

A FOSSIL DICOTYLEDONOUS WOOD FROM THE PLIOCENE BEDS OF MOTHALA, DISTRICT KUTCH, WESTERN INDIA

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ABSTRACT

A fossil dicotyledonous wood showing closest similarity with the wood of modern *Pterospermum* Schreb. of the family Sterculiaceae, is described from the Pliocene beds of Mothala, District Kutch. It is named as *Pterospermoxylon kutchensis* gen. et sp. nov. Fossil woods showing affinities with those of *Pterospermum* have not been described so far.

Key-words — Dicot fossil wood, *Pterospermoxylon*, Pliocene, Kutch (India).

सारांश

मोथाला, कच्छ जनपद, पश्चिमी भारत के प्लायोसीन संस्तरों से एक द्विवीजपत्री काष्ठाश्म - नीलाम्बर अवस्थी, जसवन्तसिंह गुलेरिया एवं राजेन्द्र नाथ लखनपाल

मोथाला, कच्छ जनपद के प्लायोसीन संस्तरों से प्राप्त स्टरकुलिएसी कुल के आधुनिक टेरोस्पर्मम श्रेण से घनिष्ठ समानता प्रदर्शित करने वाले एक द्विवीजपत्री काष्ठाश्म का वर्णन किया गया है। इसे टेरोस्पर्मम कच्छेन्से न० प्रजाति व न० जाति से नामांकित किया है। टेरोस्पर्मम से सजातीयता प्रदर्शित करने वाले काष्ठाश्म अभी तक वर्णित नहीं किये गये हैं।

THE Tertiary System is very well-developed in Kutch. It attains a thickness of about 650 m (Biswas & Raju, 1973) and is represented by a complete sequence from Palaeocene to Pliocene. Most of these rocks have proved to be rich in palynofossils. However, megafossils are not so common. So far leaf-impressions have been found in the Palaeocene, Eocene and Miocene beds while woods are confined to the Pliocene.

Until 1968, only two fossil woods were known from the Tertiary of Kutch. Ghosh and Ghosh (1959) had described *Dipterocarpoxydon malavii* from the Pliocene of Mothala and Prakash and Dayal (1968) had reported a wood resembling *Terminalia tomentosa* Wight & Arn. from near Rutnal Railway Station.

With a view to work out in detail the megafloora of the Tertiary of Kutch, extensive survey of the area was made by us during 1970, 1971 and 1975-76 and a large number of woods and leaf-impressions were collected from the different horizons. From

a detailed study of the woods it has been found that most of them belong to dicotyledons except one palm and one podocarpaceous wood. The last one has already been described by Laxhanpal *et al.* (1975). Among the large number of dicot woods studied, one shows closest resemblance with the wood of *Pterospermum* of the family Sterculiaceae and is described here in detail.

The fossil was compared with the living woods at the xylarium of the Forest Research Institute, Dehra Dun, for which the authors are thankful to the authorities of F.R.I. for all the facilities received.

DESCRIPTION

FAMILY — STERCULIACEAE

Genus — *Pterospermoxylon* gen. nov.

Pterospermoxylon kutchensis sp. nov.

Pl. 1, figs 1-4; Pl. 2, figs 6, 8-10; Text-fig. 1A-C

Material — The present description is based on a fairly well preserved piece of

petrified wood, measuring 20 cm in length and 4 cm in diameter.

Topography — Wood diffuse-porous (Pl. 1, figs 1, 2). **Growth rings** present, irregular in contour, delimited by denser and darker late wood fibres (Pl. 1, fig. 1). **Vessels** small to medium, solitary or in radial multiples of 2-3, rarely 5-6 (Pl. 1, figs 1, 2), evenly distributed, 6-10 vessels per sq mm; tyloses present, mostly thick-walled, pitted, with characteristic flat walls across the lumina at right angle to the vessel walls forming chambers, vessels sometimes containing dark contents. **Parenchyma** para-

