

Rhodopathodendron tomlinsonii gen. et sp. nov., an araceous viny axis from the Nawargaon intertrappean beds of India

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ABSTRACT

Bonde SD 2000. *Rhodopathodendron tomlinsonii* gen. et sp. nov., an araceous viny axis from the Nawargaon intertrappean beds of India. Palaeobotanist 49(1) : 85-92.

Rhodopathodendron tomlinsonii gen. et sp. nov. a monocotyledonous viny axis has been described from the Deccan intertrappean beds exposed at Nawargaon, Wardha District, Maharashtra, India. The fossil represents a thin aerial stem, endogenous roots and leaf sheaths. Externally it shows scars of roots. Broad and well differentiated cortex of the stem with a distinct vascular system and trichosclereids; vascular region with compact arrangement of amphivasal, compound and trace bundles and angular vessels suggest its close resemblance with *Rhodospatha* (Subfamily - Monsteroideae) of Araceae.

Key-words—*Rhodopathodendron*, Araceae, Petrifications, Deccan Intertrappeans (India).

भारत के नवरगाँव अन्तर्द्रुपीय संस्तरों से प्राप्त *रोडोस्पेथोडेन्ड्रॉन टॉमलिन्सोनियाइ* नव वंश एवं नव प्रजाति की एक एरोशियस द्राक्ष धुरी

एस.डी. बोन्डे

सारांश

भारत के महाराष्ट्र प्रान्त के वर्धा जनपद स्थित नवरगाँव से अनावरित दक्खन अन्तर्द्रुपीय संस्तरों से *रोडोस्पेथोडेन्ड्रॉन टॉमलिन्सोनियाइ* नव प्रजाति/एवं नव वंश की एक एकबीजपत्री लतास्तंभ अभिलक्षणित की गई है। इसका पादपाश्वर एक पतला वायवीय तना, अन्तर्जात जड़ें तथा पर्णच्छद प्रदर्शित करता है। बाहर से यह जड़ों के चिह्न प्रदर्शित करता है। सुस्पष्ट संवहन तंत्र एवं त्रिअरीय वृद्धक एवं सुविभेदित वल्कुट (कॉर्टेक्स), फ्लोएम का सुसंहत विन्यास एवं केशवत्तुद्ध कोशिका संयुक्त एवं अनुरेखित बंडल तथा कोणीय वाहिकाएँ इनकी एरेसी के *रोडोस्पेथा* (उपकुल - मॉन्स्टीरॉयडी) के साथ निकटस्थ समरूपता प्रस्तावित करती हैं।

संकेत शब्द—*रोडोस्पेथोडेन्ड्रॉन*, एरेसी, अशमीभवन, दक्खन अन्तर्द्रुपीय (भारत)।

INTRODUCTION

ALTHOUGH majority of permineralized monocotyledonous have been assigned to family Araceae (*Palmoxylon* Schenk, 1882; *Rhizopalmoxylon* Felix, 1883; *Palmostroboxylon* Biradar & Bonde, 1979; *Parapalmocaulon* Bonde, 1987), quite a few of the specimens are identified as members of the Gramineae, Cyperaceae, Scitamineae, Agavaceae and Liliaceae. They have been attributed to *Culmites* (Brongniart, 1822; Paradkar, 1975; Bonde, 1986), *Rhizocaulon* (Saporta *In*: Heer, 1861), *Glycerioxylon* (Trivedi & Bajpai, 1982), *Elymus* (Patil & Singh, 1984), *Tomlinsonia* (Nambudiri *et al.*, 1978; Tidwell & Nambudiri, 1989, 1990), *Cyperaceoxylon* (Chitale & Patel, 1970), *Scirpusoxylon* (Shete, 1989), *Cyclanthodendron* (Sahni & Surange, 1953; Biradar & Bonde, 1990), *Dracaena* (Ambwani, 1982), and *Protocyperus* (Tidwell & Parker, 1990). *Viracarbon* fruits were shown to have affinities with modern genera of Araceae (Chitale, 1954; Prakash & Jain, 1963; Nambudiri *et al.*, 1978; Mahabale, 1979). The present paper describes *Rhodopathodendron tomlinsonii* gen. et sp. nov., an araceous stem from the Deccan intertrappean beds which constitute the first record from intertrappean beds.

