

FOSSIL DICOT WOODS FROM THE TERTIARY OF ASSAM

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ABSTRACT

Fossil woods of *Cynometra* and *Melanorrhoea* along with a *Mangifera*-like wood are described here from the Tipam sandstones near the town of Hailakandi in Cachar District, Assam. The fossil wood of *Melanorrhoea* is known for the first time from India and abroad.

INTRODUCTION

THREE fossil dicot woods are described here from the Tipam sandstones exposed near Hailakandi in Cachar District of Assam. Two of them have been assigned to *Melanorrhoea* and *Cynometra* while the third shows some similarity to *Mangifera*. In addition to these, a large number of other fossil woods are known from these beds indicating the presence of a rich vegetation in this region during the Middle Tertiary (Prakash & Tripathi, 1969a,b, 1970a,b, 1972, 1974, 1975). Modern equivalents of all these fossils are still found in the forests of Assam and neighbouring areas.

It was possible to complete this work with the help of the modern wood slides made available to the authors for comparison at the Wood Anatomy Branch of the Forest Research Institute, Dehra Dun for which we wish to express our sincere appreciation to the Officer-in-charge, Wood Anatomy Branch.

SYSTEMATIC DESCRIPTION

ANACARDIACEAE

Melanorrhoeoxylon gen. nov.

1. *Melanorrhoeoxylon cacharensis* sp. nov.

Pl. 1, figs. 1-5

The following description is based on a small piece of secondary xylem measuring

about 3 cm in length and 3 cm in diameter. It shows excellent preservation.

Topography — Wood diffuse-porous (Pl. 1, figs. 1, 2). *Growth rings* indistinct; tangential bands of parenchyma sometimes give the impression of growth marks. *Vessels* moderately small to very large, majority solitary, less commonly in radial rows of 2 or more, 2-4 per sq mm, profusely tylosed, occasionally filled with brownish deposits. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric forming 1-5 cells thick sheath around the vessels (Pl. 1, figs. 1, 2); apotracheal parenchyma usually forming continuous, sometimes short, broken tangential bands, 1-10 (mostly 3-5) cells thick, closely spaced and running more or less concentrically (Pl. 1, fig. 2); parenchyma bands 5-50 μ thick and 9-10 per mm. *Xylem rays* distinct consisting both of simple and fusiform rays with gum canals (Pl. 1, fig. 4); simple rays very fine to moderately fine, 1-2 (mostly 1) seriate, 16-48 μ broad, 1-18 cells and 36-376 μ high; fusiform rays (Pl. 1, fig. 4) with horizontal gum canals, 3-5 seriate and 56-84 μ broad, 9-29 cells and 220-608 μ in height; rays 12-18 per mm; ray tissue homogeneous, rays homocellular consisting wholly of procumbent cells (Pl. 1, fig. 5). *Fibres* aligned in radial rows, interrupted by the parenchyma bands. *Intercellular canals* normal, horizontal, confined to fusiform xylem rays (Pl. 1, fig. 4), small, 8-38 μ (usually 8-25 μ) in diameter; epithelial cells present in a row round the gum ducts.

Elements — *Vessels* thin-walled, the walls about 4-6 μ thick, t.d. of solitary vessels 48-272 μ , r.d. 56-324 μ , round to oval in cross-section, those in groups flattened at the places of contact; vessel-members 150-500 μ long, with truncate or tailed ends; perforations simple; intervessel pit-pairs large, 8-12 μ in diameter (Pl. 1, fig. 3), alternate, bordered, border oval, sometimes hexagonal due to crowding with horizontal or slightly oblique, lenticular apertures;

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vessel-parenchyma and vessel-ray pits not observed. *Parenchyma cells* thin-walled, round to oval in cross section, 12-20 μ in diameter, 48-120 μ in length. *Ray cells* thick-walled, tangential height of procumbent cells 16-30 μ , radial length 40-108 μ . *Fibres* non-libriform to semi-libriform, non-septate, the walls 2-6 μ thick, angular in shape, 18-25 μ in diameter, 340-1200 μ in length; interfibre pits not preserved.

