FOSSIL WOOD RESEMBLING *SEMECARPUS* FROM THE DECCAN INTERTRAPPEAN BEDS OF MAHURZARI NEAR NAGPUR

U. PRAKASH & R. DAYAL
Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

The present paper describes a new fossil dicotyledonous wood from the Deccan Intertrappean beds of Mahurzari (21° 13′ N; 79° 1′ E) in Maharashtra. It has been assigned to the genus *Anacardioxylon* Felix (1882) and described as *A. semecarpoides* sp. nov., because of its near resemblance with the wood structure of the extant genus *Semecarpus* Linn. of the Anacardiaceae.

INTRODUCTION

THE fossil wood dealt with in the present paper was collected by the authors from a small fossiliferous patch of the Intertrappean beds exposed adjacent to the village Mahurzari, in Nagpur district, Maharashtra. This locality is about 12·6 km. north-west from Nagpur proper and lies on Lat. 21° 13′ N; 79° 1′ E. It can be reached conveniently from Nagpur by bus. At the 7th milestone on the Nagpur-Kalmeshwar Road there is a cart track leading to the village Mahurzari. Recently rich collection of fossil dicotyledonous woods was made from this locality. These woods are being botanically identified but because of their Early Eocene age it is sometimes difficult to assign them to their proper systematic position. It has been seen from the study of the angiosperm remains that the plants from the Late Tertiary horizons can be identified with modern genera and species with considerable degree of confidence but coming to plants of the Middle and Early Tertiary horizons, the comparison with adjacent floras or with living species and genera becomes progressively less distinct, while the angiosperms of the Upper Cretaceous are often difficult or impossible to correlate with modern genera or even families.

So far only a few fossil dicot woods have been described from this locality (CHITALEY & SHALLOM, 1962; PRAKASH, 1958; PRAKASH & DAYAL, 1963 a, 1963 b, 1964 a, 1964 b; SHALLOM, 1958, 1959 a, 1959 b, 1960, 1963 a, 1963 b) and the present find is a further addition to our knowledge of the fossil flora of this locality. This fossil wood has been studied in detail and in order to interpret it correctly it has been compared with the slides and samples of large number of woody genera of the modern dicotyledons.

The terminology used in the description is in accordance with that proposed by the International Association of Wood Anatomists (1957) and the terms for length of vessel-members, wood fibres, vessel diameter and ray width are those standardized by the International Association of Wood Anatomists (1937, 1939).

DESCRIPTION

Family — Anacardiaeeae

Anacardioxylon semecarpoides sp. nov.

The species described here is based on a piece of petrified secondary wood measuring about 6 cm. in length and 5 cm. in diameter. The fossil specimen appears to be a fragment from near the pith as indicated by the converging xylem rays. The preservation of the fossil wood is fairly good.

Topography — Wood diffuse-porous (PL. 1, FIG. 1). *Growth rings* not observed. *Vessels* visible as minute dots to the naked eye against the ground mass of the wood, their orifices clearly seen with a hand lens, small to medium-sized, solitary and in radial multiples of 2-3, sometimes of more cells, occasionally in irregular pore multiples or clusters, usually 4-8 per sq. mm. (PL. 1, FIGS. 1 & 4), except at one place where the vessels are somewhat crowded (16 per sq. mm.); tyloses absent. *Parenchyma* conspicuous, appearing as darker tissue round the vessels in cross-section (PL. 1, FIG. 4), paratracheal, in 1-3 or more cells thick vasicentric sheath round the vessels, some-

times with short lateral extensions, easily recognizable in the longitudinal sections. *Xylem rays* indistinct to the naked eye, clearly seen under the microscope, fine to medium, 1-3 cells and 28-75 μ wide (PL. 1, FIGS. 3 & 6), 7-11 per mm.; ray tissue heterogeneous (PL. 1, FIG. 5); uniseriate rays 2-8 or more cells and 112-375 μ high, consisting of upright and procumbent cells (PL. 1, FIG. 6); multiseriate rays 2-3 (mostly 2) seriate and up to 75 μ wide, consisting of procumbent cells with marginal rows of 1-3 upright cells (PL. 1, FIGS. 3, 5 & 6). *Fibres* nicely preserved only at some places, aligned in radial rows between the two consecutive rays.

