

PALMOSTROBOXYLON ARENGOIDUM SP. NOV.: A FOSSIL PALM PEDUNCLE RESEMBLING ARENGA FROM THE DECCAN INTERTRAPPEAN BEDS OF SHAHPURA, MADHYA PRADESH

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ABSTRACT

A fossil palm peduncle, *Palmostroboxylon*, recovered from the Deccan Intertrappean beds of the village Ghugua in Shahpura, Madhya Pradesh, has been described. The fossil specimen closely compares with the peduncle of the extant genus *Arenga*, a member of Caryotoidae. It is characterised by the presence of fibrovascular bundles with Lunaria-type of sclerenchymatous dorsal sheath, two metaxylem vessels associated with 2-4 protoxylem vessels and fused fibrovascular bundles.

Key-words — Xylotomy, Palm peduncle, *Palmostroboxylon*, Intertrappean beds, Early Eocene (India).

सारांश

मध्य प्रदेश में शाहपुरा के दक्खिन अन्तर्द्वीपी संस्तरों से अरेन्गा के अनुरूप एक ताड़-पुष्पावलि-वृन्त, पाल्मॉस्ट्रॉबॉक्सिलॉन अरेन्गॉयडम् नव जाति—कृष्ण अम्बवानी

मध्य प्रदेश में शाहपुरा जनपद के घुगुआ गाँव की दक्खिन अन्तर्द्वीपी संस्तरों से उपलब्ध पाल्मॉस्ट्रॉबॉक्सिलॉन नामक एक ताड़-पुष्पावलि-वृन्त का वर्णन किया गया है। यह प्रादर्श कैरियोटॉयडो के एक विलुप्त सदस्य अरेन्गा से घनिष्ठ तुलनीय है। यह पुष्पावलि-वृन्ताश्म अर्ध-चन्द्राकार दृढ़ोत्कीय पृष्ठ आच्छद युक्त वाहिनी बंडलों, 2-4 प्रादिदार वाहिनियों से सहयुक्त दो अनुदार वाहिनीयों तथा संयुक्त वाहिनी बंडलों की उपस्थिति से अभिलक्षित है।

INTRODUCTION

SO far the fossil palms, viz., *Palmoxylon ghuguensis* sp. nov. Ambwani & Prakash (1983), *Palmoxylon shahpuraensis* sp. nov. Ambwani (1983) resembling *Chrysalidocarpus* and *Licuala* respectively as well as *Palmoxylon siltherensis* sp. nov. Ambwani (1984) and a fossil palm fruit *Hyphaeneocarpus indicum* gen. et sp. nov. (Bande, Prakash & Ambwani, 1982) showing the affinities with modern *Hyphaene* fruit, have been described from these beds. Besides, a few dicotyledonous woods have also been described from the same beds by Ingle (1972, 1973), Bande (1973, 1974), Lakanpal, Prakash and Bande (1978),

Bande and Khatri (1980), and Bande and Prakash (1981). Recently, Mehrotra, Prakash and Bande (1983) reported *Euphorbiocarpon drypteoides* for the first time from this area.

The present fossil specimen is well-preserved to reveal all the anatomical details, and differentiated into outer and inner zones. Further, its cylindrical shape and size, vascular system differentiated into outer and inner zones, compact arrangement of fibrovascular bundles in outer and gradually becoming sparse in the inner zone as well as larger number of trace, fusion and diminutive bundles collectively suggest that the present specimen belongs to a palm peduncle.

SYSTEMATIC DESCRIPTION

MONOCOTYLEDONAE

FAMILY — PALMAE

Genus — *Palmostroboxylon* Biradar & Bonde, 1979

Palmostroboxylon arengoidum sp. nov.

Pl. 1, figs 1, 2, 4, 6, 9, 10

Material—The fossil palm peduncle about 8 cm long and 4 cm in diameter is almost cylindrical in shape and complete in cross section consisting of an outer and inner vascular zones. The outermost cortical zone is not preserved (Pl. 1, fig. 1).

