PATTERN OF MIOFLORAS THROUGH PERMO-TRIASSIC TRANSITION IN BORE-HOLE RAD-2, EAST RANIGANJ COALFIELD, W. BENGAL*

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ABSTRACT

A 623-meter bore-core (RAD-2) from Ichhapur (Raniganj Coalfield), District Burdwan, West Bengal, representing the Permo-Triassic boundary-region (Raniganj-Panchet transition) yielded well-represented succession of miofloras. The Raniganj mioflora culminates in a *Densipollenites*-rich assemblage, which is replaced by a *Lundbladispora-Densoisporites*-rich association in the Panchet Formation. The quick and sharp change in the spore-pollen spectrum at the Permo-Triassic boundary indicates a probable gap in the deposition in this region.

INTRODUCTION

In quest of getting more data regarding the palynostratigraphy of Permo-Triassic transition in the eastern-most region of the East Raniganj Coalfield, W. Bengal, analysis of samples from bore-hole RAD-2 was undertaken. This study adds to our existing knowledge about the problem of the area (TIWARI, 1979; TIWARI & RANA, 1980; RANA & TIWARI, 1980), and is a part of our continuing persuit in this direction.

The material was provided by the Coal Division of GSI which is actively engaged in coal exploration work in West Bengal. Out of forty samples, only twelve yielded the miospores (Table 1; Pl. 1).

Table 1—Bore-hole No. RAD-2 ; Location : Ichhapur, Raniganj Coalfield, District Burdwan, West Bengal; Nos. in brackets indicate assemblages

	Lab. S.No.	Depth from the surface	Lithotype		Lab. S.No.	Depth from the surface	Lithotype
	1.	54.00 m	Sandstone		21.	298.00 m	Shale
	2.	59.00 m	Sandstone		22.	301.00 m	Shale
	3.	69.00 m	Khakigreen shale		23.	310.00 m	Shale
	4.	122.00 m	Sandy shale	Assemblage	24.	332.05 m	Shale
	5.	148.00 m	Sandstone	(VII)	25.	400.00 m	Shale
	6.	157.00 m	Sandstone		26.	420.00 m	Shale
	7.	162.00 m	Sandy shale		27.	428.00 m	Shale
	8.	180.00 m	Khaki shale	(VI)	28.	430.00 m	Shale
	9.	181.95 m	Sandy shale		29.	440.00 m	Shale
	10.	183.00 m	Sandy shale		30.	460.00 m	Shale
	11.	185.00 m	Sandy shale	(V)	31.	480.00 m	Shale
	12.	220.05 m	Shale		32.	505.00 m	Shale
	13.	225.00 m	Sandy shale		33.	530.00 m	Shale
Assemblage	14.	260.80 m	Shale	(IV)	34.	545.00 m	Sst. with coal
(VIII)	15.	263.00 m	Shale		35.	550.00 m	Shale
	16.	271.00 m	Sandstone	(III)	36.	563.00 m	Coaly shale
	17.	280.00 m	Sandstone		37.	570.00 m	Coaly shale
	18.	282.00 m	Sandstone	(II)	38.	607.00 m	Coaly shale
	19.	289.00 m	Sandstone		39.	613.00 m	Coaly shale
	20.	292.00 m	Shale	(I)	40.	623.00 m	Coaly shale

