

Plant fossils from the exposure near Gopal Prasad Village, Talchir Coalfield, Orissa with remarks on the age of the bed*

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The palaeofloristics of the Lower Gondwana beds (Early Permian) exposed in a tributary of Singada Jhor Nala near Gopal Prasad Village in the western part of Talchir Coalfield, Orissa have been referred to four genera with thirteen recognizable species of pteridophytes and gymnosperms, viz., *Schizoneura gondwanensis* Feistmantel, equisetalean stems, *Neomariopteris hughesii* (Zeiller) Maithy, *Glossopteris subtilis* Pant & Gupta, *G. indica* Schimper, *G. intermedia* Feistmantel, *G. tenuinervis* Pant & Gupta, *G. tenuifolia* Pant & Gupta, *G. intermittens* Feistmantel, *G. communis* Feistmantel, *G. gigas* Pant & Singh, *G. leptoneura* Bunbury, *G. stenoneura* Feistmantel and *Eretmonia* species. The assemblage is characterised by the dominance of the genus *Glossopteris* and the absence of *Gangamopteris*-*Noeggerathiopsis* complex. The flora indicates late Early Permian age as it also contains some Late Permian characteristic forms like *G. leptoneura*, *G. gigas*, *G. subtilis*, *G. tenuifolia* and *G. tenuinervis*.

Key-words—Plant fossils, Barakar Formation, Permian, Talchir Coalfield, India.

INTRODUCTION

THE first published palaeobotanical record from Talchir Coalfield is by Blanford *et al.* way back in 1856 reporting *Glossopteris*, *Pecopteris* and equisetaceous spikes from Talchir area.

Later Feistmantel (1880) recorded the following taxa from Singada Jhor Nala near Gopal Prasad Village: *Tryzygia speciosa*, *Glossopteris indica*, *G. angustifolia*, *G. damudica*, *G. communis*, *G. intermedia*, glossopteridean fructification, *Dictyopteridium sporiferum?* and *Vertebraria indica*.

Palynological and petrological studies were carried out by Navale and Srivastava (1970) on nineteen borehole samples and two outcrop samples from near Gopal Prasad Village area. Among the assemblage zones described by them Assemblage A was dominated by *Brevitriletes*, *Faunipollenites*, *Sulcatissporites* (= *Scheuringipollenites*) and *Parasaccites*; Assemblage B was dominated by *Cyclogranisporites* and *Faunipollenites* and Assemblage C was characterised by *Striatopodocarpites* along with *Faunipollenites* and *Sulcatissporites*.

Patra and Panigrahy (1988) recorded the under-mentioned taxa from the outcrops of Singada Jhor Nala near Gopal Prasad Village: *Schizoneura gondwanensis*, *Raniganjia indica*, *Sphenophyllum speciosum*, *Sphenopteris lobifolia*, *Merianopteris major*, *Glossopteris angustifolia*, *G. conspicua*, *G. browniana*, *G. damudica* and *Vertebraria indica*.

Recently Patra and Swain (1991) also reported a ginkgoalean genus *Rhipidopsis gondwanensis* from Hingula Temple Nala section near Gopal Prasad Village.

