & Gupta 1970.

Description (Jain & Gupta 1970, p. 179): Stroma radiate, more or less rounded, ostiolate, ostiole not surrounded by specialized cells, free hyphae absent.

Classification: Ascomycetes, Microthyriales.

Remarks: Kalgutkar and Jansonius (2000) considered *Paramicrothallites* Jain & Gupta 1970 a junior synonym of *Asterothyrites* Cookson 1947.

Species: *Paramicrothallites edvensis* Rao & Ramanujam 1976

Mycobank No.: MB 319186.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Asterothyrites* Cookson 1947 [See: *Asterothyrites edvensis* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000].

Species: *Paramicrothallites konkanensis* Saxena & Misra 1990

Mycobank No.: MB 483357.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Asterothyrites* Cookson 1947 [See: *Asterothyrites*

konkanensis (Saxena & Misra 1990) Kalgutkar & Jansonius 2000].

Species: *Paramicrothallites menonii* Jain & Gupta 1970

Mycobank No.: MB 319187.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Asterothyrites* Cookson 1947 [See: *Asterothyrites menonii* (Jain & Gupta 1970) Kalgutkar & Jansonius 2000].

Species: *Paramicrothallites spinulatus* (Dilcher 1965) Jain & Gupta 1970

Mycobank No.: MB 319188.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Asterothyrites* Cookson 1947 [See: *Asterothyrites spinulatus* (Dilcher 1965) Kalgutkar & Jansonius 2000].

Genus: *Parmathyrites* Jain & Gupta 1970

Mycobank No.: MB 21223.

Type Species: *Parmathyrites indicus* Jain & Gupta 1970.

Description (Jain & Gupta 1970, p. 177): Ascumata flattened, non-ostiolate; ± circular, one layer thick; hyphae radially arranged, interconnected, forming pseudoparenchymatous non-porate cells. Outer peripheral cells prominent with thickened radial walls, spines peripheral, spine sheath present or absent. Ascospore unknown.

Emended Description (Jain 1974, p. 44): Ascumata ostiolate, flattened, circular, one layer thick, hyphae radially arranged, interconnected, forming pseudoparenchymatous non-porate cells. Outer peripheral cells prominent with thickened radial walls, spines peripheral, spine sheath present or absent, ascospores unknown. Ostiole distinct, not surrounded by any specialized cells.

Emended Description (Gupta 1994, p. 251): Ascumata ostiolate or nonostiolate, generally circular-subcircular, flattened, one cell layer thick; hyphae radially arranged, interconnected, forming pseudoparenchyma; spines peripheral, spine sheath present or absent, ascospores unknown.

Classification: Ascomycetes, Microthyriales.

Species: *Parmathyrites indicus* Jain & Gupta 1970

Fig. 284

Mycobank No.: MB 319220.

Description (Jain & Gupta 1970, p. 178): Ascumata flattened, circular, 180-190 µm in diameter, solitary, one-layer thick, radiating hyphae connected throughout whole length, central portion not well preserved, ascumata non-ostiolate. Central cells squarish, marginal ones rectangular. Cell walls thin, each peripheral cell developed into a long spine-like process. Spines about 70 in number around the periphery, unequal in size, 20-50 µm long, pointed at the apex, broader at base, walls thick, fused radially at the base, free on the upper side. Ascospore unknown.

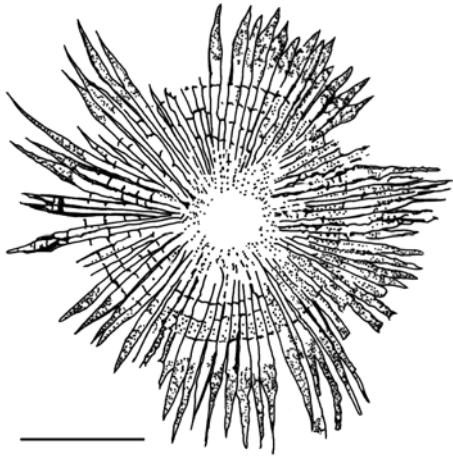


Fig. 284. *Parmathyrites indicus*. Bar = 50 μ m.

Locality: Padappakkara, Kollam, Kerala.

Age: Early Miocene.

Indian records: Jain & Gupta 1970, p. 178, pl. 1, figs. 1-2, Early Miocene, Padappakkara, Kollam District, Kerala; Jain & Kar 1979, p. 107, pl. 1, fig. 13, Neogene, around Kollam and Varkala, Kerala; Singh & Sarkar 1984b, p. 49, pl. 2, fig. 24, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Varma 1987, p. 167, pl. 1, fig. 6, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Bhattacharya 1987, p. 120, Early Eocene, Rajparadi, Broach District, Gujarat; Mallesham *et al.* 1989, p. 15, pl. 1, fig. 4, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Rajendran *et al.* 1989, p. 42, pl. 1, figs. 7, 16, pl. 2 fig. 22, Miocene, Padappakkara, Kerala; Kar 1990b, p. 232, pl. 2, fig. 19, Disang Formation (Palaeocene-Eocene), Silchar-Haflong Road Section, Assam; Kumaran *et al.* 1995, p. 1024, fig. 3m, Warkalli Formation (Miocene), Bharathi and Kundra Clay Mines, Kerala; Rao 1995, p. 233, pl. 1, fig. 3, Tertiary, Alleppey and Kannur districts, Kerala; Rao 1996, p. 156, Early Miocene, Turavur Borehole near Panchayat L.P. School, west of N.H. 47 between 380 and 381 km, Alleppey District, Kerala; Chandra & Kumar 1998, p. 62, pl. 1, fig. 17, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Rao 2000, p. 295, Kherapara Formation (Oligocene), Tura-Dalu Road Section near Kherapara, West Garo Hills District, Meghalaya; Saxena & Sarkar 2000, p. 257, pl. 1, fig. 3, Middle Siju Formation (Eocene), Simsang River Section near Siju, South Garo Hills District, Meghalaya; Mandaokar 2002b, p. 21, pl. 2, fig. 16, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Rao 2004, p. 124, Sindhudurg

Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Parmathyrites ramanujamii* Singh *et al.* 1986

Fig. 285

Mycobank No.: MB 131933.

Description (Singh *et al.* 1986, p. 96): Ascomata circular to subcircular, non-ostiolate, size 80-90 μ m in diameter. Hyphae radially arranged, interconnected, forming pseudoparenchymatous non-porate cells. Central and marginal cells being squarish and rectangular, respectively. Outer peripheral cells prominent with thickened radial walls, each peripheral cell developing into a spine-like process; spines unequal, 5-15 μ m long, pointed at the apex and broader at the base, about 40 in number; wall thick, radially fused at the base forming a continuous peripheral sheath around ascomata. Ascospores unknown.

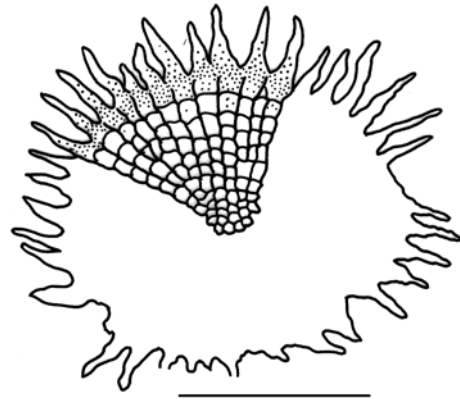


Fig. 285. *Parmathyrites ramanujamii*. Bar = 50 μ m.

Locality: Sonapur-Badarpur Road Section, Meghalaya and Assam, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 96, pl. 1, figs. 8-9, Umkiang Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Rao 1995, p. 233-234, pl. 1, fig. 9, Tertiary, Alleppey and Kannur districts, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Rao 2000, p. 295, Kherapara

Formation (Oligocene), Tura-Dalu Road Section near Kherapara, West Garo Hills District, Meghalaya; Mandaokar 2002b, p. 21, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Rao 2004, p. 124, pl. 2, fig. 8, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.

Species: *Parmathyrites robustus* Jain & Kar 1979

Fig. 286

MycoBank No.: MB 112509.

Description (Jain & Kar 1979, p. 107): Ascstromata dimidiate, 60-110 μm ; central pseudoparenchymatous cells thickened, sometimes porate, non-ostiolate. Marginal cells spinose, spines robust, closely placed, radiate, tips pointed.

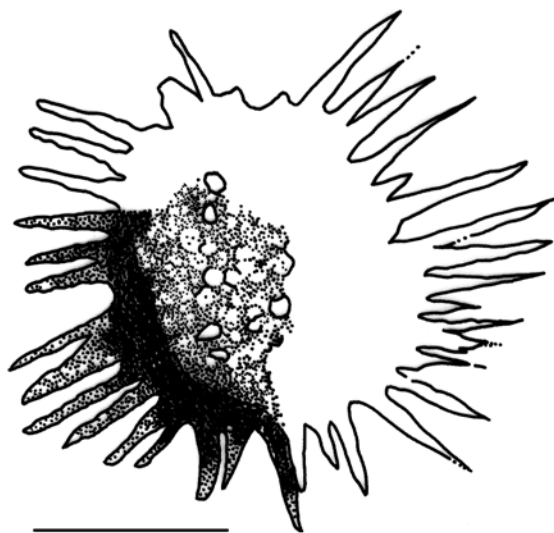


Fig. 286. *Parmathyrites robustus*. Bar = 50 μm .

Locality: Chillakur Village, Varkala, Kerala, India.

Age: Miocene.

Indian records: Jain & Kar 1979, p. 107, pl. 1, fig. 14, pl. 2, fig. 34, Neogene, around Kollam and Varkala, Kerala; Bhattacharya 1987, p. 120, Early Eocene, Rajpardi, Broach District, Gujarat; Rajendran *et al.* 1989, p. 41, 43, 44, pl. 1, fig. 1, Miocene, Tonakkal, Kundra, Edavai, Paravur, Kannur, Palayangadi, Kerala; Kar 1990a, p. 179, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar & Bhattacharya 1992, p. 251, Early Eocene, Rajpardi lignite, Bharuch District, Gujarat.

Species: *Parmathyrites tonakkalensis* Patil & Ramanujam 1988

Fig. 287

MycoBank No.: MB 519793.

Description (Patil & Ramanujam 1988, p. 264): Ascromata brownish to dark-brown, flattened, one-layered mostly, more or less rounded, 87 μm in diameter. Ostiolate, ostiole small, irregular, 5-8 μm , centric. Cells of ascromata angular (3-5 μm in diameter) towards ostiole, elongate (21-34 μm) and locally furcate towards peripheral margin. Each marginal cell drawn out into a robust, sharply pointed spine, marginal spines 11-17 μm long, often with bulbous bases.

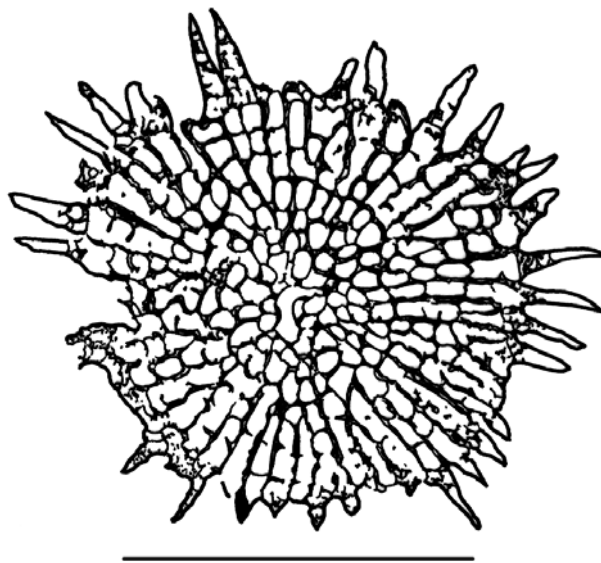


Fig. 287. *Parmathyrites tonakkalensis*. Bar = 50 μm .

Locality: Tonakkal, Kerala, India.

Age: Neogene.

Indian records: Patil & Ramanujam 1988, p. 264, pl. 1, fig. 6, Miocene, Tonakkal, Thiruvananthapuram District, Kerala.

Species: *Parmathyrites turaensis* Kar *et al.* 1972

Fig. 288

MycoBank No.: MB 319221.

Description (Kar *et al.* 1972, p. 149): Ascromata circular to subcircular, ostiolate, mostly dark brown, one-layered, 40-80 μm . Hyphae in the central part arranged to form a pseudoparenchymatous structure which is distinct from peripheral tissue. Development of radially elongated cells from central polygonal ones is gradual. Outer peripheral cells generally more thickened and provided with spine-like projections; spines are very well developed, up to 6 μm long with bulbous base and pointed tip. In some specimens, a few stromata are found together. Polygonal to rounded cells in central region are bigger than the rest and may form an ostiolate structure.

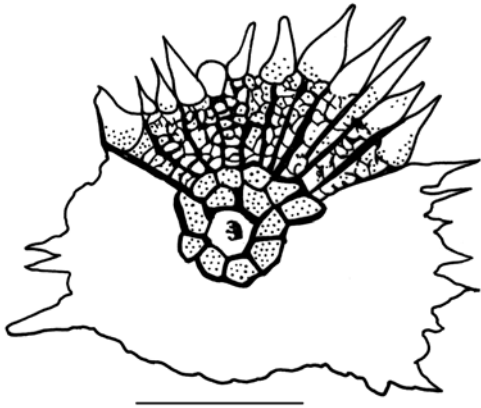


Fig. 288. *Parmathyrites turaensis*. Bar = 50 μ m.

Locality: Damalgiri, Garo Hills, Meghalaya, India.

Age: Tertiary.

Indian records: Kar *et al.* 1972, p. 149, pl. 2, fig. 17, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam.

Genus: *Perisporiacites* Felix 1894

Mycobank No.: MB 21226.

Type species: *Perisporiacites larundae* Felix 1894.

Description (combined description, Felix 1894, p. 271): The vessels of an Eocene deciduous wood specimen, originating from Perekeschkul near Baku, which I had described as *Taenioxylon porosum* and which probably belongs to the Leguminosae, contained spherical and ellipsoidal bodies that must be regarded as the perithecia of an ascomycete. They most closely resemble the perithecia of the Perisporiaceae; I describe them, therefore, as *Perisporiacites*. Their surface is covered with irregular, cellular, predominantly worm-shaped markings. Preparations and pictures of the perithecia of recent forms from the named groups available to me, show that their superficial markings are always much more regular; but considering that these perithecia are formed by the fusion of adjacent mycelial filaments, then the occurrence of irregular worm-shaped markings is not surprising. A nearly perfectly round perithecium (fig. 3a) is 0.06 mm (60 μ m) in diameter, the oblong perithecia are 0.04–0.05 mm (40–50 μ m) wide and 0.06–0.07 mm (60–70 μ m) long. All these specimens are empty. The same polished section also contains conidia and mycelia of a hyphomycete that will be described later as *Haplophragmites*.
Classification: Ascomycetes, Erysiphales, Perisporiaceae.

Species: *Perisporiacites varians* Sahni & Rao 1943

Fig. 289

Mycobank No.: MB 319365.

Description (Sahni & Rao 1943, p. 45): Perithecia black, spherical to ellipsoid, varying from about 85 to 95 μ m in length and about 70 to 80 μ m in their shorter diameter; external surface marked with a reticulum of irregular-shaped cells; mode of dehiscence unknown. Mycelium branched, cells as a rule several times longer than wide, occasionally elliptical, forming short chains (? spores). Clamps present, hook like.

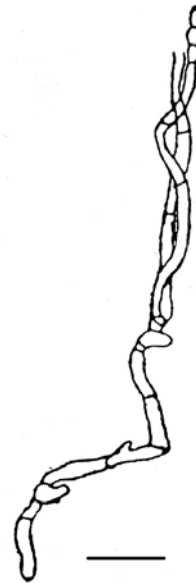


Fig. 289. *Perisporiacites varians*. Bar = 20 μ m.

Locality: Sausar, Chhindwara District, Madhya Pradesh, India.

Age: Early Tertiary (Deccan Intertrappean Series).

Indian records: Sahni & Rao 1943, p. 45, pl. 2, figs. 11–12, text-fig. 6, Deccan Intertrappean Series (Early Tertiary), Sausar, Chhindwara District, Madhya Pradesh.

Genus: *Phomites* Fritel 1910

Mycobank No.: MB 21242.

Type Species: *Phomites myricae* Fritel 1910.

Description (Fritel 1910, p. 14): An Imperfect Fungus with a subcutaneous perithecium, erumpent (breaking out after having darkened), membranous, somewhat leathery or even semi-woody; globular or flattened, without a beak; ostiole small or rudimentary.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Phomites ebenoxyloni* Chitale & Patil 1972

Fig. 290

Mycobank No.: MB 320161.

Description (Chitale & Patil 1972, p. 104): Fruiting body a pycnidium, globoid, black, ostiolate, single or in groups,

sunken in cortex of host, each 150-250 μm in size; conidiospores many, black, produced in chains on conidiophores arising from inner wall of fruiting body. Chlamydo-spores in chains, terminal or intercalary, round to oval, each 6-9 μm in size. Mycelium branched, septate; hyphae 17-22 μm long, 4-6 μm wide, inter- and intracellular; haustorium branched, present in ray cells of host.

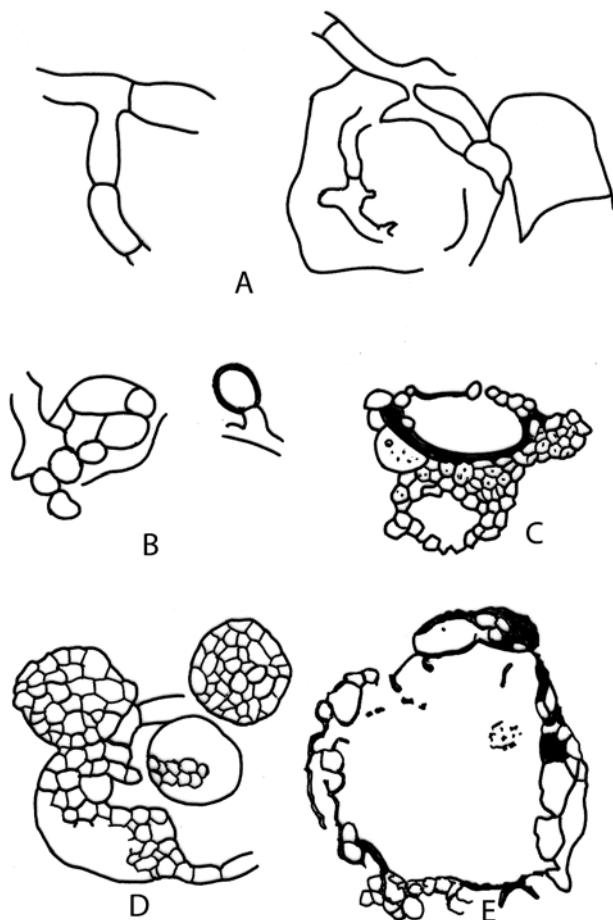


Fig. 290. *Phomites ebenoxyloni*. A. Hypha and inter- and intracellular mycelium with haustorium, B. Chlamydo-spores, terminal and intercalary chains, C. Fruiting body, partly sunken in cortex, D. Grouped immature fruiting bodies, E. Fruiting body in plan view, with a few spores, (not to scale).

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous (Deccan Intertrappean beds).

Indian records: Chitale & Patil 1972, p. 103-104, pl. 1, figs. 4-7, text-figs. 2, 8-13, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Phragmothyrites* Edwards 1922 emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21244.

Type Species: *Phragmothyrites eocaenicus* Edwards 1922. *Microthallites* Dilcher 1965.

Description (Edwards 1922, p. 67): Fossil forms belonging to the Microthyriaceae, the exact position of which is uncertain, but which appear to be most closely related to *Phragmothyrium* as defined by Von Höhnelt.

Emended Description (Kar & Saxena 1976, p. 7): No free hyphae; ascostromata subcircular-circular, dimidiate, non-ostiolate; hyphae radially arranged, interconnected to form pseudoparenchymatous cells; central cells \pm squarish-subcircular, outer cells elongated, may be setose at margin and thickened. Cells with or without pore, generally cells in the middle region are more porate than outer ones.

Emended Description (Kalgutkar & Jansonius 2000, p. 229): Ascumata subcircular to circular, astomate, with radially arranged hyphae that interconnect laterally to form a pseudoparenchymatous tissue. Hyphal cells uniform in shape or size, or showing various development in different regions of the ascumata, e.g. elongated rectangular, or isodiametric. Central cell, or cells in the immediate central area, may be cubical, hexagonal or subcircular; however, never developed into a circular region of thick-walled isodiametric cells in the central area of the ascumata (as is characteristic of *Microthyriacites*).

Classification: Ascomycetes, Microthyriales.

Species: *Phragmothyrites assamicus* (Kar *et al.*) Saxena *et al.* 1984

Mycobank No.: MB 519815.

Remarks: See: *Callimothallus assamicus* Kar *et al.* 1972.

Species: *Phragmothyrites cooksoniae* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000

Fig. 291

Mycobank No.: MB 483512.

Microthallites cooksoniae Rao & Ramanujam, Geophytology 6(1), p. 100, pl. 1, fig. 10. 1976

Description (Rao & Ramanujam 1976, p. 100): Free mycelium absent. Ascumata somewhat rounded, flattened, up to 90 μm in diameter, non-ostiolate, 2-5 wedge-shaped cells at the centre, ascumata with simple or forked radial rows of cells, 2.5-4 μm broad and 3.5-6 μm long, radial walls of cells prominently thickened and appearing as straight reinforcements, tangential walls very thin.



Fig. 291. *Phragmothyrites cooksoniae*. Bar = 50 μ m.

Locality: Warkalli, Kerala, India.

Age: Late Miocene (Warkalli lignite).

Indian records: Rao & Ramanujam 1976, p. 100, pl. 1, fig. 10, Quilon and Warkalli Beds (Miocene), Kerala; Pathak & Banerjee 1984, p. 250, pl. 2, fig. 24, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal.

Species: *Phragmothyrites edwardsii* (Rao 1958) Kar *et al.* 1972

Fig. 292

Mycobank No.: MB 320232.

Microthyriacites edwardsii Rao 1958, p. 45, pl. 1, fig. 4 (non figs. 7-10).

Phragmothyrites edwardsii (Rao 1958) Kalgutkar & Jansonius, AASP Contribution Series 39, p. 230-231. 2000, non (Rao 1958) Kar *et al.* 1972.

Description (Rao 1958, p. 45): Thyriothecia flat, dimidiate, superficial, up to 90 μ m in diameter, central cells more or less hexagonal, outer cells radially arranged, elongated, peripheral cells cleft, stigmatocysts shield-shaped. No mycelia or ostiole seen.

Emended Description (Kar *et al.* 1972, p. 150): Ascomata subcircular, 70-120 μ m, margin uneven, pseudoparenchymatous, cells well developed, cell wall thickened, radially elongated throughout.



Fig. 292. *Phragmothyrites edwardsii*. Bar = 40 μ m.

Locality: Warkalli, Kerala, India.

Age: Miocene.

Indian records: Rao 1958, p. 45, pl. 1, figs. 7-10, Warkalli lignite (Miocene), Varkala, Thiruvananthapuram District, Kerala; Kar *et al.* 1972, p. 150, pl. 2, fig. 22, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Dutta & Singh 1980, p. 620, pl. 1, figs. 9-10, Siwalik Group-Units B-C (Late Miocene-Pliocene), Bhalukpong-Bomdila Section, Kameng District, Arunachal Pradesh; Mehrotra 1983, p. 17, pl. 4, fig. 4, Mikir Formation (Palaeocene-Early Eocene), Garampani, North Cachar Hills, Assam; Singh & Tripathi 2010, p. 12, pl. 1, fig. 20, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Remarks: The absence of a central core of thick walled cells in the thyriothecia of this species, and their structural nature led Kalgutkar and Jansonius (2000) to agree with Kar *et al.* (1972) on transferring *Microthyriacites edwardsii* Rao 1958 to *Phragmothyrites*. However, they did not consider the new combination as validly published for the lack of citation of basionym. Since the basionym citation for valid publication of a new combination became mandatory only from 1 January 2007, we here consider the combination published by Kar *et al.* (1972) as validly published.

Species: *Phragmothyrites eocaenicus* Edwards 1922

Fig. 293

Mycobank No.: MB 264006.

Description (Edwards 1922, p. 67): Thyriothecia circular, radiate, with entire margin, scattered singly (rarely concretescent) on the leaf surface; stigmatocysts circular and deeply crenulate; ascospores? 5-celled; mycelium? absent or evanescent. The discoid bodies, the ascostromata, occur singly, or rarely in concretescent pairs, on the upper surface of the leaf, and in some preparations are scattered over it in considerable numbers. They are usually practically circular,

and the largest specimen is about 165 μm in diameter. They have a regularly radiate structure and the margin is entire, or very slightly crenate, but not fimbriate. None of the specimens show a definite ostiole. There is no mycelium on the surface of the leaf, but stigmocysts are abundant and all stages of growth are to be found between them and the largest of the ascromata. The stigmocysts (unicellular capitate hyphopodia) are circular and deeply crenulate, about 10-12 μm in diameter, and the clear central spot is usually distinctly seen. No asci were found, but two 4-5 celled spores in the vicinity of the ascstromata were noted.

Emended Description (Kar & Saxena 1976, p. 9): Ascstromata subcircular-circular, no free hyphae observed, dimidiate, non-ostiolate, hyphae radially arranged and interconnected with each other to form mostly one-cell thick pseudoparenchymatous cells. Cells in the middle region are less elongated than marginal ones; cell walls \pm uniformly thick throughout or marginal cells thicker and setose. Pores generally present or sometimes absent, cells uniporate, central cells generally more porate than outer ones.

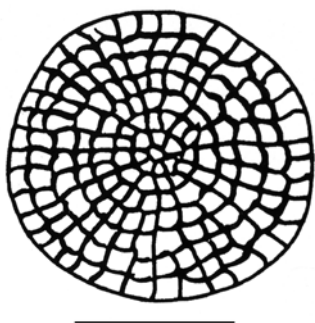


Fig. 293. *Phragmothyrites eocaenicus*. Bar = 60 μm .

Locality: Mull, Scotland.

Age: Eocene.

Indian records: Venkatachala & Kar 1969, p. 179, pl. 1, figs. 1-5, Naredi Formation (Early Eocene), Matanomadh, Kutch District, Gujarat; Kar & Saxena 1976, p. 9, pl. 3, fig. 20, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Kar 1979, p. 31, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Jain & Kar 1979, p. 107, pl. 1, figs. 1-7, pl. 2, fig. 19, Neogene, around Kollam and Varkala, Kerala; Dutta & Singh 1980, p. 620, Siwalik Group-Units B-C (Late Miocene-Pliocene), Bhalukpong-Bomdila Section, Kameng District, Arunachal Pradesh; Kar & Saxena 1981, p. 106, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Mehrotra 1983, p. 17, pl. 4, fig. 11, Mikir Formation (Palaeocene-Early Eocene), Garampani, North Cachar Hills, Assam; Singh

& Sarkar 1984a, p. 98, pl. 2, fig. 30, Miocene, Ramshahr Well-1, Solan District, Himachal Pradesh; Saxena *et al.* 1984, p. 187, pl. 2, fig. 34, Lower-Middle Siwalik (Middle Miocene-Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Kar 1985, p. 130, Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Singh *et al.* 1986, p. 94, pl. 1, figs. 1-2, pl. 2, fig. 15, Barail-Surma Groups (Oligocene-Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Siddhanta 1986, p. 64, pl. 5, fig. 48, Neyveli Formation (Palaeocene-Eocene), Neyveli, South Arcot District, Tamil Nadu; Saxena *et al.* 1988, p. 276, pl. 2, fig. 26, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Bhattacharya 1987, p. 120, Early Eocene, Rajpardi, Broach District, Gujarat; Sarkar & Singh 1988, p. 60, pl. 6, figs. 19-20, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Rajendran *et al.* 1989, p. 41, 42, 43, 44, pl. 1, fig. 6, pl. 2, fig. 39, Miocene, Tonakkal, Kundra, Padappakkara, Varkala, Edavai, Paravur, Kannur, Palayangadi, Kerala; Tripathi 1989, p. 72, pl. 2, fig. 14, pl. 3, fig. 13, Therria and Kopili formations (Palaeocene-Eocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Kar 1990a, p. 179, pl. 8, fig. 119, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 232, 233, 236, 238, 240, pl. 1, fig. 13, pl. 2, figs. 7, 11, Disang, Laisong, Jenam, Renji and Bhuban formations (Palaeocene-Early Miocene), Silchar-Haflong Road Section, Assam; Saxena & Misra 1990, p. 265, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Mandaokar 1991, p. 26, Early Miocene, north of Maibong Railway Station, North Cachar Hills District, Assam; Kar & Bhattacharya 1992, p. 251, Rajpardi lignite (Early Eocene), Bharuch District, Gujarat; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Ambwani 1993, p. 153, Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya; Kar *et al.* 1994, p. 187, Tertiary, subsurface sediments in Upper Assam; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Singh & Sarkar 1994, p. 52, pl. 1, fig. 25, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Kumaran *et al.* 1995, p. 1024, Warkalli Formation (Miocene), Bharathi and Kundra Clay Mines, Kerala; Rao 1995, p. 233, pl. 1, fig. 1, Tertiary, Alleppey and Kannur districts, Kerala; Tripathi 1995, p. 47, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Kumar 1996, p. 114, Tarkeshwar Formation (Early Eocene), Rajpardi, Bharuch District, Gujarat; Mandal *et al.* 1996, p. 80, age not mentioned, mud volcano in Baratang Island, Andaman and Nicobar Islands; Rao 1996, p. 156, Early Miocene, Turavur Borehole near Panchayat L.P. School, west of N.H. 47 between 380 and 381 km, Alleppey District, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early

Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Samant & Phadtare 1997, p. 68, pl. 14, fig. 17, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Sarkar 1997, p. 102, 104, 108, Subathu Formation (Eocene), 20 km southeast of Bilaspur on Shimla-Bilaspur Highway, Bilaspur District, Himachal Pradesh; Chandra & Kumar 1998, p. 56, pl. 3, fig. 5, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Rao & Nair 1998, p. 52, pl. 1, fig. 24, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Mandaokar 1999, p. 241, Disang Group (Late Eocene), Tirap River Section, Tinsukia District, Assam; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Mandaokar 2000b, p. 181, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Mandaokar 2000c, p. 38, pl. 1, fig. 9, Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh; Rao 2000, p. 295, Kherapara Formation (Oligocene), Tura-Dalu Road Section near Kherapara, West Garo Hills District, Meghalaya; Samant 2000, p. 16, pl. 1, fig. 20, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Samant & Tapaswi 2000, p. 29, fig. 2.14, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Sarkar & Prasad 2000a, p. 171, Subathu Formation (Late Ypresian-Middle Lutetian), Koshalia Nala Section near Koti, Shimla Hills, Solan District, Himachal Pradesh; Sarkar & Prasad 2000b, p. 147, Subathu Formation (Late Ypresian-Middle Lutetian), west bank of Ghaggar river near Kharak village, Morni Hills, Haryana; Saxena 2000, p. 163, pl. 2, fig. 13, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Saxena & Sarkar 2000, p. 257, Siju Formation (Middle Eocene), Singsang River Section near Siju, South Garo Hills District, Meghalaya; Tripathi *et al.* 2000, p. 243, Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya; Kumar *et al.* 2001, p. 244, Barail Group (Oligocene), Tinali Well-7, Upper Assam; Tripathi 2001, p. 567, fig. 3D, Rajmahal Formation (Early Cretaceous), Borehole RJNE-32, depth 95.50 m, Rajmahal Basin, Bihar; Singh & Kar 2002, p. 214, pl. 1, fig. 9, Deccan Intertrappean Beds (Palaeocene), 3 km northeast of Papro village, Latitpur District, Uttar Pradesh; Mandaokar 2002a, p. 116, Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram; Mandaokar 2002b, p. 21, Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland; Mandal *et al.* 2003, p. 102, 104, Baratang Formation (Eocene), Baratang Island, Andaman and Nicobar Islands; Singh & Kar 2003, p. 219, pl. 2, fig. 5, Deccan Intertrappean Beds (Palaeocene), northeast of Papro, Lalitpur District, Uttar Pradesh; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North

Cachar Hills, Assam; Rao 2004, p. 124, pl. 3, fig. 14, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam Kar *et al.* 2010, p. 245, Bhuban Formation (Miocene), Tlangsam, Mizoram.

Species: *Phragmothyrites lutosus* (Dilcher 1965) Kar & Saxena 1976

Fig. 294

Mycobank No.: MB 112563.

Microthallites lutosus Dilcher, Palaeontographica Abt. B. 116, p. 16, pl. 10, figs. 84-85. 1965.

Description (Dilcher 1965, p. 16): Stroma 25-40 μm in diameter, radiate, more or less circular, non-ostiolate, lacks free hyphae, margin irregular, more or less fimbriate. Stroma consists of radiating rows of cells, 1.5-5 x 2-7 μm , square to slightly rectangular, dichotomizing 2-3 times marginally. A single thick-walled cell 3-5 μm in diameter, present centrally on the upper surface of the stroma. No spores found. Found on the upper epidermis of *Sapindus* sp.

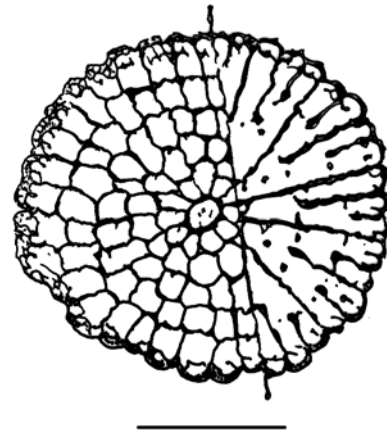


Fig. 294. *Phragmothyrites lutosus*. Bar = 20 μm .

Locality: Mull, Scotland.

Age: Eocene.

Indian records: Kar & Saxena 1976, p. 9, Bhuj-Lakhpat Road, Matanomadh Village, Kutch District, Gujarat; Saxena & Ranhotra 2009, p. 692, fig. 3.22, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Phragmothyrites quilonensis* (Jain & Gupta) Kar & Saxena 1976

Mycobank No.: MB 112564.

Remarks: See: *Callimothallus quilonensis* Jain & Gupta 1970.

Species: *Phragmothyrites ramanujamii* Samant in Saxena 2009

Fig. 295

Mycobank No.: MB 515003.

Phragmothyrites ramanujamii Samant 2000

Description (Samant 2000, p. 15): Ascromata discoidal; about 65-120µm in diameter; non-ostiolate; hyphal cells radiating; individual cell nonporate, rectangular to squarish, thick-walled; marginal cells bigger, hyaline and smooth.



Fig. 295. *Phragmothyrites ramanujamii*. Bar = 40 µm.

Locality: Near Bhavnagar, Cambay Basin, Gujarat, India.

Age: Early Eocene (Kharsalia Clay Formation).

Indian records: Samant 2000, p. 15, pl. 1, fig. 21, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Species: *Phragmothyrites serratus* Saxena & Khare 1992

Fig. 296

Mycobank No.: MB 483895.

Description (Saxena & Khare 1992, p. 39): Ascstromata circular to subcircular, non-ostiolate; size 45-73 x 42-72 µm; hyphae radiating, septate, interconnected, forming ill-developed pseudoparenchymatous tissue; cells polygonal, squarish to rectangular, sometimes central cells possessing single pore; marginal cells serrated and partially divided longitudinally into two or three incomplete divisions, imparting a serrated outline.

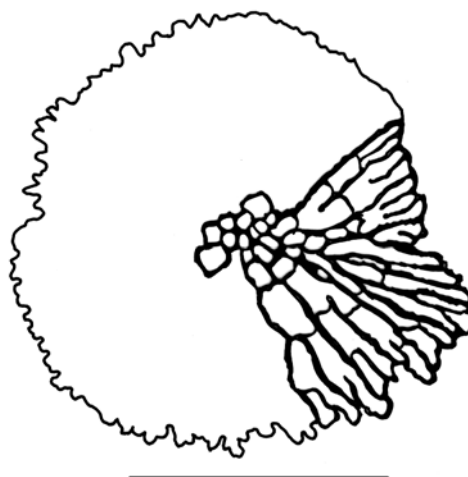


Fig. 296. *Phragmothyrites serratus*. Bar = 50 µm.

Locality: Jayamkondacholapuram Well 12, 45 km south of Neyveli, Tiruchirapalli, Tamil Nadu, India.

Age: Late Palaeocene-Middle Eocene.

Indian records: Saxena & Khare 1992, p. 39-40, pl. 1, fig. 5, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Species: *Phragmothyrites suratensis* Samant & Tapaswi 2000

Fig. 297

Mycobank No.: MB 519786.

Description (Samant & Tapaswi 2000, p. 29): Ascstromata circular; 29-50 µm in diameter; free hypha absent, nonostiolate, cells polygonal in shape, wall of individual cell distinctly thick, marginal cells with thin outer wall.

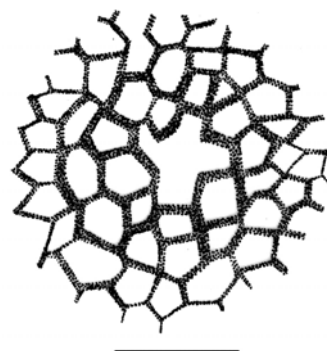


Fig. 297. *Phragmothyrites suratensis*. Bar = 20 µm.

Locality: Surat District, Gujarat, India.

Age: Early Eocene (Surat lignite, Cambay Shale).

Indian records: Samant & Tapaswi 2000, p. 29, fig. 2.15, Cambay Shale (Early Eocene), Surat District, Gujarat.

Genus - *Plochmopeltinites* Cookson 1947

Mycobank No.: MB 21254.

Type Species - *Plochmopeltinites masonii* Cookson 1947.

Description (Cookson 1947, p. 212): Fossil ascomata of dimidiate form with ascomal membranes of sinuous plectenchyma. Ascospore characters unknown.

Classification: Ascomycetes, Microthyriales.

Remarks: Cookson (1947a) stated that “The family Micropeltaceae is distinguished from the Microthyriaceae and Trichopeltaceae by the non-radiate construction of the flattened ascomata. The structure of the ascomal membrane or “scutellum” varies within the family and provides the basis for its subdivision into three subfamilies (Stevens & Manter 1925).

Species: *Plochmopeltinites cooksoniae* Ramanujam & Rao 1973

Fig. 298

Mycobank No.: MB 320732.

Description (Ramanujam & Rao 1973, p. 207): Ascomata superficial, discoid, rounded, brown to reddish brown, 65-166 μm in diameter, ostiolate; ostiole 10-18.5 μm in diameter, irregular in shape, more or less centric, border dense, slightly raised, of dark brown, thick-walled irregular cells; covering membrane of ascomata plectenchymatous, consisting of extremely sinuous, irregularly branched hyphae; hyphal cells 4-18 μm long, considerably thick-walled (3.5-6 μm), excepting cells of peripheral layer. Margin of fruit body not entire, formed of thin-walled membranous peripheral cells. Free hyphae, at times extending from marginal cells of ascomata, wavy.

Emended Description (Reddy *et al.* 1982, p. 116): Ascomata epiphyllous, discoid, more or less rounded to often somewhat irregular in shape, dark brown to reddish brown, 85-150 μm in diameter, ostiolate; ostiole 10-18 μm , rounded to irregular in shape, centric or slightly sub-centric, formed of broken-down central group of cells, ostiole border slightly elevated, made up of 2 or 3 layers of dark brown, thick-walled, angular cells; covering membrane of ascomata plectenchymatous, comprising sinuous, irregularly branched and intertwining hyphae showing a distinct but locally distorted radial pattern. Many hyphal branches end blindly against adjacent hyphae, hyphal branching more pronounced near margin. Cells in individual hyphae narrow, elongated, of variable size. Margin of fruiting body wavy, locally discontinuous, formed of close juxtaposition of peripheral parts of hyphal cells. Free hyphae present, extending locally beyond margin of ascoma, and associated with marginal cells.

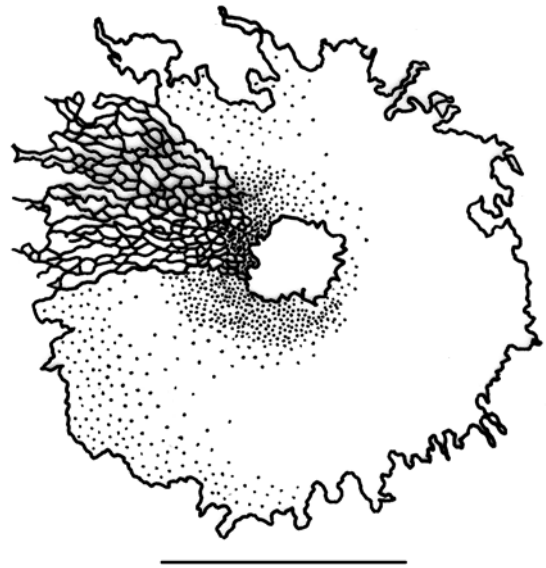


Fig. 298. *Plochmopeltinites cooksoniae*. Bar = 50 μm .

Locality: Varkala, Kerala, India.

Age: Late Miocene (Warkalli Formation).

Indian records: Ramanujam & Rao 1973, p. 207, pl. 3, figs. 22-23, Warkalli Formation (Miocene), Varkala, Kerala; Reddy *et al.* 1982, p. 116-117, pl. 1, fig. 17, pl. 2, fig. 1, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Patil & Ramanujam 1988, p. 265, pl. 2, fig. 8, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Singh & Kar 2003, p. 219, pl. 2, fig. 7, Deccan Intertrappean Beds (Palaeocene), northeast of Papro, Lalitpur District, Uttar Pradesh.

Species: *Plochmopeltinites keralensis* Patil & Ramanujam 1988

Fig. 299

Mycobank No.: MB 519796.

Description (Patil & Ramanujam 1988, p. 265): Ascomata discoid, dark brown, rounded, 145-156 μm in diameter. Ostiolate, ostiole centric, small (3 μm), of irregular shape, without distinct border; covering membrane of ascomata plectenchymatous, made up of slender (1.4-2 μm thick), sinuous, more or less radiating, irregularly branched hyphae, cells in hyphae narrow, elongated, of variable size. Margin of ascoma irregular because of many free hyphae projecting from it. Free hyphae arising from marginal cells numerous, simple or branched, hyaline or brownish and wavy.

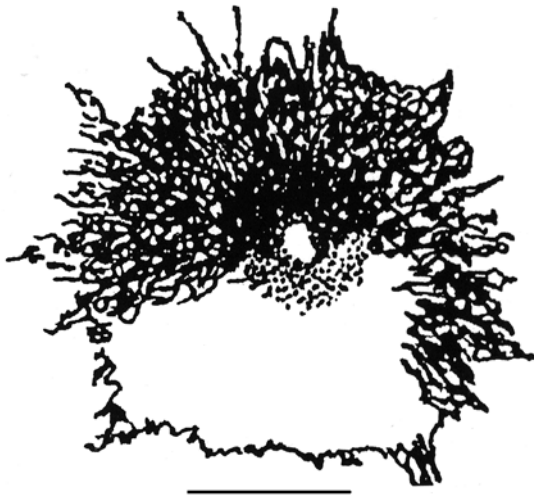


Fig. 299. *Plochmopeltinites keralensis*. Bar = 30 μm .

Locality: Tonakkal, Thiruvananthapuram District, Kerala, India.

Age: Neogene

Indian records: Patil & Ramanujam 1988, p. 265, pl. 2, fig. 9, Miocene, Tonakkal, Thiruvananthapuram District, Kerala.

Genus: *Pluricellaesporites* van der Hammen 1954a emend. Elsik & Jansonius 1974

Mycobank No.: MB 21255.

Type Species: *Pluricellaesporites typicus* van der Hammen 1954a (designated by van der Hammen 1954b, p. 14).

