Fossil dicotyledonous woods from Deccan Intertrappean sediments of Ghansor, Seoni District, Madhya Pradesh, India

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ABSTRACT


Anatomical details of three well preserved dicotyledonous woods resembling extant genera, viz. Dracontomelum Bl. (syn. Dracontomelon Bl.) of the family Anacardiaceae, Elaeocarpus Linn. of the Elaeocarpaceae, Euphoria Comm. ex Juss. - Litchi chinensis Sonn. - Otonephalium Radlk. (anatomically indistinguishable) of the Sapindaceae have been described from the Deccan Intertrappean sediments of Ghansor, Seoni District, Madhya Pradesh. The assemblage indicates occurrence of thick tropical vegetation at the time of deposition. These genera are presently found in natural association and are distributed in tropical wet-evergreen forests of Western Ghats, Tamil Nadu, Sri Lanka, Assam, Sikkim, Bangla Desh and Myanmar etc. Their presence signifies that the climate was tropical with plenty of rainfall during the period of deposition.

Key-words—Fossil woods, Deccan Intertrappean beds, Anacardiaceae, Elaeocarpaceae, Sapindaceae, Madhya Pradesh.
INTRODUCTION

The fossil woods for the present study were collected from Ghansor (22°40'40"N: 80°1'30"E) in Binori Reserve Forest, Seoni District, Madhya Pradesh. The petrified well preserved angiospermous woods are found scattered in the forest. Palms are mostly represented by wood remains, however, few leaves and fruits are also collected. The forest is about 5 km north-east of Ghansor which is about 45 km from Lakhnadon in the Seoni District (Fig. 1). The Deccan Intertrappean beds were earlier assigned to an Early Tertiary age due to the preponderence of angiosperms (Sahni, 1934; Bande, 1992). However, angiosperms had reached a position of abundance even in Maastrichtian. The faunal assemblage as well as palynological studies advocated Maastrichtian age for most of the intertrappean exposures (Khosla & Sahni, 2003). Recently, Keller et al. (2009) identified K/T boundary and recorded Early Danian planktonic foraminifers.

Sahni (1943) reported a palm wood, namely, *Palmoxylon sclerodermum* from Seoni but the exact locality was unknown. Later on, Guleria and Mehrotra (1999) reported a palm leaf *Phoenicites lakhanpalii* and few palm woods, *viz.* *Palmoxylon binoriensis*, *P. canalosum*, *P. lunarianum* and *P. vaginatum*. Recently, a fossil dicot wood, *Sonneratiaxylon preapetalum* Awasthi, have been reported from the same locality (Srivastava, 2008).

The terminology used in describing the fossil woods is based on IAWA Committee (1989) given in the ‘List for Hardwood Identification’. All the specimens and slides have been deposited in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

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![Fig. 1—Map showing fossil locality.](image-url)
SYSTEMATICS

Family—ANACARDIACEAE

Genus—DRACONTOMELUMOXYLON
Ghosh & Roy 1979

_Dracontomelumoxylon mangiferumoides_ Ghosh & Roy 1979

(Pl. 1. 1-5)

_Material_—The description is based on a single piece of fossil wood measuring 8.5 cm in length and 4.5 cm in width. The preservation is satisfactory revealing all the xylotomical details.

