

SOME PLANT REMAINS FROM THE UPPER GONDWANA OF EAST COAST, INDIA

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ABSTRACT

Description of a few fossil plant remains, recently collected from Athgarh and Vemavaram along the East Coast of India, forms the subject of the present paper. Here, for the first time a new species of *Phlebopteris*, (*P. athgarhensis*) in association with *Rhizomopteris ballii* Feistm., has been recorded from Athgarh.

INTRODUCTION

OUR knowledge of the plant remains from the Athgarh and the Vemavaram areas is mainly due to the contributions of Feistmantel (1877, 1877a & 1879), Seward and Sahni (1920) and Sahni (1928, 1931). In the recent years a few more species have also been added by Suryanarayana (1954).

The Athgarh beds named after the village of Athgarh (85°45'N; 20°30'E) are situated at the head of the Mahanadi delta near Cuttack. The plant fossil beds in the area are whitish or reddish clays. The locality, from where the plant fossils have been described here, is situated on a hill, about one mile south-south-east of the Ghantekhal village. The bed is about two feet thick and is rich in plant fossils. These beds are said to belong to the Rajmahal Stage.

In the Ongole area, the plant fossils were collected from the south-west of the village Vemavaram near a kiln. Most of the beds have been destroyed by the villagers for building their field boundaries. The fossils are also found scattered in the near about fields and in newly dug wells.

All the new material from Athgarh and Vemavaram was collected by Dr. Sukh Dev in 1961 to whom the author is most grateful.

DESCRIPTION

Fossil Plants from Athgarh

FAMILY — MATONIACEAE

Genus *Phlebopteris* Brongniart

Phlebopteris athgarhensis sp. nov.

Pl. 1, Figs. 1-5; Text-fig. 1

Diagnosis — Fronds pedate in habit, only uppermost portion of petiole preserved.

Pinnae spreading from petiole in palmate manner, 7 in number, available maximum length 9.9 cm. Pinnae rachis stout, 1.1-1.5 mm. in diameter. Pinnules falcate, attached directly to rachis with their bases, base sometimes decurrent, alternately to suboppositely disposed, 10.40 mm. × 2.5 mm. in size, margin entire, apex somewhat rounded or slightly acute. Midrib distinct, 0.5 mm. in diameter. Lateral veins inclined at an angle of 45°, dichotomizing, 1-3 times forked, lateral anastomoses seen mostly at base and apex, series of meshes parallel to midrib present, meshes very narrow. Fertile pinnae similar to sterile ones, possessing 10-17 sori in each row on either side of midrib, circular, 0.8-1 mm. in diameter; sporangia mostly 7 per sorus, annulate, oblong in shape, arranged around a raised central portion.

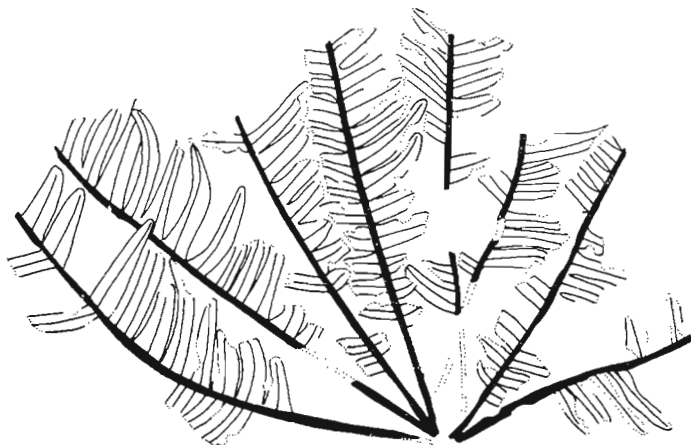
Holotype — No. 33084, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Athgarh.

Age & Horizon — Jurassic, Rajmahal Stage.

