

## MEGASPORES FROM THE PANCHET FORMATION OF EAST BOKARO COALFIELD, INDIA

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### ABSTRACT

Megaspores from the Panchet Formation of Lugu Hill have been described for the first time. The assemblage recovered from the Lugu Hill beds of East Bokaro Coalfield in Bihar qualitatively comprises *Banksisporites tenuis* (Dijkstra) Dettmann, *B. dettmannae* Banerji, Kumaran & Maheshwari, *B. gondwanensis* Maheshwari & Banerji, *Biharisporites luguensis* n. sp., *Verrutrilletes jurwaensis* n. sp., *Talchirella pantii* n. sp., *Pantiella bharadwajii* Maheshwari & Banerji, *Maiturisporites indicus* Maheshwari & Banerji, *M. endosporiferus* n. sp., *M. bokaroensis* n. sp. and *Umiaspera granulosa* n. sp. Quantitatively the genus *Banksisporites* is the most predominant form. A comparison with known megaspore assemblages reveals that Panchet Formation exposed in the Lugu Hill of East Bokaro Coalfield appears to be of late Early Triassic age.

### INTRODUCTION

The Lugu Hill Section in East Bokaro Coalfield, Bihar, includes the Panchet and Mahadeva (Supra-Panchet) Formations (Sastry *et al.*, 1977). The Panchet Formation in its type area (Raniganj Coalfield) has been classified into two members - the Maitur Member and the Deoli (Hirapur) Member (Gee, 1932; Tripathi and Satsangi, 1963; Maheshwari and Banerji, 1975). The Panchet beds exposed at the base of Lugu Hill are represented predominantly by yellowish brown micaceous arkosic sandstones intercalated with red shales and are lithologically comparable with the Deoli Member of the type area. This sequence at the base of the Lugu Hill, having a distinct disconformity with the underlying Raniganj Formation and being conformably overlain by the Mahadevas, possibly represents the youngest horizon of the Panchet Formation.

Maheshwari and Banerji (1975) described an assemblage of megaspores from the Maitur Member of Panchet Formation exposed in the Nonia Nala Section of Raniganj Coalfield, West Bengal. So far, this was the only record of megaspores from the Panchet Formation. No megaspore has ever been described from the Panchet Formation of East Bokaro Coalfield. With a view to fill this gap in knowledge rock samples belonging to the Panchet Formation exposed on the southern bank of Dhardharia Nala at the base of Lugu Hill, about 1 km west of Jurwa Village, East Bokaro Coalfield (fig. 1) were analysed and four samples from a khaki micaceous shale horizon (rich in conchostracan fauna) yielded an assemblage of well-preserved megaspores. Bright Field Microscopy with incident as well as transmitted light and Scanning Electron Microscopy reveal that the assemblage comprises 13 species belonging to 7 genera out of which 6 species are new. An approximate quantitative analysis of the assemblage was based on altogether 265 specimens. All types and figured specimens, slides, SEM

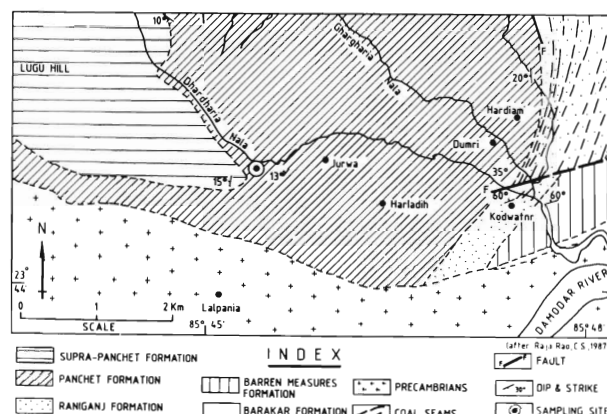


Fig. 1. Geological map of part of East Bokaro Coalfield showing sampling site (after Raja Rao, 1987).

stubs and negatives are preserved in the Palaeobotany and Palynology Section, Botany Department, Burdwan University.

### SYSTEMATIC DESCRIPTION

Genus *Banksisporites* (Dettmann) emend.  
Banerji *et al.*, 1978

*Banksisporites tenuis* (Dijkstra) Dettmann, 1961  
(Pl. I, figs. 1-2)

*Remarks* : This species is rather infrequent in the present assemblage being represented by only six specimens. The specimens resemble that of *Banksisporites tenuis* (Dijkstra) Dettmann, described by Banerji, Kumaran and Maheshwari (1978) from the Tiki Formation (Upper Triassic) of India, except for relatively smaller size.

