The present paper describes for the first time a mioflora of Barren Measures age from the Auranga Coalfield. The assemblage (13 genera and 26 species) is dominated by striate-disaccates along with a good amount of Densipollenites. The quantitatively significant genera are Faunipollenites, Densipollenites, Striatites, Verticispollenites, Schenkispollenites and Lahirates. Two species, Densipollenites brevis and Striatopodocarpites crassistriatus are new.

INTRODUCTION

The palaeobotanical investigations of the various Lower Gondwana stages, viz., Talchir, Karharbari, Barakar and Raniganj of the Auranga Coalfield have earlier been carried out by Feistmantel (1881a, 1881b, 1882, 1886), Bhattacharyya (1959) Bhattacharyya (1963), Maithy (1971), Srivastava and Anand-Prakash (1973), Srivastava (1977a, b) and Lele and Srivastava (1977).

During the present palaeobotanical studies a good assemblage of spores and pollen comparable to the Barren Measures mioflora, have been recovered. So far the Barren Measure Stage has not been recognized in the Auranga Coalfield. Rizvi (1972) in his recent geological work stated about this stage as “rocks of Barren Measures in the type area of Jharia Coalfield have not been noted in this area. Careful search along the Barakar-Raniganj could not bring to light their presence. If at all any deposition of these rocks took place, either they were eroded by the time Raniganj rocks were deposited or they are still covered and do not show any exposure”. The present sample site (see in Map, Srivastava, 1977b) has been mapped as Barakar by Rizvi (loc. cit.) but the miofloristic evidence now indicates a Barren Measures age.

MATERIAL AND METHODS

Samples have been collected from a section exposed in north-east bank of Sukri River about 1.5 km north-east of Rajbar Village (see in Map, Srivastava, 1977b). The rock section is exposed as follows in ascending order:

- Sandstone 7.00 m
- Coaly shale 1.00 m
- Brown to grey colour shale 1.00 m
- Coaly shale (mioflora 2.00 m described here)
- Sandstone 2.00 m rest concealed below

The samples were macerated with the usual Schulz’s method. All the type slides are preserved at the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

DESCRIPTION

Anteturma - Sporites Potonié, 1893
Turma - Triletes (Reinsch) Potonié & Kremp, 1954
Subturma - Azonotriletes Luber, 1935
Infraturma - Laevigati (Bennie & Kidston) Potonié, 1956

Genus - Punctatisporites (Ibrahim) Potonié & Kremp, 1954

Punctatisporites indicus Tiwari, 1968

Pl. 1, fig. 1

Description - Size range 46-50 x 40-45 μ, rays indistinct, 1/2-2/3 radius long, exine thick, finely intramicropunctate.

Remarks - Bharadwaj and Verma (1974) have restricted Punctatisporites for punctate sculptured forms, but this can not be ascertained in the few specimens available in the present material.

Turma - Monoletes Ibrahim, 1933
Subturma - Azonomonoletes Luber, 1935
Infraturma - Laevigatomonoletes Dybova & Jackowicz, 1957
Genus — *Latosporites* Potonié & Kremp, 1954

*Latosporites collionsis* (Balme & Hennelly) Bharadwaj, 1962

*Pl. I, fig. 2*

Description — Size range 60-65×50-55 \( \mu \), circular to subcircular, monolete open, running 3/4 of the length, exine 1-1.5 \( \mu \) thick, laevigate, rarely folded.

Turma — *Alekes* Ibrahim, 1933

Subturma — *Azonolates* (Luber) Potonié & Kremp, 1954

Infraturma — *Psilonapiti* Erdtman, 1947

Genus — *Kagulubeites* Bose & Maheshwari, 1968

*Kagulubeites verrucosus* Bose & Maheshwari, 1968

*Pl. 1, fig. 3*

Description — Size range 55-60×50-55 \( \mu \), splitting zone visible, exine 1-2 \( \mu \) thick, microverrucose, verrucae fine, closely placed.

Infraturma — *Tuberini* Pant, 1954

Genus — *Mammialetes* Kar, 1969

*Mammialetes mammus* Kar, 1969

*Pl. I, fig. 4*

Description — Size range 60-70×75-80 \( \mu \), subcircular, mark absent, exine sculptured with 12-15 \( \mu \) long, mamillate process with swollen tips.

