

Plant fossils from Chunakhal, Rajmahal Hills, Bihar*

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Plant fossils from the Rajmahal Formation exposed at Chunakhal in Rajmahal Hills, Bihar are described. *Eboracia* is reported for the first time from this locality. The presence of Australian index species, *Phyllopteroides laevis* Cantrill & Webb suggests Neocomian age. Occurrence of gleicheniaceus, marattiaceus, osmundaceous, dicksoniaceus and cycadophytic remains indicate tropical-subtropical climate in the area during their deposition.

Key-words—Megafossils, Rajmahal Formation (Lower Cretaceous), Chunakhal, Bihar (India).

INTRODUCTION

THE Chunakhal locality is about 5 km south of Mirzachowki railway station, south-east of Chunakhal village, Rajmahal, Hills, Bihar (25° 13'33" : 87° 29'52"). The Rajmahal Formation exposed in the area contains a fossiliferous third inter-trappean bed which is succeeded by thick sandstone and basaltic bed of fourth flow at the top and the base remains unexposed (SenGupta 1988).

The following taxa have so far been reported from the Chunakhal beds., viz., *Equisetum rajmahalensis*, *Gleichenites gleichenoides*, *Marattiopsis macrocarpa*, *Cladophlebis indica*, *Todites indicus*, *Todites* sp. cf. *T. williamsonii*, *Phyllopteroides laevis*, *Phlebopteris* sp., *Ptilophyllum* - like pinna, *Williamsonia sahnii*, *Pterophyllum medicottiana*, *P. morrisianum*, *P. princeps* and *Cycadites rajmahalensis* (Gupta, 1943; Sah & Dev, 1958; Bose & Sah, 1968; Sengupta, 1988 & Banerji, 1992). SenGupta (1988) established three biostratigraphic zones within the Dubrajpur and Rajmahal Formations. According to him, biozone 1 belongs to the upper part of Dubrajpur Formation and is Lower Jurassic in age. Whereas, 2nd biozone belongs to the 1st-4th intertrappean beds of Rajmahal Formation and is Middle-Upper Jurassic in age. The biozone-3 corresponding to the 4th intertrappean bed of Rajmahal Formation is dated as Lower Cretaceous.

The present investigation is based on the material collected from Chunakhal, Rajmahal, Bihar. The specimens are preserved as impression on grey-creamish colour siltstones. The type and figured specimens have been deposited in the B.S.I.P. Museum, Lucknow.

Check list of megafossil taxa recovered from Chunakhal

- Lycopodiaceae
 - Lycopodites rajmahalensis* sp.nov.
- Selaginellaceae
 - Selaginellites gracilis* (Oldham & Morris) Pal
- Equisetaceae
 - Equisetites rajmahalensis* Oldham & Morris 1863
- Marattiaceae
 - Marattiopsis macrocarpa* (Oldham & Morris) Seward & Sahni 1920
- Osmundaceae
 - Todites denticulatus* (Brongn.) Krasser 1921
 - Osmundopsis* sp.
 - Phyllopteroides laevis* Cantrill & Webb 1987
- Cacumen sp.
- Gleicheniaceae
 - Gleichenites gleichenoides* (Oldham & Morris) Seward & Sahni 1920
- Dicksoniaceae
 - Eboracia lobifolia* (Phill) Thomas 1911
- Schizaeaceae
 - ?*Mohriopsis* sp.
- Incertae Sedis
 - ?*Asplenites* sp.
- Sphenopteris hislopi* Oldham & Morris 1863
- S. nauckhoffiana* (Heer) Halle 1913
- Corystospermaceae
 - Pachypteris indica* (Oldham & Morris) Bose & Roy 1968
- Williamsoniaceae
 - Ptilophyllum cutchense* Morris 1840
 - P. acutifolium* Morris 1840 (Pl. 2, fig. 5)
 - Cycadolepis pilosa* Feistmantel 1876
 - Zamites chunakhalensis* sp.nov.
- Pterophyllum incisum* Sahni & Rao 1933 emend *P. morrisianum* Oldham 1863

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Uncertain

Taeniopteris sp.cf. *T. spatulata* McClelland 1850

Ctenis rajmahalensis Banerji 1990

?Podocarpaceae

Elatocladus confertus (Oldham & Morris) Halle 1913

E. jabalpurensis (Feistmantel) Sahni 1928

DESCRIPTION

Genus - *Lycopodites* Lindley & Hutton 1833

Lycopodites rajmahalensis sp.nov.
Pl. 1, fig. 1, Text-fig.A

Diagnosis—Branched or unbranched shoots arising from creeping stem; 1.5-2 mm thick, surface generally rough perhaps due to the presence of scaly leaves; upright shoot having spirally attached elongated linear leaves; leaves homophyllous, seems to be extremely delicate, 2-3 mm in length and 0.5-0.8 mm in width, gradually tapering towards pointed apex, usually with a faint midvein; at places leaves with reniform depressions, 1x1-1.5 mm in size, probably of sporangial impression, width mostly exceeds the width of leaf bases.

Holotype—B.S.I.P. Specimen No. 36540.

Type Locality—Chunakhal, Rajmahal Hills, Bihar.

Age & Horizon—Neocomian, Rajmahal Formation.

