

TWO FOSSIL WOODS FROM THE DECCAN INTERTRAPPEAN BEDS OF MANDLA DISTRICT, MADHYA PRADESH

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ABSTRACT

Two new fossil dicotyledonous woods are described from the Intertrappean beds exposed in the Mandla District of Madhya Pradesh. One of these (*Homalioxylon mandlaense* sp. nov.) shows a close similarity to the modern woods of *Homalium* (Family Flacourtiaceae) which does not grow in the vicinity of the fossil locality. The other wood (*Bischofinium deccanii* gen. et sp. nov.) compares with the woods of *Bischofia* (Family Euphorbiaceae) which occurs wild in the south-eastern parts of Madhya Pradesh.

INTRODUCTION

Only three fossil woods have so far been described from the Intertrappean exposures of the Mandla District of Madhya Pradesh viz., *Vitexoxylon indicum* Ingle (1972), *Syzigioxylon mandlaense* Ingle (1973), and *Polyalthioxylon parapaniense* Bande (1973). While in the first two cases the exact locality has not been mentioned, the third wood is described from the fossiliferous beds exposed near Parapani. The fossil woods described in this paper were also collected from Parapani. The area lies in the survey of India Toposheet No. 64B/9 and the village Parapani is situated near Chabi (22° 49' : 80° 42'), a place 56 km. north-east of Mandla in Madhya Pradesh (Map 1).