Anteturma — *Pollinates* Potonié, 1931

Turma — *Saccites* Erdtman, 1947

Subturma — *Monosaccites* (Chitaley) Potonié & Kremp, 1954

Infraturma — *Monopolsacciti* Hart, 1965

emend. Dibner, 1971

Subinfraturma — *Proximalsaccini* Dibner, 1971

Genus — *Densipollenites* Bharadwaj, 1962

*Densipollenites indicus* Bharadwaj, 1962

*Pl. 1, fig. 5*

Description — Size range 110-120×95-110 \( \mu \), circular to subcircular, body distinct, 50-55×40-58 \( \mu \), saccus folded intrareticulation fine to medium.

*Densipollenites invisus* Bharadwaj & Salujha, 1964

*Pl. 1, fig. 6*

Description — Size range 110-115×60-75 \( \mu \), body circular, thick, 30-35×40-50 \( \mu \), saccus folded, intrareticulation medium to coarse.

Remarks — The overall size and the body size is smaller than the holotype (137.5×102.5 & 54×46 \( \mu \)).

*Densipollenites densus* Bharadwaj & Srivastava, 1969

*Pl. 1, fig. 7*

Description — Size range 90-110×60-80 \( \mu \), body 30-40×40-45 \( \mu \), saccus folded, intrareticulation medium to coarse.

*Densipollenites brevis* sp. nov.

*Pl. 1, figs. 8, 9; Text-fig. 1*

Holotypo — *Pl. 1, fig. 8; Slide no. 5029.*

*Type Locality* — Sukri River Section, near Rajbar Village, Auranga Coalfield, Bihar.

TEXT-FIG. 1 — *Densipollenites brevis* sp. nov., drawing of the holotype showing small size and pleated central body × Ca 830.
Horizon & Age — Barren Measures Stage, Lower Gondwana; Lower Permian.

Diagnosis — Size range 70-80 x 72-81 μ, circular to subcircular, body 34-40 x 30-42 μ, circular, dense.

Description — Central body dark brown, thick but not as in D. densus Bharadwaj & Srivastava, (1969) tends to be segmented or grooved, saccus fine to medium intrareticulate.

Comparison — The present specimens compare with D. indicus Bharadwaj, 1962 and D. densus Bharadwaj & Salujha, 1965 in the presence of well-defined central body but differ considerably in its small size and in the absence of profuse folding of the saccus. The saccus tends to form a radial pleating around the distal attachment zone.

Subinfraturma — Distalsaccini Dibner, 1971

Genus — Potoniæsporites (Bharadwaj) Bharadwaj, 1964

Potoniæsporites sp.

Pl. 1, fig. 10

Description — Size range 100-110 x 95-105 μ, circular, body oval, 64 x 58 μ, monolette mark probably represented by a bend fold, saccus fold rim visible.

Remarks — The specimens compare with Potoniæsporites novicus Bharadwaj but the latter species is larger in size. Due to lack of specimens no specific name has been given.

Subturma — Disaccites Cookson, 1947

Infraturma — Striatiïi (Pant) Bharadwaj, 1962

Genus — Faunipollenites Bharadwaj, 1962

Faunipollenites varius Bharadwaj, 1962

Pl. 1, fig. 11

Description — Size range 105-140 x 60-80 μ, horizontal striations 4-7, branched, sulcus 4-10 μ wide.

Faunipollenites parvus Tiwari, 1965

Pl. 2, fig. 13

Description — Size range 70-80 x 40-50 μ, horizontal striations 4-6, branched, sulcus 4-10 μ broad.

Faunipollenites paroxigus Bharadwaj & Salujha, 1965

Pl. 2, fig. 14

Description — Size range 50-70 x 60-70 μ, horizontal striations 6-8, unbranched, sulcus 2-4 μ.

Remarks — This species is distinguishable from F. parvus by its rhomboid to more subcircular shape, narrow distal channel, and greater overlap of sacchi on the distal side.

Faunipollenites singularis Sinha, 1972

Pl. 1, fig. 12

Description — Size range 85-92 x 67-72 μ, horizontal striations 5-7, sulcus slit like, 1-3 μ wide.

