

THREE NEW FERN FRONDS FROM THE GLOSSOPTERIS FLORA OF INDIA

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ABSTRACT

A new species of *Neomariopteris* and a new species of *Dichotomopteris* is recorded. In addition to this a new genus *Santhalea* is instituted.

INTRODUCTION

OUR knowledge on the morphology of the ferns from the Lower Gondwanas of India has been advanced considerably from the recent work of Maithy (1974a, 1974b, 1975), Pant and Misra (1976) and Pant and Khare (1974). Recently Maithy has revised the Lower Gondwana ferns from India. On the basis of his revision, he has instituted two new genera *Neomariopteris* and *Dichotomopteris* and an unrecorded form *Dizeugotheca*. Pant and Khare (1974) and Pant and Misra (1976) have reported two new genera *Damudopteris* and *Asansolia* from the Raniganj Coalfield.

The present paper deals with three new fern fronds collected recently from Handappa, Dhenakal, Orissa and the village Tatti, on the north bank of Bansloi River, Santhal Pargana, Bihar. The materials are preserved in the form of impressions.

Sincere thanks are due to Dr K. R. Surange and Dr Shaila Chandra for passing on the Handappa collection for investigation.

Neomariopteris Maithy, 1974

Neomariopteris was proposed by Maithy (1974) for the Indian Lower Gondwana fern fronds with sphenopteroid venation, decurrent pinnules and winged rachis. Subsequently in 1975, Maithy recorded the fertile pinnules and emended the diagnosis. Pant and Khare (1974) published a new genus *Damudopteris* with same morphological characters of *Neomariopteris*. Even both the authors have chosen the same specimen, i.e. *Sphenopteris polymorpha* Feistmantel (1880), as the genotype for their proposed genus. Therefore, on the basis of priority

of dates, *Damudopteris* becomes synonym to *Neomariopteris*, because the former form has been published one month later.

Neomariopteris khanii sp. nov.

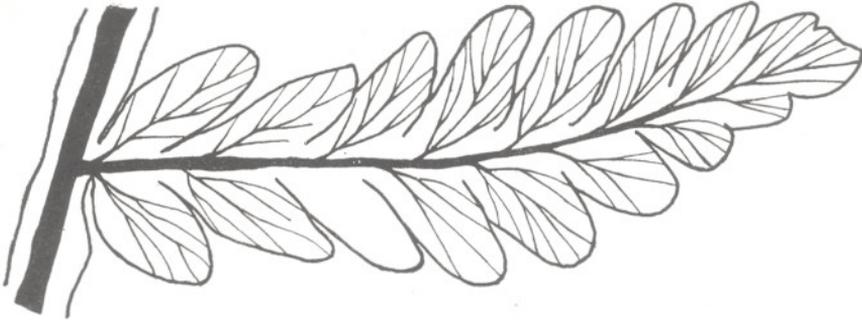
Diagnosis — Fronds large, at least tri-pinnate; catadromic, rachis winged, secondary rachis broad, emerge alternately at an angle of $\pm 60^\circ$; pinnae lanceolate; attached alternate, sub-opposite or opposite from secondary rachis; lateral pinnules ovate, 1.0 cm long and 0.4 mm broad at base, i.e. the length and breadth ratio of the pinnules is 2.5:1, lateral pinnules alternately arranged, standing at right angles to rachis, decurrent, attached by broad bases, lateral fusion of two pinnules margin is $\pm 1/4$ length of the pinnules from the base; apex acute; margin entire; both the margins show outward curvature; terminal pinnules smaller than lateral pinnules, triangular in shape, apex pointed; venation sphenopteroid, median vein distinct, emerge at 45° from the point where the lower margin of pinnules join the pinnae rachis, course straight, median vein gives fine lateral nervules which dichotomises once before reaching the margin, 10-12 nervules recorded in one pinnule.

Holotype — No. 35237, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Handappa, Orissa.

Horizon — Kamthi Formation (Upper Permian).

