

FOSSIL WOODS OF *CAREYA* AND *BARRINGTONIA* FROM THE TERTIARY OF ASSAM

U. PRAKASH & P. P. TRIPATHI*

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

Fossil woods resembling those of *Careya* and *Barringtonia* of the family Lecythidaceae are described here from the Tertiary (Miocene) of Assam. These were collected from the Tipam sandstones near the town of Hailakandi (24°26'N; 92°32'E) in district Cachar. Modern equivalents of these fossils are still found in the forests of Assam.

INTRODUCTION

IN the present paper two new fossil woods are described from the localities of Kuchila and Kartikicherra in the Tipam sandstones near the town of Hailakandi (24° 26' N; 92° 32' E) in district Cachar, Assam. These resemble the extant woods of *Careya* and *Barringtonia* of the family Lecythidaceae. Besides these, the modern genera *Adenanthera*, *Swintonia* (PRAKASH & TRIPATHI, 1969a), *Gluta-Melanorrhoea* (PRAKASH & TRIPATHI, 1969b), *Pometia*, *Mangifera*, *Lagerstroemia* (PRAKASH & TRIPATHI, 1970a), *Diospyros-Maba* and *Anisoptera* (PRAKASH & TRIPATHI, 1970b) are also known from the Tipam sandstones near Hailakandi based on petrified woods.

In general, the preservation of the structural details of fossil woods is fairly satisfactory.

SYSTEMATIC DESCRIPTION

Family — LECYTHIDACEAE

Genus — *Careoxylon* Awasthi, 1970

1. *Careoxylon kuchilense* sp. nov.

Pl. 1, Figs. 1, 3, 5-6; Text-Fig. 1

This species is based on a single piece of fairly well preserved fossil wood measuring 12 cm. in length and 6 cm. in diameter.

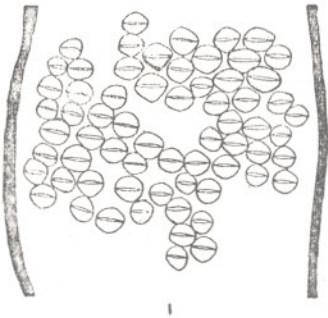
Topography — wood diffuse-porous (PL. 1, FIG. 1). *Growth rings* distinct, de-

limited by thicker walled fibres and smaller vessels. *Vessels* visible to the naked eye as small pin holes, largest at the inner margin of the ring and grading gradually into smaller vessels towards the outer margin, moderately small to very large, mostly in short radial rows of 2-6 (mostly 2-3), sometimes solitary, evenly distributed (PL. 1, FIG. 1), about 6-14 vessels per sq. mm., profusely tylosed, sometimes with black gummy deposits. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma rather scanty, occurring as few cells in association with the vessels (PL. 1, FIGS. 1, 5); apotracheal parenchyma diffuse as solitary cells or aggregated to form short, uniseriate lines (PL. 1, FIGS. 1, 5). *Xylem rays* fine to medium, 1-5 (mostly 2-3) seriate (PL. 1, FIG. 3), and 16-76 μ in width; ray tissue heterogeneous (PL. 1, FIG. 6); uniseriate rays few, 2-17 cells and 68-680 μ in height, homocellular or heterocellular consisting either wholly of upright cells or both upright and procumbent cells; multiseriate rays 2-5 (mostly 2-3) cells wide, 4-29 cells and 120-1000 μ in height, heterocellular composed of procumbent cells through the median thickened portion and 1-10 marginal rows of upright cells; sheath cells occasionally present at the flanks of the multiseriate rays; end to end ray fusion occasional; rays 7-15 per mm. *Fibres* not aligned in radial rows between the two consecutive rays.