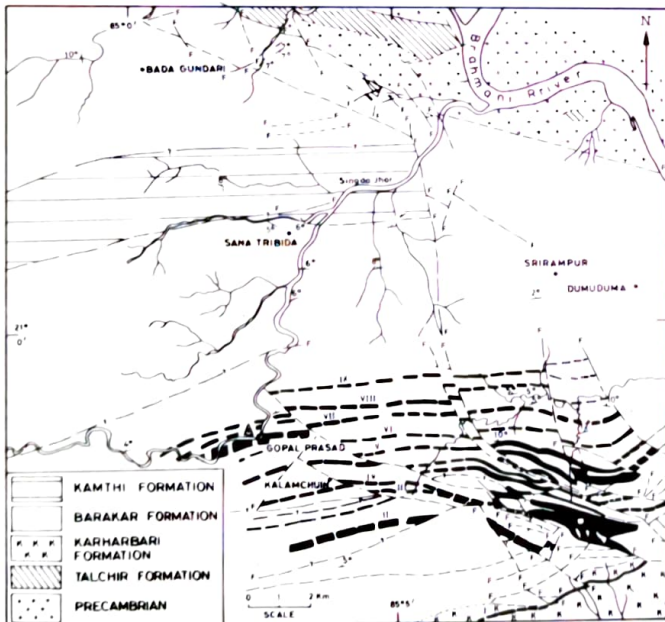
General geology of the area

The Talchir Coalfield, named after the town of Talcher in the Angul District of Orissa, forms the South easternmost coal-bearing patch of the Gondwana in the Mahanadi Valley which occupies an area of over 1800 square kilometers and is bounded by latitudes 20° 53' and 21° 12' N and longitudes 84° 20' and 85° 23' E. The Coalfield is located North of the Mahanadi River and occupies the valley of Brahmini River.

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The geology of Talchir Coalfield, first described by Blanford *et al.* (1856), comprise the Talchir, Damoodah and Mahadeva group of rocks. The general geological succession in Talchir Coalfield, in ascending order, is fluvial sedimentary pile of Talchir, Karharbari, Barakar and post-Barakar formations overlying the Precambrian granitic basement. Raja Rao (1982) thought it more appropriate to group entire post-Barakar sequence under one lithostratigraphic unit, the Kamthi Formation. He classified the lithostratigraphic succession in Talchir Coalfield into Talchir, Karharbari and Barakar Formations as Lower Permian and Kamthi Formation as Upper Permian-Triassic.

The material for the present study was collected from the exposure near Gopal Prasad Village (Latitude $20^{\circ} 58' 43''\text{N}$ and longitude $85^{\circ} 02' 28''\text{E}$) which is situated about 20 km north-west of Talcher main town (see Map-1). Good sections are exposed in a tributary of Singada Jhor Nala near this village. The lithological succession exposed at many places in this tributary of Singada Jhor Nala in ascending order is shown in fig. 1. The basal part of the section is represented by a coal seam of Barakar Formation. The exact thickness of this



Map 1

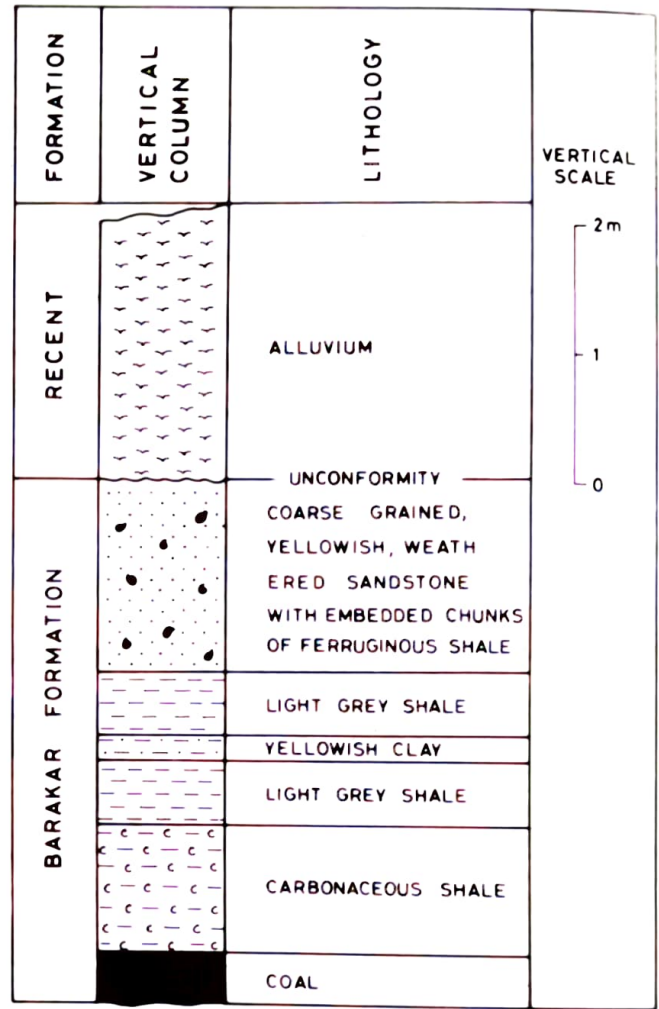


Fig. 1. Lithological succession at Singada Jhor Nala near Gopal Prasad Village.

