

TWO NEW SPECIES OF FOSSIL WOODS FROM RANIKOT FORT AREA OF SIND, PAKISTAN.

M. T. M. RAJPUT and K. M. KHAN

Department of Botany, University of Sind, Jamshoro, Pakistan.

Abstract

Fossil dicotyledonous wood belonging to genus *Cynometra* of family Leguminosae and genus *Pterocarya* of family Juglandaceae are described. Two new species *Cynometroxylon ranikotensis* sp. nov., and *Pterocaryoxylon ranikotensis* sp. nov. are established.

Introduction

The present paper describes two new fossil woods belonging to Leguminosae and Juglandaceae, which were collected from Ranikot Fort area (Pl.I; Fig. 2-3) in 1974. The Ranikot fort area is about 90 km. north of Hyderabad, 22 km. west of Sunn Railway Station in District Dadu, Sind, Pakistan.

The fossil woods were scattered in an area of about 4 square km in the exposed Manchar Rocks (Pl.I; Fig. 3). The Manchar formation is well developed in Sind and it is chiefly composed of coarse grained gritty sandstone, clay with some shale and subordinate amount of conglomerate (Farshori, 1972). From Manchar formation, Khan & Rehmatullah (1968, 1971) and Khan & Rajput (1975, 1976) identified and described a few dicot and monocot fossil woods.

Material and Methods

The fossil woods described here were collected by the authors with the help of Professor Rais Ahmed, Geology Department, University of Sind in 1974. The details of the size and color of the material are given under the morphological description of each species.

Fossil woods under investigation were cut into transverse, radial and tangential sections by means of a Rock cutting machine having diamond impregnated cutting disc. Thin sections were smoothed with the carborandum powder on a glass plate and the smooth surface fixed onto the slide with canada balsam. The mounted slide was then ground on the revolving grinding disc, then on steel and glass plates using the carborandum

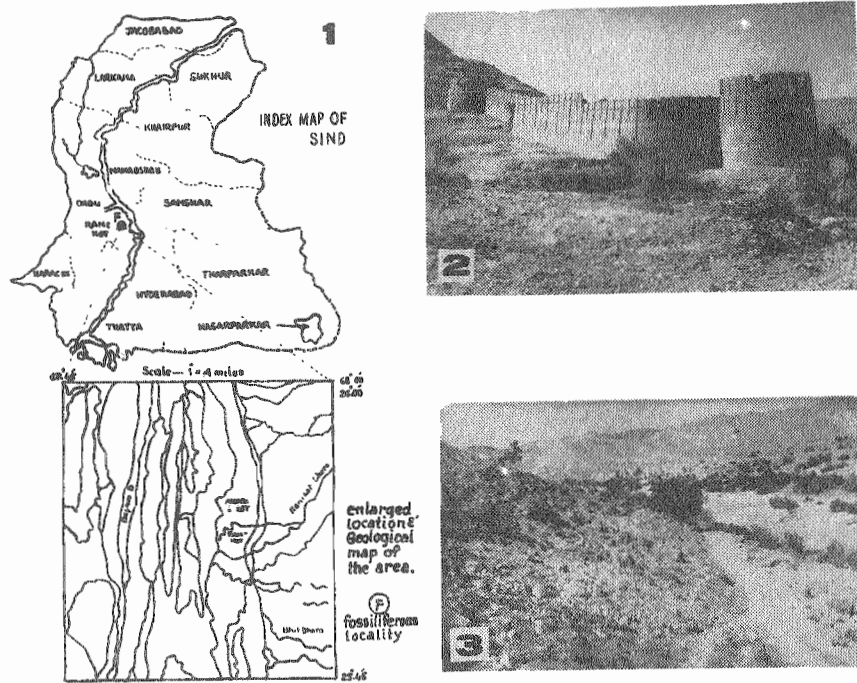


Plate - I

- Fig. 1. Map showing the fossiliferous locality.
 Fig. 2. Ranikot Fort. The specimens were scattered around this fort.
 Fig. 3. Photograph showing the scattered fossil woods.

powders of various grades. The process was continued until the sections attained the thickness of a single cell so that the section can be seen under the microscope. The thin sections were transferred onto a new glass slide and mounted with canada balsam by means of automatic slide heater. Finally the slides of the thin sections were examined under the microscope for their anatomical details.