MATERIAL AND METHODS

A silicified piece of stem about 8.5 cm in length and 1.5 cm in diameter was collected from the Deccan intertrappean beds exposed at Nawargaon (21°0' North and 78°35' East), Wardha District, Maharashtra, India. Several transverse and longitudinal sections of the wood were prepared by the usual thin section method to study the excellently preserved material. The sections were studied and photographed under the Nikon-LABOPHOT-2 microscope. Specimens are deposited in the repository of Botany Department, Agharkar Research Institute, G.G. Agarkar Road, Pune.

SYSTEMATICS

Family—ARACEAE

Subfamily—MONOSTEROIDEAE

Genus—RHODOSPATHODENDRON gen. nov.

RHODOSPATHODENDRON TOMLINSONII gen. et sp. nov.

Pl. 1·A, 1-6; Pl. 2·1-6.

Description—The present genus and species is based on a permineralized thin axis. It is entire, round, 8.5 cm long and 1.5 cm in diameter. Externally it shows a number of scars of detached roots and part of leaf sheaths (Pl. 1·A). Internally the axis exhibits three distinct regions: periderm, cortex and the vascular region. Number of endogenous root traces are also present in the cortical region. Leaf sheaths attached to the axis are also present (Pl. 1·1-2).

Stem axis—Periderm is thin, 62-125 μ m. The cells are thick-walled and compact. Cortex is 1.9-2.5 mm wide with well developed vascular system. The vascular bundles are both large and small, amphivasal, circular, with a single layered bundle sheath, and arranged in 3-6 series. Large vascular bundles are 234 x 234 - 306 x 270 μ m and small vascular bundles are 36 x 36 - 126 x 172 μ m in size. Phloem is not preserved and is generally represented by a cavity. Xylem is reduced, consisting 1 or 2 angular vessels, 6.8 x 6.8 - 13.6 x 17.0 μ m and xylem parenchyma enclosing the phloem. The bundle sheath is a single cell layer, encircling the vascular elements. The cells are sclerenchymatous and polygonal in cross section. The ground tissue is parenchymatous with thin-walled, 34 x 30.6 μ m cells. Some of the cells are occluded with dark deposit. Brachysclereids are abundant measuring 45.3 x 30.2 - 75.5 x 60.4 μ m (Pl. 1·3-4).

Vascular region—It is 9.4-10.6 mm in diameter. The vascular bundles are compactly arranged throughout the region. However, they are more crowded at the periphery, forming a thin vascular cylinder. The bundles are collateral, amphivasal and compound but mostly collateral and amphivasal at the periphery. The frequency of compound bundles is higher near the centre (Pl. 1·1-2). The collateral bundles are round to elongated, 234 x 193 - 268 x 252 μ m. The amphivasal bundles are 180 x 162 - 366 x 268 μ m. The compound bundles are irregular in shape depending upon the number and orientation of the fusing bundles. Each vascular bundle has a tangentially elongated phloem and 6-12 angular xylem vessels. Vessels are 63 x 55 - 71 x 34 μ m in diameter and show an oblique endplate with a large number (8-14) of cross bars. The encircling bundle sheath is single layered. The ground tissue is

PLATE 1



A & 1-6, petrified araceous stem - *Rhodopathodendron*.

- A. Petrified axis showing root scars - rs x 1
1. Cross section of the stem showing periderm, cortex and vascular region x 6.
2. Cross section enlarged, showing compact arrangement of vascular bundles x 10.
3. Cortical region showing amphivasal vascular bundles and

brachysclereides x 45.

4. The same showing corticle bundles with single layered bundle sheath, compact ground tissue and brachysclereids x 140.
5. Vascular region showing compact arrangement of vascular bundles x 60.
6. The same enlarged, showing amphivasal bundles with angular vessels x 140.