Comparison—The homophyllous nature of shoots differentiates it from *Selaginellites gracilis* (O & M) Pal 1984. The shoots show apparent resemblance with coniferous twigs. However, the delicate nature deduced by the faint impression of leaves rules out the coniferous affinity and this perhaps is the reason of its quick desiccation and non-availability in fossil state. In general it shows resemblance with *Lycopodium clavatum* and *L. setaceum*.

Genus - *Selaginellites* Zeiller 1906

Selaginellites gracilis (Oldham & Morris) Pal 1984
Pl. 1, fig.2

Genus - *Equisetites* Sternberg 1833

Equisetites. rajmahalensis Oldham & Morris 1863
Pl. 1, figs 3,4

Remarks—Recently the genus *Equisetum* has been divided into two sub-genera on the basis of stomatal structure, i.e., *Equisetum* Linn. and *Hippochaete* Roth. As in the present specimen the stomatal features are unknown, the author prefers to use the generic epithet *Equisetites* rather than *Equisetum*.

Comparison—The present narrow forms somewhat similar to *Equisetites rajmahalensis* (Oldham & Morris) Feistmantel described by Borkar and Chiplonkar (1973, pl. 1, fig. 1)) from Tarnetar and Kankawati (Kathiawar) perhaps were the lateral or distal branches of the stem.

Genus - *Marattiopsis* Schimper 1874

Marattiopsis macrocarpa (Oldham & Morris)
Seward & Sahni 1920
Pl. 1, fig. 5

Remarks—The common occurrence of *Marattiopsis macrocarpa* among ferns in Chunakhal locality suggests wet-tropical climate during that period.

