PERMIAN-TRIASSIC MIOFLORAS FROM THE RANIGANJ COALFIELD, INDIA

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ABSTRACT

Core samples from the Bore hole NCRD-6 in Dishergarh-Asansol Region, Raniganj Coalfield have been palynologically analysed. The *sporae dispersae* have been assigned to 35 genera and 43 species, out of which 12 species are new. Statistical analysis of these samples suggests a 3-zone miofloral succession. The oldest zone is dominated by the striate-disaccates and corresponds to the mioflora of the Raniganj Stage (Upper Permian); the youngest zone is characterized by the decline of the striate forms alongwith the prominent incoming of new trilete organizations in the Panchet (Lower Triassic); the middle zone contains a mixed mioflora representing a transition between the youngest and the oldest. It has been concluded that as compared to the Upper Permian, the palynoflora changes in the Lower Triassic where the striate-disaccates appreciably decline and the triletes prominently take their place; the transitional palynoflora shows mixed elements. Comparison with the contemporary miofloral sequence from Ondal area of Raniganj Coalfield has revealed that the middle and upper zones encountered in NCRD-6 are absent there, substantiating thereby a sedimentological break between the Raniganj and Panchet formations in that area.

INTRODUCTION

RANIGANJ Coalfield is a major coal producing coalfield of the Lower Gondwana in India. The eastern part of it is situated in West Bengal while a portion extends into Bihar. To the north, west and south the Gondwana rocks of this coalfield are bordered by Archeans while to the east they are concealed by alluvium and laterite. A generalized succession of depositions met within the Raniganj Coalfield is given below.

The Gondwana sequence is usually divided into two subdivisions: 1. Lower Gondwana containing *Glossopteris-Gangamopteris* flora and 2. Upper Gondwana having an earlier *Dicroidium* flora and the later *Ptilophyllum* flora.

The strata at the boundary of Lower and Upper Gondwanas, overlying the Raniganj Formation, were named as Panchet Series by W. T. Blanford (1861) who also recorded a small "break" between the two. However, according to Gee (1932) no large unconformable overlap could be distinguished in the Asansol region.

The Panchet Group has a mixed flora of *Glossopteris* and *Dicroidium* and therefore, it has been included in the Lower Gondwana sequence, within the Triassic System, or in "the transitional beds", of the 'Middle Gondwanas' (Feistmantel, 1876, 1882; Vredenberg, 1910). Oldham (1860, 1893) opined to restrict the term Panchet to the lower part of the group of beds above Raniganj Formation, representing the Bunter Sandstone and Keuper of Europe, while Cotter (1917) correlated the Panchet Series with the entire Triassic Period of Europe, the Lower Panchet Series representing the Bunter age.

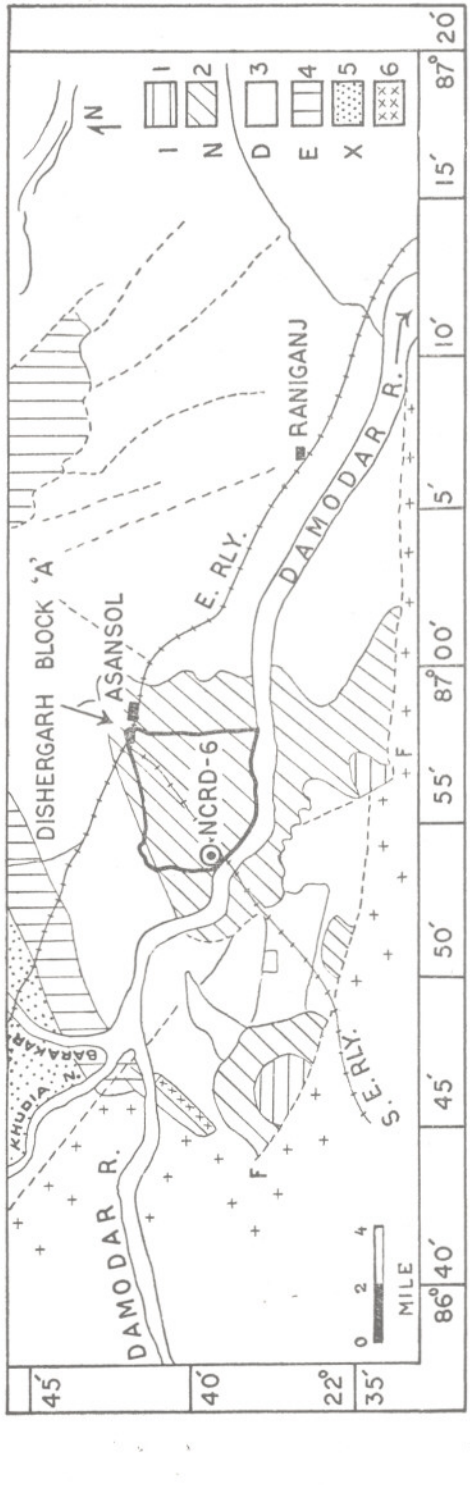
Alluvium			Recent
	Unconformity		
	Panchet Series		Triassic
Lower Gondwana	Damuda Series	Raniganj Stage Barren M. Stage Barakar Stage	Permian
	Talchir Series		
	Unconformity		
	Archeans		

Recently Tripathi and Satsangi (1963) have recorded the occurrence of *Pecopteris concinna* from the Lower Panchet of Raniganj Coalfield and have also doubted the earlier reports of the typical Raniganj plant remains in the early Panchets. This indicates a clear floral change between the Raniganj and Panchet. Palaeontologically, the age of Panchet has been established as Lower Triassic. The division of Panchets into Lower (Maitur) and the Upper (Deoli, earlier known as Hirapur) formations has been lithologically as well as palaeontologically substantiated.

Lithologically, Panchet is the group of fresh water sediments mostly devoid of coal and carbonized matter overlying non-coal bearing Kumarpur sandstone member of the coal bearing Raniganj Formation. The Lower Panchets comprise of the khaki green and yellow green sediments.

Raniganj-Panchet sequence is best exposed in the vicinity of Asansol and southwards up to the Damodar River, from where the present bore core has been studied, and also in some cases across the river up to the southern boundary of the coalfield. The present work is based on core samples from a bore hole (B.H. no. NCRD-6, max. depth 1214-78 m) in the Dishergarh 'Block A' of Raniganj Coalfield, drilled in the region near Asansol, Burdwan Distt., West Bengal, (22° 42'N: 86° 59'E; see Map 1). The mioflora obtained in 5 samples of this bore hole, is divisible into 3 zones. The lower zone, found in a shale and in a thin coalseam, is constituted by the striate-disaccate genera. The typical Panchet lithology has yielded a transitory as well as a diagnostic Lower Panchet mioflora. Thus, the Permo-Triassic palynology in this area suggests a gradual but definite change through the boundary.

Relatively little work has been done on the early Triassic mioflora of India. Sitholey (1943, 1951) described the occurrence of two winged pollen grains in the Triassic rocks of the Salt Range, Punjab (now Pakistan). Recently, the same region has been thoroughly worked out by Balme →



MAP - I

MAP 1 — East Raniganj Coalfield — a portion showing the location of borehole NCRD-6. 1. Supra Panchet; 2. Panchet; 3. Raniganj; 4. Barren Measure; 5. Barakar; 6. Metamorphics.

(1970). During the last decade, some data regarding the Permo-Triassic as well as Triassic miofloras have been accumulated through the contributions of Shrivastava and Pawde (1962), Satsangi, Chandra and Singh (1968, 1972), Bharadwaj and Srivastava (1969b), Kar (1970a, 1970b); Sarbadhikari (1972), Banerji and Maheshwari (1974), and Maheshwari and Banerji (1975).

MATERIAL AND METHODS

The material consisted of 20 samples, out of which only five (marked with asterisk) have yielded the miospores (Table 1; Text-fig. 1). All the 10 samples below 358·40 m depth (i.e. below Lab. sample no. 13) have been found to be barren of miospores.

TABLE 1 — DETAILS OF SAMPLES STUDIED FROM B.H. NCRD-6

Serial No.	Depth from the surface	Lithology	Lab. sample No.
1.	60 m	Greenish shale	4
2.	86 m	,,	5*
3.	90 m	,,	6
4.	123·50 m	,,	7*
5.	175·50 m	,,	8
6.	215 m	,,	9*
7.	278 m	,,	10
8.	287·30 m	Gray shale	11*
9.	342·20 to 344·98 m	Coal	12
10.	357·26 to 358·40 m	Coal	13*

The maceration was done by using hydroflouric acid, thereafter nitric acid and clearing with 10 per cent potassium hydroxide. The slides were prepared in glycerine jelly and sealed by paraffin wax. The preservation of the material as well as the frequency of spores is good on an average. All the slides have been deposited at the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow and the Museum Registered Numbers for the slide nos. (Laboratory) are given in parenthesis.

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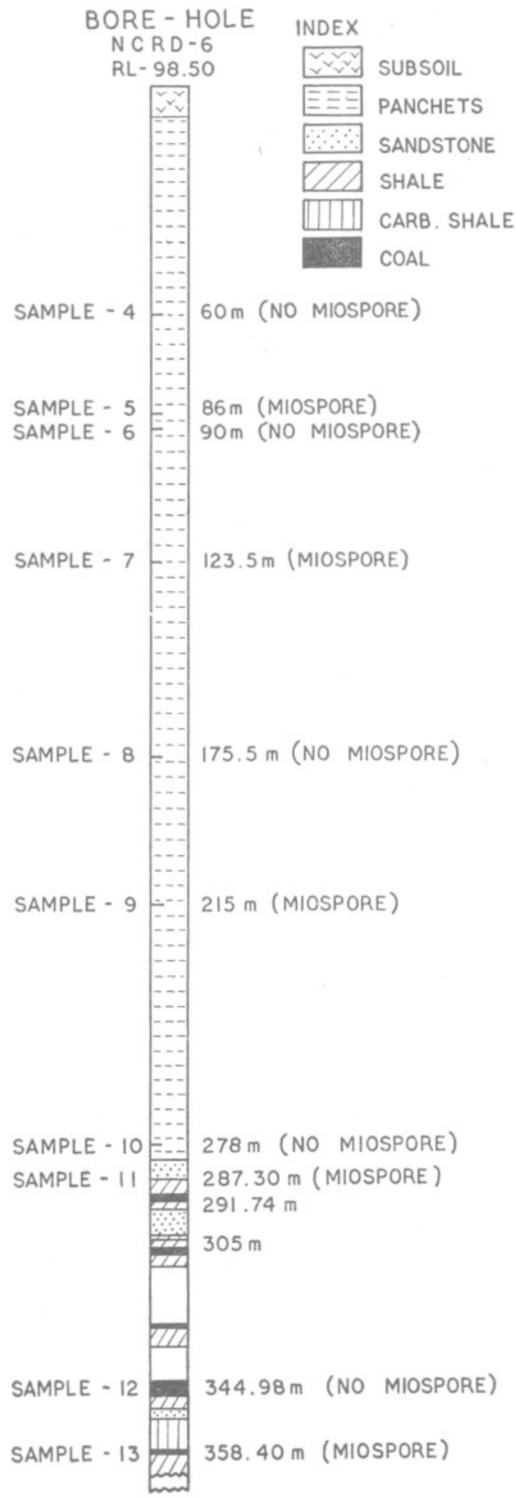
TEXT-FIG. 1 — Lithologs of Borehole NCRD-6 showing the various samples analysed for the present work.



