STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA— 24. ON TWO NEW SPECIES OF FOSSIL WOOD FROM THE RANIGANJ STAGE OF RANIGANJ COALFIELD, BENGAL

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ABSTRACT

This paper contains a description of two new species of the genus *Dadoxylon* Endl. *D. jamuriense* sp. nov. is characterized by a homogeneous pith, endarch primary xylem, 1-45 cells deep xylem rays and multiseriate radial pits. *D. ningahense* sp. nov. is characterized by multiseriate radial pits and 1-2 seriate tangential pits.

INTRODUCTION

THE knowledge of petrified woods from the Raniganj stage of the Lower Gondwanas of India is very meagre, only three species being known so far, viz., *Dadoxylon zalesskyi* (SAHNI, 1932), *D. parbeliense* (RAO, 1935) and *D. jamudhiense* (MAHESHWARI, 1964). The present fossil woods were collected from two collieries in the eastern sector of the Raniganj coalfield, Bengal and as such belong to the Raniganj stage (Upper Permian).

DESCRIPTION

Genus *Dadoxylon* Endlicher

1. *Dadoxylon jamuriense* sp. nov.

The specimen is a decorticated piece of petrified wood with pith, primary and a part of secondary xylem preserved. The wood is chocolate brown in colour and mostly it is crushed. But at places preservation is fine and there the growth zones could be discerned easily. The autumn wood zone (PL. 1, FIG. 2) is 1-3 cells wide and consists of thick-walled, rectangular tracheids with an oval lumen. The spring wood zone (PL. 1, FIG. 2) is 70-120 cells wide and consists of oblongly polygonal, thick-walled tracheids with a subcircular to circular lumen. The radial diameter of the spring wood tracheids is 39-78 μ and of autumn wood tracheids is 30-40 μ. Tangentially the tracheids measure 27-78 μ. The double walls between the tracheids measure 16-20 μ.

Pith — is homogeneous, parenchymatous, large and oval in shape (PL. 1, FIG. 1), transversely measuring 3·3×1·7 cm. From the crushing of pith cells it seems that originally the pith was circular. A greater part of the pith is filled with iron pyrite. Here and there in the pith irregular spaces occur which probably are the result of decay of pith cells, though sometimes they seem to simulate lysigineous cavities. The pith cells (PL. 1, FIG. 3) are broadly oval to isodiametrical and thin-walled measuring 40-156 μ in cross section. Longitudinally the pith cells (PL. 1, FIG. 4) are more or less rectangular, sometimes with slightly oblique end walls, usually broader than high (higher than broad cells are not uncommon) and placed end to end in vertical series, measuring 70-164 μ.

Primary xylem — Surrounding the pith is 4-12 cells wide zone of endarch primary xylem. In the transverse section it is difficult to differentiate between primary and secondary xylem, firstly because of crushing and intrusion of iron pyrite into the pith and secondly because all the elements are arranged radially. In the radial longitudinal section the elements of primary xylem near the pith show spiral thickenings while the subsequent ones show scalariform to reticuloid thickenings with a gradual transformation into bordered pitting.

Xylem rays — The xylem rays (PL. 2, FIG. 6) are numerous, homogeneous, uniseriate, sometimes partly biseriate, 1-45 cells deep with an average depth of 6-8 cells. In tangential section the ray cells are barrel-shaped, higher than broad and measure 24-36 μ×16-24 μ. The ray cells are often chambered by a wavy wall running along the long axis of the cells. Radially the ray cells are longer than high, spanning 1-4 tracheids.

Pitting — On the radial walls of the tracheids bordered pits occur in 1-2, sometimes 3 series (PL. 1, FIG. 5). The pits when

uniseriate are separate or contiguous, circular or flattened with a central and circular pore. In multiseriate condition the pits are alternate, contiguous, hexagonal with central and circular pore. In uniseriate condition the pits measure 12×12 μ and hence the coefficient $e = \frac{d}{D}$, where 'e' is the coefficient, 'd' smaller diameter and 'D' greater diameter of the pits is 1. In multiseriate condition the pits measure 12-16 μ×12-16 μ and hence the coefficient varies from 1·0 to 0·75. The pit-pore measures 5 μ. Pits in the cross-field usually number 1-3 (sometimes 5) and have an indistinct border and a large circular and centric aperture. The pit-pore measures 5 μ. The tangential walls of the tracheids are smooth.

