

ARISTOLOCHIOXYLON PRAKASHII FROM THE DECCAN INTERTRAPPEAN BEDS OF WARDHA DISTRICT*, MAHARASHTRA

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ABSTRACT

Aristolochioxylon prakashii gen. et sp. nov., a fossil dicotyledonous wood showing nearest affinity with the climbing species of *Aristolochia* of the family Aristolochiaceae has been described from the Deccan Intertrappean exposures of the forest village Nawargaon located in Arvi Tahsil of Wardha District. This is a first dicotyledonous wood to be described in detail from Wardha District and the first Indian fossil wood showing adaptations of a climbing stem.

INTRODUCTION

Deccan Intertrappean exposures of Nawargaon, Maragsur and Sindhivihira, forest villages in Arvi Tahsil of Wardha District, Maharashtra are quite rich in dicotyledonous and monocotyledonous woods. Though three palm woods, viz. *Palmoxylon sclerodermum* Sahni (SHUKLA, 1946), *P. deccanense* Sahni (1964) and *P. nawargaoensis* Shukla (1941) have been described from these exposures, no dicotyledonous woods have so far been described. *Aristolochioxylon prakashii*, a fossil dicotyledonous wood showing distinct adaptations of a climbing stem collected from Nawargaon (21°1': 78°35') has been described for the first time in this paper.

SYSTEMATIC DESCRIPTION

Family—Aristolochiaceae

Genus—**Aristolochioxylon** gen. nov.

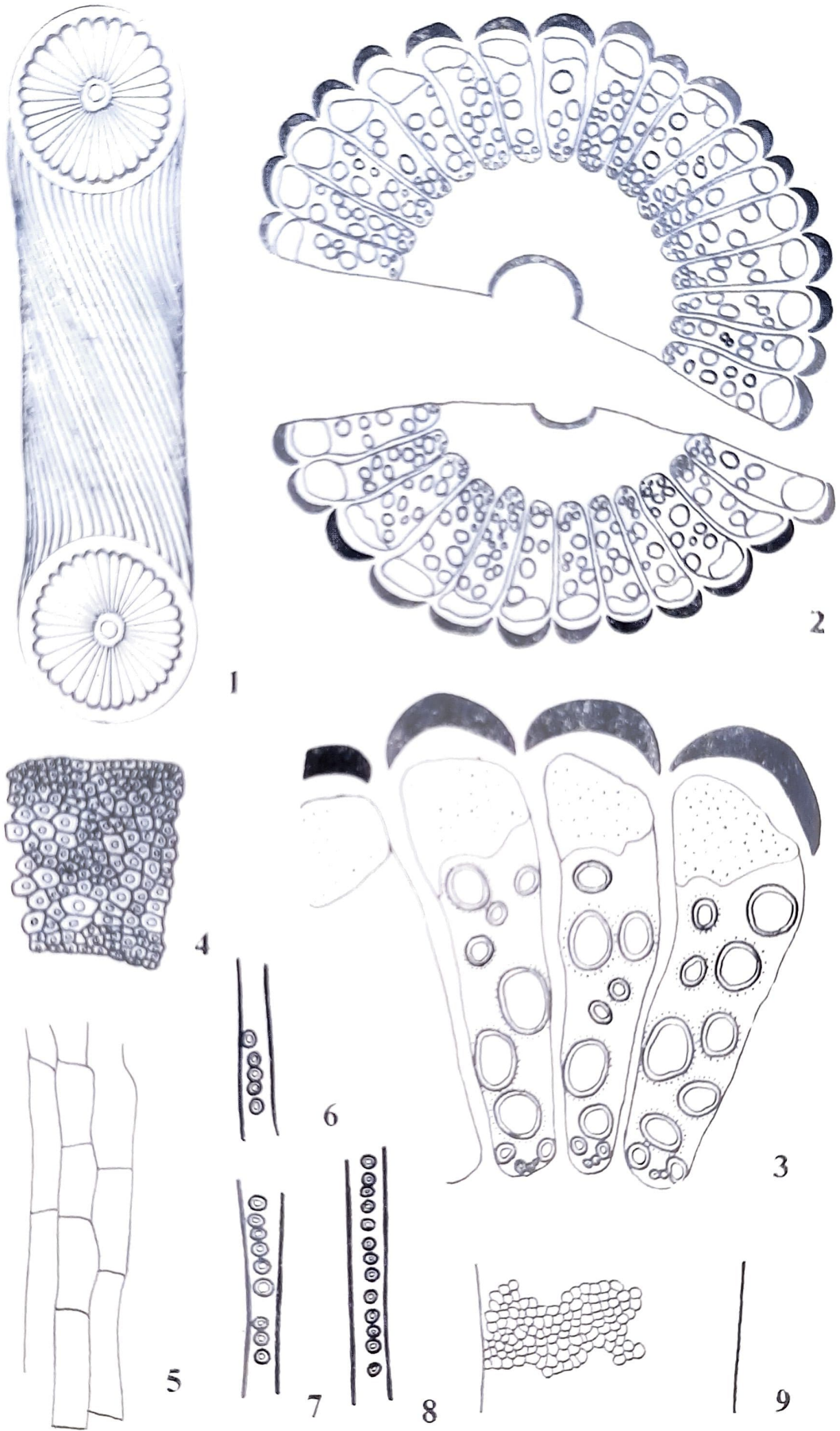
Aristolochioxylon prakashii gen. et sp. nov. (Text-figs. 1-9; Pl. 1, Figs. 1-7)