Description — A large incomplete frond has been figured in Pl. 1, fig. 1. The median rachis is thick, 7 mm at the incomplete base and 4 mm at the incomplete apex. Surface of the rachis shows fine striations. The rachis is narrowly winged. Secondary rachises are arranged alternately on both the sides of main rachis at a distance of 0.8 to 1.5 cm from apex to base. The distance in between alternating pair of secondary rachises decrease as we measure from base to apex of the frond. The



TEXT-FIG. 1 — *Neomariopteris khanii* sp. nov., a pinnae enlarged to show venation of pinnules $\times 4$.

secondary rachises are attached at 60° on the main rachis. The basal most secondary rachis is 18 cm long and 14 pinnae are arranged on it. Secondary rachis is distinctly winged. Pinnae are attached, alternate to one other at the basal portion of secondary rachis, sub-opposite in the median portion and opposite at the terminal portion or near it. Pinnae are attached at $\pm 90^\circ$ to secondary rachis, due to this a fairly good distance (5.5-6.5 cm) is observed in between succeeding secondary rachises. Pinnae lanceolate in shape measuring 2-3.5 cm in length. Lateral pinnules 5 to 8 on either side of pinnae rachis. Lateral pinnules are alternately arranged and attached \pm right angles to the rachis. The basal margin of pinnules are longer drawn than the apical end of margin. As a result of this the pinnules apex is oblique in position to pinnae rachis. A midvein is persistent up to $1/3$ from base which diffuses into secondary veins by dichotomy. Margin of the pinnules entire. Terminal pinnule is triangular and smaller than the lateral pinnules. Fertile organs are not known.

Comparison — The frond is characterised by its large size and robust look, hence it differs from all the known species of *Neomariopteris*. *Neomariopteris polymorpha* (Feistm.) Maithy, 1974 compares due to strong winged rachis, but differs in the shape of pinnules, apex and right angle alignment of pinnules. *Neomariopteris hughesii* (Feistm.) Maithy, 1974 compares in the oblique alignment of pinnules to pinnae rachis, but differs in the presence of extremely narrow winged rachis. Moreover, in *N. hughesii* the pinnule margins are serrate. Other species, *N. lobifolia* Maithy

(1974) has obovate pinnule and *N. talchirensis* Maithy (1974) is a frail species.

Derivation of Name — The species is named after late Mr A. M. Khan of Geological Survey of India, Calcutta who first discovered this fossil locality.

Santhalea gen. nov.

Generic Diagnosis — Fronds large, imparipinnate, tripinnate; rachis winged; pinnules decurrent, attached to rachis by broad base, venation pectopteroid; single midvein persistent up to apex, lateral veins towards apical part, simple, whereas in basal part divides into two, three or four veinlets; when three, the distal one divides into two and the proximal remains undivided, and when four the proximal remains undivided and in the distal one the proximal one divides into two veinlets and distal one remains unforked. Reproductive structures unknown.

Genotype — *Santhalea bansloiensis* sp. nov.

Comparison — The identification of ferns from the Glossopteris flora are based upon the morphological characters and the pattern of venation. Previous studies have demonstrated that the ferns from the Lower Gondwanas, viz., *Neomariopteris*, *Dichotomopteris* and *Dizeugothea* show a uniform type of venation in all pinnules. Similar uniformity in the pattern of venation is also known in the modern ferns, viz., *Pteris*, *Goniophlebium*, *Gymnogramma* and *Microlepidia*. There are other modern ferns where the pattern of venation varies

in different pinnules. The veins are simple in nature in the apical pinnules, while they are dichotomous once or more than once in basal pinnules. Such type of venation is seen in *Diplazium*, *Lindsaea*, *Alsophila* and *Cyathea*. The present frond *Santhalea* belongs to the second type and it shows variation in the pattern of venation in different pinnules from apex to base. But this too is characteristic in the genus as detailed below.

