

A Fossil Polypodiaceous Rhizome *Thayeriorhizomoxylon chandraii* gen. et sp. nov. from Deccan Intertrappean beds of Wardha District, Maharashtra

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Thayeriorhizomoxylon chandraii gen. et sp. nov. a fossil polypodiaceous rhizome showing close affinity with the genus *Thayeria* of the family Polypodiaceae has been described here from the Deccan Intertrappean beds of Nawargaon located in Arvi Tehsil of Wardha district. This is the first polypodiaceous rhizome to be described from Deccan Intertrappean exposures of India.

Key-words—Fossil rhizome, *Thayeriorhizomoxylon*, Deccan Intertrappean, Maharashtra, India.

INTRODUCTION

DECCAN Intertrappean exposures of Nawargaon are quite rich in dicotyledonous and monocotyledonous remains (Bande 1987, Bonde 1996). So far no Cryptogams have been reported from this region. A new polypodiaceous rhizome has been described here for first time in the present communication.

Pteridophyta

Class – Pteropsida

Order – Filicales

Family – Polypodiaceae

Genus – *Thayeriorhizomoxylon* gen. nov.

***Thayeriorhizomoxylon chandraii* sp. nov.**

(Text - figs 1 to 5; Pl. 1, figs 1 – 10; Pl.2, figs 1-6)

External Features

The present fossil is a petrified pteridophytic branched rhizome with numerous roots and leaf sheaths, clumped together (Pl.1, figs 1 & 2). The specimen is brownish externally as well as internally, about 11 cms in length and 10 cms in width. The branches are of different thickness (2.6 x 1.9 cm, 3.5 x 2.5 cm in diameter) and run in different directions. In the present work anatomy of rhizome and root has been included.

ANATOMICAL DESCRIPTION

Rhizome—For anatomical details series of transections of rhizome were prepared. In gross structure, it was found that the arrangement of vascular strands was different at different levels of rhizome. The vascular cylinder is a “false dictyostele” i.e. highly dissected by numerous lacunae and thus forms a loose reticulum similar in basic plan of construction to that of other living Polypodiaceae (Nayar & Chandra 1965, 1967; Chandra 1982). The cross section of rhizome is trigonous to circular in outline (Pl. 1, fig. 3). The epidermis and hypodermis are not preserved. The ground tissue is homogeneous (Pl. 1, fig. 4) and consists of elongated thin walled parenchyma cells, which appear circular in transection. The parenchyma cells are 168 µm long and 56 µm wide in longitudinal section. The ground tissue contains about 67-102 vascular strands. The vascular strands in cross section appear in 3 rows and are bent like horse-shoe with the concavity facing the dorsal surface of the rhizome (Text-fig. 2; Pl.1, fig. 1). At certain levels the vascular strands are bent like double horse-shoe, with concavity facing the dorsal surface (Text-fig 3; Pl.1, fig.2) i.e. the vascular cylinder becomes invaginated on the dorsal surface of the rhizome. This peculiar arrangement of vascular strands shows that the vascular bundles occur in two series forming an incomplete circle with a

broad gap on the dorsal surface. The two free margins of the gutter shaped vascular cylinder are folded, along the inner surface and juxtaposed towards the centre on the concave side. Thus, the vascular bundles in cross section appear in a double row and are bent like a horse shoe with the concavity facing the dorsal surface of the rhizome. About 15-20 cortical bundles are arranged in an incomplete circle (Text-fig. 2). The vascular strands of outer row are arranged more closely than the strands of inner row. The outermost row of vascular strands is incompletely preserved in the fossil, hence it was not possible to count the exact number of vascular strands in it. The distances between two neighbouring vascular strands in the outer row is not constant. It varies between 168-490 μm . The middle row of vascular strands is nearly triangular in shape (Text-fig. 2) and contains 36-38 vascular strands in those section which show only one horse-shoe shaped bent and 56-60 vascular strands in those sections which show two horse-shoe shaped bents (Text-fig. 3). The vascular strands are 140-350 μm apart from each other. The innermost row which shows single horse-shoe shaped bent contains 26-29 vascular strands (Text-fig. 2) while the innermost row showing two horse-shoe shaped bents contains 20-21 vascular strands in each horse-shoe bent (Text-fig. 3). The vascular strands of inner row become continuous with the strands of the middle row. These are spaced 140-240 μm apart from each other.