TEXT-FIG. 1

Slide nos. (Laboratory) 5/1 (4669), 5/2 (4670), 5/3 (4671), 5/5 (4672), 7/1 (4673), 7/2 (4674), 7/3 (4675), 7/5 (4676), 9/1 (4677), 9/3 (4678), 11/1 (4679), and 11/2 (4680).

SYSTEMATIC DESCRIPTION

In the following description of the *sporae dispersae*, the classification suggested by Bharadwaj (1974, 1975) has been followed.

Anteturma — *Sporites* H. Pot. 1893 emend. Bharad., 1974
Subanteturma — *Atenuitati* Bharad., 1974
Turma — *Curvaturati* Bharad., 1974
Subturma — *Cingulati* Pot. & Kl., 1954 emend. Bharad., 1974
Infrasubturma — *Nonexinaugeri* Bharad., 1974

Lundbladispora Balme emend. Playf., 1965

Type Species — *Lundbladispora willmotti* Balme, 1963.

Remarks — Originally, this genus has been diagnosed to possess three papillae on the intexine (i.e. inner body). However, these have not been reported either in the Salt Range forms (Balme, 1970) or seen in the present specimens. Evidently, the papillae may or may not be seen as is often the condition known for other lycopsid spore genera.

Lundbladispora sp. cf. *L. brevicula* Balme, 1963

Pl. 1, figs. 1-5

Holotype — Balme, 1963, pl. 4, figs. 8-9.

Description — Triangular to subtriangular. Inner body clear, thin-walled, usually shifted from the centre, without papillae. Trilete rays reaching up to the inner margin of the equatorial thickening. Ornamentation restricted on distal side, consisting of sparse spines, 1-2 μ wide at base, 1-3 μ long, and of coni usually with rounded narrow apices. Exine surface micropunctate. Marginal thickening 2-3 μ in optical section.

Dimensions — 60-76 μ diameter; inner body 48-60 μ.

Comparison — The size range of *L. brevicula* as given by Balme (1970, p. 344) is 41-51 μ, while in the present assemblage it is 60-76 μ.

Occurrence — Lab. sample nos. 5, 7.

Lundbladispora baculata sp. nov.

Pl. 3, figs. 37, 38

Holotype — Pl. 3, fig. 37, size 102 μ; Slide no. 5/3 (Reg. no. 4671).

Isotype — Pl. 3, fig. 38.

Locus Typicus — Bore hole NCRD-6; Lab. sample no. 5, depth 86 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Circulo-triangular spores. Y-rays reaching up to the margin. Inner body not very clear. Exine spongy in appearance with apparently punctate surface. Distal side showing big, baculate or sub-baculate, finger-shaped to pila-like, 3-9 μ long × 3-6 μ wide processes.

Dimensions — 80-120 μ diameter.

Comparison — The characteristic ornament (baculate to pila-like processes) differentiates this species from *L. willmotti*, *L. brevicula* and other known species of the genus.

Occurrence — Lab. sample nos. 5, 7.

Lundbladispora microconata sp. nov.

Pl. 1, figs. 9-11

Holotype — Pl. 1, fig. 10, size 68 μ; Slide no. 7/1 (Reg. no. 4673).

Isotype — Pl. 1, fig. 9.

Locus Typicus — Bore hole NCRD-6, Lab. sample no. 7, depth 123·5 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Triangular with convex sides and broadly rounded angles. Body 41-51 μ. Trilete rays reaching up to the margin of the inner body, mostly faint. Distal ornament consisting of short and rare, 1×1 μ coni. Exine surface finely punctate.

Comparison — *L. brevicula* Balme (1963) differs in having longer spines; *L. baculata* sp. nov. has baculate to pila-like ornamentation, and thus differs from the present species.

Occurrence — Lab. sample nos. 5, 7.

Lundbladispora densispinosa sp. nov.

Pl. 1, figs. 6-8

Holotype — Pl. 1, figs. 7-8, size 70 μ; Slide no. 5/3 (Reg. no. 4671).

Isotype — Pl. 1, fig. 6.

Locus Typicus — Bore hole NCRD-6, Lab. sample no. 5, depth 86 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Triangular with convex sides and broad round corners. Trilete-rays reaching up to the equator. Cingulum thick, 8-12 μ wide. Distal ornament consisting of closely packed massive spines with rounded base and prickle-like apex, sometimes finger-like; processes 2-5 μ wide at base and 4 to 8 μ long, arranged in radiating pattern with the bases exhibiting negatively reticulate appearance. Spines rare on cingulum and absent on margin.

Dimensions: 64-76 μ diameter, inner-body 40-50 μ.

Comparison — The compactly disposed spines, arranged in radiating pattern, distinguish the present species from *Lundbladispora willmotti* Balme (1963), *L. brevicula* Balme (1963), *L. baculata* sp. nov. and *L. microconata* sp. nov.

Occurrence — Lab. sample nos. 5, 7.

Densoisporites Weyland & Krieger emend. Dettmann, 1963

Synonym — *Decisporis* Kar, 1970b, *pars*, Pl. 1, figs. 18, 22, 23.

Type Species — *Densoisporites velatus* Weyland & Krieger, 1953.

Densoisporites contactus sp. nov.

Pl. 2, figs. 17-21

Holotype — Pl. 2, fig. 19, size 64 μ; Slide no. 5/3 (Reg. no. 4671)

Isotype — Pl. 2, fig. 17.

Locus Typicus — Bore hole NCRD-6; Lab. sample no. 5, depth 63 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Roundly subtriangular with convex sides and broadly round angles. Trilete-rays ±2/3 radius long, thin- or slightly thick-lipped, ending with broadened and thickened ends; arcuate markings of the contact area distinct. Laterally compressed specimens showing thickened exine distally. Equatorial cingulum 3-6 μ wide.

Dimensions: 52-73 μ diameter, inner body 40-55 μ.

Comparison — The contact area marked by curvaturae joining the thickened ray-ends is the important characteristic feature of this species, as compared to *D. playfordii*.

Occurrence — Lab. sample nos. 5, 7, 11.

Densoisporites sp.

Pl. 2, fig. 16

Description — Subtriangular; Y-mark distinct, rays reaching up to the equatorial angles, thin, straight. Exine laevigate; cingulum 3-4 μ wide, crassitudinous. No ornament on distal side.

Dimensions: 40 μ diameter.

Occurrence — Lab. sample no. 7.

OTHER SPECIES

Densoisporites playfordii (Balme) Dettmann, 1963

Pl. 1, figs. 12-15; Lab. sample nos. 5, 7

Indotriradites Tiwari, 1964

Type Species — *Indotriradites korbaensis* Tiwari, 1964.

Remarks — *Indotriradites* has been instituted by Tiwari (1964) to describe flanged trilete spores having distinct inner body and distally restricted ornament of coni or spines. The trilete mark in this genus is very well defined, the rays continuing to extend beyond the body margin, into the flange, mostly in the form of folds. Balme (1970) suggested to include *Indotriradites* in *Kraeuselisporites* Lesch. (1955) on the basis of organizational similarities. A recent restudy of the holotype of the type species of the latter — *K. dentatus* Lesch. (1955) has revealed that it possesses a thin trilete mark where rays terminate at the body equator and never enter the flange, that there is no indication of the presence of an inner body (intexine) and that the distal ornaments are short, round-tipped bacula to pila-like processes. This analysis suggests that the two genera under discussion represent different lines of morphography and hence should be maintained separately.

In view of the above observations, the following species described by Balme (1970) under *Kraeuselisporites*, are being transferred to *Indotriradites* as new combinations.

Indotriradites rallus (Balme) comb. nov.

1970 *Kraeuselisporites rallus* Balme, *Univ. Kansas, Deptt. Geol. Special Publication*, 4, p. 337, pl. 4, figs. 9-13.

Holotype — Balme, 1970, pl. 4, fig. 9, U.W.A. 57796.

Locus Typicus — Wargal, W. Pakistan.

Stratum Typicum — Salt Range, Chhidru Formation.

Diagnosis — See description and dimensions given by Balme, 1970, p. 337.

Indotriradites wargalensis (Balme) comb. nov.

1970 *Kraeuselisporites wargalensis* Balme, *Univ. Kansas, Deptt. Geol. Special Publication*, 4, p. 338, pl. 4, figs. 14-17.

Holotype — Balme, 1970, pl. 4, fig. 17, U.W.A. 57801

Locus Typicus — Wargal, W. Pakistan

Stratum Typicum — Salt Range, Chhidru Formation.

Diagnosis — See description and dimensions given by Balme, 1970, p. 338.

Indotriradites cuspidus (Balme) comb. nov.

1963 *Kraeuselisporites cuspidus* Balme, *Palaeontology*, 6, p. 19, pl. 5, figs. 9-11.

Holotype — Balme, 1963; pl. 5, fig. 9, slide 47549.

Locus Typicus — Geraldton Racecourse Bore, 1,465 ft (Sample 44497) Western Australia.

Stratum Typicum — Kockatea shale, Lower Triassic.

Diagnosis — See Balme, 1963, p. 20.

Indotriradites saeptatus (Balme) comb. nov.

1963 *Kraeuselisporites saeptatus* Balme, *Palaeontology*, 6, pl. 20, p. 6, figs. 8-10.

Holotype — Balme, 1963; Pl. 6, fig. 8, Slide no. 47549.

Locus Typicus — Geraldton Racecourse Bore, 1,465 ft (sample 44497), Western Australia.

Stratum Typicum — Kockatea shale, Lower Triassic

Diagnosis — See Balme, 1963, pp. 20-21

Indotriradites mamillatus sp. nov.

Pl. 2, figs. 22-26

Holotype — Pl. 2, fig. 23, size 68 μ; Slide no. 5/1 (Reg. no. 4669).

Isotype — Pl. 2, fig. 26.

Locus Typicus — Bore hole NCRD-6, Lab. sample no. 7, depth 123·5 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Roundly triangular spores. Flange 5-8 μ wide, thin, translucent; trilete rays faint, almost reaching up to the equator of the spore. Central body 50-60 μ in diameter. Distal processes spino-mamillate, 1·5 to 5 μ long, 2-5 μ wide at base, with round bulbous base and long narrow apex. Ornament sparsely arranged; no papillae on inner body, the latter being thin and folded.

