

MILLETTIOXYLON INDICUM AWASTHI, A FOSSIL WOOD OF LEGUMINOSAE FROM THE CUDDALORE SERIES OF SOUTH INDIA

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ABSTRACT

The present paper deals with a detailed account of *Millettioxylon indicum* Awasthi (1967), collected from Murattandichavadi near Pondicherry, South India. In all anatomical characters it resembles those of *Millettia* and *Pongamia* of the Leguminosae.

INTRODUCTION

IN the petrified flora of the Cuddalore Sandstones of Pondicherry, South India, the Leguminosae is represented by a variety of woods, described by Ramanujam (1955, 1960, 1961), Ramanujam and Rao (1966a, 1966b) and Navale (1959, 1963) and subsequently reallocated some of them under different genera of the same family by Muller-Stoll and Madel (1967). Further examination of fresh collection of woods from the same area has revealed the presence of some more legumes. One of them briefly described earlier by me (Awasthi, 1967) is dealt here in detail.

DESCRIPTION

Family — LEGUMINOSAE

Millettioxylon indicum Awasthi, 1967

Pl. 1, figs. 1-8

Material — Several pieces of well-preserved petrified secondary wood varying in size from small to big.

Topography — *Wood* diffuse-porous (Pl. 1, fig. 1). *Growth rings* distinct, visible to the naked eye, delimited by broad fibre bands without vessels, as well as by narrow and discontinuous lines of parenchyma (Pl. 1, fig. 1). *Vessels* small to large, mostly medium sized, usually completely enclosed by parenchyma bands (Pl. 1, fig.

1), solitary as well as in radial multiples of 2-4 (mostly 2), almost evenly distributed, about 2-4 vessels per sq. mm.; tyloses not seen, infiltration dark. *Parenchyma* visible to the naked eye as sharp, regular concentric bands alternating with the fibre bands of almost equal width (Pl. 1, fig. 1); parenchyma bands straight to wavy or undulating, completely enclosing the vessels, rarely bifurcating and joining neighbouring bands, 4-6 bands per mm., each band 2-9 cells wide. *Xylem rays* fine, 1-3 seriate, 18-64 μ wide, 4-20 cells in height and storied (Pl. fig. 3), each separated by 2-6 tangential rows of fibres, about 13-16 rays per mm.; ray tissue homogeneous to weakly heterogeneous; rays homocellular to weakly heterocellular, consisting of procumbent cells through the median thickened portion and sometimes with a single marginal row of square or upright cells at one or both the ends (Pl. 1, fig. 7). *Fibres* visible to the naked eye in cross-section as light coloured bands, alternating with the parenchyma bands of equal width (Pl. 1, fig. 1, 5).

Elements — *Vessels* circular to oval in cross-section, mostly oval, those in radial multiples flattened at the places of contact, t.d. 56-180 μ , r.d. 52-240 μ ; perforations simple; vessel-members short, 375-450 μ in length, with truncated ends, storied with parenchyma strands and xylem rays; intervessel pits alternate, bordered, vestured, about 6 μ in diameter (Pl. 1, fig. 6); vessel-ray and vessel-parenchyma pits similar to intervascular pitting. *Parenchyma strands* storied, as long as vessel members and xylem rays, 3-4 cells per, strand (Pl. 1, fig. 3), cells circular to oval in cross-section, t.d. 12-32 μ , r.d. 12-48 μ , length 60-104 μ . Upright or square *Ray cells* 28-52 μ in tangential height, 24-40 μ in radial length; procumbent ray cells 16-20 μ in tangential height, 48-128 μ in radial length; dark in-

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filtration present. *Fibres* libriform, angular to oval in cross-section, 8-20 μ in diameter, non-septate, thickwalled, walls 4-8 μ in thickness, with small circular lumen. *Ripple marks* present, traceable to storied vessel segments, parenchyma strands and xylem rays (Pl. 1, fig. 8).