Elements — *Vessels* thickwalled, the walls about 6-10 μ thick, t.d. 48-176 μ , r.d. 64-340 μ , oval in cross-section when solitary, sometimes elliptical in shape due to pressure during fossilization, those in radial multiples generally flattened at the places of contact; vessel-members 340-850 μ in length with truncated ends; perforations simple; intervessel pit-pairs large, 6-9 μ in diameter, alternate, bordered, border oval with linear, horizontal aper-

*Now Lecturer in Botany, M.L.K. Degree College, Balrampur, Gonda, U.P.

tures (TEXT-FIG. 1); vessel-parenchyma and vessel-ray pits not preserved. *Parenchyma cells* thin-walled, 20-36 μ in diameter and 120-360 μ in length. *Ray cells* thin-walled, the walls about 2-3 μ thick; procumbent cells 18-22 μ in tangential height, 40-90 μ in radial length; upright cells 42-56 μ in tangential height and 28-36 μ in radial length; cells occasionally crystalliferous. *Fibres* oval to angular in cross-section, libriform to semi-libriform, thick walled, the common walls 5-9 μ thick, non-septate, 20-30 μ in diameter and 1340-2200 μ in length; inter-fibre pits not preserved.



Careyoxylon kuchilense sp. nov.

TEXT-FIG. 1 — Intervessel pit-pairs. \times 330. (Slide No. 4086.)

Affinities — *Comparison with the modern woods*: The important anatomical features of the present fossil wood are vessels small to very large, mostly in short radial rows of 2-6 (mostly 2-3), sometimes solitary, oval, heavily tylosed with simple perforations; parenchyma paratracheal and apotracheal, paratracheal parenchyma rather scanty, occurring as few cells in association with the vessels, apotracheal parenchyma diffuse as solitary cells or aggregated to form short, uniseriate lines; xylem rays 1-5 (mostly 2-3) seriate, with heterogeneous ray tissue and fibres non-septate and thickwalled. Taking into consideration all these features, the present fossil wood indicates resemblance with the modern woods of the families Rubiaceae, Apocynaceae and Lecythidaceae (PEARSON & BROWN, 1932; DIEHL, 1935; METCALFE & CHALK, 1950).

In the family Rubiaceae, the genera *Sarcocephalus*, *Anthocephalus* and *Hymenodictyon* show some resemblance with the present fossil wood in the arrangement and the shape of the vessels, in the distributional pattern of the parenchyma, and in the structure of the xylem rays and the fibres. However, they differ markedly from the present fossil wood in having vestured intervessel pit-pairs.

In the family Apocynaceae, the genera *Wrightia* and *Holarrhena* show some resemblance with the present fossil wood in possessing similar parenchyma and in the structure of the xylem rays. But these also differ from the present fossil wood in having smaller, non-tylosed vessels with vestured, intervessel pit-pairs.

In the family Lecythidaceae, which shows closest affinity with the present fossil wood, the genera *Barringtonia*, *Planchonia* and *Careya* exhibit close resemblance (DIEHL, 1935, pp. 1-5; METCALFE & CHALK, 1950, pp. 632-635). The Modern wood of *Barringtonia* resembles the fossil in having similar parenchyma distribution and the fibre structure but differs in the arrangement and shape of the vessels, and in having comparatively longer and broader xylem rays than in the present fossil wood. The wood of the genus *Planchonia* also resembles the present fossil wood in the distribution of vessels and in the parenchyma pattern. However, it differs from the fossil wood in having uniseriate xylem rays more frequent than in the present fossil wood. Besides this, septate fibres have been reported in *Planchonia andamanica* (DIEHL, 1935, p. 11), whereas the present fossil shows non-septate fibres. Now, it is with the genus *Careya* only that the fossil wood resembles most in all the anatomical features. For finding out the nearest comparable species in this genus, thin sections of *Careya arborea* Roxb. and *C. sphaerica* Roxb. available at the Forest Research Institute, Dehra Dun, were studied in great detail. Besides, the photographs and published description of *Careya arborea* (PEARSON & BROWN, 1932, pp. 566-568, FIG. 188), *Careya* spp. (DIEHL, 1935, pp. 3-13; METCALFE & CHALK, 1950, pp. 632-635) and *C. sphaerica* Roxb. (LECOMTE, 1926, PL. 15) were also studied.

