PETRIFIED PALM STEM, *PALMOXYLON PENCHENSE* SP. NOV. FROM THE DECCAN INTERTRAPPEAN BEDS OF MADHYA PRADESH, INDIA

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ABSTRACT

The paper describes *Palmoxylon penchense* sp. nov. from the Deccan Intertrappean beds of Madhya Pradesh, India. This species is characterized by the presence of lacunar ground tissue, absence of ventral sclerenchyma, absence of both radiating and tabular parenchyma and absence of stegmata both from the fibrous bundles and fibrous part of fibrovascular bundles. It is compared with all the known species of *Palmoxylon*.

INTRODUCTION

LARGE number of petrified palm woods have been described from India and abroad, some of them are fragmentary while others are quite large. The petrified palm wood described here is quite large. It consists of cortical, dermal, subdermal and central zones. The palm wood was collected by the authors from Mohgaon Kalan in Chhindwara district, Madhya Pradesh, India. For detailed anatomical studies serial sections were prepared both in transverse as well as in longitudinal planes. The preservation of the wood is quite good hence no stains were used.

DESCRIPTION

MONOCOTYLEDONAE

PALMAE

Palmoxylon penchense sp. nov.

The petrified palm wood is quite large. Before sectioning it measured 15 cm. in diameter and about 5 cm. in thickness. In hand specimen cortex, dermal, subdermal and central zones are clearly seen (Text-fig. 1; Pl. 1, Fig. 1). The chert containing the wood is grey in colour and vascular bundles are clearly visible on the surface.

ANATOMY

Cortex — Epidermal cells are not seen. The cortical zone is 1·5 cm. in thickness. It consists of numerous small and large fibrous bundles which are variable in shape; they may be oval or elongate and are 0·10-0·40 mm. in size (Pl. 1, Fig. 2). They are irregularly arranged in parenchymatous ground tissue. Usually only one vessel is present in fibrovascular bundles that occur towards the dermal zone (Text-fig. 3).

Ground tissue is made up of round, oval or polygonal parenchymatous cells (Text-fig. 8; Pl. 1, Fig. 2).

Dermal Zone — It is about 1·8 cm thick. Fibrovascular bundles are closely packed and normally oriented in parenchymatous ground tissue (Pl. 1, Fig. 5). They are small and assume various shapes; they have one or two metaxylem vessels (Text-fig. 2) which measure 0·18 to 0·22 mm. in diameter, phloem elements are also clearly seen. The average frequency of fibrovascular bundles in this zone is 110-120/cm.^{2} and their f/v ratio is 8: 1 to 12: 1. Purely fibrous bundles of small size and round shape are of common occurrence in this zone.

Subdermal Zone — It is about 2 cm. thick. The fibrovascular bundles in this zone are regularly oriented up to some distance towards the centre, becoming somewhat irregular in distribution (Text-fig. 1). The average frequency of the bundles is 70-90/cm.^{2} and their f/v ratio is 4: 1 to 6: 1. The

