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Contributions to the Deccan Intertrappean flora of Nawargaon, Wardha District, Maharashtra, India

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ABSTRACT

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Eight fossil wood species are described from the Deccan Intertrappean beds of Nawargaon, Wardha District, Maharashtra, India. These fossil woods have affinities with the extant *Homalium tomentosum* (Flacourtiaceae), *Grewia tiliaefolia* (Tiliaceae), *Elaeocarpus robustus* (Elaeocarpaceae), *Ailanthus malabarica* (Simaroubaceae), *Canarium strictum* and *Bursera serrata* (Burseraceae) and *Barringtonia racemosa* (Lecythidaceae). The fossil flora, so far, recovered from the Nawargaon area indicates that tropical evergreen forests with some moist deciduous plants were flourishing around Nawargaon area in Central India during Early Tertiary in contrast to mixed deciduous type of present day forest. The habit and habitat of the modern comparable taxa suggest prevalence of tropical humid climate in the area during Early-Tertiary.

Key-words—Petrified woods, Xylotomy, Dicotyledon, Deccan Intertrappean beds, Early Tertiary, Palaeoclimate, Nawargaon, Maharashtra (India).

भारत के महाराष्ट्र प्रान्त के वर्धा जिले के नवरगाँव अवस्थित दक्खिनी अन्तर्ट्रेपीय वनस्पतिजात का योगदान

एकनाथ गवजी खरे, महेश प्रसाद एवं नीलाम्बर अवस्थी

सारांश

भारत के महाराष्ट्र प्रान्त के वर्धा जिले के नवरगाँव अवस्थित दक्खिनी अन्तर्ट्रेपीय संस्तरों से आठ अश्मित काष्ठ प्रजातियाँ अभिनिर्धारित की गयी हैं. ये अश्मित काष्ठ विद्यमान *होमेएलियम टोमेन्टोसम* (फ़्लेकोर्टिएसी), *ग्रीविया टिलिएइफोलिया* (टिलिएसी), *ईलियोकार्पस रोबस्टस* (ईलियोकार्पेसी), *ऐलेन्थस मालाबारिका* (साईमारोयूबेसी), *कैनेरियम स्ट्रिक्टम* तथा *बरसेरा सेर्राटा* (बरसीरेसी) एवं *बैरिंगटोनिया रेसीमोसा* (लीसीथिडेसी) के साथ समानता रखती हैं. नवरगाँव क्षेत्र से अभी तक प्राप्त किए गए अश्मित वनस्पतिजात वर्तमान मिश्रित पर्णपाती प्ररूप के वनों के विपरीत प्रारंभिक टर्शियरी समय के दौरान मध्य भारत में नवरगाँव क्षेत्र के आस-पास कुछ आर्द्र पर्णपाती पौधों से युक्त उष्णकटिबन्धीय सदाबहारी वनों की उपस्थिति का संकेत करते हैं. आधुनिक तुलनीय वर्गकों के वास एवं आवास से प्रारंभिक टर्शियरी कल्प के दौरान इस क्षेत्र में उष्णकटिबन्धीय आर्द्र जलवायु की बहुलता प्रस्तावित होती है.

संकेत शब्द—अश्मीभूत काष्ठ, ज़ाइलम शारीर, द्विबीजपत्री, दक्खिनी अन्तर्ट्रेपीय संस्तर, प्रारंभिक टर्शियरी, पुराजलवायु, नवरगाँव, महाराष्ट्र (भारत).

INTRODUCTION

THE Deccan traps are terrace-like profile observed in areas in peninsular India resulting from a succession of volcanic eruptions. The lava flows were poured out through long narrow fissures or cracks ultimately converting into a plateau. The weathering process during the geological past changed these plateaus into isolated flat-topped and square sided hills. At places the eruptions were frequently interrupted by long periods of absence resulting in the formation of intertrappean beds which separated the horizontal flow from one another. These beds contain rich deposits of plants and animals.

The problem of the age of Deccan traps has been the subject of great controversial and different views were expressed from time to time. Most of them suggest its Early-Tertiary age on the comparative study of both fossil flora and fauna (Macolmson, 1837; Oldham, 1871; Woodward, 1908; Sahni, 1934; Crookshank, 1937; Wadia, 1966; Shukla *et al.*, 1997).

Although the study on plant fossils from the Deccan Intertrappean beds was started in the beginning of 19th Century when Coulthard (1829) reported the fragments of both monocotyledonous and dicotyledonous woods from neighbourhood of Sagar. The systematic study of plant fossils from the Deccan Intertrappean was initiated by Professor Sahni and his co-workers in the 20th Century and subsequently detailed work was done during the last sixty years. As a result large number of plant fossils belonging to different groups of plant kingdom were described from different localities of Central India (Bande *et al.*, 1988).

The present fossil locality, Nawargaon (21° 1' N and 78° 35' E) is a small village situated in the Wardha District of Maharashtra (Fig. 1). The Deccan Intertrappean beds are exposed on both sides of the forest road joining to Nawargaon village. The fossil woods occur here as stray pieces in the fields along this road and also on slopes of the hills in near by area. Most of the investigated fossil woods were collected from the base of hillock near Nawargaon, Sindhi Vihira and Maragsur.

Besides palms, a number of dicotyledonous fossil woods have already been described from this area showing their close affinities with extant genera *Evodia, Amoora, Aeschynomene, Sonneratia, Ardisia, Heterophragma, Gmelina, Aristolochia*

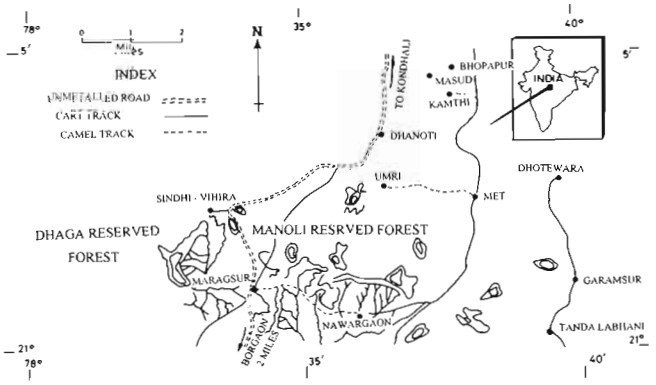


Fig. 1—Showing location of study area

and *Paraphyllanthus* of the families Rutaceae, Meliaceae, Fabaceae, Sonneratiaceae, Myrsinaceae, Bignoniaceae, Verbenaceae, Aristolochiaceae and Euphorbiaceae respectively (Shete & Kulkarni, 1982; Bande & Prakash, 1984; Bande, 1987; Kulkarni & Patil, 1977; Prakash *et al.*, 1986).

The present investigation on the fossil woods collected from the Deccan Intertrappean beds of Nawargaon area reveals the presence of some new fossil woods belonging to 7 dicotyledonous taxa which have been described in the present communication.

MATERIAL AND METHODS

The fossil wood specimens were collected from the Deccan Intertrappean beds of Nawargaon area, in Wardha District of Maharashtra, India. Most of the woods were found scattered while some of them were buried in the Earth. When the logs were very big, small pieces were taken after breaking them by hammer. All the specimens were silicified and consist of only secondary xylem. These were studied under a high power microscope. They were sliced into thin pieces in different planes (T.S., T.L.S. & R.L.S.) and their thin sections were prepared by grinding on the disc using Carborandum powder. The specimens and wood slides are preserved in the Museum of the Birbal Sahni Institute of Palaeobotany, Lucknow.

PLATE 1

Homalioxylon mandlaense Bande, 1974

1. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12292/I.
2. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibers. x 110. Slide no. BSIP 12292/II.
3. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 150. Slide no. BSIP 12292/III.
4. Intervessel pit-pairs. x 450. Slide no. BSIP 12292/II.

Grewioxylon indicum Prakash & Dayal, 1965a.

5. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12293/I.
6. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12293/II.
7. Intervessel pit-pairs. x 220. Slide no. BSIP 12293/II.

