

Early Cretaceous megafloora from Murlipahar, Rajmahal Basin, India

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The present paper deals with megafloreal investigation of Murlipahar area of Rajmahal Basin. In this assemblage the cycadophytes are dominant group followed by filicales. The assemblage includes viz., *Cladophlebis*, *Phyllopteroides*, *Coniopteris*, *Murlipaharopteris*, *Thinnfeldia*, *Ptilophyllum*, *Otozamites*, *Taeniopteris*, *Elatocladus* and *Desmiophyllum*. On the basis of assemblage correlation and the presence of an index Neocomian species of Eastern Australia viz., "*Phyllopteroides laevis*", Neocomian age has been suggested for Murlipahar fossiliferous inter-trappean bed.

Key-words- Plant fossils, Early Cretaceous. Murlipahar, Rajmahal Basin.

INTRODUCTION

THE megafloreal assemblage was collected recently during April 1994 from Murlipahar locality at Rajmahal Hills, Bihar. This locality is situated about 7.2 km east of Tinpahar. Fossiliferous intertrappeans are exposed just in front of Murli Mission Church. The plant remains are preserved as impression on brownish-grey fragile shale. Bose and Sah (1968) recorded *Todites*, *Sphenopteris* and ginkgoalean leaves from this locality. Further no detail collection has been made from this locality. The following assemblage is now being added to earlier known three taxa:

1. *Cladophlebis* sp.
2. *Phyllopteroides laevis*
3. *Coniopteris* sp. cf. *C. tatungensis*
4. *Murlipaharopteris indica* gen. et. sp. nov.
5. *Thinnfeldia indica*
6. *Ptilophyllum acutifolium*, *Ptilophyllum cutchense*
7. *Otozamites gondwanensis*
8. *Taeniopteris spatulata*
9. *Elatocladus confertus*, *Elatocladus jabalpurensis*
10. *Desmiophyllum* sp.
11. Scale leaf

Genus-*Cladophlebis* Brongniart

Cladophlebis sp.

Pl. 1, Fig. 1

Comparison — Four small fragments of leaves are preserved as impression and in transmitted light showing epidermal features in surface view. The present species differs from *Cladophlebis denticulata* by its entire margin of pinnules.

Genus-*Phyllopteroides* Medwell

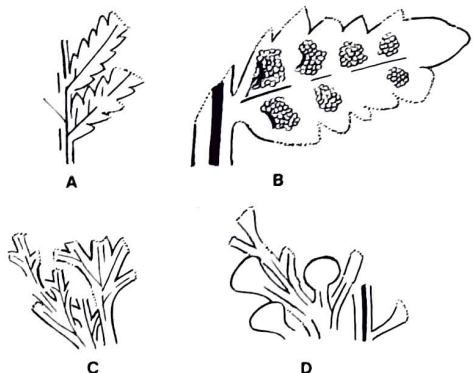
Phyllopteroides laevis Cantrill & Webb

Pl.1, Fig. 7

Description — Five well preserved specimens are found in the assemblage but all are representing detached pinna. The largest fragment of pinna is 4.5 cm in length and broadest pinna fragment is 1 cm in width. Pinnae linear-lanceolate in shape, base constricted, margin entire to finely serrated, apex acute. Midvein persistent upto apex, 0.5 mm broad at base. Laterals arise at acute angles of 30°-45°, mostly forked twice before reaching margin. Vein concentration 18-24 per cm.

Comparison & Remarks — In shape, size and venation pattern of pinnae the above specimens show similarity with *Phyllopteroides laevis* described and illustrated by Cantrill and Webb (1987, fig. 3A,F) from Early Cretaceous beds of Queensland and Victoria.

Phyllopteroides laevis is now recorded from Murlipahar also besides Chunakhal (Banerji, 1992) and Butahapahar localities in Rajmahal basin.



Text-figs A-D:- A. *Murlipaharopteris indica* gen. et sp. nov. sterile frond showing pinnules, B.S.I.P. specimen no. 37388, x1; B. Fertile pinnule of *Murlipaharopteris indica* showing subterminal position of sori, B.S.I.P. specimen no. 37387, x5; C. *Coniopteris* sp. cf. *C. tatungensis*, sterile frond, B.S.I.P. specimen no. 37383, x1; D. Fertile frond of *Coniopteris* sp. cf. *C. tatungensis* showing funnel-shape indusium, B.S.I.P. specimen no. 37385, x2.