Comparison — So far not many species of *Phlebopteris* are known from India. The only species so far known, is by Rao (1950) who described a specimen from the Rajmahal Hills, Bihar, as *Phlebopteris* sp. It differs from *P. athgarhensis* sp. nov. in having bigger and straight (at right angles) pinnules with revolute margins. Also the venation is different in the two species.

The present specimen shows its marked resemblance with the Middle Jurassic species *Phlebopteris polypodoides* Brongn. (1828, in HIRMER & HOERHAMMER, 1936) but differs mainly in having narrower and smaller parallel meshes along the midrib and lesser number (nearly half) of sporangia per sorus. *P. affinis* Schenk (1867, in HARRIS, 1931) is also comparable but differs in having wider meshes and moreover other details are not known. The two North American species *Phlebopteris smithii* (Daughtery) Arnold (1956) and *P. utensis* Arnold (*l.c.*) are somewhat comparable to the East Coast species. Arnold (*l.c.*, p. 120) regarded the



TEXT-FIG. 1 — *Phlebopteris athgarhensis* sp. nov. showing the pedate nature of the sterile frond (slightly less than $\times 1$). No. 33083.

differences in size of various frond parts as of specific importance. His *P. utensis* differs from *P. smithii* in having smaller fronds and shorter pinnae and pinnules. A comparison in this light shows that the Indian species stands in between *P. utensis* and *P. smithii*. *P. utensis* also differs in having crenate pinnule margins and in the formation of definite squares "fields" due to lateral veins. The upper Triassic species *P. smithii* compares very closely with the present species but differs in its bigger size of pinnules, number of sporangia per sorus, diameter of sori and rachis, and more or less rounded pinnule apex.

Genus *Rhizopteris* Schimper

Rhizopteris ballii Feistmantel

Pl. 2, Figs. 6-7

1877a — *Rhizopteris ballii* Feistmantel, p. 70, pl. 1, figs. 2-6.

Description — Dichotomously branched rhizome, 8.5-9.5 cm. long and 1-1.5 cm. in diameter, base of petiole scars set at an interval of 1-1.5 cm., circular scars 5 mm. in diameter. Inside the circular area lies a C-shaped groove (probably markings of vascular bundles supplying to petiole) with incurved open margins, line forming inside of 'C' even and smooth, 'C' ends swollen.

Lectotype — No. 4345, Geological Survey of India.

Locality — Athgarh.

Age & Horizon — Jurassic, Rajmahal Stage.

Remarks — Feistmantel (1877a, p. 70) described the species *R. ballii* from Athgarh sandstones but made no elaborate description or comparison. The present description is based on four well preserved specimens showing the details of the vascular supply. This species differs from the so far known Indian species of *Rhizopteris* Schimper in having dichotomously branched rhizome and circular petiolar scars of simple type. These scars show matoneaceous affinities. *R. ballii* Feistm. has been found in association with the *Phlebopteris*-type of fronds described as *Phlebopteris athgarhensis*. None of the specimens have, however, been found in any organic connection, their exact relationship still remains an open question.

FILICALES — INCERTAE SEDIS

Genus *Sphenopteris* Brongniart

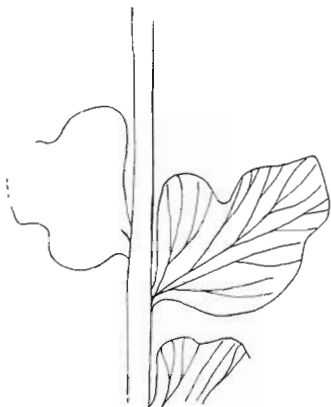
Sphenopteris sp. A

Pl. 2, Fig. 10; Text-fig. 2

Description — Detached fragmentary pinnae (? bipinnate). Rachis prominent, 1 mm. broad. Pinnae alternate, attached at narrow angles, sessile, lamina lobed, lobes 3 or 4, alternate, apex acute, 7 mm. long and 5 mm. broad at the basal regions. Veins distinct, only one single vein arising at the base, repeatedly dichotomizing to supply 6-8 veins per lobe.

