

Palmoxylon shiblaensis sp. nov. (arecoid palm wood) from the Deccan Intertrappean beds (Late Cretaceous) of Yeotmal District, Maharashtra, India

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ABSTRACT

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Palmoxylon shiblaensis sp. nov., a new species of fossil palm wood, has been described from the Deccan Intertrappean beds exposed at Shibla village in Yeotmal District, Maharashtra. The wood is fairly well preserved to reveal all the important anatomical details for its identification and comparison. In cross section, the fossil palm wood shows an outer (dermal) and an inner (central) parts. Fibrovascular bundles, leaf-trace bundles, fused bundles and satellite bundles can be seen throughout the stem. Satellite bundles and divided phloem in the bundles are important features of the stem.

Key-words: *Palmoxylon shiblaensis* sp. nov., arecoid palm wood, Deccan Intertrappean beds, Late Cretaceous, Maharashtra, India.

INTRODUCTION

A large number of fossil palm woods have been described from different localities of Central India. These are: *Palmoxylon binoriensis* Guleria & Mehrotra 1999, *P. blanfordii* Schenk 1882, *P. chhindwarenses* Prakash 1960, *P. dakshinense* Prakash 1960, *P. deccanense* Sahni 1964, *P. dhabaensis* Mandaokar et al. 2012, *P. dilacunosum* Ambwani 1984, *P. eocenum* Prakash 1962, *P. hislopii* Rode 1933, *P. jammuensis* Sahni 1931, *P. kamalam* Rode 1933, *P. kerienne* Trivedi & Verma 1971b, *P. livistonoides* Prakash & Ambwani

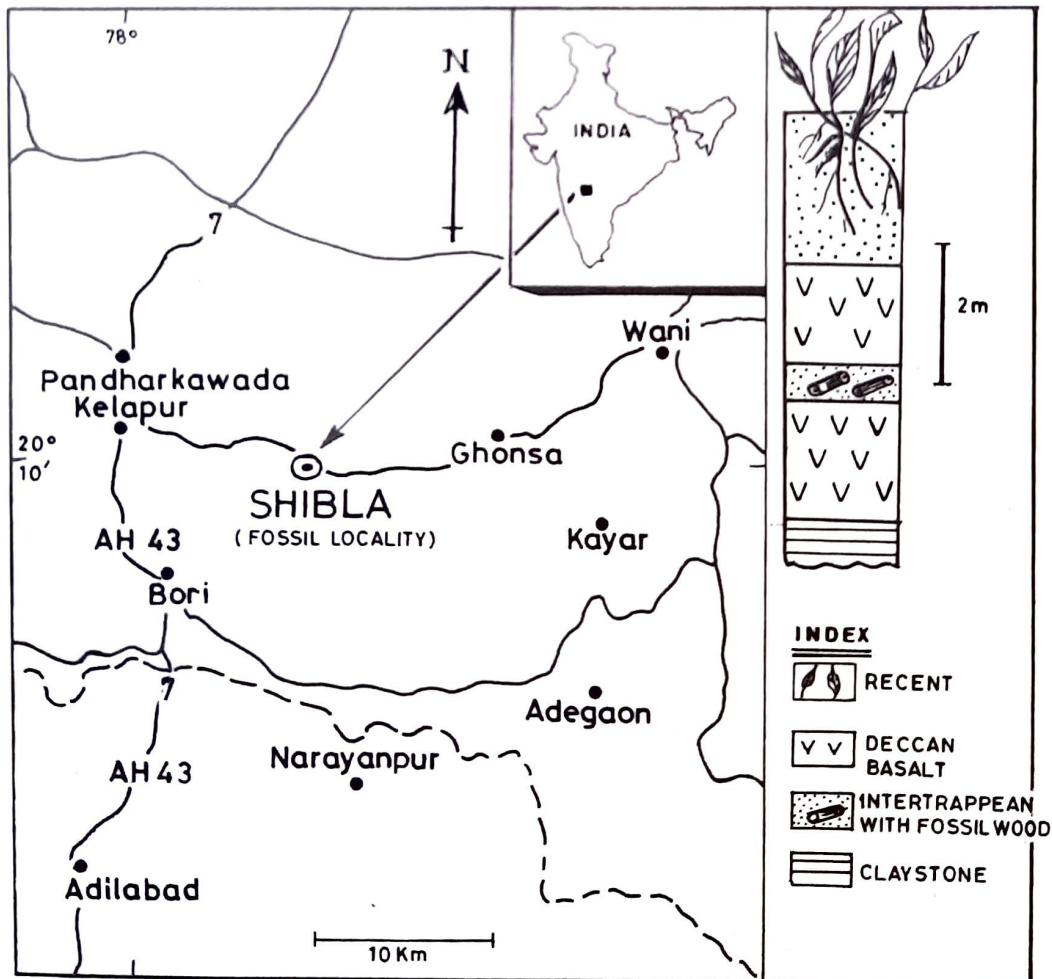
1980, *P. lunarianum* Guleria & Mehrotra 1999, *P. paraponiensis* Lakhnpal et al. 1979, and *P. superbum* Trivedi & Verma 1971a, *P. taroides* Ambwani & Mehrotra 1989, *P. vaginatum* Guleria & Mehrotra 1999 and *P. wadiae* Sahni 1931. In the present paper, a new species of *Palmoxylon*, viz. *P. shiblaensis*, has been described. The wood is well preserved to reveal all the anatomical features required for its identification. Efforts are also made to compare the fossil wood with its modern counterparts.

