The Palaeobotanist 57(2008) : 443-448
0031-0174/2008 $2.00

A petrified female strobilus from Mohgaonkalan, Madhya Pradesh, India

E.V. UPADHYE, J.A. TIDKE* AND G.V. PATIL

Department of Botany, Shri Shivaji College, Shivaji Park, Akola.
**Department of Botany, Sant Gadge Baba Amravati University, Amravati.*
Email: jaikirantidke@rediffmail.com

(Received 17 November, 2006; revised version accepted 19 October, 2008)

ABSTRACT

Upadhye EV, Tidke JA & Patil GV 2008. A petrified female strobilus from Mohgaonkalan, Madhya Pradesh, India. The Palaeobotanist 57(3) : 443-448.

A conifer female strobilus is described from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh, India. The description is based on two specimens exposed tangentially in silicified cherts. The female strobilus shows many bract scales arranged in a compact helix around the central axis. In the axil of each bract scale there is a dwarf shoot bearing a group of six megasporophylls with two inverted ovules on each, arranged spirally on condensed axis. The occurrence of dwarf shoot in the present cone distinguishes it from the earlier reported cones.

Key-words—Female conifer strobilus, Mohgaonkalan, Intertrappean beds, India.

मोहगाँवकला, मध्य प्रदेश, भारत से प्राप्त एक अश्मीभूत मादा शंकु

ई.वी. उपाध्ये, जी.ए. टिडके एवं जी.वी. पाटिल

सारांश

मोहगाँवला, मध्य प्रदेश, भारत के दक्कन अंत:ट्रापीन संस्तरों से एक शंकुवृक्ष मादा शंकु वर्णित की गई है। सिलिकीभूत चर्टों में स्पर्शरेखीय रूप से अनावरित दो नमूनों पर यह वर्णन आधारित है। मादा शंकु केंद्रीय अक्ष के चहुँओर संहत कुंडलिनी में बहुत-से सहपत्र शल्क व्यवस्थित दर्शाते हैं। हरेक सहपत्र शल्क की धुरी में तनु अक्ष पर सर्पिल रूप से व्यवस्थित प्रत्येक दो प्रतिलोमित बीजांड सहित छः स्थूल बीजाणुपर्णों के समूल की एक बौनी पिंड दिकमान है। मौजूदा शंकु में बौने पिंड की प्राप्ति पहले अभिलिखित शंकुओं में फर्क है।

मुख्य शब्द—मादा शंकुवृक्ष शंकु, मोहगाँवकलाँ, अंत:ट्रापीन संस्तरें, भारत।

INTRODUCTION

THE two fossil cherts were collected along the border of a farm to the west of village Mohgaonkalan (Lat. 22°1'0" N: Long. 79°11'18" E) in Madhya Pradesh, India. These cherts exposed two female strobili of Coniferales in tangential planes. It is important to mention here that the occurrence of fossil gymnospermous cones is known only from the peninsular part of India. So far *Takaliostrobus, Indostrobus, Pityostrobus* (Sahni, 1931), *Mohgaostrobus sahnii* (Prakash, 1956, 1962) and *Harrisostrobus* (Chitaley & Sheikh, 1973) have been described from the Deccan Intertrappean sediments, which are considered to be Maastrichtian-Danian in age (Guleria & Srivastava, 2000).

Changing Scenario in Palaeobotany and Allied Subjects
Editor : J.S. Guleria

The present description of the female strobilus is based on two specimens exposed tangentially (Pl. 1.1, 2) one of them is 5.5 cm long and 1.8 cm wide. These two female strobili are embedded in brown silicified cherts. The material in peel sections gave good results for observations but could not reveal good cellular details of parts other than the ovules. The material was thoroughly studied by ground thin sections through different planes in serial orders.

