FOSSIL WOODS FROM THE TERTIARY OF WEST BENGAL, INDIA

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ABSTRACT

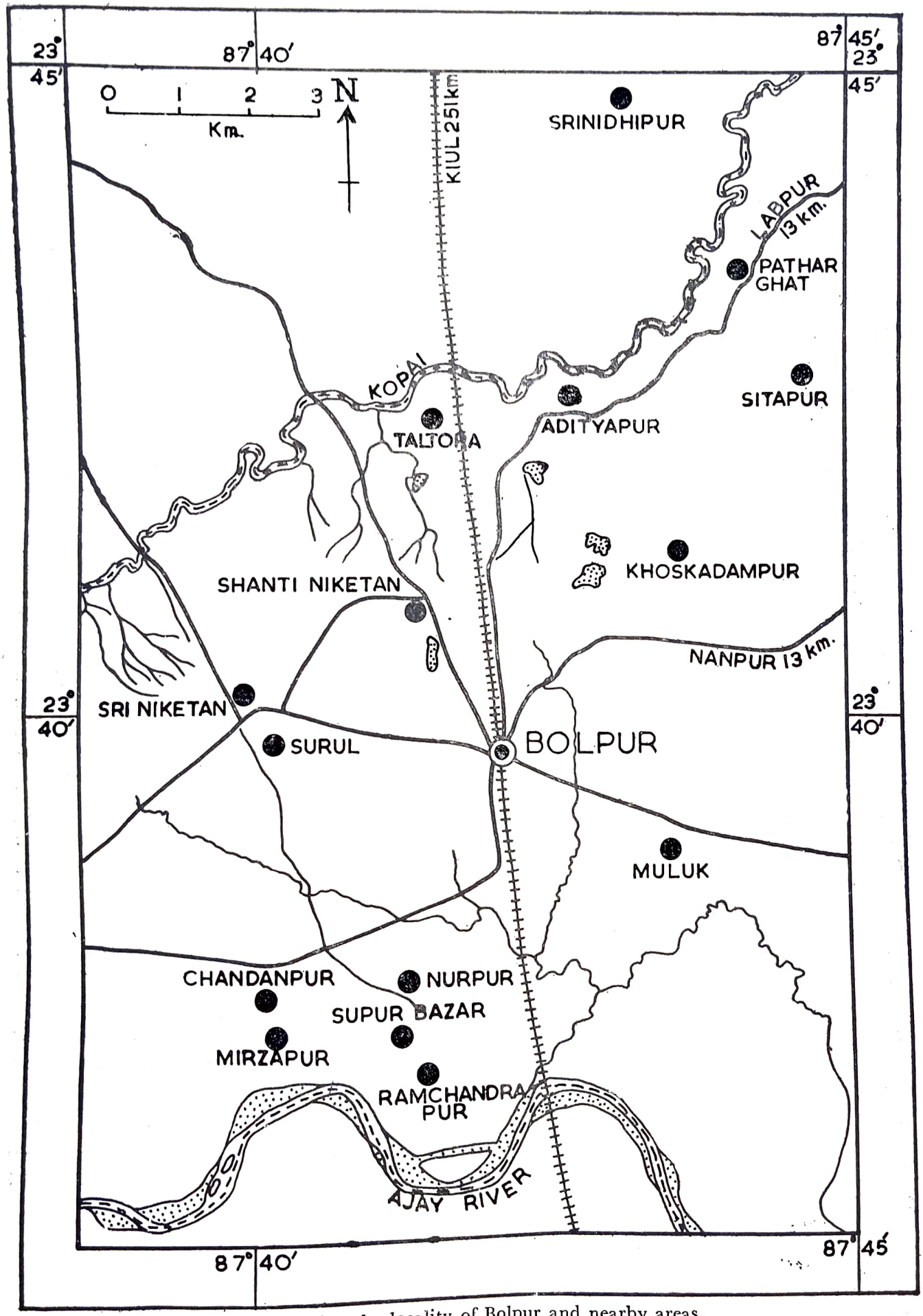
Seven fossil woods viz., *Shoreoxylon tipamense* Prakash & Awastni, *Cassinium barooahii* (Prakash) Prakash, *Cynometroxylon holdeni* (Gupta) Prakash & Bande, *Koompassioxylon elegans* Kramer, *Millettioxylon pongamiensis* Prakash, *Ormosioxylon bengalensis* gen. *et* sp. nov. and *Peltophoroxylon ferrugineoides* sp. nov. have been described from the Tertiary of West Bengal. These resemble the modern woods of *Shorea assamica* of Dipterocarpaceae and *Cassia siamea*, *Cynometra ramiflora*—*C. polyandra*, *Koompassia malaccensis*, *Millettia prainii*, *Ormosia robusta*—*O. watsonii* and *Peltophorum ferrugineum* of Leguminosae, respectively. The assemblage indicates a Neogene age for these woods.

INTRODUCTION

Although the first report about the occurrence of angiospermous fossil woods from the Tertiary of West Bengal goes back to the year 1943 (GHOSH, 1943), practically no work was done on them till recently when DEB AND GHOSH (1974) and GHOSH AND ROY (1978, 1979a, 1979b, 1979c, 1979d, 1979e, 1980) described a number of dicot woods from the Tertiary formations of this region. The fossil woods so far described are *Glutoxylon burmense* (Holden) CHOWDHURY by CHOWDHURY AND TANDON (1952), *Pahudioxylon bankurensis* CHOWDHURY *et al.* (1960), *Terminalioxylon* sp. DEB AND GHOSH (1974), *Canarioxylon indicum* GHOSH AND ROY (1978), *Millettioxylon bengalensis* GHOSH AND ROY (1979a), *Dracontomelumoxylon mangiferumoides* GHOSH AND ROY (1979b), *Dipterocarpoxylon bolpurense* GHOSH AND ROY (1979c), *Chisochetonoxylon bengalensis* GHOSH AND ROY (1979d), *Calophylloxylon bengalensis* GHOSH AND ROY (1979e) and *Anisopteroxylon shantiniketanensis* GHOSH AND ROY (1980) resembling the extant genera *Gluta*, *Afzelia-Intsia*, *Terminalia*, *Canarium*, *Millettia*, *Dracontomelum*, *Dipterocarpus*, *Chisocheton*, *Calophyllum* and *Anisoptera*, respectively. Of these, *Millettioxylon bengalensis* and *Glutoxylon burmense* have been described from near Garbeta in Midnapur District, *Pahudioxylon bankurensis* from the Upper Miocene beds of Bankura, *Dracontomelumoxylon mangiferumoides* and *Chisochetonoxylon bengalensis* from Labpur in Birbhum District and the rest from the vicinity of Santiniketan near Bolpur in Birbhum District. From the last locality ROY AND GHOSH (1979b) have further described two fossil woods *Glutoxylon burmense* (Holden) CHOWDHURY and *Anogeissusoxylon bengalensis* showing affinities to the modern woods of *Gluta* and *Anogeissus*, respectively.

