ON A FOSSIL PALM PEDUNCLE FROM DONGARGAON, DISTRICT CHANDA, MAHARASHTRA, INDIA*

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ABSTRACT

The present paper describes in detail a silicified palm wood belonging to peduncle. The specimen was collected from Dongargaon, Dist. Chanda, Maharashtra, India. It belongs to the Deccan Intertrappean Series of India. The nature and typical orientation of the fibrovascular bundles indicate its affinities with Palmae among the Monocotyledons. The differentiation of the vascular cylinder into peripheral and central zones, size and shape of the specimen, compact arrangement of fibrovascular bundles, high frequency of trace, dimunitive and fusion bundles is more closely similar and suggestive of a peduncle. It is named as *Palmostroboxylon indicum* gen. et sp. nov.

INTRODUCTION

Palm remains in the form of stems, roots, leaves, petioles, flowers and fruits belonging to the Deccan Intertrappean Series of India have been described from several localities like Mohgaonkalan, Takli, Mahurzari, Saugar, Seoni, Keria, Kateru, Maragsur, Sindhivihira, etc. by a number of authors (*see* CHITALEY, 1974; PRAKASH, 1974). Several silicified palm pieces were collected in March and October, 1976 and March, 1977 from Dongargaon (79° 06′ : 20° 12′), a new locality in district Chanda, Maharashtra State, belonging to the Deccan Intertrappean Series. The silicified piece on which the present paper is based is one of them showing excellent preservation and has been described for the first time from India.

DESCRIPTION

MONOCOTYLEDONEAE

PALMAE

Palmostroboxylon gen. nov.

Palmostroboxylon indicum gen. et sp. nov.

(Text-figs. 1-13 ; Pl. 1, Figs. 1-11)

The specimen P 70/77 is yellowish brown in colour. It is 5.5 cm long, 3.3 cm broad and 1.3 cm thick (Pl. 1, Fig. 1). The cross section of the wood is oval to oblong in shape and shows fibrovascular bundles typical of monocotyledons (Text-fig. 1 ; Pl. 1, Fig. 2). The zonations of the vascular cylinder of the wood are different from that of the typical species of *Palmoxylon* and *Cyclanthodendron*, while the arrangment, orientation and form of the fibrovascular bundles suggest the peripheral and central regions (Text-figs. 1 & 2 ; Pl. 1, Figs. 2 & 3). Epidermis, hypodermis and cortical tissues could not be seen.

The peripheral zone is narrow, 0.2-0.22 cm thick. The vascular bundles are more or less regularly oriented and somewhat closely spaced (Text-figs. 1 & 2 ; Pl. 1, Fig. 3).