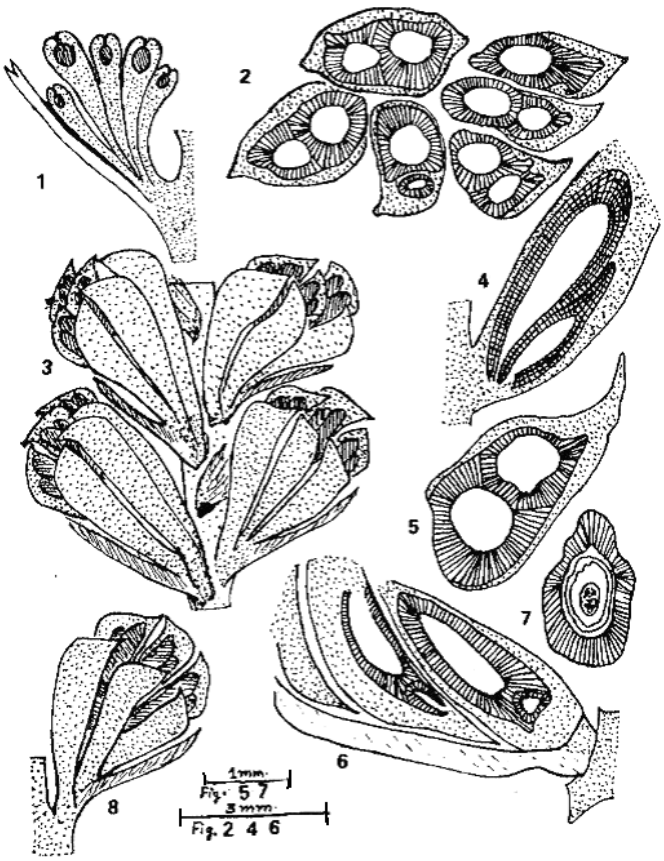


Fig. 1—*Ernestiodendron filiciforme* (Florin, 1951) A bifid bract scale with fertile appendages with terminal ovules (diagrammatic).

Fig. 2—A group of six megasporophylls in the T.S. of present specimen (Specimen No. MOH/EVU/6b).

Fig. 3—Part of female strobilus of (Specimen No. MOH/EVU/6b) with bract scales in helix on cone axis. Each bract with six megasporophylls (diagrammatic, reconstruction).

Fig. 4—Ovules in L.S. showing micropyle (Specimen No. MOH/EVU/6a).

Fig. 5—T.S. megasporophyll (O. scale) with pair of ovules and margin thining out on one side (Specimen No. MOH/EVU/6a).

Fig. 6—Part of female strobilus in L.S. showing axis, bract scale and three megasporophylls.

Fig. 7—T.S. ovule in present specimen showing endosperm in the form of patch in centre (Specimen No. MOH/EVU/6b).

Fig. 8—Part of female strobilus showing bract scale and six megasporophylls (O. scales) with ovules (diagrammatic reconstruction Specimen No. MOH/EVU/6a).

DESCRIPTION

(Pls 1.1-6; 2.1-6)

Each fossil female strobilus consists of peduncle, axis of strobilus, bract scale and dwarf shoots with megasporophylls (ovuliferous scales) bearing ovules. They are conical in shape and oval in cross section.

Peduncle—It is 5 mm long and 2.5 mm in diameter. It does not show proper preservation of tissue.

Axis of strobilus—While taking peel sections in longitudinal plane, it was exposed from base to apex. It measured about 4 cm in length and 2.4 mm in diameter. More details could not be worked out as no preservation could be seen in the axis of specimens. Vascular supply in the axis going to the dwarf shoots could only be observed as brown circular dots in T.S. and vertical lines in L.S.

Bract scale—Each strobilus has numerous scales arranged in a compact helix around central axis (Fig. 3). Each bract is narrow at the base (Fig. 6) somewhat broad in the middle region and tapers at apex again (Pl. 1.6; Fig. 5). These appear about 1 mm thick, 6-7 mm long and tapering at the distal end. In cross section attachment to the axis is not clearly seen. The tissue of bract scale is parenchymatous.

