

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

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ABSTRACT

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Anatomical details of three well preserved dicotyledonous woods resembling extant genera, viz. *Dracontomelon* Bl. (syn. *Dracontomelum* 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.

भारत में मध्य प्रदेश के सिवनी जिले के घनसोर के दक्खन अंतर्द्वीपीय अवसादों से प्राप्त द्विबीजपत्रीय काष्ठ जीवाश्म
रश्मि श्रीवास्तव

सारांश

विद्यमान वंशों अर्थात् *ड्रेकोटोमेलन ब्लूम* (सिन. *ड्रेकोटोमेलम ब्लूम*) एनाकार्डिएसी कुल, *एलियोकार्पस* लिन. *एलियोकार्पेसी* कुल, *यूफोरिया* कॉम. एक्स जुस.-*लीची चाइनेसिस* सोन.-*ओटोनेफेलियम* रेडलक (शारिरीय रूप से समान) सैपिंडेसी कुल से समानता रखती तीन सुपरिरीक्षित द्विबीजपत्रीय काष्ठों का शारिरीय वर्णन मध्य प्रदेश में सिवनी जिले के घनसोर के दक्खन अंतर्द्वीपीय अवसादों से वर्णित किया गया है। इस समुच्चय से निक्षेपण के समय घनी उष्णकटिबंधीय वनस्पति की प्राप्ति का संकेत मिलता है। ये वंश वर्तमान में प्राकृतिक रूप से एक साथ पाए जाते हैं और ये पश्चिमी घाट, तमिलनाडु, श्रीलंका, असम, सिक्किम, बंगलादेश, म्यांमार, इत्यादि के उष्णकटिबंधीय नम-सदाहरित वनों में वितरित हैं। उनकी उपस्थिति से इंगित होता है कि जलवायु निक्षेपण की अवधि के दौरान अधिक वर्षामान एवं उष्णकटिबंधीय थी।

संकेत-शब्द—काष्ठ जीवाश्म, दक्खन अंतर्द्वीपीय, एनाकार्डिएसी, एलियोकार्पेसी, सैपिंडेसी, मध्य प्रदेश।

INTRODUCTION

THE fossil woods for the present study were collected from Ghansor ($22^{\circ}40'40''\text{N}$; $80^{\circ}1'30''\text{E}$) 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 preponderance 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, *Sonneratioxylon 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.