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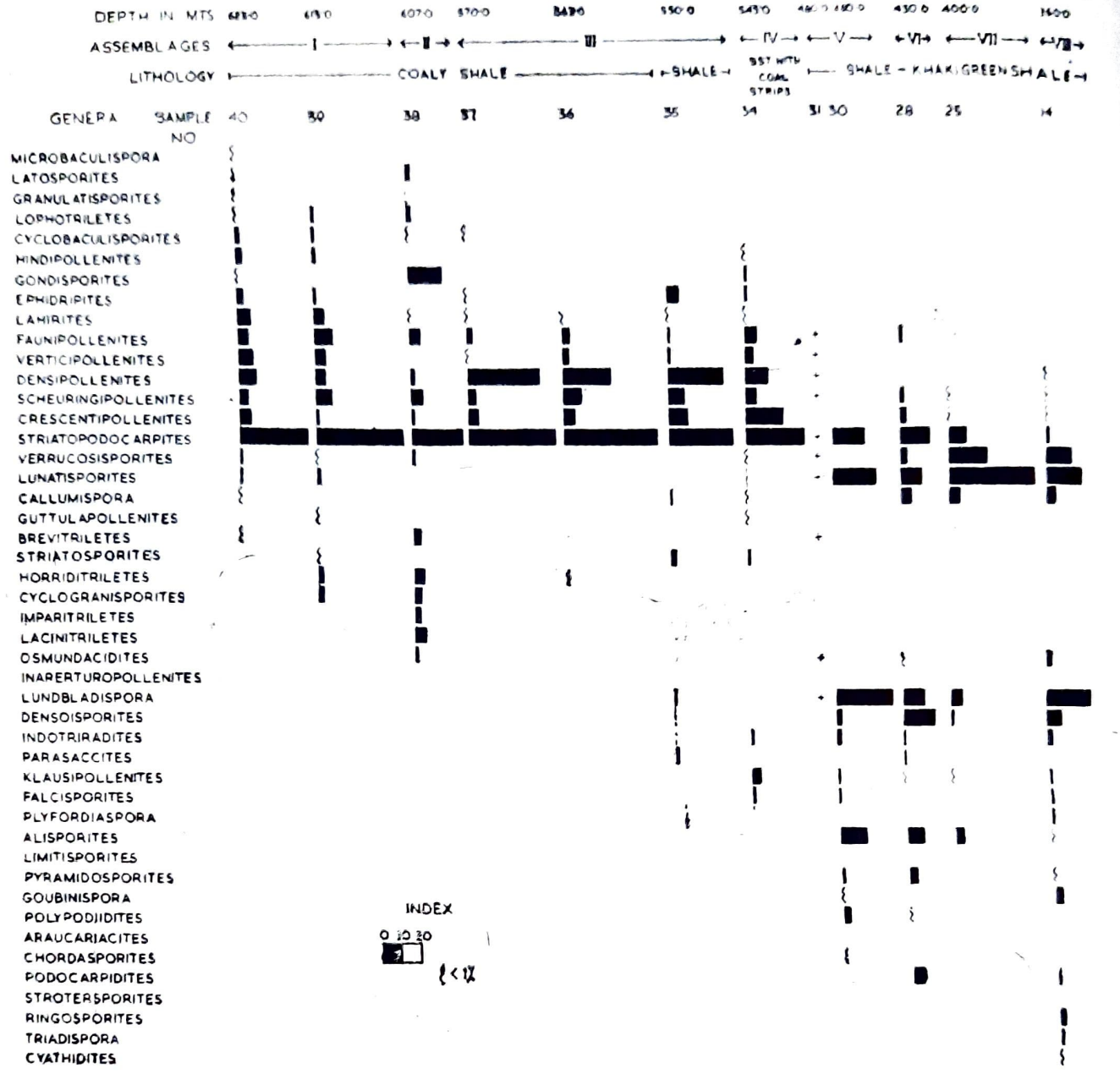
OBSERVATIONS

The 623-meter bore-core has yielded eight distinguishable assemblages whose break-up is given in table 2 ; the pattern of distribution is illustrated in histogram 1, and details in table 3.



Histogram 1—Percentage frequency of important miospore genera through Assemblages I to VIII met within bore-hole RAD-2.

The eight assemblages, depicted in table 2, fall under two groups :

1. Assemblages I to IV—having mainly striate disaccate dominance with changing pattern of combinations which corresponds with the earlier known pattern in this area.
2. Assemblages V to VIII—having mainly cavate-cingulate trilete spores, taeniate pollen and other younger genera, such as *Klausipollenites*, *Pyramidosporites*, *Podocarpidites*, *Triadispora*.