Elements — Vessels thinwalled, t.d. 45-165 μ, r.d. 45-150 μ, round to oval in cross-section, those in radial multiples slightly flattened at the places of contact; vessel-members of small to medium length, 210-450 μ long, truncate or slightly inclined (PL. 1 FIG. 3); perforations simple; intervessel pit-pairs large, 8-12 μ in diameter, alternate, bordered, with round and oval borders and lenticular, horizontal apertures (PL. 1, FIG. 2); vessel-ray and vessel-parenchyma pits not observed. *Parenchyma strands* 2-4 celled; parenchyma cells thinwalled, t.d. 24-32 μ, height 48-180 μ. *Ray cells* thinwalled, without infiltration; procumbent cells of various sizes, vertical height 30-45 μ, radial, length 60-150 μ; upright cells slightly enlarged, presumably containing crystals (PL. 1, FIG. 6), vertical height 75-105 μ, radial length 45-90 μ. *Fibres* non-septate (PL. 1, FIG. 6), thin to moderately thick-walled, polygonal in cross-section, t.d. 16-28 μ, r.d. 16-30 μ; interfibre pits not observed.

AFFINITIES AND DISCUSSION

The anatomical features exhibited by the present fossil wood suggest comparisons with the woods of Combretaceae, Sabiaceae, Lauraceae and Anacardiaceae. Of these, closest resemblance is to the secondary xylem of some genera of the Anacardiaceae in the following anatomical characters: (i) small to medium-sized vessels which are solitary and in radial multiples of 2-3 or more cells; (ii) large intervessel pit-pairs which are alternate, bordered, with round to oval border and lenticular, horizontal apertures; (iii) exclusively simple perforations; (iv) paratracheal parenchyma; (v) 1-3 (mostly 1-2) seriate, xylem rays with heterogeneous ray tissue and (vi) non-septate fibres.

The wood of *Terminalia* (METCALFE & CHALK, 1950, pp. 617-619; PEARSON & BROWN, 1932, pp. 497-537) shows some superficial resemblance with the Intertrappean wood particularly in the vessel size and their distribution and in the parenchyma pattern. But in *Terminalia* the intervessel pit-pairs are vestured (BAILEY, 1933) and the fibres are septate.

In the family Lauraceae, the present fossil wood also shows somewhat near resemblance in cross-section with the wood structure of *Machilus* Nees (METCALFE & CHALK, 1950, pp. 1149-1152; PEARSON & BROWN, 1932, pp. 836-847). However, in *Machilus* the perforations are simple as well as scalariform and there are special oil-bearing secretory cells resulting from the enlargement of the marginal upright cells.

The wood structure of *Meliosma* of Sabiaceae, while resembling the present fossil wood in some features, differs from it in having both simple and scalariform perforations and in the xylem rays which are much broader, 4-15 cells wide and usually more than 2 mm. high.

In the family Anacardiaceae (HEIMSCH, 1942, pp. 136-144; METCALFE & CHALK, 1950, pp. 455-461; MOLL & JANSSONIUS, 1908, pp. 438-512; PEARSON & BROWN, 1932, pp. 309-347; RECORD, 1939) woods of the tribes Mangiferae, Spondiae, Rhoideae, Semecarpeae and Dobineae have been described separately by Heimsch (*loc. cit.*). He has concluded from his detailed study that " from the xylem descriptions of the tribes of the Anacardiaceae it is evident that there are no characters or combination of characters of the xylem which serve to differentiate one group from the others. It is true that there appear to be trends in each of tribes, but these do not hold absolutely." However, large number of genera are characterized by the presence of radial intercellular canals (RECORD, 1925). After eliminating such genera, the present fossil wood shows near resemblance with the woods of the genus *Semecarpus* Linn.

