

Global diversity and distribution of fossil *Didymosporae* with special reference to their Indian records

Ramesh K. Saxena

Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow–226007, India

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ABSTRACT

Saxena R.K. 2024. Global diversity and distribution of fossil *Didymosporae* with special reference to their Indian records. *Geophytology* 54(1): 41–100.

Fungal spores exhibit a variety of morphological variations in number and nature of cells, apertures and spore wall characters and are divided into: Amerosporae, Didymosporae, Phragmosporae, Dictyosporae, Helicosporae, Staurosporae and Scolecosporae. The present paper deals with *Didymosporae* only, recorded so far from all over the world. These spores are dicellate. The two cells are separated from each other by a transverse septum. Altogether, 16 fossil genera and 166 species have been dealt here. These are: *Ampulliferinites* Kalgutkar & Sigler 1995 (1 sp.), *Caldesites* Puri 1963 (1 sp.), *Cladosporites* Félix 1894 (3 spp.), *Dicellaeporisporites* Kalgutkar 1997 (3 spp.), *Dicellaesporites* Elsik 1968 (61 spp.), *Didymoporisporonites* Sheffy & Dilcher 1971 (10 spp.), *Didymosporonites* Sal.-Cheb. & Loq. 1980 (1 sp.), *Diploneurospora* K.P. Jain & R.C. Gupta 1970 (1 sp.), *Disparidicellites* Kalgutkar & Janson. 2000 (1 sp.), *Dyadosporites* R.T. Clarke 1965 (41 spp.), *Felixites* Elsik ex Janson. & Hills 1976 (2 spp.), *Fusiformisporites* Rouse 1962 (20 spp.), *Hilidicellites* Kalgutkar & Janson. 2000 (18 spp.), *Pucciniasporonites* Ramanujam & Ramachar 1980 (1 sp.), *Valsarites* Puri 1963 (1 sp.) and *Verrudisporonites* O'Keefe 2017 (1 sp.). Of these, the dominant genera, both in number and variety, are *Dicellaesporites*, *Dyadosporites*, *Fusiformisporites*, *Hilidicellites* and *Didymoporisporonites*. *Didymosporae* have been recorded from Antarctica, Arabian Gulf (northern part), Arabian Sea, Argentina, Azerbaijan, Cameroon, Canada, China, Colombia, India, Malaya, Mexico, Nigeria, Norway (Spitsbergen), Peru, Poland, Taiwan, Turkey and U.S.A. In India, these are represented by seven genera and 52 species and have been recorded from many areas, e.g. Arabian Sea, Gujarat (Kutch and Cambay basins), Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Meghalaya-Assam, Punjab, Rajasthan, Tamil Nadu and West Bengal.

Keywords: Fossil fungi, fungal spores, *Didymosporae*, global diversity and distribution, Indian records.

INTRODUCTION

Studies on fossil fungi gained importance all over the world during the last fifty years. Kalgutkar and Jansonius (2000) published a synopsis of fossil fungi and tried to streamline taxonomic status of almost all fossil fungal genera and species published till then. Lakhanpal et al. (1976) and Saxena (1991, 2006) published catalogues in order to document all records of fossil fungal remains from the Indian Tertiary sediments. Saxena and Tripathi (2011) published a monographic study with the objective to synthesize the

available information on Indian fossil fungi. Saxena et al. (2021) presented diversity in dispersed fossil fungal spores recorded so far and attempted to trace affinity of fossil fungi with the living ones. Saxena and Wijayawardene (2022) attempted to establish fossil-extant relationship in Fungi and their significance in palaeoenvironmental interpretation.

In the present paper, fossil fungal spores have been treated according to Saccardoan system of grouping the spores (e.g. Amerosporae, Didymosporae, Phragmosporae, Dictyosporae, Helicosporae,

Staurosporae and Scolecosporae). This is based mainly on number and arrangement of cells. Here, only *Didymosporae* are dealt with, which includes conidia divided into two cells, each cell separated from the other by a transverse septum. This group is represented by the following genera: *Ampulliferinites* Kalgutkar & Sigler 1995 (1 sp.), *Caldesites* Puri 1963 (1 sp.), *Cladosporites* Félix 1894 (3 spp.), *Dicellaeporisporites* Kalgutkar 1997 (3 spp.), *Dicellaesporites* Elsik 1968 (57 spp.), *Didymoporisporonites* Sheffy & Dilcher 1971 (10 spp.), *Didymosporonites* Sal.-Cheb. & Locq. 1980 (1 sp.), *Diploneurospora* K.P. Jain & R.C. Gupta 1970 (1 sp.), *Disparidicellites* Kalgutkar & Janson. 2000 (1 sp.), *Dyadosporites* R.T. Clarke 1965 (41 spp.), *Felixites* Elsik ex Janson. & Hills 1976 (2 spp.), *Fusiformisporites* Rouse 1962 (20 spp.), *Hilidicellites* Kalgutkar & Janson. 2000 (18 spp.), *Pucciniasporonites* Ramanujam & Ramachar 1980 (1 sp.), *Valsarites* Puri 1963 (1 sp.) and *Verrudisporonites* O'Keefe 2017 (1 sp.).

Félix (1894) instituted the genus *Cladosporites* (Type: *C. bipartitus* Félix 1894) from the Eocene sediments of Perekeschkul, near Baku, Azerbaijan. Rouse (1962) proposed the genus *Fusiformisporites* (Type: *F. crabbii* Rouse 1962) from the Burrard Formation (Late Cretaceous-Middle Eocene) of Terminal Dock, Vancouver, British Columbia, Canada. According to Kalgutkar and Jansonius (2000), *Striadyadosporites* Dueñas 1979 is a later taxonomic synonym of *Fusiformisporites*. Puri (1963) instituted *Caldesites* and *Valsarites* from the Senonian sediments of Nigeria. Van der Hammen (1955) proposed the generic name *Dyadosporites* but did not validly publish it because he never described or illustrated the type species (Jansonius & Hills 1976). Clarke (1965) was the first to validly publish the generic name and was the first to assign it a species *Dyadosporites ellipsus* R.T. Clarke 1965. Kalgutkar and Jansonius (2000) considered *Dyadosporites* Hammen 1954 (nom. inval.), *Dyadosporonites* Elsik 1968 and *Psidimobipiospora* Sal.-Cheb. & Locquin, 1980 as later taxonomic synonyms of *Dyadosporites*. Elsik

(1968) proposed the genus *Dicellaesporites* (Type: *D. popovii* Elsik 1968) from the Palaeocene sediments of Strip mine approximately 11 km southwest of Rockdale, Milam County, Texas, U.S.A. The diagnosis of the genus *Dicellaesporites* was emended by Sheffy and Dilcher (1971) and Norris (1986). Jain and Gupta (1970) instituted genus *Diploneurospora* (Type: *D. tewarii* K.P. Jain & R.C. Gupta 1970) from the Miocene sediments of Padappakkara, Quilon, Kerala, India. Sheffy and Dilcher (1971) instituted *Didymoporisporonites* (Type: *D. psilatus* Sheffy & Dilcher 1971) from Claiborne Formation (Middle Eocene) of Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A. Elsik (1990) proposed the genus *Felixites* (Type: *F. pollenisimilis* (Horst) Elsik 1990) to accommodate *Sporonites pollenisimilis* Horst 1955 from the Carboniferous sediments of Concordia mine, Adit Andreas IV, Upper Silesia, S. Poland. According to Elsik (1990), *Felixites* was described for late Palaeozoic fungal didymospores that are aporate and characterized by a very thick medium septum. Salard-Chebaldoeff & Locquin (1980) instituted the monotypic genus *Didymosporonites* (Type: *D. saccatus* Sal.-Cheb. & Locq. 1980) from the Oligocene-Early Miocene sediments of Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa. Ramanujam and Ramachar (1980) instituted the monotypic genus *Pucciniasporonites* (Type: *P. arcotensis* Ramanujam & Ramachar 1980) from the Miocene lignite deposits of Neyveli Lignite Mine, Cuddalore District, Tamil Nadu, India. This genus is characterized by dicellate teliospores borne singly on pedicels and with one germ pore in each cell. Kalgutkar and Sigler (1995) instituted *Ampulliferinites* (Type: *A. axelheibergii* Kalgutkar & Sigler 1995) from the Amphitheatre Formation (Late Eocene or Early Oligocene) of Yukon Territory, North-western Canada. According to Kalgutkar and Sigler (1995), *Ampulliferinites* appears to be similar to modern *Ampulliferina* B. Sutton 1969. Kalgutkar (1997) described *Dicellaeporisporites* (Type: *D. oratus* Kalgutkar 1997) from the Late Palaeocene-Early Eocene sediments of Kanguk Peninsula, Axel Heiberg

Island, Northwest Territories, Canada. This genus can be distinguished from *Dicellaesporites* Elsik 1968 by the presence of a germinal pore in each cell. Kalgutkar and Jansonius (2000) published *Disparidicellites* (Type: *D. paradoxus* (P. Ke & Z. Y. Shi) Kalgutkar & Janson. 2000) from the Eocene-Oligocene sediments of Panshan, Liaoning Province, Coastal region of Bohai, China. The genus is characterized by small to medium-sized, dicellate, inaperturate fungal spores with distinctly unequal cells (the proximal cell is much smaller and thinner-walled than the distal cell). Kalgutkar and Jansonius (2000) instituted *Hilidicellites* (Type: *H. appendiculatus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000) from the Claiborne Formation (Middle Eocene) of Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A. O'Keefe (2017) proposed the genus *Verrudisporonites* (Type: *V. elsikianus* O'Keefe 2017) from the Heath Formation (Miocene) of Quebrada Bocapán, Tumbes Province, north-western Peru.

DIVERSITY IN FOSSIL *DIDYMOSPORAE*

1. Genus: *Ampulliferinites* Kalgutkar & Sigler 1995

Index Fungorum Registration Identifier: 14288.

Type species: *Ampulliferinites axelheibergii* Kalgutkar & Sigler 1995.

Original diagnosis: Fungus filamentous; filaments in short or long, determinate chains of conidia; filaments traversed by thin and thick-walled septa which alternate along the chains; conidia in arthroconidial chains separated by dark, thick septa; didymosporous, not or slightly constricted at medium septum and with truncate ends except the terminal conidium which is rounded at the apex. Monotypic (Kalgutkar & Sigler 1995, p. 515).

Number of species known: One (not recorded from India).

Remarks: Kalgutkar and Sigler (1995) stated that *Ampulliferinites* appears to be similar to modern *Ampulliferina* B. Sutton 1969 which has

didymosporous, catenate conidia that separate by fragmentation through the thick, dark brown septa along its length of arthroconidial chains. *Ampulliferinites* is also characterized by the presence of a basal cell with an attachment scar similar to one present in *Ampulliferina*. The genus name indicates its affinity to *Ampulliferina* B. Sutton.

1.1. Species: *Ampulliferinites axelheibergii* Kalgutkar & Sigler 1995

Figure 1.A

Index Fungorum Registration Identifier: 412403.

Original description: Chains comprising 5–8 conidia, straight and unbranched and slightly constricted at the thick separating septa. Filamentous chains 79–240 µm long. Didymosporous conidia occurring in arthroconidial chains separated by thick, dark brown septa which alternate with thin septa along the length of the filament. Filaments short to long, determinate; subtended by a basal cell. Basal cell pale brown, aseptate, tapering towards the base, with an attachment scar left after the detachment of the filament from the mycelium. Conidia two-celled, not or slightly constricted at septum, smooth, brown, truncate at both thickened ends, 16–22 × 7–11 µm. Detached conidia were not found (Kalgutkar & Sigler 1995, p. 517).

Location and age: Yukon Territory, North-western Canada; Late Eocene or Early Oligocene (Amphitheatre Formation).

Remarks: According to Kalgutkar and Sigler (1995), *Ampulliferinites axelheibergii* resembles *Alternoseptites elongatus* Rouse (1962) in having filaments indented at every second septum, but in *A. elongatus* the septa are not thickened and the filaments are not arthroconidial in nature. The species epithet is after its type locality on Axel Heiberg Island.

2. Genus: *Caldesites* Puri 1963

Index Fungorum Registration Identifier: 92235.

Type species: *Caldesites nigerianus* Puri 1963.

Original Diagnosis (combined description): These

are two large ascospores of more or less the same size, lying partly one on the other. The larger measures $42 \times$ nearly $20 \mu\text{m}$ (in the broadest part). The smaller spore is only a little smaller in dimensions. Both of these seem to be broken at the basal portion. They are thin-walled and are divided into more or less equal halves by the equatorial wall (Puri 1963).

Classification: *Ascomycota, Microthyriales.*

Number of species known: One (not recorded from India).

2.1. Species: *Caldesites nigerianus* Puri 1963

Index Fungorum Registration Identifier: 647741.

Figure: In Puri 1963: 16, plate 1, figure 18.

Location and age: Nigeria; Senonian?

3. Genus: *Cladosporites* Félix 1894

Index Fungorum Registration Identifier: 21055.

Type species: *Cladosporites bipartitus* Felix 1894.

Original diagnosis: As for the type species (Félix 1894, p. 276).

Number of species known: Three (none recorded from India).

Remarks: According to Félix (1894), the conidia greatly resemble those of *Cephalothecium* Corda (Current name: *Trichothecium* Link *vide* Species Fungorum 2021) and *Cladosporium* Link. The former has water-clear conidia but the fossil conidia are partially colored which may have been caused by the state of preservation of the organic substance in the conidial wall. The mycelium of *Cephalothecium* is very different, and an affiliation of the fossil conidia with the *Cladosporieae* is therefore more likely. For this reason, it was named *Cladosporites*.

3.1. Species: *Cladosporites bipartitus* Félix 1894

Figure 1.B

Index Fungorum Registration Identifier: 201043.

Original Description (combined description): The conidia are elliptical or pear-shaped, smooth and of pale-brownish coloration. They are divided by a septum into two halves, one of which is invariably of roundish, the other of occasionally somewhat rounded three-sided shape. The length of the conidia is $10.2\text{--}11.9 \mu\text{m}$, the width $5.1\text{--}6.8 \mu\text{m}$. Special conidiophores are absent or rudimentary. In the vicinity of the conidia, brown, septate mycelial filaments occur. They are ramified, here and there of gnarled appearance. Clamp connections are absent.

Location and age: Perekeschkul, near Baku, Azerbaijan; Eocene.

3.2. Species: *Cladosporites fasciculatus* E.W. Berry 1916

Index Fungorum Registration Identifier: 483913.

Figure: In Berry 1916: 77, plate 182, figures 1–2.

Original description: Mycelium intracellular in the vessels of the secondary wood, attached to the vessel walls by haustoria, and forming small fasciculate apparently unbranched tufts projecting freely in the vessel cavity. The hyphae are thin and the majority are somewhat tapering distally, although in some cases they taper proximally. Septa were not observed. In only one case was a distal branch observed (plate 182, figure 1). Although there are some hundreds of tufts of this fungus in the slides examined, only two of these show conidia (plate 182, figure 2). The latter are terminal, fusiform in outline and somewhat variable in length. They appear to be simple, and I am unable to assert positively that they are cut off from the hyphae by septa, although I imagined that I saw such septation. The hyphae average about $1.3 \mu\text{m}$ in diameter, and the conidia range from $2 \times 4 \mu\text{m}$ to $2 \times 12 \mu\text{m}$ in diameter (Berry 1916, p. 77).

Location and age: In silicified vessels of *Laurinoxylon* of Westmorland Bluff, Trinity River, Texas, U.S.A.; Middle Eocene.

Remarks: According to Berry (1916), this species is found in exceeding abundance in silicified specimens

of lauraceous wood from the Yegua Formation, Claiborne Group (Middle Eocene) of Texas and is entirely unlike any previously recorded fossil forms.

3.3. *Cladosporites oligocaenicus* E.W. Berry
1916

Index Fungorum Registration Identifier:
483912.

Figure: In Berry 1916: 77, plate 181, figures 1, 3–4, 6–7.

Original description: This form shows a much branched intracellular mycelium with united side branches and made up of fine, much-septate hyphae 2.8 μm in diameter. These hyphae proliferate freely within the cells of the parenchyma (of a mineralized rotten stem of *Palmoxylon cellulosum*) and occasionally are observed to send off haustoria to the walls. They frequently show terminal conidia that are in linear pairs, triplets or quadruplets, generally in pairs or triplets. The conidia are subspherical in form and range in diameter from 3.5 μm to 5.4 μm . For example, in plate 181, figure 4, the proximal segment is $3.57 \times 4 \mu\text{m}$; the middle segment is $4.5 \times 5.4 \mu\text{m}$; and the distal segment is $3.6 \mu\text{m} \times 4 \mu\text{m}$ (Berry 1916, p. 77).

Location and age: In petrified wood of *Palmoxylon cellulosum* Knowlton, Bayou Pierre, Mississippi, U.S.A.; Early Oligocene.

4. Genus: *Dicellaaporisporites* Kalgutkar 1997

Index Fungorum Registration Identifier:
27773.

Type species: *Dicellaaporisporites poratus* Kalgutkar 1997.

Original diagnosis: Spores dicellate, broadly elliptic-fusiform or ellipsoidal, smooth, constricted or not at the central septum. Cells uniformly broad with rounded ends or broadest near the central septum and gradually tapering towards the apices. Apices of each cell thickened or not. Spores with symmetrically placed germinal pores or lateral germinal slits or furrows. Germinal pores axial or non-axial, one pore or lateral furrow in each cell (Kalgutkar 1997, p. 210).

Number of species known: Three (none recorded from India).

Remarks: *Dicellaaporisporites* can be distinguished from *Dicellaesporites* Elsik 1968 by the presence of a germinal pore in each cell.

4.1. Species: *Dicellaaporisporites delitschiapites* (Kalgutkar & Sigler) Kalgutkar 1997

Index Fungorum Registration Identifier:
437901.

Figure: In Kalgutkar & Sigler 1995: 517, figure 6.

Basionym: *Dicellaesporites delitschiapites* Kalgutkar & Sigler 1995, Index Fungorum Registration Identifier: 412946.

Original description: Spores broadly ellipsoidal with rounded ends, 2-celled, brown, without a constriction at the septum; septum nearly median; spores with furrows or germinal slits; germinal slit lateral, usually seen in only one cell, slightly gaping and about two-thirds the length of the cell; spore wall smooth, spores $25\text{--}28 \times 11\text{--}13 \mu\text{m}$ (Kalgutkar & Sigler 1995, p. 517).

Location and age: Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada; Late Palaeocene–Early Eocene.

Remarks: Spores of this species are generally similar to the ascospores of the living loculo ascomycetous and coprophilous *Delitschia* in the presence of furrows which appear similar to the distinctive germ slits.

4.2. Species: *Dicellaaporisporites poratus* Kalgutkar 1997

Figure 1.C

Index Fungorum Registration Identifier:
437900.

Figure: In Kalgutkar 1997: 210, plate 2, figure 2.

Original description: Spores distinctive, dicellate, mid to dark brown, broadly elliptic-fusiform, smooth, deeply notched at the central septum. Each cell prominently distinct due to deep indentation at the

septum in the middle of the spore. Cells broadest near the central septum and gradually tapering towards the apices; cell wall at the apices of each cell slightly thickened. Each cell contains a distinct, subcircular germinal pore towards each end in the cell wall. Septum dark, 2 μm thick and constricted. Spore size 27–28 \times 9–10 μm (Kalgutkar 1997, p. 210).

Location and age: Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada; Late Palaeocene-Early Eocene.

Remarks: The species epithet is derived from the porate cells.

4.3. Species: *Dicellaesporisporites siglerae*
(Kalgutkar) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483291.

Figure: In Kalgutkar 1997: 215, plate 3, figure 7.

Basionym: *Fusiformisporites siglerae*
Kalgutkar 1997, Index Fungorum Registration Identifier:
437392.

Original description: Spores brown, smooth, oblong to ellipsoidal, with a single central transverse septum, and each hemisphere rounded. Spores darker at both ends than in the middle portion. Spore wall less than 1 μm thick, sculptured with irregular, dense and frail striae extending from both ends to the middle septum in each cell and forming a loose network. Each cell possesses a single, annulate germinal pore arising on either side of, and close to, the septum. Spores constricted at the septum; septum dark, 2 μm thick. Spores 24–35 \times 11–13 μm (Kalgutkar 1997, p. 215).

Location and age: Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada; Late Palaeocene-Early Eocene.

5. Genus: *Dicellaesporites* Elsik 1968

Index Fungorum Registration Identifier:
21074.

Type species: *Dicellaesporites popovii* Elsik 1968.

Original diagnosis: Inaperturate, psilate fungal

spores. Two cells, uniseptate. Shape variable (Elsik 1968, p. 269)).

Emended Diagnoses: Diagnosis of the genus *Dicellaesporites* was emended by Sheffy and Dilcher (1971) and Norris (1986), as follows: Inaperturate fungal spores or algal bodies. Two cells, uniseptate, shape variable. Sculpture psilate to scabrate (Sheffy & Dilcher 1971, p. 41); Dicellate, inaperturate, isopolar, equilateral fungal spores. Spore wall laevigate to scabrate (Norris 1986, p. 21).

Number of species known: 61 (21 species recorded from India).

Remarks: Both Elsik (1968) and Sheffy and Dilcher (1971) mentioned the shape of *Dicellaesporites* as “variable”. Norris (1986) did not accept it and emended the diagnosis to restrict this genus for dicellate aporate spores with isopolar, equilateral cells. Kalgutkar and Jansonius (2000) stated that dicellate aporate spores may be isopolar with equilaterally exactly similar cells, but some have unequal cells as well (even on the same mycelium), e.g. in *Dicellaesporites paradoxus* P. Ke & Z.Y. Shi 1978 (Plate 1, figures 10–11), *D. inaequabilis* Mart.-Hern. & Tom.-Ort. 1989 (Figure 3c), *D. keralaensis* P. Kumar 1990 (Plate 1, Figure 12) and *Dicellaesporites* sp. 1 (Kalgutkar 1997). They, therefore, did not accept Norris’ emendation.

5.1. Species: *Dicellaesporites aculeolatus* Sheffy & Dilcher 1971

Figure 1.D

Index Fungorum Registration Identifier:
111404.

Original description: Dicellate spore, slightly tapered at both ends. Single opaque septum, wall smooth 0.5–1.0 μm thick with irregular folds. Size ranges from 5.8 \times 18.4–6.8 \times 21.3 μm (two specimens). Holotype: 6.8 \times 21.3 μm (Sheffy & Dilcher 1971, p. 41).

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.2. Species: *Dicellaesporites africanus* Sal.-
Cheb. & Locq. 1980

Index Fungorum Registration Identifier:
107909.

Figure: In Salard-Cheboldaeff & Locquin 1980:
187, plate 2, figure 6.

Original description: Spore 2-celled, cylindrical, slightly constricted at the septum, septum thin; $14 \times 7 \mu\text{m}$

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

Remarks: Salard-Cheboldaeff & Locquin (1980) assigned an affinity to *Ascomycota*.

5.3. Species: *Dicellaesporites akoyolii* V.S. Ediger & Alisan 1989

Index Fungorum Registration Identifier:
125502.

Figure: In Ediger & Alisan 1989: 155, plate 3, figure 11.

Original description: Dicellate, uniseptate, aperturate fungal spores. Outline is irregularly elliptical and slightly compressed around the septum and slightly pointed at apex which is usually delicate and corroded. Exine is about $1 \mu\text{m}$ thick and has numerous small delicate baculate and echinate sculptures. These sculptural elements are corroded easily in the badly preserved specimens. Septum has a small pore and a thickening around it. Size $14\text{--}19 \times 25\text{--}28 \mu\text{m}$.

Location and age: Northern Thrace Basin, Turkey; Middle?-Late Eocene to Late Oligocene, Miocene-Pliocene.

Remarks: The species epithet is in honour of Dr. Erol Akyol.

5.4. Species: *Dicellaesporites antarcticus* Z.C.
Song & Liu Cao 1994

Index Fungorum Registration Identifier:
483765.

Figure: In Song & Cao 1994: 39, plate 1, figure 8.

Original description: Spores capsular or oblong elliptical, broadly rounded at both ends, lateral sides of both cells slightly concave; size of spores in 10 specimens $35\text{--}40 \times 18\text{--}20 \mu\text{m}$, size of holotype $40 \times 20 \mu\text{m}$; dicellate, cells similar in shape and size, contact area between two cells without constriction; septum entire, $3\text{--}4 \mu\text{m}$ in width; spore wall $1.5\text{--}2 \mu\text{m}$ in thickness, surface with dot-like markings, after etching dots clearly visible; extrema lineamenta slightly uneven; spores black.

Location and age: King George Island, Antarctica; Late Cretaceous.

Remarks: The species epithet is derived from the locality of type specimens.

5.5. Species: *Dicellaesporites arabimarinus* Sat.
K. Srivast. & Al-Tayyar 2013

Index Fungorum Registration Identifier:
818887.

Figure: In Srivastava & Al-Tayyar 2013: 166, plate 83, figures 1–5.

Original description: Dicellate fungal spore, cells of unequal size, proximal cell larger than the distal one, proximal end narrower than the distal one, distal end broadly rounded; exine about $0.5\text{--}1.0 \mu\text{m}$ thick, scabrate; septum between the cells conical and large on one side whereas thin and slightly thicker towards the cell-wall on the other side; distal cell has a sigmoid fracture (Srivastava & Al-Tayyar 2013, p. 166).

Location and age: Northern Arabian Gulf; Aptian to late Albian.

Remarks: The species epithet is after Arabian Sea, *Arabimarinus* = of the Arabian Sea.

5.6. Species: *Dicellaesporites asymmetricus* Sal.-
Cheb. & Locq. 1980

Index Fungorum Registration Identifier:
107910.