*Banksisporites gondwanensis* Maheshwari & Banerji, 1975  
(Pl. I, figs. 3-4)

*Remarks* : This species is quite common and is represented by 21 specimens. The specimens resemble those

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described as *Banksisporites gondwanensis* by Maheshwari and Banerji (1975); only these are smaller in size.

*Banksisporites panchetensis* (Maheshwari & Banerji)  
Banerji *et al.*, 1978  
(Pl. I, figs. 5-6)

*Remarks* : *Banksisporites panchetensis* was originally described as *Srivastavaesporites panchetensis* by Maheshwari and Banerji (1975). Later, Banerji, Kumaran and Maheshwari (1978) recovered similar specimens from the Tiki Formation and they placed these specimens together with those from Panchet Formation under the genus *Banksisporites* as *B. panchetensis*. Tewari and Maheshwari (1992) considered *Srivastavaesporites panchetensis* Maheshwari & Banerji (1975) as junior synonym of *Srivastavaesporites utkalensis* (Pant & Srivastava) Bharadwaj & Tiwari (1970). The latter species has been treated by Tewari and Maheshwari (1992) under the genus *Banksisporites* as *B. utkalensis* (Pant & Srivastava) Tewari & Maheshwari. However, in their list of synonymy they have not included the specimens of this species recovered from the Tiki Formation by Banerji, Kumaran and Maheshwari (1978). As the holotype of *B. panchetensis* (*S. panchetensis* Maheshwari and Banerji 1975, from the Panchet Formation) has been included in *B. utkalensis*, consequently, the status of the specimens of *B. panchetensis* from Tiki become ambiguous, those will either be synonymous with *B. utkalensis* or may be a latter homonym. Our observations reveal that the specimens from the Panchet Formation of Raniganj Coalfield, East Bokaro Coalfield and Tiki Formation are morphologically different from those of Upper Permian and, therefore, the two sets of specimens should be treated as two distinct species, *B. panchetensis* and *B. utkalensis* respectively.

*Banksisporites panchetensis* is the most predominant form at Lugu. Out of 90 specimens of this species recovered, twenty-two are compressed proximodistally and the rest are subequatorially preserved.

*Banksisporites dettmannae* Banerji *et al.*, 1978  
(Pl. I, figs. 7-8)

*Remarks* : The specimens resemble those of *Banksisporites dettmannae* Banerji, Kumaran & Maheshwari (1978) described from the Upper Triassic of Tiki Formation.

Genus *Biharisporites* Potoniè emend. Bharadwaj & Tiwari 1970

*Biharisporites luguensis* n. sp.  
(Pl. I, figs. 9-10)

*Holotype* : SEM Stub. No. BUP 4/6.

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and Age* : Panchet Formation, Early Triassic.

*Derivation of name* : The specific name is after the Lugu Hill of East Bokaro Coalfield.

*Diagnosis* : Trilete megaspores, *amb* subtriangular to subcircular (240-360 µm in dry state and 350-560 µm in wet condition); trilete laesurae well developed, little sinuous at places, gradually tapering towards ends, extending upto 3/4 of the spore radius; contact areas delimited by low and narrow (7-10 µm high) subequatorial arcuate ridges; exosporium ornamented with closely set coni (6-8 µm high and almost equal in width at base), coni relatively large in the inter-ray areas; mesosporium distinct, circular in outline (270-430 µm diameter).

*Comparison and remarks* : *Biharisporites luguensis* n. sp. is represented by three specimens. In having coniate exosporium the present species is comparable with *B. distinctus* Bharadwaj & Tiwari (1970), *B. maiturensis* Maheshwari & Banerji (1975) and *B. sparsus* Banerji, Kumaran & Maheshwari (1978). But unlike *B. luguensis*, *B. distinctus* bears elongated tapering setae intermingled with coni. *B. luguensis* differs from *B. maiturensis* and *B. sparsus* by its well developed arcuate ridges. Moreover, unlike *B. luguensis*, the central bodies in *B. maiturensis* and *B. sparsus* are large occupying the entire spore cavity.

Genus *Verrutriteles* van der Hammen ex Potonie, 1956

*Verrutriteles jurwaensis* n. sp.  
(Pl. I, figs. 11-13)

*Holotype* : SEM Stub No. BUP 7/1

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and age* : Panchet Formation, Early Triassic.