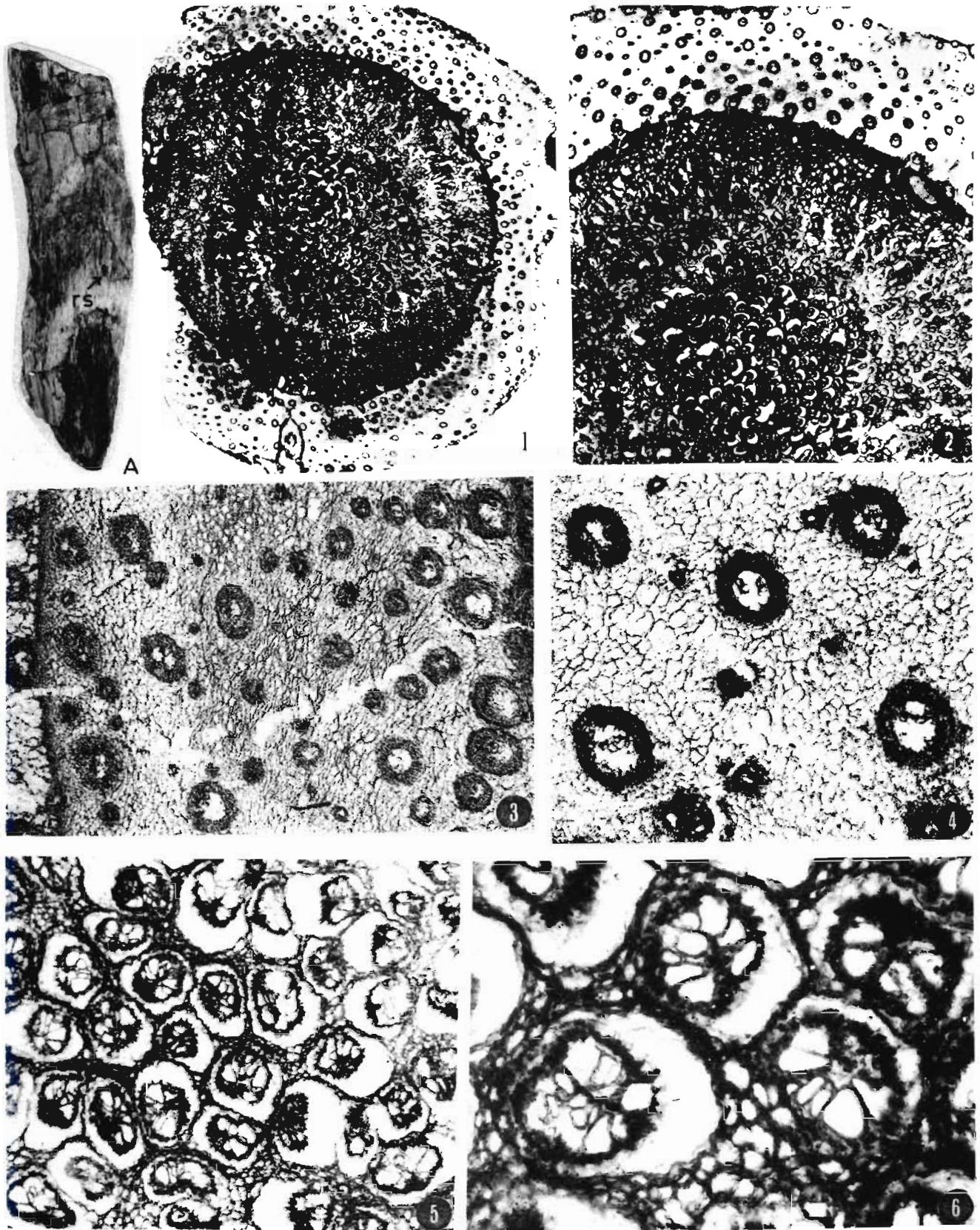


PLATE I

parenchymatous. The cells measure 20.4 x 30.6 - 40.8 x 51.2 μm (Pl. 1.5-6, Pl. 2.1, 3).

In the cortex, a number of branch initiations originating from the vascular region and supplying the branch proper at a higher level are present. Each branch initiation is formed of a group of compactly arranged vascular bundles (Pl. 2.2).

Root—Number of small, endogenous root traces have been observed in the cortical region. They are roughly circular in outline and range 850 x 935 - 1090 x 935 μm in size. Further they exhibit various developmental stages. The root trace bundle has a central vascular cylinder enclosing a small pith and has a wide cortex pierced by radiating air spaces. Epiblema and hypodermis could not be observed clearly but a thin dark strip of cells outlined the bundles. The cortex is differentiated into three distinct regions. Outer region is 3-5 celled in thickness having compactly arranged parenchyma cells. Inner zone is 2-5 cells thick with a characteristic endodermis as the innermost layer. In between them, middle cortex is characterised by radially stretched, thin-walled parenchyma enclosing radially elongated air chambers. Pericycle is not distinctly observed. The vascular cylinder consists of 18-26 xylem bundles alternating with phloem bundles and embedded in the small sized parenchymatous ground tissue. The xylem consists of a large, round metaxylem vessel, 170-234 μm in diameter and 1-2 small vessels in radial rows. The pith is composed of homogeneous, thin-walled parenchymatous tissue and devoid of medullary bundles (Pl. 2.4-5).

