

PALMOXYLON PARTHASARATHYI SP. NOV., A PETRIFIED PALM STEM FROM MOHGAON KALAN

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ABSTRACT

A petrified palm stem from Mohgaon Kalan (Madhya Pradesh, India) is described in detail. The stem differs from all petrified palms known from India in many respects including the distribution and form of the vascular bundles and their f/v ratio. The stem is referred to a new species of *Palmoxylon*-*P. parthasarathyi* and is placed in the *Reniformia* section of *Cocos*-like palms.

INTRODUCTION

SOME pieces of petrified palm woods were found in a collection of silicified plant remains collected at Mohgaon Kalan (Madhya Pradesh) in 1951. One of these petrified pieces is nearly six inches high and about 3 inches broad (PHOTO 1). This is evidently a part of a palm stem rather slightly compressed and rolled up into an irregularly elliptic form. The state of preservation is not very good although most of the necessary structural details could be made out. Another stem with identical vascular bundles and ground tissue shows in transverse sections that the tissue can be divided into different zones as in several other species of *Palmoxylon*. The nature of the ground tissue, its form, the structure of the vascular bundles, their frequency and arrangement further confirm this zonation, into central, subdermal, dermal and cortical zones which are described below in the same order.

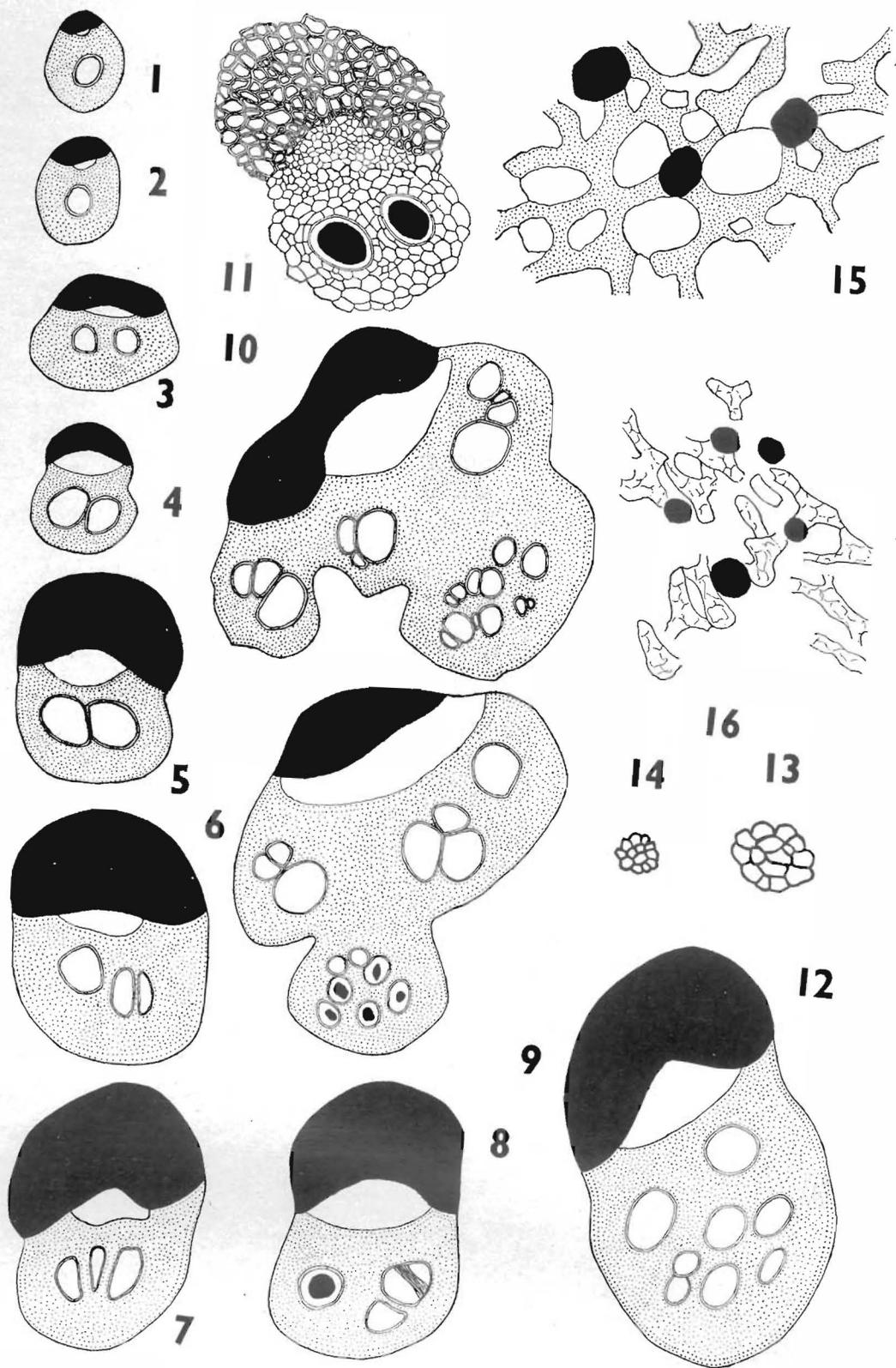
The tissues and bundles seen in the first specimen are exactly like those found in the central zone of the second specimen. It is therefore possible that the first specimen (PHOTOS 1 & 2) is only the central zone of the stem. The description of the central zone is based entirely upon this specimen as it is slightly better preserved.

