Occurrence of *Bischofia* and *Antiaris* in Namsang beds (Miocene-Pliocene) near Deomali, Arunachal Pradesh, with remarks on the identification of fossil woods referred to *Bischofia*

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Two fossil woods resembling those of *Bischofia* and *Antiaris* belonging to the family Bischofiaceae and Moraceae, respectively, are described from the Namsang beds near Deomali, Arunachal Pradesh. A critical assessment of the structural details of the fossil woods referred earlier to *Bischofia* has revealed that they are quite different from that of *Bischofia*.

**Key-words**—Xylotomy, *Bischofia*, *Antiaris*, Namsang beds, Miocene-Pliocene (India).

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**SYSTEMATIC DESCRIPTION**

**Family—Bischofiaceae**

**Genus—Bischofia Bl.**

*Bischofia palaeojavanica* sp. nov.

Pl. 1, figs 1, 3, 4, 5

**Material**—Three pieces of fairly well-preserved petrified woods.

**Description**—Wood diffuse-porous. *Growth rings* not seen. Vessels visible to the naked eye, medium to large (Pl. 1, fig. 1), solitary and mostly in radial multiples of 2-4, sometimes up to 6, tangential diameter of solitary vessels up to 300 μm and *radial* diameter up to 340 μm, solitary vessels circular to mostly oval (Pl. 1, fig. 1), uniformly distributed, about 12-25 per sq mm; perforations simple; vessel-membranes with truncate or slightly oblique ends; intervessel pits large, 16-20 μm in diameter.
1. *Bischofia palaeojavanica* sp. nov. Cross section showing both solitary and multiple vessels with tyloses × 35, Slide no. BSIP 3588* I*

2. *Bischofia javanica* Roxb.: Cross-section showing vessels similar in type and distribution and with full of tyloses as in fossil wood shown in fig. 1 × 35.

3. *Bischofia palaeojavanica* sp. nov.: Radial longitudinal section showing heterocellular ray × 90. Slide no. BSIP 3588* II*

4. *Bischofia palaeojavanica* sp. nov.: Tangential longitudinal section showing rays with sheath cells × 85. Slide no. BSIP 3588* III*

5. Another tangential longitudinal section showing rays × 70; Slide no. BSIP 3588* II*

6. *Bischofia javanica* showing similar type of rays as in fossil × 70.
1. *Antiaris deomaliensis* sp. nov.: Cross-section showing nature and distribution of vessels and parenchyma. × 35; Slide no. BSIP 35888-I.

2. *Antiaris toxicaria* Lesch.: Cross-section showing vessels and parenchyma similar in nature and distribution as in the fossil shown in fig. 7. × 55.

3. *Antiaris deomaliensis* sp. nov.: Cross-section magnified showing vessels and vasicentric to aliform and confluent parenchyma. × 90; Slide no. BSIP 35888-I.

4. Magnified tangential longitudinal section showing septate fibres. × 90; Slide no. BSIP 35888-II

5. Radial longitudinal section showing heterocellular rays. × 90; Slide no. BSIP 35888-III

6. Tangential longitudinal section showing rays × 70; Slide no. BSIP 35880-II.

7. *Antiaris toxicaria*: Tangential longitudinal section showing similar rays as in the fossil shown in fig. 12 × 70
alternate, bordered, apertures lenticular; tyloses abundant, often completely occluding the vessels. Parenchyma typically absent or 1-2 cells may be rarely present contiguous to the tangential walls of vessels. Rays 1-7 seriate, 5-7 per mm, about 70 cells high; ray tissue heterogeneous; uniserate rays frequent, often moderately low, homocellular to heterocellular; multiserate rays heterocellular, consisting of 1 to several uniseriate marginal rows of upright cells at one or both the ends (Pl. 1, figs 4, 5) and procumbent cells in the central part; sheath cells often present (Pl. 1, fig. 4); tangential height of upright or square cells about 40-80 μm, radial length 30-50 μm; tangential height of procumbent cells 20-30 μm, radial length 60-130 μm. Fibres aligned in radial rows, large, 20-40 μm in diameter, rectangular, thick-walled, walls 6-10 μm in thickness, septate.

Affinities—A combination of the important xylotomical characters of the fossil, such as medium to large vessels, solitary or mostly in radial multiples of up to 6 cells, heavily tylosed, parenchyma typically absent or rarely 1-2 cells present contiguous to tangential walls of the vessels; moderately broad rays up to 70 cells in height, heterocellular with sheath cells and the fibres bigger in size, thick walled and septate, is met with in the woods of Phyllanthoideae of the family Euphorbiaceae (including Bischofioideae). However, in all other structural details, e.g., shape, size, frequency of vessels; amount of tyloses; length and width of rays, bigger size of fibres and intervessel pits, the fossil wood shows close similarity with that of Bischofia javanica Bl. of Bischofioideae.

Remarks on fossil woods referred to Bischofia Bl.

Ramanujam (1960) instituted the genus Bischofioxylon to accommodate a fossil wood from the Cuddalore Sandstone near Pondicherry showing near resemblance with that of Bischofia. Madel (1962) opined that Bischofioxylon mioenicum as well as Euphorbioxylon kraeuseli Prakash 1957 possess the xylotomical characters of Bridelia and not of Bischofia. She, therefore, transferred both the species to Bridelioxylon Ramanujam 1956. Awasthi (1974) pointed out that Bridelioxylon mioenicum and Bridelioxylon cuddalorensense Ramanujam 1958 are identical, therefore, he merged the former with the latter.