The petrified wood under investigation carried the natural stain due to the hydrated iron oxide therefore artificial staining of the thin sections was not necessary.

CYNOMETROXYLON RANIKOTENSIS SP. NOV.

Morphological description

The material consists of a piece of well preserved silicified fossil wood, brown in colour, about 7 cm. long and 3 cm. in diameter (Plate II; Fig. 1).

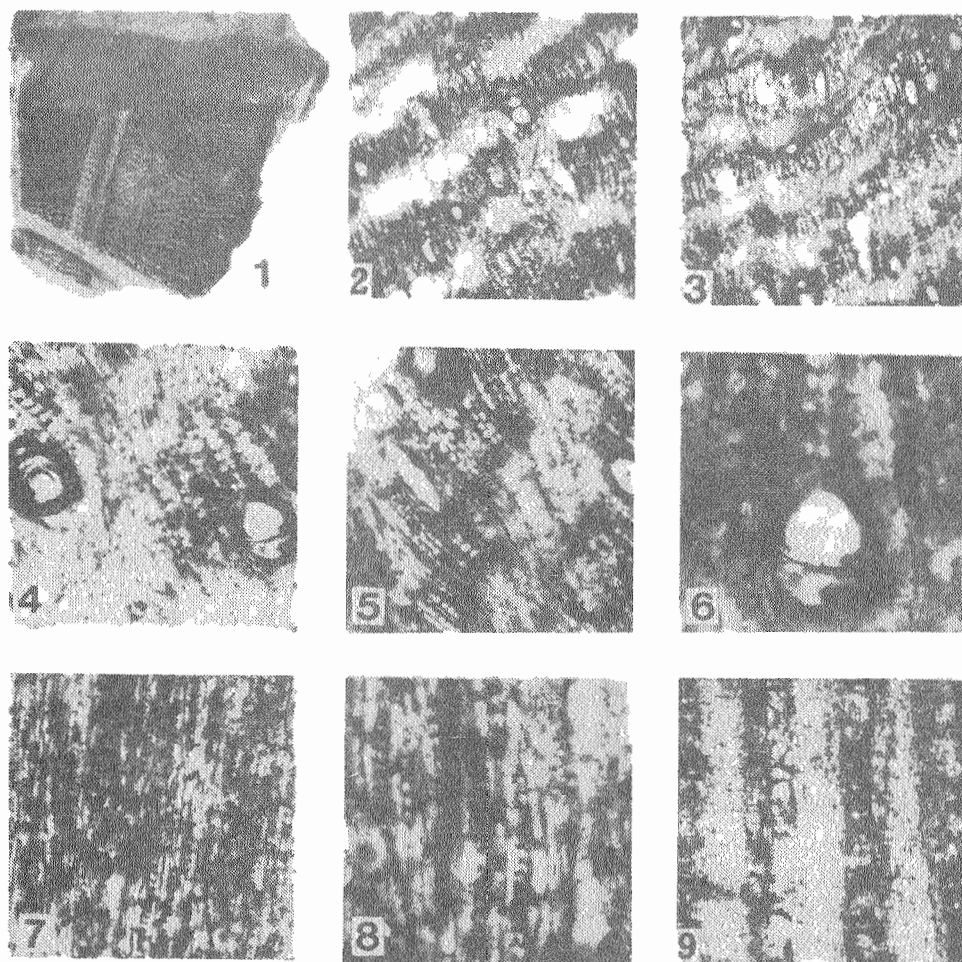


Plate - II

- Fig. 1. Silicified fossil wood, *Cynomerroxylon ranikotensis* sp. nov.
 Fig. 2. Transverse-section, showing the distribution of vessels
 Fig. 3. Transverse-section, showing alternate bands of parenchyma and fibre cells.
 Fig. 4. Transverse-section, showing the radial grouping of vessel, xylem rays and wood parenchyma
 Fig. 5. Transverse-section showing vessel filled with deposits.
 Fig. 6. Enlarged portion of transverse-section, showing radial grouping of vessels having inter vessel pits, and wood parenchyma.
 Fig. 7. Tangential-section showing distribution of vessels and xylem rays
 Fig. 8. Enlarged portion of tangential-section, showing the nature of xylem rays.
 Fig. 9. Radial-section, showing vessel, rays and fibres

*Anatomical description**Transverse section*

Wood diffuse-porous; annual rings are absent. The vessels small to medium sized, mostly solitary, (Pl.II; Fig. 2), or sometimes in radial groups of 2 and rarely in radial groups of 3 (Pl.II; Fig. 4&6). Vessels are partially filled with deposits of unknown nature (Pl.II; Fig. 5), thin walled, oval to elliptical in shape. diameter ranging from 47(104) – 243 μ m.

The wood parenchyma can easily be located by a hand lense as a fine band running tangentially on the cross surface of the wood (Pl.II; Fig. 1,3 and Text. Pl. V; Fig. 1). Parenchyma bands are aliform and confluent type which forms a sheath like structure around each vessel. Parenchyma bands are usually 8–17 cells thick, when the parenchyma encircles the vessels, the parenchyma sheath thus formed is usually in 2 to 6 layers. Parenchyma cells are mostly empty but occasionally filled with a dark brown deposit. Due to poor preservation the interpits are not seen; the diameter of the parenchyma band ranges from 158 to 474 μ m; average thickness 278 μ m, the average thickness of the parenchymatous sheath around the vessels is 88 μ m.