Leaf sheath—Leaf sheaths are triangular in shape and are adnate to the stem axis. Epidermis is seen only on the outer side, whereas the inner side is seen in continuation with the cortex. Epidermal cells are thin-walled, rectangular and measure 45 x 15 μm in size. Hypodermis is compact, 2-3 layered, with thick-walled cells, followed by inner aerenchymatous ground tissue. The aerenchyma cells are 19.4 x 12.6 μm in size and enclose elongated air spaces. The vascular bundles are few, randomly placed and 364 x 260 - 1169 x 418 μm in size. The vascular elements are highly reduced and represented only by of 1-2 small xylem vessels and an indistinguishable phloem group surrounded by a single celled thick bundle sheath. No fibre bundles, secretory cells or secretory canals were observed (Pl. 2.6).

COMPARISON AND DISCUSSION

Diagnostic features of the present stem are (i) thin, viny axis with aerial roots and spirally arranged leaves, (ii) triangular petiole with aerenchyma and reduced vascular elements, (iii) polystelic root trace bundles without medullary bundles, (iv) broad cortex differentiable into three zones, (v) amphivasal vascular bundles with reduced vascular elements, (vi) well developed vascular system composed of amphivasal, collateral and compound bundles, (vii) vessels angular, and (viii) occurrence of brachysclereids in the cortex. These characters suggest its affinity with the family Araceae.

Fossil history of Araceae

Araceous fossil remains have been described as leaves, spadices, infructescence and seeds. *Araceophyllum* sp. Kräusel (1929), *Anthuriophyllum* sp. Weyland (1957), *Philodendron limnestis* Dilcher and Daghlian (1977) and *Peltandra* Hickey (1977) are the leaves. *Acorites* sp. Crepet (1978), *Araceacites* Fritel (1910) and *Acoropsis eximia* (Goepfert *et* Menge) Bogner (1976) are the spadices and *Aracistrobus* sp. (Nikitin) Gregor and Bogner (1989) is the infructescence. Isolated araceous seeds have been referred to a number of extinct and extant genera such as *Acorus*, *Araceites*, *Aracispermum*, *Arisaema*, *Caladiosoma*, *Calla*, *Cyrtospermites*, *Epipremnites*, *Epipremnum*, *Lysichiton*, *Orontium*, *Pistia*, *Scindapsites*, *Scindapsus*, *Stenospermation*, *Urospathites*, etc. (Gregor & Bogner 1984, 1989; Madison & Tiffney, 1976; van der Burgh, 1978).

Sahnipushpam shuklae Verma (1956) is a small flower from the Deccan intertrappean beds with uncertain affinities. Prakash and Jain (1963) have suggested its affinity with Araceae on the structure of anther wall and anisopolar monocolpate boat shaped pollen grains. However, Thanikaimoni (in: Gregor & Bogner, 1989), Daghlian (1981) and Bogner (personal communication) have doubted its affinity with Araceae and emphasised the need of further work on anatomy and pollen studies of *Sahnipushpam shuklae*.

Comparison with extant Araceae

Araceae is one of the large tropical families having about 2000 species belonging to 105 genera and 9 subfamilies. They show considerable morphological diversity as climbers, vines, erect subarborescent forms, or cormous geophytes. The nine

PLATE 2



1-6. Petrified araceous stem - *Rhodospathodendron*.

1. Cross section of the stem showing formation of the branch initiation at the periphery of the vascular region x 140
2. Cross section showing a branch initiation in the cortex having compact arrangement of vascular bundles x 140
3. L.S. showing vessels and ground tissue x 140.

4. Cross section showing root initiation x 60.
5. The same showing emergence of a young root through cortex x 60.
6. Cross section showing a leaf sheath adnate to the cortex characterised with small fibrovascular bundles and aerenchymatous ground tissue x 60.

