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PALMOXYLON GHUGUENSIS SP. NOV. RESEMBLING *CHRYSALIDOCARPUS* FROM THE DECCAN INTERTRAPPEAN BEDS OF MANDLA DISTRICT IN MADHYA PRADESH

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ABSTRACT

Palmoxylon ghuguensis sp. nov. showing close resemblance with the extant *Chrysalidocarpus lutescens* has been described from the Deccan Intertrappean beds near the village Ghugua. It shows characteristic divided phloem placed above the metaxylem in the fibrovascular bundles.

Key-words — Xylotomy, *Palmoxylon*, *Chrysalidocarpus*, Deccan Intertrappean beds.

सारांश

मध्य प्रदेश में माँडला जनपद की दक्खिन अन्तर्ट्रेपी संस्तरों से क्राइसेलिडोकार्पस से मिलती-जुलती पामॉक्सीलॉन घुगुयेन्सिस नव जाति – कृष्ण अम्बवानी एवं उत्तम प्रकाश

घुगुआ गाँव के समीपस्थ दक्खिन अन्तर्ट्रेपी संस्तरों से पाल्मॉक्सीलॉन घुगुयेन्सिस नव जाति वर्णित की गई है जो कि वर्तमान क्राइसेलिडोकार्पस ल्यूटिसेन्स से घनिष्ठ सजातीयता प्रदर्शित करती है। इसमें वाहिनी बंडलों में अन्तदारू के ऊपर लाक्षणिक विभक्त पोषवाह विद्यमान है।

INTRODUCTION

A NEW species of a petrified palm stem is described here from the Deccan Intertrappean beds of Mandla District in Madhya Pradesh. The fossiliferous locality is situated between the villages Ghugua and Katangi at a distance of 13 km from Shahpura on Shahpura-Niwas road (80°45′E: 23°10′N). The present fossil palm wood shows well preserved structural details with compact ground tissue throughout the stem alongwith divided phloem in the fibrovascular bundles.

So far only a few fossil plants are known from this locality consisting mainly of petrified palms and dicotyledonous woods. These are *Sterculioxylon shahpurensis*, *Calophylloxylon dharmendrai*, *Burseroxylon preserratum*, *Heyneoxylon tertiarum*, *Dracontomelumoxylon mangiferumoides* and *Laurinoxylon deccanensis* (Bande & Prakash, 1980, 1981). Recently a fossil palm fruit resembling *Hyphaene* Bande, Prakash & Ambwani (1982) as well as a fossil palm wood resembling *Licuala* (Ambwani, 1983) has been reported from these beds.

SYSTEMATIC DESCRIPTION

MONOCOTYLEDONAE

FAMILY — PALMAE

Palmoxylon ghuguensis sp. nov.

Pl. 1, figs 1-6; Pl. 2, figs 7-10

Material — The fossil wood is almost complete in cross section consisting of outer and inner regions of the stem devoid of cortex (Pl. 1, fig. 2). It is well preserved and measures about 20 cm in length and 9 cm in diameter (Pl. 1, fig. 1).

Outer Zone — This zone is about 2 cm in thickness. The fibrovascular bundles are closely placed and usually regularly oriented. They are variously shaped, mostly

round, oval to slightly elongated with their xylem facing towards the centre. Their frequency varies from 200-250 per cm^2 and the bundles measure $600 \times 400\text{-}1000 \times 450$ μm. The f/v ratio is 1/1-3/1. The dorsal sclerenchymatous sheath is prominently developed and is generally reniform. The median sinus is concave and the auricular lobes are more or less rounded. Generally one rarely two large excluded metaxylem vessels are present in each fibrovascular bundles (Pl. 1, fig. 3). A layer of tabular parenchyma is present around the fibrous part of the fibrovascular bundles (Pl. 1, fig. 4), but radiating parenchyma are absent. The stegmata are present around the fibrous part of the fibrovascular bundles (Pl. 1, fig. 6). Phloem is usually divided into two patches and is represented by two lacunae just above the metaxylem; these are separated by a patch of sclerenchymatous tissue. However, sometimes a few phloem cells may be observed. The diminutive fibrovascular bundles are also sometimes present in this zone (Pl. 1, fig. 3). The leaf-trace bundles are frequently observed throughout this zone but the fibrous bundles are absent (Pl. 1, figs 3, 4).