The changes at the level between Assemblages IV and V (between 545 m and 480 m depth) are sharp and well-defined. The striate disaccate dominance declines and

Table 2—Assemblages recorded in B. H.—RAD-2 (Permo-Triassic)

Assemblage	Depth m	Sample No. & Lithology	Quantitatively important genera	Qualitatively important genera	Remarks
PANCHET					
VIII *Lunatisporites*, *Triadispora*	260	(14; shale)	*Lunatisporites*, *Varrucosisporites*, *Lundbladispora*, *Densoisporites*, *Goubinispora*	*Triadispora*, *Callumispora*, *Indotriradites*, *Falcisporites* *Playfordiaspora*, *Ringosporites*	Taeniate dominance, *Triadispora* appearance
VII *Lunatisporites*, *Verrucosisporites*	400	(25; shale)	*Lunatisporites*, *Verrucosisporites*, *Lundbladispora*, *Densoisporites*, *Alisporites*	*Callumispora*, *Klausipollenites*, *Indotriradites*	Taeniate phase
VI *Densoisporites*, *Lundbladispora*	430	(28; shale)	*Densoisporites*, *Lundbladispora*, *Lunatisporites*, *Alisporites*, *Striatopodocarpites*, *Verrucosisporites*	*Callumispora*, *Pyramidosporites*, *Podocarpidites*	Cavate, *Callumispora* phase
V *Lundbladispora*	460 480	(30; shale), (31; Khaki-green shale)	*Lundbladispora*, *Lunatisporites*, *Striatopodocarpites*, *Densoisporites*	*Indotriradites*, *Pyramidosporites*, *Klausipollenites*, *Falcisporites*	Cavate-*Klausi*-phase. Marked change
RANIGANJ					
IV *Striatopodocarpites*, *Crescentipollenites*	545	(34; Sst. with coal strips)	*Striatopodocarpites*, *Crescentipollenites*, *Densipollenites*, *Faunipollenites*, *Verticipollenites*	*Klausipollenites*, *Falcisporites*, *Playfordiaspora*	Last Striate disaccate phase. 'Appearance of Triassic elements'
III *Striatopodocarpites*, *Densipollenites*	550 563 570	(35; shale) (36; coaly sh.) (37; coaly sh.)	*Striatopodocarpites*, *Densipollenites*, *Lahirites*, *Faunipollenites*, *Crescentipollenites*	*Kendosporites*, *Ephedripites*	*Densipollenites* phase
II *Striatopodocarpites*, *Gondisporites*	.. 607	(38; coaly sh.)	*Striatopodocarpites*, *Gondisporites*, *Latosporites*, *Lophotriletes*, *Brevitriletes*, *Faunipollenites*	*Osmundacidites*, *Lacinitriletes*, *Horriditriletes*	Petridophytic spores
I *Striatopodocarpites*, *Faunipollenites*	613 623	(39; coaly sh.), (40; coaly sh.)	*Striatopodocarpites*, *Faunipollenites*, *Verticipollenites*, *Lahirites*, *Cyclobaculisporites*	*Densipollenites*, *Ephedripites*, *Microbaculispora*	More striate disaccate

Table 3—Distribution of miospore genera in different assemblages through Bore-hole RAD-2