The specimen is 6 cm long and 7 mm in diameter. It was loosely embedded in a rock from which it could be separated out. It is ash grey in colour, externally ribbed with about 30 longitudinally twisted ribs (Text-fig. 1).

Cross section of the specimen shows boundary of the cortex, vascular tissue and pith (Text-fig. 2; Pl. 1, Fig. 1). *Cortex* is 1.6 mm in radial extent. The internal details of cortex are not preserved.

There are 30 *primary xylem poles* (Text-fig. 2; Pl. 1, Fig. 1) more or less equidistantly placed around the periphery of the pith. Average distance between two primary xylem poles

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Aristolochioxylon prakashii gen. et sp. nov.—Text-fig. 1. Fossil specimen showing longitudinally twisted ribs, $\times 3$. Text-fig. 2. Cross section of the wood showing distribution of vessels, broad medullary rays, phloem patches with pericyclic fibrous caps, $\times 7$. Text-fig. 3. A part of the same magnified showing distribution of wood parenchyma round the vessels, $\times 23$. Text fig. 4. Median portion of the pericyclic fibrous cap in cross section, $\times 266$. Text-fig. 5. Wood parenchyma cells in longitudinal section, $\times 266$. Text-figs. 6-8. Wood fibres with bordered pits, $\times 266$. Text-fig. 9. Intervessel pit-pairs, $\times 266$.

is 180 μ . Each pole (Text-fig. 3; Pl. 1, Fig. 3) has 2-3 (mostly 2), round metaxylem elements (t.d. 16 μ , r.d. 22 μ) and 1-4 (mostly 2 or 3), angular or circular, protoxylem elements (8 μ diameter).

Secondary vascular tissue is divided into 30 radial strips (Text-fig. 2; Pl. 1, Fig. 1), each corresponding to one primary xylem pole. The two consecutive strips are separated by broad medullary rays (Text-figs. 2, 3; Pl. 1, Figs. 2-5). Each strip of *secondary xylem* extends radially to 675 μ . It is 225 μ broad in the middle part. It is narrower towards pith and becomes slightly broader towards phloem side (Text-fig. 3; Pl. 1, Fig. 2). The *vessels* are more or less evenly distributed in each strip (Text-fig. 3; Pl. 1, Fig. 2), mostly solitary, few in radial or tangential pairs, average distribution being 12 per sq. mm. They are round in outline, small to mostly medium-sized (t.d. 108 μ , r.d. 117 μ); thickness of the vessel wall 4 μ . Intervessel pits (Text-fig. 9) clearly seen, alternate, contiguous, polygonal in shape, pit diameter 6 μ ; vessel ray pitting not clearly seen.