DESCRIPTION

Central Zone—The vascular bundles number about 60-66 per square centimeter (PHOTO 2) and are irregularly orientated and scattered between them occur the

fibrous bundles (PHOTO 3). The vascular bundles are of various shapes (FIGS. 1-8, PHOTO 4). Sometimes two or three bundles unite together (FIGS. 9 & 10, PHOTOS 5 & 6). In each fibrovascular bundle the vascular part is very much more than the fibrous part, the f/v ratio being $\cdot 3/1$ to $\cdot 4/1$ mm. The average size of the bundle along its longest axis is 0.16 mm. to 0.62 mm., and 0.19 mm. to 0.43 mm. along its shortest axis. Each bundle has a clear parenchymatous sheath round the vascular part only. Stegmata are conspicuous by their absence. The fibrous part is generally less than the vascular part (FIGS. 1-6) as stated but sometimes it may be as much as the vascular part itself (FIG. 7). The cells of the fibrous part are moderately thick and polyhedral without any intercellular spaces (FIG. 11). The form of the fibrous part is generally reniform but may slightly vary in different bundles. The phloem is invariably a small irregularly lenticular patch surrounded on one side by the sclerenchyma of the fibrous part and on the other by the parenchyma of the vascular part (FIGS. 1-11). The parenchyma is made up of thin-walled, rounded and angular cells without intercellular spaces and varies from bundle to bundle in depth. Imbedded in the middle of the parenchyma are generally two or three metaxylem vessels placed side by side. The xylem have multiseriate scalariform thickenings. In some small bundles (FIGS. 1 & 2) there may be only one xylem vessel. There is always a definite layer of small parenchymatous cells surrounding the xylem vessel (FIG. 11). In some of the bundles there are a large number of vessels in addition to the normal two or three (FIG. 12). These may be regarded as leaf traces. Some of the xylem vessels have a kind of darkish contents in them (FIGS. 8 & 11 and PHOTO 7). There is no posterior sclerenchyma in the bundle as in some species of *Palmoxylon*.

Fibrous bundles occur scattered in all zones amidst the fibrovascular bundles (PHOTO 3). They are small in size, have no



TEXT-FIGS. 1-16

stigmata and are made up of generally 6-15 small, thick-walled, sclerenchymatous cells (FIGS. 13 & 14 and PHOTO 8).

Ground tissue is uniform throughout the stem and is lacunar (FIG. 15). Some of the cells present reticulations giving the appearance of a cellular structure (FIG. 16). A black deposit is found inside the cells as well as in the air spaces also.

Sub-dermal Zone — The orientation of the bundles towards the periphery of this zone is regular as in the dermal zone and is irregular towards inner side as in the central zone (FIG. 17). They are of different sizes and shapes (FIGS. 18-22). Their frequency is 90-110 per cm.² and the f/v ratio is 0.2/1 to 0.6/1. The bundles measure 0.3 mm. to 0.5 mm. along their longest axis and 0.2 mm. to 0.4 mm. along their shortest axis. The dorsal sclerenchyma is reniform in shape. The vascular part is bigger than the fibrous part. The xylem vessels are two to six. The organization of the fibrovascular bundles is the same as in the central zone. Stegmata are absent on the fibrous as well as the fibrous part of the fibrovascular bundles. Leaf traces are present (FIG. 23). Fused bundles as in the central zone are also seen.

