A NEW FOSSIL PALM WOOD FROM THE DECCAN INTERTRAPPEAN BEDS OF SHAHPURA, MANDLA DISTRICT, MADHYA PRADESH

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Abstract

A new fossil palm wood, *Palmoxylon taroides* sp. nov., bearing distinct leaf scars is described from the Deccan Intertrappean beds of Ghughua near Shahpura, Mandla District, Madhya Pradesh. The species is based on three specimens which probably belong to the same plant and show affinities with the extant genus *Corypha* L.

Introduction

Fossil palms are commonly found in the Intertrappean beds of Ghughua near Shahpura, Mandla District, Madhya Pradesh. The fossil palms described from this area include *Palmoxylon parapaniensis* Lakhanpal *et al.* 1979 *P.mandlaensis* Lakhanpal *et al.* 1979, *P. shahpuraensis* Ambwani 1983, *P. ghuguensis* A mbwani & Prakash 1983, *P. siltherensis*, Ambwani 1984a & *P. dilacunosum* Ambwani 1984c. In addition, a fruit *Hyphaeneocarpon indicum* Bande *et al.* 1982 and a palm peduncle, *Palmostroboxylon arengoidum* Ambwani 1984 b have also been recorded.

The present fossil palm, *Palmoxylon taroides* sp. nov. is a stem bearing distinct leaf scars and possesses all the anatomical characters of the genus *Corypha* (Text-fig. 1; Pl. 3, figs. 1-4).

Systematic description

Family—Palmae

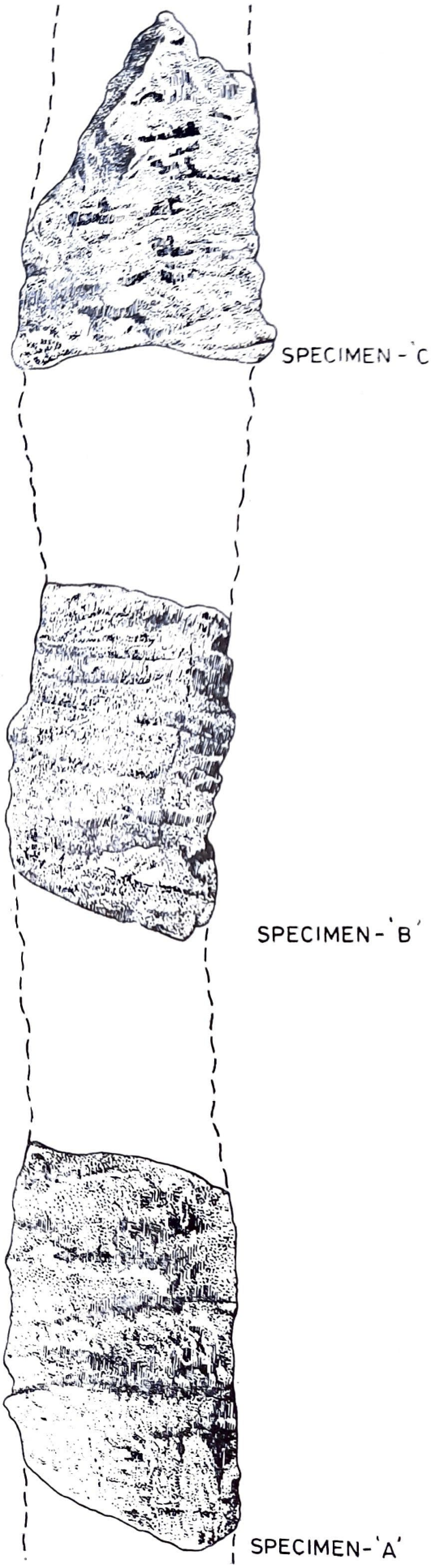
Genus—*PALMOXYLON* Schenk 1882

Palmoxylon taroides sp. nov.
(Pl. 1, figs. 1-7; Pl. 2, figs. 1-9; Pl. 3, figs. 1-4; Text-fig. 1)

Material—The species is based on three specimens which probably belong to different regions of the same plant. They are numbered as 'A', 'B', 'C' measuring 18x7 cm, 17x4 cm and 15x2.5 cm respectively in size. Each specimen bears several leaf-scars (Text-fig. 1; Pl. 1, figs. 1-3). The distance between two adjacent leaf scars varies from 2.5-4 cm in specimen 'A', 1.5-3 cm in specimen 'B' and 1-2 cm in specimen 'C'. In cross section all the three zones, the cortical, the outer and the inner are recognisable.