Genus - *Gleichenites* Goeppert 1836

Gleichenites gleichenoides (Oldham & Morris) Seward & Sahni 1920

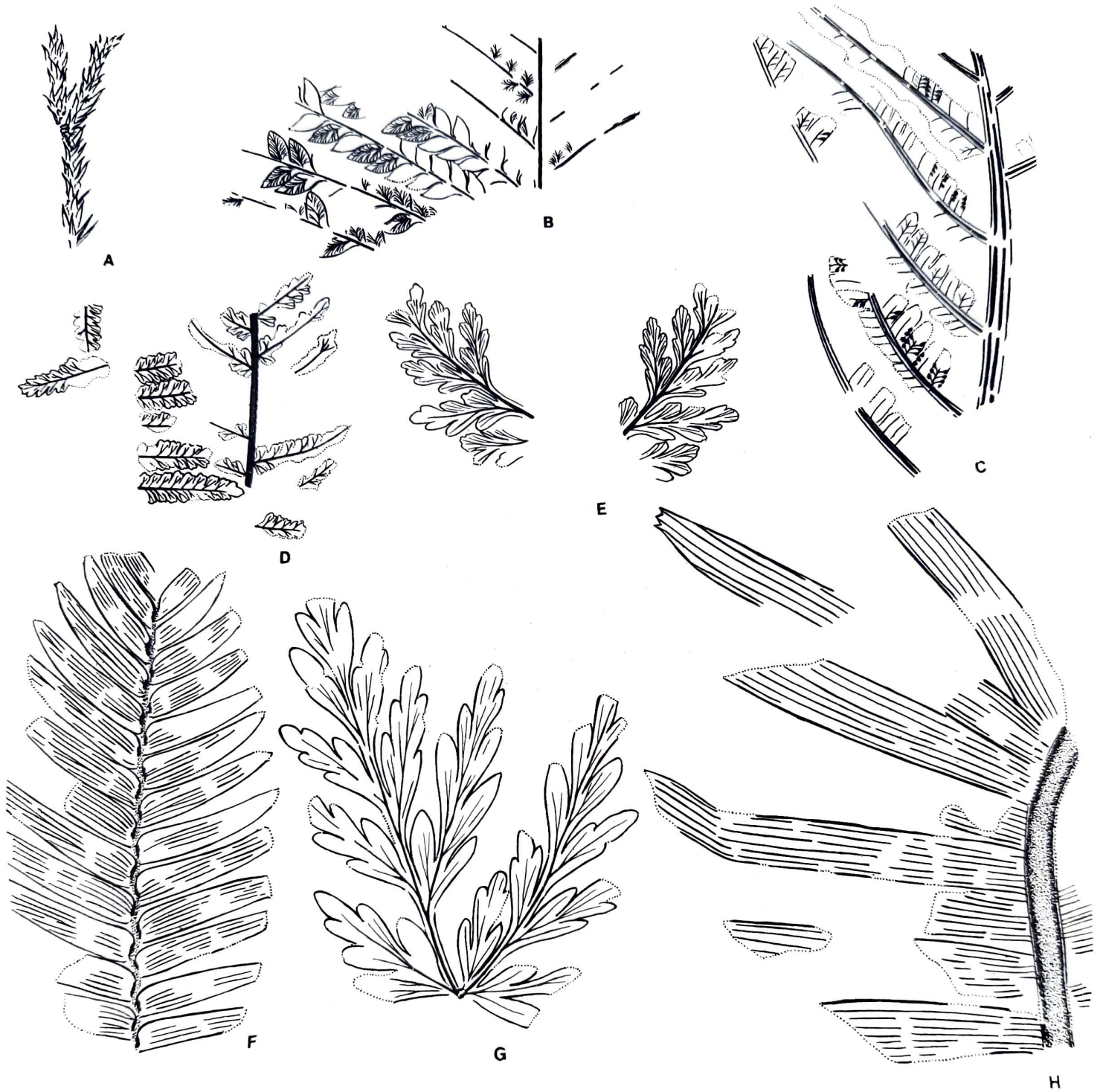
Genus - *Eboracia* Thomas 1911

Eboracia lobifolia (Phill.) Thomas 1911
Pl. 1, figs 7,8; Text-figs B, C

Description—Two fragments of sterile bipinnate leaf preserved as impression. Rachis 2 mm broad, medianly ridged; pinnae arising alternately at an angle of 50° - 60°, 7 mm apart, linear-lanceolate in shape. Secondary rachis 1 mm broad; pinnules alternately emerging at 50° - 60°, contiguously arranged, falcate, typically 5-6 mm x 3-4 mm in size, attached by broad base, margin entire, apex acute. Basal basiscopic pinnule larger and lobed, second and third basiscopic and acroscopic pinnules smaller than the middle region. Midvein giving off forked laterals slightly arching towards margin.

A fertile frond 6.5 cm in length. Rachis 3 mm broad, with ridges and grooves; pinnae arising alternately at an angle of 55° - 65°, linear-lanceolate in shape, largest pinna about 6.5 cm in length and about 8 mm in width; pinnule rachis 1 mm broad with a median ridge; pinnules sub-oppositely arising, typically 3.5-4 x 1.5-2 mm in size, smaller and narrower than sterile pinnules. Each pinnule with 1-5 marginal sori in each side, impression of indusium visible at places, midvein giving off one lateral vein to each sorus; sorus surrounded by cylindrical indusium. Details of placenta, sporangia and spores are unknown.

Comparison—Chunakhal specimens of *Eboracia lobifolia* are quite comparable with *Dicksonia (Neuropteris) lobifolia* Phillips figured by Raciborski (1894, pl. 11, figs 1-7; pl. 12, figs 1, 5) from Jurassic of Poland except that in the present specimens the fertile pinnules are narrower than in Polish specimens. In this character it comes closer to *E. lobifolia* described by Harris (1961,



Text-figure 1. All text-figures are in natural size unless otherwise mentioned. A, *Lycopodites rajmahalensis* sp. nov. showing linear delicate leaves spirally attached, B.S.I.P. specimen no. 36540; B, *Eboracia lobifolia* (Phill.) Thomas, sterile frond showing venation of pinnules, B.S.I.P. specimen no. 36546; C, A fertile frond of *E. lobifolia* showing marginal indusiate sori, B.S.I.P. specimen no. 36547, x 2; D, *Sphenopteris naukhoffiana* (Heer) Halle, frond showing pinnules with bifid apex, B.S.I.P. specimen no. 36553; E, *Pachypteris indica* (Oldham & Morris) Bose & Roy, pinnule showing venation pattern and dentate apical margin, B.S.I.P. specimen no. 36552; F, *Zamites chunakhalensis* sp. nov. showing pinnae bases and venation, B.S.I.P. Holotype, specimen no. 36556; G, *Sphenopteris hislopi* Feistmantel, frond showing pinnule shape and venation pattern, B.S.I.P. specimen no. 36558; H, *Pterophyllum incisum* Sahni & Rao, pinnae showing bi-trifid apex, B.S.I.P. specimen no. 36557.

p. 174, fig. 62A) and Von Konijnenburg-Von Cittert (1989, pl. 5, fig. 2). Sterile fronds are also similar to *E. lobifolia* figured by Jacob and Shukla (1955, pl.4, figs 45, 46), Appert (1973, pl. 56, 57) and Duan (1987, pl. 5, fig. 1; pl.6, fig. 4; pl. 7, figs 1,2) from the Jurassic sediments of Afghanistan, Madagascar and Zhaitang (China), respectively. *E. lobifolia* described by Appert (1973) differs in its comparatively small pinnules. This is the first record of fertile *Eboracia* from India.

Genus - Mohriopsis Appert 1973

?*Mohriopsis* sp.
Pl. 1, fig. 10

Description—Largest frond measuring 14 cm in length and 4.8 cm in width, bipinnate, linear-lanceolate in shape. Pinnae rachis 1 mm broad, medianly grooved; pinnae alternately attached at an angle of 75° - 80° , 5-7 mm apart of one side, imparipinnate, largest pinna 2.5 mm in length, gradually becoming smaller towards apex and base, linear-lanceolate in shape; pinnule rachis 0.5 mm broad, distinctly grooved; pinnules alternately emerging at angles of 70° - 75° , ovate in shape, margin slightly wavy-lobed, apex rounded, size varies from 1.5 - 3 x 1.5-2.5 mm; venation sphenopteroid with forked or unforked laterals.

Remarks—The above sterile fern frond comes nearest to the extant genus *Mohria* and extinct *Mohriopsis* described by Appert (1973) from Upper Jurassic beds of Manamana Basin, Madagascar, in general features and venation of the sterile frond. But due to non-availability of fertile specimens the identification and affinity of the fern fronds from Chunakhal with *Mohriopsis* remain uncertain.

Genus - Asplenites Goeppert 1836

?*Asplenites* sp.
Pl. 1, fig. 6

Description—Pinnate frond incomplete, about 5.7 cm in length and 3.5 cm in width at widest part. Rachis 1.5 mm broad; pinnae alternately arising at an angle of 45° - 50° , wedge-cuneate in shape, distal pinnae deeply dissected to form narrow elongated segments, tending to show bipinnate nature. Apical pinnules 1.5 x 0.8-1 cm in size, gradually narrowing towards tip; lateral margin of pinnae entire; apex divided into segments; base constricted; veins arising from base and occasionally forked once, leaf texture seemingly thick.

