ANOGEISSUSOXYLON INDICUM GEN. ET SP. NOV. FROM THE TERTIARY ROCKS NEAR PONDICHERRY, INDIA

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ABSTRACT

The present paper describes the anatomical structures of a new fossil dicotyledonous wood collected near Pondicherry, South India. The detailed study of the fossil specimen has shown its affinities with the genus *Anogeissus* (combretaceae). Therefore, a new form-genus *Anogeissusoxylon* is created to accommodate the fossil specimen (*A. indicum* n. sp.).

INTRODUCTION

THE Tertiary rocks near Pondicherry are rich in petrified dicotyledonous woods. Fossil woods occur either embedded in the sandstones or scattered on the ground surface. A number of fossil woods have been described from near Pondicherry region (RAMANUJAM, 1953-1960 and NAVALE, 1955-1960). The fossiliferous area is composed of Cuddalore sandstones which are argillacious or ferruginous in nature (KRISHNAN, 1949 & WADIA, 1953). The geology and other details of the area from which the present fossil specimen was collected have already been described in my earlier papers (NAVALE, 1956).

The fossil specimen is represented by two big pieces of petrified woods. They are grey to brownish grey in colour. The preservation is uniform and the internal details are moderately well preserved. Structural features of the fossil have been recorded from a large number of good sections taken in various planes.

DESCRIPTION

Growth rings are not distinct, however the region is delimited by a denser fibrous tissue and smaller vessels, or by a thin narrow band of initial parenchyma (PL. 1, FIG. 1; TEXT-FIG. 1).

Vessels are small to extremely small in size and hardly visible with the help of the hand lens (PL. 1, FIG. 1; TEXT-FIG. 1). They are usually enclosed by patches of paratracheal parenchyma (PL. 1, FIGS. 1 & 2; TEXT-FIG. 1). Vessels are round to oval in shape, solitary as well as in radial groups of two to three pores (PL. 1, FIG. 1; TEXT-FIG. 1). They are diffused, evenly distributed and filled with tyloses and other contents (PL. 1, FIG. 1; TEXT-FIG. 1). Vessel segments are short to medium in length, slightly thick-walled, truncate or tailed (PL. 1, FIG. 3; TEXT-FIG. 2). The intervessel pits are alternate, numerous, medium in size and distinctly vestured (PL. 1, FIG. 3; TEXT-FIG. 2). Vessel-ray pits are small, circular, simple and many per cell (PL. 1, FIG. 5).

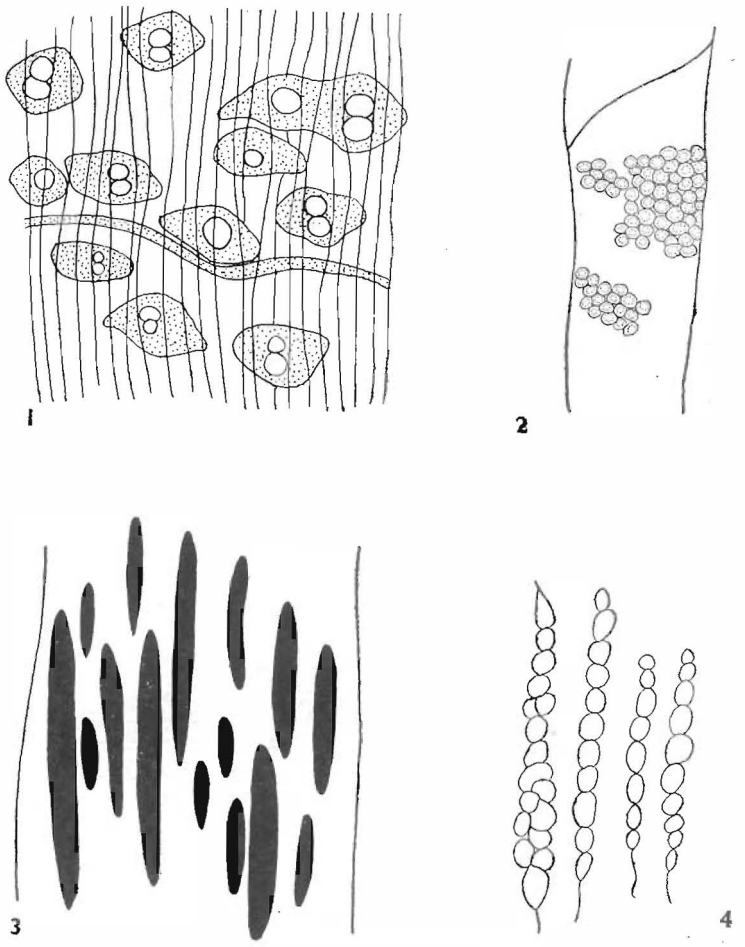
Parenchyma is visible with the help of the hand lens. The paratracheal parenchyma is abundant forming a sheath around the vessel or vessel groups (PL. 1, FIG. 2; TEXT-FIG. 1). It is vasicentric, aliform, often in irregular patches enclosing the vessels (PL. 1, FIG. 1; TEXT-FIG. 1). The initial parenchyma is limited and forms a thin, narrow, inconspicuous bands of 1-2 thin seriate rows (PL. 1, FIG. 2; TEXT-FIG. 1). Cells of the parenchyma are round, small and filled with contents (PL. 1, FIG. 2). Parenchyma pits are indistinct.