Figure: In Salard-Cheboldaeff & Locquin 1980:
187, plate 2, figure 4.

Original description: Spore 2-celled, fusiform, obtuse, slightly asymmetrical, septum thin; $55 \times 21 \mu\text{m}$.

Location and age: Coast of Equatorial Africa,

Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

Remarks: Salard-Cheboldaëff & Locquin (1980) assigned an affinity to *Ascomycota*.

5.7. Species: *Dicellaesporites bigeminatus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483292.

Figure: In Sheffy & Dilcher 1971: 45, plate 16, figure 55.

Basionym: *Multicellaesporites bigeminatus* Sheffy & Dilcher 1971.

Original description: Tetracellate $3.9 \times 21.3 \mu\text{m}$. Cell wall continuous, constriction in center separating two didymospore configurations, each having a disk-shaped septum. Psilate, light pigment, wall $0.5 \mu\text{m}$ thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

Remarks: According to Kalgutkar & Jansonius (2000), the illustrated spores are clearly dicellate and catenate and therefore the species was assigned to *Dicellaesporites* Elsik 1968, as emended by Dilcher 1971.

5.8. Species: *Dicellaesporites bisariae* R.K. Saxena & A. Kumar 2023

Index Fungorum Registration Identifier: 901375.

Figure: In Saxena & Kumar 2023: 155, figure 2.7.

Original description: Fungal spores oval, dark brown in colour. Size $42 \times 30.5 \mu\text{m}$. Dicellate, uniseptate, septa $8\text{--}11 \mu\text{m}$ thick, slightly curved. Spore wall psilate, very thick and opaque.

Location and age: West of Abha town on the southern Red Sea coast of Saudi Arabia between Jeddah in the north and Jizan in the south; Holocene.

Remarks: This species is named in honour of B.K. Bisaria, formerly of the Geological Survey of India (N.R.), Lucknow, India.

5.9. Species: *Dicellaesporites cameronensis* Sal.-Cheb. & Locq. 1980

Index Fungorum Registration Identifier: 107911.

Figure: In Salard-Cheboldaëff & Locquin 1980: 187, plate 2, figure 5.

Original description: Spore 2-celled, spore elliptical, slightly constricted at the septum, septum thin; $20 \times 10 \mu\text{m}$.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.



Figure 1. A. *Ampulliferinites axelheibergii* Kalgutkar & Sigler 1995. Scale bar = $10 \mu\text{m}$. B. *Cladosporites bipartitus* Félix 1894. Scale bar = $7 \mu\text{m}$. C. *Dicellaesporites poratus* Kalgutkar 1997. Scale bar = $10 \mu\text{m}$. D. *Dicellaesporites aculeolatus* Sheffy & Dilcher 1971. Scale bar = $5 \mu\text{m}$. E. *Dicellaesporites campanulatus* Ambwani 1983. Scale bar = $20 \mu\text{m}$. F. *Dicellaesporites classicus* R.K. Saxena & S.K.M. Tripathi 2011. Scale bar = $25 \mu\text{m}$. G. *Dicellaesporites constrictus* S.C.D. Sah & R.K. Kar 1974. Scale bar = $20 \mu\text{m}$. H. *Dicellaesporites disphaericus* Sheffy & Dilcher 1971. Scale bar = $10 \mu\text{m}$. I. *Dicellaesporites ellipticus* K.P. Jain & R.K. Kar 1979. Scale bar = $20 \mu\text{m}$. J. *Dicellaesporites elongatus* Ramanujam & K.P. Rao 1978. Scale bar = $10 \mu\text{m}$. K. *Dicellaesporites elsikii* B. Samant in R.K. Saxena 2009. Scale bar = $10 \mu\text{m}$. L. *Dicellaesporites fusiformis* Sheffy & Dilcher 1971. Scale bar = $10 \mu\text{m}$. M. *Dicellaesporites himachalensis* R.K. Saxena & A.P. Bhattach. 1990. Scale bar = $20 \mu\text{m}$. N. *Dicellaesporites himalayaensis* A. Gupta 2002. Scale bar = $7 \mu\text{m}$. O. *Dicellaesporites inaequalis* (Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson. 2000. Scale bar = $20 \mu\text{m}$. P. *Dicellaesporites indicus* A. Gupta 2002. Scale bar = $5 \mu\text{m}$. Q. *Dicellaesporites jainii* R.K. Saxena & S.K.M. Tripathi 2011. Scale bar = $10 \mu\text{m}$. R. *Dicellaesporites keralensis* P. Kumar 1990. Scale bar = $10 \mu\text{m}$. S. *Dicellaesporites levis* Sheffy & Dilcher 1971. Scale bar = $10 \mu\text{m}$. T. *Dicellaesporites minutus* R.K. Kar & R.K. Saxena 1976. Scale bar = $10 \mu\text{m}$. U. *Dicellaesporites perelongatus* Kalgutkar & Janson. 2000. Scale bar = $10 \mu\text{m}$. V. *Dicellaesporites popovii* Elsik 1968. Scale bar = $12 \mu\text{m}$. W. *Dicellaesporites singhii* R.K. Saxena & S.K.M. Tripathi 2011. Scale bar = $20 \mu\text{m}$. X. *Dicellaesporites vermae* R.K. Saxena et al. 2021. Scale bar = $17 \mu\text{m}$. Y. *Didymoporisporonites gigas* Kalgutkar & Janson. 2000. Scale bar = $10 \mu\text{m}$. Z. *Didymoporisporonites longus* (R.K. Kar) Kalgutkar & Janson. 2000. Scale bar = $20 \mu\text{m}$. AA. *Didymoporisporonites psilatus* Sheffy & Dilcher 1971. Scale bar = $7 \mu\text{m}$. AB. *Didymoporisporonites saccatus* Sal.-Cheb. & Locq. 1980. Scale bar = $10 \mu\text{m}$. AC. *Diploneurospora tewarii* K.P. Jain & R.C. Gupta 1970. Scale bar = $8 \mu\text{m}$. AD. *Disparidicellites paradoxus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000. Scale bar = $10 \mu\text{m}$. AE. *Dyadosporites bhardwaji* (C.P. Varma & Rawat) Kalgutkar & Janson. 2000. Scale bar = $20 \mu\text{m}$.

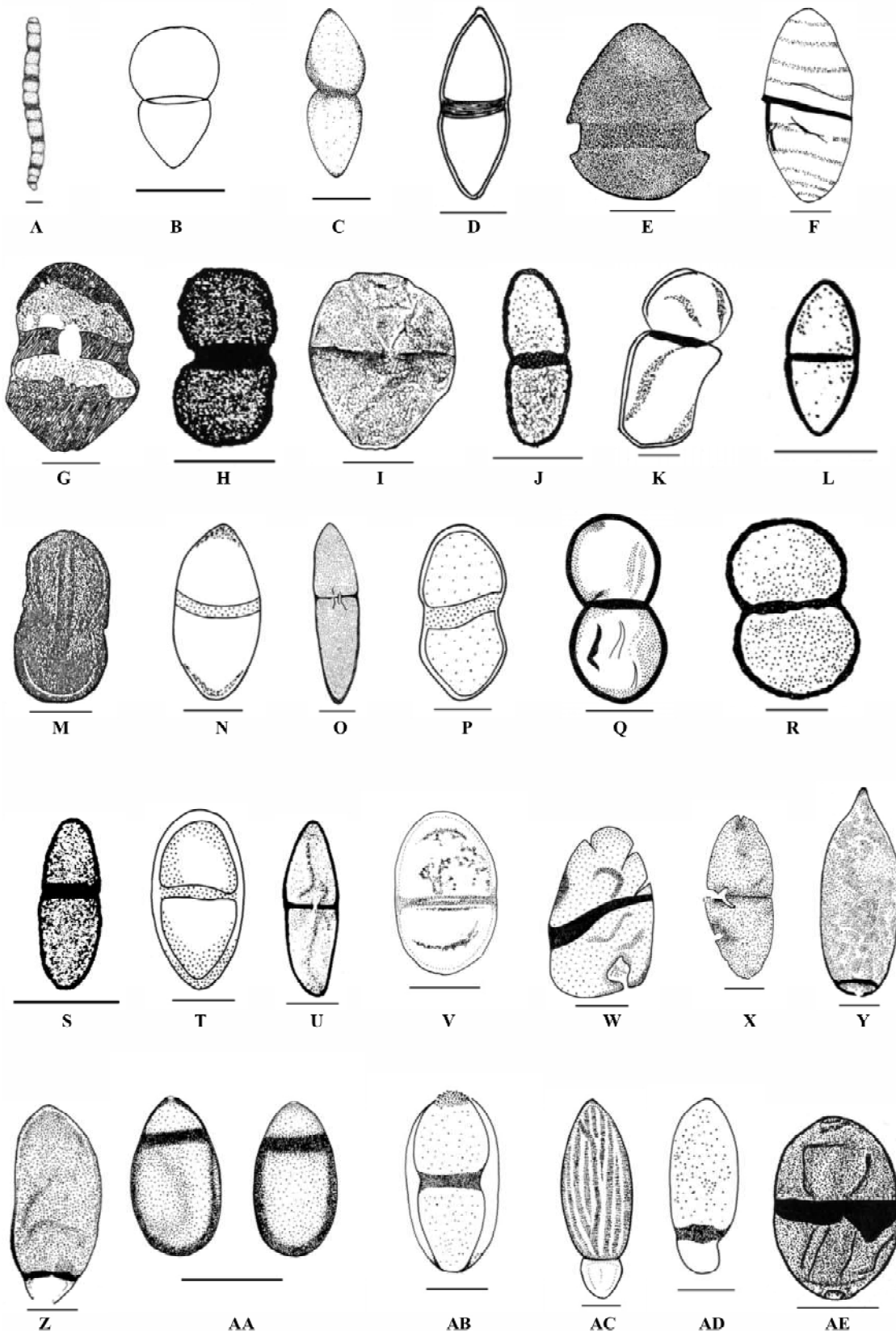


Figure 1

Remarks: Salard-Cheboldaeff & Locquin (1980) assigned an affinity to *Ascomycota*.

5.10. Species: *Dicellaesporites campanulatus*
Ambwani 1983

Figure 1.E

Index Fungorum Registration Identifier:
106768.

Original description: The inaperturate fungal spores are two-celled and uniseriate in structure, size ranges up to 80 µm and the shape is ovate. The upper cell is campanulate, while the basal cell is round. Two cells are separated by a very thick septum about 12 µm in thickness. Spore wall is thin and laevigate.

Location and age: Neyveli Lignite, Tamil Nadu, India; Late Miocene or Pliocene.

Remarks: The species epithet is derived from the campanulate upper cell.

5.11. Species: *Dicellaesporites cartos* P. Ke &
Z.Y. Shi 1978

Index Fungorum Registration Identifier:
115662.

Figure: In Ke & Shi 1978: 32, plate 1, figure 21.

Original description: Spores 61 × 52 µm. Outline ovate. Inaperturate. Two-celled, monoseptate. Each cell subcircular or semi-circular in shape, septum dark colored, disc-shaped. Spore wall about 2 µm thick, two-layered, outer and inner layers are of about equal thickness, surface provided with scabrate or granulate sculpturing. Outer contour line not quite smooth.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

5.12. Species: *Dicellaesporites cellaequalis*
Kalgutkar 1993

Index Fungorum Registration Identifier:
483862.

Figure: In Kalgutkar 1993: 71, plate 4.1, figure 13.

Original description: Aporate, monoseptate, psilate, dark brown fungal spores; spores dicellate, cells

nearly equal, spherical to rounded, separated by a conspicuously thick septum; spore outline clearly indented at the septum. Septum about 2 µm thick, black. Spore size 18–23 × 7–13 µm.

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene-Early Eocene.

Remarks: The species epithet is derived from the Latin, *cella*, cell; *aequalis*, equal, referring to the spores having both cells equal.

5.13. Species: *Dicellaesporites classicus* R.K.
Saxena & S.K.M. Tripathi 2011

Figure 1.F

Index Fungorum Registration Identifier:
561702.

Original description: Fungal spore elongated, biconvex. Size 110–126 × 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.

Location and age: Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam, India; Early Miocene (Bhuban Formation).

5.14. Species: *Dicellaesporites constrictus* S.C.D.
Sah & R.K. Kar 1974

Figure 1.G

Index Fungorum Registration Identifier:
519767.

Original description: Two-celled, psilate, inaperturate fungal spores, 89–120 × 40–101 µm; constricted in the middle, uniseptate. Individual cells subcircular to oval.

Location and age: Palana, Bikaner District, Rajasthan, India; Early Eocene (Palana lignite).

5.15. Species: *Dicellaesporites disphaericus*
Sheffy & Dilcher 1971

Figure 1.H

Index Fungorum Registration Identifier:
111406.

Original description: Two-celled spore, $16.4 \times 26.4 \mu\text{m}$, cells spherical, slightly flattened at one end. Dark pigment, wall rough, scabrate, $1 \mu\text{m}$ thick, opaque equatorial septum and pronounced constriction.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.16. Species: *Dicellaesporites dolium* Z.C. Song 1985

Index Fungorum Registration Identifier: 637484.

Figure: In Song 1985: 44, plate 1, figure 13.

Original description: Holotype $25 \times 10 \mu\text{m}$. Dicellate, capsular in outline, broadly rounded at both ends, middle part without distinct constriction. Septum with peripheral thickening, and with triangular septal folds, not showing a central pore. Spore wall rigid, without folds, about $1 \mu\text{m}$ in thickness, surface scabrate. Spore dark brown.

Location and age: Huangshi and Dafengshan, Qaidam Basin, Qinghai Province, China; Palaeocene-Late Eocene; Early Miocene-Late Pliocene.

5.17. Species: *Dicellaesporites ellipticus* K.P. Jain & R.K. Kar 1979

Figure 1.I

Index Fungorum Registration Identifier: 112269.

Original description: Spores two-celled, elliptical, $47\text{--}70 \times 30\text{--}60 \mu\text{m}$ in size, inaperturate, septa distinct, straight, cells equal. Spore wall $1\text{--}2 \mu\text{m}$ thick, ornamentation granulose-microverrucose, sculptural elements not more than $1 \mu\text{m}$ high.

Location and age: Papanasam, Varkala, Kerala Coast, India; Miocene.

5.18. Species: *Dicellaesporites elongatus* Ramanujam & K.P. Rao 1978

Figure J

Index Fungorum Registration Identifier: 115060.

Original description: Spores inaperturate, dicellate, melanin-colored, ellipsoidal to almost oblong, $21\text{--}26 \times 6\text{--}8 \mu\text{m}$. Individual cells considerably elongated; spore wall $1 \mu\text{m}$ thick, transverse septum considerably thicker, often more than twice as thick as the wall, surface psilate.

Location and age: Kannur, Kerala, India; Miocene (Quilon and Warkalli beds).

Remarks: The elongate nature of the cells and the considerably thickened transverse septum are the important features of this species.

5.19. Species: *Dicellaesporites elsikii* B. Samant in R.K. Saxena 2009

Figure 1.K

Synonym: *Dicellaesporites elsikii* B. Samant 2000 (nom. inval.).

Index Fungorum Registration Identifier: 515018.

Original Description: Fungal spores bicellate; $40\text{--}45 \times 20\text{--}26 \mu\text{m}$ in size; cells of unequal size; first cell almost circular, about $20 \mu\text{m}$ in diameter, second cell large and elongate, about $26 \times 20 \mu\text{m}$ in size; septate, septa thin or $1 \mu\text{m}$; marked constriction between cells; spore wall thin ($1 \mu\text{m}$), smooth and hyaline.

Location and age: Near Bhavnagar, Cambay Basin, Gujarat, India; Early Eocene (Kharsalia Clay Formation).

5.20. Species: *Dicellaesporites foratus* Zhong Y. Zhang 1980

Index Fungorum Registration Identifier: 485000.

Figure: In Zhong Y. Zhang 1980: 297, plate 1, figure 18.

Original description: Inaperturate fungal spores consisting of two cells, outline of the spores elliptical and their size $30.9 \times 68.5 \mu\text{m}$. Individual cells of unequal size. External wall of spore $0.7 \mu\text{m}$ thick and psilate, surface ornamented with numerous punctae, diameter of punctae approximately $0.5\text{--}0.8 \mu\text{m}$. One transverse septum is present; it is distinct, straight, $2.2 \mu\text{m}$ wide,

and composed of two layers. The spore is somewhat constricted in the area of the transverse septum.

Location and age: Lunpola Basin, northern Xizang Plateau, Xizang, China; Oligocene (Niubao Formation).

5.21. Species: *Dicellaesporites foveolatus* R.K. Saxena & A. Kumar 2023

Index Fungorum Registration Identifier: 559422.

Figure: In Saxena & Kumar 2023: 155, figure 2.8.

Original description: Fungal spore oval with broadly rounded ends; $46 \times 35 \mu\text{m}$; dicellate, cells slightly unequal; single septum, 3–4 μm thick; spore wall ca. 1–2 μm thick, foveolate, foveola irregular.

Location and age: West of Abha town on the southern Red Sea coast of Saudi Arabia between Jeddah in the north and Jizan in the south; Holocene.

Remarks: The species is named after its foveolate spore wall.

5.22. Species: *Dicellaesporites fragilis* Sheffy & Dilcher 1971

Index Fungorum Registration Identifier: 111407.

Figure: In Sheffy & Dilcher 1971: 42, plate 15, figure 32.

Original description: Oval, psilate fungal spore, $5.8 \times 6.8 \mu\text{m}$, acute to slightly rounded apices. Light pigment, walls of cells overlapping at boundary to form disk shaped septum, 0.5 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.23. Species: *Dicellaesporites fusiformis* Sheffy & Dilcher 1971

Figure 1.L

Index Fungorum Registration Identifier: 111408.

Figure: In Sheffy & Dilcher 1971: 41, plate 15, figure 29.

Original description: Fusiform fungal spore $8.7 \times 17.4 \mu\text{m}$, psilate, light pigment. Septum disk shaped, wall 1 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.24. Species: *Dicellaesporites granulatus* Z.C. Song 1985

Index Fungorum Registration Identifier: 637485.

Figure: In Song 1985: 44, plate 1, figure 11.

Original description: Holotype $25 \times 15 \mu\text{m}$. Nearly cocoon-shaped in outline. Dicellate, contact areas between two single cells with a slight constriction. Septum about 3 μm thick, both sides nearly parallel, without a pore, opaque. Spore wall about 1 μm thick, layers of spore wall indistinct; surface scabrate, with granules and fine spines; some granules and spines about 1 μm in length, pointed or blunt. Spore brown.

Location and age: Dafengshan, Qaidam Basin, Qinghai Province, China; Early Pliocene.

5.25. Species: *Dicellaesporites granuliformis* Sheffy & Dilcher 1971

Index Fungorum Registration Identifier: 111409.

Figure: In Sheffy & Dilcher 1971: 41, plate 15, figure 27.

Original description: Spore $7.7 \times 13.1 \mu\text{m}$, terminal ends rounded, one end slightly tapered toward one side of the longitudinal axis. Light pigment, granular, uniseptate, slight equatorial constriction.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.26. Species: *Dicellaesporites guineensis* Sal.-Cheb. & Locq. 1980

Index Fungorum Registration Identifier: 107678.

Figure: In Salard-Cheboldaeff & Locquin 1980: 187, plate 2, figure 7.

Original description: Spore 2-celled, broadly elliptical, septum thin; $24 \times 17 \mu\text{m}$.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

Remarks: Salard-Cheboldaeff and Locquin (1980) assigned an affinity to *Ascomycota*. Kalgutkar & Jansonius (2000) stated that there is a suggestion in the photograph of (roughly) longitudinal striations running from one end of the spore to the other. Although these may represent foreign tissue under- or overlying the specimen, a similar feature was reported for *D. striatus*.

5.27. Species: *Dicellaesporites himachalensis*
R.K. Saxena & A.P. Bhattach. 1990

Figure 1.M

Index Fungorum Registration Identifier:
519768.

Original description: Spores elliptical to spindle shaped, dark brown. Size range $53\text{--}67 \times 31\text{--}38 \mu\text{m}$. Dicellate, cells distinct, separated by an opaque septum. Inaperturate. Spore wall two layered, $2\text{--}2.5 \mu\text{m}$ thick, psilate to faintly sculptured. Longitudinal fold(s) present.

Location and age: Manjhi Khad section, Dharmsala, Kangra District, Himachal Pradesh, India; Oligocene-Early Miocene.

5.28. Species: *Dicellaesporites himalayaensis* A.
Gupta 2002

Figure 1.N

Index Fungorum Registration Identifier:
540463.

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

Location and age: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India; Eocene (Subathu Formation).

5.29. Species: *Dicellaesporites inaequabilis*
Mart.-Hern. & Tom.-Ort. 1989

Index Fungorum Registration Identifier:
483798.

Figure: In Martínez-Hernández & Tomasini-Ortiz 1989: 236, figure 3,c

Original description: Dicellular, uniseptate, inaperturate fungal spore. Its cells are of unequal size: one is $14 \mu\text{m}$ long, the other is $10 \mu\text{m}$ long. The septum is $2 \mu\text{m}$ thick. Oval perimeter with bilateral symmetry. Smooth ornamentation. Dimensions: $26 \mu\text{m}$ long by $10 \mu\text{m}$ wide.

Location and age: Piedras Negras, Coahuila State, Mexico; Maastrichtian.

Remarks: The species epithet indicates its cells are of different size.

5.30. Species: *Dicellaesporites inaequalis*
(Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson.
2000

Figure 1.O

Index Fungorum Registration Identifier:
483293.

Basionym: *Dyadosporonites inaequalis* Y.N.R. Varma & R.S. Patil 1985, Index Fungorum Registration Identifier: 133494.

Original description: Spores dicellate, diporate, fusiform, light brown, $89\text{--}92 \times 22\text{--}24 \mu\text{m}$ 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 $2\text{--}5 \mu\text{m}$ thick, with 2-pore-like cracks in the middle.

Location and age: Tonakkal area, Trivandrum District, Kerala, India; Miocene.

Remarks: *Dyadosporonites inaequalis* is characterized by having unequal-sized dicellate condition. Kalgutkar & Jansonius (2000) observed that the photograph of the type does not have axial pores at both ends as suggested by the original generic assignment. The two “pores” mentioned in the original description apparently refer to two cracks in the central

septum. This form was therefore transferred to *Dicellaesporites*.

5.31. Species: *Dicellaesporites indicus* A. Gupta
2002

Figure 1.P

Index Fungorum Registration Identifier:
540464.

Original description: Spores two celled, uniseptate, uniseriate, inaperturate, more or less doublet shaped, 9–12 µm long, 4–6.5 µm broad, variably shortly constricted in middle, transverse septum distinct, loosely ornamented with large but coarse elements, surface folded, wall ca. 1 µm thick.

Location and age: Jamtah Road Section, Sirmaur District, Himachal Pradesh, India; Eocene (Subathu Formation).

5.32. Species: *Dicellaesporites intertrappea*
Sonkusare et al. ex R.K. Saxena & P.M. Kirk 2022

Index Fungorum Registration Identifier:
559265.

Figure: In Sonkusare et al. 2021: 39, Plate III, figure 1.

Original description: Diagnosis: Spores barrel shaped; septa thin; hyaline septal girdle about 2–3 µm wide, melanin and/ or dark brown to light yellow in colour; spore wall thin; psilate. Description: Spores barrel shaped, ends flat to slightly curved; septa thick, hyaline, septal girdle generally broad throughout the width of the spore, sometimes narrow in the central part and wider towards the peripheral region, spore wall thin; psilate. Dimensions: 15–36 µm in size; septal girdle about 2–3 µm wide

Location and age: Kanhobagholi, Betul District, Madhya Pradesh, India; Maastrichtian (Intertrappean chert).

Remarks: According to Sonkusare et al. (2021), barrel shape and distinctly hyaline septal girdle are the diagnostic character of these fungal spores. The specific epithet refers to the intertrappean sediments.

5.33. Species: *Dicellaesporites jainii* R.K. Saxena
& S.K.M. Tripathi 2011

Figure 1.Q

Index Fungorum Registration Identifier:
519938.

Original description: Capsular fungal spores, dicellate, slightly constricted in middle, 17–24 × 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.

Location and age: Barmer Hill, Barmer District, Rajasthan, India; Palaeocene (Barmer Sandstone).

Remarks: The species epithet honours Dr. K.P. Jain, Birbal Sahni Institute of Palaeosciences, Lucknow, India.

5.34. Species: *Dicellaesporites keralensis* P.
Kumar 1990

Figure 1.R

Index Fungorum Registration Identifier:
126552.

Original description: Spores dicellate, inaperturate and broadly oval in shape. Size 18–22 × 13–16 µm. Broadly rounded at free ends but constricted at the septal region, cells unequal in size, 10–13 × 11–14 µm. Both septum and spore wall ± 1 µm thick and smooth.

Location and age: Padappakkara, Quilon District, Kerala, India; Early-Middle Miocene.

5.35. Species: *Dicellaesporites largelongatus*
Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483294.

Figure: In Song 1985: 44, plate 1, figure 39.

Basionym: *Dicellaesporites elongatus* Z.C. Song 1985, Index Fungorum Registration Identifier: 485267.

Original description: Size range 55–65 × 25–28 µm, holotype 62.5 × 25 µm. Dicellate, cells nearly equal in size and shape; spores ellipsoidal, tapered at both ends. Septum discoidal, with low septal folds, not

showing a pore. Spore wall thin, less than 1 µm thick, composed of two nearly equally thick layers, commonly fluted [or: with longitudinal folds?], surface scabrate or smooth, without distinct ornamentation. Spores brown.

Location and age: Huatugou and Dafengshan, Qaidam Basin, Qinghai Province, China; Palaeocene-Late Eocene; Early-Late Miocene.