Remarks—In general morphology, the frond closely resembles the sterile frond of extant genus *Asplenium* of Dennstaediaceae. But in the absence of fertile parts its direct relationship with *Asplenium* remains doubtful, though the leaf texture and raised veins give an indication of its fertile nature.

Genus - Sphenopteris (Brongn.) Sternberg 1825

Sphenopteris hislopi Oldham & Morris 1863
Pl. 1, fig. 12; Text-fig. G

Description—Fronds incomplete, seemingly bipinnate, shape unknown, largest specimen 11 cm in length; primary rachis 1.5 mm broad, medianly grooved; pinnae linear-lanceolate, emerging at angles of 45° - 55° , alternate; secondary rachis 1 mm broad, distally gradually tapering, bearing alternate pinnules which become subopposite distally; pinnules lanceolate-ovate in shape, 0.5-2.2 cm x 1.5-0.7 mm in size; margin lobed, lobing depends upon the maturity, lobing deep in proximal pinnules forming lobed margin, whereas, in distal pin-

Plate 1 →

(All figures in plate 1 & 2 are in natural size unless otherwise mentioned)

1. *Lycopodites rajmahalensis* sp. nov., shoot showing spirally attached delicate linear leaves; B.S.I.P. specimen no. 36540.
2. *Selaginellites gracilis* (Oldham & Morris) Pal, shoot showing heterophyllous leaves; B.S.I.P. specimen no. 36541.
3. *Equisetites rajmahalensis* Oldham & Morris, stem showing node with leaf-sheath; B.S.I.P. specimen no. 36542.
4. *E. rajmahalensis* Oldham & Morris, branch showing a nodal diaphragm; B.S.I.P. specimen no. 36543.
5. *Marattiopsis macrocarpa* (Oldham & Morris) Seward & Sahni, fertile frond showing pinnae with synangia; B.S.I.P. Specimen no. 36544.
6. ?*Asplenites* sp., frond showing deeply dissected elongated segments; B.S.I.P. specimen no. 36549.
7. *Eboracia lobifolia* (Phill.) Thomas, sterile bipinnate frond showing pinnule shape and venation; B.S.I.P. specimen no. 36546.
8. *E. lobifolia* (Phill) Thomas, frond showing fertile pinnules with marginal indusiate sori; B.S.I.P. specimen no. 36547.
9. *Gleichenites gleichenoides* (Oldham & Morris) Seward & Sahni; B.S.I.P. specimen no. 36562, x2.
10. ?*Mohriopsis* sp., sterile frond showing shape and size of pinnules; B.S.I.P. specimen no. 36548.
11. *Sphenopteris naukhoffiana* (Heer) Halle, pinnae showing distal pinnules with single vein and proximal pinnules with forked veins giving bifid apex; B.S.I.P. specimen no. 36551, x 2.
12. *Sphenopteris hislopi* Feistmantel, sterile frond showing shape, size and venation of pinnules; B.S.I.P. specimen no. 36550.

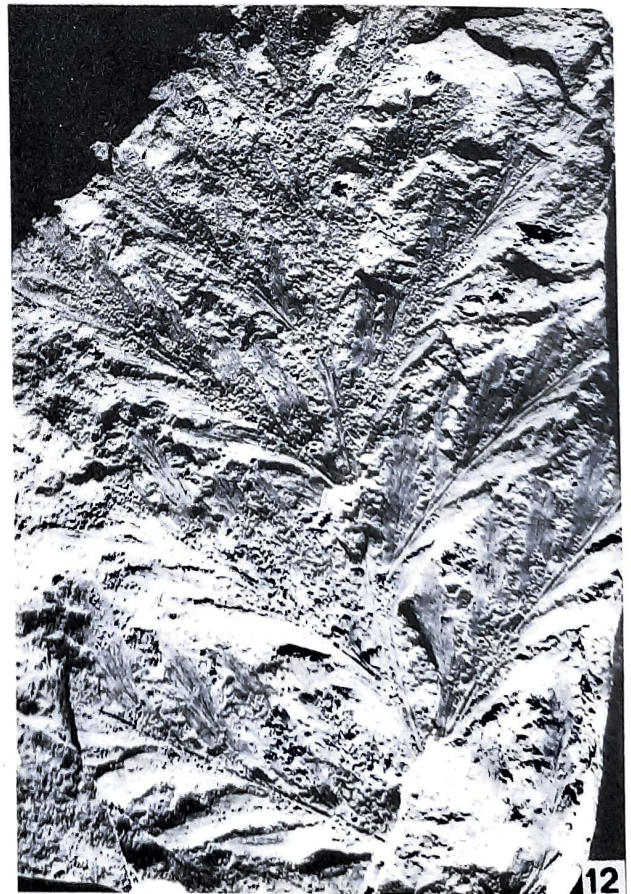
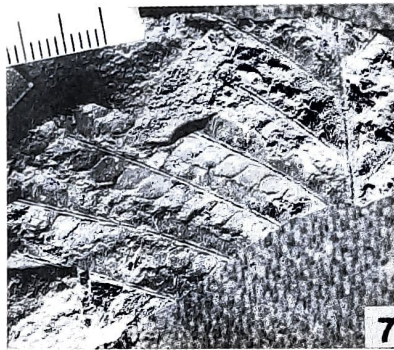
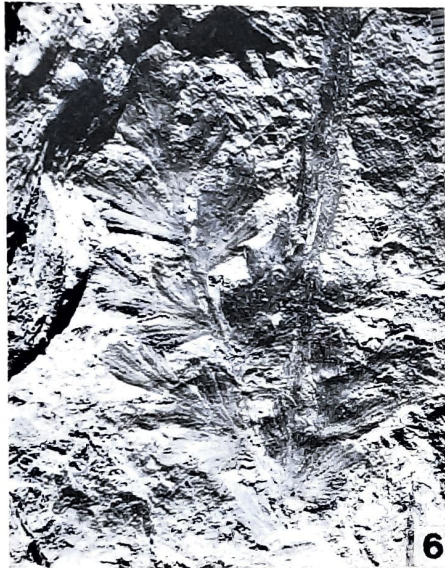
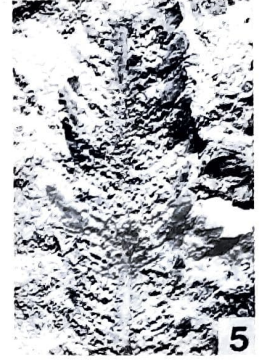
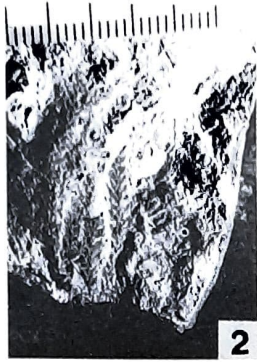
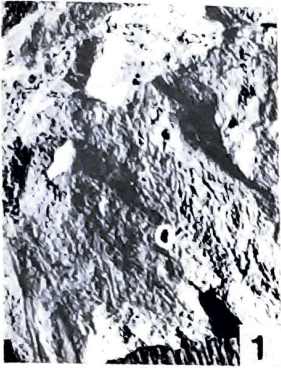


