On two new fossil woods from the Raniganj Formation : with remarks on *Zalesskioxylon zambesiensis* from Mozambique

Usha Bajpai & Hari K. Maheshwari

ABSTRACT

Bajpai, Usha & Maheshwari, Hari K. (1986). On two new fossil woods from the Raniganj Formation: with remarks on *Zalesskioxylon zambesiensis* from Mozambique. *Palaeobotanist* **35** (1) : 39-47.

Fossil woods are rather scarce in Lower Gondwana. A large percentage of woods so far reported belong to Raniganj or equivalent formations. The two new species of wood reported here also originate in the Raniganj Formation. Lepekhina's circumscription of the genus *Araucarioxylon* is not accepted as it overlaps the diagnosis of the genus *Dadoxylon*. Her assignment of *D. brandlingii* (Lindley & Hutton) Endlicher as lectogenotype of *Dadoxylon* is not acceptable because the correct type species is *D. withamii* (Lindley & Hutton) Endlicher. *Zalesskioxylon zambesiensis* Maithy has been re-investigated and found to be conspecific with *Australoxylon teixeirae* Marguerier. The genera *Parapalaeoxylon* Prasad and *Kamthioxylon* Mahabale & Vagyani are probably superfluous.

Key-words—*Araucarioxylon, Australoxylon, Damudoxylon, Zalesskioxylon,* Raniganj Formation (India).

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सारांश

रानीगंज शैल-समूह से दो नवीन काष्ठाश्म एवं मोज़ाम्बिक की ज़ेलेस्किऑक्सीलॉन ज़ेम्बेज़ियेन्सिस पर टिप्पणी

ऊषा बाजपेई एवं हरिकृष्ण माहेश्वरी

अधरि गोंडवाना में अश्मित काष्ठ वस्तुतः बहुत कम मिलती हैं। अभी तक अभिलिखित काष्ठाश्मों में अधिकाँश रानीगंज अथवा समतुल्य शैल-समूहों से सम्बद्ध हैं। इस शोध-पत्र में वर्णित काष्ठाश्मों की दो नवीन जातियाँ भी रानीगंज शैल-समूह से ही हैं। लेपेखिना का ऑरोकेरिऑक्सीलॉन प्रजाति का परिसीमन मान्य नहीं है क्योंकि यह डेडॉक्सीलॉन प्रजाति के निदान से काफी समानता प्रदर्शित करता है। इन्हीं का डे. ब्राँडलिंगाई (लिन्डले व हट्टन) ऐण्डलिशर का डेडॉक्सीलॉन के चयनवंशप्ररूप के रूप में नामाँकन स्वीकार्य नहीं है क्योंकि डे. विदमाई (लिन्डले व हट्टन) ऐण्डलिशर ही उपयुक्त जाति है। ज़ेलेस्किऑक्सीलॉन ज़ेम्बेज़ियेन्सिस माइती का पुनः अध्ययन किया गया तथा इसे ऑस्ट्रेलॉक्सीलॉन तीक्सीयेरी मारग्वेरियर से समजातिक पाया गया। पैरापेलिऑक्सीलॉन प्रसाद एवं कामथीऑक्सीलॉन महाबले व वाग्यानी नामक प्रजातियाँ सम्भवतया निरर्थक हैं।

INTRODUCTION

WHILE the Lower Gondwana formations of India abound in impressions and compressions of leaves, fossils of woods, like those of the fertile organs, are rather rare. Most of the woody axes, e.g. *Vertebraria*, are again known in the form of impressions or compressions, there being only occasional records of petrifactions.

Of the five sedimentary formations recognised in the Lower Gondwana of India, viz., Talchir, Karharbari, Barakar, Barren Measures and Raniganj in ascending order, only two, viz., Barakar and Raniganj formations have yielded identifiable woods. The major part of the Lower Gondwana woods reported so far has come from Raniganj Formation in the Raniganj Coalfield and Kamthi Formation in the Chandrapur District. Comprehensive reviews have been published by Kräusel, Maithy and Maheshwari (1963), Maheshwari (1972), Maithy (1974) and Prasad (1982).

In the present paper some new fossil woods associated with a coal seam of Raniganj Formation in the Lodna Colliery, East Raniganj Coalfield have been described and assigned to two new species. Taxonomic notes on *Zalesskioxylon zambesiensis* have also been given.

Though one of the first fossil woods recorded from the Raniganj Coalfield was *Araucarioxylon robertianum* Schenk, 1882, first detailed description was provided by Sahni (1933) who described *Dadoxylon zalesskyi* from the Kumarpur Sandstone Member of the Raniganj

Formation. Bradshaw and Sahni (1925) had earlier recorded large tree trunks from the area. Some more fossil woods have been reported by Fox (1934), Rao (1935), Maheshwari (1965, 1967), Prasad and Chandra (1980) and others.

A large number of fossil wood pieces ranging in size from 4.6-6.4 cm in length and 5.6-7.8 cm in width were cut. Both ground thin sections and acetate paper peels were prepared. Some of the pieces were also processed for scanning electron microscopy (cf. Bajpai & Maheshwari, 1983). The present account is based on observations made on four better preserved woods. Of these four, three are only pieces of secondary wood and exhibit more or less similar features. These have been assigned to the genus *Araucarioxylon* Kraus, 1870. The fourth piece has pith and primary xylem preserved and on the basis of totality of characters is referable to the genus *Damudoxylon* Maheshwari, 1967.