From this detailed study, it is seen that the fossil wood resembles most with the

wood of the modern species *Careya arborea* Roxb. (Forest Research Institute, slide no. A4554/0. 6271). The resemblance is in the shape and the distributional pattern of the vessels, in the intervessel pit-pairs, in the perforation plates, in the nature and distribution of the xylem rays and parenchyma and in the fibres. However, the vessels are slightly bigger in the fossil wood than in the modern wood of *Careya arborea*.

As the present fossil wood resembles the wood structure of the modern species *Careya arborea* Roxb., it is placed in the form genus *Careoxylon* Awasthi (1970).

Comparison with the fossil woods — The fossil wood *Careoxylon pondicherriense* Awasthi (1970) from the Cuddalore series in South India is the only fossil wood of *Careya* so far known. However, it differs from the present fossil wood in having indistinct growth rings, smaller vessels (t.d. 60-250 μ , r.d. 60-280 μ) and in somewhat narrower xylem rays which are 1-4 seriate in width and upto 40 cells in height with frequent end to end ray fusion. In the present fossil wood, the growth rings are distinct, delimited by thicker walled fibres and smaller vessels, the vessels are moderately small to very large (t.d. 48-176 μ , r.d. 64-340 μ), and the xylem rays are 1-5 (mostly 2-3) seriate and upto 29 cells in height with occasional end to end ray fusion.

As this fossil wood differs distinctly from *Careoxylon pondicherriense* Awasthi (1970), it is described as a new species, *Careoxylon kuchilense*, the specific name indicating its occurrence at Kuchila near the town of Hailakandi, district Cachar, Assam.

The genus *Careya* Roxb. consists of four species (WILLIS, 1966, p. 198) extending from India eastward through Siam and Indo-China to New Guinea and New Britain. The species *Careya arborea* Roxb. with which the present fossil wood shows closest affinity, often grows in moist localities, in ravines and valleys, and sometimes scattered in grass lands. It extends from the Kangra district eastwards, through Uttar Pradesh and Bengal, to Assam, throughout the Madhya Pradesh, Chhota Nagpur, Bombay, Madras, and the plains and lower hill forests of Burma (PEARSON & BROWN, 1932, p. 566).

DIAGNOSIS

Careoxylon kuchilense sp. nov.

Wood diffuse-porous. Growth rings distinct, delimited by thicker walled fibres and smaller vessels. Vessels moderately small to very large, t.d. 48-176 μ , r.d. 64-340 μ , mostly in short radial rows of 2-6 (mostly 2-3), sometimes solitary, 6-14 per sq. mm.; perforations simple; intervessel pit-pairs large, 6-9 μ in diameter, alternate, bordered, border oval with linear, horizontal apertures; tyloses present. Parenchyma paratracheal and apotracheal; paratracheal parenchyma scanty, occurring as few cells associated with the vessels; apotracheal parenchyma diffuse occurring as solitary cells or in uniseriate lines. Xylem rays fine to medium, 1-5 (mostly 1-3) seriate; ray tissue heterogeneous; rays homocellular to heterocellular; uniseriate rays, homocellular or heterocellular, consisting either of upright cells only or both upright and procumbent cells; multi-seriate rays 2-5 (mostly 2-3) cells broad, heterocellular, consisting of procumbent cells in the median thickened portion and upright cells at one or both the ends, sometimes also at the flanks of the rays; ray cells sometimes crystalliferous. Fibres semi-libriform to libriform, the walls 5-9 μ thick, oval to angular in cross-section, non-septate, 20-30 μ in diameter, 1340-2200 μ in length; interfibre pits not preserved.

Holotype — B.S.I.P. Museum No. 33923.

Locality — Kuchila, near the town of Hailakandi, district Cachar, Assam.

Genus — *Barringtonioxylon* Shallom, 1960

2. *Barringtonioxylon assamicum* sp. nov.

Pl. 2, Figs. 7, 9, 11, 12

The fossil wood is represented by a single piece of petrified, secondary wood measuring 5 cm. in length and 3 cm. in diameter.