Every vascular strand is oval to circular in outline nearly uniform in size and has a massive sclerenchymatous sheath (Pl. 1, figs. 5 to 9) as reported in some living drynarioid ferns (*Aglamorpha pilosa*, *A. splendens*, *A. meyencans*, *Photinopteris* and *Thayeria cornucopia*, Chandra 1982). The sclerenchymatous sheath is usually 4-8 layered and 70-140 μm in thickness in cross section. It is thicker towards the dorsal and ventral side of the vascular strands than the lateral sides.

Each vascular bundle is nearly uniform in size. The xylem tissue is 2 to 5 cells thick and tracheidal and has a patch of angular xylem tracheids (Protoxylem)

on the outer surface of the xylem strand, which takes up various shapes like circular, triangular to broad arch fashion. The metaxylem tracheids are 70-80 μm in diameter and protoxylem tracheids are 28-35 μm in diameter. The metaxylem tracheids have scalariform lateral wall pitting (Pl. 1, fig. 10). The phloem tissue is presumably restricted to either surface of the xylem tissue and is interrupted at either end. The vascular bundles are of a concentric type (amphicribal), (Pl. 1, fig. 5-8).

Root—In cross section outline of root is circular (Text-fig. 4). Epiblema is single layered and made up of squarish to rectangular cells (Text fig. 5); cortex is divided into two zones (Text-figs 4,5; Pl.2, fig. 6); outer cortex is parenchymatous and 560 μm thick, inner cortex is sclerenchymatous, 12 to 13 celled and 480 μm in thickness (Text-fig 5; Pl. 2, figs 2,4). Between inner and outer cortex there is 1-2 layered exodermis made up of thick walled cells (Text-fig. 4; Pl. 2, fig. 6). Inside the inner cortex single layered endodermis is well preserved (Text-fig. 5; Pl.2, fig.2), cells are elongated. Pericycle is also single layered. The centre of the root is occupied by triradiate, exarch xylem (Text-fig. 5; Pl.2, fig. 2). Xylem archs are alternating with phloem, xylem is compact. Xylem consists of large polygonal metaxylem elements (80 μm diameter) in the center and small polygonal protoxylem elements (32 μm diameter) at the periphery (Text-fig. 5; Pl.2, figs 3 & 5). Large xylem elements are alternating with large phloem elements (Pl.2, fig.3) consisting of sieve elements. Sieve elements are surrounded by companion cells (Text-fig. 5).

Diagnostic Features

1. The vascular cylinder of rhizome is a "false dictyostele".
2. Arrangement of vascular strands in cross section appears in three incomplete circles.
3. Vascular strands are arranged in specific "horse-shoe" manner.
4. Each vascular strand is with a massive sclerenchymatous sheath around it.