SYSTEMATIC DESCRIPTION

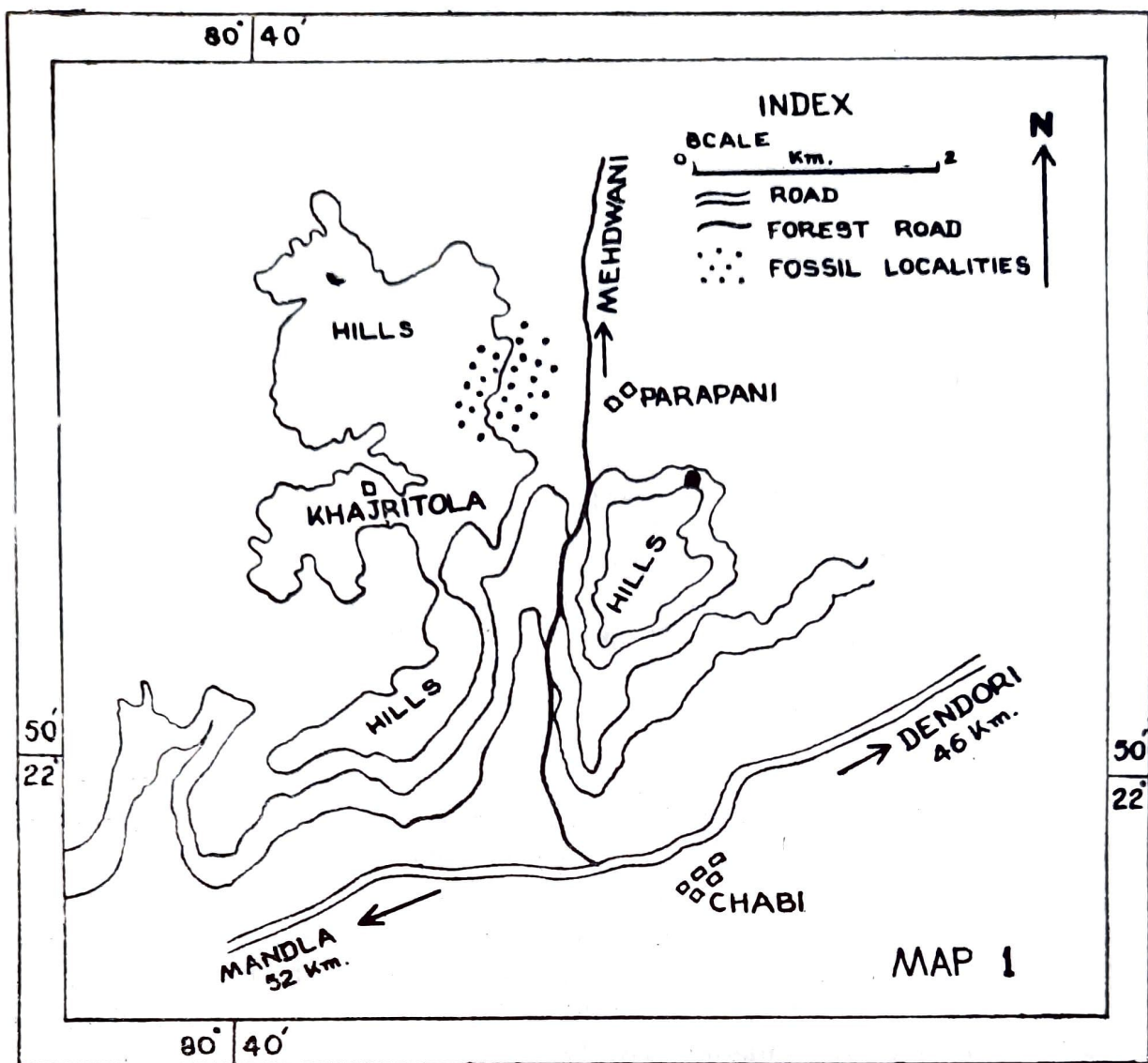
Family—**Flacourtiaceae**

Genus—**Homalioxylon** Prakash & Tripathi, 1974

Homalioxylon mandlaense sp. nov. (Pl. 1, Figs. 1-5, Text-fig. 1).

The description of the present species is based on a piece of silicified wood measuring about 20 cm. in length and 5 cm. in diameter. Cross-section of the specimen reveals the presence of pith in the centre. A number of thin sections were taken out in various planes from the mature peripheral region of the fossil wood and compared with the living species for identification.

TOPOGRAPHY—*Wood* diffuse-porous. *Growth rings* absent (Pl. 1, Fig. 1; Text-fig. 1.). *Vessels* visible to the naked eye as small dots on the cross-surface, small to medium in size, solitary and in radial groups of 2-3 (rarely up to 6), evenly distributed, 20-30 per mm². (Pl. 1, Figs. 1, 2; Text-fig. 1). *Parenchyma* scanty paratracheal, associated with some of the vessels. (Text-fig. 1): *Xylem rays* fine, 1-3 seriate, 20-30 μ in width, 5-35 cells or 100-600 μ in height, and 8-12 per mm. (Pl. 1, Fig. 3); ray tissue heterogeneous, multiseriate rays composed of both upright and procumbent cells with uniseriate extensions of upright cells frequently present at one or both the ends, (Pl. 1, Fig. 3), the extensions sometimes unite to form long rays; uniseriate rays up to 10 cells high, composed of both



procumbent and upright cells; rays sometimes crystaliferous. *Fibres* aligned in ill-defined rows in between the xylem rays.

ELEMENTS—*Vessels* thin walled, circular to oval in shape when solitary, (Pl. 1, Figs. 1-2; Text-fig. 1), t. d. 80-100 μ , r. d. 70-125 μ ; vessel-members 225-360 μ long with truncate ends; perforations simple, (Pl. 1, Fig. 4); intervessel pit-pairs bordered, alternate, oval to angular through crowding, about 8 μ in diameter with linear to lenticular orifice (Pl. 1, Fig. 5). *Ray cells* polygonal in shape in tangential longitudinal section, 10-20 μ in diameter (Pl. 1, Fig. 3). *Fibres* thick walled, polygonal in cross-section, septate, 500-550 μ long and 18-20 μ in diameter (Pl. 1, Fig. 3); interfibre pits not observed.

AFFINITIES—The important anatomical features of the fossil wood are—evenly distributed, small to medium-sized vessels which are solitary and in radial groups of 2 to 6; scanty paratracheal parenchyma; 1 to 3 seriate heterogeneous xylem rays and septate fibres. An extensive survey of these anatomical characters in the living dicotyledonous woods suggests the comparison of the fossil wood with the members of the families Magnoliaceae, Burseraceae, Rutaceae and Flacourtiaceae. However, it is with the wood of *Homalium* of the family Flacourtiaceae that the present fossil shows a close similarity, although superficial resemblance is also seen with the woods of *Gynocardia odorata* R. Br., *Hydnocarpus alpina* Wight and *H. wightiana* Blume of the same family. But in *Gynocardia odorata*, *Hydnocarpus alpina* and *H. wightiana* the parenchyma is entirely lacking and the rays are mostly 1 to 2 seriate (PEARSON & BROWN, 1932) against the scanty paratracheal parenchyma and 1 to 3 seriate xylem rays in the fossil wood.

