

GLOSSOPTERIS AND GANGAMOPTERIS SPECIES FROM SOUTH KARANPURA COALFIELD

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ABSTRACT

Four species of *Gangamopteris* and some species of *Glossopteris* have been described from the shales about 70 feet above Argada 'S' Seam. The dominance of *Gangamopteris* indicates the Karharbari age. Twelve species of *Glossopteris*, out of which three are new, have been described from the shales of Argada Seam, Lower Nakkari seam and Upper Nakkari Seam. *Glossopteris fusa* sp. nov. is distinguished by the evanescent nature of midrib and closely spaced elongate meshes of equal size. *Glossopteris barakarensis* sp. nov. is distinguished by a petiolate leaf and closely spaced, more or less straight secondary veins which form narrow polygonal meshes. *Glossopteris karanpurensis* sp. nov. is distinguished by its large size, arched secondary veins, which run straight to the margin and form open, hexagonal meshes of equal size.

INTRODUCTION

SOUTH Karanpura coalfield is one of the most important coalfields of India, occupying approximately 75 sq. miles. The sedimentary rocks in this basin are about 7000 feet thick and are comprised of Talchir, Barakar, Iron stone shale and Raniganj Stages (BANERJEE, 1960).

As regards megafossils, the only published record available so far, is by Feistmantel (1884), who recorded the following four species from the Karanpura coalfield:

1. *Glossopteris indica*
2. *Glossopteris communis*
3. *Dictyopteridium sporiferum*
4. *Noeggerathiopsis histopi*

Feistmantel did not report any plant megafossil from the Barakar stage of this coalfield.

In the following pages are described the species of *Gangamopteris* and *Glossopteris* from four coal seams:

DESCRIPTION

Genus — *Gangamopteris* McCoy

Four species of *Gangamopteris* have been recorded from only the shales about 70 feet above the Argada 'S' Seam. They are: *Gangamopteris cyclopteroides* Feist., 1879
G. spathulata McCoy, 1847

G. cf. buriadica Feistm., 1879 (PL. 1, FIG. 8)
G. intermedia Matihy, 1965 (PL. 1, FIG. 6)

Gangamopteris spathulata McCoy

Pl. 1, Fig. 2

This is the first record from India of this species, which was described by McCoy from Australia. There are three incomplete, spatulata leaves, with narrow tapering base, medium veins prominent at the base, but gradually get diffused. Secondary veins are closely spaced, arise at an acute angle and form elongate, narrow rectangular meshes (TEXT-FIG. 6). The leaf resembles with the specimens described by McCoy in 1847.

Genus — *Glossopteris* (Brong.) Sternberg

Twelve species of *Glossopteris*, of which three species are new, have been recorded from the South Karanpura coalfield. The leaves are preserved as impressions, but some possess good carbonized crust, which did not, however, yield cuticles.

I. FORMS WITH NARROW MESHES

(a) Linear forms

1. *Glossopteris angustifolia* Brong.

Pl. 1, Fig. 10

This species is rare; the best specimen measures 10×2 cm. The concentration is 13-15 veins per sq. cm. near the midrib, 23-25 veins per sq. cm. in the middle and 34-36 veins per sq. cm. near the margin. The meshes near the midrib are broad and small, while near the margin, they are large and narrow. This species has been recorded from about 70 feet above the Argada 'S' Seam.

2. *Glossopteris linearis* McCoy

Pl. 1, Fig. 3

This is a rare species; the most complete specimen measuring 8×1.5 cms. The second-

dary veins arise at 30-35° angle from the midrib and meet the margin at an angle of 40-45°. The concentration is 12-14 veins per sq. cm. near the midrib, 14-16 veins per sq. cm. in the middle and 14-17 veins per sq. cm. near the margin. The secondary veins form broad, polygonal meshes throughout the lamina, but are slightly narrow towards the margin (TEXT-FIG. 2). This species is recorded only from the shales of Lower Nakkari seam.

