

ON THE OCCURRENCE OF FOSSIL WOODS OF *GLUTA* AND *ANOGEISSUS* IN THE TERTIARY OF BIRBHUM DISTRICT, WEST BENGAL, INDIA*

S. K. ROY AND PRADIP GHOSH

Palaeobotany Laboratory, Botany Department, University of Burdwan, Burdwan

ABSTRACT

In the present paper two species of fossil woods belonging to the families Anacardiaceae and Combretaceae have been described from the banks of Mayurakshi Canal near Santiniketan (23.42' N : 87.42' E) of Birbhum District in West Bengal. One of them shows closest resemblance with the wood structure of *Gluta* L. of Anacardiaceae and is identical with *G. burmense* (Holden) Chowdhury (1952). The other resembles the wood structure of *Anogeissus* Wall ex Guillem. & Perr. of the Combretaceae. It has been referred to *Anogeissusoxylon* Navale (1962) and described as *Anogeissusoxylon bengalensis* sp. nov.

INTRODUCTION

Outcrops of Tertiary sediments occur in the districts of Birbhum, Burdwan, Bankura and Midnapur of West Bengal (HUNDAY, 1954). The typical lateritic profile is seen in patches which contains silicified woods, pebbles, fragments of quartz, quartzite and some basic rocks in ferruginous matrix. The age of this formation is believed to be Upper Miocene (KRISHNAN, 1968), equivalent to the Tipam Series in Assam.

Previously, *Palmoxylon* (GHOSH, 1943), *Terminalioxylon* (DEB & GHOSH, 1974), *Millettioxylon pongamiensis* Prakash (ROY & GHOSH, 1978), *Cynometroxylon indicum* CHOWDHURY, GHOSH AND KAZMI (1960), *Anisopteroxylon bengalensis* GHOSH AND KAZMI (1958) from Burdwan District, *Glutoxylon burmense* Chowdhury (CHOWDHURY & TANDON, 1952) from Midnapur District and *Pahudioxylon bankurensis* Chowdhury *et al.*, (1960) from Bankura District were described from the Tertiary of West Bengal.

The fossil woods recorded here were collected from the banks of Mayurakshi Canal near Santiniketan (23°42'N, 87°42'E), of Birbhum District in West Bengal. In order to make a detailed study, many sections were prepared from different parts of the petrified woods. The preservation of these woods is fairly good as to yield the necessary anatomical details for identification.

DESCRIPTION

Family—ANACARDIACEAE

Genus—**Glutoxylon** Chowdhury, 1934

Glutoxylon burmense (Holden) Chowdhury, 1952 (Pl. 1, Figs. 1-7)

The fossil wood, on which the present species is based, is represented by three well preserved pieces of silicified secondary wood. The preservation is fairly good.

Wood diffuse-porous (Pl. 1, Fig. 2). *Growth rings* delimited by thin terminal parenchyma bands (Pl. 1, Fig. 2). *Vessels* visible to the naked eye against the ground mass of the wood, mostly medium to large, solitary as well as radial multiples of 2-9, circular to oval in cross-section (Pl. 1, Fig. 2), those of radial multiples flattened at the places of contact,

*Paper presented at the Second Indian Geophytological Conference, Lucknow, March 11-12, 1978.

t.d. 99-366 μ , r.d. 133-499 μ , thick walled, common walls, 10-13 μ thickness, about 2-6 vessels per sq mm; tyloses abundant, vessel members about 165-666 μ in length, with truncate ends; perforations simple; intervessel pit-pairs large, bordered, alternate, oval with lenticular aperture, 7-13 μ diameter (Pl. 1, Fig. 6). Parenchyma paratracheal and apotracheal; paratracheal parenchyma scanty to vasicentric, often forming complete sheath of 1-3 cells around the vessels, apotracheal parenchyma represented by narrow, continuous or sometimes broken tangential bands (Pl. 1, Fig. 2); 1-5 (mostly 2-3) cells wide, 1-4 bands per mm. Xylem rays simple and fusiform (Pl. 1, Figs. 3, 4); simple rays fine, 1-2 (mostly 1) seriate (Pl. 1, Fig. 3); 6-13 cells in height, 66-332 μ in length, 13-25 μ in width; fusiform rays 3-4 seriate with a single horizontal gum canal (Pl. 1, Fig. 4); 66-93 μ in width; 332-665 μ in length; gum ducts lined with single row of epithelial cells, gum ducts 52-105 μ in diameter, rays homocellular, composed wholly of procumbent cells; procumbent cells 16-35 μ in tangential height, 52-85 μ in radial length. Fibres aligned in radial rows between two consecutive xylem rays in cross section, angular or hexagonal, non-septate, thick walled.

