

A NEW FOSSIL FUNGUS *ASCODESMISITES MALAYENSIS* GEN. ET SP. NOV. FROM TERTIARY COALS OF MALAYA

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ABSTRACT

The present paper gives a detailed account of *Ascodesmisites malayensis* gen. et sp. nov. from Tertiary coal of Malaya. The fossil fungus shows a close relationship with living genus *Desmidiospora* in asexual phase and very close to *Ascodesmis* in sexual phase. The fossil fungus has been assigned to a new genus *Ascodesmisites* because of its strong resemblance with the living fungus *Ascodesmis*.

INTRODUCTION

Previous to the present investigation, microfossils from this coal were described by TRIVEDI and CHATURVEDI (1961) and TRIVEDI and VERMA (1969 a). Fungal fruiting bodies were also described by TRIVEDI and VERMA (1969 b). In the present paper a new fossil fungus *Ascodesmisites malayensis* gen. et sp. nov. is described.

Constant occurrence of mycelia sometime with fruiting bodies in association with higher plants has been known since Silurian period. They have been reported occurring along *Psilophyton*, a primitive Pteridophyte and in Cordaitan rootlets from Europe by LIGNIER (1906), OSBORN (1909), HALKET (1930) and ZIMMERMANN (1933). The Malayan coal on maceration yielded large number of cuticles, many mycelia and numerous microspores.

Earlier to this investigation, TRIVEDI and CHATURVEDI (1961) reported two new genera of fossil fungus from Tertiary coals of Malaya, which consisted of a series of asexual and sexual stages of the fossil fungus. The stages are borne on profusely branched separate hyphae. Organic connection between the two series of stages of life cycle of the fungus could not be established, hence these two stages are separately described as two different genera.

The present investigations deal in a detailed manner and bring fresh light on the forms already reported earlier by TRIVEDI and CHATURVEDI (1961). It has now been possible to clearly establish organic link between the asexual and sexual stages (Pl. 1, Fig. 1) of the two genera earlier proposed by TRIVEDI and CHATURVEDI (1961). These two appear to be two phases of the life cycle of one and the same fungus. The two stages are so different from each other that they appear as two different genera belonging to different orders of Fungi. The asexual phase shows a close relationship with the living genus *Desmidiospora* Thaxter—*Deuteromycetes* (Moniliales). The developmental stages of the sex organs, however, suggest a position very close to *Ascodesmis* Van Tieghem, 1876 of Pezizinae Coupin, now separated in to Pezizales and Agyriales (Phacosporae) (CLEMENTS & SHEAR, 1931; SACCARDO, 1889). The latter stages are the sexual phase of the life cycle of a new genus that

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very closely correspond to *Desmidiospora*, a living imperfect fungus without the sexual phase in its life cycle (THAXTER, 1891). The present investigation is based on the study of 40 slides prepared by the authors.

DESCRIPTION

Recently while investigating the microflora of the Malayan coal in detail one of us (C. L. V.) obtained many cuticles which are heavily infected by this fungus, although the host tissue is not well preserved.

Habit—Hyphae are branched, separated and 8.5μ wide, these form a net like structure on the surface of the cuticles of the host. Various reproductive stages are shown in plate 1, figure 1. Organic connections linking the hyphae, bearing the reproductive bodies are also marked in plate 1, figure 1. Developing asexual stages are shown in plate 1, figures 2-4. In plate 1, figure 4 the initial stages of a conidium 2.5μ wide and 24μ long, budding out from the hyphae and being separated from it by a septum, is shown. The apex of the conidial cell has started lobing. Plate 1, figure 3 shows an advanced stage of young conidiospore borne on a small conidiophore. The young conidium is $45 \times 34 \mu$ and each of trilobed structures is 9μ — 13μ . The conidiophore is somewhat squarish in shape, its width is almost same as that of hypha. Plate 1, figure 2 and text-figure 4, show a conidium in ripe stage and as many as six mature conidiospores have been measured and studied. These are somewhat oval in shape, irregularly sometimes successively, dichotomously lobed, each lobe probably forming a loculus and borne on short stalk. The mature conidia vary in size ranging from 60 - 85μ (average size of 6 spores being 74μ). Text-figures 1-3 and plate 1, figure 5 show different stages of sexual development.

