

# FOSSIL WOODS FROM THE TERTIARY OF HAILAKANDI, ASSAM

U. PRAKASH & P. P. TRIPATHI

Birbal Sahni Institute of Palaeobotany, Lucknow

## ABSTRACT

Fossil woods representing *Pometia* of Sapindaceae, *Mangifera* of Anacardiaceae and *Lagerstroemia* of Lythraceae are described here from the Tertiary beds near Hailakandi, Assam. Petrified woods of *Pometia* and *Lagerstroemia* are known for the first time from India. These are of interest with regard to their palaeogeographical distribution.

## INTRODUCTION

THIS paper deals with the systematic description of three fossil woods belonging to the genera *Pometia*, *Mangifera* and *Lagerstroemia*. The field collection was made by us in March 1966 from near the town of Hailakandi, district Cachar, Assam. The fossil wood of *Pometia* was collected from Kartikcherra (24°20' N; 92°31' E) and those of *Mangifera* and *Lagerstroemia* from Sultanicherra (24°18' N; 92°33' E) at a distance of about 38 and 48 km. respectively, in the south-west of Hailakandi. As the above fossil woods were picked up from the Tipam Sandstones exposed in this area known as Rath Tila (EVANS, 1932), they are of Middle Tertiary in age (DAS GUPTA, EVANS, METRE & VISVANATH, 1964).

Not many plant fossils are known so far from this locality. Only recently we described three fossil woods, viz. *Swinonioxylon hailakandiense* and *Glutoxylon burmense* of the family Anacardiaceae and *Adenantheroxylon pavoninum* of Leguminosae (PRAKASH & TRIPATHI, 1968, 1969).

In general, the preservation of structural details of the fossil woods is quite satisfactory. These woods have been studied in great detail from their ground thin sections, prepared from all the three planes.

Family — SAPINDACEAE

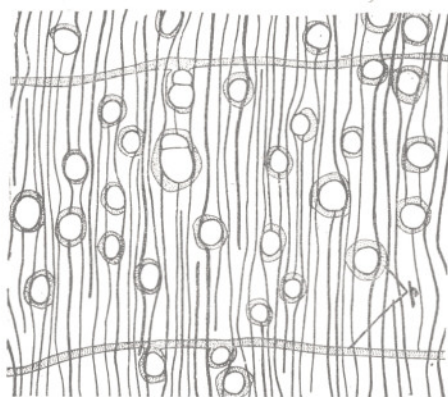
*Pometioxylon* gen. nov.

### 1. *Pometioxylon tomentosum* sp. nov.

*Topography* — Wood diffuse-porous (PL. 1, FIG. 1). Growth rings present, delimited by smaller vessels and concentric lines of

terminal parenchyma (PL. 1, FIG. 1). Vessels moderately small to moderately large, majority solitary, sometimes in short radial rows of 2-4 (PL. 1, FIG. 1), 6-11 per sq. mm.; tyloses absent, brownish-black deposits probably of gum occasionally present. Parenchyma paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric, forming 2-4 seriate sheath around the vessels (PL. 1, FIG. 1; TEXT-FIG. 1); apotracheal parenchyma represented by 1-4 cells thick bands of terminal parenchyma (PL. 1, FIG. 1). Xylem rays 1-2 (mostly 1) seriate (PL. 1, FIG. 3; TEXT-FIGS. 2, 3), fine, 20-32  $\mu$  broad and 3-27 cells or 96-560  $\mu$  high, 10-15 per mm.; ray tissue heterogenous; rays heterocellular consisting of procumbent cells in the middle portion and upright or square cells at one or both the ends or in between the procumbent cells (PL. 1, FIGS. 3, 5). Fibres aligned in radial rows between two consecutive xylem rays.

*Elements* — Vessels thick-walled, the walls about 7-12  $\mu$  thick, tangential diameter 64-216  $\mu$ , radial diameter 72-220  $\mu$ , round to oval in cross-section when solitary, those in radial groups flattened at the places of



*Pometioxylon tomentosum* gen. et sp. nov.

(Semi-diagrammatic camera lucida drawings)

TEXT-FIG. 1 — Cross-section showing the distribution of parenchyma (p).  $\times 17$ .

contact; vessel-members short to medium-sized, 225-675  $\mu$  in length with truncate or abruptly tailed ends; perforations simple; intervessel pit-pairs alternate, small, 4-5  $\mu$  in diameter, occasionally with coalescent apertures (TEXT-FIG. 4); vessel-ray and vessel-parenchyma pits not observed. *Parenchyma cells* thin-walled, 12-15  $\mu$  in tangential diameter and 16-24  $\mu$  in radial diameter as measured in cross-section. *Ray cells* thin walled; tangential height of procumbent cells 16-24  $\mu$ , radial length 44-72  $\mu$ ; upright cells 32-40  $\mu$  in tangential height

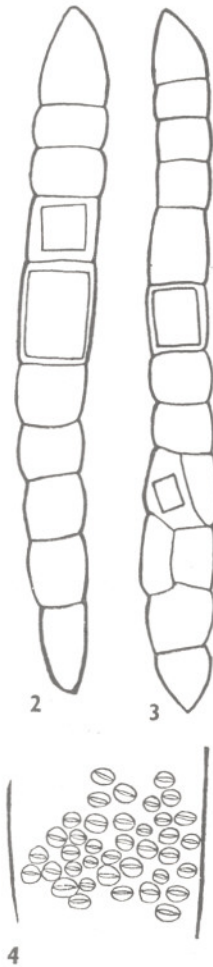
and 16-32  $\mu$  in radial length; cells crystalliferous. *Fibres* libriform with wide lumina, septate, 550-1300  $\mu$  in length and 18-26  $\mu$  in diameter; walls 3-5  $\mu$  thick; pits not observed.

*Affinities* — There is a close agreement in almost all the structural details of the present fossil wood with the wood structure of the modern genus *Pometia* Forst. of the family Sapindaceae. However, the fossil wood also resembles in gross anatomical features with the wood of *Filicium decipiens* of the same family. *Filicium decipiens* can be distinguished from the present fossil in having vessels mostly in radial rows of 2-8, in scattered crystalliferous parenchyma and homogeneous xylem rays. An examination of the published description, photographs and thin sections of woods of all the modern species of *Pometia* reveals that the present fossil wood shows nearest resemblance to the wood structure of *Pometia tomentosa* Teysm. et Binn. The present study included the examination of the thin sections of *P. tomentosa* Teysm. et Binn. and *P. pinnata* Forst. and published description and photographs of *P. pinnata* Forst. (MOLL & JANSSONIUS, 1908, p. 376; KANEHIRA, 1924, p. 22; METCALFE & CHALK, 1950, pp. 425-429, FIG. 97I; DESCH, 1954, pp. 533-534; KRIBS, 1959, p. 145, FIG. 308), *P. tomentosa* Teysm. et Binn. (MOLL & JONSSONIUS, 1908, pp. 370-375, FIG. 125; DESCH, 1954, pp. 533-534) and *P. alnifolia* Radlk., *P. macrocarpa* Kurz and *P. ridleyi* King (DESCH, 1954, pp. 533-534).