From the adjoining areas of present day Bangla Desh, SEN (1930) reported a fossil wood as *Dipterocarpoxylon* from the Pliocene of Lalmai Hills in Comilla, which was later transferred to *Glutoxylon* by MUKERJEE (1942a). MUKERJEE (1942b, 1942c) further described a species of *Glutoxylon bengalensis* from the Tertiary of Mainamati Hills, a few miles from Comilla.

In the present paper the authors describe seven more fossil dicot woods collected from the Mayurkashi canal cutting near Santiniketan, about 4 km north of Bolpur (Map 1). The woods described are *Shoreoxylon tipamense* PRAKASH AND AWASTHI (1970), *Cassinium barooahii* (PRAKASH) Prakash (1975), *Cynometroxylon holdeni* (GUPTA) PRAKASH AND BANDE



Map 1—showing the locality of Bolpur and nearby areas.

(1980), *Koompassioxylon elegans* KRAMER (1973), *Millettioxylon pongamiensis* PRAKASH (1975), *Ormosioxylon bengalensis* gen. *et* sp. nov. and *Peltophoroxylon ferrugineoides* sp. nov.

As mentioned by DEB AND GHOSH (1974) these silicified woods occur along with dark reddish brown ferruginous concretions and quartz pebbles embedded in a hard ferruginous matrix. This in turn is covered by the surface soil. Below this concretionary bed lies an impersistent greyish yellow clay bed. The relative thicknesses of different beds show much variation and near Srineketan, about 3 km south west of Santiniketan, the fossil woods are exposed on the surface due to erosion of the upper layers.

The geology of West Bengal has been worked out in detail by HUNDAY AND BANERJEE (1967) who state that the existence of Tertiary rocks is known both in the peninsular and extra-peninsular regions of this state and these are considered to be of Miocene age. After the Upper Gondwanas, no strata equivalent to the Lower Tertiary have been reported to occur in this state. This indicates the presence of a great hiatus in sedimentation since the post Gondwana period.

It is only in the peninsular region of the state, that small patches of the Tertiary grits and gravel beds, occasionally with clays and dicotyledonous fossil woods, have been reported from parts of Midnapur, Burdwan, Bankura and Birbhum Districts. In Bankura district, HUNDAY (1954) mapped patches of Tertiary formation comprising of ferruginous yellowish sandstones and red shales occasionally associated with quartz gravel beds and underlain by clays at a number of localities. Fairly large specimens of dicotyledonous fossil woods were also collected by him from these beds. These patches were found under a thin capping of alluvium or laterite. Similar beds were also noted by him in the course of traverses in Birbhum and Midnapur Districts of West Bengal and in the Mayurbhanj District of Orissa. In Burdwan District, the dicotyledonous fossil woods were collected from near 11½ mile post on the western side of Panagar and Alambazar road. They are also known from 3 km south west of Suri in Birbhum District. Similar occurrences were also noted in a well section near Bolpur, Muhammad Bazar in Birbhum District and Garbeta in Midnapur District. These, apparently isolated patches of Tertiary rocks over a wide area, suggest the presence of a continuous belt of Tertiary formation in this part of the state. HUNDAY (1954) has shown the resemblance of these formations of Bankura and Midnapur Districts to the formation overlying the Baripada limestone (Miocene) in the Mayurbhanj District of Orissa and thought that these might be equivalent to the rocks of the Tipam Series of Assam. He has also suggested that a belt of Tertiary rocks mostly covered by alluvium exists right from the eastern part of Orissa through Mayurbhanj and Balasore along the western border of the West Bengal plains as far north as Bolpur in Birbhum District. He is of the opinion that these Tertiary formations may not belong to the same facies all through and the marine facies may change to the fresh water facies through estuarine deposits when traced from south to north. From the palaeobotanical evidence, as reflected by this assemblage, a Neogene age is also suggested for these fossils because the presence of dipterocarps and the dominance of legumes is characteristically indicative of a Neogene age in the Tertiary of India. Moreover, out of the seven species of woods described in this paper, as many as four have already been described from various Neogene localities of India, thus providing an additional support to this probability.

SYSTEMATIC DESCRIPTION

Family—Dipterocarpaceae

Genus—**Shoreoxylon** Den Berger, 1923

Shoreoxylon tipamense Prakash & Awasthi, 1970

Pl. 1, Figs. 1-3

The description is based on a piece of secondary wood 9 cm in length and 7 cm in diameter.

Description—Wood diffuse-porous. *Growth rings* absent. *Vessels* solitary and in radial multiples of 2-3, small to large, t. d. 75-250 μm, r.d. 90-300 μm, 2-4 per sq mm ; perforations simple ; intervessel pit-pairs alternate, bordered, 6-8 μm in diameter. *Tracheids* vasicentric, not frequent. *Parenchyma* paratracheal and apotracheal ; paratracheal parenchyma aliform to confluent ; apotracheal parenchyma forming short tangential lines and bands enclosing gum canals. *Xylem rays* 1-6 seriate and 5-60 cells in height, 6-8 per mm; ray tissue heterogeneous ; uniseriate rays made up of upright cells only, multiseriate rays made up of procumbent cells in the central portion with 1-4 seriate extensions of upright cells at the end ; sheath cells also present. *Fibres* moderately thick-walled, non-septate, *Gum canals* vertical, in concentric tangential rows, 60-120 μm in diameter.