Xylem parenchyma (Text-fig. 3) is paratracheal, vasicentric, forming 1-2 layered sheath round the vessels. The paranchyma cells (Text-fig. 5) are tubular to rectangular and longitudinally elongated, radial width 5 μ , tangential width 13 μ and length 26 μ . Their walls have simple, circular pits of 3 μ diameter. *Secondary xylem rays* lacking.

Xylem fibres are libriform, hexagonal and somewhat radially stretched in cross section (r.d. 11 μ , t.d. 8 μ). They have about 1 μ thick common wall, and 205 μ length. Their radial and tangential walls have a single row of bordered pits (Text-figs. 6-8; Pl. 1, Figs. 6,7); pit diameter 6-8 μ , with lenticular orifices.

Medullary rays are 30-90 μ and 8-12 cells wide in cross section, cells thin walled and radially elongated, 30 μ long and 7 μ broad.

Each xylem strip is capped by a *phloem patch* (Text-figs. 2, 3; Pl. 1, Figs. 2, 4), which is enclosed in a lunate fibrous cap on the cortical side. The phloem patch is 72 μ high and 252 μ broad in the middle. The radial height of the fibre cap of the phloem is 72 μ with 20 layers of fibres in the middle (Text-fig. 4) but tapers on either side. The consecutive fibre caps are more or less marginally fused (Pl. 1, Figs. 1, 2, 4) to form an almost continuous, lobed fibrous cylinder enclosing the vascular tissues and the pith. The fibres are rectangular to polygonal in cross section, 8 \times 5 μ in size and about 172 μ in length. The thickness of common wall between two successive fibres is 2 μ ; lumen is circular with 2 μ diameter. The outermost layer of fibrous cylinder has 1 or 2 discontinuous rows of highly thick walled sclerotic cells; they are also seen in the inner layers of the fibre cap.

The *pith* (Pl. 1, Figs. 2, 3, 5) is 3 mm in diameter, the central 1 mm being hollow. The cellular part extends radially to 1.7 mm. It has cells of progressively increasing size from periphery to centre (Pl. 1, Fig. 5). The peripheral cells are polygonal, 10 μ in diameter and compactly arranged. The inner cells are thin walled, round, 34 μ in diameter and loosely arranged. The central hollow part of the pith is pentangular in outline.

AFFINITIES

Diagnostic features exhibited by this wood are: (1) externally ribbed nature with longitudinally twisted ribs, (2) the secondary vascular tissue is divided into 30 radial strips, each corresponding to one primary xylem pole, (3) two consecutive xylem strips separated by broad medullary rays of 8-12 cells width, (4) each secondary phloem patch is capped by a lunate fibrous cap on the cortical side, (5) secondary vascular rays

completely lacking, (6) vessels small to large, mostly solitary, (7) parenchyma paratracheal, vasicentric, forming 1-2 layered sheath round the vessels, and (8) xylem fibres with a single row of large, bordered pits. These features occur mainly in the families whose members have adapted for climbing habit. A general survey of dicotyledonous families with regards to the above mentioned features (METCALFE AND CHALK, 1950) shows that some members of the following families stand for comparison with the present fossil. These are Ranunculaceae, Menispermaceae, Berberidaceae, Lardizabalaceae, Sargentodoxaceae, Cucurbitaceae, and Aristolochiaceae.