After a detailed study of thin sections and published literature of various species of *Homalium* it is clear that the fossil wood shows a very close approach to the wood structure of *Homalium tomentosum* Benth. (LECOMTE, 1926, Pl. 57; PEARSON & BROWN, 1932, pp. 36-39, Fig. 15; METCALFE & CHALK, 1950, Pl. 120, Fig. 31E; CHOWDHURY & GHOSH 1958, pp. 49-51; BRAZIER & FRANKLIN, 1961; NORMAND, 1960). The resemblance is in the shape, size and distribution of vessels, parenchyma pattern and structure of the xylem rays and the fibres.

Only one fossil wood assigned to the living genus *Homalium* has so far been described under the name *Homalioxylon assamicum* Prakash and Tripathi (1974), from the Tertiary of Assam. The present species, though resembles *Homalioxylon assamicum* in a number of characters, differs from it in the structure of rays. The rays are 1-5 (mostly 3-4) seriate and 52 cells high in *Homalioxylon assamicum* whereas they are 1 to 3 seriate and only up to 30 cells high in the present fossil wood. Therefore, the present fossil wood has been assigned to a new species of the genus *Homalioxylon* Prakash and Tripathi and named as *Homalioxylon mandlaense*, the specific name indicating its occurrence in the Mandla District of Madhya Pradesh.

The genus *Homalium* Jacq. consists of 200 species (WILLIS, 1966) widely distributed throughout the Tropics, with numerous representatives in Africa, the Indo-Malayan region and Tropical America. At least 10 species are indigenous to India and Burma. *Homalium tomentosum* Benth, with which the fossil wood shows closest resemblance, grows in some parts of Tamil Nadu, Assam and Burma (GAMBLE, 1902; PEARSON & BROWN, 1932).

SPECIFIC DIAGNOSIS

Wood diffuse-porous. *Growth rings* absent. *Vessels* solitary and in radial groups of 2 to 6, evenly distributed, 20 to 30 per mm², small to medium, t. d. 80-100 μ , r. d. 70-125 μ ; vessel members 225-360 μ long with truncate ends; perforations simple, oblique; intervessel pit-pairs bordered, alternate, oval to angular through crowding, about 8 μ in diameter with linear to lenticular orifice. *Parenchyma* scanty paratracheal. *Xylem rays* heterogeneous, 1-3 seriate, 20-30 μ wide and 35 cells or 600 μ in height; uniseriate extensions at one or both the ends of multiseriate rays; crystals present. *Fibres* thick walled, polygonal in cross-section, 18-20 μ in diameter and 500-550 μ in length, septate; interfibre pits not observed.

Holotype—35151, Birbal Sahni Institute of Palaeobotany, Lucknow

Locality—Parapani in Mandla District of Madhya Pradesh

Age—Deccan Intertrappean (Early Eocene)

Family—**Euphorbiaceae**

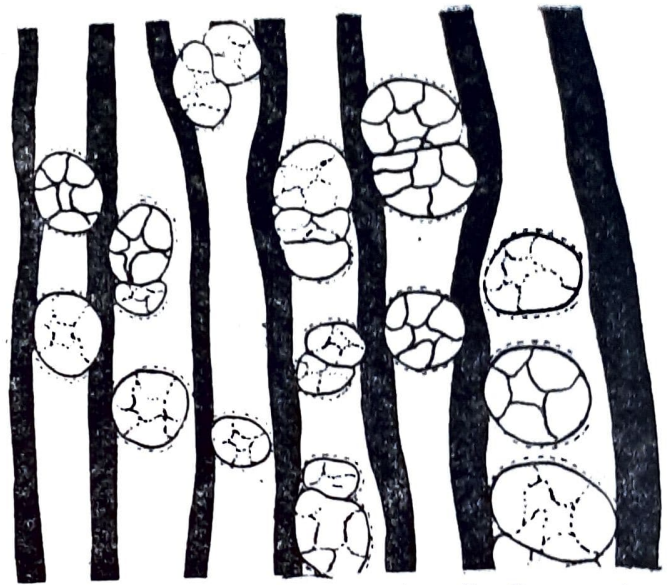
Genus—**Bischofinium** gen. nov.

Bischofinium deccanii sp. nov. (Pl. 2; Figs. 6-10; Text-fig. 2).

The present description is based on a piece of silicified secondary wood taken out from a large log, discovered near the locality of Parapani. The fossil wood is yellowish brown in colour and shows a fairly good preservation.



