STUDIES IN THE DECCAN INTERTRAPPEAN FLORA — 2. FURTHER OBSERVATIONS ON *DRYOXYLON MOHGAOENSE* RODE

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ABSTRACT

The petrified wood of *Dryoxylon mohgaoense* Rode is redescribed here giving further information as regards its structure and affinities. The wood of *D. mohgaoense* is nearly related to family Myrtaceae and shows a close relationship with the flowers of *Sahnipushpam glandulosum* Prakash (1955). The flower *Sahnipushpam glandulosum* and the wood *Dryoxylon mohgaoense* most probably belong to one and the same species.

INTRODUCTION

FROM the Deccan Intertrappean Series, so far only two dicot woods have been reported. The first, *Dryoxylon mohgaoense*, was described by Rode (1936) from Mohgaon Kalan. The second was reported from the same locality by Varma (1950) as the wood showing resemblance with the wood of *Sonneratia*.

Recently I have collected a number of twigs of *Dryoxylon mohgaoense* from Mohgaon Kalan (22°1'N.; 79°11E.) which give further information as to the structure and affinities of the fossil. A detailed study of the petrified twigs has been made both from the transverse and longitudinal sections. Some of the sections are coloured due to iron oxide enhancing the clarity of the various tissues.

DESCRIPTION

The twigs of *Dryoxylon mohgaoense* measuring 10-14 mm. in diameter were embedded in the chert blocks. The twig shows the structure of a diffuse-porous wood.

Pith — It is about 2-4 mm. in diameter (PL. 1, FIG. 1) and consists of mostly polygonal cells (PL. 1, FIG. 6; TEXT-FIG. 1). However, at one spot the cells show irregular outline which may be due to the shrinkage of the tissue.

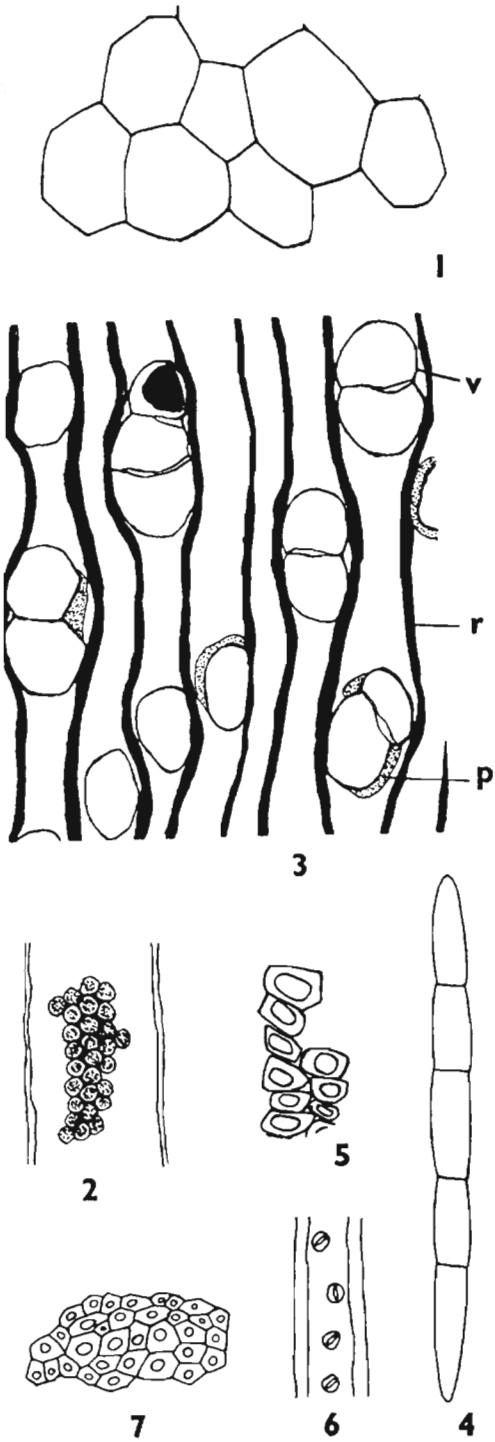
Primary Xylem — It is not possible to find out the number of primary xylem groups. The protoxylem elements are recognized in the longitudinal sections by their spiral pitting (PL. 1, FIG. 3) and the metaxylem elements by their scalariform pitting (PL. 1, FIG. 2).

Growth Rings — Not present.