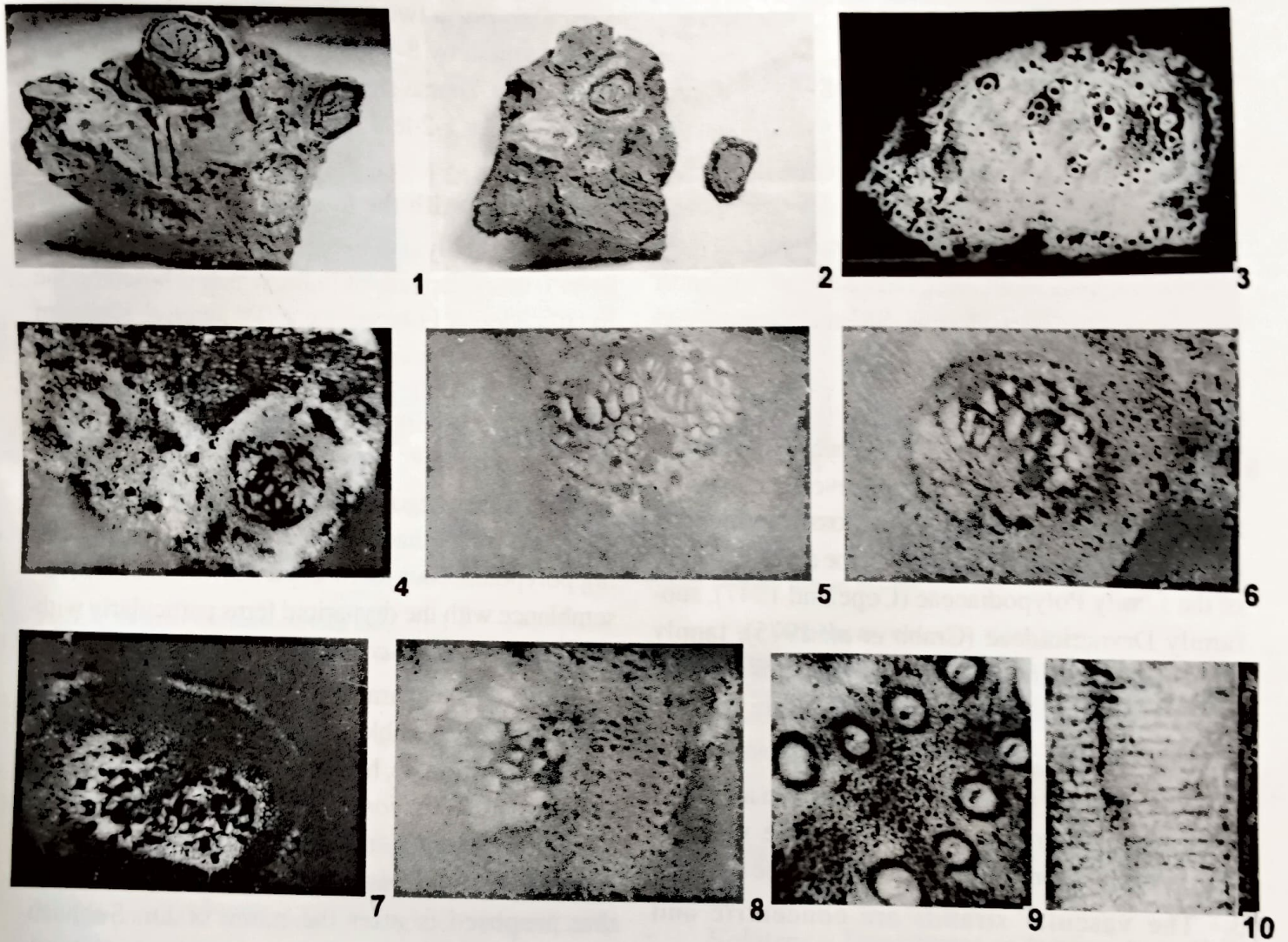


PLATE 1

Figs 1 - 10. *Thayeriorhizomoxylon chandraii* gen. et sp. nov.

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| <p>Fig. 1. Original specimen showing arrangement of vascular strands in three rows and inner single horse-shoe bent x 0.75</p> <p>Fig. 2. Original specimen showing two horse-shoe bents x 0.64</p> <p>Fig. 3. Cross section showing the arrangement of the vascular strands in three rows x 2.38.</p> <p>Fig. 4. Vascular strands with parenchymatous ground tissue x 106.</p> <p>Figs 5,6. Concentric vascular strands showing the xylem elements x 189.</p> | <p>Fig. 7. Vascular strand showing the sclerenchymatous bundle sheath x 189.</p> <p>Fig. 8. Vascular strand showing xylem elements x 189.</p> <p>Fig. 9. Typical horse-shoe shaped arrangement of the vascular strands in the inner row and ground parenchyma x 74.</p> <p>Fig. 10. Metaxylem tracheids showing scalariform lateral wall pitting x 666.</p> |
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5. The vascular bundles are of concentric and hadrocentric type.
6. Xylem tissue consists of sclerenchymatous tracheids.
7. Ground tissue is homogeneous and parenchymatous.
8. Roots are adventitious and arise from the surface of the rhizome. The cortex of the root is differentiated into outer parenchymatous and inner sclerenchymatous zones. Between outer and inner cortex there is exodermis. Stellar organisation is protostelic.

