

# A NEW SPECIES OF PETRIFIED PALM WOOD FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAON KALAN

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## INTRODUCTION

**T**HE specimen M 85 described here is one out of a number of silicified palm woods collected from Mohgaon Kalan area (Chhindwara District). Although the present specimen is fragmentary and not too well preserved, yet, it was thought desirable that it should be described fully as it shows certain characters very different from all the hitherto reported petrified palm stems from India and abroad.

## DESCRIPTION

The specimen is whitish brown in colour and measures about 5.5 cm. in diameter. It shows four different zones, viz., the cortical, dermal, subdermal and central. The preservation is not satisfactory.

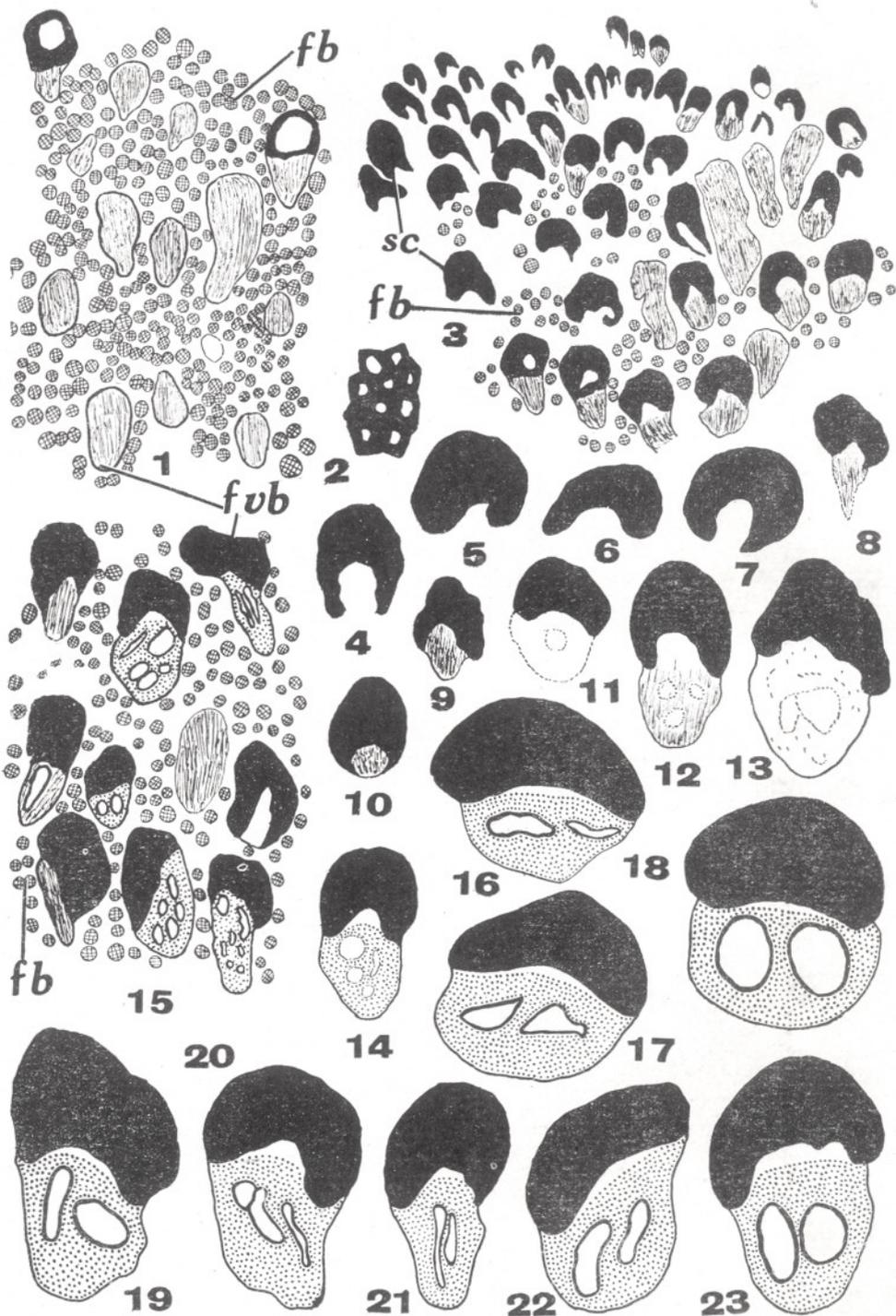
*The Cortex* consists of a very large number of crowded fibrous bundles and in between are distributed some scattered fibrovascular bundles (Fig. 1). The structural details of the fibrovascular bundles are not clear due to bad preservation. The size of the fibrous bundles vary and they are so numerous (Figs. 1 & 2) so as to almost crush the ground tissue which, therefore, cannot be clearly seen.