*Derivation of name* : After the Jurwa Village, adjacent to the Lugu Hill of East Bokaro Coalfield.

*Diagnosis* : Trilete megaspores, roundly triangular in polar view (equatorial diameter 240-260 µm in wet condition); trilete laesurae distinct, straight, sometimes slightly sinuous, uniform throughout (about 18 µm high and same in width in dry condition), reaching upto the subequatorial arcuate ridges marking the contact areas; arcuate ridge distinct (about 15 µm wide and 10 µm high in dry condition); exosporium verrucate, verrucae (10-15 µm wide and 10-15 µm high in dry state) relatively sparse over the proximal contact areas than those on the

distal face; general surface of the exosporium uniformly punctate; mesosporium indiscernible.

*Comparison and remarks* : In having a distinct arcuate ridge this species can be compared with *Verruiletes utilis* Marcinkiewicz (1971) from the Rhaeto-Liassic of Poland. However, *V. utilis* is characterised by 6-8 oblique folds in the contact areas, a feature totally absent in *V. jurwaensis*. Moreover, in *V. jurwaensis* general surface of the exosporium is uniformly punctate (Pl. I, fig. 13). Among the known Indian species *V. jurwaensis* resembles to some extent *V. obscurus* Banerji, Kumaran & Maheshwari (1978) from the Panchet and Tiki Formations but the former differs from the latter in having a distinct arcuate ridge and punctate exosporium.

*Genus Talchirella* Pant & Srivastava emend. Bharadwaj & Tiwari, 1970

*Talchirella pantii* n. sp.  
(Pl. II, figs. 10-12)

*Holotype* : Slide No. BUP 16.

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and age* : Panchet Formation, Early Triassic.

*Derivation of name* : The specific name is after Professor D. D. Pant.

*Diagnosis* : Trilete megaspores, *amb* roundly triangular (equatorial diameter 230-280  $\mu\text{m}$  in dry state and 340-480  $\mu\text{m}$  in wet condition); trilete laesurae straight to little undulated; more or less uniformly thick (15  $\mu\text{m}$  wide in dry state), extending upto the margin of the contact areas; contact area well defined by a distinct low arcuate ridge, exosporium coarsely granulose; mesosporium distinct, relatively darker in colour, subcircular (diameter of mesosporium 240-280  $\mu\text{m}$  in wet condition), proximally bearing numerous (70-80 in number) cushions in a triangular fashion around the trilete laesurae, cushions typically circular in outline, 5-10  $\mu\text{m}$  in diameter.

*Comparison and Remarks* : This species is represented by 36 specimens. In having trigonally arranged cushions *Talchirella pantii* n. sp. resembles *Talchirella trivedii* Pant & Srivastava (Pant and Srivastava, 1961; Bharadwaj and Tiwari, 1970; Tewari and Maheshwari, 1992). *T. pantii* differs in having a rather low arcuate ridge and coarsely granulose exosporium, whereas in *T. trivedii* the arcuate ridge is well developed and the exosporium is distinctly verrucate.

*Genus Pantiella* Maheshwari & Banerji, 1975

*Pantiella bharadwajii* Maheshwari & Banerji, 1975  
(Pl. II, figs. 8-9)

*Remarks* : Only two specimens have been recovered which in all available features resemble *Pantiella bharadwajii* Maheshwari & Banerji, 1975.

*Genus Maiturisporites* Maheshwari & Banerji, 1975

*Maiturisporites indicus* Maheshwari & Banerji, 1975  
(Pl. II, figs. 6-7)

*Remarks* : *Maiturisporites indicus* is represented by only five specimens. The specimens resemble those described by Maheshwari and Banerji (1975).

*Maiturisporites distinctus* Maheshwari & Banerji 1975  
(Pl. I, figs. 14-16)

*Remarks* : In all available features the solitary specimen is referable to *Maiturisporites distinctus* Maheshwari & Banerji (1975).

*Maiturisporites endosporiferus* n. sp.  
(Pl. II, figs. 1-2)

*Holotype* : SEM Stub No. BUP 8/8.

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and Age* : Panchet Formation; Early Triassic.

*Derivation of name* : The specific name is derived from the distinct mesosporium of megaspore.