Semecarpus is a large genus showing a variety of structure especially in the parenchyma distribution. In order to find out the modern species of this genus to which the fossil wood shows nearest resemblance, thin sections of the available species, viz., *Semecarpus auriculata* Bedd., *S. anacardium*

Linn. f., *S. pandurata* Kurz and *Semecarpus* sp. (from Sumatra) were cut and studied. Besides, descriptions and figures of *S. laxifolia* K. Schum. (HEIMSCH, 1942, pp. 141-142, PL. 10, FIG. 64), *S. vernicifera* Hay. et Kawakani (KANEHIRA, 1921, pp. 87-88, PL. 18, FIG. 104), *S. heterophylla* Blume and *S. albescens* Kurz (MOLL & JANSSONIUS, 1908, pp. 506-512, FIG. 143), *S. philippinensis* Engler (REYES, 1938, pp. 211-212, PL. 36, FIG. 1) and *S. cuneiformis* Blanco (SCHNEIDER, 1916, p. 146) were also consulted. A detailed examination of all these species shows that the present fossil wood resembles the wood structure of *Semecarpus anacardium* (BSIPW 516) and an undetermined species of *Semecarpus* from Sumatra (BSIPW 515), though not identical with any one of them.

Except for the difference in the size, the shape and the distribution of the vessels is similar in the present fossil wood and in the wood of *Semecarpus* sp. from Sumatra. In both, the perforations are simple and the intervessel pit-pairs are large, alternate, bordered, with lenticular and horizontal apertures and circular to oval borders. The difference in size of the v ssels both in the fossil and the modern wood of *Semecarpus* is quite marked. In the fossil wood the vessels are small to medium-sized (t.d. 45-165 μ) while in the modern wood of *Semecarpus* from Sumatra, they are large to medium-sized (t.d. 135-270 μ). The vessels are even larger in size in the woods of other species available to us.

In the distributional pattern of the parenchyma, the present fossil resembles the species of *Semecarpus* from Sumatra. In both the parenchyma is vasicentric to aliform without being confluent or banded.

The composition and distribution of the xylem rays and the nature of the fibres is very much similar in the Intertrappean fossil and the modern wood of *Semecarpus anacardium*. However, the marginal ray cells in the modern wood are crystalliferous, whereas the crystals have not been seen in the fossil wood.

From the above discussion it is evident that the present fossil wood belongs to the family Anacardiaceae with a near approach to the modern genus *Semecarpus*. It has, therefore, been assigned to the genus *Anacardioxylon* Felix (1882) and described as *Anacardioxylon semecarpoides* sp. nov.

A number of fossil woods belonging to the family Anacardiaceae are known from many parts of the World. These are *Rhoidium ungeri* Mercklin (1855, in EDWARDS, 1931, p. 70) from the ? Cretaceous of Russia; *Rhoidium juglandinum* Unger (1850) from the Tertiary of Hungary; *Rhoidium philippinense* Crié (1889) from the Tertiary of Philippines; *Anacardioxylon spondiaeforme* Felix (1882) from the Tertiary of Antiqua; *Anacardioxylon uniradiatum* Felix (1894) from the Eocene of Caucasus; *Anacardioxylon magniporosum* Platen (1908) from the Tertiary of California; *Anacardioxylon molli*[1] Kräusel (1922) from the Miocene of Sumatra; *Anacardioxylon caracoli* Schönfeld (1947) from the Tertiary of Colombia; *Anacardioxylon mangiferoides* Ramanujam (1960) from the Tertiary of South India; *Glutoxylon burmense* (HOLDEN) Chowdhury (1934, 1936, 1952; CHOWDHURY & TANDAN, 1952; GHOSH & TANEJA, 1961) from the Tertiary of Assam, Burma and West Bengal; *Glutoxylon bengalensis* Mukherjee (1941, 1942) from the Tertiary of Bengal; *Glutoxylon chowdhurii* Ghosh (1958) from the Tertiary of Manipur; *Schinoxylon actinoporosum* Kruse (1954) and *Edenoxylon parviareolatum* Kruse (1954) from the Eocene of Eden Valley, Wyoming, U.S.A.

