



LAGENICULATE MEGASPORES FROM THE LOWER GONDWANA SEDIMENTS OF MADHYA PRADESH, INDIA

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ABSTRACT

Two new taxa of lageniculate megaspores, i.e. *Maithyspora ovalis* n. gen and n. sp. and *Dijkstraea indica* n. sp., are described from the Lower Gondwana sediments of Chirimiri and Umaria Coalfields, Madhya Pradesh, India. Megaspores of *Maithyspora ovalis* are characterised by their pyramidal gula formed by expanded contact areas, granulose sexine sculpture and non-pitted nexine, while those of *Dijkstraea indica* possesses a proximal gula formed by central trijunction of trilete laesurae and part of contact areas, granulose or tuberculose sexine sculpture and pitted nexine. A new suprainfraturma, i.e. *Granutubergulati* n. is proposed. A comparative structural account of the allied megaspores is discussed.

Key words : Megaspores, Gula, Lower Gondwana, Permian, Madhya Pradesh, India.

INTRODUCTION

Dispersed lageniculate megaspores were first described by Bennie and Kidston (1886) who included them under the genus *Triletes*. Zerndt (1934) used the name *Lagenicula* as a genus for dispersed megaspores with apical gula. Potonie and Kremp (1954) described two more genera of lageniculate megaspores, i.e. *Lagenosporites* and *Setosporites*, and assigned *Triletes horridus* (Zerndt) Dijkstra and Trip (1946) as *Lagenicula horrida*, the type species of the genus *Lagenicula*. The generic distinction of these megaspores was based primarily on the character of appendages and the nature and prominence of gula.

At present, almost seven genera of lageniculate megaspores are known from Devonian (Chaloner, 1968), Carboniferous (Bharadwaj and Venkatachala, 1962; Dybova-Jackowicz, Jachowicz, Karczewska, Lachkar, Loboziak, Pierart, Turnau and Zoldani, 1979; Brack-Hanes, 1981; Scott and King, 1981; Spinner, 1983), Permian (Pant and Srivastava, 1962; Bharadwaj and Tiwari, 1970; Chaloner, Leistikow and Hill, 1979; Pant and Mishra, 1986; Mishra and Tripathi, 1991) and Triassic (Pant and Basu, 1979) pteridophytes. The Lower Gondwana sediments of Madhya Pradesh have preserved the richest assem-

blage of lageniculate megaspores in the Indian sub-continent with the occurrence of six species belonging to four genera (Pant and Mishra, 1986; Tripathi, 1992).

In the present investigation, two new lageniculate megaspores are described on material from the coalfields of Chirimiri and Umaria in Madhya Pradesh, India using SEM as well as light microscopic studies.

MATERIALS AND METHODS

Coal samples were collected from the Pondi and Chapra collieries of the Chirimiri and Umaria Coalfields, respectively (fig. 1). Samples were macerated in conc. HNO₃ followed by alkali treatment. Isolated megaspore compressions were processed under SEM and the macerated specimens under light microscope (see Tripathi and Mishra, 1997, 1998).

Lithostratigraphy of the study areas has been presented in a columnar section in fig. 2 to show the locations of the samples. The area is covered by the Lower Gondwana Supergroup of Indian stratigraphy. The lower division is represented by the Talchir Group and the upper division by the Pali Formation of the Barakar Group. The contact between the Pali Formation and the Talchir rocks is