Affinities — The important anatomical features of the present fossil wood indicate its close resemblance with the modern woods of *Gluta* and *Melanorrhoea* of the family Anacardiaceae (Pearson & Brown, 1932, pp. 319-325 & 330-333; Metcalfe & Chalk, 1950, pp. 455-459; Desch, 1957, pp. 18-20; Anonymous, 1963, pp. 279-282 & 295-298). A detailed study of thin sections of 9 species of *Melanorrhoea*, viz., *M. pilosa* Lecomte, *M. usitata* Wall., *M. curtisii* Oliver, *M. torquata* King, *M. apetra* King, *M. glabra* Wall., *M. laccifera* Pierre, *M. malayana* Corner, *Melanorrhoea* sp., and 4 species of *Gluta*, viz., *G. renghas* (Sphalm. Bienghas) Linn., *G. tavoyana* Hook., *G. coarctata* Hook., and *G. travancorica* Bedd. was made for comparison with the present fossil wood and the observations made with regard to the thickness of the apotracheal parenchyma bands and the nature of the ray tissue have already been recorded by Prakash and Tripathi (1969a, p. 60).

From this study two groups of *Gluta* and *Melanorrhoea* could be established, one group including all the *Glutas* and those *Melanorrhoeas* which have thin, 1-7 (usually 2-4) seriate, apotracheal parenchyma bands and the other group consisting only of *Melanorrhoeas* with thick, 1-10 (usually 3-7 or 8) seriate, apotracheal parenchyma bands (Table 1). For the fossil woods showing characters of the former group, the generic name *Glutoxylon* Chowdhury (1934) has been instituted but for the woods of the other group which includes only *Melanorrhoeas* with thick bands of apotracheal parenchyma, a new generic name *Melanorrhoeoxylon* may be established as suggested by Prakash and Tripathi (1969a, p. 60). Here, it may be mentioned that the gum canals are generally smaller in *Melanorrhoea* than in *Gluta* (Pearson & Brown, 1932, p. 332). As the fossil wood possesses thick, 1-10 (usually 3-5) seriate apotracheal parenchyma bands and the gum canals are

smaller it is assigned to the new organ genus *Melanorrhoeoxylon*.

None of the modern species of *Melanorrhoea* examined by us show resemblance to the present fossil wood in all the anatomical features. The only difference is in the frequency of the parenchyma bands which are more in the present fossil wood. However, the present fossil wood shows somewhat close resemblance with the modern wood of *Melanorrhoea usitata* and *M. torquata* (Pearson & Brown, 1932, p. 332), but even in these species the parenchyma bands are not so close as in the present fossil wood. In *M. usitata*, the parenchyma bands are 3-6 per mm and in *M. torquata* these bands are 4-7 per mm, whereas in the present fossil wood they are 9-10 per mm (Table 1).

In 1934, Chowdhury instituted the form genus *Glutoxylon* representing both *Gluta* and *Melanorrhoea* and described *Glutoxylon assamicum* from the Tertiary of Assam

TABLE 1 — SHOWING FREQUENCY AND THICKNESS OF APOTRACHEAL PARENCHYMA BANDS

MODERN SPECIES	THICKNESS OF APOTRACHEAL BANDS	BANDS PER MM
1. <i>Melanorrhoea pilosa</i> Lecomte	1-6 (usually 2-3) seriate	2-5
2. <i>M. usitata</i> Wall.	1-10 (usually 4-7 or 8) seriate	3-6
3. <i>M. curtisii</i> Oliver	1-7 (usually 2-4) seriate	1-2
4. <i>M. torquata</i> King	1-9 (usually 3) seriate	4-7
5. <i>M. apetra</i> King	1-6 (usually 2-3) seriate	1-4
6. <i>M. glabra</i> Wall.	1-7 (usually 3-4) seriate	2-5
7. <i>M. laccifera</i> Pierre	1-7 (usually 3-4) seriate	2-5
8. <i>M. malayana</i> Corner	1-9 (usually 3-4) seriate	2-5
9. <i>Melanorrhoea</i> sp.	1-7 seriate	1-4
10. <i>Gluta renghas</i> , (Sphalm. Bienghas) Linn.	1-7 (usually 2-3) seriate	2-5
11. <i>G. tavoyana</i> Hook.	1-7 (mostly 2-4) seriate	1-3
12. <i>G. coarctata</i> Hook.	1-6 (usually 2-4) seriate	2-4
13. <i>G. travancorica</i> Bedd.	1-6 (usually 2-4) seriate	1-3