Text-fig. 1.—*Homalioxylon mandlaense* sp. nov.—Cross-section showing shape, size, distribution of vessels, the scanty parenchyma and uniseriate and multiseriate xylem rays. $\times 70$. Slide no. 4630.



Text-fig. 2. *Bischofinium deccanii*—Cross-section showing shape, size and distribution of vessels, with tyloses, scanty paratracheal and uniseriate vasicentric parenchyma and xylem rays. $\times 70$. Slide no. 4633.

TOPOGRAPHY—*Wood* diffuse-porous. *Growth rings* indistinct. (Pl. 2, Fig. 6). *vessels* visible to the naked eye as small dots on the cross-surface, small to medium in size, mostly solitary and in radial rows of 2 to 3 (rarely 4) (Pl. 2, Fig. 7; Text-fig. 2). filled with tyloses, evenly distributed, up to 25 per mm^2 . *Parenchyma* scanty paratracheal to uniseriate vasicentric (Pl. 2, Fig. 7, Text-fig. 2). *Xylem rays* fine to broad, 1-6 (mostly 3-6) seriate, heterogeneous (Pl. 2, Fig. 8), 4-5 per mm.; the uniseriates much less numerous than the multiseriates; uniseriates made up of upright cells only and up to 15 cells in height; multiseriates composed of procumbent cells in the central portion with a continuous or interrupted sheath of upright cells at the flanks, up to 60 cells or 1700 μ in height and sometimes with uniseriate extensions of upright cells at one or both ends (Pl. 2, Fig. 8). *Fibres* aligned in radial rows in between the rays.

ELEMENTS—*Vessels* oval to circular in shape, when solitary t. d. 100-160 μ , r. d. 100-200 μ ; vessel-members 270-360 μ in length with truncate ends; perforations simple, oblique; intervessel pit-pairs bordered, alternate, elliptical with linear to lenticular apertures, 6-8 μ in diameter (Pl. 2, Fig. 10). *Ray cells* 15-30 μ in diameter in tangential section. *Fibres* thick walled, septate, 15-20 μ , in diameter and up to 400 μ in length; interfibre pits not observed.

COMPARISON AND DISCUSSION—The fossil wood shows following important anatomical characters viz., vessels mostly solitary and in radial rows of 2 to 4, scanty paratracheal and vasicentric parenchyma, 1-6 seriate heterogeneous xylem rays with sheath cells and thick walled septate fibres. Considering the above anatomical characters the fossil wood shows a close resemblance to the modern wood of *Bischofia* Blume of the family Euphorbiaceae. However, a superficial resemblance can also be seen with the mature secondary xylem of *Rhizophora mucronata* Lamk. of Rhizophoraceae, *Vitex* spp. of Verbenaceae and *Feronia elephantum* Correa of Rutaceae.

Although *Rhizophora mucronata* shows a number of characters similar to the fossil wood, the characteristic scalariform thickenings on the vessel walls and the non-septate fibres easily distinguish it from the present fossil wood.

Various species of *Vitex* viz., *V. altissima* Linn., *V. peduncularis* Wall., and *V. leucoxydon* Linn., show similar vessel and parenchyma distribution and the septate fibres as in the fossil

wood. However, the rays are homogeneous in the living species in contrast to the heterogeneous rays of the fossil wood.

Feronia elephantum also resembles the fossil wood in the distributional pattern of vessels and the structure of xylem rays. However, the terminal parenchyma present in the living wood is absent in the fossil. Moreover, the fibres are non-septate in the living wood, but septate in the present fossil.

At first the genera *Bischofia* and *Bridelia* of Euphorbiaceae seem to be anatomically indistinguishable. However, after a detailed investigation they have been separated as follows.

Growth rings are quite conspicuous and usually demarcated by a line of terminal parenchyma in *Bridelia* whereas they are indistinct in *Bischofia* and the terminal parenchyma is absent. In addition to this, the parenchyma distribution is also different in the two. In *Bridelia* it is diffuse to thick vasicentric whereas in *Bischofia* the parenchyma is scanty paratracheal to uniseriate vasicentric and the terminal parenchyma is absent. Therefore, the statement of MÄDEL (1962, p. 291) that *Bischofia* has no wood parenchyma, is incorrect. Further, the intervacular pitting is alternate and moderately large in *Bischofia* (METCALFE & CHALK, 1950), but small and vestured in *Bridelia* (JANSSONIUS, 1930; BAILY, 1933). It is quite clear from the above discussion that although the present fossil wood is somewhat related to *Bridelia*, it is almost identical with the wood of *Bischofia javanica* Blume.