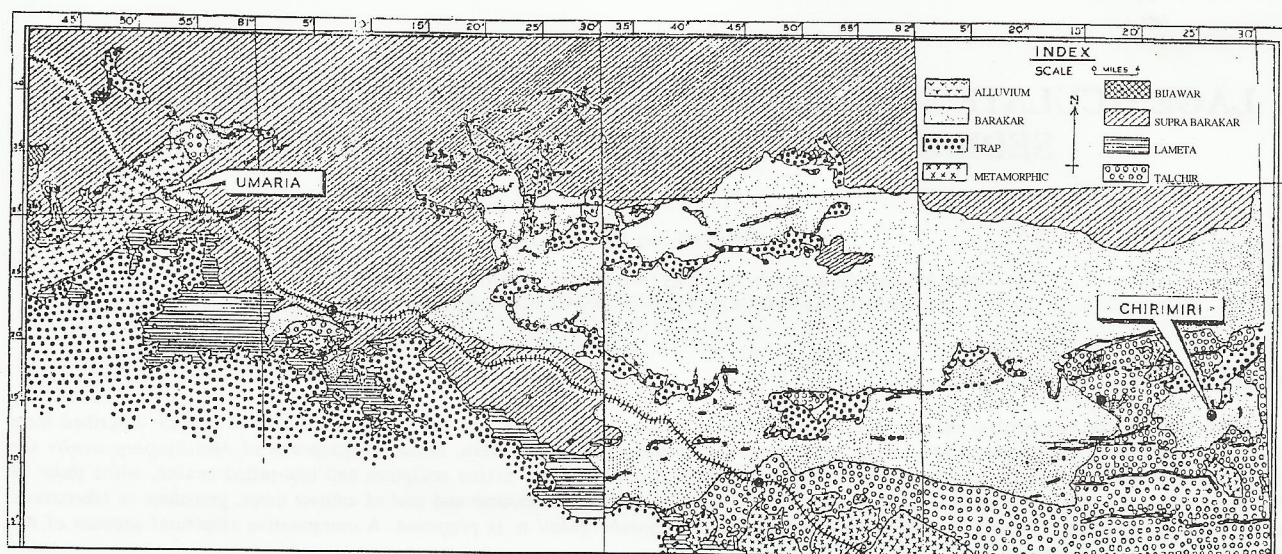


Fig. 1. Geological map of South Rewa Gondwana Basin showing the areas of the Umaria and Chirmiri Coalfields (after Hughes, 1884; Chandra & Lele, 1979)

disconformable at a few locations, specially along the nala cuttings. The Lower Pali Formation consists of fine grained muddy sandstones and alternating carbonaceous units. The carbonaceous units are mainly the carbonaceous shales tending to become coal and poor in silica. In fact, these coal horizons are the host for the samples. The Lower Pali Formation is overlain by the Upper Pali Formation consisting of coarse arkose and medium-grained sandstones. The Upper Pali Formation is devoid of coals.

SYSTEMATIC DESCRIPTION

Supraturma **Sporites** H. Potonie, 1893

Anteturma **Megasporites** Pant, 1962

Turma **Triletes** (Reinsch) Potonie and Kremp, 1954

Suprasubturma **Lagenotriletes** Potonie and Kremp, 1954

Subturma **Gulati** Bharadwaj, 1957

Suprainfraturma **Granutubergulati** n.

Remarks : Lageniculate trilete megaspores with granulose to tuberculose sexine sculptures are referred to the *suprainfraturma Granutubergulati* n.