DIAGNOSIS

Dadoxylon jamuriense sp. nov.

Pith homogeneous, parenchymatous, solid, large, oval (originally circular ?); pith cells thin-walled, vertically rectangular, placed end to end in vertical series. Primary xylem zone 4-12 cells wide, elements spiral, scalariform and reticulate.

Secondary wood with distinct growth zones; autumn wood zone narrow, 1-3 cells wide, tracheids thick-walled, rectangular, 30-40 μ radially; spring wood zone 70-120 cells wide, tracheids oblongly-polygonal, thick-walled, 39-78 μ radially; tangential diameter of the tracheids 27-78 μ; thickness of the double walls between the tracheids 16-20 μ.

Xylem rays numerous, homogeneous, uniseriate, sometimes partly biseriate, 1-45 cells deep (average depth of 6-8 cells); ray cells barrel-shaped, higher than broad.

Tangential walls of the tracheids smooth. Pits on the radial walls of the tracheids bordered, 1-2 rarely 3 seriate, alternate, separate or contiguous, circular, flattened, or hexagonal; pit-pore central and circular. Uniseriate pits 12×12 μ (coefficient=1); multiseriate pits 12-16 μ×12-16 μ (coefficient=1·0-0·75); pit aperture 5 μ. Pits in the cross-field 1-3 (rarely 5) with distinct border.

Holotype — 32905/538, Birbal Sahni Institute of Palaeobotany, Lucknow.

Horizon — Raniganj stage.

Age — Upper Permian.

Locality — West Jamuria Colliery, East Raniganj Coalfield, Bengal.

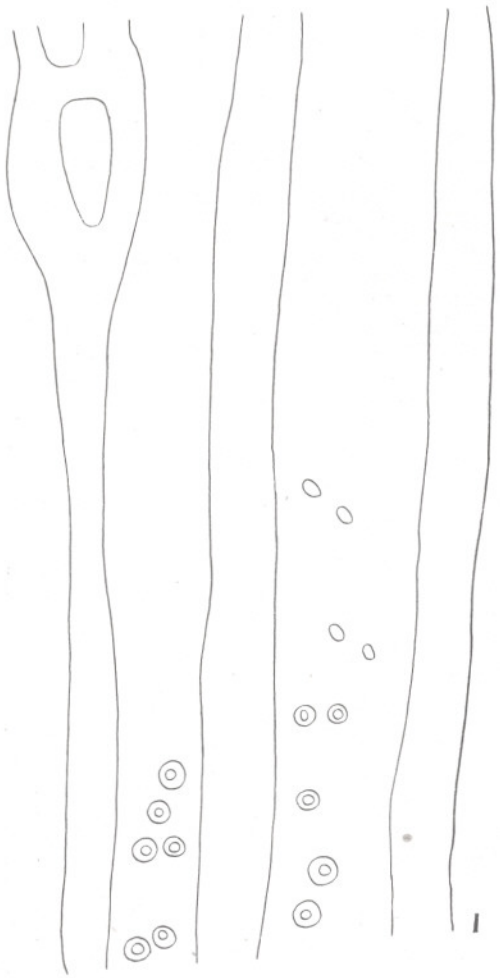
Comparison — The present species is characterized by the presence of a large, homogeneous, parenchymatous pith and an endarch primary xylem. Homogeneous parenchymatous pith is found in *Phyllocladopitys capensis* Kräus., *Taxopitys africana* Kräus., *Abietopitys perforata* Kräus., *Dadoxylon kraeuselii* Sahni, *D. rangei* Kräus., *D. porosum* Kräus., and *D. parenchymosum* Surange & Maithy. Of these *Phyllocladopitys capensis*, *Taxopitys africana* and *Abietopitys perforata* are distinguished by the presence of mesarch primary xylem. *Dadoxylon rangei* and *D. porosum* resemble the present species in the parenchymatous pith, endarch primary xylem, and 1-3 seriate 'araucarioid' radial pitting. But in both these species the pith is small being less than 2 cm. in diameter and the xylem rays,which are uniseriate, are smaller in size. The species most closely resembling *D. jamuriense* is *D. kraeuselii* (Sahni, 1932). Both these species have a large, homogeneous parenchymatous pith, endarch primary xylem and similar radial pitting of the tracheids. *D. kraeuselii*, however, is distinguished by the presence of 'Bars of Sanio' in the tracheids, larger number (9-10) of pits in the cross-field and smaller xylem rays. *D. parenchymosum* Surange & Maithy (1963) has a comparatively smaller pith with intercellular spaces. Furthermore in this species the xylem rays are only 1-18 cells deep as compared to 1-45 cells deep rays in the present wood. The other Indian Palaeozoic fossil woods differ from *D. jamuriense* in having a heterogeneous pith, e.g., *Barakaroxylon jhariense* (Surange & Sah) Surange & Maithy (1962), *B. kraeuselii* Surange & Maithy (1962) and *Indoxylon canalosum* Surange & Maithy (1963) have secretory canals, and *Dadoxylon zalesskyi* Sahni (1932) has sclerotic cells, in the pith.