_Description_—Wood diffuse-porous. _Growth rings_ indistinct. _Vessels_ mostly solitary as well as in radial multiples of 2-3, rarely up to 4 (Pl. 1.1-2); 7-9 per sq mm; small to large (mostly medium to large) sized, tangential diameter 55-220 µm, radial diameter 100-330 µm; circular to oval when solitary, flattened at the place of contact when in multiples (Pl. 1.1-2); mostly open, tyloses rarely present; vessel members short, 275-400 µm in length with truncate end walls (Pl. 1.3); perforations simple; intervessel pits bordered, alternate, hexagonal, large, about 11-13.5 µm in diameter with lenticular apertures (Pl. 1.5). _Parenchyma_ abundant, paratracheal, vasicentric forming 1-2 seriate sheath round the vessels, occasionally extending laterally (Pl. 1.1-2); parenchyma cells 28-44 µm in diameter and 80.5-137.5 µm in length. _Rays_ 1-5 (mostly 3-4) seriate, 7-10 rays per mm; heterocellular (Pl. 1.4); uniseriate few, made up wholly of upright cells or both procumbent and upright cells, 3-10 cells or 110-440 µm long; multiseralate 2-5 seriate, weakly heterocellular, made up of procumbent cells in the centre with 1-2 or more marginal row of up right cells at one or both the ends (Pl. 1.3, 4), 5-48 cells or 165-1760 µm long; end to end ray fusion seen at places; few cells filled with dark coloured content; procumbent cells with tangential height 22-40 µm and radial length 44-85 µm; upright cells 38.5-55 µm in tangential height and 22-33 µm in radial length; vessel ray pits larger than intervessel pits, half bordered. _ Fibres_ aligned between two consecutive rays, polygonal in cross section, 16.5-38.5 µm in diameter, non-septate to rarely separte, interfiber pits not seen.

_Affinities_—The anatomical features of the fossil wood closest resemblance with modern wood of _Dracontomelon dao_ Merr. and Rolfe (syn. _Dracontomelum mangiferum_) of the family Anacardiaceae (Moll & Janssonius, 1908; Kribs, 1959; Ghosh & Purkayastha, 1963; Hayashi et al., 1973; Ilic, 1991). The fossil woods resembling _D. mangiferum_ Bl. have been described as _Dracontomelumoxylon mangiferumoides_ by Ghosh and Roy (1979) from the Miocene sediments of Birbhum District, West Bengal (Ghosh & Roy, 1979), Siwalik sediments of Nalagarh, Himachal Pradesh (Prakash, 1979) and Kalagarh, Uttarakhand (Prakash, 1981); from the Deccan Intertrappean beds of Parapani and Ghughua, Dindori (Mandla) District, Madhya Pradesh (Bande & Khatri, 1980; Bande & Prakash, 1983) and from the Lignite beds of Ratnagiri, Maharashtra (Phadtare & Kulkarni, 1984). Since the present wood also shows resemblance with _Dracontomelumoxylon mangiferumoides_, it has been placed under the already reported species. As far as the author is aware, this is the only fossil wood species described from India and abroad. However, a fossil leaf of the genus _Dracontomelon_, namely, _Dracontomelon serianse_ Prasad et al. (1998) is reported from the Siwalik sediments of Gonda District, Uttar Pradesh.

_Figured specimen_—BSIP Slide No. 39852.

Family—ELAEOCARPACEAE

Genus—ELAEOCARPOXYLON Prakash & Dayal emend. Prakash & Tripathi 1975

_Elaeocarpoxylon ghughuensis_ Awasthi et al.1996

(Pl. 2.1-7)

_Material_—The description is based on three well preserved fossil twigs measuring about 6.5-8.0 cm in length and 2.5-3.0cm in diameter.
Description—Wood diffuse-porous (Pl. 2.1-3). Growth rings indistinct, faintly demarcated by smaller vessels and denser fibrous tissue. Vessels small to medium sized, tangential diameter 34-132 µm, radial diameter 22-146 µm; solitary and in radial multiples of 2-9 (mostly 2-5) (Pl. 2.1-3), evenly distributed, 7-26 per sq. mm, circular to oval when solitary and flattened at the place of contact when in multiples; tyloses absent; vessel members 220-400 µm long with tailed or oblique ends (Pl. 2.4); perforations simple; intervessel pits alternate, bordered, angular due to crowding, about 4.5-6 µm in diameter (Pl. 2.7). Parenchyma scanty paratracheal, few cells associated with some of the vessels; cells 20-24 µm in diameter and 60-80 µm in length. Rays fine, 16-22 rays per mm, 1-4 (mostly 2-3) seriate; uniseriate homocellular, composed of upright cells; 5-15 cells or 130-500 µm long, multiseriate heterocellular (Pl. 2.6), composed of procumbent cells in the median portion with long uniseriate extensions of 2-8 upright cells at one or both the ends (Pl. 2.4-5); 30-70 cells or 340-2,750 µm long; end to end ray fusion frequent; procumbent cells 16-20 µm in tangential height and 20-24 µm in radial length; upright cells 52-72 µm in tangential height and 20-24 µm in radial length. Fibres aligned in radial rows between two consecutive rays, (Pl. 2.2) semilibriform, polygonal in cross-section, 12-16 µm in diameter; septate. Pith circular in cross section, made up of 4-6 cells thick sclerenchymatous layer and inner parenchymatous tissue, few cells filled with dark coloured content (Pl. 2.1).