coal seam could not be measured as only 2-2.5 m of this seam is exposed in the nala section. The coal seam is overlain by about one metre thick carbonaceous shale band followed by 0.5 m - 0.7 m thick light grey shale, 0.2 m thick band of yellowish clay, 0.5 m thick light grey shale and 1.5 metre thick coarse-grained, yellowish, weathered sandstone with embedded chunks of ferruginous shales. This sequence is unconformably overlain by recent alluvium. The carbonaceous shale band which overlies the coal seam contains fragmentary plant remains. A few megafossils are preserved in the grey

PLATE 1

- Glossopteris subtilis*. Showing an incomplete leaf with prominent midrib and comparatively long and narrow meshes. B.S.I.P. specimen No. 37621.X 1.
- Glossopteris stenoneura*. An incomplete leaf showing dense venation pattern with very narrow and long meshes. B.S.I.P. specimen No. 37622. X 1.5.
- Glossopteris tenuifolia*. Specimen showing a complete leaf with persistent midrib and very fine lateral veins forming dense venation pattern. B.S.I.P. specimen No. 37623.X 1.
- Glossopteris intermedia*. Specimen showing an incomplete leaf with a tapering base. Midrib prominent, secondary veins emerge from midrib at very acute angles, meshes are broad, oblong-polygonal in shape and almost equal in size throughout the lamina. B.S.I.P. specimen No. 37624.X 1.
- Glossopteris tenuinervis*. Specimen showing an oblong leaf with thick midrib and dense venation pattern, apex and base ill preserved. B.S.I.P. specimen No. 37625.X 1.5.