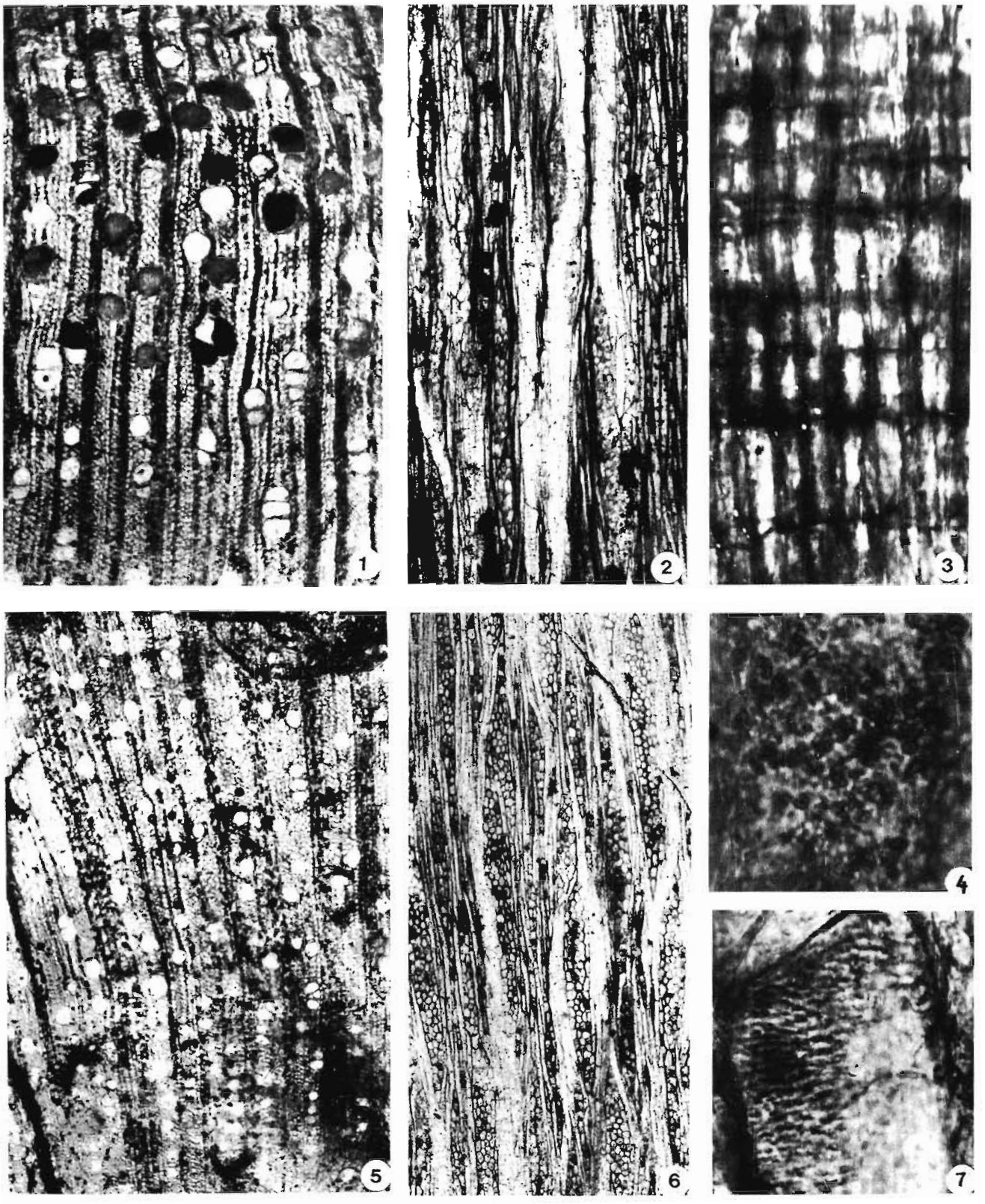


PLATE 1

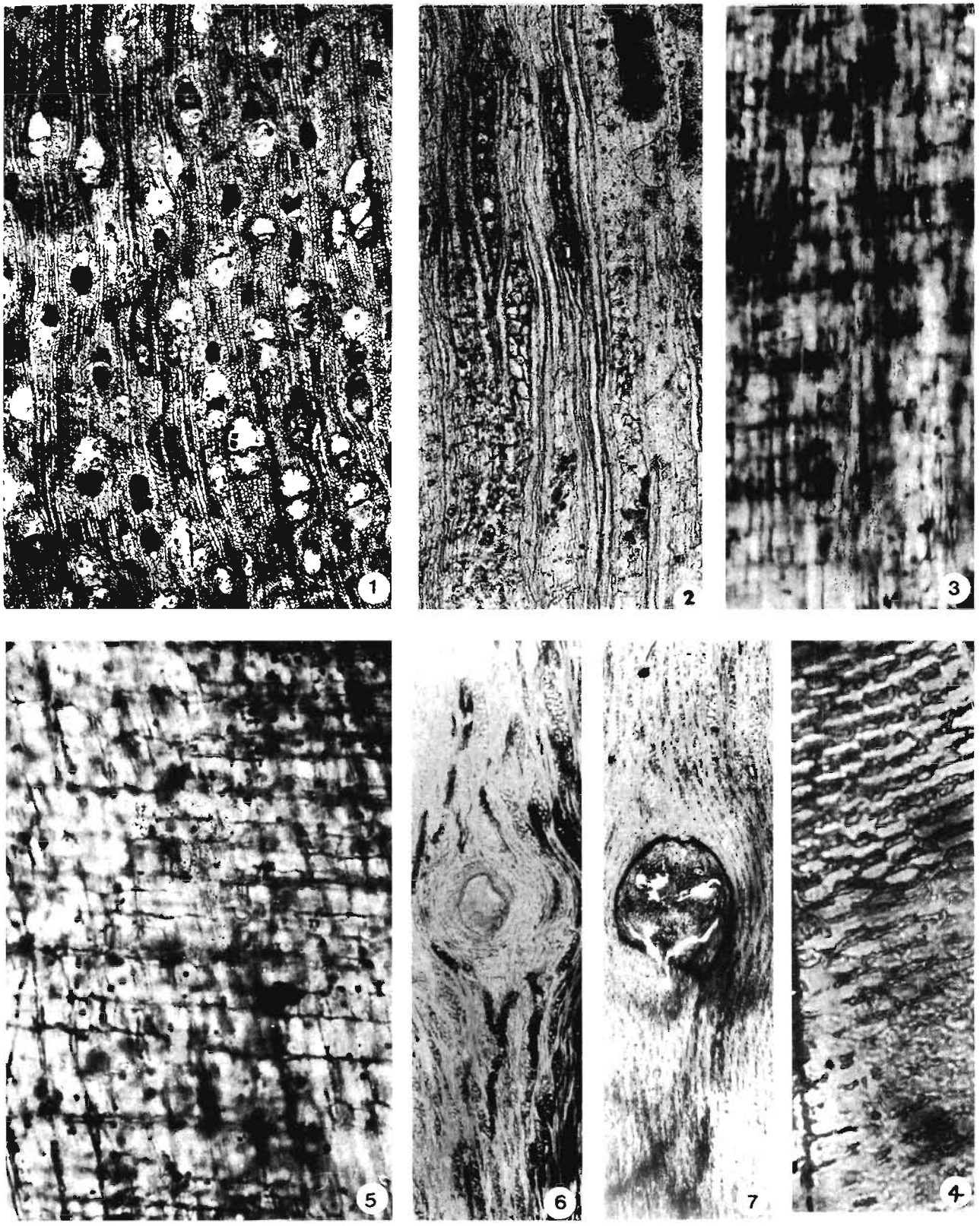


PLATE 2

SYSTEMATIC DESCRIPTIONS

DICOTYLEDONS

Family—FLACOURTIACEAE Bentham & Hooker f.

Genus—HOMALIOXYLON Prakash & Tripathi, 1974

Species—HOMALIOXYLON MANDLAENSE Bande, 1974

Pl. 1·1-4

Material—A small piece of secondary wood measuring 10 cm in length and 4 cm in width.

Description—Wood diffuse porous. *Growth rings* indistinct. *Vessels* small to medium in size, solitary and in radial multiples of 2-5, t.d. 80-120 µm, r.d. 80-160 µm, 15-18 per sq mm; tyloses present (Pl. 1·1), vessel-members 200-400 µm in length with truncate to tailed ends; perforations simple; intervessel pits bordered, alternate, 8-10 µm in diameter, round to polygonal in shape, with linear to lenticular apertures (Pl. 1·2, 4). *Parenchyma* scanty paratracheal. *Xylem rays* 1-3 (mostly 2) seriate, 8-10 per mm, ray tissues heterogeneous (Pl. 1·3), uniseriate rays made up of upright cells only, 5-7 cells or 180-250 µm in height, multiseriate rays made up of procumbent cells as well as upright cells, procumbent cells in centre and 3-5 upright cells at one or both the ends, 22-50 cells or 700-1500 µm in height; sheath cells present; procumbent cells 55-60 µm in radial length and 12-15 µm in tangential height; upright cells 40-45 µm in tangential height and 10-12 µm in radial length. *Fibres* polygonal in cross section, thick-walled and septate.

Affinities—The important anatomical characters present in the fossil are : wood diffuse porous, vessels small to medium, solitary to radial multiples, tyloses present, xylem rays 1-3 seriate; crystaliferous ray tissue heterogeneous, parenchyma scanty paratracheal and fibres septate. These features suggest its affinities with the family Flacourtiaceae. After a detailed study of thin sections and published literature of various species of *Homalium* Jacq. it is clear that the present fossil wood shows a very close resemblance with *Homalium tomantosum* Bentham in the shape, size and distribution of vessel, parenchyma pattern and structure of the xylem rays and the fibres (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Chowdhury & Ghosh, 1958).

So far, only two fossil woods resembling the genus *Homalium* Jacq. have been described under the form genus *Homalioxylon* Prakash & Tripathi. These are *Homalioxylon assamicum* Prakash & Tripathi, 1974 from the Tertiary of Assam and *H. mandlaense* Bande, 1974 from the Deccan Intertrappean beds of Mandla District, Madhya Pradesh. The present fossil wood resembles with *Homalioxylon assamicum* in number of characters but differs from it in being processing 1-5 (mostly 3-4) seriate, xylem rays which are 52 cells high as compared to 1-3 seriate xylem rays with 50 cells height in the present fossil wood. The other species *Homalioxylon mandlaense* is identical to the present fossil as it consist of 1-3 seriate xylem rays. The other anatomical characters of the present fossil wood such as shape and size of the vessel, nature of parenchyma and fibres are also identical to *Homalioxylon mandlaense*. In view of this, the present fossil wood has been described under *Homalioxylon mandlaense* Bande, 1974.