Topography — Wood diffuse-porous (Pl. 2, FIG. 7). Growth rings indistinct. Vessels visible to the naked eye, moderately small to moderately large, mostly in radial rows of 2-7 (mostly 2-3), sometimes solitary (Pl. 2, FIG. 7), 12-16 per sq. mm.; tyloses present, gummy deposits also seen. Parenchyma paratracheal and apo-

tracheal; paratracheal parenchyma scanty, occurring as 1-2 cells adjacent to some of the vessels (PL. 2, FIG. 7); apotracheal parenchyma diffuse occurring as 1-2-(3) cells scattered in the ground mass of the fibrous tissue, sometimes also forming short, uniseriate lines (PL. 2, FIG. 7). Xylem rays fine to broad, 1-7 (mostly 4-5) cells (PL. 2, FIG. 9) and 16-120 μ in width, 6-9 per mm; ray tissue heterogeneous (PL. 2, FIG. 12); uniseriate rays, fine, 16-28 μ wide, 2-14 cells and 200-540 μ high, homocellular, consisting wholly of upright cells; multiseriate rays 2-7 (mostly 4-5) cells and 32-120 μ wide, 5-90 cells and 160-2000 μ high, heterocellular, consisting of procumbent cells through the median thickened portion and upright cells in 1-7 marginal rows at one or both the ends; sheath cells present at the flanks. *Fibres* not aligned in distinct radial rows.

Elements — *Vessels* thickwalled, the wall about 8-12 μ thick, t.d. 80-144 μ , r.d. 132-220 μ , oval when solitary, those in radial multiples generally flattened at the places of contact; vessel-members short to medium, 200-525 μ in length, with truncated or tapered ends; perforations simple; intervessel pit-pairs large, 8-12 μ in diameter, bordered, alternate, oval with linear-lenticular, horizontal apertures (PL. 2, FIG. 11); vessel-parenchyma and vessel-ray pits not preserved. *Parenchyma cells* thin walled, 16-32 μ in tangential diameter, 20-44 μ in radial diameter as seen in cross-section. *Ray cells* thin walled; procumbent cells 25-50 μ in tangential height, 70-120 μ in radial length; upright cells 60-90 μ in tangential height and 35-50 μ in radial length. *Fibres* semi-libriform to non-libriform, the walls 4-9 μ thick, polygonal in cross-section, non-septate, 15-25 μ in diameter, 1200-2400 μ in length; interfibre pits not preserved.

Affinities — *Comparison with the modern woods*: In the fossil wood under investigation the vessels are moderately small to moderately large (t.d. 80-144 μ), the perforations are simple, the intervessel pit-pairs are large, bordered, alternate, with linear-lenticular apertures, the parenchyma is both scanty paratracheal and diffuse occurring as 1-2-(3) cells scattered in the ground mass of the fibrous tissue, sometimes also forming uniseriate lines, the xylem rays are 1-7 (mostly 4-5) seriate, heterocellular and the fibres are non-

septate and semi-libriform to non-libriform. Taking these features collectively, the present fossil wood can be compared with the *Aporosa* type of woods of the Phyllanthoideae in the family Euphorbiaceae and the woods of the family Lecythidaceae (PEARSON & BROWN, 1932, pp. 869-893; METCALFE & CHALK, 1950, pp. 1219-1221 & 632-635; DESH, 1957, pp. 160-194 & 251-252). However, the *Aporosa* type of woods differ from the present fossil wood in having small to minute intervessel pit-pairs, in mostly scalariform or both simple as well as scalariform perforation plates and in having the parenchyma commonly with chambered crystals (METCALFE & CHALK, 1950, p. 1219).