(Chowdhury, 1934, 1936). However, in 1952 Chowdhury transferred *Glutoxylon assamicum* to *Glutoxylon burmense* along with many other fossil woods described under different genera and species (Chowdhury, 1952, p. 376). Besides, Mukherjee (1942a,b) recorded *G. bengalensis* from the Tertiary of Mainamati Hills, Bengal, and Ghosh (1958) described *G. chowdhurii* from a recent or sub-recent deposit of Manipur. Recently both these species have been transferred to *G. burmense* (Holden) Chowdhury by Awasthi (1966) who has also described a new species *Glutoxylon cuddaloreense* from Cuddalore Series of South India. Thus, only two species of fossil woods of *Glutoxylon* are so far known from India and abroad (Awasthi, 1966, pp. 135-141; Prakash & Tripathi, 1969a, pp. 59-64). These are *Glutoxylon burmense* (Holden) Chowdhury (1952) and *G. cuddaloreense* Awasthi (1966). The present fossil wood differs from *G. burmense* in the frequency and the thickness of the parenchyma bands. In the present fossil wood the parenchyma bands are closely spaced, with 9-10 bands per mm, while in *Glutoxylon burmense* the parenchyma bands are more widely spaced, with 1-2 or 3 bands per mm. Besides, the thickness of the parenchyma bands is 1-10 (mostly 3-5) cells in the present fossil wood, while it is only 2-7 (mostly 2-4) cells in *G. burmense*.

Glutoxylon cuddaloreense differs also from the present fossil wood in some characters. In the present fossil wood the vessels are moderately small to large (t.d. 48-272 μ), parenchyma bands are abundant, closely spaced, 9-10 bands per mm and 1-10 (mostly 3-5) cells thick and the simple xylem rays are 1-2 (mostly 1) seriate, while in *G. cuddaloreense* the vessels are medium to large (t.d. 180-375 μ), the parenchyma bands are somewhat widely spaced, 3-6 bands per mm and 2-6 cells thick and the simple xylem rays are exclusively uniseriate. The present fossil wood is thus different from both these species of *Glutoxylon* so far described. As the present fossil wood resembles only the modern genus *Melanorrhoea* with thick apotracheal parenchyma bands, it is assigned to the organ genus *Melanorrhoeoxylon* and described as *Melanorrhoeoxylon cachareense* gen. et sp. nov., the specific name indicating the name of the District from where the present fossil wood was collected.

Present Distribution of Melanorrhoea Wall. — The genus *Melanorrhoea* Wall. consists of 20 species (Willis, 1966, p. 708) restricted to the Indo-Malayan region. Two species are indigenous to Burma, one of which *Melanorrhoea usitata* Wall. grows in the drier forests of Burma up to 1,200 m elevation and extends up to Manipur in India, while *M. glabra* Wall. is found in the forests of Tenasserim, Tavoy and Mergui (Anonymous, 1963, pp. 279, 295-296).

GENERIC DIAGNOSIS

Melanorrhoeoxylon gen. nov.

Growth rings distinct or indistinct. *Vessels* small to large, solitary and in radial multiples, profusely tylosed; perforations simple, horizontal or oblique; intervessel pit-pairs large, alternate, widest horizontally, border oval or hexagonal when crowded, aperture lenticular, horizontal or slightly oblique. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty, vasicentric, sometimes tending to become aiform; apotracheal parenchyma usually in close, continuous or sometimes broken tangential bands, rather irregularly spaced and running more or less concentrically or ending abruptly; bands wider and usually more numerous, up to 8-9-10 (mostly 3-7 or 8) cells thick. *Xylem rays* very fine to moderately fine, of two types simple and fusiform, the latter with horizontal gumducts; ray tissue homogeneous. *Fibres* non-libriform to semi-libriform, non-septate. *Intercellular canals* normal, small, horizontal, confined to fusiform xylem rays.

Genotype—*Melanorrhoeoxylon cachareense* sp. nov.

SPECIFIC DIAGNOSIS

Melanorrhoeoxylon cachareense sp. nov.