*Dermal Zone* bundles are closely packed and regularly orientated (Fig. 3; PHOTO 1). The preservation in this zone is very bad. Only the sclerenchymatous sheath of the bundles is preserved here (Figs. 4-11). The vascular part is preserved only in a few bundles but not in a satisfactory way (Figs. 12-14). So the number as well as the arrangement of xylem vessels could not be studied properly. The bundles just below the cortex are small and crowded. Their frequency is 400-500 per cm.<sup>2</sup> The f/v ratio taken from the fully preserved bundles is 0.5/1-0.8/1 and their diameter is 0.17 mm. to 0.27 mm. Fibrous bundles are also present here, but they are lesser in number than in the other zones. No

stigmata nor radiating and tabular parenchyma can be seen around the fibrovascular bundles.

*Subdermal Zone* shows the peripheral bundles orientated normally (Fig. 15). But those on the inner side towards the centre are irregular in orientation. The frequency of the bundles is 250 to 350 per cm.<sup>2</sup> The fibrovascular bundles of this zone are mostly compressed and are of varying forms (Figs. 16-26). Their f/v ratio is 0.4/1-1/1 and the diameter is 0.23 mm. to 0.49 mm. The vascular part of the bundles consists of mostly two big xylem vessels that lie side by side and are completely excluded from the dorsal sclerenchyma. These xylem vessels are of different shapes. Protoxylem is present in some of the bundles. Phloem is not preserved. The auricular lobes of the dorsal sclerenchyma are round to pointed, and the median sinus is concave. There is no tabular or radiating parenchyma surrounding the vascular bundles. Stegmata are totally absent. Leaf-traces are seen scattered here and there (Figs. 27-29).

*Central Zone* bundles are preserved better than those of the other two zones. They are irregularly orientated (Fig. 30; PHOTO 2) and are bigger than the bundles in the dermal and subdermal zones. Their frequency is 170 to 225 per cm.<sup>2</sup> The fibrovascular bundles are of different sizes and shapes (Figs. 31-37). Their f/v ratio is 0.3/1-0.6/1 and the diameter is 0.35 mm. to 0.57 mm. The vascular part usually consists of two, some times three rounded or oval excluded metaxylem vessels and a varying number of protoxylem elements (PHOTO 3). The auricular lobes of the sclerenchyma are round to pointed and the median sinus is concave. The xylem parenchyma is well preserved but the phloem is rarely preserved (Fig. 38; PHOTO 3). There is no distinct layer of tabular parenchyma round the fibrous part of the vascular bundles nor is there any radiating



TEXT-FIGS. 1-23 — 1. Distribution of fibrovascular and fibrous bundles in the cortical zone.  $\times 40$ . 2. One fibrous bundle of the cortex.  $\times 75$ . 3. Distribution of fibrovascular and fibrous bundles in the dermal zone.  $\times 40$ . (*fb*, fibrous bundle, *sc*, sclerenchymatous part). 4-11. Fibrovascular bundles of the dermal zone showing only the dorsal sclerenchyma.  $\times 75$ . 12-14. Fibrovascular bundles of the dermal zone showing badly preserved vascular part.  $\times 75$ . 15. Distribution of the fibrovascular and fibrous bundles in the sub-dermal zone.  $\times 40$ . (*fb*, fibrous bundle; *fvb*, fibrovascular bundle). 16-23. Different types of fibrovascular bundles in the sub-dermal zone.  $\times 75$ .