The genus *Homalium* Jacq. consists of 200 species (Willis, 1973) widely distributed throughout the tropics, with numerous representatives in Africa, Indo-Malayan region and tropical America. At least 10 species are indigenous to India and Burma. *Homalium tomentosum* Bentham with which the fossil wood shows close resemblance, grows in some part of Tamil Nadu, Assam and Burma (Gamble, 1972; Pearson & Brown, 1932).

Specimen no.—BSIP 12292.

Family—TILIACEAE

Genus—GREWIOXYLON (Schuster) Prakash & Dayal 1965a

Species—GREWIOXYLON INDICUM Prakash & Dayal, 1965a

Syn. GREWIOXYLON CANALISUM Bande & Srivastava, 1995

Pl. 1·5-7; Pl. 2·5, 6

Material—Small piece of secondary wood measuring 6 cm in length and 3 cm in width.

PLATE 2

Elaeocarpoxylon nawargaonsis sp. nov.

1. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12294/ I.
2. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12294/ II.
3. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 110. Slide no. BSIP 12294/ III.
4. Intervessel pit-pairs of fossil wood. x 110. Slide no. BSIP 12294/ II.

Grewioxylon indicum Prakash & Dayal. 1965a.

5. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 110. Slide no. BSIP 12293/ III.
6. Leaf traces of fossil wood showing their developing stage. x 220. Slide no. BSIP 12293/ II.
7. Leaf traces of modern wood of *Grewia tiliaefolia* Bedd. showing their developing stage. x 220.

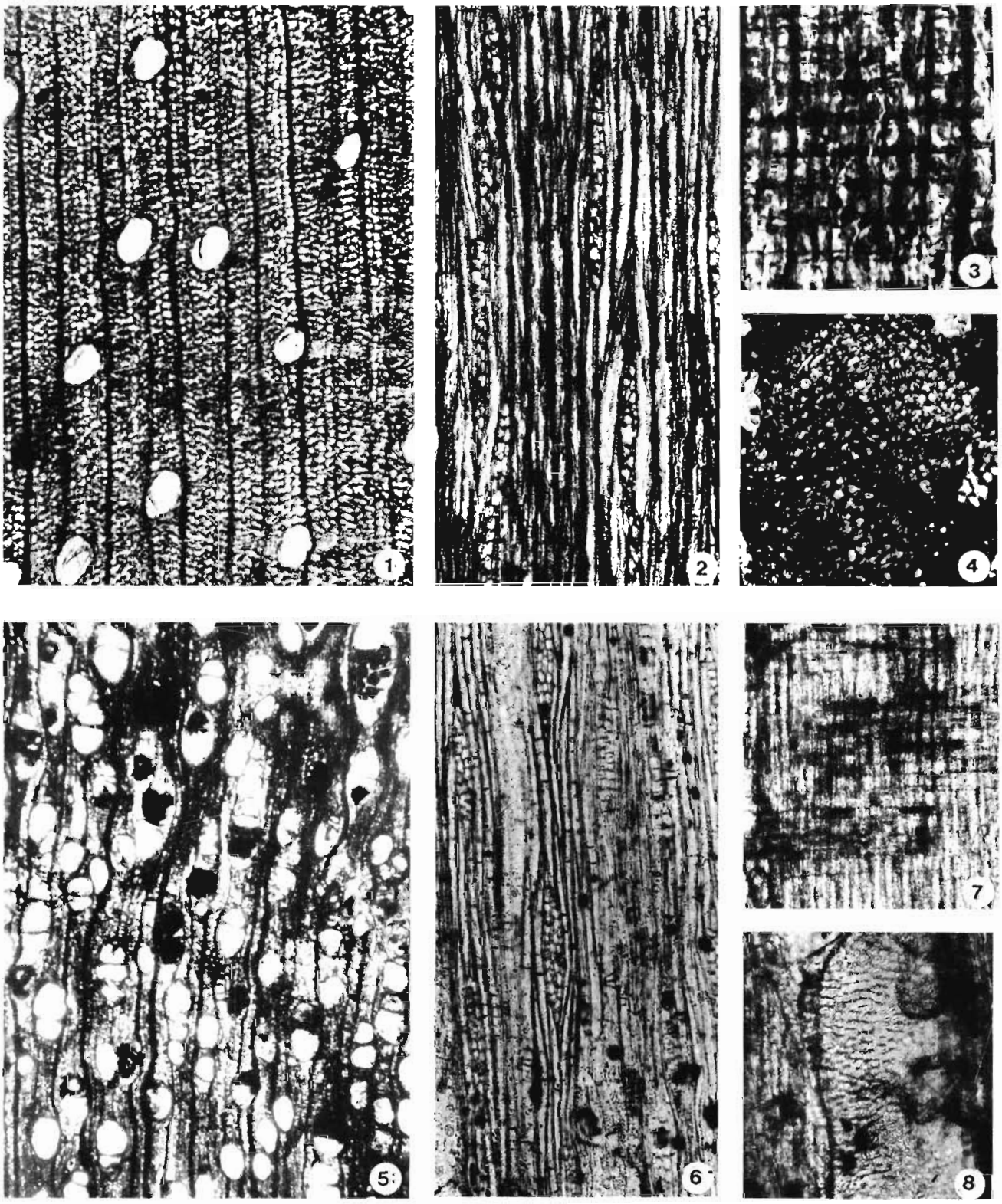


PLATE 3

Description—Wood diffuse porous. *Growth rings* present, delimited by terminal parenchyma and smaller fibre cells (Pl. 1·5). *Vessels* small to medium, rarely very small, t.d. 30-120 µm, r.d. 35-180 µm, solitary and in radial multiples of 2-3, occasionally in tangential pairs or clusters, 10-12 per sq mm, circular to oval, with flat contact walls when in multiples; tyloses observed; vessel members usually 160-450 µm long with tapering ends; perforations simple, intervessel pit-pairs small to medium in size, 4-6 µm in diameter, alternate, bordered with lenticular apertures (Pl. 1·7). *Parenchyma* paratracheal and terminal; paratracheal parenchyma scanty to vasicentric forming narrow sheath around vessels, rarely aliform, cells 10-12 µm in diameter and 300-320 µm in length, terminal parenchyma present (Pl. 1·5). *Xylem rays* 1-7 seriate, mostly 4-5 seriate, 6-8 per mm, divisible into two types; uniseriate rays made up of upright cells, 5-10 cells or 150-320 µm in height, multiseriate rays made up of upright cells as well as procumbent cells, procumbent cells at the center and 4-5 upright cells at one or both the ends, 20-30 cells or 500-675 µm in height (Pl. 1·6); procumbent cells 15-30 µm in tangential height, and 30-45 µm in radial length, upright cells 40-60 µm in tangential height and 12-20 µm in radial length; tile cells present, *Pterospermum* type (Pl. 2·5) leaf traces or knots as hollow space seen in the centre of multiseriate rays (Pl. 2·6). *Fibres* moderately thick-walled, polygonal in cross section, 15-30 µm in diameter, 300-360 µm in length, non septate.

Affinities—The most important anatomical characters of present fossil wood are: vessels small to medium, parenchyma terminal and vesicentric to aliform, ray tissue heterogeneous, xylem rays 1-7 seriate with tile cells of *Pterospermum* type; fibres non-septate. These characters indicate affinities of the fossil wood with that of the extant genus *Grewia* Linneaus of the family Tiliaceae. In order to find out its nearest living equivalent species, thin sections of the woods of several species of *Grewia* Linneaus were examined at Xylaria of the Forest Research Institute, Dehradun and Birbal Sahni Institute of Palaeobotany, Lucknow and it was observed that present fossil wood shows close similarity in all the anatomical features with that of *Grewia tiliaefolia* Linneaus Bedd.

Fossil woods of *Grewia* Linneaus are generally assigned to the genus *Grewioxylon* (Schuster) Prakash & Dayal 1965a. So far, four species of this genus are known from the Deccan Intertrappean beds of India. These are *Grewioxylon intertrappea* Shallom 1963b; *G. mahurzariense* and *G. indicum* Prakash & Dayal 1965a from Mahurzari, Nagpur District, *Grewioxylon* sp. cf. *G. mahurzariense* Prakash & Dayal from Mandla District, Madhya Pradesh (Lakhanpal *et al.*, 1978) and *G. canalisum* Bande and Srivastava 1995 from Nawargaon, Wardha District, Maharashtra & Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

The present fossil wood is almost identical to *Grewioxylon indicum* Prakash & Dayal 1965a in all the xylotomical features. It has been observed that the present fossil specimen possesses leaf traces or knots which giving an appearance of the gum canals. Such features are not reported in the *Grewioxylon indicum*. However, on critical examination of the type slides of *G. indicum*, it was found that the leaf traces or knots-like structure are present in them showing an empty space in the centre of the rays. Thus it is evident that the present fossil specimen is identical to *Grewioxylon indicum* and hence placed in the same species.

