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## SYZYGIOXYLON CHHINDWARENSE, A NEW FOSSIL WOOD FROM THE DECCAN INTERTRAPPEAN SERIES OF INDIA

E. M. V. Nambudiri<sup>1</sup> and William D. Tidwell<sup>1</sup>

**ABSTRACT.**— A petrified wood related to genera of the family Myrtaceae was collected from the Deccan Intertrappean Series of India. On comparison with fossil woods of this family, it most closely resembles *Syzygioxylon* Ingle (1973). The specimen differs from described species of *Syzygioxylon* and, therefore, it is proposed as the new species *Syzygioxylon chhindwarensis*.

Fossil wood resembling species of *Eugenia* (Myrtaceae) has been collected from a black chert in the Deccan Intertrappean beds near the Mohgaon Kalan locality in Chhindwara District, Madhya Pradesh, India. Myrtaceous woods have been described previously from these formations by Ingle (1973) and Patil and Singh (1974). Prakash (1965) reviewed reports on dicotyledonous woods from India and the Far East which included those from this locality. Since then, additional fossil woods from the Mohgaon Kalan locality have been described by Chitale and Patil (1971), Chitale and Patil (1972), Chitale and Kate (1972), and Nambudiri and Tidwell (1975).

### DESCRIPTION

The specimen is 37 mm in diameter and consists of secondary xylem. The xylem is diffuse porous, and two growth rings are faintly visible to the unaided eye. Vessels are numerous, small, and faintly visible to the unaided eye, although they are distinct under a hand lens. They are round to oval, with a tangential diameter of 77.5  $\mu\text{m}$  to 116  $\mu\text{m}$  and a radial diameter of 145  $\mu\text{m}$  to 164  $\mu\text{m}$ . They are mostly solitary, occasionally in pairs and rarely in radial multiples of 2 to 4 vessels (Figs. 1a, 2a). Distribution of these vessels is 85 per sq cm. They have simple, oblique perforation plates (Fig. 1b). The vessel wall is 2.5  $\mu\text{m}$  in thickness. Intervascular pit pairs are round to oval, al-

ternate, and vested (Fig. 1d). They have a mean diameter of 4.2  $\mu\text{m}$ .

Parenchyma is paratracheal, either scanty or vasicentric (Fig. 2b). Generally, they form one or two layers around the vessels. These are 41  $\mu\text{m}$  long and 7  $\mu\text{m}$  broad. Vessel to parenchyma pits were not observed.

Rays (Fig. 1c) are extremely fine to moderately fine, faintly visible to the unaided eye. They are heterogeneous and uniseriate as well as 2-4 seriate. Some of the multi-seriate rays are fused by their tips. Uniseriate rays range from 68  $\mu\text{m}$  to 240  $\mu\text{m}$  long. Multiseriate rays are from 435  $\mu\text{m}$  to 659  $\mu\text{m}$  in length. The former has a mean width of 9  $\mu\text{m}$ , whereas the latter are 30  $\mu\text{m}$  in width.

Vessel to ray pits (crossfield pitting) are similar to intervacular pit pairs (Fig. 2d).

Fibres are libriform and nonlibriform and thin walled. They are 388  $\mu\text{m}$  long and 14  $\mu\text{m}$  broad. Fibres are polygonal in cross section and are septate as well as nonseptate (Fig. 2c).

### DISCUSSION

The fossil wood of *Syzygioxylon chhindwarensis* is similar to members of the Ochnaceae, Sonneratiaceae, Vochysiaceae, Punicaceae, Dipterocarpaceae, and Myrtaceae families. Wood of Ochnaceae plants with very scanty parenchyma differ from the occasional occurrence of the vasicentric