Megasporophylls (Ovuliferous scales)—In the axil of each bract scale there is a condensed dwarf shoot bearing megasporophylls.

One of the specimens (Specimen No. MOH/EVU/6a), exposed in tangential longitudinal and transverse planes, shows seven groups of megasporophylls (P1. 1.1, 3). Each group consists of six megasporophylls (P1. 1.3, 5; Figs 2, 8). Megasporophylls are spirally arranged showing their wings in different directions (P1. 1.3, 4 & Pl. 2.1, 2; Figs 2, 6, 8). Each megasporophyll is near about 12 mm long, 1.5 to 5 mm broad and 0.5-1.2 mm thick. Megasporophylls arise obliquely upward from the axis of dwarf shoot (P1. 1. 1, 4). It is obliquely placed, arm is 7-8 mm long and the part turned upward is 2-5 mm in length (Fig. 5). The megasporophyll consists of epidermis and parenchymatous ground tissue (P1. 2.5) and vascular supply is observed in it. The parenchymatous cells are irregularly elongated, thin walled with intercellular spaces. They are filled with some dark contents.

Ovules—The megasporophyll bears two inverted ovules on its upper major surface closer to the axis. Each ovule is 3-8 mm long and 1-2 mm thick, unequal in size, platispermic, broad in middle and tapers at both ends and found embedded in parenchymatous tissue of megasporophyll (Pl. 2.3; Fig. 4). They are unitegmic and integument is differentiated into three layers, out of which two layers are distinct (Pl. 2.4), varying 0.23-0.25 mm in thickness. The inner layer is 0.12 mm thick. Serial transverse sections confirm the unequal size of ovules (Pl. 2.6). Inner to the integument there is thin tissue of nucellus with megaspore membrane and the endosperm is seen in the centre (P1. 2.6; Fig. 7). In cross section ovule shows distinct ridges (P1. 2.6).

Morphology of female strobilus	*Mohgaostrobus sahnii* (Prakash, 1956, 1962)	*Harrisostrobus intertrappea* (Chitaley and Sheikh, 1973)	Present strobilus (Upadhye *et al.*)
Size of cone	2.5 x 2-2.1 cm 2.5 x 8.0 mm 10.0 x 10.5 mm	4.6 x 3.6 cm	5.5 x 2.0 cm 5.0 x 1.8 cm
Peduncle	14 mm long, 1.2-15 mm in diameter		0.5 mm long and 2 mm thick
Cone axis	2.0-2.5 mm in diameter	18-19 mm long (visible), 5-6 mm broad	About 4 cm long and 2.4 mm broad.
Bract scale	Absent	1.3 mm long, 8-10 mm broad, 0.8-1 mm thick.	6-7 mm long and 1.0 mm thick.
Dwarf shoot	Absent	Absent	Present with highly condensed axis with six ovuliferous scales megasporophylls arranged in spiral manner.
Ovuliferous scales	A group of 5-6 ovuliferous scales 7.0-9.5 mm long, 4-5 mm broad.	A group of six ovuliferous scales 10-12 mm long, part turned upward 3-4 mm long, 1.5-2.6 mm broad, 1.5- 2.5 mm thick.	A group of six ovuliferous scales, each about 12 mm long, 1.5-5 mm broad and 0.5-1.2 mm thick.
Ovules	Two per ovuliferous scale, unequal in size , 3.5-4.5 x 1.0-1.5 mm, unitegmic, integument differentiated into three layers, greater sclerotesta, fleshy layer of parenchyma on inner side and outer layer not determined. Integument 0.3-0.35 mm thick. Nucellus not seen Endosperm in small patches.	Two per ovuliferous scale, unequal in size, 4-8 mm long, and 1-2 mm thick, unitegmic, integument of three layers, outer soft and merged with ground tissue of ovuliferous scale, inner soft of parenchyma and middle one stony of sclerenchyma. Nucellus not seen. Endosperm not seen.	Two per ovuliferous scales unequal in size, 3-8 mm long and 1-2 mm thick, unitegmic. 0.28-0.37 mm thick differentiating into three layers, outer soft one merged with ground tissue of scale, inner 0.07-0.12 mm thick parenchyma and middle stony of sclerenchyma.0.23-0.25 mm thick. Nucellus forms thin layer outer to megaspore membrane. Endosperm in patches.
Protecting scale	Not observed, sterile scales present.	20 mm long, 8-10 mm broad, 0.286 mm thick.	Present, about 20 mm long, 6-8 mm broad and 0.2-1 mm thick.
Apical part of cone	Sterile	Sterile	Fertile