Genus—*Araucarioxylon* Kraus, 1870 emend. Maheshwari, 1972

Type species—*Araucarioxylon carbonaceum* (Witham) Kraus (in Schimper, 1870)

1966 *Zalesskioxylon* Lepekhina & Yatsenko-Khmelevsky, *Taxon* **15** (2) : 78.

1972 *Araucarioxylon* Kraus, 1870 : Lepekhina, *Palaeontographica* **B138** : 55 (pars).

1982 *Parapalaeoxylon* Prasad, *Rev. Palaeobot. Palynol.* **38** : 147.

Remarks—Lepekhina's (1972) circumscription of the genus *Araucarioxylon* Kraus, 1870, which includes 1-5 seriate xylem rays, is against Kraus' (1870) original concept of the genus. Woods with araucarioid pits and multiseriate rays should be placed under the genus *Dadoxylon* Endlicher, 1847 because the type species of this genus, *D. withamii* (Lindley & Hutton) Endlicher has 1-4 seriate xylem rays (Lindley & Hutton, 1831, figs 2,3). The genus *Araucarioxylon* as recircumscribed by Maheshwari (1972) includes only those araucarioid fossil woods which have uniseriate or occasional biseriate rays.

The genus *Zalesskioxylon* Lepekhina & Yatsenko-Khmelevsky, 1966 differs from the genus *Araucarioxylon* only in the nature of cross-field pits, which are said to be simple, minute and numerous in the former and cupressoid in the latter. It should, however, be recollected that quite often, due to differential degradation during preservation, the border of the pits of radial walls of the tracheids is so affected that only pit pore is clearly distinguishable making it appear as if the pits are minute and simple. Further, one has to be very careful in interpreting, particularly so in ground thin sections, that the pits seen in the cross-field are in actuality cross-field pits and not the regular radial pits of the tracheid lying below the ray. There also seems to some confusion about the typification of the genus *Zelesskioxylon*. According to the authors of the genus, the type species is *Zalesskioxylon angustum* (Felix) Lepekhina, but according to Lepekhina (1972, p. 66), the type species is *Zalesskioxylon hallei* Lepekhina. She thought that about 6 species described under the genus *Dadoxylon* should find place under *Zalesskioxylon* but proposed no formal transfer. As such Prasad (1982, p. 140) was in error in ascribing *Z. chandaensis* (Chitaley, 1949) and *Z. jamudhiense* (Maheshwari, 1964) to Lepekhina.

We may add that there is no unanimity so far as to whether cross-field pits are more important or radial pitting is more important for generic separation in secondary wood. For example, Lepekhina (1972, p. 66) places *Dadoxylon barakarense* Surange & Saxena, 1959 under *Zalesskioxylon* on the basis of number of pits in the cross-field, while Marguerier (1973b, p. 101) includes the same species under her new genus *Australoxylon* erected for woods apparently similar to *Araucarioxylon* but differing in having "mixed" type of pitting on the radial walls of the tracheids, i.e. (i) 1-3 seriate, alternate, araucarioid pits, (ii) 1-3 seriate, opposite, abietinioid pits, and (iii) groups of 2 to 5 circular pits. We would concur with her that this type of variation in radial pitting was important for generic separation only if we were certain that the abietinioid or grouped pitting was not a result of

PLATE 1

Araucarioxylon bradshawianum sp. nov.

1. Transverse section showing late and early wood. BSIP slide no. 35542/1. x 40.
2. Radial longitudinal section through the secondary xylem showing 2-3 seriate bordered pits. BSIP slide no. 35542/3. x 400.
3. Tangential longitudinal section showing uniseriate to partly biseriate xylem rays. BSIP slide no. 35542/2. x 100.
4. Radial longitudinal section through the secondary xylem showing uniseriate bordered pits. Note two opposite pits in lower half. BSIP slide no. 35542/3. x 400.
5. Radial longitudinal section through the secondary xylem showing alternate to sub-opposite araucarioid pits. BSIP slide no. 35542/3. x 400.
6. Radial longitudinal section through the secondary xylem showing triseriate araucarioid pits, each with a circular pit pore. BSIP slide no. 35542/3. x 400.
7. SEM micrograph of wood along a radial longitudinal fracture. Note the disintegration of pit border at corners. One of the pits shows a torus. x 750.
8. SEM micrograph of pits in the cross-field. The borders of the pits are clearly visible. x 750.