Collection — Specimen No. 33087, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Athgarh.



TEXT-FIG. 2 — *Sphenopteris* sp. A. Showing the venation in a single pinnule. $\times 4$. No. 33087.

Age & Horizon — Jurassic, Rajmahal Stage.

Remarks — The present specimen resembles *Sphenopteris rajmahalensis* Sahni & Rao (1934). But differs in the number of veins per lobe and a less prominent central vein.

Sphenopteris sp. B

Pl. 2, Fig. 9

Description — Frond bipinnate, 4×1.2 cm. in size, rachis 0.5 mm. broad with 3-4 longitudinal striations; pinnules attached at an acute angle, long, narrow, 1×4 cm. in size, sessile, margin serrate, apex pointed; venation not well preserved still indicates the absence of midrib and only one prominent vein supply the whole pinnule.

Collection — Specimen No. 33088, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Athgarh.

Age & Horizon — Jurassic, Rajmahal Stage.

Remarks — These specimens differ from *S. rajmahalensis* Sahni & Rao (*l.c.*) in having pinnule with serrate margin and in the absence of lobes. As the specimens are not well preserved and their venation is not very clear, therefore, for the time being it is referred as *Sphenopteris* sp. B.

Fossil Plants from Vemavaram

FILICALES — INCERTAE SEDIS

Genus *Cladophlebis* Brongniart

? *Cladophlebis* sp.

Pl. 2, Fig. 8

Description — Detached pinna, (for observation assumed to be bipinnate), 8×5.5

cm. in size, pinnules attached to the rachis with their full basal width, midrib faintly marked, lateral veins simple or once forked, margin entire, crowded, straight or slightly falcate, apex acute. Pinnule 3×0.8 cm. in size towards the base but smaller at the apex (1.5×0.5 cm.).

Collection — Specimen No. 33080, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Vemavaram.

Horizon — ? Jurassic or Lower Cretaceous.

? PTERIDOSPERMAE

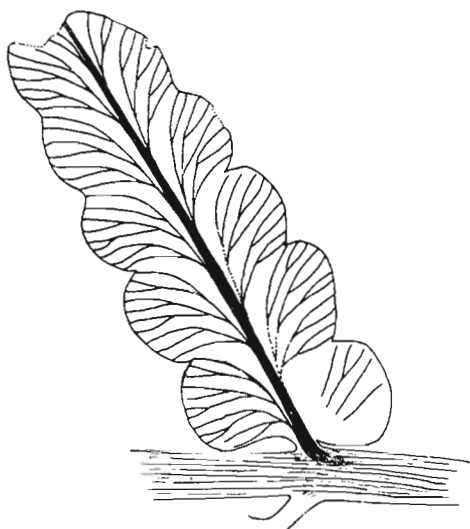
? *Dicroidium*

Pl. 2, Figs. 11-12; Text-fig. 3

1879 — *Thinnfeldia* sp. in Feistmantel, p. 13, pl. 1, figs. 6, 6a.

— *Thinnfeldia* (or *Dichopteris*), in Feistmantel, p. 13, pl. 16, figs. 1 & 1a.

Description — Frond pinnate, (? bipinnate, ? paripinnate) 5.9 cm. long; rachis stout, 3 mm. in diameter near base, narrow towards apex, striae prominent. Pinnae variable in size, opposite to alternate from base to apex, smaller near base longer towards apex, attached with very short stalk, margin lobed, lobes rounded to broadly obtuse, apex broadly pointed; lamina of apical pinna deeply notched with irregular, short and elongated lobes, the first lobe of each pinna on basiscopic side (except for basal



TEXT-FIG. 3 — ? *Dicroidium*. Single pinna magnified showing the venation. $\times 3$. No. 33081.

one) decurrent with rachis. Venation odontopteroid type. Midrib prominent but extinguishes towards apex, lateral vein single, arising at an acute angle, bifurcating 3-4 times, supplying a single lobe.

