

ON *GLUTOXYLON BURMENSE* FROM HAILAKANDI IN ASSAM WITH CRITICAL REMARKS ON THE FOSSIL WOODS OF *GLUTOXYLON* CHOWDHURY

U. PRAKASH & P. P. TRIPATHI

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

Fossil wood of *Glutoxylon burmense* (Hold.) Chowdhury is described here from a new locality of Hailakandi in district Cachar, Assam. A critical review of the hitherto described species of the genus *Glutoxylon* is made, based on an exhaustive study of the modern woods of *Gluta* and *Melanorrhoea*.

INTRODUCTION

THE material, on which the present investigation is based, was collected by Mr. A. N. Datta, Vijnan Mandir Officer, Hailakandi, district Cachar, Assam, and sent to us for identification in June 1964. The material consisted of small pieces of petrified wood, which were collected from near the town of Hailakandi (24°26' N; 92°32' E).

The age of the fossil wood is Tertiary, probably Middle Miocene, possibly being derived from the Tipam sandstones exposed in the vicinity of the fossil occurrence at Rath Tila, which is about 25 kms. from Hailakandi (EVANS, 1932).

The study of this new specimen of *Glutoxylon burmense* reveals some anatomical differences which are recorded here and thought to be of variable nature. Further, a critical examination of the hitherto described species of *Glutoxylon* Chowdhury is made, based on a detailed study of the living species of *Gluta* and *Melanorrhoea*. This has resulted in the amendment of the generic diagnosis and the regrouping of the species.

DISCUSSION

The most important anatomical features of the present fossil wood consist of vessels small to moderately large in size (t.d. 44-220 μ , r.d. 72-288 μ), mostly solitary (PL. 1, FIGS. 1 & 2), sometimes in radial rows of 2-8; intervessel pit-pairs large, alternate (PL. 1, FIG. 4), with lenticular apertures;

performations simple; parenchyma paratracheal and apotracheal, paratracheal parenchyma scanty to vasicentric forming 1-2 seriate sheath; apotracheal parenchyma in narrow, continuous or sometimes broken tangential bands 1-5 (mostly 2-3) cells thick and as diffuse-in-aggregate in short lines or groups of cells; ray tissue homogeneous composed of procumbent cells (PL. 1, FIG. 5), with simple and fusiform xylem rays; simple rays 1-2 (mostly 1) and fusiform rays 3-4 seriate with gum-canals (PL. 1, FIG. 3); and semi-libriform and non-septate fibres. In all these features the present fossil wood shows great similarity with the modern wood of *Gluta* and those *Melanorrhoeas* which have thin apotracheal parenchyma bands.

In 1934 Chowdhury instituted the form-genus *Glutoxylon* for the fossil woods resembling the modern woods of *Gluta* and those *Melanorrhoeas* which have thin apotracheal parenchyma bands and described *Glutoxylon assamicum* from the Tertiary of Assam (CHOWDHURY, 1934, 1936). However, in 1952 Chowdhury transferred *Glutoxylon assamicum* to *G. burmense* (Hold.) comb. nov. along with many other fossil woods described under different genera and species (CHOWDHURY, 1952, p. 376). Besides, Mukherjee (1942a-c) has recorded *G. bengalensis* from the Tertiary of Mainamati Hills, Bengal and Ghosh (1958) *G. chowdhurii* from recent or sub-recent deposits of Manipur. Recently both these species have been transferred to *G. burmense* (Hold.) Chowdh. by Awasthi (1966), who has also described a new species, *G. cuddalorensis* from the Cuddalore series, South India, besides recording a fossil wood of *G. burmense*. As the present fossil wood from Hailakandi shows the important anatomical features of *G. burmense*, it is being referred to it (TABLE 1), although it shows slightly broader (1-5 seriate) bands of concentric parenchyma and homogeneous ray tissue composed of procumbent cells.

Recently while working on the present fossil wood we studied 4 species of *Gluta* and 9 species of *Melanorrhoea* and the following observations have been made with regard to the thickness of the apotracheal parenchyma bands and the nature of the ray tissue (see Table below).