Secondary Wood Vessels could not be seen distinctly by the naked eye but are visible under a hand lens. The vessels are thin-walled, small, moderately numerous (PL. 1, FIG. 5) and evenly distributed. They are round to oval often slightly angular in the cross-section (PL. 1, FIG. 5). The majority are solitary and in pairs. The radial groups of 3-4 vessels are not infrequent. The vessels are mostly empty (PL. 1, FIG. 5) but sometimes they are filled with dark brown (tanniferous or resiniferous?) substance. Often the tyloses are also present. There is no difference in size of the vessels due to seasonal variations. The perforations are simple and the perforation plates are inclined to often nearly horizontal in position (PL. 1, FIG. 8). The intervessel pits are well preserved. They are small, vestured (PL. 1, FIG. 7; TEXT-FIG. 2) and arranged in several nearly vertical rows. Vessel-parenchyma pits are simple and many per cell. The vessel-ray pits are again simple and numerous per cell.

Wood parenchyma could not be located by the naked eye. However, under the microscope it is distinctly visible. The parenchyma (TEXT-FIG. 3) is scanty and typically paratracheal. It occurs in association with some of the vessels. The parenchyma cells are more or less round to oval in shape and always empty. Pits to parenchyma cells are not seen.

Xylem Rays — Fine and mostly uniseriate (PL. 1, FIG. 8; TEXT-FIG. 4). Very rarely local biseriate rays may also be seen in the cross-sections. The rays are usually homogeneous (PL. 1, FIG. 9) and composed of upright cells only. However, from a few radial sections only some of the rays appear to be heterogeneous and composed of both upright and procumbent cells. The ray cells are thin-walled and often filled



TEXT-FIGS. 1-7.

with some substance (gum-like ?) (PL. 1, FIG. 8).

Wood Fibres — Well preserved and arranged in distinct radial rows (PL. 1, FIG. 5) in between two consecutive rays. In cross-section the fibres are angled, usually rectangular or polygonal in shape (TEXT-FIG. 5). They are moderately thick-walled, non-septate and medium to short in length (PL. 1, FIG. 8). The inter-fibre pits are clearly seen on the tangential walls. They are fairly large, bordered with usually oblique orifice (TEXT-FIG. 6).

Phloem — It is about 112 μ thick and consists of 7-8 layers of cells, sometimes arranged in tiers (PL. 1, FIG. 4). The bast fibres are not seen in this region and the medullary rays are also not distinct. The patches of primary phloem could not be detected in any of the sections.

Cortex — It is about 400 μ thick and consists of slightly compressed parenchymatous cells (PL. 1, FIG. 4). There are a number of groups of stone cells scattered in this region (PL. 1, FIG. 4; TEXT-FIG. 7). In addition to this a number of secretory cavities or spherical sacs (PL. 1, FIG. 4) of perhaps oil, tannin or resin are also found near the periphery. These secretory cavities are 112-152 μ in diameter. Towards the exterior and probably just below the epidermis are present a few layers (usually 2-4) of slightly thick-walled cells (PL. 1, FIG. 4) which probably form an outer protective tissue.

The epidermis of the twig could not be detected in any of the specimens so far observed.

The *ripple marks* and *pith flecks* are also absent.

Revised Diagnosis — Pith composed of thin-walled polygonal cells. Primary xylem present but number of primary xylem groups not known. Growth rings not present. Secondary wood vessels diffuse, 60-72 per millimetre, mostly in pairs and solitary,

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TEXT-FIGS. 1-7 — 1, cells of the pith region. × 146·5. 2, vestured intervessel pits. × 373. 3, cross-section of the wood showing distribution of the scanty paratracheal parenchyma (*p*); *v* = vessel; *r* = ray. × 146·5. 4, uniseriate ray with upright cells only. × 333. 5, fibres under high magnification; note their alignment, size and shape. × 373. 6, magnified inter-fibre pits. × 666·5. 7, group of stone cells. × 146·5.

sometimes in radial groups of 3-4 round to oval, often slightly angular, small to very small, 36-80 μ, thin-walled, mostly empty; tyloses present; perforations simple, inclined to nearly horizontal; intervessel pits vestured and small; vessel-parenchyma pits simple, many per cell; vessel-ray pits simple and numerous per cell.

Parenchyma scanty, typically paratracheal; cells empty, more or less round to oval, 14-18 μ in diameter; pits not seen.