Affinities—The xylotomy characters of the fossil collectively indicate its affinity with the genus Elaeocarpus Linn., particularly with E. floribundus Bl., E. recurvatus Corner and E. tectorious (Lour.) Poir of the family Elaeocarpaceae (Moll & Janssonius, 1908; Kanehira, 1921; Lecomte, 1926; Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Desch, 1957; Chowdhury & Ghosh, 1958; Ilic, 1991; Gasson, 1996). Prakash and Dayal (1964) instituted the genus Elaeocarpxylon to accommodate the woods of Elaeocarpus L. and Sloanea L. So far, five species of the genus, viz. E. antiquum Prakash and Dayal (1964), E. mandlaensis Lakhanpal et al. (1978) E. mohgaensee Trivedi and Srivastava (1980), E. ghughuensis Awasthi et al. (1996) and E. navargaonensis Khare et al. (2000) are described from the Deccan Intertrappean beds of Madhya Pradesh and Maharashtra. One of its species, E. hailakandensis is reported from the Neogene deposits of Tipam Sandstone, Assam (Prakash & Tripathi, 1975). The present fossil wood is almost identical to the known species Elaeocarpxylon ghughuensis Awasthi et al. (1996) and hence placed under the same species. Fruits of the genus Elaeocarpus is reported from the Upper Siwalik of Arunachal Pradesh as Elaeocarpus prelanceifolius (Bera et al., 2004).

Figured Specimen—BSIP Slide No. 39853.

Family—SAPINDACEAE

Genus—EUPHORIOXYLON Awasthi et al. 1982

Euphoriocyon deccanensis Mehrotra 1987

(Pl. 3.1-6)

Material—Three small pieces of a young wood measuring about 6-7.5 cm in length and 2.5-3.2 cm in width.

Description—Wood diffuse-porous. Growth rings indistinct. Vessels evenly distributed, 10-20 per sq mm; solitary few, mostly in radial multiples of 2-5

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PLATE 1

Dracontomeloxylon palaemangiferum Prakash

1. Cross-section showing distribution of vessels. BSIP Slide No. 39852-I.
2. Same section magnified to show distribution of vessels and parenchyma. BSIP Slide No. 39852-I.
3. Tangential longitudinal section showing distribution of xylem rays. BSIP Slide No. 39852-II.
4. Radial longitudinal section showing heterocellular nature of xylem rays. BSIP Slide No. 39852-II.
5. Alternate large bordered intervessel pits. BSIP Slide No. 39852-II.
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(Pl. 3.1-2); small to medium sized, tangential diameter 30-130 µm, radial diameter 30-140 µm; oval to circular when solitary, flattened at the place of contact when in multiples; open or filled with some kind of brown or black deposits (Pl. 3.1, 2); tyloses absent; perforations simple; vessel elements 220-440 µm with truncate or oblique ends (Pl. 3.4, 5); inter-vessel pits small, alternate, bordered, hexagonal with lenticular apertures, 8.5-10 µm in diameter (Pl. 3.3); vessel-ray and vessel parenchyma pits not observed. Parenchyma scanty, paratracheal, few cells around some of the vessels, occasionally vasicentric, forming uniseriate sheath around few vessels (Pl. 3.1, 2); parenchyma cells 22-24 µm in diameter and 40-52 long. Rays 16-20 per mm; uniseriate, occasionally bicelled due to pairing of cells (Pl. 3.5); homocellular to weakly heterocellular (Pl. 3.6), made up of squarish and/or upright cells, 6-28 cells or 120-550 µm long; squarish ray cells 12-16 µm in both radial and tangential height, upright cells 16-20 µm in radial length and 60-80 µm tangential height. Fibres aligned in radial rows (Pl. 3.1-2), 14-20 µm in diameter, moderately thick walled, non-septate to septate, septa rarely seen.