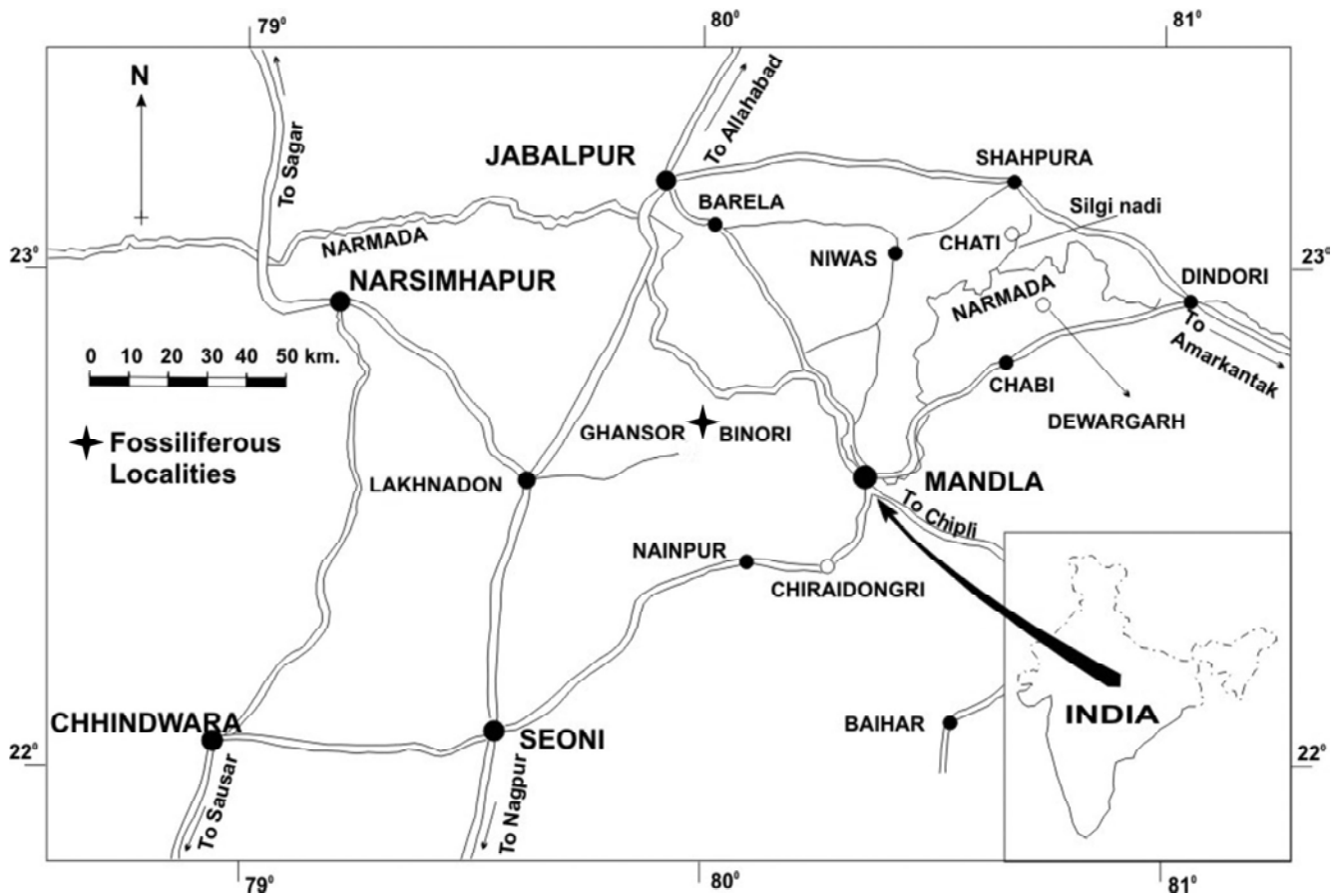


Fig. 1—Map showing fossil locality.

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; multiseriate 2-5 seriate, weakly heterocellular, made up of procumbent cells in the centre with 1-2 or more marginal row of upright 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 septate, 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*****Elaeocarpoxyylon 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.