(b) Lanceolate forms

3. *Glossopteris indica* Schimper

Pl. 1, Fig. 4

This is one of the most abundant species in three out of the four localities. The most complete leaf, which appears to have been petiolate, measures 23×4 cm. The secondary veins are closely set, arise at an angle of 40°-45° from the midrib and meet the margin at 30°-35°. The concentration is 14-16 veins per sq. cm. near the the midrib, 20-23 veins per sq. cm. in the middle and 22-25 veins per sq. cm. near the margin. The secondary veins form short and broad meshes near the midrib and narrow, elongate meshes towards the margin (TEXT-FIG. 10).

This species is found (a) from the shales about 70 feet above Argada 'S' Seam, (b) from the shales of Argada Seam, Bhurkunda colliery and (c) from the shales of Lower Nakkari Seam.

4. *Glossopteris communis* Feist.

This species is also abundant. The secondary veins arise at an angle of 25°-30° from the midrib, closely spaced and meet the margin at an angle of 45°. The concentration is 8-10 veins per sq. cm. near the midrib, 18-20 veins per sq. cm. in the middle and 22-25 veins per sq. cm. near the margin. The secondary veins sometimes form a few bigger meshes near the midrib, otherwise all the meshes are narrow and elongate throughout the lamina (TEXT-FIG. 7). The species is found in two localities (a) from

the shales about 70 feet above Argada 'S' Seam (b) and from the shales of Argada Seam, Bhurkunda Colliery.

5. *Glossopteris decipiens* Feistm.

Pl. 1, Fig. 1

The species is rare. The most complete specimen measures 10×2 cm. The midrib is distinct upto 2/3 of the leaf, gradually becoming evanescent towards the apex. The secondary veins emerge at an angle of 30°-35° and meet the margin at the same angle. The concentration is 10-12 veins per sq. cm. near the midrib, 10-12 veins per sq. cm. in the middle and 15-16 veins per sq. cm. near the margin. The meshes are broad and elongate throughout the lamina. The species is recorded only in the shales of upper Nakkari seam.

(c) Spathulate forms

6. *Glossopteris spathulocordata* Feistm.