Assemblages	RANIGANJ				PANCHET			
	I	II	III	IV	V	VI	VII	VIII
Sample nos.	(40	39)	38 (37,	36,	35)	34	(31,	30) 28	25	14
Mispore genera								
1. *Microbaculispora* Bharad., 1962	+							
Circumstriatites Lele & Makada, 1972	+							
Ibisporites Tiwari, 1968	+							
Latosporites Pot. & Kr., 1954	+	+						
Granulatisporites Ibr. emend. Pot & Kr., 1954	+	+						
Lophotrilites Naum. emend. Pot. & Kr. 1954	+	+						
Apiculatisporis (Ibr.) Pot. & Kr., 1956	+		+					
Cyclobaculisporites Bhand., 1955 ex Bharad., 1965	+	+						
Hindipollenites Bharad., 1962	+							
Gondisporites Bharad., 1962	+	+		+				
Ephedripites Bolkhov. ex Pot., 1958	+		+	+				
Lakirites Bharad., 1962	+	+	+					
Faunipollenites Bharad., 1962	+	+	+	+	+	+		
Verticipollenites Bharad., 1962	+		+	+	+			
Densipollenites Bharad., 1962	+	+	+	+	+			
Scheuringipollenites Tiwari, 1973	+	+	+	+		+	+	+
Crescentipollenites Bharad., Tiw. & Kr., 1974	+	+	+	+		+	+	+
Striatopocarpites Sedova emend. Hart, 1964	+	+	+	+	+	+	+	+
Verrucosisporites Ibr. emend. Smith *et al.*, 1967	+	+		+	+	+	+	+
Lunatisporites Lesch. emend. Bharad., 1974	+			+	+	+	+	+
Callumispora Bharad. & Sriv., 1969	+		+	+		+	+	+
Platysaccus (Naum.) Pot. & Kl., 1954	+					+		
Striatites Pant emend. Bharad., 1962	+				+			
Guttulapollenites Goubin emend. Venkatach., Goub., & Kar., 1967	+			+				
Brevitriletes Bharad., & Sriv. emend. Tiw. & Rana, 1981	+	+		+				
Striomonosaccites Bharad., 1962	+							
Striatosporites Bhard., 1954	+		+	+				
Horriditriletes Bharad., & Sal., 1964	+	+	+					
Cyclogranisporites Pot. & Kr., 1954	+	+						
Imparitriletes Tiwari & Rana, 1981		+						
Lacinitriletes Venkatach. & Kar emend. Tiw. & Rana, 1981		+						+
Osmundacidites Couper, 1953		+		+	+			+
Rhizomaspora Wilson, 1962			+		+			
Inaperturopollenites Thoms. & Pflung. emend. Pot., 1958							+	+
Lundbladispora Balme emend. Playf., 1965			+		+	+	+	+
Parasaccites Bharad. & Tiwari, 1964			+		+			
Pretricolpipollenites Danze Corsin & Laveine, 1963			+					
Cuneatisporites Lesch., 1955					+	+		
Densoisporites Weyland. & Krieg. emend. Dettm., 1963			+	+	+	+	+	+
Indotriradites Tiwari, 1964			+		+	+		+
Klausipollenites Jansonius, 1962				+	+	+	+	+
Falcisporites Lesch. emend. Kl., 1963				+	+			+

Table 3—Distribution of miospore genera in different assemblages through Bore-hole RAD-2

Assemblages	RANIGANJ				PANCHET			
	I	II	III	IV	V	VI	VII	VIII
Sample nos.	(40	39) 38	(37, 36,	35) 34	(31,	30) 28	25	14
Mispore genera								
1. *Microbaculispora* Bharad., 1962	+							
Circumstriatites Lele & Makada, 1972	+							
Ibisporites Tiwari, 1968	+							
Latosporites Pot. & Kr., 1954	+	+						
Granulatisporites Ibr. emend. Pot & Kr., 1954	+	+						
Lophotrilites Naum. emend. Pot. & Kr. 1954	+	+						
Apiculatisporis (Ibr.) Pot. & Kr., 1956	+		+					
Cyclobaculisporites Bhard., 1955 ex Bharad., 1965	+	+						
Hindipollenites Bharad., 1962	+							
Gondisporites Bharad., 1962	+	+		+				
Ephedripites Bolkhov. ex Pot., 1958	+		+	+				
Lahirites Bharad., 1962	+	+	+					
Faunipollenites Bharad., 1962	+	+	+	+	+	+		
Verticipollenites Bharad., 1962	+		+	+	+			
Densipollenites Bharad., 1962	+	+	+	+	+			
Scheuringipollenites Tiwari, 1973	+	+	+	+		+	+	+
Crescentipollenites Bharad., Tiw. & Kr., 1974	+	+	+	+		+	+	+
Striatopocarpites Sedova emend. Hart, 1964	+	+	+	+	+	+	+	+
Verrucosisporites Ibr. emend. Smith *et al.*, 1967	+	+		+	+	+	+	+
Lunatisporites Lesch. emend. Bharad., 1974	+			+	+	+	+	+
Callumispora Bharad. & Sriv., 1969	+		+	+		+	+	+
Platysaccus (Naum.) Pot. & Kl., 1954	+					+		
Striatites Pant emend. Bharad., 1962	+				+			
Guttulapollenites Goubin emend. Venkatach., Goub., & Kar., 1967	+			+				
Brevitriletes Bharad., & Sriv. emend. Tiw. & Rana, 1981	+	+		+				
Striomonosaccites Bharad., 1962	+							
Striatosporites Bhard., 1954	+		+	+				
Horriditriletes Bharad., & Sal., 1964	+	+	+					
Cyclogranisporites Pot. & Kr., 1954	+	+						
Imparitriletes Tiwari & Rana, 1981		+						
Lacinitriletes Venkatach. & Kar emend. Tiw. & Rana, 1981		+						+
Osmundacidites Couper, 1953		+		+	+			+
Rhizomaspora Wilson, 1962			+		+			
Inaperturopollenites Thoms. & Pflung. emend. Pot., 1958							+	+
Lundbladispora Balme emend. Playf., 1965			+		+	+	+	+
Parasaccites Bharad. & Tiwari, 1964			+		+			
Pretricolpipollenites Danze Corsin & Laveine, 1963			+					
Cuneatisporites Lesch., 1955					+	+		
Densoisporites Weyland. & Krieg. emend. Dettm., 1963			+	+	+	+	+	+
Indotriradites Tiwari, 1964			+		+	+		+
Klausipollenites Jensonius, 1962				+	+	+	+	+
Falcisporites Lesch. emend. Kl., 1963				+	+			+