Both in the fossil wood and the modern wood of *Pometia tomentosa*, the intervessel pit-pairs are small, alternate, bordered, the parenchyma is scanty paratracheal to vasicentric and terminal, the xylem rays are 1-2 (mostly 1) seriate and heterogeneous and the fibres are libriform and septate. However, in the modern wood of *Pometia tomentosa*, the vessels are slightly larger than in the present fossil wood.

Because of the close resemblance of the fossil wood with the wood structure of the modern *Pometia* Forst., it is being assigned to a new form genus *Pometioxylon* and specifically named as *Pometioxylon tomentosum* sp. nov.

The fossil woods of the family Sapindaceae have so far been assigned to the form genus *Sapindoxylon* Kräusel. Following nine species of this genus are known from India and abroad.



TEXT-FIGS. 2-4. — 2. Uniseriate xylem ray with procumbent and upright cells.  $\times 330$ . 3. Biseriate xylem ray with procumbent and upright cells.  $\times 330$ . 4. Tangential section showing intervessel pit-pairs.  $\times 330$ .

Sl. No.	Species	Age & Locality
1.	<i>Sapindoxylon janssonii</i> Kräusel, 1922	Tertiary of Sumatra
2.	<i>S. klitzingi</i> (Pfeiffer & Van Heurn) Edwards, 1931	Tertiary of Java
3.	<i>S. stromeri</i> Kräusel, 1939	Oligocene or Miocene of Egypt
4.	<i>S. antioquiense</i> Schönfeld, 1947	Tertiary of Columbia
5.	<i>S. pleiknense</i> Boureau, 1950	Tertiary of Indo China
6.	<i>Sapindoxylon</i> sp. Hofmann, 1952	Tertiary of Austria
7.	<i>S. indicum</i> Navale, 1956	Tertiary of South India
8.	<i>S. schleicheroides</i> Dayal, 1965	Eocene, Deccan Intertrappean beds, India
9.	<i>S. ellatostachyoides</i> Grambast, 1966	Tertiary of Castellane (Basses-Alpes), France

Besides this, the fossil wood *Djambioxylon sumatrense* from the Tertiary of Sumatra is doubtfully referred to this family (KRÄUSEL, 1922, p. 272; DEN BERGER, 1923, p. 147; EDWARDS & WONNACOTT, 1928, p. 30). However, from amongst the above species of fossil woods *Sapindoxylon janssonii* Kräusel (1922) only shows some similarity with the modern wood of *Pometia tomentosa* and *P. pinnata*. But it also differs from the present fossil wood in having diffuse, crystalliferous parenchyma and in the absence of terminal parenchyma. Therefore, the present fossil forms the first authentic record of the fossil wood of *Pometia* from the Tertiary of India and abroad.

The genus *Pometia* Forst. consists of ten species distributed mainly in Indo-Malayan region (WILLIS, 1966, p. 911) but also occurring in the Philippines and Java (ANONYMOUS, 1963, p. 228). The species *Pometia tomentosa* with which the present fossil wood shows closest resemblance, grows in Ceylon, Burma, the Andaman Islands, Thailand, Philippines and the Netherlands Indies (DESCH, 1954, p. 533). The other representative of this genus in the Indian region is *Pometia pinnata* which commonly grows in Andamans besides occurring in Ceylon, Burma, Java and Philippines and in the Malaya Peninsula (ANONYMOUS, 1963, p. 228).

*Pometioxylon* gen. nov.—*Diagnosis*: Wood diffuse-porous. *Growth rings* usually distinct. *Vessels* small to large, solitary and in radial rows (mostly 2-3), round to oval in cross-section; perforations simple; intervessel pit-pairs small, alternate, occasionally with coalescent apertures. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric and some-

times slightly aliform; apotracheal parenchyma diffuse and in narrow to moderately broad terminal lines. *Xylem rays* fine and short, 1-2 (mostly 1) seriate; ray tissue heterogeneous; rays heterocellular, composed of procumbent and upright or square cells. *Fibres* libriform, septate.

*Pometioxylon tomentosum* sp. nov.—*Diagnosis*: Wood diffuse-porous. *Growth rings* distinct. *Vessels* moderately small to moderately large, round to oval in cross-section, t.d. 64-216  $\mu$ , r.d. 72-220  $\mu$ , mostly solitary, sometimes in short radial rows of 2-4 cells, 6-11 per sq. mm.; tyloses absent, brownish-black deposits probably of gum occasional; vessel-members 225-675  $\mu$  in length with truncate or abruptly tailed ends; intervessel pitpairs small, 4-5  $\mu$ , alternate, occasionally with coalescent apertures; perforations simple. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric; apotracheal parenchyma in terminal lines at the growth rings. *Xylem rays* 1-2 (mostly 1) cells and 20-32  $\mu$  broad, 3-27 cells and 96-560  $\mu$  high, 10-15 per mm.; ray tissue heterogeneous; rays heterocellular, composed of procumbent cells in the middle and upright or square cells either at one or both the ends or in between the procumbent cells. *Fibres* septate, libriform, 550-1300  $\mu$  in length and 18-26  $\mu$  in diameter, the walls about 3-5  $\mu$  thick.

*Material*—A single specimen of mature, secondary xylem measuring 6 cm. in length and 3 cm. in diameter.

*Holotype*—B.S.I.P. Museum No. 33900.

*Locality*—Kartikcherra, near Hailakandi, district Cachar, Assam.

*Horizon*—Tipam Sandstones.

*Age*—Middle Tertiary.

Family — ANACARDIACEAE

*Mangiferoxylon* Awasthi, 19662. *Mangiferoxylon assamicum* sp. nov.

