

REINVESTIGATION OF *SAPINDOXYLON INDICUM* NAVALE FROM THE CUDDALORE SERIES NEAR PONDICHERRY

N. AWASTHI

Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow-226 007, India

ABSTRACT

The affinities of *Sapindoxylon indicum*, described by Navale (1956) from the Cuddalore Series near Pondicherry, have been revised. In all the anatomical features it shows closest resemblance with the woods of *Duabanga* of the family Sonneratiaceae but not to those of Sapindaceae. Hence, it is transferred to the genus *Duabangoxylon* Prakash & Awasthi (1971) and renamed as *Duabangoxylon indicum* (Navale) comb. nov.

Key-words — *Sapindoxylon*, Xylotomy, *Duabanga*, Miocene-Pliocene, Cuddalore Series, India.

सारांश

पाँडिचेरी के समीपस्थ कुडलोर श्रेणी से प्राप्त सैपिन्डॉक्सिलॉन इंडिकम नवले का पुनरीक्षण —
नीलाम्बर अवस्थी

पाँडिचेरी के समीपस्थ कुडलोर श्रेणी से नवले (1956) द्वारा वर्णित सैपिन्डॉक्सिलॉन इंडिकम की सजा-
तीयता पुनरीक्षित की गई है। सभी शारीरिक लक्षणों में यह काष्ठाग्रम सैपिन्डेसी कुल के बजाय सौनरेशियेसी
कुल के दुआबंगा की काष्ठों से घनिष्ठतम् समानता प्रदर्शित करती है। अतएव इसे दुआबंगॉक्सिलॉन प्रकाश
एवं अवस्थी (1971) वंश में स्थानांतरित कर दिया है तथा इसे दुआबंगॉक्सिलॉन इंडिकम (नवले) नवीन
संयोजन से पुनर्नामांकित किया है।

INTRODUCTION

THE author (Awasthi, 1971, 1975, 1977) had earlier revised the affinities of a number of woods described from the Cuddalore Sandstones of Murattandi-chavadi area near Pondicherry. Here the affinity of one more fossil wood, viz., *Sapindoxylon indicum* described by Navale (1957) from the area has been reinvestigated. On critical re-examination of the type slides it was found that the fossil shows closest resemblance with the woods of *Duabanga* of the family Sonneratiaceae.

REVISED AFFINITIES

Fossil woods possessing mostly small to medium-sized solitary or radial multiple vessels, scanty paratracheal parenchyma, 1-2 seriate homocellular rays and septate or nonseptate fibres are generally referred to the family Sapindaceae and placed under

the genus *Sapindoxylon* Kräusel (1922). *Sapindoxylon indicum* Navale is one of them which, in general, has also been shown resembling the woods of Sapindaceae.

After critical re-examination of type slides it has been found that the fossil possesses important features, such as growth rings not very clearly marked, vessels small to moderately large, profusely tylosed, intervessel pits large, vested; parenchyma scanty paratracheal or vasicentric to occasionally extending sideways; rays 1-2 (mostly 1) seriate, heterocellular, consisting of 1 or 2 marginal rows of upright or square cells and procumbent cells through the median portion, and the fibres usually thin to moderately thick-walled and nonseptate. These features do not indicate the affinities of *Sapindoxylon indicum* with the woods of the family Sapindaceae, since in almost all its members the vessels are devoid of tyloses and if at all present they are not so profuse, the intervessel pits are small to medium and non-

vestured and the fibres are mostly septate. Furthermore, in sapindaceous woods the growth rings are usually present, delimited by a zone of thick-walled fibres or by narrow line of parenchyma.

The above important features of *Sapindoxylon indicum* show its affinities with the woods of *Duabanga* of Sonneratiaceae and a few species of *Terminalia* and *Anogeissus* of Combretaceae. Its resemblance with the combretaceous woods can be seen in having scanty paratracheal parenchyma, 1-2 seriate heterocellular rays and nonseptate fibres. However, they can be differentiated from it in the presence of crystals in ray cells which sometimes also occur in parenchyma and fibres. Moreover, in *Terminalia* and *Anogeissus* the growth rings are usually present, delimited by terminal or initial parenchyma and the amount of paratracheal parenchyma is also relatively more in *Terminalia* than in *Sapindoxylon indicum*. Thus the possibilities of its being a combretaceous wood are ruled out.

From a detailed revised account given below it is quite evident that *Sapindoxylon indicum* Navale shows closest resemblance with the woods of *Duabanga* (*D. grandiflora* & *D. moluccana*) of the family Sonneratiaceae. Therefore, it is transferred to the genus *Duabangoxylon* Prakash & Awasthi (1971) and renamed as *Duabangoxylon indicum* (Navale) comb. nov.