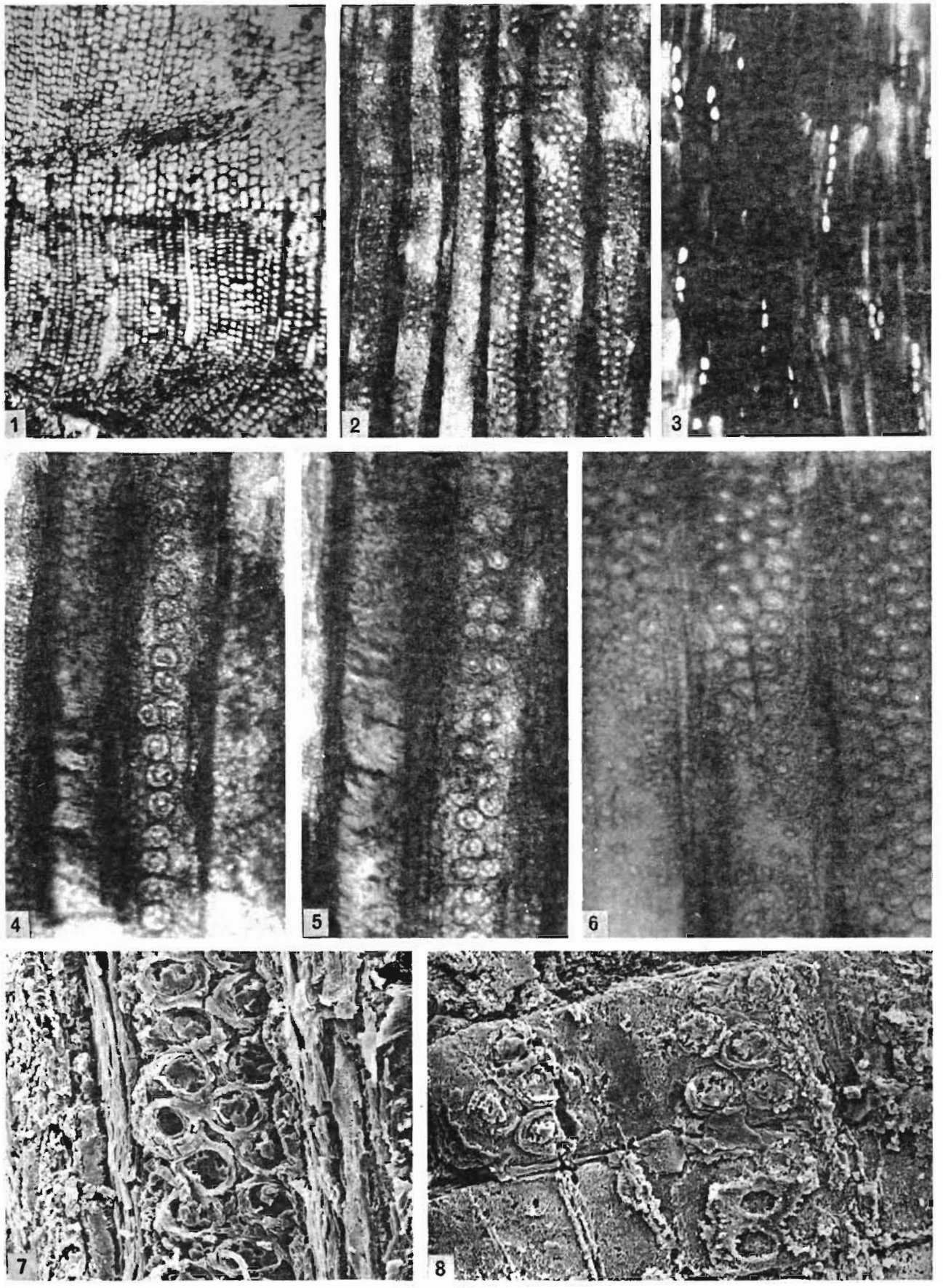


PLATE 1

disintegration or distortion of pit borders or even complete pits during preservation. Once it is conclusively proved, we have little doubt that most of Gondwana Palaeozoic secondary woods would have to be referred to the genus *Australoxylon*. However, we would certainly not agree to transfer woods with pith and primary xylem under this genus (Marguerier, 1973b, p. 101). The genus *Parapalaeoxylon* proposed by Prasad (1982, p. 147) is based on characters of dubious importance. Majority of new species proposed by him in the same work also seem to be based on too little information compounded with wrong interpretations. The genus *Kamthioxylon* Mahabale & Vagyani, 1980 is probably superfluous because it is based on interpretations not warranted by observable details in the wood.

Araucarioxylon bradshawianum sp. nov.

Pl. 1, figs 1-8; Pl. 2, figs 2, 6

Diagnosis—Secondary wood, annual growth increments distinct, autumn wood 4-5 tracheids wide, spring wood 60-75 tracheids wide; tracheids in transverse section squarish to rectanguloid in shape with a polygonal to more or less rounded lumina, arranged end to end in regular rows, xylem rays separating 2-9 tracheids wide radial bands; autumn wood tracheids measure 13-19.5 μm radially and 26-52 μm tangentially, lumina oval to rectanguloid, 13-45 μm; spring wood tracheids measure 26-52 μm radially and 32.5-52 μm tangentially with a 26-45.5 μm wide lumina; thickness of tacheidal walls 13-19.5 μm.

Tangential walls of tracheids smooth. Xylem rays in tangential section homogeneous, mostly uniseriate, at some places partly biseriate due to a middle or terminal ray cell pair, 1-21 cells high, majority of rays having 2-7 cells, cells 26-39 μm deep and 19.5-26 μm wide. Radial walls of tracheids showing uni- to penta-seriate bordered pits, pits about 13 μm in diameter, pit-pore 7 μm in diameter. Uniseriate pits more or less circular in shape and usually contiguous, pit pore small, conforming to overall shape of pit. Multiseriate pits araucarioid, alternate and hexagonal. Due to natural degeneration of tracheidal walls during fossilization many a time pits appearing somewhat circular and more or less separate. Pits in cross-field 2-4, usually 4, apparently bordered, 9-10 μm in diameter.