DISCUSSION

Affinities with the modern woods—The most important and characteristic features of the present fossil wood are the presence of (1) banded parenchyma alternating with the fibre bands of almost equal width, (2) 1-3 seriate xylem rays, (3) vested intervessel pits, and (4) ripple marks traceable to storied vessel segments, parenchyma strands and the xylem rays. In these features it resembles certain leguminous woods, viz., *Dialium*, *Millettia*, *Baphia*, *Bauhinia*, *Pongamia*, *Craibia*, etc. However, taking into consideration all the characters collectively it shows closest resemblance with those of *Millettia* and *Pongamia*. The woods of *Dialium*, though resembling the present fossil wood in having ripple marks and banded parenchyma differs from the the present fossil in that the parenchyma bands are always thinner than those of fibres, and the xylem rays are homogeneous. The xylem rays in *Baphia* are also homogeneous and irregularly storied. In *Craibia* the vessels are smaller and the parenchyma bands are thinner. The xylem rays in *Bauhinia* are always 1-2 seriate and long, and the intervessel pits are non-vested.

Among the species of *Millettia* and *Pongamia* detailed comparison was made with the thin-sections and published descriptions and figures of *Millettia atropurpurea* Benth., *M. auriculata* Baker, *M. pendula* Benth. (Pearson & Brown, 1932, pp. 350-352, fig. 125), *M. brandisiana* Kurz, *M. macrostachya* Coll. and Hemsl., *M. prainii*, *M. pulchra* Kurz, *M. racemosa* Benth., *M. laurentii* Willd. (Kribs 1959, p. 87, fig. 413), and *Pongamia glabra* Vent, (Metcalfe & Chalk, 1950; Pearson & Brown 1932, pp. 399-402, fig. 139). Of these, *Millettia pendula* and *Pongamia glabra* show closest resemblance with the present fossil wood. However, the other species of *Millettia* can be easily distinguished from it in having certain important characters. In *M. atropurpurea* the parenchyma is

aliform to aliform-confluent as well as banded and the xylem rays are irregularly storied. In *M. auriculata* the vessels are large and the xylem rays are up to 6-seriate. The xylem rays in *M. brandisiana* and *M. macrostachya* are broad, high and nonstoried. Moreover, the vessels in *M. brandisiana* are of two sizes, small and big, the smaller vessels being interspersed within the parenchyma bands. *Millettia prainii*, *M. pulchra*, and *M. laurentii* possess bigger vessels than the present fossil wood. The vessels in *M. racemosa* and *M. prainii* sometimes occur in clusters. *Millettia racemosa* is further being different in having high and broad rays. Similarly *M. prainii* and *M. pulchra* can also be further differentiated from the present fossil wood in having the parenchyma bands thinner than those of fibres.

Anatomically *Millettia pendula* and *Pongamia glabra* are so similar that they can hardly be separated from each other. Their similarity can be seen in the shape, size and distribution of vessels, parenchyma and fibres and in the presence of ripple marks due to storied arrangement of vessel members, parenchyma strands and the xylem rays. However, according to Pearson and Brown (1932) *Pongamia glabra* differs from *Millettia pendula* in having substitute fibres (fusiform parenchyma strands). But it should not be considered as one of the diagnostic characters because in some species of *Millettia* substitute fibres are occasionally present. Hence the genus *Millettioxylon* instituted earlier by me (Awasthi, 1967) for the fossil woods of *Millettia* be also considered for those of *Pongamia*.

Present distribution of Millettia Wight et Arn. and *Pongamia* Vent. —The genus *Millettia* includes 180 species (Willis, 1973, p. 746) of climbing shrubs and trees, widely distributed throughout the tropical and sub-tropical regions of Africa, Indo-Malaya, China and Australia. About 27 species occur in Indian region (India and Burma), nearly half of which are trees and other half climbing shrubs. Two species grow in South India and the rest occur in Eastern Bengal and Burma. *M. pendula* Kurz, the nearest modern equivalent of *Millettioxylon indicum*, is a deciduous tree found in Savannah forests and dry lower hill forests of Burma, up to 700 m. It does not occur in India.

The genus *Pongamia* Vent. consists of a single species, *P. glabra* Vent., which is a moderate-sized, almost evergreen tree, frequently occurring near the banks of streams and water courses, beach and tidal forests of South and Central India, extending northwards to the Himalaya, Ceylon and the Malay Archipelago, extending eastward to the coasts of South China, the Fiji Islands and tropical Australia (Pearson & Brown, 1932; Gamble, 1902)..