The xylem rays are quite prominent on the transverse surface of the wood, (Pl. II, Fig. 2-5). Wood fibres are poorly preserved and form bands which are alternate to parenchyma bands.

Tangential section

Xylem rays numerous, uniformly distributed (Pl.II; Fig. 7-8) uniseriate, homogenous (Pl. II; Fig. 7 and Text Pl. V; Fig. 2) are very rarely biseriate, 5 to 20 cell high. Total average length of the rays is 227 μ m, ray cell round to oval (Pl.II; Fig. 8), and mostly made up of procumbent cells partially filled with deposits. The wood fibers are poorly preserved.

Radial section

Vessels are elongated tube like structure mostly having partition walls (Pl. II; Fig. 9 and Text Pl. V; Fig. 3), perforations simple with transverse perforation plates. The length of the vessel member ranges from 316 to 632 μ m average length 555 μ m, average breadth 142 μ m, vessels walls have pits which are poorly preserved.

Parenchyma are found in 4 to 6 layers around the vessels. Fibres are fine, thread like structure average length 216 μ m, Cross field pits poorly preserved (Text Pl. V; Fig. 2&4), mostly fields are empty, average pit in a field is 2.

Discussion

Comparison with living species

Important anatomical features of the fossil wood under investigation are diffuse type of vessels which are solitary or in radial group of 2 or very rarely in radial groups of 3 having uniform distributions; characteristic tangential bands of parenchyma and fibres which are regularly alternate forming successive rows of almost equal width.

The above mentioned anatomical characters shows resemblance to some members of the following families e.g. Guttiferae, Moraceae, Meliaceae, Leguminosae.

Fossil under investigation shows resemblance with the following genera of the family Guttiferae, e.g. *Garcinia*, *Kayea*, *Rheedia* and *Symphonia*, however, they differ from the fossil wood under investigation by having broad and high rays. A few members of family Moraceae e.g. *Ficus* and *Malaisia* are also comparable with the fossil under investigation in having parenchyma and fibre bands more or less of equal width but the above mentioned genera of family Moraceae differs in having large sized vessels and rays.