Description—There is nothing remarkable about the transverse and tangential sections of these fossil woods which could help separating them from other known species of secondary woods (Pl. 1, figs 1, 3). The pitting of the radial walls of the tracheids is, however, quite interesting. Most of the autumn wood tracheids have uniseriate, circular and almost separate, radial pits (Pl. 1, fig. 4). In some of the autumn tracheids and the late spring tracheids the radial pits may be partly biseriate, most of the time being opposite, contiguous and slightly flattened (Pl. 1, fig. 5). They are yet not araucarioid in appearance.

The spring tracheid pits are typically araucarioid, whether biseriate or penta-seriate (Pl. 1, figs 2, 6; Pl. 2, fig. 2). The apparent circular/separate, though alternate, pits, are a result of natural degeneration of the tracheidal walls during preservation. This fact is clearly seen in scanning electron micrographs (Pl. 1, fig. 7). A torus has usually not been reported in pre-Mesozoic wood. In one of the scanning electron micrographs there is definite evidence of the presence of torus (Pl. 1, fig. 7). The pit border is composed of small granules arranged in concentric rings (Pl. 2, fig. 6). The tracheidal walls show minute pits, real nature and significance of which is not yet clear to us.

Holotype—BSIP specimen No. 35542; Upper Permian, Raniganj Formation, Lodna Colliery (Sripur Group of Collieries), East Raniganj Coalfield, West Bengal.

Comparison—About 10 species of the genus *Araucarioxylon* are known so far from the Lower Gondwana. A comparison of *A. bradshawianum* with these species is shown in Table 1. Out of these ten species, only *A. parbeliense* and *A. gondwanense* compare closely with the new species in radial pitting. However, *A. gondwanense* is distinguished by its deeper xylem rays and up to 8 cross-field pits. *A. parbeliense*, too, has larger number of cross-field pits.

Genus—*Damudoxylon* Maheshwari, 1966 emend. 1972

Type species—*Damudoxylon waltonii* Maheshwari, 1967

PLATE 2

→

Araucarioxylon bradshawianum sp. nov.

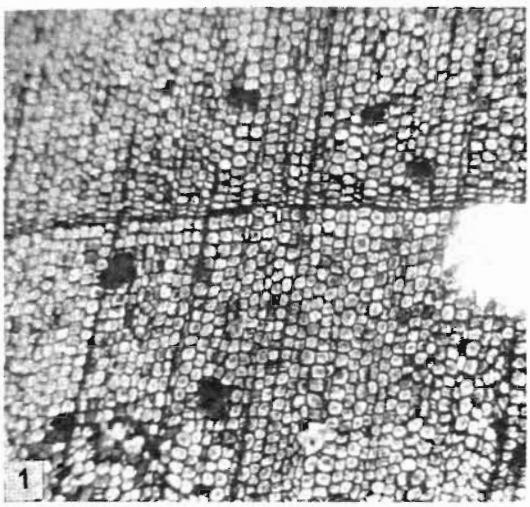
2. Scanning electron micrograph showing 2-3 seriate araucarioid pits on the radial walls of the tracheids. x 750.
6. SEM micrograph showing an advance stage in disintegration of material composing the pit border resulting in almost circular and separate alternate pits. x 1500.

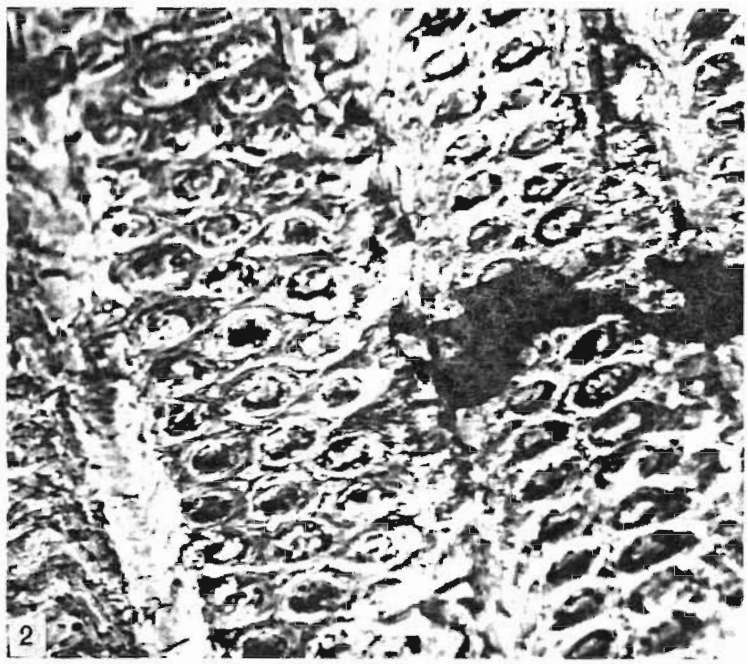
Damudoxylon lepekhinae sp. nov.

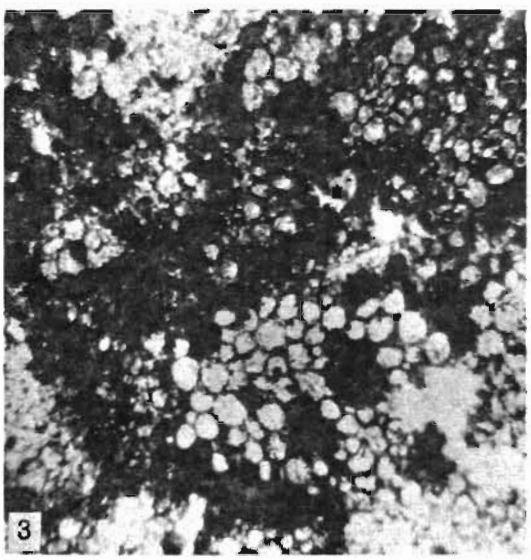
1. Transverse section through the secondary wood showing parts of two growth rings. BSIP slide no. 35544/1. x 40.
3. Transverse section through the pith showing bunches of cells with dark contents. BSIP slide no. 35544/2. x 40.
5. Radial longitudinal section through primary xylem showing annular, scalariform and bordered pitted tracheids. BSIP slide no. 35544/3. x 40.