DISCUSSION

The name *Glutoxylon* was instituted by CHOWDHURY (1934) for the fossil woods resembling the modern genus *Gluta* and *Melanorrhoea*. Here he included only those *Melanorrhoeas* which have thin apotracheal parenchyma bands. PRAKASH AND TRIPATHI (1969) observed that the thickness of parenchyma bands and nature of the ray tissue can be used for segregating the woods of *Gluta* and *Melanorrhoea* into two distinct groups. In one of the groups which includes all the species of *Gluta* and those *Melanorrhoeas* which have thin apotracheal parenchyma bands up to 7 cells wide and the second group only includes some species of *Melanorrhoeas* with thick apotracheal parenchyma bands up to 10 cells wide. The fossil wood showing the characters of former type have been placed by them under the genus *Glutoxylon* Chowdhury, while the second group with thick bands of parenchyma have been placed in *Melanorrhoeoxylon* (PRAKASH & TRIPATHI, 1969). The wood described here is comparable in its nature of parenchyma and other characters with the genus *Glutoxylon*.

So far only two species of *Glutoxylon* are known from India and abroad. These are *Glutoxylon burmense* (Hold.) Chowdhury (CHOWDHURY, 1936, 1950, 1952; CHOWDHURY & TANDON, 1952; GHOSH & TANEJA, 1961; AWASTHI, 1966; PRAKASH & TRIPATHI, 1969) and *Glutoxylon cuddalorensis* (AWASTHI, 1966). Recently, two other species, *G. bengalensis* (MUKHERJEE 1942a, 1942b) and *G. chowdhurii* (GHOSH, 1958) have been transferred to *G. burmense* (Hold.) Chowdhury by AWASTHI (1966). The present fossil wood is identical with *Glutoxylon burmense* (Hold.) Chowdhury in the presence of distinct growth ring, medium to large sized vessels either solitary or radial groups, and abundance of tyloses. Apotracheal parenchyma bands are also narrow, irregularly spaced and often ending abruptly. Rays are also likewise 1-2, (mostly 1) uniseriate, homocellular. Thus, the specimen described here is identical in all respects with *Glutoxylon burmense* and, therefore, placed under the same species.

Gluta and *Melanorrhoea* are confined to South East Asia, India and Madagascar. Most of the species of *Gluta* are mainly confined to Burma, Thailand, Malay peninsula, Indochina and as far north-east as Hainan Island. *G. turtur* occurs in Madagascar only and *G. tavoyana* grows in South India and Burma. *G. travancorica* is confined to the ever-green forests, ascending to 1,200 meters in Kerala and in the Tinnevely District of Tamil Nadu (GAMBLE, 1902). *Melanorrhoea* has 6-8 species confined to South East Asia only.

None of these genera now occur in plains of Bengal. It is evident, therefore, that during the Tertiary period *Gluta* and *Melanorrhoea* occurred in South Bengal and also in Central Bengal. Their occurrence during the Tertiary in this area in the district of Birbhum indicates that the area was covered by evergreen forest during the Miocene.

Specimen—No. P12, P238 and P281, Palaeobotany Laboratory, Department of Botany, University of Burdwan, Burdwan.

Locality—1 (one) mile North of Santiniketan along Mayurakshi canal cutting, Birbhum District, West Bengal, India.

Horizon—Tipam Series.

Age—Tertiary (Miocene).

Family—COMBRETACEAE

Genus—**Anogeissusoxylon** Navale, 1962

Anogeissusoxylon bengalensis sp. nov. (Pl. 1, Figs. 8-11)

This species is based on single piece of decorticated wood measuring 8 cm in length and 3 cm in diameter. It is brown in colour with good preservation.