2. *Dadoxylon ningahense* sp. nov.

The specimen is a decorticated piece of fossil stem devoid of the pith and primary xylem. The growth zones (Pl. 2, Fig. 7) are seen only under the microscope. The autumn wood zone is 1-3 cells broad and is composed of more or less rectangular cells with oval lumen. The spring wood zone is 14-48 cells wide and the cells are polygonal with broadly oval to circular lumen. The size of spring wood tracheids is 54-81 μ tangentially and 61-67·5 μ radially and those

of autumn wood tracheids is 54-67·5 μ tangentially and 20-34 μ radially. The thickness of double wall between the tracheids is from 18-21 μ.

Xylem rays — The xylem rays (PL. 2, FIG. 8) are homogeneous, uniseriate, rarely biseriate and 1-11 cells deep, the average depth being 2-3 cells. Of more than 300 xylem rays counted from different sections about 72 per cent are 1-3 cells deep, 16 per cent are 4 cells deep and only 12 per cent are more than 4 cells deep. Tangentially the ray cells are higher than broad. They are 27-33 μ in height and 18-21 μ in breadth.



TEXT-FIG. 1 — *Dadoxylon ningahense* sp. nov., longitudinal section showing pits on the tangential walls of the tracheids. × 500.

Radially they are much longer than high, each cell spanning 1-5 tracheids.

Pitting — On the tangential walls of the tracheids 1-2 seriate, alternate and small bordered pits are present (PL. 2, FIG. 9; TEXT-FIG. 1). The border of these pits is not distinct. The size of the tangential pit-pore is from 3·5-5 μ.

The radial walls of the tracheids have 1-4 seriate bordered pits (PL. 2, FIGS. 10, 11; TEXT-FIG. 2). The pits are alternate or opposite, contiguous and flattened, broadly oval or hexagonal. Sometimes the pits are in two series, opposite, separate and circular. The pit-pore is central and broadly oval measuring 3-4·5 μ.

In uniseriate condition the pits measure 10·5×10·5 μ–10·5×9 μ. The coefficient (e=d/D) varies from 1 to 0·86. In biseriate condition the pits measure 12×10·5 μ-10·5×10·5 μ and hence the coefficient is 1-0·88. In the triseriate and tetraseriate condition the pits measure 12×9 μ, 12×10·5 μ, 10·5×10·5 μ and so the coefficient is from 1 to 0·75. The pits in the cross-field are bordered and 1-6 in number with a broadly oval pore (PL. 2, FIG. 12; TEXT-FIG. 3). The size of these pits is mostly 10·5×10·5 μ, coefficient being 1.