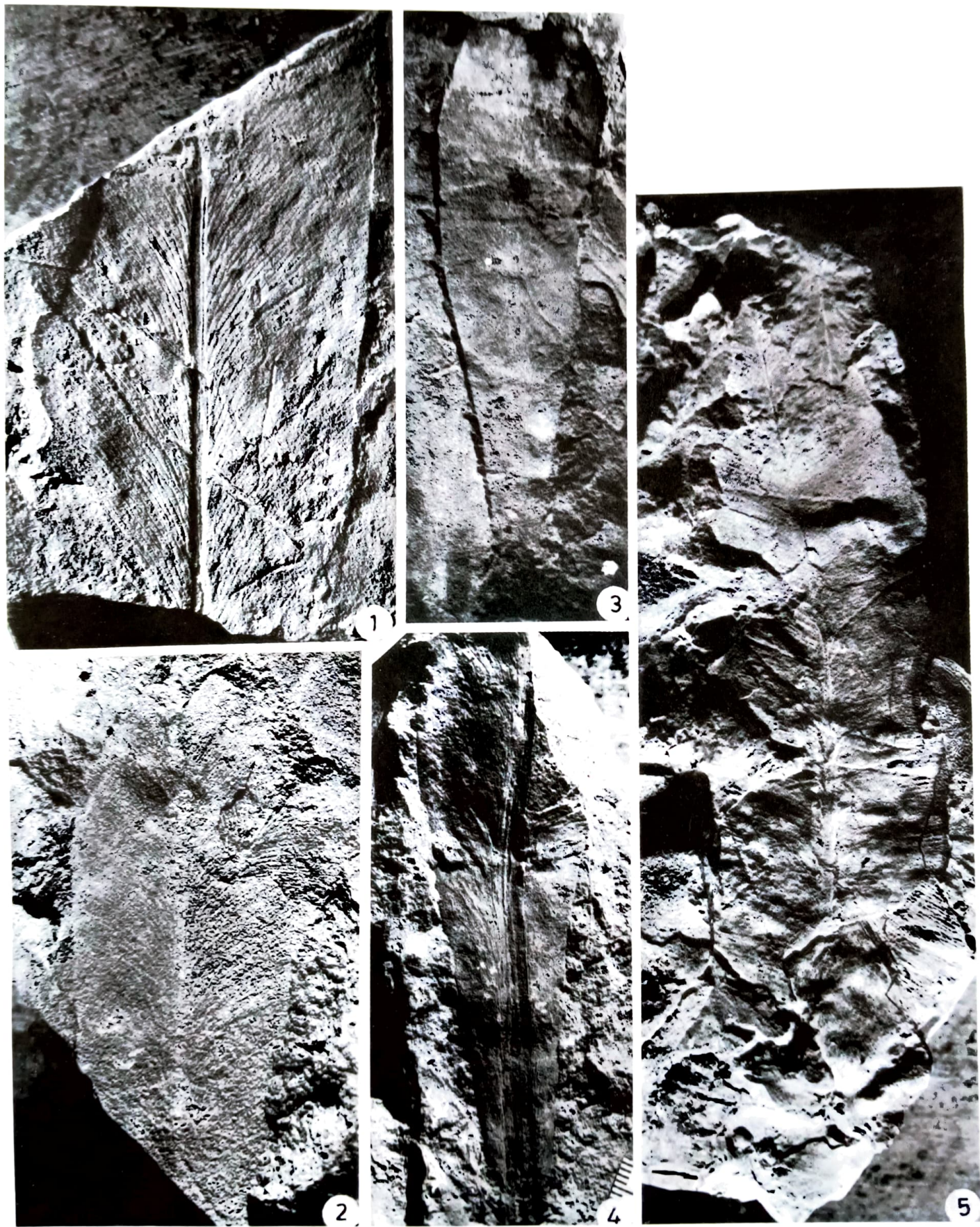


Plate 1

shale band and the overlying yellowish clay shale band. Plenty of plant megafossils are preserved in the ferruginous shales embedded in the uppermost Barakar sandstone lying just below the alluvium. Fossils are preserved only in the form of impressions in these three bands.

OBSERVATIONS AND DISCUSSION

The material for the present study comprises 85 impression specimens collected from the outcrops of Singada Jhor Nala. Nine specimens were collected from the light grey shale band which overlies the carbonaceous shale band. These fossils belong to one *Glossopteris* species i.e. *G. subtilis*. Rest 76 specimens are preserved on fine to coarse-grained hard red ferruginous shales.

An account of various taxa from this Nala and their relative percentage has been given in table 1 to give population of each species in the present collection. Similarly a complete list of plant megafossils recorded or described by various workers (including the present investigation) from this locality is depicted in table 2. The photographed specimens are deposited in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

The present fossil flora from the outcrops of Singada Jhor Nala near Gopal Prasad Village is dominated by the genus *Glossopteris* (51.7%) represented by ten species namely, *Glossopteris subtilis*, *G. indica*, *G. intermedia*, *G. tenuinervis*, *G. tenuifolia*, *G. intermittens*, *G. communis*, *G. gigas*, *G. leptoneura* and *G. stenoneura*. The other taxa in the assemblage are the fern genus *Neomariopteris hughesii* (30.5%) and equisetalean genus *Schizoneura gondwanensis* (10.5%). Large number of equisetalean stems are also preserved. A glossopteridean fructification *Eretmonia* is also observed and recorded in this assemblage (Table-1). As is evident from the percentage composition, gymnosperms and pteridophytes are represented in equal proportions in this assemblage. Neither the previous workers (Feistmantel 1880, Patra & Panigrahy 1988, Patra & Swain 1991) nor the present authors came across the *Gangamopteris-Noeggerathiopsis* complex in this area. The taxon *Raniganjia indica* recorded by Patra and Panigrahy (1988) from this locality is typically a *Raniganj* form. *Glossopteris leptoneura*, *G. subtilis*, *G. tenuinervis*, *G. tenuifolia* and *G. gigas* are characteristic forms of *Raniganj* and equivalent floras.

Table 1-Relative percentage of various plant megafossils collected from Singada Jhor Nala near Gopal Prasad Village (present study).