Wood diffuse-porous. *Growth rings* indistinct; tangential bands of parenchyma sometimes give the impression of growth marks. *Vessels* moderately small to very large, t.d. 48-272 μ , r.d. 56-324 μ , majority solitary, less commonly in radial rows of 2 or more, 2-4 per sq mm, heavily tylosed, sometimes with brownish deposits; vessel-members 150-500 μ long with truncate ends; per-

forations simple; intervessel pit-pairs large, 8-12 μ in diameter, alternate, bordered, oval to angular through crowding. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric; apotracheal parenchyma usually in continuous, sometimes broken tangential bands, 1-10 (mostly 3-5) cells thick, closely spaced, 9-10 bands per mm and running more or less concentrically or ending abruptly. *Xylem rays* both simple and fusiform with gum canals; simple rays 1-2 (mostly 1) seriate and 16-48 μ broad, 1-18 cells and 36-376 μ high; fusiform rays occasional, 3-5 seriate and 56-84 μ broad, 9-29 cells and 220-608 μ in height; rays 12-18 per mm; ray tissue homogeneous, rays homocellular consisting wholly of procumbent cells. *Fibres* non-libriform to semi-libriform, non-septate, angular, 18-25 μ in diameter, 340-1200 μ in length. *Intercellular canals* normal, horizontal, 8-38 μ (mostly 8-25 μ) in diameter; epithelial cells present in a row round the ducts.

Holotype — B.S.I.P. Museum no. 33915/882.

Locality — Sultanicherra, near Hailakandi, District Cachar, Assam.

Anacardioxylon Felix, 1882

2. *Anacardioxylon shardai* sp. nov.

Pls. 1-2, figs. 6-11

Fossil wood described below is a small piece of secondary xylem measuring 5 cm in length and 3 cm in diameter.

Topography — Wood diffuse-porous (Pl. 2, fig. 7). *Growth rings* distinct, delimited by terminal parenchyma bands. *Vessels* small to large, the majority solitary, sometime also in short radial rows of 2-5 (mostly 2), contiguous with the rays on one or both the sides, 2-3 per sq mm; tyloses abundant (Pl. 2, figs. 7, 8), deposits of gummy material occasionally present in the vessels. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric, aliform to aliform-confluent, forming 2-4 cells thick sheath around the vessels (Pl. 2, figs. 7, 8); apotracheal parenchyma in broad, 1-8 (mostly 4-5) cells thick, short and long bands, occurring usually at the growth rings. *Xylem rays* normally 1-3 (mostly

2) seriate (Pl. 2, fig. 9) and 12-48 μ , 1-22 cells and 48-580 μ in height; fusiform rays with traumatic gum canals occasional (Pl. 2, fig. 10), 5-11 seriate, 56-80 μ in width, 4-22 cells and 200-600 μ in height; rays 9-11 per mm; ray tissue heterogeneous (Pl. 2, fig. 11); rays mostly heterocellular rarely homocellular, when heterocellular composed of procumbent cells in the middle portion and upright cells at one or both the ends; homocellular rays consist of only upright cells. *Fibres* aligned in radial rows, occasionally interrupted by parenchyma bands. *Intercellular canals* rare, traumatic, horizontal (Pl. 2, fig. 10), 28-108 μ in diameter, observed only in three xylem rays which are abnormally enlarged.

Elements — *Vessels* thin-walled, the walls 6-8 μ thick, t.d. 40-216 μ , r.d. 48-300 μ , round to oval in cross section, those in radial groups flattened at the places of contact; vessel-members 200-600 μ long, with truncate or tailed ends; perforations simple; intervessel pit-pairs large, 8-10 μ in diameter, alternate, bordered, oval to angular through crowding, with lenticular apertures (Pl. 1, fig. 6); vessel-parenchyma and vessel-ray pits not preserved. *Parenchyma cells* thin walled, round to oval in cross section, 8-16 μ in diameter, 72-120 μ in length. *Ray cells* thick walled, sometimes with gummy deposits; tangential height of procumbent cells 20-32 μ , radial length 80-108 μ ; upright cells 60-84 μ in tangential height and 20-56 μ in radial length; cells crystalliferous. *Fibres* non-libriform to semi-libriform, septate only near the parenchyma strands, angular in cross section, 32-38 μ in diameter, 350-1200 μ in length; interfibre pits not preserved.