Pl. 1, Fig. 9

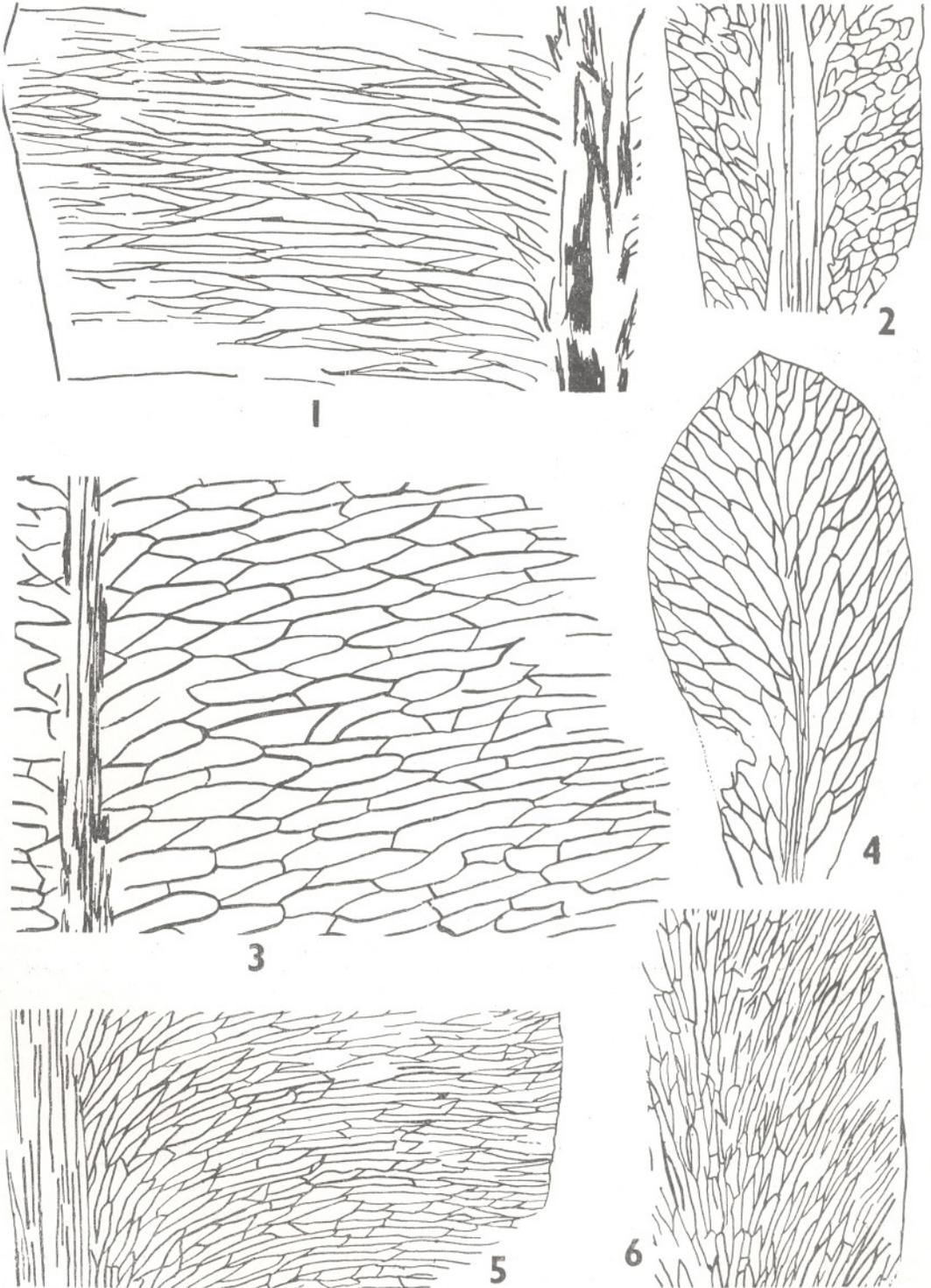
This species is very rare. The most complete leaf measures 5.5×1.5 cm. The midrib is distinct in the basal part of the leaf but gradually narrows towards the apex and disappears near the tip. The secondary veins emerge at an angle of 30°-35° and meet the margin at the same angle. The concentration is 16-20 veins per sq. cm. near the midrib and 35-40 veins per sq. cm. in the middle. The secondary veins form narrow and elongate meshes throughout the lamina, towards the margin they appear to be narrower (TEXT-FIG. 8). The species is found only in the shales of about 70 feet above Argada 'S' seam.

7. *Glossopteris fusa* sp. nov.

Pl. 2, Figs. 16, 17, 18

Diagnosis — Leaves spathulate, apex obtuse, base cuneate; midrib becoming evanescent from near the base; secondary veins emerge at acute angles, arched towards

TEXT-FIGS. 1-6 — 1. *Glossopteris stricta* Bunbury × 4. Short and broad meshes near midrib and narrow, elongate towards margin. 2. *Glossopteris linearis* McCoy × 4. broad, polygonal meshes throughout lamina. 3. *Glossopteris karanpurenensis* sp. nov. × 2. open, hexagonal meshes of equal size. 4. *Glossopteris browniana* Brong. × 4. polygonal meshes bigger along midrib, smaller towards margin. 5. *Glossopteris damudica* Feistm. × 4. broad and short meshes near midrib narrow, elongate towards margin. 6. *Gangamopteris spathulata* McCoy × 4. narrow rectangular meshes more or less of equal size.



TEXT-FIGS. 1-6

margin, form closely spaced, elongate, rectangular meshes, more or less of uniform size.

Holotype — 34060 Birbal Sahni Institute of Palaeobotany, Lucknow

Locality — Nakkari incline, Saunda sector, South Karanpura Coalfield.

Horizon — Barakar Stage.