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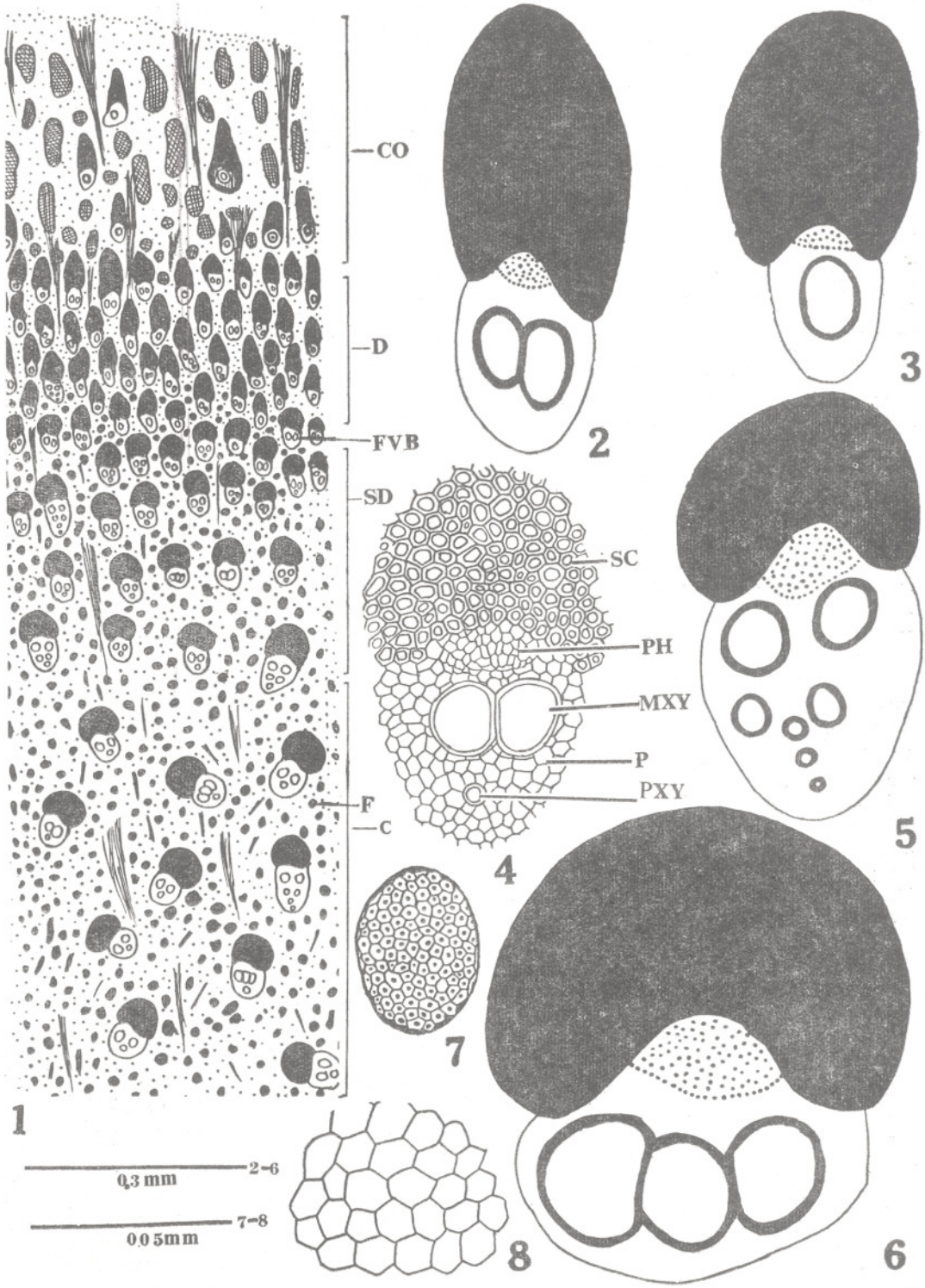
TEXT-FIGS. 1-8 — (*C*, central zone; *Co*, cortical zone; *D*, dermal zone; *F*, fibrous bundles; *FVB*, fibrovascular bundles; *MXY*, metaxylem vessels; *P*, parenchyma cells; *PH*, phloem; *PXY*, protoxylem vessel; *SC*, sclerenchymatous sheath). 1. A part of petrified palm stem in cross section, showing the cortical, dermal, subdermal and central zones with numerous fibrous and fibrovascular bundles ca × 4. 2. A fibrovascular bundle showing two metaxylem vessels placed side by side. 3. A fibrovascular bundle showing a single vessel. 4. A fibrovascular bundle showing cellular details. 5. A leaf trace bundle with many vascular elements. 6. A fibrovascular bundle showing three metaxylem vessels. 7. A fibrous bundle enlarged to show many fibrous cells. 8. Few cells of cortical zone.



TEXT-FIGS. 1-8

bundles here have two metaxylem vessels placed side by side and well developed dorsal sclerenchymatous sheath and measure 0·20-0·25 mm. in diameter. Phloem cells are clearly seen. Auricular lobes are round and median sinus concave. Tabular as well as radiating parenchyma round the fibrovascular bundles is absent.

Central Zone — It is about 10 cm. in thickness. The fibrovascular bundles are irregularly arranged in lacunate ground tissue (Text-fig. 1). Bundles are sparsely arranged in the ground tissue. The average frequency of the bundle is 30-35/cm.^{2} towards the subdermal zone but towards the centre it is 10-15/cm.^{2}. The f/v ratio of the bundles is 1: 1 to 3: 2.