<i>Palmoxylon</i> SPECIES	CORTEX	FREQUENCY OF THE FIBROVASCULAR BUNDLES	F/v RATIO OF THE BUNDLES	DIAMETER OF THE BUNDLES IN MM.	MEDIAN SINUS AND AURICULAR LOBES	PHLOEM	XYLEM VESSELS	RADIATING & TABULAR PARENCHYMA	FIBROUS BUNDLES	STEGMATA	POSTERIOR SCLEREN CHYMA	LEAF-TRACE BUNDLES	GROUND TISSUE
<i>P. chhindwarensis</i> Prakash	Consists of fibrovascular bundles	D- 297-625/cm <sup>2</sup> SD-156-250/cm <sup>2</sup> C- 60-130/cm <sup>2</sup>	D- 4.5/1-8/1 SD-3/1-5/1 C- 2.5/1-3/1	D- 0.2-0.60 SD-0.69-0.79 C- 0.58-0.80	Median sinus quite deep; auricular lobes bluntly pointed	Not preserved	1-2	×	×	×	×	Rare	D-Compact SD-Lacunar C- Lacunar
<i>P. dakshinense</i> Prakash	Fibrous and fibrovascular bundles are present	D- 200-270/cm <sup>2</sup> SD- 50- 90/cm <sup>2</sup>	D- 10/1-16/1 SD-12/1-13/1	D- 0.16-0.56 SD-0.66-0.90	Median sinus concave, auricular lobes pointed	Not preserved	1-2	×	×	—	×	Sporadic	D- Compact SD-Lacunar
<i>P. parthasarthyi</i> Rao & Menon	Consists of fibrous and fibrovascular bundles	D- 350-380/cm <sup>2</sup> SD- 90-110/cm <sup>2</sup> C- 60- 66/cm <sup>2</sup>	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-0.20-0.40 C- 0.19-0.43	Median sinus concave and auricular lobes rounded	Not preserved	2 side by side	×	—	×	×	—	Compact
<i>P. maheshwarii</i> Rao & Menon	Very big fibrovascular bundles; fibrous bundles in between them	D- 540-630/cm <sup>2</sup> SD- 86-100/cm <sup>2</sup> C- 35-45 /cm <sup>2</sup>	D- 0.2/1-0.6/1 SD-0.12/1-0.3/1 C- 0.1/1-0.2/1	D- 0.12-25 SD-0.26-0.42 C- 0.17-0.56	Crescent like	Preserved	2 side by side	×	×	×	In leaf-trace bundles	—	Compact
<i>P. sahnii</i> Menon	Both fibrous and fibrovascular bundles present	D- 245-320/cm <sup>2</sup> SD-150-170/cm <sup>2</sup> C- 100-120/cm <sup>2</sup>	D- 0.5/1-1.4/1 SD-0.4/1-1/1 C- 0.3/1-0.8/1	D- 0.23-0.5 SD-0.30-0.62 C- 0.46-0.76	Rounded median sinus	Preserved	D- 1 SD-2 C- 2 Protoxylem present	×	×	×	×	—	Compact
<i>P. fibrosum</i> sp. nov.	Consists of fibrous and fibrovascular bundles	D- 400-500/cm <sup>2</sup> SD-250-350/cm <sup>2</sup> C- 170-225/cm <sup>2</sup>	D- 0.5/1-0.8/1 SD-0.4/1-1/1 C- 0.3/1-0.6/1	D- 0.17-0.27 SD-0.23-0.49 C- 0.35-0.57	Concave median sinus and rounded auricular lobes	Not preserved	2 Protoxylem present	×	Numerous	×	×	—	Not preserved

NOTE — D-Dermal zone; SD-Sub-dermal zone; C-Central zone.

— for absence; ×, for presence.

parenchyma associated with the vascular part. No stigmata are to be seen. A few small bundles are irregularly distributed in between the big bundles (FIGS. 39-44). They are of different types, such as bundles with the usual dorsal sclerenchyma cap and vascular part (FIGS. 39 & 40), bundles with meagre dorsal sclerenchyma (FIG. 41) and bundles with xylem vessels surrounded by only parenchyma and no sclerenchyma (FIGS. 42-44). Leaf-trace bundles are often seen (FIG. 45). Fused bundles are found scattered here and there (FIGS. 46-48). The sclerenchymatous part of the fused bundle is very small and is found on one side. The fusion of the bundles is always on the vascular side.

*Fibrous bundles* are distributed throughout the wood. They are abundant in the cortical, subdermal, and central zones but are lesser in the dermal zone. Their sizes vary according to the number of cells.

*Ground Tissue* — The nature of ground tissue could not be made out partly because the fossil wood is not well preserved and partly because it is crushed beyond recognition by the large number of crowded fibrous bundles.