Genus — Crescentipollenites (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974

Crescentipollenites fuscus (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974

Pl. 2, fig. 15

Description — Size range 110-120 x 60-70 μ, body elliptical, 40-50 x 60-70 μ, horizontal striations 5-7, two vertical semilunar folds present along distal attachment, sulcus biconvex, 10-12 μ wide.

Genus — Striatopodocarpites (Soritsch & Sedowa) Bharadwaj, 1962

Striatopodocarpites diffusus Bharadwaj & Salujha, 1964

Pl. 2, fig. 16

Description — Size range 110-120 x 60-72 μ, body 55-60 x 60-72 μ, diffused, horizontal striations 9-14, sulcus 12-17 μ wide.
**Striatopodocarpites crassistriatus** sp. nov.

Pl. 2, fig. 17; Text-fig. 2

**Holotype** — Pl. 2, fig. 17; Slide no. 5030.

**Type Locality** — Sukri River Section, near Rajbar Village, Auranga Coalfield, Bihar.

**Horizon & Age** — Barren Measures Stage, Lower Gondwana; Lower Permian.

**Diagnosis** — Size range 80-100 × 50-64 μ, central body oval to rhomboidal, 48-56 × 44-63 μ, horizontal striations 6-10, sulcus 16-18 μ wide, straight to ± convex, sacci haploxylonoid.

**Description** — Bilateral, haplo to diploxylonoid, striations thick, grooved (recalling-taenae) run over the full length of the body, exine intramicroreticulate, sometimes connected vertically near the margin of the body, sacci hemispherical, distally widely apart, attachment full, straight to ± convex, sometimes associated with thin folds, intrareticulation fine to medium.

**Comparison** — In its size and shape the present specimen compare with *Striatopodocarpites decorus* described by Bharadwaj and Salujha (1964, pl. 10, fig. 140) but later has truncate ends body, whereas in the former body ends are rounded; in the thick grooved nature of striations it differs from all the known species.

**Genus — Lahirites** Bharadwaj, 1962

*Lahirites parvus* Bharadwaj & Salujha, 1964

Pl. 2, fig. 18

**Description** — Size range 115-130 × 55-67 μ, body 35-40 × 50-52 μ, horizontal striations 5-8.

**Remarks** — Some specimens show the overlapping tendency of saccus distally in the middle.

*Lahirites incertus* Bharadwaj & Salujha, 1964

Pl. 2, fig. 19

**Description** — Size range 80-95 × 30-36 μ, body 30-35 × 28-36 μ, horizontal striations 6-8, sulcus 10-12 μ wide.

**Genus — Striatites** (Pant) Bharadwaj, 1962

*Striatites barakarensis* Sinha, 1972

Pl. 2, fig. 20

**Description** — Size range 100-115 × 60-75 μ, body ± rhomboid, 30-35 × 40-45 μ, horizontal striations 7-9, sulcus ± straight, 5-7 μ wide.

Text-fig. 2 — *Striatopodocarpites crassistriatus* sp. nov., drawing of the holotype showing thick striations × Ca 950.
Genus — *Scheuringipollenites* Tiwari, 1973

*Scheuringipollenites ovatus* (Hart) comb. nov.

*Pl. 2, fig. 27*

**Remarks** — *Florites ovatus* Balme & Hennelly (1955) has been recombined as *Sulcatisporites ovatus* by Bharadwaj (1962) and as *Vesicaspora ovata* by Hart (1960).

Illustrations given by Balme and Hennelly (1955, *Pl. 5, figs. 49-52*) agree with the diagnosis and description of *Scheuringipollenites* Tiwari (1973).

**Description** — Size range 70-80 × 45-58 μ, bilateral, body thin, sacchi hemispherical, 4-6 μ wide distal free area, intrareticulation fine.

**COMPARISON AND DISCUSSION**

The present mioflora is dominated by striate-disaccates and monosaccates. Quantitatively important genera are *Faunipollenites, Densipollenites, Striatites, Verticipollenites, Scheuringipollenites* and *Lahirites*.

Other quantitatively significant genera are *Latosporites, Mammialetes* and *Crescentipollenites*.