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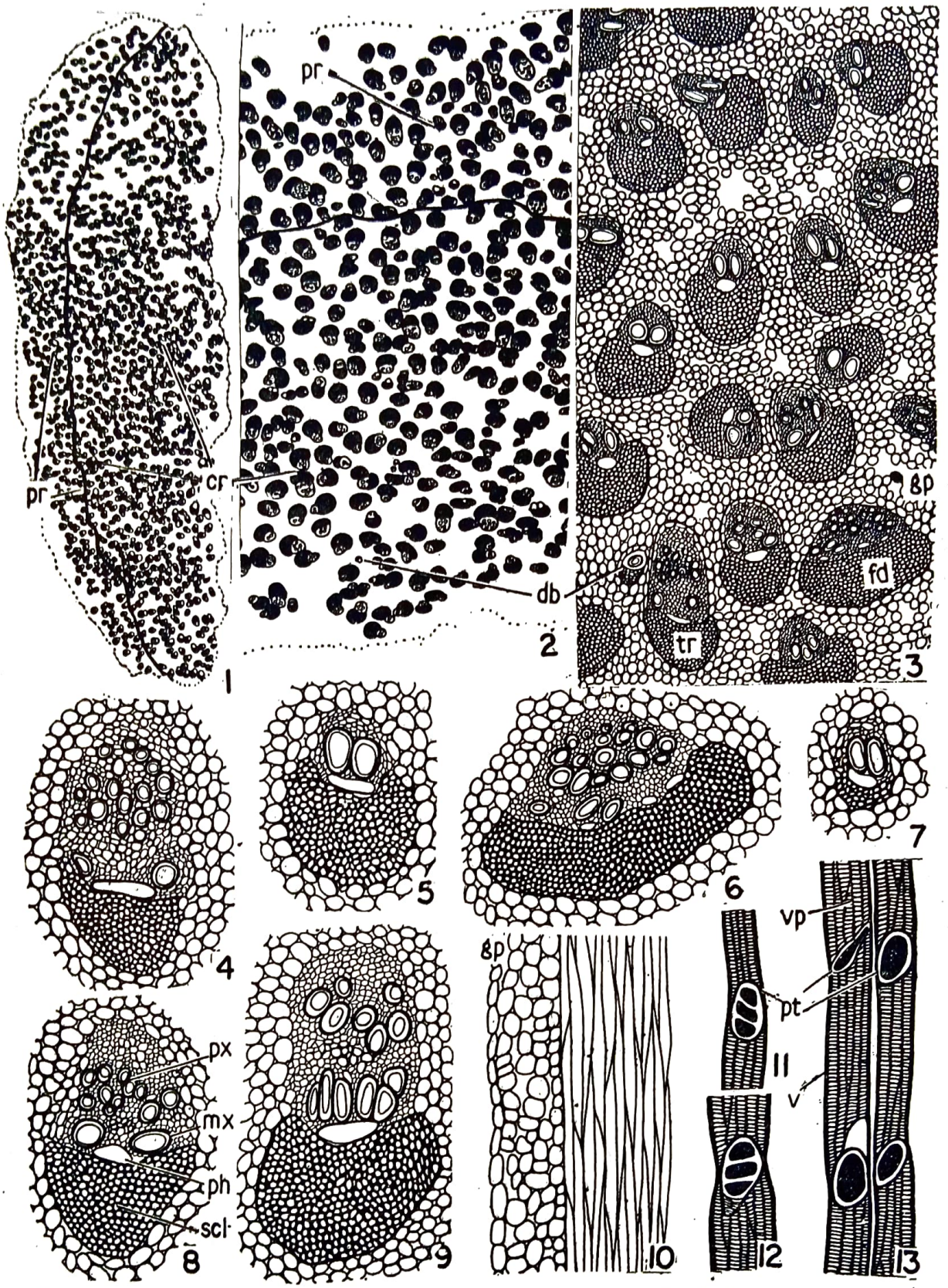

Text-figs. 1-13. A fossil palm peduncle from Dongargaon. 1. T. S. showing peripheral—*pr* and Central—*cr* regions of a petrified palm peduncle : Note its ovate to oblong size ×3. 2. The same, a part magnified in the line of thickness showing peripheral—*pr* and central—*cr* regions : Note dimunitive bundle—*db* in the central region ×9. 3. The same, a part magnified from the central region showing irregular orientation of normal, trace—*tr*, dimunitive—*db* and fusion bundles—*fd* in the thin-walled isodiametric ground parenchyma *gp* ×49. 4. A trace bundle with great number of protoxylem elements, two metaxylem and flattened phloem ×88. 5. A normal bundle ×88. 6. A fusion bundle ×88. 7. A dimunitive bundle ×88. 8. A trace bundle showing cordate sclerenchymatous cap—*Scl.* Ovate to triangular phloem—*ph.*, two metaxylem—*mx* and numerous protoxylem—*px X* 88. 9. A trace bundle ×88. 10. L.S. showing ground parenchyma—*gp* and fibre cells ×88. 11-13. L. S. of vessels—*v* showing multiseriate scalariform pitting—*vp*, and simple to obliquely placed perforation plate with 1-3 bars ×88.