Dermal Zone — The fibrovascular bundles are regularly orientated (FIG. 24), closely packed, and rounded to elongated in form (FIGS. 25-35). The frequency is 350 to 380 per cm.² and their f/v ratio is 0.2/1 to 0.8/1 and they measure 0.16 to 0.41 mm. along their longest axis and 0.09 to 0.31 mm. along their shortest axis. Smaller bundles are also present (FIGS. 27 & 28). The sclerenchyma is of the lunar or reniform type. The vascular part is bigger than the fibrous part. The structure of the fibrovascular bundles is similar to that seen in the sub-dermal and central zones.

Cortical Zone — It is not well preserved. In this zone small fibrous bundles occur in large numbers with just a few large sized

fibrous and fibrovascular bundles scattered amongst them.

DISCUSSION AND COMPARISON

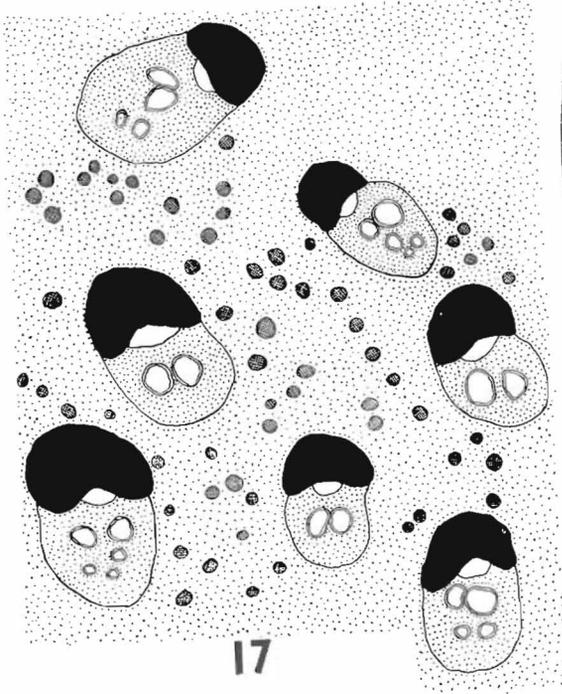
Prof. B. Sahni (1931) gave very short unillustrated descriptions of fourteen species of *Palmoxylon* from India in his paper "Materials for a monograph of the Indian petrified palms". Although all these have not been described in full, yet, he himself described in detail *P. sundaram* (1946) and *P. sclerodermum* (1943). Rode (1933) described *P. kamalam* and *P. hislopi*. Other species of *Palmoxylon* described from India are *P. sclerodermum* Sahni (SHUKLA, 1946), *P. arcotense* (RAMANUJAM, 1953), *P. surangei* (LAKHANPAL, 1955) and *P. puratanam* (RAMANUJAM, 1958). Sahni and Surange have also described *Cyclanthodendron sahnii* which was originally known as *P. sahnii* (RODE) (1953).

The specimen described in this paper when compared with the above list, seems to resemble *Palmoxylon kamalam*, *P. hislopi*, in having a lacunar ground tissue. But our specimen differs from *P. kamalam* in having bundles less closely distributed, in the possession of fibrous bundles and in the preservation of clear sclerenchyma. The ground tissue also is totally different. *P. hislopi* on the other hand differs from our specimen in having no fibrous bundles, in the frequency of fibrovascular bundles and also in having in the bundle a very small portion of the vascular part. The parenchymatous ground tissue though lacunar in this species has narrow cells radiating from the vascular part elongated parallel to the fibrous part, a feature not seen in our specimen.

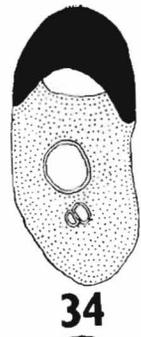
Out of the remaining species of *Palmoxylon* known from India our specimen resembles to some extent *P. sclerodermum* in the presence of fibrous bundles, but differs from it in

In the bundles sclerenchyma is shown black, parenchyma dotted and phloem blank.