Fossil under investigation can also be comparable with the *Amoora* and *Chisocheton* of Meliaceae but these genera can be separated from the fossil specimen under investigation due to the fundamental difference in the nature of the rays. The rays are homogenous uniseriate in the fossil wood under investigation, whereas the rays are heterogenous multiseriate in *Amoora* and *Chisocheton*.

The fossil specimen shows resemblance with some genera of family Leguminosae e.g., *Erythrina*, *Pongamia*, *Cynometra*, *Clitorea* and *Baphia*. Genus *Erythrina*, *Pongamia* can be eliminated as they have thick parenchyma bands. *Baphia* and *Clitorea* also differ from the fossil under study by having two distinct large and small types of vessels.

Fossil under investigation shows resemblance in most of the anatomical features with the living genus *Cynometra* (see Metcalf & Chalk vol. I, 1950). Its closest similarities can, therefore be made with the diagnosis given for *Cynometroxylon* in Chowdhury & Ghosh (1946).

Comparison with the known species of Cynometroxylon.

Only one species *Cynometroxylon indicum* (Chowdhury & Ghosh, 1946) is so far known from Nailalung, Assam. Our species of *Cynometroxylon* shows some resemblance with *C. indicum* in having equally wide regularly alternate parenchyma and fibre bands as well as small to medium sized vessels which are mostly solitary.