Affinities with the living

A critical survey of literature pertaining to anatomy of different pteridophytic groups reveals that the diagnostic features exhibited by the fossil are found in combination only in the rhizomes of the drynarioid ferns of the family Polypodiaceae (Copeland 1947), subfamily Drynarioideae (Crabb *et al.* 1975), family Drynariaceae (Ching 1940). Drynarioid ferns are characterised by the following diagnostic feature :

1. The vascular cylinder is a "false dictyostele".
2. The vascular strands in a cross section appear in a row and are bent like horse-shoe with the concavity facing the dorsal surface of the rhizome.
3. The vascular strands are concentric and hadrocentric.
4. The xylem tissue two to five cells thick and tracheidal.
5. The ground tissue is homogeneous and parenchymatous.
6. The cortical cells surrounding the endodermis have thick opaque deposits of yellow to brown black phlobaphene or two to eight celled thick sclerenchymatous sheath.
7. The phloem tissue is restricted to either side of the xylem.

The peculiar arrangement of vascular strands found in the rhizome of the present fossil is compara-

ble to vascular strands of the rhizome of *Drynariopsis*, *Pseudodrynaria* and *Thayeria* of the family Drynariaceae (Chandra 1982). In *Drynariopsis* and *Pseudodrynaria* two horse-shoe shaped concavities are separated by 8-9 leaf trace strands, however in *Thayeria* two horse-shoe shaped concavities are separated by only 1-2 leaf trace strands like the present fossil.

Comparison with the fossil

There is only one fossil report of Polypodiaceae from Tertiary deposits of India, which is based on the fructification of Polypodiaceae (Phadtare & Kulkarni 1979). No polypodiaceous fossil rhizome has been described so far therefore this is the first report of occurrence of polypodiaceous rhizome from the Tertiary deposits of India.

From the foregoing facts it seems that the present fossil is a polypodiaceous rhizome. Amongst the living polypodiaceous members it shows maximum resemblance with the drynarioid ferns particularly with the genus *Thayeria cornucopia* Copel.

Most of the characters exhibited by the present fossil rhizome resemble with the genus *Thayeria* of the family Drynariaceae, hence it is proposed to designate this fossil as *Thayeriorhizomoxylon* a new genus. Accordingly a new taxa has been proposed as *Thayeriorhizomoxylon chandrai*. The specific epithet proposed is after the name of Dr. Subhash Chandra, Scientist, National Botanical Research Institute, Lucknow (India) who has made significant contributions to the vascular studies of living pteridophytes. This is the first report of occurrence of polypodiaceous rhizome from Nawargaon-Maragsur locality.

Generic Diagnosis

Thayeriorhizomoxylon gen. nov.

A pteridophytic rhizome densely covered with adventitious roots and leaf sheath. It is trigonous to circular in outline. The vascular cylinder is a "false dictyostele". The vascular strands in a cross section appear in 3 rows and are bent like a horse-shoe with the concavity facing the dorsal surface of the rhizome.