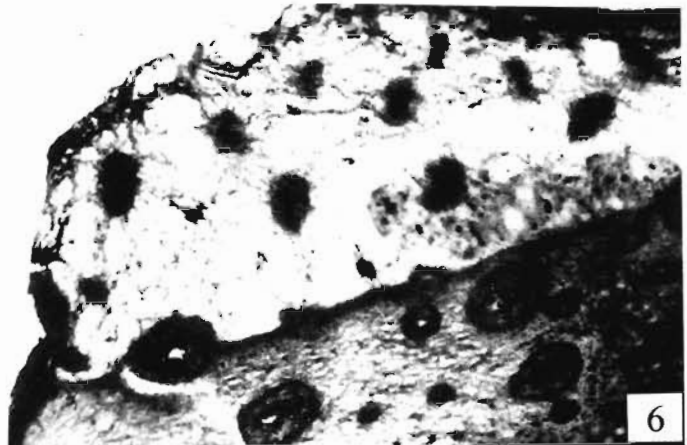
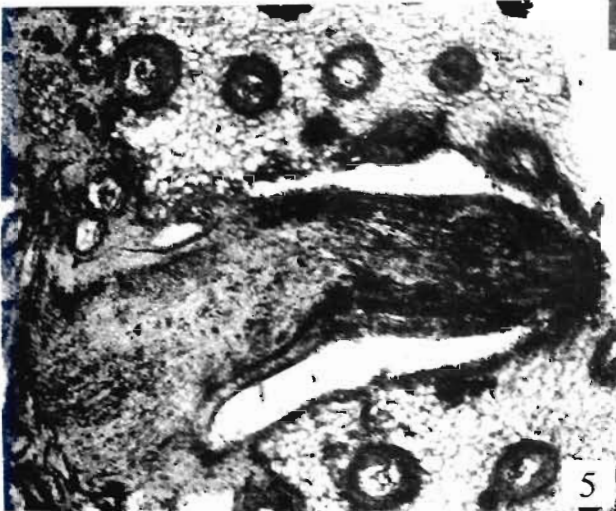
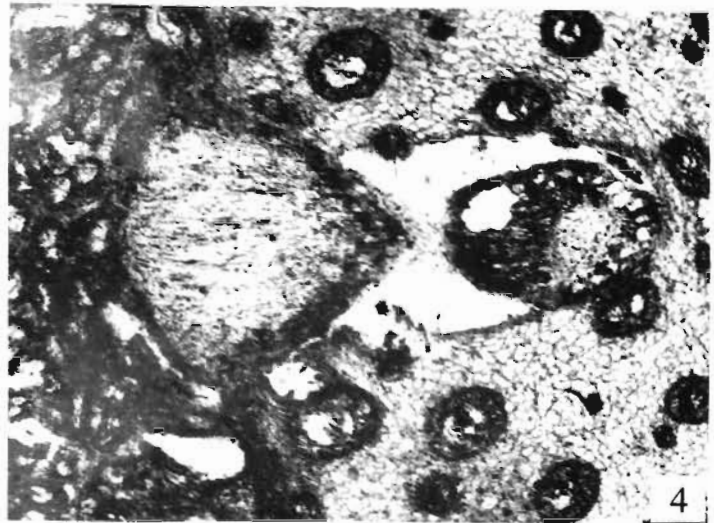
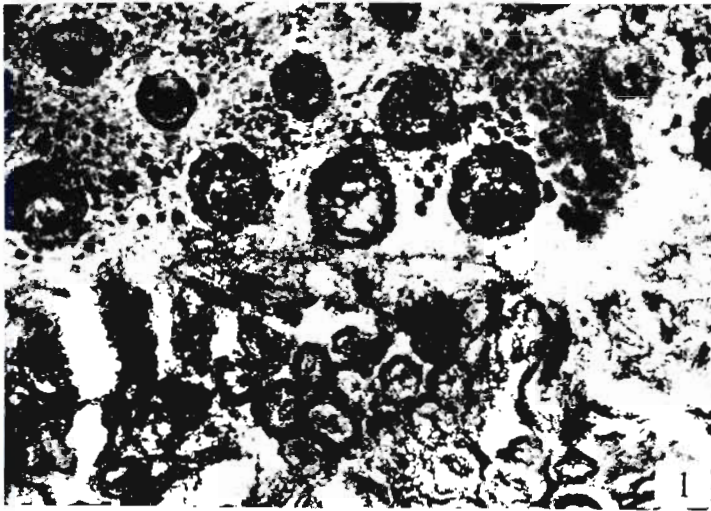


PLATE 2

subfamilies are Gymnostachydoideae, Pothoideae, Monsteroideae, Calloideae, Lasioideae, Philodendroideae, Colocasioideae, Aroideae, and Pitioidae (Bogner, 1979; Bogner & Nicolson, 1991). The viny forms, however, occur only in Pothoideae, Monsteroideae, Lasioideae, Philodendroideae and Colocasioideae.