Description (van der Hammen 1954a, p. 104): Fungal spores composed of several grains or cells aligned along a single axis. (Jansonius & Hills 1976, card no. 2047).

Restated Description (Clarke (1965, p. 90): Fungal spores uniseriate, individuals consisting of five to many cells, cells flattened at common boundary, convex on sides, each cell connected by a slit-like opening through the septa.

Emended Description (Elsik 1968, p. 276): Monoporate, psilate fungal or algal spores of three or more cells. Symmetrical or nearly symmetrical around one long axis. Two or more septa. (Sheffy & Dilcher 1971, p. 46): Monoporate, psilate to scabrate fungal or algal spores of three or more cells; two or more septa. Cells linear along one long axis.

Emended Description (Elsik & Jansonius 1974, p. 955): Fungal spores of three or more cells, two or more septa, symmetrical or very nearly so around the long axis. There is a single aperture, pore, hilum or exitus, at one end. Septa may be entire,

perforate or split. Cells are short to long in relation to overall spore length. Spore outline is lenticular, oval or cylindrical. One or two cells at aporate end never constitute the bulk of the spore. Exine is psilate to variously ornamented; if ornament is present it is subdued, i.e. of low relief.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Pluricellaesporites alleppeyensis* Ramanujam & Rao 1978

Mycobank No.: MB 115085.

Remarks: Kalgutkar & Jansonius (2000) transferred this species to *Quilonia* Jain & Gupta 1970 [See: *Quilonia alleppeyensis* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Pluricellaesporites annulatus* Chandra *et al.* 1984 Fig. 300

Mycobank No.: MB 107177.

Description (Chandra *et al.* 1984, p. 52): Elongated fungal spores; size 49 x 20 μm , hexacellate, cells elongated, rectangular, 5 septa, monoporate, pore surrounded by thick annulus, spore wall less than 0.5 μm thick, psilate.



Fig. 300. *Pluricellaesporites annulatus*. Bar = 10 μm .

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary

Indian records: Chandra *et al.* 1984, p. 52, pl. 2, fig. 33, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 2 (Lat. 18°35.2'N: Long. 69°17.2'E), Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Species: *Pluricellaesporites catenatus* Ramanujam & Rao 1978

Mycobank No.: MB 115086.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Cercosporites* Salmon 1903 [See: *Cercosporites catenatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].

Species: *Pluricellaesporites ellipticus* Mathur & Mathur 1969**Mycobank No.:** MB 483856.**Remarks:** Kalgutkar and Jansonius (2000) transferred this species to *Mathurisporites* Kalgutkar & Jansonius 2000 [See: *Mathurisporites ellipticus* (Mathur & Mathur 1969) Kalgutkar & Jansonius 2000].**Species: *Pluricellaesporites elsikii* Samant & Tapaswi 2000, non Kalgutkar 1997.****Mycobank No.:** MB 515011.**Remarks:** *Pluricellaesporites elsikii* Samant & Tapaswi 2000 is illegitimate, being junior homonym of *Pluricellaesporites elsikii* Kalgutkar 1997. For this reason, Saxena (2009) replaced it with a new name [See: *Pluricellaesporites suratensis* Saxena 2009].**Species: *Pluricellaesporites eocenicus* Samant & Tapaswi 2000**

Fig. 301

Mycobank No.: MB 519789.**Description** (Samant & Tapaswi 2000, p. 28): Fungal spores oval in shape; tri to tetracellate; 36-35 X 15-18 μm in size; monoporate; pore small, about 2 μm in diameter, pore margins generally smooth sometimes ruptured, middle cells rectangular in shape, size of individual cell variable; septate, septa about 1-2 μm thick, with or without pore; spore wall < 1 μm in thick; smooth.Fig. 301. *Pluricellaesporites eocenicus*. Bar = 10 μm .**Locality:** Surat District, Gujarat, India.**Age:** Early Eocene (Cambay Shale).**Indian records:** Samant & Tapaswi 2000, p. 28, fig. 2.7, Cambay Shale (Early Eocene), Surat District, Gujarat.**Species: *Pluricellaesporites globatus* Samant in Saxena 2009**

Fig. 302

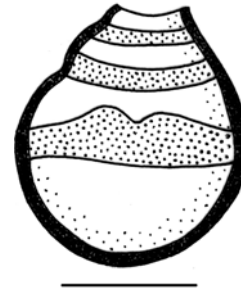
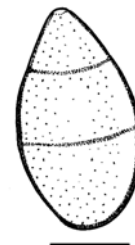
Mycobank No.: MB 515002.*Pluricellaesporites globatus* Samant, Geophytology 28(1-2), p. 15, pl. 1, figs. 22-23. 2000.**Description** (Samant 2000, p. 15): Fungal spore globular in shape; tetracellate; 46-49 x 28-33 μm in size; terminal cell with pore, pore thin margined, terminal cell smaller than rest of the cells; septa about 2-4 μm thick, septa wall curved or straight, contact between septa and spore wall smooth; spore wall about 1 μm thick, smooth.Fig. 302. *Pluricellaesporites globatus*. Bar = 40 μm .**Locality:** Bhavnagar, Cambay Basin, Gujarat, India.**Age:** Early Eocene (Kharsalia Clay Formation).**Indian records:** Samant 2000, p. 15, pl. 1, figs. 22-23, near Bhavnagar, Kharsalia Clay Formation (Early Eocene), Cambay Basin, Gujarat.**Species: *Pluricellaesporites guptae* Saxena 2009**

Fig. 303

Mycobank No.: MB 515010.*Pluricellaesporites minutus* Gupta, Tertiary Research 21, p. 138, pl. 2, fig. 22, text-fig. 2c. 2002, non Kalgutkar & Jansonius 2000.**Description** (Gupta 2002, p. 138): Spores three celled, disepitate, uniseriate, porate, elongate and slightly curved, 14.5-24 μm long, 6-11 μm broad, pore situated at one terminal end, granulate, surface folded, wall ca. 0.5 μm thick.Fig. 303. *Pluricellaesporites guptae*. Bar = 8 μm .

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

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

Indian records: Gupta 2002, p. 138, pl. 2, fig. 22, Subathu Formation (Late Palaeocene to Late Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Pluricellaesporites hillsii* Elsik 1968

Fig. 304

Mycobank No.: MB 519795.

Description (Elsik 1968, p. 276): Eight celled, psilate, monoporate, spore 25 x 48 µm. Apical chamber 5.6 µm wide, 6.4 µm long. Pore 1.5 µm wide, compressed. Spore wall two layered, 0.5 µm thick. Outer layer of wall very thin.



Fig. 304. *Pluricellaesporites hillsii*. Bar = 10 µm.

Locality: Strip mine approximately 7 miles southwest of Rockdale, Milam County, Texas, U.S.A.

Age: Palaeocene.

Indian records: Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam.

Species: *Pluricellaesporites himachalensis* sp. nov.

Fig. 305

Mycobank No.: MB 519948.

Pluricellaesporites sp. in Saxena *et al.*, Geophytology 14(2), p. 187, pl. 2, fig. 33. 1984.

Description: Fungal spore light brown in colour, size 67-77 x 13-15 µm, pentacellate, basal cells flattened, apex round with a single pore, one end of the spore highly constricted to form a cap-like structure, central cells bigger in size, septa disc like, thin few longitudinal folds observed. Spore wall psilate, ±1 µm thick.



Fig. 305. *Pluricellaesporites himachalensis*. Bar = 15 µm.

Holotype: Saxena *et al.* 1984, pl. 2, fig. 33; slide no. 6849, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh, India.

Age: Early Pliocene (Middle Siwalik).

Indian records: Saxena *et al.* 1984, p. 187, pl. 2, fig. 33, Middle Siwalik (Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh.

Species: *Pluricellaesporites kariii* Gupta 2002

Fig. 306

Mycobank No.: MB 540757.

Description (Gupta 2002, p. 140): Spores four to six celled, 3-5 septate, uniseriate, monoporate, elongate, wide at one end and with a narrow, tube like, appendage at the other, 20-47 µm long, pore situated at free end of broader side, largely granulate to subverrucose, sculpturing distinct at wider part but more or less indistinct at appendage, surface folded, wall ca. 0.5 µm thick.



Fig. 306. *Pluricellaesporites kariii*. Bar = 10 µm.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 140, pl. 3, fig. 2, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Pluricellaesporites keralensis* sp. nov.

Fig. 307

MycoBank No.: MB 519950.

Pluricellaesporites sp. in Jain & Kar, *Palaeobotanist* 26(2), p. 111, pl. 3, fig. 37. 1979.

Description: Spore fusiform, 132-150 x 27-30 μm in size, seven-celled, septa distinct, straight, operculum two-celled, spore wall less than 1 μm thick, laevigate.

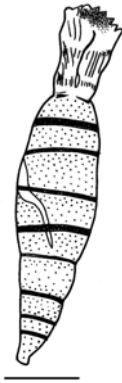


Fig. 307. *Pluricellaesporites keralensis*. Bar = 30 μm .

Holotype: Jain & Kar 1979, pl. 3, fig. 37; slide no. 5417/3, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Around Kollam and Varkala, Kerala, India.

Age: Miocene.

Indian records: Jain & Kar 1979, p. 111, pl. 3, fig. 37, Miocene, around Kollam and Varkala, Kerala.

Species: *Pluricellaesporites longicollus* Sheffy & Dilcher 1971

Fig. 308

MycoBank No.: MB 111833.

Description (Sheffy & Dilcher 1971, p. 46): Tricellate, psilate fungal spore, 6.0 x 24.2 μm . Wall 1 μm thick, light pigment, two disk-shaped septa present. One end is highly tapered into a neck with a single pore.



Fig. 308. *Pluricellaesporites longicollus*. Bar = 5 μm .

Locality: Puryear clay pit, one-half mile south of Puryear, Henry County, Tennessee, U.S.A.

Age: Middle Eocene

Indian records: Kar *et al.* 2010, p. 245, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Pluricellaesporites mehrotrae* sp. nov.

Fig. 309

MycoBank No.: MB 519951.

Pluricellaesporites sp. B in Singh *et al.*, *Palaeobotanist* 35(1), p. 101, pl. 2, fig. 24. 1986.

Description: Fungal spore with blunt ends. Size 98-106 x 36-39 μm . Spore multicellular, 9-11 celled, middle cells wider than the terminal ones. Monoporate, pore apical, pore margin not thickened, 10 μm in diameter. Septa distinct, about 2.5 μm thick, thicker than spore wall. Spore wall less than 0.5 μm thick, pitted, pits sparsely placed.



Fig. 309. *Pluricellaesporites mehrotrae*. Bar = 20 μm .

Holotype: Singh *et al.* 1986, pl. 2, fig. 24; slide no. 8135, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality: Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 101, pl. 2, figs. 11, 24, Lubha and Umkiang Members, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Species: *Pluricellaesporites minutus* Gupta 2002, non Kalgutkar & Jansonius 2000

Mycobank No.: MB 515009.

Remarks: *Pluricellaesporites minutus* Gupta 2002 is illegitimate, being junior homonym of *Pluricellaesporites minutus* Kalgutkar & Jansonius 2000. For this reason, Saxena (2009) replaced it with a new name [See: *Pluricellaesporites guptae* Saxena 2009]

Species: *Pluricellaesporites misrae* Chandra *et al.* 1984

Fig. 310

Mycobank No.: MB 107178.

Description (Chandra *et al.* 1984, p. 52): Oval fungal spores, size range 15-23 x 10-13 µm; tetracellate, terminal cells smaller than those in centre; triseptate, septa 1.5-2.5 µm thick, thicker in centre; monoaperturate, pore apical, 3-5 µm in diameter; spore wall 0.5 µm thick, psilate.

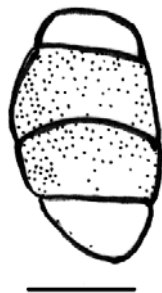


Fig. 310. *Pluricellaesporites misrae*. Bar = 10 µm.

Locality: Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 52, pl. 2, figs. 34-35, Late Quaternary, Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Pluricellaesporites planus* Trivedi & Verma 1970 ex Kalgutkar & Jansonius 2000

Fig. 311

Mycobank No.: MB 320741.

Description (Trivedi & Verma 1970, p. 72): Fungal spores multicellular, two to many cells in a spore, length varies, shape of the spore varies, sometimes upper cells of the spore large and the lower ones small, narrow, sometimes spores longer than broad, sometimes curved at the middle or at some other place, but all have flat septa or nearly dentate; wall smooth, less than 1 µm wide, dark coloured. Size of the different spores varies according to their shape. Length ranges from 66-99 µm, breadth 25-36 µm in larger specimens, 16-22 µm in smaller cells, height of individual cell ranges from 8-15 µm.



Fig. 311. *Pluricellaesporites planus*. Bar = 10 µm.

Locality: Near Kuala Lumpur, Malaya.

Age: Eocene.

Indian records: Kar & Saxena 1976, p. 10, pl. 3, figs. 25-26, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Kar 1979, p. 32, pl. 3, fig. 53, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Bhattacharya 1987, p. 120, Early Eocene, Rajpardi, Broach District, Gujarat; Rajendran *et al.* 1989, p. 42, 43, 44, Miocene, Padappakkara, Varkala, Edavai, Paravur, Kannur, Kerala; Kar 1990a, p. 178, pl. 8, figs. 122-123, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar & Bhattacharya 1992, p. 251, Early Eocene, Rajpardi lignite, Bharuch District, Gujarat; Ambwani 1993, p. 153, Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya; Saxena *et al.* 1996, p. 21, Tura Formation (Palaeocene), Nongwal Bibra area, East Garo Hills District, Meghalaya; Mandaokar 2000b, p. 181, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Tripathi *et al.* 2003, p. 90, Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam.

Species: *Pluricellaesporites psilatus* Clarke 1965

Fig. 312

Mycobank No.: MB 337285.

Description (Clarke 1965, p. 90): Fungal spores uniseriate, individuals consist of five to many cells, cells flattened at common boundaries, convex on sides, cell height 6-10 μm , diameter 13-23 μm , shorter at apices, cell wall psilate, 1-1.5 μm thick, septa 2 μm thick, bidentate, opening through each septum 0.5-1 μm diameter, overall dimensions 13-23 x 82-120 μm .

Fig. 312. *Pluricellaesporites psilatus*. Bar = 20 μm .

Locality: Canon City Coalfield, Fremont County, Colorado, U.S.A.

Age: Late Cretaceous.

Indian records: Ramanujam & Rao 1978, p. 297, pl. 2, fig. 25, Miocene, Kerala; Pathak & Banerjee 1984, p. 249-250, pl. 2, fig. 17, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Varma 1987, p. 167, pl. 1, fig. 5, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Tripathi 1989, p. 73, pl. 3, fig. 3, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh; Samant 2000, p. 16, pl. 1, fig. 16, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Saxena 2000, p. 163, pl. 2, fig. 22, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Species: *Pluricellaesporites rectangulatus* Mathur & Mathur 1969

Fig. 313

Mycobank No.: MB 483855.

Description (Mathur & Mathur 1969, p. 2): Surface view, spores horizontally septate, 45 x 8.5 μm in size, borne on short pedicel, 8-11 septa. Apical cell dome-shaped. Others rectangular; faint germ pores present. Exine ca. 1 μm thick, brown.

Fig. 313. *Pluricellaesporites rectangulatus*. Bar = 10 μm .

Locality: Naera and Baraia area of Kutch District, Gujarat, India.

Age: Pliocene.

Indian records: Mathur & Mathur 1969, p. 2, pl. 1, fig. 1, Pliocene, Naera and Baraia area of Kutch District, Gujarat; Kar 1985, p. 158-159, pl. 37, fig. 1, Pliocene, Baraia, Kutch District, Gujarat.

Species: *Pluricellaesporites sirmaurensis* Gupta 2002

Fig. 314

Mycobank No.: MB 540758.

Description (Gupta 2002, p. 138): Spores four to five celled, 3-4 septate, uniseriate, monoporate, elongate, 22-35 μm long, 7-9 μm broad, pore situated at one terminal end, largely granulate to subverrucose, surface folded.

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

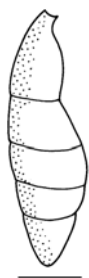


Fig. 314. *Pluricellaesporites sirmaurensis*. Bar = 10 μm .

Indian records: Gupta 2002, p. 138, pl. 3, fig. 1, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

***Pluricellaesporites suratensis* Saxena 2009**

Fig. 315

Mycobank No.: MB 515012

Pluricellaesporites elsikii Samant & Tapaswi, Gondwana Geological Magazine 15(2), p. 28-29, fig. 2.12. 2000, non Kalgutkar 1997.

Description (Samant & Tapaswi 2000, p. 28): Fungal spores oval in shape, septate, pore in every septa present, septa straight, generally thin, rarely with thick flap on septa, middle cells rectangular and variable in size, terminal and basal cells triangular, contact between septa and spore wall smooth; spore wall about 1 μm thick; smooth.



Fig. 315. *Pluricellaesporites suratensis*. Bar = 10 μm .

Locality:, Surat District, Gujarat, India.

Age: Early Eocene (Surat lignite, Cambay Shale).

Indian records: Samant & Tapaswi 2000, p. 28, 29, fig. 2.12, Cambay Shale (Early Eocene), Surat District, Gujarat.

Species: *Pluricellaesporites tamilensis* Saxena & Khare 1992

Fig. 316

Mycobank No.: MB 483894.

Description (Saxena & Khare 1992, p. 39): Spores oval to elongated, non-aperturate end broadly rounded; size range 76-97 x 29-44 μm ; multicellular, six- to nine-celled; septa 1.5-2.5 μm thick; monoporate, pore distinct, terminally placed, 3 μm in diameter; wall up to 1 μm thick, psilate.



Fig. 316. *Pluricellaesporites tamilensis*. Bar = 20 μm .

Locality: Jayamkondacholapuram Well 12, 45 km south of Neyveli, Tiruchirapalli, Tamil Nadu, India.

Age: Miocene

Indian records: Saxena & Khare 1992, p. 39, pl. 1, fig. 16, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Species: *Pluricellaesporites tricellatus* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 317

Mycobank No.: MB 483525.

Multicellaesporites tricellatus Chandra *et al.*, Biovigyanam 10(1), p. 47, pl. 2, fig. 15. 1984.

Description (Chandra *et al.* 1984, p. 47): Elongated rod-shaped fungal spore; size 21 x 6 μm , tricellate, two cells slightly larger than the third one, inaperturate, biseptate, septa thicker than spore wall; spore wall less than 1 μm thick, psilate.



Fig. 317. *Pluricellaesporites tricellatus*. Bar = 10 μ m.

Locality: Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 47, pl. 2, fig. 15, Late Quaternary, Sediment core no. 5 (Lat. 24°04.5'N: Long. 69°26.0'E), Arabian Sea.

Species: *Pluricellaesporites typicus* van der Hammen 1954a

Fig. 318

Mycobank No.: MB 337287.

Description (van der Hammen 1954a, p. 104): Spores 86 x 26 μ m; more or less delicate specimen, colour of burnt sugar.

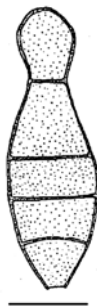


Fig. 318. *Pluricellaesporites typicus*. Bar = 20 μ m.

Locality: Magdalena Valley, Eastern Cordillera, Colombia, South America.

Age: Maastrichtian.

Indian records: Chandra & Kumar 1998, p. 62, pl. 1, fig. 8, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Species: *Pluricellaesporites verrucatus* Singh *et al.* 1986

Fig. 319

Mycobank No.: MB 131934.

Description (Singh *et al.* 1986, p. 100): Fungal spore elongate, with one end wider and the other end tubular. Size 111 x 33 μ m, 18-celled, cells wider in the middle than those towards the apertural end. Monoporate, pore apically placed at the narrower end. Septa 1-1.5 μ m thick. Spore wall 1 μ m thick, granulose-verrucose. Surface view giving a verrucose appearance.



Fig. 319. *Pluricellaesporites verrucatus*. Bar = 20 μ m.

Locality: Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar, Assam, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 100-101, pl. 2, fig. 20, Lubha Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Genus: *Polyadosporites* van der Hammen 1954a emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21256.

Type species: *Polyadosporites suescae* van der Hammen 1954a.

Description (van der Hammen 1954a, p. 105): Fungal spores composed of several grains or cells that are united along several axes or in a more or less irregular manner (Jansonius & Hills 1976, card no. 2074).

Emended Description (Kalgutkar & Jansonius 2000, p. 248): Spores subspherical, loosely aggregated in clusters, with individual cells not connected to others by shared walls; clusters (colonies?) more or less regularly spherical to subspherical.

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Polyadosporites nadahensis* Rao & Patnaik 2001
Fig. 320

Mycobank No.: MB 519784.

Description (Rao & Patnaik 2001, p. 270, 272): Fungal spore colonies composed of number of cells, 16-20 in number. Overall size range 90-130 x 65-90 μm . Inaperturate. Individual cells more or less subspherical in shape, variation in overall shape and size, size range 35-42 x 28-33 μm . Wall 1 μm thick, perforated, surface showing finely pitted reticulate ornamentation.

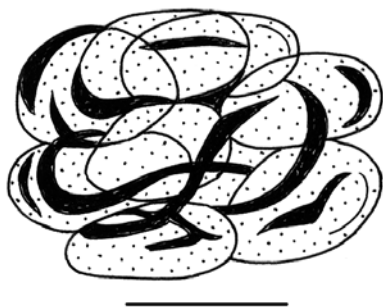


Fig. 320. *Polyadosporites nadahensis*. Bar = 40 μm .

Locality: Nadah, Panchkula, Haryana, India.

Age: Late Pliocene (Upper Siwalik, Pinjor Formation).

Indian records: Rao & Patnaik 2001, p. 270, 272, pl. 1, figs. 14-16, Pinjor Formation (Late Pliocene), Nadah, Panchkula, Haryana.

Species: *Polyadosporites siwalikus* Rao & Patnaik 2001

Fig. 321

Mycobank No.: MB 519785.

Description (Rao & Patnaik 2001, p. 272): Fungal spores composed of number of individual subspherical cells, cells inaperturate. Size range 127-145 x 112-120 μm . Cell wall thin, septa connecting to 2 or 3 cells, 1-2 μm thick, smooth.

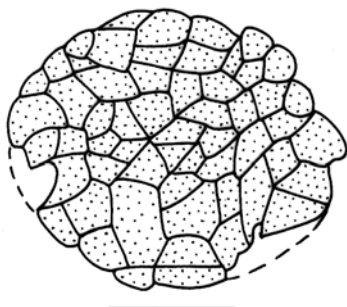


Fig. 321. *Polyadosporites siwalikus*. Bar = 40 μm .

Locality: Nadah, Panchkula, Haryana, India.

Age: Late Pliocene (Upper Siwalik, Pinjor Formation).

Indian records: Rao & Patnaik 2001, p. 272, pl. 3, figs. 6, 9, Pinjor Formation (Late Pliocene), Nadah, Panchkula, Haryana.

Genus: *Polycellaesporonites* Chandra *et al.* 1984

Mycobank No.: MB 25604.

Type Species: *Polycellaesporonites bellus* Chandra *et al.* 1984.

Description (Chandra *et al.* 1984, p. 48): Capsular fungal spores; inaperturate; one end of the spore is rounded while the other gives rise to a tube-like projection; multicellate; cells arranged in clusters, and not in a row or along a single axis; spore wall laevigate.

Emended Description (Kalgutkar & Jansonius 2000, p. 249): Muriform spores with a hilum, and distally with an elongated, knob-like or beaked, extension; overall structure as that in the modern *Alternaria*.

Emended Description (Gupta 2002, p. 145): Capsular spore, one end of the spore gives rise to tube like projection, multicellate, inaperturate, cells arranged in clusters and not in a row or along a single axis, spore wall laevigate to ornamented.

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Polycellaesporonites alternariatus* (Kalgutkar & Sigler 1995) Kalgutkar & Jansonius 2000

Fig. 322

Mycobank No.: MB 483527.

Piriurella alternariata Kalgutkar & Sigler, Mycological Research 99, p. 518, fig. 14. 1995.

Description (Kalgutkar & Sigler 1995, p. 518): 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.

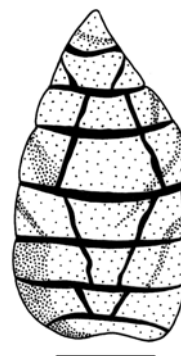


Fig. 322. *Polycellaesporonites alternariatus*. Bar = 15 μm .

Locality: Iceberg Bay Formation at Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada.

Age: Late Palaeocene or Early Eocene.

Indian records: Saxena & Ranhotra 2009, p. 692, fig. 3.30, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Polycellaesporonites bellus* Chandra *et al.* 1984
Fig. 323

MycoBank No.: MB 107183.

Description (Chandra *et al.* 1984, p. 49): Fungal spore with a capsular body and a tube-shaped unicellular appendage emerging from one end; size range 45-68 x 13-15 µm; main body of spore 33-48 x 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.

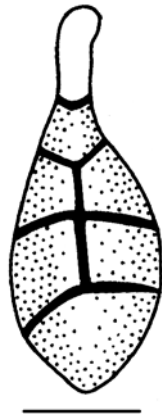


Fig. 323. *Polycellaesporonites bellus*. Bar = 15 µm.

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 49, pl. 2, figs. 20-21, text-fig. 2, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea; Saxena *et al.* 1988, p. 277, pl. 2, fig. 30, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Saxena & Bhattacharyya 1987, p. 189, Lower Siwalik-Nahan and Upper Siwalik (Middle Miocene-Pliocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh; Saxena & Bhattacharyya 1990, p. 113, Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh; Saxena & Ranhotra 2009, p. 692, fig. 3.31-32, Intertrappean Beds (Early Palaeocene), 5 km west of Naredi, on Naliya-Narayan Sarovar Road, Kutch District, Gujarat.

Species: *Polycellaesporonites psilatus* Gupta 2002

Fig. 324

MycoBank No.: MB 540760.

Description (Gupta 2002, p. 146): 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.



Fig. 324. *Polycellaesporonites psilatus*. Bar = 10 µm.

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation)

Indian records: Gupta 2002, p. 146, pl. 4, fig. 7, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Species: *Polycellaesporonites saxenae* Gupta 2002

Fig. 325

MycoBank No.: MB 540761.

Description (Gupta 2002, p. 145): Spores multicelled, elongate, showing cells arranged in clusters along more than one axis at one end 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.



Fig. 325. *Polycellaesporonites saxenae*. Bar = 5 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 145, pl. 4, fig. 4, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Polycellaesporonites sirmaurensis* Gupta 2002

Fig. 326

Mycobank No.: MB 540762.

Description (Gupta 2002, p. 145): Spores multicelled, elongate, showing cells arranged in clusters along more than one axis at one end and a tube like appendage at other, inaperturate, measuring 16-58 μ m long, number of cells across the width of cells cluster ranges up to 2, largely granulate, sculptural elements distinct at appendage, surface folded.



Fig. 326. *Polycellaesporonites sirmaurensis*. Bar = 15 μ m.

Locality: Dadahu Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 145, pl. 4, fig. 3, Subathu Formation (Eocene), Dadahu Road Section, Sirmaur District, Himachal Pradesh.

Genus: *Polyhyphaethyrites* Srivastava & Kar 2004

Mycobank No.: MB 28837.

Type species: *Polyhyphaethyrites giganticus* Srivastava & Kar 2004 (by monotypy).

Description (combined description, Srivastava & Kar 2004, p. 866-867): The ascostromatas are dimidiate and generally subcircular in shape with wavy margin, sometimes they are oval and while broken, may be semicircular. The size is unusually larger than the other known fossil ascocarps and varies from 3.5 to 4.0 mm. It has no opening in the middle, but in section the middle part is ruptured occasionally giving an ostiolate appearance. The hyphae of the specimens are characteristic; 8-25 hyphae are closely placed side by side to form radial and transverse strands, which are slightly twisted and rope-like. The strands are interconnected with each other to form a net-like structure. The cellular structures seen are often branched at the margin. The free hyphae are not observed and the stroma is one-celled. The margin is generally setose and the cells are thicker with smaller meshes.

Classification: Ascomycetes, Microthyriales.

Species: *Polyhyphaethyrites giganticus* Srivastava & Kar 2004

Fig. 327

Mycobank No.: MB 369429.

Description: Same as that of genus (combined description).

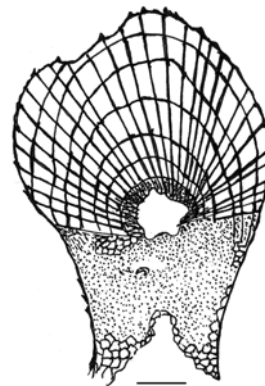


Fig. 327. *Polyhyphaethyrites giganticus*. Bar = 500 μ m.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Palaeocene (Deccan Intertrappean Beds).

Indian records: Srivastava & Kar 2004, p. 866-867, fig. 2, Deccan Intertrappean Beds (Palaeocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Protocolletotrichum* Kar *et al.* 2004

Mycobank No.: MB 29100.

Type species: *Protocolletotrichum deccanensis* Kar *et al.* 2004.

Description (Kar *et al.* 2004, p. 947): Acervuli subcircular to circular in shape, 0.03-0.05 mm in diameter, sparsely distributed on cuticle; margins slightly raised, setose. Setae arise around the margins, stout, 0.05-1.2 mm long and <0.01 mm broad, dark brown in colour, slightly swollen at base, pointed at tip, unbranched, smooth, 1-2 septate, very slightly constricted at septae.

Classification: Deuteromycetes, Melanconiaceae.

Species: *Protocolletotrichum deccanensis* Kar *et al.* 2004

Fig. 328

Mycobank No.: MB 521754.

Description (Kar *et al.* 2004, p. 947): Around 30 haphazardly placed acervuli are preserved on a cuticle fragment up to 0.5 cm long and 0.1 cm broad that lacks cellular or stomatal details. The 20-35 setae that originate from the margins of each acervulus are unbranched and slightly divergent, with broad bases and pointed tips; in some cases their tips are broken. The cell walls of the setae are ca. 2 µm thick and more or less pilate.

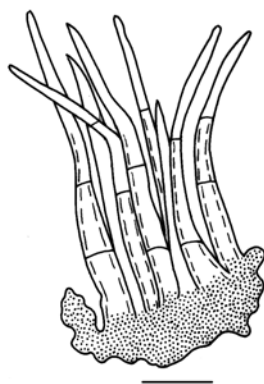


Fig. 328. *Protocolletotrichum deccanensis*. Bar = 10 µm.

Locality: Mohgaon-Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Maastrichtian (Deccan Intertrappean Bed).

Indian records: Kar *et al.* 2004, p. 947, figs. 3A, C-E, Deccan Intertrappean Bed (Maastrichtian, Mohgaon-Kalan, Chhindwara District, Madhya Pradesh; Kar *et al.* 2010, p. 245, Bhuban Formation (Miocene), Tlamsam, Mizoram).

Genus: *Protoerysiphe* Sharma *et al.* 2005 (nom. inval.)

Mycobank No.: MB 29099.

Type Species: *Protoerysiphe indicus* Sharma *et al.* 2005 (nom. inval.).

Description (Sharma *et al.* 2005, p. 76): (Diagnosis): Cleistotheca dark, subcircular, size range 67-89 µm, reticulate, with free appendages, appendages of various sizes, superficial mycelia anchoring the cleistothecium also occasionally observed. (Description): Cleistotheca generally ruptured due to liberation of asci, reticulum square - rectangular in shape. Appendages long, myceloid, 15-20 in number, 3-4 septate, wall thick, end pointed, superficial mycelia translucent.

Classification: Fungi, Incertae sedis.

Remarks: Sharma *et al.* (2005) proposed the generic name *Protoerysiphe*, but neither mentioned slide number nor repository of the holotype. The generic name, and also the name of its type species (*Protoerysiphe indicus* Sharma *et al.* 2005), are therefore not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006).

Species: *Protoerysiphe indicus* Sharma *et al.* 2005 (nom. inval.)

Mycobank No.: MB 529981.

Description (Sharma *et al.* 2005, p. 76): Cleistotheca subcircular-oval, mostly ruptured, reticulate. Appendages often broken, flaccid, resemble the hyphae, sometimes entangled, generally septate at regular intervals.

Locality: Pisdura, Maharashtra, India.

Age: Maastrichtian (Lameta Formation).

Indian records: Sharma *et al.* 2005, p. 76, pl. 2, fig. 4, Lameta Formation (Maastrichtian), Pisdura, Maharashtra.

Remarks: While proposing the new species, *Protoerysiphe indicus*, Sharma *et al.* (2005) made no mention of holotype slide and its repository, hence the species name is not validly published (ICBN: Art. 37.7, McNeill *et al.* 2006).

Genus: *Pseudosphaerialites* Venkatachala & Kar 1969

Mycobank No.: MB 21269.

Type Species: *Pseudosphaerialites senii* Venkatachala & Kar 1969.

Description (Venkatachala & Kar 1969, p. 180): Perithecium 100-140 µm, dark brown, subcircular-circular in overall shape, mostly one cell thick; 4-5 cells in the middle part of the perithecium darker than the adjacent region and lacking a hypha; perithecium pseudoparenchymatous, formed by

radiating hyphae; cells in the middle region more or less square (4 x 5 µm), but more rectangular closer to the periphery (10 x 3 µm). Outer cells thickened on periphery, minutely setose; stromatic cavities adjacent to central part possess one transparent hypha in each cell, but not all outer cells of the perithecium have one. Asci not seen but it seems that one ascus developed in each cavity.

Classification: Ascomycetes, Microthyriales.

Remarks: Jain & Gupta (1970) classified *Pseudosphaerialites* under non-ostiolate ascomata with porate cells, along with *Callimothallus*. Elsik (1978) considered *Pseudosphaerialites* a synonym of *Callimothallus* Dilcher 1965.

Species: *Pseudosphaerialites senii* Venkatachala & Kar 1969

Mycobank No.: MB 321867.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Callimothallus* Dilcher 1965 [See: *Callimothallus senii* (Venkatachala & Kar 1969) Kalgutkar & Jansonius 2000].

Genus: *Psidimobipiospora* Salard-Cheboldaeff & Locquin 1980

Mycobank No.: MB 25598.

Type Species: *Psidimobipiospora dyadospora* Salard-Cheboldaeff & Locquin 1980.

Description (Salard-Cheboldaeff & Locquin 1980, p. 191): Smooth dihilate didymospores.

Remarks: *Psidimobipiospora* Salard-Cheboldaeff & Locquin 1980 is a junior synonym of *Dyadosporites* van der Hammen 1954b ex Clarke 1965.

Species: *Psidimobipiospora scabrata* Kumar 1990

Mycobank No.: MB 126568.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites scabratus* (Kumar 1990) Kalgutkar & Jansonius 2000].

Genus - *Psilainaperturites* Pierce 1961

Mycobank No.: MB 30413.

Type Species: *Psilainaperturites psilatus* Pierce 1961

Description (Pierce 1961, p. 44): Psilate, inaperturate sporomorphs.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Psilainaperturites ovalis* Mathur 1966

Mycobank No.: MB 483820.

Remarks: See: *Monoporisorites mathurii* Kalgutkar & Jansonius 2000, non *Monoporisorites ovalis* Sheffy & Dilcher 1971

Genus: *Psilodiporites* Varma & Rawat 1963

Mycobank No.: MB 25664.

Type Species: *Psilodiporites hammenii* Varma & Rawat 1963.

Description (Varma & Rawat, p. 131): Diporate pollen grains with psilate exine (which may sometimes appear finely scabrate under high power).

Classification: Angiospermae.

Species: *Psilodiporites bhardwaji* Varma & Rawat 1963

Mycobank No.: MB 106421.

Dyadosporonites bhardwaji (Varma & Rawat) Elsik 1968 (nom. inval.).

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dyadosporites* van der Hammen 1954b ex Clarke 1965 [See: *Dyadosporites bhardwaji* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

Species: *Psilodiporites cooksoniae* Varma & Rawat 1963

Diporisporites cooksoniae (Varma & Rawat 1963) Elsik 1968 (nom. inval.).

Remarks: The holotype, published by Varma and Rawat (1963) is an angiosperm pollen, not a fungal spore. Kalgutkar and Jansonius (2000) transferred this species to pollen genus *Diporoconia* Frederiksen *et al.* 1985 as *Diporoconia? cooksoniae* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000.

Species: *Psilodiporites gunniae* Varma & Rawat 1963

Mycobank No.: MB 106424.

Diporisporites gunniae (Varma & Rawat) Elsik 1968 (nom. inval.).

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Foveodiporites* Varma & Rawat 1963 [See: *Foveodiporites gunniae* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

Species: *Psilodiporites hammenii* Varma & Rawat 1963

Remarks: The holotype, published by Varma and Rawat (1963) is an angiosperm pollen, not a fungal spore.

Species: *Psilodiporites krempii* Varma & Rawat 1963

Mycobank No.: MB 106426.

Diporisporites krempii (Varma & Rawat) Elsik 1968 (nom. inval.).

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Biporipsilonites* Kalgutkar & Jansonius 2000 [See: *Biporipsilonites krempii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

Genus: *Pucciniasporonites* Ramanujam & Ramachar 1980

Mycobank No.: MB 28628.

Type Species: *Pucciniasporonites arcotensis* Ramanujam & Ramachar 1980.

Description (Ramanujam & Ramachar 1980, p. 82): Teliospores borne singly on pedicels, two-celled by prominent horizontal

septum; wall thick, pigmented; one germ pore in each cell, more or less terminal in upper (distal) cell, and lateral in lower (proximal) cell.

Classification: Basidiomycetes, Uredinales.

Species: *Pucciniasporonites arcotensis* Ramanujam & Ramachar 1980

Fig. 329

Mycobank No.: MB 483757.

Description (Ramanujam & Ramachar 1980, p. 82): Teliospores two-celled by horizontal septum, pedicellate, obovoid to elliptical, 25-35 x 10-12 µm excluding stalk, not constricted at septum, individual cells up to 13 µm long and 12 µm broad; wall chestnut-brown, often darkly so, smooth, up to 3 µm thick, pedicel light coloured, up to 8 µm long; one germ pore in each cell, faint, up to 2 µm in diameter.



Fig. 329. *Pucciniasporonites arcotensis*. Bar = 10 µm.

Locality: Neyveli lignite, Tamil Nadu, India.

Age: Miocene.

Indian records: Ramanujam & Ramachar 1980, p. 82, pl. 1, figs. 4-6, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Genus: *Punctodiporites* Varma & Rawat 1963

Mycobank No.: MB 28617.

Type Species: *Punctodiporites harrisii* Varma & Rawat 1963.

Description (Varma & Rawat 1963, p. 136): Diporate grains with punctate exine.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Kalgutkar and Jansonius 2000 considered this genus a junior synonym of *Foveodiporites* Varma & Rawat 1963.

Species: *Punctodiporites harrisii* Varma & Rawat 1963

Mycobank No.: MB 483373.

Diporisporites harrisii (Varma & Rawat) Elsik 1968 (nom. inval.)

Remarks: Kalgutkar & Jansonius (2000) transferred this species to *Foveodiporites* Varma & Rawat 1963 [See: *Foveodiporites harrisii* (Varma & Rawat 1963) Kalgutkar & Jansonius 2000].

Genus: *Pycnidites* Chitale & Patil 1970 (nom. inval.)

Type Species: *Pycnidites acanthocaulous* Chitale & Patil 1970 (nom. inval.).

Classification: Deuteromycetes.

Species: *Pycnidites acanthocaulous* Chitale & Patil 1970 (nom. inval.)

Indian records: Chitale & Patil 1970, p. 337, Deccan Intertrappean Series (Early Tertiary), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Q

Genus: *Quilonia* Jain & Gupta 1970 emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21272.

Type Species: *Quilonia typica* Jain & Gupta 1970.

Description (Jain & Gupta 1970, p. 180): Body multicellular, filamentous. Exine thick, margin undulated. Apical and basal portions narrow, central section wide. Basal stalk prominent with one or two rectangular thick-walled cells; apical cell mostly incomplete, curved, central portion broad, elongate with irregularly shaped furrow-like suture, inside the filament at different places occur one to four small circular, ostiolate bodies.

Emended Description (Kalgutkar & Jansonius 2000, p. 257): Pluricellate hilate fungal spores, with an oval to elongate obpyriform pigmented central section, the greatest width of which tends to be near the proximal end; spore distally extended into a (very) elongated multiseptate narrow stalk that terminates in a closed cell, although the tip of the stalk is commonly lacking; proximally, there is a short tapering stalk with a hilate scar. Both stalks tend to be thin-walled or hyaline.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Quilonia alleppeyensis* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000

Fig. 330

Mycobank No.: MB 483529.

Pluricellaesporites alleppeyensis Ramanujam & Rao, in Bharadwaj, D. C. *et al.* (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow, p. 297, pl. 2, fig. 29. 1978.

Description (Ramanujam & Rao 1978, p. 297): Spores melanin-coloured, straight to slightly curved, inaperturate, uniseriate, multicellate, 80-165 μm long. Septa 8-16, lower part of spore broader, apical part narrower, tail-like; broader part confined to first 5 cells, 30 x 13 μm , narrower, tail-like part 3 μm broad. Basal cell conicotruncate. Spore wall 1-1.5 μm thick, septa in the lower, broad portion thicker than spore wall. Surface scabrate to finely granular in the lower part, psilate apically.



Fig. 330. *Quilonia alleppeyensis*. Bar = 20 μm .

Locality: Alleppey, Kerala, India.

Age: Miocene (Quilon and Warkalli beds)

Indian records: Ramanujam & Rao 1978, p. 297-298, pl. 2, figs. 29-30, Miocene, Kerala; Pathak & Banerjee 1984, p. 250, pl. 2, fig. 18, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Mallesham *et al.* 1989, p. 15, pl. 1, fig. 19, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Species: *Quilonia attenuata* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000

Fig. 331

Mycobank No.: MB 483530.

Diporicellaesporites attenuatus Ramanujam & Srisailam, Botanique 9(1-4), p. 127, pl. 2, fig. 21. 1980.

Description (Ramanujam & Srisailam 1980, p. 127): Spores brownish, elongate fusiform, 30-59.5 x 10-13.6 μm , transverse septa seven, end cells prominently attenuating, paler or almost hyaline, a prominent pore in each end cell; septa conspicuous, 3.4 μm thick, 2-layered, spore wall up to 2.2 μm thick, slightly constricted at septa, surface psilate.



Fig. 331. *Quilonia attenuata*. Bar = 5 μm .

Locality: Palayangadi and Kannur, Cheruvattur, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 127-128, pl. 2, fig. 21, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Species: *Quilonia miocenica* (Singh *et al.* 1986) Kalgutkar & Jansonius 2000

Fig. 332

Mycobank No.: MB 483536.

Inapertisporites miocenicus Singh *et al.*, Palaeobotanist 35(1), p. 97, pl. 2, fig. 13. 1986.

Description (Singh *et al.* 1986, p. 97): Fungal spores elongate; 112-218 x 21-24 μm , unicellate, aseptate, inaperturate. Spores pointed at one end, blunt at the other. Spore wall hyaline, laevigate and irregularly folded.

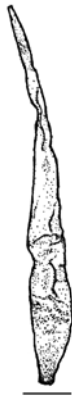


Fig. 332. *Quilonia miocenicus*. Bar = 10 μm .

Locality: 173 km stone, Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya, India.

Age: Early Miocene (Bhuban Formation).

Indian records: Singh *et al.* 1986, p. 97, pl. 2, figs. 12-13, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Quilonia multicellata* (Saxena & Khare 1992) Kalgutkar & Jansonius 2000

Fig. 333

Mycobank No.: MB 483537.

Diporicellaesporites multicellatus Saxena & Khare, *Geophytology* 21, p. 39, pl. 1, fig. 3. 1992.