Taxa	Percentage
1. <i>Schizoneura gondwanensis</i> Feistmantel	10.5
2. Equisetalean stems	6.0
3. <i>Neomariopteris hughesii</i> (Zeiller) Maithy	30.5
4. <i>Glossopteris leptoneura</i> Bunbury	1.2
5. <i>G. indica</i> Schimper	9.7
6. <i>G. communis</i> Feistmantel	1.2
7. <i>G. intermedia</i> Feistmantel	8.5
8. <i>G. intermittens</i> Feistmantel	3.6
9. <i>G. stenoneura</i> Feistmantel	1.2
10. <i>G. tenuifolia</i> Pant & Gupta	3.6
11. <i>G. subtilis</i> Pant & Gupta	13.0
12. <i>G. gigas</i> Pant & Singh	1.2
13. <i>G. tenuinervis</i> Pant & Gupta	8.5
14. <i>Eretmonia</i> sp.	1.3

Total number of specimens collected and studied = 85

Table - 2 Complete list of taxa recorded or described by various workers (including the present study) from Singada Jhor and Hingula Temple Nala outcrops near Gopal Prasad Village.

1. <i>Schizoneura gondwanensis</i> Feistmantel
2. <i>Raniganjia indica</i>
3. Equisetalean stems
4. <i>Tryzygia speciosa</i> (Royle) McClelland
5. <i>Sphenophyllum speciosa</i> (Royle) Zeiller
6. <i>Neomariopteris lobifolia</i> Morris
7. <i>Sphenopteris lobifolia</i> Morris
8. <i>Merianopteris major</i> Feistmantel
9. <i>Glossopteris angustifolia</i> Brongniart
10. <i>G. browniana</i> Brongniart
11. <i>G. leptoneura</i> Bunbury
12. <i>G. indica</i> Schimper
13. <i>G. communis</i> Feistmantel
14. <i>G. intermedia</i> Feistmantel
15. <i>G. damudica</i> Feistmantel
16. <i>G. conspicua</i> Feistmantel
17. <i>G. intermittens</i> Feistmantel
18. <i>G. stenoneura</i> Feistmantel
19. <i>G. tenuifolia</i> Pant & Gupta
20. <i>G. subtilis</i> Pant & Gupta
21. <i>G. tenuinervis</i> Pant & Gupta
22. <i>G. gigas</i> Pant & Singh
23. <i>Dictyopteridium ? sporiferum</i> Feistmantel
24. <i>Eretmonia</i> sp.
25. <i>Vertebraria indica</i> Royle
26. <i>Rhipidopsis gondwanensis</i> (Feistmantel) Seward