In family Ranunculaceae, *Clematis* and *Narvelia* resemble the fossil wood in the gross features like broad medullary rays, absence of vascular rays, presence of fibrous cap above each phloem patch, vasicentric parenchyma, etc.. However, the parenchyma strands and fibres are storied in these genera and the fibres have simple pits. A number of genera of the family Menispermaceae, e.g. *Anamitra*, *Cissampelos*, *Cocculus*, *Coscinium*, *Menispermum* and *Tinospora* exhibit the major gross anatomical features of this wood including the character of bordered pitted fibre. But in Menispermaceae, the parenchyma is apotracheal and diffuse and not paratracheal like the present fossil wood. In the members of Berberidaceae also the vascular tissues are separated by broad medullary rays, while a ring of fibres believed to be pericyclic in origin form a tube at the periphery of the stem. However, this family also differs from the present fossil wood in the absence of parenchyma and in having simple pits on the fibres. In addition, vessels have spiral thickenings in majority of them. The gross features of this wood are also seen in the members of the family Lardizabalaceae but these members differ in the absence of scanty development of parenchyma. The fibres are often septate and some of the vessels in the wood show spiral thickenings. In the genus *Sargentodoxa* also the sclerose pericycle forms a broad sinuous ring and the fibres are bordered pitted but the vascular system consists only of eight bundles, four large bundles alternating with four smaller ones. The pith consists of large stone cells. Most of the cucurbitaceous climbers also show the gross anatomical features of this wood, but in the members of this family the pericyclic sclerenchyma forms a continuous ring and the vascular bundles are nearly always bicollateral. In addition, the secondary xylem has vascular rays.

The family Aristolochiaceae shares many characters exhibited by the present fossil wood, e.g. (1) widely separated vascular bundles of primary xylem, (2) the secondary vascular tissue divided into number of longitudinal strips alternating with the broad medullary rays, (3) each phloem patch capped by a lunate pericyclic fibrous cap, (4) xylem fibres with bordered pits, and (5) the parenchymatous pith often becoming hollow in the centre.

The detailed analysis of the anatomical features of different genera of the family Aristolochiaceae reveals that the present fossil shares a number of characters of the genus *Aristolochia* such as (1) mostly medium-sized to large solitary vessels, (2) large intervascular pit-pairs (6-8 μ diameter), (3) paratracheal, vasicentric parenchyma, (4) absence of secondary vascular rays, and (5) fibres with large bordered pits (6-8 μ diameter).

The genus *Aristolochia* consists of 350 species (HUTCHINSON, 1964) distributed mostly in tropics rarely in temperate region. In India this genus is represented by seven species of which six species are climbers (HOOKER, 1879). Fresh sections of twigs of *Aristolochia indica* Linn., *A. bracteata* Retz., *A. roxburghiana* Klotzsch. and *A. brasiliensis* Mart. & Zucc. were examined for comparison.

The present wood does not resemble with any of these species in all its anatomical features but shows similarities with them in having (1) mainly medium-sized to large, solitary

vessels, (2) 8-12 cells broad medullary rays, (3) about 20 layered radial height of the pericyclic fibrous cap, and (4) the occasional tendency of the pith to become hollow in the centre. However, the striking difference is seen in the number of primary xylem poles and the corresponding number of secondary xylem arches. In none of the species examined, the number of primary xylem poles could exceed over 14, while in the fossil specimen as many as 30 primary xylem poles are present. In the present fossil, all the secondary xylem strips are of uniform width in their broadest portion, while in the modern species of *Aristolochia* examined by us certain xylem strips are excessively broader than the others. Further comparison with other species of this genus are necessary to suggest the specific affinity of this fossil.

To the best of our knowledge no fossil wood of the family Aristolochiaceae has been described so far from the Tertiary of India and abroad. Therefore, this fossil wood has been placed under a new organ genus *Aristolochioxylon*, suggesting its similarity with the modern genus *Aristolochia* of the family Aristolochiaceae. The specific epithet, *Aristolochioxylon prakashii* is after Dr. U. Prakash of Birbal Sahni Institute of Palaeobotany, Lucknow, who has made significant contributions on the Tertiary woods of India and abroad.

GENERIC DIAGNOSIS

Aristolochioxylon gen. nov.