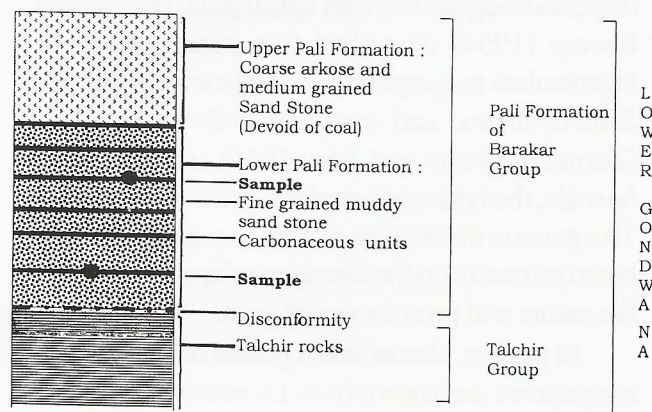


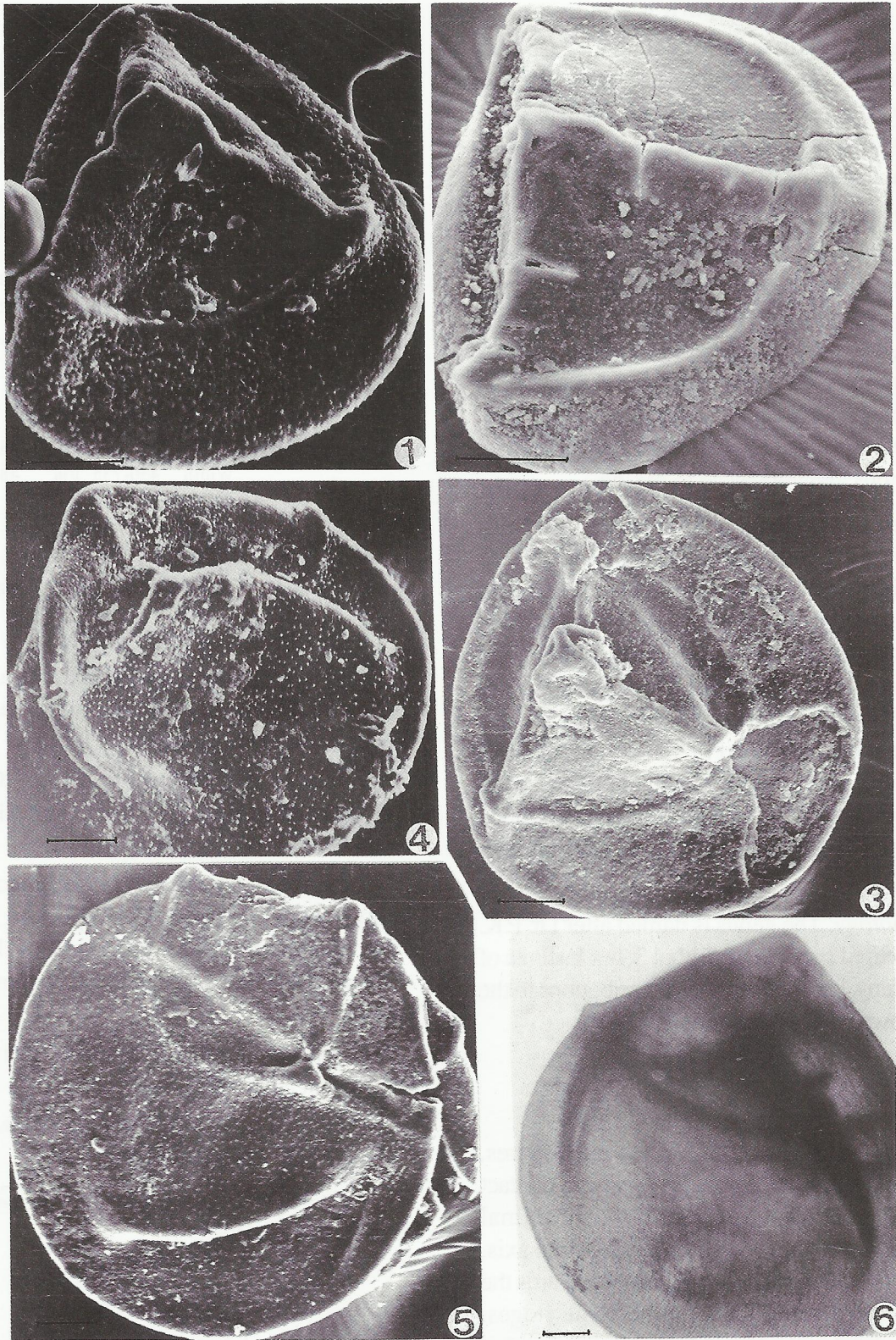
Fig. 2. Generalized columnar section of the study areas showing carbonaceous units from where samples have been obtained (Not to the scale).

EXPLANATION OF PLATE I

(Scale bar = 100 μ m)

- 1-5. SEM micrographs, 6. Light micrograph.
- 1-3. *Dijkstraea indica* n. sp. 4-6. *Maithyspora ovalis* n. gen. and n. sp.
- 1-3. Megaspores showing proximal gula formed by raised central trijunction of laesurae and part of contact areas, distinct arcuate ridges and rough (figs. 2,3) and tuberculate (fig.

- 1) sculpture. 1. Holotype, Sl. 111, 2. Sl. 126, 3. Sl. 112.
4. Megaspore showing elevated pyramidal gula formed by expanded and raised contact areas and granulose sexine sculpture. Holotype. Sl. 121.
5. Another specimen. Sl. 122.
6. Megaspore in fig. 4, after maceration.



Genus Maithyspora n. gen.

Diagnosis: Trilete lageniculate megaspores, gula pyramidal, ornamented, apically formed by expanded contact areas, arcuate ridges distinct, spore wall consisting of outer granulose sexine and inner membranous nexine.

Type species: *Maithyspora ovalis* n. sp.

Description and comparison: Megaspores of *Maithyspora* n. gen. are laterally preserved, suggesting that their polar axis is significantly longer than the equatorial axis. Gradually raised contact areas form pyramidal apical gula on the proximal face of spores. Megaspore surface, including gula, is covered with granulose sculptures. Nexine is membranous and appressed to sexine.