Cortical Zone—The cortical zone is almost uniform and about 6 mm thick. Fibrovascular bundles widely spaced, usually irregularly oriented (Pl. 2, figs. 1-3), circular to oval in outline, measuring about 160x144—300x200 μm in specimen 'A', 116x85-290x230 μm in specimen 'B' and 172x129-225x150 μm in specimen 'C'; the frequency varies from 64-80/cm^2 in specimen 'A' and 40-56/cm^2 in specimen 'B', 40-80/cm^2 in specimen 'C'. The f/v ratio usually 1/1, sometimes 2/1 in specimen 'A', 1.5/1-2/1 in specimen 'B' and 1/1 in specimen 'C'; dorsal sclerenchymatous sheath prominently developed and is generally reniform, occasionally cordate in outline; ground tissue surrounding the fibrous and fibrovascular bundles compact, consisting of small round to oval parenchymatous cells; fibrous bundles composed of exclusively fibres, profusely present, usually more abundant than the fibrovascular bundles; leaf-trace bundles are frequently observed throughout the cortical zone in all three specimens.

Outer Zone—About 1 cm thick in specimen 'A', 5 mm in specimen 'B' and 'C'. The fibrovascular bundles are usually closely



placed, regularly oriented (Pl. 2, figs. 4-6), although some of these are irregularly oriented in specimen 'B'; they are usually round to oval in outline and measure 125x105–680x 450 μm in specimen 'A', 225x180-525x405 μm in specimen 'B' and 275x135-450x300 μm in specimen 'C'. Their frequency varies 240-350/cm², 184-330/cm² and 256-360/cm² in specimens A, B & C respectively; f/v ratio usually 1/1 to 2/1 in all the specimens, occasionally exceeds 3/1 in specimen 'C'; dorsal sclerenchymatous sheath prominently developed, generally reniform in transverse outline, sometimes cordate; median sinus concave to round; auricular sinus absent, auricular lobes usually round to sometimes pointed; each fibrovascular bundle contains one, sometimes two included to partly excluded metaxylem vessels; in the inner part, there may be three vessels in a fibrovascular bundle (specimen 'C'); the ground tissue parenchyma is poorly preserved, consisting of thin walled round to oval parenchymatous cells; 1 or 2 layers of tabular parenchyma present around the fibrous portion of the fibro-vascular bundles (Pl. 1, fig. 7); radiating parenchyma absent; stegmata present both in fibrous and fibrovascular bundles (Pl. 1, figs. 5, 6): phloem poorly preserved, at places a few phloem cells visible; fibrous bundles profusely distributed; leaf-trace bundles quite abundant in specimen 'C', indicating apical portion of the stem.

Inner Zone—About 5.5 cm, 3 cm and 1.4 cm in thickness in specimens 'A', 'B' and 'C' respectively; fibrovascular bundles widely spaced, irregularly oriented (Pl. 2, figs. 7-9; circular to oval, sometimes variously shaped particularly in specimens 'B' and 'C', measuring 490×375-750×600 μm in specimen 'A', 390x300-600x540 μm in specimen 'B' and 270x225-570x525 μm in specimen 'C'; their frequency ranges 92-120/cm² in specimen 'A', 144-200/cm² in specimen 'B' and 170-248/cm² in specimen 'C'; f/v ratio usually 1/1 to 1/1.5, sometimes 1/2 in specimen 'A'; dorsal sclerenchymatous sheath generally reniform in outline, the median sinus concave to round; auricular

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Text-fig. 1—Reconstruction of the fossil palm stem, *Palmoxylon taroides* sp. nov. (specimen 'A'—lower part, specimen 'B'—representing middle portion and specimen 'C'—apical region of the stem).

sinus absent, auricular lobes usually round to sometimes pointed; each fibrovascular bundle generally contains two, occasionally three, rarely one excluded metaxylem vessel; ground parenchyma poorly preserved, parenchymatous cells thin walled, round to oval in shape; 1-2 layers of tabular parenchyma also seen around fibrous part of the fibrovascular bundles; radiating parenchyma absent; stegmata present both in fibrous and fibrovascular bundles; phloem poorly preserved, a few phloem cells occasionally visible (Pl. 1, fig. 7); fibrous bundles profusely scattered throughout the inner zone, diminutive bundles sometimes present.