So far there is only one species of *Duabangoxylon*, namely *D. tertiarum* described by Prakash and Awasthi (1971) from the Miocene-Pliocene of Namsang River beds at Deomali, Arunachal Pradesh, India. The same species was also reported by Kramer (1974) from the Tertiary of Java and Sumatra. The present fossil, although exhibiting general resemblance with *Duabangoxylon tertiarum* in the nature and distribution of vessels, parenchyma, width and length of rays and the nature of fibres, shows certain differences especially in the size and the frequency of vessels and rays and the size of the fibres. In the former the vessels are small to medium or large (60-280 μm in diameter), majority being medium-sized, 6-20 vessels per sq mm, the rays are about 15-20 per mm and the fibres are 12-40 μm in diameter. Whereas in the latter the vessels are medium to large or very large (160-432 μm in diameter), 3-6 per sq mm, the rays are 10-15 per mm and the fibres

are 16-60 μm in diameter. In order to know whether such variation really occurs in the modern woods of *Duabanga*, thin sections of several specimens of *Duabanga grandiflora* (Roxb. ex. DC.) Walp. and *D. moluccana* Bl. were also examined critically. It was found that the size of the vessels, parenchyma cells, fibres and the frequency of vessels and rays though vary considerably from specimen to specimen, the extent of variation is not so much in them than in *Duabangoxylon tertiarum* and *D. indicum* (Navale) comb. nov. Therefore, the latter is treated as a new species.

REVISED DESCRIPTION

Duabangoxylon indicum (Navale) comb. nov.

Pl. 1, figs 1, 3, 5

1957 *Sapindoxylon indicum* Navale, p. 73, pl. 1, figs 1-6; text-figs 1, 2

Topography — *Wood* diffuse-porous. *Growth rings* indistinct, however, discernible at places due to crowding of vessels (Pl. 1, fig. 1). *Vessels* small to large, solitary and in radial multiples of 2-4 (mostly 2), evenly distributed (Pl. 1, fig. 1), about 6-20 per sq mm, profusely tylosed. *Parenchyma* scanty paratracheal to vasicentric, forming 1-2 seriate complete or incomplete sheath around vessels, occasionally extending sideways (Pl. 1, fig. 1). *Rays* fine, 1-2 seriate, majority uniseriate (Pl. 1, fig. 3), 3-34 (mostly 10-20) cells in height, biseriate rays usually short, about 15-20 rays per mm, heterocellular, consisting of 1-2 marginal rows of upright or square cells at one or both the ends and rest procumbent cells (Pl. 1, figs 3, 5), crystals absent. *Fibres* aligned in distinct radial rows between two consecutive rays.

Elements — *Vessels* circular to oval, 60-280 μm in diameter, thin-walled, perforations simple; vessel-members 300-600 μm in length, with truncate or slightly inclined ends; intervessel pits moderately large, 6-8 μm in diameter, round to elliptical, alternate, vestured. *Parenchyma cells* round to oval, 40-80 μm in diameter. Upright or square *Ray cells* about 32-60 μm in tangential height, about 16-40 μm in radial length; procumbent cells 20-40 μm in tangential and 40-120 μm in radial length. *Fibres* oval to angular, about 12-40 μm in diameter, moderately thick-walled, walls 3-6 μm , nonseptate.

DIAGNOSIS

Duabangoxylon indicum (Navale) comb. nov.

Growth rings indistinct, however, discernible at places due to crowding of vessels. *Vessels* small to medium or large, majority medium-sized, solitary and in radial multiples of mostly 2-3, 60-280 μm in diameter, about 6-20 per sq mm; profusely tylosed; intervessel pits medium to large, 6-8 μm in diameter, alternate, vested. *Parenchyma* paratracheal, scanty to vasicentric, forming 1-2 cells wide sheath around the vessels, occasionally extending sideways. *Rays* 1-2 seriate, majority 1-seriate, 3-34 (mostly 3-20) cells in height, biseriate rays usually shorter, about 15-20 per mm, heterocellular, consisting of 1-2 marginal rows of upright or square cells and rest procumbent cells. *Fibres* angular, 12-40 μm in diameter, thin to moderately thick-walled, nonseptate.

Holotype — B.S.I.P. Museum no. 19406.

Locality — Tiruchitambalam near Pondicherry, South Arcot District Tamil Nadu.

Horizon & Age — Cuddalore Series; Miocene-Pliocene.

DISCUSSION

The genus *Duabanga* Buch-Ham. consists of 3 species distributed in the Indomalayan region (Willis, 1973, p. 392; Jayaweera, 1967). *Duabanga grandiflora* (Roxb. ex DC) Walp. (Syn. *Duabanga sonneratioides* Buch-Ham.) is a deciduous tree which occurs along the banks of streams and in ravines from sea level up to 2,280 m elevation in north-east India (Assam region), Andaman Islands, Bangladesh, Burma, Thailand, Cambodia, Malay Peninsula, Indochina and in Yunnan

of the mainland of China. *D. moluccana* Bl. is found along streams and slopes in primary forests of Java, Borneo, Celebes, Moluccas, New Guinea, Taland, Lesser Sunda and Philippine Islands at an altitude between 10-1,250 m. The third species, *D. taylorii* Jayaweera, which Greesink (1970) considers a probable hybrid between *D. moluccana* Bl. and *D. grandiflora*, is probably a native of Java. It was introduced into Royal Botanic Gardens, Peradeynia, Sri Lanka in 1854 from Bogor, Java and now flourishes along river banks in the moist mid-country at an elevation of 457 m above sea level (Jayaweera, 1967).