Wood diffuse-porous (Pl. 1, Fig. 8). *Growth rings* indistinct. *Vessels* small to very small in size, solitary as well as in radial groups of 2-3 (Pl. 1, Fig. 8), oval to elliptical in outline, t.d. 65-93 μ , r.d. 79-199 μ ; vessel-members short to medium, 133-399 μ in length; perforations simple; intervessel pits alternate, medium in size, vestured (Pl. 1, Fig. 11), 4-8 μ in diameter. *Parenchyma* paratracheal, vasicentric, aliform, sometimes confluent; initial parenchyma absent. *Xylem rays* fine, exclusively uniseriate (Pl. 1, Fig. 10), 2-20 cells or 66-598 μ in length, 4-6 per mm; heterocellular, made up of both procumbent and upright cells, ray 17-28 μ in height, crystals present in the ray cells. *Fibres* libriform, thick-walled, septate.

DISCUSSION

The small to very small sized solitary or radial groups of vessels, paratracheal, vasicentric to aliform parenchyma, exclusively uniseriate, heterocellular rays with crystals in ray cells and medium, septate fibres are the important anatomical characters of this fossil wood. These characters are more or less found in the woods of the families—Sapindaceae and Combretaceae (PEARSON & BROWN, 1932; CHOWDHURY, 1932; HENDERSON, 1953; GAMBLE, 1902; METCALFE & CHALK, 1950). Woods of Sapindaceae differ from the fossil in having homogeneous rays and simple pits. In the family Combretaceae, *Anogeissus* and *Terminalia* show similarities with the fossil in many anatomical details.

In *Terminalia* the vessels are medium to large, solitary or in radial multiples, parenchyma vasicentric to aliform enclosing the vessels, rays mostly homogeneous, 1-2 seriate, crystals are found in both parenchyma and rays, ray cells 27-41 μ in height, upright cells not present in the middle of the rays; intervessel pits 9-12 μ in diameter. Whereas, in *Anogeissus* the vessels are very small to small, parenchyma is more or less similar to *Terminalia*, rays are exclusively uniseriate and heterogeneous, crystals are found only in ray cells; ray cells 13 to 23 μ in height, upright cells frequently present in the middle of the rays, intervessel pits 6 to 9 μ in diameter (RAO & PURKAYASTHA, 1972). There are a few species of *Terminalia*, e.g. *T. oliveri*, *T. chebula*, *T. citrina* and *T. pallida* where the vessels are also very small like *Anogeissus*. But these species of *Terminalia* can be xylotomically distinguished from *Anogeissus* on the basis of average height of the rays and also in the degree of heterogeneity of rays (RAO & PURKAYASTHA, *l. c.*). In *Anogeissus* the

average height of the rays ranges from 13 μ —23 μ . While in *Terminalia* it varies from 22 μ —58 μ . In the fossil wood described here the height of the rays ranges from 17 μ —28 μ . In this regard also it is more like *Anogeissus*.

From the above description it is evident that the present fossil wood is more closer to the genus *Anogeissus* than *Terminalia* in the size, shape and distribution of vessels, nature and height of the ray cells and size of the intervessel pits.

Hitherto, only one species of *Anogeissusoxylon* from India (*A. indicum*) has been described by NAVALE (1962) from the Tertiary rocks near Pondicherry. The present fossil wood differs from *Anogeissusoxylon indicum* in having exclusively uniseriate rays, the tyloses and initial parenchyma are absent in the present fossil wood. Therefore, a new specific name *A. bengalensis* is used here for this wood.

Anogeissus is a genus with about eleven species, widely distributed in India and South East Asia, but a few occurring in tropical Africa and Arabia. About 6 species are reported to occur in India of which four are widely distributed throughout the greater part of the peninsula ascending to 1200 m, the other two species are found in Rajasthan only. *A. acuminata* Wall., which shows close resemblance with the present fossil wood, is a large tree found on banks of rivers and streams in Singhbhum, Bihar, extending southwards through Orissa to Andhra Pradesh and in Maharashtra. It occurs in Chittagong hill tracts and is common in deciduous forests throughout Burma. Thus, the occurrence of the genus *Anogeissus* in the plains of West Bengal during the Tertiary indicates that the forest cover in this area was deciduous mixed forest during this period.

Anogeissusoxylon bengalensis sp. nov. (Pl. 1, Fig. 8-11)

Diagnosis—Wood—diffuse-porous. *Vessels* small to very small in size, evenly distributed, solitary or in radial groups of 2 to 3, t.d. 65-93 μ , r.d. 79-199 μ ; tyloses absent; vessel-segments short with truncate ends; perforations simple; intervessel pit pairs distinctly vested, alternate, 6-8 μ in diameter. *Parenchyma* paratracheal, mainly vasicentric, aliform, sometimes confluent; initial parenchyma absent. *Rays* numerous, exclusively uniseriate, heterogeneous, 2-20 cells or 66-598 μ in length; crystals present in the ray cells. *Fibres* libriform, septate.