Description — This is the most dominant species in the collection and includes 115 specimens; several of them are complete. Leaves vary greatly in shape and may either be spathulate with broad obtuse apex, or lanceolate — spathulate to lanceolate with more or less narrow obtuse apex. In all the specimens the leaf bases are narrow and tapering. Two sides of the lamina are of unequal width. The leaves range from 6 upto 12 cm. in length.

The midrib is characteristic of this species. It becomes evanescent right from near the base and only the secondary veins appear to converge in the central part of the leaf. The secondary veins arise at an acute angle and meet the margin at the same angle, arched and closely spaced. The concentration is 8-10 veins per sq. cm. near the midrib, 10-15 veins per sq. cm. in the middle and 12-16 veins per sq. cm. near the margin. Meshes are elongate, narrow, more or less equal in size throughout the lamina (TEXT-FIG. 9).

Comparison — *G. fusa* shows similarity with *G. decipiens* Feist. (1879) in having evanescent midrib. But in *G. decipiens* the midrib is prominent upto 2/3 of the leaf and then gradually diffuses towards the apex. In *G. fusa* the midrib becomes evanescent right from near the base. Furthermore, the secondary veins near the midrib in *G. decipiens* form narrow, oblong meshes, whereas in *G. fusa* they form elongate, rectangular and more or less equal meshes.

The leaf at first glance appears to resemble *Gangamopteris* because of its evanescent midrib. A careful examination, however, reveals that the midrib region of the leaf is occupied by longitudinal veins without any inter-connections. *Gangamopteris* is charac-

terized by the presence of longitudinal, sub-parallel veins with interconnections.

8. *Glossopteris barakarensis* sp. nov.

Pl. 2, Figs. 13, 14 & 15

Diagnosis — Leaves spathulate, petiolate, apex acute, base tapering ending into a petiole; midrib distinct from base to apex; secondary veins emerge at acute angle, closely spaced, straight, forming narrow, polygonal meshes, bigger near midrib, and gradually becoming smaller towards margin.

Holotype — 34061 Birbal Sahni Institute of Palaeobotany, Lucknow.

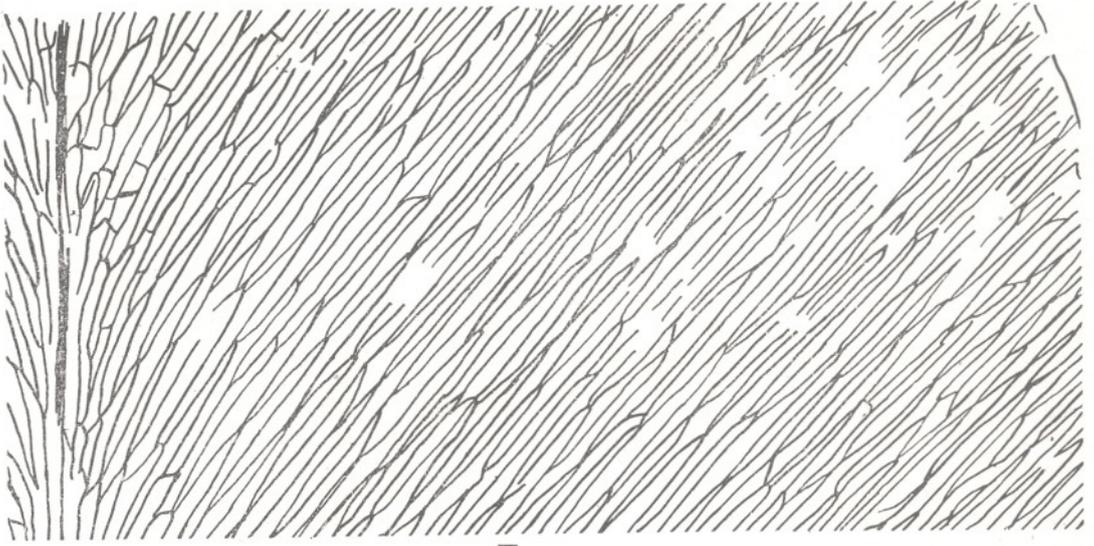
Locality — Upper Nakkari Seam, Syal 'D' Colliery.