MATERIAL AND METHOD

The fossil palm wood, described here as *Palmoxylon shiblaensis* sp. nov., was collected from the Deccan Intertrappean fossil locality at Shibla village in Yeotmal District, Maharashtra. The stratigraphic section, exposing intertrappean bed, is located at Shibla village (Lat. 19°58'N, Long. 78°40'E) on Pandharkawada-Ghonsa Road, 82 km NW of Yeotmal, Maharashtra. The Intertrappean bed (about 0.5 m thick), dipping 5-8° and sandwiched between two basaltic flows, contains fossiliferous chert with dicot roots, monocot woods and fruits (Text-figure 1). This bed, clearly seen exposed in nala section, can be traced for a distance of 12 km. The intertrappean bed consists of red clayey siltstone, dark brown shales,

fine to coarse grained friable sandstones, blackish grey cherts with carbonate nodules and root traces. The demarcation between the intertrappean and the overlying Deccan trap is clearly seen.

For detailed anatomical characterization, the specimen was cut into thin sections (T.S. and L.S.). These sections were ground and polished using carborandum powder of different grades. The important anatomical characters were noted under low and high magnifications and the photomicrographs pertaining to important characters were prepared. All the slides and residues have been deposited in the repository of the Botany Department, J. M. Patel College, Bhandara, Maharashtra.



Text-figure 1. Locality map showing fossil locality Shibla in Yeotmal District, Maharashtra.

SYSTEMATIC DESCRIPTION**Genus:** *Palmoxylon* Schenk 1882**Type species:** *Palmoxylon blanfordii* Schenk 1882*Palmoxylon shiblaensis* Mandaokar, Kapgate & Mukherjee, sp. nov.

Plate 1, figures 1-7, Plate 2, figures 1-9

Holotype: Repository No. 1882, J. M. Patel College, Bhandara, Maharashtra.**Type locality:** Shibla village, Yeotmal District, Maharashtra, India.**Horizon and age:** Deccan Intertrappean bed (Late Cretaceous).**Etymology:** The specific epithet refers to Shibla village, from where the specimen was collected.

Specific diagnosis: Wood dark brown in colour, comprising outer and inner parts. Size 6.9 x 4.2 cm, fibrovascular bundles in subdermal zone irregularly oriented with one (sometimes two) metaxylem vessel; size of bundles ranges from 450 x 500 to 425 x 650 μm ; dorsal sclerenchymatous sheath lunaria; sheath cells generally not well preserved. A layer of tabular parenchyma and stegmata present around the bundle sheaths. Presence of leaf-trace bundles, fused bundles and satellite bundles also noticed. Fibrovascular bundles of inner zone irregularly dispersed in ground tissue, smaller in size as compared to outer zone; 375 x 400 to 350 x 500 μm ; sclerenchymatous sheath lunaria, cells of this sheath partly preserved; frequency of fibrovascular bundles 120-125 per cm^2 and f/v ratio from 3/1 to 4/1; tabular parenchyma and stegmata present. Ground tissue slightly lacunar; parenchyma cells variously shaped forming air spaces; secretary cells present in ground tissue; diminutive fibrovascular bundles rare; leaf-trace bundles present.