The fibrovascular bundles are large, generally oval or elongate, and measure 0·25 to 0·3 mm. in diameter. The bundles have two or three metaxylem vessels and a protoxylem facing the centre; phloem elements are clearly visible (Text-figs. 4 & 6; Pl. 1, Fig. 3). Dorsal sclerenchymatous sheath is well developed, but ventral sclerenchyma is absent. Auricular lobes are round and median sinus is concave (Pl. 1, Fig. 3). Both tabular and radiating parenchyma are absent.

Purely fibrous bundles are present in this zone as well. One such bundle is 60 to 130 μ in diameter, usually with 25 to 30 fibrous cells (Text-fig. 7). Stegmata are not seen.

In longitudinal section of the wood the pitting of metaxylem vessel is multiseriate scalariform type and the pitting of protoxylem vessel is of spiral type (Pl. 1, Fig. 7). The end wall of the vessel shows 6-8 parallel bars of thickening (Pl. 1, Fig. 4).

The leaf trace bundles are also seen in this zone (Text-fig. 5; Pl. 1, Fig. 6). The ground tissue is lacunate i.e. it is formed by a net work of narrow cells forming large intercellular spaces of various shape.

DISCUSSION

Large number of petrified palm woods referable to the artificial genus *Palmoxylon* have been described from India and abroad. Mohl (1845, 1849), Schenk (1882), Stenzel (1904), Stevens (1912), Ogura (1952), Sahni (1931, 1943, 1946, 1964), Rode (1933), Shukla (1939, 1946), Ramanujam (1953, 1958), Lakhanpal (1955), Prakash (1958, 1961), Rao and Menon (1963, 1964, 1965, 1967), Menon (1964), Trivedi and Surange, 1968, 1969, 1971), Trivedi and Verma (1969, 1971), Trivedi and Chandra (1971) have reported 45 species of the genus *Palmoxylon* from India (Verma, 1972).

The species described here is characterized by the presence of lacunar ground tissue. Apart from this, *Palmoxylon penchense* is characterized by the (i) presence of fibrous bundles, (ii) presence of leaf trace bundles, (iii) absence of ventral sclerenchyma, (iv) absence of stegmata both from fibrous bundles and fibrous part of the fibrovascular bundles, (v) absence of both radiating and tabular parenchyma.

The present species has been compared with *P. dakshinense* (Prakash, 1958), *P. chhindwarense* (Prakash, 1958), *P. eocenum* (Prakash, 1961), *P. surangei* (Lakhanpal, 1955), *P. parthasarthyi* (Rao & Menon, 1963), *P. maheshwarii* (Rao & Menon, 1963), *P. kräuselii* (Rao & Menon, 1965) and *P. superbum* (Trivedi and Verma, 1969) in detail (Table 1).

The present species differs from all the known species of *Pamoxylon* listed by Verma, 1972 and also from species listed in Table 1, in shape, size, frequency, f/v ratio of the fibrovascular bundles, presence or absence of fibrous bundles and stegmata. The species described above is quite distinct and is not identical with any species described so far from India (Verma, 1972) or outside, hence it is given a new specific name *Palmoxylon penchense*.

DIAGNOSIS

Genus — *Palmoxylon*

Palmoxylon penchense sp. nov.

Fibrous and fibrovascular bundles irregularly oriented in cortical zone, size various; dermal bundles 110-120/cm.^{2}, f/v ratio 8/1 to 12/1, regularly oriented, median sinus concave, vessels 1 to 2; subdermal bundles regularly oriented, 70-90/cm.^{2}, f/v ratio 4/1 to 6/1, median sinus concave, vessels 2; central bundles irregularly oriented, 30-35/cm.^{2}, f/v ratio 1/1 to 3/2, median sinus concave, auricular lobes round, phloem well preserved, vessels 2 to 3; fibrous bundle 60-130 μ in diameter; stegmata absent;