Remarks: *Dicellaesporites elongatus* Z.C. Song 1985 was a later homonym of *Dicellaesporites elongatus* Ramanujam & K.P. Rao 1978. Hence, Kalgutkar and Jansonius (2000) proposed a new name (*D. largelongatus*) for it. Spores of *Dicellaesporites reniformis* Zhong Y. Zhang 1980 are larger, and somewhat reniform.

5.36. Species: *Dicellaesporites lenghuensis* Z.C. Song 1985

Index Fungorum Registration Identifier: 637486.

Figure: In Song 1985: 45, plate 1, figure 34.

Original description: Size range 35–40 × 20–22 µm, holotype 35 × 22 µm. Ellipsoidal to fusiform in outline, tapering at both ends; dicellate, without distinct constriction. Septum dark, rigid, showing two triangular septal folds, but no pore. Spore wall thin and firm, showing a few fractures; surface smooth, or scabrate due to etching. Spores brown.

Location and age: Eboliang and Dafengshan, Qaidam Basin, Qinghai Province, China; Palaeocene-Late Eocene; Early Miocene-Early Pliocene.

5.37. Species: *Dicellaesporites levis* Sheffy & Dilcher 1971

Figure 1.S

Index Fungorum Registration Identifier: 111410.

Original description: Dicellate spore, cells unequal in size, rounded at the apices, septum opaque, diskshaped, slight equatorial constriction. Wall psilate, 0.5–1 µm thick. Size ranges from 9.7 × 27.1–9.7 × 27.6 µm (two specimens). Holotype: 9.7 × 27.1 µm.

Location and age: Puryear clay pit, 800 m south

of Puryear, Henry, County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

5.38. Species: *Dicellaesporites littoralis* Sal.-Cheb. & Locq. 1980

Index Fungorum Registration Identifier: 107912.

Figure: In Salard-Chebaldoeff & Locquin 1980: 187, plate 2, figure 3.

Original description: Spore 2-celled, fusiform, obtuse, slightly asymmetrical, septum thin; 15 × 20 µm.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

Remarks: Salard-Chebaldoeff and Locquin (1980) assigned an affinity to *Ascomycota*.

5.39. Species: *Dicellaesporites longus* (Trivedi & C.L. Verma) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483295.

Figure: In Trivedi & Verma 1970: 71, plate 1, figure 14.

Basionym: *Teleutosporites longus* Trivedi & C.L. Verma 1970 (nom. inval.).

Original description: Fungal spore bivalved, valves may or may not be equal, rounded at both the ends, spore longer than broad, constricted at middle, two halves separated by thick cross wall, 3 µm thick, dark colored, walls simple, less than 1 µm in thickness, light brown in color. Fungal spore 33–35 µm in length, breadth 9–12 µm in the middle, breadth about 6–8 µm slightly above the base.

Location and age: Near Kuala Lumpur, Malaya; Eocene.

Remarks: The species name was not validly published by Trivedi and Verma (1970) because it was not assigned to a validly published generic name.

5.40. Species: *Dicellaesporites major* P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier: 115661.

Figure: In Ke & Shi 1978: 33, plate 1, figure 18.

Original description: Spores $81 \times 37 \mu\text{m}$. Outline fusiform. Inaperturate. Two-celled, each cell conical in shape, with ends in contact slightly contracted and free ends sharply narrowing to a point. Monoseptate, septum equatorial, thick, opaque, perforated in the middle. Spore wall thickness and stratification obscure. Sculpturing finely granulate.

Location and age: Beidagang, Trianjin Municipality, Coastal region of Bohai, China; Eocene-Oligocene.

5.41. Species: *Dicellaesporites megafusiformis*
Z.C. Song & G.X. Li in Z.C. Song et al. 1989

Index Fungorum Registration Identifier:
637487.

Figure: In Song et al. 1989: 32, plate 1, figure 40.

Original description: Spores fusiform, $40\text{--}45 \times 20\text{--}25 \mu\text{m}$, holotype $43 \times 22 \mu\text{m}$. Spores dicellate, without constriction between cells. Septum discoidal, about $2 \mu\text{m}$ in width, without septal folds. Spore wall probably composed of two layers, $1\text{--}1.5 \mu\text{m}$ in thickness. Surface smooth, scabrate after etching.

Location and age: Qingfeng County of Henan Province, China; Late Eocene (Shahejie Formation).

5.42. Species: *Dicellaesporites minutus* R.K. Kar & R.K. Saxena 1976

Figure 1.T

Index Fungorum Registration Identifier:
112270.

Original description: Spores bicellate, oval; $23\text{--}33 \times 7\text{--}12 \mu\text{m}$; inaperturate, septa distinct, individual cells more or less same in size and shape. Spore wall up to $1.5 \mu\text{m}$ thick, laevigate.

Location and age: Bhuj-Lakhpur Road, Matanomadh Village, District of Kutch, Gujarat, India; Palaeocene.

5.43. Species: *Dicellaesporites mollis* P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier:
115660.

Figure: In Ke & Shi 1978: 33, plate 1, figure 20.

Original description: Spores $68 \times 38 \mu\text{m}$. Outline elliptical, ends rounded. Inaperturate. Two-celled, monoseptate, septum ring-shaped, hyaline, $1.5\text{--}2 \mu\text{m}$ wide. Spore wall thin, about $1 \mu\text{m}$ thick, might be two-layered, surface provided with granulate or foveolate sculpturing. Outer contour line smooth.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

Remarks: Elsik et al. (1990) considered that *Dicellaesporites mollis* possibly is an aberrant form of *Anatolinites dongyingensis*.

5.44. Species: *Dicellaesporites nakomanii* V.S.
Ediger & Alisan 1989

Index Fungorum Registration Identifier:
125504.

Figure: In Ediger & Alisan 1989: 155, plate 3, figure 5.

Original description: Dicellate, uniseptate, inaperturate elliptical fungal spores. Exine is about $1 \mu\text{m}$ thick, commonly folded, psilate, and pitted. Septum is $1 \mu\text{m}$ thick and inaperturate. Size $22\text{--}34 \times 42\text{--}56 \mu\text{m}$.

Location and age: Northern Thrace Basin, Turkey; Middle?-Late Eocene to Late Oligocene, Miocene-Pliocene.

Remarks: The species epithet is in honour of Professor Eran Nakoman.

5.45. Species: *Dicellaesporites nodusus* V.S.
Ediger 1981

Index Fungorum Registration Identifier:
107913.

Figure: In Ediger 1981: 91, plate 2, figure 3.

Original description: Dicellate, uniseptate fungal spores. Irregularly oval shape, generally rounded at apex, slightly compressed around septum. Septum is 2-layered, formed probably by overlapping individual cells, there is an opening at the middle of the septum,

septum is thickened around this opening. Exine is 1 µm thick, much folded, smooth, psilate to finely scabrate. Size 6–11 × 12–24 µm.

Location and age: Thrace Basin, Turkey; Late Eocene-Oligocene, Miocene-Pliocene.

5.46. Species: *Dicellaesporites oblongatus* Z.C. Song & Liu Cao 1994

Index Fungorum Registration Identifier: 483764.

Figure: In Song & Cao 1994: 39, plate 1, figure 10.

Original description: Spores capsular or oblong elliptical, broadly rounded at both ends, two lateral sides nearly parallel; size of holotype 40 × 20 µm; dicellate, cells similar in size and shape, contact areas between two single cells without constriction; single septum, 2–3 µm in width, with septal folds, but without a pore; spore wall about 1 µm in thickness, surface smooth and easily fractured; spore dark brown.

Location and age: King George Island, Antarctica; Late Cretaceous.

Remarks: The species epithet is derived from ellipsoidal shape of spores.

5.47. Species: *Dicellaesporites obnixus* G. Norris 1986

Index Fungorum Registration Identifier: 126571.

Figure: In Norris 1986: 21, plate 2, figure 5.

Original description: Dicellate, inaperturate, isopolar, equilateral fungal spores with sharply rounded apices on each cell. Septum 0.5 µm thick, apparently aporate. Spore wall 0.5 µm thick or less, laevigate and slightly thickened at the apex of each cell. The cells may rupture irregularly but there appears to be no predetermined aperture or aperture shape. Spore length 33–57 µm (holotype 45 µm); spore width 10–16 µm (holotype 15 µm).

Location and age: Imperial Nuktak C–22 Well, Mackenzie Delta Region, District of Mackenzie, Northwest Territories, Canada; Eocene.

Remarks: Kalgutkar and Jansonius (2000) stated that although the holotype appears to be dicellate, other specimens appear to have (3–) 4 cells. The latter also seem to have a curved longitudinal axis.

5.48. Species: *Dicellaesporites ovatus* Z.C. Song & H.C. Luo in Song et al. 1989

Index Fungorum Registration Identifier: 637489.

Figure: In Song et al. 1989: 33, plate 1, figure 15.

Original description: Holotype 33 × 14 µm. Spores dicellate, each cell ovate in outline; spores constricted [in the middle]. Septum [dark], one-layered, flat and straight, without septal folds or pore. Spore wall about 1 µm in thickness, surface smooth.

Location and age: Shenxian County of Shandong Province, China; Late Eocene-Middle Oligocene (Shahejie Formation).

5.49. Species: *Dicellaesporites perelongatus* Kalgutkar & Janson. 2000

Figure 1.U

Index Fungorum Registration Identifier: 483296.

Basionym: *Dicellaesporites elongatus* P. Kumar 1990, Index Fungorum Registration Identifier: 126551.

Original description: Spores dicellate, fusiform and inaperturate. Size 41–50 × 14–17 µm. Cells gradually tapering at either end. Both spore wall and septum ±1 µm thick. Spore wall smooth, light colored and folded. Septum centrally porate.

Location and age: Padappakkara, Kollam District, Kerala, India; Early-Middle Miocene.

Remarks: *Dicellaesporites elongatus* P. Kumar 1990 was a later homonym of *Dicellaesporites elongatus* Ramanujam & K.P. Rao 1978. Hence, Kalgutkar and Jansonius (2000) proposed a new name (*D. perelongatus*) for it.

5.50. Species: *Dicellaesporites plicatus* R.K. Saxena & A. Kumar in Manawasinghe et al. 2024

Index Fungorum Registration Identifier: 901365.

Figure: In Saxena & Kumar 2023: 155, figure 2.9.

Original description: Fungal spore oval-elongated with one end broadly rounded and the other end pointed. Size $26.29 \times 13.15 \mu\text{m}$; dicellate, cells slightly unequal; single septum, $1.5 \mu\text{m}$ thick; spore wall ca. $1.2 \mu\text{m}$ thick, irregularly folded, folds thin and delicate.

Location and age: West of Abha town on the southern Red Sea coast of Saudi Arabia between Jeddah in the north and Jizan in the south; Holocene.

Remarks: This species can be distinguished from the other species of the genus by its spore wall having thin, delicate irregular folds. The species is named after its folded spore wall.

5.51. Species: *Dicellaesporites popovii* Elsik 1968

Figure 1.V

Index Fungorum Registration Identifier: 312948.

Original description: Capsular, inaperturate, dicellate fungal spores ca. $19 \times 29 \mu\text{m}$. Wall $0.8 \mu\text{m}$ thick, psilate. Septum $1 \mu\text{m}$ thick, appears to be of two layers.

Location and age: Strip mine approximately 11 km southwest of Rockdale, Milam County, Texas, U.S.A.; Palaeocene.

5.52. Species: *Dicellaesporites reniformis* Zhong Y. Zhang 1980

Index Fungorum Registration Identifier: 485001.

Figure: In Zhong Y. Zhang 1980: 298, plate 1, figure 19.

Original description: Inaperturate fungal spores consisting of two cells, outline of the spores reniform and their size $28.6 \times 87.3 \mu\text{m}$. Individual cells more or less similar in shape and size. External wall of spore $0.8\text{--}1 \mu\text{m}$ thick and psilate, surface of the wall wrinkled. One transverse septum is present; this septum is

prominently thickened (reaching a width of $17 \mu\text{m}$), a feature that may be an artifact of the spore's preservation.

Location and age: Lunpola Basin, northern Xizang Plateau, Xizang, China; Oligocene (Niubao Formation).

5.53. Species: *Dicellaesporites rinconii* Doub. & D. Pons 1973

Index Fungorum Registration Identifier: 637490.

Figure: In Doubinger & Pons 1973: 248, plate 5, figures 1–2.

Original description: Spore bicellular, inaperturate, brown and smooth. The two cells are unequal in size; $8 \times 7 \mu\text{m}$ and $7 \times 6 \mu\text{m}$ (length \times width). The walls are fine ($0.25 \mu\text{m}$) and the ends rounded. The cells are thickened on either side of the septum ($3 \mu\text{m}$), which is slightly constricted ($6 \mu\text{m}$). This spore is associated with septate, branched filaments $4 \mu\text{m}$ in diameter. The mycelial cells vary in length from $5\text{--}10 \mu\text{m}$, some of them (terminal ones) are globular (diameter $10 \mu\text{m}$). The mycelium and spore are found on the surface of a cuticle characterized of large polygonal cellareae.

Location and age: Cerrejon basin, Colombia, South America; Palaeocene-Eocene.

Remarks: The species is dedicated to M. Rincon, curator of the "Servicio Geológico Nacional" collection in Bogota.

5.54. Species: *Dicellaesporites scaber* Mart.-Hern. & Tom.-Ort. 1989

Index Fungorum Registration Identifier: 483797.

Figure: In Martínez-Hernández & Tomasini-Ortiz 1989: 236, figure 3, b.

Original description: Dicellular, uniseptate, inaperturate fungal spore. Each of its cells is $10.5 \mu\text{m}$ long. The septum is $1 \mu\text{m}$ thick. Oval perimeter with bilateral symmetry. Rough ornamentation. Dimensions: $22 \mu\text{m}$ long by $10 \mu\text{m}$ wide.

Location and age: Piedras Negras, Coahuila State, Mexico; Maastrichtian.

Remarks: The species epithet indicates its rough ornamentation.

5.55. Species: *Dicellaesporites septoconstrictus*
Kalgutkar 1993

Index Fungorum Registration Identifier:
483863.

Figure: In Kalgutkar 1993: 72, plate 4.1, figure 18.

Original description: Dicellate, aporate, dark brown, simple, smooth-walled spores; slightly tapering at both ends; noticeably constricted in the middle of the septum; septum about 3 μm thick. Both cells ellipsoidal to navicular. Spore size 20–28 \times 7–10 μm .

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene–Early Eocene.

Remarks: The species epithet is derived from the Latin, *septum*, wall; *constrictus*, contracted, referring to the spores being constricted at the septum.

5.56. Species: *Dicellaesporites singhii* R.K.
Saxena & S.K.M. Tripathi 2011

Figure 1.W

Index Fungorum Registration Identifier:
519939.

Original description: Fungal spore oval-fusiform, size 85–89 \times 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.

Location and age: Hoshiarpur–Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh, India; Pliocene (Upper Siwalik).

Remarks: The species epithet honours Dr. H.P. Singh, Birbal Sahni Institute of Palaeosciences, Lucknow, India.

5.57. Species: *Dicellaesporites subaequatus*
Zhong Y. Zhang 1980

Index Fungorum Registration Identifier:
484999.

Figure: In Zhong Y. Zhang 1980: 297, plate 1, figure 4.

Original description: Inaperturate fungal spores consisting of two cells, outline of the spores elliptical and their size 7.4–15.5 \times 16.7–27.4 μm (seven specimens). Individual cells subglobose and similar in size. External wall of spore 0.7–1.1 μm thick, surface psilate. One transverse septum is present; it is distinct, straight, and 1.4–3.3 μm wide. The spore is conspicuously constricted in the area of the transverse septum. Holotype 10.7 \times 21.4 μm .

Location and age: Lunpola Basin, northern Xizang Plateau, Xizang, China; Oligocene (Niubao Formation).

5.58. Species: *Dicellaesporites suborbicularis*
Z.C. Song & G.X. Li in Song et al. 1989

Index Fungorum Registration Identifier:
637491.

Figure: In Song et al. 1989: 33, plate 1, figure 9.

Original description: Holotype 20 \times 15 μm , spores subcircular to broadly ellipsoidal. Cells semispherical, slightly notched [in the middle]. Septum one-layered, flat and straight, without septal folds. Spore wall more than 1 μm thick, surface smooth.

Location and age: Heze county of Shandong Province, China; Late Oligocene (Dongying Formation).

5.59. Species: *Dicellaesporites vermae* R.K.
Saxena et al. 2021

Figure 1.X

Index Fungorum Registration Identifier:
555416.

Original description: Fungal spores elliptical in shape, size 79–87 \times 31–35 μm , dicellate, inaperturate, uniseptate, septa 1 μm thick, spore wall psilate, hyaline, sometimes with minor folds.

Location and age: Sonapur–Badarpur Road section, Jaintia Hills, Meghalaya and Cachar, Assam, India; Early Miocene (Dona Member, Bhuban

Formation, Surma group).

Remarks: The species is named in honour of late Professor C.L. Verma of the Department of Botany, Lucknow University, Lucknow, India.

5.60. Species: *Dicellaesporites verrucatus* R.K. Saxena & A. Kumar in Manawasinghe et al. 2024

Index Fungorum Registration Identifier: 901366.

Figure: In Saxena & Kumar 2023: 156, figure 2.10.

Original description: Fungal spore elliptical with both ends narrowly rounded. Size $65 \times 38 \mu\text{m}$. Dicellate, cells equal in size. Single septum, $3 \mu\text{m}$ thick; spore wall ca. $1.2 \mu\text{m}$ thick, verrucate, verrucae low and flat, irregular in shape but evenly distributed.

Location and age: West of Abha town on the southern Red Sea coast of Saudi Arabia between Jeddah in the north and Jizan in the south; Holocene.

Remarks: This species can be distinguished from the other species of the genus by its verrucate spore wall. The species is named after its verrucate spore wall.

5.61. Species: *Dicellaesporites volubilis* P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier: 115657.

Figure: In Ke & Shi 1978: 34, plate 1, figure 17.

Original description: Spores $48 \times 17 \mu\text{m}$. Outline slightly fusiform. Inaperturate. Two-celled, each cell tapering from the septum to become acute at its free end. Septum dark-colored, $1 \mu\text{m}$ wide. Spore wall $0.8 \mu\text{m}$ thick, surface scabrate or provided with foveolae; a longitudinal fold runs parallel to the major axis of the spore. Outer contour line smooth.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

6. Genus: *Didymoporisporonites* Sheffy & Dilcher 1971

Index Fungorum Registration Identifier: 21077.

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

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

Emended diagnosis: Generally small to medium dicellate conidia; the proximal cell much thinner walled and smaller than the distal one, with a distinct pore or hilum (Kalgutkar & Jansonius 2000, p. 76).

Number of species known: 10 (3 species recorded from India).

Remarks: Kalgutkar and Jansonius (2000) emended the diagnosis of *Didymoporisporonites* to include dicellate spores with dissimilar cells only, of which only the smaller is porate. In the past, a number of spores (e.g. *D. didymus*, *D. oblongatus*) with equal or near-equal cells, of which one is porate, were also assigned to this genus. Kalgutkar and Jansonius (2000) considered that the “pore” in those forms actually is a hilum, and therefore transferred spores of this type to the new *Hilidicellites*.

6.1. Species: *Didymoporisporonites conicus* Kalgutkar 1997

Index Fungorum Registration Identifier: 437904.

Figure: In Kalgutkar 1997: 211, plate 1, figure 21.

Original description: Easily recognizable 2-celled, monoporate dark spores. Cells unequal; large cell oval-ovate, dark brown; small cell light brown, characteristically cone-shaped, with axial pore. Septum dark, $2 \mu\text{m}$ thick, little darker than the dark brown large cell; spores slightly notched at the septum. Pore in the small cell terminal, simple and slightly incurved. Cell wall thin. Illustrated spore $18.5 \times 11 \mu\text{m}$; large cell $11 \times 11 \mu\text{m}$; small cell $5 \times 7 \mu\text{m}$.

Location and age: Kanguk Peninsula, Axel Heiberg Island, Northwest Territories, Canada; Late Palaeocene-Early Eocene.

Remarks: The species epithet is derived from conical shape of small cell.

6.2. Species: *Didymoporisporonites discitypicus*
(P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483309.

Figure: In Ke & Shi 1978: 35, plate 3, figure 2.

Basionym: *Multicellaesporites discitypicus* P. Ke & Z.Y. Shi 1978.

Original description: Spores $22 \times 17 \mu\text{m}$. Outline drum-shaped. Inaperturate. Three-celled, smaller cells at each end oblate. Septa dark-colored, ring-shaped. Spore wall of medium thickness, might be two-layered, surface psilate.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

Remarks: Kalgutkar and Jansonius (2000) stated that the photograph of the type specimen shows a tear in the equatorial region of the spore, that apparently was interpreted as a septum; hence the spore was called “three-celled”. They interpreted that the type is two-celled, one cell much smaller and thinner walled than the other. The small cell has subtle features suggesting the presence of a terminal pore.

6.3. Species: *Didymoporisporonites discors*
Kalgutkar 1993

Index Fungorum Registration Identifier:
483866.

Figure: In Kalgutkar 1993: 74, plate 4.1, figure 14.

Original description: Spores monoporate, dicellate, smooth. Cells of unequal size and shape, one cell much smaller than the other. Larger cell dark brown, robust, spherical to ovoid; smaller cell light brown to hyaline, spherical to dome-shaped, porate. Cell wall slightly thicker in large cell than in small cell. Spore wall constricted and thickened at the septum. Septum centrally porate. Pore in the small cell simple. Diameters: large cell $12.5 \times 20 \mu\text{m}$, small cell 5–10 μm .

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene-Early Eocene.

Remarks: Kalgutkar and Jansonius (2000)

adjusted the original spelling *discordis* of the specific epithet to *discors*, as grammatically the genitive case of an adjective is not applicable in the context used. The species epithet is derived from the Latin, *discors*, different, referring to the unequal cells.

6.4. Species: *Didymoporisporonites elegans* P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier:
115654.

Figure: In Ke & Shi 1978: 42, plate 4, figure 6.

Original description: Spores monoporate, dicellate, smooth. Cells of unequal size and shape, one cell much smaller than the other. Larger cell dark brown, robust, spherical to ovoid; smaller cell light brown to hyaline, spherical to dome-shaped, porate. Cell wall slightly thicker in large cell than in small cell. Spore wall constricted and thickened at the septum. Septum centrally porate. Pore in the small cell simple. Diameters: large cell $12.5 \times 20 \mu\text{m}$, small cell 5–10 μm .

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

6.5. Species: *Didymoporisporonites gigas*
Kalgutkar & Janson. 2000

Figure 1.Y

Index Fungorum Registration Identifier:
483310.

Basionym: *Lacrimasporonites magnus* R.K. Saxena & H.P. Singh 1983.

Original description: Fungal spore \pm elliptical, size $120 \times 47 \mu\text{m}$, 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.

Location and age: Hoshiarpur-Una Road section, near Bankhandi, Hoshiarpur District, Punjab, India; Miocene-Pliocene.

Remarks: Kalgutkar and Jansonius (2000) transferred it to *Didymoporisporonites* because of a septum at one end, as well as the apparent presence of

a pore at the same end.

6.6. Species: *Didymoporisporonites inaequalis*
Sheffy & Dilcher 1971

Index Fungorum Registration Identifier:
111421.

Figure: In Sheffy & Dilcher 1971: 42, plate 15,
figure 37.

Original description: Two-celled spore, $7.7 \times 12.6 \mu\text{m}$, cells of unequal size, round to subspherical, walls overlap at boundary to form disk-shaped septum. Potential thin-walled germinal pore in terminal end of smaller cell, wall $0.5 \mu\text{m}$ thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

Remarks: According to Sheffy and Dilcher (1971), the spore is similar in shape and dimensions to *Shortensis memorabilis* [Current name: *Vizella memorabilis* (Dilcher) Selkirk 1972] (Dilcher (1965).

6.7. Species: *Didymoporisporonites longus* (R.K. Kar) Kalgutkar & Janson. 2000

Figure 1.Z

Index Fungorum Registration Identifier:
483311.

Basionym: *Lacrimasporonites longus* R.K. Kar 1979.

Original description: Spores $67\text{--}132 \times 32\text{--}47 \mu\text{m}$, elliptical, carrot-shaped, monoporate; pore circular, distinct, margin slightly thickened, a lid-like projection present above the pore; spore coat levigate.

Location and age: Barkhana nala cutting near Sarangwara, Kutch District, Gujarat, India; Oligocene.

6.8. Species: *Didymoporisporonites panshanensis* P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier:
115652.

Figure: In Ke & Shi 1978: 43, plate 4, figure 9.

Original description: Spores $16\text{--}28 \times 11.6\text{--}23 \mu\text{m}$. Outline subcircular or broadly elliptical. Two-celled,

cells of unequal size, larger cell dark-colored, septum also dark-colored; smaller cell poriferous at apex, hyaline. Spore monoporate, pore circular-elliptical in shape, about $1.5 \mu\text{m}$ in diameter. Spore wall $1\text{--}1.5 \mu\text{m}$ thick, might be twolayered, surface psilate.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

6.9. Species: *Didymoporisporonites psilatus*
Sheffy & Dilcher 1971

Figure 1.AA

Index Fungorum Registration Identifier:
111424.

Original description: Oval, two-celled, psilate fungal spore. Cells unequal in size, single pore in smaller cell, larger cell with darker pigment. Septum opaque, wall $0.5\text{--}1.0 \mu\text{m}$ thick. Size ranges from 6.3×10.6 to $6.8 \times 11.1 \mu\text{m}$ (two specimens). Holotype: $6.8 \times 11.1 \mu\text{m}$

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

6.10. Species: *Didymoporisporonites triangulus*
P. Ke & Z.Y. Shi 1978

Index Fungorum Registration Identifier:
115702.