They are small, usually elongated to ovate in shape. Their frequency is 100 to 125 per cm². Their f/v ratio is 2.03/1 and size 430 × 280 μm. The typical fibrovascular bundle consists of a big reniform to lunate fibrous cap. The median sinus is concave and auricular lobes round to pointed. The phloem is present in the median sinus. Below this, there are two, sometimes three rounded or oval metaxylem elements placed side by side measuring 82 × 77 μm. The protoxylem are one or two as seen in few bundles, 48 × 49 μm in size, while in others they are absent. There is no tabular or radiating parenchyma. Trace bundles, fusion bundles and dimunitive bundles are seen in this region.

Central zone is 1.1 to 1.2 cm thick. The fibrovascular bundles are compactly arranged. They are irregularly oriented and oval to round in shape. Their frequency is 85 to 140 per cm², f/v ratio 1.96/1 and they are 380 × 330 to 440 × 290 μm in size. Trace, dimunitive and fusion bundles are seen in great frequency (Text-figs. 1-3; Pl. 1, Figs. 3-5).

The fibrovascular bundles consist of a big reniform to lunate dorsal fibrous cap, concave median sinus and round to pointed auricular lobes. The vascular part is partly excluded. The phloem is present in the median sinus region. It is flat to oblong and shows a tendency of lobing in few bundles. Two metaxylem elements are placed side by side measuring 88 × 90 to 111 × 87 μm. Below them one or two protoxylem elements are present, 33 × 47 to 47 × 45 μm in size, while they are absent in some of the bundles (Text-figs. 3 & 5; Pl. 1, Figs. 6 & 7).

Trace bundles are seen in both peripheral and central regions, but their frequency in the central region is greater than the peripheral region (Text-figs. 1-3 ; Pl. 1, Figs. 3-5). They are larger than the normal bundles, 440 × 290 to 520 × 300 μm in size. Their f/v ratio is 0.69/1 and consists of reniform, lunate or complanate type of dorsal fibrous cap. The median sinus may be present or absent. The auricular lobes are round to pointed. The vascular part is partly or completely excluded. The phloem is represented as a flattened cavity in the median sinus region showing a tendency of lobing. There are 2-6, oval to elongated metaxylem elements measuring 68 × 92 to 91 × 76 μm and large number of protoxylem elements ranging up to 15 to 20. They are 48 × 47 to 55 × 52 μm in size (Text-figs. 4, 8 & 9 ; Pl. 1, Fig. 9).

Dimunitive bundles—Like trace bundles, small dimunitive bundles, 190 × 150 to 270 × 200 μm in size, are seen scattered in both peripheral and central regions, but they are mostly associated around the trace bundles (Text-figs. 2 & 3; Pl. 1, Figs. 3 & 5). It consists of a small sclerenchymatous cap and 1-3 xylem elements. Their f/v ratio is 0.87—1.3/1; presence of phloem could not be recognised. The xylem elements are 25 × 28 μm in size (Text-fig. 7).

Fusion bundle—A group of fibrovascular bundles and/or trace bundles come very close to each other, and form a fusion bundle which is distinctly different from the compound bundle of *Cyclanthodendron*, where the big bundle branches out to the left and right giving a lobed appearance, but these lobes remain attached to the parent bundle. Their size varies depending upon the number and orientation of the fusing bundles (Text-figs. 3 & 6 ; Pl. 1, Fig. 8).

The ground parenchyma is compact, cells being thin-walled, isodiametric and loosely arranged, measuring 48 × 48 to 59 × 50 μm (Text-fig. 3 ; Pl. 1, Figs. 4 & 7). In longitudinal section, these cells are seen as placed in a series of vertical rows measuring 48 × 58 to 56 × 61 μm. (Text-fig. 10 ; Pl. 1, Fig. 11).