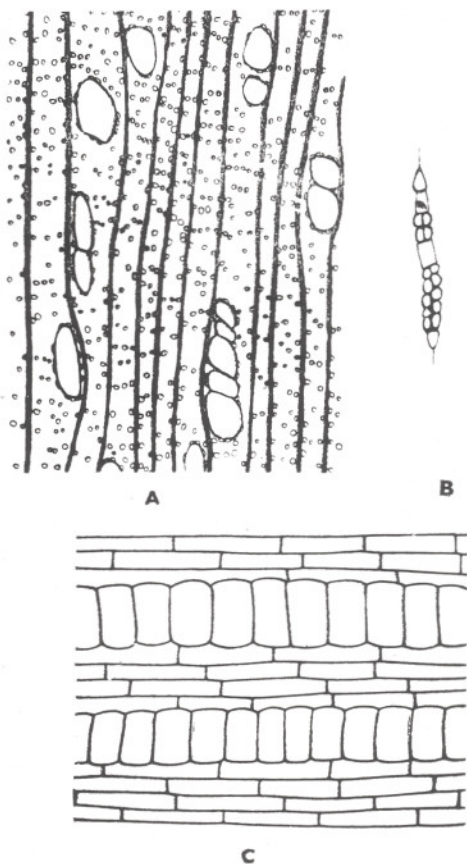
tracheal and apotracheal; paratracheal parenchyma scanty; apotracheal parenchyma diffuse or in uniseriate lines forming fine reticulum with the rays (Pl. 1, figs 2, 4; Text-fig. 1A). S rands sometimes showing tendency towards storied arrangements. **Rays** fine to medium in width, 1-5 (mostly 2) seriate (Pl. 2, figs 6, 8, 9), 12-70 μm wide, 8-70 cells or 140-1320 μm high, 10-12 per mm, closely placed; ray tissue heterogeneous; rays heterocellular, consisting of mostly procumbent cells and a few tile-cells of *Pterospermum* type (Pl. 2, figs 6, 8-10; Text-fig. 1B-C), sheath cells rarely seen, low rays showing tendency towards storied arrangements. **Fibres** aligned in radial rows between two consecutive rays.

Elements — **Vessels** oval to elliptical in cross-section, t.d. 56-132 μm (average 100 μm), r.d. 88-240 μm (average 180 μm), wall about 4 μm thick; vessel-members 300-450 μm in height (average 330 μm) with horizontal or slightly obliquely placed end walls; perforations simple; intervessel pits 4-6 μm in diameter, alternate, bordered, polygonal, with linear apertures. **Parenchyma cells** circular, oval to elliptical in cross section, 12-28 μm in diameter, 50-80 μm in height. Upright **ray cells** mostly rectangular in tangential section, thin-walled, 32-44 μm in vertical height and 20-24 μm in radial length; procumbent cells circular to oval in tangential section, thick-walled, 12-16 μm in vertical height, 40-100 μm in radial length. **Fibres** oval, angular to polygonal in cross section, 6-12 μm in diameter, thick-walled with narrow lumen, common walls about 4-8 μm thick, non-septate, interfibre pits not seen. **Ripple marks** seen at places.

AFFINITIES

The characteristic features of the present fossil are: wood diffuse-porous; vessels mostly solitary or in multiples of 2-3; paratracheal parenchyma scanty, apotracheal parenchyma diffuse, forming more or less irregular lines; rays mostly 2-seriate, rarely up to 5-seriate, heterogeneous with *Pterospermum* type of tile-cells.

Among the above mentioned characters of the fossil, the most important is the presence of *Pterospermum* type of tile-cells in the rays. Tile-cells have been reported only in some of the genera of Bombacaceae,



Pterospermoxylon kutchensis gen. et sp. nov.

TEXT-FIG. 1 — A. Cross section showing nature and distribution of vessels and parenchyma $\times 60$ (B.S.I.P. Museum slide no. 5885). B. Tangential longitudinal view of rays showing tile-cells and procumbent cells $\times 150$ (B.S.I.P. Museum slide no. 5886). C. Tile-cells and procumbent cells of a ray as seen in radial longitudinal section $\times 310$ (B.S.I.P. Museum slide no. 5887).

