FURTHER OBSERVATIONS ON *SIMAROUBOXYLON INDICUM* SHALLOM

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INTRODUCTION

RECENTLY Shallom (1960) described a fossil wood *Simarouboxylon indicum* from Mohgaon Kalan in the Deccan Intertrappean series of Madhya Pradesh. The specimen on which her description is based represents only the secondary xylem. The present writer possesses a similar wood probably from a branch of a tree showing pith, primary and secondary wood and bark. A reference to this wood was made by him in a paper entitled " A Survey of the Deccan Intertrappean flora of India " (PRAKASH, 1960). It would be evident from this reference that a paper on this fossil wood was in press and that it was named as *Simarouboxylon deccani* (PRAKASH, 1960, p. 1034). Because *Simarouboxylon indicum* and *S. deccani* are identical in wood structure, the species *S. deccani* is a synonym of *S. indicum* which is published earlier.

The present specimen, also showing pith, primary wood and the bark, provides some additional data not known from the previous description. This coupled with some more information from the secondary wood of the fossil as well as from the modern woods of *Simarouba* necessitated the present author to record some more facts about them. Mostly those details which are at variance from the previous description or were not seen by Shallom (1960) are being recorded here.

DESCRIPTION

The fossil wood is 5-6 cm. in diameter and 8 cm. in length. It consists of pith, primary and secondary xylem and bark and appears to belong to a branch of a tree.

The fossil shows the structure of a diffuse-porous wood.

Pith — is present, but the cells are not preserved.

Primary Xylem — is present although it is difficult to count the number of xylem groups in the specimen as the tissues are badly mixed up in this region. However, the metaxylem elements are recognised by the presence of scalariform pitting (PL. 1, FIG. 4).

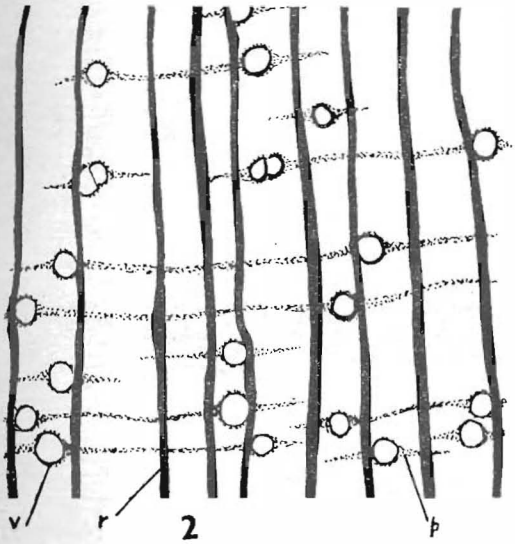
Growth Rings — Indistinct.

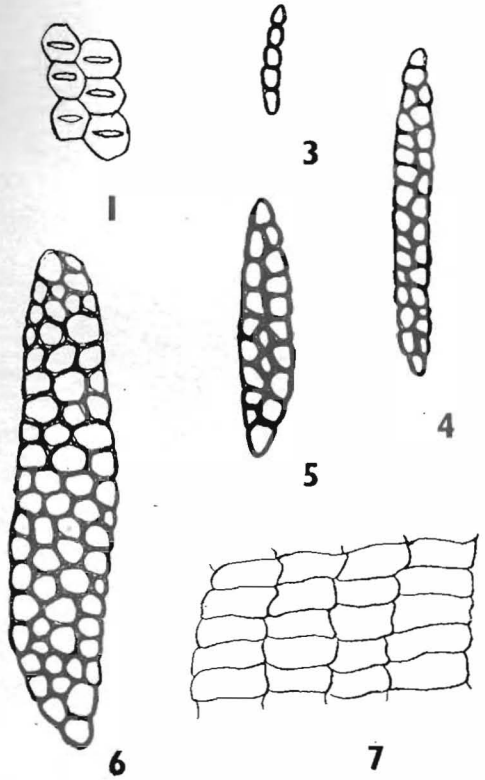
Secondary Wood Vessels — are usually medium-sized, sometimes small, moderately numerous and more or less evenly distributed, 5-11 per sq. mm. (PL. 1, FIG. 1). They are mostly solitary, and sometimes in pairs (5%) (PL. 1, FIG. 1). Very rarely the vessels are in groups of three or more cells. They are circular to oval in cross-section, 43-168 μ in radial and 43-190 μ in tangential diameter. The vessels are mostly empty but sometimes filled with tyloses and gummy deposits (PL. 1, FIGS. 1, 6). The perforations are simple and perforation plates are horizontal to slightly oblique. The intervascular pit-pairs (PL. 1, FIG. 5; TEXT-FIG. 1) are bordered, usually alternate, 6-8 μ in diameter and polygonal through crowding. The apertures appear to be linear and occasionally extended. Vessel-parenchyma pits are also bordered and many per cell. Vessel-ray pits are not conspicuous.