Plate 1

nules margin almost unlobed; apex mostly rounded, rarely pointed. Venation sphenopteroid.

Comparison and remarks—In spite of abundant specimens no fertile frond is recovered to ascertain its exact affinity. In having flavellate nature it is closer to *Ruffordia goepperti* (Dunker) var. *latifolia* Seward (1894, pl. VI, fig. 1, 1a). However, in gross features it also shows similarity with *Sphenopteris* (*Ruffordia*) *goepperti* Dunker described by Halle (1913) and Oishi (1940) from Mesozoic sediments of Grahamland and Japan respectively. *Sphenopteris warragulensis* McCoy described by Drinnan and Chambers (1986) from Early Cretaceous of Koonwarra fossil bed, South Gippsland, Victoria also shows some similarity but lack of fertile pinnules in the present collection precludes detail comparison. In some specimens numerous rounded-irregular raised areas are observed which indicate the marks of crystal impregnation of insect galls.

Sphenopteris nauckhoffiana (Heer) Halle, 1913
Pl. 1, fig. 11; Text-fig. D

- 1934 *Sphenopteris rajmahalensis* Sahni & Rao; p. 260, pl. 35, figs 1b, 2b, 2c; text-figs. 2-3.
1947 *Sphenopteris rajmahalensis* Sahni & Rao; in Ganju, p. 57.
1966 *Sphenopteris rajmahalensis* Sahni & Rao; in Surange, p. 116, fig. 74A, B.
1988 *Sphenopteris rajmahalensis* Sahni & Rao; in Sen Gupta, p. 71; pl. 17, fig. 47.

Description—Numerous sterile fronds of ? bipinnate nature. Rachis 1 mm broad, medianly grooved; pinnae alternately attached at 60° - 70° , usually 1-1.3 x 0.3-0.4 cm in size, linear-lanceolate in shape; pinnule segments rectangular with mostly bifid apex in the proximal region, margin entire, apex sub-acute; veins forked-unforked, usually each segment with one lateral vein, texture of pinnae delicate, at places cellular imprints could be seen.

Comparison and remarks—The present specimens are comparable with *Asplenium nauckhoffianum* Heer (1880, pl. 1, figs 9, 10) from Cretaceous of Greenland and *Sphenopteris nauckhoffiana* (Heer) Halle (1913,

figs 6a, b, c) from Late Jurassic/ Early Cretaceous flora of Hope Bay, Grahamland, in gross morphology and venation pattern. Sahni and Rao (1934) instituted a new species *Sphenopteris rajmahalensis* and compared it with *Sphenopteris nauckhoffiana* (Heer) Halle, showing its resemblance with Grahamland species except for irregular lobing of pinnule, broadly truncate apex and occasionally the pinnules having three veins instead of two. The present author has also examined five specimens of this species from Chunakhal area and observed that the proximal pinnules mostly possess bifid apex, usually once forked veins and the apex at places seems to be truncated. Moreover, in the distal pinnule veins are unforked, pinnules are not bifid and apex sub-acute as in *S. nauckhoffiana*. Therefore, the present author considers *S. rajmahalensis* Sahni & Rao (1934) as a junior synonym of *S. nauckhoffiana* (Heer) Halle. Sharma (1971) described somewhat similar fronds as *Klukia* sp. A & B from Dhokuti, Rajmahal Hills. Since the fertile structures are unknown in the present specimens its exact identity remains doubtful. Recently Gee (1989) has revised the Hope Bay flora and designated a new name *Sphenopteris hoppetvikensis* for *Sphenopteris nauckhoffiana* (Heer) Halle. He suggested that Grahamland's *Sphenopteris nauckhoffiana*, is distinct from Greenland's *Asplenium nauckhoffiana* Heer. But I have seen the Heer's and Halle's figured illustrations which are almost similar. This taxon shows wide geographic distribution during Late Jurassic to Early Cretaceous period.