Malvaceae, Sterculiaceae and Tiliaceae (Chattaway, 1933; Metcalfe & Chalk, 1950). Chattaway (1933) has defined the tile-cells as "Special type of erect cells, without visible contents, occurring in radial series, much narrower radially than the procumbent cells of the ray, and interspersed among them". She has divided these cells into two distinct types, the *Durio* type and the *Pterospermum* type, although acknowledging that there are intermediate forms also between these two extreme types.

In the *Durio* type, the tile-cells are conspicuous in the transverse and radial sections, but not always distinguishable in the tangential section. Tangentially they are not wider than the procumbent cells but radially they are much narrower, about 10-14 corresponding to one procumbent cell. In the tangential section the tile-cells and the procumbent cells are not much different except that the procumbent cells are a little more noticeable because of their dark contents. In the radial section the narrower diameter of the cells is very clearly marked.

In the *Pterospermum* type the rays are composed of two kinds of cells recognizable in all sections, but in the transverse section the tile-cells are not conspicuous and might even pass for ordinary marginal ray cells. In the tangential section the rays are seen to consist of large angular cells devoid of any contents, interspersed with clusters of smaller cells with dark contents. The large cells are the tile-cells and the small cells are the procumbent cells of the ray. This is more clearly seen in the radial section, where the procumbent cells are usually about half as high vertically as the tile-cells and about four to six times as long. The absence of contents makes the tile-cells more distinct from the darker procumbent cells. Since this latter type of tile-cells are seen in the present fossil, all the genera with *Durio* type of tile-cells can be easily eliminated from comparison.

According to Metcalfe and Chalk (1950, pp. 231, 239, 251, 259) and Chattaway (1933, p. 264) the *Pterospermum* type of tile-cells are found in the genera listed below:

Bombacaceae — *Hampea*, *Montezuma* and *Ochroma*.

Malvaceae — *Abutilon* (in part), *Alyogyne*, *Erioxylum*, *Gossypium*, *Hibiscus* (in

part), *Lavatera*, *Malvaviscus*, *Pavonia*, *Shantzia*, *Sphaeralcea*, *Thespesia*, *Thurberia*, *Urena* and *Wercklea*.

Sterculiaceae — *Melochia* and *Pterospermum*.
Tiliaceae — *Belotia*, *Duboscia*, *Grewia*, *Mortoniadendron*, *Sparmannia*, *Trichospermum* and *Triumfetta*.

In *Abutilon*, *Lavatera*, *Melochia* and *Sphaeralcea*, the parenchyma is vasicentric, aliform and confluent. Further, in *Belotia*, *Hibiscus*, *Sparmannia*, *Thurberia* and *Urena* the paratracheal parenchyma is more prominent as compared to our fossil in which the parenchyma is mainly apotracheal, diffuse or in uniseriate lines forming fine reticulum. The uniseriate rays in *Erioxylum*, *Gossypium* and *Shantzia* are often composed of procumbent cells and are commonly 2-3 cells high as compared to much taller rays in the present fossil. In *Malvaviscus* and *Pavonia* the uniseriate rays are much more numerous and composed of upright cells as against the present fossil in which they are mainly composed of procumbent cells with tile-cells. Similarly, *Alyogyne*, *Montezuma* and *Ochroma* can be easily differentiated from the present fossil in having rays with well-marked sheath cells. *Grewia*, *Duboscia*, *Trichospermum* and *Triumfetta* differ in having broader and taller rays. The frequency of vessels per sq mm is less in *Hampea*, *Ochroma*, *Thespesia* and *Wercklea*. Further, the frequency of rays per mm is less in *Mortoniadendron* than in the fossil.

Thus it is evident that all the genera with *Pterospermum* type of tile-cells can be differentiated from the present fossil except *Pterospermum* itself.