Parenchyma — is aliform to confluent (PL. 1, FIG. 1; TEXT-FIG. 2) and occurs in narrow, tangential bands. The lateral extensions of the aliform parenchyma usually connect with the parenchyma from other vessels thus becoming confluent (TEXT-FIG. 2) at a number of places. The parenchyma bands, thus formed are more or less irregular, only 1-3 cells thick (usually 1-2 cells), 20-52 μ wide (PL. 1, FIGS. 1, 8; TEXT-FIG. 2) and usually run for a short distance. When the parenchyma encircles the vessels, the parenchyma sheath is in 1-2 layers of cells. The parenchyma cells are thin-walled about 18-28 μ in diameter. At some places they show a tendency towards storied arrangement.

Xylem Rays — are 1-4 seriate (mostly triseriate), homogeneous and slightly widely spaced, up to 8-10 rays per mm. (PL. 1, FIGS. 2, 7; TEXT-FIGS. 3-6). The uniseriate rays are few, while the biseriate rays are quite

frequent. The ray cells are oval to angular in tangential section. The rays also show variation in their height. A few rays are only 2 cells high, while others are up to 80 cells high.





TEXT-FIGS. 1-7

Wood Fibres — are thin-walled, non-libriform, non-septate and oval to slightly angular in cross-section (PL. 1, FIGS. 2, 7, 8). They show a tendency towards storied arrangement. The lumen of the fibres is fairly large. They are 720-1600 μ long, and 16-32 μ in diameter. The inter-fibre pits could not be detected in any of the sections.

Bark is about 1-1·5 mm. thick and shows secondary phloem towards the inside and cork on the outside (PL. 1, FIG. 3), the other tissues being badly preserved.

In the phloem region only patches of thick-walled cells, probably of bast fibres, could be recognised (PL. 1, FIG. 3), while the other elements could not be detected due to bad preservation.

In the periderm, only the *cork* is well preserved and could be easily seen. It is 200-300 μ thick and consists of tiers of thin-walled cells (TEXT-FIG. 7).

Traumatic canals are not seen in the present specimen.

DISCUSSION

Only a few fossil woods of the family Simaroubaceae are thus far known. They are *Suriana inordinata* Kruse (1954) from the Eocene of Eden Valley, Wyoming. *Simarubinium crystallophorum* Platen (1908) and *S. engelhardti* Platen (1908) from the Tertiary of Nevada County, California, *Ailanthoxylon indicum Prakash* (1959) and *A. mahurzarii* Shallom (1961) from the Deccan Intertrappean beds and *A. scantiporosum* Ramanujam (1960) from the Cuddalore series, South India. The present fossil wood differs quite distinctly from all these species.

←—

Simarouboxylon indicum Shallom

(semi-diagrammatic camera lucida drawings)

TEXT-FIGS. 1-7 — 1. Magnified intervessel pit-pairs. × 680.

2 — Cross-section showing the distribution of parenchyma (p). *v* — vessel, *r* — ray. × 24.

3 — Uniseriate ray with procumbent cells. × 146.

4 — Biseriate ray with procumbent cells. × 146.

5 — Triseriate ray with procumbent cells. × 146.

6 — 4-seriate ray with procumbent cells. × 146.

7 — Cork cells arranged in tiers. × 200.

The generic name *Simarubinium* Platen includes all those fossil woods belonging to Simaroubaceae which could not be assigned to any particular genus but show similarities with a number of genera of this family. It is a well known fact that Simaroubaceae is a heterogeneous family and there are very few anatomical characters common to whole of the family (WEBBER, 1936; HEIMSCH, 1942; METCALFE & CHALK, 1950, pp. 324-25). Therefore, to include all the fossil Simaroubaceous woods, which cannot be definitely referred to modern genera, into the form genus *Simarubinium* would be unfortunate. On the other hand, as this family consists of a number of natural homogeneous groups, it would be feasible to name such a fossil wood after these groups or sub-families to which the fossil wood belongs.