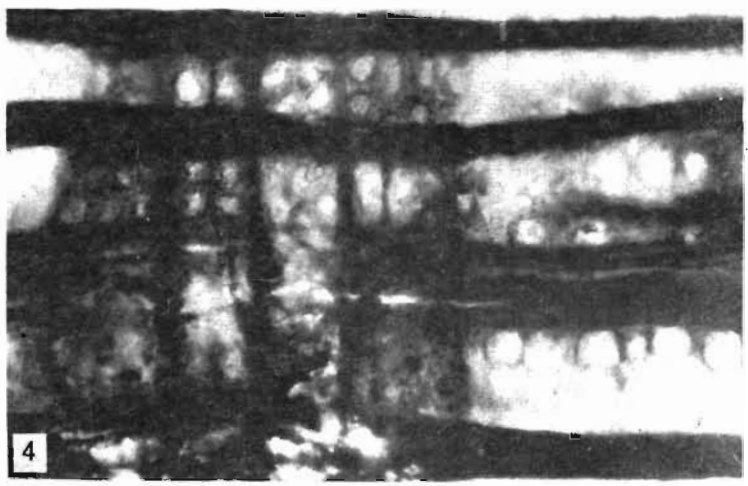
Australoxylon teixeirae Marguerier 1973

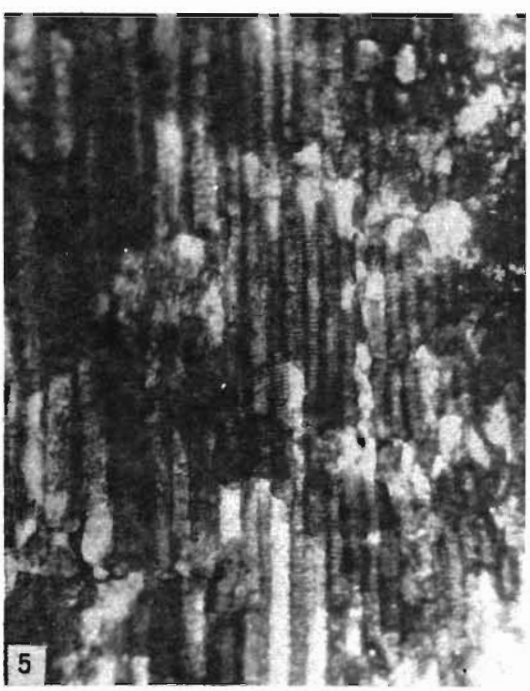
4. Radial longitudinal section showing bordered pits in the cross-field. Slide no. RG 17039 RLS.