From these observations it appears that all the species of *Gluta* have apotracheal parenchyma bands, 1-7 (usually 2-4) seriate and possess homogeneous ray tissue except in *G. tavoyana* where it is mostly homogeneous and rarely very weakly heterogeneous with a row or part of a row of upright cells in some rays. On the other hand, some species of *Melanorrhoea* also show 1-7 (usually 2-4) seriate, apotracheal parenchyma bands except *M. torquata*, *M. malayana* and *M. usitata*, where the apotracheal parenchyma bands are 1-9 or 10 (usually 3-7 or 8) seriate. The ray tissue in all the species of *Melanorrhoea* so far examined is homogeneous. Thus, there can be two groups, one

including all the *Gluta* and those *Melanorrhoeas* which have thin, 1-7 (usually 2-4) seriate, apotracheal parenchyma bands and the other comprising only *Melanorrhoeas* with thick, 1-10 (usually 3-7 or 8) seriate, apotracheal parenchyma bands. For the fossil woods showing characters of the former group, we may keep the generic name *Glutoxylon* Chowdhury, but for the woods of the other group which includes only *Melanorrhoeas* with thick bands of parenchyma we may institute a new generic name, *Melanorrhoeoxylon*.

Of all the fossil woods so far referred to *Glutoxylon* Chowdh., only *G. bengalensis* Mukherjee (1942b, 1942c) does not conform to the new definition of the genus *Glutoxylon* given above and need to be transferred to the genus *Melanorrhoeoxylon*. But the authors deem it fit to postpone this till they examine themselves the fossil wood specimen of *G. bengalensis* and ascertain its characters, because the thickness of the

Name of the species	Thickness of the apotracheal parenchyma bands	Nature of ray tissue
1. <i>Gluta renghas</i> , (Sphalm. Benghas) Linn.	1-7 (usually 2-3) seriate	Homogeneous, composed of procumbent cells
2. <i>G. coarctata</i> , Hook.	1-6 (usually 2-4) seriate	Homogeneous, composed of procumbent cells
3. <i>G. tavoyana</i> , Hook.	1-7 (usually 2-4) seriate	Mostly homogeneous, rarely very weakly heterogeneous with a row or part of a row of upright cells in few rays.
4. <i>G. travancorica</i> , Bedd.	1-6 (usually 2-4) seriate	Homogeneous, composed of procumbent cells
5. <i>Melanorrhoea</i> sp.	1-7 seriate	Homogeneous, composed of procumbent cells
6. <i>M. glabra</i> , Wall.	1-7 (usually 3-4) seriate	Homogeneous, composed of procumbent cells
7. <i>M. usitata</i> , Wall.	1-10 (usually 4-7 or 8) seriate	Homogeneous, composed of procumbent cells
8. <i>M. aptera</i> , King	1-6 (usually 2-3) seriate	Homogeneous, composed of procumbent cells
9. <i>M. curtisi</i> , Oliver	1-7 (usually 2-4) seriate	Homogeneous, composed of procumbent cells
10. <i>M. laccifera</i> , Pierre	1-7 (usually 3-4) seriate	Homogeneous, composed of procumbent cells
11. <i>M. malayana</i> , Corner	1-9 (usually 3-4) seriate	Homogeneous, composed of procumbent cells
12. <i>M. pilosa</i> , Lecomte	1-6 (usually 2-3) seriate	Homogeneous, composed of procumbent cells
13. <i>M. torquata</i> , King	1-9 (usually 3) seriate	Homogeneous, composed of procumbent cells

TABLE 1 — SHOWING IMPORTANT ANATOMICAL CHARACTERS OF FOSSIL WOODS SO FAR REFERRED TO *GLUTOXYLON BURMENSE* (HOLDEN) CHOWDHURY