The tabular and radiating parenchyma, fibrous bundles, stegmata and ventral sclerenchyma are not seen.

The vessels show multiseriate scalariform pitting and perforations are simple or with

slanting to obliquely horizontal end plate with 1-3 bars (Text-figs. 11-13 ; Pl. 1, Figs. 10 & 11).

COMPARISON AND DISCUSSION

Tertiary deposits of different countries of the world are quite rich in palm remains particularly the petrified woods which have been described by several workers like MOHL (1845, 1849), KNOWLTON (1888), STENZEL (1897, 1904), STERZEL (1900), STEVENS (1912, 1921), KRÄUSEL AND STROMER (1924), CHIARUGI (1931, 1933), JONGMANS (1935), KRÄUSEL (1939), HOFMANN (1936, 1944), STOCKMANS AND WILLIERE (1938, 1943), GOTHAN (1942), OGURA (1952, 1955), GREGUSS (1954, 1959), SCHÖNFELD (1956), GRAMBAST (1957), BOUREAU AND PRAKASH (1969) and others from abroad and a number of Indian workers have also described fossil palm woods (*see* AWASTHI, 1974; CHITALEY, 1974; PRAKASH, 1974). This includes only a few reports of petiole while the wood of peduncle has not been reported so far.

The specimen described here is unique in having vascular cylinder differentiated into peripheral and central zones. The fibrovascular bundles in the peripheral region are elongated and regularly oriented, whereas the central zone shows compact, round and irregularly oriented fibrovascular bundles, higher number of fusion, trace and dimunitive bundles, compact ground parenchyma with thin-walled, isodiametric cells and vessels with simple perforations or having slanting to obliquely horizontal end plates with 1-3 bars. These characters indicate its resemblance with the organs like younger part of the stem, petiole and peduncle.

The younger part of the stem resembles peduncle in many respects, but in the younger part of the stem the vascular cylinder is usually differentiated into three zones (dermal, subdermal and central) and the fusion bundles are very rare, whereas in peduncle the vascular cylinder is differentiated into peripheral and central zones and trace, dimunitive and especially the fusion bundles are found in greater frequency.

The petiole is characterised by concavo-convex shape, double phloem and absence of fusion bundles. The possibility of the present specimen as a stem or petiole is ruled out on account of very high number of fusion, trace and dimunitive bundles.

The sections of peduncles of the following living palms were examined, i.e. *Cocos nucifera, C. schizophylla, C. coronata, C. yatai, Phoenix sylvestris, P. dactylifera, P. acaulis, P. robusta, P. reclinata, P. paludosa, Raphis excelsa, R. humilis, Licuala grandis, L. spinosa, Livistona chinensis, Caryota mitis, Hyphaene indica, Chrysalidocarpus lutescens, Hyophorbe amaricaulis* and *Ptychosperma elegans* on which a great deal of work has been done in the Department of Botany, University of Poona by Professor T. S. Mahabale and his students. Amongst these, *Phoenix paludosa* shows number of common features such as (i) elongated and regularly oriented fibrovascular bundles in the peripheral region, (ii) fibrovascular bundles with only dorsal cap, (iii) undivided phloem showing tendency of lobing, (iv) two metaxylem elements placed side by side, (v) compact ground parenchyma with thin-walled, isodiametric cells and (vi) absence of tabular and radiating parenchyma. However, *Phoenix paludosa* shows presence of fibrous bundles and variation in the frequency of fibrovascular bundles. In *P. paludosa* the fibrous bundles are mostly seen in the abaxial side rather than the adaxial side. TOMLINSON AND ZIMMERMANN (1968), while studying the anatomy of *Raphis excelsa* suggested that the course of fibrovascular bundles vary from the so called nodal and internodal region from stem part to petiole and inflorescence. The main bundle divides and gives rise to trace, dimunitive and bridge bundles and even shows change in its constitution.

With these observations it is clear that the present specimen is a peduncle rather than a peitole or stem belonging to the Phoenicoid group.