Figure: In Ke & Shi 1978: 43, plate 4, figure 5.

Original description: Spores $15 \times 15 \mu\text{m}$. Outline triangular. Two-celled, smaller cell subcircular, larger cell triangular, dark-colored. Monoporate, pore situated at end of smaller cell, small, about $0.5 \mu\text{m}$ in diameter. Spore wall $2 \mu\text{m}$ thick. Septum dark-colored.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

7. Genus: *Didymosporonites* Sal.-Cheb. & Locq.
1980

Index Fungorum Registration Identifier:
21079.

Type species: *Didymosporonites saccatus* Sal.-Cheb. & Locq. 1980.

Original diagnosis: Same as for the type species (Salard-Chebaldaeff & Locquin 1980, p. 188).

Number of species known: One (not recorded from India).

7.1. Species: *Didymosporonites saccatus* Sal.-
Cheb. & Locq. 1980

Figure 1.AB

Index Fungorum Registration Identifier:
107928.

Original Description (combined description): Spore 2-celled, septum thick; biconical, strongly constricted at the partition, surrounded by a loose smooth sac-like perine; $25 \times 17 \mu\text{m}$ including the membrane, monohilate (monoporate).

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

Remarks: This species was described as “*Didymosporonites*” *saccatus* which is probably an unintentional orthographical error for *Didymoporisporonites*. Kalgutkar and Jansonius (2000) accepted the generic name in its original orthography as validly published with a combined description, because the unusual two-layered wall construction warrants the species to be recognized in a separate genus.

8. Genus: *Diploneurospora* K.P. Jain & R.C.
Gupta 1970

Index Fungorum Registration Identifier:
21081.

Type species: *Diploneurospora tewarii* K.P. Jain & R.C. Gupta 1970.

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

Number of species known: One (recorded from India)..

Remarks: Jain and Gupta (1970) named the present two-celled fossil ascospore genus as *Diploneurospora* for its similarity to the single celled ascospores of extant *Neurospora*.

8.1. Species: *Diploneurospora tewarii* K.P. Jain & R.C. Gupta 1970

Figure 1.AC

Index Fungorum Registration Identifier:
313231.

Original description: Ascospores two-celled, uniseriate, cells unequal in size, length ratio nearly 3:1, both ends acute, two cells attached at broader bases along one side. Larger cell dark brown in color, elliptical, $50 \times 16 \mu\text{m}$, exine $0.7 \mu\text{m}$ thick, sculptured ribs prominent on one side, extending up to margins on the other side, leaving central portion free, ribs longitudinal, discontinuous, 8–10 in number, branched. Smaller cell hyaline, tail-like, $10 \times 15 \mu\text{m}$; exine thin, ribs very faint, 4–5 μm in number.

Location and age: Padappakkara, Quilon, Western Ghats, India; Miocene.

Remarks: The species epithet honours Dr. J.P. Tewari.

9. Genus: *Disparidicellites* Kalgutkar & Janson.
2000

Index Fungorum Registration Identifier:
28614.

Type species: *Disparidicellites paradoxus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000.

Original diagnosis: Small to medium-sized, dicellate, inaperturate fungal spores; cells distinctly unequal, the proximal cell much smaller and thinner-walled than the distal cell; septum may show a perforation and/or septal folds (Kalgutkar & Jansonius 2000, p. 94).

Number of species known: One (not recorded from India).

Remarks: In *Didymoporisporites* the smaller cell has a distinct terminal pore. *Dicellaesporites* has spores with two equal cells. The name of the genus is derived

from Latin *disparatus*, dissimilar, and the dicellate structure of the spore.

9.1. Species: *Disparidicellites paradoxus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Figure 1.AD

Index Fungorum Registration Identifier: 483327.

Basionym: *Dicellaesporites paradoxus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115659.

Original description: Spores 25–28 × 12–13 µm. Outline prolate elliptical. Two-celled, cells of unequal size, smaller cell subcircular and large cell elliptical in shape. Monoseptate, septum rather hyaline, 1.5 µm thick. Spore wall about 1 µm thick. Surface psilate.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

10. Genus: *Dyadosporites* R.T. Clarke 1965

Index Fungorum Registration Identifier: 21091.

Type species: *Dyadosporites ellipsus* R.T. Clarke 1965.

Synonyms: 1. *Dyadosporites* Hammen 1954 (nom. inval.), Index Fungorum Registration Identifier: 21091. 2. *Dyadosporonites* Elsik 1968, Index Fungorum Registration Identifier: 21092. 3. *Psidimobipiospora* Sal.-Cheb. & Locquin, 1980, Index Fungorum Registration Identifier: 25598.

Original diagnosis: Fungal spores bilocular (didymosporous), elliptical, central septum simple, cell wall psilate to finely punctate, pore at apex of each cell (Clarke 1965, p. 90).

Number of species known: 43 (14 species recorded from India).

Remarks: Van der Hammen (1955) did not validly publish *Dyadosporites*. He gave generic diagnosis and the name of the type species but the latter was never described or illustrated (Jansonius & Hills 1976). Clarke (1965) treated *Dyadosporites* as having been

validly published by Van der Hammen (1955). Kalgutkar and Jansonius (2000) considered that Clarke (1965) was the first to validly publish the generic name and was the first to assign a species *Dyadosporites ellipsus* R.T. Clarke 1965 to it which became the type species through the principle of monotypy. *Dyadosporonites* Elsik 1968 and *Psidimobipiospora* Sal.-Cheb. & Locq. 1980 are later taxonomic synonyms of *Dyadosporites*.

10.1. Species: *Dyadosporites acutus* (Rouse & Mustard) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483328.

Figure: In Mustard & Rouse 1994 : 143, plate 8, figure. 25.

Basionym: *Diporicellaesporites acutus* Rouse & Mustard 1997.

Original description: Diporate, dicellatetricellate fungal spores; fusiform; outer wall levigate, about 0.5 µm; pores apical and sharp-ended, each pore forming an inward-directed V notch of about 2–4 µm, wall surrounding notch thickened, forming a diffuse margo; each septum about 1.5 µm thick, with a distinct central pore. Dimensions: range of length 31–42 µm; of width 12–16 µm.

Location and age: Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, Canada and the North-western Washington State, U.S.A.; Late mid-Eocene-Early late Eocene.

10.2. Species: *Dyadosporites annulatus* (E.J. Romero & M.T. Castro) Bianchin., Alej. Martínez & R.K. Saxena in Alej. Martínez et al. 2016

Index Fungorum Registration Identifier: 812336.

Figure: In Romero & Castro 1986: 106, plate 1, figures 12–15.

Basionym: *Dyadosporonites annulatus* E.J. Romero & M.T. Castro 1986, Index Fungorum Registration Identifier: 812335.

Original description: Spores 1-septate, fusiform elliptical, constricted at the septum, diporate. Septum medium, dark brown, 2 µm thickness. In optical section, an annulus-like (c. 3.93 µm) thickening of the septum wall is clearly visible. Terminal pores, simple, tiny. Wall psilate, medium brown, one layered, c. 1 µm. Dimensions. 6.5–8 × 17.5–25 µm (2 specimens).

Location and age: Rio Foyel section, Nirihuau Basin, Argentina; Palaeogene (El Foyel Group).

Remarks: These spores resemble *Trichodelitschia* (*Phaeotrichaceae*, *Pleosporales*) ascospores as illustrated in Cugny et al. (2010).

10.3. Species: *Dyadosporites antarcticus*
Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483330.

Figure: In Song & Cao 1994: 42, plate 1, figure 11.

Basionym: *Diporicellaesporites stenosus* Z.C.
Song & Liu Cao 1994.

Original description: Spores narrowly ellipsoidal, holotype 28 µm in length, 13 µm in width; four-celled, two middle cells large, tapering at both ends, 12–15 µm in length, cells at both ends small, triangular; septa three, rather thick, without folds; spores diporate, pores small, located one at each end cell, about 2 µm wide; spore wall solid, about 1.5 µm thick, nearly smooth; spores dark brown.

Location and age: King George Island, Antarctica; Late Cretaceous.

10.4. Species: *Dyadosporites bhardwaji* (C.P.
Varma & Rawat) Kalgutkar & Janson. 2000

Figure 1.AE

Index Fungorum Registration Identifier:
483331.

Basionym: *Psilodiporites bhardwaji* C.P. Varma & Rawat 1963, Index Fungorum Registration Identifier: 106421.

Original description: Grains 2-porate, isopolar, somewhat barrel-shaped (about 40 × 61 × 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.

Location and age: Western and eastern India, including oil exploration areas in West Bengal and Assam; Eocene-Miocene (Varma & Rawat 1963).

10.5. Species: *Dyadosporites kannanorensis*
(Ramanujam & K.P. Rao) Kalgutkar & Janson.
2000

Figure 2.A

Index Fungorum Registration Identifier:
483332.

Basionym: *Dyadosporonites kannanorensis*
Ramanujam & K.P. Rao 1978, Index Fungorum
Registration Identifier: 124439.

Original description: Spores dicellate, diporate, darkish brown, 25–35 × 10–13 µm, ellipsoidal to faintly fusiform, slightly asymmetrical. A prominent pore at each end of spore slightly off its long axis. Pores 2–4 µm in diameter, 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.

Location and age: Cannanore, Kannur District, Kerala; Miocene (Quilon and Warkalli beds).

10.6. Species: *Dyadosporites clarkii* (Sal.-Cheb.
& Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483333.

Figure: In Salard-Chebodaeff & Locquin 1980:
188, plate 2, figure 19.

Basionym: *Psidimobiospora clarkii* Sal.-
Cheb. & Locq. 1980, Index Fungorum Registration
Identifier: 108423.

Original description: Spore 2-celled, elliptic with truncated extremities, median septum thin, spore wall onelayered, smooth, 33 × 20 µm, dihilate [diporate].

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

10.7. Species: *Dyadosporites denticulatus* (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000

Figure 2.B

Index Fungorum Registration Identifier: 483334.

Basionym: *Dyadosporonites denticulatus* Ramanujam & K.P. Rao 1978, Index Fungorum Registration Identifier: 15064.

Original description: Spores dicellate, diporate, melanin-colored, fusiform to barrel-shaped, 38–45 × 20–28 μm. A conspicuous pore at each end of spore along its long axis, pores 3–5 μm in diameter, 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.

Location and age: Alleppey, Kerala, India; Miocene (Quilon and Warkalli beds).

Remarks: Prominent pores with thickened rims and teeth-like or wedge-shaped thickenings on one side of the septa are the diagnostic features of this species.

10.8. Species: *Dyadosporites didymus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483335.

Figure: In Sheffy & Dilcher 1971: 43, plate 16, figure 39.

Basionym: *Dyadosporonites didymus* Sheffy & Dilcher 1971, Index Fungorum Registration Identifier: 111446.

Original description: Psilate didymospore 5.8 × 22.2 μm, equatorial septum and constriction separating identical cells. Pore at the end of each cell, wall 1 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

10.9. Species: *Dyadosporites dubius* P. Kumar 1990

Figure 2.C

Index Fungorum Registration Identifier: 126556.

Original description: Fungal spores diporate, dicellate and broadly oval or (with) bracket-shaped (outline). Size 15–18 × 12–13 μm. Pores 4–6 μm wide, simple, one at either end. Spore wall ± 1.6 μm thick, smooth, gradually thinning out towards the pore. Septum ± 2 μm thick, opaque.

Location and age: Padappakkara, Quilon District, Kerala, India; Early-Middle Miocene.

10.10. Species: *Dyadosporites dyadosporus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483336.

Figure: In Salard-Cheboldaëff & Locquin 1980: 188, plate 2, figure 17.

Basionym: *Psidimobipiospora dyadospora* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 108424.

Original description: 42 × 20 μm, dicellate spore, body ellipsoidal with truncated extremities, median septum thin, slightly “cingulate” (constricted?; belted?) at the level of the median septum; dihilate; spore wall single layered, granulose. [Jansonius & Hills (1981), card no. 3900.]

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

10.11. Species: *Dyadosporites ellipsoideus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483337.

Figure: In Salard-Cheboldaëff & Locquin 1980: 187, plate 1, figure 28.

Basionym: *Psilodiporites ellipsoideus* Sal.-Cheb. & Locq. 1980.

Original description: Spore ellipsoid, smooth, bipolar, 35 × 24 μm, spore wall thin.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

Remarks: Kalgutkar and Jansonius (2000) stated that although the original description makes no mention of a septum, and although the authors grouped this species with the amerospores, there is no mistaking the central septum.

10.12. Species: *Dyadosporites ellipsus* R.T. Clarke 1965
Figure 2.D

Index Fungorum Registration Identifier: 330252.

Original description: 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 \times 38–55 μm .

Location and age: Canon City coal field, Fremont County, Colorado, U.S.A.; Late Cretaceous.

Remarks: The species epithet indicates elliptical shape of the spore.

10.13. Species: *Dyadosporites elsikii* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483338

Figure: In Salard-Chebaldaeff & Locquin 1980: 188, plate 2, figure 18.

Basionym: *Psidimobipiospora elsikii* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 108425.

Original description: Spores 2-celled, more or less elliptical, median septum thin, spore wall one-layered, smooth, 30 \times 20 μm , dihilate [diporate].

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Late Eocene-Oligocene.

10.14. Species: *Dyadosporites grandiporus* (H.P. Singh et al. 1986) Kalgutkar & Janson. 2000

Figure 2.E

Index Fungorum Registration Identifier: 483339.

Basionym: *Dyadosporonites grandiporus* H.P. Singh et al. 1986, Index Fungorum Registration Identifier: 131931.

Original description: Fungal spores cylindrical in shape. Size range 95 \times 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, levigate, slightly folded.

Location and age: Surma group, Sonapur-Badarpur Road section, Jaintia Hills, Meghalaya and Cachar, Assam; Early Miocene.

10.15. Species: *Dyadosporites hilatus* Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483340.

Figure: In Salard-Chebaldaeff & Locquin 1980: 188, plate 2, figure 11.

Basionym: *Didymoporisporonites didymus* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 107923.

Original description: Spore 2-celled, 32 \times 15 μm , ellipsoid, slightly constricted at the median septum, monohilate [monoporate], septum thickened around the central perforation.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

10.16. Species: *Dyadosporites inaequalis* Kalgutkar 1993

Index Fungorum Registration Identifier: 483876.

Figure: In Kalgutkar 1993: 79, plate 4.2, figure 20.

Original description: Diporate, dicellate, smoothwalled, broadly pyriform or subspherical spores. Cells generally unequal; larger one broadly ovoid, rounded, brown; smaller one roughly dome-shaped, broadly rounded in the middle and gradually tapering

apically, light brown to hyaline. Spore wall levigate, thin, slightly notched at the medium cross wall separating the two cells. Septum more than twice the cell wall in thickness, 2 μm , with a pore in the centre. Pores slit-like, apical. Spore size 15–23 \times 7–13 μm . Illustrated spores 20 \times 12.5 μm with large cell 12.5 μm and small cell 7.5 μm in length.

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene-Early Eocene.

Remarks: The specific epithet is derived from the Latin, *inaequalis*, unequal, referring to the unequal size of the cells.

10.17. Species: *Dyadosporites incisus* Kalgutkar 1993

Index Fungorum Registration Identifier: 483877.

Figure: In Kalgutkar 1993: 79, plate 4.2, figure 19.

Original description: Spores dicellate, diporate, monoseptate, broadly ovoid to elliptical, medium to dark brown. Each cell of the spore nearly equal in size, broad toward the centre and gradually pointed toward the apex, somewhat hemispherical to dome-shaped. Cells separated by a prominently thick septum, about 2 μm thick, with triangular flanges and central pore. Cell wall psilate, little constricted at the septum, less than 1 μm thick. Pores apical, simple, lacerate with slit-like openings. Spore size 30–48 \times 17–28 μm .

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene-Early Eocene.

Remarks: The specific epithet is derived from the Latin, *incisus*, cut, referring to the pores pulling apart.

10.18. Species: *Dyadosporites inornatus* (Mart.-Hern. & Tom.-Ort.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483341.

Figure: In Martínez-Hernández & Tomasini-Ortiz 1989: 238, figure 3, h.

Basionym: *Dyadosporonites inornatus* Mart.-Hern & Tom.-Ort. 1989, Index Fungorum Registration Identifier:483802.

Original description: Diporate, uniseptate fungal spore. The cells are elongate, each 25 μm long. The septum is 1 μm thick and has a tiny aperture in its centre. Its pores are located at the ends of each cell, with an aperture that measures approximately 4 μm . The exine is less than 1 μm thick. Elongate oval perimeter with bilateral symmetry. Smooth ornamentation. Dimensions: 50 μm long by 15 μm wide.

Location and age: Piedras Negras, Coahuila State, Mexico; Campanian.

Remarks: The specific epithet *inornatus* indicates lack of ornamentation.

10.19. Species: *Dyadosporites megaporus* (Z.C. Song) Z.C. Song in Song et al. 1999

Index Fungorum Registration Identifier: 483847.

Figure: In Song 1985: 49, plate 1, figure 18.

Basionym: *Dyadosporonites megaporus* Z.C. Song 1985, Index Fungorum Registration Identifier: 485263.

Original description: Spores 27–30 \times 17–20 μm , holotype 27.5 \times 18 μm . Spores broadly ellipsoidal, sides smooth, without indentation; flat at both ends. Dicellate, cells similar in shape and size. Septum disciform, 2–3 μm in width, dark. Spore wall rigid, about 1 μm thick, surface scabrate. Terminal ends having a wide and large pore, about 8 μm in diameter, with a thickened zona of about 2 μm thick. Spores dark brown.

Location and age: Youshashan and Dafengshan, Qaidam Basin, Qinghai Province, China; Palaeocene-Late Eocene; Middle Miocene-Late Miocene; Late Pliocene.

10.20. Species: *Dyadosporites minor* Sal.-Cheb. & Locq. 1980

Index Fungorum Registration Identifier: 107943.

Figure: In Salard-Cheboldaeff & Locquin 1980: 188, plate 2, figure 15.

Original description: Spore 2-celled, cylindrical,

tapering at both ends, spore wall smooth, 2-layered, septum thin; $16 \times 8 \mu\text{m}$, diporate.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Late Eocene-Oligocene.

Remarks: Salard-Cheboldaeff and Locquin (1980) assigned an affinity to *Ascomycota*.

10.21. Species: *Dyadosporites mucronatus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483342.

Figure: In Salard-Cheboldaeff & Locquin 1980: 189, plate 2, figure 20.

Basionym: *Didymoporisporonites mucronatus* Sal.-Cheb. & Locq 1980, Index Fungorum Registration Identifier: 107925.

Original description: Spore 2-celled, bifusiform, septum thick, spore wall 2-layered, slightly punctate, $33 \times 20 \mu\text{m}$, mucronate, monohilate [monoporate].

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

10.22. Species: *Dyadosporites novus* P. Kumar 1990

Figure 2.F

Index Fungorum Registration Identifier: 126557.

Original description: Fungal spores dicellate and diporate. Size $28\text{--}32 \times 13\text{--}16 \mu\text{m}$. Cells fusiform and gradually taper towards ends. Apical pore $0.5 \mu\text{m}$ and simple. Septum $2\text{--}3 \mu\text{m}$ thick, wedge-shaped or denticulate with a central pore, dark and opaque. Spore wall $1.6 \mu\text{m}$ thick, smooth, slightly constricted at septal region and showing a brief collar at one end (probably basal end) of the spore.

Location and age: Padappakkara, Quilon District, Kerala, India; Early-Middle Miocene.

10.23. Species: *Dyadosporites oblongatus* (P. Ke & Z.Y. Shi) G Norris 1986

Index Fungorum Registration Identifier: 126572.

Figure: In Ke & Shi 1978: 48, plate 5, figure 6.

Basionym: *Dyadosporonites oblongatus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115636.

Original description: Spores $30 \times 21 \mu\text{m}$. Outline elliptical, ends rounded-acute. Two-celled, septum hyaline, $1 \mu\text{m}$ in width, ring-shaped. Diporate, pores fairly small, simple, about $1.5 \mu\text{m}$ in diameter. Spore wall $1 \mu\text{m}$ thick, two-layered, outer and inner layers are of about equal thickness, surface psilate.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; (Norris): Imperial Nuktak C-22 Well, Mackenzie Delta Region, District of Mackenzie, Northwest Territories, Canada; Eocene-Oligocene; (Norris): Eocene-Oligocene.

10.24. Species: *Dyadosporites obscurus* Z.C. Song & Liu Cao 1994

Index Fungorum Registration Identifier: 483766.

Figure: In Song & Cao 1994: 40, plate 2, figure 8.

Original description: Spores oblong-elliptical, slightly constricted at central septum, flat at both ends; holotype $60 \mu\text{m}$ in length, $24 \mu\text{m}$ wide at central part, largest width $26 \mu\text{m}$, and $10\text{--}12 \mu\text{m}$ wide at both ends; spores twocelled, each cell gradually tapering towards ends, spore wall broken at ends to form two slit-like openings about $10 \mu\text{m}$ in width; single septum indistinct; thickness of spore wall unknown; spore opaque, black.

Location and age: King George Island, Antarctica; Late Cretaceous.

Remarks: The specific epithet *obscurus* is derived from the dark colour of spores.

10.25. Species: *Dyadosporites okayi* (V.S. Ediger & Alisan) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483343.

Figure: In Ediger & Alisan 1989: 156, plate 3, figure 12.

Basionym: *Dyadosporonites okayi* V.S. Ediger

& Alisan 1989, Index Fungorum Registration Identifier: 125505.

Original description: Dicellate, uniseptate, diporate fungal spores. Outline is irregularly elliptical with tapered ends. Pores are at apices and about 5–6 μm wide and slightly chambered. Septum is thicker than exine, and the pore is sometimes thickened. Exine is about 2 μm thick, psilate, and occasionally folded. Size 11–13 \times 22–27 μm .

Location and age: Northern Thrace Basin, Turkey; Middle-Late Eocene to Late Oligocene, Miocene-Pliocene.

Remarks: The specific epithet is in honour of Professor Hayrettin B. Okay.

10.26. Species: *Dyadosporites puryearensis* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483344.

Figure: In Sheffy & Dilcher 1971: 47, plate 16, figure 67.

Basionym: *Diporicellaesporites puryearensis* Sheffy & Dilcher 1971.

Original description: Tetracellate body 5.3 \times 16.4 μm , equatorial cross wall and constriction appear to connect two dicellate spores, each [of which] has an

opaque equatorial septum and slight constriction at cell boundaries. Wall smooth, 0.7 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

Remarks: The specific epithet is after the name of the pit from where the material was collected.

10.27. Species: *Dyadosporites quadratus* (Rouse & Mustard) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483345.

Figure: In Mustard & Rouse 1994: 143, plate 9, figure 6.

Basionym: *Diporicellaesporites quadratus* Rouse & Mustard 1997.

Original description: Rectangular fungal spores, diporate, triseptate. Pores apical, subtended by septa with central pores; large central septum about 1 μm thick, with central pore. Dimensions: range of length 20–22 μm ; of width 11–12 μm .

Location and age: Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, Canada, and North-western Washington State, U.S.A.; Late mid-Eocene–Early Late Eocene.



Figure 2. **A.** *Dyadosporites kannanorensis* (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **B.** *Dyadosporites denticulatus* (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **C.** *Dyadosporites dubius* P. Kumar 1990. Scale bar = 10 μm . **D.** *Dyadosporites ellipsus* R.T. Clarke 1965. Scale bar = 15 μm . **E.** *Dyadosporites grandiporus* (H.P. Singh et al. 1986) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **F.** *Dyadosporites novus* P. Kumar 1990. Scale bar = 10 μm . **G.** *Dyadosporites reticulatus* (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **H.** *Dyadosporites sahnii* (C.P. Varma & Rawat) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **I.** *Dyadosporites scabratus* (P. Kumar) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **J.** *Dyadosporites schwabii* (Elsik) Kalgutkar & Janson. 2000. Scale bar = 5 μm . **K.** *Dyadosporites singhii* R.K. Saxena et al. 2021. Scale bar = 20 μm . **L.** *Dyadosporites udarii* (A. Gupta) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **M.** *Dyadosporites verrucatus* (Ramanujam & Srisailam) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **N.** *Dyadosporites wilkinsonii* (R.K. Saxena & N.K. Misra) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **O.** *Felixites pollenisimilis* (Horst) Elsik 1990b. Scale bar = 20 μm . **P.** *Fusiformisporites acutus* P. Kumar 1990. Scale bar = 10 μm . **Q.** *Fusiformisporites barmerensis* R.K. Saxena & S.K.M. Tripathi 2011. Scale bar = 20 μm . **R.** *Fusiformisporites crabbii* Rouse 1962. Scale bar = 12 μm . **S.** *Fusiformisporites elongatus* Ramanujam & K.P. Rao 1978. Scale bar = 10 μm . **T.** *Fusiformisporites foedus* S.K. Salujha et al. 1974. Scale bar = 10 μm . **U.** *Fusiformisporites keralensis* Ramanujam & K.P. Rao 1978. Scale bar = 10 μm . **V.** *Fusiformisporites lineolatus* Sheffy & Dilcher 1971. Scale bar = 10 μm . **W.** *Fusiformisporites pseudocrabbii* Elsik 1968. Scale bar = 10 μm . **X.** *Fusiformisporites sahnii* R.K. Saxena et al. 2021. Scale bar = 15 μm . **Y.** *Hilidicellites appendiculatus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000. Scale bar = 20 μm . **Z.** *Hilidicellites constrictus* (Y.K. Mathur & K. Mathur) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **AA.** *Hilidicellites dubius* Kalgutkar & Janson. 2000. Scale bar = 20 μm . **AB.** *Hilidicellites indicus* (Anil Chandra et al.) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **AC.** *Hilidicellites siddiquiei* (Anil Chandra et al.) Kalgutkar & Janson. 2000. Scale bar = 10 μm . **AD.** *Pucciniasporonites arcotensis* Ramanujam & Ramachar 2000. Scale bar = 10 μm . **AE.** *Valsarites senonianus* Puri 1963. Scale bar = 10 μm . **AF.** *Verrudisporonites elsikianus* O'Keefe 2017. Scale bar = 10 μm .