GENERIC DIAGNOSIS

Millettioxylon Awasthi, 1967

Wood diffuse-porous. *Growth rings* indistinct to distinct, when distinct, delimited by thin lines of apotracheal parenchyma and also by broad fibre bands. *Vessels* small to large, solitary as well as in radial multiples, vessel-members usually short, often storied; perforations simple; intervessel pits medium, alternate, vestured. *Parenchyma* mostly in concentric bands alternating with the fibre bands of almost equal width. *Xylem rays* fine to broad, short to long, ray tissue homogeneous to weakly heterogeneous, rays homocellular to heterocellular, mostly storied. *Fibres* mostly banded, alternating with parenchyma bands of almost equal width, non-septate, thickwalled. *Ripple marks* usually present, traceable to storied vessel segments, parenchyma strands and xylem rays.

Genotype — *Millettioxylon indicum* Awasthi 1967.

SPECIFIC DIAGNOSIS

Millettioxylon indicum Awasthi, 1967

Wood diffuse-porous. *Growth rings* present, delimited by thin irregular lines of apotracheal parenchyma and broad fibre bands without vessels. *Vessels* small to large, mostly medium-sized, t.d. 56-180 μ , r.d. 52-240 μ , solitary and in radial multiples of 2-4, 2-4 vessels per sq. mm; perforations simple; vessel-members short, as long as parenchyma strands and xylem rays, storied; intervessel pits about 6 μ in diameter, numerous, alternate, vestured. *Parenchyma* in concentric tangential bands, alternating with the fibre bands of equal width, bands straight to wavy or undulating, completely enclosing the vessels, 4-6 bands per mm., each 2-9 cells wide. *Xylem rays* fine, 1-3 seriate, 4-20 cells in height, storied, ray tissue homogeneous to weakly heterogeneous, rays homocellular to heterocellular, consisting of procumbent cells, often with single row of upright or square cells at one or both the ends. *Fibres* banded, alternating with parenchyma bands of almost equal width, thick-walled, non-septate. *Ripple marks* present, traceable to storied vessel segments, parenchyma strands and rays.

Holotype — B.S.I.P. Museum No. 35150

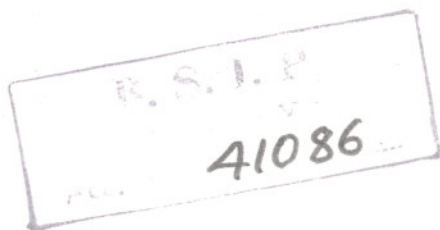
Locality — Murattandichavadi, about 8km NW of Pondicherry

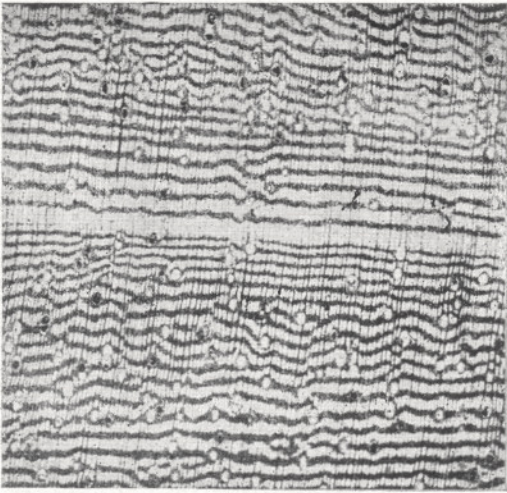
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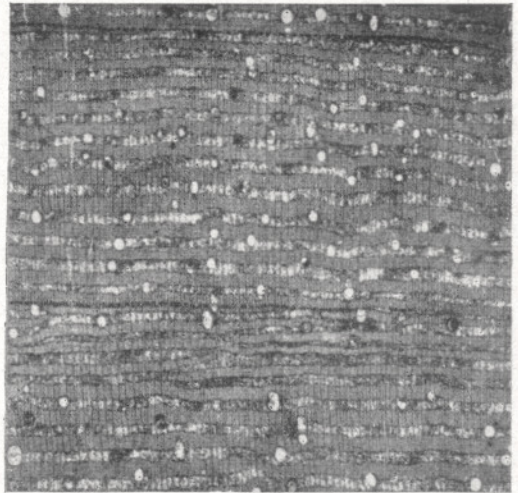
EXPLANATION OF PLATE