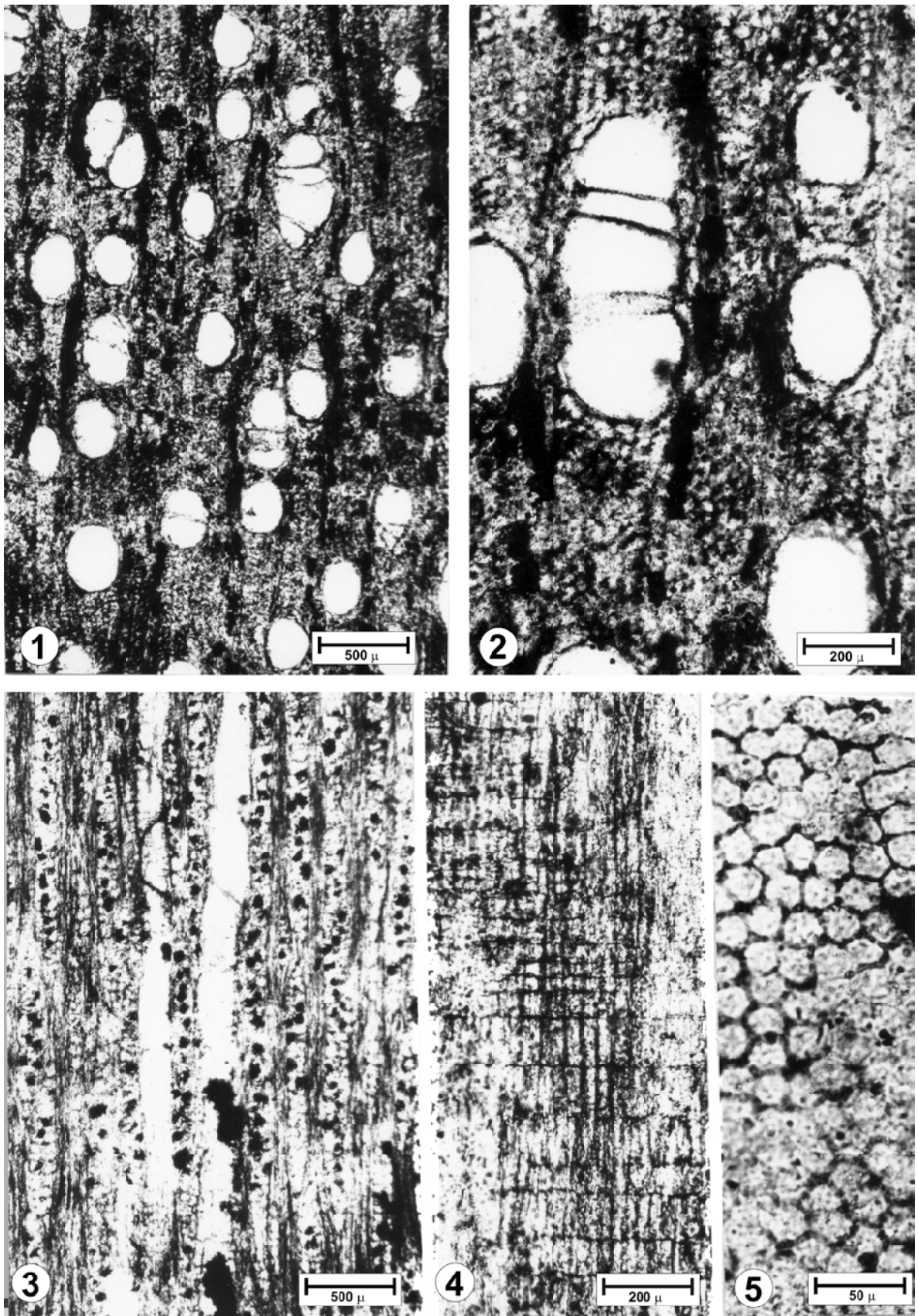


PLATE 1

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) semilibrifform, 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 xylotomical 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 *Elaeocarpoxyton* to accommodate the woods of *Elaeocarpus* L. and *Slonea* L. So far, five species of the genus, viz. *E. antiquum* Prakash and Dayal (1964), *E. mandlaensis* Lakhnupal *et al.* (1978) *E. mohgaoense* Trivedi and Srivastava (1980), *E. ghughuensis* Awasthi *et al.* (1996) and *E. nawargaonensis* Khare *et al.* (2000) are described from the Deccan Intertrappean beds of Madhya Pradesh and Maharashtra. One of its species, *E. hailakandiensis* is reported from the Neogene deposits of Tipam Sandstone, Assam (Prakash & Tripathi, 1975). The present fossil wood is almost identical to the known species *Elaeocarpoxyton 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