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type in the present wood. The aliform confluent parenchyma in genera of the Vochysiaceae separates the xylem of this family from *S. chhindwarensis*. The xylem of Sonneratiaceae has exclusively uniseriate rays. Xylem of puniceous genera lacks parenchyma, whereas woods of Dipterocarpaceae contains apotracheal parenchyma rather than the paratracheal type of *S. chhindwarensis*. Thus our specimen differs from these families. However, it is similar to several taxa of the Myrtaceae. The paratracheal scanty or vasicentric parenchyma, as observed in the present wood, is contained in the myrtaceous genera *Eucalyptus*, *Gonidesia*, *Xanthostemon*, and *Eugenia*. In contrast, vessel multiples are fewer in *S. chhindwarensis* than in *Eucalyptus*. Rays of *Gonidesia* and *Xanthostemon* differ from those of our specimen. They are up to 8 cells wide in *Gonidesia* and from 4 to 6 cells wide in *Xanthostemon*. *Eugenia* is, therefore, the closest extant genus to *S. chhindwarensis*.

Vessel arrangement, nature of the intervascular pit pairs, and type of rays in *Eugenia* correspond to that of the present wood. *Eugenia* Linn. is one of the largest genera of tropical plants, with about 1000 species—of which some 150 are represented in the lowlands and mountains of the Malaysian Peninsula (Desch 1954) and four are commercial timbers of India (Pearson and Brown 1932). The common name for this genus is Kelat in Malaysia and Makaasin in the Philippines. Species of *Eugenia* range in size from dwarfed and shrubby treelets of the mountain tops to the medium-sized or quite large trees in the lowland forests. The anatomical structure of the wood of *Eugenia* is similar, but there is an appreciable variation in the amount and, to some degree, the distribution of wood parenchyma in different species. Some species of *Eugenia* have apotracheal parenchyma, whereas in others it is aliform confluent. In *Eugenia nitidula* Ridl., as in other species of this genus, the parenchyma is paratracheal

vasicentric and only occasionally confluent. Thus no one species is entirely like our specimen. Other similar species are *E. longiflora* (Presl.) Vill., *E. polyantha* Wight, *E. rhamphiphylla* Craib, and *E. tetraptera* var. *pseudotetraptera* Herd.

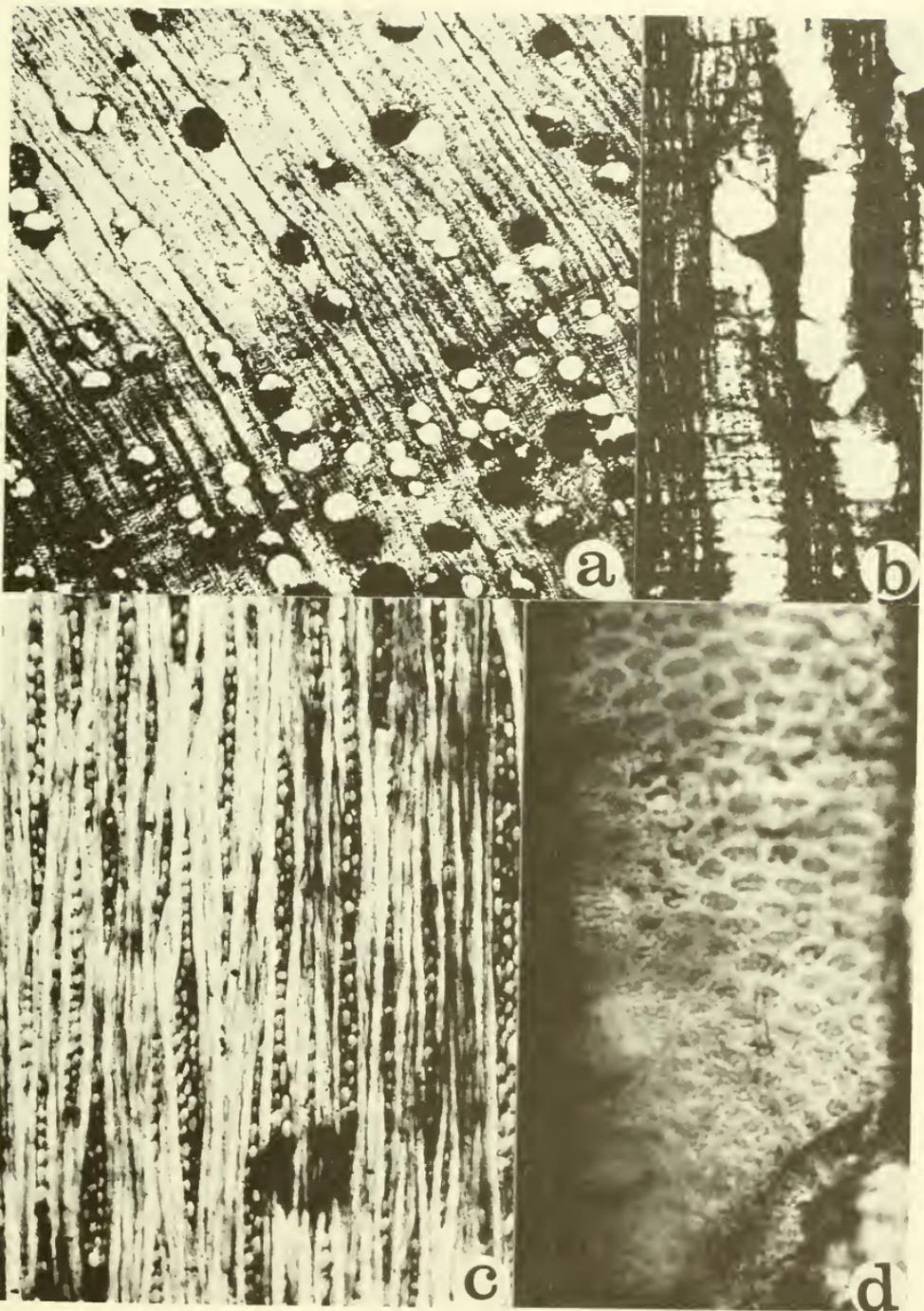
*S. chhindwarensis* varies from the above mainly in its parenchyma distribution. It lacks either the confluent or aliform parenchyma that is present in the others. However, it is similar in having more distinct growth rings, which also occur in *E. cumingiana* Vidal and *E. rhamphiphylla*. This feature stands out because one characteristic of the genus is the general lack or inconspicuous nature of the growth rings. Two features that are often present in some species of *Eugenia* but lacking in our fossil form are frequent tyloses and traumatic gum ducts, the latter occurring horizontally in the rays of some species of *Eugenia*.