Description (Saxena & Khare 1992, p. 39): Spores elliptical to elongated, tapering towards the ends; size range 79-144 x 21-

32 μm ; octacellate to dodecacellate, middle cells rectangular whereas terminal cells elongated; septa distinct, 2-4 μm thick; diporate, pores terminal, distinct, 4.5-5.5 μm in diameter; wall 1.5 μm thick, psilate to faintly punctate.



Fig. 333. *Quilonia multicellata*. Bar = 20 μm .

Locality: Jayamkondacholapuram Well-12, 45 km south of Neyveli, Tiruchirapalli District, Tamil Nadu, India.

Age: Eocene (Neyveli Formation).

Indian records: Saxena & Khare 1992, p. 39, pl. 1, fig. 3, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Species: *Quilonia prakashii* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000

Fig. 334

Mycobank No.: MB 483538.

Diporicellaesporites prakashii Chandra *et al.*, *Biovigyanam* 10(1), p. 54, pl. 2, fig. 39. 1984.

Description (Chandra *et al.* 1984, p. 54): Elongated fungal spore; size 62 x 10 μm ; septacellate, middle cells larger than the terminal ones; 6-septate; diporate, one pore at each apex of the spore; spore wall 1 μm thick, psilate, pigment medium to dark.



Fig. 334. *Quilonia prakashii*. Bar = 10 μ m.

Locality: Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Arabian Sea.

Age: Late Quaternary.

Indian records: Chandra *et al.* 1984, p. 54, pl. 2, fig. 39, Late Quaternary, Sediment core no. 1 (Lat. 17°57.9'N: Long. 70°46.0'E), Sediment core no. 4 (Lat. 21°10.0'N: Long. 70°26.9'E), Arabian Sea.

Species: *Quilonia typica* Jain & Gupta 1970

Fig. 335

Mycobank No.: MB 322212.

Description (Jain & Gupta 1970, p. 181): Body multicellular, filamentous, measuring 175-215 x 10-25 μ m. Basal stalk distinct, with one or two rectangular cells, 8-10 μ m with unevenly thickened walls. Apical portion curved and incompletely preserved, central portion broad, elongate. Exine 1.5-2.5 μ m thick, at places dense due to accumulation of upper loose covering. Furrow prominent, 40-67.5 x 2-2.5 μ m. Some small, circular, 8-10 μ m bodies occur throughout the filament.

Locality: Padappakkara, Kollam, Kerala, South India.

Age: Miocene

Indian records: Jain & Gupta 1970, p. 181, pl. 1, fig. 19, Miocene, Padappakkara, Kollam, Kerala, South India.



Fig. 335. *Quilonia typica*. Bar = 20 μ m.

R

Genus: *Rabenhorstinidium* Singh & Patil 1980

Mycobank No.: MB 21274.

Type Species: *Rabenhorstinidium intertrappeum* Singh & Patil 1980.

Description (Singh & Patil 1980, p. 17): Pycnidium isolated, circumscissile, ostiolate; ostiole covered by sterile stroma, immersed; conidiophores unbranched; conidia oval-spherical, in chains, 1-celled.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Rabenhorstinidium intertrappeum* Singh & Patil 1980

Fig. 336

Mycobank No.: MB 109228.

Description (Singh & Patil 1980, p. 17): Pycnidium isolated, black, thin-walled, circumscissile, 100 x 110 μ m in size, ostiole covered by sterile stroma; wall pseudoparenchymatous, inner wall distinct; conidiophore unbranched, 5-7 μ m long; conidia spherical, 1-5 μ m in diameter, in chains of 2-4; mycelium branched, septate, intercellular. Host: dicotyledonous wood.

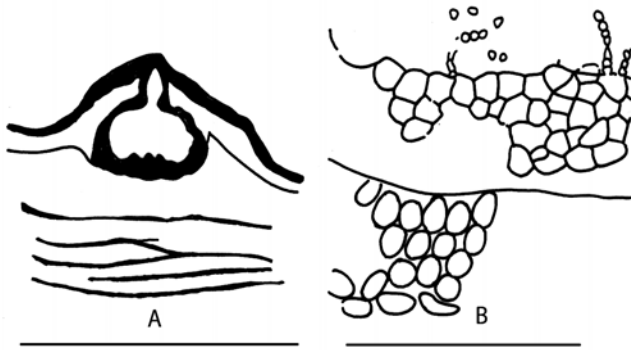


Fig. 336. *Rabenhorstinidium intertrappeum*. A. Pycnidium. Bar = 250 μm , B. Stroma cells, part of pycnidium wall and conidia. Bar = 50 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous (Deccan Intertrappean Series).

Indian records: Singh & Patil 1980, p. 17-18, pl. 1, figs. 5, 8, text-figs. 7-8, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Ramasricellites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28623.

Type Species: *Ramasricellites differentialis* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 259): Fungal spores inaperturate, tetracellate, ellipsoidal, with central cells broader, thicker walled and more pigmented than the terminal cells; terminal cells thin-walled to hyaline, with rounded ends; septa (or septal bases) thick and dark, evenly spaced.

Classification: Fungi Imperfecti, Phragmosporae.

Remarks: The sharp differentiation between the dark, broad central cells and the narrower, elongate hyaline terminal cells, as well as the lack of constriction at the median septum, differentiate this form from species in *Multicellites*.

Species: *Ramasricellites differentialis* (Ramanujam & Srisailam 1980) Kalgutkar & Jansonius 2000

Fig. 337

Mycobank No.: MB 483539.

Multicellaesporites differentialis Ramanujam & Srisailam, Botanique 9(1-4), p. 121, pl. 1, fig. 3. 1980.

Description (Ramanujam & Srisailam 1980, p. 121): Spores tetracellate, 25-35 x 7-8.5 μm with evenly spaced transverse

septa, terminal two cells almost hyaline, 9 x 5.1 μm , tapering; central two cells brown, broader, 6.8 x 8.5 μm , septa dark band-like, up to 2.5 μm thick, wall 1.7 μm thick in terminal cells, thicker in central cells, surface psilate uniformly.



Fig. 337. *Ramasricellites differentialis*. Bar = 10 μm .

Locality: Palayangadi and Cheruvattur, Kannur, Kerala, India.

Age: Miocene (Warkalli Beds).

Indian records: Ramanujam & Srisailam 1980, p. 121, pl. 1, fig. 3, Warkalli Beds (Miocene), Kannur District, Kerala.

Genus - *Ratnagiriathyrites* Saxena & Misra 1990

Mycobank No.: MB 28615.

Type Species: *Ratnagiriathyrites hexagonalis* Saxena & Misra 1990

Description (Saxena & Misra 1990, p. 268): Ascstromata subcircular or irregular in shape, dark brown, non-ostiolate, cells not arranged radially, porate, pores generally distributed throughout stromata, cells hexagonal, bigger towards periphery than in the central region; margin thick, wavy.

Classification: Ascomycetes, Microthyriales.

Species: *Ratnagiriathyrites hexagonalis* Saxena & Misra 1990

Fig. 338

Mycobank No.: MB 483356.

Description (Saxena & Misra 1990, p. 270): Ascstromata subcircular in shape, dark brown, non-ostiolate, size range 66-114 x 55.5-90 μm , cells not arranged radially, porate, pores mostly distributed throughout the ascstromata, marginal cells aporate, cells hexagonal, sometimes pentagonal, cells increasing in size towards periphery, margin thick, wavy.

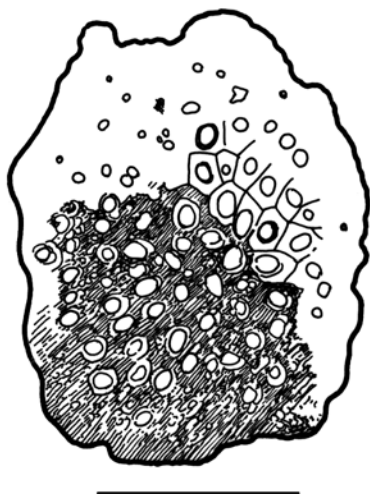


Fig. 338. *Ratnagiriathyrites hexagonalis*. Bar = 50 μm .

Locality: Amberiwadi Section, Sindhudurg District, Maharashtra, India.

Age: Neogene (Ratnagiri beds).

Indian records: Saxena & Misra 1990, p. 270, pl. 2, fig. 14, pl. 3, fig. 11, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Rao 2004, p. 124, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.

Genus: *Ravenelites* Ramanujam & Ramachar 1980

Mycobank No.: MB 28630.

Type Species: *Ravenelites tirumalacharii* Ramanujam & Ramachar 1980.

Description (Ramanujam & Ramachar 1980, p. 83): Teliospores one-celled but strongly adherent, forming discoid heads. Number of spores in each telial head variable; outer walls of peripheral cells (spores) of each head smooth or ornamented; wall pigmented; one germ pore in each cell (spore) of discoid head.

Classification: Fungi Imperfecti, Dictyosporae.

Remarks: Kalgutkar and Jansonius 2000 considered this genus a junior synonym of *Dictyosporites* Felix 1894.

Species: *Ravenelites tirumalacharii* Ramanujam & Ramachar 1980

Mycobank No.: MB 483759.

Remarks: Since *Ravenelites* Ramanujam & Ramachar 1980 is a junior synonym of *Dictyosporites* Felix 1894, Kalgutkar and Jansonius (2000) transferred this species to *Dictyosporites* Felix 1894 (See: *Dictyosporites tirumalacharii* Ramanujam & Ramachar 1980) Kalgutkar & Jansonius 2000].

Genus: *Reduviasporonites* Wilson 1962

Mycobank No.: MB 21278.

Type Species: *Reduviasporonites catenulatus* Wilson 1962.

Description (Wilson 1962, p. 91): Conidia-like spores occurring in uniseriate chains (phragmospores?) of several or more individuals; subspherical, slightly flattened at the contacts with adjacent spores, all approximately same diameter, walls 1-2 μm thick, uniform, smooth or slightly rough, yellow or brown, translucent.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Reduviasporonites catenulatus* Wilson 1962

Fig. 339

Mycobank No.: MB 338248.

Description (Wilson 1962, p. 94): Description as for the genus; consisting of a variable number of spores in moniliform chains, largest number observed 10; diameter of spores 13-23 μm ; normally subspherical, flattened specimens have compression folds and cracks. Holotype, an eight-spore chain; length of chain 118.2 μm , length of spores 15.76-23 μm , width of spores 15.76-21.67 μm .



Fig. 339. *Reduviasporonite catenulatus*. Bar = 20 μm .

Locality: North bank of Salt Fork of the Red River, Greer County, Oklahoma, U.S.A.

Age: Late Permian.

Indian records: Singh & Tripathi 2010, p. 12, pl. 1, fig. 19, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Reduviasporonites curvatus* (Ambwani 1983)
Kalgutkar & Jansonius 2000

Fig. 340

Mycobank No.: MB 483543.

Multicellaesporites curvatus Ambwani, *Palaeobotanist* 31(2), p. 149, pl. 1, fig. 3. 1983.

Description (Ambwani 1983, p. 149): Fungal spores uniseriate, dark brown; about 9-10 cells unite to form a filament; filament curved in shape. Cells separated by septa; constriction present at the junction of two cells. Size of the filament around $\pm 100 \mu\text{m}$. Individual spores inaperturate, circular, subcircular to ovate, measuring about $\pm 12 \mu\text{m}$ in size. Exine $2 \mu\text{m}$ thick and laevigate.

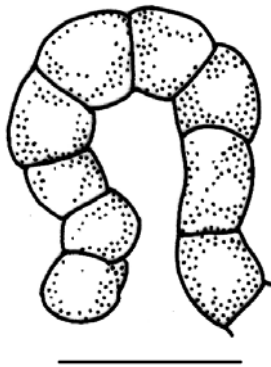


Fig. 340. *Reduviasporonites curvatus*. Bar = $20 \mu\text{m}$.

Locality: Neyveli, South Arcot District, Tamil Nadu, India.

Age: Miocene (Neyveli lignite).

Indian records: Ambwani 1983, p. 149, pl. 1, figs. 3-4, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Species: *Reduviasporonites prakashii* (Ambwani 1982)
Kalgutkar & Jansonius 2000

Fig. 341

Mycobank No.: MB 483545.

Multicellaesporites prakashii Ambwani, *Palaeobotanist* 30(1), p. 30, pl. 1, fig. 11. 1983.

Description (Ambwani 1982, p. 30): Tetracellate spore, size varies up to $80 \times 20 \mu\text{m}$, cells arranged along the longer axis (with 3 dark septa), individual spore spherical in shape, $\pm 20 \mu\text{m}$ in size, spore wall laevigate and $1.5 \mu\text{m}$ thick. Spores dark brown.



Fig. 341. *Reduviasporonites prakashii*. Bar = $20 \mu\text{m}$.

Locality: Kotta-Bommuru Village, Rajahmundry, Andhra Pradesh, India.

Age: Early Eocene

Indian records: Ambwani 1982, p. 30, pl. 1, fig. 11, Deccan Intertrapean Series (Early Eocene) Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh.

Genus: *Retidiporites* Varma & Rawat 1963

Mycobank No.: MB 21280.

Type Species: *Retidiporites bengalensis* Varma & Rawat 1963.

Description (Varma & Rawat 1963, p. 137): Diporate grains with reticulate exine.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Retidiporites bengalensis* Varma & Rawat 1963

Fig. 342

Mycobank No.: MB 106439.

Description (Varma & Rawat 1963, p. 137): Pollen grains 2-porate, bilateral, isopolar, barrel-shaped to somewhat laterally elongated (about $27 \times 45.6 \times 27 \mu\text{m}$). Pores presumably circular, about $5.7 \times 8.6 \mu\text{m}$ in diameter, slightly sunken, not covering the entire width of the lateral ends. Exine very faintly reticulate, about $1.5 \mu\text{m}$. Nexine about twice as thick as sexine.



Fig. 342. *Retidiporites bengalensis*. Bar = 20 μ m.

Locality: Western and eastern India, including oil exploration areas in West Bengal and Assam, India.

Age: Early-Middle Eocene.

Indian records: Varma & Rawat 1963, p. 137, fig. 20, Early-Middle Eocene, western and eastern India, including oil exploration areas in West Bengal and Assam.

Genus: *Retihelicosporonites* Ramanujam & Rao 1978

Mycobank No.: MB 21281.

Type Species: *Retihelicosporonites elsikii* Ramanujam & Rao 1978.

Description (Ramanujam & Rao 1978, p. 299): Spores simple, uniseriate, multicellular, inaperturate, basal cell cuneate, other cells rectangular; apical part of spore helical. Spore wall reticulate.

Classification: Fungi Imperfecti, Helicosporae.

Remarks: Elsik (1992) considered spores of *Retihelicosporonites* to be monoporate and differentiated them from other multicellate monoporate form genera on their combination of reticulate sculpture and their tendency to be loosely coiled.

Species: *Retihelicosporonites elsikii* Ramanujam & Rao 1978

Fig. 343

Mycobank No.: MB 115089.

Description (Ramanujam & Rao 1978, p. 299): Spores light to dark brown, multicellular with 3-8 transverse septa, 110-130 μ m long, apical part helical; septa very faint or almost absent in the helical region. Cell 10-13.5 x 5-7.5 μ m. Wall two-layered, reticulate, coarsely so in the helical region, meshes hexagonal, lumina smooth.

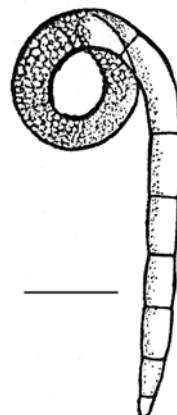


Fig. 343. *Retihelicosporonites elsikii*. Bar = 20 μ m.

Locality: Kollam and Warkalli, Kollam District, Kerala, India.

Age: Miocene (Quilon and Warkalli beds).

Indian records: Ramanujam & Rao 1978, p. 299, pl. 3, figs. 37-38, Quilon and Warkalli Beds (Miocene). Kollam District, Kerala, India.

S

Genus: *Sarcophoma* Höhnelt 1916

Mycobank No.: MB 9787.

Type Species: *Sarcophoma endogenospora* Höhnelt 1916.

Classification: Fungi Imperfecti, Sphaeropsidales.

Species: *Sarcophoma deccanii* Singh & Patil 1980

Fig. 344

Mycobank No.: MB 109235.

Description (Singh & Patil 1980, p. 18): Pycnidium immersed in stroma, ostiolate, spherical to oval, 170-200 x 110-150 μ m in size, wall thin, pseudoparenchymatous; conidiophores branched, septate, 1-celled or in chains of 3-4 or more.

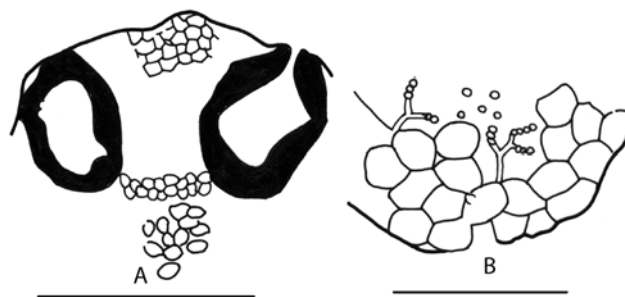


Fig. 344. *Sarcophoma deccanii*. A. Pycnidium and stroma. Bar = 250 μ m, B. Wall of pycnidium, conidiophores and spores. Bar = 50 μ m.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Cretaceous (Deccan Intertrappean Series).

Indian records: Singh & Patil 1980, p. 17-18, pl. 1, figs. 6-7, text-figs. 9-10, Deccan Intertrappean Series (Late Cretaceous), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Scabradiporites* Mathur 1966

Mycobank No.: MB 21292.

Type Species: *Scabradiporites varius* Mathur 1966.

Description (combined description, Mathur 1966, p. 43): Amb elliptical, 42 x 14 µm in size, diporate, pores elliptical, larger axis 4 µm. Exine less than 1 µm thick, scabrate, brown.

Classification: Fungi Imperfecti, Amerosporae.

Remarks: Kalgutkar and Jansonius (2000) considered *Scabradiporites* Mathur 1966 a junior taxonomic synonym of *Diporisporites* van der Hammen 1954a emend. Elsik 1968.

Species: *Scabradiporites varius* Mathur 1966

Mycobank No.: MB 483818.

Remarks: Kalgutkar and Jansonius (2000) transferred *Scabradiporites varius* Mathur 1966 to *Diporisporites* van der Hammen 1954a emend. Elsik 1968 [See: *Diporisporites varius* (Mathur 1966) Kalgutkar & Jansonius 2000].

Genus: *Sclerotites* Massalongo in Massalongo & Scarabelli 1859

Mycobank No.: MB 21295.

Type Species: *Sclerotites salisburiae* Massalongo 1859.

Classification: Hyphomycetes, Mycelia Sterilia.

Species: *Sclerotites chitaleyii* Khubalkar 2003

Fig. 345

Mycobank No.: MB 561373.

Description (Khubalkar 2003, p. 290-293): (Diagnosis): Fungus pathogenic; free mycelium lacking; sclerotia of dark brown colour; varying in shape from somewhat rounded-oblong, reniform, cordate, ovate to irregular; about 20 to 45 µm in length and 20 to 30 µm in breadth; with or without outgrowths; sheath (rind) one-cell-thick, about 3-7 µm; outer wall of sheath cells convex, about 1 mm thick; cells of sheath rectangular to squarish to polygonal in shape, about 2 x 2 to 7 x 6 µm in size, some with or without pores (?); interior irregularly segmented forming anastomoses of pseudoparenchyma, cells not much differentiated from sheath cells, and not differentiated into medulla (loose) and cortex (compact), cell walls up to 1 µm in thickness. (Description): Nine sclerotia observed and are described. These appeared dark-brown in colour varying in shape and size. Shapes varied from round-oblong, reniform, cordate, and ovate to irregular, with or without outgrowths or bud-like projections. Surface

was smooth and without any prominent projections. Size varied from 20-40 µm in length and 20-30 µm in breadth. The sclerotium was lined by one cell thick sheath - the rind, measuring about 3-7 µm in thickness, the cells of which were rectangular to squarish to polygonal in shape and measured about 2 x 2 to 7 x 6 µm in size. Some cells in some sclerotia showed pores. Outer wall of sheath cells was convex and about 1 mm thick. Interior of the sclerotia was variously 'segmented' which, in fact, formed the compact anastomoses of pseudoparenchyma. These hyphal cells were not much different from the sheath cells.

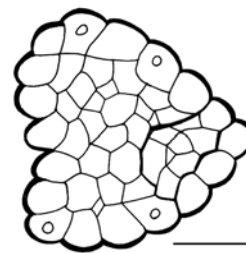


Fig. 345. *Sclerotites chitaleyii*. Bar = 10 µm.

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Late Maastrichtian (Deccan Intertrappean Beds).

Indian records: Khubalkar 2003, p. 293-294, pl. 1, figs. 1-3, text-fig. 1-9, Deccan Intertrappean Beds (Late Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Scolecospores* Lange & Smith 1971

Mycobank No.: MB 21296.

Type species: *Scolecospores maslinensis* Lange & Smith 1971.

Description (Lange & Smith 1971, p. 676): Scolecospores of lengths 15-30x the breadth, the outline of walls and septa ladder-like.

Emended Description (Kalgutkar & Jansonius 2000, p. 267): Long to very long, linear filamentous phragmospores, hilate, with or without distal pore; length many times width of spore. Spores scalariform, commonly broken and lacking proximal and/or distal portions; wall and septa commonly thin; septa often with septal folds. Not or barely indented at septa.

Classification: Fungi Imperfecti, Phragmosporae.

Species: *Scolecospores scalaris* (Kalgutkar 1993) Kalgutkar & Jansonius 2000

Fig. 346

Mycobank No.: MB 483548.

Diporicellaesporites scalaris Kalgutkar, Review of Palaeobotany and Palynology 97, p. 76, pl. 4.2, fig. 13. 1993.

Description (Kalgutkar 1993, p. 76): Spores filamentous, scalariform, multicellular, typically with some 25 cells arranged in a row; spores brown, straight, slightly tapering toward the base. Cells usually equally spaced with regular transverse septation; broader than long, except those at the tapered end, with prominent triangular or wedge shaped septal folds and clear perforations. Spore wall thin. Spores much longer than broad, generally with length greater than eight or nine times the width. Spores with a simple pore at one end and a hyaline, small pedicel-like attachment cell at the tapered end. Illustrated spore 137.5 x 12.5 μm .



Fig. 346. *Scolecospirites scalaris*. Bar = 20 μm .

Locality: Peel River, Yukon Territory, Canada.

Age: Late Palaeocene–Early Eocene.

Indian records: Singh & Tripathi 2010, p. 12, pl. 1, fig. 16, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Genus: *Shuklania* Dwivedi 1959 ex Dwivedi 1968

Mycobank No.: MB 21301.

Type species: *Shuklania enigmocarponae* Dwivedi 1968 (by monotypy).

Description: The cuticular layer of each locule is more or less disorganised. The epidermal layer is intact. Below this layer are seated the fungal cups which greatly resemble the sori of Ascomycetes and Basidiomycetes of parasitic fungi. Cups: The cups occur scattered along the rim of the fruit, all over its outer surface. These are fairly prominent and their number varies in the peel sections taken after grinding every 5mm. thickness of the fruit. The cups are wider than high. The round, dome shaped upper covering of the cups seems to be made either of the epicarp or the thin outer cuticular layer of

the fruit. The cups vary in size. Some are empty while others show either bicelled spores or mycelia or both spores as well as mycelia. The biggest of these cups measure 143 μm x 240 μm , medium ones 157 μm x 113 μm and the smallest 93 μm x 50 μm . Mycelium: The mycelium is often abundant inside the cups, infecting the hypodermal tissue of the host. The hyphae are generally 1.1 μm broad, septate, closely packed and profusely branched. The remnants of the septa are seen at places. In several cups the mycelium is meagre and bicelled spores are seen lying in situ. This, obviously, is a comparatively advanced stage of fungal infection. Spores: The spores are either in groups or isolated. Where in groups, they appear to have been held together by some gelatinous substance. At a later stage the spores got separated. This feature brings the present fungus very close to the living form *Gymnosporangium* of the family Pucciniaceae. Isolated spores are nearly seen in 50% of the cups or even more. In some cases the spores are seen lying even outside the epidermal layer of the fruit, mostly isolated and some times in groups (Pl. 5, fig. 3; text-fig. 5). Medium-sized spores are nearly always double walled and measure 6.7 X 3.3mm. “When very young, these are round in shape’ but gradually become oval-shaped at maturity. Each spore is bicellular. It was, however, not possible to study the contents of the spores.

Classification: Basidiomycetes.

Species: *Shuklania enigmocarponae* Dwivedi 1968

Mycobank No.: MB 561624.

Description: As for the genus (combined description).

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Eocene (Intertrappean Beds).

Indian records: Dwivedi 1968, p. 9-10, pl. 1, figs. 1-7, text-figs. 1-7, Intertrappean Beds (Eocene). Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Remarks: Dwivedi (1959) reported a rust fungus, infecting the fossil fruit *Enigmocarpon parijai* Sahnii, from the Intertrappean beds (Eocene) and stated that the detailed description of the same would be published later. Dwivedi (1968) published a detailed description of the genus *Shuklania*, along with illustrations. He stated that “the fossil fungus seems to be in teliospore stage and not a single uredospore is found inside the sori. It is probable that these fungal cups might have produced the uredospores prior to the present stage. Septate mycelia are well preserved. The septa, being very thin and few, are, however, partially preserved.

Genus: *Siwalikiathyrites* Saxena & Singh 1982

Mycobank No.: MB 519782.

Type Species: *Siwalikiathyrites ramanujamii* Saxena & Singh 1982.

Description (Saxena & Singh 1982, p. 294): Ascostromata subcircular to circular, dimidiate, non-ostiolate, no free hyphae, arrangement of hyphae not radial, divided into cells, central cells polygonal, outer cells mostly elongate. Pores absent.

Classification: Ascomycetes, Microthyriales.

Remarks: Kalgutkar and Jansonius (2000) considered *Siwalikiathyrites* Saxena & Singh 1982 a junior taxonomic synonym of *Callimothallus* Dilcher 1965.

Species: *Siwalikiathyrites ramanujamii* Saxena & Singh 1982

Mycobank No.: MB 519783.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Callimothallus* Dilcher 1965 [See: *Callimothallus ramanujamii* (Saxena & Singh 1982) Kalgutkar & Jansonius 2000].

Genus: *Sorosporium* Rudolphi 1829

Mycobank No.: MB 16318.

Type Species: *Sorosporium saponariae* Rudolphi 1829.

Classification: Basidiomycetes, Ustilaginales.

Species: *Sorosporium mohgaoense* Chitale & Yawale 1978

Mycobank No.: MB 111035.

Remarks: Kalgutkar and Jansonius (2000) transferred *Sorosporium mohgaoense* Chitale & Yawale 1978 to *Papulosporonites* Schmiedeknecht & Schwab 1964 [See: *Papulosporonites mohgaoensis* (Chitale & Yawale) Kalgutkar & Jansonius 2000].

Genus: *Spegazzinites* Felix 1894

Mycobank No.: MB 21303.

Type Species: *Spegazzinites cruciformis* Felix 1894.

Description (combined description, Felix 1894, p. 279): The remains are the conidia of a hyphomycete. Their shape and size varies more than is usually the case with such structures. However, the morphology is the same in all of them as far as the somewhat thick polished sections disclose: they consist of 4 partial cells. In the smaller conidia, these partial cells are of a slightly elongated shape, and their narrow sides are oriented towards a point in such a way that together they form a regular, equal-armed cross (figs. 8a-c). In the larger specimens, the individual cells are more roundish, the arms of the cross therefore shortened, so that the entire structure approaches the shape of a tightly tied, cube-shaped parcel, a shape found, for instance, in the body of the genus *Sarcina*. The size of the smaller conidia is 0.012-0.015 mm (12-15 μ m), that of the larger ones 0.021-0.024 mm (21-24 μ m); in between occur numerous transitional forms. Some of the conidia are spinose, and not only the larger ones as was claimed by

Hoffmann, but rather small conidia as well. The spines are of various lengths, in the larger conidia they are generally shorter than in the smaller specimens. The dimensions specified above refer to aetose specimens. In addition to conidia, the respective polished sections also contain numerous mycelial remains. A connection between them and the conidia could not be definitely established, but there is one case where a conidium appears to sit at the end of a hyphal branch. The mycelium is sparsely ramified, septa were not observed. The thicker filaments are 0.003-0.006 mm (3-6 μ m) in diameter.

Classification: Fungi Imperfecti, Staurosporaes.

Species: *Spegazzinites indicus* Ramanujam & Srisailam 1980

Fig. 347

Mycobank No.: MB 109246.

Description (Ramanujam & Srisailam 1980, p. 120): Spores melanin coloured, inaperturate, 18-23.8 μ m in diameter, cruciately or squarishly septate to form 4 subcircular or obovoid cells, studded all over with sharply pointed spines up to 2.5 μ m long. Spore wall 2-layered, 1.5 μ m thick.



Fig. 347. *Spegazzinites indicus*. Bar = 10 μ m.

Locality: Palayangadi and Cheruvattur, Kannur beach, Kerala, India.

Age: Miocene.

Indian records: Ramanujam & Srisailam 1980, p. 120, pl. 1, fig. 1, Warkalli Beds (Miocene), Kannur District, Kerala; Malleshram *et al.* 1989, p. 16, pl. 1, fig. 22, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Genus: *Sphaerialites* Venkatachala & Kar 1969

Mycobank No.: MB 21304.

Type Species: *Sphaerialites ovatus* Venkatachala & Kar 1969.

Description (Venkatachala & Kar 1969, p. 181): Perithecium 60-150 μ m, subcircular-circular, dark brown. Central part of perithecium comprises 4-5 more or less square-hexagonal cells, surrounded by an at least two-layer thick, darker, plate-like structure, with slightly undulating margin, remaining part one-layered and composed of unequally long,

pseudoparenchymatous cells formed by radiating interconnected hyphae. Mycelium or ascospores not seen.

Classification: Ascomycetes, Microthyriales.

Remarks: *Sphaerialites* Venkatachala & Kar 1969 is a junior synonym of *Trichothyrites* Rosendahl 1943.

Species: *Sphaerialites ovatus* Venkatachala & Kar 1969

Mycobank No.: MB 323724.

Remarks: Since *Sphaerialites* Venkatachala & Kar 1969 is a junior synonym of *Trichothyrites* Rosendahl 1943, Kalgutkar and Jansonius (2000) transferred this species to *Trichothyrites* Rosendahl 1943 [See: *Trichothyrites ovatus* (Venkatachala & Kar 1969) Kalgutkar & Jansonius 2000.

Genus: *Spinosporonites* Saxena & Khare 1992

Mycobank No.: MB 28635.

Type Species: *Spinosporonites indicus* Saxena & Khare 1992.

Description (Saxena & Khare 1992, p. 40): Spores circular to subcircular, inaperturate; multicellular, each cell giving rise to a robustly built spine.

Classification: Ascomycetes, Microthyriales.

Species: *Spinosporonites indicus* Saxena & Khare 1992

Fig. 348

Mycobank No.: MB 483896.

Description (Saxena & Khare 1992, p. 40): Spores subcircular, size 42-46 x 38-40 μm (excluding spines); inaperturate; multicellular, each cell giving rise to a robustly built spine; spines 7-9 μm long, up to 3 μm wide at the base and pointed at the tip.

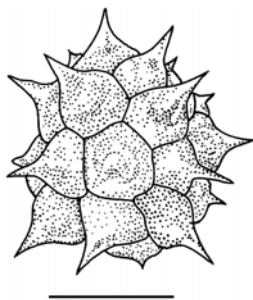


Fig. 348. *Spinosporonites indicus*. Bar = 20 μm .

Locality: Jayamkondacholapuram Well 12, 45 km south of Neyveli, Tiruchirapalli, Tamil Nadu, India.

Age: Late Palaeocene-Middle Eocene.

Indian records: Saxena & Khare 1992, p. 40, pl. 1, figs. 18-19, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.

Genus: *Spirotremesporites* Dueñas-Jimenez 1979, p. 564; emend. Elsik 1990

Mycobank No.: MB 21309.

Type Species: *Spirotremesporites simplex* Dueñas-Jimenez 1979.

Varisulcosporites Rouse & Mustard 1997

Description (Dueñas-Jimenez 1979, p. 564): Ellipsoidal to elongate fungal spores possessing one or several spiralling furrows. (Jansonius & Hills 1980, card no. 3769).

Emended Description (Elsik 1990, p. 163): Psilate, aseptate fungal spores. The aperture is a single furrow at an angle to the axis of the spore, straight or curved to S-shaped or sigmoidal in outline, or spiral around the spore axis. The furrow can be short and straight, entirely visible on one face of the spore; longer and curved; or long and spiral around the outside of the spore. The spore wall is generally rigid. The spore outline is elongate elliptical to oval, sometimes somewhat reniform in side view, i.e. with bilateral symmetry. The ends of the spore can be similar or dissimilar; one end can be truncated by an attachment scar.

Classification: Fungi Imperfecti, Amerosporae.

Affinity: Xylariaceae.

Remarks: Nandi *et al.* (2003) ascribed all her species of *Spirotremesporites* to *Spirotremesporites* Elsik (1990) whereas the genus was effectively and validly published by Dueñas-Jimenez (1979). Elsik (1990) emended the generic diagnosis to include spores having only a single furrow in contrast to the original diagnosis where spores possessing one or several spiralling furrows were included. This emendation, however, does not affect any change in the authority of the genus. Therefore, citation of Elsik (1990) as author of *Spirotremesporites* (and also of its type: *S. simplex*) by Nandi *et al.* (2003) is considered as an inadvertent error of citation and all her species, validated above, are considered to have been published under *Spirotremesporites* Dueñas-Jimenez (1979).

Species: *Spirotremesporites clinatus* Elsik 1990

Fig. 349

Mycobank No.: MB 130383.

Description (Elsik 1990, p. 162): Bilateral, aseptate, psilate fungal spores of somewhat fusiform shape and with an elongate, curving furrow crossing the longitudinal face of the spore at an angle. Overall size ca. 12 x 25 μm ; spore wall rigid, ca. 1 μm , not thickened, but is slightly protruding at the apices. The furrow is ca. 15 μm long.



Fig. 349. *Spirotremesporites clinatus*. Bar = 10 μ m.

Locality: The Gulf Coast.

Age: Neogene.

Indian records: Nandi *et al.* 2003, p. 60, pl. 1, figs. 7, 12, Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dupitila formations), North-eastern India.

Species: *Spirotremesporites ellipticus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 350

Mycobank No.: MB 519758.

Description (Nandi *et al.* 2003, p. 60): Spores monocellate, outline narrowly elliptical, sides straight to slightly convex, ends narrowly rounded or broadly protruded. Furrow obliquely placed and crossed the longitudinal axis at an angle, long, broad, sometimes slightly curved. Exine thin surrounding the furrow, much thicker around the spore outline, surface smooth. Size range 9 μ m - 10 μ m x 28 μ m - 32 μ m.

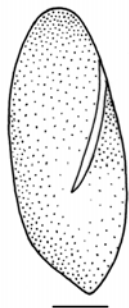


Fig. 350. *Spirotremesporites ellipticus*. Bar = 6 μ m.

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Cretaceous-Tertiary (Mahadeo, Langpar, Cherra Sandstone, Siju, Bhuban, Bokabil, Tipam and Dupitila formations).

Indian records: Nandi & Banerjee in Nandi *et al.* 2003, p. 60, pl. 2, fig. 9, text-fig. 3.8, Cretaceous-Tertiary (Mahadeo, Langpar, Cherra Sandstone, Siju, Bhuban, Bokabil, Tipam and Dupitila formations), North-eastern India.

Remarks: *Spirotremesporites ellipticus* resembles the ascospores of *Xylaria polymorpha* that shows short, straight to slightly curved furrow. Nandi and Banerjee in Nandi *et al.* (2003) did not validly publish "*Spirotremesporites ellipticus*" as they did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Spirotremesporites eminens* (Rouse & Mustard 1997) Kalgutkar & Jansonius 2000

Fig. 351

Mycobank No.: MB 483550.

Varisulcosporites eminens Rouse & Mustard, Palynology 21, p. 208. 1997.

Varisulcosporites eminens Mustard & Rouse, Geological Survey of Canada, Bulletin 481, p. 143, pl. 11, fig. 6. 1994. (nom. inval.)

Description (Rouse & Mustard 1997, p. 208): elliptical outline; spore wall laevigate and dark melanin brown, about 0.5 μ m in equatorial regions, thickened to about 1.25 μ m at the poles to form apical caps. Aperture a single sulcus (in holotype weakly oblique), or sometimes developed as an oblique sulcus, extended as a thin groove towards both poles, plus a second thin groove on the opposite side, also extending to the poles, possibly connecting at the poles with the two grooves coming off the main sulcus. Dimensions: range of length 22-46 μ m; of width 18-20 μ m.



Fig. 351. *Spirotremesporites eminens*. Bar = 10 μ m.

Locality: Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, and the north-western Washington State, Canada and U.S.A.

Age: Late Eocene-Early Oligocene.

Indian records: Singh & Tripathi 2010, p. 10, pl. 1, fig. 2, Akli Formation (Early Palaeogene), Borehole near Barakha, Barmer District, Rajasthan.

Species: *Spirotremesporites longiletus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 352

Mycobank No.: MB 519757.

Description (Nandi *et al.* 2003, p. 60): Spores solitary, ovoid-elliptical to somewhat fusiform in shape, aseptate, equatorially expanded, ends gradually and narrowly rounded. Furrow single, curved, flattened, S-shaped, long, running along the full length of the spore axis up to the ends and crossing the longitudinal axis of the spores at an angle. Spore wall about 1.5 μm thick and smooth. Size range 35 μm - 42 μm x 15 μm - 25 μm .

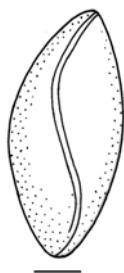


Fig. 352. *Spirotremesporites longiletus*. Bar = 7 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dupitila formations).

Indian records: Nandi *et al.* 2003, p. 60, pl. 2, figs. 10, 17, text-fig. 3.7, Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dupitila formations), North-eastern India.

Remarks: The ascospores with spiral furrow have been reported in some species of *Xylaria*, i.e. *Xylaria apiculata*, *Xylaria longiceps* and *Xylaria persicaria* and also in *Hypoxylon conostomum* and *Hypoxylon quisquilarium* (Nandi *et al.* 2003). Nandi and Banerjee in Nandi *et al.* (2003) did not validly publish "*Spirotremesporites longiletus*" as they did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Spirotremesporites miocenicus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 353

Mycobank No.: MB 519756.

Description (Nandi *et al.* 2003, p. 61): Description Spores unicellate, aseptate, narrowly to broadly elliptical to dumbbell shaped, ends broadly rounded, sides straight to slightly convex, rarely slightly concave in the middle. Furrow single, long, extended one end of the spore to the other, and spirally encircles the spore body cutting the sides of the spore two times and diagonally crossed the centre. Exine thin, smooth. Size range 15 μm - 21 μm x 25 μm - 32 μm .

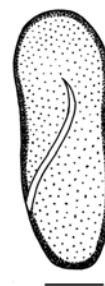


Fig. 353. *Spirotremesporites miocenicus*. Bar = 5 μm .

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Kherapara, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations).

Indian records: Nandi *et al.* 2003, p. 61, pl. 2, figs. 8, 13, Tertiary (Kherapara, Bhuban, Bokabil, Tipam, Dupitila and Dihing formations), North-eastern India.

Remarks: *Spirotremesporites miocenicus* resembles the ascospores of some species of the modern genus *Xylaria*, e.g. *Xylaria apiculata*, *Xylaria longiceps* and *Xylaria persicaria* and *Hypoxylon*, e.g. *Hypoxylon conostomum* and *Hypoxylon quisquilarium* (Nandi *et al.* 2003). Nandi and Banerjee in Nandi *et al.* (2003) did not validly publish "*Spirotremesporites miocenicus*" as they did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Spirotremesporites reniformis* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 354

Mycobank No.: MB 519755.

Description (Nandi *et al.* 2003, p. 61): Spores monocellate, aseptate, reniform shaped, sides concave towards the furrow

end and convex at other side, ends narrowly rounded. Furrow single, short, obliquely placed and form 15°-20° angle with the concave side of the spore. Spore wall 1.5 µm thick, smooth. Size ranges 6 µm – 10 µm x 28 µm – 30 µm.

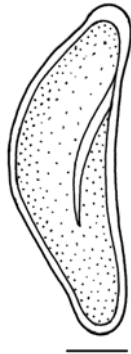


Fig. 354. *Spirotremesporites reniformis*. Bar = 6 µm.

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dihing formations).

Indian records: Nandi *et al.* 2003, p. 61-62, pl. 2, figs. 4, 6, text-fig. 3.9, Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dihing formations), North-eastern India.

Remarks: Ascospores of many genera of modern Xylariaceae are characterized by having helical to slightly oblique furrow, e.g. *Xylaria polymorpha* (Nandi *et al.* 2003). Nandi and Banerjee in Nandi *et al.* (2003) did not validly publish “*Spirotremesporites reniformis*” as they did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Species: *Spirotremesporites tertiarus* Nandi & Banerjee in Nandi *et al.* 2003 (nom. inval.)

Fig. 355

Mycobank No.: MB 519754.

Description (Nandi *et al.* 2003, p. 62): Spores solitary, aseptate, elliptical to subelliptical in shape, ends narrowly rounded, sides straight to narrowly convex. Furrow long, obliquely placed and crossed one side of the spore at 45° angle. Spore wall 2 µm thick, smooth. Size ranges from 12 µm - 18 µm x 15 µm - 26 µm.



Fig. 355. *Spirotremesporites tertiarus*. Bar = 5 µm.

Locality: Renkte Kawn-Sherlui Road, Mizoram, India.

Age: Tertiary (Kherapara, Bhuban, Bokabil, Tipam and Dihing formations).

Remarks: Xylariaceae. *Spirotremesporites tertiarus* resembles the ascospores of *Xylaria polymorpha* (Nandi *et al.* 2003). Nandi and Banerjee in Nandi *et al.* (2003) did not validly publish “*Spirotremesporites tertiarus*” as they did not cite information on where its holotype is stored (McNeill *et al.* 2006: Art. 37.7).

Genus: *Staphlosporonites* Sheffy & Dilcher 1971 emend. Kalgutkar & Jansonius 2000

Mycobank No.: MB 21316.

Type Species: *Staphlosporonites conoideus* Sheffy & Dilcher 1971.

Transeptaesporites Ediger 1981, p. 94.

Description (Sheffy & Dilcher 1971, p. 48): Inaperturate, psilate to punctuate fungal or algal bodies of four or more irregular cells. Cells in clusters, shape variable along more than one axis.

Emended Description (Kalgutkar & Jansonius 2000, p. 284): Inaperturate multicellate fungal spores, with muriform architecture (cells internally dividing without a regular pattern), lacking a plane or axis of symmetry. Cells rounded or rounded polygonal, septa may be depressed where they intersect the amb. Overall shape generally more or less elongate; sometimes oval to ellipsoidal, rarely subspherical. Always with a distinct proximal hold-fast cell and/or a hilar scar.

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Staphlosporonites chandrae* Gupta 2002

Fig. 356

Mycobank No.: MB 540809.

Description (Gupta 2002, p. 143): Spores multicelled, cells arranged along more than one axis, inaperturate, elongate, 17.5-67 μm long, 8-29 μm broad, cells irregularly arranged, number of cells across width ranges from two to four and across thickness by more than one, septa thin to as thick as wall, psilate-faintly granulate, wall 1 μm thick.

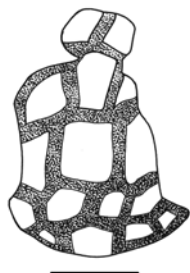


Fig. 356. *Staphlosporonites chandrae*. Bar = 20 μm .