*Diagnosis* : Trilete megaspores, circular in polar view (equatorial diameter 210  $\mu\text{m}$  in dry state and 266  $\mu\text{m}$  in wet condition); trilete rays strongly developed (20-25  $\mu\text{m}$  high and 10-15  $\mu\text{m}$  wide in dry state), little wavy at places, gradually tapering towards ends, extending almost up to the equator; contact areas well delimited by a strongly developed (about 20  $\mu\text{m}$  high) narrow arcuate ridges, situated close to the equator; exosporium reticulate, muri sharp, 4-9  $\mu\text{m}$  high, lumina polygonal, 6-15  $\mu\text{m}$  wide; mesosporium distinct, circular (about 200  $\mu\text{m}$  in diameter in wet condition).

*Comparison and Remarks* : *Maiturisporites endosporiferus* n. sp. resembles *M. indicus* Maheshwari & Banerji, 1975 in ornamentation of exosporium. Both of these species are characterized by the absence of coniate projections at the trijunctions of muri. However, *M. endosporiferus* can readily be distinguished from *M. indicus* and other known species of the genus by the presence of a distinct mesosporium. *M. endosporiferus* is represented by only three specimens.

*Maiturisporites bokaroensis* n. sp.  
(Pl. II, figs. 3-5)

*Holotype* : Slide No. BUP 19.

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and Age* : Panchet Formation; Early Triassic.

*Derivation of name* : After the East Bokaro Coalfield of Bihar.

*Diagnosis* : Megaspores trilete, *amb* subcircular in polar view (equatorial diameter 200-300  $\mu\text{m}$  in dry state and 320-480  $\mu\text{m}$  in wet condition); trilete rays well developed (20-25  $\mu\text{m}$  high, 15-20  $\mu\text{m}$  wide), almost straight, little undulating at places, gradually tapering towards ends, extending close to the equator; contact areas shallowly grooved, arcuate ridge indistinct; exosporium reticulate; lumina predominantly tetragonal, occasionally pentagonal, at places irregular; muri sharp, well developed (15-25  $\mu\text{m}$  high), with 10-20  $\mu\text{m}$  high coniate - spinate projection at each trijunction; mesosporium thin, folded, occupying almost the whole spore cavity, sometimes perceptible.

*Comparison and Remarks* : *Maiturispurites bokaroensis* n. sp. is represented by 39 specimens. In its surface features as well as the nature of mesosporium this species is comparable with *M. distinctus* Maheshwari & Banerji (1975). However, *M. distinctus* is readily distinguishable from *M. bokaroensis* by its distinct highly developed arcuate ridges and hexagonal to polygonal lumina of surface reticulation. Other known species of the genus viz., *M. endosporiferus* Pal et al., *M. indicus* Maheshwari & Banerji (1975), *M. spinotriletes* Maheshwari & Banerji (1975) distinctly differ from the present species in the absence of coniate-spinate projections at the trijunctions of the muri over sporoderm.

*Genus Umiaspura* Singh, Srivastava & Roy 1964

*Umiaspura granulosa* n. sp.  
(Pl. II, figs. 13-14)

*Holotype* : Slide No. BUP 20.

*Locality* : Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, India.

*Horizon and Age* : Panchet Formation; Early Triassic.

*Derivation of name* : The specific name is after the granulose exosporium of the megaspore.

*Diagnosis* : Trilete zonate megaspores,  $\pm$  circular in polar view (equatorial diameter  $\pm$  330  $\mu\text{m}$  in dry state and 420  $\mu\text{m}$  in wet condition); spore body thick, dark coloured; zona equatorial, quite thick, more or less uniformly broad ( $\pm$  45  $\mu\text{m}$  wide); trilete rays low, extending upto the outer margin of the zona, exosporium uniformly granulose; mesosporium indiscernible.

*Comparison and Remarks* : *Umiaspura granulosa* is represented by three proximodistally compressed specimens. The present species characterised by low trilete laesurae and distinctly granulose exosporium differs from *U. bosei* Singh, Srivastava & Roy (1964) from the Bhuj Formation which has raised laesurae and smooth exosporium.

## QUANTITATIVE ANALYSIS

Per cent frequencies of different species of the megaspores are based on count of 265 specimens. The assemblage is dominated by *Banksisporites panchetensis* (34.0%) followed by *B. dettmannae* (20.4%), *Maiturispurites bokaroensis* (14.7%) and *Talchirella pantii* (13.6%). *Banksisporites gondwanensis* (8.0%) is a commonly occurring form. *B. tenuis* (2.3%), *Maiturispurites indicus* (1.9%), *M. endosporiferus* (1.1%), *M. distinctus* (0.4%), *Biharisporites luguensis* (1.1%), *Umiaspura granulosa* (1.1%), *Verrutrilletes jurwaensis* (0.7%) and *Pantiella bharadwajii* (0.7%) are rather low in occurrence.