Description: Outer Part – The outer part is about 1.5 cm thick; fibrovascular bundles are slightly apart and irregularly oriented, gradually become closer to each other. Shape of these bundles varies from oval to elongate with one (sometimes two) extruded metaxylem vessel, which seems compressed in appearance. The dorsal sclerenchymatous sheath is generally Lunaria-type with very thick walled sclerenchyma cells having small lumen. The size of the fibrovascular bundles varies from 400 x 600 to 450 x 650 μm ; frequency of these bundles varies from 100-120 per cm^2 and f/v ratio is generally 3/1 to 4/1. Each fibrovascular bundle has one elongated, protruded metaxylem vessel. Tabular parenchyma and stegmata are present while fibrous bundles are absent. Presence of leaf trace bundles, fused bundles and a few satellite bundles is also noticed. The ground tissue is compact, tending to be spongy in nature and the cells of this part are generally isodiametric, becoming slightly armed. Inner Part – This part is 2.5 cm thick in the inner side of the stem extending towards centre. The fibrovascular bundles, in this part, are generally irregularly oriented and scattered apart. The shape of these bundles become oval to round with generally two metaxylem vessels, the dorsal sclerenchymatous sheath is generally Lunaria-type; rarely Reniform-type can also be present. The cells of the fibrous cap are thick walled (appear as stone cells). The size of the fibrovascular bundles in this part ranges from 350 x 400 to 700 x 550 μm and the frequency extends from 80 to 90 per cm^2 ; the f/v ratio varies from 4/1 to 5/1, here the xylem part of the bundles is not protruded as observed in outer part. Presence of tabular parenchyma and stegmata is noticed. Leaf-trace and fusion bundles are present. The ground tissue is lacunar and comprised of thin elongated cells forming mesh-like appearance.

COMPARISON

Comparison with fossil palm stems having Lunaria-type dorsal sclerenchymatous sheath:

The characteristic anatomical features of the present fossil palm wood fall under the group Lunaria-type. The fibrovascular bundles are oval to slightly elongate with one (sometimes two) extruded metaxylem vessel. These bundles are sometimes laterally compressed and generally extend from 600 to 700 μm , while their frequency varies from 80 to 120 per cm^2 . The f/v ratio of the fibrovascular bundles is 3/1 to 5/1. Presence of stegmata and tabular parenchyma is commonly seen throughout the stem whereas the fibrous bundles are altogether absent in the stem. Occurrence of fused, leaf-trace and satellite bundles are generally observed. The ground tissue gradually tends to become spongy in nature towards inner side of the stem. Based on the anatomical characters revealed by the fossil, it has been compared with other known palms. These are *Palmoxylon sinuosum* Sahni 1964, *P. lunarianum* Guleria & Mehrotra 1999 and *P. dhabaensis* Mandaokar et al. 2012. *Palmoxylon sinuosum* resembles with the present species in its general anatomy having fusion and satellite bundles and the ground tissue tending to be spongy towards the inner side of the stem. However, it also shows some characters of differences, such as the number of fibrovascular bundles (21-30 per cm^2) which is much lower than the present species and lower f/v ratio. *P. lunarianum* Guleria & Mehrotra 1999 also shows some resemblance with the present species in having Lunaria-type dorsal sclerenchymatous sheath, presence of stegmata and absence of fibrous bundles as well as occurrence of satellite

and fusion bundles but shows higher number of fibrovascular bundles per cm^2 and greater f/v ratio. It also shows compact ground tissue. *P. dhabaensis* Mandaokar et al. 2012 is also comparable with the present species in showing presence of stegmata and spongy ground tissue and absence of fibrous bundles. However, it differs in the number of fibrovascular bundles and the f/v ratio being 120 and 1/3 to 3/2 respectively. It is evident from the above comparison that fossil species falling under Lunaria group, although show some resemblance with the present fossil species, differ in many other anatomical features, hence provide the ground to assign the present fossil specimen under a new species as *Palmoxylon shiblaensis* sp. nov. (Table 1).