Longitudinal sections show the scalariform pitting of the metaxylem vessels. The ground parenchyma cells are placed in a series of vertical rows as seen in Photo 4.

#### DISCUSSION AND COMPARISON

After a careful comparison with all the known fossil palm woods from India it was found that the specimen described in this paper can only be compared to some extent with *Palmoxylon edwardsi* Sahnii (1931), *P. chhindwarensense* Prakash (1958) and *P. dakshinense* Prakash (1958), *P. parthasarathyi* Rao & Menon (1963a), *P. maheshwarii* Rao & Menon (1963b) and *P. sahnii* Menon (1964), all known from the Mohgaon kalan area.

The present specimen resembles *Palmoxylon edwardsi* Sahnii in only one character i.e. the sclerenchyma being smaller than the vascular part. But in *P. edwardsi* the median sinus is flat or has a slightly concave margin. In my specimen this part is always concave. Further comparison is not possible as *P. edwardsi* is not yet fully described.

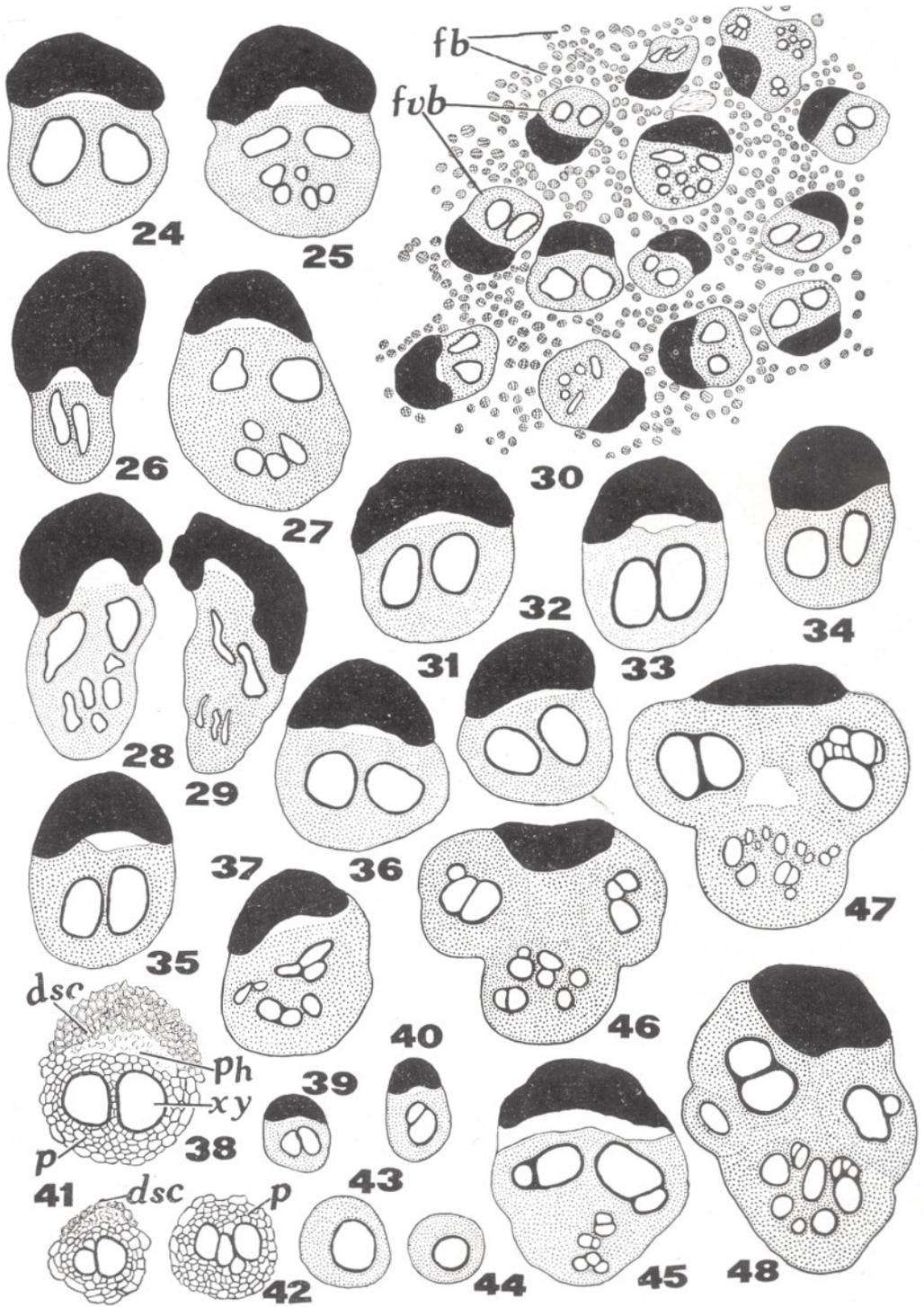
The specimen described in this paper resembles *Palmoxylon chhindwarensense* Prakash,