Inter Zone — This zone is about 3 cm in radius and the fibrovascular bundles are sparsely placed, irregularly oriented and round to oval in shape. The frequency of the fibrovascular bundles is 120-140 per cm^2 and they measure $800 \times 500\text{-}1200 \times 800$ μm in size. The f/v ratio varies from 1/1-1/2. The dorsal sclerenchymatous sheath is rather poorly developed and is generally reniform in shape. The median sinus is concave and the auricular sinus is absent. The auricular lobes are rounded. Generally one sometimes two large and very rarely three (one large and two small) excluded metaxylem vessels are present in each fibrovascular bundle (Pl. 2, fig. 7). Tabular parenchyma is not clearly observed and the radiating parenchyma is absent in this zone. Stegmata are present in the fibrous part of the fibrovascular bundles. Here the phloem is usually divided into two patches (Pl. 2, fig. 9) and is represented by two lacunae due to bad preservation. These lacunae are separated by a patch of thick-walled cells. These phloem lacunae are clearly observed just above the metaxylem vessels in the fibrovascular bundles. The diminutive fibrovascular bundles are frequently seen in this zone (Pl. 2, fig. 7). The larger leaf-trace bundles are sometimes fused together (Pl. 2, fig. 7) and the fibrous bundles are also absent in this zone.

Ground Tissue — The ground tissue is compact throughout the stem of the present species. Outer part, generally composed of round to oval parenchymatous cells (Pl. 1, fig. 3) while in the inner part, though not well preserved, usually exhibits the same type of parenchymatous cells as in the outer part of the stem. Here, the parenchymatous cells are slightly larger in size and their shape is usually round to oval (Pl. 2, fig. 10). At some places a layer of tangentially elongated cells can be seen between the two adjacent fibrovascular bundles.

Diminutive Fibrovascular Bundles — These bundles are present both in the outer as well as in inner zone of the stem but they are not many in number. They are smaller in size and vary from 400-500 μm. They reveal similar structural details as seen in larger fibrovascular bundles. Generally the diminutive fibrovascular bundles possess one metaxylem vessel.

Leaf-Trace Bundles — These are present throughout the stem but are more frequent in the inner part. They are recognized by their protruded tongue-like vascular part. Sometimes two leaf-trace bundles are fused together. Each leaf-trace bundle has many small protoxylem vessels, alongwith one to two large metaxylem vessels (Pl. 1, figs 3, 4; Pl. 2, figs 7, 10). The metaxylem vessels have scalariform while protoxylem vessels possess annular to spiral thickenings.

DIAGNOSIS

Stem large brownish stump, complete in cross section, about 20 cm in length and 9 cm in diameter. *Outer zone* with regularly oriented, round to oval sometimes slightly elongated fibrovascular bundles, $600 \times 400\text{-}1000 \times 450$ μm in size, 200-250 per cm^2, mostly with one large excluded metaxylem vessel; f/v ratio 1/1-3/1; dorsal sclerenchymatous sheath generally reniform with median sinus concave and auricular lobes rounded; tabular parenchyma present but radiating parenchyma absent; stegmata present; phloem usually divided into two patches; diminutive fibrovascular bundles evenly distributed; leaf-trace bundles

frequent and the fibrous bundles absent. *Inner zone* with irregularly oriented, sparsely placed, round to oval fibrovascular bundles 800 × 500-1200 × 800 μm in size, 120-140 per cm², with generally one large sometimes two excluded metaxylem vessels; f/v ratio 1/1-1/2; dorsal sclerenchymatous sheath poorly developed and reniform with median sinus concave; auricular lobes round, auricular sinus absent; stegmata present; tabular parenchyma not clearly seen, radiating parenchyma absent; phloem usually divided into two patches; diminutive fibrovascular bundles evenly present; leaf-trace bundles frequent and fibrous bundles absent. *Ground tissue* compact, composed of round to oval parenchymatous cells.

Holotype — B.S.I.P. Museum no. 35447.

Locality — Ghugua Village near Shahpura, Mandla District, Madhya Pradesh.

Horizon — Deccan Intertrappean Series.

Age — Early Eocene.