Affinities—The above anatomical features of the fossil wood indicate its affinity with members of the family Sapindaceae, particularly with Euphoria, Litchi and Otonephelium (Metcalfe & Chalk, 1950; Li et al., 1995). These genera are xylotomically indistinguishable from each other (Ramesh Rao, 1963, p. 212). For naming such woods Awasthi et al. (1982) instituted the genus Euphorioxylon. So far, two of its species are reported from India, namely, Euphorioxylon indicum Awasthi et al. is known from the Neogene sediments of Gujarat and Tamil Nadu (Awasthi et al., 1982), Uttarakhand (Prasad, 1993), Arunachal Pradesh (Awasthi & Mehrotra, 1993), Assam (Prakash et al., 1994) and Kerala (Srivastava & Awasthi, 1994) and Lameta Fromation, Maharashtra (Kar et al., 2004). Another species Euphorioxylon deccanensis Mehrotra is reported from Deccan Intertrappean sediments (Mehrotra, 1987), Neyveli Lignite deposits, Tamil Nadu (Agarwal, 1997) and Arunachal Pradesh (Mehrotra et al., 1999).

The present fossil wood shows gross resemblance with both the species, however, in having homocellular to weakly heterocellular rays it is closer to E. deccanensis Mehrotra (1987). Hence, it has been assigned to the same species. Besides woods, two leaves belonging to the genus Euphoria, viz. Euphoria longanoides Antal and Awasthi (1994) are reported from the Siwalik sediments of West Bengal and Euphoria siwalika Prasad (1994) from Uttarakhand.

Figured Specimen—BSIP Slide No. 39854.

DISCUSSION

The modern counterparts of fossil assemblage namely, Dracontomelon dao Merr. and Rolfe (syn. Dracontomelum mangiferum) of the family Anacardiaceae, Elaeocarpus L., particularly with E. floribundus Bl., E. recurvatus Corner and E. tectorious (Lour.) Poir of the Elaeocarpaceae and Euphoria longan (Lour.) Steud, Otonephelium stipulaceum Radl. and Litchi chinensis Comm. (anatomically indistinguishable) of the family Sapindaceae reported in the present communication indicate presence of thick tropical vegetation at the time of deposition. These genera are presently found in natural association and are distributed in tropical wet-evergreen forests of Western Ghats, Tamil Nadu, Sri

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PLATE 2

Elaeocarpoxylon ghughuensis Awasthi et al.

1. Cross-section showing distribution of vessels and pith. BSIP Slide No. 39853-I.
2. Cross-section from peripheral portion showing distribution of vessels BSIP Slide No. 39853-I.
3. Same section magnified to show distribution of vessels, scanty parenchyma cells and fibres. BSIP Slide No. 39853-I.
4. Tangential longitudinal section showing long rays and end to end ray fusion. BSIP Slide No. 39853-II.
5. Same section magnified showing broad rays. BSIP Slide No. 39853-II.
6. Radial longitudinal section showing heterocellular nature of xylem rays. BSIP Slide No. 39853-III.
7. Alternate intervessel pits. BSIP Slide No. 39853-II.
Lanka, Assam, Sikkim, Bangla Desh and Myanmar etc. The presence of moisture loving evergreen elements signifies that the climate was tropical with plenty of rainfall. Presence of palm remains (Sahni, 1943; Guleria & Mehrotra, 1999) and Sonneratia (Srivastava, 2008) indicate swampy and near-shore conditions during the Maastrichtian-Danian in central India.

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