Collection — Specimen No. 33081, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Vemavaram.

Horizon — ? Jurassic or Lower Cretaceous.

Comparison — The present specimen closely resembles *Thinnfeldia odontopteroides* Seward (1910, p. 538-540; FIGS. 356A-D & 357) which was later on included under *Dicroidium feistmanteli* (Johnston) Gothan by Townrow (1957), in having clusters of forked veins and with a lamina showing different degree of lobing. But its reference directly to *D. feistmanteli* seems to be unjustified. It also shows close comparison with *Dicroidium* sp. cf. *D. feistmanteli* (Johnston) Gothan described by Lele (1961, p. 54) from South Rewa Gondwana Basin. It differs mainly in the character of apex and venation which is not well preserved in Lele's specimen though regarded as Odontopteroid type. The other comparable form is *Microphylopteris pectinata* (Hector) Arber (1917) reported from the Lower Jurassic of New Zealand. But differs in having smaller pinnule size,

only once or twice forked veins, and doubtful bipinnate condition.

FAMILY — ARAUCARIACEAE

Genus *Pagiophyllum* Heer

Pagiophyllum sp.

Pl. 2, Figs. 13-14

1879 — *Pachyphyllum heterophyllum* Feistmantel, p. 219; pl. 16, fig. 16

Description — Unbranched twig, 4.1 cm. long and 1.2 cm. broad, leaves fleshy, spirally arranged, lanceolate, 9-11 mm. in length, directed towards apex, slightly falcate, crowded, lower leaves cover the base of the upper ones, broader at base narrow towards apex; tetragonal leaf scars present, leaf apex acutely rounded, margin entire, abaxial surface keeled.

Collection — Specimen No. 33082, Birbal Sahni Institute of Palaeobotany, Lucknow.

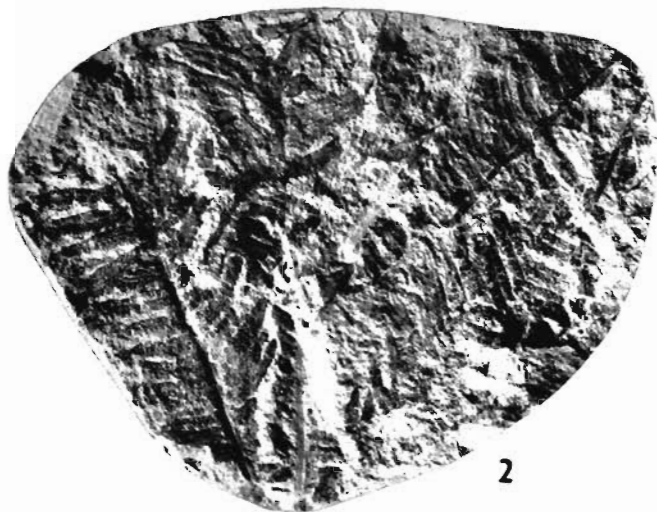
Locality — Vemavaram.

Horizon — ? Jurassic or Lower Cretaceous.

Remarks — The present specimen may be compared with *Pagiophyllum* sp. cf. *P. peregrinum* (L. & H.) Sahni (1928, p. 25; PL. 3, FIGS. 34-35), reported from the Rajmahal Hills but the leaves here are not as spreading as in cf. *P. peregrinum*.