Horizon — Barakar Stage.

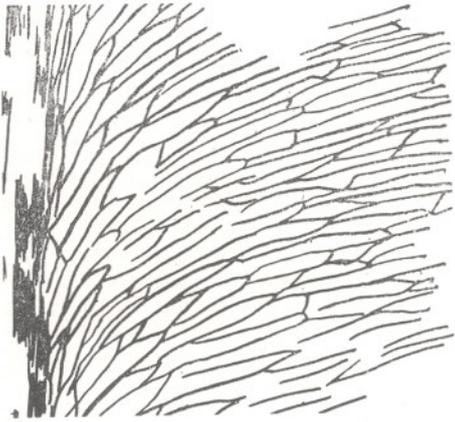
Description — There are twenty-five specimens in the collection, many of them are complete. The shape of the leaf is spathulate, some of them are curved. The leaves range from 5 to 9 cm. in length, are broad at the base and 2 to 3 cm. in breadth. Apex is bluntly acute. Leaf tapers rapidly near the base and drawn into a long petiole. The midrib is distinct throughout the whole length of the leaf. The secondary veins emerge from the midrib at an acute angle (30°-40°) and meet the margin at the same angle. The concentration is 18-21 veins per sq. cm. near the midrib, 24-26 veins per sq. cm. in the middle and 25-30 veins per sq. cm. near the margin. The secondary veins are closely spaced, more or less straight and form narrow polygonal meshes. The meshes are somewhat bigger near the midrib and gradually become smaller towards the margin (TEXT-FIG. 11).

Comparison — *G. barakarensis* shows similarity with *G. brownii* Brong. 1828, *G. indica* Schimper 1869 and *G. decipiens* Feistm. 1879, in arrangement of secondary veins. However, the meshes in *Glossopteris brownii* are open, whereas in *Glossopteris barakarensis* they are closely spaced. In *G. indica* the meshes are broad and short near the midrib and elongate narrow towards the margin. *G. decipiens* differs in possessing

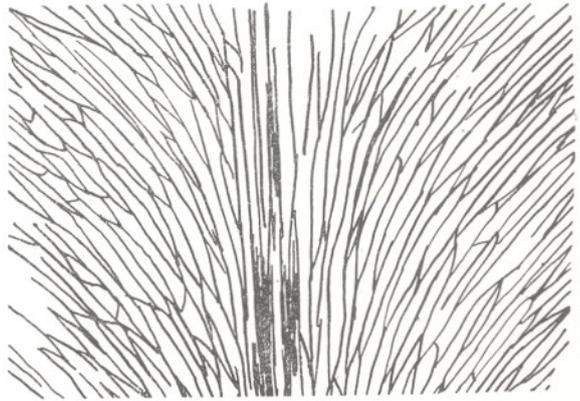
TEXT-FIGS 7-11 — 7. *Glossopteris communis* Feistm. × 4. narrow, elongate meshes throughout the lamina. 8. *Glossopteris spathulocordata* Feistm. × 4. narrow, elongate meshes throughout lamina slightly narrower towards margin. 9. *Glossopteris fusa* sp. nov. × 4. closely spaced narrow, rectangular meshes more or less uniform in size. 10. *Glossopteris indica* Schimper. × 4. short and broad meshes near midrib and narrow elongate towards margin. 11. *Glossopteris barakarensis* sp. nov. × 4. polygonal meshes bigger near midrib gradually becoming smaller towards margin.