In spite of the above mentioned similarities, fossil under investigation differs

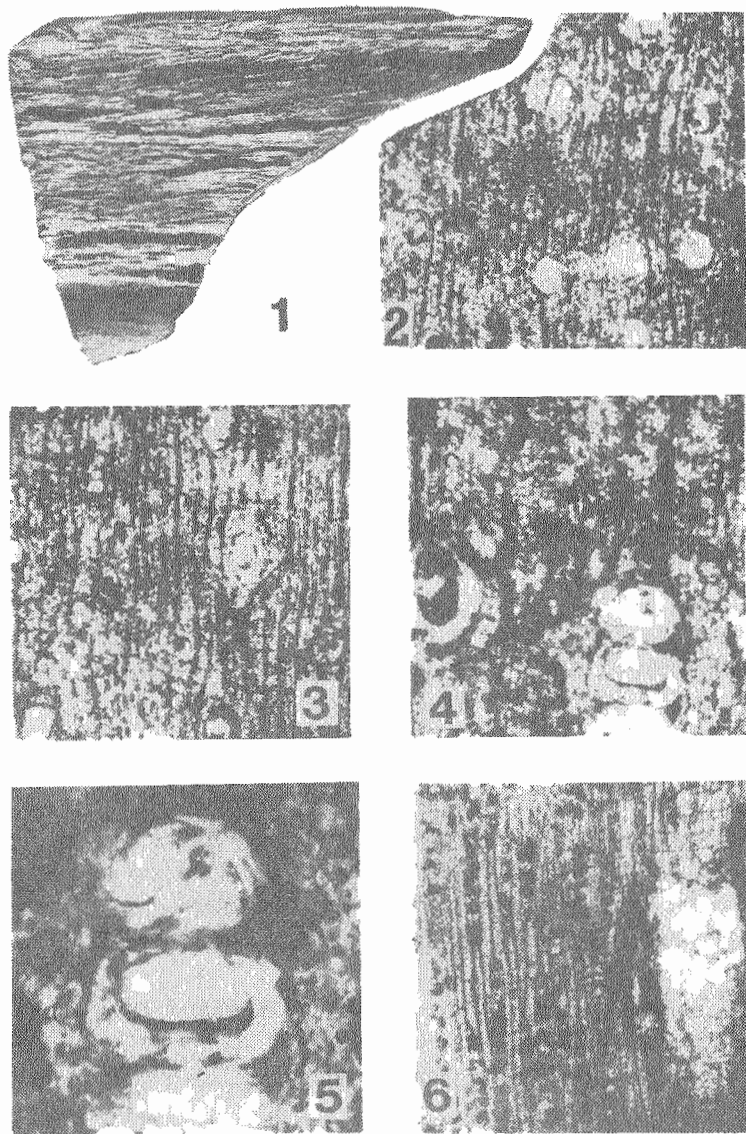


Plate III

- Fig. 1. Petrified wood, *Pterocaryoxylon ranikotensis* sp. nov.
 Fig. 2. Transverse-section, showing the distribution of vessels, rays and wood parenchyma.
 Fig. 3. Transverse-section, showing the vessels, partially filled with deposits.
 Fig. 4. Transverse-section showing the radial grouping of two vessel.
 Fig. 5. Part of the transverse-section enlarged, showing radial grouping of vessels and pits.
 Fig. 6. Tangential-section, showing the distribution of rays, vessels and fibres.

from *C. indicum* in many respects (Table I). The difference appears to be significant enough to separate the fossil under investigation into a separate taxon.

Table 1. Comparison of the reported species of *Cynometroxylon*.

	Terminal parenchyma	Thickness of parenchyma band	Rays
<i>Cynometroxylon indicum</i> Chowdhary & Chosh.	Present	3 - 9 cell	1-4 seriate
<i>Cynometroxylon ranikotensis</i> sp. nov.	Absent	2 - 6 cell	Mostly or rarely 2-seriate.

The specific epithet refers the locality from where it was collected. The genus *Cynometroxylon* is reported for the first time from Pakistan.

Diagnosis

CYNOMETROXYLON RANIKOTENSIS SP. NOV.

Wood diffuse porous; annual rings absent; vessels small to medium sized, mostly solitary as well as in radial groups of 2, partially filled with deposits; parenchyma distinct in regular bands, which are alternating with fibres bands; rays mostly uniseriate or rarely biseriate, homogenous, 6 to 20 cell high.

Locality	Ranikot Fort area, District Dadu, Sind, Pakistan.
Horizon	Ranikot formation.
Age	Tertiary
Holotype	R.K. 11, 1974. Palaeobotany museum, Department of Botany, University of Sind, Jamshoro, Pakistan.

PTEROCARYOXYLON RANIKOTENSIS SP. NOV.

Morphological description

The material consists of one piece of well preserved silicified fossil wood, about

10.5 cm. long, and 7.5 cm. in diameter, wood is dark brown in colour, wood is dark brown in colour (Pl.III, Fig. 1).

Anatomical description

Transverse section

Wood diffuse porous: annual rings absent, vessels small to medium sized, solitary as

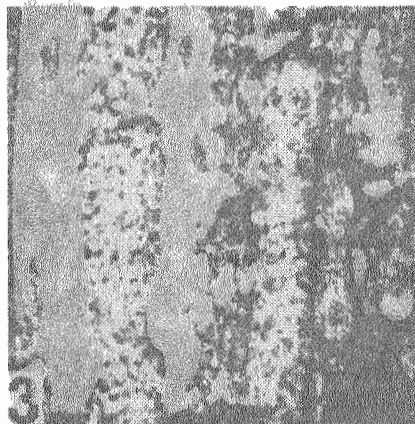


Plate - IV

- Fig. 1 Tangential-section, showing homogenous xylem rays and fibres.
 Fig. 2 Radial-section, showing the vessels and vessel segments.
 Fig. 3. Enlarged radial-section, showing the pits in the wall of the vessels.
 Fig. 4 Radial-section, showing vessel segments filled with deposits.