Recently, Bande and Srivastava (1995) created a new species *Grewioxylon canalisum* from the Deccan Intertrappean beds of Nawargaon and Mohgaon Kalan on the basis of presence of radial gum canals in the fossil wood. When its type slides were re-examined, it was found that these gum canal like structures are actually leaf traces or knots. From a careful study of the type slides of already known species of *Grewioxylon*, it was found that these leaf traces are very common in them. The comparative study of *G. canalisum* Bande and Srivastava with other known fossil species, it was found that this species is also almost identical to *Grewioxylon indicum* Prakash and Dayal, 1965a.

The genus *Grewia* Linneaus consists of more than 100 species found in tropical to sub-tropical regions from Africa to Queensland. The modern comparable species *G. tiliaefolia* Bedd. distributed presently in north west Provinces, Chittagong,Western Peninsula, south as far as Travancore (Brandis, 1971).

Revised Specific Diagnosis

GREWIOXYLON INDICUM Prakash & Dayal 1965a

Syn.-GREWIOXYLON CANALISUM Bande & Srivastava 1995

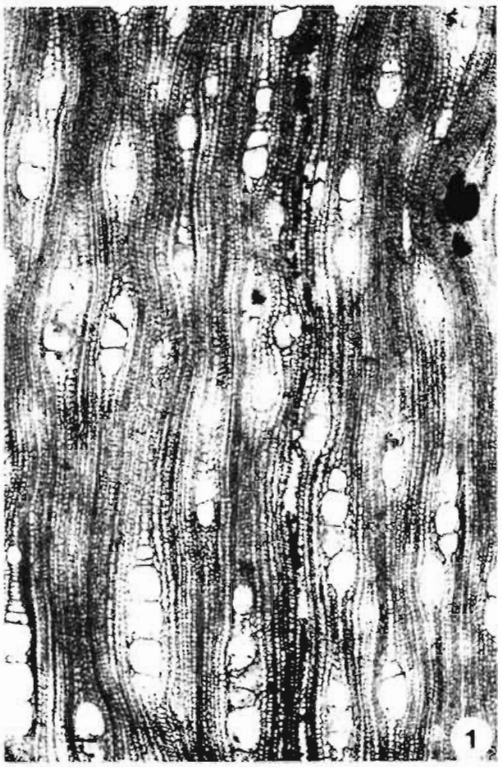
PLATE 3

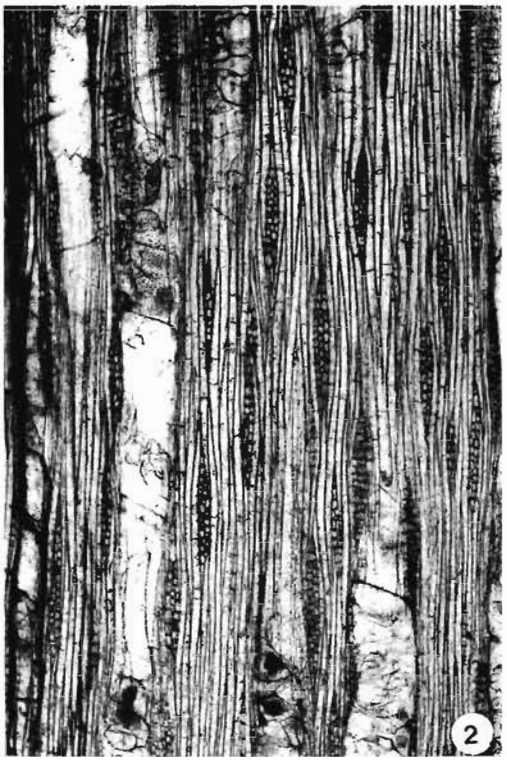
Ailanthoxylon indicum (Prakash) Prakash *et al.*, 1967.

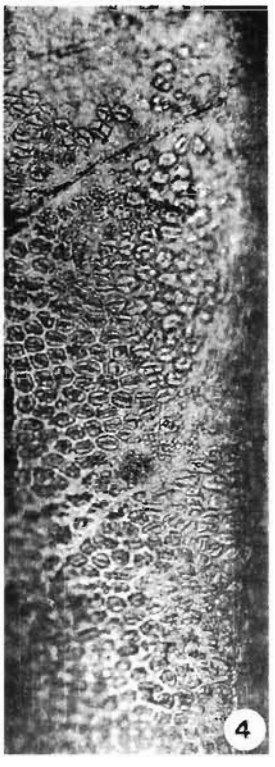
1. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12295/ I.
2. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12295/ II.
3. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 150. Slide no. BSIP 12295/ III.
4. Intervessel pit-pairs of fossil wood. x 550. Slide no. BSIP 12295/ II.

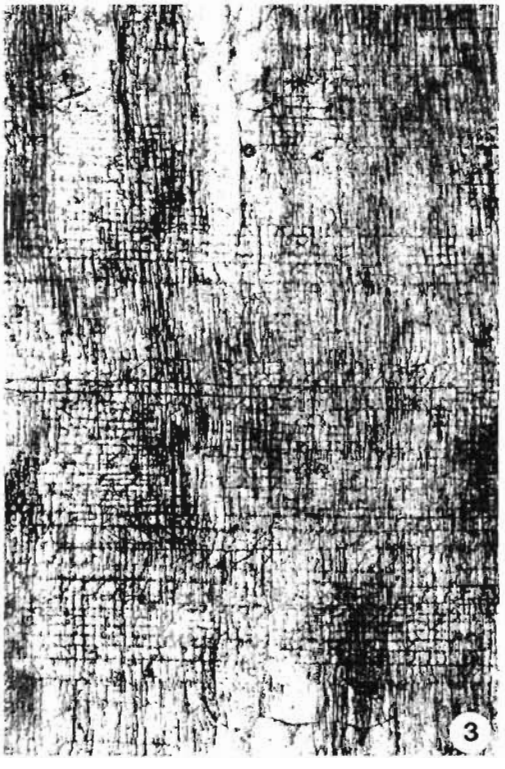
Burseroxylon preserratum Prakash & Tripathi, 1975

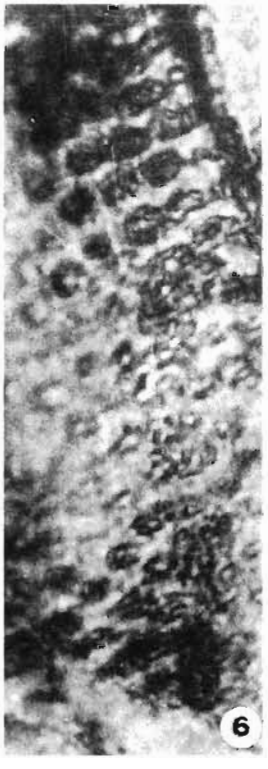
5. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12296/ I.
6. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12296/ II.
7. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 110. Slide no. BSIP 12296/ III.
8. Intervessel pit-pairs of fossil wood. x 450. Slide no. BSIP 12296/ II.











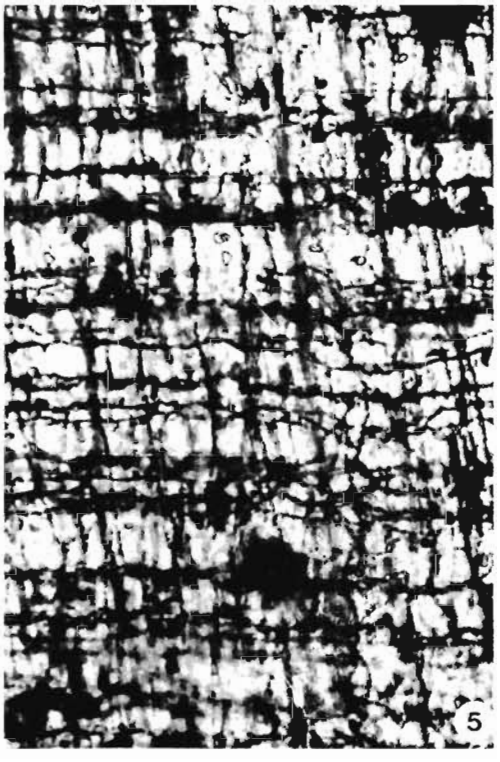


PLATE 4

Wood diffuse porous. *Growth rings* distinct, delimited by narrow lines of terminal parenchyma. *Vessels* mostly small to medium, t.d. 30-180 µm, r.d. 35-225 µm, solitary to radial multiples of 2-3, occasionally in short tengential rows or in clusters of 3-5 cells or more, 5-15 per sq mm; vessel members usually 160-450 µm in length with tapering ends; perforations simple; intervessel pit-pairs 4-8 µm in diameter, alternate to opposite, polygonal in shape with linear apertures. *Parenchyma* paratracheal, forming 2-3 seriate sheath around the vessels, sometimes with lateral extensions of aliform, confluent parenchyma, terminal parenchyma also observed. *Xylem rays* fine to broad, broad multiseriate rays separated by number of uniseriate rays, closely spaced, 6-15 per mm, *Pterospermum* type of tile cells, leaf traces or knots present. *Fibres* non-libriform to semilibriform, polygonal in shape, 10-12 µm in diameter, non-septate.

Specimen no.—BSIP 12293.

Family—ELAEOCARPACEAE

Genus—ELAEOCARPOXYLON (Prakash & Dayal) Prakash & Tripathi, 1975

Species—ELAEOCARPOXYLON NAWARGAONENSIS sp. nov.