Comparison with extant palms: The present fossil specimen is comparable with the extant taxa of Areceaceae. It was found that the arecoid taxa *Chrysalidocarpus madagascariensis* and *Rhapis excelsa*, belonging to Arecoideae group, show anatomical similarities with the fossil. Both the fossil and extant stems of *Chrysalidocarpus madagascariensis* show Lunaria type dorsal sclerenchymatous sheath, absence of fibrous bundles and presence of stegmata; the fibrovascular ratio(f/v) are almost same being 3/1 to 4/1 while the frequency of the fibrovascular bundles in the modern stem is considerably similar to that of fossil. The ground tissue, in both the taxa, is compact in the outer part while it tends to become spongy in the inner part of the stem. Presence of leaf-trace and fused bundles are present in both the taxa. Although *Rhapis excelsa* shows similarity to the fossil in having Lunaria type,

Plate 1

- 1-7. *Palmoxylon shiblaensis* sp. nov. 1. Silicified palm wood, scale = 1 cm, Specimen no. 1882. 2. Cross section of the same showing dispersal of fibrovascular bundles x1.5. 3. Details of the cross section showing outer (o) and inner (I) parts of the stem. 4. Cross section showing the distribution of fibrovascular bundles and compact ground tissue. 5. Cross section of outer part showing leaf-trace bundle. 6. Cross section of inner part showing dispersal of the fibrovascular bundles with one to two metaxylem vessels and spongy ground tissue. 7. Cross section of the stem showing details of the ground tissue of inner part.