Affinities — The important anatomical features exhibited by the present fossil wood are seen among the woods of the families Meliaceae, Anacardiaceae, Lauraceae and Combretaceae (Pearson & Brown, 1932, pp. 309-347; Normand, 1950, pp. 78-80; Metcalfe & Chalk, 1950, pp. 452-460; Kribs, 1959, pp. 5-10).

In the family Meliaceae, the woods of *Carapa*, *Khaya*, and *Swietenia* resemble the present fossil wood in the size and arrangement of the vessels and in the parenchyma distribution. However, they differ from the present fossil wood in the absence of tyloses and in having minute, vested intervessel pit-pairs.

The genera *Cinnamomum*, *Phoebe*, and *Machilus* of the family Lauraceae show somewhat near resemblance in gross features with the present fossil wood. However, they differ also in having simple as well as scalariform perforations and in possessing oil cells in the parenchyma, fibres and the xylem rays.

In the family Combretaceae, the wood of *Terminalia* shows superficial resemblance with the present fossil wood in the nature and distribution of vessels and in the parenchyma pattern. But in *Terminalia* the intervessel pit-pairs are vested and the fibres are profusely septate.

In the family Anacardiaceae, the genus *Mangifera* shows somewhat near resemblance to the present fossil wood. The wood of *Mangifera*, *altissima* although resembling the present fossil wood, differs from it in having more numerous long and short, broken apotracheal parenchyma bands and in the absence of horizontal gum canals. Although horizontal gum canals are present in *Mangifera longipes* but the parenchyma is scanty paratracheal to vasicentric unlike the present fossil wood (Anonymous, 1963, p. 292).

As such, it is obvious that this fossil wood belongs to the family Anacardiaceae and shows a near resemblance to the modern wood of *Mangifera*. It is, therefore, assigned to the organ genus *Anacardioxylon* Felix (1882).

A number of fossil woods belonging to the family Anacardiaceae are known from the Cretaceous onwards. These have already been enumerated by Edwards (1931), Edwards and Wonnacott (1935) and Boureau (1957). Those belonging to *Anacardioxylon* Felix (1882) are as follows:

All these differ quite distinctly from the present fossil wood. Thus, *Anacardioxylon spondiaeforme* Felix (1882) differs from the present fossil wood in the absence of growth rings, in having only vasicentric parenchyma and in uniseriate xylem rays. *A. uniradiatum* Felix (1894) can also be distinguished from this fossil wood in having uniseriate xylem rays and scanty to vasicentric parenchyma. *A. magniporosum* Platen (1908) is distinct from the present fossil wood in having smaller vessels, and broader and higher xylem rays. *A. caracoli* Schönfeld (1947) can also be discarded as the growth rings are absent, the vessels are large (t. d. 150-400 μ , r.d. 200-500 μ) and elliptical to circular in shape, the intervessel pit-pairs are larger, 12-15 μ in diameter, the parenchyma is vasicentric, rarely confluent, and the xylem rays are 1-2 (mostly 1) seriate. Lastly, *A. semecarpoides* Prakash & Dayal (1965) is also distinct from the present fossil wood in the absence of growth rings, in having small to medium-sized vessels (t.d. 45-165 μ , r.d. 45-150 μ), and in scanty paratracheal to aliform parenchyma and non-septate fibres. In 1953 Ramanujam, reported a fossil wood resembling *Mangifera* from the Tertiary of South India without giving any description and the name. Later in 1960, he described probably the same wood under the name *Anacardioxylon mangiferoides*. However, this wood does not seem to belong to Anacardiaceae and needs further investigation.

As the present fossil wood is quite distinct from all the species of *Anacardioxylon* so far described, it is assigned to a new species *Anacardioxylon shardai*, the specific name is given after Sharda Brothers, the owner

FOSSIL SPECIES	LOCALITY	AGE	NEAREST RESEMBLING MODERN TAXA
1. <i>Anacardioxylon spondiaeforme</i> Felix (1882)	Antigua	Tertiary	<i>Spondias lutea</i>
2. <i>A. uniradiatum</i> Felix (1894)	Caucasus	Eocene	<i>Spondias lutea</i>
3. <i>A. magniporosum</i> Platen (1908)	California	Tertiary	—
4. <i>A. caracoli</i> Schönfeld (1947)	Columbia	Tertiary	<i>Anacardium rhinocarpus</i>
5. <i>A. semecarpoides</i> Prakash & Dayal (1965)	India	Eocene	<i>Semecarpus</i>

of Sultanicherra Tea Estate, of Assam who helped the authors in collecting the fossil woods.