Pl. 2·1-4

Material—A small piece of well preserved secondary wood measuring 10 cm in length and 6 cm in width.

Description—Wood diffuse porous (Pl. 2·1). *Growth rings* indistinct. *Vessels* small to medium in size, solitary and in radial multiples of 2-3, t.d. 60-120 µm, r.d. 60-160 µm, 18-22 per sq mm; circular to oval, tyloses not seen, brownish gummy deposits present; vessel-members 240-320 µm in length, with truncate to tailed ends; perforations simple, intervessel pits bordered, alternate, 8-10 µm in diameter, round to polygonal in shape with linear to lenticular apertures (Pl. 2·4). *Parenchyma* scanty paratracheal (Pl. 2·1). *Xylem rays* 1-4 (mostly 3) seriate, 7-8 per mm (Pl. 2·2), ray tissue heterogeneous (Pl. 2·3), uniseriate rays made up of upright cells, 6-11 cells or 300-800 µm in height, multiseriate rays made up of procumbent cells in the centre and upright cells at one or both the ends, 4-50 cells or 180-1575 µm in height, sheath cells present on both sides of the rays; procumbent cells 25-35 µm in tangential height; 85-95 µm in radial length, upright cells 45-115 µm in tangential height; 40-65 µm in radial length. *Fibres* polygonal in cross section, thick-walled, 10-12 µm in diameter, 125-225 µm in length and septate.

Affinities—The important anatomical characters of the present fossil wood are: wood diffuse porous, vessels small to medium, solitary to radial multiples, xylem rays 1-4 seriate with sheath cells; ray tissue heterogeneous, with numerous uniseriate xylem rays, parenchyma scanty paratracheal and fibres septate. These characters indicate its affinities with *Elaeocarpus* and *Echinocarpus* of the family Elaeocarpaceae (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Desch, 1957; Chowdhury & Ghosh, 1958). All the available species of *Elaeocarpus* and *Echinocarpus* were studied in order to get specific affinity at the Xyleria of the Birbal Sahni Institute of Palaeobotany, Lucknow and Forest Research Institute, Dehradun. Besides, the published description and photographs of some more species of this genus (Moll & Jansonius, 1908; Kanehira, 1924; Record, 1925; Lecomote, 1926; Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Desch, 1957; Chowdhury & Ghosh, 1958; Miles, 1978) were also examined and it was found that the woods of *Elaeocarpus robustus* Roxburgh resembles more closely to the present fossil wood.

Prakash & Dayal 1964 instituted the genus *Elaeocarpoxylon* to include the fossil woods having a combination of anatomical characters which occur in mature woods of *Elaeocarpus* and *Echinocarpus*. So far, four species of *Elaeocarpoxylon* are known from Tertiary of India. These are *Elaeocarpoxylon antiquum* Prakash & Dayal 1964 from the Deccan Intertrappean beds of Mahurzari, Nagpur District, Maharashtra; *E. mandlaensis* Lakhanpal, Prakash & Bande from the Deccan Intertrappean beds of Mandla District of Madhya Pradesh (Lakhanpal *et al.*, 1978; Awasthi *et al.*, 1996). *E. hailakandiense* Prakash & Tripathi, 1975 from the Tipam series of Assam and *E. ghughuensis* Awasthi, Mehrotra and Srivastava, 1996 from the Deccan Intertrappean beds of Ghughua, Chhindwara District, Madhya Pradesh.

Elaeocarpoxylon antiquum differs from the present fossil wood, in having traumatic gum canals and large amount of parenchyma in short tangential lines. *E. hailakandiense* and *E. mandlaensis* differ in the size of the vessels and having broader xylem rays (1-8 seriate) and *E. ghughuensis* differs in being presence of growth ring, and 1-3 (Mostly 2) seriate xylem rays as compared to 1-4 seriate xylem rays in the present fossil wood. Thus, after a detailed comparative study it was found that the present fossil is entirely different from all the known species either in size and distribution of vessels or in

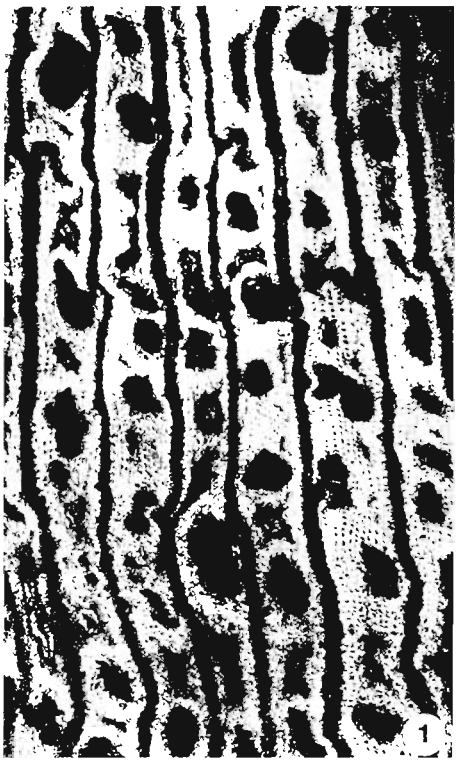
PLATE 4

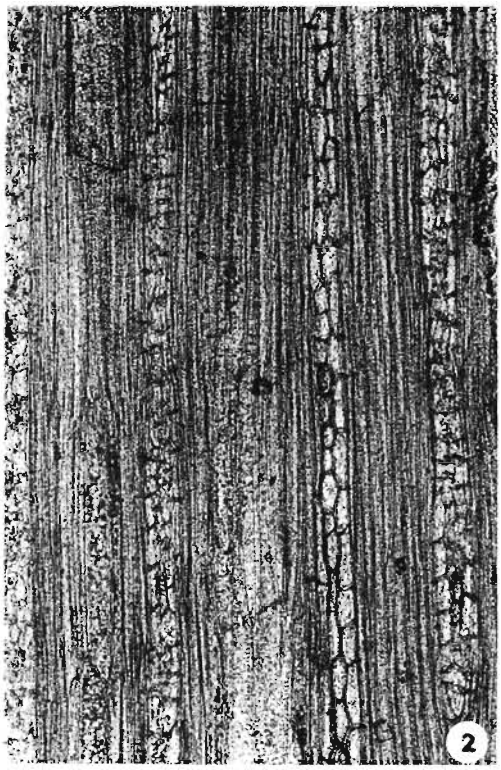
Canarioxylon shahpuraensis Trivedi & Srivastava, 1985

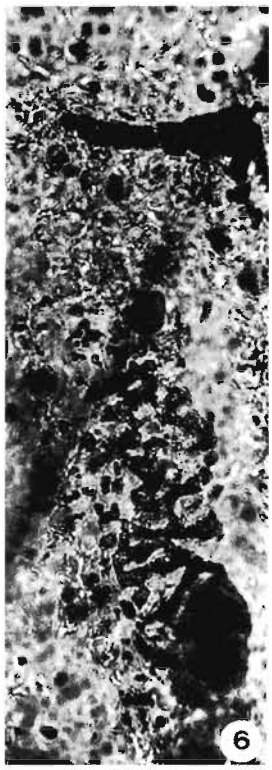
1. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12297/ I.
2. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 90. Slide no. BSIP 12297/ II.
3. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 110. Slide no. BSIP 12297/ III
4. Intervessel pit-pairs of fossil wood. x 400. Slide no. BSIP 12297/ II.

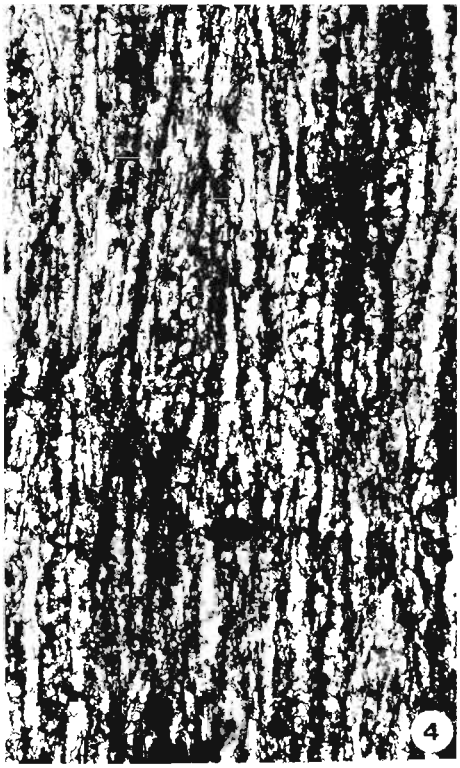
Barringtonioxylon mandlaensis Bande & Khatri, 1980

5. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 150. Slide no. BSIP 12298/ III.
6. Intervessel pit-pairs of fossil wood. x 450. Slide no. BSIP 12298/ II.