Affinities — The structural features of the present fossil wood with characteristic divided condition of the phloem are closely comparable with the modern arecoid palm, *Chrysalidocarpus* especially with *Chrysalidocarpus lutescens* H. Wendl. (Tomlinson, 1961, p. 90).

Apart from *Chrysalidocarpus*, three other genera of lepidocaryoid palms, viz., *Calamus*, *Daemonorops* and *Korthalsia* also show divided condition of the phloem and mostly one wide vessel in the fibrovascular bundles. However, *Calamus* and *Daemonorops* differ from *Chrysalidocarpus* in having lateral postion of the divided phloem with respect to the metaxylem vessels. Besides, all these three genera also differ from *Chrysalidocarpus* in possessing lacunar ground tissue (Tomlinson, 1961, pp. 224, 232, 238) as against compact ground tissue in *Chrysalidocarpus* (Tomlinson, 1961, p. 90).

Both in *Chrysalidocarpus lutescens* and the fossil species the stem can be demarcated into outer and inner zones. The fibrovascular bundles in the outer zone of both the living and fossil species are closely placed and usually round to oval in shape. They are almost similar in size and range from 1000 × 400 to 1000 × 800 μm and 600 × 400 to 1000 × 450 μm respectively. The frequency of the fibrovascular bundles in the outer zone of living species is 200-230 per cm² which is almost similar to the outer zone of our fossil being 200-250 per cm². The f/v ratio is also closely comparable in both the living (1/1 to 2/1) as well as fossil species (1/1 to 3/1). The number of metaxylem vessels in fibrovascular bundles is generally one both in living and fossil species, which is large and excluded. Rarely two smaller vessels may also be seen. Stegmata are present around the fibrous part of the fibrovascular bundles, both in the living as well as fossil species. Tabular parenchyma is present while the radiating parenchyma is absent in both.

The inner zone of living as well as fossil species also resembles closely. The fibrovascular bundles show almost similar shape and size (Pl. 2, figs 7, 8). They are usually oval in shape and measure 1000 × 800-1600 × 1000 μm in the living, whereas they are 800 × 500-1200 × 800 μm in the fossil. The fibrovascular bundles are irregularly oriented and the dorsal sclerenchymatous sheath is reniform in both. The frequency of the fibrovascular bundles is more or less similar in living and the fossil species, i.e. 120-130 per cm² and 120-140 per cm² respectively. The f/v ratio of the fibrovascular bundles in the living species is 1/1 whereas it varies from 1/1-1/2 in the fossil species. Both show the presence of stegmata around the fibrous part of the fibrovascular bundles.

The ground tissue is compact, composed of round to oval parenchymatous cells (Pl. 2, fig. 10) in both and the cells are slightly bigger in the inner than the outer zone. Phloem is divided into two parts by a narrow sclerenchymatous patch of cells; it is usually indicated by two separate lacunae above the metaxylem vessels (Pl. 2, fig. 9) in the present fossil.

Presence of diminutive fibrovascular bundles as well as leaf-trace bundles have been recorded both in the living and fossil species whereas the fibrous bundles are absent throughout the stem in both. Further, the stem *Chrysalidocarpus lutescens* attains a diameter about 8 cm (Blatter, 1926) which is quite comparable with the diameter of the fossil species.

Because of a close resemblance of the fossil palm wood with the structural features of the stem wood of *Chrysalidocarpus lutescens* H. Wendl. which is indigenous to Madagascar (Blatter, 1926), it seems quite likely that *Chrysalidocarpus* might have been growing in the Deccan Trap country during the Late Cretaceous/Early Eocene times.

It has now been proved that the peninsular Indian Plate was close to Madagascar 40° south of the equator about 180-200 million years ago during the Triassic period (Dietz & Holden, 1970, 2 maps on pp. 824, 825; Schuster, 1972, pp. 3-86) and as it gradually migrated northward, it most probably carried with it a large and complex flora of austral origin including those from the Madagascar (Schuster, 1972, pp. 3-86). The presence of *Chrysalidocarpus* in the Deccan Intertrappean beds would explain this. However, this genus became extinct from the Trap country after the Palaeogene and is presently found only in Madagascar (Willis, 1973). This is because drier climatic conditions prevailed in peninsular India specially in the Deccan Trap country due to its migration at about 40° north of the equator where there is less of atmospheric precipitation. Besides, there are certain modern species of angiosperms, viz., *Flacourtia indica* and *Eriocaulon seiboldianum* which are still found in the flora of Madagascar and the Indo-Malayan region (Meher-Homji, 1974).

