A FOSSIL WOOD OF EBENACEAE FROM THE TERTIARY OF SOUTH INDIA

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ABSTRACT

A new fossil dicotyledonous wood has been described from the Tertiary rocks of South India near Pondicherry, South Arcot district, Tamil Nadu (Madras). In all the anatomical details it shows closest resemblance with those of modern *Diospyros* and *Maba* of the family Ebenaceae.

INTRODUCTION

THE present paper deals with the anatomical description and affinities of a fossil wood collected from Murattandichavadi near Pondicherry, South Arcot district, Tamil Nadu (Madras). After a detailed comparative study with the modern woods it has been found very close to those of *Diospyros* and *Maba* of the family Ebenaceae. This is another addition of a new species of fossil woods to the already known flora of the Cuddalore Series of South India. Prior to this, ebenaceous woody structure has been reported by Navale (1968) from the Neyveli lignite, South Arcot district, Tamil Nadu (Madras).

DESCRIPTION

Family — EBENACEAE

Genus — *Ebenoxylon* Felix, 1882

Ebenoxylon arcotense sp. nov.

Pl. 1, Figs. 1-5; Text-figs. 1-2

The present species is based on a small piece of a secondary wood measuring about 5×4 cm. in length and diameter. The preservation is fairly good.

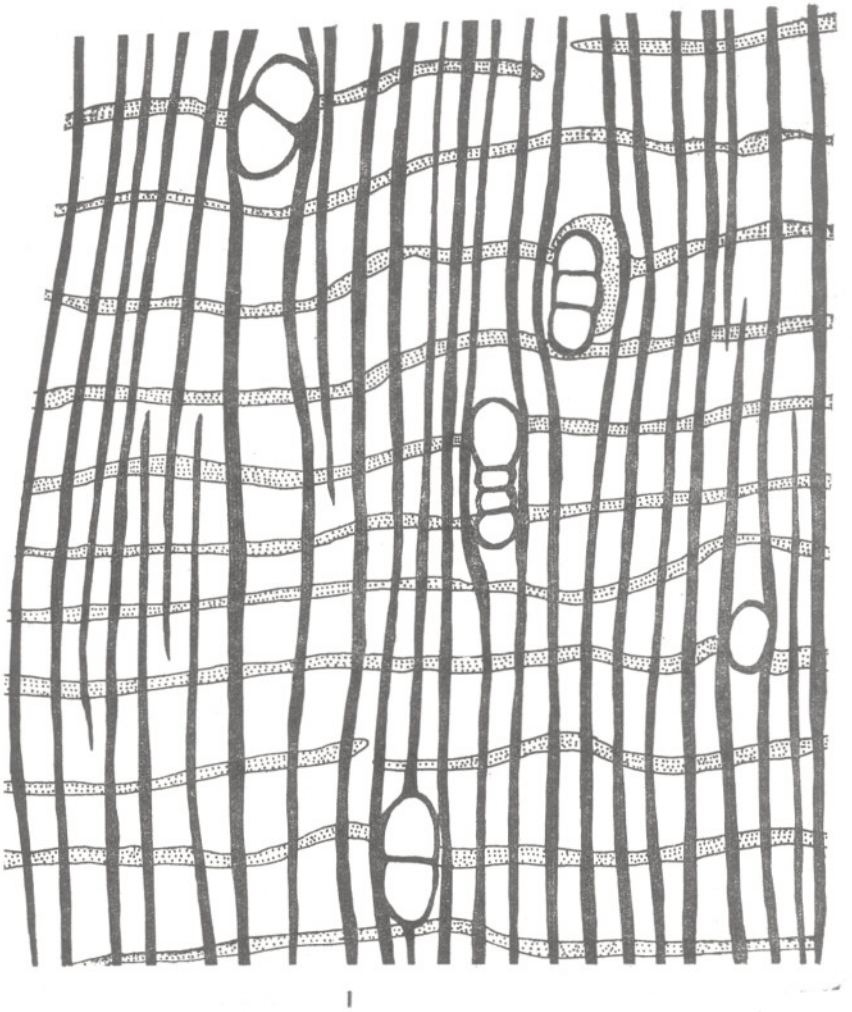
Topography — Wood diffuse-porous. *Growth rings* not seen. *Vessels* visible with the hand lens as small dark pin holes, small to medium (mostly small), solitary as well as in radial multiples of 2-3 (PL. 1, FIGS. 1-2; TEXT-FIG, 1), rarely in partial double rows, evenly distributed, about 3-6 vessels per sq. mm.; perforations simple; tyloses not seen; vessels plugged with dark gummy deposits. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma very sparse, occasionally only a few cells associated with the tangential wall of the vessels (TEXT-FIG. 1); apotracheal parenchyma represented by uniseriate concentric, tangential lines, mostly regular, wavy, somewhat undulating the vessels (PL. 1, FIGS. 1-2; TEXT-FIG. 1), about 5-7 lines per mm., each separated by 5-14 radial rows of fibres. *Xylem rays* fine, uniseriate (PL. 1, FIG. 3), occasionally biseriate due to pairing of procumbent cells through the median portion; ray tissue heterogeneous; rays heterocellular, consisting of procumbent cells through the median portion and 1-2 marginal rows of upright cells at one or both the ends (PL. 1, FIGS. 3-4; TEXT-FIG. 2), about 4-40 cells in height, 13-18 rays per mm., each separated by 1-6 tangential rows of fibres. *Fibres* aligned in radial rows between the two consecutive xylem rays.