The most recent comprehensive account of the Simaroubaceae is that given by Engler (1931) who classified it in the following sub-families:

(1) Surianoideae — 4 genera
(2) Simaruboideae — 22 genera
(3) Kirkioideae — 1 genus
(4) Irvingioideae — 3 genera
(5) Picramnioideae — 1 genus
(6) Alvaradoideae — 1 genus.

In 1936, Webber made a detailed anatomical study of the woods of this family and concluded that from the standpoint of wood anatomy each of the sub-families Kirkioideae, Irvingioideae, Picramnioideae and Alvaradoideae represents a distinct homogeneous group (WEBBER, 1936) whereas Surianoideae shows some diversity and the Simaruboideae exhibits somewhat wide variation.

As indicated by Shallom (1960) the structural features of the fossil wood indicate its closest affinity with the genus *Simarouba* (WEBBER, 1936; HENDERSON, 1953; HEIMSCH, 1942; METCALFE & CHALK, 1950, pp. 320-324). Shallom, however, mentions difference in the 'distribution' of xylem rays of the extant wood of *Simarouba* and the fossil. The present author's own observations on the modern woods of seven species of this genus (*Simarouba amara*, *S. glauca*, *S. officinalis*, *S. tulae*, *S. versicolor*, *S. berteroana*, and *Simarouba* sp.) has shown that this is not true and the xylem rays of the fossil show similar distribution and arrangement as shown by some species of the modern wood of this genus. Modern woods of *Simarouba* have been examined from the xylarium of the Forest Research Institute, Dehra Dun, Harvard wood collections, Cambridge, U.S.A. and Imperial Forestry Research Institute, Oxford, England. The comparison of the fossil wood with the modern wood of different species of *Simarouba* has shown that the closest approximation in wood structure is to be found in some specimens of *Simarouba amara*. Sections of *Simarouba amara* from the woods obtained from Brazil, British Guiana and Venezuela (Forest Research Institute Collection, Dehra Dun) were examined and it was interesting to know that the sections from the Venezuela wood (Specimen No. F. 1240) did not show any storied nature of the rays, thus resembling closely the fossil wood although those of British Guiana and Brazil showed storied rays. Also from Harvard Wood collections, *Simarouba glauca* (wood specimen No. 8440), *S. tulae* and *Simarouba* sp. do not show any storied structure. However, *S. glauca* (F.R.I. Collection) from a specimen from Honduras did show storied rays.

Simarouba also shows storied parenchyma and fibres but some of the species examined (*Simarouba glauca* No. 8440, *S. tulae*, *Simarouba* sp. from Harvard wood collection and *S. amara* No. F.1240 from F.R.I. Collection) either do not show any storied nature of these elements or show them irregularly. The fossil wood although does not typically show storied arrangement of these elements but at some places there is a tendency in these elements to become storied.

There is, however, one character in which the fossil wood differs from the living wood, viz. in the presence of vertical ?traumatic canals in the modern wood (WEBBER, 1936) of *Simarouba*. This is a feature which can occur in any part of the wood due to injury and, therefore, is not very reliable in case of small specimens.

The genus *Simarouba* with nine species of shrubs and small, medium-sized or large trees, is widely distributed in tropical America. The species *S. glauca* is found in Florida, West Indies, Yucatán, Central America and part of South America. *S. tulae* is a Puerto Rican tree. *S. versicolor* grows in coastal forests of eastern Brazil, while *S. amara* is known from Brazil, Venezuela and British Guiana (RECORD & HESS, 1943).

In the modern flora, the genus *Simarouba* is not known to grow in India and is of interest both anatomically and in its paleo-

geographic distribution in the Tertiary of Central India. The genus *Simarouba* is widely distributed in tropical America. Its species, *Simarouba amara* with which the present fossil wood shows a near resemblance grows in Brazil, Venezuela and British Guiana. This again reminds an interesting fact that the living representatives of two other important fossil plants from the Deccan Intertrappean series, namely *Cyclanthodendron*, (SAHNI & SURANGE, 1953) related to modern Cyclanthaceae growing in shallow waters and estuaries in Brazil, and *Rodeites* (SAHNI, 1943; MAHABALE, 1956), a fossil representative of the monotypic genus *Regnellidium* belonging to Marsiliaceae, are also known from Brazil. The present fossil provides another interesting link between the Early Tertiary flora of the Deccan and the modern flora of tropical South America.