Both in the living and fossil wood growth rings are indistinct, vessels are medium to small in size, heavily tylosed, solitary and in radial rows of 2-4, with simple perforations and moderately large, oval, alternate, bordered pits with linear to lenticular apertures.

The parenchyma in *Bischofia javanica* Blume as well as in the fossil wood is scanty paratracheal to uniseriate vasicentric, and the terminal parenchyma is absent.

The xylem rays of *Bischofia javanica* are quite similar to those of the fossil wood being heterogeneous and possessing sheath cells in both. However, they are 1-5 seriate in *B. javanica* but 1-6 seriate in the present fossil. Lastly, the fibres are thick walled and septate in fossil and also in the living wood.

In 1960 RAMANUJAM identified a fossil wood as *Bischofia* from the Cuddalore series of South India and instituted the form genus *Bischofioxylon*. However, MÄDEL (1962) pointed out that *Bischofioxylon miocenicum* Ramanujam (1960) has nothing to do with *Bischofia*; instead it shows resemblance to the wood structure of *Bridelia* and should be considered as a new species of *Bridelioxylon* Ramanujam viz., *Bridelioxylon miocenicum*. From the published description, photographs and text-figures of *Bridelioxylon cuddaloreense* Ramanujam (1956) and *Bischofioxylon miocenicum* Ramanujam (1960) the author also feels that there is no generic difference in the structure of these two woods except in the nature of intervessel pits. The intervessel pits are described as vestured in *Bridelioxylon cuddaloreense* and bordered in *Bischofioxylon miocenicum*. However, the photograph of the intervessel pits of *Bischofioxylon miocenicum* is so small and indistinct that nothing can be said about the nature of the pits in this wood (RAMANUJAM, 1960, Pl. 27; Fig. 61). So, the statement of MÄDEL (1962) that the wood of *Bischofioxylon miocenicum* should be placed under the form genus *Bridelioxylon* Ramanujam, stands true although on different grounds.

As the generic name *Bischofioxylon* has already been used by RAMANUJAM (1960) to include the fossil woods showing affinities to the living woods of *Bischofia* and because the type species *Bischofioxylon miocenicum* has been transferred to the form genus *Bridelioxylon* Ramanujam (1956), the generic name *Bischofioxylon* would be misleading and should not be used for the fossil woods of *Bischofia*. Hence, a new form genus *Bischofinium* is proposed

to include the fossil wood of *Bischofia* described here. The specific name *Bischofinium deccanii* indicates its occurrence in the Deccan area.

The genus *Bischofia* is a monotypic genus with a single species *Bischofia javanica* (WILLIS, 1966). It is a tall, straight, deciduous tree widely distributed in the Indo-Malayan region from the Western Peninsula eastwards through Burma and Siam to Cochin-China, the Philippines, Formosa and Polynesia, and southwards into Malaya (PEARSON & BROWN, 1932; DESCH, 1957). In India *Bischofia javanica* is distributed from Jammu eastwards through Oudh and Gorakhpur to Bengal and Assam; southwards to Bihar and Orissa, Tinnevely and Madura, and on the West coast from the Konkan to the Nilgiris in hills and plane forests, scarce in the Andaman Islands (PEARSON & BROWN, 1932).

GENERIC DIAGNOSIS

Wood diffuse-porous. *Growth rings* indistinct. *Vessels* solitary and in radial multiples, small to medium; tylosed; perforations simple; intervessel pit-pairs bordered, alternate, moderately large, oval, with linear to lenticular orifices. *Parenchyma* scanty paratracheal to vasicentric. *Xylem rays* moderately broad, heterogeneous, with sheath cells. *Fibres* thick walled, septate.

SPECIFIC DIAGNOSIS

Wood diffuse-porous. *Growth rings* indistinct. *Vessels* 100-200 μ in diameter, circular to oval in cross-section, solitary and in radial multiples of 2-4, evenly distributed, up to 25 per mm^2 ; tyloses present; vessel-members 270-360 μ in length with truncate ends perforations simple, oblique; inter-vessel pit-pairs bordered, alternate, 6-8 μ in diameter oval with linear to lenticular orifices. *Parenchyma* scanty paratracheal to uniseriate vasicentric. *Xylem rays* 1-6 (mostly 3-6) seriate, up to 60 cells high, heterogeneous with sheath cells, multiseriate *rays* sometimes with uniseriate extensions of upright cel's up to 6 cells high. *Fibres* thick walled, septate, 15-20 μ in diameter and about 400 μ in length; interfibre pits not observed.

