

PTERIDOPHYTIC REMAINS FROM THE SELECTED SEARSOLE COLLIERY, RANIGANJ COALFIELD, WEST BENGAL, INDIA

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ABSTRACT

Sterile and fertile remains of the filicales from the Raniganj Formation of Selected Searsole Colliery of the Raniganj Coalfield have been described in the present paper. *Leleopteris* gen. nov. is proposed for fronds having contiguous pinnules where lateral veins are always once dichotomous. The three species, *Leleopteris raniganjensis*, *L. ovata* (Maithy) comb. nov. and *L. srivastavae* (Surange) comb. nov. are distinct species. The other well known fern genera, *Neomariopteris*, *Dizeugotheca* and *Dichotomopteris* are also reported.

INTRODUCTION

Majority of the Lower Gondwana ferns are known to occur from different collieries of the Raniganj Formation of the Raniganj Coalfield, W. Bengal, India. They were identified as *Sphenopteris*, *Pecopteris*, *Alethopteris*, *Asplenium*, *Merianopteris*, *Asterotheca* and *Ptychocarpus*, on the basis of northern hemisphere form-genera. FEISTMANTEL (1881), ZEILLER (1902), ARBER (1905), SRIVASTAVA (1955), SURANGE (1964), MAHESHWARI AND PRAKASH (1965), KULKARNI (1971), VIMAL AND SINGH (1971), and others have described several form-genera under the existing northern forms.

Recent contributions by MAITHY (1974a, 1974b, 1975, 1977), PANT AND KHARE (1974), PANT AND MISRA (1976, 1977) and SRIVASTAVA (1978) in the study of Lower Gondwana ferns have given a new impetus to the southern fern genera. Several new forms, *Neomariopteris*, *Damudopteris*, *Dichotomopteris*, *Santhalea*, *Dizeugotheca*, *Damudosorus* and *Trithecopteris*, were instituted on the basis of venation pattern and fertile structures. Some of the genera described by MAITHY, and PANT and his associates are published simultaneously and are now proved to be synonymous to each other. The locality for above mentioned genera by both the authors has been Raniganj Coalfield, except *Santhalea*. The material for the present paper was collected from the Selected Searsole Colliery (Seam VIII) of Raniganj Coalfield, W. Bengal, India. The collection includes several sterile and fertile specimens of different known genera and one new genus with its three species. The type and figured specimens of known genera preserved at the Museum of B.S.I.P. were also studied to confirm the observations and studies of previous workers. Celloidin pulls and synthetic gum pulls of carbonaceous matters were prepared and mounted in DPX mountant for microscopic examination. Maceration of the carbonised crust by usual Schulze's solution treatment has sometimes yielded good laminar cuticle, sporangia and spores from the fertile pinnules of the fronds.

OBSERVATIONS

Neomariopteris Maithy, 1974

Type species—*Neomariopteris polymorpha* (Feistm.) Maithy, 1974a

The genus *Neomariopteris* was instituted by MAITHY (1974a) for fronds having winged rachis and decurrent pinnules with sphenopteroid venation. He selected G.S.I.

terminal pinnule short and broad with broadly acute apex, base broad and decurrent, pinnules 3-7 mm in length and 2-4 mm in width; venation well preserved having, median vein arising at 40°-60° angle with pinnae rachis, midvein distinct up to 1/2—3/4, evanescent towards apical region, giving out 4-6 lateral veins on either side, each lateral vein dichotomises only once, giving out two forked veins reaching the pinnule margin.