Dimensions: 67-80 μ diameter.

Comparison — Among the comparable species, *Indotriradites wargalensis* (Balme) comb. nov. differs from the present species in the presence of papillae on the inner body, and being smaller in size.

Occurrence — Lab. sample no. 5, 7.

Turma — *Noncurvaturati* Bharad., 1974
Subturma — *Triquetri* Bharad., 1974
Infrasubturma — *Abalti* Bharad., 1974
Infraturma — *Brevipolaxi* Bharad., 1974

Cyathidites Couper, 1953

Type Species — *Cyathidites australis* Couper, 1953.

Remarks — In *Cyathidites* the sides are concave and the trilete rays are always 2/3 or more of the radius; the structure of the exine is not described by the author (Couper, 1953, p. 27), although psilate, structureless forms are usually included in this genus. Balme (1970, p. 321) has described concave-sided, triangular spores under *Leiotriletes* which in our opinion belong to *Cyathidites*.

Cyathidites australis Couper, 1953

Pl. 2, fig. 30

Holotype — Couper, 1953, pl. 2, fig. 1.

Remarks — The presently described specimens resemble closely with those described by Couper (1953) from the Jurassic of New Zealand in having concave sides, long trilete rays and broadly round angles. *C. concavus* (Bolkhovitina) Dettmann, 1963 reported by Maheshwari and Banerji (1975) also resembles the present species.

Occurrence — Lab. sample no. 5

***Tigrisporites* Klaus, 1960**

Type Species — *Tigrisporites hallensis* Klaus, 1960.

Tigrisporites sp.

Pl. 2, figs. 27, 28

Description — Triangular with straight to slightly concave sides and broad round angles. Trilete mark distinct, rays more than 4/5 of the spore radius; labra thin, vertex low. Exine ±2 μ thick, bearing 6-8 faint rugulae radiating in the equatorial region of inter-ray areas, and passing to the distal face. Rugulae very faint and low, recognized mostly by the equatorial margin imparting to the latter a wavy appearance.

Comparison — This genus is scantily represented in the presently studied material. The specimens differ from *T. playfordii* de Jersey & Hamilt. as described by Balme (1970) by having very faint and low rugulae.

Dimensions: 60-68 μ diameter.

Occurrence — Lab. sample no. 5.

***Lophotriletes* (Naum.) Pot. & Kr., 1954**

Type Species — *Lophotriletes gibbosus* (Ibr.) Pot. & Kr., 1954.

Lophotriletes minimus Salujha, 1965

Pl. 2, fig. 29

Holotype — Salujha, 1965, pl. 1, fig. 13.

Occurrence — Lab. sample nos. 11, 13.

Subturma — *Nontriquetri* Bharad., 1974
Infrasubturma — *Nonstructurati* Bharad., 1974
Infraturma — *Sphaerae* Bharad., 1974
Subinfraturma — *Nonoperculati* Bharad., 1974

***Verrucosisporites* Ibr., 1933 emend. Smith *et al.*, 1964**

Type Species — *Verrucosisporites verrucosus* Ibr., 1933.

Verrucosisporites narmianus Balme, 1970

Pl. 3, fig. 39

Holotype — Balme, 1970, pl. 1, fig. 14.

Remarks — This species has been described from the Mianwali Formation of Surghar Range (Lower Triassic) by Balme (1970). The present specimens resemble the holotype in major characters. *V. jenensis* Reinhardt & Schmitz (1965), *V. reinhardtii* Visscher (1966) and *V. pseudomorulae* Visscher (1966), apart from other differences, possess bigger ornament and thicker exine.

Occurrence — Lab. sample nos. 5, 7, 9, 13.

Verrucosisporites triassicus sp. nov.

Pl. 2, figs. 31, 32

Holotype — Pl. 2, fig. 31, size 110 μ; Slide no. 5/3 (Reg. no. 4671).

Isotype — Pl. 2, fig. 32.

Locus Typicus — Bore hole NCRD-6. Sample no. 5, depth 86 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Subcircular; rays 3/4 radius long, simple. Exine closely packed with 2-3 μ long conically rounded verrucae all over except around the apical region. Exine thickening 3 μ in optical section.

Dimensions: 65-88 μ diameter.

Comparison — This species differs from *V. narmianus* in having roundly conical verrucae which are absent from the apical region.

Occurrence — Lab. sample nos. 5, 7, 9.

Verrucosisporites densus sp. nov.

Pl. 3, figs. 33-35

Holotype — Pl. 3, fig. 33, size 100 μ; Slide no. 5/1 (Reg. no. 4669).
Isotype — Pl. 3, fig. 35.
Locus Typicus — Bore hole NCRD-6. Lab. sample no. 5, depth 86 m. Raniganj Coalfield, India.
Stratum Typicum — Maitur Formation; Lower Triassic.
Diagnosis — Circular to triangulo-circular. Trilete rays 1/2 to 2/3 radius long, lips slightly thickened. Ornament of massive verrucae all over, 3-6 μ high × 8-12 μ long, partially fused, dark brown and compact in distribution.
Dimensions: 70-140 μ diameter.
Comparison — *Verrucosisporites narmianus* Balme (1970) and *V. triassicus* sp. nov. differ from the present species in having smaller verrucae of discrete nature. *V. reinhardtii* Visscher (1966) is also different in having very thick exine and separate verrucae on the exine. None of the Lower Gondwana species of this genus possesses partially confluenced massive verrucae and hence, they are different. *V. surangei* Maheshwari & Banerji (1975) possesses comparatively robust verrucae at the contact area.
Occurrence — Lab. sample nos. 5, 7.

Osmundacidites Couper, 1953

Type Species — *Osmundacidites wellmanii* Couper, 1953.
Remarks — Originally *Osmundacidites* has been described to possess granular-papillate ornamentation. Later on, forms having small verrucae and roundly conical, short processes have also been included in it. This seems to be correct as the figure of the type specimen (Couper, 1953; pl. 1, fig. 5) appears to show the presence of variedly mixed type of short elements as ornament. *Osmundacidites* has not been reported from the Lower Gondwana deposits, although some of the species of *Cyclobaculisporites* or *Verrucosisporites* show mixed type of ornamentation. From the Raniganj Stage, for example, *Cyclobaculisporites bharadwajii* Salujha (1965) should be assigned to *Osmundacidites* on the grounds of its apparently mixed ornamentation. This genus seems to appear in the Upper Permian (Raniganj Stage) with rare incidences, but acquires significance in the Lower Triassic.

Osmundacidites senectus Balme, 1963

Pl. 3, figs. 40-42

Holotype — Balme, 1963, pl. 4, fig. 1.
Remarks — The present specimens do not show the presence of bacula in their ornament as in the specimens described by Balme (1970). However, broad based roundly conical processes, short verrucae and grana are found as the elements of the mixed ornament.
Occurrence — Lab. sample nos. 5, 7.

Lycopodiumsporites (Thierg.) ex Delc. & Sprum., 1955

Type Species—Lycopodiumsporites agathoecus (Pot.) Thierg, 1938

cf. *Lycopodiumsporites* sp.

Pl. 3, fig. 36

Description — Subcircular; reticulum having 3-11 μ wide meshes, polygonal to irregular muri, 1·5 μ in thickness, uniform. Y-mark not clear probably due to distortion.
Dimensions: 72 μ diameter.
Remarks — The nature of Y-mark is uncertain. In the Raniganj mioflora certain similar forms have been already reported as *Reticulatisporites* (Ibr.) Pot. & Kr., *Lycopodiumsporites* Thierg. (see Bharadwaj, 1962, pl. 3, figs. 62-64) and *Dictyotriletes* (Bharadwaj & Salujha, 1964, pl. 3, figs. 59-60).
Occurrence — Lab. sample no. 5.

Infraturma — *Nonsphaerae* Bharad., 1974
Subinfraturma — *Circuli* Bharad., 1974
Infrasubinfraturma — *Leti* Bharad., 1974

Playfordiaspora Maheshw. & Ban., 1975

Type Species — *Playfordiaspora cancellosa* (Playford & Dettm.) Maheshw. & Ban., 1975
Remarks — The central body sometimes shows eccentric disposition in obliquely flattened grains (Pl. 4, fig. 48). This suggests the shifting of the body in relation to the saccus (exoexine). The laterally preserved specimens (Pl. 4, fig. 47) clearly indicate the distal continuation of the saccus.

Playfordiaspora cancellosa (Playf. & Dettm.) Maheshw. & Ban., 1975

Pl. 4, figs. 45-49

Description — Subcircular to subtriangular outline. Central body circulo-triangular, scabrate, sometimes triangular due to folds. Body-saccus ratio nearly 1:2. Trilete mark faint or clear, 1/2 or slightly more than 1/2 of the body radius, simple. Saccus thin, translucent, with microfolds, finely intrareticulate.

Dimensions: 72-88 μ diameter.

Occurrence — Lab. sample nos. 5, 7, 9, 13.

Turma — *Noncurvaturati* Bharad., 1974
Subturma — *Nontriquetri* Bharad., 1974
Infrasubturma— *Structurati* Bharad., 1974
Infraturma — *Globi* Bharad., 1974
Subinfraturma — *Cavati* Bharad., 1974

Densipollenites Bharad., 1962

Type Species — *Densipollenites indicus* Bharad., 1962.

Densipollenites invisus Bharad. & Salujha, 1964

Pl. 5, fig. 52

Holotype — Bharadwaj and Salujha, pl. 4, fig. 74.

Remarks — This is a rare species in the assemblage. However, it is quite frequent in the Raniganj Stage as described by Bharadwaj and Salujha (1964) and also in the Nidpur assemblage as reported by Bharadwaj and Srivastava (1969).

Occurrence — Lab. sample nos. 9, 11.

Subinfraturma — *Acavati* Bharad., 1974

Callumispora Bharad. & Sriv., 1969b

Type Species — *Callumispora barakarensis* Bharad. & Sriv., 1969b.

Remarks — The genus *Callumispora* was instituted by Bharadwaj and Srivastava (1969b) to accommodate circular trilete spores, having laevigate, thick exine with a tendency to become punctate and microverrucose in inter-ray area and intrapunctate elsewhere. From time to time, some of the similar forms from Gondwanas have also been referred to the genus *Punctatisporites* Ibrahim emend. Potonié & Kremp (1954). As such, there has been an overlapping of characters in the above two genera. Recently Bharadwaj and Varma (1974) analysed the morphographic characters of *Punctatisporites* and restricted this genus to triangular, trilete miospores with laevigate, non-structured exine. The species, so far referred to *Punctatisporites* from the Gondwana assemblages, are circular, spherical with incipient to distinct intrapunctation of exine and characteristic exinal thickening. Therefore, these forms should be referred to *Callumispora* and not to the genus *Punctatisporites*. However, the punctate and microverrucose nature of the exine in the inter-ray area described for *Callumispora* should be considered as a tendency and not a generic character.