1. Cross-section of *Millettioxylon indicum* Awasthi showing nature and distribution of vessels and parenchyma bands. $\times 8$. B.S.I.P. Museum, Slide No. 4616.
2. Cross-section of *Millettia pendula* showing similar nature and distribution of vessels and parenchyma. $\times 8$.
3. Tangential longitudinal section of *Millettioxylon indicum* Awasthi showing xylem rays. $\times 43$. B.S.I.P. Museum, Slide No. 4617.
4. Tangential section of *Millettia pendula* showing similar xylem rays. $\times 43$.
5. Magnified cross-section of *Millettioxylon indicum* Awasthi showing vessels and parenchyma. $\times 50$. B.S.I.P. Museum, Slide No. 4616.
6. Intervessel pits of *Millettioxylon indicum* Awasthi. $\times 480$. B.S.I.P. Museum, Slide No. 4617.
7. Radial longitudinal section of *Millettioxylon indicum* Awasthi showing homocellular to weakly heterocellular xylem rays. $\times 70$. B.S.I.P. Museum, Slide No. 4618.
8. Tangential section of *Millettioxylon indicum* Awasthi showing ripple marks. $\times 7$. B.S.I.P. Museum, Slide No. 4617.

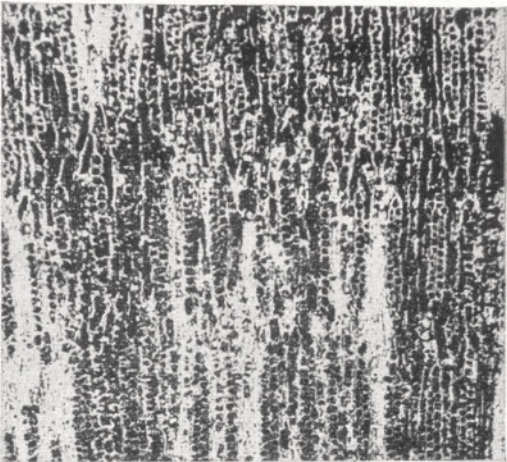




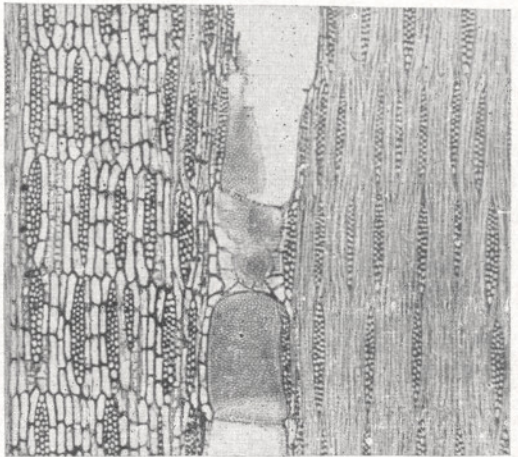
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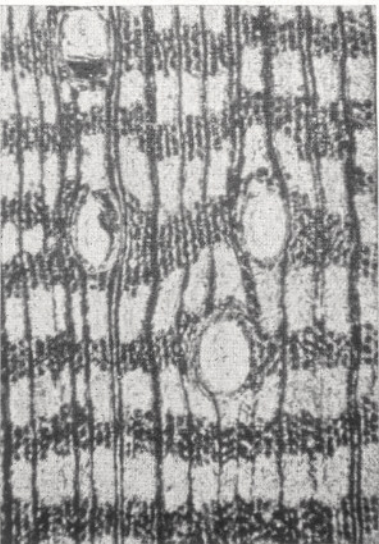
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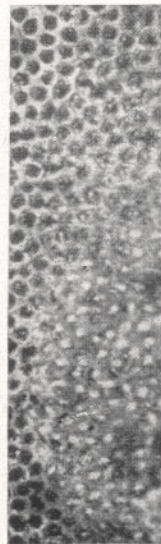
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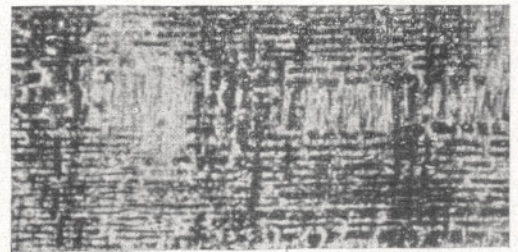
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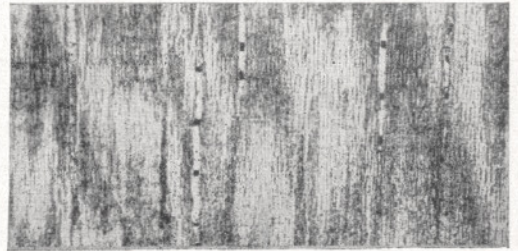
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