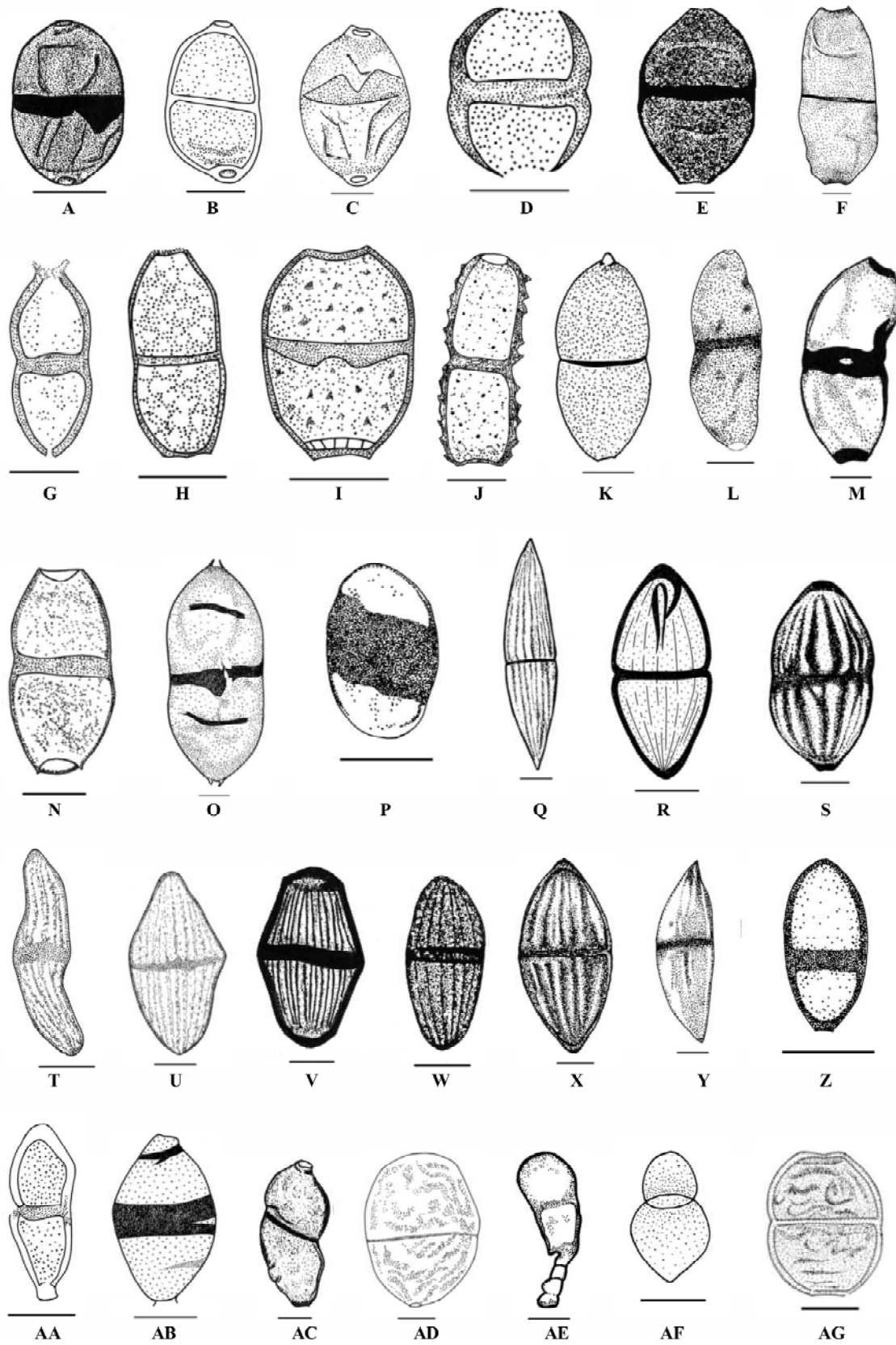


Figure 2

10.28. Species: *Dyadosporites reticulatus*
(Ramanujam & K.P. Rao) Kalgutkar & Janson.
2000

Figure 2.G

Index Fungorum Registration Identifier:
483346.

Basionym: *Dyadosporonites reticulatus*
Ramanujam & K.P. Rao 1978, Index Fungorum
Registration Identifier: 115065.

Original description: Spores dicellate, diporate, melanin-colored, more or less barrel-shaped, $22\text{--}30 \times 8\text{--}15 \mu\text{m}$. A single pore at each flattened or truncate end of spore along its long axis. Pore simple, up to $3.5 \mu\text{m}$ in diameter. Spore wall less than $1 \mu\text{m}$ thick, transverse septum slightly thicker; surface reticulate; muri of low height, meshes polygonal, lumina irregular, smooth.

Location and age: Quilon and Warkalli beds of Kerala along the west coast of India. Locality: Cannanore; Miocene.

10.29. Species: *Dyadosporites sahnii* (C.P. Varma & Rawat) Kalgutkar & Janson. 2000

Figure 2.H

Index Fungorum Registration Identifier:
483347.

Basionym: *Granodiporites sahnii* C.P. Varma & Rawat 1963, Index Fungorum Registration Identifier: 115065.

Original description: Grains 2-porate, bilateral, iso- to paraisopolar, somewhat barrel-shaped ($21 \times 30 \times 21 \mu\text{m}$), with constrictions in the middle where a septum runs the entire width of the grain. Ledges on both sides of the median line of the septum are presumably due to the obliquely placed wall of the septum. Pores at each end of the longest axis of the grain presumably circular (about $8.6 \mu\text{m}$). Pore area covered by a dome-shaped sexinous fragile membrane (figures 15a–b), opening irregularly (figure 15b) or by a small central pore (figure 15a). Exine granulate (first order), less than $1.4 \mu\text{m}$ thick.

Location and age: Western and eastern India, including oil exploration areas in West Bengal and Assam; Eocene-Miocene.

Remarks: The species epithet is in honour of Professor Birbal Sahni.

10.30. Species: *Dyadosporites scabratus* (P. Kumar) Kalgutkar & Janson. 2000

Figure 2.I

Index Fungorum Registration Identifier:
483348.

Basionym: *Psidimobipiospora scabrata* P. Kumar 1990.

Original description: Fungal spores cylindrical, dicellate and diporate. Size range $35\text{--}45 \times 13\text{--}16 \mu\text{m}$. Cells rectangular in shape, each cell $19 \times 13\text{--}14 \mu\text{m}$, and \pm equal in size, with a pore at the free end. Pore $4\text{--}6 \mu\text{m}$ wide, simple and slightly sunken. Septum $\pm 3 \mu\text{m}$ thick, opaque and simple. Spore wall $\pm 2 \mu\text{m}$ thick, thinner around pore, surface smooth to finely scabrate or echinate, slightly constricted at septal region.

Location and age: Padappakkara, Quilon District, Kerala, India; Early-Middle Miocene.

10.31. Species: *Dyadosporites schwabii* (Elsik) Kalgutkar & Janson. 2000

Figure 2.J

Index Fungorum Registration Identifier:
126573.

Basionym: *Dyadosporonites schwabii* Elsik 1968, Index Fungorum Registration Identifier: 313436.

Original description: Fusiform, slightly asymmetrical, psilate, dicellate, diporate fungal spores, $9 \times 20 \mu\text{m}$. Pores about $1 \mu\text{m}$ 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 $0.5 \mu\text{m}$ thick.

Location and age: Strip mine approximately 7 miles southwest of Rockdale, Milam County, Texas, U.S.A.; Palaeocene.

10.32. Species: *Dyadosporites singhii* R.K.
Saxena et al. 2021

Figure 2.K

Index Fungorum Registration Identifier:
555425.

Basionym: *Diporicellaesporites* sp. in R.Y. Singh et al. Journal of Palynology 21: 53, plate 3, figure 54. 1985.

Original description: Fungal spores brown coloured, fusiform with tapering ends, size 78–90 × 23–28 µm, diporate, pores terminal, distinct, large, 6–10 µm in diameter, dicellate, uniseptate, septum 4 µm thick, spore wall 1.5 µm thick, psilate.

Location and age: Assam and Meghalaya, India; Oligocene (Barail Group).

Remarks: The species is named in honour of late Dr. H.P. Singh of the Birbal Sahni Institute of Palaeosciences, Lucknow, India.

10.33. Species: *Dyadosporites solidus* (P. Ke & Z.Y. Shi) Z.C. Song in Song et al. 1999

Index Fungorum Registration Identifier:
483848.

Figure: In Ke & Shi 1978: 49, plate 5, figure 10.

Basionym: *Dyadosporonites solidus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115635.

Original description: Spores 62 × 32 µm. Outline fusiform. Diporate, pores small, about 2.5 µm in diameter. Two-celled, septum hyaline. Spore wall about 3.2 µm thick, two-layered, outer layer conspicuously thicker than the inner one, outer layer gradually thins and separates from the inner layer at pores, also protrudes outward at pores, surface provided with granulate sculpturing.

Location and age: Kenli, Shandong Province, Coastal region of Bohai, China; Eocene-Oligocene.

10.34. Species: *Dyadosporites stenosis* (Z.C. Song & G.X. Li in Song et al.) Z.C. Song in Song et al. 1999

Index Fungorum Registration Identifier:
483849.

Figure: In Song et al. 1989: 44, plate 4, figure 14.

Basionym: *Dyadosporonites stenosis* Z.C. Song & G.X. Li in Song et al. 1989, Index Fungorum Registration Identifier: 485264.

Original description: Spores ellipsoidal, holotype 30 × 11 µm, dicellate; cells similar in size and shape, contact area between cells with slight constriction. Septum single-layered, discoidal, without septal folds. Spores diporate, pores terminal, distinct, about 4 µm in diameter, edges of pores slightly thickened. Spore wall about 1 µm in thickness, surface smooth.

Location and age: Shenxian county of Shandong Province, China; Late Eocene-Middle Oligocene (Shahejie Formation).

10.35. Species: *Dyadosporites subovalis* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483349.

Figure: In Sheffy & Dilcher 1971: 43, plate 16, figure 40.

Basionym: *Dyadosporonites subovalis* Sheffy & Dilcher 1971, Index Fungorum Registration Identifier: 111447.

Original description: Dicellate, psilate fungal spore 6.3 × 10.6 µm. Pores in both terminal ends, one apex round, the opposite apex flat. Single septum is opaque, wall 1 µm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

10.36. Species: *Dyadosporites substrangulatus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier:
483350.

Figure: In Salard-Chebaldaeff & Locquin 1980: 189, plate 2, figure 21.

Basionym: *Psidimobipiospora substrangulata* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 108426;

Original description: Spore 2-celled, median septum thickened around a central perforation; spore elliptical, slightly constricted at the septum, dihilate [diporate], spore wall one-layered, smooth, $30 \times 16 \mu\text{m}$

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Late Eocene-Oligocene.

10.37. Species: *Dyadosporites taiwanensis* T.C. Huang 1981

Index Fungorum Registration Identifier: 115746.

Figure: In Huang 1981: 46, plate 1:4.

Original description: Spores elliptic; $22 \times 14 \mu\text{m}$; septum darker, $2 \mu\text{m}$ wide; exine psilate; sexine smooth.

Location and age: Taiwan; Miocene.

10.38. Species: *Dyadosporites udarii* (A. Gupta) Kalgutkar & Janson. 2000

Figure 2.L

Index Fungorum Registration Identifier: 483351.

Basionym: *Dyadosporonites udarii* A. Gupta 1984, Index Fungorum Registration Identifier: 483858.

Original description: Spore diporate, $65\text{--}89 \times 31\text{--}39 \mu\text{m}$, uniseptate. Pores distinct, circular, margin thickened, spore coat levigate, generally constricted in middle.

Location and age: Barkhana nala cutting, near the village Sarangwara, District of Kutch, western India; Oligocene.

Remarks: The species epithet is in honour of Professor Ram Udar..

10.39. Species: *Dyadosporites urniformis* Kalgutkar 1993

Index Fungorum Registration Identifier: 483878.

Figure: In Kalgutkar 1993: 79, plate 4.2, figure 18.

Original description: Spores diporate, monoseptate, psilate, broadly ovoid, medium to dark brown. Cell wall thin, smooth, clearly constricted at the septum; central septum thicker than cell wall. Spore cells urnshaped, with apical pores. Pores annulate, circular, incurved. Spore size $25\text{--}40 \times 12\text{--}23 \mu\text{m}$.

Location and age: Peel River, Yukon Territory, Canada; Late Palaeocene-Early Eocene.

Remarks: The specific epithet is derived from the Latin, *urniformis*, urn-shaped, referring to the shape of the cells.

10.40. Species: *Dyadosporites verrucatus* (Ramanujam & Srisailam) Kalgutkar & Janson. 2000

Figure 2.M

Index Fungorum Registration Identifier: 483352.

Basionym: *Dyadosporonites verrucatus* Ramanujam & Srisailam 1980, Index Fungorum Registration Identifier: 108852.

Original description: Spores brown to light brown, dicellate, oblong, $22.1\text{--}25.5 \times 8\text{--}9.5 \mu\text{m}$, one conspicuous pore at each truncate end, pore up to $4 \mu\text{m}$ in diameter, transverse septum prominent in the form of dark band, spore wall $1.7 \mu\text{m}$ thick, slightly constricted at the septum, surface densely studded with verrucae; verrucae of low height, locally fusing to form sinuous ridges.

Location and age: Cannanore beach area, Palayangadi and Cheruvattur (southern side of Karingottu River), Kerala, India. Locality: Palayangadi; Miocene.

10.41. Species: *Dyadosporites wilkinsonii* (R.K. Saxena & N.K. Misra) Kalgutkar & Janson. 2000

Figure 2.N

Index Fungorum Registration Identifier: 483353.

Basionym: *Diporicellaesporites wilkinsonii* R.K. Saxena & N.K. Misra 1990.

Original description: Fungal spores capsular in shape, size range $98\text{--}126 \times 36\text{--}40 \mu\text{m}$; tetracellate, middle septum complete, $2.5\text{--}3 \mu\text{m}$ thick, whereas other two septa incomplete, not covering full width of spore; diporate, pores apical, situated on protuberances, sometimes slightly offset; wall up to $1 \mu\text{m}$ thick, psilate.

Location and age: Ratnagiri beds, Amberiwidi section, Sindhu Durg District, Maharashtra, India; Neogene.

11. Genus: *Felixites* Elsik ex Janson. & Hills 1976

Index Fungorum Registration Identifier: 25443.

Type species: *Felixites pollenisimilis* (Horst) Elsik 1990.

Original diagnosis: Psilate, aporate, dicellate fungal spores with an elliptical outline. The spore outline occasionally can be slightly indented at the septum; individual dispersed cells can have an ovate outline. The septal area is generally very dark due to its excessive development; the septum can be several times the thickness of the cell wall. The septum typically is thick and darkly translucent to practically opaque. The septum is of two main layers, one continuing into the wall of each cell; in extreme cases the cells are found isolated as a dome-shaped cell truncated by the dark septal layer. The septal pore is distinct or not discernible. The spore wall is rigid at the septum, less rigid to folded away from the septum. Rarely a third cell is present; in those specimens the spore is oriented with a trilobate outline; the dark central septal area serves as a common junction for all three cells, but the exact nature of attachment and the septum of the third cell is generally obscured by the opacity of the attachment area (Elsik 1990, p. 155).

Number of species known: Two (none recorded from India).

Remarks: Elsik (1990) stated that *Felixites* was described for late Palaeozoic fungal didymosporae that are aporate and characterized by a very thick medium septum. *Chaetosphaerites* Felix 1894 is tetracellate and the two end cells are more lightly pigmented than

the two central cells. The genus is named in honour of Dr. Johannes Felix.

11.1. Species: *Felixites playfordii* Elsik 1990

Index Fungorum Registration Identifier: 126549.

Figure: In Playford 1962: 573, plate 78, figure 1.

Original description: Aporate, psilate, dicellate fungal spores ca. $14\text{--}20 \times 36\text{--}52 \mu\text{m}$ overall. Single dispersed cells ca. $14\text{--}20 \times 20\text{--}26 \mu\text{m}$ are occasionally seen. Occasional specimens have a third cell budded from the midpoint of the spore; the second and third cells share the septum across the base of the first cell, forming roughly a Y-shaped, trilobate spore; the second and third cells appear to share a wall along part of their length. The septum is a very thick layer truncating the base of each cell. The two layers of the septum are distinct and can split apart at maturity, resulting in the dispersed, single-celled, half specimens. The spore wall thickens into the septal layer, resulting in a circular or broadly ovate inner outline of the cell cavities. The overall spore outline, for a typically compressed dicellate specimen, is bicampanulate (Ainsworth, 1971, plate 16, figure 20), with a very slight indentation at the midpoint of the septum, i.e. where the two layers of the septum adjoin. The spore outline would be elliptical for any uncompressed specimen which lacks indentation at the septum. The thinner-walled portions of the cells tend to be somewhat squashed, i.e. flared, whereas the rigid septum does not appear to be compressed at all. The spore wall is $1\text{--}2 \mu\text{m}$ at the ends of the cell, thickening at the base of each cell into the $6\text{--}12 \mu\text{m}$ thick septal layer; the septum is $12\text{--}24 \mu\text{m}$ thick. A septal pore is not evident.

Location and age: Spitsbergen; Early Carboniferous.

Remarks: *Felixites playfordii* is characterized by its bicampanulate outline. The species epithet is in honour of Professor Geoffrey Playford.

11.2. Species: *Felixites pollenisimilis* (Horst) Elsik 1990

Figure 2.O

Index Fungorum Registration Identifier: 126548.

Basionym: *Sporonites pollenisimilis* Horst 1955.

Synonym: *Chaetosphaerites pollenisimilis* (Horst) M.A. Butterworth & R.W. Williams 1958 *vide* Elsik 1990a.

Original Description: In several adits of Upper Silesia and the Mahrish-Ostrau mining area, a form was found that consists of a central body with two distinct blister-like cells. It is a smooth elliptical body of brown color, with yellow bubble-like cells with a diameter of 13–20 μm (Figure 84–87). In the midsection the body is frequently constricted, such that the round form of the cells becomes visible.

Emended description: (Playford): In addition to the usual bicellular forms, occasional specimens possessing one or three translucent “heads” were encountered. Measurements of thirty-five specimens gave a size range of 21–52 μm (mean 36 μm).

(Elsik): Aporate, psilate, dicellate fungal spores of elliptical to bilobate outline; the spore outline can be indented at the septum. Occasionally 3-celled specimens are seen with a trilobate outline; the cells radiate from a common center, or two cells share the septum of the third. The overall spore size is 13–20 \times 23–39 μm . An individual dispersed cell would have an ovate outline truncated at the base by the septal layer; those specimens would be 13–20 \times 10–20 μm . The inner outline of each cell cavity is nearly ovate, but is truncated at the septum; the inner cavity has a more or less hemispherical shape. The spore wall is 1–3 μm at the ends of the spore, and does not thicken into the septum. The septum is of two distinct layers, 10–12 μm or thicker. The septal pore is not obvious. The septal area is the most darkly pigmented, and is practically opaque in many specimens.

Location and age: Concordia mine, Adit Andreas IV, Upper Silesia, S. Poland (Horst 1955), Lothians, Central and West Fife coalfields, Scotland (Butterworth & Williams 1958), Billefjorden Sandstones, Spitsbergen, Norway (Playford 1962); Carboniferous (Horst 1955, Playford 1962), Early Carboniferous

(Butterworth & Williams 1958).

12. Genus: *Fusiformisporites* Rouse 1962

Index Fungorum Registration Identifier: 21113.

Type species: *Fusiformisporites crabbii* Rouse 1962.

Synonym: *Striadyadosporites* Dueñas 1979, Index Fungorum Registration Identifier: 21325.

Original diagnosis: Spores? very distinctly fusiform in outline. The unit is split into two 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 (Rouse 1962, p. 210).

Emended diagnosis: 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 (Elsik 1968).

Number of species known: 20 (8 species recorded from India).

Remarks: Elsik (1968) emended the generic diagnosis to include forms with less obvious parallel ornamental elements. Spores of *Fusiformisporites* have a close resemblance to the ascospores of the modern *Cookeina* (Wolf & Cavaliere 1966). Wolf (1970) also reported non-petrified spores from Pleistocene and Eocene sediments that are similar in appearance to *Cookeina*. Although *Fusiformisporites* is generally known from the late Palaeocene to Recent (Elsik 1992), Martínez-Hernández & Tomasini-Ortiz (1989) reported *F. striaoctiformis* from Maastrichtian strata.

12.1. Species: *Fusiformisporites acutus* P. Kumar 1990

Figure 2.P

Index Fungorum Registration Identifier: 126560.

Original description: Fungal spores dicellate, inaperturate and elongated-fusiform. Size range 90–112 × 20–24 µm, generally tapering towards acute ends. Septum ± 1 µm thick. Spore wall 1–1.6 µm thick and ribbed. Ribs about 1 µm wide, wider (1.6–2.6 µm) at septal region, closely spaced, alternate or continuously running end to end, sometimes bifurcating and converging at the ends, furrows very narrow.

Location and age: Padappakkara, Kollam District, Kerala, India; Early-Middle Miocene.

12.2. Species: *Fusiformisporites annafrancescae* G. Norris 1997

Index Fungorum Registration Identifier: 483789.

Figure: In Norris 1997: 30, plate 2, figure 12.

Original description: Fungal spores dicellate, equilateral, isopolar, fusiform in outline, without preformed apertures. Each cell with subparallel striae in a zone adjacent to the septum and with smooth to scabrate apical areas divided by meridionally disposed arcuate muri into faceted sectors. Spore wall 0.25–0.5 µm thick except at the apices, where arcuate muri cross the amb and at the locus of septal insertion where the wall thickens up to 1 µm. Septum 1–2 µm thick, apparently aperforate. Striate zone occupies slightly more than half of each cell and comprises subparallel, occasionally bifurcating muri 0.25–0.5 µm wide, spaced 0.5–1 µm apart, orientated parallel to the apical line. The muri terminate adapically at the annular curvilinear murus that is confluent with a meridional murus; the latter passes across the apex from one side of the annular murus to the other. The spore wall in the sectors created by the curvilinear muri is levigate, scabrate or subgranular; the granules are up to 0.5 µm in diameter.

Location and age: Imperial ADGO F–28 Well, Mackenzie River delta, Canada; Palaeocene-Eocene.

Remarks: Norris (1997) named this species in honour of his wife Mrs. Anne Frances Norris.

12.3. Species: *Fusiformisporites barmerensis* R.K. Saxena & S.K.M. Tripathi 2011

Figure 2.Q

Index Fungorum Registration Identifier: 519942.

Synonyms: 1. *Fusiformisporites* sp. in Jain et al., *Geophytology* 3(2), p. 161, plate 2, figure 77. 1973. 2. 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, plate 1, figure 2. 1984.

Original description: Fusiform, inaperturate, dicellate fungal spores, 68–76 × 32–40 µm, wall 0.5 µm thick, striations thin, occasionally open, apices thickened, smooth, septum two layered.

Location and age: Barmer Hills, Barmer District, Rajasthan, India; Palaeocene (Barmer Sandstone).

12.4. Species: *Fusiformisporites crabbii* Rouse 1962

Figure 2.R

Index Fungorum Registration Identifier: 109769.

Original description: As for the genus, with the 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 the appearance of constriction. Size range 45–52 µm.

Location and age: Terminal Dock, Vancouver, British Columbia, Canada; Late Cretaceous-Middle Eocene (Burrard Formation).

12.5. Species: *Fusiformisporites duenasii* Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483379.

Figure: In Dueñas 1979: 564, plate 3, figure 8.

Basionym: *Striadyadosporites elongatus* Dueñas 1979, Index Fungorum Registration Identifier:

112651.

Original description: 8–10 × 28–32 μm (holotype 10 × 32 μm); two-celled, with a very dark septum; the striations of the surface extend to the extremities of the grain. [Jansonius & Hills (1980, card no. 3770.)]

Location and age: Tarragona, Sabana de Bogota, Colombia, South America; Pleistocene.

12.6. Species: *Fusiformisporites elongatus*
Ramanujam & K.P. Rao 1978

Figure 2.S

Index Fungorum Registration Identifier:
115067.

Original description: Spores light brown, inaperturate, prominently elongated, dicellate, 35–38.5 × 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.

Location and age: Kannur, Kerala, India; Miocene (Quilon and Warkalli beds).

12.7. Species: *Fusiformisporites foedus* S.K.
Salujha et al. 1974

Figure 2.T

Index Fungorum Registration Identifier:
519807.

Original description: Brown, oval with pointed ends, size 43.2–46.4 × 24.5–27.2 μm; on the equator a 2–2.5 μm wide disc with a wavy margin present, exine about 1.2 μm thick, ridged, ridges 10 in number, about 1.5 μm wide, running from one pole to the other.

Location and age: Bali-Chara Nadi Traverse, Khasi-Jaintia Hills, India; Palaeogene (Disang Formation).

Remarks: A comparable specimen is illustrated by Baksi (1962) under *Fungus striatus*.

12.8. Species: *Fusiformisporites keralensis*
Ramanujam & K.P. Rao 1978

Figure 2.U

Index Fungorum Registration Identifier:
115068.