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 143, pl. 3, fig. 12, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporonites conoideus* Sheffy & Dilcher 1971

Fig. 357

Mycobank No.: MB 111946.

Description (Sheffy & Dilcher 1971, p. 48): Seven or more irregular cells arranged in conical shaped body 13.5 x 24.2 μm . Psilate, wall and septa opaque, varying in thickness.

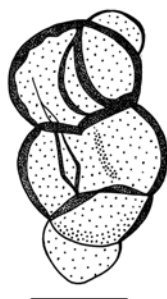


Fig. 357. *Staphlosporonites conoideus*. Bar = 5 μm .

Locality: Puryear clay pit, one-half mile south of Puryear, Henry County, Tennessee, U.S.A.

Age: Middle Eocene.

Indian records: Singh & Sarkar 1984b, p. 48, pl. 2, fig. 27, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh; Singh & Sarkar 1994, p. 52, pl. 1, fig. 28, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Staphlosporonites dichotomus* Gupta 2002

Fig. 358

Mycobank No.: MB 540810.

Description (Gupta 2002, p. 142): Spores multicelled, many cells wide, dichotomously branched or lobed bodies, inaperturate, 52-93 μm long, 17.5-29 μm (rarely up to 49 μm) broad, cells irregularly placed, more than one cell thick, septa thickness variable, from thin to as thick as wall, psilate-granulate.

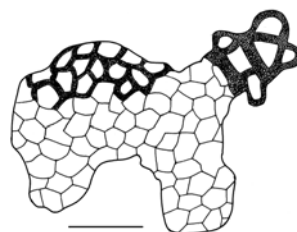


Fig. 358. *Staphlosporonites dichotomus*. Bar = 20 μm .

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 142, pl. 3, fig. 11, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporonites elongatus* Gupta 2002

Fig. 359

Mycobank No.: MB 540811.

Description (Gupta 2002, p. 142): Spores multicelled, cells arranged along more than one axis, inaperturate, elongate, 17.5-35 μm long, 7.5-13 μm broad, number of cells along width varies by up to two, largely granulate-subverrucose, surface folded.



Fig. 359. *Staphlosporonites elongatus*. Bar = 8 μ m.

Locality: Jantah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 142, pl. 3, fig. 9, Subathu Formation (Eocene), Jantah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporonites elsikii* Ramanujam & Srisailam 1980

Fig. 360

Mycobank No.: MB 109551.

Description (Ramanujam & Srisailam 1980, p. 122): Spores dark brown, irregularly cylindrical to elongate ovoid in shape, inaperturate, 50-57.8 x 12-15.3 μ m, more or less rounded at apex, truncate at base, muriform with 6-12 transverse and 4-8 longitudinal or oblique septa, septa fairly thick (3.4 μ m), spore wall up to 2 μ m thick psilate.

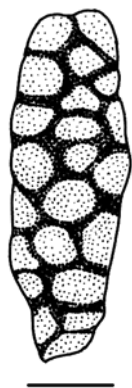


Fig. 360. *Staphlosporonites elsikii*. Bar = 10 μ m.

Locality: Kannur beach area, Palayangadi and Cheruvattur, Kerala, India.

Age: Miocene.

Indian records: Ramanujam & Srisailam 1980, p. 122, pl. 1, figs. 6-7, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

Remarks: Kumar 1990 transferred this species to *Multicellaesporites*, as *Multicellaesporites elsikii* (Ramanujam & Srisailam 1980) Kumar 1990, non *Multicellaesporites elsikii* Kar & Saxena 1976. However, Kalgutkar & Jansonius 2000 did not accept this transfer.

Species: *Staphlosporonites neyveliensis* Ambwani 1983

Fig. 361

Mycobank No.: MB 107315.

Description (Ambwani 1983, p. 149): The fungal body consisting of about 17 fungal cells arranged in an oblong structure; brown in colour measuring about 105 x 60 μ m in size. The fungal body is 2-3 cells wide and the whole mass tapering to a single cell thickness. Each cell is psilate, measuring up to 20 μ m in size. Wall of the spore is thin and smooth.

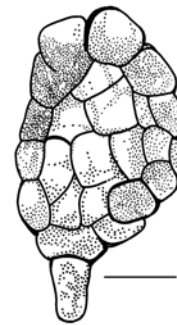


Fig. 361. *Staphlosporonites neyveliensis*. Bar = 20 μ m.

Locality: Neyveli Lignite, South Arcot District, Tamil Nadu, India.

Age: Miocene.

Indian records: Ambwani 1983, p. 149-150, pl. 1, fig. 7, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Species: *Staphlosporonites raoi* Gupta 2002

Fig. 362

Mycobank No.: MB 540812.

Description (Gupta 2002, p. 142): Spores multicelled, showing a many cells wide multistratose main body and thin branch(es), inaperturate, main body 32-40 μ m long, 8-15 μ m (rarely up to 29 μ m) broad, cells irregularly placed, in main body but along single axis in side branch, psilate.



Fig. 362. *Staphlosporonites raoi*. Bar = 10 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: ?Eocene (Dagshai Formation).

Indian records: Gupta 2002 p. 142, pl. 3, fig. 10, Dagshai Formation (?Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporonites settyi* Gupta 2002

Fig. 363

Mycobank No.: MB 540813.

Description (Gupta 2002, p. 143): Spores multicelled, comprising a globular mass, inaperturate, subcircular, 20 x 17 - 32 x 23 μ m, cells variable in shape (i.e. \pm hemispherical to polyangular), irregularly placed, number more than one across thickness; septa variable in thickness, thin or thick as wall; nearly psilate, surface slightly folded.



Fig. 363. *Staphlosporonites settyi*. Bar = 10 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 143, pl. 3, fig. 13, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporonites siwalikus* Saxena & Bhattacharyya 1987

Mycobank No.: MB 483890.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Papulosporonites* Schmiedeknecht & Schwab 1964 [See: *Papulosporonites siwalikus* (Saxena & Bhattacharyya 1987) Kalgutkar & Jansonius 2000].

Species: *Staphlosporonites subcircularis* Chandra *et al.* 1984

Mycobank No.: MB 107316.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Papulosporonites* Schmiedeknecht & Schwab 1964 [See: *Papulosporonites subcircularis* (Chandra *et al.* 1984) Kalgutkar & Jansonius 2000.]

Species: *Staphlosporonites tetracellatus* Gupta 2002

Fig. 364

Mycobank No.: MB 540814.

Description (Gupta 2002, p. 142): Spores tetrad/four celled mass, cells arranged along more than one axis in a manner forming a one cell thick plate, inaperturate, 12 x 8-17 x 15 μ m, psilate, surface often folded, wall up to 1.5 μ m thick, often two layered.

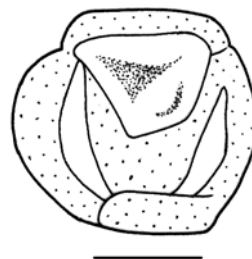


Fig. 364. *Staphlosporonites tetracellatus*. Bar = 10 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 142, pl. 3, fig. 8, Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Species: *Staphlosporites tristratosus* Sheffy & Dilcher 1971

Mycobank No.: MB 111948.

Remarks: Kalgutkar and Jansonius (2000) transferred this species to *Dictyosporites* Felix 1894 [See: *Dictyosporites tristratosus* (Sheffy & Dilcher 1971) Kalgutkar & Jansonius 2000].

Genus: *Stauromyca* Kar *et al.* 2010

Mycobank No.: MB 541737.

Type species: *Stauromyca radiata* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 247): Hyphomycetaceous fungi, conidiophores unbranched, tubular, septate; conidia solitary, globular, generally four armed, basal cell septate, swollen at base, arms of variable length, mostly nonseptate, tubular, light brown.

Classification: Fungi, Incertae sedis.

Species: *Stauromyca radiata* Kar *et al.* 2010

Fig. 365

Mycobank No.: MB 542344.

Description (Kar *et al.* 2010, p. 247): Conidiophores long, tubular, straight to bent, 12-15 x 2-3 µm, wall less than 1 µm thick, laevigate, 3 septa distinct, straight, conidia triangular, folded, attachment cell of conidiophore slightly swollen, 12-18 x 10-16 µm, four arms divergent, straight or bent, unequal in length, 8-16 x 3-4 µm, bulged at base, nonseptate except one at base, wall about 1 µm thick, laevigate.

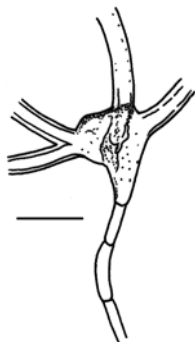


Fig. 365. *Stauromyca radiata*. Bar = 10 µm.

Locality: Tlansam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 247, pl. 2, fig. 9, Bhuban Formation (Miocene), Tlansam, Mizoram.

Genus: *Striadiporites* Varma & Rawat 1963

Mycobank No.: MB 21324.

Type Species: *Striadiporites reticulatus* Varma & Rawat 1963.
Stridiporosporites Ke & Shi 1978

Description (Varma & Rawat 1963, p. 137): Diporate grains with striated exine.

Emended Description (Elsik & Jansonius 1974, p. 954): Fungal spores of oval to fusiform ambitus and with longitudinally ribbed to broadly reticulate ornament. Two pores, one at each end of the spore on the long axis. One cell; no septa, except occasionally a very thin membrane across inner edge of apertures.

Classification: Fungi Imperfecti, Amerosporae.

Species: *Striadiporites reticulatus* Varma & Rawat 1963

Fig. 366

Mycobank No.: MB 111055.

Diporisporites reticulatus (Varma & Rawat) Elsik 1968 (nom. inval.)

Description (Varma & Rawat 1963, p. 137): Pollen grains 2-porate, bilateral, isopolar, somewhat barrel-shaped (29 x 46 x 29 µm). Pore on either side of the long axis simple and sunken, about 7.1-8.6 µm in diameter, presumably circular. Grain dark in colour. Exine less than 1 µm thick, distinctly striated (striation running from pore to pore). Lists connected by oblique, smaller, slightly irregular lists. In this way a sort of network, with lumina of different shapes and sizes, is formed. Individual lists about 1-2 µm broad.



Fig. 366. *Striadiporites reticulatus*. Bar = 20 µm.

Locality: Western and eastern India.

Age: Late Oligocene-Early Miocene

Indian records: Varma & Rawat 1963, p. 137, fig. 21, Late Oligocene-Early Miocene; Western and eastern India, including oil exploration areas in West Bengal and Assam.

T

Genus: *Teliosporites* Kar *et al.* 2010

Mycobank No.: MB 541742.

Type species: *Teliosporites globatus* Kar *et al.* 2010.

Description (Kar *et al.* 2010, p. 246): Fungal teliospores, always in mass, 21–32 x 19–28 μm , generally surrounded by gelatinous translucent sheath, up to 2 μm thick, spores laevigate, sterile cells may be associated with fertile ones, pseudobaculate appearance on surface view.

Classification: Basidiomycetes, Ustilaginales.

Species: *Teliosporites globatus* Kar *et al.* 2010

Fig. 367

Mycobank No.: MB 542358.

Description (Kar *et al.* 2010, p. 246): Spore mass subcircular–oval, 21–28 x 19–27 μm , margin undulated due to the presence of gelatinous covering; 12–18 spores joined together, individual spore subcircular, 8–11 x 6–9 μm , spore wall up to 2 μm thick, laevigate, light brown; gelatinous sheath often disappears during maceration, about 2 μm thick, translucent, weakly granulose, grana less than 1 μm high, sparsely placed.

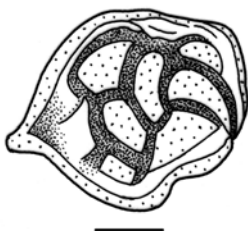


Fig. 367. *Teliosporites globatus*. Bar = 10 μm .

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 2, fig. 1, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Species: *Teliosporites hirsutus* Kar *et al.* 2010

Fig. 368

Mycobank No.: MB 542359.

Description (Kar *et al.* 2010, p. 246): Teliospores always occur in mass, 12–24 spores joined together to form subcircular shape, 18–31 x 16–29 μm . Cells of two kinds - fertile and sterile, fertile cells bigger 12–18 x 10–16 μm , sterile cells 4–8 x 3–7 μm ; spore wall about 1 μm thick, laevigate; fertile cells 12–28 in number, sterile cells numerous, covering fertile cells, closely placed to form reticulate pattern.



Fig. 368. *Teliosporites hirsutus*. Bar = 10 μm .

Locality: Tlamsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 246, pl. 2, fig. 3, Bhuban Formation (Miocene), Tlamsam, Mizoram.

Genus: *Tetracoccosporium* Szabó 1905

Mycobank No.: MB 10192.

Type Species: *Tetracoccosporium paxianum* Szabó 1905.

Classification: Fungi Imperfecti, Dictyosporae.

Species: *Tetracoccosporium eocenum* Biradar & Mahabale 1974

Fig. 369

Mycobank No.: MB 51978.

Description (Biradar & Mahabale 1974, p. 223): Hyphae septate, thin walled to moderately thick walled, hyaline, profusely branched; individual cell measuring 9.4 x 5 μm . Conidia 13 x 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 x 9 μm . Conidiophores very short, 6 x 7 μm .

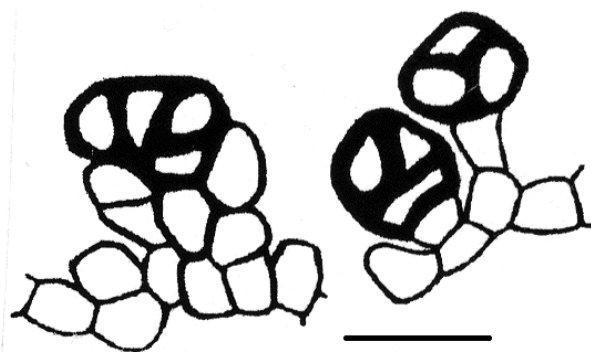


Fig. 369. *Tetracoccosporium eocenum*. Bar = 20 μm .

Locality: Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India.

Age: Maastrichtian (Deccan Intertrappean Series).

Indian records: Biradar & Mahabale 1974, p. 223-226, pl. 1, figs. 1-4, text-figs. 1-4, Deccan Intertrappean Series (Maastrichtian), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Genus: *Tetradigita* Kar *et al.* 2010

Mycobank No.: MB 541743.

Type species: *Tetradigita stellata* Kar *et al.* 2010.

Description (Kar *et al.* 2010, 246): Fungal conidia, blastic in development, conidium long, tubular, bends in middle to produce generally two lateral arms, simultaneously giving a stellate appearance, arms equal-unequal in length (5-30 x 2-4 μm), sometimes with further branching, spore wall 1 μm thick, laevigate, translucent-light brown, mostly not septate.

Classification: Fungi, Incertae sedis.

Species: *Tetradigita stellata* Kar *et al.* 2010

Fig. 370

Mycobank No.: MB 542360.

Description (Kar *et al.* 2010, 247): Conidiogenous cells like ordinary hyphae, conidia develop before septation of conidiogenous cells, filamentous, straight in young stage, slightly curved at maturity to bear two arms laterally at the same time; arms 14-28 x 2-4 μm , tubular, generally without septa, 8-10 times longer than broad, arms gradually tapering at terminal end, generally 4 armed, sometimes 5, arm may be branched laterally or dichotomously at base; wall roughly 1 μm thick, laevigate.

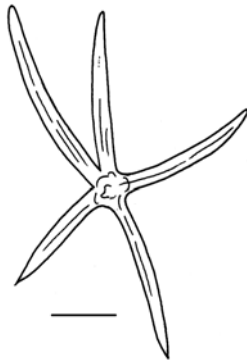


Fig. 370. *Tetradigita stellata*. Bar = 10 μm .

Locality: Tlangsam, Mizoram, India.

Age: Miocene (Bhuban Formation).

Indian records: Kar *et al.* 2010, p. 247, pl. 2, fig. 4, Bhuban Formation (Miocene), Tlangsam, Mizoram.

Genus: *Tricellaesporonites* Sheffy & Dilcher 1971

Mycobank No.: MB 21339.

Type Species: *Tricellaesporonites triangularis* Sheffy & Dilcher 1971.

Description (Sheffy & Dilcher 1971, p. 48): Tricellate, cells spherical or subspherical, inaperturate, shape variable. Disepitate or triseptate, ornamentation psilate to punctate.

Emended Description (Gupta 2002, p. 135): Tricelled, di- or triseptate, inaperturate, fungal spores or algal bodies, cells along more than one axis, psilate or ornamented, shape spherical, subspherical to subcircular.

Classification: Fungi, Incertae sedis.

Species: *Tricellaesporonites granulatus* Gupta 2002

Fig. 371

Mycobank No.: MB 540845.

Description (Gupta 2002, p. 135) Spores three celled, not uniseriate, inaperturate, nearly subcircular, 10 x 6 μm , faintly granular, surface folded, wall <0.5 μm thick.

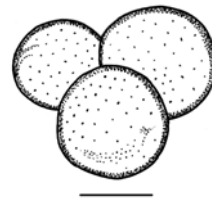


Fig. 371. *Tricellaesporonites granulatus*. Bar = 5 μm .

Locality: Dadahu Road Section (left bank of Giri River), Sirmaur District, Himachal Pradesh, India.

Age: Eocene (Subathu Formation).

Indian records: Gupta 2002, p. 135, pl. 2, fig. 11, Subathu Formation (Eocene), Dadahu Road Section (left bank of Giri River), Sirmaur District, Himachal Pradesh.

Genus: *Trichopeltinites* Cookson 1947

Mycobank No.: MB 21340.

Type Species: *Trichopeltinites pulcher* Cookson 1947.

Description (Cookson 1947, p. 211): Thallus that of the Trichopeltineae. Ascomata developed as thickened areas of the thallus and dehiscing by an irregular ostiole as in *Trichopeltis* Theiss. (Stevens 1925). Ascospores unknown.

Classification: Ascomycetes, Microthyriales.

Species: *Trichopeltinites folius* Kar *et al.* 2010

Fig. 372

Mycobank No.: MB 542362.

Description (Kar *et al.* 2010, p. 247): Ascstromata leaf-like with lobes, 90-110 x 20-25 μm , margin undulated, hyphae radially arranged one layered thick, more or less parallel to each other, raised, often branched, transverse septa few, anastomose to form pseudoparenchymatous cells particularly on fruiting bodies, fruiting bodies subcircular, 8-10 μm , alternately placed, internal structure not visible due to hyphae.

Fig. 372. *Trichopeltinites folius*. Bar = 10 μm .**Locality:** Tlansam, Mizoram, India.**Age:** Miocene (Bhuban Formation).**Indian records:** Kar *et al.* 2010, p. 247, pl. 2, fig. 7, Bhuban Formation (Miocene), Tlansam, Mizoram.**Species:** *Trichopeltinites fusilis* Dilcher 1965

Fig. 373

Mycobank No MB 340373.

Description (Dilcher 1965, p. 21): Stromata extremely variable in size and shape, 30-500 μm in diameter, circular to tongue-shaped with irregular lobed margins. Stromata most common on upper epidermis, one cell thick, free hyphae may be present. Hyphae closely appressed together and to the surface of the host leaf, forming radiate and linear stromata. Rows of hyphae originate from a central area in a stroma and grow out in all directions, dichotomizing and forming arms or lobes of various shapes and sizes. Cells near central area of stroma generally isodiametric, 3-8 μm in diameter, angular, lack any specific

orientation. Cells elsewhere in stroma square to elongate, 2-4 x 8-25 μm , frequently dichotomize, increasing the radiating rows of cells. Upper surface of stroma slightly granulose. Mature stromata characterized by ascromata that are local, round, thickened areas 25-50 μm in diameter, located centrally within the lobes or main body of the stroma. One to several fruiting bodies present in a single stroma. At maturity the thickened cells located over the stromata arch away from the surface of the host leaf and split apart. Eventually they break away from the stroma leaving holes which then indicate the position of the former ascromata. Small fruiting bodies 25-40 μm in diameter, developing central irregular openings 5-7 μm in diameter at maturity, are associated with and/or connected to large stromata by evanescent hyphae, appear to be diminutive fertile stroma. Seta bases 4-5 μm in diameter, rarely present, dark, thickened points, may be surrounded by rosette of mycelial cells. No spores found. Host plants various species of *Sapindus*.

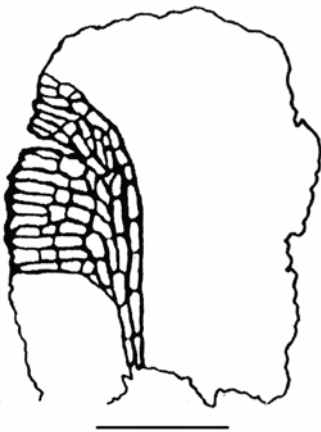
Fig. 373. *Trichopeltinites fusilis*. Bar = 100 μm .**Locality:** Western Tennessee, U.S.A.**Age:** Early Eocene.**Indian records:** Rao & Ramanujam 1976, p. 101, pl. 2, fig. 14, Quilon and Warkalli Beds (Miocene), Kerala; Tripathi 2001, p. 566, figs. 3G-I, Rajmahal Formation (Early Cretaceous), Borehole RJNE-32, depth 95.50 m, Rajmahal Basin, Bihar.

Species: *Trichopeltinites kiandrensis* Selkirk 1975

Fig. 374

Mycobank No.: MB 324955.

Description (Selkirk 1975, p. 85): Mycelium a radiate prosenchymatous membrane one cell thick; no free outgrowths from the margin. Mycelial membrane linear, branched, often almost circular where crowded. Individual hyphae dichotomously branched, septate; cells square to rectangular, 4-26 μm long and 2-5 μm wide; hyphal walls straight, ca. 0.5 μm thick. Fructifications formed centrally under the mycelial membrane, 50-185 μm diameter. Cells above fructifications markedly shorter than elsewhere in the membrane, 4-10.5 μm long, thick-walled. Upper wall of fructification of radiate dichotomously branched hyphae.

Fig. 374. *Trichopeltinites kiandrensis*. Bar = 50 μm .**Locality:** Kiandra, New South Wales, Australia.**Age:** Early Miocene.

Indian records: Reddy *et al.* 1982, p. 117-118, pl. 2, figs. 5-6, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Patil & Ramanujam 1988, p. 265-266, pl. 2, fig. 10, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Chandra & Kumar 1998, p. 60, pl. 1, fig. 18, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Genus: *Trichothyrites* Rosendahl 1943**Mycobank No.:** MB 21342.**Type Species:** *Trichothyrites pleistocaenicus* Rosendahl 1943.*Notothyrites* Cookson 1947*Sphaerialites* Venkatachala & Kar 1969

Description (combined description, Rosendahl 1943, p. 137): Mycelium consisting of yellowish or brownish, branching, septate hyphae with occasional anastomoses, 5-6.7 μm in diameter, individual cells (20) 28-33 (41) μm long, perithecia dark brown to nearly black, circular or nearly so, disk-shaped or, because of slightly upturned margin, shallow saucer-

shaped, 70-95 μm in diameter, complete, with upper and lower membranes composed of radially arranged cells, upper membrane with a central papilla having a distinct pore or ostiole, marginal cells of membrane 4-5 μm wide, 6-8 μm long, cells of papilla more nearly quadrangular and thick walled, several of the marginal cells of pore prolonged into finger-like processes, cells of lower membrane all thin walled and radiating from a circular central cell, asci and spores lacking.

Emended Description (Smith 1980, p. 209): Thyriothechia appearing disc- or saucer-shaped due to compression; possessing definite upper and lower walls of radiate rows of almost square cells (3-8 x 3-8 μm). Cell walls of upper layer of thyriothechium generally more strongly thickened than those of the lower layer. Thyriothechia ranging from 70 μm to 200 μm in diameter, and bearing on upper wall an erect ostiolar collar (papilla) made up of 2-6 tiers of small (2 x 2 μm) extremely thick-walled quadrilateral cells. Upper most tier (ostiolar margin) of cells may have short prolongations (setae) in some cases. Thyriothechial outline usually smooth, but may appear lobate.

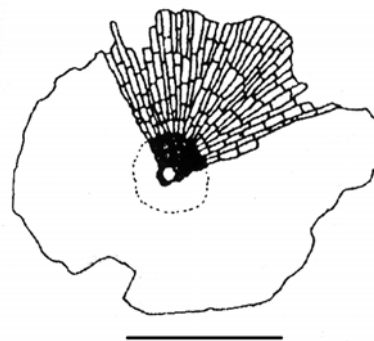
Classification: Ascomycetes, Microthyriales.**Species:** *Trichothyrites airensis* (Cookson 1947) Kalgutkar & Jansonius 2000

Fig. 375

Mycobank No.: MB 483563.*Notothyrites airensis* Cookson 1947, p. 209, pl. 11, fig. 7.

Trichothyrites airensis (Cookson 1947) Reddy *et al.*, Records of the Geological Survey of India 114(5), p. 114. 1982. (nom. inval.).

Description (Cookson 1947, p. 209): Ascomata flattened-hemispherical, glabrous, 90-160 μm in diameter, composed of radiating hyphae united along their whole length, cells thin walled, cubical to rectangular, 2.5-5.5 μm thick and 3-13 μm long. Margin thin, entire. Ostiole well defined, 8 μm in diameter, surmounting a prominently-raised, dark brown, conical border composed of four or five layers of thick walled cells, the base of which is 29.5 μm in diameter.

Fig. 375. *Trichothyrites airensis*. Bar = 40 μm .

Locality: Australia, New Zealand and the Kerguelen Archipelago.

Age: Oligocene-Miocene.

Indian records: Ramanujam & Rao 1973, p. 205, pl. 1, fig. 9, Warkalli Formation (Miocene), Varkala, Kerala.

Remarks: Reddy *et al.* (1982) proposed the new combination *Trichothyrites airenensis* (Cookson), but did not provide the basionym or bibliographic details, and hence did not validly publish this combination.

Species: *Trichothyrites amorphus* (Kar & Saxena 1976) Saxena & Misra 1990

Fig. 376

Mycobank No.: MB 483359.

Notothyrites amorphus Kar & Saxena, Palaeobotanist 23(1), p. 9, pl. 4, figs. 44-45. 1976.

Description (Kar & Saxena 1976, p. 9): Ascostromata mostly subcircular, 45-105 x 40-98 μm , dimidiate, ostiolate; ostiole surrounded by a wall of few cells thick. Hyphae radially arranged but do not anastomose to form distinct pseudoparenchymatous cells.

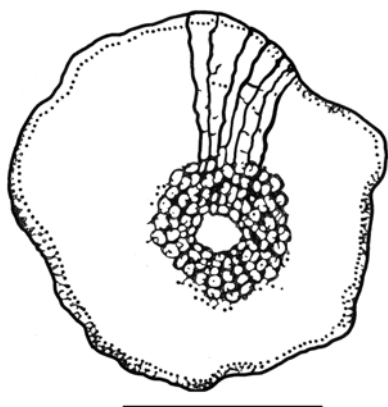


Fig. 376. *Trichothyrites amorphus*. Bar = 50 μm .

Locality: Matanomadh, Kutch District, Gujarat, India.

Age: Palaeocene (Matanomadh Formation).

Indian records: Kar & Saxena 1976, p. 9, pl. 4, figs. 44-45, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Jain & Kar 1979, p. 108, pl. 2, figs. 21-22, Neogene, around Kollam and Varkala, Kerala; Phadtare & Kulkarni 1980, p. 166, pl. 1, fig. 2, Ratnagiri Beds (Miocene), Ratnagiri-Pawas Road near Third Dharamshala stop 10 km south of Ratnagiri, Ratnagiri District, Maharashtra; Kar & Saxena 1981, p. 106, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Singh & Saxena 1984, p. 624, pl. 2, fig. 33, Girujan Clay (Neogene), Jorajan Well-3, Assam; Singh & Sarkar 1984b, p. 50, pl. 2, figs. 28-29, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena *et al.* 1984, p. 188, pl. 2, fig. 39,

Lower Siwalik (Middle-Late Miocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Kar 1985, p. 130, Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Singh *et al.* 1986, p. 96, pl. 1, fig. 10, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rajendran *et al.* 1989, p. 43, pl. 1, fig. 15, Miocene, Edavai, Kerala; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Saxena & Misra 1990, p. 270, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Saxena & Sarkar 2000, p. 257, Siju Formation (Middle Eocene), Simsang River Section near Siju, South Garo Hills District, Meghalaya.

Species: *Trichothyrites denticulatus* (Ramanujam & Rao 1973) Kalgutkar & Jansonius 2000

Fig. 377

Mycobank No.: MB 483564.

Notothyrites denticulatus Ramanujam & Rao, Palaeobotanist 20(2), p. 204, pl. 1, fig. 7. 1973.

Trichothyrites denticulatus (Ramanujam & Rao 1973) Reddy *et al.*, Records of the Geological Survey of India 114(5), p. 114. 1982. (nom. inval.).

Description (Ramanujam & Rao 1973, p. 204): Free mycelium lacking. Ascostromata discoid, dimidiate, rounded, margin smooth, rigid; 69-81 μm in diameter. Ostiolate, ostiole centric, 10-15 μm in diameter, elevated on slightly raised border. Ostiole border 3-4-layered, cells dark brown, thick-walled, rounded to flattened, lumina narrow. Marginal cells of ascostromata 5-16 x 3.8-6.5 μm , tangential walls thickened. Cells between ostiole border and ascostromata periphery squarish to rectangular, with thickened tangential walls; 4-7 conical, teeth-like (denticular) processes protruding into ostiole cavity from inner layer of border. Denticular processes 3-5 μm long, 4-5 μm broad basally, tip blunt or subacute, often slightly reflexed.



Fig. 377. *Trichothyrites denticulatus*. Bar = 50 μm .

Locality: Warkalli, Kerala, India.

Age: Late Miocene.

Indian records: Ramanujam & Rao 1973, p. 204-205, pl. 1, figs. 7-8, Warkalli Formation (Miocene), Varkala, Kerala; Rao & Ramanujam 1976, p. 98, pl. 1, figs. 1-2, Quilon and Warkalli Beds (Miocene), Kerala; Phadtare & Kulkarni 1980, p. 166, pl. 1, fig. 1, Ratnagiri Beds (Miocene), Ratnagiri-Pawas Road near Third Dharamshala stop 10 km south of Ratnagiri, Ratnagiri District, Maharashtra.

Remarks: Ramanujam compared this species with *Notothyrites neyveli*. However, although “*N. neyveli*” was mentioned by Ramanujam in the abstract published in the Proceedings of the 50th Indian Congress (1963b), this name was not validly published. Reddy *et al.* (1982) proposed the new combination *Trichothyrites denticulatus* (Cookson), but did not provide the basionym or bibliographic details, and hence did not validly publish this combination.

Species: *Trichothyrites echinatus* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000

Fig. 378

MycoBank No.: MB 483565.

Notothyrites echinatus Rao & Ramanujam, Geophytology 6(1), p. 99, pl. 1, fig. 3. 1976.

Trichothyrites echinatus (Rao & Ramanujam 1976) Reddy *et al.*, Records of the Geological Survey of India 114(5), p. 114. 1982. (nom. inval.)

Description (Rao & Ramanujam 1976, p. 99): Ascomata flattened, dimidiate, rounded, margin even and firm; 90-115 µm in diameter; ostiolate, ostiole centric, 11-14 µm in diameter, elevated on a thick border of 4-5 layers of thick-walled cells, inner layer of ostiole border with 15-22 prominent spinous processes, spines 5-8 µm long, 2.0-2.5 µm broad at the base. Rest of the fruiting body with radially aligned squarish to rectangular cells, 3.0-3.5 x 2.5-4.5 µm in size, radial walls of these cells thick-walled.

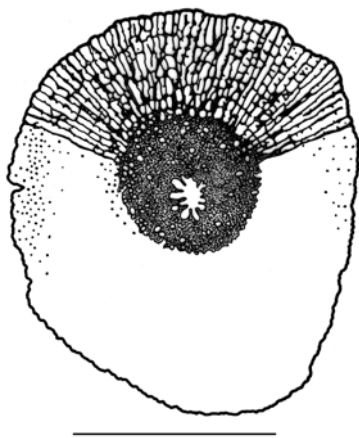


Fig. 378. *Trichothyrites echinatus*. Bar = 50 µm.

Locality: Warkalli, Kerala, India.

Age: Late Miocene.

Indian records: Rao & Ramanujam 1976, p. 99, pl. 1, figs. 3-4, Quilon and Warkalli Beds (Miocene), Kerala.

Remarks: Reddy *et al.* (1982) proposed the combination *Trichothyrites echinatus* (Cookson), but did not provide the basionym or bibliographic details, and hence did not validly publish this combination.

Species: *Trichothyrites keralensis* (Rao & Ramanujam 1976) Kalgutkar & Jansonius 2000

Fig. 379

MycoBank No.: MB 483258.

Asterothyrites keralensis Rao & Ramanujam, Geophytology 6(1), p. 101, pl. 2, fig. 12. 1976.

Description (Rao & Ramanujam 1976, p. 101): Ascomata rounded, dimidiate, margin even to crenate, firm, 58-85 µm in diameter. Ostiolate, ostiole centric, round, 7-9 µm in diameter, with a prominent border of 2-3 layers of thick-walled dark brown cells. Hyphopodiate free mycelial shreds near ostiole border, rest of ascomata with strictly radially arranged, squarish to rectangular 2-4 µm wide cells; outer walls of marginal cells thickened. Ascospores unknown.

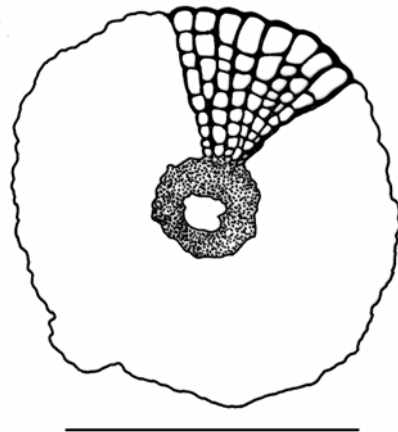


Fig. 379. *Trichothyrites keralensis*. Bar = 50 µm.

Locality: Warkalli, Kerala, India.

Age: Late Miocene.

Indian records: Rao & Ramanujam 1976, p. 100-101, pl. 2, figs. 11-12, Quilon and Warkalli Beds (Miocene), Kerala; Singh & Sarkar 1994, p. 52, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh.

Species: *Trichothyrites ovatus* (Venkatachala & Kar 1969) Kalgutkar & Jansonius 2000

Fig. 380

MycoBank No.: MB 483567.

Sphaerialites ovatus Venkatachala & Kar, Palaeobotanist 17(2), p. 182, pl. 1, fig. 11. 1969.

Description (Venkatachala & Kar 1969, p. 182): Perithecium dark brown, subcircular-circular, size range 60-150 μm . Central part of perithecium lighter, comprising 4-5 hexagonal cells, surrounded by a thick, at least two-layered, dark, plate-like, well-defined, rounded area consisting of square-hexagonal cells. Remaining part of perithecium one-layered and comprising square to somewhat hexagonal pseudoparenchymatous cells of unequal length and width, produced by the radiating interconnected hyphae. Outer margin slightly undulating, not thickened.

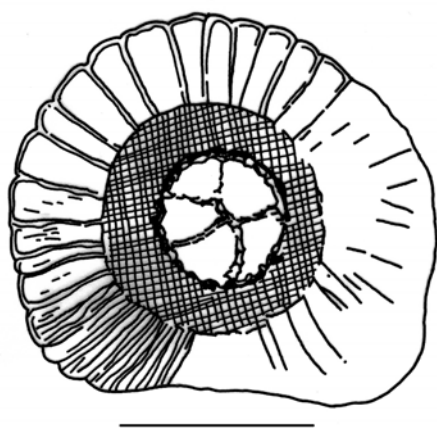


Fig. 380. *Trichothyrites ovatus*. Bar = 50 μm .

Locality: Bore-hole No. 14, Matanomadh, Kutch District, Gujarat, India.

Age: Eocene.

Indian records: Venkatachala & Kar 1969, p. 182, pl. 1, figs. 9-11, Naredi Formation (Early Eocene), Bore-hole No. 14, Matanomadh, Kutch District, Gujarat; Rawat *et al.* 1977, p. 187, Kadi Formation (Early Eocene), Cambay Basin, Gujarat.

Species: *Trichothyrites padappakkarensis* (Jain & Gupta 1970) Kalgutkar & Jansonius 2000

Fig. 381

Mycobank No.: MB 483568.

Notothyrites padappakkarensis Jain & Gupta, Palaeobotanist 18(2), p. 178, pl. 1, fig. 14. 1970.

Trichothyrites padappakkarensis (Jain & Gupta 1970) Reddy *et al.*, Records of the Geological Survey of India 114(5), p. 114, pl. 1, fig. 8. 1982. (nom. inval.)

Description (Jain & Gupta 1970, p. 178): Ascum flattened, subcircular, ostiolate, outline sinuous, 40-100 μm in diameter, solitary, made up of interconnected radiating hyphae; cells 2.5 x 4 μm , elongated towards periphery; wall thin, tangential

walls of peripheral cells strongly thickened and entire. Ostiole well defined, 7-10 μm in diameter, distinctly elevated, centric to slightly eccentric, bordered by two to four layers of dark brown, thick-walled, papillate cells; degree of raise of papillate surface variable, 1.5-2.5 μm high. Hyphae absent. Ascospores unknown.

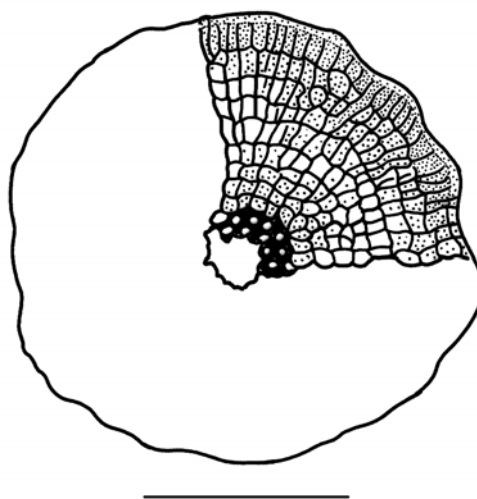


Fig. 381. *Trichothyrites padappakkarensis*. Bar = 100 μm .

Locality: Padappakkara, Kollam, Kerala, South India.

Age: Miocene.

Indian records: Jain & Gupta 1970, p. 178, pl. 1, figs. 13-14, Quilon Beds (Early Miocene), Kollam District, Kerala; Rao & Ramanujam 1976, p. 99, pl. 1, fig. 5, Quilon and Warkalli Beds (Miocene), Kerala; Dutta & Singh 1980, p. 620, pl. 1, fig. 6, Siwalik Group-Units A-C (Late Miocene-Pleistocene), Bhalukpong-Bomdila Section, Kameng District, Arunachal Pradesh; Reddy *et al.* 1982, p. 114, pl. 1, fig. 8, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Varma 1987, p. 167, pl. 1, fig. 9, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 96, pl. 1, fig. 7, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam.

Remarks: *Trichothyrites padappakkarensis* was originally described from the Quilon sediments of Kerala (Jain & Gupta 1970). Rao and Ramanujam (1976) recorded similar fruiting bodies from the Quilon and Warkalli beds of Kerala. Reddy *et al.* (1982) expressed their agreement with Elsik (1978) that Cookson's (1947a) form genus *Notothyrites* is indistinguishable from *Trichothyrites* described earlier by Rosendahl (1943) and opined that all the species described under *Notothyrites* should be incorporated under

Trichothyrites. Reddy *et al.* (1982) proposed the new combination *Trichothyrites padappakkarensis* (Jain & Gupta), but did not provide the basionym or bibliographic details, and hence did not validly publish this combination.

Species: *Trichothyrites sastryi* Patil & Ramanujam 1988

Fig. 382

Mycobank No.: MB 519780.

Description (Patil & Ramanujam 1988, p. 262): Ascumata light brown, discoid, rounded, 163 μm in diameter (holotype), one-layered, mostly free mycelium lacking, ostiolate. Ostiole 23 μm , more or less rounded, slightly raised from the general surface of ascoma, centric, encircled by 2-4 layers of dark-brown, thick-walled angular cells. Rest of ascoma composed of strictly radiating hyphae, with both longitudinal and cross walls distinct, cells rectangular, 15-20 μm in length and 3-11 μm in width, longer towards ascomal margin. Marginal layers of cells thicker than rest of cells, dark-brown, simple or furcate, forming a rather well-defined band, margin uneven.



Fig. 382. *Trichothyrites sastryi*. Bar = 40 μm .

Locality: Tonakkal, Kerala, India.

Age: Miocene.

Indian records: Patil & Ramanujam 1988, p. 262-263, pl. 1, fig. 2, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Samant & Tapaswi 2000, p. 29, fig. 2.16, Cambay Shale (Early Eocene), Cambay Basin, Gujarat.

Species: *Trichothyrites setifer* (Cookson 1947) Saxena & Misra 1990

Fig. 383

Mycobank No.: MB 483358.

Notothyrites setifer Cookson, Proceedings of the Linnean Society, New South Wales 72 (3-4), p. 209, pl. 11, fig. 1. 1947a.

Description (Cookson 1947, p. 209): Ascumata flattened-hemispherical with a somewhat sinuous outline, 70-135 μm in

diameter, solitary, composed of radiating hyphae connected throughout their whole length. Cells approximately 4-13 μm long and 4-10 μm thick, frequently becoming more elongated towards the periphery. Cell walls of the majority of cells thin, but the outer walls of the peripheral layer frequently strongly thickened to form the firm, entire margin of the ascoma. The ostiole is well defined, distinctly elevated and either centrally or slightly eccentrically placed. It is 10-16 μm in diameter and bordered by three or four layers of dark brown, thick-walled cubical cells. The border is cylindrical and some of the cells bear setae, and their walls are thick and brown below, thinning towards lighter, bluntly-pointed apices (pl. 11, fig. 4).

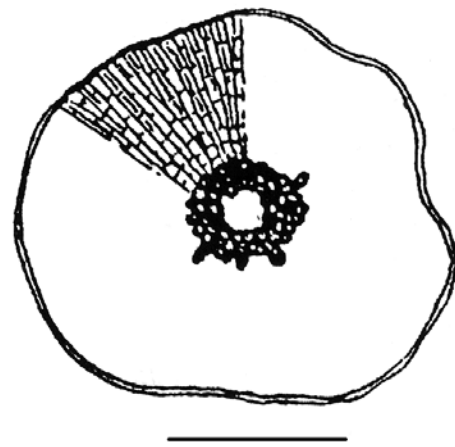


Fig. 383. *Trichothyrites setifer*. Bar = 40 μm .

Locality: Australia, New Zealand and the Kerguelen Archipelago;

Age: Oligocene-Miocene.

Indian records: Rajendran *et al.* 1989, p. 41, 42, 44, Miocene, Tonakkal, Padappakkara, Kannur, Palayangadi, Kerala; Kar 1990a, p. 179, pl. 8, fig. 118, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 232, 236, 240, pl. 2, fig. 6, Disang, Jenam and Bhuban formations (Palaeocene-Eocene, Middle Oligocene and Early Miocene), Silchar-Haflong Road Section, Assam; Saxena & Misra 1990, p. 270, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Kar & Bhattacharya 1992, p. 251, Rajpardi lignite (Early Eocene), Bharuch District, Gujarat; Saxena & Khare 1992, p. 37, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Ambwani 1993, p. 153, Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya; Kar *et al.* 1994, p. 187, Tertiary, subsurface sediments in Upper Assam; Rao 1995, p. 233, Tertiary, Alleppey and Kannur districts, Kerala; Kumar 1996, p. 114, Tarkeshwar Formation (Early Eocene), Rajpardi, Bharuch District, Gujarat; Rao 1996,

p. 156, Early Miocene, Turavur Borehole near Panchayat L.P. School, west of N.H. 47 between 380 and 381 km, Alleppey District, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Samant & Phadtare 1997, p. 68, pl. 14, fig. 16, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Rao & Nair 1998, p. 52, pl. 1, fig. 26, Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala; Mitra *et al.* 2000, p. 126, pl. 1, fig. 1, Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya; Rao 2000, p. 295, Kherapara Formation (Oligocene), Tura-Dalu Road Section near Kherapara, West Garo Hills District, Meghalaya; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Tripathi *et al.* 2000, p. 243, Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya; Chakraborty 2004, p. 116, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam; Rao 2004, p. 124, pl. 3, fig. 16, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Kar *et al.* 2010, p. 242, Bhuban Formation (Miocene), Tlamsam, Mizoram, India.