NAME OF THE FOSSIL WOOD	GROWTH RINGS	VESSELS	PARENCHYMA	XYLEM RAYS	FIBRES	LOCALITY	AGE
1	2	3	4	5	6	7	8
1. <i>Dipterocarpoxyton annamense</i> Colani, 1919	Vessels and parenchyma arranged in such a manner as to give the impression of annual-rings.	Diffuse, large to very large, 270-600 μ in diameter, solitary or in radial groups of 2-3, elliptical in cross-section.	Not very clear, round the vessels and in bands.	Uni- to multiseriate, 7-16 cells high; broad rays with resin canals.	—	Basin du Dadung, Indo-China.	Tertiary
2. <i>Irrawadioxyton burmense</i> Gupta, 1935	Indistinct	Diffuse, large to very large, usually solitary, occasionally in radial groups of rarely more than 3 or 4, round in shape, tylosed.	Vasicentric, and forming tangential bands of 2-4 cells thick; 3 or more bands occurring at the same place.	Mostly uniseriate, occasionally 2-4 seriate containing gum canals, 2-30 cells high; ray cells nearly squarish in radial section.	—	Gwedindon, Saging District, Burma.	Tertiary (Pliocene), Irrawady series.
3. <i>Glutoxyton assamicum</i> Chowdhury, 1936	Indistinct	Diffuse, medium to large, t.d. of solitary vessels 153-213 μ , r.d. 213-281 μ , solitary or in radial pairs of 2-9 (mostly 2-4), oval in shape; perforations simple; intervessel pits large, alternate, border oval or hexagonal when crowded, with lenticular aperture; profusely tylosed.	Paratracheal and apotracheal; paratracheal scanty, in sheath of 1-2 cells, seldom forming eyelets; apotracheal bands, 1-4 cells wide (mostly 2), continuous or ending blindly, spaced irregularly; diffuse not observed.	Simple and fusiform; simple 1-2 seriate (mostly 1); fusiform 2-4 seriate with gum canals; rays more than 15 cells high; ray tissue weakly heterogeneous; ray cells mostly procumbent, rarely square or upright.	Thin to thick walled, somewhat tangentially compressed, aligned in radial rows, short in length.	Nailalung, Assam.	Tertiary (Miocene)
4. <i>Glutoxyton</i> sp. Mukherjee, 1942a = (<i>Dipterocarpoxyton</i> sp. Sen, 1930)	Indistinct to distinct	Diffuse, medium to large-sized, mostly solitary sometimes in radial groups of 2-4, circular in cross section, heavily tylosed.	Paratracheal and apotracheal; apotracheal bands, 2-7 seriate (mostly 2-4); metatracheal rare.	Simple and fusiform; simple 1-3 seriate (mostly 1); fusiform 2-4 seriate (mostly 3) containing gum canals.	—	Lalmai Range in Comilla, Bengal.	Tertiary (Pliocene)
5. <i>Glutoxyton bengalensis</i> Mukherjee, 1942b, 1942c	Distinct	Diffuse, medium to large-sized, solitary or in radial multiples of 2-9 (mostly 2-3), heavily tylosed.	Paratracheal and apotracheal; paratracheal vasicentric, rarely forming eyelets; apotracheal bands 2-9 cells (mostly 2-4) thick; diffuse rare.	Simple and fusiform; simple 1-2 (mostly 1) seriate; fusiform 2-3 cells wide with gum canals.	Thin to thick-walled.	Maināmati Hills, District Comilla, Bengal	Tertiary
6. <i>Glutoxyton burmense</i> (Hold.) Chowdhury (Chowdhury & Tandon, 1952)	—	—	Apotracheal parenchyma bands, narrow, irregularly spaced and ending abruptly.	Fusiform rays with horizontal gum ducts.	—	Bed of river Silabati, near Garbeta, District Midnapur, West Bengal.	Late Tertiary
7. <i>Glutoxyton burmense</i> (Hold.) Chowdhury (Chowdhury, 1950, 1952)	—	—	Description not given.	—	—	Cachar Hills, Assam.	Tertiary (Miocene)
8. <i>Glutoxyton burmense</i> (Hold.) Chowdhury (Chowdhury, 1952)	—	—	Description not given.	—	—	Laterite of Raniganj Coalfield, Bengal.	Miocene to Pleistocene
9. <i>Glutoxyton chowdhurii</i> Ghosh, 1958	Indistinct	Diffuse, moderately small to large, 75-300 μ in diameter, usually solitary, sometimes in radial rows of 2-4 or more, round to oval in shape.	Paratracheal and apotracheal; paratracheal mostly vasicentric, occasionally extending side ways; apotracheal in 1-6 cells thick bands, rather irregularly spaced and running more or less concentrically or ending abruptly.	Simple and fusiform; simple uniseriate to partly biseriate but majority uniseriate, 2-17 cells high; fusiform rays 3-4 seriate with gum canals.	Non-libriform to semi-libriform, aligned in radial rows; fairly thick tangential patches of fibres simulating gelatinous fibres.	Manipur	Recent to Sub-recent.
10. <i>Glutoxyton burmense</i> (Hold.) Chowdhury (Awasthi, 1966)	Distinct, (seen on careful examination, delimited by thin, terminal parenchyma bands).	Diffuse, small to large (mostly medium to large), t.d. 40-300 μ , r.d. 30-345 μ , solitary as well as in radial multiples of 2-4, sometimes 2-10, circular to oval in cross-section; perforations simple; intervessel pit-pairs large, bordered, alternate, with lenticular apertures; tyloses abundant.	Paratracheal and apotracheal; paratracheal scanty to vasicentric, often forming complete sheath of 1-3 cells around the vessels, occasionally tending to become aliform; apotracheal occurring at growth rings as well as in between ending abruptly; bands 2-5 cells wide.	Simple and fusiform; simple rays 1-2 (mostly 1) seriate, 3-20 cells in height; fusiform 3-4 seriate, with gum canals; ray tissue homogeneous, rays homocellular, consisting of procumbent cells.	Thick-walled, angular (mostly hexagonal), non-septate, aligned in radial rows.	Between Murattandichavadi and Kashipalayam, near Pondicherry, South Arcot District, Madras.	Tertiary (Miocene), Cuddalore series.
11. <i>Glutoxyton burmense</i> (Hold.) Chowdhury (Prakash & Tripathi, 1969)	Indistinct, appear to be delimited by smaller vessels and bands of apotracheal parenchyma.	Diffuse, small to moderately large, t.d. 44-220 μ , r.d. 72-288 μ , majority solitary, less commonly in radial rows of 2-8 (mostly 2-3), round to oval in cross-section; perforations simple; intervessel pit-pairs large, bordered, alternate, aperture lenticular; profusely tylosed.	Paratracheal and apotracheal; paratracheal scanty to vasicentric forming 1-2 cells thick sheath around the vessels; apotracheal in narrow, continuous or sometimes broken tangential bands 1-5 (mostly 2-3) cells thick, irregularly spaced and running more or less concentrically or ending abruptly; diffuse-in-aggregate occurring as short lines or in groups of cells.	Simple and fusiform; simple rays 1-2 (mostly 1) seriate, 2-28 cells high; fusiform 3-4 seriate, with gum canals, 7-22 cells high; ray tissue homogeneous, rays homocellular, consisting of procumbent cells.	Semi-libriform with big lumina, non-septate and polygonal in cross section.	Hailakandi, District Cachar, Assam.	Tertiary (Middle Miocene), Tipam series).