Outer Zone—It is a narrow zone about 4 mm wide. The fibrovascular bundles are more or less regularly oriented, round to oval, 200×400 – 300×400 μm . Their frequency varies from 200–250 per cm^2 . The f/v ratio is usually 1 : 1. The dorsal sclerenchymatous sheath is well-developed and Lunaria-type. The median sinus is concave and the auricular lobes are pointed. Generally two metaxylem vessels are seen in each fibrovascular bundle, rarely three or more may also be present (Pl. 1, fig. 4). Tabular parenchyma, stegmata as well as radiating parenchyma are absent. Phloem is represented by a wide semicircular lacuna (Pl. 1, fig. 4). The diminutive fibrovascular bundles may be seen frequently in this zone whereas the fusion bundles are sometimes seen (Pl. 1, fig. 9). Trace bundles are present while the fibrous bundles are absent.

Inner Zone—It covers a wider portion of the axis and is about 2 cm in thickness. The fibrovascular bundles in this zone are 150–200 per cm^2 and their size ranges from 400×400 – 400×600 μm . The shape of the fibrovascular bundles varies from round to oval but sometimes elongated bundles may also be seen. The f/v ratio is 1:1 or less. Dorsal sclerenchymatous sheath is prominently developed and is generally of Lunaria-type (Pl. 1, fig. 6). The median sinus is concave and the auricular lobes are pointed. Usually two rarely three metaxylem vessels along with a few smaller protoxylem elements are present in each fibrovascular bundle (Pl. 1, fig. 6). Tabular as well as radiating parenchyma are absent. Stegmata are also not seen. Phloem is represented by a semicircular

lacuna (Pl. 1, fig. 6). The diminutive fibrovascular bundles are sometimes seen dispersed in the ground mass. Trace bundles are present while the fibrous bundles are absent (Pl. 1, fig. 6). Metaxylem element shows scalariform thickening while the protoxylem element has spiral to annular thickenings. The perforation plates of metaxylem vessels have 6–8 bars (Pl. 1, fig. 10).

Ground Tissue—The ground tissue is compact throughout and composed of isodiametric parenchymatous cells. Cells of outer zone are generally isodiametric and the amount of parenchymatous cells is lesser as compared to the fibrovascular bundles (Pl. 1, fig. 4), while in the inner part the ground parenchymatous cells are also isodiametric, but slightly larger in size.

Diminutive Fibrovascular Bundles—The diminutive fibrovascular bundles are present throughout the peduncle and are distinguished by their smaller size and absence of protoxylem elements. They show irregular orientation. Each diminutive fibrovascular bundle reveals similar structure to that of normal fibrovascular bundle but possesses only one metaxylem vessel and measures 200×200 μm in size (Pl. 1, figs 4, 6).

Fusion Bundles—A few fusion bundles may be seen dispersed among the normal fibrovascular bundles in the fossil specimen. The fusion of the fibrovascular bundles is only by their fibrous part while the vascular part remains free (Pl. 1, fig. 9). Their size ranges from 800×800 – 800×1000 μm .

Trace Bundles—The trace bundles are scattered throughout the peduncle but are more frequently seen in the outer zone (Pl. 1, fig. 4). They are easily recognised by their enlarged vascular portion revealing similar structure to that of a normal fibrovascular bundle and range up to 800×600 μm in size.

SPECIFIC DIAGNOSIS

A small portion of the axis, complete in cross section, measuring 8×4 cm in size; vascular region demarcated by outer and inner zones. *Outer zone* narrow, 4 mm wide; fibrovascular bundles more or less regularly oriented; frequency 200–250 per cm^2 ; size 200×200 to 300×400 μm , shape round to oval. F/v ratio usually 1:1;