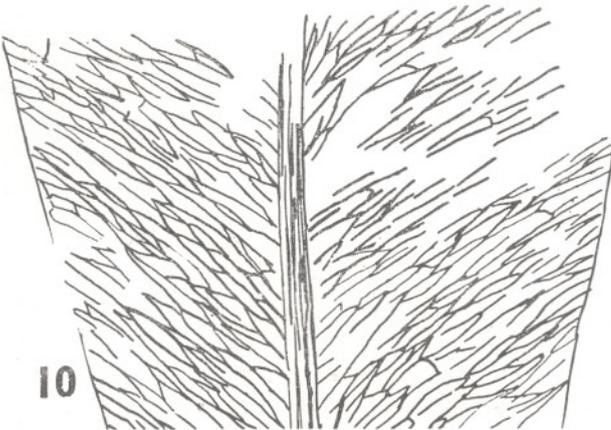
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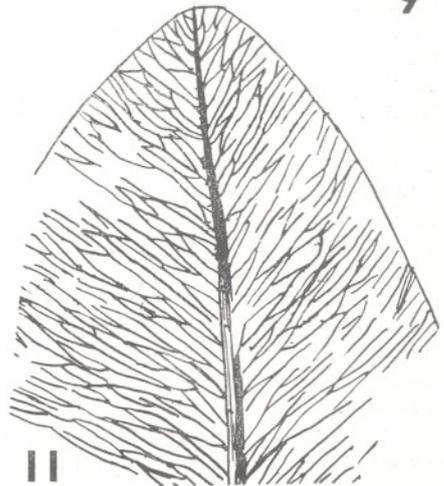
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11

evanescent midrib. Thus the presently described specimens have distinct type of venation amongst the *Glossopteris* leaf form having closely spaced veins and therefore a new specific name is proposed.

II. FORMS WITH BROAD MESHES

9. *Glossopteris browniana* Brong.

Pl. 1, Fig. 7

The species is abundant. The leaves display a wide size range from 2.5 to 15 cm. in length. The smallest specimen measures 2.3×1.8 cm. The shape of the leaves also vary greatly from distinctly lanceolate to sub-spathulate. Midrib is distinct. The secondary veins emerge at an angle of 48° and meet the margin at the same angle. The concentration is 6-8 veins per sq. cm. near the midrib, 10-12 veins per sq. cm. near the middle and 14-16 veins per sq. cm. near the margin. The secondary veins form polygonal meshes, bigger in size near the midrib and smaller towards the margin (TEXT-FIG. 4). The species is found only from the shales about 70 feet above Argada 'S' seam.

10. *Glossopteris karanpurensis* sp. nov.

Pl. 2, Figs. 11, 12

Diagnosis — Lanceolate leaf, apex acute, base cuneate, tapering, margin entire; midrib distinct from base to apex; secondary veins emerge almost at right angles from the midrib, gently curve upwards, meshes equal in size throughout the lamina.

Holotype — 34062, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — Argada Seam, Bhurkunda Colliery.

Horizon — Barakar Stage.

Description — The species is abundant in the collection and is represented by twenty specimens. The shape is lanceolate with blunt acute apex. The base is tapering but in no specimen it is completely preserved. The leaves vary a great deal in size, some measure more than 40 cm. in length (PL. 2, FIG. 11). As far as I am aware this is the largest specimen of *Glossopteris* on record. Usually the leaves range in size from 12 to more than 40 cm. in length and 5 to 10 cm. in breadth. The margin is en-

tire and the width of the lamina is same on both the sides. The midrib is distinct from the base to the apex measuring 0.5 cm. towards the base, gradually narrows and persist right upto the apex. The secondary veins emerge almost at right angles from the midrib and run towards the margin with a gentle upward curve which is the characteristic feature of this species. In other *Glossopteris* leaves the secondary veins are generally arched or they run straight to the margin. The concentration is 10-12 veins per sq. cm. near the midrib, 12-14 veins per sq. cm. in the middle and 12-14 veins per sq. cm. near the margin. The meshes are open, hexagonal and more or less of equal size throughout the lamina. In the specimen shown Pl. 2 Fig. 11, the meshes in the basal region are broader than the meshes in the middle and apical region (TEXT-FIG. 3).