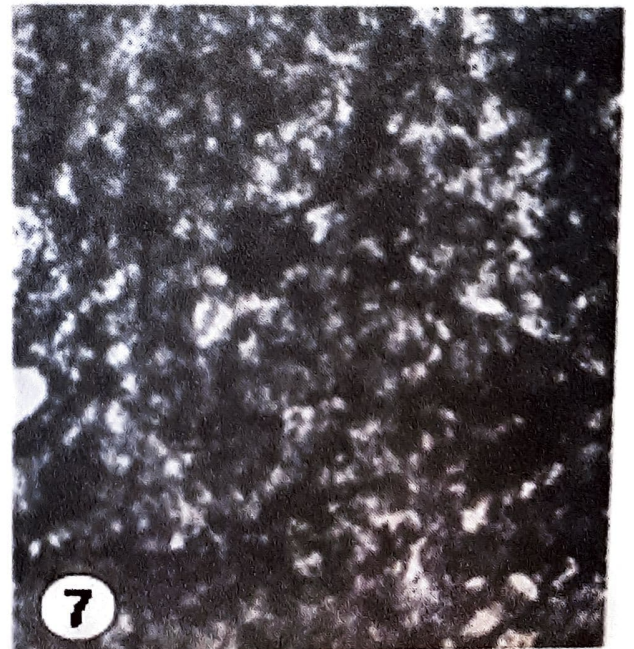
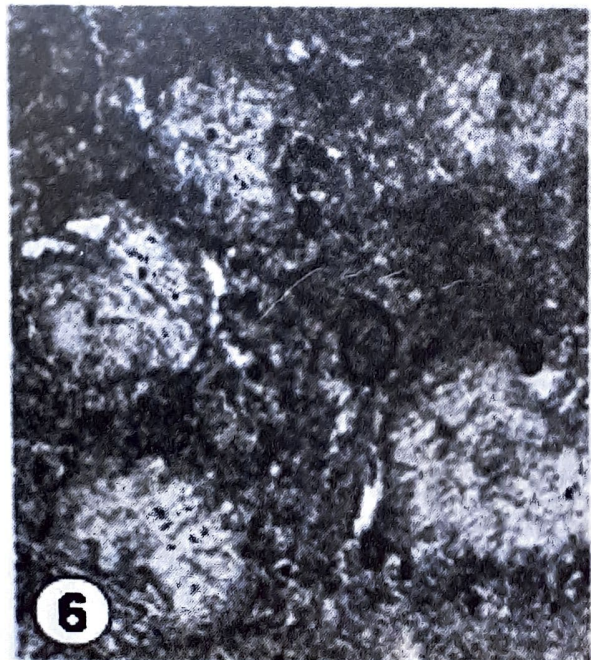
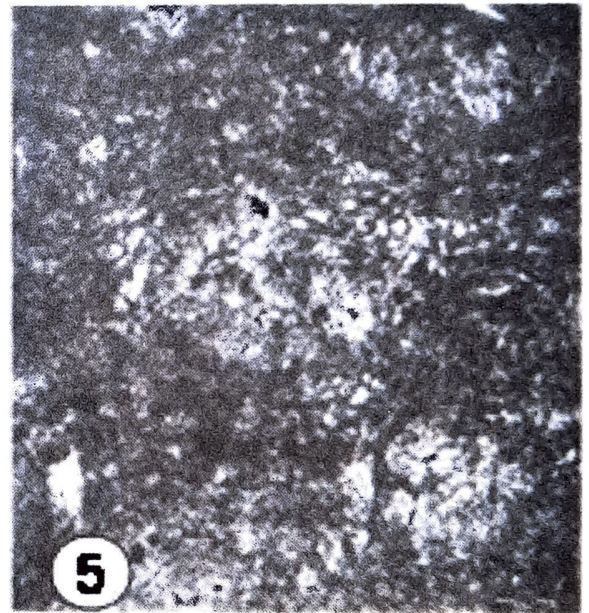
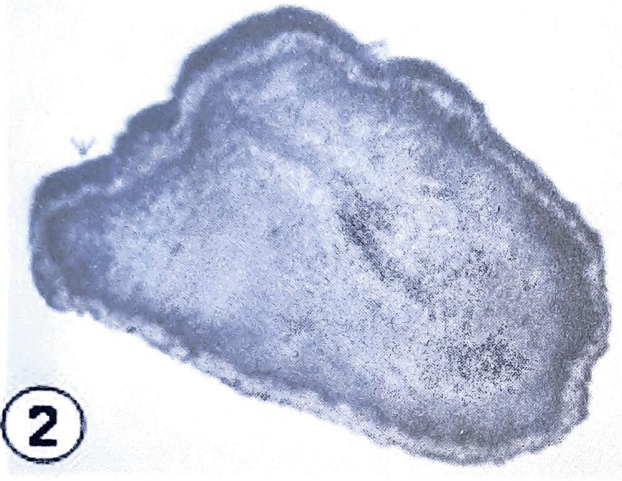
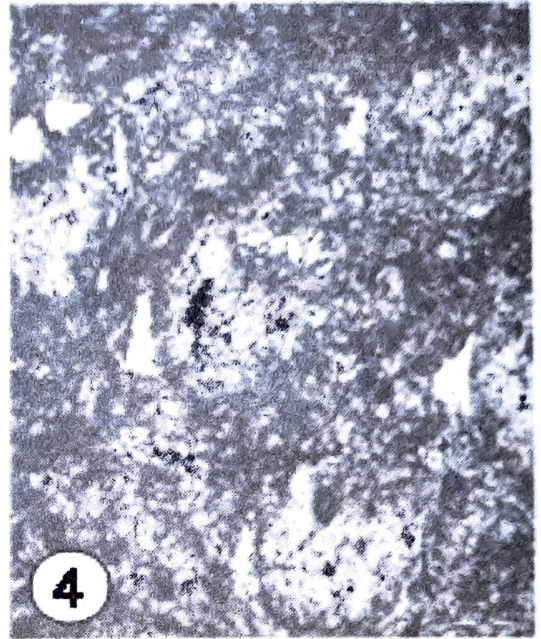


Plate 1

Table 1. Comparison of characters of *Palmoxylon shiblaensis* sp. nov. with other species of *Palmoxylon*.