apotracheal parenchyma bands can be mistaken in somewhat badly preserved specimens like this.

As the generic diagnosis given by Chowdhury (1936) does not cover the characters shown by *Glutoxylon cuddalorensis* Awasthi (1966), and the present fossil wood from Hailakandi, it is being emended as follows:

Glutoxylon Chowdhury emend.

Growth rings distinct or indistinct. *Vessels* small to large-sized, solitary and in radial multiples of 2-9 (mostly 2-4) or more, profusely tylosed, occasionally filled with solid contents; perforations simple, horizontal or oblique; vessel elements with or without tail; intervessel pit-pairs large, alternate, widest horizontally, border oval, or hexagonal when crowded, aperture lenticular, horizontal or slightly oblique; vessel-ray pits very large, round to oval, one to several per ray cell, with wide aperture and narrow border, horizontally aligned; vessel-parenchyma pits are of the same type as those of vessel-ray pits but vertically aligned. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty, vesicentric and sometimes tending to become aliform; apotracheal parenchyma in narrow, 1-7 cells thick, continuous or sometimes broken tangential bands, rather irregularly spaced and running more or less concentrically or ending abruptly; diffuse in groups

of cells or in short lines. *Xylem rays* very fine to moderately fine, of two types, the simple rays uniseriate, rarely biseriate; the fusiform rays with horizontal gumducts, 2-4 seriate; ray tissue homogeneous with procumbent cells or rarely weakly heterogeneous with mostly procumbent, rarely square or upright cells.

It is rather difficult to distinguish anatomically almost all the modern species of *Gluta* and those *Melanorrhoeas* which have thin apotracheal bands of parenchyma. The ray tissue is homogeneous in all except *Gluta tavoyana* where it is mostly homogeneous but rarely weakly heterogeneous. It is, therefore, suggested that the diagnosis of *Glutoxylon burmense* which according to its original description (CHOWDHURY, 1936, 1952), should have ray tissue mostly homogeneous, rarely weakly heterogeneous, may now be emended to have homogeneous or almost homogeneous ray tissue.

ACKNOWLEDGEMENTS

Thanks are due to Mr. A. N. Dutta, Vijnan Mandir Officer, Hailakandi, district Cachar, Assam, for kindly sending the fossil wood specimens for investigation. To Sri K. Ramesh Rao, Officer-in-charge, Wood Anatomy Branch, Forest Research Institute, Dehra Dun, the authors are grateful for facilities to consult the xylarium.