dorsal sclerenchymatous sheath well-developed, Lunaria-type. Median sinus concave; auricular lobes pointed. Two metaxylem vessels in each fibrovascular bundle, rarely three to four; stegmata, tabular and radiating parenchyma absent; phloem represented by semicircular lacuna. Fusion, trace and diminutive bundles present. Metaxylem scalariform, perforation plates with 6-8 bars, protoxylem spiral to annular. Fibrous bundles absent. *Inner zone* wider, 2 cm thick; fibrovascular bundles irregularly oriented, frequency 150-200 per cm², size 400 × 400-400 × 600 μm, shape round to oval sometimes elongated, f/v ratio 1:1 or less. Dorsal sclerenchymatous sheath prominent, Lunaria-type. Median sinus concave, auricular sinus absent, auricular lobes pointed; generally two rarely three metaxylem vessels in a fibrovascular bundle associated with a few smaller protoxylem vessels; stegmata, tabular and radiating parenchyma absent; phloem represented by semicircular lacuna, diminutive fibrovascular bundles, trace and fusion bundles present, fibrous bundles absent; metaxylem scalariform, perforation plates with 6-8 bars, protoxylem spiral to annular. *Ground tissue* compact throughout, cells isodiametric, slightly larger in inner zone.

Holotype — B.S.I.P. Museum no. 35474.

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

Horizon — Deccan Intertrappean Series.

Age — Early Eocene.

AFFINITIES

The present palm peduncle differs from *Palmoxylon indicum* Biradar & Bode, 1979 in having dorsal sclerenchymatous sheath Lunaria-type, fibrovascular bundles of the inner zone usually bigger in size, f/v ratio almost constant (1:1) throughout. The frequency of the fibrovascular bundles is usually much more whereas the end wall perforation plate of the vessel bears 6-8 bars. The general ground tissue cells are compactly arranged.

The characteristic anatomical features of the present fossil palm peduncle with Lunaria-type of dorsal sclerenchymatous sheath and undivided semicircular patch of phloem as well as absence of fibrous bundles and stegmata, are the characters met with the

caryotoid palms, especially the peduncle of *Arenga* Labill. Caryotoid palms are represented by the genera like *Arenga* Labill., *Caryota* L., *Didymosperma* Wendl. et Drude and *Wallichia* Roxb. (Tomlinson, 1961). However, from the living material as well as available related literature, it has been observed that the present fossil palm peduncle differs from *Caryota*, *Didymosperma* as well as *Wallichia*, as they possess reniform as well as segetate, rarely lunaria type of dorsal sclerenchymatous sheath. The number of the fibrovascular bundles per unit area is greater, usually more than 300 per cm² whereas the f/v ratio is always less than one throughout these peduncles. The fibrous bundles are present in all these genera. Median sinus is usually triangular to mucronate in shape, usually one rarely two metaxylem vessels are present in each fibrovascular bundle of *Caryota*, *Didymosperma* and *Wallichia*, whereas there are generally two metaxylem vessels in each fibrovascular bundle of the present fossil specimen. The diminutive fibrovascular bundles are profusely present in the above living specimens and the presence of raphide sacs is also observed in the ground tissue.

On the basis of anatomical features, the present fossil specimen can closely be compared with the peduncle of *Arenga (saccharifera) pinnata* Labil. as both show demarcation of an outer and inner zones. The fibrovascular bundles in the outer zone of the fossil as well as living specimens are closely placed and usually regularly oriented. They have Lunaria-type of dorsal sclerenchymatous sheath. The size of the fibrovascular bundles is almost similar in both, ranging from 200 × 400-300 × 400 μm in fossil and 200 × 300-300 × 500 μm in *Arenga (saccharifera) pinnata* Labil. The frequency of the fibrovascular bundles in the outer zone of fossil and living specimens varies from 200-250 and 200-270 per cm² respectively. The f/v ratio is generally 1:1 or less and the number of metaxylem vessels is usually two, both in the fossil and living specimens. Median sinus is concave and the auricular sinus is absent whereas the auricular lobes are pointed in both. Tabular as well as radiating parenchyma are absent whereas diminutive fibrovascular bundles, trace bundles and fusion bundles are also present in the fossil and living specimens (Pl. 1, figs 8, 9).