Rays are not recognizable without the help of the microscope. They are small and closely placed in distribution (PL. 1, Figs. 1 & 4; TEXT-FIG. 3). Rays are short mostly uniseriate with occasional twin cells (PL. 1, FIG. 4; TEXT-FIG. 4). Rays are heterogeneous and made up of both procumbent and vertical cells (PL. 1, FIG. 5; TEXT-FIG. 4). Crystals are common in upright cells of the rays (PL. 1, FIG. 5).

Fibres are libriform and form the ground mass of the wood. They are fine, round in transverse section and arranged in radial rows (PL. 1, FIG. 2). Fibres are medium in height and septate (PL. 1, Fig. 4). The fibre pits are minute, small and simple.

AFFINITIES AND DISCUSSION

The important set of features which help in the identification of this fossil



TEXT-FIGS. 1-4 — 1. Transverse section showing the distribution and nature of vessels and parenchyma. *ca.* 56. 2. Tangential section showing the vestured pits. *Ca.* 270. 3. Another tangential section showing the distribution rays. *ca.* 180. 4. Tangential section showing the ray cells and their nature. *ca.* 56.

specimen are, the small to very small sized solitary or radial groups of vessels; paratracheal, aliform parenchyma forming irregular patches along with the initial parenchyma in the form of thin bands; exclusively uniseriate, heterogeneous short rays with distinct crystals in each ray cell and medium septate fibres. These characters are more or less found in the woods of the families of Leguminosae, Meliaceae, Urticaceae, Guttiferae, Lythraceae, Anacardiaceae, Burseraceae, Sapindaceae and Combretaceae (PEARSON and BROWN, 1932; CHOWDHURY, 1932; KANEHIRA, 1924; HENDERSON, 1953; METCALFE & CHALK, 1950; GAMBLE, 1902; MOLL & JANSSONIUS, 1908). Woods of Caesalpinoidae (*Cassia, Caesalpinia, Afzelia, Cynometra*) and Mimosae (*Acacia, Albizzia* and others) agree in one or two anatomical details with the fossil, yet they show very distinct differences in having multiseriate homogeneous or heterogeneous rays, medium to large sized vessels having simple pits. Meliaceous woods (*Guarea, Amoora, Dysoxylum*) resemble the fossil in having uniseriate rays, smaller vessels and abundant parenchyma, but on careful examination they can be differentiated by many differences in the nature of pits, rays and vessels. Timbers of the Urticaceae (*Ficus* and related genera) disagree with the fossil

in having larger solitary vessels without vestured pits and multiseriate rays. Few members of Guttiferae (*Callophyllum, Kaeya* and *Garsinae* group) show similarities in some features with the fossil, but markedly differ in the nature and arrangement of parenchyma and rays. Similarly woods of Lythraceae can be discarded, on the basis of a large number of variation in the arrangement of vessels, parenchyma and rays. Some woods of Anacardiaceae and Burseraceae resemble in many structural details with the fossil, but conspicuously enough they differ in having radial gum canals, bigger solitary vessels with simple pits and rays having no crystals in the cells. Woods of Sapindaceae also differ from the fossil in spite of the fact that some resemblances exist between the two. In Sapindaceous woods, parenchyma is very scanty, rays are homogeneous and pits are simple. Woods of *Terminalia* and *Anogeissus* of Combretaceae agree with the fossil in many anatomical details, namely, the nature and arrangement of the vessels, parenchyma and rays. Because of similarity of these two genera with the fossil, 16 species of *Terminalia* and 4 species of *Anogeissus* occurring in India have been studied in detail. Also the detailed references (see page 4) show that the species of *Terminalia*, except two species of *Terminalia*, namely *T. oliveri* and *T. manii*, have medium to large sized solitary or radial vessels, abundant vasicentric parenchyma in patches enclosing the vessels, one to two seriate medium to high, mostly homogeneous rays and crystals in both parenchyma and ray cells. Whereas in *Anogeissus*, vessels are small to extremely small, parenchyma is more or less similar to *Terminalia* and rays are short, exclusively uniseriate, heterogeneous and crystals are found only in ray cells.