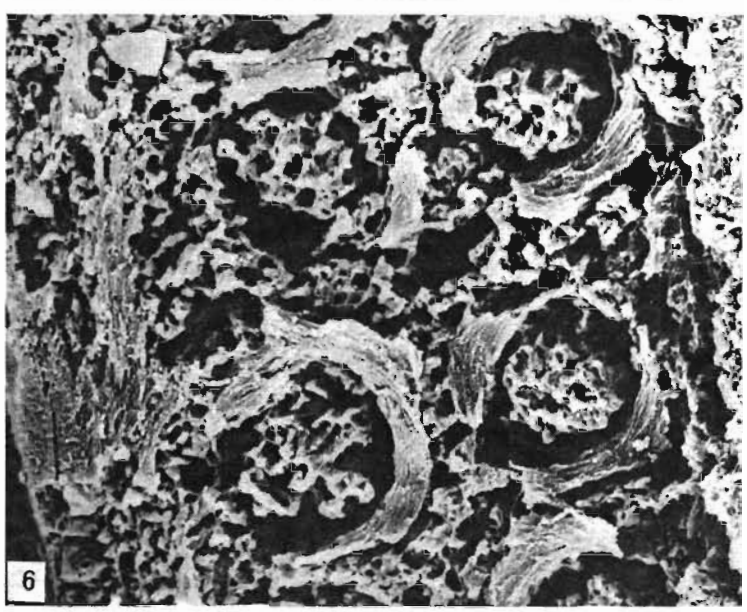


PLATE 2

Table 1

Species	*Height of Xylem rays in cells*	*Pitting on tangential walls*	*Pitting on the radial walls*	*Cross-field pits*
Araucarioxylon parbeliense (Rao, 1935) Maheshwari, 1972	1-24 (average 2-3), uniseriate	Absent	1-5 seriate, araucarioid, pore circular to oval	8-9, bordered, pore oblique, slit like
A. gondwanense (Maithy, 1964) Maheshwari, 1972	1-43 (average 8-9), 13% bi-seriate	Absent	1-5 seriate, alternate or sub-opposite, contiguous	2-8, contiguous or separate, circular oval
A. ningabense Maheshwari, 1964	1-11 (average 2-3 cells), uniseriate	Present	1-4 seriate, alternate or opposite, contiguous, hexagonal	1-6, bordered, pore oval
A. kharkhariense (Maithy, 1964), Maheshwari, 1972	1-29 (average 6-7), uni-to biseriate	Absent	1-3 seriate, contiguous; biseriate pits alternate or opposite, triseriate pits alternate	2-7, contiguous, pore elliptical
A. lobarense Agashe, *et al.*, 1978	1-27 (average 11), biseriate common	Present	1-4 seriate, separate or contiguous, hexagonal or circular or slightly elongated appearing araucarioid	2-9, most common 2,4,6
A. nandori Vagyani *et al.*, 1981	2-30 (average 8)	Absent	1-3 seriate, araucarioid	2-6, cupressoid, circular to oval
A. surangei Agashe *et al.*, 1981	1-35 (average 4), uni-to biseriate	Absent	1-4 seriate, separate or contiguous, opposite or alternate, pit pore circular or oblique in shape	1-11, Cupressoid, round to oval in shape
A. lathiense Agashe *et al.*, 1981	1-27 (average 5), uniseriate	Absent	1-4 seriate, separate or contiguous, round, oval to hexagonal.	1-10, cupressoid, circular to oval with thin border
A. bengalense (Holden, 1917) Maheshwari, 1972	1-20	Absent	1-3 seriate, araucarioid	2-7, cupressoid
Dadoxylon ghorawariense Pareek, 1969	1-10, uniseriate	Absent	1-3 seriate, mostly biseriate, araucarioid	2-6, border pits circular oval
Araucarioxylon bradshawianum sp. nov.	1-21 (average 2-7) uni- to biseriate	Absent	1-5 seriate, araucarioid	2-4, bordered pits

Remarks—The genus *Damudoxylon* was established by Maheshwari (1967) for gymnospermous fossil axes having araucarioid secondary wood, endarch primary xylem and a parenchymatous pith with secretory cells. Later, he (Maheshwari, 1972) enlarged the circumscription of the genus to include woods with homogeneous pith, too. Lepekhina and Yatsenko-Khmelevsky (1966) and Lepekhina (1972) diagnosed the genus *Dadoxylon* Endlicher, 1847 in such a way that its circumscription overlapped that of the genus *Damudoxylon*. They, however, erred in assigning *Dadoxylon brandlingii* (Lindley & Hutton) Endlicher, 1847 as the lectogenotype (type species) of *Dadoxylon*. The correct assignment is *D. withamii* (Lindley & Hutton) Endlicher, 1847 (see Andrews, 1970, p. 68), being the first species included under *Dadoxylon* by Endlicher (1847, p. 298). They further erred in believing that remains with nonseptate pith and endarch primary xylem belong to the genus *Dadoxylon* according to its original diagnosis. Prasad (1982, p. 127) also made the similar mistake in believing that original descriptions of Lindley and Hutton (1831) and Endlicher (1847) had made references to the nature of pith and primary xylem. Keeping in view that the publications of Lindley and Hutton (1831) and Endlicher (1847) are not easily accessible to all the workers, we reproduce below description of the genus *Dadoxylon* given by Endlicher (1847, pp. 298-299).

→

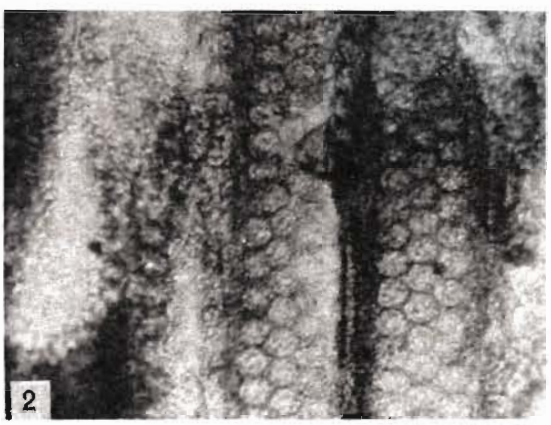
PLATE 3

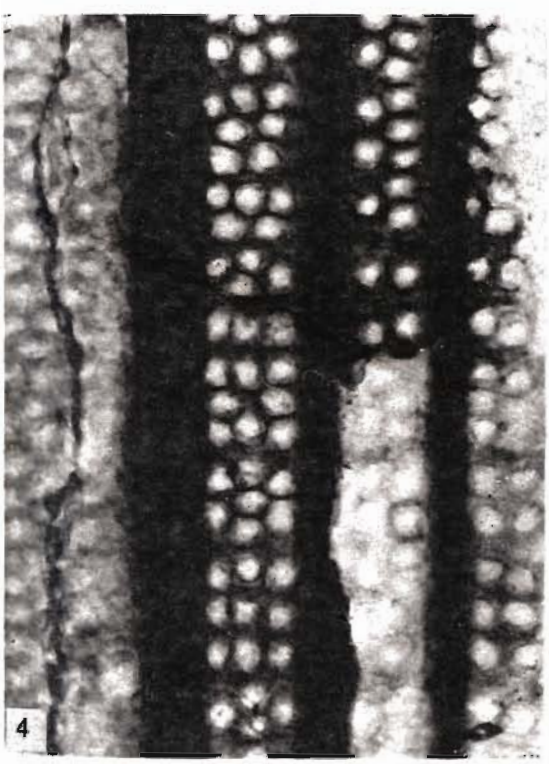
Damudoxylon lepekhinae sp. nov.