Original description: Spores dark brown to light brown, large, inaperturate, fusiform to rhomboidal, 51–56 × 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.

Location and age: Kannur, Kerala, India; Miocene (Quilon and Warkalli beds).

12.9. Species: *Fusiformisporites lineatus* Rouse
& Mustard 1997

Index Fungorum Registration Identifier:
463997.

Figure: In Mustard & Rouse 1994: 142, plate 13, figure 1.

Original description: Fusiform fungal spores, dicellate, inaperturate, with striate levigate wall 0.75–1.0 μm, uniform in thickness, deep melanin brown; striations varying from prominent and running from one pole to the other, to smaller, shorter, and less distinct extending between the middle septum and either pole; full-length and prominent striae in some specimens extend through polar wall to exterior; polar cap broken away from pole in a few cases (plate 13, figure 1). There are occasional branches in some striae, both prominent (plate 13, figure 1, 2) and weak (plate 13, figure 1). Dimensions: range of length 58–62 μm; of width 23–29 μm.

Location and age: Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, Canada, and the North-western Washington State, U.S.A.; Late Eocene-Early Oligocene.

Remarks: According to Rouse & Mustard (1997), this species is a good index fossil for Late Eocene-Early Oligocene age of western coastal deposits in North America.

12.10. Species: *Fusiformisporites lineolatus*
Sheffy & Dilcher 1971

Figure 2.V

Index Fungorum Registration Identifier:
111493.

Original description: Fusiform fungal spore 18.4 × 33.8 μm, inaperturate, bearing 6–7 continuous longitudinal ribs. Two cells separated by an opaque septum 1 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

Remarks: The species epithet *lineolatus* refers to the continuous longitudinal lines.

12.11. Species: *Fusiformisporites mackenziei*
M.G. Parsons & G. Norris 1999

Index Fungorum Registration Identifier:
483920.

Figure: In Parsons & Norris 1999: 122, plate 5, figure 4.

Original description: Dicellate, isopolar, fusiform fungal spores with rounded apices. Commonly, a minor constriction in the spore outline subapically creates a very slight apical nub. Spore wall may show some thickening at the apices. In optical view, from 15 to 20 ribs can be seen to extend from the apices to the median septum. The spores tend to split between the ribs. This splitting generally extends from the apices to the median septum, and may cross the septum, but it may not be as extensive. In the absence of splitting, it is difficult to distinguish the ribs. The spore wall is psilate. Occasionally, when the splitting extends through the apex, the spore is partially separated into two segments. In other specimens, the splitting may not reach either the apex or the median septum. Split specimens show no internal evidence of a median septum; this suggests that either the septa have gone, or these spores are incompletely septate (see Elsik et al., 1983). No septal flaps have been observed, although some species (e.g. *F. annafrancescae*) do show septal flaps. Overall length 31–41 μm, width 15.5–24 μm; holotype 36 × 21 μm.

Location and age: Caribou Hills, Mackenzie River delta, Canada; Early Eocene.

Remarks: The species epithet is derived from the Mackenzie Delta.

12.12. Species: *Fusiformisporites marii* Elsik
1968

Index Fungorum Registration Identifier:
314247.

Figure: In Elsik 1968: 270, plate 2, figure 10.

Original description: Capsular to ovoid, inaperturate, dicellate fungal spores, 12 × 21 μm. Wall ca. 1 μm. thick, may be layered. Cross wall [septum] slightly thicker, of two layers. Many specimens are almost opaque. Two opposite thinned or broken areas in each hemisphere, elongate, parallel to the long axis of the grain. The two ridges in one hemisphere are rotated 90 degrees from the two ridges in the opposite hemisphere.

Location and age: Strip mine approximately 7 miles southwest of Rockdale, Milam County, Texas, U.S.A.; Palaeocene.

12.13. Species: *Fusiformisporites microstriatus*
Hopkins 1969

Index Fungorum Registration Identifier:
637492.

Figure: In Hopkins 1969: 1126, plate 11, figure 170.

Original description: Oval spore, 42–49 μm in length. Grain divided into two cells by a septum in middle of grain. Fine longitudinal ribs extend from the poles to the equatorial septum (which is very slightly constricted). Most of these ribs terminate at the equator, although occasionally several may be continuous across it. The wall is thick and appears granular.

Location and age: Kitsilano outcrops and excavations of the Highbury Tunnel, southwestern British Columbia, Canada; Late Eocene–Early Oligocene.

12.14. Species: *Fusiformisporites paucistriatus*
Rouse & Mustard 1997

Index Fungorum Registration Identifier:
463996.

Figure: In Mustard & Rouse 1994: 142, plate 4, figure 11.

Original description: Fungal spores dicellate, inaperturate, with striate wall; wall levigate, 0.25–0.5 μm , thickening to 1.5–2.0 μm at apices. Striae mostly very thin and irregular in length and width; occasionally flaring, concentrated in the mid-sections of the wall in both cells. Striae variable in number from 3–10 in each hemisphere. Dimensions: range in length 39–42 μm ; width 15–22 μm .

Location and age: Strait of Georgia, eastern Vancouver Island, the Fraser River lowlands of southwest British Columbia, Canada, and the North-western Washington State, U.S.A.; Late Palaeocene.

Remarks: Rouse & Mustard (1997) stated that this species is distinguishable from others by generally low number of weak, thin, and often short striae concentrated in the mid-section of each hemisphere.

12.15. Species: *Fusiformisporites pseudocrabbii*
Elsik 1968

Figure 2.W

Index Fungorum Registration Identifier:
314248.

Original description: Fusiform, inaperturate fungal bodies bearing broad longitudinal ribs or folds. Fine inner striae made up of rows of punctae parallel to the coarse ribs. Width of spores ca. 25 μm . Length 40 to 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 thick, psilate. Equatorial septum 2 μm thick, of two layers. Slight constriction of spore wall equatorially. Spore wall occasionally split between ribs.

Location and age: Strip mine approximately 7 miles southwest of Rockdale, Milam County, Texas, U.S.A.; Palaeocene.

12.16. Species: *Fusiformisporites rugosus* Sheffy & Dilcher 1971

Index Fungorum Registration Identifier:
111494.

Figure: In Sheffy & Dilcher 1971: 48, plate 16,

figure 73.

Original description: Fusiform, inaperturate, dicellate fungal spore, 19.3 \times 43.5 μm . Rounded at one apex, with flat basal attachment at other end. Wall with longitudinal folds and tears, 1 μm thick; opaque equatorial septum 2–3 μm thick.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

Remarks: The species epithet refers to the irregular creases in the cell wall.

12.17. Species: *Fusiformisporites sahi* R.K.
Saxena et al. 2021

Figure 2.X

Index Fungorum Registration Identifier:
555491.

Basionym: *Fusiformisporites* sp. in R.K. Saxena & S. Khare 1992.

Original description: Spores fusiform with pointed ends, size 103–110 \times 35–38 μm , inaperturate, dicellate, septum 3–4 μm thick, each cell having longitudinal ribs, spore wall 1 μm thick, psilate.

Location and age: Jayamkondacholapuram Well 12, Tiruchirappalli District, Tamil Nadu, India; Late Palaeocene-Middle Eocene.

Remarks: The species is named in honour of late Dr. S.C.D. Sah of the Wadia Institute of Himalayan Geology, Dehradun, India.

12.18. Species: *Fusiformisporites striaoctoformis*
Mart.-Hern. & Tom.-Ort. 1989

Index Fungorum Registration Identifier:
263516.

Figure: In Martínez-Hernández & Tomasini-Ortiz 1989: 238, figure 3i.

Original description: Inaperturate, uniseptate, dicellular fungal spore. Each cell is 13 μm long. The septum is less than 1 μm thick. The exine is less than 1 μm thick. Oval perimeter with bilateral symmetry. The spore has a constriction at its equator. It has striae or

grooves along the length of the body, approximately 0.1 μm thick and separated by a 0.1 μm space. Smooth ornamentation. Dimensions: 26 μm long by 12 μm wide.

Location and age: Piedras Negras, Coahuila State, Mexico; Maastrichtian.

Remarks: The species epithet is derived from its figure-eight shape and its striation.

12.19. Species: *Fusiformisporites striatus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483380.

Figure: In Ke & Shi 1978: 34, plate 1, figure 19.

Basionym: *Dicellaesporites striatus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115658.

Original description: Spores 46.4 \times 29 μm . Outline elliptical. Two-celled. Inaperturate. Monoseptate, septum opaque, 3 μm wide, divided into two layers of equal thickness. Spore wall 1.5 μm thick, two-layered, outer layer thicker than the inner one. Surface provided with six sulci running parallel to the major axis of the spore and converging slightly at each of its ends. Surface of the spore wall is scabrate-psilate.

Location and age: Tangjiahe, Tianjin Municipality, Coastal region of Bohai, China; Eocene-Oligocene.

12.20. Species: *Fusiformisporites taiwanensis* T.C. Huang 1981

Index Fungorum Registration Identifier: 115777.

Figure: In Huang 1981: 47, plate 1:13.

Original description: Spores bicellate; elongated elliptic, 24 \times 7 μm ; septum thick, darker, 3 μm wide; exine less than 1 μm thick; exine longitudinal striae about 10; less than 1 μm thick.

Location and age: Taiwan; Miocene.

13. Genus: *Hilidicellites* Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 28618.

Type species: *Hilidicellites appendiculatus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000.

Original Diagnosis: 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 (Kalgutkar & Jansonius 2000, p. 133).

Number of species known: 18 (4 species recorded from India).

Remarks: In *Didymoporisporonites*, the proximal cell is much smaller than the distal cell. *Dicellaesporites* lacks a hilum or pore. The genus name is derived from Latin *hilum*, scar, and the dicellate structure of these spores.

13.1. Species: *Hilidicellites appendiculatus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Figure 2.Y

Index Fungorum Registration Identifier: 483381.

Basionym: *Dicellaesporites appendiculatus* Sheffy & Dilcher 1971, Index Fungorum Registration Identifier: 111405.

Original Description: Capsular, dicellate spore 9.7 \times 19.3 μm , pore in one cell leading to a flat basal attachment. Psilate, opaque equatorial septum, 2.9 μm thick. Medium pigment, wall 0.7 μm thick.

Location: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.

Age: Middle Eocene (Claiborne Formation).

13.2. Species: *Hilidicellites constrictus* (Y.K. Mathur & K. Mathur) Kalgutkar & Janson. 2000

Figure 2.Z

Index Fungorum Registration Identifier: 519810.

Basionym: *Dyadosporonites constrictus* Y.K. Mathur & K. Mathur 1969, Index Fungorum Registration Identifier: 483857.

Original description: Surface view. Spores bilocular, horizontally septate, strongly constricted at the septum, individual cells 12 \times 9.8 μm in size, two-

layered, psilate, brown.

Location and age: Naera and Baraia area of Kutch, Gujarat, India; Pliocene.

Remarks: Mathur & Mathur (1969) incorrectly cited the generic name as “*Dyadosporonites* Hammen 1954”. Kalgutkar and Jansonius (2000) stated that this error in bibliographic citation does not invalidate the publication of the species name. The specific epithet is derived from the strong constriction at the septum.

13.3. Species: *Hilidicellites crassiseptus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483383.

Figure: In Salard-Cheboldaef & Locquin 1980: 187, plate 2, figure 10.

Basionym: *Didymoporisporonites crassiseptus* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 107922.

Original description: Spore 2-celled, septum thickened around the central perforation; $27 \times 15 \mu\text{m}$.

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

13.4. Species: *Hilidicellites dubius* Kalgutkar & Janson. 2000
Figure 2.AA

Index Fungorum Registration Identifier: 483384.

Basionym: *Dicellaesporites crassiseptus* Ramanujam & Srisailam 1980, Index Fungorum Registration Identifier: 108842.

Original description: Spores dark brown, dicellate, elliptical, $15.5\text{--}20.4 \times 7\text{--}8.5 \mu\text{m}$, 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 ($6.8 \mu\text{m}$) band; spore wall up to $2.2 \mu\text{m}$ thick, psilate to finely granular.

Location and age: Cannanore beach area, Palayangadi and Cheruvattur (southern side of Karingottu River), Kerala, India; Miocene.

13.5. Species: *Hilidicellites henanensis* (Z.C. Song & G.X. Li in Song et al.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483385.

Figure: In Song et al. 1989: 39, plate 3, figure 18.

Basionym: *Didymoporisporonites henanensis* Z.C. Song & G.X. Li in Song et al. 1989, Index Fungorum Registration Identifier: 485262.

Original description: Spores ellipsoidal, holotype $50 \times 24 \mu\text{m}$. Spores dicellate, cells tapering at both ends, contact area between cells generally without constriction. Single pore situated at the pointed end; pore small and indistinct, simple. Septum discoidal, about $2 \mu\text{m}$ thick, without septal folds. Spore wall $1\text{--}1.5 \mu\text{m}$ in thickness, composed of two layers, surface nearly smooth, but with a number of regularly arranged folds.

Location and age: Qingteng county of Henan Province, China; Late Eocene-Early Oligocene (Shahejie Formation).

Remarks: This species can be distinguished from other species of *Didymoporisporonites* by its large size, and having folds on the surface.

13.6. Species: *Hilidicellites indicus* (Anil Chandra et al.) Kalgutkar & Janson. 2000
Figure 2.AB

Index Fungorum Registration Identifier: 483386.

Basionym: *Didymoporisporonites indicus* Anil Chandra et al. 1984, Index Fungorum Registration Identifier: 106776.

Original description: Spindle-shaped fungal spore, size $35 \times 15 \mu\text{m}$; dicellate, both cells almost equal in size, uniseptate; monoporate, pore on the apex of one cell, pore margin not thickened, wall $0.5 \mu\text{m}$ thick, punctate.

Location and age: Cores from the Arabian Sea, type locality Core no. 1; Late Quaternary.

13.7. Species: *Hilidicellites lacrymosus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483387.

Figure: In Salard-Chebodaeff & Locquin 1980: 188, plate 2, figure 13.

Basionym: *Didymoporisporonites lacrymosus* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 107924.

Original description: Spore 2-celled, tear-shaped, septum thin, body [spore] tear-like, spore wall smooth, one-layered, $15 \times 12 \mu\text{m}$, monohilate [monoporate].

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

13.8. Species: *Hilidicellites major* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483388.

Figure: In Ke & Shi 1978: 42, plate 4, figure 12.

Basionym: *Lacrimasporonites major* P. Ke & Z.Y. Shi 1978.

Original description: Spores $58 \times 28 \mu\text{m}$. One-celled, outline prolate elliptical. Monoporate, pore simple, about $3 \mu\text{m}$ in diameter. Spore wall $1.5 \mu\text{m}$ thick, one-layered or possibly two-layered, surface psilate, thrown into transverse folds that have the appearance of a septum. Outer contour line smooth.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

13.9. Species: *Hilidicellites normalis* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483389.

Figure: In Sheffy & Dilcher 1971: 42, plate 15, figure 36.

Basionym: *Didymoporisporonites normalis* Sheffy & Dilcher 1971, Index Fungorum Registration Identifier: 111422.

Original description: Two-celled spore, slight

constriction at boundary of cells. Psilate, opaque septum, wall $0.5\text{--}1.0 \mu\text{m}$ thick, pore at one end. Size ranges from 3.9×9.7 to $5.8 \times 13.5 \mu\text{m}$ (two specimens). Holotype: $5.8 \times 13.5 \mu\text{m}$.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle Eocene (Claiborne Formation).

13.10. Species: *Hilidicellites oblongatus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483390.

Figure: In Ke & Shi 1978: 43, plate 4, figure 10.

Basionym: *Didymoporisporonites oblongatus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115671.

Original description: Spores $36\text{--}40 \times 25\text{--}28 \mu\text{m}$. Two-celled. Outline elliptical, ends rounded or rounded-acute. Monoporate, pore simple, small, $1.5\text{--}2 \mu\text{m}$ in diameter. Septum $2\text{--}3 \mu\text{m}$ wide, hyaline. Spore wall $1.5 \mu\text{m}$ thick, two-layered, outer layer thicker than the inner one, surface psilate, often provided with secondary wrinkles. Outer contour line smooth.

Location and age: Panshan, Liaoning Province, Coastal region of Bohai, China; Eocene-Oligocene.

13.11. Species: *Hilidicellites obtectus* (Sheffy & Dilcher) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483391.

Figure: In Sheffy & Dilcher 1971: 43, plate 15, figure 38.

Basionym: *Didymoporisporonites obtectus* Sheffy & Dilcher 1971, Index Fungorum Registration Identifier: 111423.

Original description: Capsular, punctate; equatorial constriction, with single opaque septum $3.4 \mu\text{m}$ thick. One end flat, with large pore $2.8 \mu\text{m}$ wide; wall $1.5 \mu\text{m}$ thick, heavily punctate. Psilate sheath encloses spore.

Location and age: Puryear clay pit, 800 m south of Puryear, Henry County, Tennessee, U.S.A.; Middle

Eocene (Claiborne Formation).

Remarks: The species epithet refers to the presence of an external psilate sheath.

13.12. Species: *Hilidicellites ovatus* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483392.

Figure: In Ke & Shi 1978: 43, plate 4, figure 3.

Basionym: *Didymoporisporonites ovatus* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115653.

Original description: Spores 16.5–17.4 × 8.7–9 µm. Outline ovate. Two-celled, cells of unequal size. Monoporate, pore 1 µm in diameter, situated at end of larger cell. Septum hyaline. Spore wall 1.2 µm thick. Surface psilate.

Location and age: Tanggu, Tianjin Municipality; Kenli, Shandong Province, Coastal region of Bohai, China; Eocene-Oligocene.

13.13. Species: *Hilidicellites ovumformis* (Mart.-Hern. & Tom.-Ort.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483393.

Figure: In Martínez-Hernández & Tomasini-Ortiz 1989: 238, figure 3,d.

Basionym: *Didymoporisporonites ovumformis* Mart.-Hern. & Tom.-Ort. 1989, Index Fungorum Registration Identifier: 483799.

Original description: Dicellular, uniseptate, monoporate fungal spore. The cells are unequal: the one with the pore is elongated and is 10 µm long; the other has a rounded apex and is 8 µm long. The septum is 1 µm thick. The exine is 1 µm thick. Oval perimeter with bilateral symmetry. Smooth ornamentation. Dimensions: 18 µm long by 8 µm wide.

Location and age: Piedras Negras, Coahuila State, Mexico; Maastrichtian.

Remarks: The genus name was incorrectly spelled “*Dydimoporisporites* Sheffy & Dilcher” in Martínez-Hernández and Tomasini-Ortiz. (1989). The epithet is

derived from its oval shape.

13.14. Species: *Hilidicellites siddiquiei* (Anil Chandra et al.) Kalgutkar & Janson. 2000

Figure 2.AC

Index Fungorum Registration Identifier: 483394.

Basionym: *Didymoporisporonites siddiquiei* Anil Chandra et al. 1984, Index Fungorum Registration Identifier: 106777.

Original description: Oval fungal spores, size 38 × 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.

Location and age: Cores from the Arabian Sea, type locality Core no. 2; Late Quaternary.

Remarks: The present species epithet is in honour of Dr. H.N. Siddiquie, National Institute of Oceanography, Dona Paula, Goa, India.

13.15. Species: *Hilidicellites strangulatus* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000;

Index Fungorum Registration Identifier: 483395.

Figure: In Salard-Cheboldaëff & Locquin 1980: 188, plate 2, figure 14.

Basionym: *Didymoporisporonites strangulatus* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 107926.

Original description: Spore 2-celled, strongly constricted in the middle, monohilate [monoporate]; spore wall smooth, one-layered, septum thick; 14 × 8 µm

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene.

13.16. Species: *Hilidicellites teleutosporoides* (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483396.

Figure: In Salard-Chebouldaeff & Locquin 1980: 188, plate 2, figure 12.

Basionym: *Didymoporisporonites teleutosporoides* Sal.-Cheb. & Locq. 1980, Index Fungorum Registration Identifier: 107927.

Original description: Spore 2-celled, septum thick, without central perforation, ellipsoid, slightly constricted at the septum, $32 \times 14 \mu\text{m}$, monohilate [monoporate].

Location and age: Coast of Equatorial Africa, Gulf of Guinea, Cameroon, Africa; Oligocene-Early Miocene.

13.17. Species: *Hilidicellites trivedii* Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483397.

Figure: In Trivedi & Verma 1970: 71, plate 1, figure 10.

Basionym: *Teleutosporites ovatus* Trivedi & C.L. Verma 1970 (nom. inval.).

Original description: Fungal spores two-celled, spore broad in the middle, pointed at both ends, septal wall much thicker, dense, surface smooth, dark colored, spore wall $0.5 \mu\text{m}$ thick. Size: Spore $33 \mu\text{m}$ in length, $25\text{--}30 \mu\text{m}$ in breadth at middle.

Location and age: Near Kuala Lumpur, Malaya; Eocene.

Remarks: Trivedi and Verma (1970) stated that these spores come closest to the teleutospores of rusts. The specific epithet is derived from the oval shape of the spores. Kalgutkar and Jansonius (2000) stated that the species name *T. ovatus* was not validly published by Trivedi and Verma (1970) because it was not assigned to a validly published generic name. They validated the species name and transferred it to *Hilidicellites*. The name *Hilidicellites ovatus* was preoccupied, necessitating a new specific epithet. The species epithet is in honour of Professor B.S. Trivedi, Department of Botany, Lucknow University, Lucknow, India.

13.18. Species: *Hilidicellites varius* (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000

Index Fungorum Registration Identifier: 483398.

Figure: In Ke & Shi 1978: 44, plate 4, figure 4.

Basionym: *Didymoporisporonites varius* P. Ke & Z.Y. Shi 1978, Index Fungorum Registration Identifier: 115688.

Original description: Spores $23.2 \times 11.6 \mu\text{m}$. Twocelled, outline fusiform or elliptical. Monoporate. Septum opaque, about $3 \mu\text{m}$ wide. An arcuate fold appears at the middle of each cell, with the arc of the fold oriented towards the ends of the spore. Spore wall $0.5 \mu\text{m}$ thick. Surface psilate.

Location and age: Nanjiao, Tianjin Municipality, Coastal region of Bohai, China; Eocene-Oligocene.

14. Genus: *Pucciniasporonites* Ramanujam & Ramachar 1980

Index Fungorum Registration Identifier: 28628.

Type species: *Pucciniasporonites arcotensis* Ramanujam & Ramachar 1980.

Original diagnosis: 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 (Ramanujam & Ramachar 1980, p. 82).

Number of species known: One (recorded from India).

14.1. Species: *Pucciniasporonites arcotensis* Ramanujam & Ramachar 1980

Figure 2.AD

Index Fungorum Registration Identifier: 483757.

Original description: Teliospores two-celled by horizontal septum, pedicellate, obovoid to elliptical, $25\text{--}35 \times 10\text{--}12 \mu\text{m}$ excluding stalk, not constricted at septum, individual cells up to $13 \mu\text{m}$ long and $12 \mu\text{m}$ broad; wall chestnut-brown, often darkly so, smooth, up to $3 \mu\text{m}$ thick, pedicel light colored, up to $8 \mu\text{m}$ long;

one germ pore in each cell, faint, up to 2 µm in diameter.

Location and age: Neyveli Lignite Mine, Cuddalore District, Tamil Nadu, India; Miocene.

Remarks: According to Ramanujam and Ramachar (1980), the fossil spores are quite similar to spores of modern *Puccinia*, which parasitizes members of the family Poaceae.

15. Genus: *Valsarites* Puri 1963

Index Fungorum Registration Identifier: 646215.

Type species: *Valsarites senonianus* Puri 1963.

Original Diagnosis (Combined description):

This is an ascospore of some Ascomycota, measuring 21 × 12 µm in the middle of the broader segment. It is divided into two halves by an equatorial wall that is continuous. The lower half is narrower, about 10 µm or so. There seems to be some sort of irregular and faint reticulation. The wall of the spore is not thickened.

Number of species known: One (not recorded from India).

Remarks: According to Puri (1963), spores of this genus resemble ascospores of *Endothia* Fr., *Didymosphaeria* Fuckel, and *Valsaria* Ces. & De Not. Spores of *Valsaria insitiva* (Tode) Ces. & De Not. are closest in size.

15.1. Species: *Valsarites senonianus* Puri 1963

Figure 2.AE

Index Fungorum Registration Identifier: 646216.

Original description: As for the generic diagnosis.

Location and age: Nigeria; Senonian.

16. Genus: *Verrudisporonites* O'Keefe 2017

Type species: *Verrudisporonites elsikianus* O'Keefe 2017.

Index Fungorum Registration Identifier: 821913.

Original diagnosis: Dicellate, diporate fungal spores with broadly fusiform to oval outlines which may or may not be indented at the median septum. Median

septum annulate. Spore axis is straight or nearly so. Typically, 18–24 µm wide × 25–33 µm long. Pores may or may not be surrounded by protruding collars and are typically annulate, the annulus being formed by a thickening of the wall. Pores may be modified by a basal septum into pore chambers, which may be obscured in some species by very thick, dark spore walls. Surface has scattered to abundant verrucae (O'Keefe 2017, p. 322).

Number of species known: One (not recorded from India).

Remarks: The name of the genus is derived from the verrucate spore wall and two cells of this spore.

16.1. Species: *Verrudisporonites elsikianus*
O'Keefe 2017

Figure 2.AF

Index Fungorum Registration Identifier: 821914.

Original description: Description. Dicellate, diporate fungal spore with oval outline and minor indentation at the median septum. Median septum annulate; spore axis straight; 18 mm wide × 25 mm long; pores annulate. Surface has scattered verrucae (O'Keefe 2017, p. 322).