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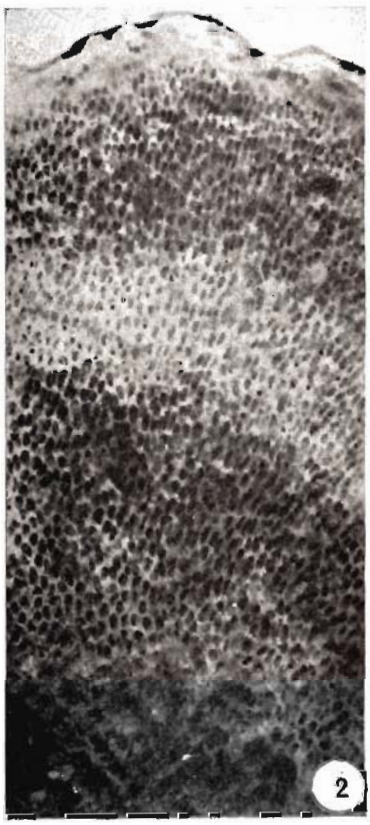
EXPLANATION OF PLATES

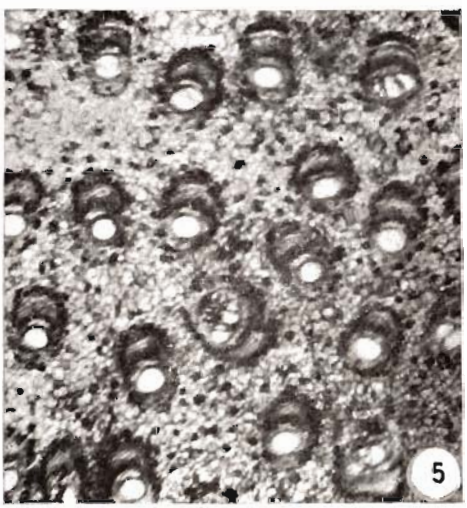
PLATE 1

1. A specimen of *Palmoxylon ghuguensis* sp. nov. × 1/2. Specimen no. 35447.
2. A sector of the same in cross section under low power showing orientation of the fibrovascular bundles. × 8. Slide no. 6557.
3. Cross section of outer portion of outer zone showing fibrovascular bundles with usually one large metaxylem vessel and leaf-traces. × 15. Slide no. 6557.
4. Cross section of inner portion of outer zone showing fibrovascular bundles with one to two large vessels and leaf-traces. × 15. Slide no. 6557.
5. Cross section of the portion of outer zone of *Chrysalidocarpus lutescens* (younger stem) showing fibrovascular bundles with usually single metaxylem vessels. × 15. B.S.I.P. Herbarium slide no. 2648.
6. Longitudinal section showing stegmata in the fibrous portion of fibrovascular bundle. × 60. Slide no. 6558.

PLATE 2

7. Cross section of inner part of inner zone of *Palmoxylon ghuguensis* sp. nov. showing irregular orientation of the fibrovascular bundles. × 15. Slide no. 6557.
8. Cross section of the inner portion of inner zone of *Chrysalidocarpus lutescens* showing irregular orientation of the fibrovascular bundles with usually one metaxylem vessel and divided phloem. × 15. B.S.I.P. Herbarium slide no. 2677.
9. Enlarged fibrovascular bundles of *Palmoxylon ghuguensis* sp. nov. from the inner zone to show divided condition of the phloem. × 60. Slide no. 6557.
10. Enlarged inner portion of inner zone of the same to show compact ground tissue. × 60. Slide no. 6557.