DIAGNOSIS

Dadoxylon ningahense sp. nov.

Secondary wood with distinct growth rings; autumn wood zone 1-3 cells wide, tracheids measuring 20-34 μ radially and 54-67·5 μ tangentially; spring wood zone 14-48 cells wide, tracheids measuring 61-67·5 μ radially and 54-81 μ tangentially; thickness of double walls between the tracheids 18-21 μ.

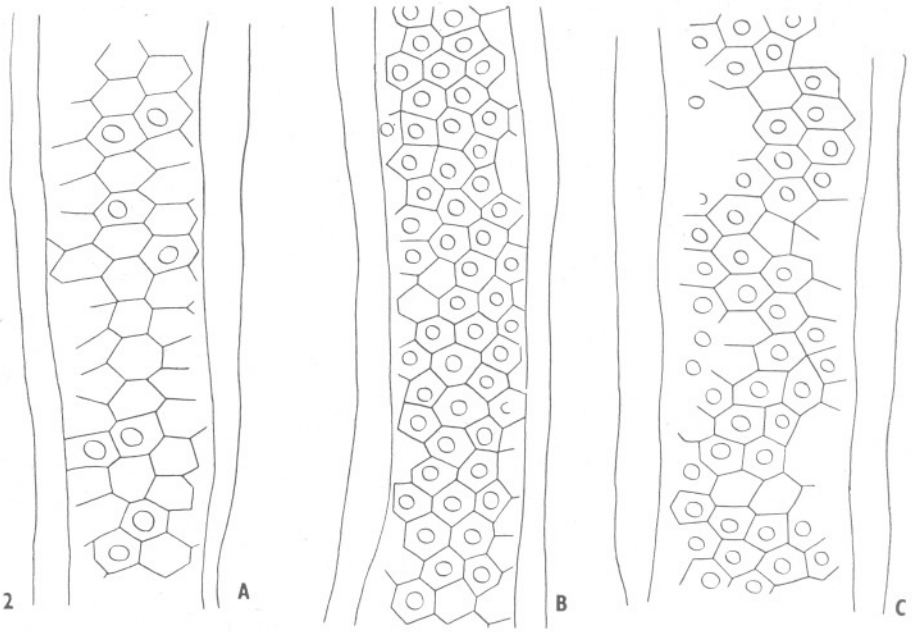
Xylem rays homogeneous, uniseriate or rarely biseriate, 1-11 cells deep, average depth 2-3 cells; cells barrel-shaped.

Tangential walls of the tracheids pitted. Radial pits bordered, 1-4 seriate, alternate or opposite, contiguous and flattened or hexagonal. Pit-pore central and broadly oval. In uniseriate condition the pits have coefficient 1-0·86 while in multiseriate condition the coefficient is 1-0·75. Pits in the cross-field, 1-6 and bordered.

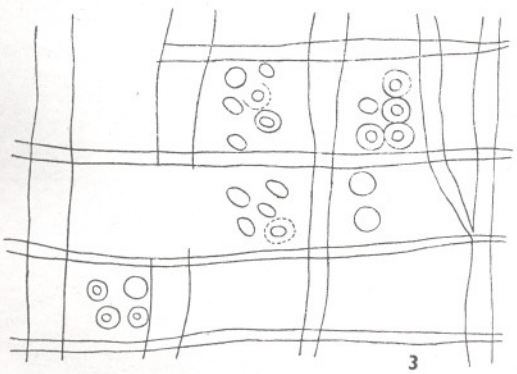
Holotype — 32906/494, Birbal Sahni Institute of Palaeobotany, Lucknow.

Horizon — Raniganj stage.

Age — Upper Permian.



TEXT-FIG. 2 — *Dadoxylon ningahense* sp. nov., radial longitudinal section showing tri- and tetraseriate pits. × 500.