REFERENCES

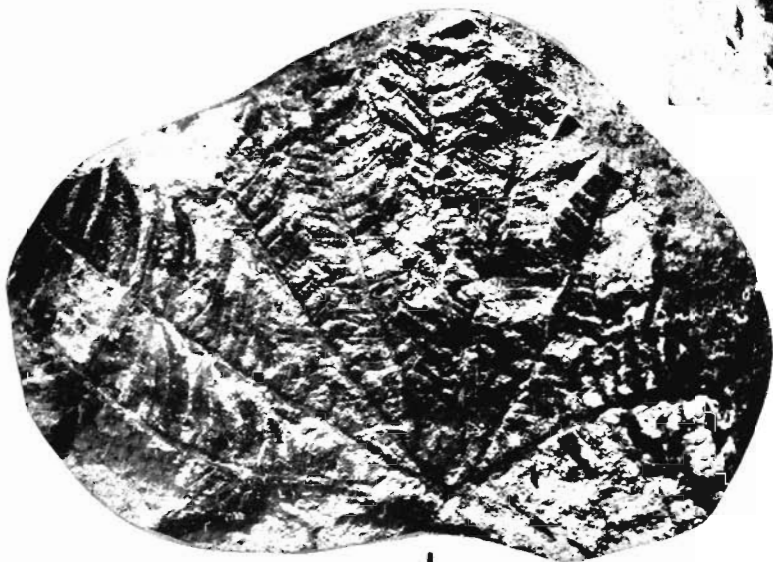
- ARBER, E. A. N. (1917). The earlier Mesozoic floras of New Zealand. *Palaeont. Bull., Wellington*. No. 6. 1-80.
- ARNOLD, C. A. (1956). Fossil ferns of the Matoniaceae from North America. *J. palaeont. Soc. India*. **1** 118-121.
- FEISTMANTEL, O. (1877). Jurassic (Liassic) flora of the Rajmahal group, from Golapili (near Ellore), South Godavari District. *Mem. geol. Surv. India, Palaeont. indica*. **1**(3): 164-190.
- Idem (1877a). Notes on fossil flora of India. *Rec. geol. Surv. India*. **10** (2) 68-76.
- Idem (1879). The fossil flora of the Upper Gondwanas. Outliers on the Madras Coast. *Mem. geol. Surv. India, Palaeont. indica*. **1**(4): 191-224.
- HARRIS, T. M. (1931). The fossil flora of Scoresby Sound East Greenland. *Medd. Om Grønland*. **85** (2): 1-102.
- HIRMER, M. & HOERHAMMER, L. (1936). Morphologie, Systematik und geographische verbreitung der fossilen und rezenten Matoniaceen. *Palaeontographica*. **81** 1-70.
- LELE, K. M. (1961). Studies in the Indian Middle Gondwana flora-1. On *Dicroidium* from the South Rewa Gondwana basin, India. *Palaeobotanist*. **10** (1-2) 48-68.
- RAO, A. R. (1950). Two hitherto unreported plant fossils from the Rajmahal Hills, Bihar. *Curr. Sci.* **19** (12). 378-380.
- RAO, A. R. & LELE, K. M. (1963). On the cuticle of *Dicroidium* (*Thinnfeldia*) *sahnii* (Seward) with some observations on the genera *Thinnfeldia* and *Dicroidium*. *Palaeobotanist*. **11** (1-2): 7-12.
- SAHNI, B. (1928). Revision of Indian fossil plants. Pt. 1. Coniferales (a. impressions and incrustations). *Mem. geol. Surv. India, Palaeont. indica*. **11**. 1-49.
- SAHNI, B. (1931). Revision of Indian fossil plants. Pt. 2. Coniferales (b. petrifications). *Ibid.*: 51-124.
- SAHNI, B. & RAO, A. R. (1934). *Rajmahalia paradoxa* gen. et sp. nov. and other Jurassic plants from the Rajmahal Hills. *Proc. Indian Acad. Sci.* **1** (6) 258-269.
- SAHNI, B. & SITHOLEY, R. V. (1945). Some Mesozoic ferns from the Salt Range, Punjab. *Proc. natn. Acad. Sci. India*. **15** (3) 61-73.
- SEWARD, A. C. (1910). Fossil plants. **2**. London.
- SEWARD, A. C. & SAHNI, B. (1920). Indian Gondwana Plants: A revision. *Mem. geol. Surv. India, Palaeont. indica*. **7** (1). 1-41.
- SURYANARAYANA, K. (1954). Fossil plants from the