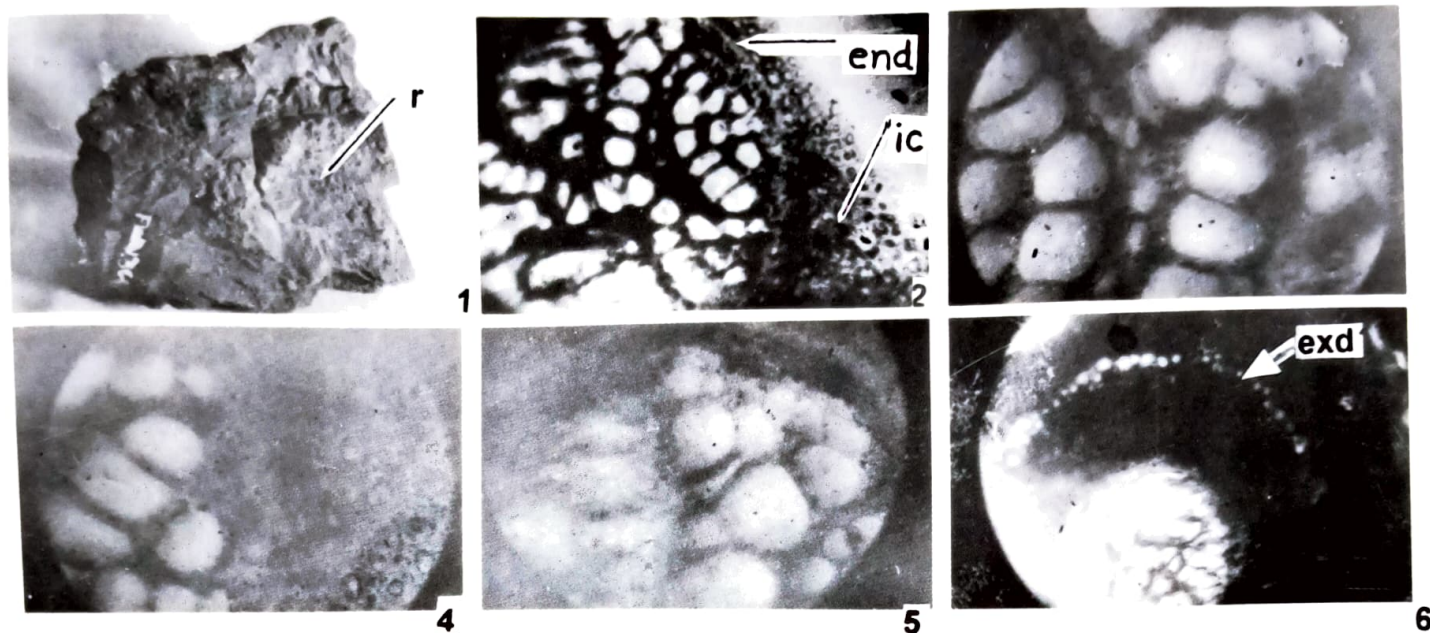


PLATE 2

Figs. 1-6. Root of *Thayeriorhizomoxylon chandraii* gen. et sp. nov.

- Fig. 1. Original specimen showing roots - **r** x 6
 Fig. 2. Cross section of root showing inner cortex - **ic**, endodermis **end** and stele x 94.
 Fig. 3. Metaxylem elements x 406.
 Fig. 4. Cross section of root showing sclerenchymatous inner cor-

- tex and phloem elements x 406.
 Fig. 5. Protoxylem elements x 406
 Fig. 6. Cross section of root showing exodermis - **exd**, inner cortex, outer cortex and stele x 196.

Each vascular strand has a sclerenchymatous sheath. The vascular strands are concentric and hadrocentric. Xylem consist of tracheids. Ground parenchyma lacks intercellular spaces.

Specific Diagnosis

Thayeriorhizomoxylon chandraii gen. et sp. nov.

Vascular strands in a cross section are arranged in three rows. There are 26-29 vascular strands in single horse-shoe bent and section with two horse-shoe bent contain 20-21 vascular strands in each horse-shoe bents. Each vascular strand is surrounded by 4-8 layered sclerenchymatous sheath. Most of the vascular strands are of concentric, hadrocentric type. The largest xylem element with scalariform wall pitting, metaxylem elements 70x56 μm in diameter, while protoxylem elements 28 μm in diameter. Ground pa-

renchyma cells thin walled 56 μ in width and 168 μm in height.

Holotype - Department of Botany, Smt. K.W. College, Sangli Museum No. - FWN364.