Araceae is one of the monocotyledonous families which has comprehensively been investigated anatomically (Doshi, 1985; French, 1986; French & Tomlinson, 1980, 1981, a, b, c, 1983, 1984; Nicolson, 1960; Rao, 1977). Occurrence of amphivasal bundles in the present fossil suggests its resemblance with *Pothos*, *Pothidium*, *Rhodospatha*, *Epipremnum*, *Rhapidophora*, *Amydrium*, *Scindapsus*, *Monstera*, *Alloschemone*, *Zamioculcas*, *Montrichardia*, *Philodendron* and *Dieffenbachia*. However, occurrence of compound bundles along with amphivasal bundles in the present fossil shows its resemblance with *Cercestis*, *Stenospermation*, *Montrichardia*, *Philodendron*, *Dieffenbachia*, *Zamioculcas* and *Rhodospatha* (French & Tomlinson, 1986).

Stenospermation is an epiphyte with short erect stem. It differs from the fossil in having a single series of vascular bundles in a narrow cortex and a sclerotic region in between the cortex and vascular cylinder. *Zamioculcas* has a rhizomatous underground stem. Having a narrow cortex, uniform distribution of vascular bundles in both cortex and vascular regions, and poorly developed vascular elements, it is not comparable. Moreover, there is no bundle sheath in *Zamioculcas*. *Cercestis*, having a single series of vascular bundles, secretory canals and laticifers in the cortex and a single metaxylem vessel in the vascular bundles, is also taken out. *Montrichardia* is an aquatic genus with sympodial rhizome, characterized by a single series of vascular bundles in the cortex, aerenchymatous ground tissue with idioblast cells, and bi- tri- or tetra- polar vascular bundles differs from the present fossil. *Philodendron* is a very large genus having about 350 species, which are generally scandant or arborescent forms. However, *P. maxicanum*, *P. seguine*, and few others are the root climbers. These species differ from the fossil by having a single series of collateral vascular bundles and resin and mucilage canals in the cortex. *Dieffenbachia* is an erect herb. It contrasts from the fossil in having bi-tri or tetra polar compound bundles. Moreover, there is no bundle sheath in *Dieffenbachia*. *Rhodospatha* having a wide cortex with 3-4 series of vascular bundles, well developed bundle sheath, reduced vascular tissue, small angular vessels and trichosclereids, shows affinities with our specimen. This fossil has further similarity with *Rhodospatha* in having a central vascular cylinder with compact arrangement of collateral, amphivasal, and compound bundles and a large number of angular metaxylem vessels.

The present fossil thus matches best with *Rhodospatha*. It is a root climber flourishing well in the humid climate of Central and tropical South America. It has a shoot system developed as a polyphyllus sympodium having roots restricted at the nodes. The present fossil form has been named as *Rhodospathodendron tomlinsonii* gen. et sp. nov. in honour of Dr Parl Barry Tomlinson, who is known for his work on the anatomy of monocotyledons.

GENERIC DIAGNOSIS

RHODOSPATHODENDRON gen. nov.

Stem—viny with spiral phyllotaxy and aerial roots.

Cortex—broad; vascular system well developed. Vascular bundles in 3-6 series, vascular elements reduced, trichosclereids abundant.

Vascular region—compact arrangement of amphivasal, collateral and compound bundles. Vessels many, angular.

Type species—RHODOSPATHODENDRON TOMLINSONII gen. et sp. nov.

Specific Diagnosis

Stem—thin, viny; nodes and internodes indistinct, leaf and root arrangement spiral.

Periderm—thin, 62-125 μm .

Cortex—broad, 1.9-2.5 mm in 3-6 series; Vascular bundles variable in size; small bundles 36 x 36 - 126 x 172 μm , large bundles 234 x 234 - 306 x 270 μm ; bundle sheath single layered; vascular elements reduced.

Vessels—small, angular, 6.8 x 6.8 - 13.6 x 10.2 μm , phloem band elongated. Brachysclereids abundant.

Vascular region—wide; vascular bundles amphivasal, collateral and compound; compact arrangement at the periphery. Compound bundles variable in size and shape, uniformly distributed.

Vessels—many, large, angular, 63 x 55 - 71 x 34 μm .

Holotype—N/105, Botany Department, Agharkar Research Institute, G.G. Agarkar Road, Pune.

Locality—Nawargaon, Wardha District, Maharashtra, India.

Horizon—Deccan Intertrappeans.

Age—Uppermost Cretaceous (Late Maastrichtian).

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