Xylem rays moderately numerous, 15-18 per millimetre; usually homogeneous, sometimes heterogeneous; fine, mostly uniseriate rarely few rays show local biseriate parts, 10-24 μ in width; 3-36 cells high, 80-1472 μ in length; ray cells thin-walled, often filled with some substance.

Fibres moderately thick-walled, arranged in radial rows, of short to medium length, 576-920 μ; typically non-septate; inter-fibre pits bordered and fairly large.

Cortex 400 μ thick composed of slightly compressed cells and with groups of stone cells scattered here and there; spherical sacs or secretory cavities (112-152 μ in diameter) of perhaps oil, tannin or resin also observed near the periphery.

Phloem consists of a few layers of cells sometimes arranged in tiers.

Locality — Mohgaon Kalan in Chhindwara district of Madhya Pradesh.

Age — Early Tertiary.

Type Specimen — B.S.I.P. Nos. 5572, 5582.

COMPARISON AND DISCUSSION

The present fossil wood differs widely from the other Indian species of dicot woods (CHOWDHURY, 1934, 1936, 1938, 1942, 1952a, 1952b; CHOWDHURY & GHOSH, 1946; CHOWDHURY & TANDON, 1949, 1952; SEN, 1930; RAMANUJAM, 1953, 1954a, 1954b, 1955, 1956; VARMA, 1950; NAVALE, 1955).

From the Deccan Intertrappean Series, besides the present species, another dicot wood showing resemblance with the wood of *Sonneratia* was reported by Varma (1950). It differs from the present fossil wood in the presence of aggregate rays with 1-3 resin canals in the body of the ray, and in the absence of parenchyma, the vestured intervessel pits, the secretory cavities and the groups of stone cells.

Comparison with the Living Species — The diffuse nature of the vessels coupled with the vestured type of intervessel pitting, paratracheal wood parenchyma and the xylem rays, spherical sacs or secretory cavities and the groups of stone cells in the cortex are the distinguishing characters of the fossil wood. The presence of vestured pits on the vessel-walls is a significant feature which has been reported in the secondary wood of the genera of about twenty-four dicotyledonous families (BAILEY, 1933; METCALFE & CHALK, 1950, p. 1350). A comparison with these families shows that the fossil wood somewhat resembles families like Lythraceae, Combretaceae and Myrtaceae. However, it differs from the members of Lythraceae in having groups of stone cells in the cortical region. The family Lythraceae is further distinguished from the fossil by the presence of intraxylary phloem and in the low xylem rays (METCALFE & CHALK, 1950, pp. 649-654; PEARSON & BROWN, 1932).

The present fossil wood also differs from the members of Combretaceae in the presence of groups of stone cells in the cortical region. However, in Combretaceae (METCALFE & CHALK, 1950, pp. 612-619) some stone cells or cells thickened only on one side are often present in the cork. Besides this the family Combretaceae is further distinguished from the fossil by the presence of typically abundant parenchyma which is aliform to confluent and with some scattered cells among the fibres (METCALFE & CHALK, 1950, p. 617) except in genera *Guiera* and *Lumnitzera* where the parenchyma is scanty and paratracheal (loc. cit., p. 619). However, in *Guiera* the vessels are exclusively solitary (METCALFE & CHALK, 1950, pp. 617-618) and the rays are 2-seriate as opposed to 1 to 2-seriate (mostly uniseriate) rays and mostly solitary and paired vessels in the present fossil wood. On the other hand, in *Lumnitzera* the vessels have radial multiples of 4 to several cells, a character not seen in the fossil wood (METCALFE & CHALK, 1950, p. 617, FIG. 137B; GAMBLE, 1902). As such the families Lythraceae and Combretaceae can be easily eliminated.

In the family Myrtaceae the fossil shows some resemblance with the genera *Eugenia*, *Xanthostemon* and *Eucalyptus*, especially with the last one (METCALFE & CHALK, 1950, pp. 620-628; PEARSON & BROWN, 1932, pp. 549-569; MOLL & JANSSONIUS, 1918, pp. 383-518; BAKER, 1919, pp. 123-298; KANEHIRA, 1924a, p. 12; KANEHIRA, 1924b, pp. 33-35; HENDERSON, 1953, pp. 56-58, FIGS. 286-297). I have also cut and

examined the sections of twigs (of more or less same diameter) of *Eugenia jambolana*, and a number of species of *Eucalyptus*, e.g. *E. crebra*, *E. tereticornis*, *E. citridora* and *E.* spp. However, the living wood of *Xanthostemon* could not be examined as it was not available. It also does not grow in India (GAMBLE, 1902).