Comparison — In the present species the course of secondary veins is characteristic and distinct from all the known species of *Glossopteris*. The two species *Glossopteris sahnii* Srivastava (1957) and *Glossopteris tortuosa* Zeiller (1902) have some resemblance with *Glossopteris karanpurensis* sp. nov., in all the three the veins emerge at right angles from the midrib. In *Glossopteris sahnii* the midrib is not so prominent and the meshes are almost 4 times bigger than *Glossopteris karanpurensis*, and furthermore, *Glossopteris sahnii* is based on the cuticular evidences. In *Glossopteris tortuosa* the secondary veins are comparatively spaced closely and they form broad and bigger meshes near the midrib and narrow, smaller meshes towards the margin.

III. INTERMEDIATE FORMS

Meshes broad and short along the midrib, and narrow, elongate towards the margin.

11. *Glossopteris stricta* Bunbury

Pl. 1, Fig. 5

The species is very rare. The most complete specimen measures 13×4 cm. The secondary veins arise at an angle of about 90° , run more or less parallel to each other and meet the margin at an angle of 90° . The concentration is 13-15 veins per sq. cm. near the midrib, 24-26 veins per sq. cm.

TABLE 1 — DISTRIBUTION OF GLOSSOPTERIS AND GANGAMOPTERIS SPECIES FROM SOUTH KARANPURA COALFIELD

NAME OF THE SPECIES	70 FEET ABOVE ARGADA 'S' SEAM	ARGADA SEAM BHURKUNDA COLLIERY	LOWER NAKKARI SEAM NAKKARI INCLINE, SAUNDA COLLIERY	UPPER NAKKARI SEAM, SYAL 'D' COLLIERY
1. <i>Gangamopteris cyclopteroides</i> Feistm.	+	—	—	—
2. <i>Gangamopteris spathulata</i> McCoy	+	—	—	—
3. <i>G. cf. buriadica</i> Feistm.	+	—	—	—
4. <i>G. intermedia</i> Maithy	+	—	—	—
5. <i>Glossopteris indica</i> Schimper	+	+	+	—
6. <i>G. angustifolia</i> Brong.	+	—	—	—
7. <i>G. linearis</i> McCoy	—	—	+	—
8. <i>G. communis</i> Feistm.	+	+	—	—
9. <i>G. spathulata</i> Feistm.	+	—	—	—
10. <i>G. fusa</i> sp. nov.	—	—	+	—
11. <i>G. barakarensis</i> sp. nov.	—	—	—	+
12. <i>G. browniana</i> Brong.	+	—	—	—
13. <i>G. karanpurensis</i> sp. nov.	—	+	—	—
14. <i>G. decipiens</i> Feistm.	—	—	—	+
15. <i>G. stricta</i> Bunbury	—	—	—	+
16. <i>G. damudica</i> Feistm.	—	—	—	+

in the middle and 33-35 veins per sq. cm. near the margin. The secondary veins form distinct, short and broad meshes along the midrib, and narrow, elongate meshes towards the margin (TEXT-FIG. 5). The species is found only in the shales of upper Nakkari Seam.

12. *Glossopteris damudica* Feistm.

The species is very rare. The most complete specimen measures 13.5 × 4.5 cm. The secondary veins arise at an angle of 90° from the midrib, and meet the margin at the same angle. The secondary veins are more or less parallel to each other. The concentration is 10-14 veins per sq. cm., along the midrib, 30-32 veins per sq. cm. in the middle and 40-45 veins per sq. cm. near the margin. The secondary veins form broad and short meshes along the midrib and narrow elongate meshes towards the margin (TEXT-FIG. 1). The species is found only in Upper Nakkari Seam.

DISCUSSION

In Table 1 is shown the distribution of plant megafossils from the South Karanpura coalfield, from which it can be seen that the genus *Gangamopteris* is abundant in shales about 70 feet above the Argada 'S' seam, which

in its turn lies just above the Talchir beds. The Argada 'S' seam as well as the shales lying above it are regarded as the basal most part of the Barakar stage. Basu (1964), however, on the evidence of coal petrography, regards them as of the Karharbari age.