The frond of this genus is identified by winged rachis and characteristic venation pattern, which is from simple to dichotomous into 2, 3 or 4 veinlets. The dichotomy of veins is also characteristic. The present frond shows its closest resemblance to *Pecopteris* Brongniart, but it differs from *Santhalea* gen. nov. in the absence of basal contiguity of the pinnules and winged rachis. *Alethopteris* Sternberg agrees due to basal contiguity of pinnules, but differs in the presence of veins from pinnae rachis in the basal region of pinnules. *Dizeugotheca* Archangelsky & Sota (1960) compares morphologically but differs due to presence of only simple veins. *Dichotomopteris* Maithy (1974b) differs in the venation pattern. In *Dichotomopteris* the midvein is evanescent whereas in *Santhalea* it is persistent upto apex. Moreover the lateral veins in *Dichotomopteris* is always divided into 2 or 3 veinlets, whereas in *Santhalea* the veins are simple and divided into 2, 3 or 4 veinlets. Further, in *Santhalea* the rachis is winged whereas in *Dichotomopteris* the rachis is non-winged. *Lobopteris* Wagner (1958a) and *Polymorphopteris* Wagner (1958b) compares somewhat morphologically, but differs in having the basal veins forked into two. In *Santhalea* the veins are forked.

Derivation of Name — After the district Santhal Pargana, Bihar.

Santhalea bansloiensis sp. nov.

Pl. 2, figs. 3-6; Text-figs. 2A-C

Synonymy:

- 1965—*Pecopteris* sp., Maheshwari & Prakash; pl. 1, fig. 1; text-fig. 4.
 1965—*Alethopteris* sp. A, Maheshwari & Prakash; pl. 1, fig. 8; text-fig. 4.
 1965—*Alethopteris* sp. B, Maheshwari & Prakash; pl. 1, fig. 9; text-fig. 5.

Diagnosis — Sterile fronds imparipinnate, tripinnate frond, rachis broadly winged, 5 mm broad with two distinct ridges; pinnae lanceolate, arranged alternately, at an angle of 45°; pinnules attached to pinnae rachis at wide angle, 80°-90°, contiguous to each other by base, cleft between pinnules deep, oblong in shape with obtuse apex, midvein distinct and persistent upto apex, lateral veins arranged alternately; simple or divides into 2, 3 or 4 veinlets; when 3, the proximal one remains undivided and the distal one divides into 2; and when 4, the proximal remains undivided, while the distal divided into two and lastly the vein of proximal side divides into two and the distal one remains unforked.

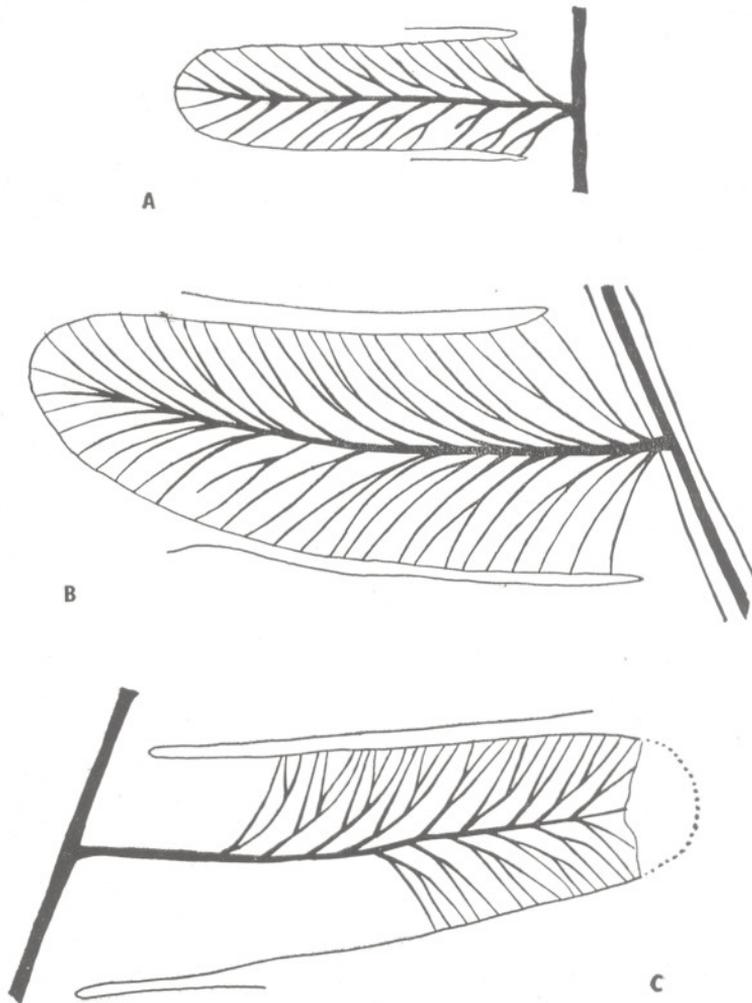
Holotype — No. 35238, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — On the north bank of Bansloi River near the village Tatti, Pachwara Coalfield, Santhal Pargana, Bihar.