Holotype—No. P284, Palaeobotany Laboratory, Department of Botany, University of Burdwan, Burdwan.

Locality—1 mile north of Santiniketan along Mayurkashi canal cutting, Birbhum District, West Bengal India.

Horizon—Tipam Series.

Age—Tertiary (Miocene).

GENERAL DISCUSSION

In the modern flora of India, *Anogeissus* is represented by four species; *A. latifolia* Wall, *A. acuminata* Wall, *A. serica* Brandis and *A. pendula* Edgew. Among these, *A. latifolia* is the most widely distributed species occurring in dry deciduous forests of sub-Himalayan tract from the river Ravi to Nepal up to a height of 3000 ft., in the Chhotanagpur region of Bihar, Madhya Pradesh, Nilgiri Hills, Kerala coast and in Sri Lanka.

Anogeissus acuminata Wall, which is identical with the fossil (*Anogeissusoxylon bengalensis* sp. nov.), is also a dry deciduous tree mainly occurring along the eastern coast of India from Godaveri District of Andhra Pradesh to Ganjam District of Orissa, in the Chhotanagpur Hills of Bihar, hills of Chittagong in Bangladesh and in the adjacent area of Burma.

The only record of Tertiary fossil wood from India resembling *Anogeissus* is *Anogeissusoxylon indicum* Navale 1964. It occur in the Miocene beds near Pondicherry which is more

than 1500 km away from the location of occurrence of *A. bengalensis* in West Bengal. If we consider the distribution of *Anogeissus acuminata* together with the fossil record in Miocene, it appears that the genus was not disjunct in the past in its distribution as in the present day, but a continuous belt of distribution existed in the Tertiary from the south-eastern coast of India to Burma through Bengal and Bihar. The other two extant species, *A. serica* and *A. pendula* occur in the north-western coast, and in Narmada Valley, (BRANDIS, 1906).

In the modern forest flora of India, *Gluta* is represented by *G. travancorica* Bedd., *G. tavoyana* Hook. and *G. elegans* Kurz. These species occur in Kerala. The record of fossil wood belonging to *Gluta* are already known from the Middle Tertiary sediments of India. *Glutoxylon burmense* occurs in Miocene beds of Assam, West Bengal, Tamil Nadu and Manipur (CHOWDHURY 1952, CHOWDHURY & TANDON 1952, GHOSH & TANEJA 1961, AWASTHI 1966, PRAKASH & TRIPATHI 1969) and *Glutoxylon cuddaloreense* from the Cuddalore Series of Tamil Nadu (AWASTHI, 1966).