Holotype—35152, Birbal Sahni Institute of Palaeobotany, Lucknow

Locality—Parapani in Mandla District of Madhya Pradesh

Age—Deccan Intertrappean (Early Eocene)

ACKNOWLEDGEMENTS

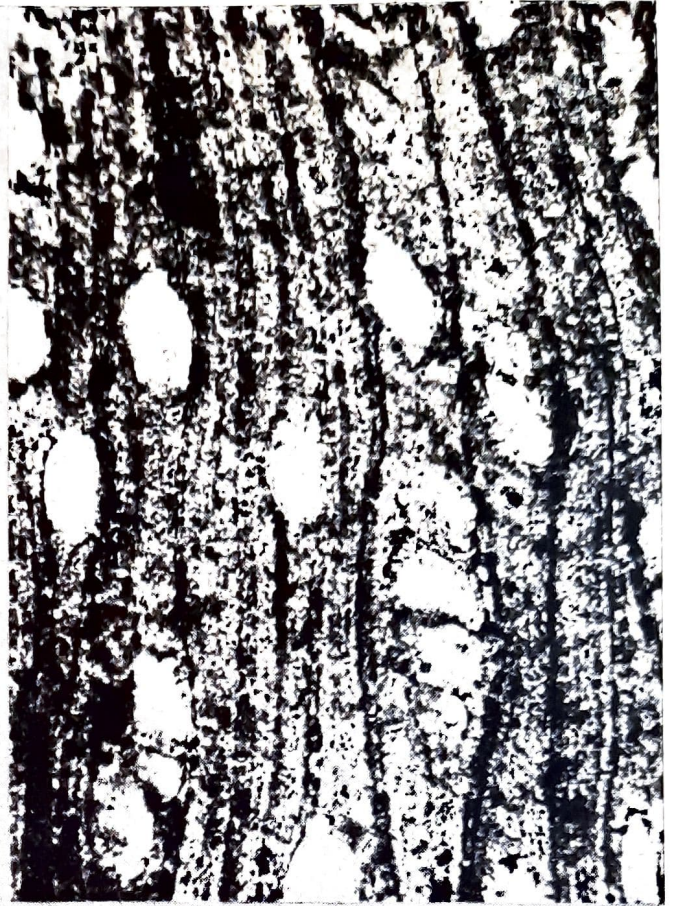
I am thankful to Dr. J. K. Verma, Professor and Head, Department of Botany, Government Science College, Jabalpur, for his guidance and encouragement during the course of this work. I am also thankful to Dr. R. N. Lakhanpal and Dr. U. Prakash for their valuable suggestions. The identification of these woods was carried out with the help of the slides of modern woods at the Wood Anatomy Branch of the Forest Research Institute, Dehra Dun. I take this opportunity to express my sincere thanks to the authorities of the Forest Research Institute, Dehra Dun, for the facility so kindly provided.