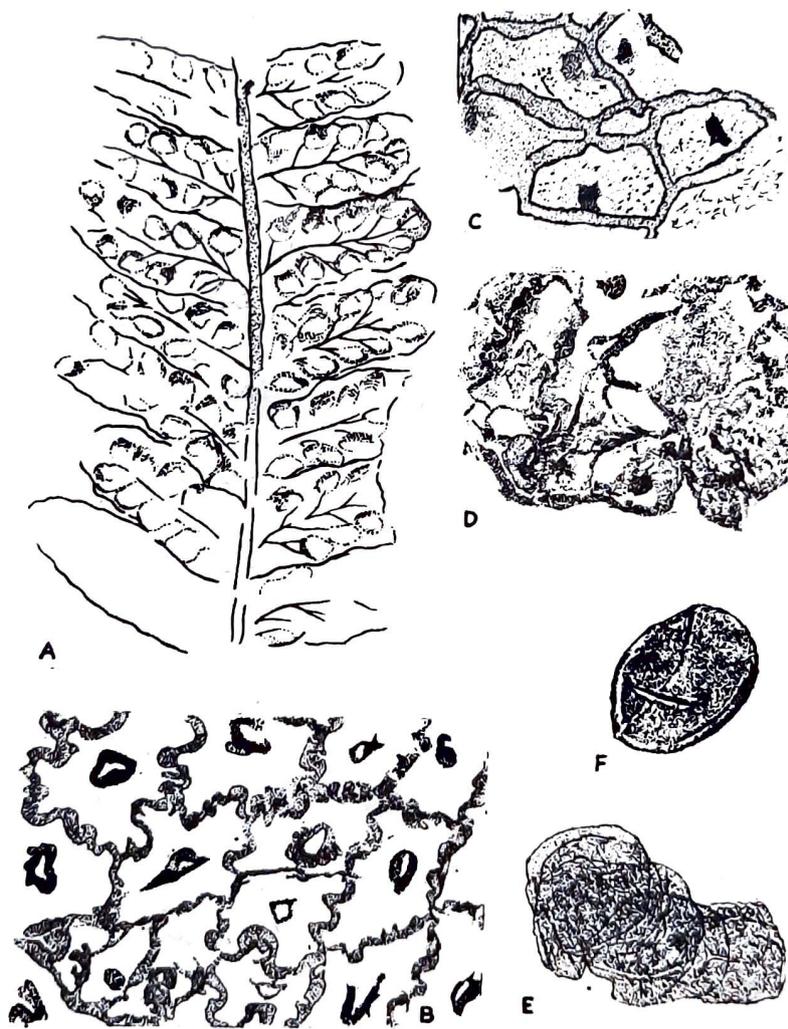
Holotype—Specimen No. 35239, B.S.I.P. Museum.

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

Horizon & Age—Raniganj Formation, late Permian.

Figured specimen—No. 35977, B.S.I.P. Museum.

Comparison and discussion—MAITHY (1977) reported a new species *Dichotomopteris ovata* from the Pachwara Coalfield, Santhal Pargana. The lateral vein of pinnule in this species dichotomises always once and the pinnules are oblong in shape accordingly it has been transferred under new genus *Leleopteris*. The flexuos and the radial curvature of the lateral veins of the pinnules could very well be a preservational aspect and can not be taken as the specific character.



Text-fig. 3. *Leleopteris srivastavae* (Surange) comb. nov.

- A. portion of fronds showing the position of sorus and the venation pattern. ×2.
- B. Lower cuticle of pinnules showing wavy cell walls and flat papillae. ×300.
- C. Upper cuticle showing straight walled cells with papillae. ×300.
- D. Lower cuticle showing the stoma with two dark colour semilunar guard cells. ×300.
- E. Spore mass recovered from the sorus. ×400.
- F. Single spore showing verrucae. ×425.

The present species differs from *L. raniganjensis* in having oval oblong or sub-triangular shape pinnule. The terminal pinnule of *L. raniganjensis* is narrow, elongate with sharply acute apex whereas in *L. ovata* the terminal pinnule is short and broad with broadly acute apex.

Leleopteris srivastavae (Surange) comb. nov.

Pl. 1, Figs. 5, 6 ; Pl. 2, Figs. 7-14 ; Text-fig 3. A-F

Synonymy

1966 *Ptychocarpus srivastavae* Surange, page 72, fig. 42A C.

Emended Diagnosis—Fertile bipinnate frond, main rachis 5-7 cm long and up to 2-3 mm in width ; pinnae imparipinnate alternately arranged, pinnae 4-5 cm in length and its rachis 1-1.5 mm wide attached with 80—90° angle to primary rachis bearing 7-10 alternately arranged pinnules, 10-15 mm in length and 4-6 mm in breadth, narrow oblong to ovate in shape, broad base, decurrent, pinnule margin lobed to crenulate, pinnule venation well preserved, having distinct median vein, evanescent towards apex ; lateral veins 6-8 on either side only once dichotomous ; 6-8 sori arranged in linear rows on either side of the midvein, between midvein and pinnule margin ; each sorus having 6-8 loculi (sporangia), spores trilete having verrucate exine.