Elements — Vessels circular to oval, t.d. 32-160 μ, r.d. 32-176 μ, thick-walled, walls about 8-12 μ, vessel-members 90-630 μ in length, truncate (PL. 1, FIG. 3) or tapered; intervessel pits small, 3-4 μ in diameter, oval or polygonal through crowding (PL. 1, FIG. 5), apertures small; circular or lenticular; vessel-ray and vessel-parenchyma pits not seen. *Parenchyma* cells circular to oval, those associated with the vessels peripherally flattened, 40-60 μ in diameter, while those of apotracheal lines mostly circular or tangentially elongated, 20-40 μ in diameter; infiltration dark; crystalliferous cells not seen. *Ray cells* upright and procumbent, upright cells 40-60 μ in tangential height, 32-40 μ in radial length; procumbent cells 24-32 μ in tangential height, 32-100 μ in radial length, infiltration dark. *Fibres* angular, 12-24 μ in diameter, semi-libriform to libriform, nonseptate, thick-walled, 4-6 μ in thickness.

AFFINITIES

Comparison with the Modern Woods

The most important anatomical feature of the present fossil wood is the predomi-



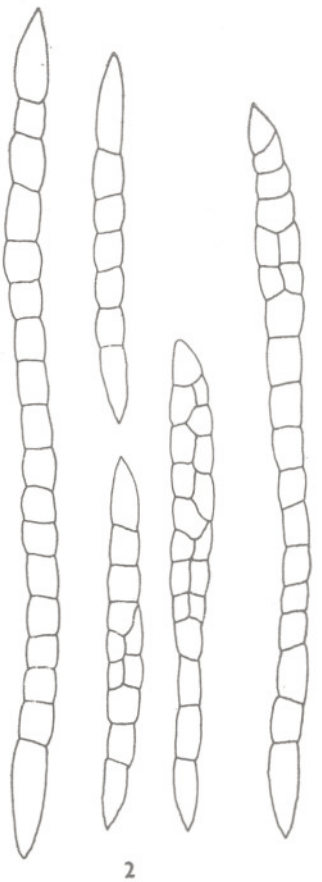
TEXT-FIG. 1 — Cross-section showing nature and distribution of vessels and parenchyma. × 70. (B.S.I.P. Museum, Slide No. 3896).

nantly apotracheal parenchyma occurring as uniseriate, concentric, tangential lines at regular intervals. This type of parenchyma is found in some genera of Annonaceae, Polygalaceae, Theaceae, Malvaceae, Bambacaceae, Sterculiaceae, Tiliaceae, Humiriaceae, Rosaceae, Rubiaceae, Sapotaceae, Ebenaceae, Apocynaceae, Boraginaceae, Euphorbiaceae and Fagaceae.