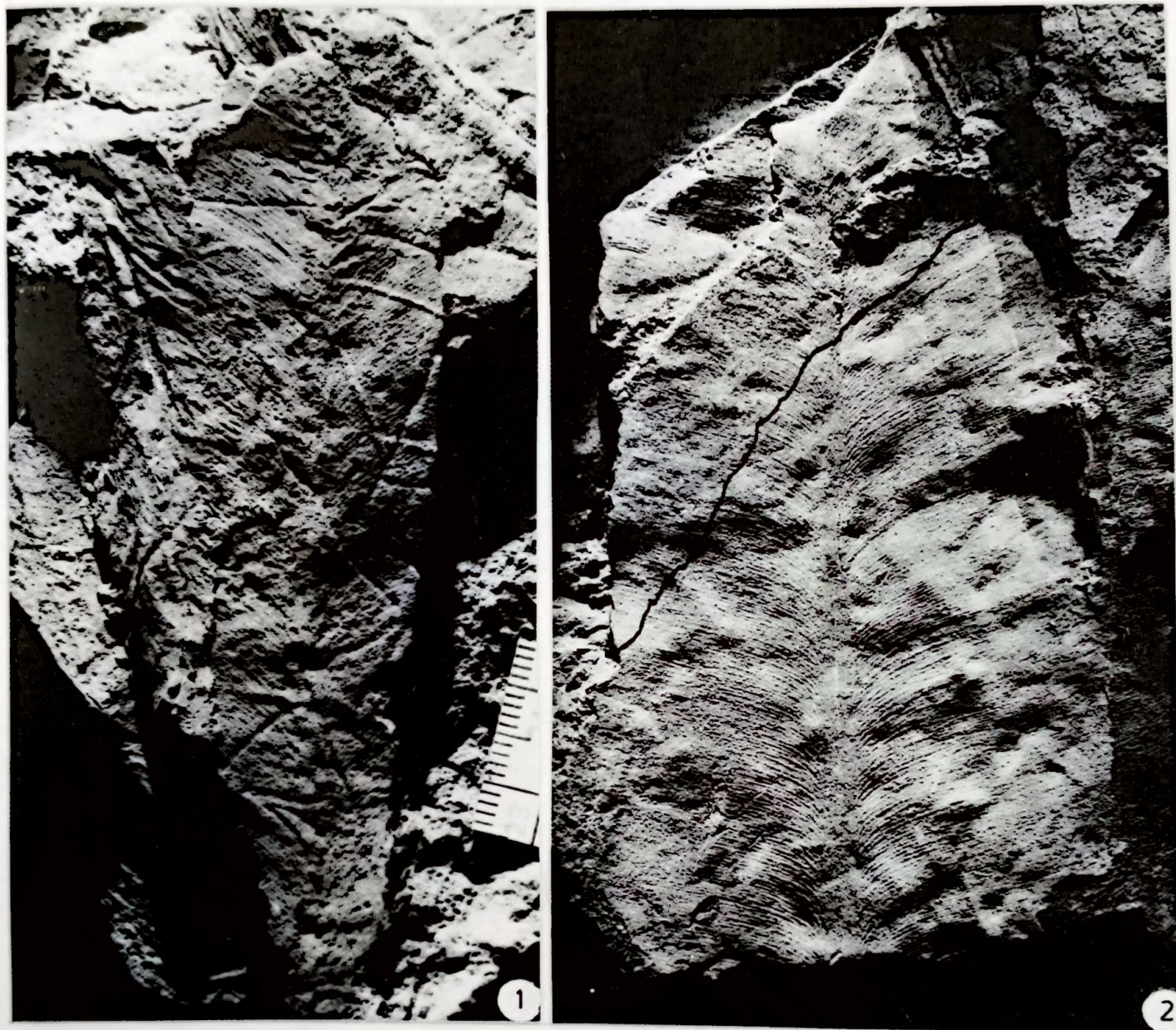


PLATE 2

1. *Glossopteris indica*. Almost a complete leaf, veins arise at an angle of 25-30 and go straight to the margin to meet it at 40-45°. B.S.I.P. specimen No. 37626.X 1.5.
2. *Glossopteris gigas* showing thick and prominent midrib, uniform fine secondary veins forming very dense venation pattern. B.S.I.P. specimen No. 3762(A) X 1.

Feistmantel (1880) on the basis of megaflora placed the outcrops at Gopal Prasad Village equivalent to Upper Barakars. The fertile form of *Dictyopteridium* has never been reported from the Barakars or older sediments. So far it has been recorded only from the Raniganj and equivalent beds.

Pollen assemblages B and C described from near Gopal Prasad Village by Navale and Srivastava (1970) date these outcrops as Upper Barakar.

Patra and Panigrahy (1988) correlated these beds equivalent to the Barakar on the basis of megaplant

fossils. Later Patra and Swain (1991) designated the rocks near Gopal Prasad Village exposed in the Hingula Temple Nala as equivalent to Upper Barakar.

The plant megaflora of the Gopal Prasad beds compares well with the known Barakar floras described by Maheshwari and Prakash 1965 (from Bansloi Valley, Rajmahal Hills), Kulkarni 1971 (from South Karanpura Coalfield), Maithy 1971 (from Auranga Coalfield), Srivastava 1977 (from Auranga Coalfield) and recently Srivastava 1992 (from Raniganj Coalfield).