Species: *Trichothyrites siwalikus* Phadtare 1989

Fig. 384

Mycobank No.: MB 519779.

Description (Phadtare 1989, p. 128): Ascomata of variable sizes, slightly to distinctly eccentric, profusely and deeply lobed along periphery, ostiolate, radiate; individual cells distally porate, rectangular, elongated along the radius, thinning towards the periphery, mycelium lacking.



Fig. 384. *Trichothyrites siwalikus*. Bar = 100 μ m.

Locality: Kali River Section near Thuli Gad, about 18 km NE of Tanakpur, Uttarakhand, India.

Age: Middle Miocene (Lower Siwalik).

Indian records: Phadtare 1989, p. 128, fig. 5, Middle Miocene, Kali River Section near Thuli Gad, about 18 km NE of Tanakpur, Uttarakhand.

Genus: *Trimmatostroma* Corda 1837

Mycobank No.: MB 10312.

Type Species: *Trimmatostroma salicis* Corda 1837.

Classification: Dematiaceous Hyphomycetes.

Species: *Trimmatostroma intertrappea* Patil & Datar 2002

Fig. 385

Mycobank No.: MB 530090.

Description (Patil & Datar 2002, p. 32-34): (Diagnosis): Mycelium septate, branched, thin walled, hyaline, individual cells circular to oval, thin walled, 4-12 μ m in length and 4-8 μ m in breadth, dark brown coloured, quadrate conidia on short conidiophores, terminal, 16-24 μ m x 8-16 μ m and an individual spore in the quadrate conidium 1-5 μ m in diameter. Conidiophore 8 μ m long and 8 μ m 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 x 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 μ m in length and 4-8 μ m 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 μ m 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 μ m x 8-16 μ m 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 μ m.

Locality: Nawargaon-Maragsur area, Wardha District, Maharashtra, India.

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

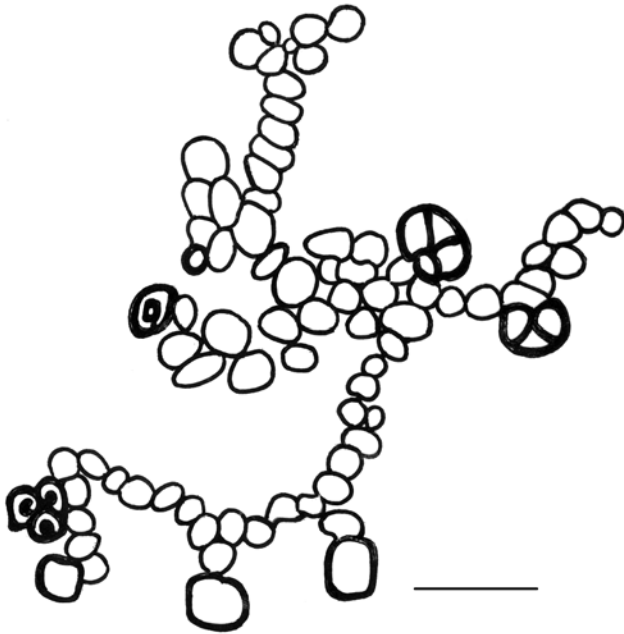


Fig. 385. *Trimmatostroma intertrappea*. Bar = 10 μ m.

Indian records: Patil & Datar 2002, p. 32-34, pl. 1, figs. 1-4, text-figs. 1-8, Deccan Intertrappean Beds (Late Cretaceous-Palaeocene), Nawargaon-Maragsur area, Wardha District, Maharashtra.

U

Genus: *Udaria* Gupta 1996

Mycobank No.: MB 519776.

Type Species: *Udaria singhii* Gupta 1996.

Description (Gupta 1996, p. 103): (Diagnosis) Various subcircular-ellipsoidal-oval, with germ slit (furrow) and a tube-like appendage, generally irregularly folded, psilate. (Description): 39 x 33 - 116 x 81.5 μ m (excluding appendage), appendage 3-8 μ m broad. Position of slit and appendage variable; these two occur at opposite ends, very close to each other, often between these two positions. Slit elongate, small-large, running around nearly up to whole surface; situated irregularly, somewhat obliquely, often obliquely horizontal, nearly vertically in relation to appendage; one, rarely appears more. Number of folds in individual specimen variable ranging from rare to copious, folds irregularly distributed occasionally parallel to margin. Body shape variable due to haphazard foldings and widened opening of wall at the slit.

Classification: Zygomycetes, Endogonales.

Remarks: Gupta (1996, p. 104) differentiated this genus from *Aplanosporites* Kar 1979 (here considered a taxonomic synonym of *Palaeomycites* Meschinelli 1902) in having a germ slit (furrow) which is lacking in the latter. The illustrations of both the species of this genus (*Udaria singhii* and *Udaria saxenae*), however, are very poor and do not clearly show the germ slit.

Species: *Udaria saxenae* Gupta 1996

Fig. 386

Mycobank No.: MB 519778.

Description (Gupta 1996, p. 104): Light brown, subcircular-ellipsoidal, with slit and a tube-like appendage. 65 x 46 - 116 x 81.5 μ m (excluding appendage), wall up to 7 μ m thick, surface irregularly folded, psilate, appendage 3-8 μ m broad.

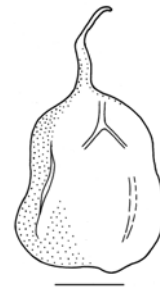


Fig. 386. *Udaria saxenae*. Bar = 30 μ m.

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Early Tertiary (Subathu Formation).

Indian records: Gupta 1996, p. 104, figs. 9-14, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Remarks: Gupta (1996) ascribed this species to acritarchs. However, its fungal affinity, related to VAM fungi, is unquestionable.

Species: *Udaria singhii* Gupta 1996

Fig. 387

Mycobank No.: MB 519777.

Description (Gupta 1996, p. 104): Deep brown, subcircular-oval with slit and a tube-like appendage, 39 x 33 - 75.5 x 67 μ m (excluding appendage), wall ca. 2-2.6 μ m thick, surface irregularly folded, psilate, appendage 4-8 μ m broad.

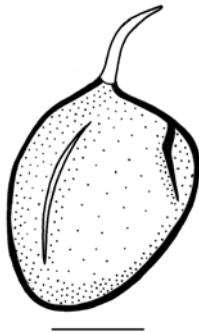


Fig. 387. *Udaria singhii*. Bar = 30 μm .

Locality: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India.

Age: Early Tertiary (Dagshai Formation)

Indian records: Gupta 1996, p. 104, figs. 1-8, Dagshai Formation (Early Tertiary) Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Remarks: Gupta (1996) ascribed this species to acritarchs. However, its fungal affinity, related to VAM fungi, is unquestionable.

Genus: *Ustilago* (Persoon 1801) Roussel 1806

Mycobank No.: MB 16391.

Type Species: None designated.

Classification: Basidiomycetes, Ustilaginales.

Species: *Ustilago deccanii* Chitale & Yawale 1978

Mycobank No.: MB 111080.

Remarks: Kalgutkar and Jansonius (2000) transferred *Ustilago deccanii* Chitale & Yawale 1978 to *Inapertisporites* van der Hammen 1954a [See: *Inapertisporites deccanii* (Chitale & Yawale 1978) Kalgutkar & Jansonius 2000].

V

Genus: *Varmasporites* Kalgutkar & Jansonius 2000

Mycobank No.: MB 28626.

Type Species: *Varmasporites tonakkalensis* (Varma & Patil 1985) Kalgutkar & Jansonius 2000.

Description (Kalgutkar & Jansonius 2000, p. 309): Fusiform, four-celled, inaperturate fungal spores, with a pronounced constriction at the thick median septum, and with a distinct ribbed or striate sculpture parallel to the long axis. The two centrifugal septa may be less strongly developed.

Classification: Fungi Imperfecti, Phragmosporae.

Remarks: *Fusiformisporites* is two-celled and lacks a strong median constriction. *Kumarisporites* is three celled, and its ribs extend continuously from one pole to the other.

Species: *Varmasporites tonakkalensis* (Varma & Patil 1985) Kalgutkar & Jansonius 2000

Fig. 388

Mycobank No.: MB 483572.

Fusiformisporites tonakkalensis Varma & Patil, Geophytology 15(2), p. 153, pl. 1, fig. 11. 1985.

Description (Varma & Patil 1985, p. 153): Tetracellate, inaperturate, striate, spindle-shaped, brownish fungal spores; 48-52 x 8-10 μm . Heteroseptate, central septum 2.5 μm thick, 8 μm long, constricted, imparting a girdle shape to the spore and dividing the spore into two equal halves. Each half with conical outline, pointed ends, septate, septum porate (1 μm wide), with two septal folds, 2.5 μm wide. About 5-6 longitudinal striae are seen on each exposed facet of the spore; striae 1.5 μm wide, not continuous, ending up in the median septum; spore wall 2 μm thick.



Fig. 388. *Varmasporites tonakkalensis*. Bar = 10 μm .

Locality: Tonakkal area, Thiruvananthapuram District, Kerala, India.

Age: Miocene.

Classification: Fungi Imperfecti, Phragmosporae.

Indian records: Varma & Patil 1985, p. 153, pl. 1, fig. 11, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.

W

Genus: *Warkallisporonites* Ramanujam & Rao 1978**Mycobank No.:** MB 21361.**Type Species:** *Warkallisporonites denticulatus* Ramanujam & Rao 1978.**Description** (Ramanujam & Rao 1978, p. 298): Spores simple, melanin coloured, multicellular, uniseriate, fusiform, multiporate. Spores distinctly constricted in the central region. Denticulate or wedge-shaped thickenings on some septa, pore slit-like in each septum. Spore wall granular to scabrate.**Classification:** Fungi Imperfecti, Phragmosporea.**Remarks:** Kalgutkar and Jansonius (2000) considered this genus a junior synonym of *Multicellaesporites* Elsik 1968.**Species: *Warkallisporonites denticulatus* Ramanujam & Rao 1978****Mycobank No.:** MB 115097.**Indian records:** Ramanujam & Rao 1978, p. 298, pl. 2, figs. 27-28, Miocene, Kerala; Varma & Patil 1985, p. 156, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.**Remarks:** Since *Warkallisporonites* Ramanujam & Rao 1978 is a junior synonym of *Multicellaesporites* Elsik 1968, Kalgutkar and Jansonius (2000) transferred this species to *Multicellaesporites* Elsik 1968 [See: *Multicellaesporites denticulatus* (Ramanujam & Rao 1978) Kalgutkar & Jansonius 2000].**OTHER RECORDS OF INDIAN FOSSIL FUNGI**

In addition to the formally named species of Indian fossil fungi, described earlier, there are several fungal records that are informally reported. In order to record all available published fossil fungal remains, informally reported taxa where no binomials are given have also been listed below.

These entries contain informal name of fungal remain, its author(s), year of publication, page number(s), reference to plate(s), figure(s) and text-figure(s), age (in capital letters) and name of the horizon in parentheses, locality and names of district and state where it is situated. All the entries are arranged in alphabetical order. In case a particular species is reported more than once by the same or different author(s), all its occurrences are given in chronological order with relevant details as mentioned above.

Actinopelte*.** Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 21-22, Late Holocene, Demagiri, Mizoram.Alternaria* spp.** Rao & Menon 1970, p. 75, pl. 1, figs. 6, 7, text figs. 10-15, Quaternary, Pykara, Ootacamund, Tamil Nadu; Sharma 1976, p. 79, pl. 1, figs. 5-8, Quaternary, Malvan, Surat District, Gujarat; Malleshram *et al.* 1989, p. 16, pl. 1, fig. 18, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, TamilNadu; Hait & Banerjee 1994, p. 118, pl. 4, fig. 63, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Mitra *et al.* 2000, p. 126, pl. 1, fig. 3, Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya; Gupta *et al.* 2003, p. 210, Palaeocene-Eocene, Ganga Basin, Mohabey & Samant 2003, p. 230, pl. 3, fig. 10, Lameta Formation (Maastrichtian), Pisdura, Nand-Dongargaon Basin, Maharashtra; Singh & Chauhan 2008, p. 76, pl. 2, figs. 1, 4, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.***Alternariaites* sp.** Pathak & Banerjee 1984, p. 250, pl. 2, fig. 22, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal.***Annellophora mussandae* Ellis.** Gupta 1970, p. 236, pl. 1, fig. 4, Pleistocene, Sankrail, Howrah District, West Bengal.***Aplanosporites* (now *Palaeomycites*) spp.** Singh & Sarkar 1984a, p. 98, pl. 2, fig. 29, Miocene, Ramshahr Well-1, Solan District, Himachal Pradesh; Dutta *et al.* 1998, p. 64, pl. 1, fig. 1, Upper Disang and Lower Barail groups (Late Eocene-Early Oligocene), Kohima District, Nagaland.***Appendicisporonites* sp.** Saxena & Khare 1992, p. 40, 42, pl. 1, fig. 12, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu.***Ascoma* (thyriothecium).** Patil & Ramanujam 1988, p. 266, pl. 2, fig. 12, Miocene, Tonakkal, Thiruvananthapuram District, Kerala.***Ascomycetes* types.** Bajpai & Maheshwari 1988, p. 211, pl. 1, fig. 1, Basal Barakar Formation (Early Permian), Chitra mine area, Deogarh Coalfield, Bihar; Bajpai & Maheshwari 1988, p. 211, pl. 1, figs. 2-2, Sivaganga Formation (Early Cretaceous), Naicolam, Tiruchirapalli District, Tamil Nadu.***Ascomycetes*, fruiting bodies of.** Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 23, Late Holocene, Demagiri, Mizoram.**cf. *Ascomycetes*, perithecium of.** Ambwani 1983, p. 150-151, pl. 1, figs. 12-14, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.***Ascospores*.** Singh & Chauhan 2008, p. 78, pl. 2, fig. 15, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 12-13, Late Holocene, Demagiri, Mizoram.**cf. *Aspergillus* sp.** Rao & Menon 1970, p. 75, pl. 1, figs. 10-12, Quaternary, Pykara, Ootacamund, Tamil Nadu.***Asterinaceae*.** Ratan & Chandra 1982, p. 262, pl. 1, fig. 6, surface (bottom) sediments, Arabian Sea.***Asterothyrites* spp.** Ramanujam & Rao 1973, p. 206-207, pl. 3, fig. 24, Warkalli Formation (Miocene), Varkala, Kerala; Gupta 1994, p. 250-251, fig. 3, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

- Bahusandhika Subramanian.** Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.
- Basidiosporites spp.** Koshal & Uniyal 1984, p. 242, pl. 3, figs. 1-2, 4-5, 7-8, 10, 12-13, 15, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Varma & Patil 1985, p. 152, pl. 1, fig. 3, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Saxena & Misra 1990, p. 265, pl. 3, fig. 12, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena & Misra 1990, p. 265, pl. 3, fig. 8, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra.
- Callimothallus sp. cf. C. pertusus Dilcher.** Kar *et al.* 1972, p. 151, pl. 2, fig. 21, Tura Formation (Palaeocene), Garo Hills, Meghalaya.
- Callimothallus spp.** Patil & Ramanujam 1988, p. 263, pl. 1, fig. 4, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Ramanujam *et al.* 1991, p. 54, Early Miocene, Pattanakad Borewell, Alleppey District, Kerala; Samant 2000, p. 12, pl. 1, figs. 4-5, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.
- Camptomeris** Sydow. Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.
- Cellulasclerotes abnormalis Stach & Pickhardt.** Chatterjee & Chandra 1957, p. 189, Barakar Formation (Permian), Kurasia Seam, Kurasia Coalfield, Madhya Pradesh.
- Chaetomium sp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 18, (Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizwal District, Mizoram.
- Chaetosphaerites.** Chitale 1950, p. 30, pl. 2, fig. 21, Deccan Intertrappean Series (Early Tertiary), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.
- Cladosporium.** Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 20, 24-25, Late Holocene, Demagiri, Mizoram.
- Clasterosporium.** Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 24-25, Late Holocene, Demagiri, Mizoram.
- Cleistothecium type.** Singh & Chauhan 2008, p. 76, pl. 2, fig. 3, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Closely coiled septate conidiospore with a large number of chambers.** Rao 1958, p. 46, pl. 1, fig. 13, Tertiary.
- Cookeina.** Singh & Chauhan 2008, p. 78, pl. 2, fig. 20, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand. Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 14, 19, Late Holocene, Demagiri, Mizoram.
- cf. Coprinus, spore of.** Ambwani 1983, p. 151, pl. 1, fig. 15, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- Coronasclerotes africanus Neol.** Navale 1968, p. 143, pl. 2, fig. 19, Neyveli lignite (Miocene-Pliocene), Neyveli, South Arcot District, Tamil Nadu.
- Coronasclerotes australis Stach & Pickhardt.** Chatterjee & Chandra 1957, p. 189, Barakar Formation (Permian), Kurasia Seam, Kurasia Coalfield, Madhya Pradesh.
- Crenasclerotes stachii Pickhardt.** Chatterjee & Chandra 1957, p. 189, Barakar Stage (Permian), Kurasia Seam, Kurasia Coalfield, Madhya Pradesh.
- Cucurbitariaceites sp.** Kar *et al.* 1972, p. 149, pl. 1, fig. 16, Tura Formation (Palaeocene), Garo Hills, Meghalaya.
- Cunninghamella.** Mandaokar *et al.* 2008, p. 200, pl. 2, fig. 23, Late Holocene, Demagiri, Mizoram.
- Curvularia.** Rao & Menon 1970, p. 75, pl. 2, fig. 5, Quaternary, Pykara, Ootacamund, Tamil Nadu; Sharma 1976, p. 79, pl. 1, fig. 10, Quaternary, Malvan, Surat District, Gujarat; Gupta *et al.* 2003, p. 210, Palaeocene-Eocene, Ganga Basin; Singh & Chauhan 2008, p. 76, pl. 2, fig. 14, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 13-14, Late Holocene, Demagiri, Mizoram.
- Deuteromycetaceae (Spores).** Chatterjee & Ghosh 1962, p. 148, figs. 8, 11-12, 14, 16, Eocene, Dharangiri area, Garo Hills, Meghalaya.
- Deuteromycetes types.** Bajpai & Maheshwari 1988, p. 211, pl. 1, figs. 4-6, Sivaganga Formation (Early Cretaceous), Naicolam, Tiruchirapalli District, Tamil Nadu.
- Dicellaesporites spp.** Prasad & Ramesh 1983, p. 255, fig. 2.15, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 238, 242, pl. 1, fig. 7, pl. 3, fig. 22, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Singh *et al.* 1986, p. 98, pl. 2, figs. 18, 23, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Sarkar & Singh 1988, p. 59, pl. 6, fig. 23, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Rajendran *et al.* 1989, p. 41, 42, 43, 44, Miocene, Tonakkal, Kundra, Padappakkara, Edavai, Paravur, Kannur, Kerala; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 10, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizwal District, Mizoram; Hait & Banerjee 1994, p. 119, pl. 4, figs. 71-74, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Kar *et al.* 1994, p. 187, Tertiary, subsurface sediments in Upper Assam; Singh & Sarkar 1994, p. 52, pl. 1, fig. 4, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Saxena & Rao 1996, p. 46, pl. 3, fig. 8, Boldamgiri Formation (Early Miocene), Adu giri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Mandaokar 2000b, p. 181, Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Saxena 2000, p. 163,

Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Trivedi & Saxena 2000, p. 273, Kopili Formation (Late Eocene), Umrongso-Haflong Road near Umrongso, North Cachar Hills District, Assam; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam; Singh & Chauhan 2008, p. 76, pl. 2, fig. 12, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Dictyoarthrinium. Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 27-28, Late Holocene, Demagiri, Mizoram.

Dictyosporites sp. Chandra & Kumar 1998, p. 56, pl. 1, fig. 14, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.

Dictyosporium sp. Malleshm *et al.* 1989, p. 15-16, pl. 1, fig. 13, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.

Dictyosporium spore types. Ramanujam & Srisailam 1980, p. 130, pl. 2, fig. 29, Warkalli Beds (Miocene), Kannur District, Kerala; Varma & Patil 1985, p. 154, pl. 1, figs. 23-24, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh & Chauhan 2008, p. 78, pl. 2, fig. 19, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Didymoporisporonites spp. Varma & Patil 1985, p. 152, pl. 1, fig. 4, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Banerjee & Nandi 1992, p. 84, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.

Diplodia Type. Singh & Chauhan 2008, p. 78, pl. 2, fig. 18, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Diporicellaesporites spp. Kar *et al.* 1972, p. 152, pl. 2, fig. 27, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Venkatachala & Rawat 1972, p. 328, pl. 5, fig. 21, Palaeocene-Eocene, Cauvery Basin, Tamil Nadu; Jain *et al.* 1973, p. 161, pl. 2, fig. 79, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Ramanujam & Rao 1978, p. 297, pl. 2, figs. 21, 26, Miocene, Kerala; Jain & Kar 1979, p. 111, pl. 3, figs. 41, Neogene, around Quilon and Varkala, Kerala; Prasad & Ramesh 1983, p. 255, fig. 2.10, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 242, pl. 3, fig. 32, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Pathak & Banerjee 1984, p. 250, pl. 2, figs. 20-21, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Singh *et al.* 1985, p. 53, pl. 3, fig. 54, Barail Group (Oligocene), Assam and Meghalaya; Varma & Patil 1985, p. 154, pl. 1, fig. 18, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 101, pl. 2, figs. 25-

26, Lubha and Umkiang Members, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rajendran *et al.* 1989, p. 43, Miocene, Edavai, Kerala; Tripathi 1989, p. 74, pl. 2, fig. 4, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; cf. Kar 1990a, p. 178, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 233, Laisong Formation (Early Oligocene), Silchar-Haflong Road Section, Assam; Kumar 1990, p. 24-25, pl. 1, fig. 20, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam district, Kerala; Saxena & Misra 1990, p. 265, pl. 3, fig. 19, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Saxena & Khare 1992, p. 39, pl. 1, fig. 6, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Chandra & Kumar 1998, p. 62, pl. 1, fig. 19, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Samant & Tapaswi 2000, p. 26, fig. 2.3, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Rao 2004, p. 125, pl. 3, fig. 10, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 76, pl. 2, fig. 5, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Diporisporites spp. Prasad & Ramesh 1983, p. 255, fig. 2.13, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 238, 242, pl. 1, figs. 5, 8, pl. 3, figs. 16, 20, 35, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Singh *et al.* 1986, p. 100, pl. 1, fig. 16, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rajendran *et al.* 1989, p. 42, Miocene, Varkala, Kerala; Tripathi 1989, p. 74, pl. 3, fig. 11, Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Kar & Bhattacharya 1992, p. 252, Early Eocene, Gujra Dam Section and Akri lignite, Kutch District, Gujarat; Hait & Banerjee 1994, p. 118, pl. 4, figs. 61-62, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Bera & Banerjee 1995, p. 150, Bengal lignite (Middle-Late Eocene), Panagarh-Domra Sector, Burdwan District, West Bengal; Rao 1995, p. 233, Tertiary, Alleppey and Kannur districts, Kerala; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam district, Kerala; Gupta *et al.* 2003, p. 210, Palaeocene-Eocene, Ganga Basin; Singh & Chauhan 2008, p. 75, pl. 1, fig. 9, Neogene,

Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Dyadosporites spp. Hait & Banerjee 1994, p. 119, pl. 4, fig. 66, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Trivedi & Saxena 2000, p. 273, pl. 1, fig. 15, Kopili Formation Late Eocene), Umrongso-Haflong Road near Umrongso, North Cachar Hills District, Assam.

Dyadosporonites (now Dyadosporites) spp. Prasad & Ramesh 1983, p. 255, figs. 2.6, 14, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 242, pl. 3, figs. 23, 33, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Singh *et al.* 1986, p. 100, pl. 1, fig. 14, Jenam Formation (Middle Oligocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Mallesham *et al.* 1989, p. 18, pl. 1, fig. 7, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Saxena & Misra 1990, p. 265, pl. 2, figs. 4, 11, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Kumar & Takahashi 1991, p. 609, pl. 17, fig. 10, Bokabil Formation (Middle Miocene), Silchar-Haflong Road Section, Assam; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 11, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Kumar 1994, p. 89, pl. 41, fig. 10, Bokabil Formation (Middle Miocene), Silchar-Haflong Road Section, Assam; Kumaran *et al.* 1995, p. 1024, fig. 3h, Warkalli Formation (Miocene), Bharathi and Kundra Clay Mines, Kerala; Rao 1995, p. 234, pl. 1, fig. 4, Tertiary, Alleppey and Kannur districts, Kerala; Chandra and Kumar 1998, p. 62, pl. 1, fig. 9, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Rao 2004, p. 125, pl. 2, fig. 1, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 7-8, Late Holocene, Demagiri, Mizoram.

Entophlyctis lobata Willoughby & Townley. Gupta 1970, p. 236, pl. 1, figs. 5, 6, Pleistocene, Sankrail, Howrah District, West Bengal.

Entophlyctis. Mandaokar *et al.* 2008, p. 200, pl. 2, fig. 5, Late Holocene, Demagiri, Mizoram.

Eoglobella sp. Banerjee & Nandi 1992, p. 84, Bhuban Formation (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.

Exesisporites spp. Mallesham *et al.* 1989, p. 16, pl. 1, fig. 21, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Kumar 1990, p. 15, pl. 1, fig. 3, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam district, Kerala; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 3, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 34,

Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram; Hait & Banerjee 1994, p. 119, pl. 4, fig. 75, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram.

Foveoletisporonites. Prasad & Ramesh 1983, p. 255, fig. 2.3, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 9-10, Late Holocene, Demagiri, Mizoram.

Frasnacritetrus spp. Saxena *et al.* 1984, p. 189, pl. 2, fig. 38, Lower Siwalik (Middle-Late Miocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Saxena & Sarkar 1986, p. 216-221, pl. 1, figs. 6-7, pl. 2, figs. 1-8, text-figs. 4-8, Subathu Formation (Eocene), Jhimroti-Banethi Section, Sirmaur District, Himachal Pradesh, Lower Siwalik (Middle-Late Miocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh and Ramshahr Well no.1, Solan District, Himachal Pradesh, Upper Siwalik (Plio-Pleistocene), Hoshiarpur-Una Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh, Gagret-Bharwain Section, Una District, Himachal Pradesh; Singh *et al.* 1986, p. 102, pl. 2, fig. 9, Barail and Surma Groups (Oligocene-Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Sarkar & Singh 1988, p. 61, pl. 5, fig. 21, pl. 6, fig. 18, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Saxena & Khare 1992, p. 42, pl. 1, fig. 11, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Kumar 1994, p. 42, 48, 88, 97, pl. 21, fig. 8, pl. 41, fig. 6, Jenam, Renji, Bokabil and Dupitila formations (Middle-Late Oligocene, Middle Miocene and Plio-Pleistocene), Silchar-Haflong Road Section, Assam; Rao 1995, p. 234, pl. 1, fig. 10, Tertiary, Alleppey and Kannur districts, Kerala; Chandra & Kumar 1998, p. 60, pl. 1, fig. 13, pl. 3, fig. 10, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Trivedi & Saxena 2000, p. 273, pl. 1, fig. 13, Kopili Formation (Late Eocene), Umrongso-Haflong Road near Umrongso, North Cachar Hills District, Assam; Rao & Patnaik 2001, p. 272, pl. 3, figs. 7-8, Pinjor Formation (Late Pliocene), Nadah, Panchkula, Haryana; Rao 2004, p. 128, pl. 3, fig. 11, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.

Fungal/algal remain type 3. Ambwani 1983, p. 151, pl. 1, fig. 19, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.

Fungal bodies. Pareek 1958, p. 214, pl. 40, figs. 1-5, Permian, Talchir Coalfield, Orissa; Tripathi 1995, p. 48, pl. 1, fig. 20, Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan; Rao & Nair 1998, p. 52, pl. 1, fig. 25, Miocene, Kannanellur-Kundra Road area, Kollam district, Kerala.

- Fungal Forma A.** Kumar 1994, p. 48, pl. 22, fig. 12, Renji Formation (Late Oligocene), Silchar-Haflong Road Section, Assam.
- Fungal Fruiting Body Types.** Ratan & Chandra 1982, p. 263, pl. 1, fig. 12, surface (bottom) sediments, Arabian Sea; Rao 2004, p. 125, pl. 2, fig. 9, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 75, pl. 1, fig. 7, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Fungal hypha types.** Singh & Sarkar 1984b, p. 51, pl. 2, fig. 33, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Kumar 1994, p. 89, pl. 41, fig. 9, Bokabil Formation (Middle Miocene), Silchar-Haflong Road Section, Assam; Samant & Tapaswi 2000, p. 27, fig. 2.17, Cambay Shale (Early Eocene), Cambay Basin, Gujarat; Rao 2004, p. 125, pl. 2, figs. 13-14, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Fungal Incertae-sedis type 1.** Kar *et al.* 1972, p. 152, pl. 2, fig. 29, Tura Formation (Palaeocene), Garo Hills, Meghalaya.
- Fungal Polyad.** Hait & Banerjee 1994, p. 119, pl. 4, fig. 77, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram.
- Fungal remain types.** Ambwani 1982, p. 30, pl. 1, figs. 14-15, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh; Ambwani 1983, p. 151, pl. 1, figs. 17-18, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Kumar 1994, p. 55, pl. 27, fig. 4, Lower Bhuban Formation (Early Miocene), Silchar-Haflong Road Section, Assam; Mandal 1997, p. 100, pl. 1, fig. 32, Barail Group (Late Eocene), Mariani-Mokokchung Road, Mokokchung District, Nagaland.
- Fungal Sporangium.** Tripathi *et al.* 1999, p. 112, pl. 1, figs. 5-7, Eocene, Barsingsar, Bikaner District, Rajasthan.
- Fungal spores** Sahni & Rao 1943, p. 48, pl. 2, figs. 14-19, pl. 3, figs. 20, 21, text figs. 7-9, Deccan Intertrappean Series (Early Tertiary), Sausar, Chhindwara District, Madhya Pradesh; Sitholey *et al.* 1953, p. 200, pl. 2, figs. 11-13, Sirbu Shale (Precambrian), east of Saia, 20 km west of Vidisha, Madhya Pradesh; Ganju 1956, p. 34, pl. 1, figs. 1-7, ?Early Eocene, Jammu area, Jammu and Kashmir; Das 1961, p. 89, pl. 2, figs. 18, 19, Holocene, Sundarbans, West Bengal; Salujha *et al.* 1967, p. 58, pl. 2, fig. 36, Early Palaeozoic, Ujhani Well 2, Badaun District, Uttar Pradesh; Navale 1968, p. 142, pl. 2, figs. 9, 10, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Dutta & Ghosh 1970, p. 84 Neolithic, Barudih, Singhbhum District, Bihar; Jain & Gupta 1970, p. 181, pl. 1, figs. 22-24, Quilon Beds (Early Miocene), Kollam, Kerala; Nandi & Bandyopadhyay 1970, p. 240, Middle Siwalik (Miocene), Bhed Khad between Ghasoti and Badahr, Himachal Pradesh; Salujha *et al.* 1972, p. 289, pl. 3, fig. 107, Palaeocene, Garo Hills, Meghalaya; Venkatachala & Rawat 1973, p. 258, pl. 1, fig. 11, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Salujha *et al.* 1973, p. 112, Bhuban and Bokabil Subgroups (Miocene), South Shillong Plateau, Meghalaya; Salujha *et al.* 1974, p. 281, pl. 3, figs. 100-101, Palaeogene, Khasi and Jaintia Hills, Meghalaya; Salujha *et al.* 1979, p. 92, pl. 4, fig. 113, Miocene, Gojalia Anticline, South Tripura District, Tripura; Koshal & Uniyal 1984, p. 242, pl. 3, fig. 27, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Salujha & Kindra 1986, p. 246, pl. 3, fig. 81, Oligocene-Miocene, Silchar-Haflong Road Traverse, Cachar District, Assam; Kumar & Takahashi 1991, p. 610, pl. 6, fig. 5, pl. 11, fig. 2, pl. 17, fig. 4, Renji, Bhuban and Bokabil formations (Late Oligocene-Miocene), Silchar-Haflong Road Section, Assam; Salujha *et al.* 1991, p. 67, pl. 2, fig. 71, Neogene, Adamtila Well-A, Cachar District, Assam; Kumar 1994, p. 42, 55, 65, 76, 88, pl. 21, fig. 6, pl. 24, fig. 17, pl. 26, fig. 5, pl. 27, figs. 9, 16, 22, 24, pl. 30, figs. 13, 16, pl. 31, fig. 4, pl. 32, fig. 7, pl. 36, fig. 19, pl. 43, fig. 10, Jenam and Bhuban and Bokabil formations (Middle Oligocene-Miocene), Silchar-Haflong Road Section, Assam; Mehrotra *et al.* 2002, p. pl. 1, fig. 10, Late Eocene, Narsapur area, Krishna-Godavari Basin, Andhra Pradesh; Mohabey & Samant 2003, p. 230, pl. 3, fig. 7, Lameta Formation (Maastrichtian), Pisdura, Nand-Dongargaon Basin, Maharashtra.
- Fungal Spores, Host cuticle with.** Tripathi *et al.* 1999, p. 114, pl. 1, figs. 3-4, Eocene, Barsingsar, Bikaner District, Rajasthan.
- Fungal Spore, Rod shaped.** Tripathi *et al.* 1999, p. 112, pl. 2, fig. 2, Eocene, Barsingsar, Bikaner District, Rajasthan.
- Fungal Spore, Spindle shaped.** Tripathi *et al.* 1999, p. 112, pl. 2, fig. 1, Eocene, Barsingsar, Bikaner District, Rajasthan.
- Fungal Spore Tetrad.** Saxena & Rao 1996, p. 46, pl. 3, fig. 21, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya.
- Fungal spores types.** Chitale & Patel 1972, p. 213, text-fig. 28, Deccan Intertrappean Series (Eocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh; Jain *et al.* 1973, p. 162, pl. 2, fig. 75, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Venkatachala & Rawat 1973, p. 258, pl. 6, fig. 14, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Singh & Sarkar 1984b, p. 51, pl. 2, fig. 25, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena *et al.* 1988, p. 278, pl. 2, fig. 25, Tatrot Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Banerjee & Nandi 1992, p. 87, pl. 1, fig. 24, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Samant &

- Phadtare 1997, p. 69, pl. 15, fig. 10, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Rao & Patnaik 2001, p. 272, pl. 2, fig. 18, Pinjor Formation (Late Pliocene), Nadah, Panchkula, Haryana; Rao & Patnaik 2001, p. 274, pl. 2, fig. 19, Pinjor Formation (Late Pliocene), Nadah, Panchkula, Haryana; Rao 2004, p. 128, 130, pl. 2, figs. 17-18, pl. 3, fig. 13, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 75, 76, 78, pl. 1, fig. 10, pl. 2, figs. 2, 7, 9, 16, 21, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 199, 200, pl. 1, figs. 15-20, pl. 2, figs. 19, 26, Late Holocene, Demagiri, Mizoram.
- Fungal teleutospores.** Pareek 1962, p. 827, pl. 42, figs. 9, 11-12, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan.
- Fungal Tetrad Spore.** Kumar & Takahashi 1991, p. 610, pl. 8, fig. 10, Lower Bhuban Formation (Early Miocene), Silchar-Haflong Road Section, Assam.
- Fungal types.** Venkatachala & Rawat 1973, p. 258-259, pl. 6, figs. 15-16, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Jain & Kar 1979, p. 112, pl. 2, fig. 28, pl. 3, fig. 48, Neogene, around Quilon and Varkala, Kerala; Barlinge & Paradkar 1980, p. 227-237, pl. 1, figs. 1-3, 5, 7-10, 12-14, 16-21, text-figs. 1-12, 14-26, 28, 33-36, 39-46, Deccan Intertrappean Beds (Eocene), Nanded District, Maharashtra; Paradkar & Barlinge 1980, p. 244-251, pl. 1, figs. 5, 9-12, 14-18, text-figs. 1-12, 15a-b, 16a-b, 18, 22a-b, Deccan Intertrappean Beds (Eocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh; Prasad 1986, p. 373-383, pl. 3, figs. 1-21, pl. 4, figs. 1-18, pl. 5, figs. 1-6, pl. 6, figs. 1-6, Holocene, Tripura; Sarkar & Singh 1988, p. 61, pl. 5, figs. 8, 16, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh.
- Fungi-conidia.** Purekar 1962, p. 420, fig. 1, Lower Karewas (Pleistocene), Ningal Nala, Kashmir.
- Fusiformisporites spp.** Ramanujam & Rao 1978, p. 300, pl. 3, figs. 43-45, Miocene, Kerala; Salujha *et al.* 1979, p. 91-92, pl. 4, fig. 111, Miocene, Gojalia Anticline, South Tripura District, Tripura; Prasad & Ramesh 1983, p. 255, fig. 2.11, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 242, pl. 3, figs. 28-29, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Varma & Patil 1985, p. 153, pl. 1, fig. 10, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 102, pl. 2, fig. 8, Laisong Formation (Oligocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena & Misra 1990, p. 265, pl. 2, fig. 12, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 5, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Saxena & Khare 1992, p. 38, pl. 1, fig. 8, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 32, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram; Hait & Banerjee 1994, p. 119, pl. 4, fig. 65, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Chakraborty 2004, p. 116, pl. 1, fig. 13, Lakadong Sandstone (Late Palaeocene), around Bhalukurung, North Cachar Hills, Assam.
- Gelasinospora spp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 17, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Hait & Banerjee 1994, p. 119, pl. 4, figs. 68-69, 77-78, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Gupta *et al.* 2003, p. 210, Palaeocene-Eocene, Ganga Basin; Mandaokar 2004, p. 146, Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram.
- Globosasclerotes aegiranus Stach & Pickhardt.** Chatterjee & Chandra 1957, p. 189, Barakar Formation (Permian), Kurasia Seam, Kurasia Coalfield, Madhya Pradesh; Pareek 1962, p. 828, pl. 42, figs. 3-6, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan.
- cf. Globosasclerotes** Pareek 1962, p. 828, pl. 42, figs. 3-6, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan.
- Granateleutospores sp.** Salujha *et al.* 1969, p. 38, pl. 4, fig. 45, Subathu Formation (Early Eocene), Shimla Hills, Himachal Pradesh.
- Hadrotrichum** Fuckel. Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.
- Helicoma.** Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 3-4, Late Holocene, Demagiri, Mizoram.
- Helminthosporium spp.** Rao & Menon 1970, p. 74, pl. 1, figs. 1-3, text figs. 1-5, Quaternary, Pykara, Ootacamund, Tamil Nadu; Sharma 1976, p. 79, pl. 1, fig. 9, Quaternary, Malvan, Surat District, Gujarat; Ambwani 1983, p. 151, pl. 1, fig. 16, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Mohabey & Samant 2003, p. 230, pl. 3, fig. 9, Lameta Formation (Maastrichtian), Pisdura, Nand-Dongargaon Basin, Maharashtra; Singh & Chauhan 2008, p. 76, pl. 2, fig. 6, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Herpotrichiella.** Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 11, 18, Late Holocene, Demagiri, Mizoram.
- Heterosporium Klotzsch ex Cooke.** Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.

- Hormiscium Kunze ex Wallr./Torula Pres. ex Fr.** Sharma 1976, p. 80, pl. 1, fig. 12, Quaternary, Malvan, Surat District, Gujarat.
- Hypha types.** Koshal & Uniyal 1984, p. 238, 242, pl. 1, fig. 4, pl. 3, fig. 9, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Varma & Patil 1985, p. 155, pl. 1, fig. 30, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.
- Hyphomycetous conidia.** Sarkar & Singh 1994, p. 99, pl. 1, figs. 4-5, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.
- Hyphopodia.** Banerjee & Nandi 1994, p. 216, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram.
- Hypopodiata mycelium.** Samant & Phadtare 1997, p. 105, pl. 14, fig. 20, Tarkeshwar Formation (Early Eocene), Rajparadi, Cambay Basin, Gujarat.
- Hypopodium Type.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 16, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Hypoxylonites spp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 1, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Saxena & Khare 1992, p. 38, pl. 1, figs. 2, 14, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 31, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram.
- Inapertisporites spp.** Kar & Saxena 1976, p. 10, pl. 3, fig. 24, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat; Jain & Kar 1979, p. 109-110, pl. 3, fig. 38, Neogene, around Quilon and Varkala, Kerala; Ambwani 1982, p. 29-30, pl. 1, figs. 5-9, Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh; Prasad & Ramesh 1983, p. 255, fig. 2.16, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura; Pathak & Banerjee 1984, p. 248, pl. 1, fig. 2, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Varma & Patil 1985, p. 152, pl. 1, fig. 1, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 97, pl. 2, fig. 3, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena *et al.* 1988, p. 276-277, pl. 2, fig. 21, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Kumar 1990, p. 15, pl. 1, fig. 17, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam district, Kerala; Saxena & Bhattacharyya 1990, p. 113, pl. 1, fig. 20, Dharmasala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmasala, Kangra District, Himachal Pradesh; Kumar & Takahashi 1991, p. 611, pl. 18, fig. 9, Bokabil Formation (Middle Miocene), Silchar-Haflong Road Section, Assam; Kumar 1994, p. 88, pl. 41, fig. 11, Bokabil Formation (Middle Miocene), Silchar-Haflong Road Section, Assam; Singh & Sarkar 1994, p. 52, pl. 1, fig. 20, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Rao 1995, p. 234, pl. 1, figs. 6, 8, Tertiary, Alleppey and Kannur districts, Kerala; Saxena & Rao 1996, p. 46, pl. 3, fig. 16, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Rao 2004, p. 125, pl. 1, fig. 11, (Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Indeterminate fungal hyphae** Saluja *et al.* 1967, p. 58, pl. 2, fig. 37, Early Palaeozoic, Ujhani Well 2, Badaun District, Uttar Pradesh.
- Involutisporonites spp.** Kar *et al.* 1972, p. 152, pl. 2, fig. 28, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Varma & Patil 1985, p. 155, pl. 1, fig. 26, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Rao 2004, p. 126, pl. 1, fig. 14, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Isthmospora sp.** Ramanujam & Srisailam 1980, p. 120-121, pl. 1, fig. 2, Warkalli Beds (Miocene), Kannur District, Kerala.
- Isthmospora sp., parasitic mycelium of.** Phadtare & Kulkarni 1984, p. 517, pl. 1, fig. 2, Ratnagiri Beds (Miocene), well at Golap on Ratnagiri-Pawas Road, Ratnagiri District, Maharashtra.
- Kutchiathyrites spp.** Varma 1987, p. 167, pl. 1, fig. 10, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Malleshram *et al.* 1989, p. 15, pl. 1, fig. 3, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Saxena & Khare 1992, p. 39, pl. 1, fig. 4, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Rao *et al.* 1995, p. 374, fig. 3, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala; Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 16017, Late Holocene, Demagiri, Mizoram.
- Lacrimasporonites spp.** Saxena & Singh 1982a, p. 295, pl. 2, fig. 32, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Koshal & Uniyal 1984, p. 242, pl. 3, fig. 18, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Singh *et al.* 1986, p. 100, pl. 1, fig. 15, (Laisong Formation (Early Oligocene)), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Saxena & Khare 1992, p. 38-39, pl. 1, fig. 13, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Hait & Banerjee 1994, p. 118, pl. 4, fig. 64, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram; Mandaokar 2000b, p. 181, pl. 1, fig. 23, Tikak

Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam.