Genus - *Pachypteris* Brongniart 1828

Pachypteris indica (Oldham & Morris) Bose & Roy 1968
Pl. 2, fig. 2; Text-fig. E

Genus - *Cycadolepis* Saporta 1873

Cycadolepis pilosa Feistmantel 1876
Pl. 2, fig. 4

Description—Single detached scale leaf, linear in shape; incomplete, 4 cm in length, 0.6 cm in width, surface fully covered with hairs, hairs about 1 cm in length.

Plate 2 

1. *Taeniopteris* sp. cf. *T. spatulata* McClelland; B.S.I.P. specimen no. 36543, x 2.
2. *Pachypteris indica* (Oldham & Morris) Bose & Roy, pinnules showing dentate apical margin and venation pattern; B.S.I.P. specimen no. 36552.
3. *Zamites chunakhalensis* sp. nov., pinnae showing symmetrical median attachment with contracted base; B.S.I.P. specimen no. 36556.
4. *Cycadolepis pilosa* Feistmantel, bract with hairs; B.S.I.P. specimen no. 36555, x 1.
5. *Ptilophyllum acutifolium* Morris; B.S.I.P. specimen no. 36554.
6. *Ctenis rajmahalensis* Banerji; B.S.I.P. specimen no. 36559.
7. *Pterophyllum incisum* Sahni & Rao, pinnae showing bitrifid apex; B.S.I.P. specimen no. 36557.
8. *Elatocladus confertus* (Oldham & Morris) Halle; B.S.I.P. specimen no. 36560.
9. *Elatocladus jabalpurensis* (Feistmantel) Sahni; B.S.I.P. specimen no. 36561.

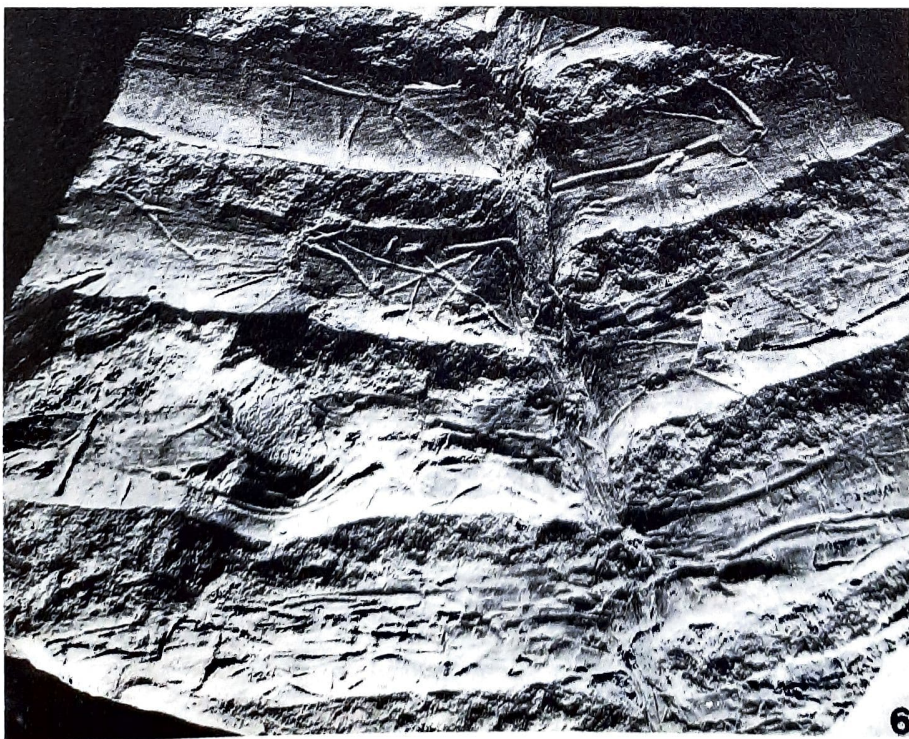
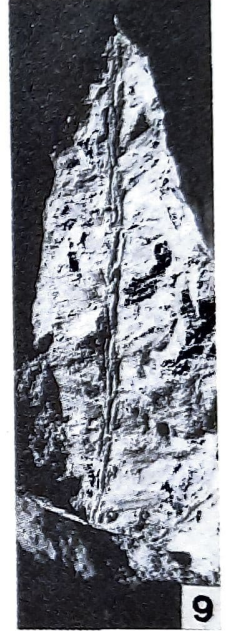
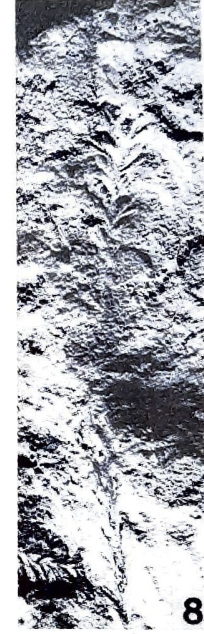
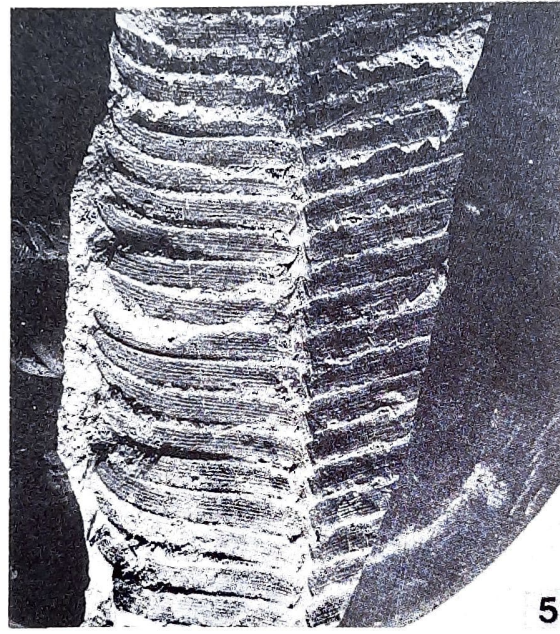
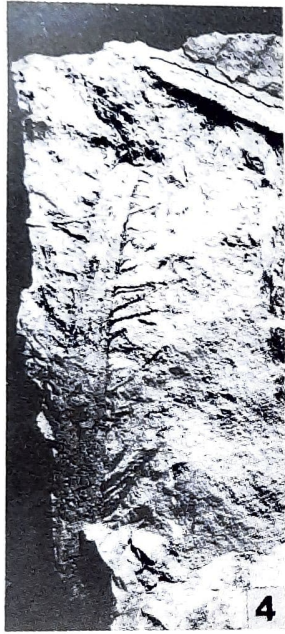
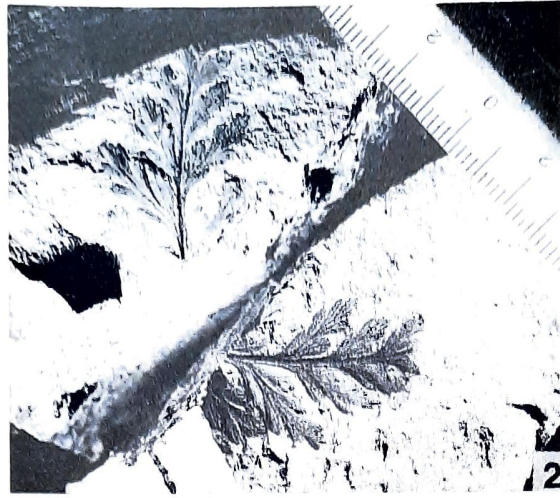