The fossil wood resembles the genus *Eucalyptus* in the presence of secretory cavities and stone cells in the cortex and also in the broad characters of the wood. They differ markedly from each other in xylem ray characters. The xylem rays in *Eucalyptus* are either homogeneous with only procumbent cells or weakly heterogeneous with 1-3 marginal rows of upright cells (METCALFE & CHALK, 1950, p. 627). In the fossil wood, the rays are mostly uniseriate (rarely locally biseriate) and composed usually of upright cells.

As the fossil does not resemble with any of the living genera of Myrtaceae in all respects (especially in the xylem rays), it is rather premature to say anything definite about its affinity at this stage. However, the presence of secretory cavities in the cortex of the fossil twig, a character so very common and noteworthy among the members of the family Myrtaceae (METCALFE & CHALK, 1950, p. 620), is quite striking.

It appears, therefore, that the fossil wood is nearly related to, if not belonging to, the family Myrtaceae.

The presence of identical spherical sacs or secretory cavities, both in the flowers of *Sahnipushpam glandulosum* (PRAKASH, 1955) and in the present fossil twig, which shows relationship with the family Myrtaceae, suggests that in the Mohgaon cherts both the flowers and the woods of the same species may be present. However, no organic connection between the two has been found. The close association of both the flowers and twigs in the chert blocks is quite interesting.

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EXPLANATION OF PLATE 1

Dryoxylon mohgaoense Rode

1. Cross-section of the fossil twig under low magnification showing pith, primary and secondary xylem and the cortex. × 6·5.
2. Magnified scalariform pitting. × 380.
3. Magnified spiral pitting of the protoxylem vessels. × 380.
4. Cross-section of the cortical region (*c*) and phloem tissue (*ph*). Note spherical sacs or secretory cavities (*s.c.*) and islands of stone cells (*st*) in the cortex. Also note the protective tissue (*pr*). × 115.
5. Cross-section of the secondary xylem showing size, shape and distribution of the vessels. × 45.
6. Cells of the pith region. × 91.
7. Magnified vestured intervessel pits. × 400.
8. Tangential longitudinal section showing the nature and distribution of xylem rays. × 56.
9. Radial longitudinal section showing the nature of xylem rays. × 90.

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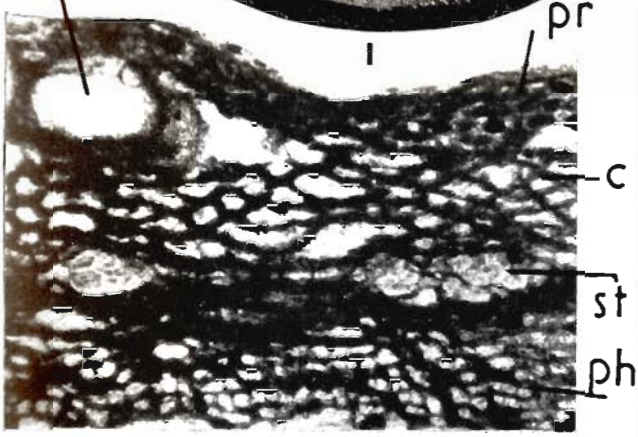

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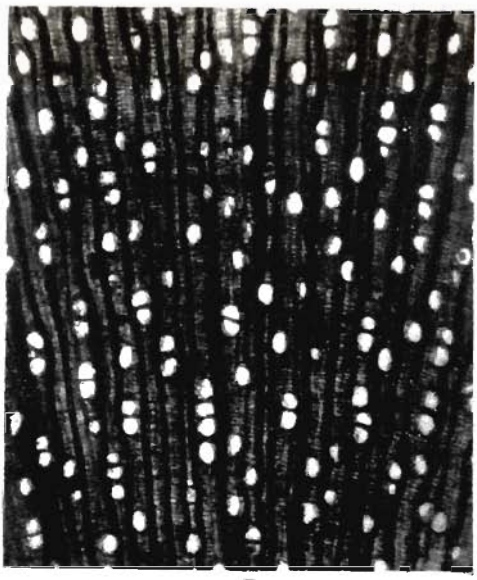

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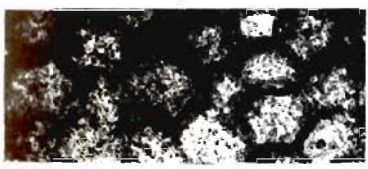

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