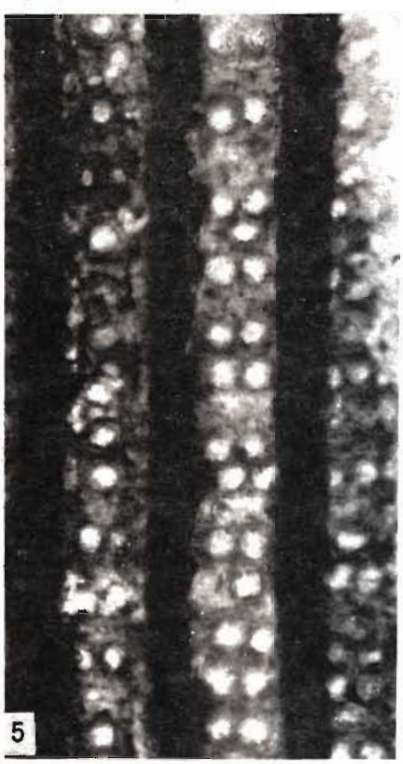
1. Tangential longitudinal section showing uniseriate sparse xylem rays. BSIP slide no. 35544/4. x 100.
2. Radial longitudinal section of the wood showing triseriate araucarioid pits. BSIP slide no. 35544/5. x 500.
3. SEM micrograph of pit borders showing onset of disintegration of material composing the pit borders, particularly at corners. x 3000.

Australoxylon teixeirae Marguerier, 1973

4. 2-3 seriate radial wall pitting showing alternate to sub-opposite arrangement. Grouping of pits is more evident here. Slide no. RG 17039 R.L.S.
5. Radial longitudinal section showing pits in groups of 2, 3 or 4. Note the large space between groups of pits. Slide no. RG 17039 R.L.S.
6. Radial longitudinal section showing pairs of opposite pits. Note the large space between pairs of pits. Slide no. RG 17039 R.L.S.







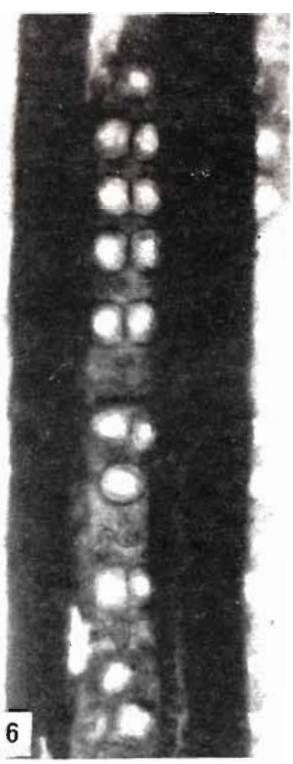


PLATE 3

"Truncus cylindricus, e medulla centrali et ligni stratis concentricis obsoletis aut rarius distinctes et e cortice compositus. *Vasa* ligni cellulae prosenchymatosae poroso, poris in series 1-4 spiraliter dispositis, quam maxime approximatis, demum ob mutuam pressionem sexangularibus, plerumque nonnisi in parietibus radiis medullaribus parallelis et invicem oppositis obviis. *Radii medullares* e cellularum parenchymatosarum series unice v. pluribus formati, simplices v. compositi".

Knowing fully well that a number of woods with comparative secondary xylem have different types of pith and primary xylem, there is no justification for placing woods with pith and primary xylem under the genus *Dadoxylon* because, so far no detailed information is available about these features in the holotype of *D. withamii*.

Damudoxylon lepekhinae sp. nov.

Pl. 2, figs 1, 3, 5; Pl. 3, figs 1-3

Diagnosis—Pith solid, parenchymatous, homogeneous, 1.5 mm in cross section. Pith cells oval to isodiametric in cross-section, thick-walled, 19.5-105 μm in diameter, intercellular spaces present, but probably result of cell wall decay during preservation, longitudinally pith cells squarish to rectanguloid in shape, arranged end to end in vertical tiers, 19.5-104 μm in width, 30-97.5 μm in height, radial walls pitted.

Primary xylem not clearly decipherable in transverse section but distinctly seen in radial longitudinal sections, 10-13 cells deep, endarch, showing spiral and scalariform secondary thickenings, annular thickening not seen.

Secondary wood with distinct annual growth zones, autumn wood 1-4 tracheids wide, spring wood 35-69 tracheids wide, a xylem ray separates 2-18 tracheids wide radial bands; autumn wood tracheids rectanguloid in shape in cross section, measuring 13-15 μm radially and 32.5-39 μm tangentially, lumina oval to rectanguloid; spring wood tracheids polygonal in cross section, 19.5-45.4 μm radially and 26-52 μm tangentially, lumina subcircular to polygonal, tracheidal walls 6.5 μm thick.

Tangential walls of the tracheids smooth. Xylem rays in tangential section homogeneous, mostly uniseriate, 1-7 cells high, individual ray cells 9-13 μm wide, 13-26 μm deep.

Radial walls of the tracheids showing 1-3 seriate bordered pits. Uniseriate pits mostly circular, usually contiguous, rarely separate, mostly occurring in autumn wood tracheids. Multiseriate pits araucarioid, alternate, hexagonal and contiguous, pits borders often showing signs of preservational decay resulting in an apparently circular shape. Average diameter of pits 13 μm, that of pit pore 6.5 μm. Pits in the cross-field 2-4 in number, bordered, 13 μm in diameter.