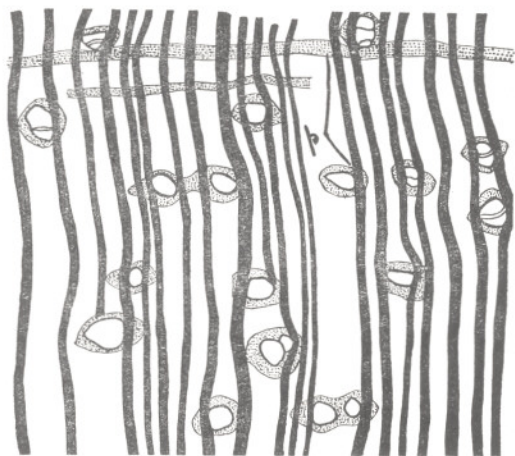
*Topography* — Wood diffuse-porous (PL. 2, FIG. 7). *Growth rings* present, usually delimited by terminal parenchyma (PL. 3, FIG. 12). *Vessels* small to medium-sized, usually solitary or in short radial rows of 2-4 cells (PL. 2, FIG. 7), 2-5 per sq. mm.; tyloses sometimes present, and gummy deposits of reddish-brown also occasionally seen. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma mostly vasicentric to aliform, sometimes aliform-confluent, forming 2-5 cells thick sheath around the vessels (PL. 2, FIG. 7; TEXT-FIG. 5); apotracheal parenchyma represented by bands 2-10 cells thick, usually delimiting the growth rings, sometimes arranged quite closely, and occasionally short and broken (PL. 3, FIG. 12); 2-4 bands per mm. *Xylem rays* fine, 1-3 (mostly 2) seriate (PL. 2, FIG. 9; TEXT-FIGS. 6, 7 & 8), the triseriate rays being very rare formed by the addition of 1-2 cells, 12-40  $\mu$  broad and 1-28 cells or 88-760  $\mu$  high; 10-14 rays per mm.; ray tissue heterogeneous; rays mostly heterocellular, rarely homocellular; heterocellular rays consist of procumbent cells through the median thickened portion and 1-4 (mostly 1) marginal rows of upright cells at

one or both the ends; homocellular rays short, usually 1-3 cells high consisting wholly of upright cells (TEXT-FIG. 6). *Fibres* aligned in radial rows between the two consecutive rays.

*Elements* — *Vessels* thick-walled, the walls about 7-10  $\mu$  thick, tangential diameter 40-128  $\mu$ , radial diameter 48-180  $\mu$ , oval to round in cross-section when solitary and well preserved, mostly irregular in shape probably due to pressure during fossilization, those in radial groups flattened at the places of contact (PL. 2, FIG. 7); vessel-members short to medium, 300-600  $\mu$  in length with truncate or tailed ends; perforations simple; intervessel pit-pairs large, 8-10  $\mu$  in diameter, oval to elliptical or angular when crowded, with broad border and lenticular orifices (PL. 2, FIG. 10; TEXT-FIG. 9); vessel-ray and vessel-parenchyma pits could not be observed. *Parenchyma cells* thin-walled, about 40-160  $\mu$  in length and 7-16  $\mu$  in diameter. *Ray cells* thick walled; tangential height of procumbent cells 20-26  $\mu$ , radial length 40-72  $\mu$ ; upright cells 40-80  $\mu$  in tangential and 24-44  $\mu$  in radial length. *Fibres* angular, often tangentially flattened or irregular in shape due to compression (PL. 2, FIG. 7), 7-14  $\mu$  in diameter, rarely septate, thin to slightly thick walled with wide lumina, common walls 3-5  $\mu$ ; pits not observed.

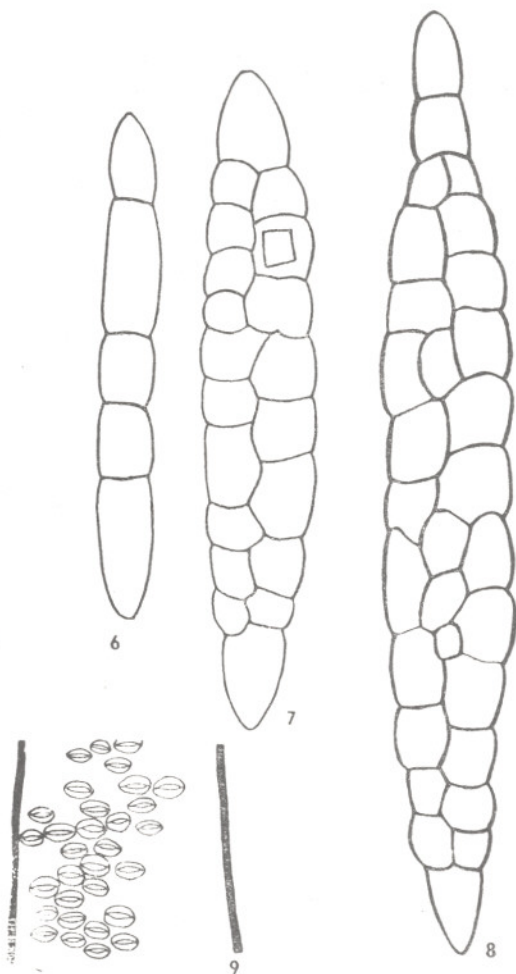
*Affinities* — The important anatomical features exhibited by the present fossil wood are: wood diffuse-porous; vessels small to medium-sized, usually solitary or in radial multiples of 2-4; intervessel pit-pairs large, bordered, alternate with lenticular apertures; parenchyma paratracheal and apotracheal; paratracheal parenchyma mostly vasicentric to aliform, sometimes aliform-confluent; apotracheal parenchyma forming continuous to short, broken bands, usually delimiting the growth rings; xylem rays (1-3 mostly 2) seriate, heterocellular or rarely homocellular; and fibres rarely septate and libriform. All these features indicate a close resemblance of the present fossil wood with the wood structure of *Mangifera* of the family Anacardiaceae (PEARSON & BROWN, 1932, pp. 314-319; HEIMSCH, 1942, pp. 136-137; METCALFE & CHALK, 1950, pp. 456; DESCH, 1957, p. 8; KRIBS, 1959, p. 9; BRAZIER & FRANKLIN, 1961, p. 21; ANONYMOUS, 1963, pp. 289-295).

A comparison of the present fossil wood with the thin sections of the woods of



*Mangiferoxylon assamicum* sp. nov.

TEXT-FIG. 5 — Cross-section showing the distribution of parenchyma (p).  $\times 20$ .



TEXT-FIGS 6-9 — 6. Uniseriate xylem ray with only upright cells.  $\times 300$ . 7. Biseriate xylem ray with procumbent and upright cells.  $\times 300$ . 8. Triseriate xylem ray with upright and procumbent cells.  $\times 300$ . 9. Tangential section showing intervessel pit-pairs.  $\times 300$ .