As regards the species of *Pterospermum* it has been remarked by Rao (in Chowdhury & Ghosh, 1958, p. 207) that after studying nine species out of about a dozen occurring in the Indian region, he found their woods very similar and indistinguishable from one another. The present authors studied the thin sections of the woods of *Pterospermum acerifolium* Willd., *P. elongatum* Korth., *P. glabrescens* W. & A., *P. heyneanum* Wall., *P. jackianum* Wall., *P. javanicum* Jungh., *P. lancaefolium* Roxb., *P. reticulatum* W. & A., *P. rubiginosum* Heyne, *P. semisagittatum* Ham., *P. stapfianum* Ridley and *P. suberifolium* Lam. In addition, published data of *P. diversifolium* Bl. (Desch, 1954) and *P. greviaefolium* Pierre

(Lecompte, 1926) were also consulted. However, as remarked earlier by Rao, it was not possible to determine which of the above species showed closest resemblance with the fossil. It is only presumed on the basis of phytogeographical distribution that the three modern species of *Pterospermum*, i.e. *P. glabrescens*, *P. reticulatum* and *P. rubiginosum* occurring South of Kutch in the Western Ghats, would most probably be allied to the fossil species.

Since the characters of the fossil wood are in conformity with those of the extant genus *Pterospermum*, it has been designated as *Pterospermoxylon* gen. nov. It is specifically named as *Pterospermoxylon kutchensis* sp. nov., indicating its occurrence in the Kutch District.

The genus *Pterospermum* Schreb. consists of 40 species (Willis, 1973, p. 963). It is a tropical Asiatic genus and is widely distributed in south-east Asia, the Andamans, Java, Borneo and the Philippines. As mentioned earlier, about a dozen species occur in the Indian region (Chowdhury & Ghosh, 1958, pp. 206-207).

GENERIC DIAGNOSIS

Pterospermoxylon gen. nov.

Wood diffuse-porous. *Growth rings* present, delimited by denser and darker late-wood fibres. *Vessels* small to medium, solitary or in radial multiples of up to 6, usually up to 10 per sq mm; perforations simple; intervessel pits alternate, bordered; tyloses present, mostly thick-walled, pitted. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty; apotracheal parenchyma diffuse or forming fine reticulum with rays, strands sometimes storied. *Rays* fine to medium; ray tissue heterogeneous; rays heterocellular, consisting of procumbent and tile-cells of *Pterospermum* type, sheath cells rarely seen, irregularly storied. *Fibres* thick-walled, non-septate. *Ripple marks* seen at places.

Genotype — *Pterospermoxylon kutchensis* sp. nov.

SPECIFIC DIAGNOSIS

Pterospermoxylon kutchensis sp. nov.

Vessels small to medium, t.d. 56-132 μm (average 100 μm), r.d. 88-240 μm (average 180 μm), solitary as well as in radial multiples of 2-6 (mostly 2-3), 6-10 vessels per sq mm; vessel-members 300-450 μm (average 330 μm) in height; perforations simple; intervessel pits 4-6 μm in diameter; tyloses present, thick-walled, pitted, with characteristic flat walls across the lumina at right angle to the vessel walls forming chambers, sometimes containing dark contents. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma scanty, a few cells associated with the vessels; apotracheal parenchyma diffuse, or in uniseriate lines, forming fine reticulum with the rays, strands sometimes showing tendency towards storied arrangement. *Rays* fine to medium, 1-5 (mostly 2) seriate, 12-70 μm wide, 8-70 cells or 140-1320 μm high, 10-12 per mm, closely placed; ray tissue heterogeneous; rays heterocellular, consisting of mostly thick-walled oval procumbent cells and a few thin-walled rectangular tile-cells of *Pterospermum* type, sheath cells rarely seen, tile-cells or upright cells 32-44 μm in vertical height and 20-24 μm in radial length, procumbent cells 12-16 μm in vertical height and 40-100 μm in radial length, irregularly storied. *Fibres* aligned in radial rows, oval or angular to polygonal, 6-12 μm in diameter, thick-walled, common wall about 4-8 μm thick, non-septate, interfibre pits not seen. *Ripple marks* seen at places.

Holotype — Birbal Sahni Institute of Palaeobotany Museum no. 35316.

Locality — Mothala, about 66 km West of Bhuj, district Kutch, Gujarat.

Horizon — Kankawati Series.

Age — Pliocene.

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EXPLANATION OF PLATES

PLATE 1

Pterospermoxylon kutchensis gen. et sp. nov.