Besides the presence of uniseriate lines of parenchyma, the other important features of the present fossil wood are small to medium-sized vessels with small pits, predominantly uniseriate hetero-cellular xylem rays, and semi-libriform to libriform and non-septate fibres. A combination of all these features are found in the woods of *Maba* and *Diospyros* of the family Ebenaceae.

In gross features the present fossil wood also shows resemblance with some genera of Apocynaceae and Sapotaceae. However, there are some important characters by which it can be distinguished from them.

In most genera of Apocynaceae the fibres are septate and the xylem rays are 1-6 (usually 2-3) seriate, composed wholly of upright cell; while the multiseriate rays are with 4-10 marginal rows of upright cells. Whereas in the present fossil wood the xylem rays are almost uniseriate with



TEXT-FIG. 2 — 1-2 seriate xylem rays. × 150. (B.S.I.P. Museum, Slide No. 3897).

exception being biseriate due to pairing of procumbent cells through the central portion, they are composed of 1-2 marginal rows of upright cells at one or both the ends and the rest of procumbent cells. Moreover, in some of the woods of Apocynaceae the vasicentric tracheids are present.

Similarly the present fossil can also be distinguished from the members of Sapotaceae. In most genera of Sapotaceae the vessels are characteristically grouped loosely together to form a radial or oblique pattern, the vasicentric tracheids are commonly present, and the xylem rays are 1-5 (typically 2-3) seriate.

Among the modern woods of Ebenaceae there is a close resemblance between the present fossil wood and those of *Maba* and *Diospyros*. Basically the wood anatomy of these two genera is so similar that they cannot be distinguished easily.

In order to find out the nearest modern equivalent of the present fossil wood, a critical examination of 2 species of *Maba* and 45 species of *Diospyros* was made at the Wood Anatomy Branch, Forest Research Institute, Dehra Dun. Besides, it was also compared with the published anatomical descriptions and figures of several species of *Diospyros* and *Maba* (METCALFE & CHALK, 1950; pp. 883-885; PEARSON & BROWN, 1932, pp. 689-708; KANEHIRA, 1924, pp. 40-43; DESCH, 1957, pp. 148-152; MOLL & JANSSONIUS, 1920, pp. 413-470; HENDERSON, 1953, p. 24; CHOWDHURY, 1934, p. 54, PL. 29; 1945, p. 40, PL. 29; KRIBS, 1959, pp. 37-39, FIGS. 127-129, 358-359; NORMAND, 1960, pp. 323-326, PL. 143-145). It is found that the present fossil wood is similar to the woods of *Diospyros assimilis* Bedd., *D. crumenata* Thw., *D. ebenum* Koenig., *D. kurzii* Hiern., and *D. melanoxylon* Roxb. Out of these the wood of *D. assimilis* Bedd. appeared to be almost identical with our fossil.

In view of its closest resemblance with those of modern *Diospyros* and *Maba* the present fossil wood has been placed under the genus *Ebenoxylon* Felix, and named as *Ebenoxylon arcotense* sp. nov.