Affinities—The fossil is almost identical to *Shoreoxylon tipamense* Prakash and Awasthi (1970) described from the Buri Dihing river bed near Jaipur, Assam. It resembles closely the modern wood of *Shorea assamica* Dyer. The minor difference observed from *Shoreoxylon tipamense* is in the frequency of vessels which are 3-9 per sq. mm as against 2-4 vessels per sq. mm in the present fossil. Besides, the xylem rays are 1-5 seriate in *S. tipamense* as against 1-6 seriate in the fossil wood. As these are only minor variations, the present fossil has been placed under *Shoreoxylon tipamense*. The only other species of *Shoreoxylon* recorded from the Tertiary of West Bengal is *Shoreoxylon bengalensis* Roy and Ghosh (1979a). However, it differs from *S. tipamense* in the parenchyma pattern. The paratracheal parenchyma is only vasicentric in *S. bengalensis* as against aliform to confluent parenchyma in *S. tipamense*. Moreover, the lines of apotracheal parenchyma present in the latter species are absent in the former species, *S. bengalensis*. Recently, Trivedi and Ahuja (1979) reccorded a fossil wood of Dipterocarpaceae from the Siwalik beds of Kalagarh and named it as *Pentacmeoxylon ornatum* gen. *et* sp. nov. indicating its resemblance to the modern woods of *Pentacme suavis* and *Pentacme mindamensis*. As it is not possible to distinguish the modern woods of *Shorea obtusa*, *Pentacme suavis*, *Parashorea stellata* and some allied species of the tribe Shoreae, there seems no justification in instituting the organ genus *Pentacmeoxylon* for the fossil woods of *Pentacme* alone, when a comprehensive organ genus *Shoreoxylon* Den Berger already exists for the anatomically allied genera *Shorea*, *Pentacme*, *Parashorea*, *Balanocarpus* and *Doona*. Consequently, *Pentacmeoxylon* Trivedi and Ahuja (1979) becomes a latter synonym of *Shoreoxylon* Den Berger (1923) and *Pentacmeoxylon ornatum* Trivedi and Ahuja (1979) should be named as *Shoreoxylon ornatum* (Trivedi & Ahuja) comb. nov.

Shorea assamica Dyer, which resembles the fossil wood described above, is a large tree found in Upper Assam, chiefly in Lakhimpur Division, on the North Bank, along the foot hills, in the Naga country and the Sibsagar Division and in Upper Burma. It also occurs in Lower Burma and Tenasserim (Pearosn and Brown, 1932, pp. 106, 119).

Specimen—B.S.I.P. Museum No. 35399

Genus—**Cassinium** Prakash, 1975

Cassinium barooahii (Prakash) Prakash, 1975

Pl. 1, Figs. 4, 5

The following description is based on a small piece of secondary xylem 10 cm in length and 5 cm in diameter.

Description—*Wood* diffuse-porous. *Growth rings* absent. *Vessels* large to medium sized, 150-480 μm in diameter, solitary and in radial multiples of 2-3, circular to oval in shape, 2-3 per sq. mm ; perforations simple ; intervessel pit-pairs vestured, alternate, 4-6 μm in diameter. *Parenchyma* usually in the form of concentric tangential bands, 4-8 cells in width. *Xylem rays* 1-3 (mostly 2) seriate, 10-30 cells high ; ray tissue homogeneous with rays composed of procumbent cells. *Fibres* moderately thick walled, non-septate, polygonal in cross section, 15-20 μm in diameter.

The fossil wood is assigned to *Cassinium barooahii* (Prakash) PRAKASH (1975) described from the Tertiary (probably Middle Miocene) beds of Mikir Hills, Assam (PRAKASH, 1967) and the Lower Siwalik beds near Kalagarh in Uttar Pradesh (PRAKASH, 1978). The extant species *Cassia siamea* Lam. with which the present fossil wood shows a near resemblance, is a moderate sized tree, common in the southernmost part of Tamil Nadu, where it is reported to be indigenous. It is also found in Chittagong, the dry forests of Upper and Lower Burma, Ceylon, Malaya and Thailand (RAMESH RAO AND PURKAYASTHA, 1972, pp. 74-75).

Specimen—B.S.I.P. Museum No. 35400.

Genus—**Cynometroxylon** Chowdhury & Gohsh, 1946

Cynometroxylon holdeni (Gupta) Prakash & Bande, 1980

Pl. 2, Figs. 6, 7

The fossil consists of a piece of secondary wood 7 cm in length and 4 cm in diameter.

Description—Wood diffuse-porous. *Growth rings* not seen. *Vessels* 75-350 μm in diameter, solitary and in radial multiples of 2-5, 4-6 per sq. mm ; perforations simple ; intervessel pit-pairs vestured, 4-6 μm in diameter. *Parenchyma* apotracheal, in concentric tangential bands alternating with the fibre bands of nearly same thickness, 3-8 cells wide. *Xylem rays* 1-3 (mostly 2) seriate, heterocellular, consisting of procumbent cells in the middle portion and 1-2 marginal rows of upright cells at one or both the ends. *Fibres* thick walled, non septate.

The fossil is identical to the already known species *Cynometroxylon holdeni* (Gupta) Prakash & Bande, first described from the Mio-Pliocene of Burma under the name *Dipterocarpoxylon holdeni* by GUPTA (1935) and later on transferred to the genus *Cynometroxylon* Chowdhury & Ghosh (1946) which is known from the various Neogene localities of India (RAMANUJAM AND RAGHU RAMA RAO, 1966 ; PRAKASH 1967, 1973, 1975, 1978 ; PRAKASH AND AWASTHI, 1971; MÜLLER-STOLL AND MÄDEL, 1967; TRIVEDI AND AHUJA, 1978). The present finding, however, is the first authentic record of *Cynometroxylon holdeni* from the Tertiary of Bengal. The earlier record of this species from West Bengal is from a microlithic site at Birbhanpur near Durgapur in the Damodar Valley of this province (GHOSH AND KAZMI, 1960).

Cynometroxylon holdeni has been compared with two species of the extant genus *Cynometra* Linn. viz. *Cynometra ramiflora* and *C. polyandra* Roxb. which are anatomically inseparable. *C. ramiflora* is an evergreen tree growing in the tidal and coastal forests from the Sunderiban to Chittagong and Tenasserim, Andaman, Coast of Konkon and Kanara. The other species *C. polyandra* is also a large tree growing in the Khasi Hills and Cachar (BRANDIS, 1971).

Specimen—B.S.I.P. Museum No. 35401

Genus—**Koompassioxylon** Kramer, 1973

Koompassioxylon elegans Kramer, 1973

Pl. 2, Figs. 8, 9

The material consists of a decorticated piece of secondary wood 10 cm in length and 4 cm in diameter.

Description—Wood diffuse-porous. *Growth rings* not seen. *Vessels* small to large, t.d. 75-270 μm, r.d. 90-315 μm, solitary and in radial multiples of 2-4, evenly distributed, 2-4 per sq. mm ; perforations simple ; intervessel pit pairs alternate, bordered ; vessel elements storied. *Parenchyma* paratracheal, aliform to confluent with pointed wings; strands storied. *Xylem rays* 1-3 (mostly 2) seriate, homocellular to heterocellular, made up either of procumbent cells only or with an upright cell at the end in at least some of the rays, 5-20 cells high, storied, 9-11 per mm; ray tissue heterogeneous. *Fibres* thick walled, non-septate, 15-20 μm in diameter. *Ripple marks* present due to the storied rays.