*Mangifera indica* Linn., *M. altissima* Blanco, *M. sylvatica* Roxb., *M. minor* Blume, *M. longipes* Griff. and *M. zeylanica* Hook., and with the published description and figures of *Mangifera laurina* Blume, and *M. odorata* Griff. (MOLL & JANSSONIUS, 1908, pp. 466-468), *M. foetida* Lour. (BRAZIER & FRANKLIN, 1961), *Mangifera* spp. (DESCH, 1957, p. 8), *M. indica* Linn. (LECOMTE, 1926, PL. 50; CHOWDHURY, 1932, PL. 19; 1945, pp. 46-47, PL. 40; PEARSON and BROWN, 1932, pp. 314-315, FIG. 113; METCALFE and CHALK, 1950, p. 456, FIGS. 103A & 103C; HENDERSON, 1953, p. 8), *M. caloneura* (ANONY-

MOUS, 1963, pp. 290-294, PL. 60, FIG. 358) and *M. altissima* Blanco (KRIBS, 1959, p. 9, FIG. 69). This study showed that the present fossil wood bears a close similarity with the wood structure of *Mangifera indica* Linn. (F.R.I. slide No. A544/E6060). The resemblance is in shape, size and distributional pattern of the vessels, in the nature of intervessel pitting, in parenchyma distribution and in the fibre and ray structure. The only observable difference between the present fossil wood and the modern wood of this specimen (F.R.I. slide no. A544/E6060) is in slightly higher xylem rays in some parts of the modern wood. However, in another specimen of *Mangifera indica* (F.R.I. No. A545/6060) although the rays are of similar height but they are less broad, mostly partly biseriate. It is interesting to note that anatomical variations with regard to the distributional pattern of parenchyma and the structure of the xylem rays have been seen in the modern woods of *Mangifera indica*. In one of the specimens (F.R.I. slide No. A540/6060), the paratracheal parenchyma is mostly aliform to aliform-confluent but sometimes vasicentric and the xylem rays are 1-2 (mostly 2) seriate, while in another specimen (F.R.I. slide No. A544/E6060), the parenchyma associated with the vessels is mostly vasicentric to aliform and sometimes aliform-confluent and the xylem rays are 1-3 (mostly 2) seriate.

A large number of fossil woods belonging to the family Anacardiaceae are known from India and abroad, but those supposed to show affinities with *Mangifera* are *Anacardioxylon mangiferoides* Ramanujam (1960) and *Mangiferoxylon scleroticum* Awasthi (1966). From the description and figures of the fossil wood referred to *Anacardioxylon mangiferoides*, it does not appear to show any affinities with the family Anacardiaceae. *Mangifera* and *Anacardium* to which it is said to show relationship do not possess homogenous xylem rays as described in Ramanujam's fossil wood. *Mangiferoxylon scleroticum*, the only other fossil wood of *Mangifera*, differs from the present fossil wood in having larger vessels (t.d. 45-270  $\mu$ , r.d. 45-300  $\mu$ ), thinner (2-6 cells) and less frequent (1-3) bands of apotracheal parenchyma, abundant sclerotic tyloses and only 1-2 (mostly 1) seriate and less frequent (1-2 per mm.) xylem rays.

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 upto Philippines and New Guinea, and in the south to the Sunda and Sulu Archipelago in the Indian Ocean. *Mangifera indica* Linn., with which the present fossil wood resembles, grows throughout India up to 900 m. elevation excepting the north-western part. According to Mukherjee (1953), *Mangifera indica* had its origin in Assam-Burma zone. It occurs wild in the Himalayas, in the hills of Eastern and Western Ghats, Ceylon, forests of Central India, Orissa, Bihar, Bengal and Assam and extends through Chittagong Hill tracts in East-Pakistan to Burma, Thailand, Vietnam and Malaya Peninsula. It is also extensively cultivated throughout the tropics and is now common in many parts of Southern Florida, Brazil, East and West Africa (ANONYMOUS, 1963, pp. 289, 291).

*Mangiferoxylon assamicum* sp. nov.—  
*Diagnosis:* Wood diffuse-porous. Growth rings present, usually delimited by terminal parenchyma. *Vessels* small to medium-sized, usually solitary or in short radial rows of 2-4, oval to round, t.d. 40-128  $\mu$ , radial diameter 48-180  $\mu$ ; vessel-members short to medium, 300-600  $\mu$  in length with truncate or tailed ends; perforations simple; intervessel pit-pairs large, 8-10  $\mu$  in diameter, alternate, bordered, with linear to lenticular apertures; tyloses present. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma mostly vasicentric to aliform, sometimes aliform-confluent; apotracheal parenchyma in bands of 2-10 cells, usually delimiting the growth rings, sometimes arranged quite closely, occasionally short and broken; 2-4 bands per mm. *Xylem rays* 1-3 (mostly 2) seriate; ray tissue heterogeneous; rays mostly heterocellular, rarely homocellular, heterocellular rays consisting of procumbent cells through the median thickened portion and 1-4 (mostly 1) marginal rows of upright cells at one or both the ends, the homocellular rays consisting wholly of upright cells; rays 2-28 cells or 88-760  $\mu$  high, 10-14 per mm. *Fibres* non-libriform, rarely septate.

*Material* — A single specimen of mature secondary xylem measuring 6 cm. in length and 3 cm. in diameter.

*Holotype* — B.S.I.P. Museum No. 33901.

*Locality* — Sultanicherra, near Hailakandi, district Cachar, Assam.

*Horizon* — Tipam Sandstones.

*Age* — Middle Tertiary.

Family — LYTHRACEAE

*Lagerstroemioxylon* Mädlér, 1939

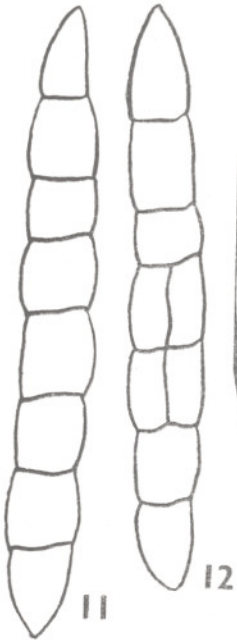
3. *Lagerstroemioxylon eoflosreginum* sp. nov.

*Topography* — Wood ring-porous to semi-ring-porous (PL. 3, FIG. 15). *Growth rings* distinct, marked by terminal bands of parenchyma and large spring wood vessels of the early wood (PL. 3, FIG. 15). *Vessels* small to large, largest in the early wood and grading rather abruptly into smaller vessels in the late wood, solitary as well as in radial multiples of 2-5 (mostly 2), 5-8 per sq. mm.; tyloses present. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma abundant, sometimes vasicentric to aliform, usually aliform-confluent to confluent, forming long and short, often forked bands in the late wood; apotracheal parenchyma diffuse, occurring in group of cells and as terminal bands at the growth rings (PL. 3, FIG. 15, TEXT-FIG. 10); cells often crystalliferous (PL. 3, FIG. 13). *Xylem rays* fine, 1-2 (mostly 1) seriate (PL. 3, FIG. 17; TEXT-FIGS. 11 & 12), 8-24  $\mu$  in width, 2-65 cells or 40-1052  $\mu$  high, 9-15 per mm.; ray tissue homogeneous; rays homocellular, consisting only of procumbent cells (PL. 3, FIG. 13). *Fibres* aligned in distinct radial rows between the two consecutive xylem rays.