Table 1 (*Contd.*)

Playfordiaspora Maheshw. & Banerji, 1975	+				+
Alisporites Daugh. emend. Nils., 1958		+	+	+	+
Limitisporites (Lesch.) Pot. 1958		+	+	+	+
Pyramidosporites Segroves, 1967		+	+	+	+
Goubinispora Tiwari & Rana, 1981		+			+
Polypodiidites Ross, 1949		+	+		
Laricoidites Pot., Thomson & Thiergart, 1950		+	+	+	
Auracariacites Cookson, 1947		+	+	+	
Chordasporites Kl., 1962		+			
Podocarpidites Cooks. ex Couper, 1953			+		+
Strotersporites Wilson, 1962				+	+
Ringosporites Tiwari & Rana, 1981					+
Triadispora Klaus, 1964					+
Cyathidites Couper, 1953					+

suddenly *Lundbladispora-Lunatisporites* appear on the scene. After a comparison with the known data from the Damodar basin (BHARADWAJ, TIWARI & ANAND-PRAKASH, 1979 ; TIWARI & RANA, 1981) it is concluded that the Permo-Triassic boundary lies somewhere between 480 and 545 meter depth-level in the presently investigated bore-hole. The Assemblages I—IV represent the Raniganj Formation while Assemblages V to VIII indicate the Lower Panchet affinities. However, the lower-most Panchet mioflora is not present in this succession, which could be represented in the 65-meter thick sediment between 480 and 545 m depth-level (sample nos. 31 & 34, respectively). This gap is because of the non-availability of the closer samples as well as the barren nature of the samples at our disposal. Inspite of this, however, it could be ascertained that probably a mioflora represented by *Klausipollenites*-rich association is missing. This could as well indicate a gap in the sequence (see BHARADWAJ & TIWARI, 1977).

CONCLUSION

The present observations corroborate with the already known pattern of vertical distribution of miospores through Permo-Triassic transition. The abrupt change at 480-545 m depth in the pollen-spore complex indicates the location of Raniganj-Panchet boundary at this region. The Raniganj mioflora is characterized by the striate disaccate rich assemblage with *Densipollenites*, *Gondisporites* and *Guttulapollenites* as characteristic genera and in having no cavate, taeniate forms. On the other hand, the Lower Triassic assemblages show definite presence of the cavates and taeniates, and the absence of *Densipollenites-Gondisporites* group. In Triassic, the assemblages show quicker changes and the younger aspect is depicted in the assemblages no. VII and VIII where younger elements start coming. The change-over from Permian to Triassic is associated with the lithological changes as well.

This study records a good succession, although incomplete one, through Permian-Triassic sequence in the Raniganj Coalfield. Availability as well as productivity of more closely-spaced samples shall give still precised results in this area.