Euphorioxylon 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

PLATE 1

Dracontomeloxylon palaeomangiferum Prakash

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| <p>1. Cross-section showing distribution of vessels. BSIP Slide No. 39852-I.</p> <p>2. Same section magnified to show distribution of vessels and parenchyma. BSIP Slide No. 398521-I.</p> <p>3. Tangential longitudinal section showing distribution of xylem rays. BSIP Slide No. 39852-II.</p> | <p>4. Radial longitudinal section showing heterocellular nature of xylem rays. BSIP Slide No. 39852-II.</p> <p>5. Alternate large bordered intervessel pits. BSIP Slide No. 39852-II.</p> |
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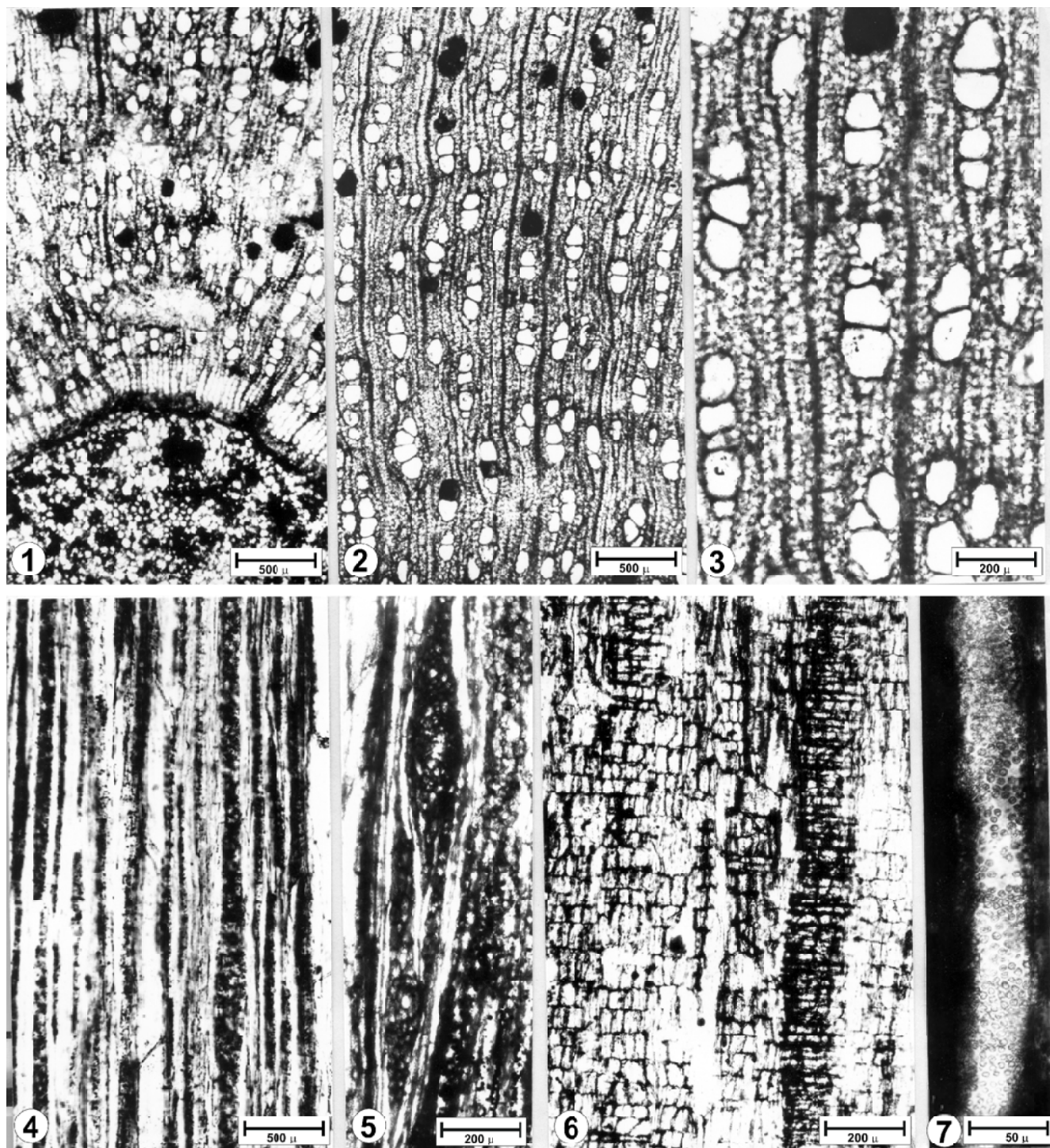


PLATE 2

(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. *Parcnchyma* 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, occassionly 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 *Otonophelium* (Metcalf & 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.

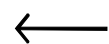
Figured Specimen—BSIP Slide No. 39854.

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, *Otonophelium stipulaceum* Radlk. 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

PLATE 2

Elaeocarpoxyton ghughuensis Awasthi *et al.*



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| 1. Cross-section showing distribution of vessels and pith. BSIP Slide No. 39853-I. | 4. Tangential longitudinal section showing long rays and end to end ray fusion. BSIP Slide No. 39853-II. |
| 2. Cross-section from peripheral portion showing distribution of vessels BSIP Slide No. 39853-I. | 5. Same section magnified showing broad rays. BSIP Slide No. 39853-II. |
| 3. Same section magnified to show distribution of vessels, scanty parenchyma cells and fibres. BSIP Slide No. 39853-I. | 6. Radial longitudinal section showing heterocellular nature of xylem rays. BSIP Slide No. 39853-III. |
| | 7. Alternate intervessel pits. BSIP Slide No. 39853-II. |