Location and age: Quebrada Bocapán, Tumbes Province, north-western Peru; Miocene (Heath Formation).

Remarks: The specific epithet was chosen to honour Dr. William C. Elsik.

DISTRIBUTION

Altogether, fossil *Didymosporae* are represented by 16 genera, viz. *Ampulliferinites* Kalgutkar & Sigler 1995, *Caldesites* Puri 1963, *Cladosporites* Félix 1894, *Dicellaesporisporites* Kalgutkar 1997, *Dicellaesporites* Elsik 1968, *Didymoporisporonites* Sheffy & Dilcher 1971, *Didymosporonites* Sal.-Cheb. & Locq. 1980, *Diploneurospora* K.P. Jain & R.C. Gupta 1970, *Disparidicellites* Kalgutkar & Janson. 2000, *Dyadosporites* R.T. Clarke 1965, *Felixites* Elsik ex Janson. & Hills 1976, *Fusiformisporites* Rouse 1962, *Hilidicellites* Kalgutkar & Janson. 2000,

Table 1. Showing global distribution of various species of fossil *Didymosporae* and their occurrences in India.

| Country | Species | Reference | Age | |
|---|--|---|------------------------------|--------------------------------|
| Antarctica | <i>Dicellaesporites antarcticus</i> Z.C. Song & Liu Cao 1994 | Song & Cao 1994 | Late Cretaceous | |
| | <i>Dicellaesporites oblongatus</i> Z.C. Song & Liu Cao 1994 | Song & Cao 1994 | Late Cretaceous | |
| | <i>Dyadosporites antarcticus</i> Kalgutkar & Janson. 2000 | Song & Cao 1994 | Late Cretaceous | |
| | <i>Dyadosporites obscurus</i> Z.C. Song & Liu Cao 1994 | Song & Cao 1994 | Late Cretaceous | |
| Arabian Gulf (northern part) | <i>Dicellaesporites arabimarinus</i> Sat. K. Srivast. & Al-Tayyar 2013 | Srivastava & Al-Tayyar 2013 | Aptian to late Albian | |
| Arabian Sea | <i>Hilidicellites indicus</i> (Anil Chandra et al.) Kalgutkar & Janson. 2000 | Chandra et al. 1984 | Late Quaternary | |
| | <i>Hilidicellites siddiquiei</i> (Anil Chandra et al.) Kalgutkar & Janson. 2000 | Chandra et al. 1984 | Late Quaternary | |
| Argentina | <i>Dyadosporites annulatus</i> (E.J. Romero & M.T. Castro) in Martínez et al. 2016. | Romero & Castro 1986 | Palaeogene | |
| Azerbaijan | <i>Cladosporites bipartitus</i> Félix 1894 | Félix 1894 | Eocene | |
| Cameroon | <i>Dicellaesporites africanus</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Dicellaesporites asymmetricus</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Dicellaesporites camerounensis</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene. | |
| | <i>Dicellaesporites guineensis</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Dicellaesporites littoralis</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Didymosporonites saccatus</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Dyadosporites clarkii</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Dyadosporites dyadosporus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Dyadosporites ellipsoideus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Dyadosporites elsikii</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Late Eocene-Oligocene | |
| | <i>Dyadosporites hilatus</i> Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Dyadosporites minor</i> Sal.-Cheb. & Locq. 1980 | Salard-Cheboldaeff & Locquin 1980 | Late Eocene-Oligocene | |
| | <i>Dyadosporites mucronatus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Dyadosporites substrangulatus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Late Eocene-Oligocene | |
| | <i>Hilidicellites crassiseptus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Hilidicellites strangulatus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000; | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | <i>Hilidicellites teleutosporoides</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene-Early Miocene | |
| | <i>Hilidicellites lacrymosus</i> (Sal.-Cheb. & Locq.) Kalgutkar & Janson. 2000 | Salard-Cheboldaeff & Locquin 1980 | Oligocene | |
| | Canada | <i>Ampulliferinites axelheibergii</i> Kalgutkar & Sigler 1995 | Kalgutkar & Sigler 1995 | Late Eocene or Early Oligocene |
| | | <i>Dicellaesporites delitschiapites</i> (Kalgutkar & Sigler) Kalgutkar 1997 | Kalgutkar & Sigler 1995 | Late Palaeocene-Early Eocene |
| | | <i>Dicellaesporites poratus</i> Kalgutkar 1997 | Kalgutkar 1997 | Late Palaeocene-Early Eocene |
| | | <i>Dicellaesporites siglerae</i> (Kalgutkar) Kalgutkar & Janson. 2000 | Kalgutkar 1997 | Late Palaeocene-Early Eocene |
| | | <i>Dicellaesporites cellaequalis</i> Kalgutkar 1993 | Kalgutkar 1993 | Late Palaeocene-Early Eocene |
| <i>Dicellaesporites obnixus</i> G. Norris 1986 | | Norris 1986 | Eocene | |
| <i>Dicellaesporites septoconstrictus</i> Kalgutkar 1993 | | Kalgutkar 1993 | Late Palaeocene-Early Eocene | |
| <i>Didymoporisporonites conicus</i> Kalgutkar 1997 | | Kalgutkar 1997 | Late Palaeocene-Early Eocene | |
| <i>Didymoporisporonites discors</i> Kalgutkar 1993 | | Kalgutkar 1997 | Late Palaeocene-Early Eocene | |
| <i>Dyadosporites inaequalis</i> Kalgutkar 1993 | | Kalgutkar 1993 | Late Palaeocene-Early Eocene | |
| <i>Dyadosporites incisus</i> Kalgutkar 1993 | Kalgutkar 1993 | Late Palaeocene-Early Eocene | | |

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| | <i>Dyadosporites oblongatus</i> (P. Ke & Z.Y. Shi) G. Norris 1986 | Norris 1986 | Eocene-Oligocene |
| | <i>Dyadosporites urniformis</i> Kalgutkar 1993 | Kalgutkar 1993 | Late Palaeocene-Early Eocene |
| | <i>Fusiformisporites annafrancescae</i> G. Norris 1997 | Norris 1997 | Palaeocene-Eocene |
| | <i>Fusiformisporites crabbii</i> Rouse 1962 | Rouse 1962 | Late Cretaceous-Middle Eocene |
| | <i>Fusiformisporites mackenziei</i> M.G. Parsons & G. Norris 1999 | Parsons & Norris 1999 | Early Eocene |
| | <i>Fusiformisporites microstriatus</i> Hopkins 1969 | Hopkins 1969 | Late Eocene-Early Oligocene |
| China | <i>Dicellaesporites cartos</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Dicellaesporites dolium</i> Z.C. Song 1985 | Song 1985 | Palaeocene-Late Eocene; Early Miocene |
| | <i>Dicellaesporites granulatus</i> Z.C. Song 1985 | Song 1985 | Late Pliocene |
| | <i>Dicellaesporites foratus</i> Zhong Y. Zhang 1980 | Zhang 1980 | Early Pliocene |
| | <i>Dicellaesporites largelongatus</i> Kalgutkar & Janson. 2000 | Song 1985 | Oligocene |
| | <i>Dicellaesporites lenghuensis</i> Z.C. Song 1985 | Song 1985 | Palaeocene - Late Eocene; Early-Late Miocene |
| | <i>Dicellaesporites major</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Palaeocene - Late Eocene; Early Miocene – Early Pliocene |
| | <i>Dicellaesporites megafusififormis</i> Z.C. Song & G.X. Li in Z.C. Song et al. 1989 | Song et al. 1989 | Eocene-Oligocene |
| | <i>Dicellaesporites mollis</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Late Eocene |
| | <i>Dicellaesporites ovatus</i> Z.C. Song & H.C. Luo in Song et al. 1989 | Song et al. 1989 | Eocene-Oligocene |
| | <i>Dicellaesporites reniformis</i> Zhong Y. Zhang 1980 | Zhang 1980 | Late Eocene-Middle Oligocene |
| | <i>Dicellaesporites subaequatus</i> Zhong Y. Zhang 1980 | Zhang 1980 | Oligocene |
| | <i>Dicellaesporites suborbicularis</i> Z.C. Song & G.X. Li in Song et al. 1989 | Song et al. 1989 | Oligocene |
| | <i>Dicellaesporites volubilis</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Late Oligocene |
| | <i>Didymoporisporonites discitypicus</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Didymoporisporonites elegans</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Didymoporisporonites panshanensis</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Didymoporisporonites triangulus</i> P. Ke & Z.Y. Shi 1978 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Disparidicellites paradoxus</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Dyadosporites megaporus</i> (Z.C. Song) Z.C. Song in Song et al. 1999 | Song et al. 1999 | Palaeocene-Late Eocene; Middle Miocene-Late Miocene |
| | <i>Dyadosporites solidus</i> (P. Ke & Z.Y. Shi) Z.C. Song in Song et al. 1999 | Ke & Shi 1978 | Late Pliocene. |
| | <i>Dyadosporites stenosis</i> (Z.C. Song & G.X. Li in Song et al.) Z.C. Song in Song et al. 1999 | Song et al. 1999 | Eocene-Oligocene |
| | <i>Fusiformisporites striatus</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Late Eocene-Middle Oligocene |
| | <i>Hilidicellites henanensis</i> (Z.C. Song & G.X. Li in Song et al.) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Hilidicellites major</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Late Eocene-Early Oligocene |
| | <i>Hilidicellites oblongatus</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Hilidicellites ovatus</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| | <i>Hilidicellites varius</i> (P. Ke & Z.Y. Shi) Kalgutkar & Janson. 2000 | Ke & Shi 1978 | Eocene-Oligocene |
| Colombia | <i>Dicellaesporites rinconii</i> Doub. & D. Pons 1973 | Doubinger & Pons 1973 | Palaeocene-Eocene |
| | <i>Fusiformisporites duenasi</i> Kalgutkar & Janson. 2000 | Dueñas 1979 | Pleistocene |
| India | <i>Dicellaesporites campanulatus</i> Ambwani 1983 | Late Miocene or Pliocene. | Late Miocene or Pliocene |
| | <i>Dicellaesporites classicus</i> R.K. Saxena & S.K.M. Tripathi 2011 | Saxena & Tripathi 2011 | Early Miocene |
| | <i>Dicellaesporites constrictus</i> S.C.D. Sah & R.K. Kar 1974 | Sah & Kar 1974 | Early Eocene |
| | <i>Dicellaesporites ellipticus</i> K.P. Jain & R.K. Kar 1979 | Jain & Kar 1979 | Miocene |
| | <i>Dicellaesporites elongatus</i> Ramanujam & K.P. Rao 1978 | Ramanujam & Rao 1978 | Miocene |
| | <i>Dicellaesporites elsikii</i> B. Samant in R.K. Saxena 2009 | Samant 2000 | Early Eocene |
| | <i>Dicellaesporites himachalensis</i> R.K. Saxena & A.P. Bhattacharya. 1990 | Saxena & Bhattacharyya. 1990 | Oligocene-Early Miocene |
| | <i>Dicellaesporites inaequalis</i> (Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson. 2000 | Varma & Patil 1985 | Miocene |
| | <i>Dicellaesporites indicus</i> A. Gupta 2002 | Gupta 2002 | Miocene |
| | <i>Dicellaesporites intertrappea</i> Sonkusare et al. ex R.K. Saxena & P.M. Kirk 2022 | Sonkusare et al. 2021 | Eocene |
| | <i>Dicellaesporites jainii</i> R.K. Saxena & S.K.M. Tripathi 2011 | Saxena & Tripathi 2011 | Maastrichtian |
| | <i>Dicellaesporites keralensis</i> P. Kumar 1990 | Kumar 1990 | Palaeocene |
| | <i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena 1976 | Kar & Saxena 1976 | Early-Middle Miocene |
| | | | Palaeocene |

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| | <i>Dicellaesporites perelongatus</i> Kalgutkar & Janson. 2000 | Kumar 1990 | Early-Middle Miocene |
| | <i>Didymoporisporonites gigas</i> Kalgutkar & Janson. 2000 | Saxena & Singh 1983 | Miocene-Pliocene |
| | <i>Didymoporisporonites longus</i> (R.K. Kar) Kalgutkar & Janson. 2000 | Kar 1979 | Oligocene |
| | <i>Diploneurospora tewarii</i> K.P. Jain & R.C. Gupta 1970 | Jain & Gupta 1970 | Miocene |
| | <i>Dyadosporites bhardwaji</i> (C.P. Varma & Rawat) Kalgutkar & Janson. 2000 | Varma & Rawat 1963 | Eocene-Miocene |
| | <i>Dyadosporites camnanorensis</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 | Ramanujam & Rao 1978 | Miocene |
| | <i>Dyadosporites denticulatus</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 | Ramanujam & Rao 1978 | Miocene |
| | <i>Dyadosporites dubius</i> P. Kumar 1990 | Kumar 1990 | Early-Middle Miocene |
| | <i>Dyadosporites grandiporus</i> (H.P. Singh et al.) Kalgutkar & Janson. 2000 | Singh et al. 1986 | Early Miocene |
| | <i>Dyadosporites novus</i> P. Kumar 1990 | Kumar 1990 | Early-Middle Miocene |
| | <i>Dyadosporites reticulatus</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 | Ramanujam & Rao 1978 | Miocene |
| | <i>Dyadosporites sahnii</i> (C.P. Varma & Rawat) Kalgutkar & Janson. 2000 | Varma & Rawat 1963 | Eocene-Miocene |
| | <i>Dyadosporites scabratus</i> (P. Kumar) Kalgutkar & Janson. 2000 | Kumar 1990 | Early-Middle Miocene |
| | <i>Dyadosporites singhii</i> R.K. Saxena et al. 2021 | Singh et al. 1985 | Oligocene |
| | <i>Dyadosporites udarii</i> (A. Gupta) Kalgutkar & Janson. 2000 | Gupta 2002 | Oligocene |
| | <i>Dyadosporites verrucatus</i> (Ramanujam & Srisailam) Kalgutkar & Janson. 2000 | Ramanujam & Srisailam 1981 | Miocene |
| | <i>Dyadosporites wilkinsonii</i> (R.K. Saxena & N.K. Misra) Kalgutkar & Janson. 2000 | Saxena & Misra 1990 | Neogene |
| | <i>Fusiformisporites acutus</i> P. Kumar 1990 | Kumar 1990 | Early-Middle Miocene |
| | <i>Fusiformisporites barmerensis</i> R.K. Saxena & S.K.M. Tripathi 2011 | Jain et al. 1973 | Palaeocene |
| | <i>Fusiformisporites elongatus</i> Ramanujam & K.P. Rao 1978 | Ramanujam & K.P. Rao 1978 | Miocene |
| | <i>Fusiformisporites foedus</i> S.K. Salujha et al. 1974 | Salujha et al. 1974 | Palaeocene |
| | <i>Fusiformisporites keralensis</i> Ramanujam & K.P. Rao 1978 | Ramanujam & Rao 1978 | Miocene |
| | <i>Fusiformisporites sahnii</i> R.K. Saxena et al. 2021 | Saxena et al. 2021 | Late Palaeocene-Middle Eocene |
| | <i>Pucciniasporonites arcotensis</i> Ramanujam & Ramachar 1980 | Ramanujam & Ramachar 1980 | Miocene |
| | <i>Hilidicellites constrictus</i> (Y.K. Mathur & K. Mathur) Kalgutkar & Janson. 2000 | Mathur & Mathur 1969 | Pliocene. |
| | <i>Hilidicellites dubius</i> Kalgutkar & Janson. 2000 | Ramanujam & Srisailam 1981 | Miocene |
| Malaya | <i>Dicellaesporites longus</i> (Trivedi & C.L. Verma) Kalgutkar & Janson. 2000 | Trivedi & Verma 1970 | Eocene |
| | <i>Hilidicellites trivedii</i> Kalgutkar & Janson. 2000 | Trivedi & Verma 1970 | Eocene |
| Mexico | <i>Dicellaesporites inaequabilis</i> Mart.-Hern. & Tom.-Ort. 1989 | Martínez-Hernández & Tomasini-Ortiz 1989 | Maastrichtian |
| | <i>Dicellaesporites scaber</i> Mart.-Hern. & Tom.-Ort. 1989 | Martínez-Hernández & Tomasini-Ortiz 1989 | Maastrichtian |
| | <i>Dicellaesporites scaber</i> Mart.-Hern. & Tom.-Ort. 1989 | Martínez-Hernández & Tomasini-Ortiz 1989 | Maastrichtian |
| | <i>Dyadosporites inornatus</i> (Mart.-Hern. & Tom.-Ort.) Kalgutkar & Janson. 2000 | Martínez-Hernández & Tomasini-Ortiz 1989 | Campanian |
| | <i>Dicellaesporites himalayaensis</i> A. Gupta 2002 | Gupta 2002 | Eocene |
| | <i>Dicellaesporites singhii</i> R.K. Saxena & S.K.M. Tripathi 2011 | Saxena & Tripathi 2011 | Pliocene |
| | <i>Dicellaesporites vermae</i> R.K. Saxena et al. 2021 | Saxena et al. 2021 | Early Miocene |
| | <i>Fusiformisporites striaoctoformis</i> Mart.-Hern. & Tom.-Ort. 1989 | Martínez-Hernández & Tomasini-Ortiz 1989 | Maastrichtian |
| | <i>Hilidicellites oviformis</i> (Mart.-Hern. & Tom.-Ort.) Kalgutkar & Janson. 2000 | Martínez-Hernández & Tomasini-Ortiz 1989 | Maastrichtian |
| Nigeria | <i>Valsarites senonianus</i> Puri 1963 | Puri 1963 | Senonian |
| Norway (Spitsbergen) | 12.1. Species: <i>Felixites playfordii</i> Elsik 1990b | Elsik 1990b | Early Carboniferous |
| | <i>Felixites pollenisimilis</i> (Horst) Elsik 1990b | Playford 1962 | Carboniferous |
| | | Butterworth & Williams 1958 | |
| Peru | <i>Verrudisporonites elsikianus</i> O'Keefe 2017 | O'Keefe 2017 | Miocene |
| Poland | <i>Felixites pollenisimilis</i> (Horst) Elsik 1990b | Horst 1955 | Carboniferous |
| Taiwan | <i>Dyadosporites taiwanensis</i> T.C. Huang 1981 | Huang 1981 | Miocene |
| | <i>Fusiformisporites taiwanensis</i> T.C. Huang 1981 | Huang 1981 | Miocene |
| Turkey | <i>Dicellaesporites akoyolii</i> V.S. Ediger & Alisan 1989 | Ediger & Alisan 1989 | Middle?-Late Eocene to Late Oligocene, Miocene-Pliocene |
| | <i>Dicellaesporites nakomanii</i> V.S. Ediger & Alisan 1989 | Ediger & Alisan 1989 | Middle?-Late Eocene to Late Oligocene, Miocene-Pliocene |
| | <i>Dicellaesporites nodusus</i> V.S. Ediger 1981 | Ediger 1981 | Late Eocene-Oligocene |
| | <i>Dyadosporites okayi</i> (V.S. Ediger & Alisan) Kalgutkar & Janson. 2000 | Ediger & Alisan 1989 | Miocene-Pliocene |
| | | | Middle?-Late Eocene to Late Oligocene, Miocene-Pliocene. |
| U.S.A. | <i>Cladosporites fasciculatus</i> E.W. Berry 1916 | Berry 1916 | Middle Eocene |

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| <i>Cladosporites oligocaenicus</i> E.W. Berry 1916 | Berry 1916 | Early Oligocene |
| <i>Dicellaesporites aculeolatus</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites bigeminatus</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites disphaericus</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites fragilis</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites fusiformis</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites granuliformis</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites levis</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dicellaesporites popovii</i> Elsik 1968 | Elsik 1968 | Palaeocene |
| <i>Didymoporisporonites inaequalis</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Didymoporisporonites psilatus</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dyadosporites acutus</i> (Rouse & Mustard) Kalgutkar & Janson. 2000 | Rouse & Mustard 1997 | Late mid-Eocene-Early late Eocene |
| <i>Dyadosporites didymus</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dyadosporites ellipsus</i> R.T. Clarke 1965 | Clarke 1965 | Late Cretaceous |
| <i>Dyadosporites puryearensis</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Dyadosporites quadratus</i> (Rouse & Mustard) Kalgutkar & Janson. 2000 | Rouse & Mustard 1997 | Late mid-Eocene-Early late Eocene |
| <i>Dyadosporites schwabii</i> (Elsik) Kalgutkar & Janson. 2000 | Elsik 1968 | Palaeocene |
| <i>Dyadosporites subovalis</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Fusiformisporites lineatus</i> Rouse & Mustard 1997 | Rouse & Mustard 1997 | Late Eocene-Early Oligocene |
| <i>Fusiformisporites lineolatus</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Fusiformisporites marii</i> Elsik 1968 | Elsik 1968 | Palaeocene |
| <i>Fusiformisporites paucistriatus</i> Rouse & Mustard 1997 | Rouse & Mustard 1997 | Late Palaeocene |
| <i>Fusiformisporites pseudocrabbii</i> Elsik 1968 | Elsik 1968 | Palaeocene |
| <i>Fusiformisporites rugosus</i> Sheffy & Dilcher 1971 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Hilidicellites appendiculatus</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Hilidicellites normalis</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |
| <i>Hilidicellites obtectus</i> (Sheffy & Dilcher) Kalgutkar & Janson. 2000 | Sheffy & Dilcher 1971 | Middle Eocene |

Pucciniasporonites Ramanujam & Ramachar 1980, *Valsarites* Puri 1963 and *Verrudisporonites* O'Keefe 2017 and 166 species. These have been recorded from widespread areas, e.g. Antarctica, Arabian Gulf (northern part), Arabian Sea, Argentina, Azerbaijan, Cameroon, Canada, China, Colombia, India, Malaya, Mexico, Nigeria, Norway (Spitsbergen), Peru, Poland, Taiwan, Turkey and U.S.A. Global distribution of various species of fossil *Didymosporae* is summarized in Table 1. The dominant genera, both in number and variety, are *Dicellaesporites* (61 spp.), *Dyadosporites* (41 spp.), *Fusiformisporites* (20 spp.), *Hilidicellites* (18 spp.) and *Didymoporisporonites* (10 spp.).

Distribution in India: In India, fossil *Didymosporae* is represented by 7 genera, viz. *Dicellaesporites* Elsik 1968, *Didymoporisporonites*

Sheffy & Dilcher 1971, *Diploneurospora* Jain & Gupta 1970, *Dyadosporites* Hammen 1954 ex R.T. Clarke 1965, *Fusiformisporites* Rouse 1962, *Hilidicellites* Kalgutkar & Janson. 2000 and *Pucciniasporonites* Ramanujam & Ramachar 1980 and 52 species. These have been recorded from many areas, e.g. Arabian Sea, Gujarat (Kutch and Cambay basins), Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Meghalaya-Assam, Punjab, Rajasthan, Tamil Nadu and West Bengal. Distribution of various species of fossil *Didymosporae* in various states of India is summarized in Table 2. Distribution of species of fossil *Didymosporae* in India, with stratigraphic unit (geologic age) and areas of their occurrence, along with citation of relevant References is summarized in Tables 2 and 3.