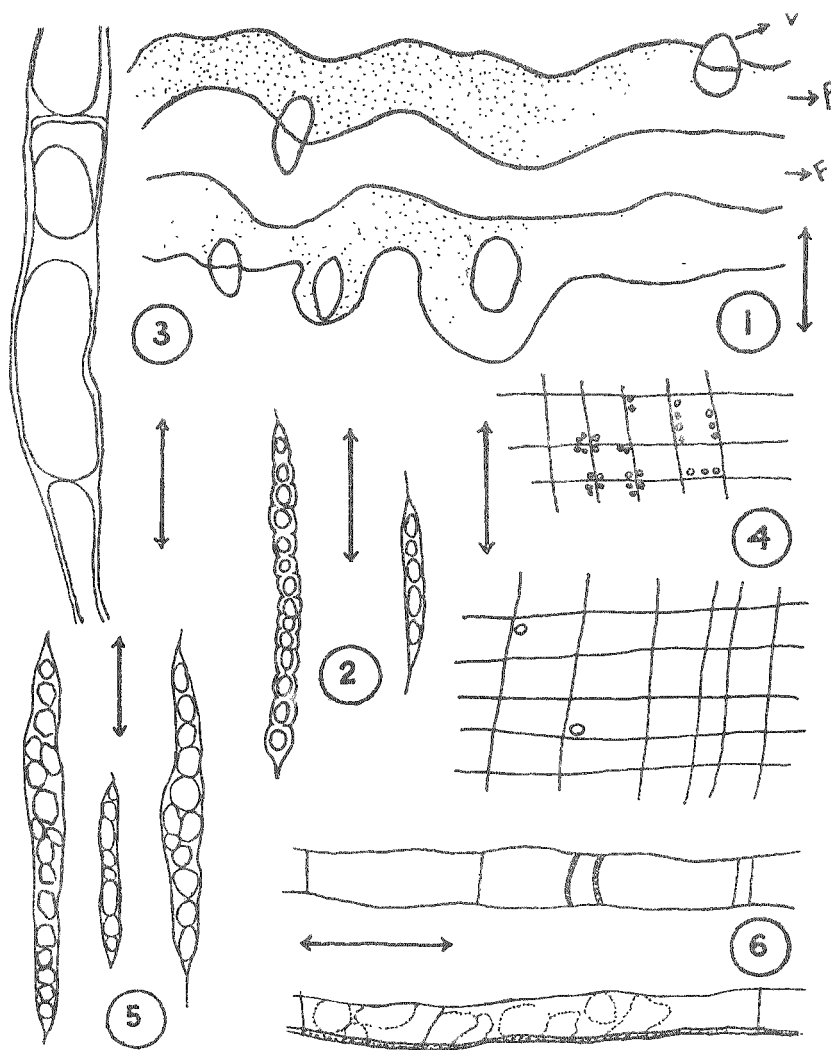


Plate V (Text Figs.)

- Fig. 1. Camera Lucida sketch of *Cynometroxylon ranikotensis* sp. nov. showing the vessels (V) alternate bands of fibres (F) and Parenchyma (P).
- Fig. 2. Camera lucida sketch, showing the uniseriate rays.
- Fig. 3. Camera lucida sketch, showing the vessel and vessel segments.
- Fig. 4. Radial-section sketch, showing the cross field pits.
- Fig. 5. Camera lucida sketch of *Pterocaryoxylon ranikotensis* sp. nov., showing the uniseriate xylem rays.
- Fig. 6. Camera lucida sketch, showing vessel having tyloses vessel segments and pits in the wall of the vessels.

well as in radial groups of 2 to 4 (Pl.III; Fig. 2,3 and 5), oval to elliptical in shape. The pore of the vessels are filled with brown deposits (Pl.III, Fig. 4). The radial diameter of the vessel ranges from 74 to 210 μm , and 140 to 168 μm wide. Vessels are thick walled, thickness is ca. 26 μm . Inter-vessel pits are poorly preserved due to heavy deposition. Ground substance consists of xylem fibres, arranged in longitudinal rows and interrupted by uniseriate or biseriate parenchyma bands (Pl.III; Fig. 2-3).

The average diameter of wood parenchyma cell ranges from 21 to 25 μm . In some parenchyma cells crystal like deposits are found. Average diameter of the fibre cell is ca. 14 μm . Xylem rays are 1 to 2 cell layer wide.