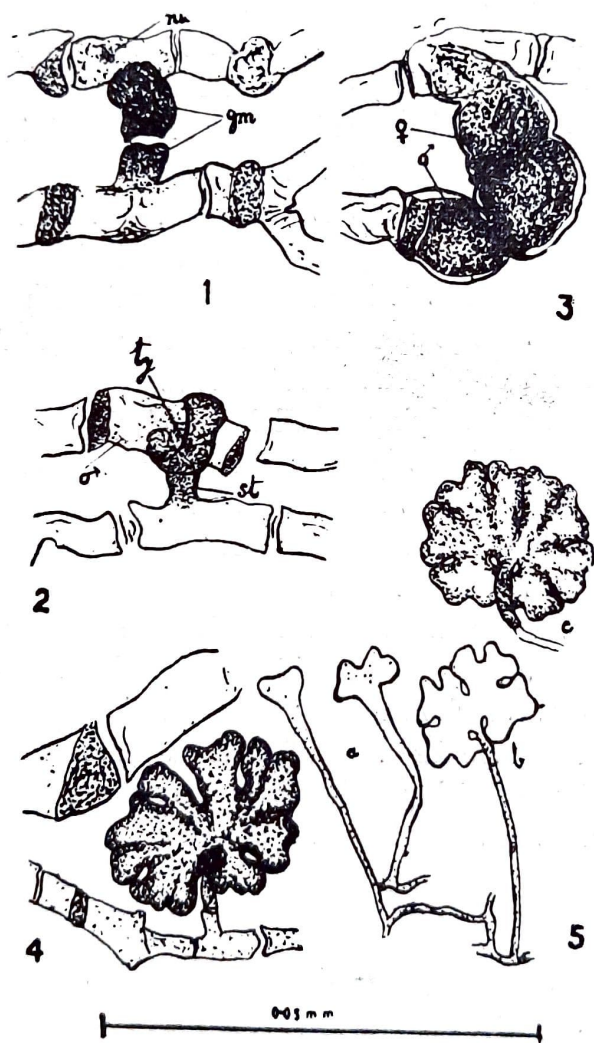
Text-figure 1 shows hyphae lying parallel to each other. On one, a shortly stalked, beak like gametangium (gm) in its early stage of development can be seen. This is probably the female reproductive body with an immature trichogyne. The cell on the other hypha has also probably started reproductive activity to form the male gametangium. The size of ascogonium is $22 \times 17 \mu$ and the gametangiophore is more or less 22μ square. Further development of a stalked ascogonium with a trichogyne is shown in text-figure 2. The trichogyne of ascogonium appears to be coiling round the developing male hypha. The mature stage of the sex organs is shown in text-figure 3. A fully formed male cell 34μ long and 10μ broad is shown to have fused with female gametangium (ascogonium) 56μ long and 17 - 34μ broad. A minute fruiting body 65μ in diameter is shown in plate 1, figure 5. All the sexual stages are found growing on a mycelium.

DISCUSSION

Desmidiospora (Duteriomycetes, Moniliales) was described by THAXTER (1891) and BARNETT (1956) as growing on a large black ant fastened to the under surface of a rooting log. In this fungus only asexual phase of the life cycle is found to occur, though, it shows certain Ascomycetaceous affinities. Thaxter suggested, that it was not impossible that the genus *Desmidiospora* might be the imperfect form of *Cordyceps*, perhaps *C. unilateralis* Tul (Sphaeriales). This statement was based exclusively on the fact that among the perfect fungi *C. unilateralis* alone grew on ants in the vicinity. The fossil fungus is found growing on plant tissue and not on insects such as ants as in the case in *Cordyceps* and *Desmidiospora*. The asexual stages of the fossil fungus reported above are, however, almost identical to those of *Desmidiospora* the conidiospore of which measure 80 - 100×68 - 90μ and 12 - 14μ