Ground tissue—Compact, poorly preserved and at places the parenchymatous cells seen as small, round to oval in shape, sometimes spongy nature may also be observed (Pl. 2, figs. 4-6). *Fibrous bundles* profusely scattered throughout the stem (Pl. 2., figs. 1-9), ranging 34-275 μm in diameter, each bundle made up of 6-80 fibre cells, larger bnndles usually found in the cortical zone of all the three specimens. *Diminutive bundles* present throughout the stem, similar in structural details to normal fibrovascular bundles having irregular orientation, usually smaller than the normal fibrovascular bundles, measuring 50-480 μm in diameter, each bundle contains 1-2 small metaxylem vessels. *Leaf-trace bundles* present throughout the stem, more frequent in specimen 'C' (Pl. 2, figs. 3, 6, 9), these bundles recognised by their protruded tongue-like vascular part, each leaf-trace bundle contains 1-4 metaxylem vessels with scalariform thickenings and 3-20 protoxylem vessels with annular to spiral thickenings (Pl. 1, fig. 4). *Stegmata* present in the fibrous as well as in the fibrous part of the fibrovascular bundles; they are of the druse type (Pl. 1, figs. 5, 6).

Discussion

Specimens 'A', 'B' and 'C' belong to *Reniformia* group of *Palmoxylon* (Stenzel, 1904). The fibrous bundles are profusely distributed having f/v ratio more or less same. The median sinus is concave to rounded, the auricular sinus is absent, the vascular part of the fibrovascular bundles is mainly excluded with usually 1-3 large vessels. Frequency of fibrovascular bundles in the cortical and outer zones is almost similar in all the specimens, whereas in the inner zone, their frequency varies from 92-120/cm^2, 144-200/cm^2 and 170-248/cm^2 in specimens 'A', 'B' and 'C' respectively. Diminutive and leaf-trace bundles are present in all the specimens. Ground tissue is compact with thin walled, small, circular to oval parenchymatous cells. The tabular parenchyma is present as 1-2 layers around the sclerenchymatous sheath of the fibrovascular bundles while, radiating parenchyma is absent. Stegmata are also present in all these specimens. The similarities in all the above mentioned features indicate that the three specimens belong to the same stem. However, slight variation in the size of the fibrovascular bundles can be seen. The largest bundles (maximum size 750x600 μm) can be seen in specimen 'A' while in specimens 'B' and 'C', size ranges 600x540 μm and 570x525 μm respectively.

The leaf-scars in specimen 'C' are closely packed (usually 1-2 cm apart), suggesting that it is a part of the upper portion of the stem. This is also supported by the occurrence of numerous leaf-trace bundles. The maximum distance between the two consecutive rows of leaf-scars is 2.5-4 cm and 3-1.5 cm in specimens 'A' and 'B' suggesting that they belong to basal (or lower) and middle portion of the stem respectively.

Affinities—The important anatomical characters of the present fossil specimens such as shape, size and distribution of the fibrovascular bundles, compact ground tissue, reniform dorsal sclerenchymatous sheath, profusely scattered fibrous bundles, 1-2 layers of tabular parenchyma, usually 1-2, sometimes 3 excluded metaxylem vessels indicate that all the three specimens of silicified palm wood resemble that of the genus *Corypha* L. of sabaloid group of palms.

Cross sections of three species of the genus *Corypha*, namely *Corypha elata* Roxburgh, *C. talliera* Roxburgh and *C. umbraculifera* L. were available for comparison. The fossil shows similarties with *C. talliera* in most of the features (Pl. 3, figs 1-4) such as reniform dorsal sclerenchymatous sheath, profusely scattered fibrous bundles, median sinus concave to round, auricular lobes round to slightly pointed, f/v ratio, 1-2, sometimes 3 excluded metaxylem vessels, presence of stegmata in the fibrous and fibrovascular bundles, ground tissue compact, made up of round to oval parenchymatous cells, presence of tabular parenchyma, diminutive fibrovascular bundles, leaf-trace bundles and absence of auricular sinus and

radiating parenchyma. However, it differs slightly in having greater frequency of the fibrovascular bundles (92-360/cm² in fossil, 16-108/cm² in *C. talliera*). Moreover, the fibrovascular bundles in the present fossil are slightly smaller (125x105-750x600 μm) than in *C. talliera* (570x420-825x630 μm).