The present wood demonstrates closest affinities to described species of the fossil genus *Syzygioxylon* Ingle. However, there are sufficient differences between them and our specimen to propose ours as the new species, *Syzygioxylon chhindwarensis*.

Ingle (1973) described *Syzygioxylon mandlaense* from the Mandla District in Madhya Pradesh, India. This species shows both paratracheal and metatracheal parenchyma, a condition differentiating it from the present specimen. In proposing *Syzygioxylon* as a new genus, Ingle (1973) demonstrated similarities between the living genus *Syzygium* and his taxon. However, many species of *Syzygium* with which he compared his specimen have been placed in *Eugenia* by Pearson and Brown (1932).

From the Mohgaon Kalan locality, Patil and Singh (1974) reported *Syzygioxylon mohgaense*. This species has metatracheal parenchyma along with the paratracheal vasicentric type. In *S. mohgaense* the vasicentric parenchyma becomes aliform. Kramer (1974) described a myrtaceous wood from the Tertiary beds of Java under the name *Syzygioxylon bataviae*. However, he

Fig. 1. *Syzygioxylon chhindwarensis* sp. nov.: a) Transverse section illustrating vessel distribution (X45). b) Vessels with simple perforation plates (X50). c) Tangential section showing narrow rays (X110). d) Vessel exhibiting alternating, vested intervascular pitting (X900).



was not aware of the institution of the genus *Syzygioxylon* by Ingle (1973) and treated *Syzygioxylon* as a new genus in his paper (Kramer 1974). *Syzygioxylon bataviae* has paratracheal aliform parenchyma. The short lateral extensions of the aliform parenchyma in this species unite and form discontinuous confluent strands.