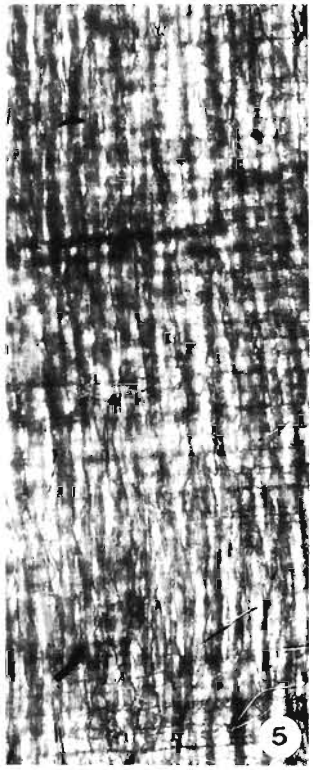


PLATE 5

the nature of xylem rays. Therefore, it is being described as a new species *Elaeocarpoxylon nawargaonensis*.

The genus *Elaeocarpus* Linnaeus consists of 200 species (Willis, 1973) spread over a wide area, most of them found in the Indo-Malayan region. It is also represented in Madagascar, Cochin-China, Phillippines, Formosa, the Pacific Island, and New-Zealand. About 25 species occur in the Indian region. *Elaeocarpus robustus* Roxburgh with which the present fossil wood shows its resemblance grows in the north eastern Himalayas up to 600 m in Sikkim and North Bengal and also in Assam, the Andamans and Malayan Peninsula (Chowdhury & Ghosh, 1958).

Specific diagnosis

ELAEOCARPOXYLON NAWARGAONENSIS sp. nov.

Wood diffuse porous. *Growth rings* indistinct. *Vessels* small to medium in size, occasionally solitary, mostly radial rows of 2-3, 18-22 per sq mm, t.d. 60-120 µm, r.d. 60-160 µm; vessel members 240-320 µm in length, perforations simple; inter vessel pits bordered, alternate, 8-10 µm in diameter, with linear to lenticular apertures. *Parenchyma* scanty paratracheal. *Xylem rays* 1-4 seriate, ray tissue heterogeneous, with numerous uniseriate rays, uniseriate rays made up of upright cells, 6-11 cells or 300-480 µm in height; multiseriate rays with sheath cells 6-50 cells or 180-1575 µm in height. *Fibres* septate.

Specimen no.—BSIP 12294.

Entymology—After fossil locality.

Family—SIMAROUBACEAE

Genus—AILANTHOXYLON Prakash 1959

Species—AILANTHOXYLON INDICUM (Prakash) Prakash *et al.* 1967

(Pl. 3·1-4; Pl. 5·3-6)

Material—A well preserved secondary wood measuring 15 cm in length and 8 cm in diameter.

Description—Wood diffuse porous. *Growth rings* absent. *Vessels* small to medium, t.d. 75-150 µm, r.d. 135-195 µm, 8-10 per sq mm, solitary as well as in radial multiples of 2-3, circular to oval when solitary, tyloses not observed (Pl. 3·1; Pl. 5·3), vessel members 150-300 µm in height, truncate to oblique ends, perforations simple, inter vessel pit-pairs 8-10 µm in diameter, bordered, alternate with lenticular apertures (Pl. 3·4). *Parenchyma* paratracheal, aliform to confluent and also in short, thin tangential bands (Pl. 3·1; Pl. 5·1). *Xylem rays* 1-3 (mostly 2) seriate, 9-11 per mm, 3-12 cells or 75-225 µm in height (Pl. 3·2; Pl. 5·4), ray tissues homogeneous, made up of procumbent cells (Pl. 3.3; Pl. 5·5). *Fibres* thick walled, non-septate.

Affinities—The above anatomical characters of the present fossil wood such as mostly solitary, small to medium sized vessels, paratracheal, aliform to confluent parenchyma, 1-3 (mostly 2) seriate, homogeneous xylem rays and non-septate fibres, indicate its affinity with the modern genus *Ailanthus* Desf. of the family Simaroubaceae (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Kribs, 1959). On critical examination of wood slides of all the available species of *Ailanthus*, viz., *A. altissima* Mill, *A. glandulosa* Desf, *A. excelsa* Roxb., *A. grandis* Prain, *A. kurzii* Prain, *A. malabarica* DC. at the Xylaria of the Forest Research Institute, Dehradun and Birbal Sahni Institute of Palaeobotany, Lucknow. It was found that the fossil shows close resemblance with *A. grandis* Prain and *A. malabarica* DC. in the nature and distribution of parenchyma, xylem rays, fibres and intervessel pits. However, the former differs from the fossil in size and distribution of vessels which are smaller and more frequent as compared to the fossil wood. In shape, size and vessel distribution, the fossil shows close resemblance with *A. malabarica* DC., although the amount of parenchyma in this species is comparatively less than the fossil.

Prakash (1959) instituted the genus *Ailanthoxylon* to include the fossil woods showing close resemblance with the genus *Ailanthus* Desf. So far, five fossil woods have been described under this genus from India. They are *Ailanthoxylon indicum* Prakash 1959 from Mohgaonkalan, Chhindwara District, Madhya Pradesh; *A. mahurzariense* Shallom 1961 from Mahurzari, District Nagpur, Maharashtra; *A. pondicherriense* Navale 1964 from Cuddalore, South India; *A. scantiporosum* Ramanujam 1960 from Mortandra, South Arcot, Madras. Later on Mehrotra 1990 described an other fossil wood under *A. indicum* Prakash from Deccan Intertrappean beds. The present fossil wood has been compared

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PLATE 5

Barringtonioxylon mandlaensis

1. Cross section of the fossil wood showing shape, size and distribution of vessels and parenchyma. x 45. Slide no. BSIP 12298/ I.
2. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12298/ II.

Ailanthoxylon indicum (Prakash) Prakash *et al.*, 1967

3. Cross section of the pith region of fossil wood showing shape, size and distribution of vessels and apotracheal parenchyma. x 45. Slide no. BSIP 12299/ I.
4. Tangential longitudinal section of the fossil wood showing nature of xylem rays and fibres. x 110. Slide no. BSIP 12299/ II.
5. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 110. Slide no. BSIP 12299/ III.
6. Intervessel pit-pairs of fossil wood. x 110. Slide no. BSIP 12299/ II.

FOSSIL TAXA	MODERN COMPARABLE TAXA	DISTRIBUTION	TROPICAL FOREST TYPE
DICOTYLEDONS			
Flacourtiaceae			
Homalioxylon mandlaense Bande, 1974	*Homalium tomentosum* Jacq.	Sub- Himalaya tract, Western & southern India	Deciduous
Tiliaceae			
Grewioxylon indicum Prakash & Dayal, 1965a	*Grewia tiliaefolia* Bedd.	Western Ghats	Moist deciduous
Elaeocarpaceae			
Elaeocarpoxylon nawargaonensis	*Elaeocarpus robustus* Roxb.	Eastern Himalayas, Sikkim & North Bengal Chittagong, Andamans & Malaya Peninsula	Evergeen
Rutaceae			
Evodinium intertrappeum Shete & Kulkarni, 1982	*Evodia roxburghiana*	Western & southern India, Andamans	Evergeen to moist deciduous
E. indicum Bande & Prakash, 1984	-do-	-do-	-do-
Simaroubaceae			
Ailanthoxylon indicum Mehrotra, 1990	*Ailanthus malabarica* DC	Western Ghats central India, south India	Deciduous
Burseraceae			
Canarioxylon shahpuraensis Trivedi & Srivastava, 1985	*Canarium strictum* Roxb.	Western Ghats, Bombay, Mysore & Travancore	Deciduous
Burseroxylon preserratum Prakash & Tripathi, 1975	*Bursera serrata* Wall.	Garo Hills, Rajmahal Hills, Santhal Pargana & Eastern Ghats	Wet Evergreen
Meliaceae			
Amooroxylon deccanensis Bande & Prakash, 1984	*Amoora rohituka* W.&A.	Western Ghats, Konkan, Karnataka, Andamans, Assam, Sylhet	Evergreen to moist deciduous
Fabaceae			
Aeschynomenoxylon nawargaonensis Shete & Kulkarni, 1982	*Aeschynomene indica* Linn.	Throughout India	Evergreen
Lecythidaceae			
Barringtonioxylon mandlaensis Bande & Khatri, 1980	*Barringtonia racemosa* Blume	Bengal, Assam, Madhya Pradesh, Coastal districts of Peninsula	Wet evergreen
Sonneratiaceae			
Sonneratioxylon preapetalum Shete & Kulkarni, 1982	*Sonneratia apetala* Ham.	West Bengal, Konkan Coromandal, Myanmar, Srilanka	Wet evergreen
Myrsinaceae			
Ardisioxylon indicum Shete & Kulkani, 1982	*Ardisia involucrata* Kurz. *A. solanacea* Roxb.	Sikkim Himalayas and Throughout India	Moist deciduous to Evergreen