Lagenidialen fungus. Lakhnopal *et al.* 1967, p. 210, fig. 1, Deccan Intertrappean Series (Early Tertiary), Mohgaon Kalan, Chhnidwara District, Madhya Pradesh.

Leptosphaeria. Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 1-2, Late Holocene, Demagiri, Mizoram.

Lirasporis spp. Jain & Kar 1979, p. 108, pl. 3, fig. 39, Neogene, around Quilon and Varkala, Kerala; Raha *et al.* 1987, p. 213, Early Miocene, Ambalapuzha borehole, Kerala; Saxena & Misra 1990, p. 265, pl. 3, fig. 18, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra.

Mediaverrunites sp. Banerjee & Nandi 1992, p. 84, pl. 1, fig. 20, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.

Meliola spp. Ramanujam & Rao 1978, p. 293-294, pl. 1, figs. 1-4, Miocene, Kerala; Ramanujam & Srisailam 1980, p. 121-122, pl. 1, figs. 4-5, Warkalli Beds (Miocene), Kannur District, Kerala; Prasad & Ramesh 1983, p. 255, fig. 2.9, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura; Varma & Patil 1985, p. 154-155, pl. 1, fig. 25, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Varma 1987, p. 167, pl. 1, fig. 4, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Malleshham *et al.* 1989, p. 15, pl. 1, fig. 17, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 21, Bhuban, Bokabil and Tipam sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Rao *et al.* 1995, p. 374, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Mohabey & Samant 2003, p. 230, pl. 3, fig. 8, Lameta Formation (Maastrichtian), Pisdura, Nand-Dongargaon Basin, Maharashtra; Kumar *et al.* 2004, p. 157, pl. 1, fig. 15, Neogene and Pleistocene, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Rao 2004, p. 125, pl. 2, fig. 2, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 75, pl. 1, fig. 13, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Meliola sp., parasitic mycelium of. Phadtare & Kulkarni 1984, p. 517, pl. 1, fig. 2, Ratnagiri Beds (Miocene), well at Golap on Ratnagiri-Pawas Road, Ratnagiri District, Maharashtra.

Meliolinites spp. Chandra & Kumar 1998, p. 56, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Mitra *et al.* 2000, p. 126, pl. 1, fig. 2, Siwalik

Group (Neogene), Darjeeling Foothills, Eastern Himalaya.

Microthallites spp. Reddy *et al.* 1982, p. 115, pl. 1, fig. 12, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Tripathi 1989, p. 73, pl. 3, fig. 1, Kopili Formation (Late Eocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya.

Microthyriaceae. Jacob & Jacob 1950, p. 572, Cuddalore Series (Miocene-Pliocene), South Arcot District, Tamil Nadu; Banerjee & Misra 1968, p. 100, pl. 4, fig. 66, Late Cretaceous, Karaikal Well 2, Pondicherry; Koshal 1980, p. 687, pl. 3, fig. 75, Eocene, Dabka, Gujarat; Ratan & Chandra 1982, p. 260, pl. 1, figs. 1-5, surface (bottom) sediments, Arabian Sea; Koshal & Uniyal 1984, p. 238, pl. 1, fig. 30, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Phadtare *et al.* 1994, p. 75, pl. 1, fig. Q, Upper Siwalik (Plio-Pleistocene), Haripur Khol, Sirmaur District, Himachal Pradesh.

Microthyriaceous discs. Salujha *et al.* 1973, p. 113, Bhuban and Bokabil Subgroups (Miocene), South Shillong Plateau, Meghalaya; Venkatachala & Sharma 1984, p. 449, Miocene, Narsapur Well no. 1, West Godavari District, Andhra Pradesh.

Microthyriaceae germling. Samant 2000, p. 12, pl. 1, fig. 28, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat.

Microthyriaceae Incertae-sedis. Rao & Ramanujam 1976, p. 102, pl. 2, figs. 8-9, Quilon and Warkalli Beds (Miocene), Kerala.

Microthyriaceous ascomata. Jain & Dutta 1978, p. 108, pl. 2, fig. 22, Early Tertiary, Lekabali-Along Road Section, Siang District, Arunachal Pradesh.

Microthyriaceous Ascostromata. Sarkar & Singh 1994, p. 99, pl. 1, fig. 16, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.

Microthyriaceous Fruit Body. Hait & Banerjee 1994, p. 119, pl. 4, fig. 70, Early Miocene, near Suangpuilawn village about 20 km northeast of Aizawl, Mizoram.

Microthyriaceous Fruit Body, Young. Rao *et al.* 1995, p. 373, fig. 28, Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala.

Microthyriaceous fungi types 1-2. Jain & Kar 1979, p. 109, pl. 1, figs. 8-9, Neogene, around Quilon and Varkala, Kerala.

Microthyriaceous fungi, germling of. Ramanujam & Rao 1973, p. 204, pl. 1, figs. 1-3, Warkalli Formation (Miocene), Varkala, Kerala.

Microthyriaceous germings. Reddy *et al.* 1982, p. 113, pl. 1, figs. 4-7, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Samant & Phadtare 1997, p. 105, pl. 14, fig. 19, Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat; Mitra

et al. 2000, p. 126, pl. 1, fig. 8, Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya.

Microthyriaceous taxon. Gupta 1994, p. 256-257, fig. 11, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh.

Microthyriacites spp. Jain & Gupta 1970, p. 181, pl. 1, fig. 11, Quilon Beds (Early Miocene), Kollam, Kerala; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 15, Bhuban, Bokabil and Tipam sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 21, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram; Gupta 1994, p. 255-256, figs. 9-10, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh; Rao 2004, p. 124, pl. 2, fig. 7, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 74, pl. 1, fig. 1, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Microthyrium sp. Singh & Chauhan 2008, p. 74, pl. 1, fig. 2, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Microthyrium type, fruiting body of. Singh & Chauhan 2008, p. 75, pl. 1, fig. 4, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.

Monoporate spore type. Saxena & Singh 1982a, p. 295, pl. 2, fig. 31, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh.

Monoporisporites spp. Venkatachala & Rawat 1972, p. 327, pl. 5, fig. 16, Palaeocene-Eocene, Cauvery Basin, Tamil Nadu; Jain *et al.* 1973, p. 161, pl. 2, figs. 72-73, 76, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Prasad & Ramesh 1983, p. 255, fig. 2.7, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 242, pl. 3, figs. 3, 6, 11, 14, 17, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Saxena *et al.* 1984, p. 187, pl. 2, fig. 27, Lower-Middle Siwalik (Middle Miocene-Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Rajendran *et al.* 1989, p. 42, Miocene, Padappakkara, Kerala; Kar 1990a, p. 178, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 233, 236, Laisong and Jenam formations (Early-Middle Oligocene), Silchar-Haflong Road Section, Assam; Kar & Bhattacharya 1992, p. 258, pl. 1, fig. 21, Early Eocene, Gujra Dam Section and Akri lignite, Kutch District, Gujarat; Rao 1995, p. 233, Tertiary, Alleppey and Kannur districts, Kerala; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Mandaokar 2000b, p. 181, Tikak Parbat Formation (Late

Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam; Mandaokar 2005, p. 55, Tikak Parbat Formation (Late Oligocene), Ledo Colliery, Makum Coalfield, Assam.

cf. Mucor. Rao & Menon 1970, p. 75, pl. 1, fig. 9, text fig. 17, Quaternary, Pykara, Ootacamund, Tamil Nadu.

Multicellaesporites spp. Ramanujam & Rao 1978, p. 296-297, pl. 1, figs. 16, 20, Miocene, Kerala; Singh & Saxena 1980, p. 278, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Prasad & Ramesh 1983, p. 255, fig. 2.2, Holocene, Khowai and Sonai valleys, West Tripura District, Tripura; Singh & Saxena 1981, p. 177, pl. 1, fig. 8, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Ambwani 1983, p. 149, pl. 1, fig. 6, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Koshal & Uniyal 1984, p. 238, 242, pl. 1, fig. 6, pl. 3, figs. 24-26, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Pathak & Banerjee 1984, p. 249, pl. 2, figs. 15-16, Geabdat Sandstone (Neogene), Darjeeling District, West Bengal; Saxena *et al.* 1984, p. 186, pl. 2, figs. 30-32, Lower-Middle Siwalik (Middle Miocene-Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh; Varma & Patil 1985, p. 154, pl. 1, fig. 21, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 98, 100, pl. 2, figs. 5, 17, 19, 21, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Sarkar & Singh 1988, p. 59-60, pl. 4, fig. 22, pl. 5, fig. 3, Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh; Kar 1990a, p. 178, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 236, Jenam Formation (Middle Oligocene), Silchar-Haflong Road Section, Assam; Banerjee & Nandi 1992, p. 84, 87, pl. 1, figs. 8, 23, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Saxena & Khare 1992, p. 38, pl. 1, figs. 9-10, Late Palaeocene-Middle Eocene, Jayamkondacholapuram Well 12, Tiruchirapalli District, Tamil Nadu; Singh & Sarkar 1992, p. 185, Subathu Formation (? Late Palaeocene-Eocene), Garkhal, Solan District, Himachal Pradesh; Hait & Banerjee 1994, p. 119, pl. 4, fig. 67, Early Miocene, near Suanguwilawn village about 20 km north-east of Aizawl, Mizoram; Sarkar *et al.* 1994, p. 201, Middle Siwalik (Late Miocene), Bagh Rao, Dehradun District, Uttarakhand; Singh & Sarkar 1994, p. 52, pl. 1, fig. 24, Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh; Saxena & Rao 1996, p. 46, pl. 3, fig. 12, Boldamgiri Formation (Early Miocene), Adu giri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya;

- Sarkar 1997, p. 107, pl. 2, fig. 12, Subathu Formation (Eocene), 20 km southeast of Bilaspur on Shimla-Bilaspur Highway, Bilaspur District, Himachal Pradesh; Rao & Nair 1998, p. 52, Miocene, Kannanellur-Kundra Road area, Kollam district, Kerala; Samant 2000, p. 15, pl. 1, fig. 15, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Sarkar & Prasad 2000a, p. 171, Subathu Formation (Late Ypresian-Middle Lutetian), Koshalia Nala Section near Koti, Shimla Hills, Solan District, Himachal Pradesh; Sarkar & Prasad 2000b, p. 147, Subathu Formation (Late Ypresian-Middle Lutetian), west bank of Ghaggar river near Kharak village, Morni Hills, Haryana; Rao 2004, p. 126, pl. 2, fig. 5, pl. 3, fig. 4, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 75, pl. 1, fig. 12, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Nigrospora.** Singh & Chauhan 2008, p. 75, pl. 1, fig. 11, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 11-12, Late Holocene, Demagiri, Mizoram.
- Notothyrites (now Trichothyrites) spp.** Kar 1979, p. 32, pl. 3, fig. 48, Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat; Raha *et al.* 1987, p. 213, Early Miocene, Ambalapuzha borehole, Kerala; Gupta 1994, p. 248, 250, figs. 1-2, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh; Kumar *et al.* 2001, p. 244, Barail Group (Oligocene), Tinali Well-7, Upper Assam; Mandal *et al.* 2003, p. 104, Baratang Formation (Eocene), Baratang Island, Andaman and Nicobar Islands; Kar & Saxena 1976, p. 10, pl. 3, fig. 22, Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat.
- Ornasporonites.** Prasad & Ramesh 1983, p. 255, fig. 2.8, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura; Mandaokar *et al.* 2008, p. 199, pl. 1, figs. 5-6, Late Holocene, Demagiri, Mizoram.
- Palaeoamphisphaerella spp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 7, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 27, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram.
- Palaeocirrenalia spp.** Banerjee & Nandi 1992, p. 84, 87, pl. 1, figs. 13, 22, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Rao 2004, p. 126, pl. 1, fig. 13, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Papulosporonites sp.** Banerjee & Nandi 1992, p. 84, Bhuban Formation (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Paramicrothallites (now Asterothyrites) spp.** Reddy *et al.* 1982, p. 115, pl. 1, fig. 13, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Tripathi 1989, p. 73, pl. 3, fig. 7, Kopili Formation (Late Eocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Chandra & Kumar 1998, p. 56, pl. 1, fig. 16, pl. 3, fig. 7, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean.
- Parmathyrites spp.** Kar *et al.* 1972, p. 149-150, pl. 2, fig. 18, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Ambwani 1983, p. 150, pl. 1, fig. 9, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Kar & Saxena 1981, p. 114-115, pl. 4, fig. 77, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Reddy *et al.* 1982, p. 115-116, pl. 1, figs. 14-16, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Singh & Sarkar 1984b, p. 49, pl. 2, fig. 30, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Kar 1985, p. 130, 131, Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat; Raha *et al.* 1987, p. 213, Early Miocene, Ambalapuzha borehole, Kerala; Saxena & Misra 1990, p. 265, pl. 3, fig. 17, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Ramanujam *et al.* 1991, p. 54, Early Miocene, Pattanakad Borewell, Alleppey District, Kerala; Gupta 1994, p. 251-252, fig. 4, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh.
- Periconia spp.** Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh; Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 15-16, Late Holocene, Demagiri, Mizoram.
- Permulariaceae.** Ratan & Chandra 1982, p. 262, pl. 1, figs. 7-9, surface (bottom) sediments, Arabian Sea.
- Phragmothyrites germiling.** Koshal & Uniyal 1986, p. 225, pl. 7, fig. 332, Tertiary, Cambay Basin, Gujarat.
- Phragmothyrites sp. cf. P. eoceanicus Edwards.** Kar *et al.* 1972, p. 150, pl. 2, fig. 23, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Venkatachala & Rawat 1972, p. 328, pl. 5, fig. 17, Palaeocene-Eocene, Cauvery Basin, Tamil Nadu; Jain *et al.* 1973, p. 161, pl. 2, fig. 78, Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan; Rawat *et al.* 1977, p. 187, Kadi Formation (Early Eocene), Cambay Basin, Gujarat.
- Phragmothyrites spp.** Kar *et al.* 1972, p. 150-151, pl. 2, fig. 24, Tura Formation (Palaeocene), Garo Hills, Meghalaya; Venkatachala & Rawat 1973, p. 258, pl. 1, fig. 9, pl. 6, fig. 13, Oligocene-Miocene, Cauvery Basin, Tamil Nadu; Kar 1978, p. 173, pl. 1, fig. 30, Harudi Formation (Middle Eocene), near Harudi, Kutch District, Gujarat; Salujha *et al.* 1980, p. 678, pl. 3, fig. 90, Bokabil Subgroup (Miocene), Tulamura Anticline, South Tripura District, Tripura; Saxena *et al.* 1984, p. 188, pl. 2, fig. 36, Lower Siwalik (Middle-Late Miocene), Bhakra-Nangal Section, Bilaspur

- District, Himachal Pradesh; Koshal & Uniyal 1986, p. 225, pl. 7, figs. 330-331, Tertiary, Cambay Basin, Gujarat; Salujha & Kindra 1986, p. 246, pl. 3, fig. 82, Oligocene-Miocene, Silchar-Haflong Road Traverse, Cachar District, Assam; Singh *et al.* 1986, p. 94, 96, pl. 1, fig. 3, Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Raha *et al.* 1987, p. 213, Early Miocene, Ambalapuzha bore hole, Kerala; Saxena *et al.* 1988, p. 276, pl. 2, fig. 29, Pinjor Formation (Pliocene), Masol-Kiratpur Section, Ambala District, Haryana; Patil & Ramanujam 1988, p. 263-264, pl. 1, fig. 5, Miocene, Tonakkal, Thiruvananthapuram District, Kerala; Tripathi 1989, p. 72-73, pl. 3, fig. 2, Kopili Formation (Late Eocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya; Salujha *et al.* 1991, p. 67, pl. 2, fig. 70, Neogene, Adamtila Well-A, Cachar District, Assam; Gupta 1994, p. 252, 254-255, figs. 5-6, 8, Subathu Formation (Early Tertiary), Jamtah Road Section, Sirmaur District, Himachal Pradesh; Tripathi *et al.* 1999, p. 112, pl. 2, fig. 3, Eocene, Barsinghsar, Bikaner District, Rajasthan; Srivastava & Bhattacharyya 2000, p. 375, Early Tertiary, Kimin-Ziro Road Section, Lower Subansiri District, near Rilu village, West Siang District and Pasighat to Rengging Section, East Siang District, Arunachal Pradesh; Singh & Kar 2003, p. 221, pl. 2, fig. 10, Deccan Intertrappean Beds (Palaeocene), northeast of Papro, Lalitpur District, Uttar Pradesh; Rao 2004, p. 124, pl. 2, fig. 6, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra; Singh & Chauhan 2008, p. 75, pl. 1, fig. 6, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- cf. *Phycomycetes*** Singh & Mathew 1954, p. 29, Cuddalore Series (Miocene-Pliocene), South Arcot District, Tamil Nadu.
- Pleospora* spp.** Malleshram *et al.* 1989, p. 16, pl. 1, fig. 14, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 6, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 33, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram.
- Pleurophragmium* Costantin.** Sarkar & Singh 1994, p. 100, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh.
- Pluricellaesporites* spp.** Kar *et al.* 1972, p. 152, pl. 2, fig. 26, Tura Formation Palaeocene, Garo Hills, Meghalaya; Ramanujam & Rao 1978, p. 297, pl. 2, fig. 24, Miocene, Kerala; Prasad & Ramesh 1983, p. 255, fig. 2.1, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura; Koshal & Uniyal 1984, p. 238, 242, pl. 1, figs. 1-3, pl. 3, figs. 19, 21, 30-31, 34, 36-37, Palaeocene-Early Eocene, North Cambay Basin, Gujarat; Singh & Sarkar 1984a, p. 98, pl. 2, fig. 24, Miocene, Ramshahr Well-1, Solan District, Himachal Pradesh; Varma & Patil 1985, p. 154, pl. 1, fig. 19, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala; Singh *et al.* 1986, p. 101, pl. 2, figs. 11, Lubha and Umkiang Members, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam; Rajendran *et al.* 1989, p. 41, Miocene, Tonakkal, Kerala; Kar 1990a, p. 178, Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura; Kar 1990b, p. 236, 238, Jenam and Renji formations (Middle-Late Oligocene), Silchar-Haflong Road Section, Assam; Banerjee & Nandi 1992, p. 84, pl. 1, fig. 4, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Mandaokar 1993, p. 139, Tikak Parbat Formation (Late Oligocene), Dangri Kumari Colliery, Dibrugarh District, Assam; Misra *et al.* 1996, p. 95, Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya; Saxena & Rao 1996, p. 46, Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya; Chandra & Kumar 1998, p. 60, pl. 3, fig. 15, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Samant 2000, p. 15, pl. 1, figs. 17-18, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Gupta *et al.* 2003, p. 210, Palaeocene-Eocene, Ganga Basin; Rao 2004, p. 126, pl. 2, figs. 3-4, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Polyadosporites* spp.** Kumar 1994, p. 22, pl. 3, fig. 8, Laisong Formation (Early Oligocene), Silchar-Haflong Road Section, Assam; Mitra *et al.* 2000, p. 126, pl. 1, fig. 4, Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya.
- Prospodium*, teliospore of.** Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 7-8, Late Holocene, Demagiri, Mizoram.
- Puccinia* Persoon.** Sharma 1976, p. 80, pl. 1, fig. 11, Quaternary, Malvan, Surat District, Gujarat.
- Puccinia*, uredospore of.** Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 9-10, Late Holocene, Demagiri, Mizoram.
- Pythiaceus fungus.** Saxena 1984, p. 363-364, text-figs. 1-3, Deccan Intertrappean Beds (Eocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.
- Ratnagiriathyrites* sp.** Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra.
- Retihelicosporonites*.** Prasad & Ramesh 1983, p. 255, figs. 2.4-5, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura.

- cf. *Sclerospora***. Rao & Menon 1970, p. 75, pl. 1, fig. 8, text fig. 16, Quaternary, Pykara, Ootacamund, Tamil Nadu.
- Sclerosporis bicellus*** Chandra 1958 (nom. inval.), p. 211, pl. 38, figs. 1-2, Cuddalore Series (Miocene-Pliocene), South Arcot District, Tamil Nadu.
- Sclerosporis cavatoglobosus* Stach & Chandra**. Chatterjee & Ghosh 1962, p. 147, fig. 9, 15, Eocene, Dharangiri area, Garo Hills, Meghalaya; Ghosh 1964, p. 93, Tura Formation (Palaeocene), Dharangiri Coalfield, Garo Hills, Meghalaya.
- Sclerotids**. Casshyap 1963, p. 263, figs. 1-2, Barakar Stage (Permian), Kargali Seam, Quarry No. 2, Bokaro Coalfield, Bihar.
- Sclerotites brandonianus*** Jeffrey & Chrysler. Chandra 1954, p. 47-48, fig. 1, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan; Chatterjee & Ghosh 1962, p. 148, figs. 3-5, Eocene, Dharangiri area, Garo Hills, Meghalaya; Ghosh 1964, p. 93, Tura Formation (Palaeocene), Dharangiri Coalfield, Garo Hills, Meghalaya; Navale 1968, p. 143, pl. 2, figs. 14-17, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- cf. *Sclerotites brandonianus*** Jeffrey & Chrysler. Pareek 1962, p. 828, pl. 42, figs. 3, 7-8, 12, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan.
- Sclerotites crassitesta*** Stach. Chandra 1954, p. 47-48, fig. 2, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan; Chatterjee & Ghosh 1962, p. 147, fig. 2, Eocene, Dharangiri area, Garo Hills, Meghalaya; Pareek 1962, p. 828, pl. 42, figs. 10, Palana Lignite (Eocene), Palana, Bikaner District, Rajasthan; Ghosh 1964, p. 93, fig. 9, Tura Formation (Palaeocene), Dharangiri Coalfield, Garo Hills, Meghalaya; Navale 1968, p. 143, pl. 2, figs. 11-13, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- Sclerotites multicellatus*** Stach. Navale 1968, p. 143, pl. 2, fig. 18, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- Sclerotites***. Chandra 1954, p. 47-48, fig. 3, Raniganj Stage (Upper Permian), Poniati Seam, Raniganj Coalfield, West Bengal.
- Sirophoma like fungus***. Patil & Singh 1974, p. 144, pl. 1, figs. 1-2, 7, Deccan Intertrappean Series (? Palaeocene), Mohgaon Kalan, Chhindwara District, Madhya Pradesh.
- Sivalikiathyrites* sp.** Rao 2004, p. 125, pl. 1, fig. 19, Sindhudurg Formation (Miocene), Kalviwadi, Sindhudurg District, Maharashtra.
- Spegazzinia* sp.** Ramanujam & Rao 1978, p. 294, pl. 3, fig. 49, Miocene, Kerala.
- Spegazzinia***. Prasad & Ramesh 1983, p. 255, fig. 2.12, Holocene, Khawai and Sonai valleys, West Tripura District, Tripura; Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 17-18, Late Holocene, Demagiri, Mizoram.
- Spinoporonites***. Singh & Chauhan 2008, p. 75, pl. 1, fig. 8, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Spirotremesporites* spp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 2, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram; Banerjee & Nandi 1994, p. 216, pl. 1, fig. 30, Middle Bhuban Formation (Early-Middle Miocene), near Kolasib, Aizawl District, Mizoram.
- Spores types 1-6 (Uredinales)**. Ramanujam & Ramachar 1963, p. 271-272, figs. 1-6, Cuddalore Series (Miocene), Pilot Quarry, Borehole PB5, Neyveli, South Arcot District, Tamil Nadu.
- Spore type, 3-celled striate**. Ramanujam & Srisailam 1980, p. 131, pl. 2, fig. 28, Warkalli Beds (Miocene), Kannur district, Kerala.
- Spore types**. Ramanujam & Rao 1978, p. 296, 301, pl. 1, figs. 17-19, pl. 3, figs. 39, 50, Miocene, Kerala; Ramanujam & Ramachar 1980, p. 83-84, pl. 1, figs. 10, 13, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Varma & Patil 1985, p. 152, pl. 1, figs. 5-6, Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala.
- Staphlosporonites* spp.** Singh & Sarkar 1984b, p. 48, pl. 2, fig. 31, Kasauli Formation (Early Miocene), Banethi, Sirmaur District, Himachal Pradesh; Saxena & Bhattacharyya 1987, p. 193, pl. 1, fig. 18, Lower Siwalik-Nahan (Middle-Late Miocene), Kala Amb-Nahan Section, Sirmaur District, Himachal Pradesh; Saxena & Misra 1990, p. 265, pl. 3, fig. 14, 16, Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra; Srivastava & Bhattacharyya 2000, p. 375, pl. 2, fig. 10, Early Tertiary, Kimin-Ziro Road Section, Lower Subansiri District, near Riluvillage, West Siang District and Pasighat to Rengging Section, East Siang District, Arunachal Pradesh; Singh & Chauhan 2008, p. 76, pl. 2, fig. 13, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- cf. *Stemonites* sp.** Ambwani 1983, p. 150, pl. 1, figs. 10-11, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- Stemphylium***. Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 6, 29-30, Late Holocene, Demagiri, Mizoram.
- Striadiporites* sp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 14, (Bhuban, Formation (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Synchytrium***. Mandaokar *et al.* 2008, p. 200, pl. 2, figs. 21-22, Late Holocene, Demagiri, Mizoram.
- Tetracoccusporium* sp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 19, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Tetraploa aristata* Berkley & Broome**. Gupta 1970, p. 236, pl. 1, figs. 1-2, Pleistocene, Sankrail, Howrah District, West Bengal.

- Tetraploa ellisii* Cooke.** Gupta 1970, p. 236, pl. 1, fig. 3, Pleistocene, Sankrail, Howrah District, West Bengal.
- Tetraploa* spp.** Rao & Menon 1970, p. 75, pl. 1, fig. 13, Quaternary, Pykara, Ootacamund, Tamil Nadu; Sharma 1976, p. 79, pl. 1, figs. 1-4, Quaternary, Malvan, Surat District, Gujarat; Singh & Saxena 1981, p. 177, pl. 1, fig. 13, Upper Siwalik (Plio-Pleistocene), Gagret-Bharwain Road Section, Una District, Himachal Pradesh; Saxena & Singh 1982a, p. 295-296, pl. 2, fig. 30, Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh; Singh & Sarkar 1984a, p. 98, pl. 2, fig. 37, Miocene, Ramshahr Well-1, Solan District, Himachal Pradesh; Mallesham *et al.* 1989, p. 16, pl. 1, fig. 23, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu; Kumar 1990, p. 25, pl. 1, figs. 24, 26, Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam district, Kerala; Sarkar & Singh 1994, p. 99, pl. 1, figs. 4-5, Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh; Singh & Chauhan 2008, p. 76, pl. 2, fig. 10, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand; Mandaokar *et al.* 2008, p. 198, pl. 1, figs. 1-2, Late Holocene, Demagiri, Mizoram.
- 3-celled striated sporomorph.** Mallesham *et al.* 1989, p. 16, pl. 1, fig. 20, Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu.
- Thyriothecium* types 1-3.** Ramanujam 1963a, p. 327-328, figs. 1-2, 4, Cuddalore Series (Miocene), Neyveli, South Arcot District, Tamil Nadu.
- Triangulosporonites* sp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 12, Bhuban and Bokabil formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Trichopeltinites* spp.** Rao & Ramanujam 1976, p. 101, pl. 2, fig. 16, Quilon and Warkalli Beds (Miocene), Kerala; Pant *et al.* 1988, p. 49, pl. 3, fig. 35, Bansa beds (Early Cretaceous), Madhya Pradesh; Kar 1990a, p. 179, pl. 8, fig. 120, (Surma and Tipam groups (Miocene), Rokhia Borehole No. 1, Gojalia Borehole No. 1 and Baramura Borehole No. 2, Tripura.
- Trichothyriaceae.** Ratan & Chandra 1982, p. 262, pl. 1, figs. 10-11, surface (bottom) sediments, Arabian Sea.
- Trichothyrites* spp.** Reddy *et al.* 1982, p. 114, pl. 1, fig. 9, Neyveli lignite (Miocene), Neyveli, South Arcot District, Tamil Nadu; Kumar 1996, p. 114, Tarkeshwar Formation (Early Eocene), Rajparadi, Bharuch District, Gujarat; Chandra & Kumar 1998, p. 60, pl. 3, fig. 6, Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean; Mandaokar 2000a, p. 320, Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram; Samant 2000, p. 16, pl. 1, fig. 24, Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat; Saxena 2000, p. 163, Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra; Ramanujam *et al.* 1991, p. 54, Early Miocene, Pattanakad Borewell, Alleppey District, Kerala; Singh & Chauhan 2008, p. 75, pl. 1, figs. 3, 5, Neogene, Rampur Nala, Mahuadanr Vally, Latehar District, Jharkhand.
- Trilobosporonites* sp.** Banerjee & Nandi 1992, p. 84, Bhuban, Bokabil and Tipam Sandstone formations (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.
- Triporicellaesporites* sp.** Banerjee & Nandi 1992, p. 84, pl. 1, fig. 9, Bhuban Formation (Miocene), Rengte Anticline near Kolasib, Aizawl District, Mizoram.

DISCUSSION

In the present publication, 12 new combinations and 15 new species have been proposed. These are listed in the Introduction part. Salient morphologic features of fossil fungal spores and fungal fruiting bodies are discussed below.

I. Fungal spores

Majority of fungal spores found in palynological preparations belong to Ascomycetes. Only few spores of Basidiomycetes have been described in some fossil assemblages. Palynological assemblages are often rich in different varieties of conidia. These are produced by Fungi Imperfecti and the holomorphic Ascomycetes. They may be one-celled to multi-celled and are of varied shapes.

Spores of some fungi, especially conidia and ascospores, possess distinctive features leading to their identification and categorization with the extant forms. Fossil spores can be generally assigned to a natural class system of Phycomycetes, Ascomycetes or Basidiomycetes if the diagnostic morphographic features are observable. Some fossil materials are assigned to the class Fungi Imperfecti where spores or isolated structures (conidia, pycnidia or other sporangia, or isolated mycelia) are of exclusive morphology. Numerous types of fossil fungal remains are reported from Late Cretaceous to Cenozoic sediments. These include detached spores, microscopic sporangia, hyphae or fragmented mycelia. In a classification system proposed by van der Hammen (1956) fossil fungal spores were grouped under various morphologic categories having the suffix 'Sporites'. Clarke (1965) proposed the suffix 'Sporonites' for naming the fossil fungal spores. Considering shape, size and symmetry of spores, absence/presence and number of apertures, septa characters and the wall features, Elsik (1976) attempted to prepare a comprehensive applicable taxonomy for the fossil spores. He proposed artificial supra-generic categories for classification of fossil fungal spores. These categories were primarily based on the cell number and presence or absence of apertures. Under these

Taxa	Diagnostic features
Amerospores	
<i>Basidiosporites</i> Elsik	Spores with single offset pore, unicellate, elongate, wall psilate, shape variable.
<i>Biporipsilonites</i> Kalgutkar & Jansonius	Elongate fusiform to barrel-shaped, generally with a plane of symmetry through the equator; spore wall generally smooth, occasionally with some subdued sculpture, two terminal pores, septa, thin or thick, may show a central perforation and/or small septal folds.
<i>Cervichlamydospora</i> Kar <i>et al.</i>	Chlamydospores sub-circular, dark brown-black, originate from neck of hyphae; solitary, many hyphae adhere together at base, branch out laterally at tip; hyphae wall laevigate-granulose, grana up to 1 µm thick, sparsely placed.
<i>Diporisporites</i> van der Hammen	Shape generally elongate, diporate, pores on opposite ends.
<i>Exesisporites</i> Elsik	Unicellate, lenticular, monoporate, pore small, pore surrounded by thickening.
<i>Foveodiporites</i> Varma & Rawat 1963	Monocellate, diporate fusiform to elliptic in shape, wall relatively thin, externally smooth, internally smooth, or with punctate, granulate, foveolate or similar sculpture; pores terminal, complex, consisting of a thin collar and separated from the spore interior by one or two septa.
<i>Hypoxylonites</i> Elsik	Oval to elongate, bilateral, psilate, provided with elongate scar, slit or furrow.
<i>Inapertisporites</i> van der Hammen <i>ex van der Hammen</i>	Inaperturate, shape and size variable, wall psilate to variously ornamented.
<i>Lacrimasporonites</i> Clarke	Spatulate to elliptical in shape, wall psilate, monoporate, pore apical.
<i>Monoporisorites</i> van der Hammen	Spherical to sub-spherical, monoporate, wall psilate to finely punctuate.
<i>Palaeoamphisphaerella</i> Ramanujam & Srisailam	Shape elliptical, oblong or rhomboidal with rounded ends, provided with equatorial pore.
<i>Psilainaperturites</i> Pierce	Psilate, inaperturate sporomorphs.
<i>Retidiporites</i> Varma & Rawat	Diporate grains with reticulate exine.
<i>Spirotremesporites</i> Dueñas-Jimenez <i>emend.</i> Elsik	Psilate, aseptate, elongate elliptical to oval, aperture in the form of single furrow at an angle to the axis of the spore, straight or curved to S-shaped or sigmoidal in outline, or spiral around the spore axis.
<i>Striadiporites</i> Varma & Rawat	Ambitus oval to fusiform, single celled, wall provided with longitudinally ribbed to broadly reticulate ornamentation. Two pores, one at each end of the spore on the long axis.
Didymospores	
<i>Dicellaesporites</i> Elsik	Two-celled, uniseptate, shape variable, inaperturate, wall psilate.
<i>Didymoporisoronites</i> Sheffy & Dilcher	Dicellate, uniseptate, apex of one cell provided with pore, psilate to punctuate.
<i>Dyadosporites</i> van der Hammen <i>ex Clarke</i>	Diporate, with a single pore at each end, wall psilate to variously sculptured.
<i>Fusiformisporites</i> Rouse	Fusiform, inaperturate, the unit is split into equal halves by equatorial wall, bearing characteristic elongate striae, ribs, ridges or costae oriented parallel to longer axis.

(cont.)

<i>Hilidicellites</i> Kalgutkar & Jansonius	Small to medium-sized dicellate spores, with the proximal end flattened or truncate, due to the presence of a hilum or pore-like structure; the two cells generally of comparable size; spore wall thin, smooth or with subdued sculpture.
Phragmospores	
<i>Alleppeysporonites</i> Ramanujam & Rao	Spores branched, multicellate, septate, individual cell rectangular, basal and terminal cells provided with a conspicuous appendage.
<i>Axisporonites</i> Kalgutkar & Jansonius	Inaperturate, tricellate elliptical in shape, two polar cells smaller, thicker, triangular, with dark pigmentation, central cell large, hyaline; septa thick.
<i>Brachysporisporites</i> Lange & Smith	Obovate, turbinate or pyriform, multi-celled, cells broader than long, gradually diminishing in size towards the attachment cell which is the smallest, with very dark, thick bands of septa similarly reducing in size.
<i>Cannanorosporonites</i> Ramanujam & Rao	Tetracellate, barrel-shaped, basal and terminal cells smaller than central cells.
<i>Ceratohirudispora</i> Kar <i>et al.</i>	Conidiophore small, growth terminated by production of apical conidium; conidium enlarges laterally in opposite direction to produce two-three arms, conidia 5–10 celled, septa with broad base and narrow tip.
<i>Chaetosphaerites</i> Felix	Sporidia strongly obtuse spindle-shaped, almost like that of a cylinder with rounded ends, consist of 4 segments, two median, dark coloured cells larger than the two others.
<i>Circinoconites</i> Kar <i>et al.</i>	Conidia acrogenous, strongly spiralled, solitary, coiled, not in chains or slime, 8–14 septate, fist-shaped, dark brown, constricted at septa, cells increasing in diameter from base to apex, dissimilar, spirally arranged.
<i>Diporicellaesporites</i> Elsik	Elongate, diporate, one pore at each end of the spore, wall psilate to finely structured.
<i>Diporopollis</i> Dutta & Sah	Diporate; globular to sub-spheroidal; pores placed one over the other, circular in shape, and encircled by one or more thickened rims; exine thin, surface sculpture psilate to scabrate or finely granulate.
<i>Foveoletisporonites</i> Ramanujam & Rao	Four or more celled, elongate, foveolate, foveolae irregularly aligned.
<i>Kumarisporites</i> Kalgutkar & Jansonius	Tricellate, inaperturate, central cell may be larger than the tapering terminal cells; septa thicker than spore wall; spore wall ornamented by longitudinal ribs running full length of the spore, tapering towards the poles.
<i>Mathurisporites</i> Kalgutkar & Jansonius	Hilate spores, generally consisting of a darker central part with 2-4 cells, and proximal and distal parts of a single to few hyaline cells. No distal pore.
<i>Multicellaesporites</i> Elsik emend. Kumar	Three or more celled, shape variable, inaperturate, spore wall psilate.
<i>Multicellites</i> Kalgutkar & Jansonius	Multicellate, uniserial, inaperturate, number of cells three to many, terminal cells usually rounded; spore wall usually smooth, of medium thickness, septa generally perforate, or with septal folds.
<i>Ornasporonites</i> Ramanujam & Rao	Fusiform, four-celled, diporate, basal and apical cells much small, one pore at each end.
<i>Pluricellaesporites</i> van der Hammen emend. Elsik & Jansonius	Three or more celled, long, monoporate, psilate to scabrate.

(cont.)

- Quilonia* Jain & Gupta emend. Kalgutkar & Jansonius Filamentous, multicellular, apical and basal portions narrow, central wide. Basal stalk prominent with one or two rectangular thick-walled cells; apical cell mostly incomplete, curved, central portion broad, elongate with irregularly shaped furrow-like suture, inside the filament at different places occur one to four small circular, ostiolate bodies. Exine thick, margin undulated.
- Ramasricellites* Kalgutkar & Jansonius Inaperturate, tetracellate, ellipsoidal, with central cells broader, thicker walled and more pigmented than the terminal cells; terminal cells thin-walled to hyaline, with rounded ends; septa (or septal bases) thick and dark, evenly spaced.
- Reduviasporonites* Wilson Conidia-like spores occurring in uniseriate chains, subspherical, slightly flattened at the contacts with adjacent spores, all approximately same diameter, walls 1-2 μm thick, uniform, smooth or slightly rough, yellow or brown, translucent.
- Scolecospores* Lange & Smith Long to very long, linear filamentous phragmospores, hilate, with or without distal pore; length many times width of spore. Spores scalariform, commonly broken and lacking proximal and/or distal portions; wall and septa commonly thin; septa often with septal folds. Not or barely indented at septa.
- Varmasporites* Kalgutkar & Jansonius Fusiform, four-celled, inaperturate, with a pronounced constriction at the thick median septum, and with a distinct ribbed or striate sculpture parallel to the long axis.

Dictyospores

- Dictyosporites* Felix Inaperturate, multicellate, muriform, cells rounded to rounded polygonal. Overall shape rounded, oval/ovoid to elongate.
- Kutchiathyrites* Kar Hilate conidia, fan shaped, formed by numerous linear filaments radiating out from the hilum; conidia may be flattened, filaments may be joined to their neighbours, or partially free, and may branch towards the periphery.
- Lirasporis* Potonié & Sah Fungal bodies oval-elliptical with equal or unequal, broad, generally notched ends. Mycelia, long, septate, \pm parallel to one another, extending from one end to other; wall generally laevigate, sometimes granulose.
- Papulosporonites* Schmiedeknecht & Schwab Fungal remains of globular to elongate shape, consisting of numerous more or less polygonal cells that are firmly fused into mulberry-shaped aggregates. Cells without any regular order, or concentrically arranged; one to three of the innermost cells commonly much larger. Occasionally individual aggregates fused together.
- Polyadosporites* van der Hammen emend. Kalgutkar & Jansonius Spores subspherical, loosely aggregated in clusters, with individual cells not connected to others by shared walls; clusters (colonies?) more or less regularly spherical to subspherical.
- Polycellaesporonites* Chandra *et al.* Elongate, multicellate, inaperturate, psilate, one end rounded, other end giving rise to a tube-like projection, cells arranged in clusters.
- Staphlosporonites* Sheffy & Dilcher Shape variable, four or more irregular cells arranged in clusters along more than one axis, inaperturate, psilate to punctate.

Helicospores

- Colligerites* Jain & Kar Multicellular, coiled, cells generally smaller, rounded in central region and bigger, rectangular in outer region. Spore wall mostly laevigate, sometimes granulose. Pore may be present or absent in each cell.
- Elsikisporonites* Kumar Tubular and coiled in shape, monoporate, pore at outer end, non-septate, spore wall smooth and hyaline.

(cont.)

<i>Helicominites</i> Barlinge & Paradkar	Mycelium septate, branched, hyphae faint in colour; pycnidium and acervulus absent; conidia coiled in loose spirals and narrow at both ends.
<i>Involutisporonites</i> Clarke	Coiled, transversely septate, monoporate, psilate to variously ornamented.
<i>Palaeocirrenalia</i> Ramanujam & Srisailam	Inaperturate, helicoid, 1 to 1 1/4 times loosely coiled, multicellular, 2- to 6-septate, septa transverse, prominent, as thick and dark bands, cells of unequal size, terminal cell dome-shaped and broader, basal cell usually cuneate, pale-coloured, surface psilate.
<i>Retihelicosporonites</i> Ramanujam & Rao	Uniseriate, multicellular, inaperturate, basal cell cuneate, other cells rectangular; apical part of spore helical. Spore wall reticulate.
Staurospores	
<i>Frasnacritetrus</i> Taugourdeau	Main body rectangular, spherical or oval, psilate to variously ornamented, body provided with four unicellular processes.
<i>Spegazzinites</i> Felix	Hyphomycetous conidia consist of 4 partial cells, individual cells more roundish, some conidia spinose, spines of various length.

Fig. 389. Diagnostic characters of fossil fungal spores.

categories artificial genera and species could be conveniently described. Pirozynski and Weresub (1979) suggested a system named as 'Saccardoan System' for classifying the fungal spore types that are not referable to extant families. This scheme is based on shape and number of cells and fungal spores are recognized as Amerospores, Didymospores, Phragmospores, Dictyospores, Scolecospores, Helicospores or Staurospores (star-like). Characteristic features of each of these groups are as follows:

Amerosporae: Spores unicellate, inaperturate or aperturate; aperturate spores with one pore or hilum, two or more pores, or variable apertures.

Didymosporae: Spores dicellate, inaperturate or aperturate; aperturate spores with one pore or hilum at the proximal end, or two pores, one each at or near the proximal and distal end.

Phragmosporae: Spores tri- or pluricellate, only transversely septate, inaperturate or aperturate; aperturate spores with a pore or hilum at the proximal end; with or without attenuated distal end, or with two pores, one each at the proximal and distal end.

Dictyosporae: Spores muriform, divided by few or many intersecting longitudinal and transverse or diagonal septa; shapes variable, inaperturate or with a more or less distinct hilum, that may be a scar or protruding.

Helicosporae: Spores uni- or pluricellate; with curved axis (spirally coiled), coiled in one plane or twisted in three planes.

Staurospora: Spores pluricellate; with more than one axis, or stellate (star-shaped).

Scolecospora: Elongate pluricellate spores with ladder-like septation; length/width ratio of spore body exceeding 15:1;

spores narrow, filamentous, transversely septate, with a pore or hilum at the proximal end or two pores, one each at the proximal and distal end.

Following this system of classification, the commonly found fossil spore genera and their salient characters are given in Fig. 389.