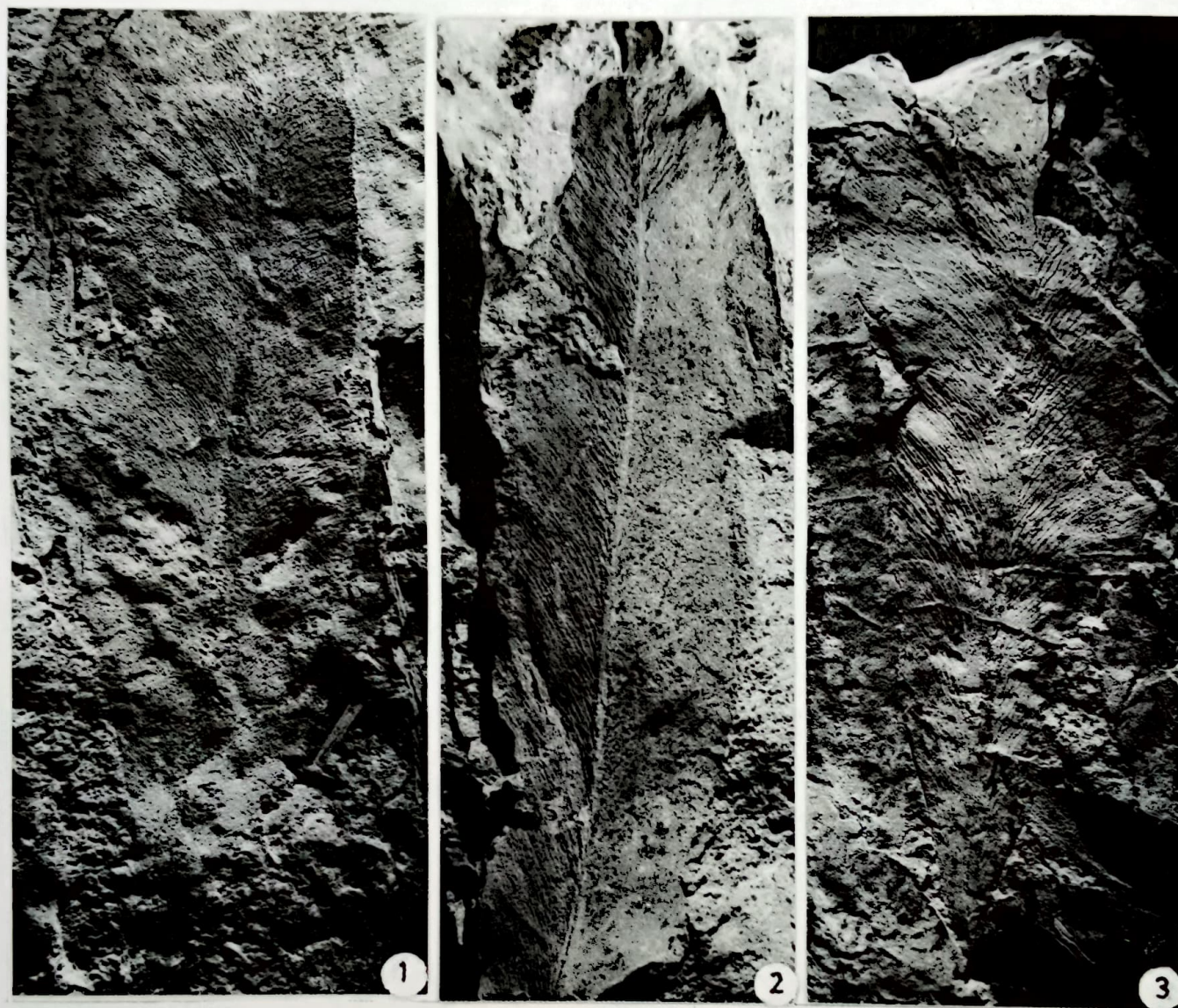


PLATE-3

1. *Glossopteris communis*. Specimen showing almost a complete leaf with very dense venation. B.S.I.P. specimen No. 37627(B).X 1.
2. *Glossopteris intermittens*. Specimen showing almost a complete leaf with veins going straight to the margin to meet it at 40-45°.