In the family Lecythidaceae, the present fossil wood shows near resemblance with the modern woods of *Barringtonia* Forst. Thin-sections of 8 species of *Barringtonia* Forst. were studied at the Forest Research Institute, Dehra Dun, in order to find out the nearest modern equivalent of the present fossil wood within this genus. The species examined are *Barringtonia angusta* Kurz, *B. acutangula* (Linn.) Gaertn., *B. cymosa* C.F.C. Fischer, *B. macrostachya* Kurz, *B. asiatica* Kurz, *B. racemosa* Blume and *B. pterocarpa* Kurz. Besides these, the present fossil wood has also been compared with the figures and published description of *Barringtonia scortechinii* King, *B. asiatica* Kurz, *B. macrostachya* Kurz (DESH, 1957, pp. 251-252, PL. 60, FIG. 1), *B. acutangula* (Linn.) Gaertn. (PEARSON & BROWN, 1932, pp. 563-565, FIG. 187; METCALFE & CHALK, 1950, pp. 633-635, FIGS. 142A & B; Kribs, 1959, p. 57, FIG. 153), *B. speciosa* Linn., *B. spicata* Blume, *B. insignis* Miq. and *B. gigantostachya* Koord. et Valet. (MOLL and JANSONIUS, 1914, pp. 489-502, FIGS. 196-197; KANEHIRA, 1921, p. 111, PL. 22, FIGS. 128-129). From this study it is evident that the affinity of the present fossil wood within this genus is with *Barringtonia acutangula* (Linn.) Gaertn. (F.R.I. slide no. 6030/7020). The fossil wood resembles the modern wood of *Barringtonia acutangula* in the size and distributional pattern of the vessels, in the intervessel pit-pairs, in the type of perforation plates and in the distribution and structure of the xylem rays and the fibres. However, the present fossil wood differs somewhat from the modern wood of *Barringtonia acutangula*

in the parenchyma pattern. In the modern wood of *Barringtonia acutangula* (F.R.I. slide no. 6030/7020) the parenchyma is scanty paratracheal and diffuse to diffuse-in-aggregates forming numerous, short, irregular lines especially in the late wood, whereas in the present fossil wood the paratracheal parenchyma is also scanty, but the apotracheal parenchyma normally occurs as 1-2 scattered cells in the ground mass of the fibrous tissue, sometimes forming short, uniseriate lines in between the two consecutive xylem rays.

It is interesting to note that there is slight variation in the wood structure of *Barringtonia acutangula* as regards the frequency of vessel multiples (F.R.I. slide nos. 6125/7010, 6024/5050 and B.S.I.P. slide no. 664). In some specimens studied at the F.R.I. Dehra Dun, the vessels are mostly solitary, whereas in others (F.R.I. slide no. 6030/7020), the vessels are mostly in radial multiples.

As the present fossil wood shows the wood structure of the family Lecythidaceae indicating resemblance with the genus *Barringtonia*, it is proposed to place it under the form genus *Barringtonioxylon* Shallom (1960).

Comparison with the fossil woods — Only three species of fossil woods belonging to the genus *Barringtonia* are known so far from India and abroad. These are *Barringtonioxylon deccanense* Shallom (1960) and *B. eopterocarpum* Prakash & Dayal (1965) both from the Deccan Inter-trappean series and *B. acrotense* Awasthi (1970) from the Cuddalore series of South India.

The present fossil wood differs quite markedly from all the species of fossil woods mentioned above. Thus *Barringtonioxylon deccanense* differs from the present fossil wood in having slightly smaller vessels (t.d. 78-100 μ ; r.d. 100-150 μ) which are mostly solitary or in radial rows of 2-4, in shorter (1-46 cells high), 2-6 seriate, xylem rays and in possessing vertical intercellular canals of the traumatic type. Similarly, *B. eopterocarpum* differs also in possessing slightly smaller vessels (t.d. 60-165 μ ; r.d. 75-150 μ) and in apotracheal parenchyma which occurs mostly as uniseriate, irregular, tangential lines. Lastly, *B. acrotense* is also distinct from *B. assamicum* in having slightly larger vessels (t.d. 40-270 μ ; r.d. 40-300 μ), in paratracheal parenchyma

which is usually aliform to confluent and in slightly broader, 1-8 seriate xylem rays.

As the present fossil wood is quite distinct from all the species of *Barringtonioxylon* so far described, it is assigned to a new species *Barringtonioxylon assamicum*, the specific name indicating its occurrence in Assam.