Description—The pith is only partially preserved. In living plant it was probably circular in cross-section; the present distortion in shape possibly took place during fossilization. Some of the pith cells have dark contents, but it is not clear if these have any thing to do with the secretion activity (Pl. 2, fig. 3). The primary xylem, though endarch, is surprisingly lacking annular elements (Pl. 2, fig 5). Metaxylem elements comprise scalariform and pitted tracheids. The pitted metaxylem elements gradually pass into secondary wood tracheids.

The xylem rays are usually uniseriate and relatively sparse (Pl. 3, fig. 1). Average spring wood tracheid has araucarioid pits on its radial walls (Pl. 3, fig. 2).

Holotype—BSIP specimen no. 35543; Upper Permian, Raniganj Formation, Lodna Colliery (Sripur Group of Collieries), East Raniganj Coalfield, West Bengal.

Comparison—A comparison of *Damudoxylon lepekhinae* with the four known species of the genus is shown in Table 2. *D. parenchymosum* and *D. jamuriense* are distinct in having a homogeneous pith. *D. indicum* has a transfusion sheath around the pith. *Dadoxylon adhariense* and *D. maharashtraensis* lack growth rings. *Damudoxylon waltonii* has larger number (1-9) of pits in the cross-field.

Genus—*Australoxylon* Marguerier, 1973

Type species—*Australoxylon teixeirae* Marguerier, 1973

Australoxylon teixeirae Marguerier, 1973

Pl. 2, fig 4; Pl. 3, figs 4-6

1977 *Zalesskioxylon zambesiensis* Maithy, *Geophytology* **7** (1) 24, pl. 1, figs 1-7.

Remarks—As discussed elsewhere, the genus *Australoxylon* was established for those Palaeozoic secondary woods in which the radial walls of the tracheids had 'mixed' pitting. Two species, viz., *A. teixeirae* and *A. natalense*, were referred to this genus by Marguerier (1973a). The woods, which originated from Mozambique and Natal respectively, differed mainly in the presence of "bars of Sanio" in the latter wood. Maithy (1977) reported another wood from Mozambique under the name *Zalesskioxylon zambesiensis*. As this wood has mostly abietinioid or grouped pits on the radial walls of the tracheids, it rather belongs to the genus *Australoxylon*. Maithy reports that the pits in the cross-field in his wood are simple and up to 14 in number. That is not so. This wood not only has all the characters of *Australoxylon teixeirae* but was also collected from the same general locality, i.e. Tete Basin near Carinde, Mozambique. A re-examination of the Maithy specimen (no. 17039, Museé Royal du Africa Centrale, Tervuren, Belgium) shows following salient features.

Wood pycnoxylic. Annual growth increments clearly demarcated, autumn wood 1-2 tracheids wide in transverse section.

Xylem rays homogeneous, 1-30 cells high, uniseriate, up to 12 per cent partly biseriate. Tangential walls of the tracheids with doubtful pits.

Pits on radial walls of tracheids bordered, 1-3 seriate, mostly separate, subcircular-circular in out-line and

Table 2

Species	*Pith*	*Growth rings*	*Xylem rays*	*Radial pitting*	*Cross-field pits*
Damudoxylon waltonii Maheshwari, 1972	With secretory Cells	Distinct	1-14 cells high mostly 2-3 cells	1-3 seriate, rarely 4 seriate, araucarioid	1-9, bordered
D. indicum (Holden, 1917) Maheshwari, 1972	Heterogeneous with transfusion sheath	Distinct	2-7 cells	1-2 seriate, araucarioid	1-4, bordered
D. parenchymosum (Surange & Maithy, 1962) Maheshwari, 1972	Homogeneous	Distinct	1-18 cells, average 3 cells	1-4, mostly 2-3 seriate	2-8, bordered
D. jamuriense Maheshwari (1964) 1972	Homogeneous	Distinct	1-45 cells, mostly 6-8 cells	1-2 seriate, rarely 3 seriate	1-5, bordered
Dadoxylon chandrapurensis Prasad, 1982	Heterogeneous	Distinct	1-30 cells, average 10-11 cells	1-2 seriate	1-6, bordered
D. maharashtraensis Prasad, 1982	Heterogeneous with with secretory cells	—	1-16 cells, average 5-6 cells	1-3 seriate	5-6, bordered
D. adhariense Prasad, 1982	Heterogeneous	Absent	1-17 cells, transverse walls are pitted	1-4 seriate	3-5, araucarioid
Damudoxylon lepekhinae sp. nov.	With secretory cells	Distinct	1-7 cells	1-3 seriate, araucarioid	2-4, bordered

opposite, occasionally hexagonal in outline and alternately disposed in adjacent rows (Pl. 3, figs 4-6). Very often pits separate, circular and in groups of 2-6 (Pl. 3, fig 5). Pit pore always circular and central. Pits in cross-field bordered, 2-6 in number, more or less cupressoid.

The larger number of pits reported in the cross-field, both by Marguerier (1973a) and Maithy (1977) is due to the fact that they observed not real cross-field pits but those pits on the radial walls of the tracheids which fell under the area of cross-field observed (see Marguerier, 1973a, fig. 7).

Two of the Palaeozoic woods from India referred to the genus *Australoxylon*, viz., *A. kanhargaoense* Prasad & Chandra, 1978 and *A. longicellularis* Prasad & Chandra, 1981, require better photographic documentation to prove that these have real "mixed" pitting.

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