Callumispora gretensis (Balme & Henn., 1956) Bharad. & Sriv., 1969b

Pl. 5, fig. 50

1956 *Punctatisporites gretensis* Balme & Henn., *Aust. J. Bot.*, p. 245, pl. 2, figs. 11-13.

Holotype — Balme & Hennelly, 1956, pl. 2, fig. 11.

Remarks — *Callumispora* (*Punctatisporites*) *gretensis* has been differentiated from *Callumispora* (*Punctatisporites*) *fungosa* on the basis of smaller size and thinner exine in optical section (Balme, 1963, p. 16). However, the size range and the range of exine thickness in these two species are overlapping (see Balme & Hennelly, 1956, p. 245; Balme, 1963, 1970). The difference in the ray-length, which according to Balme (1970) is a distinctive character, is, however, a variable character and hence undependable. What appears to be more important to us is the coarse, uniform intrapunctation in the exine and the conspicuous exine thickness (7 μ cf. Balme, 1963) in *C. fungosa* whereas fine intrapunctation to indistinct structure of exine and relatively less thickened exine (1-4 μ) in optical section, in *P. gretensis*. The specimen referred by Balme (1970, pl. 2, fig. 9) to *P. fungosus* belongs here.

Occurrence — Lab. sample nos. 5, 7.

Callumispora fungosa (Balme) Bharad. & & Sriv., 1969b emend.

Pl. 4, figs. 43, 44

1963 *Punctatisporites fungosus* Balme, *Palaeontology*, 6, p. 16, pl. 4, figs. 10, 11.

Holotype — Balme, 1963, pl. 4, fig. 10.

Diagnosis — (emend.) Circular; trilete rays straight, half to two-third radius long, exine 4-7 μ thick with distinctly visible, somewhat coarse intrapunctation all over the body.

Remarks — As it is clear from the photomicrographs of *C. fungosa* (Balme, 1963, pl. 4, figs. 10, 11), the exine in this species is somewhat coarsely intrapunctate. The proposed amendment in the specific diagnosis provides a distinction between *C. fungosa* and *C. gretensis*.

Occurrence — Lab. sample nos. 5, 7.

Callumispora sp.

Pl. 5, fig. 51

Description — Circular; exine thin, folded, without a line of thickening in optical section. Y-mark clear, rays 3/4 radius long, exine folded, yellow, smooth and finely intrapunctate.

Dimensions: 65-72 μ diameter.

Occurrence — Lab. sample no. 7.

Subanteturma — *Tenuitati* Bharad., 1974
Turma — *Sulcati* Bharad., 1975
Subturma — *Polaesulcati* Bharad., 1974
Infrasubturma — *Nondefiniri* Bharad., 1974
Infraturma — *Distarae* Bharad., 1974
Subinfraturma — *Bilaterae* Bharad., 1974
Infrasubinfraturma — *Corugati* Bharad., 1975

Weylandites Bharad. & Sriv., 1969a

Type Species — *Weylandites indicus* Bharad. & Sriv., 1969a.

Weylandites indicus Bharad. & Srivastava, 1969a

Pl. 7, fig. 85

Holotype — Bharadwaj & Srivastava, 1969a, pl. 28, fig. 92.

Occurrence — Lab. sample no. 11.

Infrasubinfraturma — *Noncorugati* Bharad., 1975

Klausipollenites Jansonius, 1962

Type Species — *Klausipollenites schaubergeri* (Pot. & Kl.) Janson., 1962.

Klausipollenites schaubergeri (Pot. & Kl.) Janson., 1962

Pl. 5, figs. 53-55

Holotype — Pot. & Kl. 1954, pl. 10, figs. 7, 8.

Occurrence — Lab. sample nos. 5, 7, 9.

Infrasubturma — *Definiri* Bharad., 1975
Infraturma — *Fossati* Bharad., 1974
Subinfraturma — *Taeniati* Bharad., 1974
Infrasubinfraturma — *Proximi* Bharad., 1974

2. DISTALAE

Lunatisporites Lesch. 1955 emend. Bharadwaj, 1974

1955 *Taeniaesporites* Lesch., *Schweiz. Paläont. Abh.* 72, p. 58.

1964 *Striatisaccus* Mädler, *Beih. geol. Jb.*, 65, p. 56.

1966 *Taeniaepollenites* Visscher, *Acta bot. neerl.*, 15, p. 360.

Type Species — *Lunatisporites acutus* Lesch., 1955.

Remarks — Scheuring (1970, p. 46) restudied the type material of Leschik (1955) and analysed the organization in *Lunatisporites* and *Taeniaesporites*. Since both are similar in their construction and in the nature of taeniae, the latter genus is considered as the junior synonym of the former. However, this genus as emended by Bharadwaj (1974) includes taeniate-disaccates which possess a biradial tenuitas distally between the sacci, irrespective of the number of taeniae. Morbey (1975) has over-emphasized the importance of the monolete mark and hence his suggestions are not acceptable.

Lunatisporites rhombicus sp. nov.

Pl. 5, figs. 56-62

Holotype — Pl. 5, fig. 59, size 85×54 μ; Slide no. 5/2 (Reg. no. 4670).

Isotype — Pl. 5, figs. 61.

Locus Typicus — Bore hole NCRD-6. Lab. sample no. 5, depth 86 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Diploxylonoid, central body rhomboidal with rounded, narrow lateral ends, 44-48 × 51-60 μ. Proximally 4-6 clear strips (taeniae) with microintrareticulate structure; one of the strips could be half of the body width in length. At times one or more taeniae may get folded. Distal sulcus marked by 6-8 μ wide lunar folds at the saccus bases.

Dimensions: 68-85 μ longer axis, 51-60 μ shorter axis.

Comparison — *Striatopodocarpites pantii* (Jansonius) Balme (1970) now referable to *Lunatisporites* (see Bharadwaj, 1974), as illustrated by Balme (1970, pl. 12, figs. 7-9), superficially resembles this species in organization but it is bigger in size and has more taeniae; *Lunatisporites puntii* Visscher (1966), although similar in having rhomboidal central body, includes bigger pollen with coarser body structure and much wider lunar folds. *Lunatisporites acutus* Leschik emend. Scheuring (1970) possesses subcircular body, more pronounced taeniae and less defined arcuate folds at the saccus base. *Chordasporites raniganjensis* Maheshw. & Ban. (1975) includes some of the similar specimens as included here, with one or two folds on the proximal face. These folds do not represent the true chorda and are simple folds formed by preservational factors, therefore, they have not been given any importance here.

Occurrence — Lab. sample nos. 5, 7, 9, 11, 13.

Lunatisporites diffusus sp. nov.

Pl. 5, fig. 63; Pl. 6, figs. 64-66

Holotype — Pl. 6, fig. 64, size 104×60 μ; Slide no. 9/1 (Reg. no. 4673).

Isotype — Pl. 6, fig. 65.

Locus Typicus — Bore hole NCRD-6, Lab. sample no. 9; depth 215 m, Raniganj Coalfield, India.

Stratum Typicum — Raniganj-Maitur Formations; Permo-Triassic.

Diagnosis — Haploxylonoid, central body diffused, apparently vertically oval. Taeniae 6-8 in number, 4-8 μ wide with narrow irregular clefts. Distal channel defined, apparent by thinner wide area. Sacci laterally widely apart, finely intrareticulate.

Dimensions: 102-160 μ longer axis, 60-92 μ shorter axis.

Comparison — *Lunatisporites rhombicus* sp. nov. has distinctly marked central body. From other species of the genus also, the present species differs in having indistinct central body.

Occurrence — Lab. samples nos. 5, 7, 9, 11, 13.

Subinfraturma — *Ataeniati* Bharad., 1974
Infrasubinfraturma — *Longiquataxi* Bharad., 1974

1. Rugulati

***Rhizomaspora* Wilson, 1962**

Type Species — *Rhizomaspora radiata* Wilson, 1962.

Rhizomaspora sp.

Pl. 6, figs. 74, 75

Description — Disaccate, diploxylonoid, central body subcircular, 40-50 μ in diameter, dense, bearing horizontally oriented reticuloid striation. Exine of the body thick, finely intramicropunctate. Sacci big, more than hemispherical, distally inclined, finely intrareticulate.

Dimensions: 100-110 μ longer axis, 60-80 μ shorter axis.

Remarks — The pollen grains showing reticuloid pattern of striations are very rare in this assemblage.

Occurrence — Lab. sample nos. 5, 9, 11.

***Faunipollenites* Bharad., 1962**

Type Species — *Faunipollenites varius* Bharad., 1962.

Remarks — *Faunipollenites* Bharad. (1962) has been referred to as a synonym of *Protohaploxypinus* by Hart (1964) and Balme (1970), and that of *Striatopiceites* Sedova

(1956) by Kar (1968a) and Venkatachala and Kar (1968a, 1968b). However, the two genera in question are ill-defined and not fully known; on the other hand, *Faunipollenites* is a well established genus which includes haploxylonoid pollen grains with almost ill-defined body, horizontal striations, and a distal sulcus without sharp outlines. The following species have been described *sensu* Bharadwaj (1962).

Faunipollenites varius Bharad., 1962

Pl. 6, fig. 68

Holotype — Bharadwaj, 1962, pl. 18, fig. 230.

Occurrence — Lab. sample nos. 5, 7, 9, 11, 13.

Faunipollenites parvus Tiwari, 1965

Pl. 6, fig. 67

1965 — *Faunipollenites minor* Salujha, *Palaeobotanist*, 13, p. 232, pl. 2, figs. 30-32.

Holotype — Tiwari, 1965, pl. 7, fig. 158.

Remarks — Small grains described as *F. parvus*, are mature grains and show the development of striations, distal channel and intrareticulation. *Faunipollenites perexiguus* Bharad. & Salujha (1965), another small species, can be distinguished from the present one in being subcircular in shape and in having no distinct sulcus.

Occurrence — Lab. sample nos. 5, 7, 9, 11, 13.

Faunipollenites bharadwajii Maheshwari, 1967

Pl. 6, fig. 73

Holotype — Maheshwari, 1967, pl. 8, fig. 63.

Remarks — The species described by Balme (1970) as *Protohaploxypinus microcorpus* is similar to the present one in size range but could be distinguished by its more distinctly seen central body and wider distal channel.

Occurrence — Lab. sample no. 5.

Striatopodocarpites Sedova, 1956

Type Species — *Striatopodocarpites tojmensis* Sedova, 1956.