*Elements* — *Vessels* thin-walled, the walls about 6-8  $\mu$  thick, tangential diameter 52-200  $\mu$ , radial diameter 56-260  $\mu$ , the solitary vessels round in cross-section, those in radial multiples flattened at the places of contact; vessel-members 152-400  $\mu$  long, with truncate or abruptly tailed ends at one or both the ends; perforations simple; intervessel pit-pairs large, 6-9  $\mu$  in diameter, vested, alternate, border oval or polygonal through crowding (PL. 3, FIG. 14; TEXT-FIG. 13); vessel-parenchyma and vessel-ray pits not observed. *Parenchyma cells* thin-walled 48-140  $\mu$  in length and 14-25  $\mu$  in diameter. *Ray cells* thin-walled, the walls about 2-3  $\mu$  thick; tangential height of procumbent cells 10-30  $\mu$  and radial length 15-70  $\mu$ . *Fibres* non-libriform to semi-libriform, the walls about 3-6  $\mu$  thick, septate, 300-1500  $\mu$  long, 20-30  $\mu$  in diameter, sometimes crystalliferous; inter-fibre pits not preserved.



10



11

12



13

*Lagerstroemioxylon coflosreginum* sp. nov.

TEXT-FIGS 10-13 — 10. Cross-section showing distribution of vessel and parenchyma (*p*).  $\times 35$ . 11. Uniseriate xylem ray with only procumbent cells.  $\times 500$ . 12. Biseriate xylem ray with only procumbent cells.  $\times 500$ . 13. Magnified vestured intervessel pit-pairs.  $\times 500$ .

*Affinities* — The presence of ring to semi-ring porosity, in the present fossil wood, is of great diagnostic value. There are only 109 families amongst dicotyledons in which the wood is ring or semi-ring porous (METCALFE & CHALK, 1950, pp. 1350-1351). Considering this feature together with the vestured inter-vascular pitting of the present fossil wood, the following families only need a detailed consideration.

Apocynaceae  
Asclepiadaceae  
Combretaceae  
Dipterocarpaceae  
Euphorbiaceae  
Leguminosae  
Loganiaceae  
Lythraceae  
Malpighiaceae  
Oleaceae  
Polygonaceae  
Rubiaceae  
Thymelaceae

Of these Apocynaceae, Asclepiadaceae, Dipterocarpaceae, Oleaceae and Thymelaceae can be discarded as these possess vasicentric tracheids (METCALFE & CHALK, 1950, p. 1351).

However, on taking into consideration all other characters of the present fossil, the rest of the families except Combretaceae and Lythraceae can be eliminated.

In the family Combretaceae although some species of *Terminalia* show some similarity with the fossil wood in gross structure, but on careful examination, they can also be separated from it. The woods of *Terminalia* do not show ring-porosity and the fibres are never profusely septate as seen in the present fossil wood.

In the family Lythraceae it is only with the genus *Lagerstroemia* Linn. (PEARSON & BROWN, 1932, pp. 575-596; KRIBS, 1959, p. 104; METCALFE & CHALK, 1950, pp. 652-654) that the present fossil wood shows nearest affinity. A detailed comparison of the present fossil wood has been made with the thin sections of the modern woods of *Lagerstroemia calyculata* Kurz, *L. collettii* Craib, *L. floribunda* Jack, *L. villosa* Wall. ex Kurz, *L. flosreginae* Retz., *L. parviflora* Roxb., *L. lanceolata* Wall., *L. tomentosa* Presl., *L. hypoleuca* Kurz and *L. speciosa* (L.) Pers. and also with the photographs and published description of *Lagerstroemia flosreginae* Retz. (LECOMTE, 1926, PL. 51; CHOWDHURY, 1945, p. 12, PL. 1; PEARSON

TABLE 1

<i>Name of species</i>	<i>Wood</i>	<i>Growth rings</i>	<i>Vessels</i>	<i>Parenchyma</i>	<i>Xylem rays</i>	<i>Fibres</i>	<i>Locality</i>	<i>Age</i>
1. <i>Lagerstroemioxylon durum</i> Mädlér, 1939	Diffuse-porous	Indistinct	Small to medium-sized, t.d. 30-170 $\mu$ , r.d. 19-170 $\mu$ , mostly solitary, sometimes in radial rows of 3-4, circular to elliptically cylindrical, 10-20 per sq. mm.	Paratracheal and metatracheal; paratracheal sometimes winged, metatracheal often intermittent; often crystalliferous	1-2 (rarely 3) seriate, homogeneous, 50-60 cells high	Libriform, thick-walled, crystalliferous, 30 $\mu$ wide, 150-500 $\mu$ long	Frankfurt am Main, Germany	Tertiary (Pliocene)
2. <i>L. parenchymatosum</i> Prakash, 1965	Graded-porous	Distinct, delimited by narrow lines of terminal parenchyma and large spring wood vessels	Large to medium-sized, t.d. 105-270 $\mu$ , r.d. 105-370 $\mu$ , solitary as well as in radial multiples of 2-3 (4), round to oval; 6-11 per sq. mm.; perforations simple; intervessel pit-pairs vestured, 6-8 $\mu$ in diameter; tyloses abundant	Paratracheal and apotracheal; paratracheal parenchyma vasicentric, aliform to aliform-confluent; apotracheal parenchyma diffuse occurring as solitary or in groups of cells and in narrow terminal bands at the growth rings	Mostly uniseriate, occasionally biseriate, 13-18 per mm.; ray tissue homogenous; rays composed of procumbent cells	Semi-libriform, septate, sometimes crystalliferous	Burma	Tertiary
3. <i>L. eoflosreginum</i> sp. nov.	Ring-porous to semi-ring porous	Distinct marked by terminal bands of parenchyma and large spring wood vessels	Large to small, t.d. 52-200 $\mu$ , r.d. 56-260 $\mu$ , solitary as well as in radial multiples of 2-5 (mostly 2), round, 5-8 per sq. mm.; perforations simple; intervessel pit-pairs vestured, 6-9 $\mu$ in diameter; tyloses abundant	Paratracheal and apotracheal; paratracheal sometimes vasicentric to aliform, usually aliform-confluent to confluent, forming long and short often forked bands in the late wood; apotracheal parenchyma diffuse, occurring in groups of cells and in terminal bands at the growth rings	1-2 (mostly 1) seriate, 9-15 per mm.; ray tissue homogenous; rays composed of procumbent cells, 2-65 cells high	Non-libriform to semi-libriform, septate, often crystalliferous, 20-30 $\mu$ in diameter, 3.0-1500 $\mu$ long	Sultanicherra, near Hailakandi, district Cachar, Assam	Tertiary (Miocene)



& BROWN, 1932, pp. 586-588, FIG. 193; METCALFE & CHALK, 1950, pp. 652-654, FIG. 147A & B; DESCH, 1957, pp. 307-308), *L. ovalifolia* Teysm. et Binn. (DESCH, 1957, pp. 307-308; BRAZIER & FRANKLIN, 1961, p. 53), *L. pyriformis* Koehne (KANEHIRA, 1924, p. 36; KRIBS 1959, p. 104, FIG. 233), and *L. speciosa* Pearson (MOLL & JANSONIUS, 1914, p. 585; KANEHIRA, 1924, p. 36; KRIBS, 1959, p. 104, FIG. 234; BRAZIER & FRANKLIN, 1961, p. 53). It is concluded from this study that the present fossil wood resembles in almost all the anatomical features with the modern wood of *Lagerstroemia flosreginae*. In both, the wood is ring-porous to semi-ring-porous, vessels possess simple perforations; intervessel pit-pairs are large, 6-9  $\mu$  in diameter and vested; parenchyma is paratracheal and apotracheal, paratracheal parenchyma abundant, vasicentric to sometimes aliform, aliform-confluent to confluent, forming long and short, often forked bands in the late wood; apotracheal parenchyma diffuse, occurring in group of cells and in terminal bands at the growth rings; xylem rays are 1-2 (mostly 1) seriate, homocellular consisting only of procumbent cells and the fibres are non-libriform to semi-libriform and profusely septate. However, the fossil wood slightly differs from the modern wood in the size of the vessels in the spring wood. Spring wood vessels in the modern wood of *Lagerstroemia flosreginae* are slightly larger than the present fossil wood.