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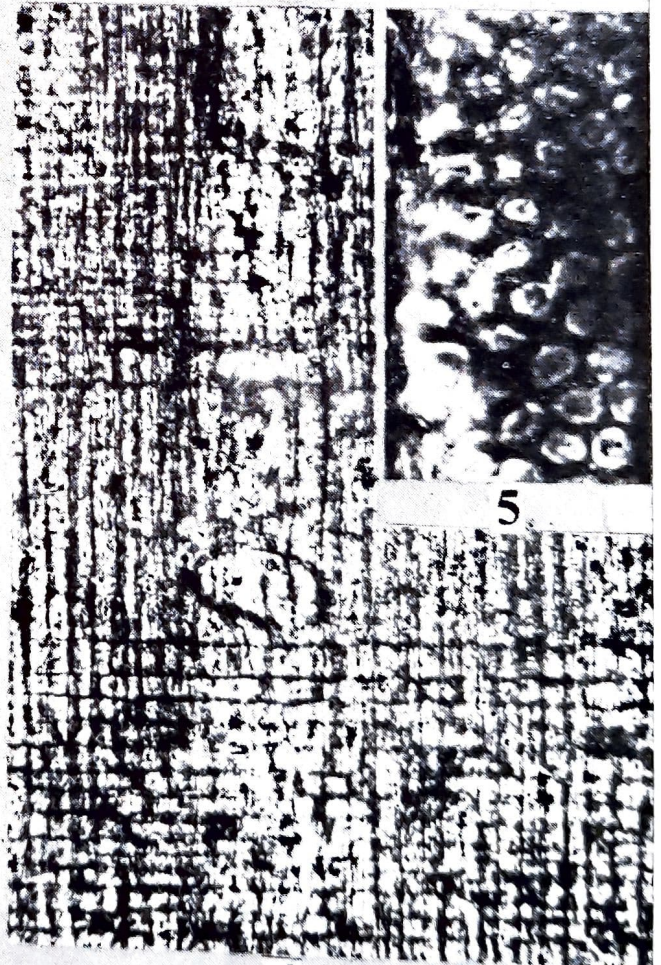
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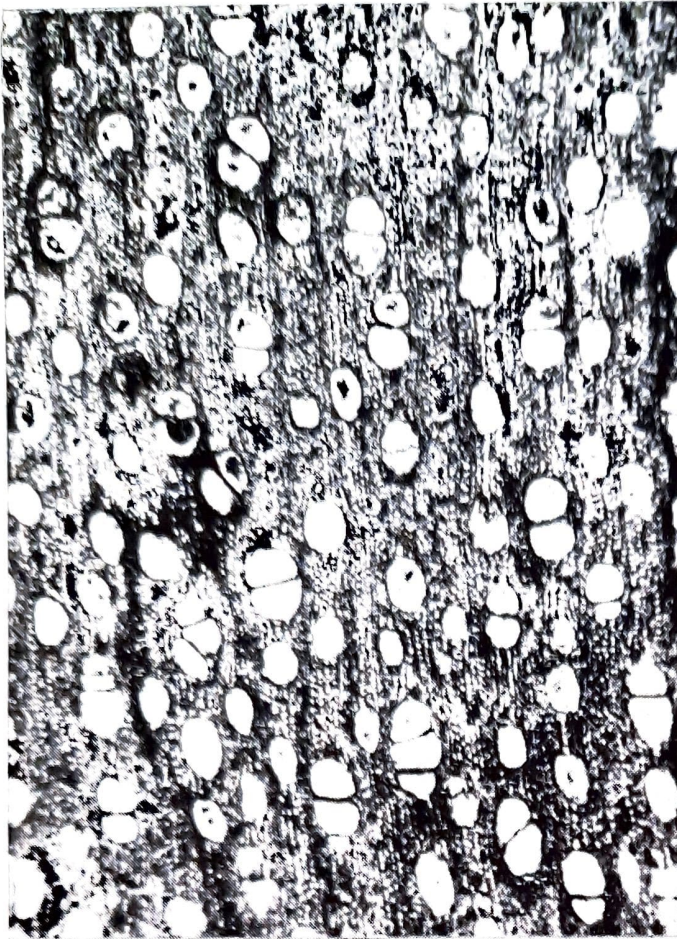


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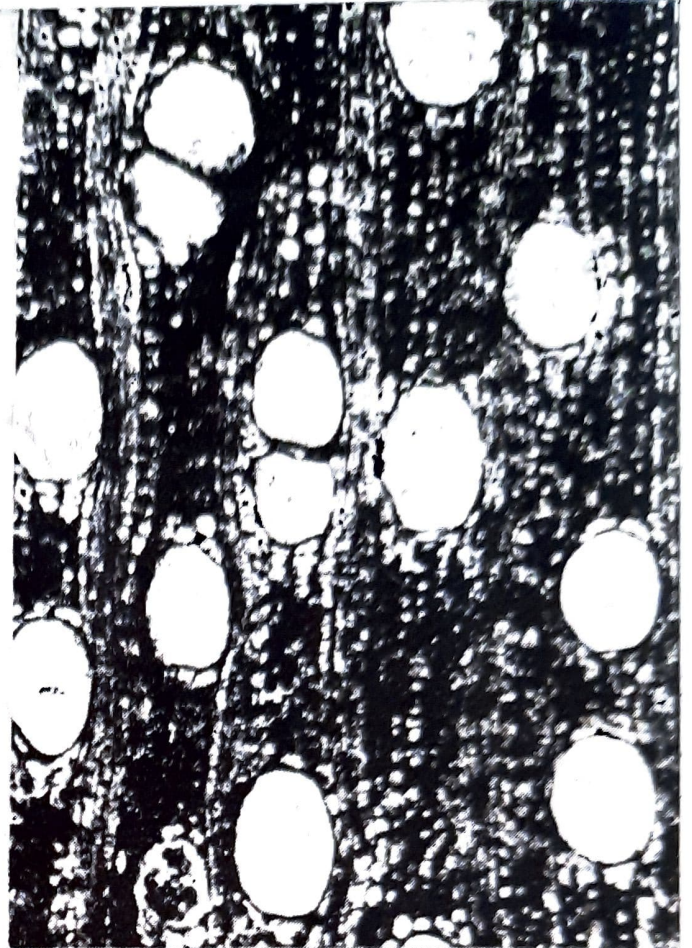