Comparison with the fossil species — Fossil woods referred to Ebenaceae are known from Cretaceous onwards. They are *Ebenoxylon ebenoides* Schenk (SCHENK, 1883; KAISER, 1890) from the Upper Cretaceous of Libyan desert (near Regenfeld); *E. diospyroides* (FELIX, 1882, 1883; KAISER, 1890) from the Tertiary of Antigua; *E. speciosum* Platen (1908) from the Tertiary of California; *E. tenax* Beck (BECK, 1886; KAISER, 1890; SCHONFELD, 1930) from the Oligocene of Saxony, E. Germany; *E. tunetanum* Fliche (FLICHE, 1888; THOMAS, 1893) from the Pliocene of Tunisia (Ain Cherichira); *Ebenoxylon* sp. Fliche (FLICHE, 1898) from the ? Tertiary of Mytilene (Orthymnos); *E. boreale* Platen (1908) from the Tertiary (? Oligocene) of Alaska; *E. aegypticum* Kräusel (1939) from the Tertiary of Egypt; *E. knollii* Hofmann (1944) from the Oligocene of Prambachkirchen, and also described by Greguss (1956) from the Oligocene of Darnó-Berges (Kom. Heves), Hungary; *E. hofmannae* Greguss (1956) from the Oligocene of Darnó-Berges, Hungary; *Diospyroxylon* cf. *ebenaster*

Greguss (1967) from the Miocene of Ipolytarnóc, Hungary; *Diospyroxylon* sp. Greguss (*l.c.*) from the Helveti of Érd-Törökbalint, Hungary; *Diospyros washingtonia* Prakash and Barghoorn (1961) from the Miocene of Columbia basalts, Central Washington; *Diospyros* sp. Slijper (1932) from the Pliocene of Holland; *Ebenoxylon indicum* Ghosh and Kazmi (1958) from the Tertiary of NEFA, Assam, and wood cf. *Diospyros* and *Maba* (NAVALE, 1968) from the Neyveli lignite, Tertiary of South India.

Considering the anatomical features collectively, the present fossil wood is different from the above species.

In *Ebenoxylon indicum*, the already known Indian species, the vessels are comparatively larger (t.d. 82-225 μ, r.d. 164-328 μ); the apotracheal parenchyma is diffuse-in-aggregate, in uniseriate irregular or interrupted closely spaced tangential lines, forming reticulum or net-like structure with the rays; and the xylem rays are often appearing as homogeneous. On the other hand in the present fossil the vessels are small to medium (t.d. 32-160 μ, r.d. 32-176 μ); apotracheal parenchyma is in uniseriate, concentric, tangential lines (not so much closely spaced as in *Ebenoxylon indicum*) and the rays are heterogeneous.

The other fossil wood of which only the structural details have been observed in cross-section of the lignite (NAVALE, 1968) differs from *E. arcotense* in having more frequent apotracheal-diffuse parenchyma. Besides, the xylem rays are almost homogeneous, whereas in the present fossil wood they are heterogeneous.

Present distribution of Diospyros — According to Willis (1966) the genus *Diospyros* (= *Maba*) now consists of about 500 species of trees and shrubs, widely distributed throughout the tropical and subtropical regions of the world. In points of numbers of species, *Diospyros* attains its best development in the Indo-Malayan region. In the Indian region there are nearly 100 species, chiefly occurring in South India, Ceylon, Burma, Eastern Bengal, and a few extending to North India (GAMBLE, 1902, 1956). In the South Indian region, from where the fossil wood was collected, there are about 24 species of *Diospyros*, found mainly in the evergreen forests. Those species which resemble very closely in wood structure with the present fossil are still very common in the South Indian evergreen forests. *Diospyros assimilis* is found in North Circars, Palkonda Hills of Visakhapatam, Western Ghats, South Kanara to Travancore from 300-900 m. in evergreen forests. *D. ebenum* is true ebony producing species, moderate sized to large tree, found in Madras, in Deccan and Carnatic, extenbing westward to North Coimbatore and northwards to the southern corner of South Mangalore and southward, through Malabar, Coorg, Cochin and Travancore where it is very scattered in the evergreen forests (PEARSON & BROWN 1932, p. 693). *D. melanoxylon* is the commonest Indian black ebony tree, a moderate sized tree, found throughout the Central India and Bombay in South of Central India, as far as the Panch Mahal, Maharashtra, in the North Circars, Carnatic and Southwards to Ceylon (GAMBLE, 1956; PEARSON & BROWN, 1932).