The genus *Mangifera* Linn. consists of 41 species confined mainly to the Indo-Malayan region. The western limit of its distribution is Ceylon and India, the northern limit being the Himalayas, Yunan (China) and Vietnam. In the east it extends up to Philippines and New Guinea, and in the south to the Sunda and Sulu Archipelago in the Indian ocean (Anonymous, 1963, p. 289).

SPECIFIC DIAGNOSIS

Anacardioxylon shardai sp. nov.

Wood diffuse-porous. *Growth rings* distinct, appear to be delimited by terminal parenchyma. *Vessels* small to large, t.d. 40-216 μ , r.d. 48-300 μ , round to oval in cross section, majority solitary, sometimes also in short radial rows of 2-3 (mostly 2); 2-3 vessels per sq mm; tyloses abundant; vessel-segments 200-600 μ in length with truncate or tailed ends; perforations simple; intervessel pit-pairs large, 8-10 μ in diameter, bordered with lenticular apertures. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric, aliform to aliform-confluent forming 2-4 cells thick sheath around the vessels; apotracheal parenchyma in broad, 1-8 (mostly 4-5) cells thick, short and long bands usually at the growth rings. *Xylem rays* fine to moderately broad, normally 1-3 seriate, 12-48 μ broad, 1-22 cells and 48-580 μ in height; fusiform rays occasional, with traumatic gum canals, 5-11 seriate, 56-80 μ in width, 4-22 cells and 200-640 μ in height; rays 9-11 per mm; ray tissue heterogeneous, rays mostly heterocellular, rarely homocellular, when heterocellular consisting of procumbent cells in the middle portion and upright cells at one

or both the ends; homocellular rays consisting only of 1-2 upright cells; ray cells crystalliferous. *Fibres* angular in cross section, nonlibriform to semi-libriform, rarely septate, 32-38 μ in diameter, 350-1200 μ in length. *Intercellular canals* very rare, traumatic, horizontal, confined only to few xylem rays, 28-108 μ in diameter.

Holotype — B.S.I.P. Museum no. 33924/884.

Locality — Kartikcherra, near Hailakandi, District Cachar, Assam.

LEGUMINOSAE

Cynometroxylon Chowdhury & Ghosh, 1946

3. *Cynometroxylon indicum* Chowdhury & Ghosh, 1946

Pl. 2, figs. 12, 13

Fossil wood is about 2 cm in length and 2.5 cm in diameter. It shows good preservation.

The most important anatomical features exhibited by the fossil indicate that the affinities of the present fossil wood are with the modern genus *Cynometra*. In 1946, Chowdhury and Ghosh instituted the organ genus *Cynometroxylon* for the fossil woods showing structural features of *Cynometra*, and described the species *Cynometroxylon indicum* from near Nailalung railway station in Assam. As the present fossil is identical to this species, it is assigned to it.

The genus *Cynometra* is represented in India by four wild and one cultivated species. *Cynometra polyandra*, which resembles the fossil wood most, grows in Khasi hills, Sylhet and Cachar (Gamble, 1902, p. 275).

Specimen — B.S.I.P. Museum no. 33792/882.

Locality — Sultanicherra, near Hailakandi, District Cachar, Assam.

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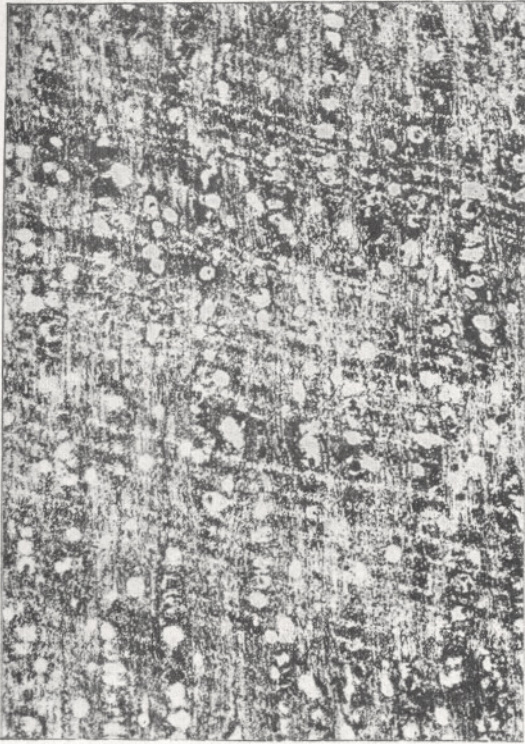
EXPLANATION OF PLATES