Narrow elongate tracheids having scalariform pitting obtained from rachis. Cells of upper epidermis over pinnule lamina showing straight-walled cells, each cell show flat papillae ; lower epidermal cells wavy to sinuous wall, each cell possesses distinct hollow papillae in the centre ; stomata rare, present between veins, guard cells slightly thickened, semilunar, no differentiation between subsidiary and epidermal cells, stomatal pore distinct.

Holotype—Specimen No. 8669, B.S.I.P. Museum.

Locality—Raniganj Coalfield, West Bengal, India.

Horizon & Age—Raniganj Formation, late Permian.

Figured Specimen—No. 35979, B.S.I.P. Museum.

Comparison—*L. srivastavae* (Surange) comb. nov. is based on fertile fronds. The pinnule margins are lobed to crenulate in *L. srivastavae* whereas in *L. ovata* and *L. raniganjensis* margins are straight. It is quite likely that *L. srivastavae* may turn out to be fertile frond of any of the two sterile species as we find two types of pinnules in *Trithecopteris gondwanensis* Pant & Misra and *Dichotomopteris lindleyii* (Royle) Maithy. Unless we have actually found the sterile and fertile pinnules on one frond, it is better to keep the fertile specimens under a new species.

Discussion—SRIVASTAVA (1955) reported a fertile frond under ?*Ptychocarpus* sp. which was later transferred to a new species *P. srivastavae* by SURANGE (1964). SRIVASTAVA (1955) and SURANGE (1964) have noticed that the lateral veins of the fertile pinnules in *P. srivastavae* dichotomise only once. SURANGE has given this feature under the specific diagnosis of *P. srivastavae*. We have also observed the type specimens of SRIVASTAVA and found this character as a constant feature accordingly we have transferred this species under *Leleopteris srivastavae*. Although MAITHY (1974b, 75) has placed this species under *Dichotomopteris lindleyii* but on the basis of pinnule venation we are placing it under new genus *Leleopteris*. The epidermal features as observed by SRIVASTAVA (1955) are quite similar with the epidermal features of *L. srivastavae*.

As compared to ferns of northern hemisphere, ferns of *Glossopteris* flora are poor in genera and species. In all we have 10 genera described from the Lower Gondwana of India. They are *Neomariopteris* Maithy (1974a), *Dizeugotheca* Archangelsky & Sota (1960), *Dichotomopteris* Maithy (1974b), *Santhalea* Maithy (1977), *Damudosorus* Pant & Misra (1977), *Trithecopteris* Pant & Misra (1977), *Pantopteris* Chandra & Rigby (in press), *Leleopteris* gen. nov., *Kashmiropteris* Kapoor (1978) and *Botrychiopsis* Kurtz (1954). In India maximum number of ferns are known from the Raniganj Formation where the climate was favourable for their growth. This is also true for the northern fern genera where the climate was warm and humid which favoured maximum and luxuriant growth of ferns. Many of the northern fern genera turned out to be pteridosperms as the ultimate pinnules of the fronds transformed into seed-bearing structures. So far, from the Lower Gondwana countries we have no records of fern fronds with seeds. With recent studies of MAITHY, and PANT and his associates we have found fertile structures of fronds which are true ferns having homosporous spores in single sporangia or synangia.

The fertile Lower Gondwana ferns are classified under two families by PANT AND MISRA (1977), viz., Damudopteridaceae with free sporangia and Asterothecaceae with synangia. The authors have discussed affinities of these two families with leptosporangiate and Marrattiaceous ferns, respectively.

PANT AND KHARE (1974) have also shown the importance of Damudopteridaceae in the evolution of a vertical annulus of modern leptosporangiate ferns.