Similarly, the inner zone of the fossil is also comparable with that of *Arenga (saccharifera) pinnata* Labil. It is a wider zone in both; the fibrovascular bundles are irregularly oriented and sparsely placed. The dorsal sclerenchymatous sheath is Lunaria-type in both. The shape and size of the fibrovascular bundles is almost similar, they are round to oval in shape; the size ranges from 400×400 – 600×480 μm in the fossil and 400×400 – 640×500 μm in the living specimen. The frequency of the fibrovascular bundles in the fossil and living specimens is nearly same ranging from 150–200 per cm^2 and 150–180 per cm^2 respectively. The f/v ratio is generally 1:1 or less in both. The number of metaxylem vessels is usually two in the fossil as well as living specimens which are associated with a few smaller protoxylem vessels. Median sinus is concave and the auricular sinus is absent. Auricular lobes are pointed both in the fossil and living specimens. The diminutive fibrovascular bundles, trace bundles as well as fusion bundles are also present in the fossil and living specimens.

Ground Tissue — Apart from the above mentioned facts the ground tissue both in the fossil and living species can also be compared. It shows similar features in outer and inner zones, being compact throughout in the fossil as well as in the living specimen. The cells are isodiametric in shape and slightly larger in size in the

inner zone as compared to the cells of the outer zone.

Presently, the genus *Arenga* Labil. is represented by 11 species growing in tropical Asia and Australia (Blatter, 1926; Brandis, 1971; Tomlinson, 1961; Willis, 1973). *Arenga (saccharifera) pinnata* Labill. grows in Burma, Assam, Martban and Tenasserim, occasionally on the Pegu Yoma while *Arenga wightii* Griff. grows in North Kanara, evergreen forests of the Western Ghats and very common near the falls of Gairsoppah, Nilgiris and Travancore. The genus extends to an altitude of about 500–3000 ft.

The resemblance of the fossil specimen with the peduncle of modern *Arenga* which is also indigenous to India, indicates that similar plants must have also been growing in the Deccan Trap country during the Early Eocene time.

It may be mentioned here that the pollen grains assignable to *Arenga* have also been recovered by Dr R. K. Kar (Personal communication) from the Panandhro lignite field (Lower Eocene) of Kachchh, Gujarat. Thus it becomes apparent that during the Lower Tertiary *Arenga* was quite wide spread in central and western parts of India enjoying a warm, humid climate with much rainfall. From this it may be surmised that with the advent of drier climate, *Arenga* migrated towards east in Assam in farther east as well as Western Ghats in Nilgiris.

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EXPLANATION OF PLATE

Palmostroboxylon arengoidum sp. nov.

1. Transectional view of the fossil specimen. $\times 1.5$; specimen no. 35474.
2. Transverse section of the fossil to show general distributional pattern of fibrovascular bundles in outer and inner zones. $\times 6$; slide no. 6273.
3. Transverse section of *Arenga (saccharifera) pinnata* Labill. peduncle to show the general pattern of distribution of fibrovascular bundles in outer and inner zones. $\times 6$; B.S.I.P. Herbarium slide no. 2644.
4. Transverse section of fossil to show the arrangement of fibrovascular bundles in the outer zone. Note the regular orientation of the bundles with Lunaria-type of dorsal sclerenchymatous sheath. $\times 25$; slide no. 6723.
5. Transverse section of *Arenga (saccharifera) pinnata* peduncle to show regular arrangement of fibrovascular bundles in the outer zone with Lunaria-type of dorsal sclerenchymatous sheath. Also note the number of metaxylem vessels in each fibrovascular bundle. $\times 25$; B.S.I.P. Herbarium slide no. 2644.
6. Transverse section of fossil to show the irregular arrangement of the fibrovascular bundles in the inner zone with Lunaria-type of dorsal sclerenchymatous sheath. Note the number of metaxylem vessels in each fibrovascular bundle. $\times 25$; slide no. 6723.
7. Transverse section of *Arenga (saccharifera) pinnata* peduncle to show the irregular orientation of the fibrovascular bundles in the inner zone with Lunaria-type of dorsal sclerenchymatous sheath. Also note number of metaxylem vessels in each fibrovascular bundle and a semicircular patch of phloem in each fibrovascular bundle. $\times 25$; B.S.I.P. Herbarium slide no. 2644.
8. A single enlarged fusion bundle of the fossil. $\times 60$; slide no. 6723.
9. A single enlarged fusion bundle of *Arenga (saccharifera) pinnata* peduncle. $\times 60$; B.S.I.P. Herbarium slide no. 2644.
10. A portion of longitudinal section of fossil showing lateral wall pitting and nature of end plate of the metaxylem elements. $\times 60$; slide no. 6724.