Plate 2

Comparison—Present specimen is closely comparable with *Cycadolepis pilosa* figured by Feistmantel (1876) and Bose and Banerji (1984) from Bhajodi, Kurbi and Kakadbhiti localities at Kachchh.

Genus - *Zamites* Brongniart 1828

Zamites chunakhalensis sp. nov.
pl. 2, fig. 3; Text-fig. F

Diagnosis—Single fragment of a pinnate leaf preserved with counterpart, about 6.6 cm in length, bearing alternately attached pinnae on the upper surface of rachis; largest complete pinnae measuring 2.2 x 0.5 cm, falcate to linear-lanceolate in shape; acroscopic and basiscopic basal margins contracted, attached symmetrically at the middle of the pinnae bases; margin entire, apex acute; 6-8 veins emerging from base, slightly diverging at distal end and forking at various levels; cellular imprints at places inconspicuously seen.

Holotype—B.S.I.P. specimen no. 36556.

Type Locality—Chunakhal, Rajmahal Hills, Bihar.

Age & Horizon—Neocomian, Rajmahal Formation.

Remarks and comparison—*Zamites* was earlier recorded from India by Feistmantel (1877, 1879) from Rajmahal Hills and Vemavaram areas, as *Z. proximus*. Later the Rajmahal specimen has been transferred to *Ptilophyllum acutifolium* by Bose and Kasat (1971) and Vemavaram specimen to *Pterophyllum footeanum* by Bose and Banerji (1981). In the present specimen the pinnae bases are well preserved and are clearly visible (Fig. 3). This feature differentiates this taxon from other allied genera, *Ptilophyllum* and *Otozamites*. In general outlook and number of veins per pinna the present species comes nearest to *Zamites pusillus* Halle (1913) described from Jurassic of Hope Bay. But differs in its obtuse apex and smaller size of pinnae. In having thick lamina, the specimen is somewhat comparable with *Zamites pachyphyllum* (Halle, 1913) but is distinguished in the greater number of veins per pinna. In the absence of cuticular details comparison with other species could not be done.

Genus - *Pterophyllum* Brongniart 1828

Pterophyllum incisum Sahni & Rao 1933
Pl. 2, fig. 7, Text-fig. H

Genus *Taeniopteris* Brongniart 1832

Taeniopteris sp. cf. *T. spatulata* McClelland 1850
Pl. 2, fig. 1

Comparison—*Taeniopteris* sp. cf. *T. spatulata* described here is closely comparable with *T. cf. T. spatulata* McClelland described by Bose & Banerji (1984) from Kakadbhiti, Kachchh in general outlook and concentration of veins. This is the most commonly occurring species in India recorded from East Coast, Rajmahal Hills, Godavari, Satpura, Kachchh and Rajasthan Basins.