The genus *Barringtonia* Forst., with which the present fossil wood shows resemblance, consists of about 100 species (WILLIS, 1966, p. 120) confined to the Old World. The species are mostly littoral and are scattered from tropical Africa through the Indo-Malayan region to Formosa, and eastward to northern Australia and Polynesia. About 10 species are represented in the modern flora of India. *Barringtonia acutangula* (Linn) Gaertn., with which the present fossil wood shows near resemblance is moderate-sized tree in Bengal, Assam, Burma and on the West Coast, and a small tree in the Central Provinces, Khandesh, Deccan, Carnatic, and in parts of Bihar and Orissa and Chhota Nagpur. It is indigenous from the Ganges along the sub-Himalayan tract eastwards through Oudh, Bengal to Assam; in Bihar and Orissa, Chhota Nagpur, Central Provinces, on the East and West Coasts and more scattered in Deccan and Carnatic. It is generally found along streams and in damp places (PEARSON & BROWN, 1932, pp. 563, 564).

DIAGNOSIS

Barringtonioxylon assamicum sp. nov.

Wood diffuse-porous. *Growth rings* indistinct. *Vessels* moderately small to moderately large, t.d. 80-144 μ , r.d. 132-220 μ , usually in radial rows of 2-7 (mostly 2-3), sometimes solitary, 12-16 vessels per sq. mm.; perforations simple; intervessel pit-pairs, large, 8-12 μ in diameter, bordered, alternate, oval with linear-lenticular, horizontal apertures; tyloses present. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty, occurring as few cells adjacent to some of the vessels; apotracheal parenchyma diffuse as solitary cells, sometimes also forming short, uniseriate lines. *Xylem rays* fine to broad, 1-7 (mostly 4-5) seriate, 6-9 per mm.; uniseriate rays, fine, 16-28 μ in width, 2-14 cells high, homocellular con-

sisting wholly of upright cells; multiseriate rays, 2-7 (mostly 4-5) seriate, 5-90 cells and 160-2000 μ in height, heterocellular, consisting of procumbent cells through the median thickened portion and 1-7 marginal rows of upright cells at one or both the ends; sometimes sheath cells also present; ray cells occasionally crystalliferous.

Fibres thin to thick-walled, the walls 4-9 μ thick, non-septate, polygonal in cross-section, 15-25 μ in diameter, 1200-2400 μ in length; interfibre pits not preserved. *Holotype* — B.S.I.P. Museum No. 33929.

Locality — Kartikcherra, near the town of Hailakandi, district Cachar, Assam.

REFERENCES

- AWASTHI, N. (1970). On the occurrence of two new fossil woods belonging to the family Lecythidaceae in the Tertiary rocks of South India. *Palaeobotanist*, **18**(1): 67-74, 1969.
- DESCH, H. E. (1957). Manual of Malayan Timbers **1**. *Malay. For. Rec.* **15**: 1-328.
- DIEHL, G. A. (1935). A study of the Lecythidaceae. *Trop. Woods*. **43**: 1-15.
- KANEHIRA, R. (1921). Anatomical characters and identification of Formosan Woods. *Taihoku*.
- KRIBS, D. A. (1959). Commercial foreign woods on the American market. *Pennsylvania*.
- LECOMTE, H. (1926). Les bois de L'Indochine. *Paris*.
- METCALFE, C. R. & CHALK, L. (1950). Anatomy of the dicotyledons. **1 & 2**. *Oxford*.
- MOLL, J. W. & JANSSONIUS, H. H. (1914). Mikrographie des holzes der auf Java vorkommenden Baumarten. **3**. *Leiden*.
- PEARSON, R. S. & BROWN, H. P. (1932). Commercial Timbers of India. **1 & 2**. *Calcutta*.
- PRAKASH, U. & DAYAL, R. (1965). *Barringtonioxylon eoptero carpum* sp. nov., a fossil wood of Lecythidaceae from the Deccan Intertrappean beds of Mahurzari. *Palaeobotanist*, **13**(1): 25-29, 1964.
- PRAKASH, U. & TRIPATHI, P. P. (1969a). Fossil woods of Leguminosae and Anacardiaceae from the Tertiary of Assam. *Ibid*, **17**(1): 22-32, 1968.
- Idem (1969b). On *Glutoxylon burmense* from Hailakandi in Assam with critical remarks on the fossil woods of *Glutoxylon Chowdhury*. *Ibid* **17**(1): 59-64, 1968.
- Idem (1970a). Fossil woods from the Tertiary of Hailakandi, Assam. *Ibid*. **18**(1): 20-31, 1969.
- Idem (1970b). Fossil woods from the Tipam Sandstones near Hailakandi, Assam. *Ibid*. **18**(2): 183-191, 1969.
- SHALLOM, L. J. (1960). Fossil dicotyledonous wood of Lecythidaceae from the Deccan Intertrappean beds of Mahurzari. *J. Indian bot. Soc.* **39**(2): 198-203.
- WILLIS, J. C. (1966). A dictionary of the flowering plants and ferns. *Cambridge*.