in the orientation and frequency of fibrovascular bundles, in the arrangement of xylem vessels, and in the absence of stigmata and radiating parenchyma round the fibrovascular bundles. The two species, however, are quite different from each other in a number of other important characters. Fibrous bundles are absent in *P. chhindwarensense*, whereas they are present in my specimen in addition to the fibrovascular bundles. The f/v ratio and diameter of the fibrovascular bundles in *P. chhindwarensense* is greater than the species described here. Tabular parenchyma is present round the fibrous part of the fibrovascular bundles in *P. chhindwarensense*, while it is not seen in the present species. Further, the ground parenchyma of *P. chhindwarensense* is compact in the dermal zone, but becomes lacunar in the subdermal and central zones. In my specimen the ground parenchyma is not preserved well. But the crowded nature of the fibrous bundles suggests that the ground tissue was probably not lacunar.

With *Palmoxylon dakshinense* Prakash, also the fossil specimen described here shows some resemblance in the orientation of the fibrovascular bundles, and in presence of numerous fibrous bundles along with the scattered fibrovascular bundles in the cortex. But *P. dakshinense* differs from the present specimen in having lesser frequency and higher f/v ratio of the fibrovascular bundles, presence of stigmata, radiating or tabular parenchyma round the vascular bundles, absence of fibrous bundles in the dermal, subdermal and central zones and lastly in the lacunar nature of the ground tissue.

The present species has some similarity with *Palmoxylon parthasarathyi* Rao & Menon in the presence of fibrous bundles in all the zones, in similar diameter of the fibrovascular bundles and in the absence of stigmata, radiating or tabular parenchyma. But some important characters which separate both these species are the lesser frequency, f/v ratio, and shape of the fibrovascular bundles and lacunar nature of the ground tissue in *P. parthasarathyi*.

*Palmoxylon maheshwarii* Rao and Menon, can also be compared with the species described here in the similar diameter of the fibrovascular bundles, arrangement of the xylem vessels, absence of stigmata, radiating or tabular parenchyma and presence of fibrous bundles in the cortex. But it differs from the present fossil wood in the



following characters: (1) the frequency of the bundles in the dermal zone of *P. maheshwarii* is higher than in the species described here, but it is lesser in the subdermal and central zones of *P. maheshwarii*, (2) the f/v ratio of the bundles in *P. maheshwarii* is lesser than in my specimen, (3) the fibrous bundles are present only in the cortical zone of *P. maheshwarii* but they are seen throughout in the fossil described here, (4) the cortical fibrovascular bundles of *P. maheshwarii* are very much bigger than the cortical bundles of the present species, and (5) the sclerenchymatous part in the bundles of *P. maheshwarii* is crescent-shaped and thin but in the present fossil the sclerenchyma is thick and varies in shape, from bundle to bundle.

The palm wood described in this paper resembles *Palmoxylon sahnii* Menon, in having fibrous and fibrovascular bundles in the cortex, in more or less the same f/v ratio and the absence of stigmata. But it differs from *P. sahnii* in having a greater frequency of fibrovascular bundles in all the zones, in the comparatively smaller sizes of the bundles throughout the wood, and in the presence of fibrous bundles in the dermal, subdermal and central zones.

*Palmoxylon antiquense* (STENZEL, 1904) is the only foreign species with which the present specimen can be compared to some extent. The resemblances are in the form of the vascular bundles as seen in cross section, the shape and amount of sclerenchyma, and the number and disposition of xylem elements in the fibrovascular bundles. But with regard to other important characters like frequency of the fibrovascular bundles, their f/v ratio, and presence or absence of radiating and tabular parenchyma, etc there is considerable difference.