Genus-*Murlipaharopteris* gen. nov.

Diagnosis – Leaf incomplete, most probably repeatedly pinnate. Ultimate pinnule lanceolate-triangular in shape, margin lobed, lobes with subacute apices, with a midvein and lateral veins. Lateral veins forked or unforked, branching catadromic to isodromic. Sterile and fertile leaves almost similar. Sori borne under surface of lamina, inframedial-subterminal in position, indusiate-exindusiate, indusium perhaps absent on maturity, indusium oblong linear to horse-shoe shaped, a small vascular strand branches off from the fertile vein and seems to pass into receptacle. Sporangia stalked and perhaps with vertical annulus, spores unknown.

Type Species – *Murlipaharopteris indica*, B.S.I.P. specimen no. 37386

Type Locality – Murlipahar, Rajmahal Basin, Bihar.

Horizon & Age – Rajmahal Formation, Early Cretaceous.

Discussion – Numerous specimens are preserved as impressions on fragile grey shale. Sterile frond (Pl. 1, fig. 6) is not found attached with the fertile one but associated with *Phyllopteroides laevis*. On the basis of external morphology of the pinnules, position of sori, shape of sorus, nature of indusium and stalked sporangia in sorus show affinity with the asplenoid leptosporangiate fern (*Athyrium*) rather than aspedoid ferns (Bower, 1928, p. 149).

Murlipaharopteris indica sp. nov.

Pl. 1, Figs 4-6; Text-figs A, B

Diagnosis – Fronds incomplete, seems to be repeatedly pinnate, ultimate pinnule lanceolate with lobed margin, lobes with sub-acute apices. Midvein distinct with forked or unforked laterals. Sterile and fertile pinnules are alike, sori borne abaxially, inframedial to subterminal in position, indusiate - exindusiate, indusium oblong linear to horse-shoe shaped. Sporangia stalked, spores unknown.

Description – Leaf as a whole unknown, for description assume to be bipinnate. Best preserved pinna fragment is 2.2 cm in length. Secondary rachis 0.8-1 mm broad, medianly grooved, finely striated. Pinnule 5-8 mm in length and 2.5-3 mm in width, attached at an angle of 45°-80°, subopposite, linear-lanceolate in shape, margin pinnatifid or lobed, lobes with sub-acute apices; each pinnule with a distinct midvein, laterals forked or unforked, branching catadromic-isodromic. Sori borne dorsally, indusiate-exindusiate, indusium mostly indistinct, aborted probably on maturity, seems to be linear oblong to horse-shoe shaped, at places a small vascular strand seems to enter the receptacle.

Plate 1

- Cladophlebis* sp., B.S.I.P. specimen no. 37382, x1.
- Coniopteris* sp. cf. *C. tatungensis*, Sterile frond showing linear pinnae segments with a midvein, B.S.I.P. specimen no. 37383, x1.
- Coniopteris* sp. cf. *C. tatungensis*, fertile frond showing funnel-shape indusium. B.S.I.P. specimen no. 37385, x4.
- 4-6. *Murlipaharopteris indica* gen. et sp. nov., fertile fronds showing pinnules with inframedial or subterminal sori, and sterile frond showing shape and size of pinnules, B.S.I.P. specimen nos. (Holotype) 37386, 37387 & 37388, x2, xca4 & x1.5.
- Phyllopteroides laevis*, pinnae showing venation pattern, B.S.I.P. specimen no. 37389, x2.
- Thinnfeldia indica*, pinnae showing venation pattern, B.S.I.P. specimen no. 37391, x1.
- Taeniopteris spatulata*, B.S.I.P. specimen no. 37397, x4.
- 10-11. *Otozamites gondwanensis*, B.S.I.P. specimen nos. 37396 & 37395, x 2.
- Desmiophyllum* sp., leaf showing parallel veins, B.S.I.P. specimen no. 37402, x1.
- Scale leaf, B.S.I.P. specimen no. 37399, x1.
- Ptilophyllum acutifolium*, B.S.I.P. specimen no. 37394, x 1.5.
- P. cutchense*, B.S.I.P. specimen no. 37393, x1.
- Elatocladus jabalpurensis*, shoot showing spirally attached leaves, B.S.I.P. specimen no. 37400, x2.
- E. confertus*, branched shoot with spirally attached small oblong to elliptical leaves, B.S.I.P. specimen no. 37401, x2.