From the above description it can be seen that both genera have many similarities in anatomical details. However, *Terminalia* woods except *T. oliveri* and *T. manii* can be separated from *Anogeissus* as they have larger vessels, high, uniseriate and biseriate, mostly homogeneous rays and crystals in both rays and parenchyma. Even *T. oliveri* and *T. manii* can be differentiated from *Anogeissus* by careful and close comparison of minute details. Pearson & Brown (1939) working on the anatomy of these woods states that in *Anogeissus* species crystals are restricted to rays, whereas in *T. oliveri* and *T. manii* crystals are restricted to both parenchyma and rays, a feature generally sufficient to distinguish *Anogeissus* from *T. oliveri* and *T. manii*. Apart from this difference, the later woods have very sparce parenchyma and multiple vessels. The key to the genera *Terminalia* and *Anogeissus* (Pearson & Brown, 1939) described above and careful comparisons of the fossil with the two genera (*Terminalia* and *Anogeissus*) indicate the affinity of the fossil wood with the genus *Anogeissus*.

Comparisons with the fossil woods of Leguminosae, Anacardiaceae, Sapindaceae, described from India (Ramanujam, 1954; Navale, 1955) can be easily eliminated as their affinities are with the modern timbers of the above families and, therefore, they do not compare with the present fossil as discussed earlier. Closely resembling the fossil wood are 4 species of *Terminalioxylon* described from South-India (Navale, 1955; Ramanujam, 1956). and a fossil *Terminalia* wood described from Assam (Prakash & Navale, 1963).

Terminalioxylon speciosum and *T. felixii* (Ramanujam, 1956) compare with the present fossil in some features, but markedly differ in having medium to large vessels (150-300 μ), uniseriate to biseriate rays of medium height and having crystals in both parenchyma and rays. Similarly *T. mortandrense* (Navale, 1955) agrees with the fossil under investigation in the nature of parenchyma rays and fibres but conspicuously disagree in possessing bigger vessels, homogeneous rays, and not having the initial parenchyma. *T. sahnii*, shows a few similarities in the nature vessels, fibres and rays, but it differs in having abundant, zonate parenchyma without the initial bands of parenchyma and high (up to 40 cells) homogeneous rays. Likewise the Assam fossil also differs in many features although agrees in gross-structures.

Few fossil woods of comparable structure have been recorded from outside India. The fossil woods described in the families of Guttiferae, Urticaceae, Sapindaceae, Anacardaceae, Leguminosae need no comparison as they differ in many diagnostic characters, although one or two features might agree with the present fossil. There are 3 species of *Terminalioxylon* which require some comparison with fossil. The foreign species of *Terminalioxylon* (Schönfeld,

1947; BOUREAU, 1950) show some similarities in overall features but also show differences distinctly. Comparing my specimen with *T. porosum* (SCHÖNFELD, 1947), the latter shows many differences in the nature of vessels rays and parenchyma. *T. narango* (SCHÖNFELD, 1947), is also not comparable as its vessels are large, rays are high and homogeneous and the parenchyma is abundant without initial bands. Similarly *T. annamense* (BOUREAU, 1950) markedly differs in having secretory cells in parenchyma, high rays and larger vessels.

DIAGNOSIS

It is evident from the above descriptions and comparisons that the fossil under investigation shows close affinities with the living genus *Anogeissus* (Combretaceae). Therefore a form genus *Anogeissusoxylon is* created to include fossils having affinities with the genus *Anogeissus*. The fossil specimen is named as *Anogeissusoxylon indicum* Gen. et sp. nov.

Anogeissusoxylon gen. nov.

Growth rings — Inconspicuous, the initial bands of parenchyma and the size variations in fibres and vessels often delimit the growth region.