1. Cross section showing nature and distribution of vessels and growth rings. $\times 7$ (B.S.I.P. Museum slide no. 5885).
2. A portion of the cross section further magnified to show nature and distribution of vessels and parenchyma. $\times 30$ (B.S.I.P. Museum slide no. 5885).
3. Intervessel pits. $\times 500$ (B.S.I.P. Museum slide no. 5886).
4. Cross section further magnified showing distribution of parenchyma and vessels. $\times 90$ (B.S.I.P. Museum slide no. 5885).

Pterospermum reticulatum W. & A.

5. Magnified cross section showing parenchyma and vessels similar in distribution to those in the fossil as shown in fig. 4. $\times 90$.

PLATE 2

Pterospermoxylon kutchensis gen. et sp. nov.

6. Tangential longitudinal section showing rays with tile-cells. $\times 140$ (B.S.I.P. Museum slide no. 5886).

Pterospermum reticulatum W. & A.

7. Tangential longitudinal section showing rays with tile-cells similar to those as shown in fig. 6. $\times 140$.

Pterospermoxylon kutchensis gen. et sp. nov.

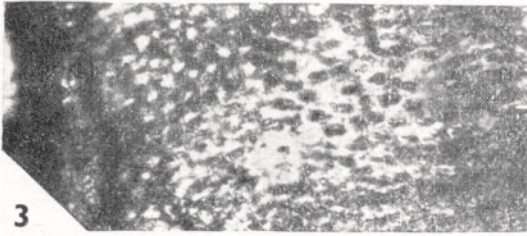
8. Tangential longitudinal section showing rays with storied tendency. $\times 70$ (B.S.I.P. Museum slide no. 5886).
9. A portion of the tangential longitudinal section showing uniseriate to multiseriate rays with tile-cells. $\times 165$ (B.S.I.P. Museum slide no. 5886).
10. Radial longitudinal section showing heterocellular rays with tile-cells. $\times 150$ (B.S.I.P. Museum slide no. 5887).