EXPLANATION OF PLATES

PLATE 1

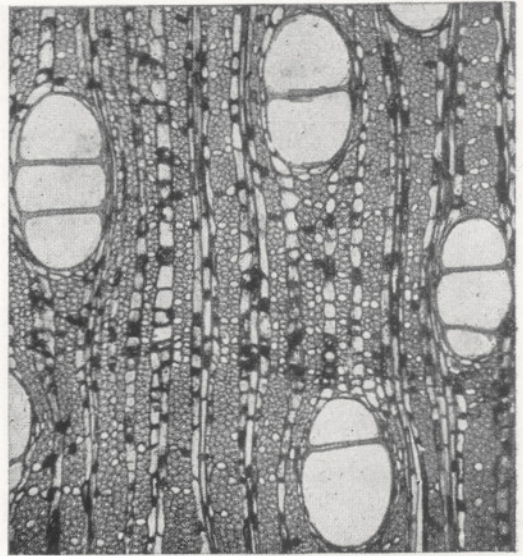
- Careyoxylon kuchilense* sp. nov.— Cross-section showing shape, size and distribution of vessels and the parenchyma pattern. $\times 60$. Slide No. 4085.
- Careya arborea* — Cross-section showing similar shape, size and distribution and the parenchyma pattern. $\times 60$.
- Careyoxylon kuchilense* sp. nov.— Tangential longitudinal section showing xylem rays. $\times 60$. Slide No. 4086.
- Careya arborea* — Tangential longitudinal section showing similar xylem rays. $\times 60$.
- Careyoxylon kuchilense* sp. nov.— Magnified cross-section showing the type and distribution of parenchyma. $\times 90$. Slide No. 4087.
- Careyoxylon kuchilense* sp. nov.— Radial longitudinal section showing heterocellular xylem rays. $\times 120$. Slide No. 4088.

PLATE 2

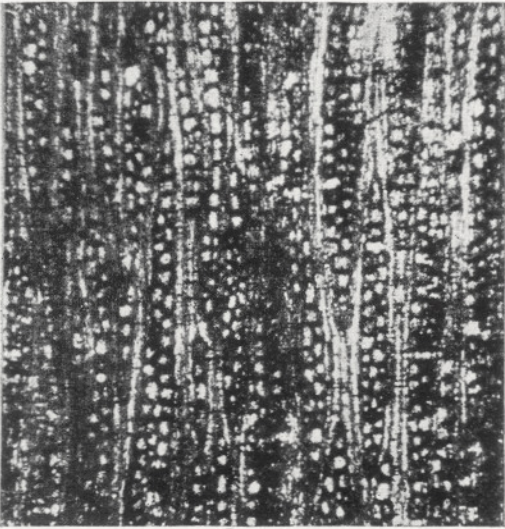
- Barringtonioxylon assamicum* sp. nov.— Cross-section showing shape, size and distribution of vessels and the parenchyma pattern. $\times 60$. Slide No. 4089.
- Barringtonia acutangula* — Cross-section showing similar shape, size and distribution of vessels and the parenchyma pattern. $\times 60$.
- Barringtonioxylon assamicum* sp. nov.— Tangential longitudinal section showing the xylem rays. $\times 60$. Slide No. 4090.
- Barringtonia acutangula* — Tangential longitudinal section showing similar xylem rays. $\times 60$.
- Barringtonioxylon assamicum* sp. nov.— Magnified inter-vessel pit-pairs. $\times 500$. Slide No. 4091.
- Barringtonioxylon assamicum* sp. nov.— Radial longitudinal section showing heterocellular xylem rays. $\times 130$. Slide No. 4092.