The fossil is almost identical to *Koompassioxylon elegans* Kramer (1973) described from the Tertiary of South East Asia which has been compared with the modern wood of *Koompassia malaccensis*. Consequently, it has been assigned to it. However, there is a slight difference in the size of the vessels which are upto 270 μm in diameter in *Koompassioxylon elegans* Kramer and upto 315 μm in the present fossil.

Koompassia Maingay is a genus with four species distributed in the Malay Peninsula, Borneo and New Guinea (Willis, 1973). *Koompassia malaccensis* Benth. is a tree 100 to 150 ft. tall found in the forests of Singapur, Malacca, Penang, Sumatra, etc. (Ridley, 1967, p. 620).

Specimen—B.S.I.P.—Museum No. 35402.

Genus—**Millettioxylon** Awasthi, 1967

Millettioxylon pongamiensis Prakash, 1975

Pl. 2, Figs. 10, 11.

The description is based on a piece of secondary wood 9 cm in length and 4.5 cm in diameter.

Description—Wood diffuse porous. *Growth rings* present. *Vessels* small to large, t.d. 75-180 μm, r.d. 90-300 μm, mostly solitary and in radial multiples of 2-3, 3-4 per sq. mm; vessel segments storied ; perforations simple ; intervessel pit-pairs vestured, alternate, 4-6 μm in diameter with lenticular apertures. *Parenchyma* in 4-8 seriate, concentric, tangential bands alternating with the fibres ; strands storied, cells frequently crystalliferous. *Xylem rays* 1-3 (mostly 2) seriate, homocellular made up of procumbent cells only, storied, 8-11 per mm. *Fibres* libriform, non-septate, polygonal in cross section, 15-20 μm in diameter. *Ripple marks* present due to storied parenchyma strands, rays and the vessel elements.

The fossil is identical to *Millettioxylon pongamiensis* Prakash (1975) decsribed from the Lower Siwalik beds of Nalagarh. It resembles the wood of modern species *Millettia prainii*. The only other species of *Millettioxylon* described from the Tertiary of West Bengal is *Millettioxylon bengalensis* from Silabati river bed, near Garbeta in Midnapur District (Ghosh and Roy, 1979a). This has been shown to resemble the wood of *Millettia pulchra* and differs from *Millettioxylon pongamiensis* in the thickness of parenchyma bands. The parenchyma bands are only 2-4 cells thick in *Millettioxylon bengalensis* as compared to much thicker, 2-8 seriate parenchyma bands of *Millettioxylon pongamiensis*. Besides, the vessels are slightly smaller (52-240 μm) and xylem rays are heterocellular in *Millettioxylon bengalensis* as against bigger vessels (90-300 μm) and homocellular xylem rays of *M. pongamiensis*.

Millettia prainii Dunn is a small tree occurring in the eastern Himalayas in the foot hills of Sikkim extending a short distance into the plains of North Bengal, and also in

Assam along the right bank of the river Manas in Golpara and in the Garo Hills (Ramesh Rao and Purkayastha, 1972, p. 117).

Specimen—B.S.I.P. Museum No. 35403.

Genus—**Ormosioxylon** gen. nov.

Ormosioxylon bengalensis sp. nov.

Pl. 3, Figs. 12-16.

The description is based on a well preserved piece of secondary wood 8 cm in length and 6 cm in diameter.

Topography—Wood diffuse-porous. *Growth rings* indistinct. *Vessels* small to large, solitary and in radial multiples of 2-5 (mostly 2-3) (Pl. 3, Figs. 12, 13), uniformly distributed, 4-7 per sq. mm. *Parenchyma* paratracheal, aliform-confluent to banded enclosing several vessels tangentially (Pl. 3, Figs. 12, 13). *Xylem rays* 1-4 (mostly 2-3) seriate or 20-60 μm in width and 6-25 cells or 100-500 μm in height, closely spaced, 7-9 rays per mm (Pl. 3, Fig. 14); ray tissue weakly heterogeneous with rays made up either of procumbent cells only or with a single upright cell at the end of some of the rays; rays show storied tendency at places (Pl. 3, Fig. 14). *Fibres* arranged in radial rows in between the xylem rays.

Elements—Vessels thick walled, circular to oval when solitary, with flat contact walls when in groups, t.d. 75-225 μm, r.d. 75-250 μm; vessel members 150-450 μm long with transverse to oblique ends ; perforations simple ; intervessel pit-pairs alternate to opposite, bordered, 6-8 μm in diameter with linear-lenticular apertures (Pl. 3, Fig. 16). *Parenchyma cells* thin walled, squarish. *Ray-cells* thin walled, procumbent cells 20-25 μm in tangential height and 50-60 μm in radial length ; upright ray cells 25-35 μm in tangential height and 15-20 μm in radial length (Pl. 3, Fig. 15). *Fibres* thick walled, non-septate.

Affinities—Important anatomical characters of the present fossil such as small to large vessels with simple perforations, aliform-confluent to banded parenchyma, 1-4 (mostly 2-3) seriate, homocellular to weakly heterocellular xylem rays with storied tendency and non-septate fibres clearly indicate the affinity of the present fossil with the genus *Ormosia* G. Jack of Leguminosae. A near resemblance was also observed with anatomically similar genera *Koompassia* and *Pericopsis* of the same family. However, in both these genera the xylem rays are distinctly storied while they show only a tendency towards storied arrangement in the present fossil. Moreover, in *Pericopsis*, the ray tissue is homogeneous, made up of procumbent cells only, but in the wood under discussion a single upright cell is present at the end in at least some of the rays.

Modern wood sections of four species of *Ormosia* viz., *Ormosia glauca* Wall., *O. macrodisca* Baker, *O. robusta* Wight (syn. *Arilaria robusta* Kurz) and *O. watsoni* C. E. C. Fischer were compared with the fossil wood, besides published description and photographs of the woods of *Ormosia robusta* and *O. watsonii* (Ramesh Rao and Purkayastha, 1972, p. 119, pl. 81, fig. 486). The comparison revealed that the fossil resembles closely the modern woods of *Ormosia robusta* and *O. watsonii* which are anatomically inseparable. Thus in the above two species as well as in the present fossil, the wood is diffuse-porous, vessels medium to large, solitary and in short radial multiples, parenchyma aliform-confluent to banded enclosing several vessels, xylem rays 1-4 (mostly 2-3) seriate, homocellular to weakly heterocellular with storied tendency and fibres thick walled and non-septate.

As the present fossil closely resembles the modern woods of *Ormosia*, it has been described under a new genus *Ormosioxylon* instituted to include the fossil woods similar to *Ormosia*. The specific name *Ormosioxylon bengalensis* indicates its presence in the province of Bengal.