TEXT-FIG. 3 — *Dadoxylon ningahense* sp. nov., radial longitudinal section showing pits in the cross-field. × 500.

Locality — Ningah Colliery, East Raniganj Coalfield, Bengal.

Comparison — Due to the absence of a pith and primary xylem, a detailed comparison is not possible with most of the known fossil woods from the Lower Gondwanas. The tangential wall pitting is so far reported only from 4 woods. Of these *Dadoxylon barakarense* (SURANGE & SAXENA, 1959) stands out by the presence of xylem parenchyma and much higher xylem rays. In *Dadoxylon roxoi* (MANIERO, 1946) from Brazil the secondary xylem has intercellular spaces and the pore of the bordered pits is boat-shaped while in the present wood there are no intercellular spaces in secondary wood and the pit-pore is broadly oval. *Dadoxylon derbyi* (OLIVIERA, 1936) also from Brazil resembles *Dadoxylon ningahense* in the presence of tangential pits but in the former the radial pits are always uniseriate while in the latter the radial pits are multiseriate. Present specimen compares favourably with the secondary xylem of *Barakaroxylon jhariense* (Surange & Sah) Surange & Maithy (1962). In both the tangential walls of the tracheids are pitted, radial pitting is multiseriate and the number of pits in the cross-field is the same. The two, however, differ in the depth of xylem rays which are comparatively higher in my specimen than in *B. jhariense*. But pith and primary xylem so well described for *B. jhariense* are not known for the present specimen and, therefore, until a better specimen with pith and primary xylem is found it is safer to keep it as a separate species. The present wood

also compares with *Dadoxylon zalesskyi* Sahni in tangential and radial sections. In both the xylem rays are low and the radial pitting is multiseriate. But in *D. ningahense* the tangential walls of the tracheids are pitted while in *D. zalesskyi* they are smooth. Further more in *D. zalesskyi* the pits in the cross-field are simple and 1-4 in number while in *D. ningahense* they are bordered and 1-6 in number. *D. parbeliense* Rao while resembling the present wood in radial pitting differs in having much higher xylem rays (1-24 cells), larger number (1-9) of pits in the cross-field and in the absence of tangential pits.

Of the other two Indian species of fossil wood, *D. indicum* (HOLDEN, 1917) differs in having only 1-2 seriate radial pits and in the absence of tangential pits. In *D. bengalense* Holden (*l. c.*) the radial pits have the tendency towards grouping, tangential walls of the tracheids are smooth and the pits in the cross-field are half bordered.

D. parenchymosum (SURANGE & MAITHY, 1963) does not possess pitting on the tangential walls of the tracheids. *D. jamudhiense* (MAHESHWARI, 1964) differs in the absence of growth zones and also in radial pitting.

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EXPLANATION OF PLATES

PLATE 1

Dadoxylon jamuriense sp. nov.

1. Transverse section of the pith. × 3.
2. Transverse section of the wood showing autumn and spring wood tracheids. × 60.
3. Transverse section of the pith. × 45.
4. Longitudinal section through the pith. × 45.
5. Radial longitudinal section showing pits on the tracheidal walls. × 260.

PLATE 2

Dadoxylon jamuriense sp. nov.

6. Tangential longitudinal section showing xylem rays. × 60.

Dadoxylon ningahense sp. nov.

7. Transverse section showing spring and autumn wood tracheids. × 30.
8. Tangential longitudinal section showing xylem rays. × 60.
9. Tangential longitudinal section showing pits on the tracheidal walls. × 275.
10. Radial longitudinal section showing tetraseriate pits on the tracheidal walls. × 275.
11. Radial longitudinal section showing triseriate pits on the tracheidal walls. × 275.
12. Radial longitudinal section showing pits in the cross-field. × 275.