| Genus/Species | Stenzel's Classification and stigmata (1904) | Fibrous bundles and stigmata | FVB Ratio | Frequency of FVBs/cm | Ground Tissue | Parts available | Fossil records |
|--|--|--|---|-------------------------------------|---|---|---|
| <i>Palmoxylon livistonoides</i> Prakash & Ambwani 1980 | Reniformia | Fibrous bundles present; stigmata absent | D. 1/1-6/1 SD. 3/1-7/1 C. NA | D. 240-800 SD. 400-800 C. NA | D. Compact SD. Slightly Lacunar C. N.A. | Roots present in bark region | Nawargaon, Wardha District, Maharashtra |
| <i>Palmoxylon shahpuraensis</i> Ambwani 1983 | Cordata to Reniformia | Fibrous bundles absent; stigmata present | D. 4/1-6/1 SD. 2/1-4/1 C. 1/1-2/1 | D. 140-150 SD. 65-70 C. 40-45 | D. Compact SD. Cells with small air spaces C. Cells with bigger intercellular spaces. | - | Ghugua, Mandla District, Madhya Pradesh |
| <i>Palmoxylon binoriensis</i> Guleria & Mehrotra, 1999 | Reniformia | Fibrous bundles present; stigmata absent | SD. 12/1-16/1 | SD. 50-56 | Spongy to lacunar | Absence of tabular parenchyma | Seoni District, Madhya Pradesh |
| <i>Palmoxylon lunarianum</i> Guleria & Mehrotra 1999 | Lunaria | Fibrous bundles present; stigmata absent | SD. 4.5-14/1 | SD. 200-220 | Compact | - | Seoni District, Madhya Pradesh |
| <i>Palmoxylon jammuensis</i> , Sahni 1964 | Lunaria | Fibrous bundles and stigmata present | 10-12 | 12/1-16/1 | Compact to slightly spongy | - | |
| <i>Palmoxylon sinuosum</i> , Sahni 1964 | Reniformia to Lunaria | Fibrous bundles absent, Stegmata present | 3/1-4/1 | 21-30 | Tendency to become slightly lacunar | Satellite and fusion bundles present | Pegu-Irravadi Formation |
| <i>Palmoxylon shiblaensis</i> sp. nov. | Lunaria | Fibrous bundles absent, stigmata present | O = 3/1-4/1 I = 4/1-5/1 | O = 100-120 I = 80-90 | Compact to slightly spongy | Satellite, fusion and leaf trace bundles present | Shibla, Yeotmal, Maharashtra |
| <i>Chrysalidocarpus madagascariensis</i> Wendland 1878 | Lunaria | Fibrous bundles absent, stigmata present | O = 3/1-4/1 I = 3/2-3/1 | O = 90-100 I = 70-75 | Compact to slightly lacunar | Leaf trace, fused bundles present | Personal slide collection (BDM) |
| <i>Rhapis excelsa</i> Zimmermann & Tomlinson 1965 | Lunaria to Sagittata | Fibrous bundles absent, stigmata present | O = 10/5-8/1 I = 2/1-3/1 | O = 70-85 I = 50-55 | Compact throughout | Leaf-trace and fused bundles rare, satellite bundles absent | Personal slide collection (BDM) |

it sometimes possesses Sagittata-type of dorsal sheath of bundles; absence of fibrous bundles and the ground tissue exhibits compact to spongy nature. However, it shows some differences in the fibrovascular ratio and frequency of fibrovascular bundles (Table 1). It is therefore inferred that *Palmoxylon shiblaensis* sp. nov. shows near relationship with extant taxon *Chrysalidocarpus madagascariensis*. This leads to surmise that

plants similar to *Chrysalidocarpus* must have been growing in Shibla area. A fossil palm wood *Palmoxylon livistonoides* (Prakash & Ambwani 1980), described from the Deccan Intertrappean beds of Wardha District, Maharashtra, shows close affinity with *Chrysalidocarpus* and thus further supports existence of these plants in the Shibla area during the deposition of Deccan Intertrappean beds.