Corypha L. is a stout, tall, tree, occuring in Ceylon, South-East Asia and Indo-Malaya. It consists of eight species (Willis, 1973), of which four species, viz., *Corypha elata* Roxburgh, *C. macropoda* Kurz, *C. talliera* Roxburgh, *C. umbraculifera* L. are distributed in Bengal, Malabar coast and Andaman Islands (Blatter, 1926).

Comparison with other Palmoxylon species—The present fossil palm wood possesses compact ground tissue and is therefore, compared only with those species which show this feature, viz., *Palmoxylon liebigianum* (Schenk, 1882; Sahni, 1931, 1964), *P. edwardsi* (Sahni, 1931, 1964), *P. sclerodermum* (Sahni, 1943, 1964; Shukla, 1946), *P. sundaram* (Shukla, 1946; Sahni, 1964), *P. surangei* Lakhanpal (1955), *P. narayani* Rao and Menon (1962), *P. compactum*, *P. krishna*, *P. rewahense*, *P. seriatum* (Sahni, 1964), *P. maheshwarii* Rao and Menon (1963), *P. pyriforme* (Sahni, 1964; Rao & Menon, 1968), *P. raoi* Menon (1968), *P. cordatum* Trivedi and Surange (1969), *P. mohgaonensis* Trivedi and Surange (1970), *P. mandlaensis* Lakhanpal *et al.* (1979), *P. shahpuraensis* Ambwani (1983), *P. ghuguensis* Ambwani and Prakash (1983), *P. kachchhensis* Guleria (1983) and *P. siltherensis* Ambwani (1984 a). Of these, only two species *P. shahpuraensis* and *P. ghuguensis* are closely comparable to the present fossil palm. *Palmoxylon shahpuraensis* and the present fossil species are characterised by the presence of compact ground tissue, stegmata, 1-3 excluded metaxylem vessels per bundle, mostly concave median sinus and round auricular lobes, diminutive fibrovascular bundles, leaf-trace bundles and the absence of radiating parenchyma. However, the latter differs from the former in other important anatomical characters such as fibrovascular bundles in *P. shahpuraensis* are larger (1200 × 800 μm); f/v ratio is 6/1-1/1 in *P. shahpuraensis* and 3/1-1/2 in the present fossil species. Frequency of the fibrovascular bundles extends to 150/cm² in *P. shahpuraensis* being lesser than the present fossil. Fibrous bundles are absent in *P. shahpuraensis* whereas they are profusely present in the present fossil species. *P. ghuguensis* and the present fossil species are characterised by the presence of reniform dorsal sclerenchymatous sheath, concave median sinus, rounded auricular lobes, compact ground tissue, stegmata, diminutive as well as leaf-trace bundles, the absence of auricular sinus and radiating parenchyma and f/v ratio. However, they also differ in some important features such as phloem is mostly divided into two patches in *P. ghuguensis* whereas it is only a single patch in the present species. Fibrous bundles are absent in *P. ghuguensis* whereas they are frequently noted in the present fossil specimen.