Because of the close resemblance of the present fossil wood with the wood structure of the modern genus *Lagerstroemia*, it is being assigned to the form genus *Lagerstroemioxylon* Mädlér (1939) and named as *Lagerstroemioxylon eoflosreginum* sp. nov.

So far only two species of fossil woods of *Lagerstroemia* are known. These are *Lagerstroemioxylon durum* Mädlér (1939) from the Tertiary of Frankfurt in Germany, and *L. parenchymatosum* Prakash (1965) from the Tertiary of Burma. Both these species differ quite distinctly from the present fossil wood (see TABLE 1).

The genus *Lagerstroemia* Linn. consists of 50 species (WILLIS, 1966, p. 614) confined only in the Old World. The centre of distribution is in south-eastern Asia, but the genus extends from Madagascar through south-eastern Asia and the East Indies to tropical eastern Australia, China and Japan (PEARSON & BROWN, 1932, p. 573). Only

seven species of this genus grow in India. These are *Lagerstroemia indica* Linn., *L. parviflora* Roxb., *L. lanceolata* Wall., *L. flosreginae* Retz.; *L. hypoleuca* Kurz, *L. villosa* Wall. and *L. tomentosa* Presl. *Lagerstroemia flosreginae* Retz., with which the present fossil wood shows near resemblance, grows in Assam Valley, Eastern Bengal, Chittagong, Chota Nagpur, Circars and also scarcely in Western Coast from the south Konkan southwards, throughout Burma and moist low country of Ceylon (GAMBLE, 1902, p. 373).

*Lagerstroemioxylon eoflosreginum* sp. nov. — *Diagnosis*: Wood ring-porous. Growth rings distinct, marked by lines of terminal parenchyma and large spring wood vessels. Vessels small to large, largest in the early wood and grading rather abruptly into smaller vessels in the late wood, round, t.d. 52-200  $\mu$ , r.d. 56-260  $\mu$ , solitary and in short radial rows of 2-4 (mostly 2), 5-8 per sq. mm., tylosed; vessel-members with truncate or abruptly tailed ends; intervessel pit-pairs large, 6-9  $\mu$  in diameter, vested; perforations simple. Parenchyma paratracheal and apotracheal; paratracheal parenchyma abundant, sometimes vasicentric to aliform, usually aliform-confluent to confluent forming long and short, often forked bands in the late wood; apotracheal parenchyma occurring in group of cells and as terminal bands demarcating growth rings; cells sometimes crystalliferous. Xylem rays 1-2 (mostly 1) cells and 8-24  $\mu$  broad, 2-65 cells or 40-1052  $\mu$  in height, 9-15 per mm.; ray tissue homogeneous; rays homocellular, composed of procumbent cells only. Fibres thin to slightly thick-walled, the walls about 3-6  $\mu$  thick, non-libriform to semi-libriform, septate, 300-1500  $\mu$  long, 20-30  $\mu$  in diameter; cells often crystalliferous.

*Material* — A single specimen of mature, secondary xylem measuring 10 cm. in length and 4 cm. in diameter.

*Holotype* — B.S.I.P. Museum No. 33902.

*Locality* — Sultanicherra, near Hailakandi, district Cachar, Assam.

*Horizon* — Tipam Sandstones

*Age* — Middle Tertiary.

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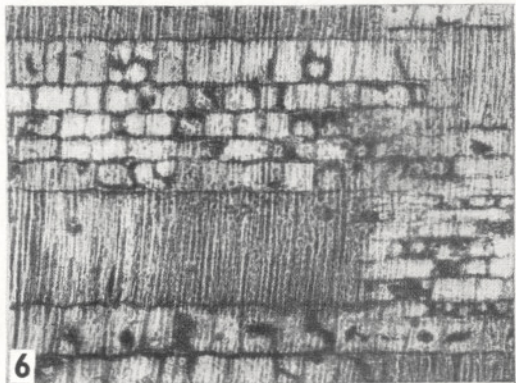
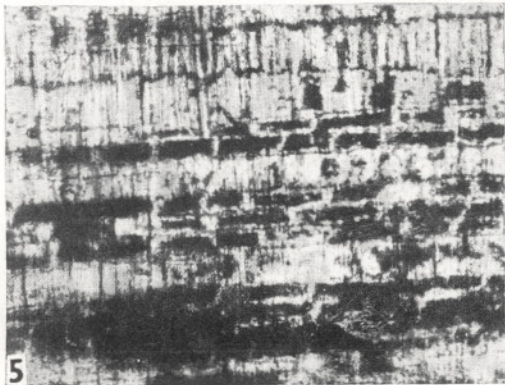
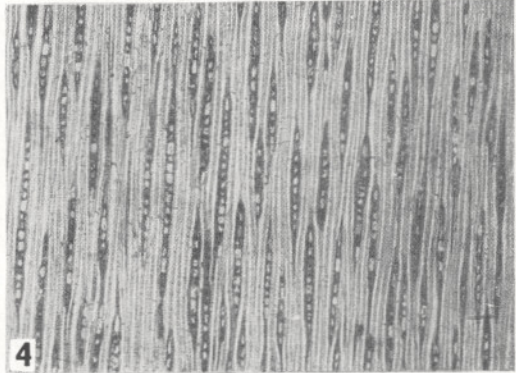
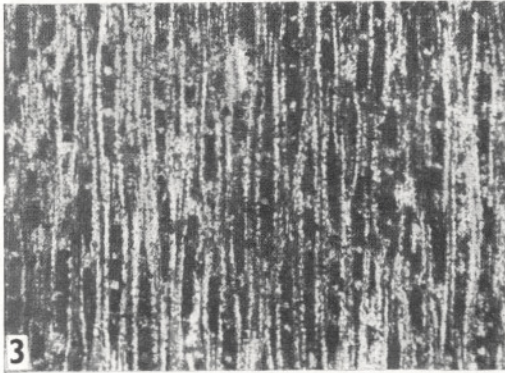
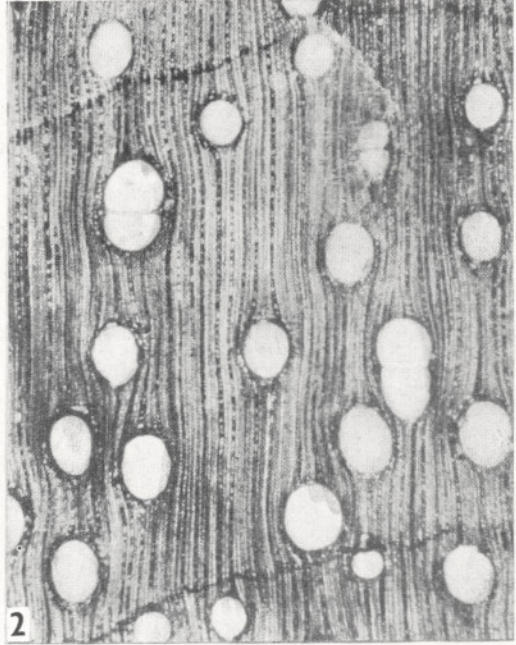
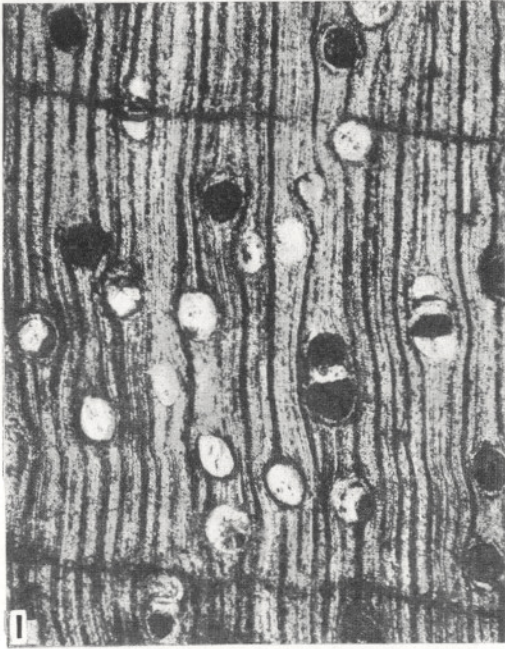
The authors wish to acknowledge their sincere appreciation to Mr. A. N. Datta,