Frequency distribution of megaspores at generic level (fig. 2) reveals that the assemblage is overwhelmingly dominated by the genus *Banksisporites* (64.7%). The genera *Maiturispurites* (18.1%) and *Talchirella* (13.6%) are common. *Biharisporites* (1.1%), *Verrutrilletes* (0.7%), *Pantiella* (0.7%) and *Umiaspura* (1.1%) are rather rare.

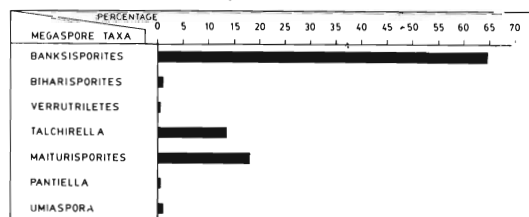


Fig. 2. Frequency distribution of megaspore genera in the assemblage.

## DISCUSSION

Among the known Indian megaspore assemblages the present assemblage is most closely comparable with that from the Maitur Member (early Lower Triassic) of Panchet Formation, in Raniganj Coalfield, West Bengal, described by Maheshwari and Banerji (1975) and later modified by Banerji, Kumaran and Maheshwari (1978). Both the Maitur and the Lugu assemblages are characterised by many common genera viz., *Banksisporites*, *Biharisporites*, *Verrutrilletes*, *Talchirella*, *Pantiella* and *Maiturispurites*. Even at least five species, *Banksisporites gondwanensis*, *B. panchetensis*, *Pantiella bharadwajii*, *Maiturispurites indicus* and *M. distinctus* are also common to both the assemblages. However, the frequencies of occurrence of megaspore taxa in Maitur rocks are not known. Therefore, comparison of the two assemblages, based on quantitative data, is not possible. Unlike the Maitur assemblage, *Banksisporites dettmannae* which is a

preponderant element in the Lugu section is totally absent in Maitur. This species has so far been recorded from the Upper Triassic rocks only. Moreover, the genus *Umiaspora* is present in the Lugu assemblage but is absent in Maitur one. *Umiaspora* is known to occur in the early Cretaceous of Bhuj Formation. Thus, it appears that the present assemblage may be slightly younger than that known from the Maitur Member of Panchet Formation.

The assemblages described by Banerji, Kumaran and Maheshwari, 1978 from the Tiki Formation (Upper Triassic) are comparable with the present assemblage in having *Banksisporites tenuis*, *B. dettmannae* and *B. panchetensis*. But the presence of characteristic Rhaetio-Liassic elements, *Banksisporites pinguish*, *Horstisporites areolatus*, *Erlansonisporites triassicus* and *Nathorstisporites hopliticus* in the Tiki assemblage indicates that the present assemblage from the Panchet Formation of East Bokaro Coalfield is much older than Tiki one.

The assemblage described by Pant and Basu (1979) from the Nidhpuri beds of South Rewa Gondwana Basin is characterised by *Banksisporites* (= *Srivastavaesporites*), *Grambastisporites*, *Trikonia*, *Mamillaespora* and *Lagenicula* (= *Nidhitriletes*). Out of these only the genus *Banksisporites* is common to both the present and Nidhpuri assemblages, however, its species in the two assemblages are different. In fact all the species of megaspores described from Nidhpuri were new and none of them has later been recorded from elsewhere. Therefore, composition of the present assemblage with that from Nidhpuri is different.

The foregoing account reveals that the megaspore assemblage recovered from the Panchet Formation, exposed on the southern bank of Dhardharia Nala Section, Lugu Hill, East Bokaro Coalfield, Bihar, ascribes an age younger than that of Maitur one. The Maitur Member has been dated as early Lower Triassic (Maheshwari and Banerji, 1975; Maheshwari, Kumaran and Bose, 1978). Ghosh and Shah (1977) suggested an early Triassic age for the Panchet Formation of Lugu Hill beds on the basis of estheriids. On the basis of megaspore content, this section of rocks belonging to the Panchet Formation appears to be of Late early Triassic.