Fig. 9—Showing comparison of three Intertrappean female strobili from Mohgaonkalan, M.P., India.

DISCUSSION

The presently described female cone, characterized by spirally arranged bract scales, each with axillary dwarf shoot of ovule-bearing megasporophylls, belongs to Coniferophyta. However, because of this compound nature, it differs strikingly from the families of the modern Coniferales and resembles more with some members of Voltziales, viz. *Ernestiodendron* (Fig. 1). As in the present cone, the axillary dwarf shoot is highly reduced in *Ernestiodendron* comprising only 4-7 megasporophylls (Stewart & Rothwell, 1993). Among the conifer female cones described earlier from the Deccan Intertrappeans, *Mohgaostrobus* Prakash (1962) and *Harrisostrobus* Chitaley and Sheikh (1973) are comparable with the presently described cone. However, the existence of sterile bract scale is yet to be recovered in specimens of *Mohgaostrobus,* though a group of approximately six megasporophylls are apparently visible in Pl. 1.7 and 10 of Prakash (1962). In *Harrisostrobus,* ovuliferous scales have been described to occur in groups, with six scales in each group, though their organization into axillary dwarf shoot has been mentioned. A detailed study of the typed material of *Mohgaostrobus* and *Harrisostrobus* together with the above described cone is required for proper conclusions.

The present strobilus is compared with *Mohgaostrobus* (Prakash, 1956, 1961) and *Harrisostrobus* (Chitaley & Sheikh, 1973). These female strobili have many common characters such as presence of ovuliferous scales each bearing two ovules. The present specimen shows peduncle like *Mohgaostrobus* (Prakash, 1956, 1961) in which upper part is sterile and protecting scales are absent while the present specimen shows dwarf shoots with six megasporophylls arranged in a spiral manner.

In *Harrisostrobus* (Chitaley & Sheikh, 1973) dwarf shoots and upper fertile part is lacking, however, the ovules are of unequal size like the present specimen. Besides this there are morphological variations as regards to the size of various parts of the cone (Fig. 9).