Table 2. Representation of species of fossil *Didymosporae* in various states of India.

| Geographical area | Species recorded (References) |
|-----------------------------------|---|
| Andhra Pradesh | <i>Dicellaesporites popovii</i> Elsik: Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh (Ambwani 1982). |
| Arabian Sea | <i>Dicellaesporites jainii</i> R.K. Saxena & S.K.M. Tripathi: Late Quaternary, Core no. 5, Arabian Sea (Chandra et al. 1984). <i>Dicellaesporites singhii</i> R.K. Saxena & S.K.M. Tripathi: Late Quaternary, Core no. 1, Arabian Sea (Chandra et al. 1984). <i>Hilidicellites indicus</i> (Anil Chandra et al.) Kalgutkar & Janson.: Late Quaternary, Sediment core no. 1, Arabian Sea (Chandra et al. 1984). <i>Hilidicellites siddiquiei</i> (Anil Chandra et al.) Kalgutkar & Janson.: Late Quaternary, Sediment core no. 2, Arabian Sea (Chandra et al. 1984). |
| Arunachal Pradesh | <i>Hilidicellites constrictus</i> (Y.K. Mathur & K. Mathur) Kalgutkar & Janson.: Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh (Mandaokar 2000c). |
| Gujarat (Kutch and Cambay basins) | <i>Dicellaesporites elsikii</i> B. Samant in Saxena: Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat (Samant 2000). <i>Dicellaesporites keralensis</i> P. Kumar: Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat (Samant 2000). <i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat (Kar & Saxena 1976). <i>Dicellaesporites popovii</i> Elsik: Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat (Kar & Saxena 1976); Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat (Samant & Phadtare 1997). <i>Didymoporisporonites longus</i> (R.K. Kar) Kalgutkar & Janson.: Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat (Kar 1979); Middle Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar & Saxena 1981, Kar 1985). <i>Dyadosporites udarii</i> (A. Gupta) Kalgutkar & Janson.: Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat (Kar 1979); Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar & Saxena 1981). <i>Hilidicellites constrictus</i> (Y.K. Mathur & K. Mathur) Kalgutkar & Janson.: Pliocene, Naera and Baraia area, Kutch District, Gujarat (Mathur & Mathur 1969, Kar 1985); Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar 1985). |
| Haryana | <i>Dicellaesporites levis</i> Sheffy & Dilcher: Subathu Formation (Late Ypresian-Middle Lutetian) west bank of Ghaggar river near Kharak village, Morni Hills, Haryana (Sarkar & Prasad 2000b). |
| Himachal Pradesh | <i>Dicellaesporites ellipticus</i> K.P. Jain & R.K. Kar: Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh (Saxena & Bhattacharyya 1990). <i>Dicellaesporites elongatus</i> Ramanujam & K.P. Rao: Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh (Singh & Sarkar 1994). <i>Dicellaesporites fusiformis</i> Sheffy & Dilcher: Middle Siwalik (Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh (Saxena et al. 1984). <i>Dicellaesporites himachalensis</i> R.K. Saxena & A.P. Bhattach.: Lower Dharmsala Group (Early Miocene), Manjhi Khad Section near Dharmsala, Kangra District, Himachal Pradesh (Saxena & Bhattacharyya 1990). <i>Dicellaesporites himalayaensis</i> A. Gupta: Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh (Gupta 2002). <i>Dicellaesporites indicus</i> A. Gupta: Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh (Gupta 2002). <i>Dicellaesporites levis</i> Sheffy & Dilcher: Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh (Sarkar & Singh 1988). <i>Dicellaesporites singhii</i> R.K. Saxena & S.K.M. Tripathi: Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh (Saxena & Singh 1983). <i>Didymoporisporonites gigas</i> Kalgutkar & Janson.: Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh (Saxena & Singh 1983). |
| Kerala | <i>Dicellaesporites aculeolatus</i> Sheffy & Dilcher: Miocene, Kerala (Ramanujam & Rao 1978). <i>Dicellaesporites ellipticus</i> K.P. Jain & R.K. Kar: Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979). <i>Dicellaesporites elongatus</i> Ramanujam & K.P. Rao: Miocene, Kerala (Ramanujam & Rao 1978). <i>Dicellaesporites inaequalis</i> (Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson.: Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985). <i>Dicellaesporites keralensis</i> P. Kumar: Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990). <i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Miocene, Kerala (Ramanujam & Rao 1978). <i>Dicellaesporites perelongatus</i> Kalgutkar & Janson.: Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990). <i>Dicellaesporites popovii</i> Elsik: Miocene, Kerala (Ramanujam & Rao 1978); Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala (Rao & Nair 1998). <i>Didymoporisporonites longus</i> (R.K. Kar) Kalgutkar & Janson.: Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979). <i>Diploneurospora tewarii</i> K.P. Jain & R.C. Gupta: Early Miocene, Padappakkara, Kollam District, Kerala (Jain & Gupta 1970). <i>Dyadosporites kannanorensis</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Miocene, Kerala (Ramanujam & Rao 1978); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985). <i>Dyadosporites denticulatus</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Miocene, Kerala (Ramanujam & Rao 1978); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985). |

- Dyadosporites dubius* P. Kumar: Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990).
- Dyadosporites novus* P. Kumar: Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990).
- Dyadosporites reticulatus* (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Quilon and Warkalli beds (Miocene), Kerala (Ramanujam & Rao 1978); Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980).
- Dyadosporites scabratus* (P. Kumar) Kalgutkar & Janson.: Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990).
- Dyadosporites schwabii* (Elsik) Kalgutkar & Janson.: Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979); Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985).
- Dyadosporites verrucatus* (Ramanujam & Srisailam) Kalgutkar & Janson.: Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980).
- Hilidicellites dubius* Kalgutkar & Janson.: Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985).
- Madhya Pradesh *Dicellaesporites intertrappea* Sonkusare et al. ex R.K. Saxena & P.M. Kirk: Intertrappean chert (Maastriichtian), Kanhobagholi, Betul District, Madhya Pradesh (Sonkusare et al. 2021).
- Maharashtra *Dicellaesporites fusiformis* Sheffy & Dilcher: Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990).
- Dicellaesporites inaequalis* (Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson.: Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra (Saxena 2000).
- Dicellaesporites popovii* Elsik: Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990).
- Dyadosporites wilkinsonii* (R.K. Saxena & N.K. Misra) Kalgutkar & Janson.: Sindhudurg Formation (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990).
- Meghalaya-Assam *Dicellaesporites classicus* R.K. Saxena & S.K.M. Tripathi: Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986).
- Dicellaesporites fusiformis* Sheffy & Dilcher: Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986); Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam (Mandaokar 2000b).
- Dicellaesporites minutus* R.K. Kar & R.K. Saxena: Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya (Tripathi 1989); Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya (Ambwani 1993); Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya (Saxena & Rao 1996).
- Dicellaesporites perelongatus* Kalgutkar & Janson.: Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya (Tripathi et al. 2000).
- Dicellaesporites popovii* Elsik: Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya (Tripathi 1989).
- Dicellaesporites vermae* R.K. Saxena et al.: Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar, Assam (Saxena et al. 2021).
- Didymoporisporonites longus* (R.K. Kar) Kalgutkar & Janson.: Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya (Ambwani 1993).
- Dyadosporites grandiporus* (H.P. Singh et al.) Kalgutkar & Janson.: Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986).
- Dyadosporites reticulatus* (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya (Misra et al. 1996).
- Hilidicellites constrictus* (Y.K. Mathur & K. Mathur) Kalgutkar & Janson.: Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya (Misra et al. 1996); Subsurface Tertiary sediments in Upper Assam (Kar et al. 1994).
- Mizoram *Dicellaesporites minutus* R.K. Kar & R.K. Saxena: Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram (Mandaokar 2000a); Dulte Formation (Early Miocene), 2 km from Dulte Village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a); Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhimituipui District, Mizoram (Mandaokar 2003); Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004).
- Dicellaesporites perelongatus* Kalgutkar & Janson.: Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004); Bhuban Formation (Miocene), Tlamsam, Mizoram (Kar et al. 2010).
- Didymoporisporonites longus* (R.K. Kar) Kalgutkar & Janson.: Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a).
- Dyadosporites ellipsus* R.T. Clarke: Bhuban Formation (Miocene), Tlamsam, Mizoram (Kar et al. 2010).
- Dyadosporites udarii* (A. Gupta) Kalgutkar & Janson.: Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a).
- Nagaland *Dicellaesporites minutus* R.K. Kar & R.K. Saxena: Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland (Mandaokar 2002b).

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| Rajasthan | <p><i>Dicellaesporites constrictus</i> S.C.D. Sah & R.K. Kar: Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan (Sah & Kar 1974).</p> <p><i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan (Tripathi 1995).</p> <p><i>Dicellaesporites jainii</i> R.K. Saxena & S.K.M. Tripathi: Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan (Jain et al. 1973).</p> <p><i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan (Tripathi et al. 2003).</p> <p><i>Dicellaesporites popovii</i> Elsik: Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan (Tripathi 1995); Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan (Tripathi et al. 2003); Akli Formation (Early Palaeocene), Borehole near Barakha, Barmer District, Rajasthan (Singh & Tripathi 2010).</p> <p><i>Fusiformisporites barmerensis</i> R.K. Saxena & S.K.M. Tripathi: Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan (Jain et al. 1973).</p> |
| Tamil Nadu | <p><i>Dicellaesporites campanulatus</i> Ambwani: Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ambwani 1983).</p> <p><i>Dicellaesporites disphaericus</i> Sheffy & Dilcher: Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ambwani 1983).</p> <p><i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleshm et al. 1989).</p> <p><i>Dyadosporites kannanorensis</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleshm et al. 1989).</p> <p><i>Hilidicellites constrictus</i> (Y.K. Mathur & K. Mathur) Kalgutkar & Janson.: Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleshm et al. 1989).</p> <p><i>Hilidicellites dubius</i> Kalgutkar & Janson.: Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleshm et al. 1989).</p> <p><i>Pucciniasporonites arcotensis</i> Ramanujam & Ramachar: Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ramanujam & Ramachar 1980).</p> |
| West Bengal | <p><i>Dicellaesporites elongatus</i> Ramanujam & K.P. Rao: Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984).</p> <p><i>Dicellaesporites minutus</i> R.K. Kar & R.K. Saxena: Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984); Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya (Mitra et al. 2000).</p> <p><i>Didymosporites psilatus</i> Sheffy & Dilcher: Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984).</p> <p><i>Dyadosporites bhardwaji</i> (C.P. Varma & Rawat) Kalgutkar & Janson.: Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam (Varma & Rawat 1963).</p> <p><i>Dyadosporites denticulatus</i> (Ramanujam & K.P. Rao) Kalgutkar & Janson.: Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984).</p> <p><i>Dyadosporites sahnii</i> (C.P. Varma & Rawat) Kalgutkar & Janson.: Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam (Varma & Rawat 1963).</p> <p><i>Dyadosporites schwabii</i> (Elsik) Kalgutkar & Janson.: Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984).</p> |

Table 3. Distribution of species of fossil *Didymosporae* in India with stratigraphic unit (age) and area of their occurrence.

| Genus | Species | Stratigraphic unit, age and areas of occurrences (References) |
|---------------------------------------|--|---|
| <i>Dicellaesporites</i> Elsik 1968 | <i>D. aculeolatus</i> Sheffy & Dilcher 1971 | Miocene, Kerala (Ramanujam & Rao 1978, p. 295, plate 1, figure 11). |
| | <i>D. campanulatus</i> Ambwani 1983 | Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ambwani 1983, p. 148, plate 1, figure 1). |
| | <i>D. classicus</i> R.K. Saxena & S.K.M. Tripathi 2011 | Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986, p. 98, plate 2, figure 23). |
| | <i>D. constrictus</i> S.C.D. Sah & R.K. Kar 1974 | Palana lignite (Early Eocene), Palana, Bikaner District, Rajasthan (Sah & Kar 1974, p. 181, plate 4, figure 99). |
| | <i>D. disphaericus</i> Sheffy & Dilcher 1971 | Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ambwani 1983, p. 149, plate 1, figure 2). |
| | <i>D. ellipticus</i> K.P. Jain & R.K. Kar 1979 | Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979, p. 110, plate 2, figures 31–32, Jain & Kar 1979, p. 110, plate 2, figures 31–32); Dharmsala Group (Oligocene-Early Miocene), Churan Khad Section near Dharmsala, Kangra District, Himachal Pradesh (Saxena & Bhattacharyya 1990, p. 13). |
| | <i>D. elongatus</i> Ramanujam & K.P. Rao 1978 | Miocene, Kerala (Ramanujam & Rao 1978, p. 295, plate 1, figures 9–10); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 248, plate 1, figure 8); Kasauli Formation (Early Miocene), Kasauli, Solan District, Himachal Pradesh (Singh & Sarkar 1994, p. 52). |
| | <i>D. elsikii</i> B. Samant in Saxena 2009 | Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat (Samant 2000, p. 12, plate 1, figure 7). |

- D. fusiformis*** Sheffy & Dilcher 1971 Middle Siwalik (Early Pliocene), Bhakra-Nangal Section, Bilaspur District, Himachal Pradesh (Saxena et al. 1984, p. 186, plate 2, figure 29); Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986, p. 97, plate 2, figure 7); Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990, p. 265); Tikak Parbat Formation (Late Oligocene), Jeypore Colliery, Dilli-Jeypore Coalfields, Dibrugarh District, Assam (Mandaokar 2000b, p. 181).
- D. himachalensis*** R.K. Saxena & A.P. Bhattach. 1990 Lower Dharmasala Group (Early Miocene), Manjhi Khad Section near Dharmasala, Kangra District, Himachal Pradesh (Saxena & Bhattacharyya 1990, p. 113, plate 2, figure 9).
- D. himalayaensis*** A. Gupta 2002 Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh (Gupta 2002, p. 131, plate 2, figure 1).
- D. inaequalis*** (Y.N.R. Varma & R.S. Patil) Kalgutkar & Janson. 2000 Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 153, plate 1, figure 7); Sindhudurg Formation (Miocene), Mavli Mine at Redi, Sindhudurg District, Maharashtra (Saxena 2000, p. 163).
- D. indicus*** A. Gupta 2002 Subathu Formation (Eocene), Jamtah Road Section, Sirmaur District, Himachal Pradesh (Gupta 2002, p. 132, plate 2, figure 2).
- D. jainii*** R.K. Saxena & S.K.M. Tripathi 2011 Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan (Jain et al. 1973, p. 161, plate 2, figure 67); Late Quaternary, Core no. 5, Arabian Sea (Chandra et al. 1984, p. 46, plate 2, figure 12).
- D. keralensis*** P. Kumar 1990 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 20, plate 1, figure 12, text-figure 9); Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat (Samant 2000, p. 16, plate 1, figure 6).
- D. levis*** Sheffy & Dilcher 1971 Subathu Formation (Eocene), Banethi-Bagthan area, Sirmaur District, Himachal Pradesh (Sarkar & Singh 1988, p. 58-59, plate 5, figure 2); Subathu Formation (Late Ypresian-Middle Lutetian) west bank of Ghaggar river near Kharak village, Morni Hills, Haryana (Sarkar & Prasad 2000b, p. 147).
- D. minutus*** R.K. Kar & R.K. Saxena 1976 Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat (Kar & Saxena 1976, p. 10, plate 3, figure 28); Miocene, Kerala (Ramanujam & Rao 1978, p. 295, plate 1, figures 9-10); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 248, plate 1, figure 8); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleshram et al. 1989, p. 18, plate 1, figure 5); Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya (Tripathi 1989, p. 73, plate 3, figure 12); Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya (Ambwani 1993, p. 153); Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan (Tripathi 1995, p. 47); Boldamgiri Formation (Early Miocene), Adugiri-Purakhasia Road near Boldamgiri, West Garo Hills District, Meghalaya (Saxena & Rao 1996, p. 46, plate 3, figure 17); Bhuban Formation (Early Miocene), Ramrikawn near Chandmari, Aizawl District, Mizoram (Mandaokar 2000a, p. 320); Siwalik Group (Neogene), Darjeeling Foothills, Eastern Himalaya (Mitra et al. 2000, p. 126, plate 1, figure 5); Dulte Formation (Early Miocene), 2 km from Dulte Village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a, p. 116); Tikak Parbat Formation (Late Oligocene), Borjan Coalfield, Nagaland (Mandaokar 2002b, p. 21); Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhimituipui District, Mizoram (Mandaokar 2003, p. 187); Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan (Tripathi et al. 2003, p. 90); Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004, p. 146).
- D. perelongatus*** Kalgutkar & Janson. 2000 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 20, plate 1, figure 9, text-figure 8); Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya (Tripathi et al. 2000, p. 243); Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004, p. 146); Bhuban Formation (Miocene), Tlamsam, Mizoram (Kar et al. 2010, p. 242).
- D. popovii*** Elsik 1968 Matanomadh Formation (Palaeocene), Matanomadh, Kutch District, Gujarat (Kar & Saxena 1976, p. 10, plate 3, figure 27); Miocene, Kerala (Ramanujam & Rao 1978, p. 295, plate 1, figure 8); Deccan Intertrappean Series (Early Eocene), Kotta-Bommuru near Rajahmundry, East Godavari District, Andhra Pradesh (Ambwani 1982, p. 30, plate 1, figure 10); Therria Formation (Palaeocene), Jowai-Sonapur Road Section, Jaintia Hills District, Meghalaya (Tripathi 1989, p. 73, plate 1, figure 7); Ratnagiri Beds (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990, p. 265); Palaeocene-Eocene, subsurface sediments near Kapurdi, Barmer District, Rajasthan (Tripathi 1995, p. 47); Tarkeshwar Formation (Early Eocene), Rajpardi, Cambay Basin, Gujarat (Samant & Phadtare 1997, p. 66, plate 15, figure 6); Miocene, Kannanellur-Kundra Road area, Kollam District, Kerala (Rao & Nair 1998, p. 52); Akli Formation (Late Palaeocene), Barmer Basin, Rajasthan (Tripathi et al. 2003, p. 90); Akli Formation (Early Palaeocene), Borehole near Barakha, Barmer District, Rajasthan (Singh & Tripathi 2010, p. 11, plate 1, figure 12).
- D. singhii*** R.K. Saxena & S.K.M. Tripathi 2011 Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh (Saxena & Singh 1982a, p. 294, plate 2, figure 26); Late Quaternary, Core no. 1, Arabian Sea (Chandra et al. 1984, p. 46, plate 2, figure 11).
- D. vermae*** R.K. Saxena et al. 2021 Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar, Assam (Saxena et al. 2021, p. 839, figure 9P).

- Didymoporisporites*** Sheffy & Dilcher 1971
- D. gigas*** Kalgutkar & Janson. 2000 Upper Siwalik (Pliocene), Hoshiarpur-Una Road Section, Hoshiarpur District, Punjab and Una District, Himachal Pradesh (Saxena & Singh 1982a, p. 295, plate 2, figure 27).
- D. longus*** (R.K. Kar) Kalgutkar & Janson. 2000 Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat (Kar 1979, p. 33, plate 3, figure 56); Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979, p. 112, plate 3, figure 47); Middle Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar & Saxena 1981, p. 106); Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar 1985, p. 130); Palaeocene-Early Eocene, Rekmangiri Coalfield, Garo Hills, Meghalaya (Ambwani 1993, p. 153); Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a, p. 116).
- D. psilatus*** Sheffy & Dilcher 1971 Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 248, plate 1, figure 7).
- Diploneurospora*** Jain & Gupta 1970
- D. tewarii*** K.P. Jain & R.C. Gupta 1970 Early Miocene, Padappakkara, Kollam District, Kerala (Jain & Gupta 1970, p. 180, plate 1, figure 21).
- Dyadosporites*** Hammen 1954 ex R.K. Clarke 1965
- D. bhardwaji*** (C.P. Varma & Rawat) Kalgutkar & Janson. 2000 Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam (Varma & Rawat 1963, p. 133, figure 10).
- D. kannanorensis*** (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 Miocene, Kerala (Ramanujam & Rao 1978, p. 295-296, plate 1, figure 13); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Malleham et al. 1989, p. 15).
- D. denticulatus*** (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 Miocene, Kerala (Ramanujam & Rao 1978, p. 296, plate 1, figure 14); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 249, plate 1, figure 12); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156).
- D. dubius*** P. Kumar 1990 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 22, plate 1, figure 19, text-figure 13).
- D. ellipsus*** R.T. Clarke 1965 Bhuban Formation (Miocene), Tlamsam, Mizoram (Kar et al. 2010, p. 242).
- D. grandiporus*** (H.P. Singh et al.) Kalgutkar & Janson. 2000 Dona Member, Bhuban Formation (Early Miocene), Sonapur-Badarpur Road Section, Jaintia Hills, Meghalaya and Cachar District, Assam (Singh et al. 1986, p. 100, plate 2, figures 6, 22).
- D. novus*** P. Kumar 1990 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 21, plate 1, figure 16, text-figure 12).
- D. reticulatus*** (Ramanujam & K.P. Rao) Kalgutkar & Janson. 2000 Quilon and Warkalli beds (Miocene), Kerala (Ramanujam & Rao 1978, p. 295, plate 1, figure 12); Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980, p. 126, plate 2, figure 18); Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya (Misra et al. 1996, p. 95).
- D. sahnii*** (C.P. Varma & Rawat) Kalgutkar & Janson. 2000 Eocene-Miocene, western and eastern India, including oil exploration areas in West Bengal and Assam (Varma & Rawat 1963, p. 136, figure 15).
- D. scabratus*** (P. Kumar) Kalgutkar & Janson. 2000 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 22, plate 1, figure 10, text-figure 14).
- D. schwabii*** (Elsik) Kalgutkar & Janson. 2000 Neogene, around Kollam and Varkala, Kerala (Jain & Kar 1979, p. 111, plate 2, figure 35); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 249, plate 1, figure 11); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156); Late Tertiary, Site 218, Deep Sea Drilling Project Leg 22, Bengal Fan, Indian Ocean (Chandra & Kumar 1998, p. 62, plate 1, figure 10).
- D. udarii*** (A. Gupta) Kalgutkar & Janson. 2000 Maniyara Fort Formation (Oligocene), Barkhana Nala Cutting near Sarangwara, Kutch District, Gujarat (Kar 1979, p. 33, plate 3, figures 54-55); Middle-Late Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar & Saxena 1981, p. 106); Eocene, bore core no. 27 near Rataria, Kutch District, Gujarat (Kar 1985, p. 130); Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a, p. 116).
- D. verrucatus*** (Ramanujam & Srisailam) Kalgutkar & Janson. 2000 Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980, p. 126, plate 2, figure 19).
- D. wilkinsonii*** (R.K. Saxena & N.K. Misra) Kalgutkar & Janson. 2000 Sindhudurg Formation (Neogene), Amberiwadi Section, Sindhudurg District, Maharashtra (Saxena & Misra 1990, p. 272, plate 3, figure 13).
- Fusiformisporites*** Rouse 1962
- F. acutus*** Kumar 1990 Quilon Beds (Miocene), clay mine section near Kanjantheria House, Padappakkara, Kollam District, Kerala (Kumar 1990, p. 21, plate 1, figure 22, text-figure 11); Upper Bhuban Formation (Late Miocene), Champai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004, p. 146).
- F. barmerensis*** R.K. Saxena & S.K.M. Tripathi 2011 Barmer Sandstone (Palaeocene), near Barmer Hill, Barmer District, Rajasthan (Jain et al. 1973, p. 161, plate 2, figure 77).

- F. crabii* Rouse 1962 Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980, p. 123, plate 1, figures 8-9); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Mallesham et al. 1989, p. 15, plate 1, figures 15-16); Kundlu and Nalagarh formations (Miocene), Kundlu and Ramshahr, Solan District, Himachal Pradesh (Sarkar & Singh 1994, p. 100); Early Miocene, Borewell at Kulasekharamangalam, Kottayam District, Kerala (Rao et al. 1995, p. 374); Tarkeshwar Formation (Early Eocene), Rajparadi, Cambay Basin, Gujarat (Samant & Phadtare 1997, p. 67, plate 15, figure 9); Dulte Formation (Early Miocene), 2 km from Dulte village on Dulte-Keifang Road, Aizawl District, Mizoram (Mandaokar 2002a, p. 116); Keifang Formation (Early Miocene), eastern flank of Aizawl Hills, Mizoram (Mandaokar 2002c, p. 79); Middle Bhuban Formation (Early Miocene), Lawngtlai, Chhimituipui District, Mizoram (Mandaokar 2003, 187); Upper Bhuban Formation (Late Miocene), Champhai area, Eastern Mizo Hills, Mizoram (Mandaokar 2004, p. 146); Bhuban Formation (Miocene), Tlamsam, Mizoram (Kar et al. 2010, p. 242).
- F. elongatus* Ramanujam & K.P. Rao 1978 Miocene, Kerala (Ramanujam & Rao 1978, p. 300-301, plate 3, figures 46-48); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 248-249, plate 1, figure 10).
- F. foedus* Salujha et al. 1974 Palaeocene, Khasi and Jaintia Hills, Meghalaya (Salujha et al. 1974, p. 281, plate 3, figures 98-99); Quilon and Warkalli beds (Miocene), Kollam District, Kerala (Ramanujam & Rao 1978, p. 300, plate 3, figure 42); Tura Formation (Early Eocene), Tura-Dalu Road, West Garo Hills District, Meghalaya (Tripathi et al. 2000, p. 243).
- F. keralensis* Ramanujam & K.P. Rao 1978 Quilon and Warkalli beds (Miocene), Kerala (Ramanujam & Rao 1978, p. 300, plate 3, figure 42); Geabdat Sandstone (Neogene), Darjeeling District, West Bengal (Pathak & Banerjee 1984, p. 248, plate 1, figure 9); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156).
- F. lineolatus* Sheffy & Dilcher 1971 Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980, p. 123, plate 1, figure 109); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Mallesham et al. 1989, p. 15); Kharsalia Clay Formation (Early Eocene), near Bhavnagar, Cambay Basin, Gujarat (Samant 2000, p. 16, plate 1, figure 11).
- F. pseudocrabii* Elsik 1968 Oligocene-Miocene, Cauvery Basin, Tamil Nadu (Venkatachala & Rawat 1973, p. 257-258, plate 1, figure 4); Kadi Formation (Early Eocene), Cambay Basin, Gujarat (Rawat et al. 1977, p. 187); Subsurface Tertiary sediments in Upper Assam (Kar et al. 1994, p. 187); Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh (Mandaokar 2000c, p. 38).
- Hilidicellites* *H. constrictus* (Y.K. Mathur & K. Mathur) Kalgutkar & Janson. 2000 Pliocene, Naera and Baraia area, Kutch District, Gujarat (Mathur & Mathur 1969, p. 3, plate 1, figure 3); Pliocene, Naera, Kutch District, Gujarat (Kar 1985, p. 159, plate 37, figure 3); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Mallesham et al. 1989, p. 15, plate 1, figure 8); Subsurface Tertiary sediments in Upper Assam (Kar et al. 1994, p. 187, plate 2, figure 30); Baghmara Formation (Early Miocene), Tura-Dalu Road Section along Bugi River, Garo Hills, Meghalaya (Misra et al. 1996, p. 95); Tikak Parbat Formation (Late Oligocene), Namchik River Section, Changlang District, Arunachal Pradesh (Mandaokar 2000c, p. 38).
- H. dubius* Kalgutkar & Janson. 2000 Warkalli Beds (Miocene), Kannur District, Kerala (Ramanujam & Srisailam 1980, p. 127, plate 2, figure 20); Miocene, Tonakkal clay mine, Thiruvananthapuram District, Kerala (Varma & Patil 1985, p. 156); Miocene, Godavari-Krishna Basin, Andhra Pradesh and Palk Bay area in Cauvery Basin, Tamil Nadu (Mallesham et al. 1989, p. 15).
- H. indicus* (Anil Chandra et al.) Kalgutkar & Janson. 2000 Late Quaternary, Sediment core no. 1, Arabian Sea (Chandra et al. 1984, p. 51, plate 2, figure 31).
- H. siddiquiei* (Anil Chandra et al.) Kalgutkar & Janson. 2000 Late Quaternary, Sediment core no. 2, Arabian Sea (Chandra et al. 1984, p. 51, plate 2, figure 32).
- Pucciniasporonite* *P. arcotensis* Ramanujam & Ramachar 1980 Neyveli lignite (Miocene), Neyveli, Cuddalore District, Tamil Nadu (Ramanujam & Ramachar 1980, p. 82, plate 1, figures 4-6).

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