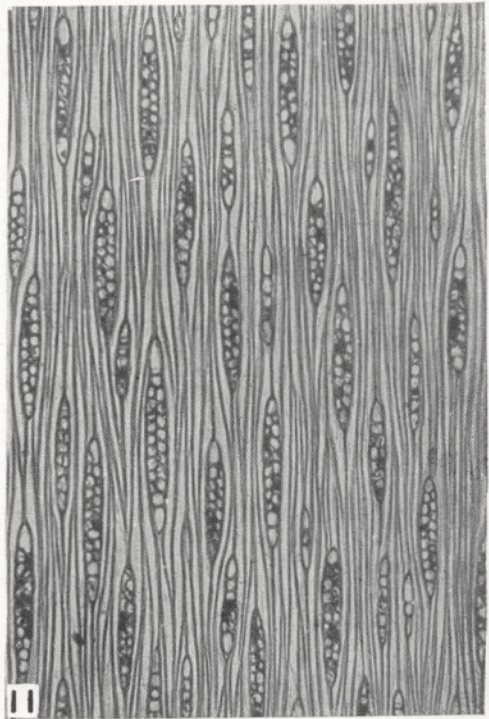
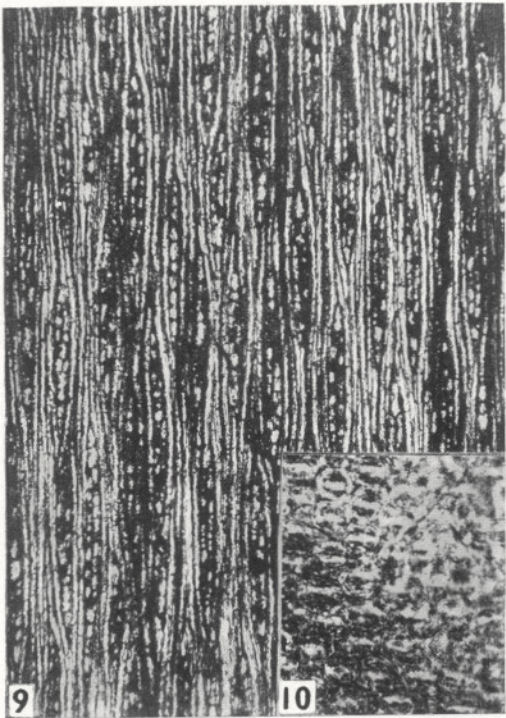
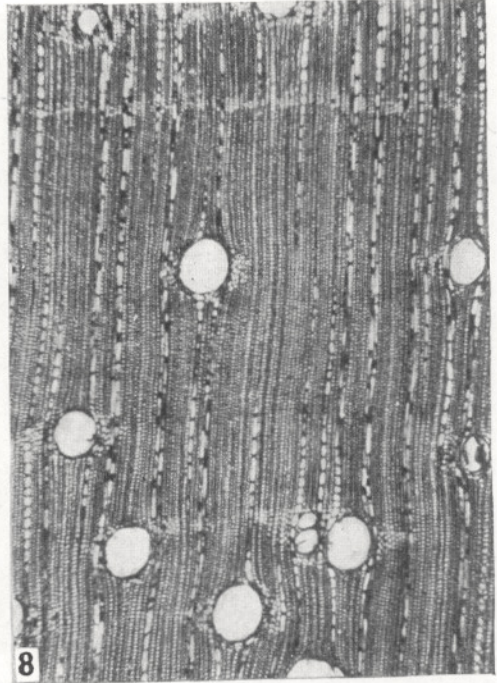
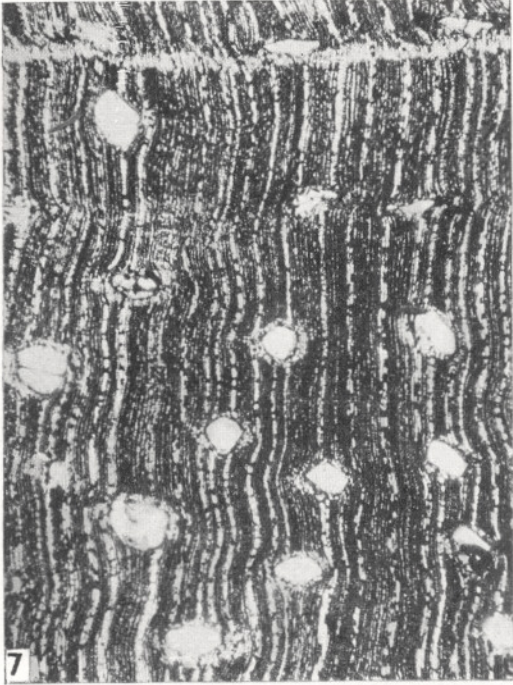
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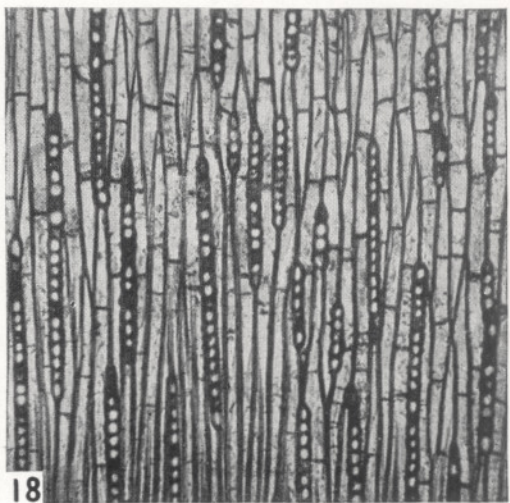
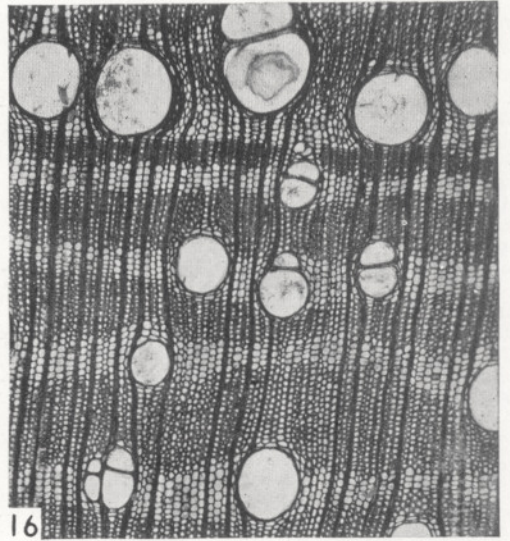
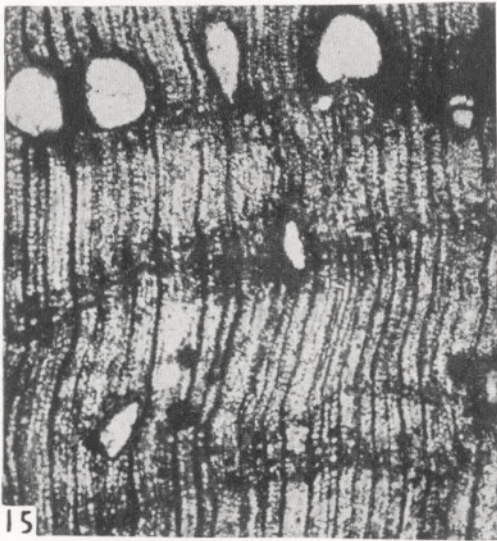
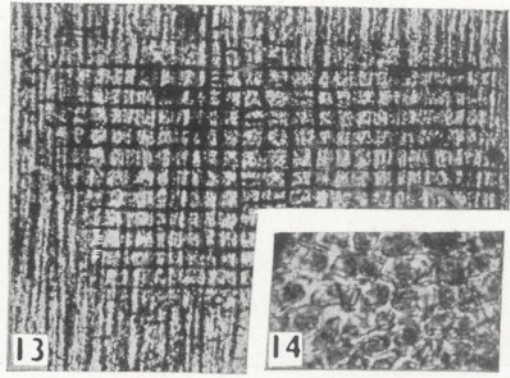
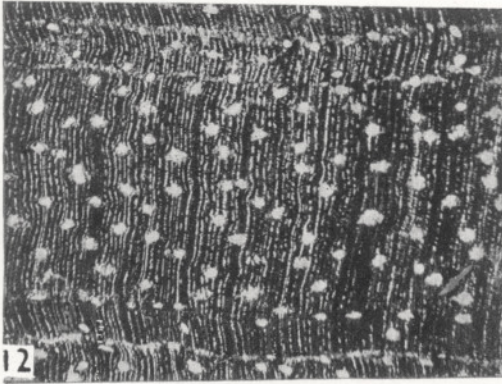
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EXPLANATION OF PLATES