From the above detailed comparison summarized in the accompanying table it appears that the specimen described here

differs from the other nearly related species in various respects specially in possessing exceedingly large number of fibrous bundles. It is, therefore, advisable that the specimen should be referred to a new species of palm wood, *Palmoxylon fibrosum*, in view of the enormous number of fibrous bundles, found in it.

#### DIAGNOSIS

*Cortex* — Fibrovascular bundles scattered, fibrous bundles in larger numbers.

*Dermal Zone* — Fibrovascular bundles regular in orientation with only sclerenchymatous sheath preserved in most of them, 400-500 per cm.<sup>2</sup>, the f/v ratio of the fibrovascular bundles is 0.5/1-0.8/1, diameter 0.17-0.27 mm., fibrous bundles present. Ground tissue badly preserved.

*Subdermal Zone* — Fibrovascular bundles regularly orientated in the peripheral region, irregular in the inner region, 250-350 per cm.<sup>2</sup>; f/v ratio 0.4/1-1/1, diameter 0.23-0.49 mm., sclerenchyma varies from bundle to bundle, median sinus concave, auricular lobes rounded, xylem vessels two lying side by side, excluded. Protoxylem present. Stegmata, and both radiating and tabular-parenchyma absent. Fibrous bundles numerous. Leaf-traces present. Ground parenchyma not well preserved.

*Central Zone* — Fibrovascular bundles with irregular orientation, 170-225/cm.<sup>2</sup>, f/v ratio 0.3/1-0.6/1, diameter 0.35-0.57 mm., median sinus concave and auricular lobes rounded. Xylem vessels 2-3, placed side by side, excluded, fibrous bundles abundant. Stegmata as well as radiating and tabular parenchyma absent. Leaf-traces seen clearly.

#### SUMMARY

A new species of petrified palms, *Palmoxylon fibrosum* has been described from

TEXT-FIGS. 24-48 — 24-26. Bigger fibrovascular bundles of the sub-dermal zone.  $\times 60$ . 27-29. Leaf-trace bundles of the sub-dermal zone.  $\times 60$ . 30. Distribution of the fibrovascular and fibrous bundles in the central zone.  $\times 32$ . (fb. fibrous bundle; fvb. fibrovascular bundle). 31-37. Different types of fibrovascular bundles in the central zone.  $\times 60$ . 38. A fibrovascular bundle from the central zone showing all the structural details.  $\times 60$ . (dsc, dorsal sclerenchyma; p, parenchyma; ph, phloem; xy, xylem). 39,40. Smaller fibrovascular bundles of the central zone.  $\times 60$ . 41. Small fibrovascular bundle of the central zone showing meagre dorsal sclerenchyma.  $\times 60$ . (dsc, dorsal sclerenchyma; p, parenchyma). 42-44. Smaller fibrovascular bundles in the central zone with xylem vessels surrounded by parenchymatous cells only.  $\times 60$ . (p, parenchyma). 45. Leaf-trace bundle of the central zone.  $\times 60$ . 46-48. Fused bundles from the central zone.  $\times 60$ .

Mohgaon kalan area, Madhya Pradesh. The specimen may be referred to the *Mauritia*-like palms whose distinguishing characters (VON MOHL HUGO 1845, 1849 & STENZEL, 1904) are: the outer bundles are crowded, the inner bundles far apart and fibrovascular ratio decreases from the dermal to the central region.

*Locality* — Mohgaon Kalan, District Chhindwara, Madhya Pradesh.

*Age* — Eocene.

*Type specimen* — M 85 kept in the Department of Botany, University of Lucknow.

#### ACKNOWLEDGEMENTS

I am extremely grateful to Professor A. R. Rao for his kind and valuable guidance. My grateful thanks are also due to the authorities of Birbal Sahni Institute of Palaeobotany, Lucknow, for permission to consult their library.