REFERENCES

- AWASTHI, N. (1966). Fossil woods of Anacardiaceae from the Tertiary of South India. *Palaeobotanist*. **14** (1-3): 131-143.
- CHOWDHURY, K. A. (1934). A fossil dicotyledonous wood from Assam. *Curr. Sci.* **3** (6): 255-256.
- Idem (1936). A fossil dicotyledonous wood from Assam. *Ann. Bot.* **59** (199): 501-510.
- Idem (1950). Assam, Nowgong district fossil wood (*Glutoxylon*) from Assam. *Palaeobot. India*. **7**. *J. Indian bot. Soc.* **29** (1): 34.
- Idem (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.
- COLANI, M. M. (1919). Sur un *Dipterocarpoxyton annamense* nov. sp. Du Tertiaire suppose de L'Annam. *Bull. Service geol. Indochine*. **6** (3): 1-8.
- EVANS, P. (1932). Explanatory notes to accompany a table showing the Tertiary succession in Assam. *Trans. Min. geol. Inst. India*. **27**: 155-260.
- GHOSH, S. S. (1958). A new record for the fossil wood '*Glutoxylon*' from Manipur. *Sci. & Cult.* **23**: 431-433.
- GUPTA, K. M. (1935). Critical remarks on *Dipterocarpoxyton burmense* Holden: *Irrawadioxyton* Gen. Nov. *Proc. Indian Acad. Sci.* **1** (9): 549-555.
- MUKHERJEE, A. (1942a). Identification of fossil wood from the Lalmai Range in Comilla, Bengal. *Sci. & Cult.* **7** (11): 572-574.
- Idem (1942b). A fossil dicotyledonous wood from Mainamati hills. *Ibid.* **7** (7): 370-371.
- Idem (1942c). A fossil dicotyledonous wood from Mainamati hills in Tipperah district, Bengal. *Q. Jl. geol. Min. metall. Soc. India*. **14** (2): 75-82.
- SEN, J. (1930). Fossil wood of *Dipterocarpoxyton* type from the Lalmai Range in Comilla, Bengal. *Ibid.* **2**: 139-141.

EXPLANATION OF PLATE 1

Glutoxylon burmense (Holden) Chowdhury (B.S.I.P. Specimen No.33750)

PLATE 1

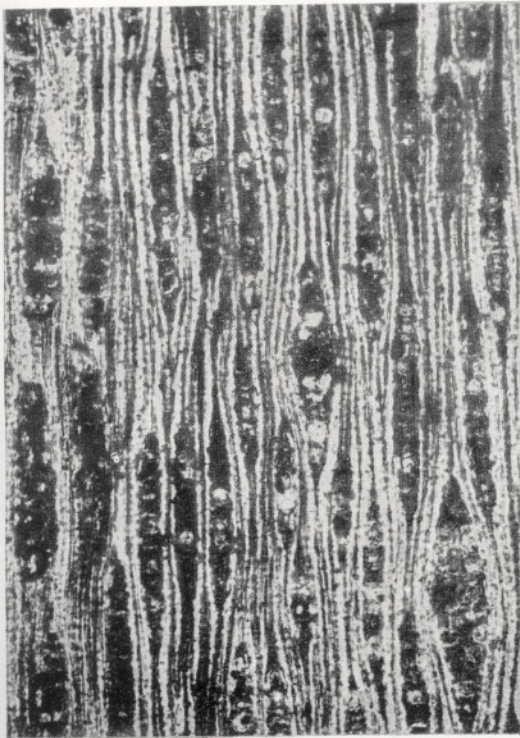
1. Cross-section of the fossil wood showing vessel and parenchyma distribution. $\times 9$. (Slide No. 3259)
2. Cross-section of the fossil wood slightly magnified showing vessels, and thin apotracheal bands of parenchyma. $\times 35$. (Slide No. 3259)
3. Tangential longitudinal section showing xylem rays. Note two fusiform rays with gum ducts. $\times 100$. (Slide No. 3260)
4. Magnified intervascular pitting. $\times 600$. (Slide No. 3260)
5. Radial longitudinal section to show the nature of xylem rays. $\times 120$. (Slide No. 3261)



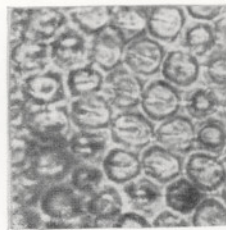
1



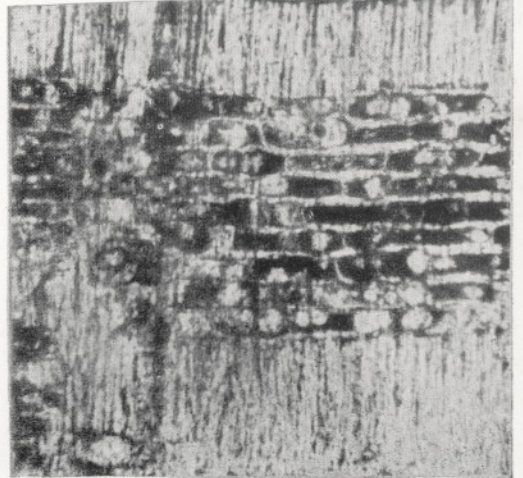
2



3



4



5