Of all the above fossil woods only *Anacardioxylon caracoli* and *Anacardioxylon mangiferoides* can be compared with the present fossil wood. However, *Anacardioxylon caracoli* Schönfeld (1947) differs from the present fossil in having very large vessels (mostly 200-300 μ in tangential diameter and 300 μ radial diameter) which are 1-2 per sq. mm., and the ray cells are crystalliferous. Similarly *Anacardioxylon mangiferoides* Ramanujam (1960) also differs from this Intertrappean fossil wood in having 2-3 seriate initial parenchyma and in the xylem rays which are mostly uniseriate.

The genus *Semecarpus*, which is nearest in wood structure to the present fossil wood, consists of about 40 species (WILLIS, 1957, p. 603) of trees with a blistering acrid juice, distributed in the Indo-Malayan region and extending to Australia. About 13 species are endemic in Ceylon. In the Indian region about 8 species are reported to occur. Of these 5 species are found in India proper, while the rest occur in Burma and East Pakistan. *Semecarpus anacardium*, a moderate-sized, deciduous tree, is found scattered

1. Berger (1923) compared it with the Burseraceae and gave it a non-committal name, *Sumatroxylon mollii* (Kräusel) Berger. However, even now the affinities of this fossil wood are uncertain.

in the sub-Himalayan tract, in Bengal, Assam, Chittagong, Chota Nagpur, and throughout the greater part of the Indian Peninsula (TROUP, 1921, p. 236). *S. travancorica* and *S. auriculata* are distributed in moist forests of Travancore, and *S. kurzii* is found in the Andamans.

SPECIFIC DIAGNOSIS

Anacardioxylon semecarpoides sp. nov.

Wood diffuse-porous. *Growth rings* not observed. *Vessels* small to medium-sized, t.d. 45-165 μ, r.d. 45-150 μ, solitary and in radial multiples of 2-3, sometimes of more cells; vessel-members of small to medium in length, 210-450 μ long; perforations simple; intervessel pit-pairs large, 8-12 μ in diameter, bordered, alternate, round to oval with lenticular, horizontal apertures. *Parenchyma* paratracheal in 1-3 cells or more broad sheath round the vessels, sometimes with short lateral extensions; parenchyma strands 2-4 celled. *Xylem rays* 1-3 cells and 28-75 μ wide, 7-11 per mm., heterogeneous consisting of procumbent cells, with 1-3 marginal rows of upright cells. *Fibres* thin to moderately thickwalled, non-septate.

Holotype — B.S.I.P. Museum No. 32807.

Locality — Mahurzari, district Nagpur, Maharashtra.

Horizon — Deccan Intertrappean series.

Age — Early Tertiary (Probably Eocene).

REFERENCES

BAILEY, I. W. (1933). The cambium and its derivative tissues: VIII. Structure, distribution and diagnostic significance of vestured pits in dicotyledons. *J. Arnold Arbor.* **14**: 259-273.

BERGER, L. G. DEN (1923). Fossiele Houtsoorten uit het Tertiair van Zuid-Sumatra. *Verh. Geol. Mijnb. Gen. Nederland en Kol.* **7**: 143-148.

CHITALEY, S. D. & SHALLOM, L. J. (1962). A fossil wood of Rutaceae from the Deccan Intertrappean beds of India. *Proc. Raj. Acad. Sci.* **9** (2): 31-35.

CHOWDHURY, K. A. (1934). A fossil dicotyledonous wood from Assam. *Curr. Sci.* **3** (6): 255-256.

Idem (1936). A fossil dicotyledonous wood from Assam. *Ann. Bot. Lond.* **50** (199): 501-510.

Idem (1952). Some more fossil woods of *Glutoxylon* from South-East Asia. *Ann. Bot.* N.S. **16** (63): 373-378.