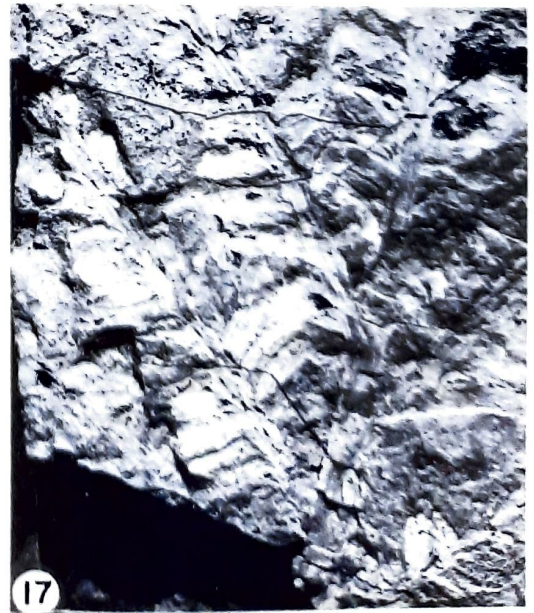
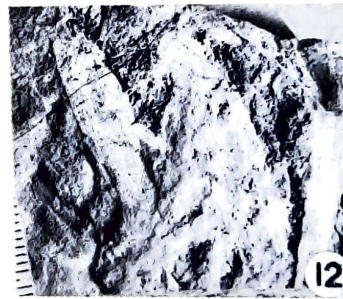
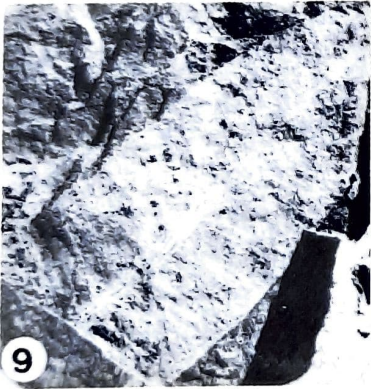
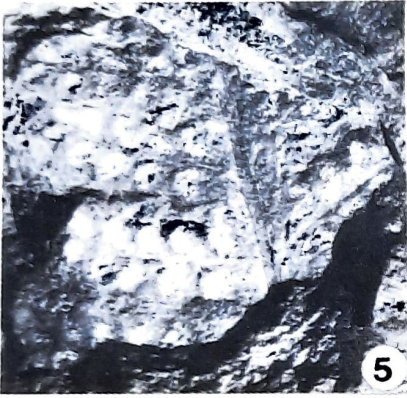


Plate 1

Sporangia globose, stalked and perhaps with vertical annulus. Spores not preserved.

Holotype – B.S.I.P. specimen no. 37386

Type Locality – Murlipahar, Rajmahal Basin, Bihar.

Remarks & Comparison – So far no definite fossil Asplenoid fern has been described from Upper Gondwana Sequence of India. Banerji (1993) recorded? *Asplenites* sp. from Chunakhal locality of Rajmahal Basin. In gross morphological features these fronds show somewhat similarity with Aspedioid fern described by Sharma (1971) as *Dryopteris indica* and *D. cladophleboides* from Dhokuti beds of Rajmahal Hills. But the present taxa is readily differentiated from *Dryopteris* in the position of sori. In *Dryopteris* sori are on the vein insertion. But the exact affinity of *Murlipaharopteris* must be awaited for want of more better preserved specimens with details of spores and sporangia.

Genus-*Coniopteris* Brongniart

Coniopteris sp. cf. *C. tatungensis* (Sze) Shuying

Pl. 1, Figs 2 & 3; Text-figs C, D

Description – Leaf as a whole unknown, large number of extremely fragile specimens of sterile and fertile frond fragments are preserved as impression. Largest sterile fragment is 2 cm long. Rachis slender, 1.5 mm broad, medianly grooved, finely striated. Pinnae incomplete, seems to be linear-lanceolate, attached at an angle of 45°-50°. Pinnules are also mostly incomplete, attached to the pinnae rachis at distance of 5 mm, catadromic. Pinnule segment linear oblong in shape, 3 mm x 0.8 mm in size, margin entire, apex sub-acute to obtuse, with distinct midvein. Midvein rarely forked, on higher magnification in reflected light shows rectangular cells and the lamina consisting of polygonal epidermal cells.

Fertile pinnule at distal end gradually expanded into funnel-shaped indusium, measuring 2x1 mm in size, distinct vein could be seen at the base of the indusium. Sporangia and spores are unknown.