The microfloral evidence as published elsewhere (LELE & KULKARNI, 1969) confirms the view that these two beds are of Karharbari age. *Gangamopteris*, which is characteristic of Karharbari age, is abundant in the shales about 70 feet above the Argada 'S' seam. Argada 'S' seam, which lies below this bed, therefore, must also belong to the Karharbari age. The genus *Gangamopteris* is totally absent in Barakar localities of South Karanpura Coalfield. It must, however, be mentioned that the other typical Karharbari plants like *Buriadia*, *Gondwanidium* and *Noeggerathiopsis* have not been found so far in these localities. Plant megafossils from Argada Seam, Lower Nakkari seam and Upper Nakkari Seam contains *Glossopteris* in abundance. *Gangamopteris* is absent from these localities. Thus the floral assemblages from these three seams show dominance of *Glossopteris* and the total absence of *Gangamopteris*, *Noeggerathiopsis*, *Gondwanidium* and *Buriadia* which points to the Barakar age for these assemblages.

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EXPLANATION OF PLATES

PLATE 1

1. *Glossopteris decipiens* Feistm. to show lanceolate leaf. $\times 1$
2. *Gangamopteris spathulata* McCoy to show spathulate leaf. $\times 1$.
3. *Glossopteris linearis* McCoy to show cuneate base. $\times 1$.
4. *Glossopteris indica* Schimper to show petiolate base. $\times 1$.
5. *Glossopteris stricta* Bunbury to show acuminate apex and petiolate base. $\times 1$.
6. *Gangamopteris intermedia* Matihy to show broadly rounded apical portion. $\times 1$.
7. *Glossopteris browniana* Brong. to show smallest specimen of the species. $\times 1$.
8. *Gangamopteris* cf. *huriadica* Feistm. to show narrow tapering base. $\times 1$.
9. *Glossopteris spathulocordata* Feistm. to show emarginate rounded apex and narrow tapering base. $\times 1$.
10. *Glossopteris angustifolia* Brong. to show

pointed acute apex. $\times 1$.

PLATE 2

11. *Glossopteris karanpurenensis* sp. nov. to show lanceolate leaf; acute apex and distinct midrib. $\times 1/2$. Holotype number 34062.
12. *Glossopteris karanpurenensis* sp. nov. to show open hexagonal meshes of equal size. $\times 1$.
13. *Glossopteris barakarensis* sp. nov. to show lanceolate leaf and petiolate base. $\times 1$. Holotype number 34061.
14. *Glossopteris barakarensis* sp. nov. $\times 1$.
15. *Glossopteris barakarensis* sp. nov. to show narrow polygonal meshes bigger near midrib and gradually become smaller towards margin. $\times 4$.
16. *Glossopteris fusa* sp. nov. to show spathulate leaf, obtuse apex and cuneate base. $\times 1$. Holotype No. 34060.
17. *Glossopteris fusa* sp. nov. $\times 1$.
18. *Glossopteris fusa* to show elongate, narrow, rectangular meshes of equal size. $\times 4$.



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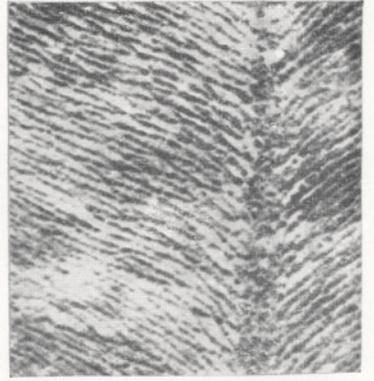
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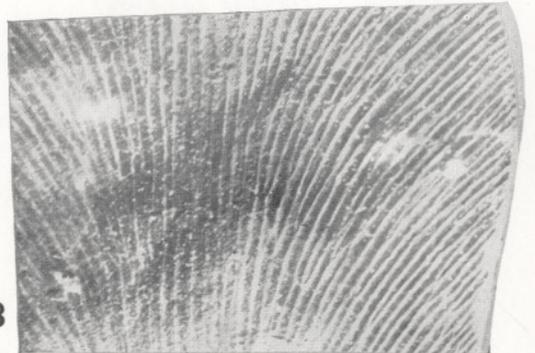
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