Vessels — Small to extremely small, solitary as well as in radials of 2 to 3, evenly distributed, filled with tyloses and contents, thick walled, enclosed by vasicentric irregular patches of parenchyma; perforation simple, vessel segments truncate or tailed, intervessel pits vestured, alternate, moderate sized; vessel-ray pits minute, many per cell.

Parenchyma — Both paratracheal and apotracheal; paratracheal parenchyma abundant, conspicuous, vasicentric, aliform, forming irregular patches enclosing vessels; initial parenchyma limited, conspicuous, 1-2 rows; parenchyma cells small, circular without contents, parenchyma pits small, circular, difficult to recognize.

Rays — Not visible to the naked eye; closely distributed, short, mostly uniseriate, heterogeneous, both procumbent and verticle cells common; crystals in ray cells present.

Fibres — Libriform, septate, medium; round to angular in cross-section, arranged in radial rows; forms the ground mass of the wood.

Anogeissusoxylon indicum sp. nov.

Vessels — Evenly distributed, 12-40 per mm., solitary or in radial group of 2 to 3, small, more or less circular, usually 80 μ maximum up to 95 μ in tangential diameter, 80-114 μ in radial diameter, 228 in radial diameter when in groups; vessel-segments 110-380 μ long, truncate or tailed, intervessel pits angular horizontally oval, many, 9 μ in size, distinctly vestured; vessel-ray pits small, many per cell 4 μ in size.

Parenchyma Both paratracheal and apotracheal; paratracheal parenchyma vasicentric, aliform, confluent and forms irregular patches, cells of the parenchyma small, 19-22 μ in size; initial parenchyma limited, thinly banded, 1-2 rows of cells; parenchymatous cell very small, 10-12 μ in size.

Rays — Numerous, closely placed 13-20 per mm., mostly uniseriate, heterogeneous, largest 38 μ in size and 20 ray cells high; pits extremely small 4-5 μ in size. Crystal present in ray cells only.

Fibres — Libriform, septate, 375-1600 μ long and 12-20 μ in cross-section.

Holotype — B.S.I.P. Museum.

Locality — Near Pondicherry, South-India.

Horizon — Tertiary.

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EXPLANATION OF PLATE 1

1. Transverse section showing the nature, distribution of vessels and parenchyma. × 35.

2. Another transverse section enlarged showing paratracheal vasicentric parenchyma along with narrow apotracheal strip of parenchyma and rays. × 75.

3. Tangential section showing a portion of tailed vessel segment and vestured pits. × 400.

4. Another tangential section showing the uniseriate heterogeneous rays. × 200.

5. Radial section showing the nature of rays. × 400.

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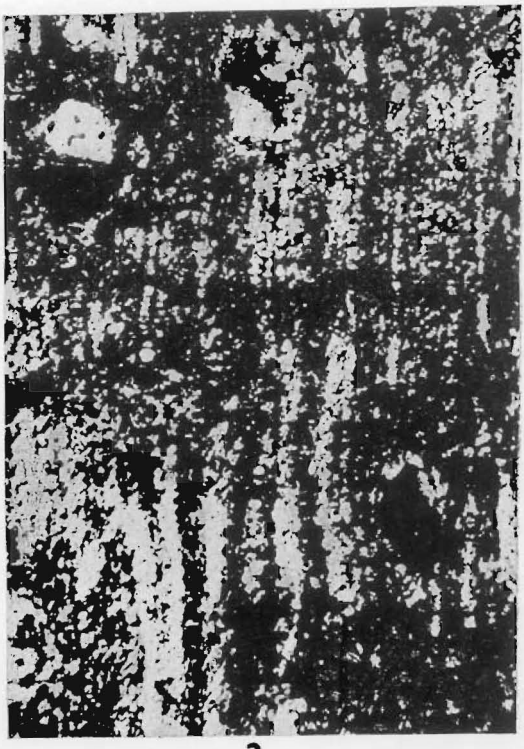

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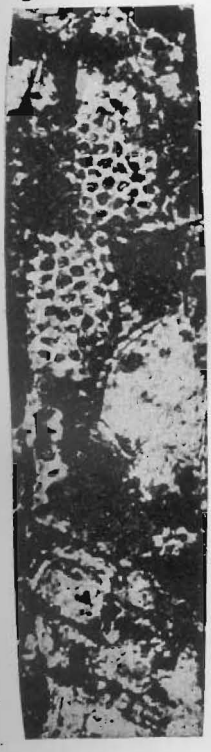

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