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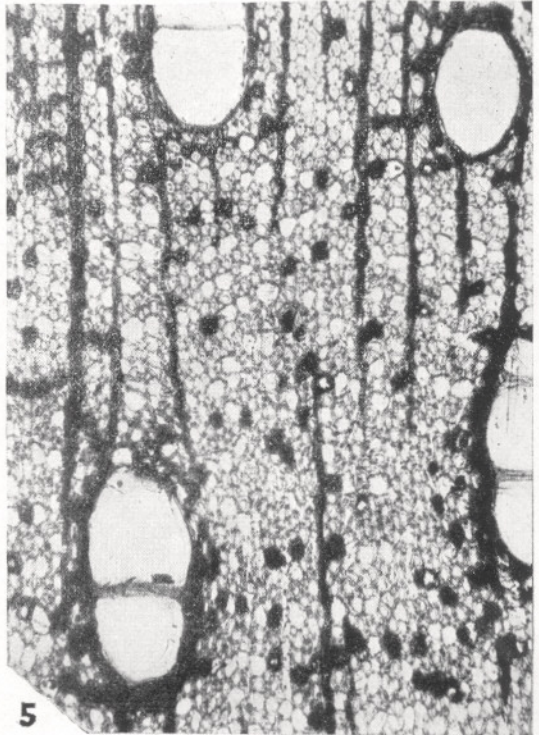
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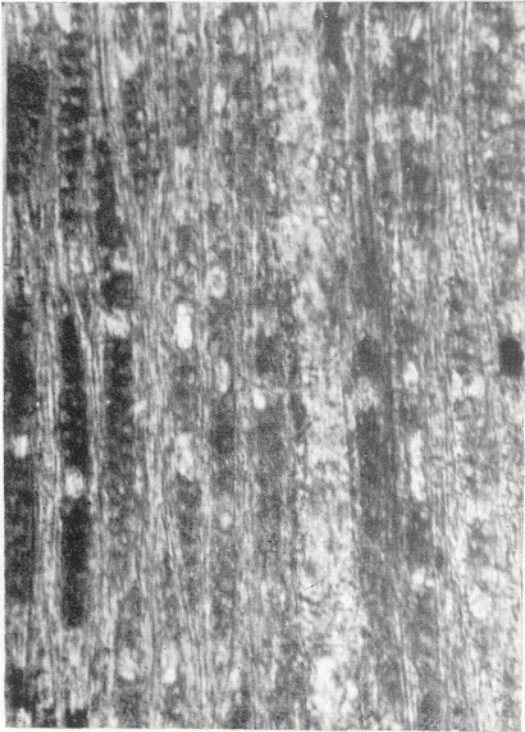
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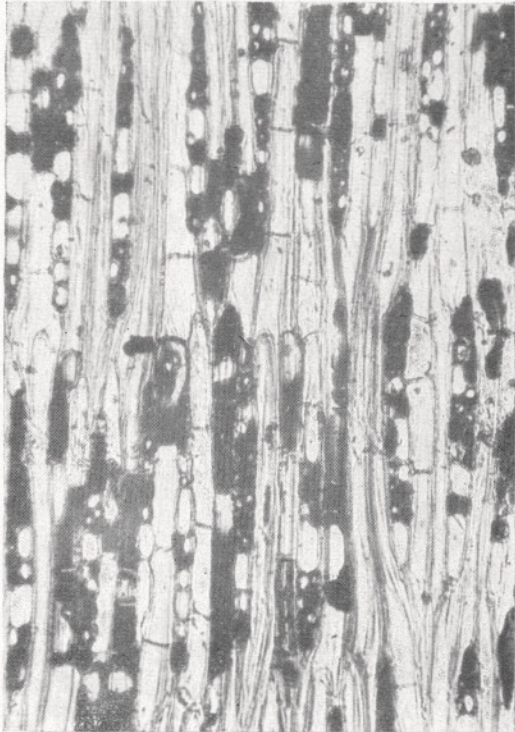
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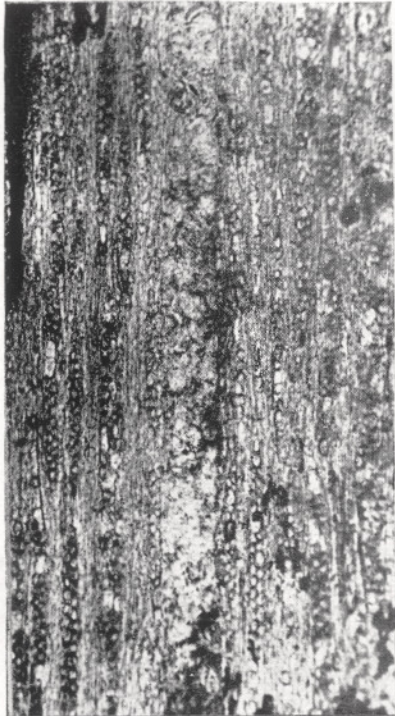
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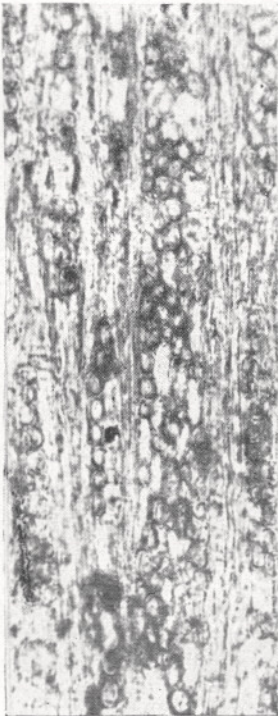
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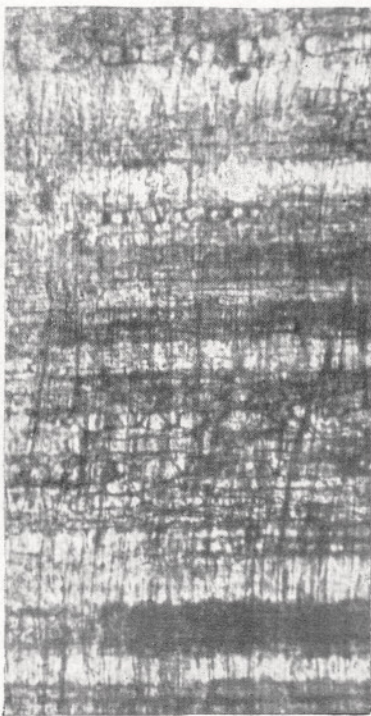
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