Revised Diagnosis of the genus *Simarouboxylon* —

A diffuse-porous wood.

Growth rings indistinct.

Secondary wood vessels diffuse, small to medium-sized, solitary, and in multiples, circular to oval in cross-section; vessels mostly open, sometimes filled with tyloses or gummy deposits; vessel-segments short, truncate or with slightly tapered ends; perforations simple; intervascular pit-pairs bordered, usually alternate and polygonal through crowding, apertures appear linear and occasionally extended; vessel-parenchyma pits bordered.

Parenchyma aliform to confluent and occurs in tangential bands usually short, more or less irregular and narrow; paratracheal parenchyma sheath few layered; elements storied or unstoried.

Xylem rays uniformly distributed, unstoried or storied, somewhat widely spaced; 1-4 seriate and homogeneous.

Wood fibres non-libriform, oval to slightly angular in cross-section, arranged in distinct radial rows; walls thin with fairly large lumina; non-septate; elements storied or unstoried.

Bark about 1-1·5 mm. thick showing secondary phloem, and the cork.

Revised Diagnosis of *Simarouboxylon indicum* Shallom syn. *Simarouboxylon deccani* Prakash. —

Diffuse-porous wood.

Growth rings indistinct.

Secondary wood vessels 43-200 μ in tangential diameter, evenly distributed, 5-11 per sq. mm.; mostly solitary, sometimes in pairs, very rarely in groups of 3 or more cells, thin to slightly thick-walled, circular to oval in cross-section, mostly open, sometimes filled with tyloses and brown or black gummy deposits; vessel-segments up to 340 μ long, truncate or with slightly tapered ends; perforations simple; intervascular pit-pairs bordered, usually alternate, polygonal through crowding, 6-9 μ in size, apertures appear to be linear and occasionally extended; vessel-parenchyma pits bordered and many per cell; vessel-ray pits not conspicous.

Parenchyma aliform to confluent; tangential parenchyma bands usually short, more or less irregular, narrow, 1-3 (usually 1-2) cells thick, 20-52 μ wide; paratracheal parenchyma sheath 1-2 layered; cells thin-walled, oval or tangentially elongated in cross-section, 18-32 μ in diameter showing tendency to storied arrangement at some places.

Xylem rays homogeneous composed of procumbent cells; unstoried; 1-4 (mostly 3) cells or 16-98 μ wide; 2-80 cells or 43-1760 μ high; up to 8-10 rays per mm.; ray cells oval to angular in tangential section.

Wood fibres non-libriform; non-septate; oval to slightly angular in cross-section with 3-4 μ thick walls and fairly large lumina; 720-1600 μ long, 16-33 μ in diameter; interfibre pits not conspicuous; cells sometimes show tendency to storied arrangement.

Bark with secondary phloem towards inside and cork on the outside, other tissues being badly preserved; bast fibres seen in short tangential bands or patches in phloem region; cork 200-300 μ thick, composed of thin-walled cells.

Locality — Mohgaon Kalan in Chhindwara district of Madhya Pradesh.

Horizon — Deccan Intertrappean series.

Age — Early Tertiary (probably Eocene).

Hypotype — B.S.I.P. Museum No. 5585.

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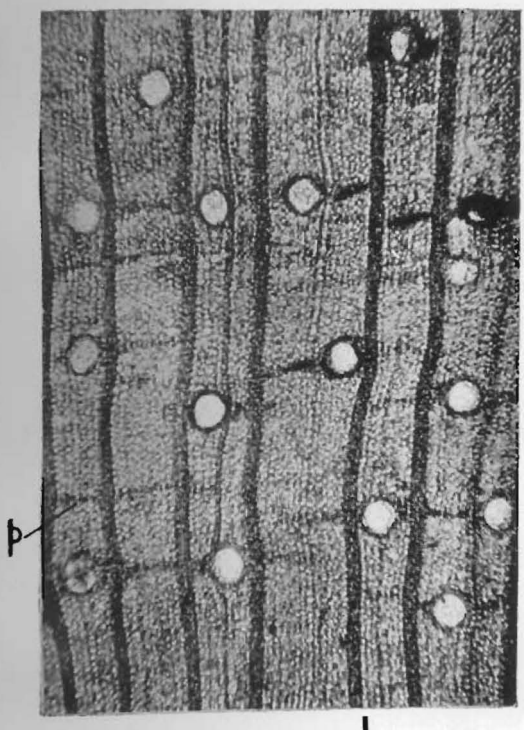
EXPLANATION OF PLATE 1