Ormosia is a genus of about 50 species (*Willis*, 1973) distributed in the tropics of Asia and America. About eight species occur in India and Burma. *Ormosia robusta* (syn. *Arillaria robusta* Kurz) is a large tree which occurs wild in Arunachal Pradesh, Sibsagar and Cachar districts of Assam, Sylhet and Chittagong in Bangla Desh and Burma. The other species, *Ormosia watsonii* is found only in south Tenasserim in Burma (RAMESH RAO AND PURKAYASTHA, 1972, p. 119).

GENERIC DIAGNOSIS

Ormosioxylon gen. nov.

Wood diffuse-porous. *Growth rings* indistinct or absent. *Vessels* small to medium, solitary and in radial multiples ; perforations simple; intervessel pit-pairs alternate to opposite, bordered. *Parenchyma* paratracheal, aliform-confluent to banded. *Xylem rays* fine to medium, homocellular to heterocellular, with or without storied tendency. *Fibres* non-septate.

Genotype—Ormosioxylon bengalensis sp. nov.

SPECIFIC DIAGNOSIS

Ormosioxylon bengalensis sp. nov.

Wood diffuse-porous. *Growth rings* indistinct. *Vessels* small to large, t.d. 75-225 μm, r.d. 75-250 μm, solitary and in radial multiples of 1-5 (mostly 2-3), 4-7 per sq. mm; vessel members 150-450 μm long with transverse to oblique ends; perforations simple; intervessel pit-pairs alternate to opposite, bordered, 6-8 μm in diameter with linear-lenticular apertures. *Parenchyma* paratracheal, aliform-confluent to banded enclosing several vessels. *Xylem rays* 1-4 (mostly 2-3) seriate and 5-25 cells high, 7-9 per mm ; ray tissue weakly heterogeneous, rays made up of either procumbent cells only or with a single upright cell at the end in some of the rays ; storied tendency observed at places. *Fibres* thick walled, non-septate.

Holotype—B. S. I. P. Museum No. 35404.

Genus—**Peltophoroxylon** Müller-Stoll & Mädel, 1967

Peltophoroxylon ferrugineoides sp. nov.

Pl. 4, Fig. 17-20

The species is based on a silicified piece of secondary wood 10 cm in length and 8 cm in diameter.

Topography—Wood diffuse-porous. *Growth rings* demarcated by thin lines of terminal parenchyma (Pl. 4, Figs. 17, 18). *Vessels* small to large, solitary and in radial multiples of 2-4, 4-6 per sq. mm. *Parenchyma* terminal and paratracheal ; paratracheal parenchyma thick vasicentric to aliform with short lateral extensions sometimes joining 2-3 vessels (Pl. 4, Figs. 17, 18). *Xylem rays* fine, mostly uniseriate, sometimes with paired cells, homocellular, made up of procumbent cells only, 4-15 cells or 80-300 μm in height and closely spaced, 12-18 per mm. *Fibres* arranged in ill defined raidal rows in between the rays.

Elements—Vessels circular to oval when solitary, with flat contact walls when in groups, t.d. 50-225 μm, r.d. 75-225 μm ; vessel members 100-300 μm long with oblique to transverse ends ; perforations simple ; intervessel pit-pairs alternate, bordered, 4-6 μm in diameter with linear apertures. *Parenchyma cells* squarish, 15-20 μm in diameter and 20-35 μm in length. *Xylem ray cells* thin walled, 14-18 μm in tangential height and 60-75 μm in radial length. *Fibres* moderately thick walled, 15-20 μm in diameter.

Affinities—Anatomical characters such as small to large vessels, terminal as well as vasicentric to aliform-confluent parenchyma and 1-2 (mostly 1) seriate, homogeneous xylem rays, indicate that the present fossil shows a close affinity to the modern woods of the extant genus *Peltophorum* Walp. of the family Leguminosae. Amongst *Peltophorum* species, a nearest resemblance is seen with the wood of *P. ferrugineum* Benth. This study included the examination of thin sections of five species of *Peltophorum* viz., *P. dasyrachis* Kurz, *P. ferrugineum* Benth., *P. grande* Prain, *P. pterocarpum* (DC) Baker and *P. vegelianum* Walp. Besides, published description and photographs of *Peltophorum ferrugineum* Benth. (Ramesh Rao and Purkayastha, 1972, pp. 85-86, pl. 76, fig. 451) were also studied.

In 1967 Müller-Stoll and Mädel instituted the genus *Peltophoroxylon* to include the fossil woods showing anatomical characters similar to the modern woods of *Cassia*, *Peltophorum* and *Xylia* which are structurally very close to each other. Prakash (1975) while describing a fossil wood *Cassinium prefistulai*, from the Lower Siwalik beds near Nalagarh, separated the woods of *Cassia* from *Peltophorum* and *Xylia* and suggested that "all those fossil woods which can be definitely assigned to *Cassia* should, henceforth, be placed under a new generic name *Cassinium* instead of dumping them under a comprehensive form genus *Peltophoroxylon* Müller-Stoll & Mädel, which should now be used for the fossil woods of *Peltophorum* and *Xylia*". Consequently, Prakash (1975) transferred those species of *Peltophoroxylon* which showed affinities with the modern woods of *Cassia*, to a new genus *Cassinium* except *Peltophoroxylon indicum* (Ramanujam) Müller-Stoll & Mädel (1967), which was said to possess affinities with *Acacia* (Ramanujam, 1954). Recently two more species of *Peltophoroxylon* Müller-Stoll & Mädel have been described. These are *Peltophoroxylon parenchymatosum* Kramer (1973) from the Tertiary of South East Asia and *Peltophoroxylon emergeri* Lemoigne (1978) from the Tertiary of Ethiopia. Both these species differ markedly from the fossil wood from West Bengal. In *Peltophoroxylon parenchymatosum* the vessels are bigger (r.d. 300-340 μm), the parenchyma is aliform-confluent to banded and the xylem rays are 3-4 seriate as against smaller vessels (r.d. 75—225 μm), mostly uniseriate, sometimes partly biseriate xylem rays and terminal and vasicentric to aliform confluent parenchyma with short lateral extensions in the present fossil wood. Similarly *Peltophoroxylon embergeri* also differs from the fossil wood under discussion in possessing much broader (2-5 seriate) xylem rays.

As the present fossil wood resembles the modern wood of *Peltophorum* Walp., it is assigned to the newly circumscribed genus *Peltophoroxylon* Müller-Stoll & Mädel (1967). It is being described here as a new species, *Peltophoroxylon ferrugineoides* the specific name indicating its near resemblance with the wood of *Peltophorum ferrugineum*.