Tangential section

Xylem rays are uniseriate as well as biseriate (Pl.III; Fig. 6, Pl. IV; Fig. 1 and Pl. V; Fig. 5), uniseriate rays mostly homogenous, whereas biseriate rays are homogenous as well as heterogenous rays are 4 to 27 cell high, ray cells are round to oval in shape (Text. Pl. V; Fig. 5) and partially filled with deposits. The average diameter of the ray cell ca. 28 μm .

Fibres are septate with tapering ends (Pl.III; Fig. 6 and Pl. IV; Fig. 1), average length 112 μm and average breadth 6 μm . Simple pits are present in the wall of the fibres.

Radial section

Vessels are long (Pl. IV; Fig. 2-4), length of the vessel member ranges from 420 to 1680 μm , and 28 to 154 μm wide. The wall of the vessels have simple as well as bordered pits, which are irregularly distributed (Pl. IV; Fig. 3, and Text Pl. V; Fig. 6) Vessels are more or less completely or partially filled with deposits (Pl. IV; Fig. 4), some vessels have crystal like deposition. Partition walls are transversely arranged, with simple perforation, sometimes tyloses are present (Text Pl. V; Fig. 6).

Discussion

The anatomical characters of the present fossil wood viz., vessels small to medium sized, which are solitary as well as in pairs, wall of the vessels have simple and bordered pits; apotracheal parenchyma; ground substance consists of fibres; xylem rays 1-2 cell layer wide, which are homogenous as well as heterogenous, shows resemblance with the family Meliaceae and Juglandaceae (Metcalf & Chalk, 1950). On the other hand, the family Meliaceae is characterized by the presence of yellow resin or milk-like contents in the ground substance and parenchyma tissue which are paratracheal. However, resin like deposits are absent in the present fossil, moreover parenchyma are apotracheal, therefore family Meliaceae can be eliminated.

Table 2. Comparison of the reported species of the genus *Pterocaryoxylon* (Based on Greguss, 1969)

Sl. No.	Name of the species	Vessels	Xylem rays	Wood parenchyma	Growth rings	Wood
1.	<i>Pterocaryoxylon pannonicum</i> Muller-Stoll & Madel	Solitary as well as in radial groups of 2, 3-5, radial diameter 120-150 μ m, walls with small bordered pits.	1-2 cell layers wide, 2-2.5 cell high heterogeneous.	Apotracheal, cell full of calcium oxalate crystals.	Present	Diffuse porous.
2.	<i>Pterocaryoxylon</i> cf. <i>panonicum</i> Greguss	Solitary as well as in radial groups of 2-3 or 4.	1-2 cell layers wide, 6-10 cell high, heterogeneous.	Apotracheal	Present	Diffuse porous
3.	<i>Pterocaryoxylon pilinyense</i> Greguss	Solitary as well as in radial groups of 2-3 or 4, radial diameter 140-150 μ m	Mostly 1-2 or occasionally 3 cell layers wide.	Paratracheal, cell contains calcium oxalate crystals.	Present	Diffuse porous
4.	<i>Pterocaryoxylon</i> sp. Andreatsky.	Solitary as well as in radial groups of 2, 3 and 5.	1-3 cell layers side.			
5.	<i>Pterocaryoxylon runikotensis</i> sp. nov	Solitary as well as in radial groups of 2-3 and 4, radial diameter 84 to 210 μ m, walls with tiny bordered pits.	1-2 cell layers wide, 4-27 cells high homogenous as well as heterogeneous.	Apotracheal some cell contain crystals	Present	Diffuse porous

A comparison of the fossil under investigation with the various members of the family Juglandaceae has revealed that it approaches the genus *Pterocarya* (see Metcalfe & Chalk, 1950). As the anatomical character of the present fossil fully agree with the characteristic features of the living genus *Pterocarya* of family Juglandaceae, therefore it can be named as *Pterocaryoxylon*.