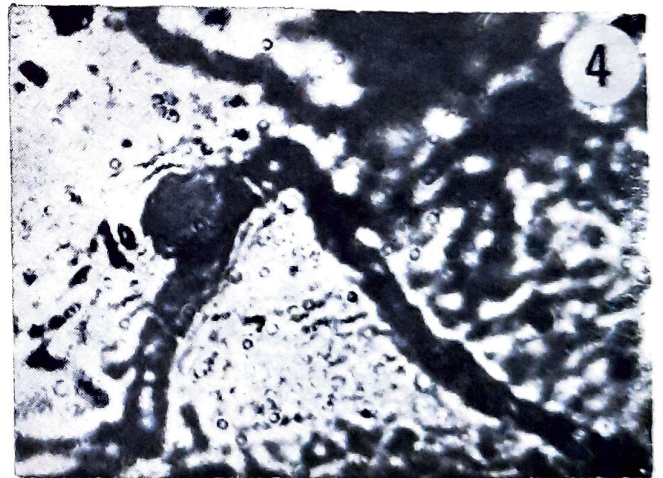
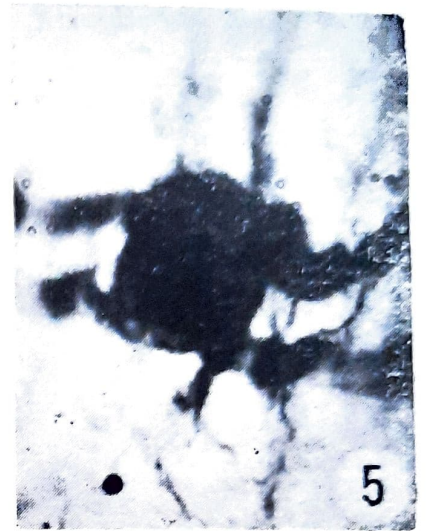
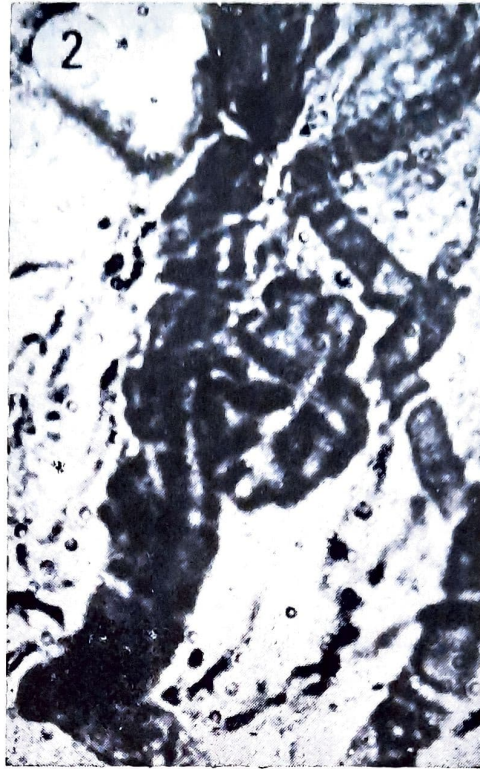
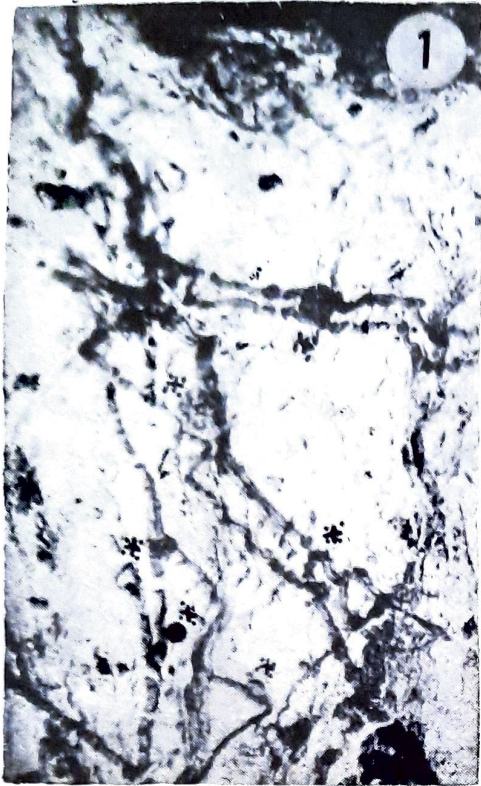
in thickness. In *Desmidiospora* two type of conidia are found, macroconidia and microconidia. In the fossil specimen, some microconidia can be seen lying adjacent to the hyphae, yet they are not organically connected with the mycelium, on which reproductive organs occur.