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## EXPLANATION OF PLATES

## Plate 1

- 1-2. *Banksisporites tenuis* (Dijkstra) Dettmann.
  - 1, Scanning Electron Micrograph of a dry megaspore showing its folded contact area and granulose exosporium. SEM Stub No. BUP 8/5 x200.
  - 2, another specimen under macerated condition. Slide No. BUP 11 x150.
- 3-4. *Banksisporites gondwanensis* Maheshwari & Banerji.
  - 3, Scanning Electron Micrograph of a dry specimen showing its granulose exosporium. SEM Stub No. BUP 9/3 x200.
  - 4, another specimen under macerated condition showing well-defined thin circular mesosporium. Slide No. BUP 12 x150.
- 5-6. *Banksisporites pancheiensis* Maheshwari & Banerji.
  - 5, macerated megaspore showing mesosporium. Slide No. BUP 13 x150.
  - 6, Scanning Electron Micrograph of another specimen showing mediumly developed arcuate ridges and granulose exosporium. SEM Stub No. BUP 9/1 x200.
- 7-8. *Banksisporites dettmannae* Banerji, Kumaran & Maheshwari.
  - 7, Scanning Electron Micrograph of a dry megaspore showing granulate exosporium and arcuate ridges. SEM Stub No. BUP 8/3 x200.
  - 8, Megaspore under macerated condition showing a defined mesosporium. Slide No. BUP 14 x150.
- 9-10. *Biharisporites luguensis* n. sp.
  - 9, Scanning Electron Micrograph of Holotype showing subequatorial arcuate ridges and small coniate exosporium. SEM Stub No. BUP 4/6 x250.
  - 10, Holotype showing distinct circular mesosporium x150.
- 11-13. *Verrutrilletes jurwaensis* n. sp.
  - 11, Scanning Electron Micrograph of the Holotype showing arcuate ridges, trilete laesurae and verrucate exosporium. SEM Stub No. BUP 7/1 x200.
  - 12, Holotype in wet condition x150.
  - 13, A portion of the specimen in figure 11 magnified to show the verrucate exosporium and uniformly distributed puncta on the general surface x800.
- 14-16. *Maiturisporites distinctus* Maheshwari & Banerji.
  - 14, Scanning Electron Micrograph of the megaspore showing well developed arcuate ridges and reticulate exosporium. SEM stub No. BUP 7/2 x150.
  - 15, Megaspore in wet condition showing mesosporium. Slide No. BUP 22 x150.
  - 16, Magnified portion of the specimen in figure 14 showing the cone like projection at the trijunction of the muri x600.

## PLATE II

- 1-2. *Maiturisporites endosporiferus* n. sp.
  - 1, Scanning Electron Micrograph of the Holotype showing arcuate ridges, trilete laesurae and reticulate exosporium. SEM Stub No. BUP 8/8 x200.
  - 2, Holotype in wet condition showing a distinct circular mesosporium.
- 3-5 *Maiturisporites bokaroensis* n. sp.
  - 3,4, Scanning Electron Micrograph of two specimens showing indistinct arcuate ridge and well developed reticulum of exosporium. SEM Stub No. BUP 3/5/1. Figure 3 x200, Figure 4 x150.
  - 5, Holotype in wet condition showing mesosporium. Slide No. BUP 19 x100.
- 6-7. *Maiturisporites indicus* Maheshwari & Banerji.
  - 6, Scanning Electron Micrograph of dry megaspore showing arcuate ridge and reticulate exosporium. SEM Stub No. BUP 3/7 x200.
  - 7, Megaspore in wet condition. Slide No. BUP 18 x150.
- 8-9. *Pantiella bharadwajii* Maheshwari & Banerji.
  - 8, Scanning Electron Micrograph showing reticulate exosporium and arcuate ridges. SEM Stub No. BUP 7/3 x200.

- 9, Megaspore in wet condition showing faint trianguloid mesosporium. Slide No. BUP 17 x100.
- 10-12. *Talchirella pantii* n. sp.
  - 10, Scanning Electron Micrograph of a dry megaspore showing low arcuate ridge and granulate exosporium. SEM Stub No. BUP 9/2 x200.
  - 11, Holotype in wet condition showing distinct mesosporium and cushions around trilete laesurae arranged in a triangular fashion. Slide No. BUP 16 x150.
  - 12, Megaspore in over macerated condition, mesosporium isolated from exosporium and in proximal view showing the trigonally arranged cushions. Slide No. BUP 23 x150.
- 13-14. *Umiaspora granulosa* n. sp.
  - 13, Scanning Electron Micrograph of a dry specimen showing granulate exosporium, low trilete laesurae and equatorial zona. SEM Stub No. BUP 3/4 x150.
  - 14, Holotype in wet condition showing distinct equatorial zona. Slide No. BUP 20 x1000