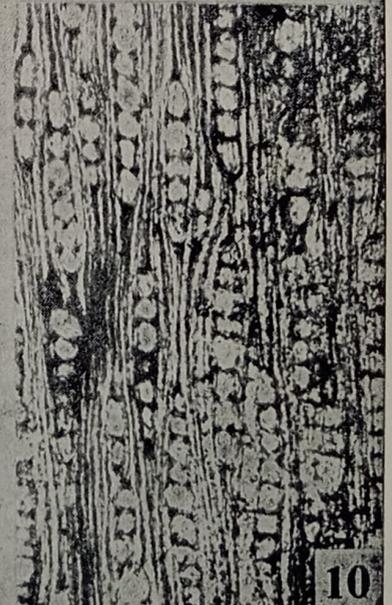
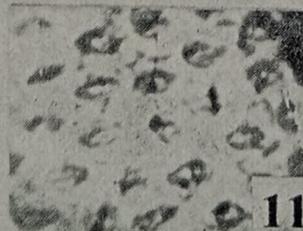
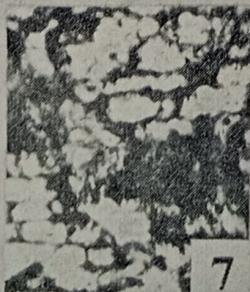
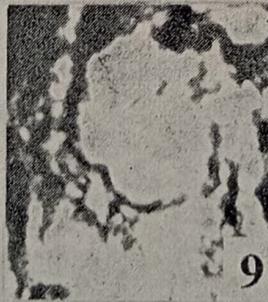
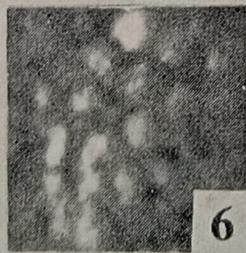
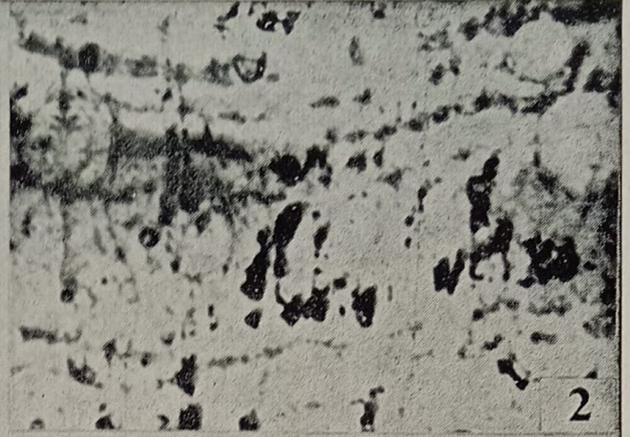
Both *Gluta* and *Anogeissus* occurred more widely in the Miocene Pliocene flora in India than their present range of distribution. Since the fossil record of these two genera is not known in the rocks older than Miocene, it is concluded that the Tertiary sediments of Birbhum District, where *Glutoxylon burmense* occurs, are also not older than Miocene.

ACKNOWLEDGEMENTS

We are grateful to Dr. U. Prakash and Dr. N. Awasthi of Birbal Sahni Institute of Palaeobotany, Lucknow for their valuable suggestions. We are also indebted to Dr. S. K. Purkayastha, officer-in-charge, Dr. R. Dayal and Mr. M. H. Kazmi of Wood Anatomy Branch, F. R. I., Dehra Dun, for providing us facilities to consult the xylarium of the Institute.

REFERENCES

- AWASTHI, N. ((1966). Fossil Woods of Anacardiaceae from the Tertiary of South India. *Palaeobotanist* **14** (1-3) : 131-143.
- CHOWDHURY, K. A. (1932). *The identification of important sleeper woods*. Calcutta.
- CHOWDHURY, K. A. (1934). A fossil dicotyledonous wood from Assam. *Curr. Sci.* **3** (6) : 255-256.
- CHOWDHURY, K. A. (1936). A fossil dicotyledonous wood from Assam. *Ann. Bot.* **50** (199) : 501-510.
- CHOWDHURY, K. A. (1950). Assam Nowgong district fossil wood (*Glutoxylon*) from Assam. *Palaeobot. India*. **7**. in *Jl. Indian bot. Soc.* **29** (1) : 34.
- CHOWDHURY, K. A. (1952). Some more fossil woods of *Glutoxylon* from South East Asia. *Ann. Bot. N. S.* **16** (63) : 373-378.
- CHOWDHURY, K. A. & TANDON, K. N. (1952). A new record for the fossil wood *Glutoxylon* from the Southern part of West Bengal. *Curr. Sci.* **21** : 161.
- CHOWDHURY, K. A., GHOSH, S. S. & KAZMI, M. H. (1960). *Pahudioxylon bankurensis* gen et sp. nov. A fossil wood from the Miocene bed of Bankura District, West Bengal (India). *Proc. nat. Inst. Sci. India* **26B** (1) : 22-28.
- DEB, URMILLA & GHOSH, A. K. (1974). On the occurrence of *Terminalioxylon* An angiospermous fossil wood from the vicinity of Santiniketan, Birbhum district, W. B. *Indian J. Earth Sci.* **1** (2) : 208-213.
- GAMBLE, J. S. (1902). *A manual of Indian Timbers*. London.
- GHOSH, A. K. (1943). Petrified wood from new localities in Bengal. (Abstract). *Proc. 30th Indian. Sci. Cong.*, Pt. **III** : 37.
- GHOSH, S. S. (1958). A new record for the fossil wood *Glutoxylon* from Manipur. *Sci. Cult.* **23** : 431-433.
- GHOSH, S. S. & KAZMI, M. H. (1958). *Anisopteroxylon bengalensis* gen. et sp. nov., a new fossil wood from microlithic site of West Bengal. *Sci. Cult.* **23** (9) : 485-487.
- GHOSH, S. S. & KAZMI, M. H. (1960). Botanical and other aspects of fossil wood tools of the Microlithic man of West Bengal. *Sci. Cult.* **25** : 650-653.