Remarks — After the important re-investigation of the Leschik's material by Scheuring (1970), it has been established that *Taeniaesporites* is a synonym of *Lunatisporites*. Therefore, *Striatopodocarpites* may not be a synonym of *Lunatisporites* as has been earlier assumed by certain workers (Venkatachala & Kar, 1964; Bose & Maheshwari, 1968).

It has been established now that the striate and taeniate forms represent two separate lines of morphography and therefore, such forms as *Lunatisporites* Lesch. (incl. *Taeniaesporites*) and "*Lunatisporites fuscus*" Bharadwaj (1962, pl. 14, figs. 189-192) should be kept separate. The latter species represents striate group and hence it has been accommodated under a new genus *Crescentipollenites* by Bharadwaj, Tiwari and Kar (1974).

Striatopodocarpites decorus Bharad. & Salujha, 1964

Pl. 6, fig. 70

Holotype — Bharadwaj & Salujha, 1964, pl. 10, fig. 140.

Remarks — Thin, trapezoid nature of central body is the main distinguishing feature of this species.

Occurrence — In all samples studied.

Other species (Not illustrated)

Striatopodocarpites brevis Sinha, 1972
S. labrus Tiwari, 1965
S. magnificus Bharad. & Salujha, 1964
S. rarus Bharadwaj & Salujha, 1964
S. venustus Bharad. & Salujha, 1965

Occurrence — In all samples.

Striatites Pant emend. Bharad., 1962

Type Species — *Striatites sewardii* (Virkki) Pant, 1955.

Striatites varius Kar, 1968

Pl. 6, fig. 69

Holotype — Kar, 1968, pl. 2, fig. 55.

1970 — *Taeniaesporites* sp. cf. *T. transversundatus* Janson., — Balme, *Univ. Kansas Deptt. Geol. Special Publication*, 4, p. 372, pl. 12, figs. 4-6.

Remarks — Balme (1970) has put similar specimens in the species *T. transversundatus* Janson. with which they do not resemble; on the other hand, the Salt Range specimens (Balme, 1970, pl. 12, figs. 4-6) could be well accommodated in *Striatites varius*. Balme's remark (1970) that the genus *Striatites* is an ambiguous genus, does not hold good because a large number of species have been reported to possess microverrucose sculpture on the central body rather than microintrareticulate structure which is a character of the genus *Striatopodocarpites*. Thus, it is desirable to keep these two types of body characters separate.

Occurrence — Lab. sample no. 11.

Striatites levistriatus sp. nov.

Pl. 6, figs. 71-73

Holotype — Pl. 6, fig. 72, size 110×60 μ; Slide no. 5/3 (Reg. no. 4671).

Isotype — Pl. 6, fig. 71.

Locus Typicus — Bore hole NCRD-6, Lab. sample no. 5, depth 86 m; Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Bilateral, diploxylonoid; central body circular, 52-64 μ, dark brown, with 2-3 μ thick equatorial rim, bearing few to many, faint, indeterminate horizontal striations. Sacci spherical, distally 10-16 μ apart forming straight-sided channel. Intrareticulation of sacci fine to medium-sized.

Dimensions: 83-100 μ longer axis, 54-64 μ shorter axis.

Comparison — So far no striate species has been described to possess indeterminate striations. The present species shows few (e.g. 6 is the lowest number counted) to numerous, complete or incomplete, mostly faint and not fully traceable striations.

Occurrence — Lab. sample nos. 5, 7.

Lahirites Bharadwaj, 1962

Type Species — *Lahirites raniganjensis* Bharad., 1962.

Lahirites triassicus sp. nov.

Pl. 7, figs. 77, 78

Holotype — Pl. 7, fig. 78, size 100×60 μ; Slide no. 5/3 (Reg. no. 4671).

Isotype — Pl. 6, fig. 77.

Locus Typicus — Bore hole NCRD-6; Lab. sample no. 5, depth 86 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Diploxylonoid; central body subcircular to horizontally elongate and with flat ends laterally, 62×50 μ in holotype. Striations observed 6-9. Exine finely intramicropunctate. Distal channel 20-30 μ wide, more or less straight sided. Sacci finely intrareticulate with fine meshes and thick muri.

Dimensions: 100-120 μ longer axis, 58-68 μ shor er axis

Comparison — *Lahirites raniganjensis*, the type species (Bharadwaj, 1962), is the only comparable species but has circular body, and horizontal striations with vertical partitions, and hence it is different.

Occurrence — Lab. sample no. 5, 7.

OTHER SPECIES (Not illustrated)

L. raniganjensis — Present in all samples, abundant in sample nos. 11, 13.

L. incertus — Rare to significant in all samples.

L. rarus — Significant in all samples.

Verticipollenites Bharadwaj, 1962

Type Species — *Verticipollenites secretus* Bharad., 1962.

Verticipollenites finitimus Bharad. & Salujha, 1964

Pl. 7, figs. 81, 82

Holotype — Bharad. & Salujha, 1964, pl. 7, fig. 110.

Occurrence — Lab. sample no. 11.

Verticipollenites sp.

Pl. 7, fig. 80

Crescentipollenites Bharadwaj, Tiwari & Kar, 1974

1962 — *Lunatisporites* Lesch., 1955—Bharad., *Palaeobotanist*, 9, p. 93, pl. 14, figs. 189-196; pl. 15, figs. 200-208; pl. 16, figs. 209-217; pl. 17, figs. 218, 219.

Type Species — *Crescentipollenites* (*Lunatisporites*) *fuscus* (Bharad.) Bharad., Tiwari & Kar, 1974.

Remarks — This genus is differentiated from *Striatopodocarpites* in having prominent foldings at the saccus baseline in the body exine, and from *Striatites* and *Lahirites*, apart from the inner folds, in having intrareticulate body structure in place of microverrucose and intrapunctate structure respectively. *Lunatisporites* (incl. *Taeniaesporites*) exhibits irregular taeniae with unevenly broad furrows (sulci-cf. Bharadwaj, 1974) while the present genus shows regularly and uniformly spaced, simple, linear grooves (striations).

Crescentipollenites fuscus (Bharad.) Bharad., Tiwari & Kar, 1974

Pl. 7, fig. 79

1962 — *Lunatisporites fuscus* Bharad., *Palaeobotanist*, 9, p. 93, pl. 14, figs. 189-192.

Holotype — Bharad., 1962, pl. 14, figs. 189, 190.

Occurrence — In all Lab. samples.

Infrasubturma — *Breviquataxi* Bharadwaj, 1974

Platysaccus (Naum.) Pot. & Kl., 1954

Type Species — *Platysaccus papilionis* Pot. & Kl., 1954.

Platysaccus fuscus Goubin, 1965

Pl. 7, figs. 83, 84

Holotype — Goubin, 1965, pl. 3, fig. 83.

Remarks — The present specimens are bigger in size-range than those described by Goubin (1965). In other characters, however, they resemble the latter.

Occurrence — Lab. sample nos. 5, 9.

Alisporites Daugherty emend. Nilsson, 1958

Type Species —*Alisporites opii* Daugherty, 1941.

Alisporites grobus sp. nov.

Pl. 7, figs. 86, 87

Holotype — Pl. 7, fig. 86, size 85×75 μ; Slide no. 7/1 (Reg. no. 4673).

Isotype — Pl. 7, fig. 87.

Locus Typicus — Bore-hole NCRD-6, Lab. sample no. 7, depth 123·50 m, Raniganj Coalfield, India.

Stratum Typicum — Maitur Formation; Lower Triassic.

Diagnosis — Circular to suboval. Central body thin, well-defined, vertically oval with round ends, 75-115×47-74 μ, finely intrareticulate. Distal sulcus ± uniformly, 8-12 μ wide. Sacci less than hemispherical, coarsely intrareticulate with up to 5 μ wide meshes; reticulum sometimes distorted.

Dimensions: 80-128 μ longer axis, 75-115 μ shorter axis.

Comparison — The coarse nature of saccus intrareticulation distinguishes this species from other comparable species of the genus.

Alisporites sp.

Pl. 7, fig. 88

Description — Miospore bilateral, 104×60 μ, central body oval, well-defined, 60×56 μ, distal sulcus wide and well-defined. Sacci less than hemispherical, finely intrareticulate.

Occurrence — Lab. sample nos. 5, 7, 9, 11.

INCERTAE SEDIS

Inaperturopollenites (Thomson & Pflug) Nilsson, 1958

Type Species — *Inaperturopollenites dubius* (Potonié & Venitz, 1934) Thoms. & Pflug., 1953.

Inaperturopollenites nebulosus Balme, 1970

Pl. 7, figs. 89-91

Holotype — Balme 1970; pl. 21, fig. 25.

Description — Circular, alete. Exine thin, psilate to finely scabrate; irregular to ring-like folding along the peripheral region present.

Dimensions: 76-115 μ diameter.

Occurrence — Lab. sample nos. 5, 7, 9, 11.

OTHER MIOSPORE GENERA

Miospore genera *Scheuringipollenites* Tiwari 1973, *Cuneatisporites* (Lesch.) Bharad. and *Pilasporites* (Balme & Henn.) Tiw. & Navale, 1967 have also been generally encountered while counting. In addition to the above taxa, the following genera have been found only in the counting of the Lab. sample no. 13.

Brevitriletes Bharad. & Sriv., 1969
Horriditriletes Bharad. & Sal., 1964
Indospora Bharad., 1962
Cyclobaculisporites Bhard. ex Bharad., 1965
Thymospora Wils. & Venkat., 1963
Latosporites Pot. & Kr., 1954
Vesicaspora Schemel emend. Wils. & Venkat., 1963

MIOFLORA

The sample nos. 5, 7, 9, 11 and 13 yielded good variety of miospores; other samples were barren. Quantitatively, the following miospore genera have been found to be important.

Cyathidites Couper, 1953
Tigrisporites Klaus, 1960
Callumispora Bharad. & Sriv., 1969
Osmundacidites Couper, 1953
Lundbladispora Balme emend. Playf., 1965
Densoisporites Weyl. & Krieg. emend. Dettm., 1963
Indotriradites Tiwari, 1964
Latosporites Pot. & Kr., 1954
Playfordiaspora Maheshw. & Ban., 1975
Klausipollenites Jansonius, 1962
Alisporites Daugherty emend. Nilsson, 1958
Faunipollenites Bharad., 1962
Striatites Pant emend. Bharad., 1962
Striatopodocarpites Sedova, 1956
Lahirites Bharad., 1962
Verticipollenites Bharad., 1962
Lunatisporites Lesch. emend. Bharad., 1974
Crescentipollenites Bharad., Tiwari & Kar, 1974
Inaperturopollenites (Thomson & Pflug) Nilsson, 1958

Following genera, although rare and inconsistent in occurrence, have also been found in these samples:

Brevitriletes Bharad. & Sriv., 1969
Horriditriletes Bharad. & Sal., 1964
Verrucosisporites Ibr., 1933 emend. Smith *et al.*, 1964
Lophotriletes (Naum.) Pot. & Kr., 1954
Lycopodiumsporites (Thierg.) ex Delc. & Sprum., 1955
Lycospora S. W. & B. emend. Pot. & Kr., 1954
Densipollenites Bharad., 1962
Platysaccus Pot. & Kl., 1954
Rhizomaspora Wils., 1962
Weylandites Bharad. & Sriv., 1969a
Indospora Bharad., 1962
Thymospora Wilson & Venkat., 1963
Scheuringipollenites Tiw., 1973
Cuneatisporites Lesch., 1955
Pilasporites Balme & Henn. emend. Tiwari & Navale, 1967
Vesicaspora Schem. emend. Wils. & Venkat., 1963

Quantitative Analysis

Histogram 1 has been prepared to depict the distributional pattern of important genera in these samples in the bore hole NCRD-6. The percentage frequencies have been determined after counting two hundred specimens per sample.