Peltophorum Benth. is a tropical genus of 12 species (Willis, 1973) represented in India by a single species *Peltophorum ferrugineum* Benth. with which the fossil shows near resemblance. This is a large handsome evergreen tree found in the coastal forests of the Andamans and largely cultivated in India and Burma as an avenue tree and in the gardens. The tree is believed to be native of the Andamans, Ceylon, Malaya and North Australia (Ramesh Rao & Purkayastha, 1972, p. 85).

SPECIFIC DIAGNOSIS

Peltophoroxylon ferrugineoides sp. nov.

Wood diffuse porous. *Growth rings* demarcated by thin lines of terminal parenchyma. *Vessels* small to large, t.d. 50-225 μm, r.d. 75-225 μm, solitary and in radial multiples of 2-4, 4-6 per sq. mm; perforations simple; intervessel pit-pairs alternate, bordered, 4-6 μm, in diameter with linear apertures. *Parenchyma* paratracheal and terminal demarcating

the growth rings ; paratracheal parenchyma vasicentric to aliform-confluent with short lateral extensions joining 2-3 vessels. *Xylem rays* 12-18 per mm, mostly uniseriate, sometimes with paired cells, 4-15 cells or 80-300 μm in height; ray tissue homogeneous, rays composed of procumbent cells. *Fibres* moderately thick walled, 15-20 μm in diameter.

Holotype—B.S.I.P. Museum No. 35405.

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EXPLANATION OF PLATES

PLATE 1

1. *Shoreoxylon tipamense* Prakash & Awasthi—Cross section showing shape, size and distribution of vessels, tangential band of gum canals, paratracneal and apotracheal parenchyma and xylem rays. ×40. B.S.I.P. Slide No. 6215/35399.

2. *Shoreoxylon tipamense* Prakash & Awasthi—Tangential section showing uniseriate and multiseriate xylem rays. ×16. B.S.I.P. Slide No. 6216/35399.

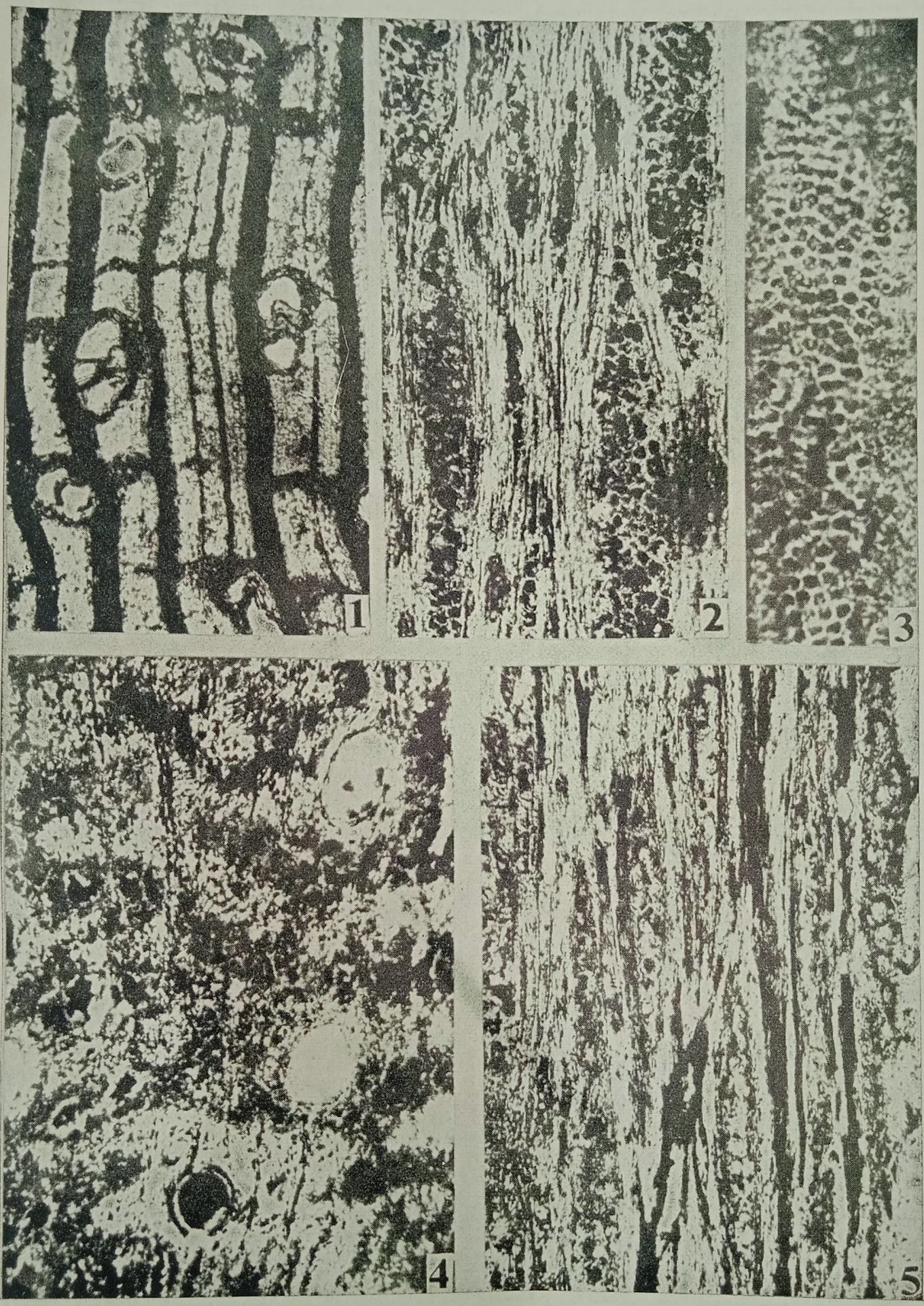
3. *Shoreoxylon tipamense* Prakash & Awasthi—Intervessel pit-pairs. ×200. B.S.I.P. Slide No. 6216/35399.

4. *Cassinium barooahii* (Prakash) Prakash—Cross section showing vessels and alternating tangential bands of parenchyma and fibres. ×40. B.S.I.P. Slide No. 6217/35400.

5. *Cassinium barooahii* (Prakash) Prakash—Tangential section showing 1-2 seriate xylem rays. ×100. B.S.I.P. Slide No. 6218/35400.