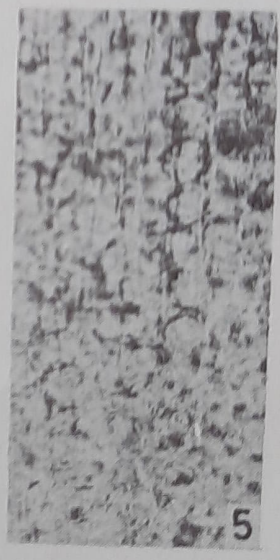
Of the known species other than Indian *Palmoxylon*, none shows nearest similarities with the present fossil. However, the following species, namely *Palmoxylon arenarium* Watelet, *P. cottae* Unger, *P. didymosolen* Sprengel, *P. oligocaenum* Beck, *P. ovatum* Stenzel, *P. tenue* Stenzel and *P. withamii* Unger described by Stenzel (1904) show apparent similarity with the present fossil in having reniform sclerenchymatous sheath and presence of fibrous bundles but differ in most of the characters, viz., shape, size, frequency and f/v ratio of the fibrovascular bundles, nature of ground tissue. *Palmoxylon paniselianum* described by Stockmans and Williere (1943) also shows similarities with the present fossil wood in having compact ground tissue, similar shape and size of the fibrovascular bundles, each bundle bearing 1-2 excluded metaxylem vessels and also presence of fibrous bundles. The present species differs from the above mentioned species in having fibrovascular bundles reniform whereas it is cordate in *P. paniselianum*. The f/v ratio is comparatively more in *P. paniselianum*; ground tissue cells usually small and round to oval in the present fossil while they are large, usually polygonal and elongated in *P. paniselianum*.

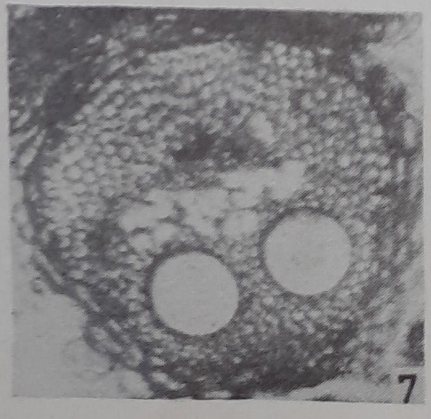
All the species of *Palmoxylon* known so far are different from the present species. Therefore, we place this fossil under a new species, *Palmoxylon taroides*. The specific name indicates its resemblance with Tara which is a vernacular name of the genus *Corypha*.