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#### EXPLANATION OF PLATE 1

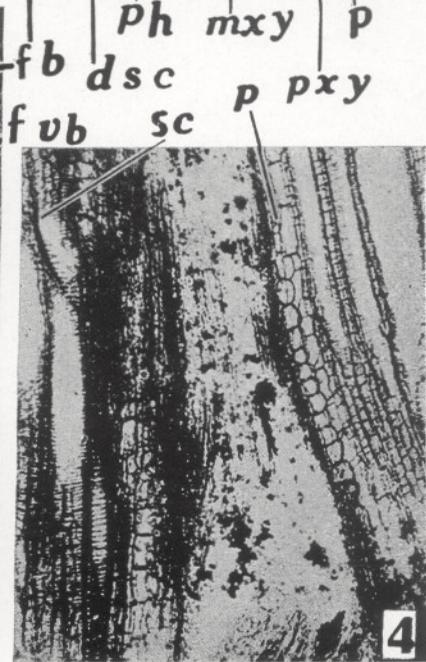
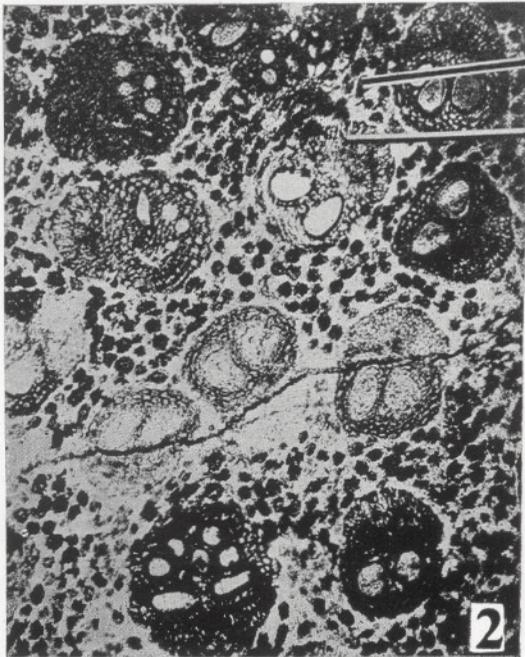
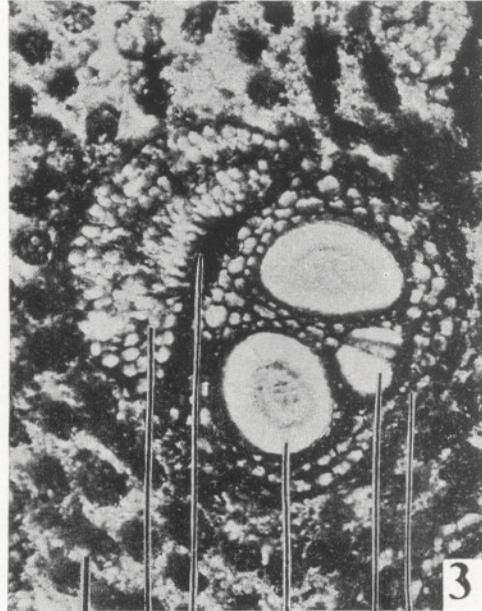
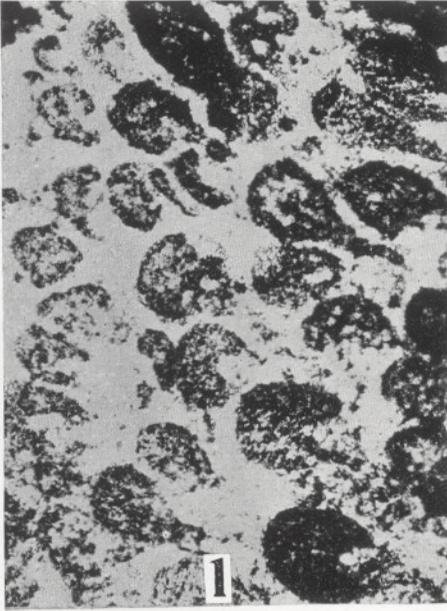
##### PLATE 1

1. Distribution of the badly preserved bundles of the dermal zone showing only the dorsal sclerenchyma.  $\times 16$ .

2. Irregularly orientated fibrovascular bundles and fibrous bundles in the central zone.  $\times 40\cdot9$ . (fb, fibrous bundle; fvb, fibrovascular bundle).

3. One fibrovascular bundle of the central zone.  $\times 22\cdot5$ . (dsc, dorsal sclerenchyma; fb, fibrous bundle; mxy, metaxylem; p, parenchyma; ph, phloem; pxy, protoxylem).

4. Longitudinal section of the specimen showing scalariform pitting and a vertical row of ground parenchyma cells.  $\times 65\cdot5$ . (p, parenchyma; sc, scalariform pitting).



fb dsc p pxy  
fub sc p