Regardless of these differences, *S. chhindwarensis* shows resemblances to *S. mandlaensis* Ingle (1973) and *S. bataviae* Kramer (1974). The similarities are in the arrangement of vessels and in the septate and nonseptate fibres. However, the wood is closer to *S. mohgaonensis* Patil and Singh (1974) than to the other two species. The characteristics common to *S. mohgaonensis* and *S. chhindwarensis* are the nature and arrangement of vessels, some united rays, and the septate or nonseptate fibres. However, they differ from each other in the total absence of metatracheal diffuse parenchyma and the presence of vested pits in the present specimen. Shallom (1960) described a similar fossil wood, *Barringtonioxylon decanense*, from the Intertrappean beds of Mahurzari. She assigned it to the family Lecythidaceae, whereas Chowdhury (1965) considered it to be a member of the Myrtaceae. However, Chowdhury (1965) suggested that *B. decanense* be reinvestigated.

Myrtaceae is probably the oldest representative of Myrtales (Muller 1970) and possibly extended back into Cenomanian time (Penny 1969). From the Eocene Green River Formation of northwestern Colorado and northeastern Utah, MacGinitie (1969) reported a leaf impression *Eugenia americana*. *E. arenaceaformis* was described earlier from the Oligocene Florissant flora of Colorado (MacGinitie 1953). Myrtaceous fossils are also known from Eocene of Europe (Kruttsch 1967) and Cretaceous of Argentina (Menendez 1972). The family is estimated to contain over 70 genera and about 2,800 species of trees and shrubs, widely distributed throughout the tropical and subtropical regions of the world. Members of this family occur especially in the hot zones of low rainfall bordering on the tropics rather than in the rain forest belt (Desch 1954). Raven and Axelrod (1974) noted that

they are abundant in tropical Asia, South America, and Australia.

Several researchers (Dadswell and Ingle 1947, Pike 1956, Chattaway 1959, Schmid 1972) have studied the taxonomic problem of *Eugenia* and *Syzygium*. They, generally, followed Merrill and Perry (1938) in suggesting that genus *Eugenia* be restricted to species of the New World and *Syzygium* be utilized for the majority of species of this taxon in the Old World.

In comparing the fossil species of *Syzygioxylon* with the criteria used by Dadswell and Ingle (1947) for separating *Eugenia* and *Syzygium*, two species (*S. chhindwarensis* and *S. mandlaensis*) have more characters in common with *Eugenia* than *Syzygium*. This is interesting considering that their collection localities are in the Old World and not the New. This paradox can be partially explained by speculating upon the origin of *Eugenia* and *Syzygium*. The origin of these two genera may have been from a common ancestor such as *Syzygioxylon*.

#### DIAGNOSIS OF SPECIES

*Syzygioxylon chhindwarensis*, nov. sp., wood diffuse porous, two growth rings faintly visible; vessels numerous; solitary, in pairs or in radial multiples of 2 to 4; tangential diameter 77.5  $\mu\text{m}$  to 116  $\mu\text{m}$  radial diameter, 145  $\mu\text{m}$  to 164  $\mu\text{m}$ , vessel wall 2.5  $\mu\text{m}$  thick; perforation simple, plates obliquely placed; intervascular pit pairs round to oval, alternate, 4.2  $\mu\text{m}$  in diameter, vested; parenchyma paratracheal, vasicentric or scanty; rays extremely to moderately fine, uniseriate rays 68  $\mu\text{m}$  to 240  $\mu\text{m}$  long and 9  $\mu\text{m}$  broad, multiseriate rays 435  $\mu\text{m}$  to 659  $\mu\text{m}$  in length and 30  $\mu\text{m}$  in width; vessel ray pits similar to intervascular pit pairs; fibres libriform and nonlibriform, mostly aseptate but few septate, 388  $\mu\text{m}$  long and 14  $\mu\text{m}$  broad, polygonal in cross view.

HOLOTYPE.—MOG 69/N (To be deposited at the Birbal Sahni Institute of Palaeobotany, Lucknow, India.)