Genus - *Ctenis* Lindley & Hutton 1834

Ctenis rajmahalensis Banerji 1990
Pl. 2, fig. 6

Genus - *Elatocladus* Halle 1913

Elatocladus confertus (Oldham & Morris) Halle 1913
Pl. 2, fig. 8

Elatocladus jabalpurensis (Feistmantel) Sahni 1928
Pl. 2, fig. 9

GENERAL REMARKS

The fossil flora of Chunakhal, Rajmahal Hills comprises 25 taxa. Filicales are the most prominent and diversified group. Marattiaceae, Gleicheniaceae and Osmundaceae are the common families in this assemblage. Conifers are rare, representing only by two species of the genus *Elatocladus*. In overall composition, the Chunakhal flora seems to be contemporaneous to the Dhokuti assemblage in having dominance of filicales and cycadophytes (Table 1). Some elements of the Dhokuti flora, viz., *Dryopteris*, *Dicksonia*, *Dennstaedia*, *Haydenia*, *Klukia*, *Ginkgoites* and *Torreyites* are absent in the present assemblage. It is significant to note that the typical association of *Ptilophyllum*, *Pachypteris*, *Taeniopteris* and *Phyllopteroides* is common to that of the Lower Cretaceous assemblage Zone-B recorded from Australia (Cantrill & Webb, 1987, fig. 14). Further this assemblage also indicates relationship with the Lower Cretaceous Koonwarra, Victoria fossil assemblage (Drinnan & Chambers, 1986, p. 7).

Koonwarra floral assemblage seems to be younger than Chunakhal and is closely comparable with that of Nipania. The presence of an Australian index Neocomian species *Phyllopteroides laevis* suggests Neocomian age for the 3rd intertrappean bed exposed at Chunakhal, Rajmahal Hills. Occurrence of gleicheniaceae, marattiaceae, osmundaceae and dicksoniaceae fossils suggests tropical-subtropical climate during their deposition in the Rajmahal Basin.

Table 1

Name of Taxa	Locality		Name of Taxa	Locality	
	Chunakhal	Dhokuti		Chunakhal	Dhokuti
<i>Equisetites rajmahalensis</i> Oldham & Morris	+	+	<i>P. medlicottianum</i> (Oldham & Morris) Feistm	+	+
<i>Lycopodites</i> sp.	+		<i>P. princeps</i> Oldham & Morris	+	+
<i>Selaginellites gracilis</i> (Oldham & Morris) Pal	+		<i>P. incisum</i> Sahni & Rao	+	
<i>Selaginellites</i> sp.		+	<i>Ctenis rajmahalensis</i> Banerji	+	+
<i>Marattiopsis macrocarpa</i> (Oldham & Morris) Seward & Sahni	+	+	<i>Taeniopteris lata</i> Oldham	+	
<i>Gleichenites gleichenoides</i> (Oldham & Morris) Seward & Sahni	+	+	<i>Taeniopteris</i> sp. cf. <i>T. spathulata</i> McClelland	+	
<i>Gleichenia dhokutense</i> Sharma		+	<i>Taeniopteris crassinervis</i> (Feistm.) Walkom	+	
<i>Cladophlebis denticulata</i> Brongn.		+	<i>Ginkoites</i> sp.		+
<i>Todites denticulatus</i> (Brongn.) Krasser	+		<i>Elatocladus confertus</i> (Oldham & Morris) Halle	+	
<i>T.</i> sp. cf. <i>T. williamsonii</i> (Brongniart) Seward	+		<i>E. jabalpurensis</i> (Feistmantel) Sahni	+	
<i>Osmundopsis</i>	+		<i>Torreyites</i> sp.		+
<i>Phyllopteroides laevis</i> Cantrill & Webb	+		<i>Conites sessilis</i> Sahni		+
<i>Cacumen</i> sp.	+		<i>Araucarioxylon santalense</i> (Sah & Jain) Bose & Maheshwari		+
<i>Phlebopteris</i> sp.	+				
<i>Dryopteris indica</i> Sharma		+			
<i>D. cladophleboides</i> Sharma		+			
<i>Dicksonia speciosa</i> Sharma		+			
<i>Eboracia lobifolia</i> (Phill.) Thomas	+				
<i>Dennstaedia rajmahalensis</i> Sharma		+			
<i>Haydenia thyrsopteroides</i> Seward		+			
<i>Klukia rajmahalensis</i> Sharma		+			
<i>Klukia</i> sp.		+			
? <i>Mohriopsis</i> sp.	+				
? <i>Aspenites</i> sp.	+				
<i>Sphenopteris naukhoffiana</i> (Heer) Halle	+				
<i>S. hislopii</i> Feistmantel	+				
<i>S. elaminata</i> Sharma		+			
<i>S. species</i> cf. <i>S. imbricata</i>		+			
<i>Thinnfeldia</i> cf. <i>T. amarjolense</i> Sharma		+			
<i>Dicroidium</i> sp.		+			
<i>Pachypteris indica</i> (Oldham & Morris) Bose & Roy	+				
<i>Ptilophyllum acutifolium</i> Morris	+				
<i>P. cutchense</i> Morris	+	+			
<i>Williamsonia companulatiformis</i> Sharma		+			
<i>Cycadolepis pilosa</i> Feistmantel	+				
? <i>Cycadolepis</i> sp.		+			
<i>Zamites chunakhalensis</i> sp. nov.	+				
<i>Cycadites rajmahalensis</i> Oldham	+	+			
<i>Morrisia maclellandii</i> (Oldham & Morris) Bose		+			
<i>Pterophyllum morrisianum</i> Oldham	+	+			

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