PANT and his associates were able to procure the cuticles and tracheids of some of the ferns. MAITHY also found some cuticular pieces in *Neomariopteris hughesii* and tracheids in *Dichotomopteris major*. We could also obtain some cuticle pieces and tracheids of *Leleopteris*. The cuticles of *Neomariopteris*, *Asansolia*, *Trithecopteris* and *Leleopteris* have proved that they are true ferns as all these genera have very delicate cuticles which are non-resistant to maceration. To obtain the cuticles special care is required. All the four ferns have sinuous-walled characteristic epidermal cells. Their stomata are simple with two neighbouring cells. The tracheids are unpitted in all the cases wherever they are obtained.

We are taking two major criteria for identifying and separating the fern genera.

1. Attachment and venation pattern of the pinnule

MAITHY (1974) has for the first time emphasised the importance of the mode of attachment of pinnules. He has observed that the Lower Gondwana ferns have decurrent base as compared to the ferns of northern hemisphere which are nondecurrent in nature.

As majority of the ferns are found in sterile condition, the generic separation is made on the basis of venation of pinnules and in addition the attachment, shape and margin of the pinnules is also taken into consideration. The Indian Lower Gondwana fern genera *Neomariopteris*, *Dichotomopteris*, *Santhalea*, *Dizeugotheca* and *Leleopteris* are based mainly on the basis of their pinnule venation. *Pantopteris* is the only Indian fern genus where we find occurrence of anastomoses in secondary veins.

2. Position of the sorus and kind of sporangia

Majority of the fern genera in the Lower Gondwana have fertile structures situated in between the margin and the midvein of the pinnules. In few exceptional cases, like *Dizeugotheca neuburgiae*, we find sporangia fringing along the margin. It is also an

important character whether the sporangia occur singly or in groups and whether they are separate or fused. In *Trithecopteris* the three synangiate sporangia are found on a common fused stalk.

Regarding the habit of these fern genera we have not been able to say much as we do not know anything about their stem and mode of attachment of the fronds. It is quite likely that they exhibited variety of habits.

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EXPLANATION OF PLATES

PLATE-1

- Fig. 1. *Leleopteris ovata* (Maithy) comb. nov. Bipinnate fronds showing the pinnae, the arrangement and nature of pinnules. Specimen no. 35977 \times Nat. Size.
2. *L. ovata* Pinnules enlarged to show the venation and shape of pinnules. $\times 4$.
 3. *L. raniganjensis* sp. nov. Holotype portion of the frond showing pinnae, the arrangement and nature of pinnules. Specimen no. 35978 \times Nat. size.
 4. *L. raniganjensis* sp. nov. Pinnules of the holotype enlarged to show the venation and shape of pinnules $\times 4$.
 5. *L. srivastavae* (Surange) comb. nov. A portion of the frond showing two fertile fronds. Specimen no. 35979 \times Nat. size.
 6. *L. srivastavae* enlarged portion of the pinnules to show the position of sori. $\times 4$.

PLATE-2

- Fig. 7. *L. srivastavae* (Surange) comb. nov. Lower cuticle of the pinnules showing wavy cell wall and flat papillae $\times 300$. Slide no. 6613.
8. Enlargement of the lower cuticle cells of *L. srivastavae* showing distinct median papillae $\times 500$. Slide no. 6614.
 9. Lower cuticle showing the stoma with two similar guard cells. $\times 400$. Slide no. 6613.
 10. Upper cuticle of the pinnules showing thick straight-walled cells with flat median papillae. $\times 400$. Slide no. 6613.
 11. A portion of the broken sporangium. $\times 250$. Slide no. 6615.
 12. Spore mass recovered from sorus. $\times 400$. Slide no. 6616.
 13. A single spore showing the folded exine. $\times 500$. Slide no. 6616.
 14. Tracheids showing the scalariform thickenings. $\times 100$. Slide no. 6613.