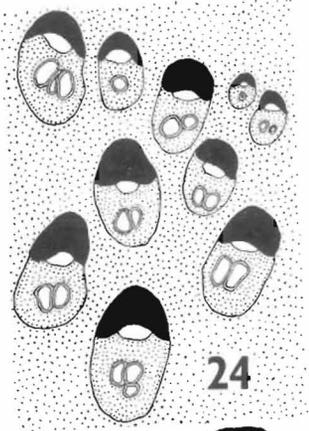
TEXT-FIGS. 1-16 (Bundles of Central Zone) — 1-8. Different kinds of bundles in transverse section. × 100. 1 & 2. Small bundles with only one xylem vessel. × 100. 9, 10. Fused bundles. × 100. 11, one Fibro vascular bundle showing all the tissues and the dark deposit in the xylem vessel. × 100. 12. A bundle enlarged to show the leaf trace. × 100. 13-14. Fibrous bundles in transverse section. × 190 & × 125. 15. Ground tissue (dotted) with scattered fibrous bundles (black). × 100. 16, part of ground tissue which shows cellular appearance at places. × 100.



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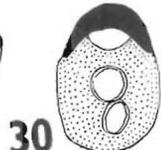
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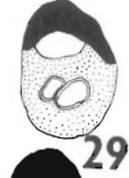
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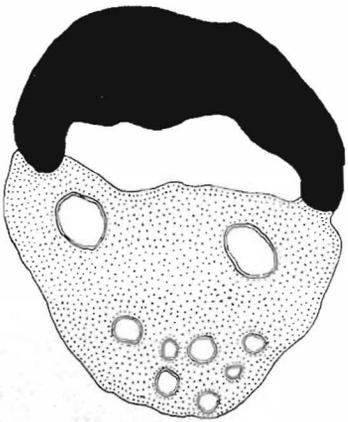
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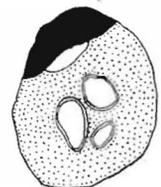
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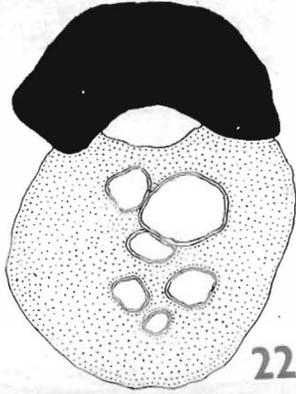
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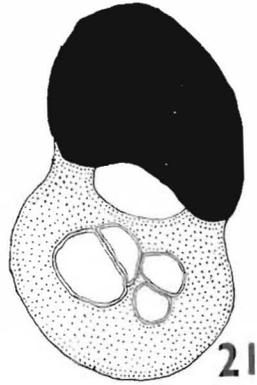
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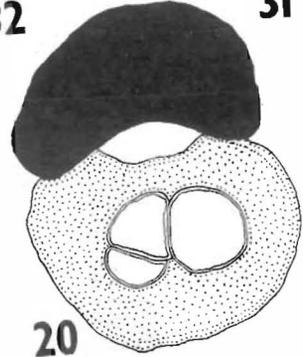
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the size of the bundles, its distribution, f/v ratio, and absence of stigmata. Although it resembles *P. surangei* in the orientation of fibrovascular bundles and fibrous bundles, our specimen differs from it in its f/v ratio, in the frequency of fibrovascular bundles form of sclerenchyma, form of parenchymatous ground tissue and also in the absence of stigmata. Our specimen resembles also *P. sundaram* in the distribution of fibrovascular and fibrous bundles and in the lacunar ground tissue and in the absence of tabular parenchyma. But it differs again in the absence of posterior sclerenchyma, f/v ratio and absence of stigmata. There is some similarity between *P. arcotense* and our specimen, in the absence of stigmata, tabular parenchyma, posterior sclerenchyma, and in the presence of lacunar ground tissue. But the differences centre round the frequency of the bundles and f/v ratio and also the presence of fibrous bundles in our specimen. The same differences separate our specimen from *P. puratanam* (RAMANUJAM, 1961). Further, the ground tissue is compact in *P. puratanam* while it is lacunar in our specimen. Our specimen resembles *P. dakshinense* Prakash (U. PRAKASH, 1958) only in having a lacunar ground tissue and in the absence of radiating parenchyma and stigmata.