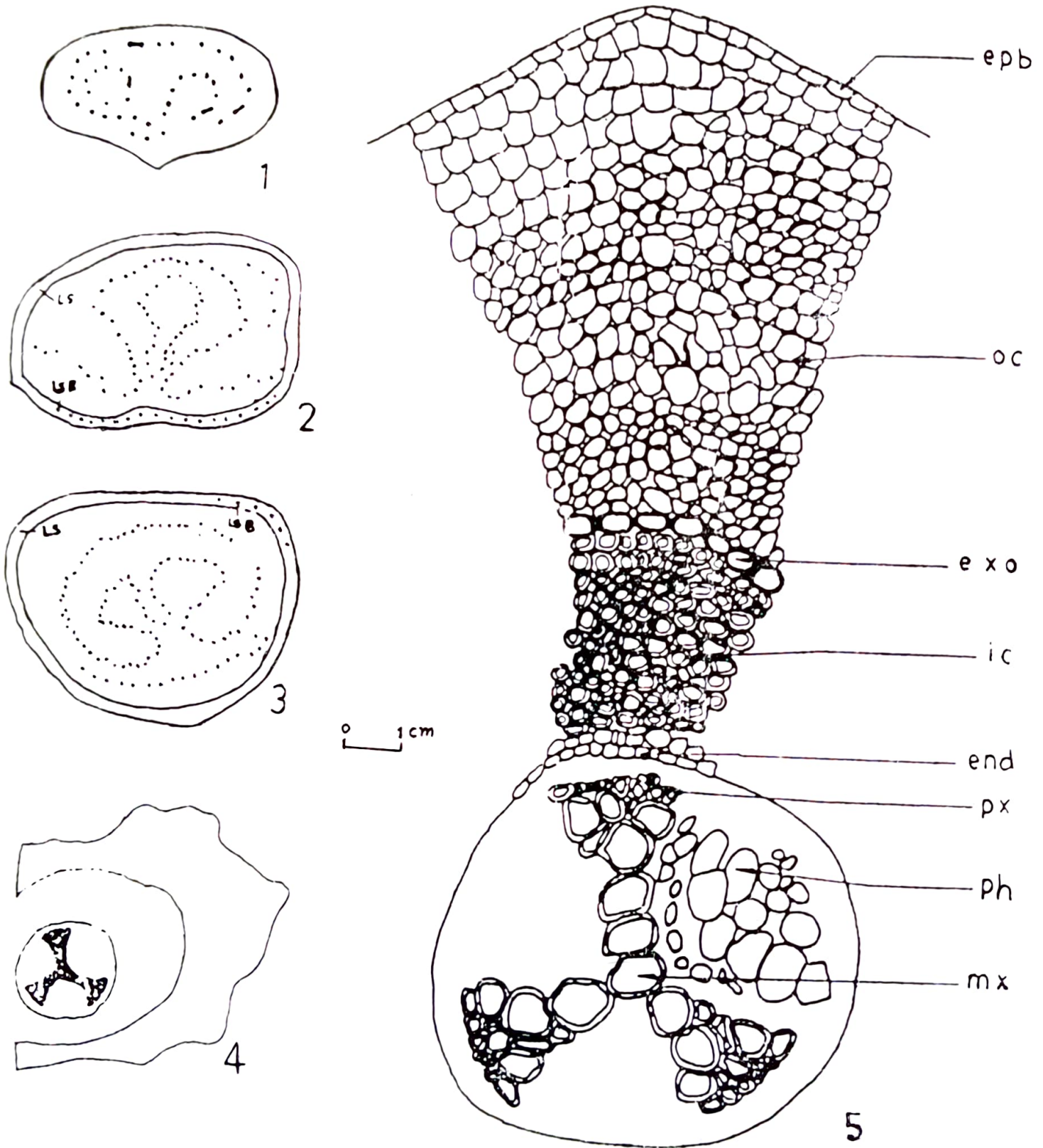
Locality - Nawargaon, Wardha district, Maharashtra.

Horizon - Deccan Intertrappean Series.

Age - Late Cretaceous-Palaeocene.

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Text-figs 1-5. *Thayeriorhizomoxydon chandraii* gen et sp. nov.

Fig. 1 : Outline of the transections of the vascular strands of the adult rhizome showing configuration of the mensteles in *Thayeria* (after Chandra, 1982), Fig. 2, 3- Transections of *Thayeriorhizomoxydon chandraii* at different levels x NS, 2 – Transections of rhizome showing vascular bundles arranged in single omega shaped manner x 1.4 LS – Leaf Sheath, LSB – Leaf Sheath Bundle, 3- Transection of rhizome showing vascular bundles arranged in double omega shaped manner x Natural size, LS leaf sheath, LSB leaf sheath bundle. Fig. 4 – Transverse section of the adventitious root of *Thayeriorhizomoxydon chandraii* showing triarch xylem x 25., Fig. 5 – Sector of the root with stele x 100. Epb – epiblema, oc – Outer cortex, exd. – exodermis ic – inner cortex, end – endodermis, px – protoxylem elements, ph – phloem, mx – metaxylem elements

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