Maithyspora n. gen. is comparable with *Lagenicula* (Bennie and Kidston) Potonie & Kremp, 1954 in its long polar axis but differs in having granulose sexine sculpture (in *Lagenicula*, sexine is spinose). It is also comparable with *Dijkstraea* (Pant & Srivastava) Bharadwaj & Tiwari, 1970 in granulose sexine sculpture but differs entirely from the latter in their pyramidal gula formed by expansion and raising of contact areas (in *Dijkstraea*, the proximal gula is triangular/armed made up of trilete laesurae and part of contact areas).

Etymology: The genus is named after Dr. P.K. Maithy (retired scientist) of Birbal Sahni Institute of Palaeobotany, Lucknow, for his contributions to the Indian Lower Gondwana Palaeobotany.

Maithyspora ovalis n. sp.

(Pl. I, figs. 4-6; figs. 3 b-d).

Diagnosis: Lageniculate trilete megaspores, amb oval, apical gula formed by expanded contact areas, laesurae straight, highest at proximal trijunction, polar axis longer than equatorial axis, gula wide at base, narrowing gradually towards the apex, contact areas bounded by arcuate ridges, sexine covered with granulose sculpture, nexine membranous, unpitted, subcircular, diameter 2/3-

3/4 or more that of spores.

Dimensions:

	Dry Megaspores		Macerated megaspores mounted in glycerine jelly
Equatorial diameter	605 (725)	760 μ m	603-800 μ m
Polar diameter	624 (752)	996 μ m	650-922 μ m
Trilete laesurae			
	Length	190-320 μ m	220-340 μ m
	Width	50-70 μ m	70-105 μ m
	Height	24-30 μ m	
Arcuate ridges			
	Width	40-60 μ m	64-85 μ m
	Height	20-30 μ m	
Gula	Height	240-320 μ m	244-355 μ m
	Width	430-735 μ m	480-770 μ m
Grana	Height	5-10 μ m	5-14 μ m
	Width	4-10 μ m	5-10 μ m
Sexine	Thickness	-	20-25 μ m
Nexine	Diameter	-	480-640 μ m

Holotype: Pl. I, fig. 4, Sl. no. 121.

Repository: Palaeobotany Laboratory, Department of Botany, Govt. Autonomous Science College, Rewa-486 001, M.P. India.

Locality and Horizon: Pondi Colliery, Chirimiri Coalfield, Madhya Pradesh, Lower Gondwana (Lower Permian), India.

Description: Ten compressed specimens of megaspores, isolated from sample nos. Pd-2 and Pd-5, are assigned to *M. ovalis* n. sp. All of them show more or less typical characters of the species.

Genus *Dijkstraea* (Pant & Srivastava) Bharadwaj & Tiwari, 1970

Type species: *Dijkstraea brassiliensis* (Dijkstra) Pant & Srivastava, 1962

Type Locality: Rio Grand, near Candiotas, Santa Catarina, Brazil.

Dijkstraea indica n. sp.

(Pl. I, figs. 1-3; figs. 3a, e-f)

Diagnosis: Lageniculate trilete megaspores, amb roundly trianguloid, gula formed by expanded

and raised trilete laesurae and part of contact areas, contact areas about 1/2 of spore radius, bounded by arcuate ridges; spore wall consisting of outer thick sexine and inner thin nexine, sexine covered with granulose to tuberculate sculptures all over the spore surface, nexine membranous, diameter about 1/2 of spore radius, pitted.

Dimensions:

	Dry Megaspores	Macerated megaspores mounted in glycerine jelly
Equatorial diameter	428x412- 528x480 µm	448x416-534x487µm
Trilete laesurae		
Length	224-256 µm	226-258 µm
Width	62-93 µm	70-104 µm
Height	32-40 µm	
Contact areas		
Diameter	230x220 - 368x320 µm	240x225 - 370-330 µm
Arcuate ridges		
Width	25-55 µm	42-65 µm
Height	12-35 µm	
Gula		
Height	104-128 µm	110-140 µm
Width	98-112 µm	100-118 µm
Sculptures		
Height	5-10 µm	8-10 µm
Width	4-7 µm	5-10 µm
Sexine	Thickness	- 16-18 µm
Nexine	Diameter	- 250-300 µm

Holotype: Pl. I, fig. 1, Sl. no. 111.