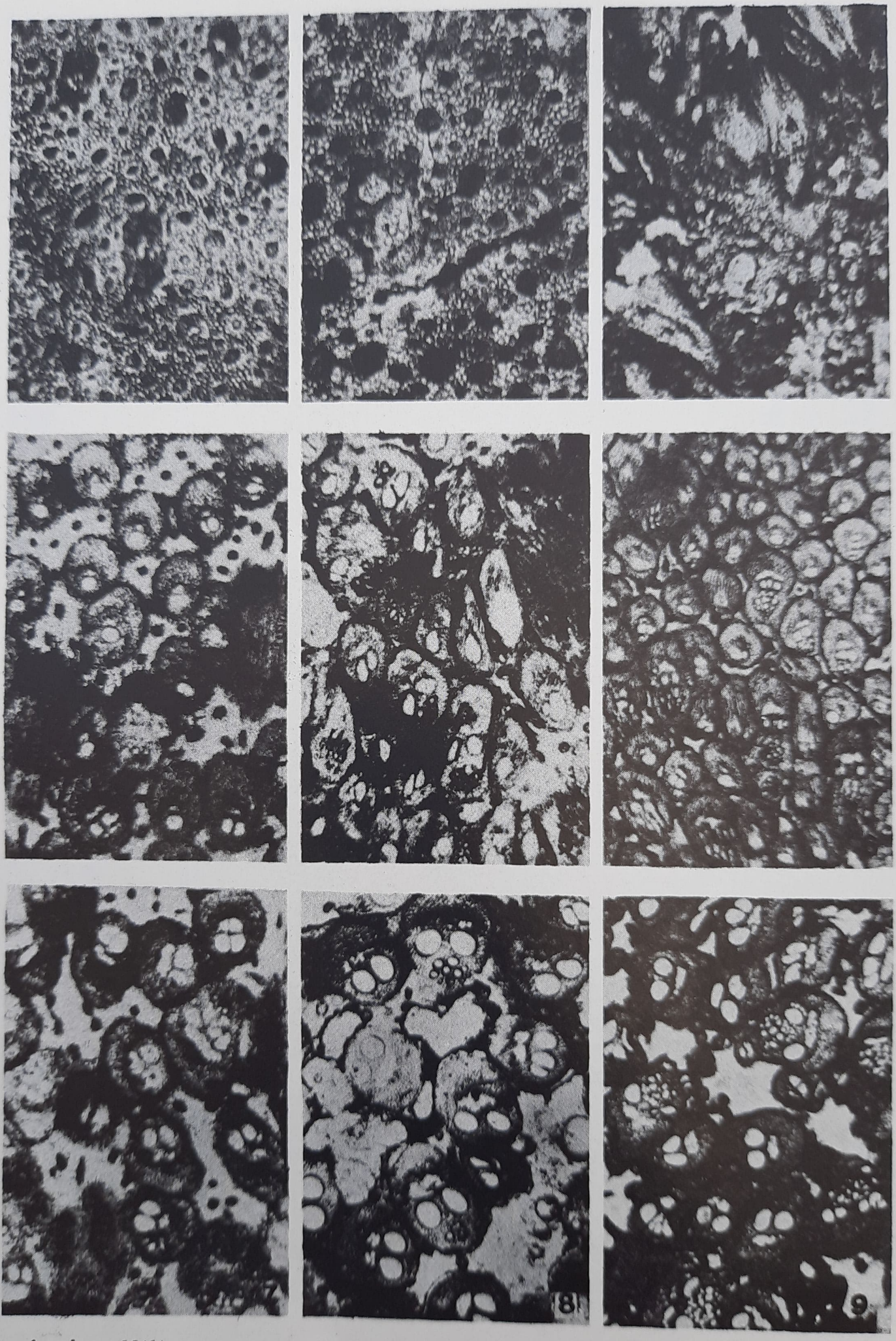
Specific Diagnosis

Palmoxylon taroides sp. nov.

Stem—Consisting of three specimens, lower, middle and upper ('A', 'B' and 'C',



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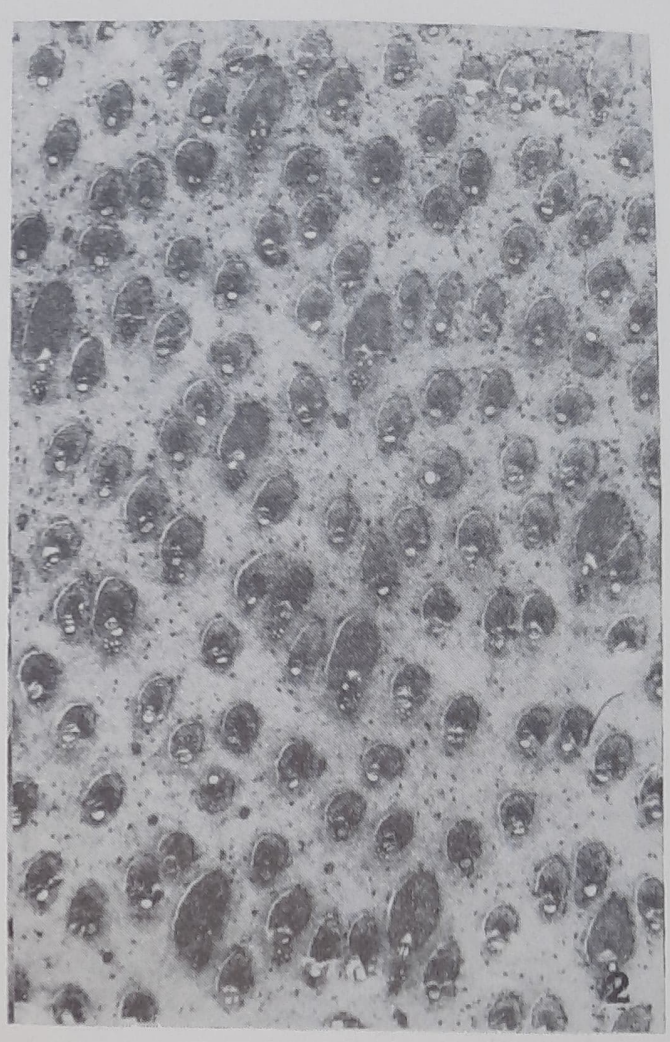