Bignoniaceae			
Heterophragmoxylon indicum Shete & Kulkarni, 1982	*Heterophragma adenophyllum* Seem.	Assam, East Bengal & Myanmar	Moist deciduous
Verbenaceae			
Gmelina tertiara Bande, 1987	*Gmelina arborea* Linn.	Burma, Uttar Pradesh, Lower Himalaya, Sub-Himalaya, Bombay, South India	Moist deciduous
Aristolochiaceae			
Aristolochioxylon prakashii Kulkarni & Patil, 1977a	*Aristolochia* Linn.	Assam, Myanmar, South India & Bengal	Deciduous
Euphorbiaceae			
Paraphyllanthoxylon palaeoemblica Prakash, Bande & Lalitha, 1986	*Phyllanthus emblica* Linn.	India & Myanmar	Moist deciduous
P. deccanensis sp. nov.	-do-	-do-	-do-
P. wardhaensis sp. nov.	-do-	-do-	-do-
Arecaceae			
Palmoxylon nawargaonensis Shukla, 1941	Palmae	Coastal region	Evergreen
P. livistonoides Prakash & Ambwani, 1980	*Livistona* Rob. Brown	-do-	Evergreen
P. arviensis Ambwani, 1981	Palmae	-do-	Evergreen
P. sclerodermum Shukla, 1946	Palmae	-do-	Evergreen
P. deccanense Sahni, 1964	Palmae	-do-	Evergreen
P. hyphaeneoides Rao & Shete, 1989	*Hyphaene* Gaertn.	Western Coast, Goa	Wet Evergreen
Palmocaulon hyphaeneoides Shete & Kulkarni, 1980	*Hyphaene* Gaertn.	Western Coast, Goa	Wet Evergreen
P. costapalmatum Kulkarni & Patil, 1977b	Palmae	Wetern Coast, Goa	Evergreen
Palmocarpon coryphoidium Shete & Kulkarni, 1985	Palmae	Western Coast, Goa	Evergreen
Borassus palm root Ambwani, 1981	*Borassus flabellifer* Linn.	Andaman & Nicobar, Bengal, Malabar coast, Coromandal coast	Littoral and Swampy
Rhizopalmoxylon borassoides Awasthi, Mehrotra & Khare, 1996	*Borassus flabelifer* Linn.	-do-	Littoral and Swampy

Fig. 2—Present distribution and forest types of comparable taxa recovered from Nawargaon, Wardha District, Maharashtra.

with all the known fossil woods and it is found that present fossil is more or less identical to *A. indicum* Prakash described from the Deccan Intertrappean beds of Madhya Pradesh, India and therefore, it is being placed under the same species.

The genus *Ailanthus* Desf. is represented by 10 species of trees (Santapau & Henry, 1973) distributed in South Asia, Malaya, China and Australia (Pearson & Brown, 1932). In India, it is represented by four species. The modern equivalent species *A. malabarica* DC is found in the forest of the Western Ghats up to 500 ft and in South Canara (Pearson & Brown, 1932; Ghosh, 1963).

Specimen nos.—BSIP 12295, 12299.

Fossil Plants form of Nawargaon	Mandla	Nagpur-Chhindwara	Bombay-Malabar-Worli Hills	Rajahmundry
Flacortiaceae				
Homalioxylon mandlaense	+	+	–	–
Tiliaceae				
Grewioxylon indicum	+	+	–	–
Elaeocarpaceae				
Elaeocarpoxylon nawargaonensis	+	+	–	–
Rutaceae				
Evodinium intertrappeum	+	+	–	–
E. indicum	+	+	–	–
Simaroubaceae				
Ailanthoxylon indicum	+	+	–	–
Burseraceae				
Canarioxylon shahpuraensis	+	+	–	–
Burseroxylon preserratum	+	+	–	–
Meliaceae				
Amooroxylon deccanensis	+	+	–	–
Fabaceae				
Aeschynomenoxylon nawargaonensis	+	+	–	–
Lecythidaceae				
Barringtonioxylon mandlaensis	+	+	–	–
Sonneratiaceae				
Sonneratioxylon preapetalum	+	+	–	–
Myrsinaceae				
Ardisioxylon indicum	–	–	–	–
Bignoniaceae				
Heterophragmoxylon indicum	–	–	–	–
Verbinaceae				
Gmelina tertiara	+	–	–	–
Aristolochiaceae				
Aristolochioxylon prakashii -	–	–	–	–
Euphorbiaceae				
Paraphyllanthoxylon palaeoemblica	+	+	–	–
Arecaceae				
Palmoxylon nawargaonensis	–	–	–	–
P. sclerodermum	+	–	–	–
P. livistonoides	–	–	–	–
P. arviensis	–	–	–	–
P. intertrappeum	–	+	–	–
P. deccanense	–	–	–	–
P. hyphaeneoides	+	–	–	–
Palmocaulon hyphaeneoides	–	–	–	–
P. costapalmatum	–	–	–	–
Palmocarpon coryphoidium	–	–	–	–
Borassus sp.	+	–	–	–
Rhizopalmoxylon borassoides -	–	–	–	–

Fig. 3—Showing comparison of the taxa from Nawargaon area with the known Deccan Intertrappean Assemblages.

Family—BURSERACEAE

Genus—BURSEROXYLON Prakash & Tripathi, 1975

Species—BURSEROXYLON PRESERRATUM Prakash & Tripathi, 1975

(Pl. 3·5-8)

Material—A piece of well preserved secondary wood measuring 7 cm in length and 5 cm in width.

Description—Wood diffuse porous. *Growth rings* absent. *Vessels* small to medium in size, t.d. 40-120 µm, r.d. 80-160 µm, 15-20 per sq mm, solitary and in radial multiples of 2-4, uniformly distributed, circular to oval, with flat contact walls when in multiples, sometimes filled with brownish gum deposits (Pl. 3·5), vessel-members 80-360 µm in length with truncate to tapering ends, perforations simple, intervessel pit pairs 6-8 µm in diameter, alternate, bordered, polygonal with lenticular apertures (Pl. 3·8). *Parenchyma* scanty paratracheal to vasicentric, forming 1-2 cells thick sheath around vessels; cells 12-15 µm in diameter, 195-225 µm in height (Pl. 3·5-6). *Xylem rays* 1-3 (mostly 2) seriate, 13-15 per mm; ray tissue heterogeneous (Pl. 3·7), uniseriate rays made up of procumbent cells, 4-7 cells or 90-105 µm in height, multiseriate rays made up of procumbent in the center and upright cells at one or both ends (Pl. 3·6), 3-9 cells or 105-600 µm in height; procumbent cells 10-12 µm in tangential height and 12-15 µm in radial length, upright cells 25-30 µm in tangential height and 10-12 µm in radial length (Pl. 3·7). *Fibres* thin-walled, 20-25 µm in diameter and 380-825 µm in length, septate (Pl. 3·6).

Affinities—The important anatomical characters of present fossil wood are: vessels small to medium in size, parenchyma scanty paratracheal to vasicentric, xylem rays 1-3 seriate, ray tissue heterogeneous, fibres septate. These features obviously indicate the affinities of the fossil wood with that of the genus *Bursera* Linneaus of the family Burseraceae (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Kribs, 1959; Ghosh *et al.*, 1963).

From a detailed comparison with the woods of various species of *Bursera* Linneaus available at the Xylaria of the Birbal Sahni Institute of Palaeobotany, Lucknow and Forest Research Institute, Dehradun, it was found that the fossil shows maximum resemblance with *Bursera serrata* Wallich.

Prakash and Tripathi (1975) instituted the genus *Burseroxylon* to include fossil woods belonging to modern genus *Bursera*. So far two species of this genus have been described from Tertiary of India. These are *Burseroxylon preserratum* Prakash & Tripathi from Hailakandi, Assam, (Prakash & Tripathi, 1975), from the Deccan Intertrappean beds of Mandla District (Bande & Prakash, 1983) and from Siwalik sediments of Uttar Pradesh (Prasad, 1993) and *B. garugoides* Lakhanpal, Prakash & Awasthi 1981 from Deomali, Arunachal Pradesh. After a detailed comparative study it was found that the present fossil wood shows close resemblance with *Burseroxylon preserratum* Prakash & Tripathi, 1975 therefore it is placed under the same species.

The genus *Bursera* Linneaus consists of 80 species widely distributed in tropical America, (Willis, 1973) *Bursera serrata* Wallich with which the present fossil wood shows resemblance is found in moist zone of Bengal, Assam, Orissa, Bangladesh and tropical forests of Upper and Lower Myanmar. It also grows in Eastern Ghats and the Rajasthan especially in the valley along water courses (Pearson & Brown, 1932).

Specimen no.—BSIP 12296.

Family—BURSERACEAE

Genus—CANARIOXYLON Prakash, Brezinova & Awasthi, 1974

Species—CANARIOXYLON SHAHPURAENSIS Trivedi & Srivastava, 1985

(Pl. 4·1-4)

Material—A small piece of well preserved secondary wood measuring 10 cm in length and 4·5 cm in width.

Description—Wood diffuse porous. *Growth rings* not observed. *Vessels* small to medium in size, rarely very small, t.d. 60-160 µm, r.d. 80-180 µm, 12-15 per sq mm, solitary and in radial multiples of 2-9, uniformly distributed, circular to oval, with flat contact walls when in multiples, tylosed (Pl. 4·1); vessel-members 65-250 µm in length with oblique to horizontal ends; perforations simple; intervessel pit-pairs bordered, alternate, 8-10 µm in diameter, angular in shape with linear apertures (Pl. 4·4). *Parenchyma* scanty paratracheal, occurring as a few cells around vessels (Pl. 4·1), circular to oval in shape. *Xylem rays* 1-3 (mostly 2) seriate, ray tissues heterogeneous (Pl. 4·2, 3); rays 10-12 per mm, occasionally end fusion observed, uniseriate rays made up of upright to square cells and 5-13 cells or 75-195 µm in height, multiseriate rays made up of procumbent cells in the centre with 1-2 upright cells at one or both the ends, 7-9 cells or 225-450 µm in height; procumbent cells 20-40 µm in radial length and 18-20 µm in tangential height, upright cells 18-20 µm in radial length and 16-32 µm in tangential height. *Fibres* angular in cross section, 10-15 µm in diameter and 375-725 µm in height, septate (Pl. 4·2).