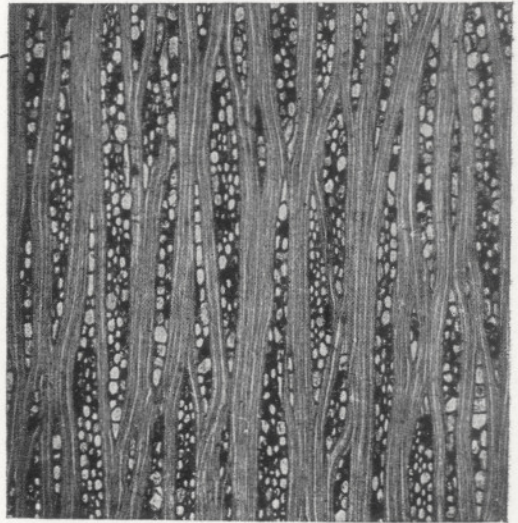
1



2



3



4



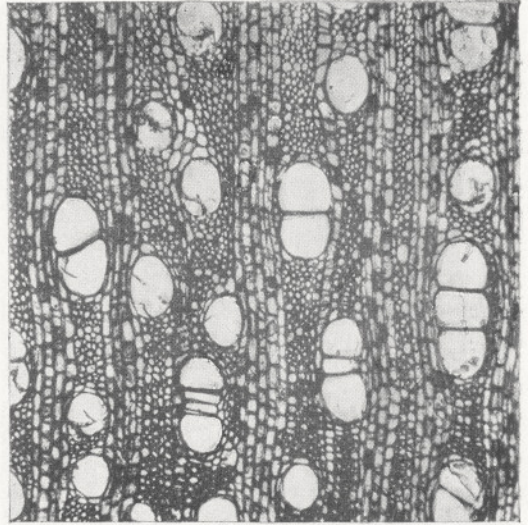
5



6



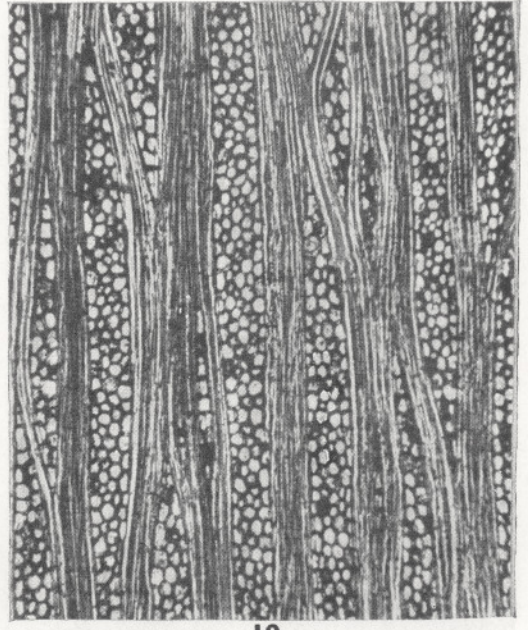
7



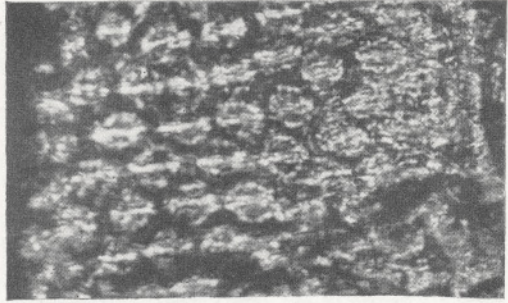
8



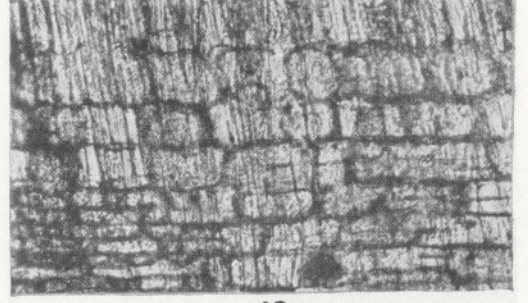
9



10



11



12