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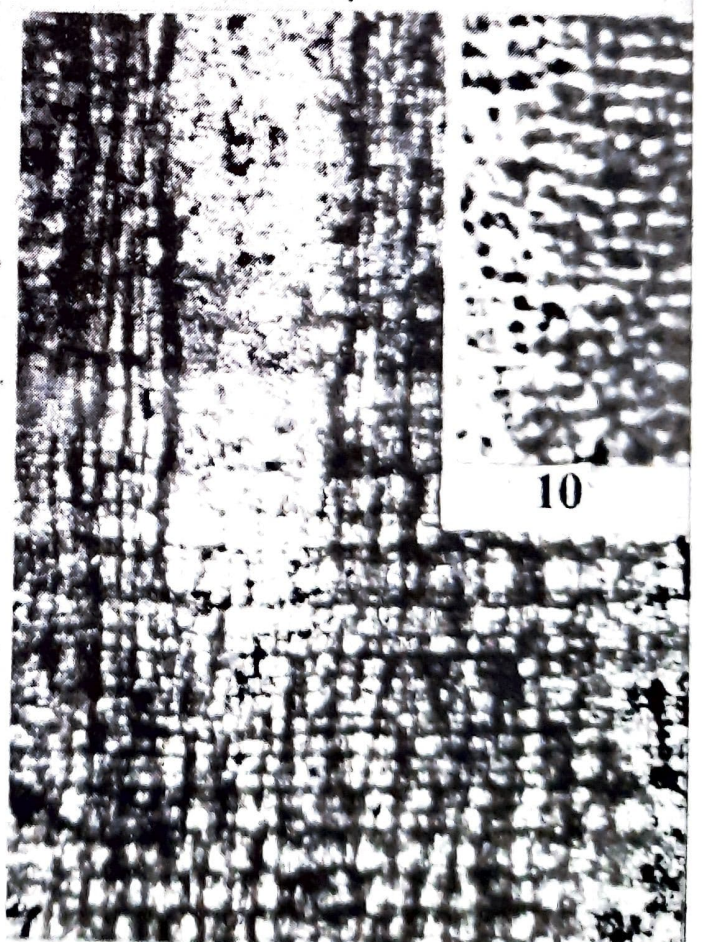
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EXPLANATION OF PLATES

PLATE 1

Homalioxylon mandlaense sp. nov.

1. Cross-section showing shape, size and distribution of vessels. $\times 30$, Slide no. 4630.
2. Cross-section enlarged to show uniseriate and multiseriate rays. $\times 90$. Slide no. 4630.
3. Tangential longitudinal section showing xylem rays and septate fibres. $\times 100$. Slide no. 4631.
4. Radial longitudinal section showing the structure of xylem rays and the perforation plates. $\times 130$. Slide no. 4632.
5. Intervessel pit-pairs. $\times 300$. Slide no. 4631.

PLATE 2

Bischofinium aeccanii gen. et sp. nov.

6. Cross-section showing the shape, size and distribution of vessels. $\times 30$. Slide no. 4633.
7. Cross-section enlarged to show the parenchyma. $\times 100$. Slide no. 4633.
8. Tangential longitudinal section showing heterogeneous xylem rays with sheath cells and septate fibres. $\times 70$. Slide no. 4634.
9. Radial longitudinal section showing heterogeneous xylem rays and perforation plates. $\times 140$. Slide no. 4635.
10. Intervessel pit-pair, $\times 400$. Slide no. 4634.