However, on critical re-examination of the type slides of all these fossils it was found that these fossil woods are quite different from those of Bischofia and Bridelia. One of the important differences is that the vessels in these fossils are mostly in several radial multiples, often reaching up to 25 vessels and appearing as short chains; whereas in Bridelia and Bischofia they are in radial multiples of mostly 2-5 and occasionally up to 8. Moreover, in Bischofia the parenchyma is absent or rarely a few cells may be associated with vessels, and the rays have sheath cells; while in Bridelia the aprotarchal parenchyma is often present in addition to paratraceal, as widely spaced narrow bands, and the sheath cells in rays are absent. To which extant genus of Euphorbiaceae or other than Euphorbiaceae, these woods belong is yet to be ascertained.

Bande (1974) described a fossil wood from the Deccan Intertropical beds of Parapani in Mandla District, Madhya Pradesh showing resemblance with that of Bischofia javanica. A critical examination of the type slides has revealed that the fossil is quite different from Bischofia javanica. In Bischofia javanica the parenchyma is typically absent or sometimes one or two cells may be present associated with the vessels that are mostly large. On the contrary, in Bischofinium decannii the parenchyma is paratraceal, vasicentric, completely sheathing the vessels and sometimes aliform and the vessels are mostly medium-sized (Bande, 1974, pl. 2, figs 6, 7). In view of these major anatomical differences, Bischofinium decannii cannot be considered as a fossil wood of Bischofia javanica.

Since the present fossil wood shows close similarity with that of Bischofia, in accordance with the suggestions of Prakash and Lakhani (1980) and Wheeler, Scott and Barghoorn (1977) it is being placed under the same genus and named as Bischofia palaeojavanca sp. nov.

Holotype—Specimen no. BSIP 35887; Namsang River beds, Deomali, Arunachal Pradesh; Miocene.

Family—Moraceae
Genus—Antiaris Lescch.

Antiaris deomalensis sp. nov.
Pl. 2, figs 1, 3-6

Material—One piece of fairly well-preserved petrified wood.

Description—Wood diffuse porous. Growth rings not seen. Vessels medium to large, mostly large, sometimes small, solitary and in radial multiples of 2-4 (Pl. 2, fig. 1), sometimes small vessels present in groups associated with bigger vessels, solitary vessels up to 320 μm in tangential diameter and up to 340 μm in radial diameter, thick-walled, common walls up to 16 μm, evenly distributed, about 3-4 vessels per sq mm; perforations simple; vessel-members truncate, very short, about 100-400 μm in length; intervessel pits
medium to large, 6-8 μm in diameter, bordered, alternate with lenticular apertures; tyloses present. Parenchyma paratracheal, vasicentric to aliform, sometimes narrow aliform extension seen meeting with those of adjacent vessels (Pl. 2, fig. 3), cells about 16-24 μm in diameter, filled with dark contents. Rays 1-4 seriate (Pl. 2, fig. 6), 7-10 per mm in cross section, about 10-30 cells in height, ray tissue heterogeneous; rays heterocellular, consisting of procumbent cells and 1-2 uniseriated marginal rows of upright or square cells (Pl. 2, fig. 5); crystals present in upright or square cells. Fibres aligned in radial rows between two consecutive rays, small, 8-24 μm in diameter, mostly thick-walled (Pl. 2, fig. 4), walls about 3-5 μm in thickness, sejate (Pl. 2, fig. 4).

Affinities—The above anatomical features of the fossil indicate that it belongs to the family Moraceae and is comparable to the woods of Artocarpus and Antiaris. In shape, size and distribution of parenchyma, length and width of rays the fossil wood is very similar to Antiaris and differs from that of Artocarpus in having vessels relatively smaller in size and the rays narrower and shorter. Among the modern woods of Antiaris, A. toxicaria Lesch. shows closest resemblance with the present fossil wood. As far as the author is aware this is the first record of the fossil wood of Antiaris Lesch. It is being described under this genus and assigned to a new species, Antiaris deomaliensis indicating its occurrence in the Namsang beds at Deomali.

Holotype—Specimen no. BSIP 35888; Namsang River beds, Deomali, Arunachal Pradesh; Mio-Pliocene.

DISCUSSION

The genus Bischofia Bl. is represented by a single species, B. javanica Bl. (Willis, 1973, p. 141) which is a large deciduous tree widely distributed in the Indo-Malayan region ranging from the western Peninsula eastward through Burma and Thailand to Cochin China (South Vietnam), the Philippines, Formosa and Polynesia and southward into Malaya. In India, it occurs in Lower Himalaya up to 300 m and sub-Himalayan tract from Jamuna River eastwards, through Uttar Pradesh to Bengal and Assam; southward to Bihar and Orissa, Tirunelveli and Madurai, and on the West Coast from Konkan to the Nilgiris; throughout upper and lower Burma in hills and plains forest; scarce in Andaman Islands (Pearson & Brown, 1932, p. 881). Antiaris toxicaria Lesch. which is closely comparable to the fossils, is found in the evergreen forest of Western Ghats, Sri Lanka and Burma (Gamble, 1972, p. 651).

It is important to mention here that out of several taxa recovered from the Namsang sediments near Deomali, Holigarna, Glita, Kingiodendron and Antiaris no longer exist in north-east India, though some of their species are known to occur in the evergreen forest of Bangladesh and Burma. Extinction of these elements from this region might have been caused due to considerable change in the environmental conditions in the region since the time of their deposition.

REFERENCES