CHOWDHURY, K. A. & TANDAN, K. N. (1952). A new record for the fossil wood *Glutoxylon* from the Southern part of West Bengal. *Curr. Sci.* **21** (6): 161.

CRIÉ, L. (1889) Beiträge zur kenntnis der fossilen Flora einiger Inseln des Südpacifischen und Indischen Oceans. *Pal. Abh.* **2**: 77-90.

EDWARDS, W. N. (1931). Fossilium Catalogus II: Plantae Dicotyledones (Ligna). **17**: 3-96. *Berlin.*

FELIX, J. (1882). Studien über fossile hölzer. *Diss. Leipzig*: 1-81.

Idem (1894). Untersuchungen über fossile hölzer. IV. *Z. dtsch. geol. Ges.* **46**: 79-110.

GHOSH, S. S. (1958). A new record for the fossil wood *Glutoxylon* from Manipur. *Sci. & Cult.* **23**: 431-433.

GHOSH, S. S. & TANEJA, K. K. (1961). Further record of *Glutoxylon* from the Miocene (?) of Tripura. *Ibid.* **27**: 581-582.

HEIMSCH, C. Jr. (1942). Comparative anatomy of the secondary xylem in the " Gruinales " and " Terebinthales " of Wettstein with reference to taxonomic grouping. *Lilloa* **8**: 83-198.

Int. Assoc. Wood Anat. (1937). Standard terms of vessel-members and wood-fibres. *Trop. Woods* **51**: 21.

Idem (1939). Standard terms of size for vessel diameter and ray width. *Ibid.* **59**: 51-52.

Idem (1957). International Glossary of Terms used in Wood Anatomy. *Ibid.* **107**: 1-36.

KANEHIRA, R. (1921). Anatomical characters and identification of Formosan woods. *Taihoku.*

KRÄUSEL, R. (1922). Fossile hölzer aus dem Tertiar von Süd-Sumatra. *Verh. Geol. Mijnb. Gen. Nederland en Kol.* **5**: 231-287.

KRUSE, H. O. (1954). Some Eocene dicotyledonous woods from Eden Valley, Wyoming. *Ohio J. Sci.* **54** (4): 243-268.

METCALFE, C. R. & CHALK, L. (1950). Anatomy of the Dicotyledons. **1** & **2**. *Oxford.*

MOLL, J. W. & JANSSONIUS, H. H. (1908). Mikrographie des holzes der auf Java vorkommenden Baumarten. **2**: 1-540. *Leiden.*

MUKHERJEE, A. (1941). Identification of fossil wood from the Lalmai Range in Comilla, Bengal. *Sci. & Cult.* **7**: 572-574.

Idem (1942). A fossil dicotyledonous wood from Mainamati hills in Tipperah district, Bengal. *Quart. J. geol. Soc. India* **14** (2): 75-82.

PEARSON, R. S. & BROWN, H. P. (1932). Commercial timbers of India **1** & **2**. *Calcutta.*

PLATEN, P. (1908). Untersuchungen fossiler hölzer aus dem westen der vereinigten Staaten von Nord-amerika. *Leipzig.*

PRAKASH, U. (1958). Studies in the Deccan Intertrappean Flora-4. Two silicified dicotyledonous woods from Madhya Pradesh. *Palaeobotanist* **7** (1): 12-20.

PRAKASH, U. & DAYAL, R. (1963a). Fossil wood resembling *Grewia* from the Deccan Intertrappean beds of Mahurzari near Nagpur, India. *Curr. Sci.* **32** (7): 315-316.

Idem (1963b). Fossil woods resembling *Elaeocarpus* and *Leea* from the Deccan Intertrappean beds of Mahurzari near Nagpur. *Palaeobotanist* **12** (2): 121-127.

Idem (1964a). Fossil woods of *Grewia* from the Deccan Intertrappean Series, India. *Ibid.* **13** (1): 17-24.

Idem (1964b). *Barringtonioxylon eopterocarpum* sp. nov., a fossil wood of Lecythidaceae from the Deccan Intertrappean beds of Mahurzari. *Ibid.* **13** (1): 25-29.