PLATE 2

6. *Cynometroxylon holdeni* (Gupta) Prakash & Bande—Cross section showing shape, size and distribution of vessels, xylem rays and tangential bands of parenchyma. ×40. B.S.I.P. Slide No. 6219/35401.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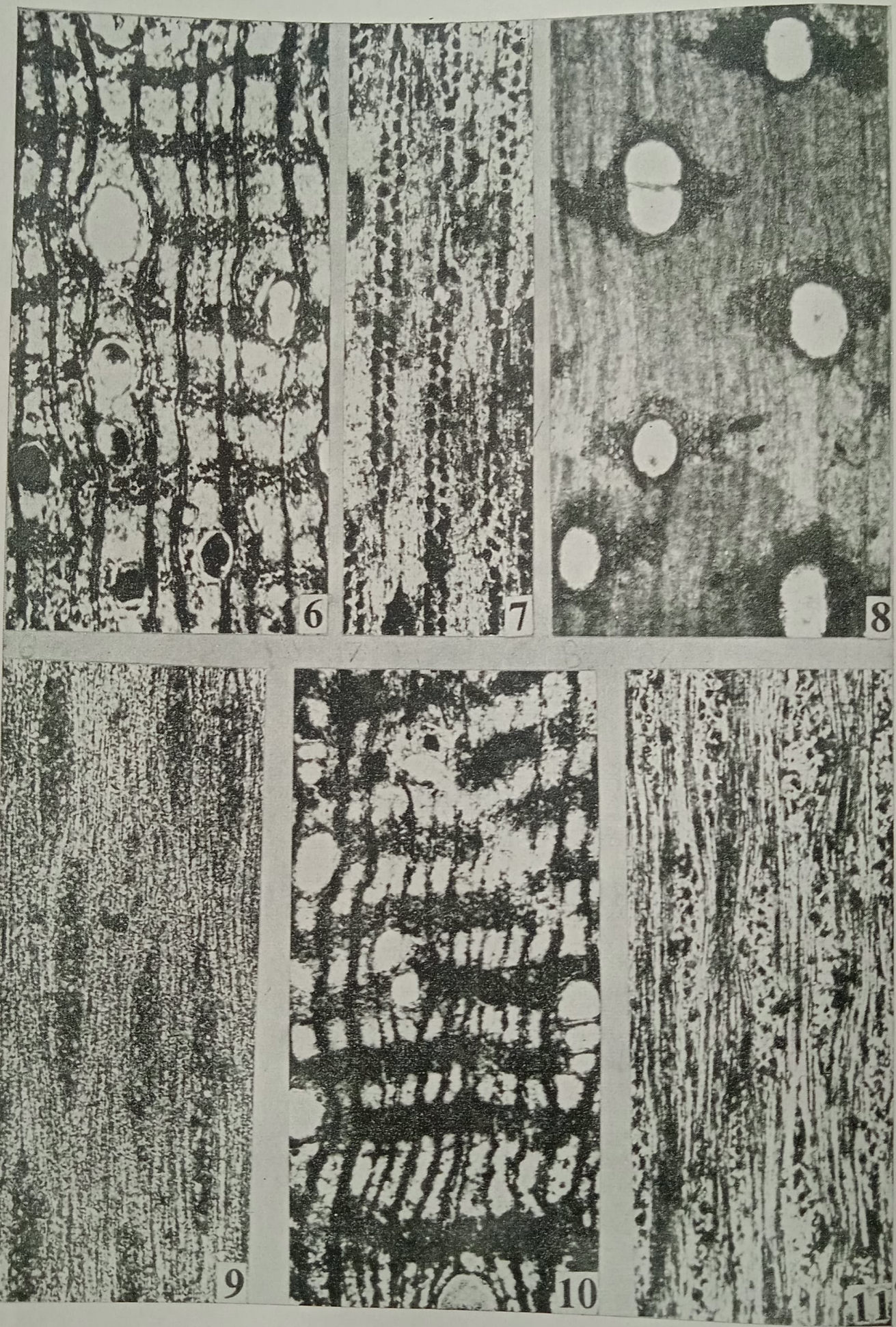
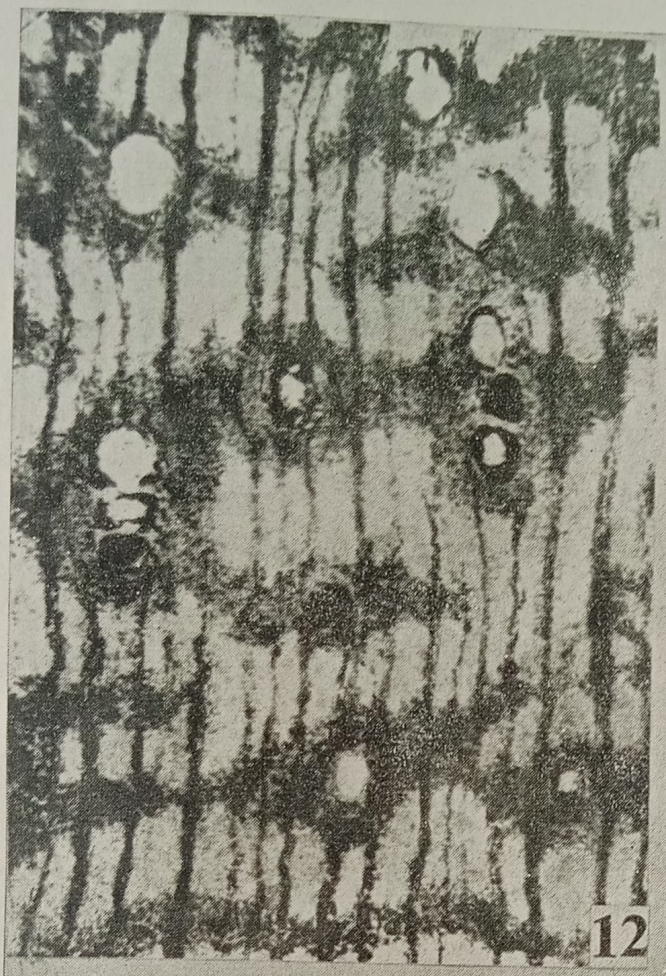