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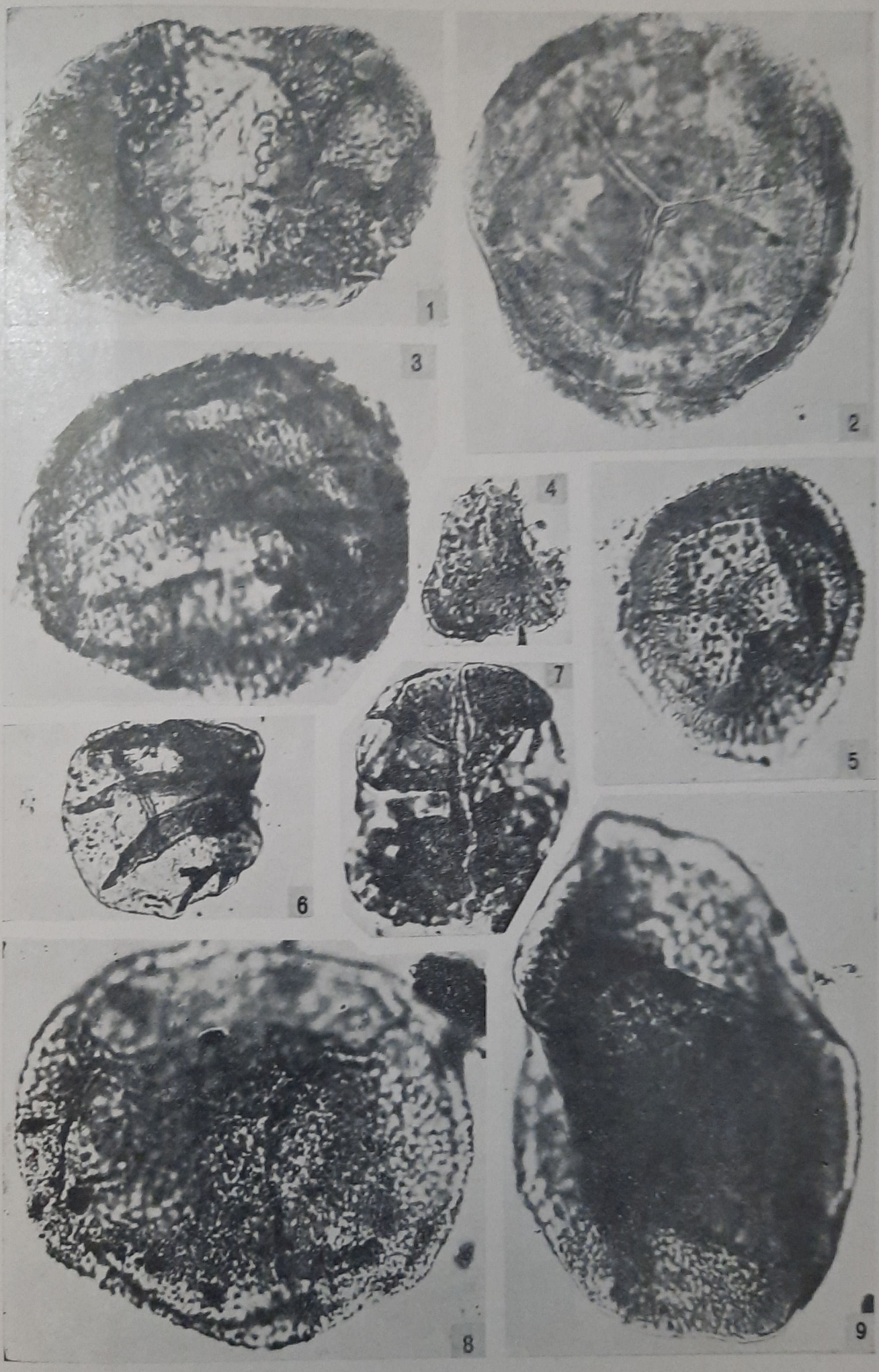
EXPLANATION OF PLATE 1

Statement No. 498 ; All figures ×500

1. *Alisporites*, BSIP Sl. No. 6733.
2. *Densoisporites*, BSIP Sl. No. 6733.
3. *Striatosporites*, BSIP Sl. No. 6734.
4. *Horriditriletes*, BSIP Sl. No. 6735.
5. *Lundbladispora*, BSIP Sl. No. 6735.
6. *Laricoidites*, BSIP Sl. No. 6736.
7. *Guttulapollenites*, BSIP Sl. No. 6737.
8. *Gondisporites*, BSIP Sl. No. 6738.
9. *Densipollenites*, BSIP Sl. No. 6739.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