Axis ribbed and longitudinally twisted. *Primary xylem poles* 30 in number and equidistantly placed around the pith. *Secondary vascular tissue* divided into radial strips alternating with broad medullary rays. *Secondary xylem* devoid of vascular rays. *Phloem patches* capped by lunate fibrous patches on the cortical side. *Xylem fibres* with conspicuous bordered pits on radial and tangential walls. *Vessels* mostly medium-sized, a few small, evenly distributed. *Parenchyma* paratracheal, vasicentric, forming 1-2 layered sheath round the vessels. *Pith* with central hollow cavity.

SPECIFIC DIAGNOSIS

Aristolochioxylon prakashii sp. nov.

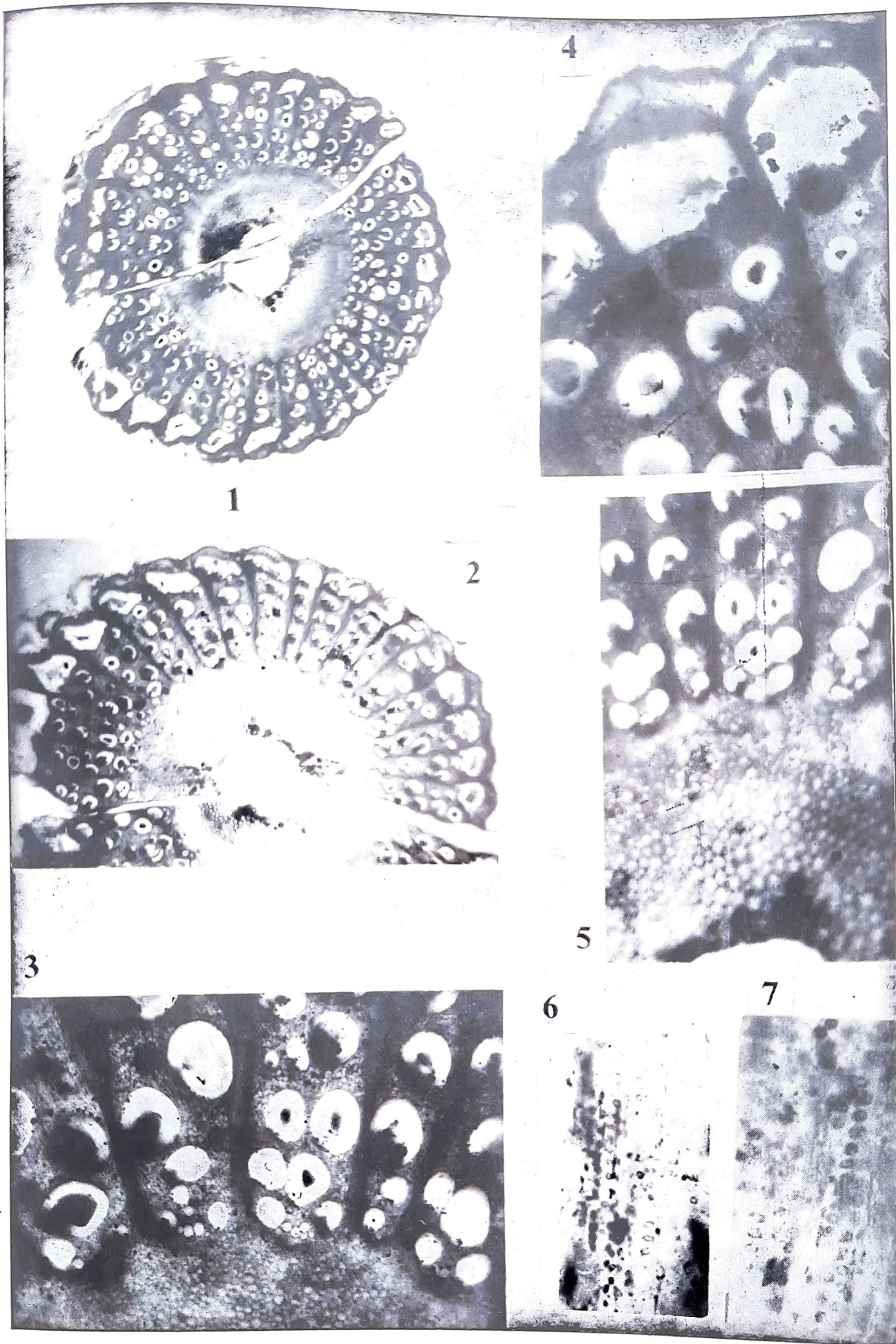
Axis longitudinally ribbed with 30 longitudinally twisted ribs. *Primary xylem poles* 30 in number and arranged equidistantly around the pith, the distance between the two consecutive poles being 180 μ ; each pole with 2-3 metaxylem and 1-4 protoxylem elements. *Secondary vascular tissue* divided into 30 radial strips separated by 8-12 cells wide medullary rays, each strip 675 μ in radial extent and 225 μ in width. *Vessels* mostly solitary, 12 per sq mm, round in outline, t.d. 108 μ , r.d. 117 μ ; intervessel pits alternate, contiguous, polygonal in cross section. *Xylem parenchyma* paratracheal, vasicentric, forming 1-2 layered sheath round the vessels; cells tubular to rectangular, r.d. 5 μ , t.d. 13 μ , length 26 μ ; walls with simple, circular pits of 3 μ diameter. *Secondary xylem rays* absent. *Xylem fibres* libriform, hexagonal to radially stretched in cross section, r.d. 11 μ , t.d. 8 μ , length 205 μ ; radial and tangential walls with single vertical row of bordered pits. *Phloem patch* (72 \times 252 μ), enclosed in a lunate fibrous cap on cortical side; two consecutive fibre caps somewhat marginally fused forming more or less continuous lobed fibrous cylinder; outer part of fibrous cylinder with 1-2 discontinuous rows of highly thick walled sclerotic cells. *Pith* 3 mm in diameter, centrally hollow.