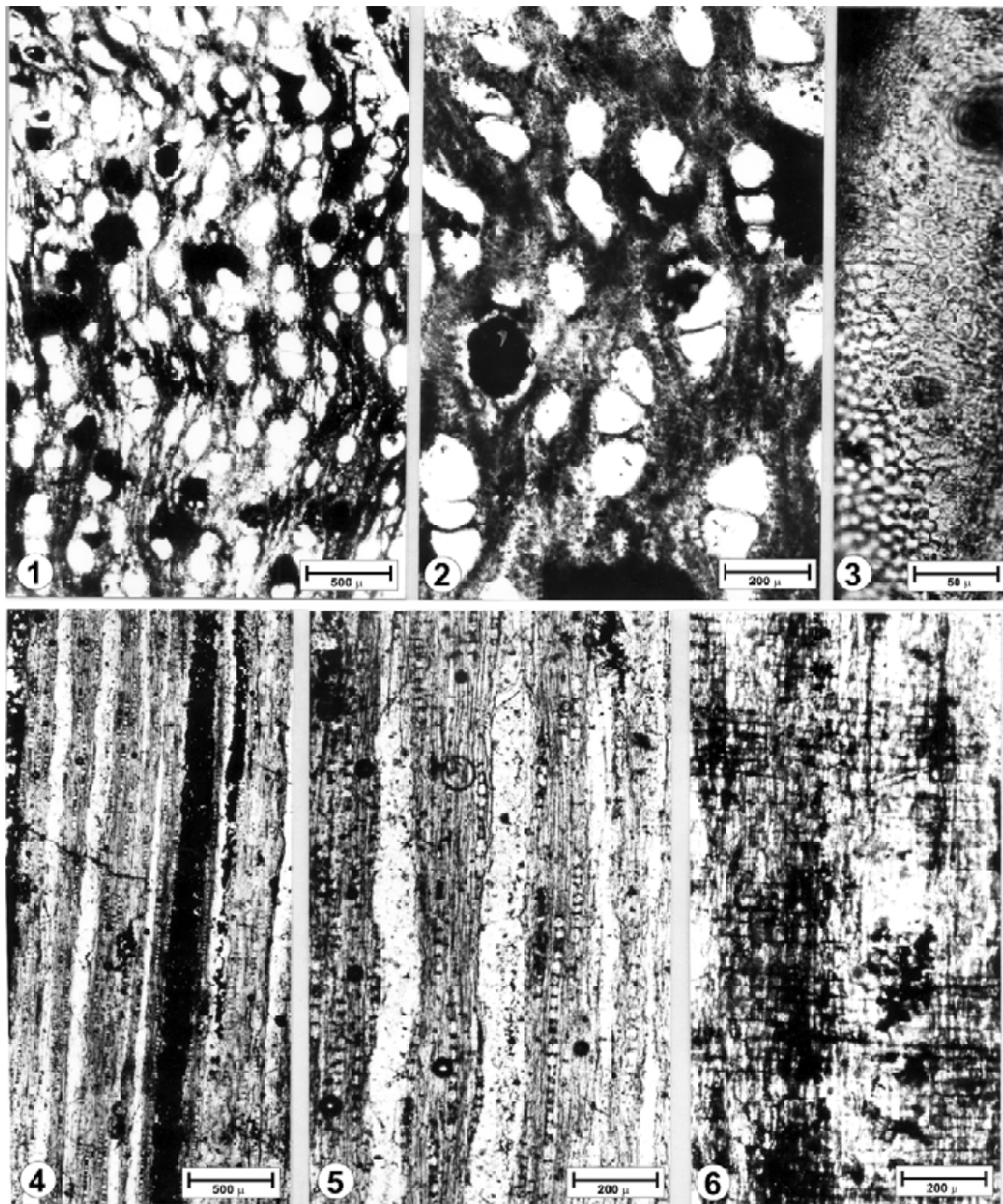


PLATE 3

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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PLATE 3

Euphorioxylon deccanensis Mehrotra

1. Cross-section showing distribution of vessels. BSIP Slide No. 39854-I.
2. Same section magnified to show distribution and shape of vessels and scanty paratracheal parenchyma. BSIP Slide No. 39854-I.
3. Alternate bordered intervessel pits. BSIP Slide No. 39854-I.
4. Tangential longitudinal section showing distribution of rays. BSIP Slide No. 39854-II.
5. Same section magnified to show uniseriate rays. BSIP Slide No. 39854-I.
6. Radial longitudinal section showing heterocellular nature of xylem rays. BSIP Slide No. 39854-I.

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