Comparison with the fossil specimens

Greguss (1969) has mentioned following few species of fossil wood *Pterocaryoxylon* known from Tertiary Formation, which are *P. pannonicum* Muller-Stoll & Madel described by Greguss, *P. pillinyense* Greguss and *Pterocaryoxylon* sp. Andreanszky. The described specimens have shown similarities with the diagnosis given for the genus.

However, detailed comparative studies (see Table 2) with the fossil woods described so far, indicate that fossil specimen under investigation differs from all in many respects and hence is separated into a new species as *Pterocaryoxylon ranikotensis* sp.nov.

The specific epithet refers to the locality Ranikot from where the specimen under investigation was collected. This species is also reported for the first time from Pakistan.

Diagnosis

PTEROCARYOXYLON RANIKOTENSIS SP. NOV.

Wood diffuse porous; growth rings absent; vessels small to medium sized, solitary as well as in radial groups of 2 to 4, thick walled, oval to elliptical in shape, radial diameter 84 to 210 μm , wall of vessels with simple as well as bordered pits; tyloses present ground substance consisting of xylem fibres; wood parenchyma apotracheal and contains some crystals.

Xylem rays numerous, uniseriate as well as biseriate, uniseriate rays mostly homogenous, biseriate rays homogenous as well as heterogenous, rays 4 to 27 cell high, ray cells round to oval, average diameter 28 μm , fibres septate with simple pits

Locality	Ranikot, District Dadu, Pakistan.
Horizon	Ranikot Formation.
Age	Tertiary
Holotype	R.K. 12, 1974, Paleobotanical Museum, Department of Botany, University of Sind, Jamshoro, Pakistan.

Acknowledgements

We wish to acknowledge the University Grants Commission, Islamabad, for the provision of travelling funds to enable us to visit the Ranikot Fort area. Special thanks are due to Professor Rais Ahmed, Dr. Rahmatullah Ch. for valuable suggestions and help. We wish to express our appreciation to Mrs. Saleha Tahir and Mr. E. H. Naqvi for the drawing and photographs.

Reference

- Blenford, W.T. 1879. – On the geology of Sind. Ind. Geol. Surv. Rech; 9 : B-22.
- Chowdhury, K.A and Ghosh, S.S. 1964. On the anatomy of *Cynometroxylon indicum* gen. et. sp. nov. A fossil dicotyledonous wood from Naulung, Assam. Proc. Nat. Inst. Sci. India., 12: 433-447.
- Esau, K. 1959. Anatomy of seed plants. John Willey, N.Y.
- Farshori, M.Z. 1972. Geology of Sind. Dept. Geol. Univ. Sind, Pakistan.
- Greguss, P. 1969. Tertiary angiosperm woods in Hungary. Akademiai kiado, Budapest.
- Khan, K. M. and Rehmatullah Ch. 1968. *Sapindoxylon petaroense* sp. nov. A new species of fossil dicot. wood from the late Tertiary deposits of Sind. Sind Univ. Sci. Res. J., 3: 137-142.
- Khan, K. M. and Rehmatullah Ch. 1971. *Albizzioxylon dhaproense* sp. nov. A new species of silicified fossil wood from ranikot Formation (Paleocene) near Amari Sind. Sind Univ. Sci. Res. J., 2:207-213.
- Khan, K. M. 1971. *Palmoxylon amriense* sp. nov. A new species of silicified palm from Ranikot formation (Paleocene) near Amri Sind. Palaeontographic Abt. B. 132 : 128-129.
- Khan, K. M. and M.T.M. Rajput, 1975. *Laurinoxylon rehmanense* sp. nov. A new species of fossil dicot. wood from the Tertiary Rocks of Sind, Pakistan. Sind. Uni. Res Jour., 9: 5-13.
- Metcalfe, C.R. and I. Chalk. 1950. Anatomy of the dicotyledon. Clarendon Press. Oxford, Vol. 1 & 2.