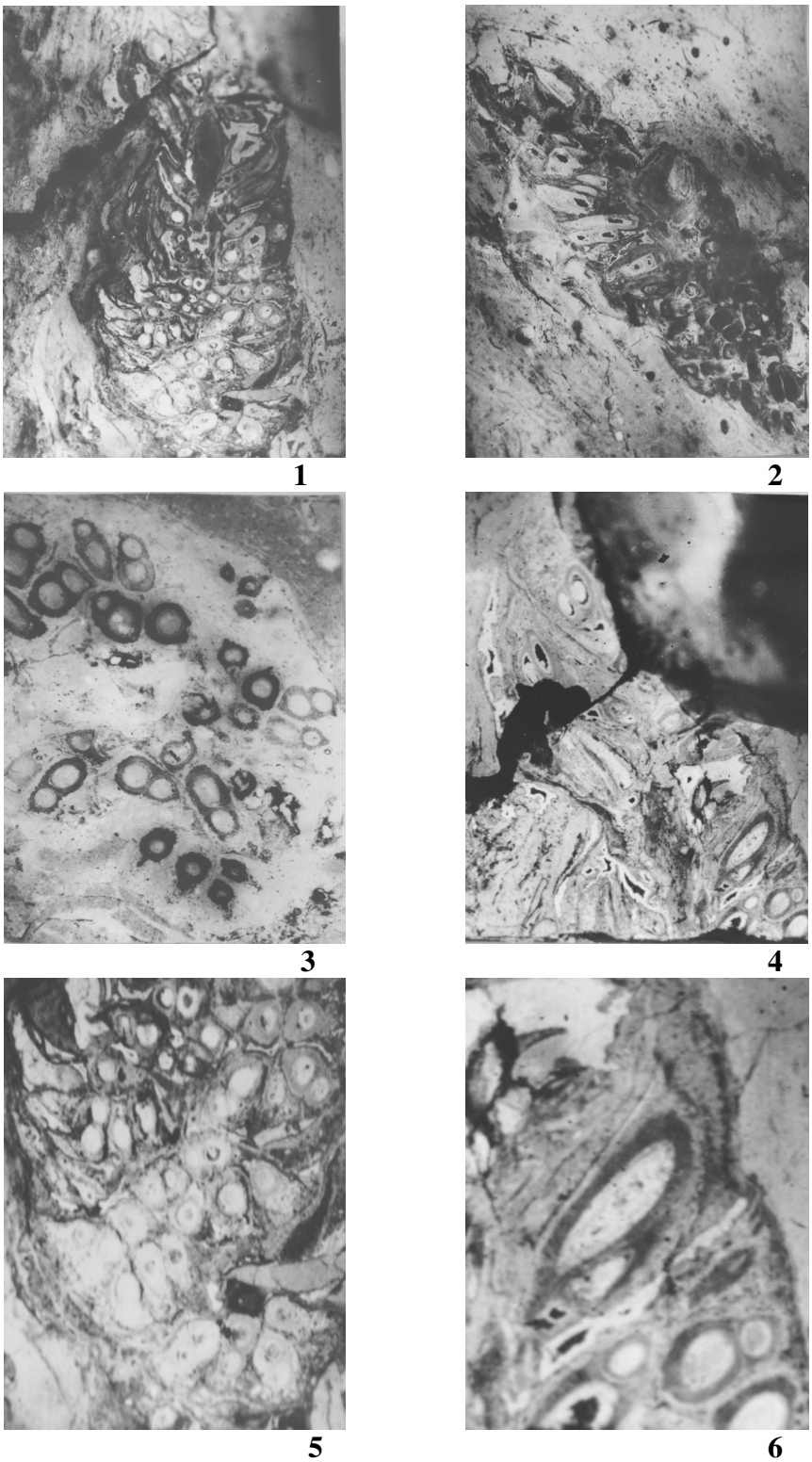
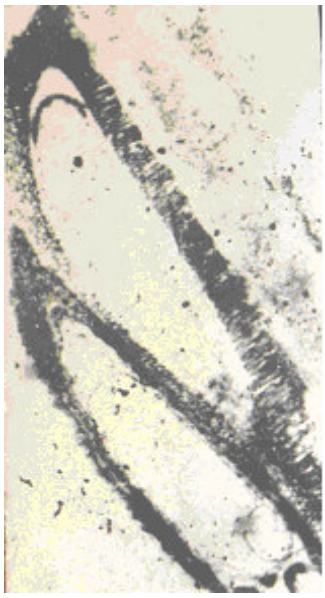