A perusal of the Histogram 1 and Table 2 indicates that the mioflora is divisible into three assemblages, namely Assemblage I, II and III.

Assemblage I: (Sample 5, depth from the surface 86 m; Sample 7, depth from the surface 123·5 m)

Miospore genera:

Dominant — *Lundbladispora/Striatopodocarpites*.

Subdominant — *Densoisporites*, *Faunipollenites*.

Significant — *Playfordiaspora*, *Lunatisporites*, *Crescentipollenites*, *Klausipollenites*, *Callumispora*.

Other genera are insignificant or inconsistent in occurrence.

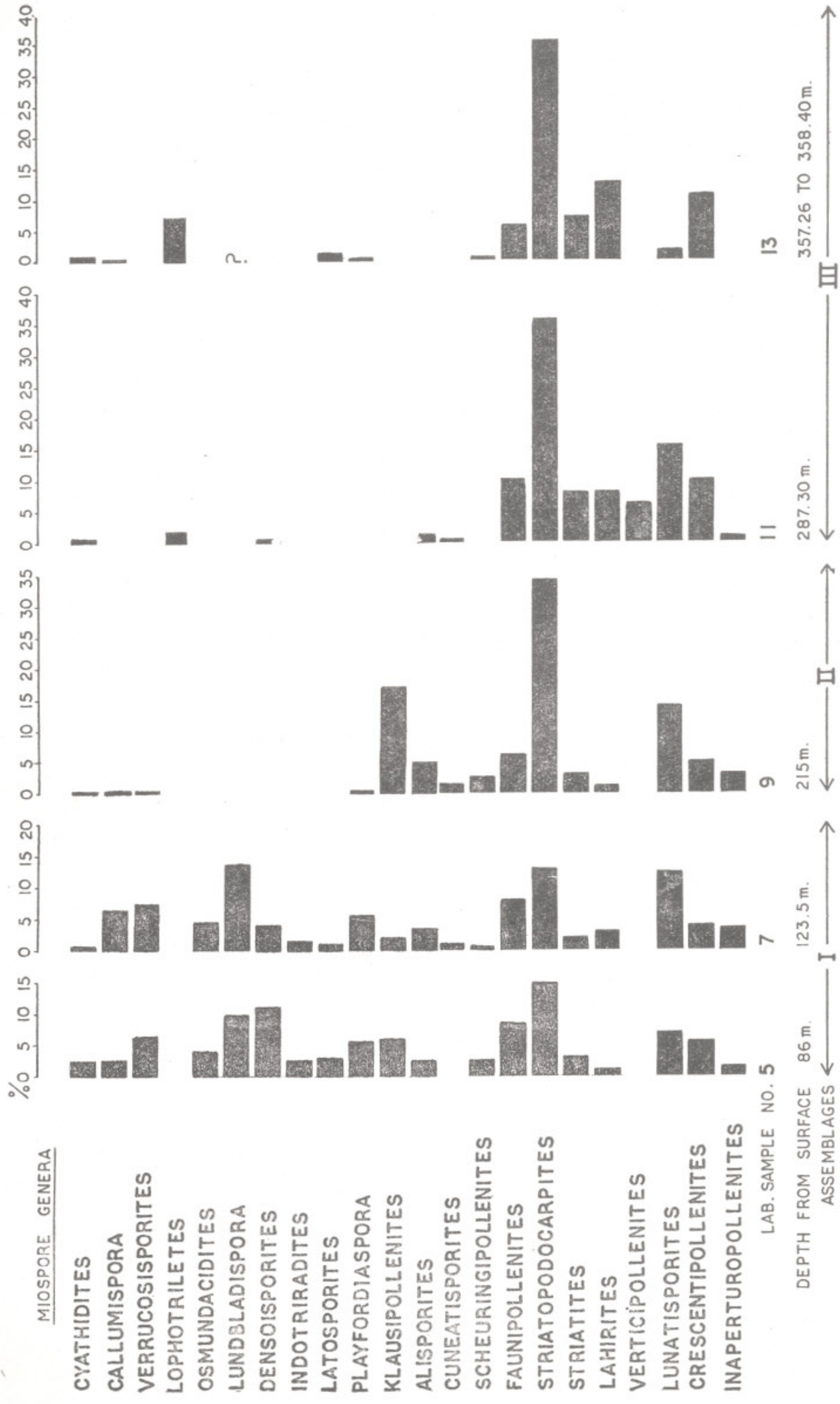
Assemblage II: (Sample 9, depth from the surface 215 m)

Miospore genera:

Dominant — *Striatopodocarpites*.

Subdominant — *Klausipollenites*.

Significant — *Lunatisporites*, *Faunipollenites*, *Lahirites*, *Crescentipollenites*, *Alisporites*.



HISTOGRAM 1 — Percentage frequencies of important miospore genera found in the yielding samples of the Borehole NCRD-6.

TABLE 2 — SHOWING THE PERCENTAGE DISTRIBUTION OF MIOSPORE GENERA IN 5 SAMPLES OF B.H. NCRD-6 UNDER STUDY

SAMPLE NOS. / MIOSPORE GENERA	5	7	9	11	13
1. *Cyathidites*	2·0	1·0	0·5	1·0	1.0
2. *Tigrisporites*	0·5	—	—	—	—
3. *Callumispora*	2·5	6·5	0·5	—	0·5
4. *Verrucosisporites*	4·0	4·0	0·5	—	1·5
5. *Brevitriletes*	—	—	—	—	1·5
6. *Lophotriletes*	—	—	—	2·0	7·0
7. *Horriditriletes*	—	—	—	—	3·5
8. *Indospora*	—	—	—	—	0·5
9. *Osmundacidites*	4·0	4·5	—	—	—
10. *Lycopodiumsporites*	0·5	—	—	—	—
11. *Lundbladispora*	12·0	18·0	—	—	0·5
12. *Lycospora*	—	0·5	—	—	—
13. *Densoisporites*	11·0	4·0	—	0·5	—
14. *Indotriradites*	2·0	1·5	—	—	—
15. *Thymospora*	—	—	—	—	2·0
16. *Latosporites*	3·0	1·0	—	—	1·5
17. *Playfordiaspora*	5·5	5·5	0·5	—	0·5
18. *Densipollenites*	—	—	0·5	0·5	—
19. *Platysaccus*	0·5	—	4·0	—	—
20. *Klausipollenites*	6·0	2·0	16·5	—	—
21. *Alisporites*	2·0	3·5	5·0	1·0	—
22. *Vesicaspora*	—	—	—	—	8·0
23. *Scheuringipollenites*	2·5	0·5	2·5	—	0·5
24. *Cuneatisporites*	—	1·0	1·5	0·5	—
25. *Rhizomaspora*	—	—	2·0	—	—
26. *Faunipollenites*	8·5	8·0	6·0	10·0	5·5
27. *Striatopodocarpites*	15·0	13·0	34·0	35·5	35·0
28. *Striatites*	3·0	2·0	3·0	8·0	7·0
29. *Lahirites*	1·0	3·0	1·0	8·0	12·0
30. *Verticipollenites*	—	—	—	6·0	—
31. *Lunatisporites*	7·0	12·5	14·0	15·5	1·5
32. *Crescentipollenites*	5·5	4·0	5·0	10·0	10·5
33. *Weylandites*	—	—	—	0·5	—
34. *Inaperturopollenites*	1·5	3·5	3·0	1·0	—
35. *Pilasporites*	0·5	0·5	—	—	—

Other genera are rare or absent, as seen in the Histogram 1.

Assemblage III: (Sample 11, depth from the surface 287·30 m; Sample 13, 357·26-358·40 m).

Miospore genera:

Dominant — *Striatopodocarpites*.
Subdominant — *Crescentipollenites*
Significant — *Faunipollenites*, *Striatites*, *Lahirites*, *Verticipollenites*.

Other genera are rare or absent as seen in the Histogram 1. The following rare genera are restricted to Lab. sample no. 13. *Brevitriletes*, *Horriditriletes*, *Indospora*, *Cyclobaculisporites*, *Thymospora*, *Latosporites* and *Vesicaspora*.

Stratigraphically, Assemblage III is the oldest, Assemblage II represents the middle and Assemblage I is the youngest in the present sequence. In general components, Assemblage III and II are close to each other because of the dominance of the striate-disaccate genera in them. However, they differ also in the subdominant occurrences of *Crescentipollenites* or *Klausipollenites* respectively. Between Assemblages II and I, the latter shows marked differences due to the significant presence of triletes, monoletes and monosaccate genera in it. Thus, as evidenced from this analysis (Histogram 1), it is clear that Assemblages I and III are the two major assemblages, Assemblage II being transitory between the two.

MIOFLORISTIC COMPARISON

The palynological investigations of the Raniganj Stage (Upper Permian) have been carried out by a number of workers while such studies of the Triassic mioflora are relatively fewer at hand. Following are the important publications to be considered here:

1. *Triassic Palynology* — Shrivastava and Pawde (1962); Chandra and Satsangi (1965); Satsangi, Chandra and Singh (1968, 1972); Bharadwaj and Srivastava (1969b); Balme (1970); Kar (1970, 1970a); Sarbadhikari (1972); Maheshwari and Banerji (1975).
2. *Raniganj Palynology* — Bharadwaj (1962, 1966, 1971); Bharadwaj and Salujha (1965); Salujha (1965); Kar (1968a); Navale and Srivastava (1972).

The mioflora of Raniganj Stage is well established (*loc. cit.*). A survey of literature reveals that the following genera are the important constituents of Raniganj assemblage, in general:

Striatopodocarpites, *Faunipollenites*, *Crescentipollenites*, *Striatites*, *Lahirites*, *Verticipollenites*, *Scheuringipollenites*, *Horriditriletes*, *Cyclogranisporites*, *Indospora*, *Thymospora*, *Densipollenites*.