There is no record of a petrified palm peduncle, so far, from India and abroad. However, Professor MAHABALE (1950) reported the petrified palm inflorescence axis of Cyclanthaceae from Mohgaonkalan and compared it with that of *Carludovica palmata*. In the same year he (MAHABALE, 1950) reported an impression of a female palm inflorescence. He compared it with the inflorescence of *Bactris* and *Hyphaene* and proposed the name *Palmostrobus* for this mould of palm inflorescence. As the present petrified wood belongs to a palm peduncle, a new generic name *Palmostroboxylon* is proposed for it and the species is named as *Palmostroboxylon indicum* gen. et sp. nov., the specific name indicates its occurrence in the Indian subcontinent.

GENERIC DIAGNOSIS

Palmostroboxylon gen. nov.

Vascular cylinder differentiated into peripheral and central zones, compact arrangement of fibrovascular bundles, very high frequency of fusion, dimunitive and trace bundles.

Genotype—**Palmostroboxylon indicum** sp. nov.

SPECIFIC DIAGNOSIS

Palmostroboxylon indicum sp. nov.

The specimen oval to oblong in shape, vascular cylinder differentiated into peripheral and central zones. *Peripheral zone* 0.2-0.22 cm thick ; fibrovascular bundles regularly oriented, closely spaced, elongated, frequency 100-125 per cm^2, f/v ratio 2.03/1, size 430 × 280 μm and 2-3 metaxylem. *Central zone* 1.1-1.2 cm thick; fibrovascular bundles compact, oval to elongated, irregularly oriented, frequency 85-140 per cm^2, f/v ratio 1.96/1, size 380 × 330 to 440 × 290μm, frequency of fusion, trace and dimunitive bundles higher in the central region than the peripheral one.

Trace bundles 440 × 290 to 520 × 300μm in size, f/v ratio 0.69/1, fibrous cap reniform, lunate or complanate ; vascular part excluded with 2-6 metaxylem and 15-20 protoxylem elements.

Dimunitive bundles mostly associated with trace bundles, 190 × 150 to 270 × 200μm in size, f/v ratio 0.87-1.33/1 consisting small fibrous cap and 1-3 xylem elements.

Fusion bundles more common in the central zone with different size and shapes depending upon the number of fusing bundles and their orientation.

Tabular and radiating parenchyma, fibrous bundles, stegmata and ventral sclerenchyma absent ; ground parenchyma compact with isodiametric thin-walled cells.

Locality—Dongargaon, Dist. Chanda, Maharashtra, India.

Horizon—Deccan Intertrappean Series of India.

Age—Eocene.

Holotype—P 70/77, Botany Department, University of Poona, Pune-411007, India.