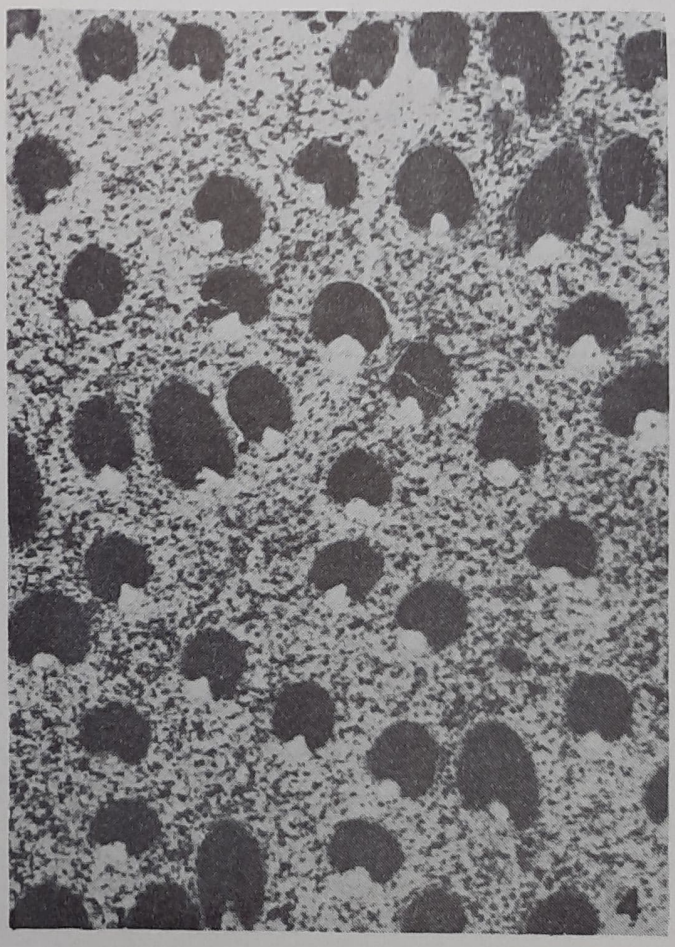

Explanation of Plates

Plate 1

Palmoxylon taroides sp. nov.

1. Basal part of the palm stem (specimen 'A') showing widely spaced leaf-scars. × 0.45; specimen no. BSIP 35966/A.
2. Middle part of the palm stem (Specimen 'B') showing leaf scars. × 0.45; specimen no. BSIP 35966/B.
3. Upper part of the palm stem (specimen 'C') showing closely placed leaf scars. × 0.45; specimen no. BSIP 35966/C.
4. Longitudinal section of the stem showing metaxylem vessels with scalariform thickening and protoxylem vessels with anular to spiral thickenings. × 105; slide no. BSIP 35966/B-II.
5. Longitudinal section of the fossil showing stegmata in the fibrous portion of fibrovascular bundles. × 200; slide no. BSIP 35966/B-II.
6. Longitudinal section of the fibrous bundles of the fossil showing presence of stegmata. × 200; slide no. BSIP 35966/A-II.
7. A magnified fibrovascular bundle of the fossil showing phloem cells. × 52; slide no. BSIP 35966/A-I.

Plate 2

Palmoxylon taroides sp. nov.

1-3. Cortical zones of the fossil specimens 'A', 'B' and 'C' respectively showing shape, size and distribution of fibrous and fibrovascular bundles. Note the nature of ground tissue. × 20; slide nos. BSIP 35966/A-I, 35966/B-III, 35966/C-I.

4-6. Outer zones of the fossil specimens 'A', 'B' and 'C' respectively showing shape, size, distribution and orientation of fibrovascular bundles. × 20; slide nos. BSIP 35966/A-I, 35966/B-I, 35966/C-I.

7-9. Inner zones of the fossil specimens 'A', 'B' and 'C' respectively showing above characters. × 20; slide nos. BSIP 35966/A-I, 35966/B-I, 35966/C-I.

Plate 3

1. *Palmoxylon taroides* sp. nov.—Cross section of the stem showing outer zone. ×6 : slide no. BSIP 35966 A/I.
2. *Corypha talliera* Roxb.—Cross section of the stem showing outer zone. ×6.
3. *Palmoxylon taroides* sp. nov.—Cross section of the fossil palm showing the general pattern of fibrous and fibrovascular bundles. Note the nature of xylem vessels in the fibrovascular bundles of inner zone. ×15; slide no. BSIP 35966 A/I.
4. *Corypha talliera* Roxb.—Cross section of inner zone showing general pattern of the fibrous, fibrovascular bundles as well as xylem vessels in fibrovascular bundles. ×15.