TABLE 1

Name of sepcies	Parts available	Frequency of fibrovascular bundles per cm²	f/v Ratio of the bundle	Size of bundle in mm	Median sinus and auricular lobe	Xylem vessels	Phloem	Leaf trace bundle	Posterior sclrenchyma	Ground tissue			Fibrous bundle and stegmata
										General parenchyma	Tabular parenchyma	Radiating parenchyma	
P. dakshinense (Prakash, 1958)	Cortex incomplete, dermal, subdermal	D 200-270/cm² SD 50-90/cm²	D 10/1-16/1 SD 12/1-17/1	D 0·16-0·56 SD 0·60-0·90	Concave lobes pointed	1-2	Not preserved	Present	Present	Lacunar	+	+	Fibrous bundle absent, stegmata present in fibrous part of dermal bundle
P. chhindwarense (Prakash, 1958)	Cortex, dermal, subdermal & central	D 297-625/cm² SD 156-250/cm² C 60-130/cm²	D 4·5/1-8/1 SD 3/1-5/1 C 2·5/1-3/1	D 0·2-0·62 SD 0·69-0·72 C 0·58-0·80	Deep, concave lobe rounded sometimes pointed	1-2	Not seen clearly	Present	Present	Lacunar	+	—	Both absent
P. eocenum (Prakash, 1961)	Dermal, subdermal, central	D 300-366/cm² SD 66-132/cm² C 30-60/cm²	D 6·5/1-10·5/1 SD 3/1 C 2·5/1-3·5/1	D 0·28-0·56 SD 0·52-0·94 (0·24-0·40 small bundle) C 0·60-1·07 0·40-0·27	Concave lobes rounded to pointed	1-2	Not preserved	Sporadic	—	Lacunar	+	+	Both absent
P. surangei (Lakhanpal, 1955)	Cortex, dermal, subdermal, central	D 90-95/cm² outer 140/cm² SD 45-50/cm² C 25/cm²	D 7/8-7/1 SD 5/1-6/1 C 4/1	D 1×0·5 SD 0·95×0·65 C 0·95×0·8	Lobes rounded	2-3 rarely 4	Poorly preserved	Present	Absent	Compact	+	—	Both fibrous bundle and stegmata present
P. parthasarthyi (Rao & Menon, 1963)	Cortex, dermal, subdermal, central	D 350-380/cm² SD 90-110/cm² C 60-66/cm²	D 0·2/1-0·8/1 SD 0·2/1-0·6/1 C 0·3/1-0·4/1	D 0·16-0·42 SD 0·20-0·42 C 0·19-0·43	Concave lobes round	2	Not preserved	Present	Absent	Compact	—	—	Fibrous bundle present
P. maheshwarii (Rao & Menon, 1963)	Cortex, dermal subdermal· Central	D 540-630/cm² SD 80-100/cm² C 35-55/Cm²	D 0.2/1-0·6/1 SD0·12/1-0·3/1 C0·1/1-0·2/1	D 0·12-0·25 SD0·26-0·42 C0·17-0·56	Crescent like	2	Preserved	Present	Present in leaf trace bundle	Compact	—	—	Both absent
P. kräuselei (Rao & Menon 1965)	Cortex absent	SD 50-55/cm²	D 0·2/1-1·1/1 SD 0·4/1-1/1	D 0·18-0·3 SD 0·27-0·4	Concave & lobes round	D-1 2-3	Not preserved	—	Absent	Lacunar	—	+	Fibrous bundle and stegmata present
P. superbum (Trivedi & Verma 1969)	Cortex, dermal, subdermal, central	D 100-130/cm² SD 60-70/cm² C 40-45/cm²	D 9/1-12/1 SD 10/1-17/1 C 1·5/1-2/1	D 0·33×0·45 SD 0·33-0·41 0·49-0·57 C 0·60×0·41 0·41×0·33	Concave lobes round	D 1-2 SD us. 2 C 2-3	Well preserved	Present in subdermal & central zone	Present	Extremely lacunar	+	—	Both fibrous bundle and stegmata present stegmata spherical
P. penchense sp. nov.	Cortex, dermal, subdermal, central	D 100-120/cm² SD 70-90/cm² C 30-35/cm² in centre 10-15/cm²	D 8/1-12/1 SD 4/1-6/1 C 1/1-3/2	D 0·18×0·22 SD 0·20-0·25 C 0·25-0·3	Concave lobes round	D us. 1 2-3	Well preserved	Present	Absent	Lacunar	—	—	Fibrous bundles present, stegmata absent

D. Dermal zone, SD. Subdermal zone, C. Central zone, + Present, — Absent.

leaf trace bundles present in subdermal and central zone; ground tissue lacunate; radiating and tabular parenchyma absent.

Locality — Mohgaon kalan (22°1'N, 79°11' E), a village in Chhindwara district, M.P.