The mode of development of macroconidia in the fossil material and *Desmidiospora* is almost similar except that the conidiophore of the fossil fungus is much shorter when compared to the living form (Thaxter, Barnett). This difference persists from the early stages of conidia formation till their maturity and dispersal (Pl. 1, Figs. 2, 3, 4; Text-figs. 4 & 5 a, b, c). The early lobing of the conidial cell in both the fossil as well as living genera is identical. In both the lobing is reported irregularly and dichotomously (Pl. 1, Fig 3; Text-fig. 4). The prominent conidiophore is present in the living while it is not at all prominent in the fossil genus. It is therefore not proper to include the living and the fossil forms under a single genus. Moreover, in living *Desmidiospora* the asexual phase is not known to occur. The fossil fungus shows typical Ascomycetaceous characters. It is therefore, only correct to place the fossil within the Ascomycetes.



Text-Figs. 1-5.-1. Initial stages of development of sex organs; 2. Coiling of trichogyne of ascogonium round male organ; 3. Fusion of male and female sex organs; 4. Ripe conidium with very short conidiophore attached to the vegetative hypha; 5. Development of conidia in *Desmidiospora* (a)=Initial stage of conidium; (b)=Young conidium; (c)=Reproduced from Thaxter 1891; gm=ascogonium; nu=nucleus of the male cell; st=stalk of ascogonium; ty=trichogyne; ♂ =male cell; ♀ =female cell).

The asexual phase of the fossil specimen resembles that of the members of Pezizinae or Pezizales and Agyriales (SACCARDO, 1889; CLEMENTS & SHEAR, 1931). Presence of dark coloured minute fruiting body only reduced by the loss of exciple and paraphysis confirms the Agyriallean affinity of the fossil. The order is described as polyphyletic containing gela-



tinous, fleshy and membranous type of apothecia closely related to Bulagariaceae, Pezizaceae Ascobolaceae and Myriangiaceae and probably derived from these families.

The fossil specimen shows a close affinity with the family Pezizaceae, however, it differs from the same by the absence of exciple. Paraphysis are missing in the fossil fungus and it is not possible to ascertain correctly the nature of fossilised hypothecium. Minute fruiting bodies and various sexual stages (Text-figs. 1-3) somewhat closely resemble those of *Ascodesmis* Van Tieghem, 1876. In text-figure 5 stalked female gametangium (ascogonium) is ready to throw the trichogyne which ultimately coils round the male cell which is formed on the opposite cell of the neighbouring hypha (Text-fig. 2).

After the fusion of male and female cells, the ascogonium swells and gets ready for the parenchymic activity (Text-fig. 3), ultimately a minute fruiting body without the exciple is developed (Pl. 1, Fig. 5).

The sexual stages though closely related to *Ascodesmis*, differ from the same in one of the most important character, viz. the absence of paraphysis.

In fossil specimen, the male and female sex organs are found growing on two different hyphae. It is therefore, likely that the fungus may have been dioecious.

***Ascodesmisites malayensis* gen. et sp. nov.**

Diagnosis—Profusely branched septate hyphae, conidia irregularly repeatedly and dichotomously lobed; mulilocular, oval $60\ \mu$ — $85\ \mu$ in diameter, conidiophore very short.

Mycelium dioecious, fruiting bodies minute, dark coloured, without exciple and paraphysis.

Collections—Samples were collected by Dr. B. S. Trivedi in 1953, all the slides are with the authors, Botany Department, Lucknow University.

Locality—Kuala Lumpur, Malaya.

Age—Tertiary (Eocene).

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EXPLANATION OF PLATE 1

Ascodesmisites malayensis gen. et sp. nov.

1. Habit photograph of the fossil fungus showing the stages of reproduction marked (*) $\times 180$.
2. Ripe conidium $\times 1,107$.
3. Developing stalked conidium $\times 1,107$.
4. Initial stage of a conidium budding out of the septate hyphae $\times 1,107$.
5. Minute fruiting body $\times 1,107$.