Comparison & Remarks – The above specimens are somewhat comparable to *C. simplex* described by Harris (1961, p. 142) but latter species differs in having linear-lanceolate shape of leaf and sorus tending to be on acroscopic side. In gross morphological features it comes nearest to *C. tatungensis* (Sze) Shuying (1987) but due to the absence of complete leaf fronds at present these specimens are assigned under *Coniopteris* sp. cf. *C. tatungensis* (Sze) Shuying. This is the first record of

fertile frond of the genus from Rajmahal Basin. In Rajmahal Basin Dicksoniaceae is now represented by *Dicksonia*, *Eboracia*, *Onychiospis* and *Coniopteris* which shows that Dicksoniaceae is the most diversified family of filicales during that period.

Genus - *Thinnfeldia* Ettingshausen

Thinnfeldia indica Feistmantel

Pl. 1, Fig 8

Description – Leaf pinnate, leaf fragments 3.5-5 cm in length. Pinna rachis 4 mm broad, gradually tapering towards apex, finely striated. Pinnae suboppositely attached at an angle of 45°-60°, laterally attached to rachis. Pinnae shape variable, lanceolate-obovate, base constricted, margin entire wavy or undulated, apex sub-acute-obtuse, maximum length of pinna preserved is 3 cm, width is 1.1-2 cm, acroscopic margin truncate, basi-scopic margin decurrent. Midrib distinct at base, at places feebly marked by a groove, evanescent at apex. Lateral veins numerous, arise at acute angles, forked 1-3 times at various levels and runs towards margin with slight arching, vein concentration at middle region of pinna is 20-22 per cm.

Comparison & Remarks – *Thinnfeldia indica* described above is identical with *Thinnfeldia indica* described by Feistmantel (1877), Zeba-Bano (1979) from Buskoghath, Burio, Ghutiari and Pathargama localities of Rajmahal basin in general features and venation pattern of pinnae. In Pathargama locality *Thinnfeldia* is found in association with *Ginkgo rajmahalensis* and on the basis of assemblage correlation it shows close affinity with Sakrigalight fossil bed (Zeba-Bano, 1979). *Thinnfeldia* sp. cf. *T. indica* described by Drinnan and Chambers (1986) from Early Cretaceous fossil bed at Koonwarra, Victoria shows variation in pinna which considered to be time related variation. But in Koonwarra beds, too, *Thinnfeldia* is found in association with *Ginkgo australis* probably showing contemporary floras.

Genus-*Taeniopteris* Brongniart

Taeniopteris spatulata McClelland

Pl. 1, Fig. 9

Description – Largest incomplete fragment of leaf is 5 cm in length and 1 cm in width, seems to be strap-shaped, with a distinctly grooved and finely striated midrib. Midrib 1.5 mm wide, lateral veins simple or forked once, arising at wide angle from the midrib, run almost straight towards margin. Margin entire.

Remarks – All *Taeniopteris spatulata* are found as impression, therefore, its exact affinity remains undecided whether they are cycadophytic or pentoxylean leaves.

Genus-Otozamites Braun

Otozamites gondwanensis Bose

Pl. 1, Figs 10 & 11

Description – Leaves incomplete, available largest length of fragment is 4.8 cm. Rachis almost concealed by pinnae. Pinnae closely set, arise at angles of 65°-75°, 0.7-1.8 cm in length and 3-4 mm in width, somewhat falcate in shape, apex rounded, upper basal angle slightly expanded to form auricle, lower basal angle rounded. Veins arise from base and run throughout the lamina sub-parallel or with slight divergence, veins forked at various levels.

Remarks – *Otozamites gondwanensis* is described for the first time from Murlipahar locality of Rajmahal Basin. This species is earlier known from Butahapahar and Kendua localities of Rajmahal Basin.

Genus-Elatocladus Halle

Elatocladus confertus (Oldham & Morris) Halle

Pl. 1, Fig. 17

Description – The best preserved leafy twig is about 3.5 cm in length. Variously branched at an angle of 45°-60°. Axis is 2.5 mm broad, finely striated. Leaves spirally borne, elliptic lanceolate in shape, measuring 4-5 mm x 1.5-2 mm, attached by broad angles. Margin entire, apex sub-acute to obtuse, base decurrent but seems to be contracted due to twisting. Basal and apical leaves are smaller in size than middle one. Some of the lateral branches bearing oval-rounded seeds terminally.