Holotype — No. M/418, in Botany Department, Lucknow University.

Horizon and Age — Deccan Intertrappean series, Tertiary (Eocene).

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EXPLANATION OF FIGURES

PLATE 1

Palmoxylon penchense sp. nov.

1. Cross-section of petrified palm stem showing all the zone. × 3.
2. A part of cortical region enlarged to show the fibrous bundles. × 22.
3. A fibrovascular bundle showing metaxylem vessels placed side by side × 35.
4. A vessel slightly oblique in l.s. showing 8-12 parallel bars of thickening. × 60.
5. Few fibrovascular bundles of dermal zone showing regular orientation. × 10.
6. A leaf trace bundle. × 30.
7. Vascular elements in l.s. showing multiseriate and spiral type of pitting. × 90.


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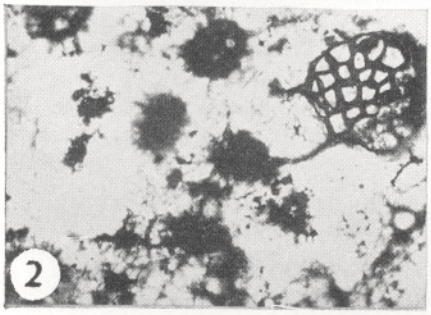
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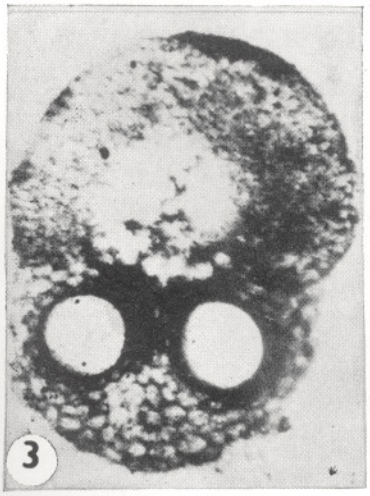
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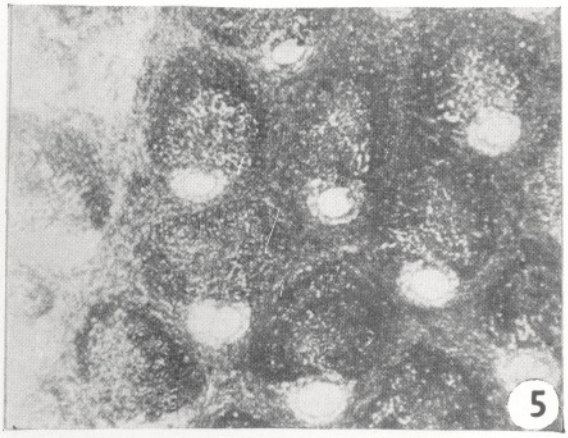
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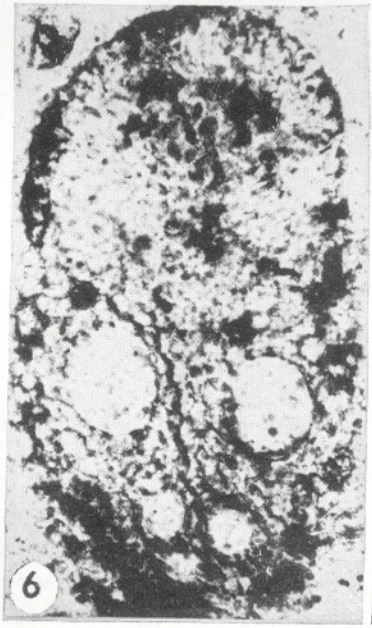
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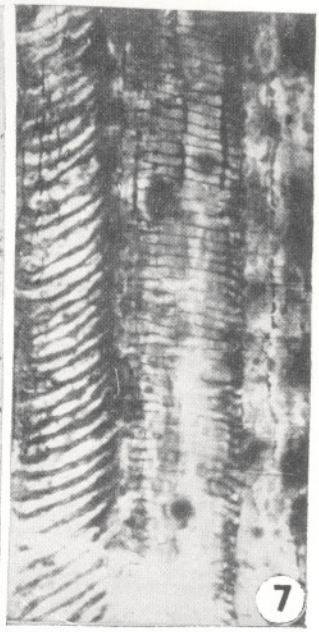
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