Group-wise occurrence of miospore genera suggests that the striate pollen grains form an absolute majority while triletes are relatively less common. The Assemblage III of the present investigation shows close affiliation with Raniganj mioflora in the high incidence of the striate-disaccate genera. There are, however, some differences in the decline of the trilete forms in the comparable assemblage (i.e. Assemblage III) presently described. This is apparently so because the more commonly known Raniganj mioflora is from the Lower and Middle Raniganj Formation, the uppermost beds being still lesser known. Presumably in the latter, due to the onset of a change in the climatic conditions, the triletes declined considerably and only the striate-saccate genera dominated. As such, sample 13 represents the upper coal of the Raniganj Stage in the Dishergarh-Asansol region, and the general pattern clearly establishes the relationship between the Raniganj mioflora and that in the Assemblage III of the present work.

As regards the Triassic palynology, Shrivastava and Pawde (1962) made a palynological study of the core samples from the Bore hole no. R.O. 1(B), Ondal, (about 30 km east of Asansol) in the West Raniganj Coalfield. The mioflora, when reduced and adjusted to the taxonomy adopted here on the basis of descriptions and photographs given by Shrivastava and Pawde (1962, pls. 11-16), appears to contain the following genera as important elements.

Alisporites, Lunatisporites, Striatopodocarpites, Faunipollenites, Crescentipollenites, Klausipollenites, Verticipollenites, Densoisporites, Indotriradites, Lundbladispora and Apiculate triletes and others.

It is obvious that qualitatively the mioflora found in Bore hole R.O. 1(B) shows affinities with the present Panchet assemblage (i.e. Assemblage I). However, quantitatively this is different in having more of trilete spores than the disaccates. Shrivastava and Pawde (1962, p. 382) opine that " the assemblage (b-ii) between 896-1,145 ft though marked with few gymnospermous pollen types, is seen to dominate in the 'pteridophytic' spores, and may well represent the beginning of a new era ".

Although we are not in a position to break up the percentage of various disaccate genera of Shrivastava and Pawde's (1962) analysis, it is evident that the assemblage is not akin to the Assemblage I of the present bore hole. On the other hand, it seems to be younger to our Assemblage I because of the considerable decline of the striate-disaccates and significant prominence of the triletes.

Kar (1970a, 1970b) has analysed certain surface (?) as well as subsurface samples from the Raniganj Coalfield, and has attempted to fix a palynological boundary between the Raniganj and Panchet formation. A critical analysis of these data, however, reveals that there are some apparent qualitative differences between the Panchet mioflora of the present investigations and that described by Kar (*loc. cit*). This apparent divergence, however, is due to the difference in the taxonomic approaches of the two works under discussion. For example — *Divaripunctites* Kar (1970a) includes forms like *Callumispora* (Kar, 1970a; pl. 1, figs. 6, 7) and *Decisporis* Kar (1970a) obviously contains a number of forms already known as *Densoisporites* and *Indotriradites*. By reduction and adjustment of the taxonomic units described by Kar (1970), on the lines followed in the present paper, it could be concluded that the Panchet mioflora described by Kar (1970a, 1970b) is constituted by the following miospore genera.

Leiotriletes, Verrucosisporites, Callumispora, Lundbladispora, Densoisporites, Indotriradites, Osmundacidites, Klausipollenites, Faunipollenites, Striatopodocarpites, Lunatisporites, Verticipollenites, and Aletes and other rare forms.

According to Kar (1970a, 1970b) the triletes constitute about three fourth of the population while striate-disaccates are only 15 to 20 per cent. Obviously this mioflora does not correspond quantitatively with our Assemblage I but does indicate a qualitative similarity except for the frequency of striate-disaccates which is reduced. Thus, the trend of reduction in the striate-disaccates clearly evidences that the RE-9 mioflora designated as the Lower Panchet by Kar (1970a, 1970b), represents a younger position with respect to the Assemblage I of the present work.

Sarbadhikari (1972) has also described Raniganj/Panchet mioflora from a G.S.I. Bore-hole RE-1 in the eastern part of Raniganj Coalfield. This bore-hole is also located within a mile to the east of bore-hole RE-9, worked out by Kar (1970, 1970a). According to Sarbadhikari (*loc. cit.*) also, in Raniganj assemblage nearly eighty per cent of the miospore population is made up of striate-disaccate pollen, while in the Panchet "mostly it consists of triletes and negligible striate-disaccates". These observations, as expected, are in agreement with those reported by Kar from the nearby bore hole. The break-ups of the genera illustrated by Sarbadhikari (1972, pls. 1-3) on the line of taxonomy followed in the present work also coincide with that given above for Kar's mioflora, in general. The Panchet flora of the bore-hole RE-9, therefore, does not compare with that in the present bore-core, and indicates a younger stratigraphic position for it.

Satsangi, Chandra and Singh (1968, 1972) have described the distribution of spores in the khaki-green shales of the Panchet group, immediately overlying the Raniganj Formation in the Nonia Nala section in the Raniganj Coalfield. According to these workers, only the following genera continue to occur in the Lower Triassic in relation to the Raniganj mioflora:

Striatites, *Hindipollenites*, *Striatopodocarpites*, *Crescentipollenites*, *Faunipollenites*, *Distriatites*, *Leiotriletes*, *Retusotriletes*, *Microbaculispora*, *Lycopodiumsporites*, *Cyclogranisporites*, *Acanthotriletes*, and *Lophotriletes*.

Although, neither the quanti ative analysis nor the detailed taxonomy of this assemblage was done by these workers, their statement, "the abundance of disaccate forms", and "poverty of pteridophytic spores" as characteristic feature of the Lower Triassic mioflora (Satsangi, Chandra & Singh, 1972, p. 104), is significant. This observation corresponds, in general, with our findings for zone II and differs from those of Shrivastava and Pawde (1962), Kar (1970) and Sarbadhikari (1972) who maintain the abundance of pteridophytic spores to be characteristic in the Lower Triassic.

Banerji and Maheshwari (1974) and Maheshwari and Banerji (1975) have worked out the Raniganj/Panchet succession in the Nonia Nala section near Asansol, East Raniganj Coalfield, W. Bengal. In the gradual decrease of the disaccate-striate genera from Raniganj through Lower Panchet, the Nonia Nala miospore succession resembles the results of the present study. The arrivals of the genera like *Callumispora*, *Lunatisporites*, *Verrucosisporites*, and the non-striate disaccate genera in significant quantities in the younger sequence of the Nonia Nala, is in correspondence with the trend observed in the bore hole NCRD-6, and hence, the conclusion that the mioflora between Raniganj-Lower Panchet boundary changed gradually has been supported.

Balme (1970) has described the Permo-Triassic palynological assemblages from the Salt Range, W. Punjab (Pakistan). According to him, the uppermost Permian in this region contains striate-disaccate pollen grains in dominance along with non-striate disaccates, non-saccates and others. In the early Triassic spores assemblages, a great decline in the diversity of the Late Permian assemblages has been noticed. Apart from *Lunatisporites* (=*Taeniaesporites*), disaccate pollen grains are quantitatively unimportant components of the early Triassic spore assemblage of the Salt Range. A detailed comparison, however, suggests that the older Lower Triassic mioflora compares well with the Assemblage I of the present work in the occurrence of *Densoisporites*, *Lundbladispora*, and the taeniate-disaccate genera. The simple striate genera are more in kind in the presently described Assemblage I, but the general trend of occurrence appears to be closely resembling. The conclusion that the younger part of the Lower Triassic (Scythian) showing an increase in the trilete forms and a negligible occurrence of the striate (Taeniate) disaccate genera (Balme, 1970, p. 443, fig. 21) is in agreement with the findings from the Panchets of Ondal area as discussed above.

DISCUSSION

PALYNOSTRATIGRAPHY

The detailed comparisons, as given above, suggest that there exists a controversy about the palynological transitions between the Raniganj and the Panchet. Some data reveal that the striate-disaccate genera drastically decline in the Panchets (Shrivastava & Pawde, 1962; Kar, 1970a, 1970b; Sarbadhikari, 1972), while others indicate that the striate-disaccate genera continue to flourish in the Panchets with, of course, the significant incoming of the triletes (Satsangi, Chandra & Singh, 1968, 1972; Maheshwari & Banerji, 1975, and the present work).

Our findings, when co-ordinated with the geological observations, indicate that the above mentioned controversy is not a *controversy* in the real sense. The present mioflora comprising Assemblages III, II and I, passes in a gradual manner from the dominance of the striate-saccates in Raniganj to the striate-saccates+triletes combination of the Panchets. The apparent controversy is only due to the two areas in the Raniganj Coalfield, where from the data have been available, being different.

First area is in the region of Ondal (Southeastward of the Asansol region) from where the data by Shrivastava and Pawde (1962), Kar (1970a, 1970b) and Sarbadhikari (1972) have been collected. The second area is in Asansol region from where the present work (Dishergarh Block) as well as that by Satsangi *et al.* (1968, 1972; Maheshwari & Banerji, 1975; Nonia Nala) has been done.

Stratigraphically, these two regions of the Raniganj Panchet transition are not similar. Gee (1932) has opined that the Lower Panchets are well-developed in and around the Nonia Nala to the west and north-west of Asansol; farther south-west these lower strata crop out to the north of Damodar river (near the region where the present bore hole NCRD-6 has been drilled). On the contrary, the Panchet areas in the vicinity of Ondal (near the region where Shrivastava & Pawde, 1962; Kar, 1970; and Sarbadhikari, 1972 have worked) show rocks of Upper Raniganj age immediately below the strata of Upper Panchet. He (Gee, 1932) further points out that probably the upper most Raniganj are also missing in the Ondal area. Thus, the observations by Gee indicate an overlap of the Upper Panchet strata on to the Raniganj beds in Ondal area, whereas there exists a continuity of deposition from Raniganj into Panchets in the Asansol area.

This conclusion is now supported by our palynological findings. The above mentioned "controversy" can thus be straightened out in the following way.

The Nidpur mioflora described by Bharadwaj and Srivastava (1969) contains more of nonstriate-disaccate genera, e.g. *Satsangisaccites*, *Scheuringipollenites*, and forms like *Weylandites*, *Densipollenites*, etc. Moreover, the trilete genera like *Lundbladispora*, *Densoisporites*, *Osmundacidites*, *Indotriradites*, etc. are also not represented in the Nidpur mioflora. A comparison in the light of present researches, therefore, indicates that the Nidpur Triassic mioflora is younger to the Panchet mioflora from Asansol and Ondal area, in age.