As already mentioned that the fossil woods of *Duabanga* are also known from the Tertiary of Java and Sumatra (Kramer, 1974) and from the Tertiary of Deomali in Arunachal Pradesh (Prakash & Awasthi, 1970). Besides woods, pollen grains referable to *Duabanga* have been found in the lignite deposits of Quilon in Kerala coast by Rao and Ramanujam (1975). From these records it is evident that in the Indian subcontinent the genus *Duabanga* was widely distributed during the Neogene. At present it is confined to only in the moist to semi-evergreen tropical forests of North Bengal and Assam region. The disappearance of *Duabanga* from South India along with many other genera and species representing the assemblage of the Cuddalore flora seems to have been caused by significant changes in the environmental conditions.

ACKNOWLEDGEMENT

The author sincerely thanks the authorities of the Forest Research Institute Dehradun for facilities to consult the Xylarium of their Institute.

REFERENCES

- AWASTHI, N. (1969). A fossil wood of *Sonneratia* from the Tertiary of South India. *Palaeobotanist*, **17** (3): 254-257.
- AWASTHI, N. (1971). Revision of some dipterocarpaceous woods previously described from the Tertiary of South India. *Palaeobotanist*, **18** (3): 226-233.
- AWASTHI, N. (1974). Neogene angiospermous woods, pp. 341-358 in Surange, K. R. et al. (Eds)—*Aspects and Appraisal of Indian Palaeobotany*. Birbal Sahni Institute of Palaeobotany, Lucknow, India.
- AWASTHI, N. (1975). Revision of some dicotyledonous woods from the Tertiary of South India. *Palaeobotanist*, **22** (3): 186-191.
- AWASTHI, N. (1977). Revision of *Hopeoxylon indicum* Navale and *Shoreoxylon speciosum* Navale from the Cuddalore Series near Pondicherry. *Palaeobotanist*, **24** (2): 102-107.
- GRESINK, R. (1970). *Duabanga taylorii* Jayaweera (Sonneratiaceae) a putative hybrid. *Blumea*, **18** (2): 453-456.
- JAYAWEERA DON, M. A. (1967). The genus *Duabanga*. *J. Arnold. Arb.*, **48**: 89-100.

- KRAMER, K. (1974). Die Tertiären Hölzer Südost-Asiens (Unter Ausschluss der Dipterocarpaceae). *Palaeontographica*, **B 144**: 45-181.
- KRAUSEL, R. (1922). Fossil hölzer aus dem Tertiär von Süd-Sumatra. *Verh. geol. mijnb. Genoot. Ned. Geol. Ser.*, **5**: 231-287.
- NAVALE, G. K. B. (1957). *Sapindoxylon indicum* sp. nov., a new fossil wood from the Tertiary of South India. *Palaeobotanist*, **5** (2): 73-77.
- PRAKASH, U. & AWASTHI, N. (1971). Fossil woods from the Tertiary of eastern India. 1. *Palaeobotanist*, **18** (1): 32-44.
- RAO, K. P. & RAMANUJAM, C. G. K. (1975). A palynological approach to study the Quilon beds of Kerala State in South India. *Curr. Sci.*, **44**: 730-732.
- WILLIS, J. C. (1973). *A Dictionary of the Flowering Plants and Ferns*. Eighth edition. Cambridge Univ. Press, Cambridge.

EXPLANATION OF PLATE

PLATE 1

1. *Duabangoxylon indicum* (Navale) comb. nov.—cross section showing nature and distribution of vessels (tylosed) and parenchyma. $\times 28$. B.S.I.P. Museum slide no. 740.
2. *Duabanga moluccana* Bl.—cross section showing vessels (tylosed) and parenchyma similar in nature and distribution to those of fossil as shown in fig. 1. $\times 28$.
3. *Duabangoxylon indicum* (Navale) comb. nov.—tangential longitudinal section showing rays. $\times 80$. B.S.I.P. Museum slide no. 743.
4. *Duabanga moluccana* Bl.—tangential longitudinal section showing rays similar to those shown in fig. 3. $\times 80$.
5. *Duabangoxylon indicum* (Navale) comb. nov.—radial longitudinal section showing heterocellular rays. $\times 110$. B.S.I.P. Museum slide no. 746.
6. *Duabanga moluccana* Bl.—radial longitudinal section showing heterocellular rays similar to those of fossil as shown in fig. 5. $\times 110$.