Locality.—Mohgaon Kalan

Horizon.—Deccan Intertrappean Series

Age.—Early Eocene

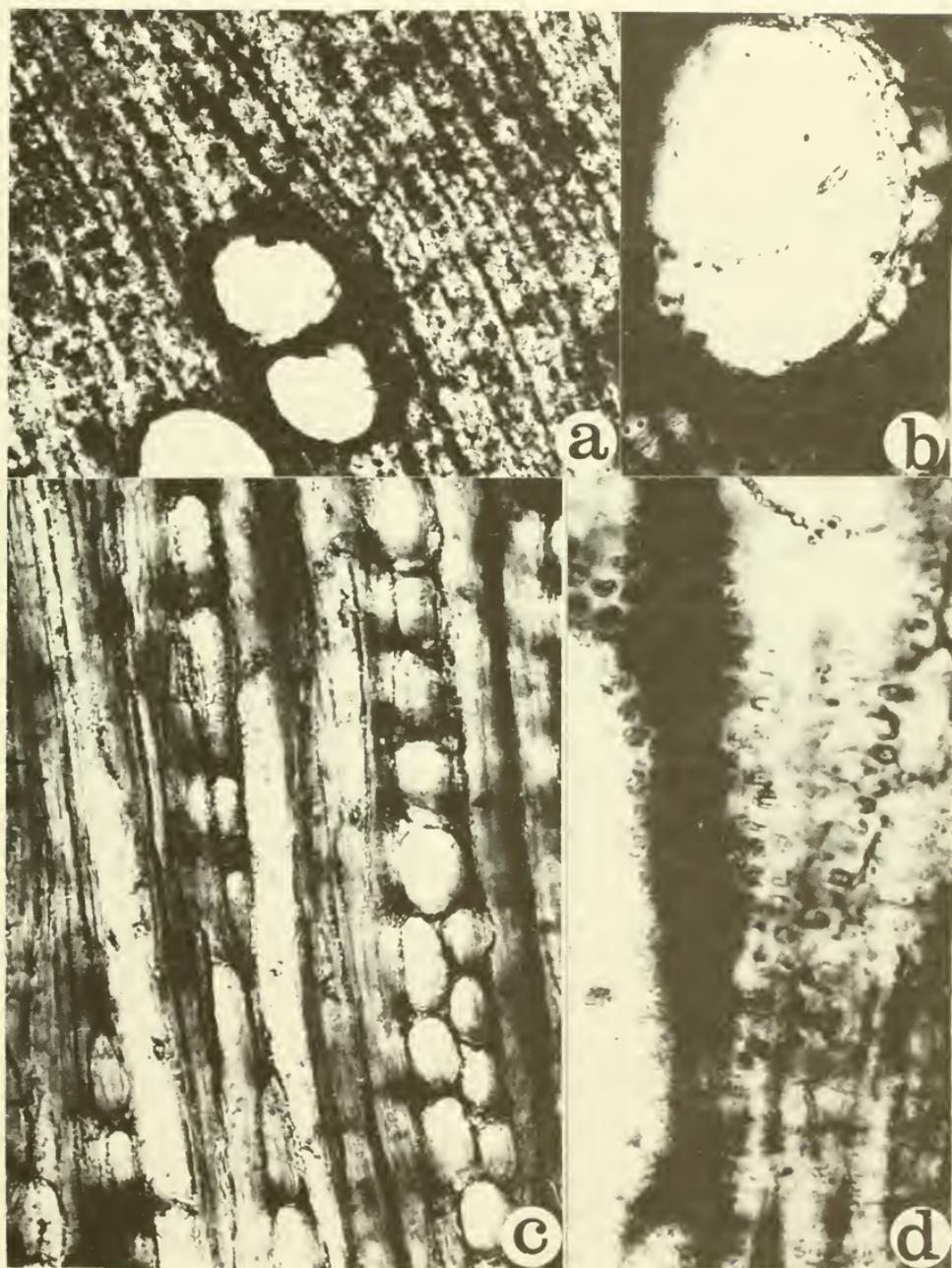


Fig. 2. *Syzygioxylon chhindwacense* sp. nov.: a) Close up of radial multiple of two vessels (X145). b) Vessel in transverse section with vascentric parenchyma (X340). c) Tangential section showing nonseptate fibres (X450). d) Vessel to ray pits (crossfield pitting) on vessel. Note their similarity to the intervascular pitting (X620) (See Fig. 1d).

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