PLATE 1

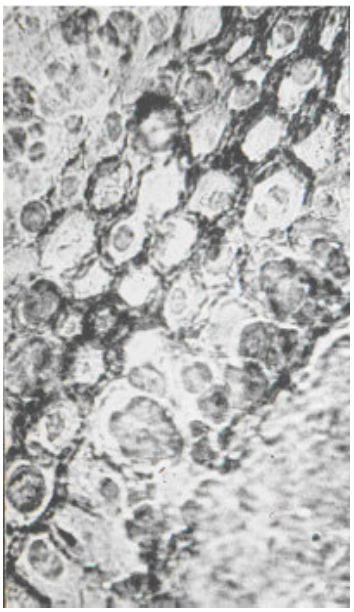
1. T.L.S. of female strobilus showing axis, ovuliferous scale with ovules and protecting scales. x 1.8.
2. T.L.S. of female strobilus and fertile apex. x 1.8.
3. T.S. of female strobilus showing seven groups of ovuliferous scales (Megasporophylls). x 2.6.
4. L.S. of female strobilus showing axis, two ovules per megasporophyll and protecting scale. x 4.5.
5. T.L.S. of strobilus with group of six megasporophylls. x 3.5.
6. T.L.S. of strobilus with bract scale, megasporophyll and two ovules with micropyle. x 12.

1

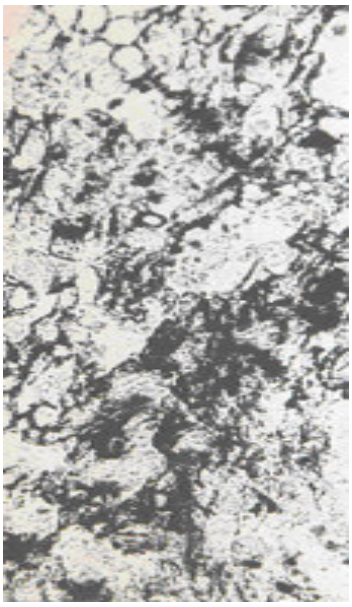
2



3



4



5

6

PLATE 2

1. L.S. of female strobilus showing axis (arrow) and megasporophyll with ovules. x 7.
2. A group of three megasporophylls in L.S. on axis. x 10.
3. L.S. ovule with micropyle. x 12.
4. Cells from middle stony layer of integument. x 150.
5. Parenchymatous cells of megasporophyll. x 125.
6. Pair of ovules of unequal size in T.S. showing middle stony layer, nucellus and endosperm. x 35.

Considering all these three cones, earlier described two and present specimen seems to be the growth phases of the same species. Hence the authors feel that creation of a new species is unwarranted. To merge all these three cones together, further studies from the well preserved specimen are needed.

Specimen No.—MOH/EVU/6a.
MOH/EVU/6b.

Repository—Department of Botany, Institute of Science, Nagpur.

Locality—Mohgaonkalan, M.P., India.

Horizon—Deccan Intertrappean Series.

Age—Maastrichtian-early Palaeogene.

REFERENCES

Chitale SD & Sheikh MT 1973. *Harrisostrobus intertrappea* gen. *et*. sp. nov. a petrified gymnospermous cone from Deccan Intertrappean beds of India. Palaeontographica 144: 25-30.

Guleria JS & Srivastava R 2000. Fossil dicotyledones woods from the Deccan Intertrappean beds of Kachchh, Gujarat, western India. Palaeontographica 257 B: 17-33.

Prakash U 1956. Studies in the Deccan Intertrappean Flora-1. On a petrified ovuliferous cone from Mohgaon cherts in the Deccan. Palaeobotanist 5: 91-94.

Prakash U 1962. Further observations on a petrified ovuliferous cone (*Mohgaostrobus sahnii)* gen. *et.* sp. nov. from Mohgaon cherts in the Deccan. Palaeobotanist 10: 1-5.

Sahni B 1931. Revisions of Indian fossil plants: Part II. Coniferales (b petrifications). Memoirs Geological Survey of India. Palaeontologia Indica (n.s.) 11: 51-124.

Stewart WN & Rothwell GW 1993. Palaeobotany and the evolution of plants. Cambridge University Press.