Bharadwaj, Sah and Tiwari (1965) studied the Barren Measures miofloral assemblages from the type area of Jharia Coalfield, Bihar. They have shown that the assemblage is dominated by the striate-disaccate along with a significant percentage of *Densipollenites*; triletes are very few. Kar (1973) studied the Barren Measures miofloral assemblages of the North Karanpura basin and found that the striate-disaccates, viz., *Striatopiceites, Stratiopodocarpites* and *Kagulubeites*, are rare.

Bharadwaj, Sah and Tiwari (1965) studied the Barren Measures miofloral assemblages from the type area of Jharia Coalfield, Bihar. They have shown that the assemblage is dominated by the striate-disaccate along with a significant percentage of *Densipollenites*; triletes are very few. Kar (1973) studied the Barren Measures miofloral assemblages of the North Karanpura basin and found that the striate-disaccates, viz., *Striatopiceites, Stratiopodocarpites* and *Kagulubeites*, are rare.

**Infraturma — Disaccintriadi** (Leschik) Potonić, 1958

Genus — *Scheuringipollenites* Tiwari, 1973

*Scheuringipollenites ovatus* (Hart) comb. nov.

*Pl. 2, fig. 27*

**Remarks** — *Florites ovatus* Balme & Hennelly (1955) has been recombined as *Sulcatisporites ovatus* by Bharadwaj (1962) and as *Vesicaspora ovata* by Hart (1960).

Illustrations given by Balme and Hennelly (1955, *Pl. 5, figs. 49-52*) agree with the diagnosis and description of *Scheuringipollenites* Tiwari (1973).

**Description** — Size range 70-80 × 45-58 μ, bilateral, body thin, sacchi hemispherical, 4-6 μ wide distal free area, intrareticulation fine.
The present assemblage which is dominated by *Faunipollenites, Striatites, Verticipollenites* and *Lahirites* along with, *Densipollenites* can be closely compared to that of the known Barren Measures miosfloras (esp. Middle Biozone) according to the present palynostratigraphic standard. This evidence thus indicates the possible existence of the Barren Measures Formation in the Auranga Coalfield which has hitherto remained geologically unrecognized.

**REFERENCES**


EXPLANATION OF PLATES

(All magnifications x 500)

PLATE 1

1. Punctatisporites indicus Tiwari; Slide no. 5030.
2. Latosporites colliensis (Balme & Hennelly) Bharadwaj; Slide no. 5030.
3. Kagulubeites verrucosus Bose & Maheshwari; Slide no. 5030.
4. Mammialetes mammus Kar; Slide no. 5030.
5. Densipollenites indicus Bharadwaj; Slide no. 5029.
6. D. invisus Bharadwaj & Salujha; Slide no. 5030.
7. D. densus Bharadwaj & Srivastava; Slide no. 5029.
8. D. brevis sp. nov. (Holotype); Slide no. 5029.
9. D. brevis sp. nov.; Slide no. 5029.
11. Faunipollenites varius Bharadwaj; Slide no. 5030.
12. F. singraulensis Sinha; Slide no. 5029.
13. Faunipollenites parvus Tiwari; Slide no. 5030.
14. F. perexiguus Bharadwaj & Salujha; Slide no. 5030.
15. Crescentipollenites fusus (Bharadwaj) Bharadwaj, Tiwari & Kar; Slide no. 5030.
16. Striatopodocarpites diffusus Bharadwaj & Salujha; Slide no. 5029.
17. S. crassistriatus sp. nov. (Holotype); Slide no. 5030.
18. Lahirites parvus Bharadwaj & Salujha; Slide no. 5030.
19. L. incertus Bharadwaj & Salujha; Slide no. 5030.
20. Striatites barakarensis Sinha; Slide no. 5030.
21. S. subtilis Bharadwaj & Salujha; Slide no. 5029.
22. S. notus Bharadwaj & Salujha; Slide no. 5029.
23. S. communis Bharadwaj & Salujha; Slide no. 5030.
24. Vertiicipollenites gibusus Bharadwaj; Slide no. 5030.
25. V. subcircularis Bharadwaj & Salujha; Slide no. 5030.
26. V. finitimus Bharadwaj & Salujha; Slide no. 5029.
27. Scheuringipollenites ovatus (Hart) comb. nov.; Slide no. 5029.

PLATE 2

13. Faunipollenites parvus Tiwari; Slide no. 5030.