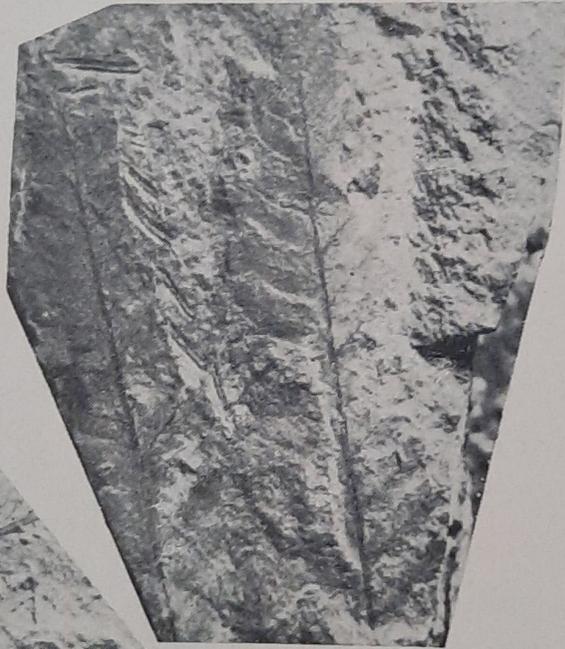
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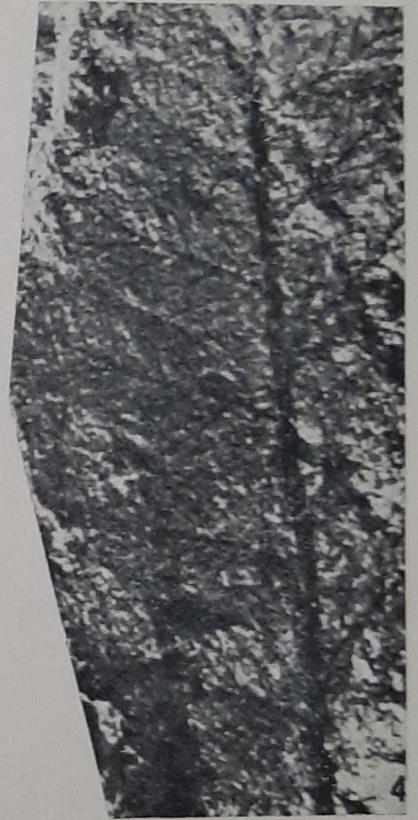
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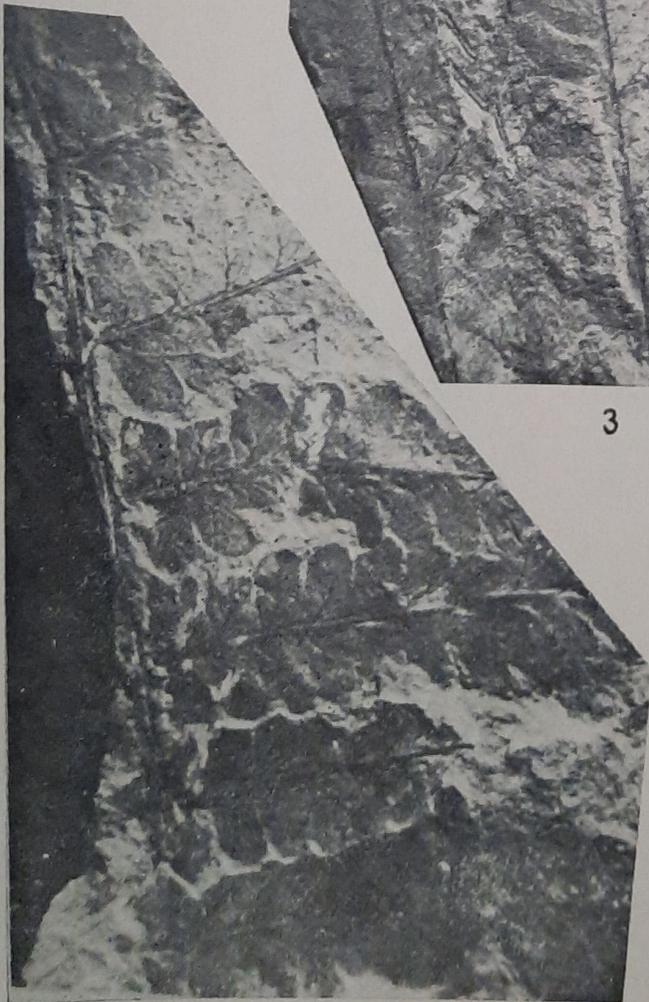
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