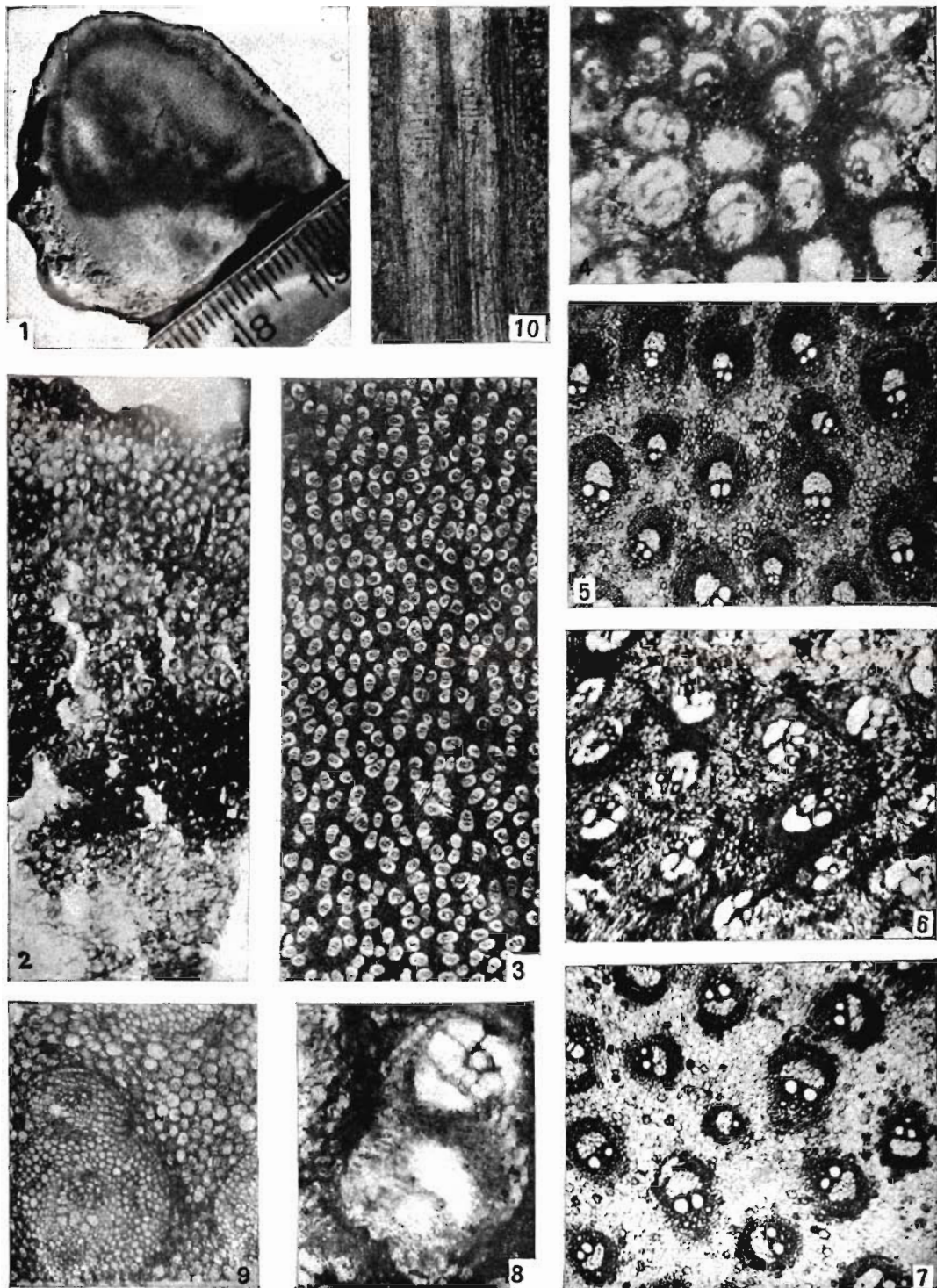


PLATE 1