Affinities—The important anatomical characters of present fossil wood are: small to medium, solitary to radial multiple vessels with tyloses, large angular intervessel pits, scanty paratracheal parenchyma, 1-3 (mostly 2) seriate heterogeneous xylem rays and septate fibres. These features strongly indicate the affinity of the fossil with the woods of the genus *Canarium* Linneaus. of the family Burseraceae. A detailed comparison with the woods of various species of this

genus revealed that the fossil shows maximum resemblance with the modern woods of *Canarium strictum* Roxburgh.

Prakash, Brezinova and Awasthi 1974 instituted the genus *Canarioxylon* to include the fossil woods belonging to the modern genus *Canarium*. So far, only four species of this genus have been described from India and abroad. These are *Canarioxylon ceskobudejovicense* Prakash *et al.* 1974 from the Tertiary of South Bohemia, *C. indicum* Ghosh & Roy from the Tertiary of West Bengal (Ghosh & Roy, 1978), from Assam (Awasthi & Mehrotra, 1993), *C. shahpuraensis* Trivedi & Srivastava (1985) from the Deccan Intertrappean beds of Mandla and *Canarium palaeoluzonicum* Awasthi & Srivastava (1989) from the Tertiary of Kerala Coast. The present fossil wood has been compared with above already known species and it was found that this is identical to *Canarioxylon shahpuraensis* Trivedi & Srivastava 1985 and therefore it has been placed under the same species. The present fossil wood has also been compared with the Burceraceous fossil wood, *Burseroxylon preserratum* described earlier in this text and it is found that this fossil wood differs from that in being possessing comparatively smaller vessel without gum deposits with large sized intervessel pits. Further the xylem rays are comparatively fine and less in height.

Canarium Linneaus. is a genus of usually trees, occasionally shrubs and consists of approximately 100 species, out of which only 8 species occur in India (Santapau & Henry, 1973) *Canarium strictum* Roxburgh with which fossil shows resemblance is an evergreen tree found in Western Ghats up to 4500 ft from Konkan southwards (Brandis,1971).

Specimen no.—BSIP 12297.

Family—LECYTHIDACEAE

Genus—BARRINGTONIOXYLON Shallom, 1960

Species—BARRINGTONIOXYLON MANDLAENSIS Bande & Khatri, 1980

(Pl. 4·5, 6; Pl. 5·1, 2)

Material—A small piece of well preserved secondary wood measuring 15 cm in length and 7 cm in width.

Description—Wood diffuse porous. *Growth rings* absent. *Vessels* small to medium, solitary and radial multiples of 2-3, 12-15 per sq mm (Pl. 5·1), circular to oval, t.d. 80-120 μm, r.d. 120-160 μm, tyloses present; vessel-members, 240-320 μm in length with truncate to tapering ends; perforations simple, intervessel pit-pairs large, 10-12 μm in diameter, alternate, bordered with linear apertures (Pl. 4·6). *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma represented by narrow sheath of 1-2 cells around the vessels, apotracheal parenchyma poorly preserved, diffuse to diffuse in aggregate forming 1-2 cells thick tangential lines (Pl. 5·1). *Xylem rays* 1-4 (mostly 3) seriate, 5-6 per mm, ray tissue heterogeneous (Pl. 4·5), rays both uniseriate and multiseriate; uniseriate rays made up of upright cells only, 4-13 cells or 75-225 μm in height, multiseriate rays made up of procumbent cells in the center and 5-8 upright cells at one or both the ends, 35-52 cells or 2400-3600 μm in height; procumbent cells 35-45 μm in radial length, 15-20 μm in tangential height; upright cells 15-25 μm in radial length, 45-48 μm in tangential height; sheath cells present (Pl. 5·2). *Fibres* libriform to non-libriform and non-septate.

Affinities—The diagnostic features of the present fossil wood are; small to medium, solitary to radial multiple of 2-3, tylosed vessels, both apotracheal and paratracheal parenchyma, 1-4 seriate, heterogeneous, xylem rays, presence of sheath cells and large intervessel pits. The above features indicate its affinities with the woods of the family Lecythidaceae especially with the genus *Barringtonia* Forst. (Metcalfe & Chalk, 1950; Pearson & Brown, 1932). After critical examination of wood slides of all the available species of this genus it was found that the present fossil wood closely resembles the wood of *Barringtonia racemosa*. Blume.

Shallom (1960) instituted the genus *Barringtonioxylon* to include fossil woods of *Barringtonia* Forst. Six species of *Barringtonioxylon* have been described so far, from various parts of India. These are *Barringtonioxylon deccanense* Shallom 1960, *B. eopterocarpum* Prakash & Dayal 1965b, *B. mandlaensis* Bande & Khatri 1980, from the Deccan Intertrappean beds of Mandla, *B. arcotense* Awasthi 1970 from the Tertiary of South India and *B. assamicum* Prakash & Tripathi, 1972 from the Tertiary of Assam. Lastly a fossil wood resembling *B. deccanense* Shallom has also been described from Namsang River beds, Deomali, Arunachal Pradesh (Awasthi & Mehrotra, 1993). From a comparative study with those known fossil woods it was concluded that the present fossil wood closely resembles *Barringtonioxylon mandlaensis* and hence it is being placed under it.

The genus *Barringtonia* Forst. comprises about 100 species of small to medium sized trees, characteristic of beach forests of Australia, Malaya, Myanmar, India and Sri Lanka. They occur along the stream and swamps. Three species are reported from India which are distributed in Andaman and Nicobar Islands, sub Himalayan tracts from Ganga eastwards to Bengal and Assam, West Coast, Madhya Pradesh, and coastal districts of the peninsula, along the bank of rivers and swampy land. The comparable species *B. racemosa* Blume with which fossil shows close resemblance is an evergreen tree found to grow in West Coast from the Konkan southwards near rivers and back waters but also in land in Sunderban, Andmans, Nicobars, Ceylon, Malaya Peninsula and Polynesia (Brandis, 1971).

Specimen no.—BSIP 12298.

DISCUSSION

The whole Deccan Intertrappean flora constituted by the plant fossils preserved in the sediments deposited between

successive lava flows can be considered to the most important flora of Palaeogene period in India. The flora consists of stem, roots, leaves, flower, fruits, seed and other organs representing all the major group of plant kingdom. The present fossil assemblage recovered from the Deccan Intertrappean beds of Nawargaon area in the Wardha District of Maharashtra comprises a variety of fossil woods. These fossil woods have been compared with the living ones in order to show their botanical affinities. With addition of seven new taxa viz., *Homalioxylon mandlaensis, Grewioxylon indicum, Elaeocarpoxylon nawargaonensis, Ailanthoxylon indicum, Burseroxylon preserratum, Canarioxylon shahpuraensis, Barringtonioxylon mandlaensis* described in the present paper, the megafossil (wood) assemblage of Nawargaon area consists of 17 species of dicotyledons belonging to 16 genera of 15 families. Besides 13 monocot species based on wood, leaf, fruit and rhizome of the family Arecaceae have also been reported from this area. An analysis of the floral assemblage with respect to the forest types (Fig. 2) revealed that the flora was dominated by evergreen elements followed by moist deciduous elements excepting a few taxa among them which still occur in Central India (Deccan Intertrappean area). Most of the equivalent modern species of Deccan Intertrappean flora of Nawargaon area are distributed in the tropical evergreen to most deciduous forests of Western Ghats, Andaman Islands and North east regions. Thus, it is broadly concluded that warm humid climate with high precipitation prevailed in Nawargaon area during sedimentation. More over, the presence of several palm species in Deccan Intertrappean beds of Nawargaon area indicates the occurrence of Tropical littoral and swampy forest in the Central India during Early Tertiary Period. Bande *et al.* (1988) analysed the fossil flora recovered from various Deccan Intertrappean localities and recognised them into four different floral assemblage, viz., (1) Rajahmundry assemblage (2) Nagpur-Chhindwara assemblage (3) Bombay-Malabar-Worli Hills assemblage (4) Mandla assemblage. Keeping in view the above four floral assemblages, the present assemblage recovered from Deccan Intertrappean beds of Nawargaon area has been compared with them and found that the most of the taxa from Nawargaon area are common to the Mandla and Nagpur-Chhindwara assemblages (Fig. 3). The important common elements among both the assemblages are *Homalioxylon mandlaensis, Grewioxylon indicum, Elaeocarpoxylon nawargaonensis, Evodinium intertrappium, Ailanthoxylon indicum, Burseroxylon preserratum, Canarioxylon shahpuraensis, Amooroxylon deccanensis, Aeschynomenoxylon nawargaonensis, Barringtonioxylon mandlaensis, Sonneratioxylon preapetalum* and *Paraphyllanthoxylon palaeoemblicum*. In view of this it is concluded that the most parts of Deccan Intertrappean region were flourished with evergreen to moist deciduous type of forests having almost similar type of taxa under warm humid climate.

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