II. Ascocarps (Fruiting bodies)

Enormous variety of fossil epiphyllous fruiting bodies are recorded from Indian Tertiary strata. These were amongst the first fungal groups that were unquestionably identified in the microfossil assemblages. Because of distinctive morphological features, fossil fungal fructifications can be compared with extant counterpart with greater accuracy than the dispersed spores. Commonly occurring as parasites on epidermis of leaves, stem and flowers of higher plants, these belong to Ascomycetes and are placed in the family Microthyriaceae. These have been extensively recorded from Neocomian to Quaternary sediments world over (Cookson 1947, Elsik 1978a). Fruit bodies of Microthyriaceous fungi are known as **Ascocarps**. These are provided with radiating rows of mycelial cells giving an appearance of tissues arranged in radial fashion. Ascocarps contain asci that are surrounded by or enclosed within protective tissues and may be globose, flask-shaped or saucer shaped open bodies. These may or may not possess an opening known as ostiole.

Fossil fungal fruiting bodies are also classified under the artificial system grouping them with Fungi Imperfecti. Several workers attempted to classify and formally describe the fossil ascocarps (Edwards 1922, Rosendahl 1943, Cookson 1947, Rao 1959, Dilcher 1965, Venkatachala & Kar 1969, Jain & Gupta

Ascocarp cells aporate		Ascocarp cells porate	
		Body radiate (<i>Callimothallus</i>)	Body non-radiate (<i>Ratnagiriathyrites</i>)
Body radiate, margin smooth or irregular			Body radiate, margin with projecting spines (<i>Parmathyrites</i>)
Ostiole distinct 1. Body made up of intertwined thin hyphae; ostiole margin thickened (<i>Plochmopeltinites</i>) 2. Ostiole bordered with single/double walled cells (<i>Trichothyrites</i>)	Ostiole indistinct (<i>Microthyriacites</i>)	Non-ostiolate 1. Central cells modified, provided with star-shaped opening (<i>Asterothyrites</i>) 2. Central cells unmodified (<i>Phragmothyrites</i>)	
Ascocarp cells aporate, body non-radiate			
Ostiolate		Non-ostiolate (<i>Trichopeltinites</i>)	
Irregular ostiole, body fan-shaped (<i>Brefeldiellites</i>)	Elongated dehiscence, body multi fan-shaped (<i>Euthythyrites</i>)		

Fig. 390. Classification of fossil Ascocarps (after Elsik 1978).

1970, Elsik 1978b, Pirozynski 1978). Fruiting bodies of Microthyriaceae fungi are classified on the basis of dehiscence mode (through irregular or regular cracking pattern or by a central pore or ostiole). Other characteristic features considered for their classification are: shape and margin of the fruiting body, presence or absence of pores in individual cells and nature of the central part of the fruiting body. Widely accepted classification scheme to describe the dispersed ascocarps is summarized in Fig. 390. This system is primarily based on porate or aporate individual cells of multicellular fruiting body. Forms with porate individual cells are kept under the genus *Callimothallus* whereas those without pores are divided into Non-radiate and Radiate forms. The Non-radiate forms may be ostiolate or non-ostiolate. The Radiate forms are further divided into genera having smooth, fimbriate or spinose margins. The Radiate forms with smooth to fimbriate margins are further divided on the basis of presence, absence or nature of ostiole. Salient characters of fossil genera described as fruiting bodies are given in Fig. 391.

Fruiting bodies of Microthyriaceae are most common in fossil assemblages. However, some other members of the epiphyllous fungi produce morphologically similar

fructifications. The family Asterinaceae shows the presence of thyrtothecium resembling those of Microthyriaceae. Fructifications of this family open by irregular crumbling, cracking or gelatinization of the central area forming an irregular wide opening or stellate crack (Pirozynski 1978). Fruiting bodies of Trichothyriaceae resemble those of Asterinaceae but are lenticular rather than scutelliform. The ostiole in these forms is often protruding and may be bordered by dark pigmented cells which sometimes bear spine-like setae. This family is represented in fossil records by *Trichothyrites*. Thalli of the family Trichopeltaceae are irregularly branched, membranous and are composed of regular cells arranged into orderly parallel or radiating patterns. The fructifications are in the form of circular ostiolate bulges in thallus. These common tropical epiphytes have fossil representatives assigned to the genera *Trichopeltinites* and *Brefeldiellites*. Fructifications of the family Micropeltaceae are also shield-shaped and centrally ostiolate. Walls in these fruiting bodies are composed of haphazardly arranged indistinct hyphae forming a delicate hyphal reticulum at the margins. Members of this family are epiphytes growing on tropical evergreen plants. *Plochmopeltinites* are the fossil members of the family. Fruiting

Taxa	Diagnostic features
<i>Asterothyrites</i> Cookson	Ascomata round, flat, made up of radially arranged hyphae, cells isodiametric. Ascomata ostiolate, ostiole stellate in shape, probably formed by dissolution of central cells.
<i>Brefeldiellites</i> Dilcher	Hyphae produce a large rounded membranous structure with marginal fertile areas or ascomata. Central ascoma cells break away as a dehiscence mechanism.
<i>Callimothallus</i> Dilcher	Stroma round, radiate, no central dehiscence, individual cells may possess single pore.
<i>Euthythyrites</i> Cookson	Ascomata linear, elliptical to oblong, ends rounded or flattened, lateral margins uneven, dehiscence by a longitudinal slit, cells radiating from mid-vertical line, hyphopodiate, hyphopodia small.
<i>Microthyriacites</i> Cookson	Ascomata very large (1000-1200 µm), slightly convex. Central part constituted by thick isodiametric cells, peripheral cells elongated, radial.
<i>Parmathyrites</i> Jain & Gupta	Ascomata flattened, non-ostiolate, more or less circular, hyphae radially arranged. Peripheral cells prominent with thickened radial walls, spines peripheral. Ostiole distinct.
<i>Phragmothyrites</i> Edwards	Ascomata sub-circular to circular with radially arranged hyphae, hyphal cells may be differentiated forming separate regions in the fruiting body. Central cells isodiametric.
<i>Plochmopeltinites</i> Cookson	Ascomata of dimidiate form with ascomal membranes of sinuous plectenchyma.
<i>Ratnagiriathyrites</i> Saxena & Misra	Ascomata sub-circular or irregular in shape, margin thick, wavy, dark brown in colour, margin thick, wavy, non-ostiolate. Cells not arranged radially, porate. Pores generally distributed throughout stromata. Peripheral cells hexagonal, bigger, central cells small.
<i>Trichopeltinites</i> Cookson	Ascomata developed as thickened areas of the thallus and dehiscing by an irregular ostiole as in <i>Trichopeltis</i> Theiss Stevens.
<i>Trichothyrites</i> Rosendahl	Thyriothecia disc- or saucer-shaped, made up of almost square radiating cells. Ostiolate, ostiole placed on an erect collar, made up of 2-6 tiers of thick walled quadrilateral cells. Uppermost tier of cells may have short prolongations in some cases. Outline usually smooth but may appear lobate.

Fig. 391. Diagnostic features of fossil ascocarps (fruiting bodies).

bodies of the epiphyllous Ascomycetes of the family Parmulariaceae superficially resemble those described earlier but are thicker and less distinctly cellular. Fossil representatives of these forms are *Callimothallus* and *Microthallites*.

Stratigraphic Implications

Fungal spore stratigraphy

Although most of the fungal spores are long ranging and do not bear any stratigraphical significance, some are morphologically distinct and have restricted range in geological time. Applicability of fungal spores has, therefore, increased with the record of such characteristic spores (Kalgutkar &

Jansonius 2000). Graham (1962) was amongst the pioneers to suggest the possibility of using fungal spores for supplementing age determinations in palynological studies. According to Elsik (1970), although variety of fungal spores are recorded from Mesozoic strata world over, their morphological complexity and frequency increase in Cenozoic. He noted that *Fusiformisporites* and similar longitudinally ribbed forms appear to be restricted to the Cenozoic. Elsik (1970) further observed that fossil fungal spores described as *Exesisporites* which resemble with extant *Hypoxylon* type are more frequently recorded in Neogene sediments. Ramanujam (1982) opined that overall diversity in morphology of fungal spore was attained by late Cretaceous and Early Tertiary. While evaluating the stratigraphic potential of fungal remains in

Taxa	Palaeocene	Eocene	Oligocene	Miocene	Pliocene
<i>Callimothallus</i> Dilcher	—————				
<i>Cucurbitariaceites</i> Kar <i>et al.</i>	—————				
<i>Phragmothyrites</i> Edwards	—————				
<i>Microthyriacites</i> Cookson		—————			
<i>Kalviwadithyrites</i> Rao				—————	
<i>Parmathyrites</i> Jain and Gupta				—————	
<i>Plochmopeltinites</i> Cookson				—————	
<i>Ratmagiriathyrites</i> Saxena and Misra				—————	
<i>Trichopeltinites</i> Cookson				—————	
<i>Trichothyrites</i> Rosendahl				—————	
<i>Asterothyrites</i> Cookson				—————	
<i>Euthythyrites</i> Cookson				—————	

Fig. 392. Stratigraphic distribution of some fossil ascocarp genera in Indian Tertiary sediments.

Indian stratigraphic sequences, he further observed that spores with relatively simpler morphology were recorded from early Mesozoic strata but in younger sediments ornamented spores with complex morphology were recorded.

Fossil ascocarp stratigraphy

Records of fossil microthyriaceous fungi show that these occur in major parts of the Cenozoic. An attempt has been made to summarize the stratigraphic distribution (at generic level only) of different fossil fruiting bodies recorded from Indian Tertiary sequences (Fig. 392). Taxa assigned to *Callimothallus* and *Cucurbitariaceites* are long ranging and are recorded from Palaeocene to Pliocene sediments. Different species of *Phragmothyrites* mark their presence in Palaeocene to Miocene and *Microthyriacites* in Eocene to Miocene. Forms restricted to Miocene sequences only are: *Asterothyrites*, *Euthythyrites*, *Parmathyrites*, *Plochmopeltinites*, *Ratmagiriathyrites*, *Trichopeltinites* and *Trichothyrites*.

Palaeoclimatic Interpretations

Fungi are found in close association with specific plants and animals and if found in a fossil state are indicative of similar kind of situations during the geological past. Fossil fungi, therefore, may provide useful information about the palaeoecology, past habitats and their hosts. In this regard, fossil epiphyllous fungi can be more reliable and advantageous. Occurrence of these fossils reflects moist and humid climate of tropical to subtropical belts. The fossil peltate fungi are generally identified to the extant Microthyriaceae

which are ectoparasites on leaves of higher plants of tropical to subtropical zones growing particularly in areas with high humidity. Edwards (1922) reported the occurrence of this group on conifer needles. Microthyriaceous fungi grow best in rain forests, rain forest margins and along creek banks (Ramanujam 1982). Hence their presence is generally indicative of a wet tropical climate with heavy precipitation. The palaeohabitat interpretations based on fossil epiphyllous microthyriaceous fungi and their germlings is well established through the studies on their modern equivalents growing on leaf litter from various Australian regions. These studies have shown the occurrence of microthyriaceous germlings in greater number on the plants growing in moist tropical habitats. Such studies have great potential in interpreting the palaeoclimate and should be undertaken for other geographical areas. However, the ecological interpretations based on epiphyllous fungi should be made with caution because some of these are reported to occur in wider latitudinal ranges (Dilcher 1965, Selkirk 1975). It is therefore, advisable to take into consideration the complete palynological assemblage for palaeoenvironmental interpretations. In most of the cases, coordinated studies on megafossils in association with palynological assemblages may provide more accurate information about the palaeoenvironmental conditions. Dilcher (1965) published an account of epiphyllous fungi thriving on leaves of different plants of Eocene age. Such studies bear great potential for determining the regional palaeoclimate by comparing the fossils with extant taxa of known habitats. Environmental interpretations based on the presence of Microthyriaceae may, however, sometimes be hampered due to the incorrect identification of the material. Their presence in

dispersed fossil assemblage should, therefore, be ascertained before deciphering the past climate. The red alga *Caloglossa leprieurii*, generally found on grasses of brackish water marshes may be confused with *Trichopeltinites* due to morphological resemblance. Similarly, marine green alga *Ulvella lens* also resembles the fructifications of Microthyriaceae.

Studies particularly focusing on host fungus relationship are also of great significance in attempting the palaeoenvironmental interpretations. Chitale (1978) and Chitale and Yawale (1978) provided valuable palaeoecological information based on the presence of fossil fungal spores in petrified plant materials from the Deccan Intertrappean beds of India. Similar kinds of interpretations were published by Kar *et al.* (2004a, b, 2005, 2006). These studies emphasize the importance of some fungal spores in evaluation of palaeoenvironment. Ramanujam and Srisailam (1980) noticed prevalence of *Palaecirrenalia*, the helicoid spore, in Neogene sediments of Kerala, South India and interpreted brackish to marine conditions by comparing them with modern fungi. Similarly, based on the presence of some other spores in the same strata a tropical climate has been interpreted by Ramanujam and Rao (1978) and Ramanujam and Srisailam (1980). A warm and humid environment has been interpreted by Kalgutkar and McIntyre (1991) in the Canadian Arctic due to the presence of helicosporous fungal types. Studies on fossil fungal remains in coordination with micro- and megafossils of other groups have sometimes been used to infer the palaeoenvironment (Dilcher 1973, Pirozynski 1976, Ramanujam 1982). These assessments are based on the assumption that the palaeoclimatic sensitivity of fossil taxa was similar to that of the comparable modern counterparts. In this regard special stress was laid to explore the possibility of relating fossil fungal spores with those of modern fungi so as to realize their full potential in determining the ancient environment. However, only those types that could be related to the modern forms with certainty should be taken into account for this specific purpose.

General Remarks

Fungal remains have been reported from the Permian (Bajpai & Maheshwari 1988) and Early Cretaceous (Banerji & Misra 1968, Pant *et al.* 1983, Bose & Banerjee 1984, Tiwari & Tripathi 1995, Tripathi 2001) sediments of India. Diverse fungal remains have been described from Indian Tertiary sedimentary sequences (Rao 1943, Chitale 1957, Potonié & Sah 1960, Baksi 1962, Venkatachala & Kar 1969, Deb 1970, Jain & Gupta 1970, Chitale & Sheikh 1971, Chitale & Patil 1972, Kar *et al.* 1972, Ramanujam & Rao 1973, 1977, 1978, Kar & Saxena 1976, Rao & Ramanujam 1975, 1976, 1978, Chitale 1978, Chitale & Yawale 1978, Patil & Ramanujam 1980, Kumar 1990, Rao 1995, Kar *et al.* 2003, 2004a, b, 2005, 2006, Srivastava 2008, etc.). A few of these are briefly discussed here.

Potonié and Sah (1960) described *Lirasporis intergranifer* from the Cannanore lignite (Miocene) of Kerala to accommodate oval spores with notches at the ends and having parallel longitudinal ribs through the body. The size of the fossil ranges 69-103 μm \times 116-134 μm . Jain and Kar (1979), emending the diagnosis of the taxa, described the form as a fungal body made up of long septate mycelia which run more or less parallel to each other from one end to other. The wall of the body is generally laevigate but sometimes granulate. Kalgutkar and Jansonius (2000) commented that this form may have some stratigraphic significance. Kar *et al.* (1972) described fungal fruiting body *Cucurbitariaceites* from early Tertiary sediments of Meghalaya. The fruiting bodies are circular to sub-circular in shape, 40-120 μm in size, the outer region is dark in colour. The asci is up to 20 in number, cylindrical, generally developing from the inner region of the pseudoperithecia and mostly connect with each other from a broad polygonal area. In some cases the asci extend outwards crossing the external margin of the pseudoperithecia. A rupture is observed in some specimens in the central polygonal area bordered by basal parts of the asci. *Cucurbitariaceites* is distinguished from all other fossil genera of Microthyriales by its shape, darker outer layer, in the absence of true paraphyses and the presence of cylindrical asci. Kalgutkar and Jansonius (2000), while commenting on this genus, stated that it shows affinity with the extant family Cucurbitariaceae belonging to the order Pseudosphaeriales. Most of the members of this order are confined to tropical areas though some are reported from temperate regions also.

Tiwari and Tripathi (1995) and Tripathi (2001) described a diversified fungal assemblage from the Intertrappean beds (Early Cretaceous) of the Rajmahal Basin, Jharkhand. The assemblage shows presence of many microthyriaceous fruiting bodies. Kar *et al.* (2003) reported a fruiting body assignable to Polyporaceae (Basidiomycetes) from the Lameta Formation exposed in Madhya Pradesh. This fossil, called *Lithopolyporales zeerabadensis*, resembles the modern genus *Fomes* which are found as saprophytes on dead wood of various trees. Rao (2003) described a new fungal fruiting body *Kalviwadithyrites* from Sindhudurg Formation exposed at Kalviwadi, Sindhudurg District, Maharashtra. The cleistothecium is circular to subcircular in shape, dimidiate, non-ostiolate; the body made up of two sets of aporate cells, marginal cells rectangular to polygonal in shape, central cells isodiametric. Kar *et al.* (2004a) described a fossil fungus showing affinity to *Colletotrichum* Corda, belonging to the family Melanconiaceae (Deuteromycetes), from an Intertrappean bed exposed at Mohgaon-Kalan Village, Chhindwara District, Madhya Pradesh. The modern species of this genus causes red rot in the economically important plants. The fossil of this fungus shows setae on the margins of the acervuli and was found to be preserved on a leaf cuticle. It was called *Protocolletotrichum deccanensis*. Kar *et al.*

(2004b) described fossil parasitic fungi and epiphyllous fruiting bodies from the coprolite of dinosaurs. The coprolite yielding these fossils was collected from the Lameta Formation (Maastrichtian) of Central India. Occurrence of these fungi indicates that the plant leaves infected by the recovered fungi were part of dinosaurs' diet.

Mycorrhizal fungi constituted by fungal hyphae, auxillary cells, chlamyospores and a sporocarp belonging to the family Glomaceae were reported from Miocene sediments of Mizoram (Kar *et al.* 2005). Two types of fossil Ingoldian aquatic fungi were reported from Miocene sediments of Mizoram ((Kar *et al.* 2006). The first type of fossil is needle shaped and belongs to the scoliospores. It is comparable to the extant genus *Tetrachaetum*. The other type of fossil, possessing globular to triangular body, belongs to staurospores and shows similarity with the extant genus *Ceratosporella*.

Scope of future studies

During the last four decades, efforts have been made towards the study of fossil fungi resulting into diverse fungal reports from almost all Tertiary horizons of India. Sincere efforts are now required to trace the affinity of these fossils with extant fungi. Such endeavour will help in elucidating the palaeoecology and evolutionary trends within this group. Exploring the stratigraphic significance of fossil fungal taxa is another inviting task. Host-pathogen interaction is another aspect, which does not have basic information in the form of fossil evidence. The interaction of fungi with higher plants with reference to the palaeobotanical evidences need to be documented in appropriate manner by exploring more fossil fungi along with chemical and geological aspects.

Acknowledgements—*The authors are thankful to Dr N.C. Mehrotra, Director, Birbal Sahni Institute of Palaeobotany, Lucknow (BSIP), for his constant encouragement and permission to publish this work. Authors are also thankful to Dr Neerja Jha, Scientist-F (BSIP) for some feedback and to Mr P.K. Bajpai, Technical Officer-C (BSIP) for making illustrations.*

REFERENCES

- Alexopoulos CJ 1958. Introductory mycology. John Wiley and Sons, New York, 613 p.
- Ambwani K 1982. Palynology of the Deccan Intertrappean Beds of Rajahmundry District, Andhra Pradesh. *Palaeobotanist* 30(1): 28-33.
- Ambwani K 1983. Fungal remains from Neyveli lignite, South India. *Palaeobotanist* 31(2): 148-153.
- Ambwani K 1993. Palynological investigation of coal bearing sediments of Rekmangiri coal mine, Garo Hills, Meghalaya, India. *Phytomorphology* 43(3-4): 153-164.
- Aswal HS & Singh K 2000. Dinoflagellate cysts and calcareous nannoplankton biostratigraphy of well Saripalli-A, Krishna-Godavari Basin, India. *ONGC Bulletin* 37(1): 117-127.
- Bajpai U & Maheshwari HK 1988. Epiphyllous fungi from the Gondwana. *Palaeobotanist* 36: 210-213.
- Baksi SK 1962. Palynological investigation of Simsang River Tertiaries, South Shillong Front, Assam. *Bulletin of the Geological, Mining and metallurgical Society of India* 26: 1-22.
- Banerjee D & Misra CM 1968. Cretaceous microflora from South India: pp. 99-104 in Cretaceous formations of South India, Memoirs of the Geological Society of India No. 2.
- Banerjee S & Nandi B 1992. Fossil fungi in Miocene sediments, Mizoram. *Journal of the Mycopathological Research* 30(1): 81-90.
- Banerjee S & Nandi B 1994. Palynology of the Middle Bhuban Formation near Kolasib, northern Mizoram. *Geophytology* 23(2): 215-220.
- Barlinge SG & Paradkar SA 1980. Fossil microflora of a new locality from Nanded District, Maharashtra. *Advances in Pollen-Spore Research* 5-7: 225-241.
- Barlinge SG & Paradkar SA 1982. Records of new fossil algal and fungal forms from the Deccan Intertrappean of Mohgaon Kalan, M.P., India. *Botanique* 10(1-4): 163-174.
- Barnett HL 1956. Illustrated genera of imperfect fungi. Burgess Publishing Company, Minneapolis, 218 p.
- Bera S & Banerjee M 1995. Eocene palynoassemblage from lignite deposits of West Bengal, India with remarks on environment of deposition. *Indian Journal of Earth Sciences* 22(4): 149-152.
- Berkeley MJ & Broome CE 1850. Notices of British fungi. *Ann. Nat. Hist. Ser. 2. 5*: 459.
- Berry CM 1990. Source rock palynology of Subathu sediments of Simla Hills. *Geophytology* 19(2): 140-146.
- Bhattacharya M 1987. Fungal remains from the Rajpardi lignite, Broach District, Gujarat. *Geophytology* 17(1): 120.
- Biradar NV & Mahabale TS 1974. On the occurrence of an imperfect fungus *Tetracoccosporium* obtained from a fossil wood belonging to the Deccan Intertrappean Series, (M.P.), India. *Palaeobotanist* 21(2): 223-226.
- Bolkhovitina NA 1953. Spore-pollen characteristics of the Cretaceous sediments of the central region of the U.S.S.R. (in Russian). *Trudy Geologicheskogo Instituta Akademiia Nauk S.S.S.R.* 61, 184 p.
- Bose MN & Banerji J 1984. The fossil flora of Kutch. I. Mesozoic megafossils. *Palaeobotanist* 33: 1-189.
- Bradley WH 1967. Two aquatic fungi (Chytridiales) of Eocene age from the Green River Formation of Wyoming. *American Journal of Botany* 54: 577-582.
- Casshyap SM 1963. Scleroids in the Kargali coals of East Bokaro Coalfield, Bihar. *Current Science* 32(6): 263-264.
- Chakraborty M 2004. Palynology of the Lakadong Sandstone (Late Palaeocene) exposed around Bhalukurung, North Cachar Hills, Assam. *Palaeobotanist* 53(1-3): 113-121.
- Chandra A & Kumar M 1998. Palynology of the Late Tertiary sediments (DSDP Site 218) in the Bengal Fan, Indian Ocean. *Palaeobotanist* 46(3): 51-69.
- Chandra A, Saxena RK & Setty MGAP 1984. Palynological Investigation of the sediment cores from the Arabian Sea. 1. Fungal spores. *Biovigyanam* 10(1): 41-58.
- Chandra D 1954. Sclerotia in Indian coals. *Quarterly Journal of the Geological Mining and Metallurgical Society of India* 26: 47-48.
- Chandra D 1958. Microfossils in lignites of India and Pakistan. *Journal of the Palaeontological Society of India* 3: 211-213.
- Chatterjee NN & Chandra D 1957. Permian fossil fungi in Kurasia Seam from Barakar Coal Measures, Kurasia Coalfield, M. P. *Quarterly Journal of the Geological Mining and Metallurgical Society of India* 29(3): 189.
- Chatterjee NN & Ghosh TK 1962. Fungal spores in Tertiary coal from Garo Hills, Assam. *Quarterly Journal of the Geological Mining and Metallurgical Society of India* 34(2-3): 147-148.

- Chitale SD 1950. Microflora of the Deccan Intertrappean Cherts - Palaeobotany in India 7. *Journal of the Indian Botanical Society* 29: 30.
- Chitale SD 1951. Fossil microflora from the Mohgaon Kalan beds of the Madhya Pradesh, India. *Proceedings of the National Institute of Science, India* 17(5): 373-383.
- Chitale SD 1957. Further report on the fossil microflora from the Mohgaon Kalan beds of the Madhya Pradesh, India. *Proceedings of the National Institute of Science, India* 23B(2-4): 69-79.
- Chitale SD 1978. Fungal spores from the Deccan Intertrappean beds of Mohgaon Kalan, India: 305-311. In: Bharadwaj D C *et al.* (Editors) - *Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow.*
- Chitale SD & Patel MZ 1972. Microflora of Intertrappean and Lameta formations of India: pp. 212-219 in Ghosh A. K. *et al.* (Editors) - *Proceedings of the Seminar on Palaeopalynology and Indian Stratigraphy Calcutta 1971, Botany Department, Calcutta University.*
- Chitale SD & Patil GV 1970. An acanthaceous fossil wood with deuteromycetous fungus from the Deccan Intertrappean beds of Mohgaon Kalan, India. *Proceedings of the 57th Indian Science Congress, Kharagpur* 3: 337-338 (Abstract).
- Chitale SD & Patil GV 1972. Ebenaceous fossil wood infected with deuteromycetaceous fungus from the Deccan Intertrappean Beds of India. *Botanique* 3(2): 99-106.
- Chitale SD & Sheikh MT 1971. An infected grain from the Deccan Intertrappean cherts of Mohgaon Kalan. *Journal of the Indian Botanical Society* 50: 137-142.
- Chitale SD & Yawale NR 1978. Fungal remains from the Deccan Intertrappean Beds of Mohgaon Kalan, India. *Botanique* 7(4): 189-194.
- Clarke RT 1965. Fungal spores from Vermejo Formation coal beds (Upper Cretaceous) of Central Colorado. *Mountain Geologist* 2: 85-93.
- Cookson IC 1947. Fossil fungi from Tertiary deposits in the southern hemisphere. Part I. *Proceedings of the Linnean Society, New South Wales*, 72: 207-214.
- Cookson IC 1950. Fossil pollen grains of proteaceous type from Tertiary deposits in Australia. *Australian Journal of Scientific Research* 3: 166-177.
- Das P 1961. Recent microscopic flora from the Bengal delta, India. *Micropaleontology* 7(1): 87-94.
- Deb U 1970. Palynological investigation of Tertiary sediments of Bengal Basin, south of Calcutta. *Quarterly Journal of the Geological, Mining and Metallurgical Society of India* 41(3): 127-140.
- Dilcher DL 1965. Epiphyllous fungi from Eocene deposits in western Tennessee, U.S.A. *Palaeontographica Abt. B. Palaeophytol.* 116: 1-54.
- Dilcher DL 1973. A revision of the Eocene flora of southeastern North America. *Palaeobotanist* 20: 7-18.
- Dueñas-Jimenez H 1979. Estudio palinológico de los 35 mts. superiores de la sección Tarragona, Sabana de Bogata. *Caldasia* 12: 539-571.
- Dutta SK 1980. Palynostratigraphy of the sedimentary formations of the Arunachal Pradesh -2. *Palynology of the Siwalik equivalent rocks of Kameng District. Geophytology* 10(1): 5-13.
- Dutta S & Ghosh AK 1970. Palynology of a Neolithic site in eastern India: a preliminary report. *Palynological Bulletin* 6(2): 84-86.
- Dutta SK, Bhuyan D & Kumar M 1998. Record of palynodebris from the Upper Dsang - Lower Barail group around Kohima District, Nagaland. *Geophytology* 27: 61-65.
- Dutta SK & Sah SCD 1970. Palyno-stratigraphy of the Tertiary sedimentary formations of Assam: 5. Stratigraphy and palynology of south Shillong Plateau. *Palaeontographica, Abt. B* 131: 1-72.
- Dutta SK & Singh HP 1980. Palynostratigraphy of sedimentary formations in Arunachal Pradesh -1. *Palynology of Siwalik rocks of the Lesser Himalayas, Kameng District: pp. 617-626. In: Bharadwaj DC et al. (Editors) - Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 2, Birbal Sahni Institute of Palaeobotany, Lucknow.*
- Dwivedi JN 1959. Fossil thallophytes from Mohgaon-Kalan locality, Chhindwara District, M.P. *Current Science* 28: 285-286.
- Dwivedi JN 1968. Fungal infection of the fruit wall of *Enigmocarpon parijai* Sahni. *Journal of the Palaeontological Society of India* 10: 8-13.
- Ediger VS 1981. Fossil fungal and algal bodies from Thrace Basin, Turkey. *Palaeontographica Abt. B* 179: 87-102.
- Ediger VS & Alisan C 1989. Tertiary fungal and algal palynomorph biostratigraphy of the northern Thrace Basin, Turkey. *Review of Palaeobotany and Palynology* 58: 139-161.
- Edwards WN 1922. An Eocene microthyriaceous fungus from Mull, Scotland. *Transactions of the British Mycological Society* 8: 66-72.
- Elias MK 1966. Living and fossil algae and fungi, formerly known as structural parts of marine bryozoans. *Palaeobotanist* 14: 5-18.
- Ellis D 1915. Fossil micro-organisms from the Jurassic and Cretaceous rocks of Great Britain. *Proceedings of the Royal Society of Edinburgh* 35: 110-132.
- Ellis MB 1971. *Dematiaceae Hyphomycetes*. Commonwealth Mycological Institute, Kew, England, 608 p.
- Elsik WC 1968. Palynology of a Paleocene Rockdale lignite, Milam County, Texas. I. Morphology and taxonomy. *Pollen Spores* 10(2): 263-314.
- Elsik WC 1969. Late Neogene palynomorph diagram, northern Gulf of Mexico. *Trans-Gulf Coast Assoc. Geol. Soc.* 19: 509-528.
- Elsik WC 1970. Palynology of a Paleocene Rockdale lignite, Milam County, Texas, III. Errata and taxonomic revisions, *Pollen et Spores* 12: 99-101.
- Elsik WC 1976. Microscopic fungal remains and Cenozoic palynostratigraphy. *Geoscience and Man* 15: 115-120.
- Elsik WC 1978. Classification and geologic history of the Microthyriaceous fungi. *Proceedings of the IV International Palynological Conference, Lucknow (1976-77)*, 1: 331-342.
- Elsik WC 1990. *Hyposylonites* and *Spirotremesporites* form genera for Eocene to Pleistocene fungal spores bearing a single furrow. *Palaeontographica Abt. B* 216(1-6): 137-169.
- Elsik WC 1992. The morphology, taxonomy, classification and geologic occurrence of fungal palynomorphs. A short course presented under the auspices of the American Association of Stratigraphic Palynologists, Houston, Texas, 287 p. (Unpublished.)
- Elsik WC & Jansonius J 1974. New genera of Paleogene fungal spores. *Canadian Journal of Botany* 52: 953-958.
- Ethridge Glass DL, Brown DD & Elsik WC 1986. Fungal spores from the Upper Eocene Manning Formation, Jackson Group, east and south-central Texas, U.S.A. *Pollen Spores* 28: 403-420.
- Felix J 1894. Studien über fossile Pilze. *Zeitschrift der Deutschen Geologischen Gesellschaft* 46: 269-280.
- Frederiksen NO, Wiggins VD, Ferguson IK, Dransfield J & Ager CM 1985. Distribution, paleoecology, paleoclimatology, and botanical affinity of the Eocene pollen genus *Diporoconia* n. gen.. *Palynology* 9: 37-60.
- Fritel PH 1910. Étude sur les végétaux fossiles de l'étage sparnacien du Bassin de Paris. *Mémoires de la Société géologique de France, Paléontologie*, no. 40: 5-37.
- Ganju PN 1956. The micro-structure of coals from the Jangalali and Kalakot areas in the Jammu Province. *Proceedings of the Indian Academy of Science* 44: 30-37.
- Ghosh TK 1964. On the Tertiary coal from Dharangiri, Garo Hills, Assam. *Quarterly Journal of the Geological Mining and Metallurgical Society of India* 36(2): 91-94.
- Graham A 1962. The role of fungal spores in palynology. *Journal of Paleontology* 36: 60-68.
- Gupta A 1984. *Dyadosporonites udarii*: a new name for *Dyadosporonites constrictus* Kar, 1979. *Geophytology* 14(2): 248.

- Gupta A 1985. *Inapertisporites udarii* nom. nov.-a correction for *Inapertisporites punctatus* Chandra, Saxena and Setty, 1984. *Geophytology* 15(2): 226.
- Gupta A 1994. Fungal fruiting bodies from Lower Tertiary sediments of Sirmaur District, Himachal Pradesh, India. *Botanical Journal of the Linnean Society* 115: 247-259.
- Gupta A 1996. *Udaria* gen. nov. with two new species from Lower Tertiary sediments of Himachal Pradesh, India. *Flora and Fauna* 2(2): 103-104.
- Gupta A 2002. Algal/fungal spores from Early Tertiary sediments of Sirmaur District, Himachal Pradesh, India. *Tertiary Research* 21(1-4): 123-153.
- Gupta HP 1970. Fungal remains from Bengal peat. *Current Science* 39(10): 236-237.
- Gupta S, Mitra S, Bera S & Banerjee M 2003. Record of palynomorphs comparable to Lower Tertiary palynoflora and reworked microfossils from subsurface sediments of Ganga Basin, India. *Gondwana Geological Magazine, Special Volume 6*: 207-216.
- Hait AK & Banerjee M 1994. Palynology of lignite sediments from Mizoram, eastern India with remarks on age and environment of deposition. *Journal of Palynology* 30(1-2): 113-135.
- Haseldonckx P 1973. The palynology of some Paleogene deposits between the Rio Esera and the Rio Segre, Southern Pyrenees, Spain. *Leidse Geologische Mededelingen* 49: 145-165.
- Jacob C & Jakob K 1950. Cuticle from the Tertiary lignite of Cuddalore, S. Arcot, India, *Proceedings of the 7th International Botanical Congress, Stockholm*: 572-573.
- Jain KP 1974. Fossil fungi: pp. 38-46 in Surange K. R. *et al.* (Editors) - *Aspects and Appraisal of Indian Palaeobotany*, Birbal Sahni Institute of Palaeobotany, Lucknow.
- Jain KP & Dutta SK 1978. Lower Tertiary dinoflagellates, spores and pollen grains from Siang District, Arunachal Pradesh. *Journal of the Palaeontological Society of India* 21-22: 106-111.
- Jain KP & Gupta RC 1970. Some fungal remains from the Tertiaries of Kerala Coast. *Palaeobotanist* 18(2): 177-182.
- Jain KP & Kar RK 1979. Palynology of Neogene sediments around Quilon and Varkala, Kerala coast, South India-I. Fungal remains. *Palaeobotanist* 26(2): 105-118.
- Jain KP, Kar RK & Sah SCD 1973. A palynological assemblage from Barmer, Rajasthan. *Geophytology* 3(2): 150-165.
- Jansonius J 1976. Palaeogene fungal spores and fruiting bodies of the Canadian Arctic. *Geoscience and Man* 15: 129-132.
- Jansonius J & Hills LV 1976. Genera file of fossil spores. *Spec. Pub., Dept. Geology, Univ. Calgary, Canada*: 1-3287.
- Jansonius J & Hills LV 1977. Genera file of fossil spores-supplement. *Spec. Pub., Dept. Geology, Univ. Calgary, Canada*: 3288-3431.
- Jansonius J & Hills LV 1979. Genera file of fossil spores-supplement. *Spec. Pub., Dept. Geology, Univ. Calgary, Canada*: 3521-3628.
- Jansonius J & Hills LV 1980. Genera file of fossil spores - supplement. *Special Publication, Department of Geology, University of Calgary, cards 3629-3800*.
- Kalgutkar RM 1993. Paleogene fungal palynomorphs from Bonnet Plume Formation, Yukon Territory. *Contributions to Canadian Paleontology, Geological Survey of Canada, Bulletin* 444: 51-105.
- Kalgutkar RM 1997. Fossil fungi from the lower Tertiary Iceberg Bay Formation, Eureka Sound Group, Axel Heiberg Island, Northwest Territories, Canada. *Review of Palaeobotany and Palynology* 97: 197-226.
- Kalgutkar RM & Jansonius J 2000. Synopsis of fungal spores, mycelia and fructifications. *AASP Contribution Series* 39: 1-423.
- Kalgutkar RM & McIntyre DJ 1991. Helicosporous fungi and early Eocene pollen, Eureka Sound Group, Axel Heiberg Island, Northwest Territories. *Canadian Journal of Earth Sciences* 28: 364-371.
- Kalgutkar RM, Nambudiri EMV & Tidwell WD 1993. *Diplodites sweetii* sp. nov. from the Late Cretaceous (Maastrichtian) Deccan Intertrappean beds of India. *Review of Palaeobotany and Palynology* 77: 107-118.
- Kalgutkar RM & Sigler L 1995. Some fossil fungal form-taxa from the Maastrichtian and Palaeogene ages. *Mycological Research* 99: 513-522.
- Kapoor R, Singh RY, Dogra NN & Singh YR 2003. Palaeobotanical constraints on palaeoenvironmental and palaeoclimatic implications to Siwalik rocks of Nurpur region and Dharamsala Formation, Kangra district, Himachal Pradesh. *Gondwana Geological Magazine, Special Volume 6*: 175-183.
- Kar R, Mandaokar BD & Kar RK 2010. Fungal taxa from the Miocene sediments of Mizoram, northeast India. *Review of Palaeobotany and Palynology* 158: 240-249.
- Kar RK 1978. Palynostratigraphy of the Naredi (Lower Eocene) and the Harudi (Middle Eocene) formations in the district of Kutch, India. *Palaeobotanist* 25: 161-178.
- Kar RK 1979. Palynological fossils from the Oligocene sediments and their biostratigraphy in the District of Kutch, Western India. *Palaeobotanist* 26(1): 16-49.
- Kar RK 1985. The fossil floras of Kachchh -IV. Tertiary palynostratigraphy. *Palaeobotanist* 34: 1-280.
- Kar RK 1990a. Palynology of Miocene and Mio-Pliocene sediments of north-east India. *Journal of Palynology* 26: 171-217.
- Kar RK 1990b. Palynological studies of the Barail Group (Oligocene) in the type area, Assam. *Palaeobotanist* 38: 229-242.
- Kar RK 1992. Stratigraphical implications of Tertiary palynological succession in north-eastern and western India. *Palaeobotanist* 40: 336-344.
- Kar RK & Bhattacharya M 1992. Palynology of Rajpardi lignite, Cambay Basin and Gujra Dam and Akri lignite, Kutch Basin. *Palaeobotanist* 39(2): 250-263.
- Kar RK, Handique GK, Kalita CK, Mandal J, Sarkar S, Kumar M & Gupta A 1994. Palynostratigraphical studies on subsurface Tertiary sediments in Upper Assam Basin, India. *Palaeobotanist* 42(2): 183-198.
- Kar RK, Mandaokar BD & Kar R 2005. Mycorrhizal fossil fungi from the Miocene sediments of Mizoram, Northeast India. *Current Science* 89: 257-259.
- Kar RK, Mandaokar BD & Kar R 2006. Fossil aquatic fungi from the Miocene sediments of Mizoram, North-east India. *Current Science* 90: 291-292.
- Kar RK & Saxena RK 1976. Algal and fungal microfossils from Matanomadh Formation (Palaeocene), Kutch, India. *Palaeobotanist* 23(1): 1-15.
- Kar RK & Saxena RK 1981. Palynological investigation of a bore core near Rataria, southern Kutch, Gujarat. *Geophytology* 11(2): 103-124.
- Kar RK, Sharma N, Agarwal A & Kar R 2003. Occurrence of fossil wood rotters (Polyporales) from Lameta Formation (Maastrichtian), India. *Current Science* 85: 37-40.
- Kar RK, Sharma N & Kar R 2004. Occurrence of fossil fungi in Dinosaur Dung and its implication on food habit. *Current Science* 87: 1053-1056.
- Kar RK, Sharma N & Verma UK 2004. Plant pathogen *Protocolletotrichum* from the Deccan Intertrappean Bed (Maastrichtian), India. *Cretaceous Research* 25: 945-950.
- Kar RK, Singh RY & Sah SCD 1972. On some algal and fungal remains from Tura Formation of Garo Hills, Assam. *Palaeobotanist* 19(2): 146-154.
- Ke & Shi 1978. (pseudonym of Sung ZC, Tsao L, Chou HI, Kwang HL & Wang KT) Early Tertiary spores and pollen grains from the coastal region of the Bohai (in Chinese). *Academy of Petroleum Exploration, Development and Planning Research of the Ministry of Petroleum and Chemical Industries and the Nanjing Institute of Geology, and Paleontology, Chinese Academy of Sciences, Kexue Chubanshe, Peking*, 177 p.
- Khubalkar NV 2003. *Sclerotites chitaleyii* sp. nov., a permineralized fungus from Deccan Intertrappean Beds of Mohgaonkalan, Madhya

- Pradesh, India. Gondwana Geological Magazine, Special Volume 6: 289-295.
- Kidston R & Lang WH 1921. On Old Sandstone plants showing structure, from the Rhynie Chert Bed, Aberdeenshire. Part V. The thallophyta occurring in the peat-bed; the succession of the plants through a vertical section of the bed, and the conditions of accumulation and preservation of the deposit. Transactions of the Royal Society of Edinburgh 52: 855-902.
- Koshal VN 1980. Palynology of the Tertiary subsurface of Dabka, Gujarat: pp. 686-690. In: Bharadwaj DC *et al.* (Editors) – Proceedings of the 4th International Palynological Conference, Lucknow 1976-77, Volume 2, Birbal Sahni Institute of Palaeobotany, Lucknow.
- Koshal VN & Uniyal SN 1984. Palaeocene - Early Eocene palynofossils in the subsurface of North Cambay Basin, Gujarat (western India): pp. 233-243. In: Badve RM *et al.* (Editors) - Proceeding of the 10th Indian Colloquium on Micropalaeontology and Stratigraphy, Pune 1982, Maharashtra Association for the Cultivation of Science, Pune.
- Koshal VN & Uniyal SN 1986. Palynostratigraphy of the Cenozoic succession of Cambay Basin, Gujarat. Bulletin of the Geological, Mining and Metallurgical Society of India 54: 208-226.
- Kumar A 1994. Palynology of the Tertiary sediments exposed along the Silchar – Haflong Road Section, southern Assam. Palaeontographica Indica 2: 1-241.
- Kumar A & Takahashi K 1991. Palynology of the Tertiary sediments of southern Assam, India. Bull. Faculty Liberal Arts, Nagasaki Univ. (Natural Science) 31(2): 515-659.
- Kumar M 1996. Palynostratigraphy and palaeoecology of Early Eocene palynoflora of Rajparadi lignite, Bharuch District, Gujarat. *Palaeobotanist* 43(3): 110-121.
- Kumar M, Mandal JP, Dutta SK., Bhuyan D, Das B & Saikia B 2001. Palynostratigraphy of the subsurface sediments of Upper Assam Basin, India. *Geobios* 34(3): 241-251.
- Kumar M, Saxena RK & Chandra A 2004: Dispersed organic matter from Neogene and Pleistocene sediments of Site 218 of Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean. *Palaeobotanist* 53(1-3): 155-160.
- Kumar P 1990. Fungal remains from the Miocene Quilon Bed of Kerala state, South India. *Review of Palaeobotany and Palynology* 63: 13-28.
- Kumaran KPN, Soman K, Kamble CV & Joseph A 1995. Palynofloral analysis of sections from Bharathi and Kundra Clay Mines of Kerala Basin: Palaeoecological and tectonic perspective. *Current Science* 69(12): 1023-1027.
- Lakhanpal RN., Dayal R & Jain RK 1967. A fossil lagenidialean fungus from the Deccan Intertrappean beds of Mohgaon Kalan, Madhya Pradesh. *Current Science* 36(8): 210-211.
- Lange RT & Smith PH 1971. The Maslin Bay flora, South Australia. 3. Dispersed fungal spores. *Neves Jahrb. Geol. Palaontol. Monatsh.* 11: 663-681.
- Léveillé JH 1845. Descriptions des champignons du Muséum du Paris. *Annaes de Ciencias Naturaes* 5: 111-304.
- Mahabale TS 1969. On a fossil species of *Diplodia redei* from the Deccan Intertrappean Series, M. P., India. *Palaeobotanist* 17(3): 295-297.
- Mallesham C, Ramakrishna H & Ramanujam CGK 1989. Fungal assemblage from the subsurface Miocene sediments of East Coast of southern India: pp. 15-18. In: Patil GV *et al.* (Editors) - Proceedings of the Fifth All India Symposium on Palynology, Nagpur, 1979. Department of Botany, Institute of Science, Nagpur.
- Mandal J 1997. Palynofossils from the Tertiary (Barail Group) of Nagaland: Palaeoecological interpretation and age. *Palaeobotanist* 45 98-108.
- Mandal J, Chandra A & Bhattacharyya AP 2003. Palynology of the Baratang Formation, Andaman-Nicobar Islands and the significance of reworked palynomorphs. *Palaeobotanist* 52(1-3): 97-112.
- Mandal J, Chandra A & Kar RK 1996. Palynological findings from the mud volcanoes of Baratang Island (Andaman and Nicobar Islands) *Geophytology* 25: 77-81.
- Mandaokar BD 1991. Palynology of Miocene rocks around Maibong, Assam. *Geophytology* 20(1): 24-29.
- Mandaokar BD 1993. A palynological investigation of the Tikak Parbat Formation (Oligocene) of Dangri Kumari Colliery, Dibrugarh District, Assam, India. *Tertiary Research* 14(4): 127-139.
- Mandaokar BD 1999. Occurrence of palynofossils from the Tirap River Section (Disang Group), Tinsukia District, Assam. *Palaeobotanist* 48(3): 239-243.
- Mandaokar BD 2000a. Palynology and palaeoenvironment of the Bhuban Formation (Early Miocene) of Ramrikawn near Aizawl, Mizoram, India. *Palaeobotanist* 49(2): 317-324.
- Mandaokar BD 2000b. Palynology of coal bearing sediments in the Tikak Parbat Formation from Jeypore Colliery, Dilli-Jeypore Coalfields, Assam, India. *Journal of the Palaeontological Society of India* 45: 173-185.
- Mandaokar BD 2000c. Palynology of coal bearing sediments of the Tikak Parbat Formation (Oligocene) from Namchik River Section, Changlang District, Arunachal Pradesh, India. *Tertiary Research* 20(1-4): 37-46.
- Mandaokar BD 2002a. An interpretation of the palynology and palaeoecology of the Early Miocene Dulte Formation, Mizoram, India. *Palaeobotanist* 51(1-3): 113-121.
- Mandaokar BD 2002b. Palynological investigation of the Tikak Parbat Formation (Late Oligocene) of Borjan area, Nagaland, India. *Minetech* 23(1-2): 19-33.
- Mandaokar BD 2002c. Palynoflora from the Keifang Formation (Early Miocene), Mizoram, India and its environmental significance. *Journal of the Palaeontological Society of India* 47: 77-83.
- Mandaokar BD 2003. Palynology and palaeoecological consideration of Middle Bhuban Formation (Miocene), Lawngtlai, Mizoram, India. *Gondwana Geological Mag., Special Volume 6*: 185-193.
- Mandaokar BD 2004. Age and depositional environment of the Upper Bhuban Formation of Champhai area (Eastern Mizo Hills), India – A palynological approach. *Palaeobotanist* 53(1-3): 143-153.
- Mandaokar BD 2005. Palynostratigraphy of the coal-bearing sediments of the Tikak Parbat Formation from Ledo Colliery, Makum Coalfield, Assam, India. *Minetech* 26(1): 46-55.
- Mandaokar BD, Chauhan MS & Chatterjee S 2008. Fungal remains from Late Holocene lake deposits of Demagiri, Mizoram, India and their palaeoclimatic implications. *Journal of the Palaeontological Society of India* 53(2): 197-205.
- Martinez-Hernández E & Tomasini-Ortiz AC 1989. Spores, hyphae and other fungal remains from the Fuentes-Rio Escondino Carboniferous basin (Campanian-Maastrichtian), Coahuila State, Mexico. *Universidad Nacional Autonoma de Mexico, Instituto de Geologia, Revista* 8: 235-242.
- Mathur YK 1966. Studies in the fossil microflora of Kutch, India. II. On the microflora in the Supra-trappeans of western Kutch, India. *Quarterly Journal of the Geological, Mining and Metallurgical Society of India* 38: 33-51.
- Mathur YK & Mathur K 1969. Studies in the fossil flora of Kutch (India) - 3. On the palaeopalynoflora in the Pliocene sediments of Naera-Baraia area, Kutch. *Bulletin of the Geological, Mining and Metallurgical Society of India* 42: 1-12.
- McNeill J, Barrie FR, Burdet HM, Demoulin V, Hawksworth DL, Marhold K, Nicolson DH., Prado J, Silva PC, Skog JE, Wiersema JH & Turland NJ (Editors) 2006. International Code of Botanical Nomenclature (Vienna Code), adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005. ARG Gantner Verlag, Ruggell, Liechtenstein. [Regnum Veg. 146].
- Mehrotra NC 1983. Palynology of Mikir Formation in the type area. *Geosci. JI* 4: 1-34.