From the above comparisons it appears that our specimen comes nearest to *P. arcotense* and differs from it in various respects already enumerated. But the main features in which it differs from all known Indian species are the structure of the vascular bundle and its f/v ratio and frequency. In the normal bundle there is only a lesser amount of anterior reniform sclerenchyma. The f/v, ratio is 0.3/1-0.4/1 in the central, 0.2/1-0.6/1 in the sub-dermal and 0.2/1-0.8/1 in the dermal zone. The fact that our specimen does not fully agree in all particulars with any of the known species and differs from all other species in the character of the vascular bundle warrants its being kept as a separate species. We therefore propose to designate it as *Palmoxylon parthasarathyi*

after Prof. M. O. Parthasarathy Iyengar the distinguished algologist from whom one of us has received advice and guidance. So far as we could see our specimen does not stand any comparison with the species figured and described by Stenzel (1904).

Comparison with living palms is rather difficult with the meagre data and material that we have. But it appears that our specimen can be accommodated in the section Cocos-like palms and sub-section *Reniformia* (SÄHNH, 1943) based upon the combined scheme of Von Mohl (1849) and Stenzel (1904).

DIAGNOSIS

Wood differentiated into four zones, Central zone: Fibrovascular bundles and fibrous bundles present, frequency of vascular bundles 60-66 per cm. square. Bundles rounded or elliptical. Sometimes fused, only anterior sclerenchyma present. f/v ratio 0.3/1 to 0.4/1, 0.19 mm. to 0.43 mm. in diameter. Xylem vessels mostly two, side by side, with multiseriate scalariform thickening. Stigmata absent, Leaf traces present, made up of 4 to 8 xylem vessels. They are present throughout the stem.

Sub-dermal Zone — Bundles more or less regular in orientation and similar size as in the central zone, frequency 90-110 per cm.², f/v ratio 0.2/1 to 0.6/1, diameter 0.2 to 0.4 mm. Other features are as in the central zone.

Dermal Zone — Bundles regularly oriented, rounded to elongated and smaller than those of the sub-dermal and central zones. Frequency 350-380 per cm.², f/v ratio 0.2/1-0.8/1 and diameter 0.09 to 0.31 mm. Other characters are same as in the sub-dermal and central zones.

Cortical Zone — Fibrous bundles larger in number with a few scattered large sized fibrous and fibrovascular bundles. *Ground tissue* lacunar throughout the wood with cells elongated forming meshes.

Locality — Near Mohgaon Kalan, exact locality not known.

Age — Eocene.

TEXT-FIGS. 17-35 — 17. Distribution of the bundles in the sub-dermal zone × 40. 18-22. Different kinds of bundles in the Sub-dermal zone. × 100. 23. One leaf trace bundle of the sub-dermal zone. × 100. 24. Distribution of the bundles in the dermal zone. × 40. 25-35. Different kinds of bundles in the dermal zone. × 100.

Type Specimens — M 140 & M 80 (kept in the Botany Department, Lucknow University).

We are very grateful to the authorities of the Birbal Sahni institute of Palaeobotany for permitting us to consult their library.

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EXPLANATION OF PLATE 1

(All photographs are of the central zone only)

1. Specimen of palm wood before sectioning. $\times 0.4$.
2. Transverse section of a part of the wood. $\times 0.6$
3. Part of transverse section showing fibrovascular bundles and fibrous bundles. $\times 42$.
4. Bundles of various sizes orientated in different directions, and the general ground tissue. $\times 31.5$.
5. Section of wood showing fused bundles. Note the leaf trace bundle on the extreme right. $\times 33.6$.
6. Part of similar section showing four bundles fused together. $\times 42$.
7. A single fibrovascular bundle enlarged to show the reniform scherenchyma, phloem, xylem vessels with black contents and the parenchyma of the bundle. $\times 142.5$.
8. Longitudinal section of a part of the wood showing fibrous bundles and xylem. $\times 43$.