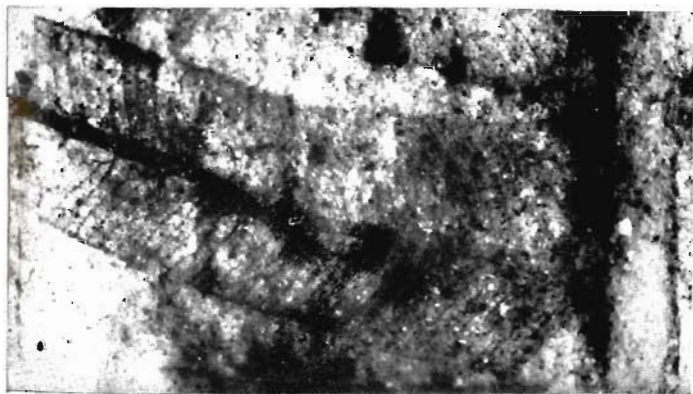
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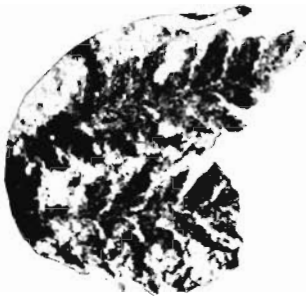
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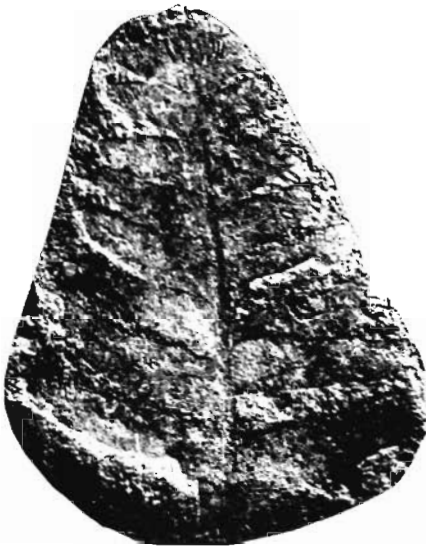
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Jurassic rocks of the Madras Coast. *Palaeobotanist*. **3**: 87-90.
 TOWNROW, J. A. (1957). On *Dicroidium*, probably

a pteridospermous leaf, and other leaves now removed from this genus. *Trans. geol. Soc. S. Afr.* **60**. 21-56.

EXPLANATION OF PLATES

PLATE 1

Phlebopteris athgarhensis sp. nov.

- 1 Sterile pinnae in pedate habit. $\times 1$. No. 33083.
- 2 Fertile pinnae in pedate habit. $\times 1$. No. 33084.
- 3 A single sterile pinnule magnified showing the venation. $\times 10$. No. 33085.
- 4 A part of fertile pinna magnified. $\times 2$. No. 33084.
- 5 A single fertile pinnule magnified showing the arrangement of sori. $\times 10$. No. 33084.

PLATE 2

6. *Rhizomopteris ballii* Feistmantel. Showing the bifurcated rhizome with petiolar scars. $\times 1$. No. 33086.
7. Same, a single magnified petiolar scar showing C-shaped, simple incurved end of the vascular supply. $\times 10$.
8. *Cladophlebis* sp. $\times 1$. No. 33080.
9. *Sphenopteris* sp. B $\times 1$. No. 33088.
10. *Sphenopteris* sp. A $\times 1$. No. 33087.
11. ? *Dicroidium*. $\times 1$. No. 33081.
12. Same showing venation in a single magnified pinna. $\times 3$.
13. *Pagiophyllum* sp. $\times 1$. No. 33082.
14. Same magnified. $\times 2$.