Plate 2

1-9. *Palmoxylon shiblaensis* sp. nov. 1. Cross section of inner part showing two metaxylem vessels in fibrovascular bundles and slightly lacunar ground tissue. 2. Leaf-trace bundle with many xylem vessels. 3. Thick walled cells (sclerenchyma) with small lumen. 4. Longitudinal section showing stigmata in the fibrous part of the bundle. 5. Cross section of outer part of *Chrysalidocarpus madagascariensis* showing Lunaria type dorsal sheath with one to two metaxylem vessels in fibrovascular bundle and compact ground tissue. 6. Thick walled cells of fibrous sheath of the fibrovascular bundles in *Chrysalidocarpus madagascariensis*. 7. Cross section of the same showing inner part with spongy ground tissue. 8. Cross section of *Rhapis excelsa* of outer part showing lunate dorsal sheath with compact ground tissue. 9. Cross section of the same showing sagittata dorsal sheath with spongy ground tissue.

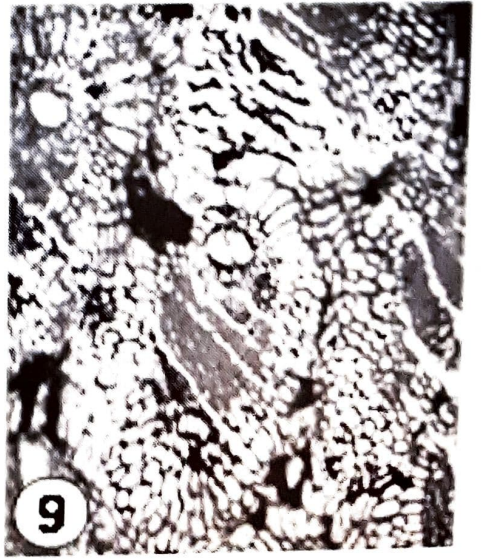
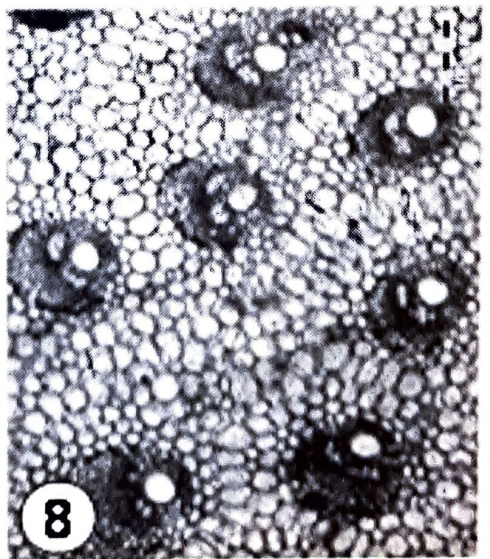
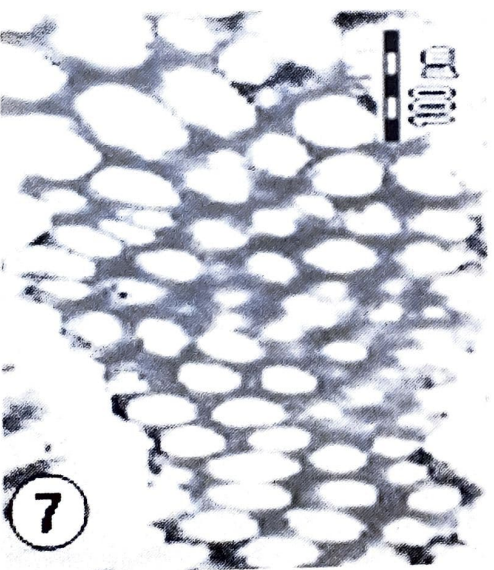
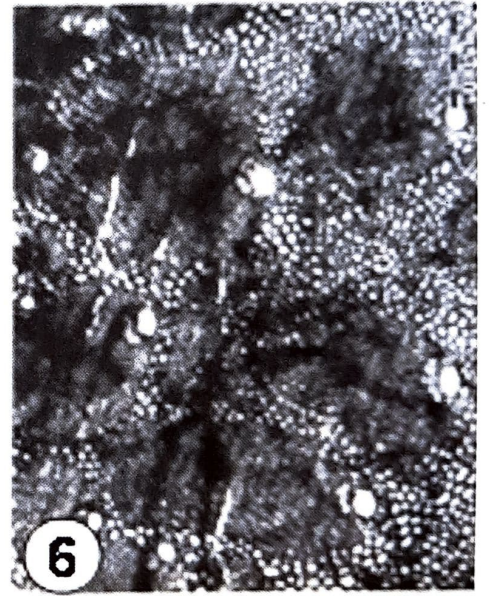
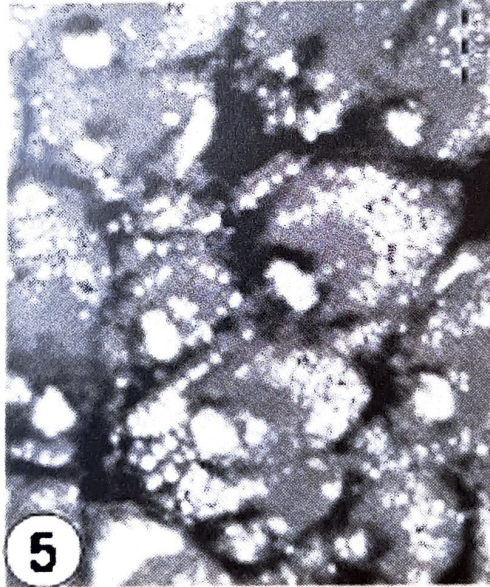
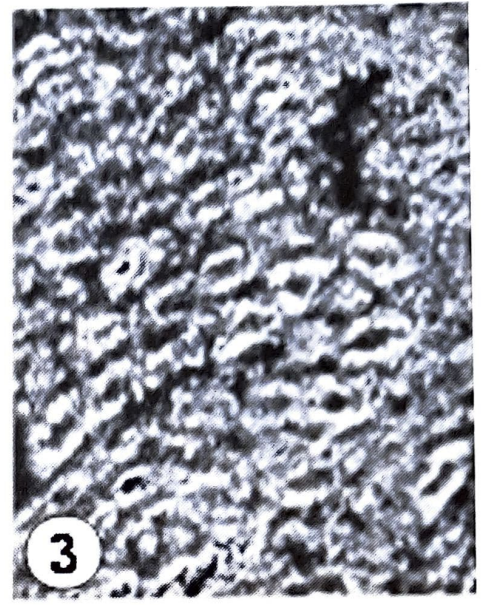
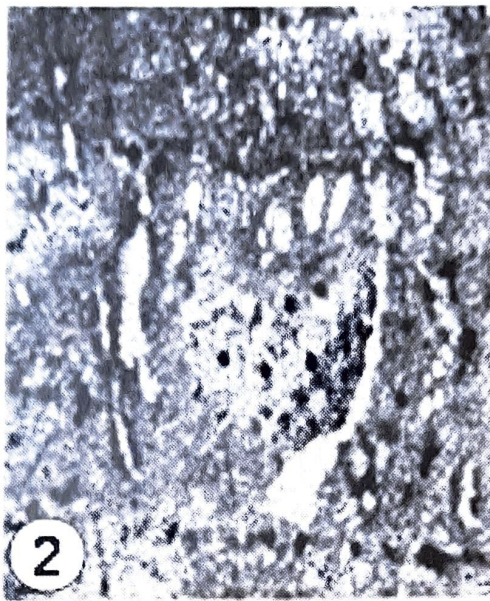
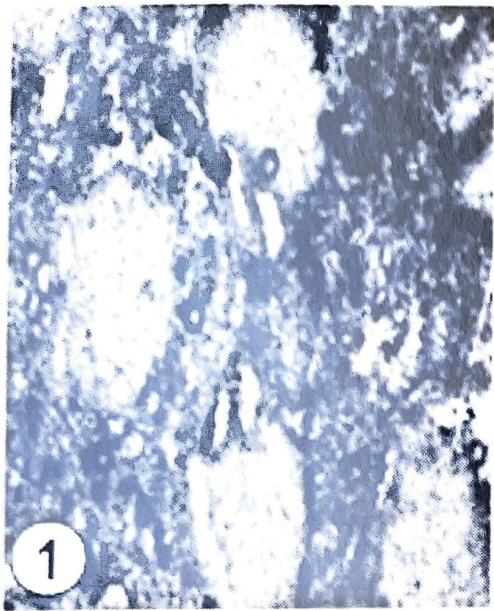


Plate 2

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