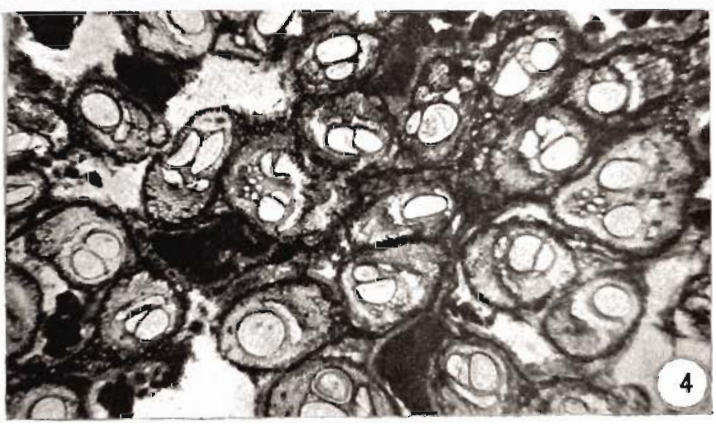
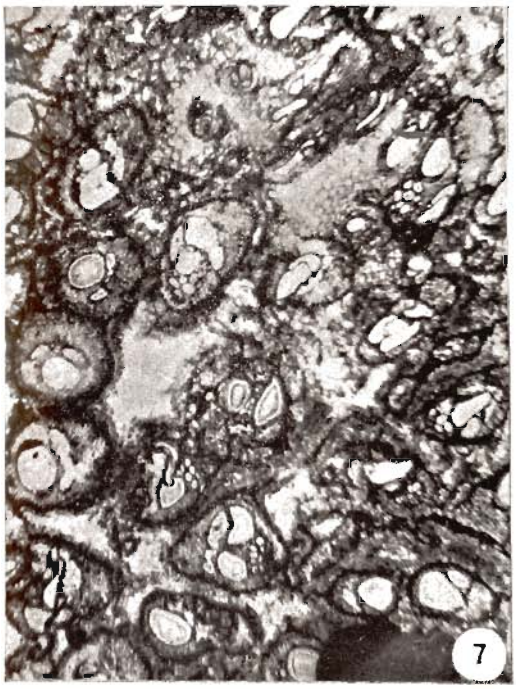
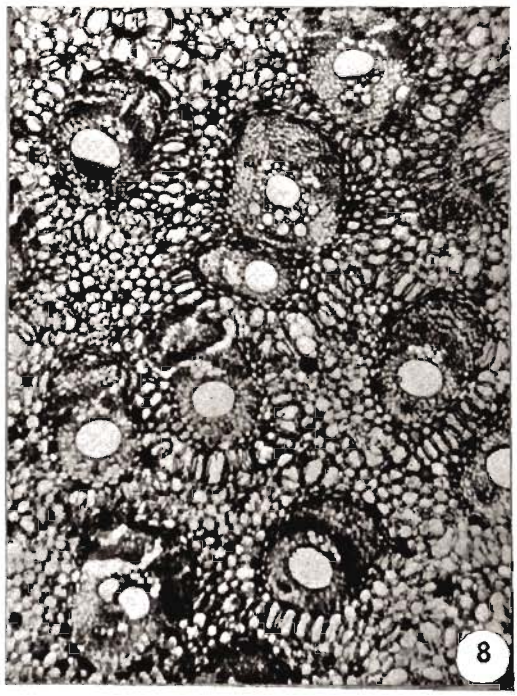


PLATE 1





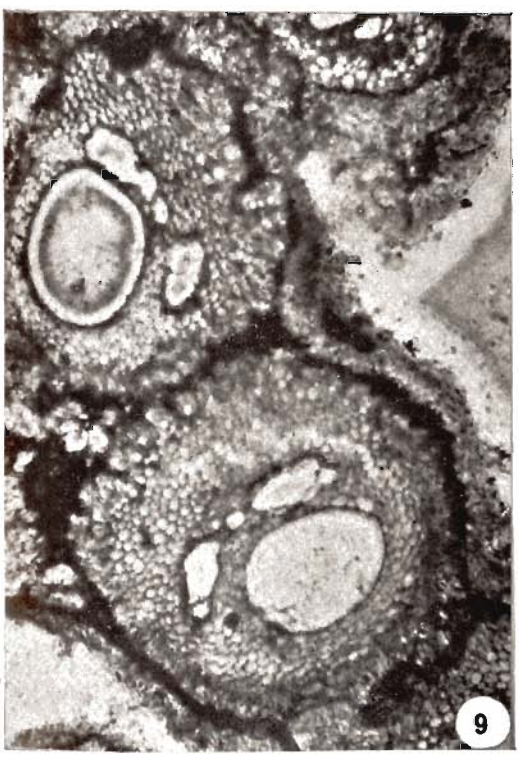


PLATE 2