Horizon — ? Raniganj.

Description — The identification of frond is based upon number of incomplete specimens collected from the above mentioned locality and the specimens described by Maheshwari and Prakash (1965). The specimen figured here in Pl. 2, fig. 3 is a portion of bipinnate frond. The primary rachis is distinctly winged with two distinct vertical ridges in the middle region. Veins in the pinnules present at the apical part of pinnae are simple and rarely dichotomous, whereas the veins in the pinnules present in the basal part of fronds are either divided into two or three or four veinlets. All the variations of the venation patterns are seen in the specimen figured by Maheshwari and Prakash (1965, pl. 1, fig. 9). In this specimen, the pinnules towards the apical end of frond show simple veins or veins divided into two veinlets, whereas the pinnules in the basal portion of frond show that the veins are either divided into two, three or four veinlets (see Pl. 2, figs. 3, 4, 5; Text-figs. 2 A-C).

Comparison & Discussion — The present form shows characteristic arrangement of venation in the entire frond. A careful examination of the specimens described by Maheshwari and Prakash (1965) under *Pecopteris* sp., *Alethopteris* A and *Alethopteris* B show that they are different portions of the same frond. The specimen described *Alethopteris* A represents the



TEXT-FIG. 2.—A-C, *Santhalea bansloiensis* gen. et sp. nov.; A. a pinnule enlarged to show simple and dichotomous veins $\times 4$; B. a pinnule enlarged to show simple and dichotomous veins into 2 or 3 vein endings $\times 4$; C. a pinnule enlarged to show dichotomous veins dividing into 2, 3 or 4 vein endings.

apical portion of frond, *Pecopteris* sp. represents the middle portion and *Alethopteris* B represents the basal portion. Hence, all of them have been transferred here under one species.

Lacey and Huard-Moine (1966) reported *Cladophlebis* cf. *nibbensis* from Wankie, Rhodesia. This specimen appears alike to the present form.

***Dichotomopteris* Maitly, 1974**

Dichotomopteris ovata sp. nov.

Pl. 2, fig. 7; Text-fig. 3

Synonymy:

1960 — *Merianopteris* sp. Archangelsky & Sota, p. 118; pl. 4, fig. 19; text-figs. 74-75.



TEXT-FIG. 3 — *Dichotomopteris ovata*, pinnules enlarged to show venation $\times 4$.

Diagnosis — Fronds bipinnate, rachis non-winged; pinnae alternate, perpendicular to rachis; lateral pinnules alternate, attached obliquely, $\pm 50^\circ$ from rachis, oblong in outline, 8-12 mm long and 6-9 mm broad, apex obtuse, base broad and decurrent; lateral fusion $\pm 1/2$ length from the base of pinnules; venation catadromic, single distinct midvein arises just at the line of pinnule base, which passes to pinnule with strong radial curvature; midvein persistent $1/2$ length of the pinnule from base and then dissolving into secondary veins by repeated dichotomy. Lateral veins commonly two pairs, arranged alternately, dichotomise always into two, course of veins characteristic, they show strong curvature parallel to pinnule margins. The first lateral vein of the proximal side arises just at the point of emergence of midvein from pinnae rachis, its direction is more or less parallel to pinnule margin; while the lateral vein of distal side emerges distinctly away from the first basal vein, subsequent veins are closely arranged; course of veins flexuous.

Holotype — No. 35239, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Near the Tatti Village on the north bank of Bansloi River, Pachwara Coalfield, Santhal Pargana, Bihar.

Horizon — ?Raniganj.