Simarouboxylon indicum Shalom

1. Cross-section showing size, shape and distribution of vessels and parenchyma (p). Note short tangential parenchyma bands. × 31.
2. Tangential section showing the nature and distribution of xylem rays. × 30.
3. Cross-section through bark showing patches of bast fibres (f) and the cork. × 28.
4. Scalariform pitting of metaxylem vessels. × 90.
5. Magnified intervessel pit-pairs. × 200.
6. A vessel showing tyloses. × 160.
7. Radial longitudinal section showing the nature of xylem rays. × 90.
8. Cross-section magnified to show the nature of parenchyma (p). Note parenchyma cells. × 90.



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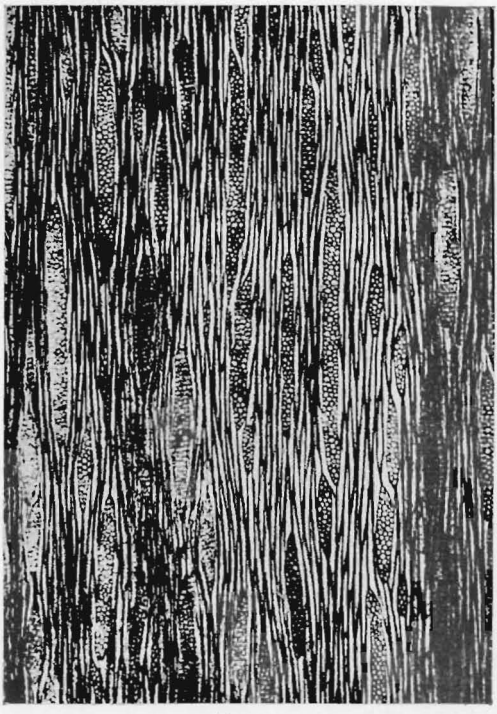

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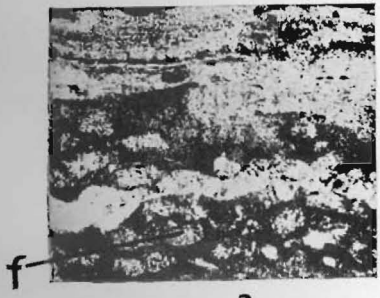

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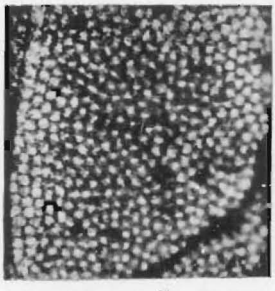

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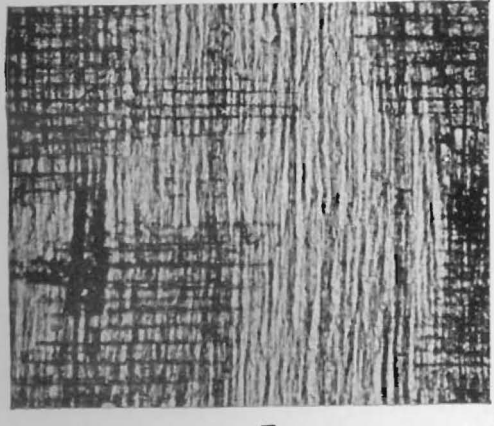

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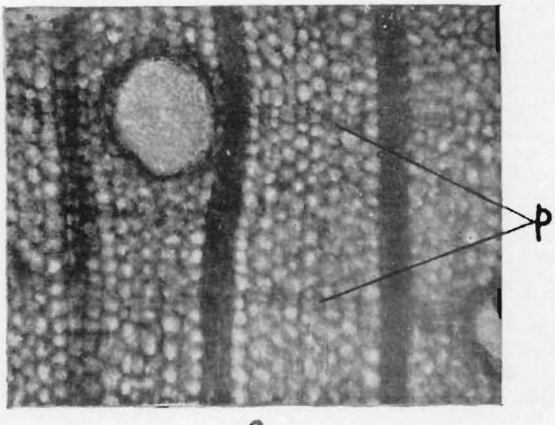

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