Repository: Palaeobotany Laboratory, Department of Botany, Govt. Autonomous Science College, Rewa-486 001, M.P., India.

Locality and Horizon: Chappha Colliery, Umaria Coalfield, Madhya Pradesh, Lower Gondwana (Lower Permian), India.

Description and Comparison: Six specimens are referred to *D. indica* n. sp. All the megaspores are proximo-distally compressed with eccentric trijunctions. Central trijunction of the laesurae and middle part of the contact areas are expanded and elevated, forming proximal gula (Pl. I, figs. 1-3). Contact areas are marked by arcuate ridges. Sexine is rough (Pl. I, fig. 2) with minute grana (Pl. I, fig. 3) or covered with tuberculose

ornamentation (Pl. I, fig. 1) with rounded apices all over the surface, except on the apical gula. In alkali treated spores, a membranous nexine, measuring 16-18 µm in thickness, was observed with scattered rounded pits (fig. 3a).

D. indica n. sp. differs from *D. brassiliensis* (Dijkstra) Pant & Srivastava (1962) in its smaller size of spores and smaller sexine sculptures.

DISCUSSION

Pierart (1978) and Dybova-Jackowicz *et al.* (1979) used the structure gula as the character for generic delimitation. These authors have created four new genera, i.e. *Sublagenicula*, *Auritlagenicula*, *Crassilagenicula* and *Zonolagenicula*. Generic distinction given by Dybova Jackowicz *et al.* (1979) is conjectural and not acceptable here because they have not consid-

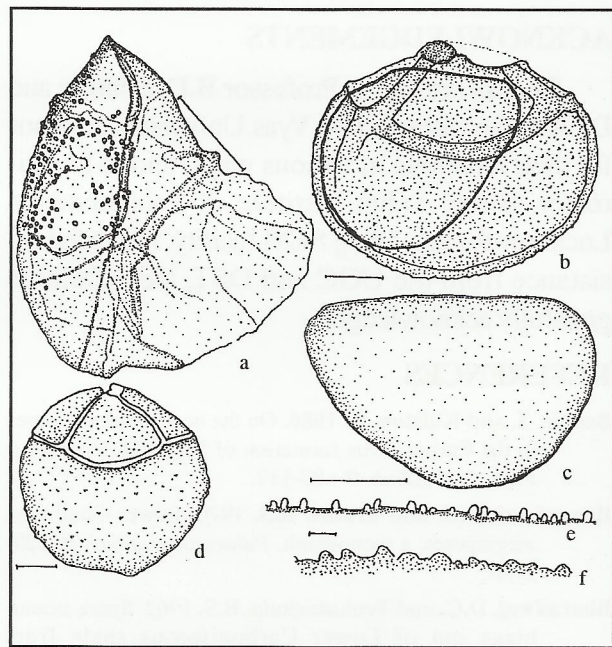


Fig. 3. Sketches of the studied megaspores.

(Scale bar= 100 µm unless otherwise mentioned)

Figs. 3a, e-f *Dijkstraea indica* n. sp.; b-d. *Maithyspora ovalis* n. gen. and n. sp.; a. Membranous and pitted nexine detached from the megaspore (in Pl. I, fig. 3) (P-pits); b. Megaspore under controlled overmaceration showing nexine sac appressed to sexine on the proximal side. Part of the apical gula is broken. (n-nexine) Sl. 124.; c. Nexine detached from the megaspore in fig. b.; d. An overmacerated dry megaspore. Sl. 125.; e-f. Marginal portions of the megaspore in fig. 1, showing tuberculose sexine sculpture. e. macerated and mounted spore, f. dry spore (Scale bar = 10 µm).

ered the character of various types of ornamentations in distinguishing different taxa of lageniculate megaspores. Subsequently, Spinner (1983) included two entirely distinct megaspore forms in the genus *Lagenicula* and described them as *L. piloverrucata* and *L. biverrucata*. The sexine sculpture of the megaspores of these two species is verrucose, while those of the type species of *Lagneicula*, *L. horrida*, is spinose. Pant and Mishra (1986) suggested that only such lageniculate megaspores should be included in the genus *Legenicula* where the sexine outside the contact area is covered with simple spines. Accordingly, lageniculate megaspores with verrucose sexine, such as *L. piloverrucata* Spinner and *L. biverrucata* Spinner should be included under the genus *Rostratispora* Bharadwaj and Venkatachala (1962).

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