RAMANUJAM, C. G. K. (1960). Silicified woods from the Tertiary rocks of South India. *Palaeontographica* **106B**: 99-140.

RECORD, S. J. (1925). Occurrence of Intercellular canals in dicotyledonous woods. *Trop. woods* **4**: 17-20.

Idem (1939). American woods of the family Anacardiaceae. *Ibid.* **60**: 11-45.

REYES, L. J. (1938). Philippine woods. *Tech. Bull. Dep. Agric. Phil. Is.* **7**.

SCHNEIDER, E. E. (1916). Commercial woods of the Philippines: their preparation and uses. *Manila.*

SCHÖNFELD, G. (1947). Hölzer aus dem Tertiär von Kolumbien. *Abh. senckenb. naturf. Ges.* **475**: 1-48.

SHALLOM, L. J. (1958). A fossil dicotyledonous wood from the Deccan Intertrappean beds of Mahurzari. *J. Indian bot. Soc.* **37** (2): 492-498.

Idem (1959a). *Simarubaceoxylon mahurzari* gen. et sp. nov.—a new fossil wood from the Deccan Intertrappean beds of Mahurzari. *Curr. Sci* **28** (4): 168-169.

Idem (1959b). *Ailanthoxylon mahurzarii* sp. nov., new fossil dicotyledonous wood from the Deccan Intertrappean beds of Mahurzari. *Palaeobotanist* **8** (1 & 2): 65-68.

Idem (1960). Fossil dicotyledonous wood of Lecythidaceae from the Deccan Intertrappean beds of Mahurzari. *J. Indian bot. Soc.* **39** (2): 198-203.

Idem (1963a). Fossil dicotyledonous wood of the family Guttiferae from the Deccan Intertrappean beds of Mahurzari. *Proc. 50th Indian Sci. Congr.*: 397-398.

Idem (1963b). A fossil dicotyledonous wood with tile cells, from the Deccan Intertrappean beds of Mahurzari. *J. Indian bot. Soc.* **42** (2): 170-176.

TROUP, R. S. (1921). The silviculture of Indian trees. **1**. *Oxford.*

UNGER, F. (1850). Genera et Species Plantarum Fossilium *Vindobonae.*

WILLIS, J. C. (1957). A dictionary of the flowering plants and ferns. *Cambridge.*

EXPLANATION OF PLATE 1

1. Cross-section at low magnification to show the distribution of the vessels. × 28.

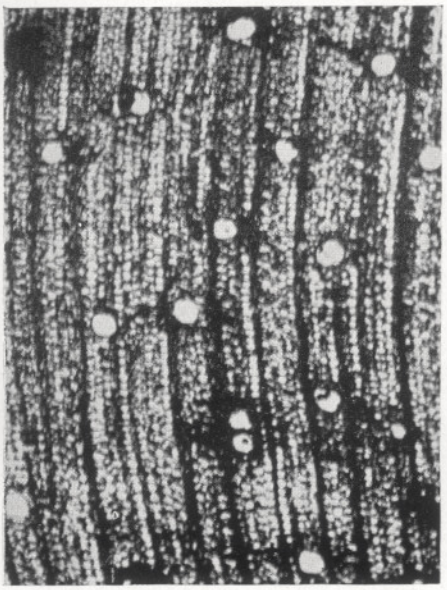
2. Intervessel pit-pairs. × 400.

3. Tangential longitudinal section showing the vessel-members, and the distribution of the xylem rays. × 50.

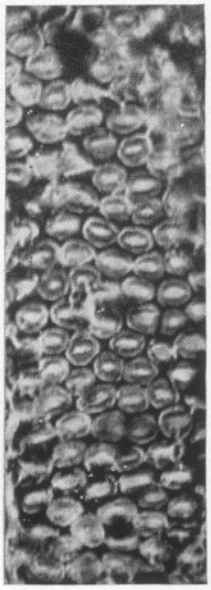
4. Cross-section showing the shape and size of the vessels, arrangement of the fibres and the distribution of the parenchyma. × 50.