Holotype—Department of Botany, Shivaji University Museum No. 218.

Locality—Nawargaon, Wardha District, Maharashtra.

Horizon—Deccan Intertrappean Series.

Age—Early Tertiary (probably Eocene).



REFERENCES

- HOOKEE, J. D. (1879). *The Flora of British India*. Vol. 2. L. Reeve and Co., London.
- HUTCHINSON, J. (1964). *The Genera of Flowering Plants (Angiospermae)*. *Dicotyledons*. Vol. I. Clarendon Press, Oxford.
- METCALFE, C. R. & CHALK, L. (1950). *Anatomy of the Dicotyledons*. Vol. I & II. Clarendon Press, Oxford.
- SAHNI, B. (1954). *Revision of Indian fossil plants. Part III—Monocotyledons*. Monogr. Birbal Sahni Inst. Palaeobot., Lucknow.
- SHUKLA, V. B. (1941). Central Provinces (Intertrappean beds). Palaeobotany in India 2. *J. Indian bot. Soc.* 20 (1, 2): 6.
- SHUKLA, V. B. (1946). *Palmoxylon sclerodermum* Sahni from the Deccan Intertrappean beds of Nawargaon, Wardha district, C. P. *J. Indian bot. Soc.* 25 (3): 105-116.

EXPLANATION OF PLATE 1

Aristolochioxylon prakashii gen. et sp. nov.

1. Cross section of the wood, $\times 10$.
2. A sector of cross section of the wood magnified showing cellular and hollow part of the pith, vascular strips alternating with medullary rays and a lobed pericyclic sclerotic cylinder towards periphery, $\times 17$.
3. The same magnified showing secondary xylem strips along with primary xylem elements and a portion of the cellular part of pith, $\times 50$.
4. Peripheral part of vascular strips magnified showing lunate patches of pericyclic sclerenchyma capping the secondary phloem patches (phloem tissue not preserved), $\times 50$.
5. Cross section showing cellular details of the pith, $\times 50$.
6. Wood fibres in longitudinal section showing bordered pits, $\times 150$.
7. The same magnified, $\times 400$.