Diagnosis — *Wood* diffuse-porous. *Growth rings* not seen. *Vessels* small to medium, t.d. 32-160 μ, r.d. 32-176 μ, circular to oval, solitary as well as in radial multiples of 2-3, rarely in partial double rows, 3-6 vessels per sq. mm., perforations simple; intervessel pits small, 3-4 μ in diameter, with small circular apertures; tyloses absent; dark gummy infiltration abundant. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma sparse, only a few cells associated with the tangential wall of the vessels; apotracheal parenchyma in uniseriate, concentric, tangential lines, lines somewhat wavy and undulating the vessels, about 5-7 per mm. *Xylem rays* fine, uniseriate, rarely biseriate due to pairing of procumbent cells through the central portion and 1-2 marginal rows of upright cells at one or both the ends, 4-40 cells in height. *Fibres* semi-libriform to libriform, nonseptate, thickwalled, wall thickness 4-6 μ.

Holotype — B.S.I.P. Museum No. 34056.

Locality — Murattandichavadi, about 8 km. W.N.W. of Pondicherry, South Arcot district, Tamil Nadu (Madras).

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EXPLANATION OF PLATE 1

Ebenoxylon arcotense sp. nov.

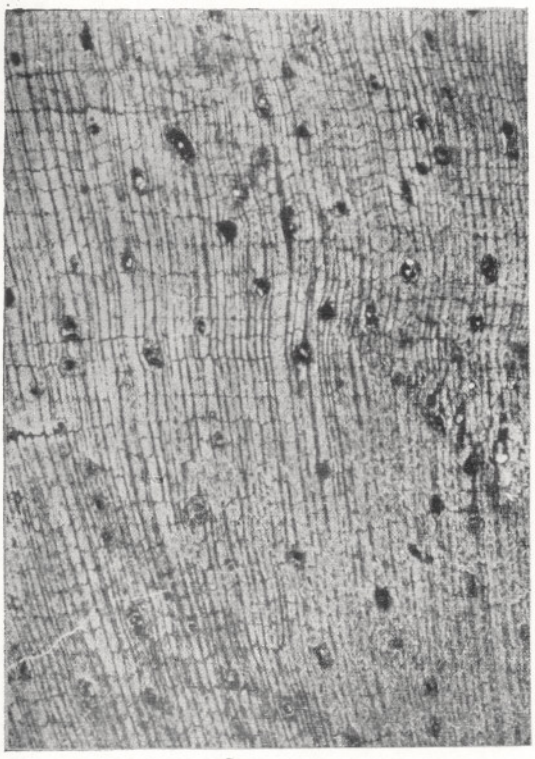
1. Cross-section showing general type and distribution of vessels and parenchyma. × 12 (B.S.I.P. Museum, Slide No. 3896).

2. Another cross-section magnified to show vessels and parenchyma. × 50 (B.S.I.P. Museum, Slide No. 3896).

3. Tangential longitudinal section showing xylem rays. × 80 (B.S.I.P. Museum, Slide No. 3897).

4. Radial longitudinal section showing heterocellular xylem rays. × 100 (B.S.I.P. Museum, Slide No. 3898).

5. Intervessel pits. × 600 (B.S.I.P. Museum, Slide No. 3899).



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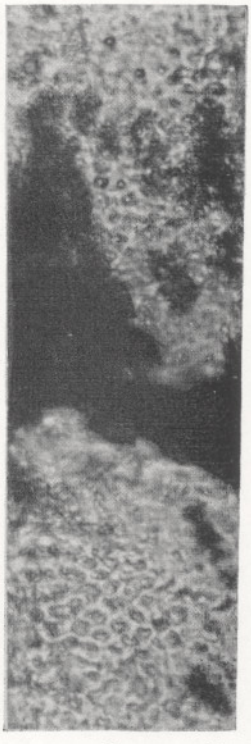

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