- GHOSH, S. S. & TANEJA, K. K. (1961). Further record of *Glutoxylon* from the Miocene (?) of Tripura. *Sci. Cult.* **27** : 581-582.
- HENDERSON, F. Y. (1953). An atlas of end-grain Photomicrographs for the identification of hard woods. *Forest Proc. Res. Bull.* **26** : 2-73.
- HUNDAY, A. (1954). On the newly found Tertiary patches in Bankura, Burdwan & Birbhum districts in West Bengal. *Sci. Cult.* **20** : 245-246.
- KRISHNAN, M. S. (1968). *Geology of India and Burma*. Madras.
- METCALFE, C. R. & CHALK, L. (1950). *Anatomy of Dicotyledons*. **1 & 2** Oxford.
- MUKHERJEE, A. (1942a). Identification of fossil wood from the Lalmai Range in Comilla, Bengal. *Sci. Cult.* **7** (11) : 572-574.
- MUKHERJEE, A. (1942b). A fossil dicotyledonous wood from Mainamati hills. *Sci. Cult.* **7** (7) : 370-371.
- NAVALE, G. K. B. (1964). *Anogeissusoxylon indicum* gen. et. sp. nov. from the Tertiary rocks near Pondicherry, India. *Palaeobotanist* **11** (3) : 154-158.
- PEARSON, R. S. & BROWN, H. P. (1932). *Commercial Timbers of India*. **1 & 2**, Calcutta.
- PRAKASH, U. & AWASTHI, N. (1969). Fossil woods from the Tertiary of Eastern India. *Palaeobotanist* **18** (3) : 219-225.
- PRAKASH, U. & TRIPATHI, P. P. (1969). On *Glutoxylon burmense* from Hailakandi in Assam with critical remarks on the Fossil woods of *Glutoxylon* Chowdhury. *Palaeobotanist* **17** (1) : 59-64.
- RAO, RAMESH & PURKAYASTHA, S. K. (1972). *Indian Woods*. Vol. **3**. Dehra Dun.
- ROY, S. K. & GHOSH, P. (1978). On the occurrence of *Millettioxylon pongamiensis* Prakash, a fossil wood of Leguminosae from the Tertiary of West Bengal, India. *Abst, Proc. 65th Ind. Sci. Congr.* Ahmedabad. **3** : 72.

EXPLANATION OF PLATE 1

1. Cross-section of the modern wood of *Gluta tavoyana* Hook. showing vessel and parenchyma distribution, $\times 30$.
2. Cross-section of the fossil wood of *Glutoxylon burmense* (Hold.) Chowdhury showing similar vessel distribution and parenchyma pattern, $\times 30$ (Slide No. P 12).
3. Tangential longitudinal section of the fossil wood (*Glutoxylon burmense*) showing the type of xylem rays and their distribution, $\times 100$ (Slide No. P 12).
4. Tangential longitudinal section of the fossil wood (*Glutoxylon burmense*) showing fusiform ray with single radial gum canal, $\times 100$ (Slide No. P 12).
5. Tangential longitudinal section of *Gluta tavoyana* Hook. showing similar type of rays and their distribution, $\times 100$.
6. Radial longitudinal section showing intervessel pits in *Glutoxylon burmense*, $\times 800$.
7. Radial longitudinal section (*G. burmense*) showing homocellular rays, $\times 100$.
8. Cross-section of *Anogeissusoxylon bengalensis* sp. nov. showing vessel and parenchyma distribution, $\times 30$ (Slide No. P 284).
9. Magnified cross-section of *Anogeissusoxylon bengalensis* sp. nov. showing a multiple vessel and parenchyma distribution, $\times 200$ (Slide No. P 284).
10. Tangential longitudinal section of *Anogeissusoxylon bengalensis* sp. nov. showing the type of xylem rays and their distribution, $\times 100$ (Slide No. P 284).
11. Tangential longitudinal section of *Anogeissusoxylon bengalensis* sp. nov. magnified to show intervessel pits, $\times 800$ (Slide No. P 284).