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## A PETRIFIED PECULIAR BENNETTITALEAN FOSSIL FROM AMARJOLA IN THE RAJMAHAL HILLS, INDIA

**ABSTRACT.** External morphology and anatomy of a peculiar fossil are described showing resemblances with the microsporangiate fructification of Bennettitales. Basal parts of 5-6 microsporophylls (?) are preserved. They are wedge shaped in cross-section and each possesses two lateral rows of vascular bundles. The fertile parts are not seen. Relationship is discussed with the cycadeoideae and allied plants.

### INTRODUCTION

The fossiliferous locality of Amarjola is very rich in petrified material of Bennettitales (Sharma 1971). Specially, seed bearing williamsonias (Gupta 1958; Bose 1968 and Sharma 1974), *Bucklandia* stems (Bose 1953; Sharma 1974a) and the fronds of *Ptilophyllum* (Sharma 1967), occur very frequently. However, microsporangiate fructification is yet to be discovered from this locality. The fossils are found embedded in a dark brown, ferrugeneous, sandy rock. They are fragile; thus are boiled in Canada balsam prior to sectioning with the help of a wire bandsaw. Slides were prepared by the usual method of cutting, grinding and polishing techniques and mounted in Canada balsam.

### DESCRIPTION

The specimen No. BDB. 250/Raj. A (Pl. fig. 1) is more or less a triangular structure measuring  $4.5 \times 3.2$  cm in size. The outer surface is provided with ridges and furrows seen diverging and originating from the base of the specimen. The distal part is flat as if cut transversely. On the interior side there are seen converging 5-6 wedge shaped structures, measuring  $4.5 \times 1.7$  cm in size.

Serial cross-sections have been prepared. A section passing through the upper part of the specimen shows 5-6, wedge shaped structures converging towards the centre (Fig. 1). The size of wedge shaped individuals gradually decrease in the lower serial sections. Their outer surface is provided with

ridges and furrows (Pl. fig. 1). The lateral walls are wavy (Pl. fig. 6; Fig. 1) or smooth (Pl. fig. 4). All the surfaces are provided with thick cuticle. Epidermal cells of the lateral sides are very distinct and squarish in shape (Pl. fig. 7). Stomata and trichomes are not seen. The hypodermis is 3 to 4 cells thick and consists of closely placed sclerenchyma, arranged more or less in rows (Pl. figs. 4,6). The ground tissue is parenchymatous (Pl. fig. 3) with two lateral

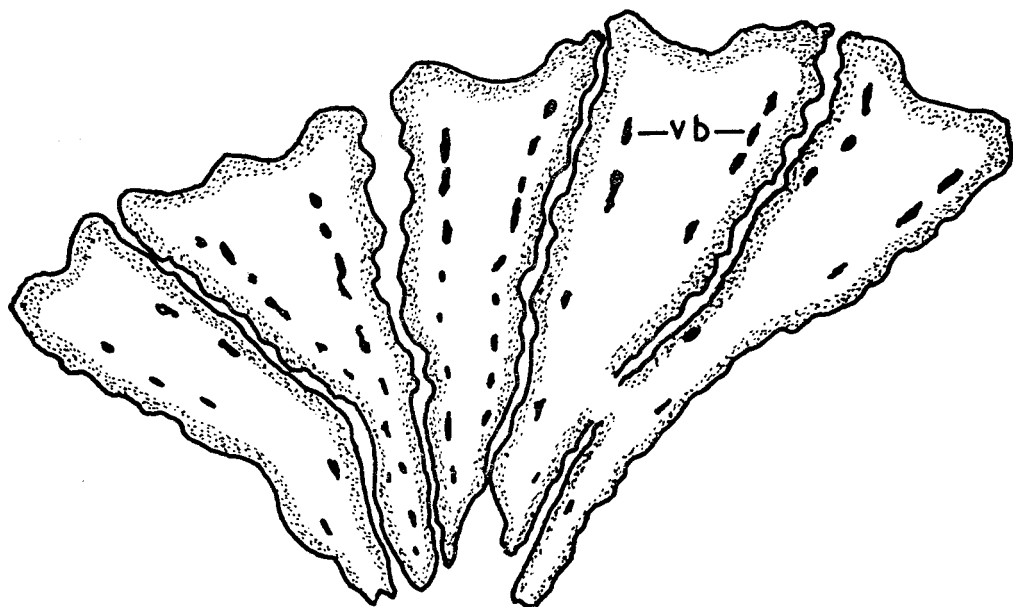


Fig. 1. Cross-section through the upper part of specimen No. BDB. 250/Raj. A. Showing five wedge shaped constituents each with two rows of bundles,  $\times 6.5$  (Vb — vascular bundle)

rows of vertically running vascular bundles (Pl. figs. 2,5). In a section through the upper most part of the specimen, there are seen 8 to 10 bundles in each row. The number is reduced gradually in the lower serial sections. The bundles are small and unequal in size. The outer ones are comparatively bigger and better developed than the interior bundles. In the majority of the sections the bundles are seen cut obliquely and thus distinction of xylem and phloem elements is not visible. Similarly, the differentiation of protoxylem and metaxylem cells could not be seen. The lateral walls of tracheids are provided with spiral and scalariform thickenings.

#### DISCUSSION

In addition to the Bennettitales, the locality of Amarjola also yields fossil plants of *Osmundaceae* (Gupta 1970; Sharma 1973), *thinnfeldias* (Sharma et al. 1971), cycads (Gupta 1971; Jain 1964), *Pentoxylales* (Sharma 1969a)

and the conifers (Bhardwaja 1953; Sah & Jain 1964). The present material however, shows resemblances in external morphology as well as anatomy with the bennettitalean plants. The specimen represents a detached part of an organ which was originally a circular structure and made up of nearly twenty, closely placed constituents. In cycadeoideas (Delevoryas 1968) as well as in majority of the weltrichias (Harris 1969) e. g., *W. santalensis* Sitholey and Bose (1971) the male fructification was consisted of nearly 20 microsporophylls arranged in a ring. May be the present material is representing the vegetative, closely adhered basal parts of the microsporophylls of a bennettitalean fructification. But the presence of bundles in two rows on the lateral sides of each constituent does not favour the foliar nature of the latter. The presence of well developed hypodermis adds support to this presumption. Probably, the individual wedge shaped structure in the present material is representing a modified cladode.

Like Bennettitales, in Pentoxylales also the male fructification (*Sahnia nipaniensis* (Mittre 1953) was consisted of 20 microsporophylls with fused bases forming a cup like structure. It was described to be produced terminally on a dwarf shoot (Mittre 1953). The present material is quite large and cannot be deemed to have been produced on the weak dwarf shoot of Pentoxylales. The former also differs in anatomy from the latter.

In the morphology of the external surface i.e. diverging ridges and furrows the present specimen can also be compared with the controversial genus *Sanmiguelia* (Ash 1976). However, the latter is known only as impression of lamina and has been correlated with the leaf of *Palmae*. On the other hand the present material is a detached part of a circular structure and consists of 5-6, separate wedge shaped individuals.

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## PLATE

# Plate

1. Specimen No. BDB. 250/Raj. A. External morphology
- 2,5. Cross sections showing two rows of bundles,  $\times 120$
3. Same. Parenchymatous ground tissue,  $\times 250$
4. Same. Two rows of bundles,  $\times 24$
6. Same. Wavy lateral margins of the constituents,  $\times 24$
7. Same. Epidermis with squarish cells and thick cuticle,  $\times 120$