Remarks – Large number of fragmentary twigs are present in this collection. *Elatocladus confertus* described above matches exactly with *E. confertus* described by Bose and Banerji (1984) and Sukh Dev and Rajanikanth (1988) from Bhuj Formation of Kachchh and Gangapur Formation of Andhra-Pradesh, respectively.

Elatocladus jabalpurensis (Feistmantel) Sahn

Pl. 1, Fig. 16

Description – Largest shoot preserved is 2.5 cm in length. Axis is 2 mm wide bearing spirally attached linear-lanceolate leaves. Leaves measuring 2cm x 2mm with a distinct midvein, base decurrent, margin entire, apex acute.

In one specimen an ovoid seed is laterally attached. Seed size 5x4 mm, except a narrow border no further details are preserved.

Remarks – The present specimens may be compared with *Elatocladus jabalpurensis* figured by Feistmantel (1877b), Sahn (1928) and Bose and Banerji (1984) from Jabalpur Group of South Rewa and Satpura Basin and Bhuj Formation of Kachchh Basin, respectively. The seed in Murlipahar specimens is found in organic connection with shoot also resemble with *Strobilites sewardi* Sahn (1928, pl. 5, figs 73-75) in size and shape etc., and proved that they are the megastrobilus of *Elatocladus jabalpurensis* (Feist.) as suggested by Sahn (1928).

Genus - Desmiophyllum Lesquereux

Desmiophyllum sp.

Pl. 1, Fig. 12

Description – Numerous oblong-strap shaped leaf fragments are found in the assemblage but all the fragments are incomplete either from proximal or distal regions. Leaf margins entire and gradually tapering at base, apex obtusely rounded. Largest fragment of leaf is 3.5 cm in length. Veins enter from base and running sub-parallelly towards distal end of lamina and seems to be slightly converging at apex. Vein concentration 26-28 per cm in the middle region.

Remarks – At present these incomplete fragments have been assigned under an non-committal generic name *Desmiophyllum* Lesquereux because they cannot be proved to belong to ginkgoalean or coniferous group of plants.

Scale leaf

Pl. 1, Fig. 13

Description – Single specimen of scale leaf is preserved with counterpart. Scale leaf triangular in shape, measuring 4.5 x 8 mm, with broad truncated base and acuminate apex with a distinct groove, surface of scale leaf with fine striations and a distinct hemispherical depression could be seen at base.

DISCUSSION

The Murlipahar assemblage described above consists of ten genera belonging to various groups of pteridophytes and gymnosperms. Besides one new genus viz. *Murlipaharopteris indica*, *Phyllopteroides laevis*, *Coniopteris* sp. cf. *C. tatungensis*, *Thinnfeldia indica*, *Otozamites gondwanensis*, *Ptilophyllum acutifolium*, *P.*

cutchense, *Taeniopteris spatulata*, *Elatocladus confertus*, *E. jabalpurensis* and *Desmiophyllum* sp. are described for the first time from this locality. In Murlipahar assemblage, cycadophyte is the predominant group represented by two genera viz., *Ptilophyllum* and *Otozamites*. *Ptilophyllum* is the dominant taxon encountered in this assemblage.

Filicales is the second dominant group and represented by osmundaceous and dicksoniaceous remains. *Taeniopteris* and *Thinnfeldia* are also frequently met in this assemblage. Conifer is represented by one podocarpaceous taxa viz., *Elatocladus* and the affinity of *Desmiophyllum* remains uncertain.

In comparison with other inter-trappean assemblages of Rajmahal Basin, the Murlipahar assemblage shows some resemblance with Pathargama assemblage in having similar genera like *Thinnfeldia indica*, *Taeniopteris spatulata*, *Ptilophyllum acutifolium*, *Elatocladus* and ginkgoalean leaves. According to Zeba-Bano *et al.* (1979) Pathargama plant bed belongs to Floral Group 1 and is dominated by *Thinnfeldia indica* unlike the Murlipahar assemblage. The Murlipahar assemblage is dominated by cycadophytes followed by filicales. The common occurrence of *Cladophlebis*, *Taeniopteris*, *Ptilophyllum*, *Elatocladus* and an index Neocomian species of Eastern Australia, *Phyllopteroides laevis*, in Murlipahar and Chunakhal assemblages suggests that perhaps both these floras are contemporary Neocomian Floras of Rajmahal Basin.

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