Maheshwari and Prakash (1965) described *Phyllothea* sp., *Stellothea robusta*, *Schizoneura gondwanensis*, *Sphenophyllum speciosum*, *Sphenopteris hughesii*, *S. lobifolia*, *Pecopteris phegopteroides*, *Alethopteris* sp., *Noeggerathiopsis hislopi*, *Gangamopteris cyclopteroides*, *Vertebraria indica*, *Glossopteris browniana*, *G. communis*, *G. indica*, *G. angustifolia*, *G. emarginata*, *G. damudica*, *G. retifera* and *G. parallela* from the Barakar beds of Bansloi Valley, Rajmahal Hills, Bihar. The plant types *Phyllothea*, *Stellothea*, *Pecopteris*, *Noeggerathiopsis*, *Alethopteris*, *Gangamopteris* and *Glossopteris emarginata*, *G. parallela* and *G. retifera* recorded from Bansloi (Maheshwari & Prakash 1965) are not present in the Gopal Prasad flora.

- B.S.I.P. specimen No. 37628.X 1.5.
3. *Glossopteris subtilis*. Specimen showing an elliptical leaf with comparatively long and narrow meshes. B.S.I.P. specimen No. 37629.X 1.

Surange and Maheshwari (1970) instituted a new species of *Eretmonia*, *E. karanpuraensis* from the Barakar beds of South Karanpura Coalfield.

Kulkarni (1971) described four species of *Gangamopteris* and 12 species of *Glossopteris* from the Barakar Formation of South Karanpura Coalfield out of which *Glossopteris browniana*, *G. damudica*, *G. communis*, *G. indica* and *G. angustifolia* are common between Gopal Prasad and South Karanpura flora.

Maithy (1971) reported *Trizygia speciosa*, *Barakaria dichotoma*, equisetalean stems, *Rhabdotaenia danaeoides*, *Pseudoctenis balli*, *Sphenopteris polymorpha*, *Vertebraria indica*, *Glossopteris angustifolia*, *G. tortuosa* and *G. retifera*

from the Barakar Stage of Auranga Coalfield. Except for *Rhabdotaenia*, *Pseudoctenis*, *Barakaria*, *Glossopteris linearis*, *G. tortuosa*, and *G. retifera*, rest of the plant types are recorded in the Gopal Prasad flora.

Srivastava (1977) described *Glossopteris indica*, *G. barakarensis*, *G. leptoneura*, *G. fuchsii*, *G. conspicua*, *G. pandurata*, *G. intermittens*, *G. churiensis*, *G. communis*, *G. browniana* and *Vertebraria indica* from the Barakars of Auranga Coalfield. Except for *Glossopteris barakarensis*, *G. fuchsii*, *G. pandurata* and *G. churiensis*, rest of the species are common between Gopal Prasad and Auranga flora.

The Barakar flora recently described by Srivastava (1992) from the Raniganj Coalfield contains typical plant fossils of Barakar Formation like *Phyllothea*, *Giridia*, *Lelstotheca*, *Palasthalia*, *Euryphyllum*, *Palaeovittaria*, *Maheshwariphyllum*, *Gangamopteris*, *Gondwanophyllites*, *Noeggerathiopsis*, *Trizygia*, *Gondwanophyton* and *Neomariopteris* besides a number of *Glossopteris* species. Barring *Neomariopteris* and *Trizygia* none of these taxa are present in the Gopal Prasad flora while almost all the *Glossopteris* species of Gopal Prasad flora are common between the two.

Thus it seems there are two distinct types of Barakar floras. One type contains species of *Noeggerathiopsis* and *Gangamopteris* along with other elements of *Glossopteris* flora as exhibited by megafloora from Rajmahal Hills (Maheshwari & Prakash 1965), South Karanpura Coalfield (Kulkarni 1971) and Raniganj Coalfield (Srivastava 1992). The presence of *Gangamopteris*-*Noeggerathiopsis* complex indicates Early Barakar or the base of the Barakar flora. The other type from Auranga Coalfield (Maithy 1971, Srivastava 1977) and the present one from Gopal Prasad, Talchir Coalfield is devoid of *Gangamopteris*-*Noeggerathiopsis* complex. These certainly indicate Late Barakar age. This age determination is also supported by results of palynological studies by Navale and Srivastava (1970) who also dated equivalent beds as Upper Barakar.

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