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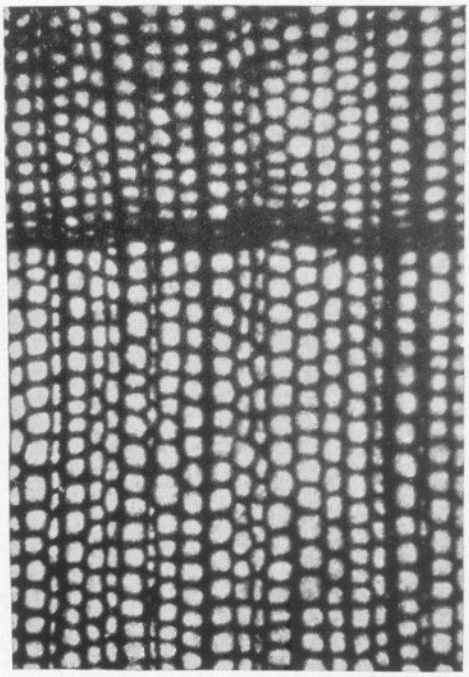

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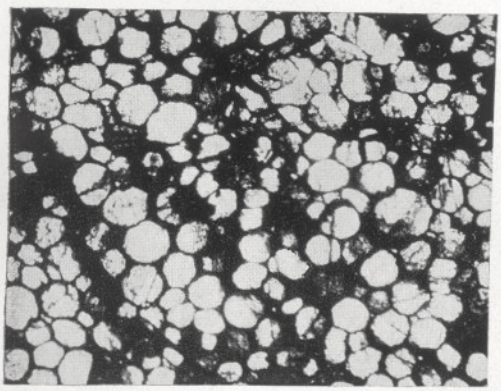

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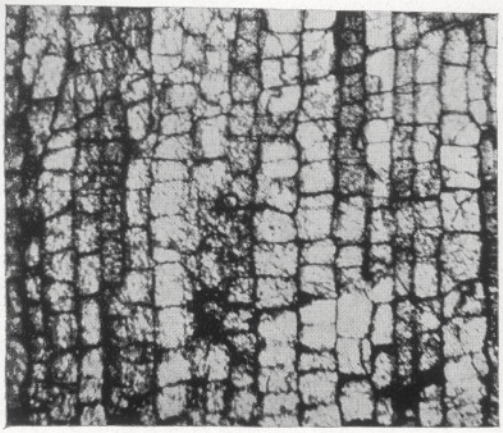

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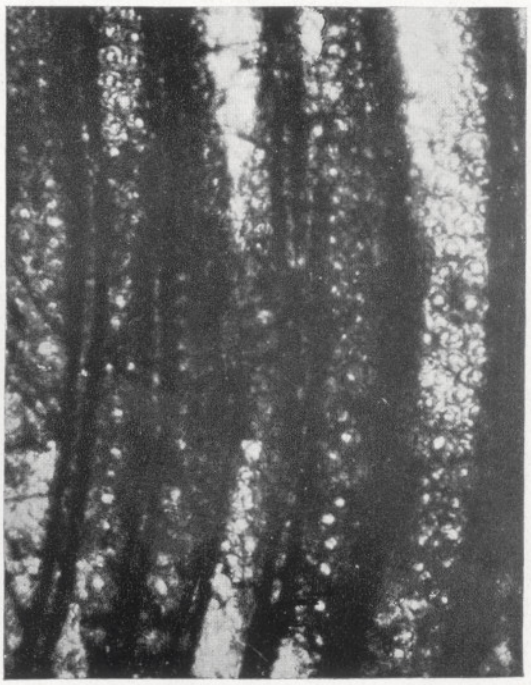

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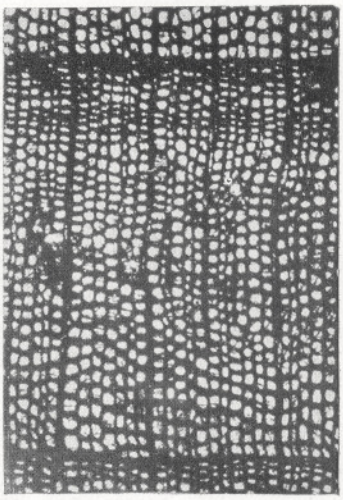

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