5. Radial longitudinal section showing the heterogeneous ray tissue. × 80.

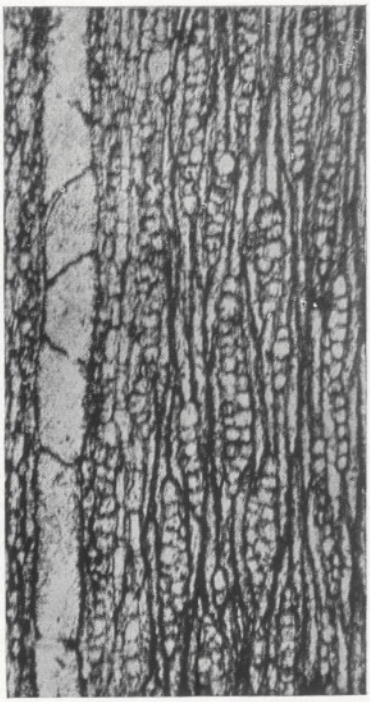
6. Tangential longitudinal section magnified to show non-septate fibres and the xylem rays with enlarged upright cells presumably containing crystals. × 100.



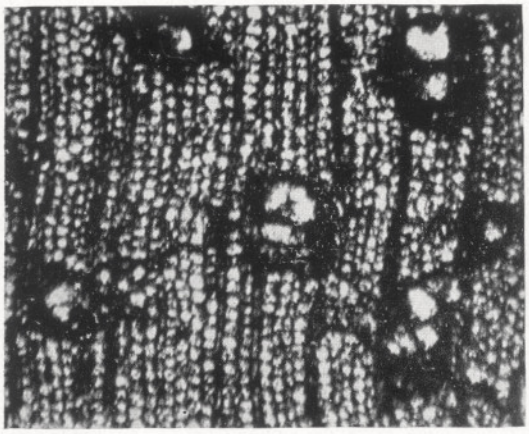
1



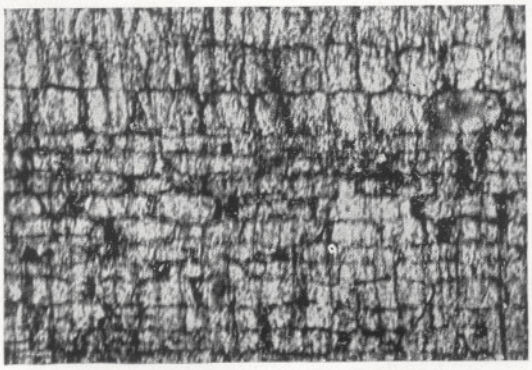
2



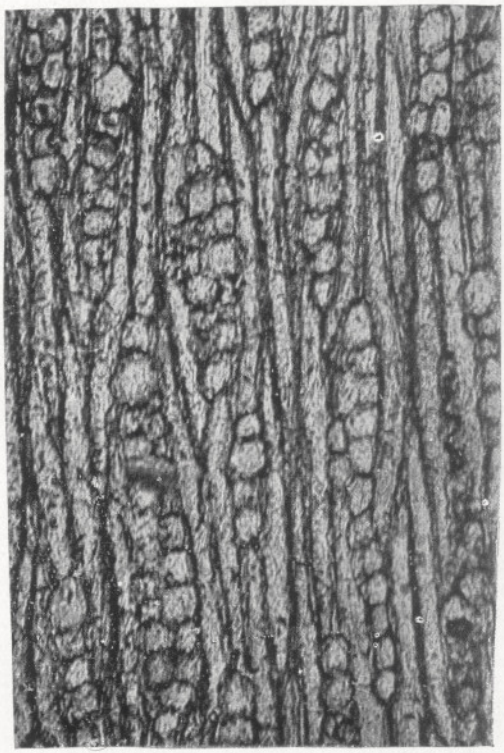
3



4



5



6