- Mehrotra NC, Saxena RK & Sharma J 2000. Palynological interpretation of the Pre-Barail sediments in the Upper Assam Basin, India. *ONGC Bulletin* 37(1): 145-156.
- Mehrotra NC, Venkatachala BS, Swamy SN & Kapoor PN 2002. Palynology in hydrocarbon exploration (The Indian Scenario) - Part I: Category - I Basins. *Memoir Geol. Soc. India* 48: 1-161.
- Meschinelli A 1902. *Fungorum fossilium omnium Iconographia*. In Aedibus J. Galla, Vicetiae, 144 p.
- Miller JH 1961. A monograph of the world species of *Hypoxylon*. University of Georgia Press, Athens, 158 p.
- Misra CM & Kapoor PN 1994. Palaeocene to Middle Miocene palynoflora, age and palaeoenvironment of the Jwalamukhi-B, Himalayan Foothills: 147-160. In: Biswas SK *et al.* (Editors) - Proceedings of the Second Seminar on Petroliferous basins of India 3. Himalayan Foothills and Gondwana Basins, Geoscientific studies and Hydrocarbon Exploration Techniques. Indian Petroleum Publishers, Dehradun.
- Misra CM, Swamy SN, Prasad B, Pundeer BS, Rawat RS & Singh K 1996. *Netothyrites* gen. nov. a fungal fossil fruit-body from the Paleocene sediments of India. *Geoscience Journal* 17(1): 17-23.
- Misra UK, Shanker K & Patil RS 1996. Biostratigraphy of the post-Kopili sediments of Garo Hills, Meghalaya. *Journal of the Geological Society of India* 48(1): 93-100.
- Mitra S & Banerjee M 2000. On the occurrence of epiphyllous Deuteromycetous fossil fungi *Palaeocercospora siwalikensis* gen. et sp. nov. and *Palaeocolletotrichum graminioides* gen. et sp. nov. from Neogene sediments of Darjeeling Foothills, Eastern Himalaya. *Journal of Mycopathological Research* 37(2): 7-11.
- Mitra S, Bera S & Banerjee M 2000. Palynofloral assemblage from Siwalik Foredeep Neogene sediments of Darjeeling Foot Hills, Eastern Himalaya. *Geophytology* 28(1-2): 121-127.
- Mohabey DM & Samant B 2003. Floral remains from Late Cretaceous faecal mass of sauropods from Central India: Implication to their diet and habitat. *Gondwana Geological Magazine, Special Volume* 6: 225-238.
- Mukherjee B & Chakraborty K 1984. Palynology of the Calcutta peat with reference to its origin and environment of deposition: 505-514. In: Badve RM *et al.* (Editors) - Proceedings of the 10th Indian Colloquium on Micropaleontology and Stratigraphy, Pune, 1982. Maharashtra Association for the Cultivation of Science, Pune.
- Mustard PS & Rouse GE 1994. Stratigraphy and evolution of Tertiary Georgia Basin and subjacent Upper Cretaceous sedimentary rocks, southwestern British Columbia and northwestern Washington State. *Geological Survey of Canada, Bulletin* 481: 97-169.
- Nandi B & Bandyopadhyay NN 1970. Preliminary observations on the microfossils and microstructures of Siwalik lignite from Himachal Pradesh, India. *Sci. Cult.* 36: 240-242.
- Nandi B, Banerjee S & Sinha A 2003. Fossil Xylariaceae spores from the Cretaceous and Tertiary sediments of Northeastern India. *Acta Palaeontologica Sinica* 42(1): 56-67.
- Navale GKB 1968. Microfossil analysis of Neyveli Lignite by polished surface technique. *Palaeobotanist* 16: 141-144.
- Norris G 1986. Systematic and stratigraphic palynology of Eocene to Pliocene strata in the Imperial Nuktak C-22 well, Mackenzie Delta Region, District of Mackenzie, N.W.T. *Geological Survey of Canada Bulletin, Bulletin* 340, 89 p.
- Pant DD, Srivastava GK & Pant R 1983. On the cuticular structure of leaves of *Desmiophyllum* type from Bansa beds of India and their assignment to the genus *Harrisiohyllum* nov. *Palaeontographica Abt. B* 185: 38-55.
- Paradkar SA 1975. On a new monocot axis with pathogenic fungi from the Deccan Intertrappean Beds of India. *Geophytology* 5(1): 94-97.
- Paradkar SA 1976. Pollen and fungal spores association on a fossil leaf from the Deccan Intertrappean Beds of India. *Journal of Palynology* 10(2): 119-125.
- Paradkar SA & Barlinge SG 1980. Addition to the microflora of Deccan Intertrappean Beds of Mohgaon-Kalan. *Advances in Pollen-Spore Research* 5-7: 243-256.
- Pareek HS 1962. Microscopic study of Palana lignite. *Records of the Geological Survey of India* 87(4): 823-830.
- Pareek HS 1958. Fungal bodies in Talchir coals. *Journal of the Palaeontological Society of India* 3: 214-215.
- Parsons MG & Norris G 1999. Paleogene fungi from the Caribou Hills, Mackenzie Delta, northern Canada. *Palaeontographica Abt. B* 250: 77-167.
- Pathak NR & Banerjee M 1984. Fungal spores from the Neogene sediments of the eastern Himalayan foothills, Darjeeling District: 245-259. In: Badve RM *et al.* (Editors) - Proceeding of the 10th Indian Colloquium on Micropalaeontology and Stratigraphy, Pune 1982, Maharashtra Association for the Cultivation of Science, Pune.
- Patil GV & Singh RB 1974. An infected stem from the Deccan Intertrappean Beds of Mohgaon Kalan. *Botanique* 5(2): 141-145.
- Patil KS & Datar K 2002. A new Hyphomycetes fungus from the Deccan Intertrappean Beds of Wardha District, Maharashtra. *Geophytology* 30(1-2): 31-35.
- Patil RS & Ramanujam CGK 1988. Fungal flora of the carbonaceous clays from Tonakkal area, Kerala. *Geological Survey of India, Special Publication* 11(2): 261-270.
- Phadtare NR 1989. Palaeoecologic significance of some fungi from the Miocene of Tanakpur (U.P.) India. *Review of Palaeobotany and Palynology* 59: 127-131.
- Phadtare NR & Kulkarni AR 1980. Palynological investigation of Ratnagiri lignite, Maharashtra. *Geophytology* 10(2): 158-170.
- Phadtare NR & Kulkarni AR 1984. Palynological assemblage of lignite exposure of Ratnagiri District: 515-531. In: Badve RM *et al.* (Editors) - Proceeding of the 10th Indian Colloquium on Micropalaeontology and Stratigraphy, Pune 1982, Maharashtra Association for the Cultivation of Science, Pune.
- Phadtare NR, Kumar R & Ghosh SK 1994. Stratigraphic palynology, floristic succession and the Tatrot/Pinjar Boundary in Upper Siwalik sediments of Haripur Khol area, District Sirmaur (H.P.), India. *Himalayan Geology* 15: 68-82.
- Pierce RL 1961. Lower Upper Cretaceous plant microfossils from Minnesota. *Bulletin of the Minnesota Geological Survey, University of Minnesota* 42: 1-86.
- Pirozynski KA 1976. Fungal spores in the fossil record. *Biological Memoirs (In collaboration with International Society of Applied Biology)* 1: 104-120.
- Pirozynski KA 1978. Fungal spores through the ages - a mycologist's view. *Proceedings of the IV International Palynological Conference, Lucknow, (1976-77)* 1: 327-330.
- Pirozynski KA & Weresub LK 1979. The classification and nomenclature of fossil fungi. In: *The whole fungus, the Sexual-Asexual Synthesis*. B. Kendrick (Editor) - Proceedings of the 2nd International Mycological Conference, University of Calgary, Kananaskis, Alberta, Canada 2: 653-688.
- Potonié R & Sah SCD 1960. Sporae dispersae of the lignites from Cannanore beach of the Malabar Coast of India. *Palaeobotanist* 7(2): 121-135.
- Prasad MNV 1986. Fungal remains from the Holocene peat deposits of Tripura state, North-eastern India. *Pollen Spores* 28(3-4): 365-390.
- Prasad MNV & Ramesh NR 1983. Fungal spores from the Holocene sediments of Tripura, India. *Current Science* 52(6): 254-256.
- Purekar PN 1962. Microflora of Karewa beds. *Current Science* 31: 420-421.
- Raha PK, Rajendran CP & Kar RK 1987. Record of Early Tertiary deposits in Kerala, India and its palaeogeographic significance. *Geophytology* 17(2): 209-218.
- Rajendran CP, Raha PK & Kar RK 1989. Palynological assemblage from Neogene outcrops of Kerala coast, India. *Indian Minerals* 43(1): 39-46.

- Ramanujam CGK 1963a. Thyriothecia of Asterineae from the south Arcot lignite, Madras. *Current Science* 32: 327-328.
- Ramanujam CGK 1963b. On two new species of fossil fungi from the South-Arcot lignite. *Proceedings of the 50th Indian Science Congress* 13: 396.
- Ramanujam CGK 1982. Recent advances in the study of fossil fungi: pp. 287-301. In: Bharadwaj DC (Editor) - *Recent Advances in Cryptogamic Botany 2*, Palaeobotanical Society, Lucknow.
- Ramanujam CGK & Ramachar P 1963. Spores dispersae of the rust fungi (Uredinales) from the Miocene lignite of South India. *Current Science* 32: 271-272.
- Ramanujam CGK & Ramachar P 1980. Recognizable spores of rust fungi (Uridinales) from Neyveli lignite, Tamil Nadu. *Records of the Geological Survey of India* 113(5): 80-85.
- Ramanujam CGK & Rao KP 1973. On some microthyriaceous fungi from a Tertiary lignite of South India. *Palaeobotanist* 20(2): 203-209.
- Ramanujam CGK & Rao KP 1977. A palynological approach to the study of Warkalli deposits of Kerala in South India. *Geophytology* 7(2): 160-164.
- Ramanujam CGK & Rao KP 1978. Fungal spores from the Neogene strata of Kerala in South India: 291-304. In: Bharadwaj DC *et al.* (Editors) - *Proceedings of the 4th International Palynological Conference*, Lucknow 1976-77, Volume 1, Birbal Sahni Institute of Palaeobotany, Lucknow.
- Ramanujam CGK, Reddy PR & Rao GM 1991. Palynoassemblages of the subsurface Tertiary at Pattanakad, Alleppey District, Kerala State. *Journal of the Palaeontological Society of India* 36: 51-58.
- Ramanujam CGK & Srisailam K 1980. Fossil fungal spores from the Neogene Beds around Cannanore in Kerala state. *Botanique* 9(1-4): 119-138.
- Rao AR 1943. Jurassic spores and sporangia from the Rajmahal Hills, Bihar. *Proceedings of the National Academy of Science, India* 13(2): 113-133.
- Rao AR 1958. Fungal remains from some Tertiary deposits of India. *Palaeobotanist* 7(1): 43-46.
- Rao AR & Menon VK 1970. Fungal remains and associated leaf cuticles from the Quaternary bed of Pykara. Ootacamand, South India. *Journal of Palynology* 5(2): 74-84.
- Rao GM, Reddy PR & Ramanujam CGK 1995. Palynoassemblage of the subsurface Tertiary sediments at Kulasekharamangalam in Kottayam District, Kerala. *Proceedings of the International Conference on Global environment and diversification of plants through geological time*. Birbal Sahni Centenary Volume: 371-374. Society of Indian Plant Taxonomists, Allahabad.
- Rao KP & Ramanujam CGK 1975. A palynological approach to the study of Quilon Beds of Kerala State in South India. *Current Science* 44: 730-732.
- Rao KP & Ramanujam CGK 1976. A further record of microthyriaceous fungi from the Neogene deposits of Kerala in South India. *Geophytology* 6(1): 98-104.
- Rao MR 1990. Palynological investigation of Arthungal Borehole, Alleppey District, Kerala. *Palaeobotanist* 38: 243-255.
- Rao MR 1995. Fungal remains from Tertiary sediments of Kerala Basin, India. *Geophytology* 24(2): 233-236.
- Rao MR 1996. An Early Miocene palynofloral assemblage from Turavur Borehole, Alleppey District, Kerala – its palaeoecological and stratigraphical significance. *Geophytology* 25(1-2): 155-163.
- Rao MR 2000. Palynological investigation of the Kherpara Formation (Oligocene) exposed along Tura-Dalu Road near Kherapara, West Garo Hills District, Meghalaya, India. *Palaeobotanist* 49(2): 293-309.
- Rao MR 2003. *Kalviwadithyrites*, a new fungal fruiting body from Sindhudurg Formation (Miocene) of Maharashtra, India. *Palaeobotanist* 52(1-3): 117-119.
- Rao MR 2004. Palynological investigation of the Sindhudurg Formation (Miocene) exposed at Kalviwadi, Sindhudurg District, Maharashtra, India. *Palaeobotanist* 53(1-3): 123-135.
- Rao MR & Nair KK 1998. Palynological investigation of Miocene sediments exposed in Kannanellur – Kundara area, Kollam district, Kerala. *Geophytology* 27(1-2): 49-59.
- Rao MR & Patnaik R 2001. Palynology of the Late Pliocene sediments of Pinjor Formation, Haryana, India. *Palaeobotanist* 50(2-3): 267-286.
- Ratan R & Chandra A 1982. Isolated thyriothecia from the surface (bottom) sediments of the Arabian Sea. *Geophytology* 12(2): 260-263.
- Rawat MS, Mukherjee JS & Venkatachala BS 1977. Palynology of the Kadi Formation, Cambay Basin, India: 179-192. In: Venkatachala BS and Sastri VV (Editors) – *Proceedings of the 4th Colloquium on Indian Micropalaeontology and Stratigraphy*, Dehradun 1974-75, Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehradun.
- Reddy PR, Ramanujam CGK & Srisailam K 1982. Fungal fructifications from Neyveli lignite, Tamil Nadu - their stratigraphic and palaeoclimatic significance. *Records of the Geological Survey of India* 114(5): 112-122.
- Rosendahl CO 1943. Some fossil fungi from Minnesota. *Bulletin of the Torrey Botanical Club* 70: 126-138.
- Rouse GE 1959. Plant microfossils from Kootenay coal-measures strata of British Columbia. *Micropaleontology* 5: 303-324.
- Rouse GE 1962. Plant microfossils from the Burrard Formation of Western British Columbia. *Micropaleontology* 8: 187-218.
- Rouse GE & Mustard PS 1997. Nomenclatural note and corrections. *Palynology* 21: 207-208.
- Saccardo PA 1882-1926. *Sylloge fungorum omnium hucusque cognitorum*. Volumes 1-25.
- Sah SCD & Kar RK 1974. Palynology of the Tertiary sediments of Palana, Rajasthan. *Palaeobotanist* 21(2): 163-188.
- Sahni B & Rao HS 1943. A silicified flora from the Intertrappean cherts round Sausar in the Deccan. *Proceedings of the National Academy of Sciences, India* 13(1): 36-75.
- Salard-Chebouldaef M & Locquin MV 1980. Champignons présents au Tertiaire le long du littoral de l'Afrique équatoriale. 105e Congrès National des Sociétés savantes, Caen, 1980, Sciences, fascicule 1: 183-195.
- Salmon ES 1903. *Cercosporites* sp., a new fossil fungus. *Journal of Botany* 41: 127-130.
- Salujha SK, Basavaraju MH & Kindra JS 1991. Palynological study of Tertiary sediments met within the well Adamtila-A (Cachar) with remarks on age and palaeoenvironment. *ONGC Bulletin* 27(2): 63-78.
- Salujha SK & Kindra GS 1986. Palynostratigraphy of the Silchar-Haflong Road Traverse, District Cachar. *Bull. geol. Min. metall. Soc. India* 54: 238-249.
- Salujha SK, Kindra GS & Rehman K 1972. Palynology of the South Shillong Front. Part I: The Palaeogene of Garo Hills: 265-291. In: Ghosh AK *et al.* (Editors) - *Proceedings of the Seminar on Paleopalynology and Indian Stratigraphy* Calcutta 1971, Botany Department, Calcutta University.
- Salujha SK, Kindra GS & Rehman K 1974. Palynology of the South Shillong Front. Part II: The Palaeogenes of Khasi and Jaintia Hills. *Palaeobotanist* 21(3): 267-284.
- Salujha SK, Kindra GS & Rehman K 1979. Palynostratigraphy of Tertiary sediments of the Gojalia Anticline, Tripura: Pt. 2-Systematic palynology. *Journal of Palynology* 14(1): 71-93.
- Salujha SK, Kindra GS & Rehman K 1980. Palynostratigraphy of the Tertiary sediments of the Tulumura Anticline, Tripura: 667-685. In: Bharadwaj DC *et al.* (Editors) – *Proceedings of the 4th International Palynological Conference* Lucknow 1976-77, Volume 2, Birbal Sahni Institute of Palaeobotany, Lucknow.

- Saluja SK, Rawat MS & Rehman K 1967. Palynological study of pre-Tertiary (Ujhani) sediments in Uttar Pradesh, India. *ONGC Bulletin* 4(1): 56-61.
- Saluja SK, Rehman K & Kindra GS 1973. Distinction between the Bhuban and Bokabil sediments on the southern edge of Shillong Plateau based on palynofossil assemblage. *ONGC Bulletin* 10(1-2): 109-117.
- Saluja SK, Srivastava NC & Rawat MS 1969. Microfloral assemblage from Subathu sediments of Simla Hills. *Journal of the Palaeontological Society of India* 12: 25-40.
- Samant B 1994. Age of the Bhaunagar lignite deposit of Gujarat. *Journal of Palynology* 30(1-2): 49.
- Samant B 2000. Fungal remains from the Bhavnagar lignite, Gujarat, India. *Geophytology* 28(1-2): 11-18.
- Samant B & Phadtare NR 1997. Stratigraphic palynoflora of the Early Eocene Rajpardi lignite, Gujarat and the lower age limit of the Tarkeshwar Formation of South Cambay Basin, India. *Palaeontographica Abt. B* 245(1-6): 1-108.
- Samant B & Tapaswi PM 2000. Fungal remains from the Surat lignite deposits (Early Eocene) of Gujarat, India. *Gondwana Geological Magazine* 15(2): 25-30.
- Samant B & Tapaswi PM 2001. Palynology of the Early Eocene Surat lignite deposits of Gujarat, India. *Journal of the Palaeontological Society India* 46: 121-132.
- Samoilovich SR 1953. Pollen and spores from the Permian deposits of the Chedynsk and Aktyubinsk areas, Cis-Urals. *Paleobotanicheskiy sbornik, Vsesoiuznii nauchnoissledovatel'skii geologo-razvedochnyi Institut, Leningrad, Trudy, new series, no. 75: 5-57.*
- Sarkar S 1991. Eocene palynofossils from the Kakara Series of the Lesser Himalaya, Himachal Pradesh, India. *Review of Palaeobotany and Palynology* 67(1-2): 1-11.
- Sarkar S 1997. Palynostratigraphy and palaeoenvironment of the Subathu Formation (Eocene) of Lesser Himalaya, Himachal Pradesh, India. *Indian Journal of Petroleum Geology* 6(1): 99-115.
- Sarkar S, Bhattacharyya AP & Singh HP 1994. Palynology of Middle Siwalik sediments (Late Miocene) from Bagh Rao, Uttar Pradesh. *Palaeobotanist* 42(2): 199-209.
- Sarkar S & Prasad V 2000a. Palaeoenvironmental significance of dinoflagellate cysts from the Subathu Formation (Late Ypresian-Middle Lutetian) of Koshalia Nala Section, Shimla Hills, India. *Himalayan Geology* 21(1-2): 167-176.
- Sarkar S & Prasad V 2000b. Palynostratigraphy and depositional environment of the Subathu Formation (Late Ypresian-Middle Lutetian), Morni Hills, Haryana, India. *Journal of the Palaeontological Society of India* 45: 137-149.
- Sarkar S & Prasad V 2003. *Koshalia*, an Incertae sedis fossil from the Subathu Formation (Late Ypresian) Himachal Pradesh, India. *Palaeobotanist* 52: 113-116.
- Sarkar S & Singh HP 1988. Palynological investigation of the Subathu Formation (Eocene) in the Banethi-Bagthan area of Himachal Pradesh. *Palaeontographica* 209B: 29-109.
- Sarkar S & Singh HP 1994. Palaeoecology of the Lower Siwalik palynofloras from Kundlu and Nalagarh formations, Himachal Pradesh, India. *Himalayan Geology* 15: 95-106.
- Sarma PS & Reddy PR 1988. Fungal spores from the Neyveli lignite deposit. *Journal of Swamy Botanical Club*. 6(1): 5-11.
- Saxena G 1984. A pythiaceus fungus from the Deccan Intertrappean Beds of Mohgaon Kalan, M.P., India: 363-364. In: Tiwari RS *et al.* (Editors) - Proceedings of the 5th Indian Geophytological Conference, Lucknow 1983, Special Publication, Palaeobotanical Society, Lucknow.
- Saxena RK 1991. A catalogue of fossil plants from India - Part 5B. Tertiary fungi. Special Publication, Birbal Sahni Institute of Palaeobotany, Lucknow: 1-19.
- Saxena RK 1992. *Hypoxylosporites* Elsik 1990, a correct name for *Hypoxylosporites* Kumar 1990 and its Indian records. *Geophytology* 21: 211-212.
- Saxena RK 1992. Neyveli lignites and associated sediments - their palynology, palaeoecology, correlation and age. *Palaeobotanist* 40: 345-353.
- Saxena RK 2000. Palynological investigation of the Sindhudurg Formation in the type area, Sindhudurg District, Maharashtra, India. *ONGC Bulletin* 37(1): 157-166.
- Saxena RK 2006. A Catalogue of Tertiary Fungi from India (1989-2005). Special Publication, Birbal Sahni Institute of Palaeobotany, Lucknow: 1-37.
- Saxena RK 2009. Substitute names for later homonyms of five species and validation of the names of eight species of fossil fungi from Indian Tertiary sediments. *Mycotaxon* 110: 47-51.
- Saxena RK & Bhattacharyya AP 1987. Palynology of the Siwalik sediments of Kala Amb-Nahan area in Sirmour District, Himachal Pradesh. *Palaeobotanist* 35(2): 187-195.
- Saxena RK & Bhattacharyya AP 1990. Palynological investigation of the Dharmsala sediments in Dharmsala area, Kangra District, Himachal Pradesh. *Geophytology* 19(2): 109-116.
- Saxena RK & Khare S 1992. Fungal remains from the Neyveli Formation of Tiruchirappalli District, Tamil Nadu, India. *Geophytology* 21: 37-43.
- Saxena RK & Misra NK 1990. Palynological investigation of the Ratnagiri Beds of Sindhu Durg District, Maharashtra. *Palaeobotanist* 38: 263-276.
- Saxena RK & Ranhotra PS 2009. Palynofloral study of the Intertrappean Bed exposed at a new locality in Kutch District, Gujarat, India and its implications on palaeoenvironment and age. *Journal of the Geological Society of India* 74: 690-696.
- Saxena RK & Rao MR 1996. Palynological investigation of the Boldamgiri Formation (Early Miocene) in type area, Garo Hills, Meghalaya. *Geophytology* 26(1): 43-56.
- Saxena RK & Sarkar S 1986. Morphological study of Frasnacritetus Taugourdeau emend. from Tertiary sediments of Himachal Pradesh, India. *Review of Palaeobotany and Palynology* 46: 209-225.
- Saxena RK & Sarkar S 2000. Palynological investigation of the Siju Formation (Middle Eocene) in the type area, South Garo Hills, India. *Palaeobotanist* 49(2): 253-267.
- Saxena RK, Sarkar S & Singh HP 1984. Palynological investigation of Siwalik sediments of Bhakra-Nangal area, Himachal Pradesh. *Geophytology* 14(2): 178-198.
- Saxena RK & Singh HP 1980. Occurrence of palynofossils from the Pinjor Formation (Upper Siwalik) exposed near Chandigarh. *Current Science* 49(12): 479-480.
- Saxena RK & Singh HP 1982a. Palynological investigation of the Upper Siwalik sediments exposed along Hoshiarpur-Una Road Section in Punjab and Himachal Pradesh. *Geophytology* 12(2): 287-306.
- Saxena RK & Singh HP 1982b. Palynology of the Pinjor Formation (Upper Siwalik) exposed near Chandigarh, India. *Palaeobotanist* 30(3): 325-339.
- Saxena RK, Singh HP & Rao MR 1988. Palynology of the Tatrot-Pinjor sequence exposed between Masol and Kiratpur in Ambala District, Haryana. *Geophytology* 17(2): 270-284.
- Saxena RK, Tripathi SKM & Prasad V 1996. Palynofloral investigation of the Tura Formation (Palaeocene) in Nongwal Bibra area, East Garo Hills, Meghalaya. *Geophytology* 26(1): 19-31.
- Schmiedeknecht M & Schwab G 1964. Bulbillen fossiler Pilze aus einer tertiären Weichbraunkohle. *Deutsche Akademie der Wissenschaften zu Berlin* 6: 683-692.
- Selkirk DR 1975. Tertiary fossil fungi from Kiandra, New South Wales. *Proceedings of the Linnean Society, New South Wales* 100: 70-94.
- Shanmukhappa M & Koshal VN 1993. Palynological investigation of Eocene sediments in Gandhar area, Broach Depression, Cambay Basin: 191-202. In: Biswas SK *et al.* (Editors) - Proceedings of the Second Seminar on Petroliferous basins of India 2. Indian Petroleum Publishers, Dehradun.
- Sharma C 1976. Some fungal spores from Quaternary deposits of Malvan, Gujarat. *Palaeobotanist* 23(2): 79-81.

- Sharma N, Kar RK, Agarwal A & Kar R 2005. Fungi in dinosaurian (Isisaurus) coprolites from the Lameta Formation (Maastrichtian) and its reflection on food habit and environment. *Micropaleontology* 51(1): 73-82.
- Sheffy MV & Dilcher DL 1971. Morphology and taxonomy of fungal spores. *Palaeontographica Abt. B* 133(1-3): 34-51.
- Siddhanta BK 1986. The age of Neyveli lignite with reference to stratigraphy and palynology. *Indian Minerals* 40: 61-82.
- Singh H & Tripathi SKM 2010. Fungal remains from the Early Palaeogene subsurface sediments of Barakha, Barmer District, western Rajasthan, India. *Geophytology* 39(1-2): 9-15.
- Singh HP & Sarkar S 1984a. Palynological investigation of Ramshahr Well-1, Himachal Pradesh, India. *Palaeobotanist* 32(2): 91-112.
- Singh HP & Sarkar S 1984b. A Kasauli palynoflora from Banethi area of Himachal Pradesh, India. *Geophytology* 14(1): 40-54.
- Singh HP & Sarkar S 1992. Palynology and palaeoenvironment of Lower Tertiary sediments around Garkhal, Himachal Pradesh, India. *Geophytology* 22: 181-192.
- Singh HP & Sarkar S 1994. Palynostratigraphy of the Kasauli Formation (Lower Miocene), Himachal Pradesh, India. *Geophytology* 24(1): 49-54.
- Singh HP & Saxena RK 1980. Upper Siwalik palynoflora from Gagret-Bharwain Road Section, Himachal Pradesh. *Geophytology* 10(2): 278-279.
- Singh HP & Saxena RK 1981. Palynology of the Upper Siwalik sediments in Una District, Himachal Pradesh. *Geophytology* 11(2): 173-181.
- Singh HP & Saxena RK 1984. Palynology of the Neogene sediments of Jorajan Well-3, Upper Assam: 613-631. In: Sharma AK *et al.* (Editors) - Proceedings of the Symposium on Evolutionary Botany and Biostratigraphy Calcutta 1979, AK Ghosh Commemoration Volume, Current Trends in Life Sciences 10
- Singh HP, Saxena RK & Rao MR 1986. Palynology of the Barail (Oligocene) and Surma (Lower Miocene) sediments exposed along Sonapur-Badarpur Road Section, Jaintia Hills (Meghalaya) and Cachar (Assam). Part II. Fungal remains. *Palaeobotanist* 35(1): 93-105.
- Singh RB & Patil GV 1980. On remains of Coelomycetes in Mohgaon Kalan Intertraps, M.P., India. *Botanique* 9(1-4): 13-20.
- Singh RS 1990. Palynology of Langrin Coalfield, South Shillong Plateau, Meghalaya. *Palaeobotanist* 38: 217-228.
- Singh RS. & Kar R 2003. Palynological assemblage from the Deccan Intertrappean sediments, Lalitpur, U.P., India. *Gondwana Geological Magazine, Special Volume* 6: 217-223.
- Singh RS & Kar RK 2002. Palaeocene palynofossils from the Lalitpur Intertrappean Beds, Uttar Pradesh, India. *Journal of the Geological Society of India* 60: 213-216
- Singh RY, Dogra NN & Vimal KP 1985. Palynology of the Barail sediments in the states of Assam and Meghalaya, India. *Journal of Palynology* 21: 28-55.
- Singh SK. & Chauhan MS 2008. Fungal remains from the Neogene sediments of Mahuadanr Vally, Latehar District, Jharkhand, India and their palaeoclimatic significance. *Journal of the Palaeontological Society of India* 53(1): 73-81.
- Singh T & Tripathi SKM 1990. Siwalik sediments of Arunachal Himalaya: palynology, palaeoecology and palaeogeography. *Palaeobotanist* 38: 325-332.
- Singh TCN & Mathew K 1954. On the occurrence of certain mummified fossil plants in Neyveli lignite. *Proceedings of the 41st Indian Science Congress, Hyderabad* 4: 29 (Abstract).
- Singhai LC 1974. Fossil fungi from the Deccan Intertrappean Beds of Madhya Pradesh, India. *Journal of Biological Sciences* 17: 92-102.
- Singhai LC 1978. *Palaeophthora mohgaonensis* Singhai - a fossil fungus from the Deccan Intertrappean Beds of Mohgaon Kalan, Chhindwara District, M.P., India. *Palaeobotanist* 5: 481-485.
- Sitholey RV, Srivastava PN & Varma CP 1953. Microfossils from the Upper Vindhyan, with a discussion on the age of the Vindhyan in the light of plant fossil discoveries. *Proceedings of the National Institute of Sciences of India* 19(2): 195-202.
- Smith PH 1980. Trichothyriaceous fungi from the Early Tertiary of southern England. *Palaeontology* 23: 205-212.
- Song Zhichen 1985. A research on Tertiary palynology from the Qaidam Basin, Qinghai Province. Edited by Research Institute of Exploration and Development, Qinghai Petroleum Administration, [and] Nanjing Institute of Geology and Palaeontology, Academia Sinica, 297 p. (in Chinese). Petroleum Industry Press.
- Song Zhichen & Cao Liu 1994. Late Cretaceous fungal spores from King George Island, Antarctica. *Stratigraphy and Palaeontology of Fides Peninsula, King George Island, Antarctica, Monograph* 3: 47-49.
- Srivastava R 2008. Fossil woods resembling *Sonneratia* with fungal infection from Deccan Intertrappean sediments of Seoni District, Madhya Pradesh. *Geophytology* 37: 87-92.
- Srivastava R, Kappate DK & Chatterjee S 2009. Permineralized fungal remains in the fossil wood of *Barringtonia* from the Deccan Intertrappean sediments of Yavatmal District, Maharashtra, India. *Palaeobotanist* 58: 11-19.
- Srivastava R & Kar RK 2004. Record of new petrified epiphyllous fungi (Polyhyphaethyrites) from the Deccan Intertrappean beds of Mohgaon Kalan, Madhya Pradesh, India. *Current Science* 87: 866-867.
- Srivastava SC & Bhattacharyya AP 2000. Palynology in stratigraphy of Lesser Himalayan sedimentary sequences from Arunachal Pradesh, India. *Palaeobotanist* 49(3): 371-383.
- Srivastava SK 1968. Fungal elements from the Edmonton Formation (Maestrichtian), Alberta, Canada. *Canadian Journal of Botany* 46: 1115-1118.
- Stevens FL 1925. Hawaiian fungi. *Bernice P. Bishop Museum Bulletin* 19: 1-189.
- Stevens FL & Manter HW 1925. The Hemisphaeriaceae of British Guiana and Trinidad. *Botanical Gazette* 79: 265-294.
- Subramanian CV 1971. Hyphomycetes, an account of Indian species, except Cercosporae. *Indian Council of Agricultural Research, New Delhi*, 930 p.
- Taugourdeau P 1968. Sur un curieux microfossile incertae sedis du Frasnien du Boulonnais. *Cahiers de Micropaléontologie, Série 1*, no. 10 (Archives originales du Centre de Documentation du C.N.R.S. no. 452): 1-4.
- Teterevnikova-Babaian DN & Taslakhchian MG 1973. New data on fossil fungal spores in Armenia. *Academy of Sciences of the USSR, Mycology and Phytology* 4: 159-164.
- Thaxter R 1891 On certain new or peculiar North American Hyphomycetes. II. *Helicocephalum*, *Gonatorrhodiella*, *Desmidiospora* nov. genera and *Everharti lignatilis* n. sp. *Botanical Gazette (Crawfordsville)* 16: 201-205.
- Theissen F 1914. Trichopeltaceae n. fam. *Hemisphaerium*. *Zentralblatt für Bakteriologie und Parasitenkunde* 93: 625-640.
- Thirumalachar MJ 1944. A new genus of smuts. *Mycologia* 36: 591-597.
- Tiwari RS & Tripathi A 1995. Palynological assemblages and absolute age relationships of Intertrappean beds in Rajmahal Basin, India. *Cretaceous Research* 16: 53-72.
- Tripathi A 2001. Fungal remains from Early Cretaceous Intertrappean Beds of Rajmahal Formation in Rajmahal Basin, India. *Cretaceous Research* 22: 565-574.
- Tripathi RP, Shrivastava KL & Sharma BD 1999. Plant microfossils from the lignite deposit (Eocene) of Barsingshar in Bikaner District, Rajasthan, India. *Palaeobotanist* 47: 110-115.
- Tripathi SKM 1989. Algal and fungal remains from Jowai-Sonapur Road Section (Palaeocene-Eocene), Meghalaya. *Palaeobotanist* 37(1): 63-74.
- Tripathi SKM 1995. Palynology of subsurface Palaeocene-Eocene sediments near Kapurdi, Barmer District, Rajasthan, India. *Palaeobotanist* 43(1): 45-53.
- Tripathi SKM 2009. Fungi from palaeoenvironments: their role in environmental interpretations. In Misra, JK and Deshmukh S (eds.)

- Fungi from different environments: 1-27. Science Publishers Enfield, Hampshire, USA.
- Tripathi SKM, Saxena RK & Prasad V 2000. Palynological investigation of the Tura Formation (Early Eocene) exposed along Tura-Dalu Road, West Garo Hills, Meghalaya, India. *Palaeobotanist* 49(2): 239-251.
- Tripathi SKM, Singh UK & Sisodia MS 2003. Palynological investigation and environmental interpretation on Akli Formation (Late Palaeocene) from Barmer Basin, Rajasthan, India. *Palaeobotanist* 52(1-3): 87-95.
- Trivedi BS & Verma CL 1973. A new fossil fungus from the Deccan Intertrappean Beds of Madhya Pradesh, India. *Palaeobotanist* 20(1): 71-73.
- Trivedi GK & Saxena RK 2000. Palynofloral investigation of the Kopili Formation (Late Eocene) exposed near Umrongso in North Cachar Hills District, Assam, India. *Palaeobotanist*. 49(2): 269-280.
- Van der Hammen T 1954a. El desarrollo de la flora Colombiana en los periodos geologicos-1. Maestrichtiano hasta Terciario mas inferior (Una investigacion Palinologica de la formacion de Guaduas y equivalentes). *Boletin Geologico (Bogota)* 2(1): 49-106.
- Van der Hammen T 1954b. Principios para la nomenclatura palinologica sistematica. *Boletin Geologico (Bogota)* 2(2): 3-24.
- Van der Hammen T 1956. A palynological systematic nomenclature. *Boletin Geologico (Bogota)* 4: 63-101.
- Varma CP & Rawat MS 1963. A note on some diporate grains recovered from Tertiary horizons of India and their potential marker value. *Grana Palynologica* 4(1): 130-139.
- Varma YNR 1987. Palynomorphs of ecological significance from Tonakkal Tertiary clays of Kerala State. *Indian Journal of Botany* 10(2): 163-168.
- Varma YNR & Patil RS 1985. Fungal remains from the Tertiary carbonaceous clays of Tonakkal area, Kerala. *Geophytology* 15(2): 151-158.
- Venkatachala BS & Kar RK 1969. Palynology of the Tertiary sediments in Kutch-2. Epiphyllous fungal remains from the borehole no. 14. *Palaeobotanist* 17(2): 179-183.
- Venkatachala BS & Rawat MS 1972. Palynology of the Tertiary sediments in the Cauvery Basin-1. Palaeocene-Eocene palynoflora from the subsurface: 292-335. In: Ghosh AK *et al.* (Editors) - Proceedings of the Seminar on Palaeopalynology and Indian Stratigraphy Calcutta 1971, Botany Department, Calcutta University.
- Venkatachala BS & Rawat MS 1973. Palynology of the Tertiary sediments in the Cauvery Basin-2. Oligocene-Miocene palynoflora from the subsurface. *Palaeobotanist* 20(2): 238-263.
- Venkatachala BS & Sharma KD 1984. Palynological zonation in subsurface sediments in Narsapur Well no.1, Godavari-Krishna Basin, India: 445-465. In: Badve RM *et al.* (Editors) - Proceedings of the 10th Colloquium on Indian Micropalaeontology and Stratigraphy, Pune, 1982, Maharashtra Association for the Cultivation of Science, Pune.
- Watanabe K, Nishida H & Kobayasi T 1999. Cretaceous Deuteromycetes on a cycadeoidalean bisexual cone. *International Journal of Plant Sciences* 160: 435-443.
- Williamson WC 1878. On the organization of fossil plants of the Coal Measures. Part IX. *Philosophical Transactions of the Royal Society of London* 169: 319-364.
- Williamson WC 1880. On the organization of the fossil plants of the Coal-Measures.-Part X. Including an examination of the supposed radiolarians of the Carboniferous rocks. *Philosophical Transactions of the Royal Society of London* 171: 493-539.
- Wilson LR 1962. A Permian fungus spore type from the Flowerpot Formation of Oklahoma. *Oklahoma Geological Notes* 22: 91-96.
- Wolf FA & Wolf FT 1949. *The Fungi* - Volume 1. John Wiley and Sons, Inc., New York.