Bande & Prakash—Plate 2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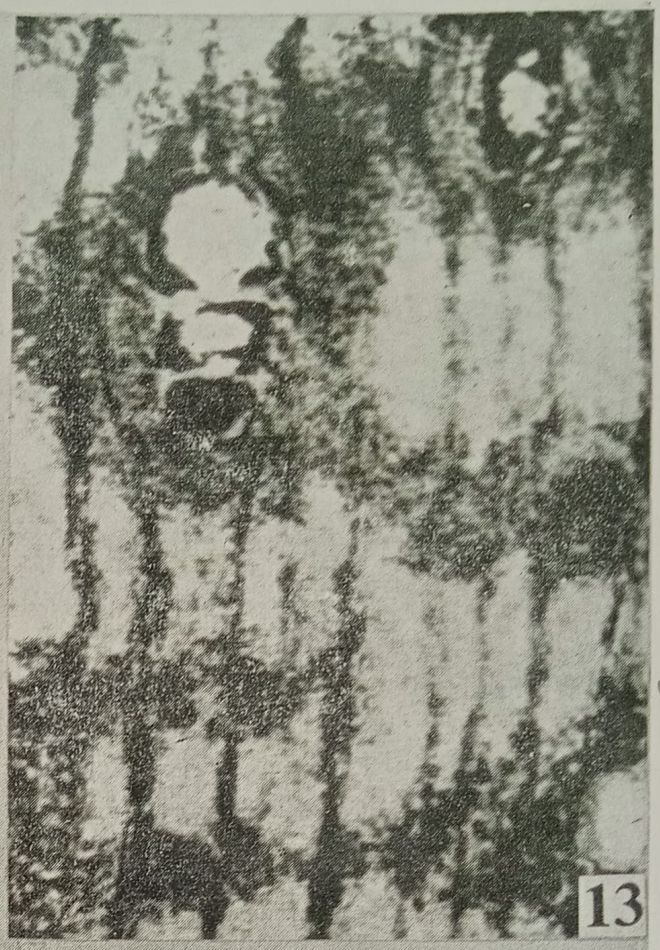
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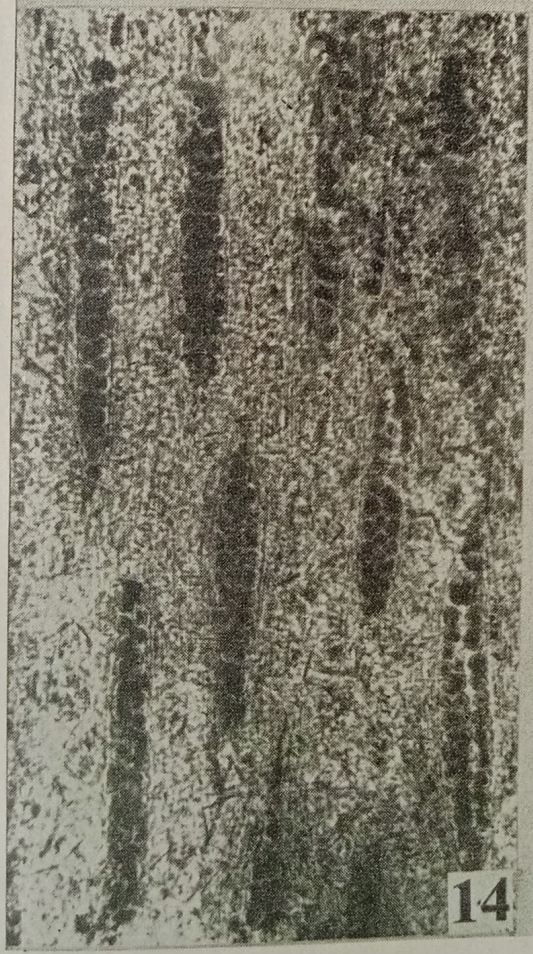
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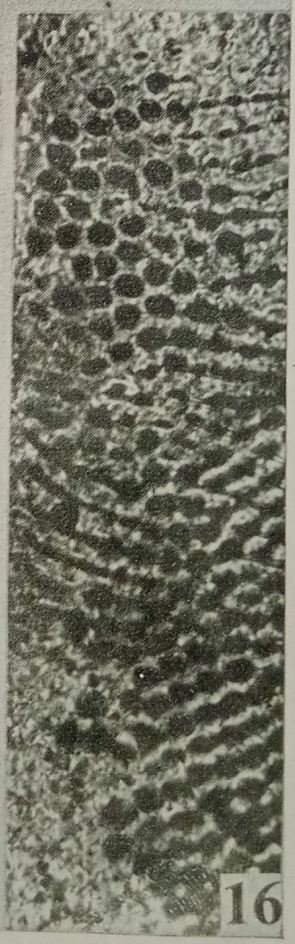
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7. *Cynometroxylon holdeni* (Gupta) Prakash & Bande—Tangential section showing biseriate, heterocellular xylem rays. ×100. B.S.I.P. Slide No. 6220/35401.

8. *Koompassioxylon elegans* Kramer—Cross section showing shape, size and distribution of vessels and aliform to confluent parenchyma. ×40. B.S.I.P. Slide No. 6221/35402.

9. *Koompassioxylon elegans* Kramer—Tangential section showing storied xylem rays. ×100. B.S.I.P. No. 6222/35402.

10. *Millettioxylon pongamiensis* Prakash—Cross section showing vessels, xylem rays and tangential bands of parenchyma. ×40. B.S.I.P. Slide No. 6223/35403.

11. *Millettioxylon pongamiensis* Prakash—Tangential section showing homocellular xylem rays with storied arrangement. ×40. B.S.I.P. Slide No. 6224/35403.

PLATE 3

12. *Ormosioxylon bengalensis* gen. *et* sp. nov.—Cross section showing shape, size and distribution of vessels, xylem rays and aliform-confluent to banded parenchyma. ×40. B.S.I.P. Slide No. 6225/35404.

13. *Ormosioxylon bengalensis* gen. *et* sp. nov.—Cross section enlarged. ×70. B.S.I.P. Slide No. 6225/35404.

14. *Ormosioxylon bengalensis* gen. *et* sp. nov.—Tangential section showing xylem rays with storied tendency. ×100. B.S.I.P. Slide No. 6226/35404.

15. *Ormosioxylon bengalensis* gen. *et* sp. nov.—Radial longitudinal section showing heterocellular xylem rays. ×100. B.S.I.P. Slide No. 6227/35404.

16. *Ormoxioxylon bengalensis* gen. et sp. nov.—Intervessel pit-pairs. ×400. B.S.I.P. Slide No. 6226/35404.

PLATE 4

17. *Peltophoroxylon ferrugineoides* sp. nov.—Cross sectoin showing shape, size and distribution of vessels, xylem rays and aliform to confluent parenchyma. ×40. B.S.I.P. Slide No. 6228/35405.

18. *Peltophoroxylon ferrugineoides* sp. nov.—Cross section magnified. ×60. B.S.I.P. Slide No. 6228/35405.

19. *Peltophoroxylon ferrugineoides* sp. nov.—Tangential section showing mostly uniseriate, xylem rays. ×100. B.S.I.P. Slide No. 6229/35405.

20. *Peltophoroxylon ferrugineoides* sp. nov.—Radial longitudinal section showing homocellular xylem rays. ×100. B.S.I.P. Slide No. 6230/35405.