PLATE 1

*Pometioxylon tomentosum* gen. et sp. nov.

1. Cross-section of the fossil wood showing vessel distribution and the parenchyma pattern.  $\times 30$ . Slide no. 3428.
2. Cross-section of *Pometia tomentosa* Teysm. et Binn. showing similar vessel distribution and the parenchyma pattern.  $\times 30$ .
3. Tangential section of the fossil wood showing the type of xylem rays and their distribution.  $\times 90$ . Slide no. 3429.
4. Tangential section of *Pometia tomentosa* Teysm. et Binn. showing similar ray type and their distribution.  $\times 90$ .
5. Radial section of the fossil wood showing the heterocellular xylem rays.  $\times 130$ . Slide no. 3430.

*Mangiferoxylon assamicum* sp. nov.

6. Radial section of the fossil wood showing the heterocellular xylem rays.  $\times 80$ . Slide no. 3431.

PLATE 2

*Mangiferoxylon assamicum* sp. nov.

7. Cross-section of the fossil wood showing vessel and parenchyma distribution.  $\times 30$ . Slide no. 3432.
8. Cross-section of *Mangifera indica* Linn. showing similar vessel and parenchyma distribution.  $\times 30$ .

9. Tangential section of the fossil wood showing the xylem rays and their distribution.  $\times 60$ . Slide no. 3433.

10. Tangential section of the fossil wood magnified to show intervessel pits.  $\times 450$ . Slide no. 3434.

11. Tangential section of *Mangifera indica* Linn. showing the xylem rays similar to the rays shown in Fig. 9.  $\times 60$ .

PLATE 3

*Mangiferoxylon assamicum* sp. nov.

12. Cross-section of the fossil wood in low magnification to show the detailed vessel and parenchyma distribution.  $\times 8$ . Slide no. 3432.

*Lagerstroemioxylon eoflosreginum* sp. nov.

13. Radial section of the fossil wood showing homocellular xylem rays.  $\times 130$ . Slide no. 3435.

14. Tangential section of the fossil wood magnified to show intervessel pit-pairs.  $\times 500$ . Slide no. 3436.

15. Cross-section of the fossil wood showing vessel and parenchyma distribution.  $\times 45$ . Slide no. 3437.

16. Cross-section of *Lagerstroemia flos-reginae* Retz. showing similar vessel and parenchyma distribution as shown in Fig. 15  $\times 45$ .

17. Tangential longitudinal section of the fossil wood showing the type of xylem rays and their distribution.  $\times 90$ . Slide no. 3436.

18. Tangential longitudinal section of *Lagerstroemia flosreginae* Retz. showing similar ray type and their distribution.  $\times 90$ .