Comparison — Till now only three species of *Dichotomopteris*, viz., *D. major* Maithy (1974b, 1975), *D. lindleyii* Maithy (1974b, 1975) and *D. falcata* Maithy (1975) are known from the Lower Gondwanas of India. Morphologically the present form agrees to the above mentioned species but differs due to characteristic venation, i.e. the veins are flexuous and the lateral veins show outward radial curvature parallel to pinnule margin. Moreover, *D. lindleyii* and *D. falcata* differs in the shape of pinnules. *D. major* compares in shape but differs in the course of veins and also the alignment of pinnules on the pinnae rachis.

Archangelsky and Sota (1960) described *Merianopteris* sp. (figs. 74-75; pl. 4, fig. 19) from the Permian of Patagonia, which agrees morphologically to the present form and are alike.

GENERAL REMARKS

Earlier the Indian Lower Gondwana fern genera have been classed under *Sphenopteris*, *Pecopteris*, *Alethopteris* and *Merianopteris*. Recent studies have rightly demonstrated that the Lower Gondwana ferns, though superficially alike to northern Carboniferous forms, but differs considerably. This has also been supported by the record of their fertile fronds. A common feature noticed in all the Indian forms that the pinnules near the bases are laterally contiguous, though they differ in their venation pattern. Therefore, the generic identification of ferns are based on the pattern of venation. The specific identifications are based on the morphology of pinnules (shape and apex). This approach of identification appears to be satisfactory, because, often only the sterile parts of fronds are found in Palaeozoic strata and these are the specimens with which the palaeobotanical stratigrapher works.

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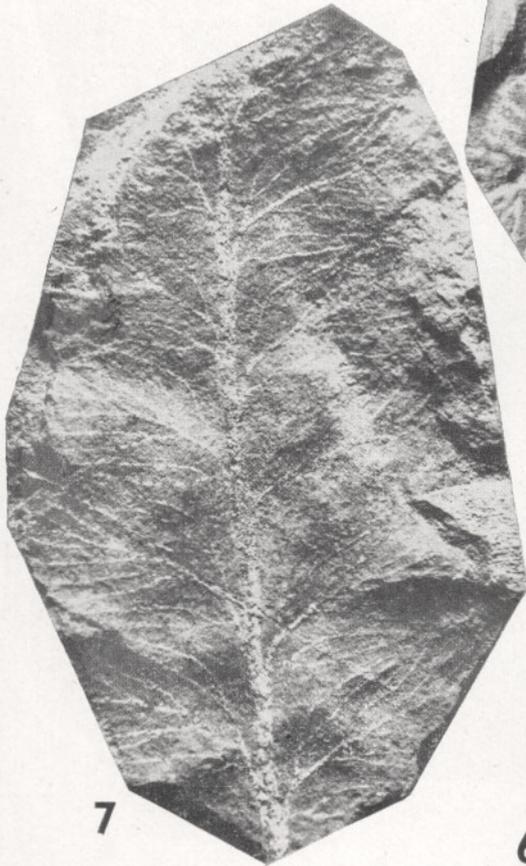
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EXPLANATION OF PLATES

PLATE 1

1. *Neomariopteris khanii* sp. nov. × 2/3. B.S.I.P. specimen no. 35237.
2. A pinnae of the above specimen enlarged to show venation. × 4.

PLATE 2

- Santhalea bansloiensis* gen. et sp. nov.
3. A specimen showing the attachment of pinnae to winged rachis. × 1. B.S.I.P. specimen no. 35238

4. Pinnules enlarged to show simple and single dichotomous veins. × 4. B.S.I.P. specimen no. 32851.
5. Two pinnules enlarged to show their lateral contiguity at base and persistent midvein. × 4. Lateral veins simple or dichotomous into 2 or 3 veinlets. B.S.I.P. specimen no. 35238.
6. A pinnule enlarged to show dichotomy of lateral veins into 2, 3 or 4 veinlets. × 4. B.S.I.P. specimen no. 32853.

Dichotomopteris ovata sp. nov.

7. A pinnae enlarged to show venation. × 4. B.S.I.P. specimen no. 35239.