PLATE 1

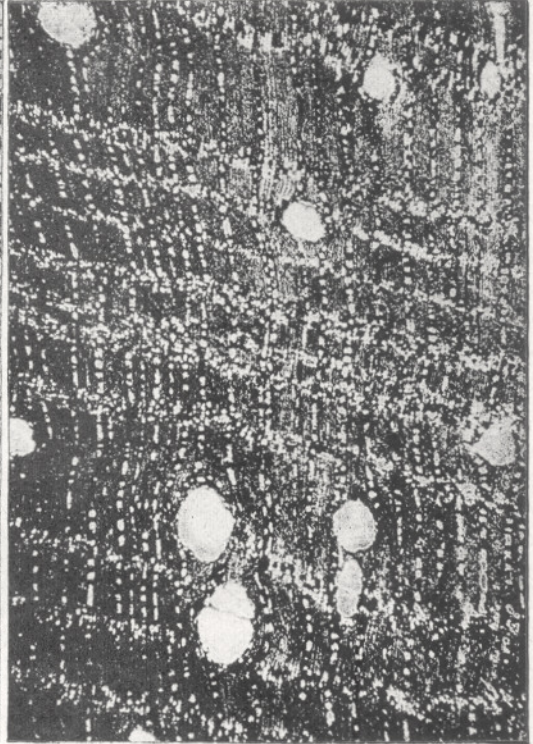
1. *Melanorrhoeoxylon cacharensense* gen. et sp. nov.—Cross section of the fossil wood in low power showing vessel distribution and parenchyma pattern. $\times 10$. Slide no. 4826-33915/882.
2. *Melanorrhoeoxylon cacharensense* gen. et sp. nov.—Cross section slightly magnified to show the thickness of parenchyma bands. $\times 30$. Slide no. 4826-33915/882.
3. *Melanorrhoeoxylon cacharensense* gen. et sp. nov.—Tangential longitudinal section of the fossil wood showing xylem rays. $\times 120$. Slide no. 4828-33915/882.
4. *Melanorrhoeoxylon cacharensense* gen. et sp. nov.—Radial longitudinal section of the fossil wood showing homocellular xylem rays. $\times 120$. Slide no. 4829-33915/882.
5. *Melanorrhoeoxylon cacharensense* gen. et sp. nov.—Magnified intervessel pit-pairs. $\times 400$. Slide no. 4827-33915/882.
6. *Anacardioxylon shardai* sp. nov.—Magnified intervessel pit-pairs. $\times 400$. Slide no. 4830-33924/884.

PLATE 2

7. *Anacardioxylon shardai* sp. nov.—Cross section of the fossil wood in low power showing vessel distribution and the parenchyma pattern. $\times 30$. Slide no. 4831-33924/884.
8. *Anacardioxylon shardai* sp. nov.—Cross section magnified to show parenchyma distribution. $\times 45$. Slide no. 4831-33924/884.
9. *Anacardioxylon shardai* sp. nov.—Radial longitudinal section of the fossil wood showing heterocellular xylem rays. $\times 120$. Slide no. 4832-33924/884.
10. *Anacardioxylon shardai* sp. nov.—Tangential longitudinal section of the fossil wood showing xylem rays. $\times 90$. Slide no. 4830-33924/884.
11. *Anacardioxylon shardai* sp. nov.—Tangential longitudinal section of the fossil wood showing a horizontal gum canal. $\times 100$. Slide no. 4833-33924/884.
12. *Cynometroxylon indicum* Chowdhury & Ghosh—Cross section of the wood showing vessel distribution and the parenchyma pattern. $\times 30$. Slide no. 4834-33792/882.
13. *Cynometroxylon indicum* Chowdhury & Ghosh—Tangential longitudinal section of the fossil wood showing xylem rays. $\times 60$. Slide no. 4835-33792/882.



1



2



3



4



5



6