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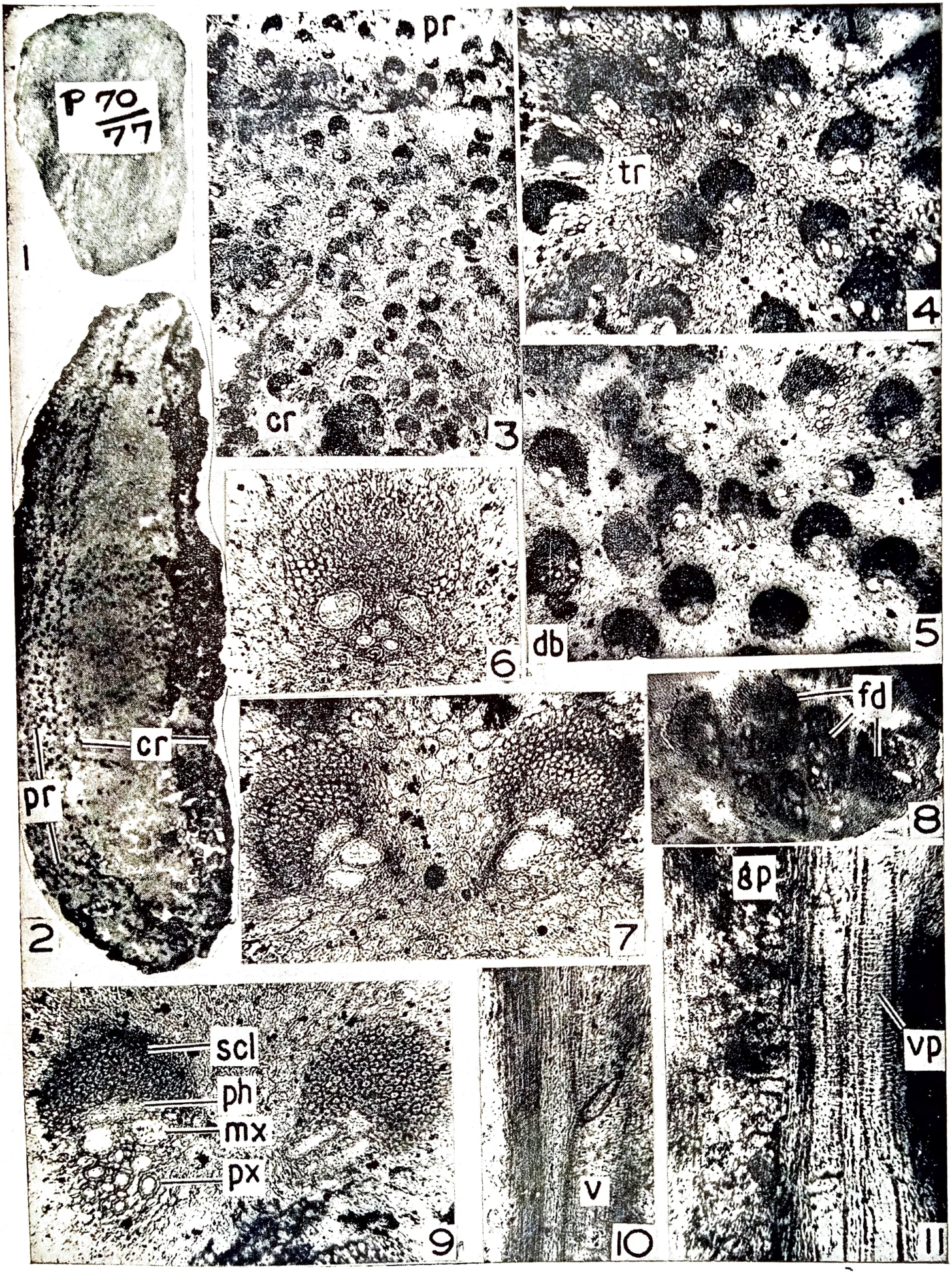
EXPLANATION OF PLATE 1

Pl. 1. Figs. 1-11. A fossil palm peduncle from Dongargaon. 1. An entire piece of fossil palm peduncle ×2/3 N. S. 2. T. S. showing peripheral—*pr* and central-*cr*, regions of oval to oblong size of peduncle ×3. 3. The same, a part magnified along with the line of thickness of specimen showing peripheral—*pr* and central—*cr* regions ×13. 4. The same, a part magnified in the junction of peripheral and central region showing normal, trace—*tr* and fusion bundles ×24. 5. The same showing irregular distribution of normal, trace and diminutive bundles *db* ×24. 6 & 7. Normal bundles ×105. 8. A group of fusion bundles—*fd* ×40. 9. Normal bundle on right hand side and a trace bundle on left hand side showing dorsal sclerenchymatous cap—*Scl.*, phloem—*ph*, two mataxylem—*mx* and numerous protoxylem—*px* ×113. 10& 11. L. S. of vessels—v, showing multiseriate scalariform pitting—*vp*, perforation plates and ground parenchyma—*gp* ×88.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