Miofloristics

The important miospore genera, which constitute the dominant percentage in the Lower Triassic mioflora, show a distinctive pattern of distribution when compared with their occurrence in the older formations. Thus, the genera *Tigrisporites*, *Osmundacidites*, *Lundbladispora*, *Densoisporites*, *Playfordiaspora*, *Klausipollenites*, *Alisporites*, *Lunatisporites* and *Weylandites* are more or less unreported from the Lower Gondwana formations and, in general, they appear for the first time in the Lower Triassic, some of them in considerably good numbers.

Genus *Callumispora* is dominant in the Karharbari Stage. It becomes sporadic in the Barakar, Barren Measure and Raniganj stages, to become significant again in the Lower Triassic. Similarly, *Indotriradites* has been reported from the Barakar and Triassic miofloras only, although sporadic incidences are recorded from other stages also.

The disaccate genera bearing horizontal striations on the central body are characteristically dominating the miofloras of Upper Barakar to Raniganj Stage. This trend is arrested in the Lower Triassic miofloras as it has been seen in the above account.

	Asansol Region	*Ondal Region*
Upper Panchet		Triletes in dominance, striate-disaccates rare
Lower Panchet	Striate-disaccates + Triletes (new elements) ± equal	Unconformity
Upper Raniganj	Striate-disaccates in dominance, Triletes rare	Striate-disaccates in dominance, Triletes rare

Among other sporadically occurring miospores recorded in the Triassic mioflora, *Verrucosisporites* is significant in the Barakar-Raniganj miofloras, rare in the onset of Triassic but increases again to become significant. The genus *Densipollenites,* a rare form in Triassic, has been reported to be significantly prominent in the Barren Measure miofloras and quite common in the Raniganj miofloras. The extremely rare forms of the Triassic, e.g. *Platysaccus, Rhizomaspora, Parasaccites, Scheuringipollenites*, and *Cuneatisporites* are, in general, subdominant to rare but consistent genera of the Barakar Stage, although they are reported from other stages also. Their negligible occurrence in the Lower Triassic is suggestive of their phase of disappearing incidence.

This brief account, thus evidences that there is a set of genera in Triletes which appears for the first time after the close of the Lower Gondwana depositions. At the same time the striate-disaccates arrest their trend of dominance which is well established right from the Barakar Stage. The recurrence of the genus *Callumispora* as well as the beginning of the taeniate genera in the Lower Triassic mioflora is of great significance for the miofloristics of the Permo-Triassic in India.

CONCLUSIONS

The palynological analysis of a bore core (B.H. no. NCRD-6) in the Dishergarh-Asansol region has revealed the occurrence of three assemblages. The oldest assemblage (Assemblage III) found in typically Permian lithology, contains dominant striate-disaccate miospore genera. The assemblage II, median in position and found in the Panchet shales, contains besides the dominant striate-disaccate genera, significant percentage of *Klausipollenites.* The youngest mioflora in the Assemblage I shows a characteristic change in having new trilete elements like *Lundbladispora, Densoisporites* and a monosaccate genus *Playfordiaspora,* alongwith more or less equal representation of the striate-disaccate pollen genera. As evident from Histogram-1, Assemblage II depicts the transition between the Raniganj (Assemblage III) and the older Panchet (Assemblage I) to be continuous and smooth. However, the trend of increasing triletes evident in Assemblage I is carried farther in the still younger Panchet deposits palynographed from Ondal area where triletes become abundant as compared to much less striate-disaccates.

Palynologically, it is now clearly evidenced that the mioflora of Raniganj (Upper Permian) is quite distinguishable from that of the Lower Panchets (Lower Triassic) due to incoming of the new trilete miospore organizations as well as their increasing representation and the downward trend of the striate-disaccate genera in the latter. However, as believed so far, our findings do not support the contention of a drastic floral change at this point. On the contrary floristic change-over was gradual and at the same time positive. The continuity of striate-disaccate prominence gives an older aspect (i.e. Permian-affinity) to the lower part of the Panchets while at the same time the younger aspect (i.e. Triassic-affinity) is well established by the distinctive trilete miospore elements.

It is further concluded that the Panchet in the Dishergarh-Asansol region almost conformably overlies the Upper Raniganj Formation, while it is not so in the Ondal Region — farther east of Asansol, where the Upper Panchet overlies the Upper Raniganj suggesting an unconformity between the two horizons.

REFERENCES

BALME, B. E. (1963). Plant microfossils from the Lower Triassic of Western Australia. *Palaeontology.* **6** (1): 12-40.

IDEM (1970). Palynology of Permian and Triassic strata in the Salt Range and Surghar Range, West Pakistan. *Strat. Bound. Problems Perm. Trias. W. Pakistan. Uni. Kansas Deptt. of Geol. Special Publ.* **4**: 306-453.

BALME, B. E. & HENNELLY, J. P. F. (1956). Trilete sporomorphs from Australian Permian sediments. *Aust. J. Bot.* **4** (3): 240-260.

BANERJI, J. & MAHESHWARI, H. K. (1974). Palynology of the Panchet Group exposed in the Nonia Nala, near Asansol, West Bengal. *Palaeobotanist.* **21** (3): 368-372.

BHARADWAJ, D. C. (1962). The miospore genera in the coals of Raniganj Stage (Upper Permian), India. *Ibid.* **9** (1-2): 68-106.

IDEM (1966). Distribution of spores and pollen grains dispersed in the L. Gondwana formations of India. *Symp. Floristics Stratigr. Gondwd.*, Birbal Sahni Inst. Palaeobotany 1964: 69-84.

IDEM (1971). Permian palyno-stratigraphy in India. *Proc. 3rd Internat. Palynol. Confr. Novosibrisk*, 1974; Palynology of Proterophyte and Palaeophyte.: 125-129.

IDEM (1974). On the classification of gymnospermous sporae dispersae. Birbal Sahni Inst. Palaeobotany. *Spl.. Pub.* **4**: 7-52.

IDEM (1975). Classification for sporae dispersae. *Geophytology.* **5** (1): 81-91.

BHARADWAJ, D. C. & SALUJHA, S. K. (1964). A sporological study of seam VIII in Raniganj Coalfield, Bihar (India)-Part **1**. Description of sporae dispersae. *Palaeobotanist.* **12** (2): 181-215.

IDEM (1965). Sporological study of seam VIII in East Raniganj Coalfield, Bihar, India — Part **2**. Distribution of sporae dispersae and correlation. *Ibid.* **13** (1): 57-73.

BHARADWAJ, D. C. & SRIVASTAVA, SHYAM C. (1969a). A Triassic mioflora from India. *Palaeontographica.* **125** (B): 119-149.

BHARADWAJ, D. C. & SRIVASTAVA, SURESH C. (1969b). Some new miospores from Barakar Stage, Lower Gondwana India. *Palaeobotanist.* **17** (2): 220-229.

BHARADWAJ, D. C., TIWARI, R. S. & KAR, R. K. (1974). *Crescentipollenites* gen. nov.— a new name for the hitherto known *Lunatisporites* Leschik (1955) from the Lower Gondwanas. *Geophytology.* **4** (2): 141-146.

BHARADWAJ, D. C. & VARMA, C. P. (1974). On the genus *Punctatisporites* Ibrahim, 1933. *Ibid.* **4** (1): 106-108.

BLANFORD, W. T. (1861). On the geological structure and relations of the Raniganj Coalfield Bengal. *Mem. geol. Surv. India.* **3** (1): 1-195.

BOSE, M. N. & MAHESHWARI, H. K. (1968). Palaeozoic sporae dispersae from Congo. VII. Coal measure near Lake Tanganyika South of Albertville. *Annls Mus. r. Afr. cent. Sér.* 8° **60**: 1-116.

CHANDRA, A. & SATSANGI, P. P. (1965). Microflora from the *Dicroidium* bearing beds of Sidhi District, Madhya Pradesh. *Curr. Sci.* **34** (1): 459-460.

COTTER, G. DE P. (1917). Revision of the Gondwana system. *Rec. geol. Surv. India.* **43**: 23-33.

COUPER, R. A. (1953). Upper Mesozoic and Cainozoic spores and pollen grains from New Zealand. *N.Z. geol. Surv. Paleont. Bull.* **22**: 1-77.

FEISTMANTEL, O. (1876). Notes on the age of some fossil Floras of India. III. Flora and probable age of the Panchet Group. *Rec. geol. Surv. India.* **9**: 65-67.

IDEM (1882). Fossil flora of Gondwana System of India. The Fossil Flora of South Rewa Gondwana Basin. *Mem. geol. Surv. India Palaeont. Indica.* **4** (1): 1-52.

IDEM (1886). The fossil flora of the Gondwana system, IV (2). The fossil flora of some of the coalfields in western Bengal. *Ibid. Ser.* 12, **4** (2): 1-71.

GEE, E. R. (1932). The geology and coal resources of the Raniganj Coalfield. *Mem. geol. Surv. India.* **61**: 40-59.

GOUBIN, N. (1965). Description et répartition des principaux Pollenites Permiens Triassiques et Jurassiques des sondages du bassin de Marondava (Madagascar). *Rev. Inst. Franc. Petrole.* **20**: 1415-1461.

HART, G. F. (1964). A review of the classification and distribution of the Permian miospore: Disaccate striatiti. *C.R. 5th Internat. Congr. Carbonif. Stratigr. Geol.* **3**: 1171-1199.

KAR, R. K. (1968a). Palynology of the North Karanpura Basin, Bihar, India-3. Raniganj exposure near Lungatoo, Hazaribagh District. *Palaeobotanist.* **16** (3): 273-282.

IDEM (1968b). Palynology of the Barren Measures sequence from Jharia Coalfield, Bihar, India-2. General Palynology. *Ibid.* **16** (2): 115-140.

IDEM (1970a). Palynological distinction between Upper Permian and Lower Triassic in Raniganj Coalfield, Bengal, India. *Ibid.* **18** (2): 118-126.

IDEM (1970b). Sporae dispersae from Panchet (Lower Triassic) in the bore-core No. RE9. Raniganj Coalfield, West Bengal. *Ibid.* **18** (1): 50-62.

LESCHIK, G. (1955). Die Keuperflora von Neuewelt bei Basel. II. Die Iso-und Mikrosporen. *Schweiz. Palaeont. Abh.* **72**: 1-70.

MÄDLER, K. (1964). Die geologische Verbreitung von Sporen und Pollen in der deutschen Trias. *Beih. geol. Jb.* **65**: 147.

MAHESHWARI, H. K. & BANERJI, J. (1975). Lower Triassic palynomorphs from the Maitur Formation, West Bengal, India. *Palaeontographica.* **152** (B): 149-190.

MORBEY, S. J. (1975). The palynostratigraphy of the Rhaetian Stage, Upper Triassic in the Kendelbachgraben, Austria. *Ibid.* **152** (B): 1-75.

NAVALE, G. K. B. & SRIVASTAVA, S. C. (1972). A microscopic study of some Raniganj coals. *Palaeobotanist.* **19** (3): 263-269.

OLDHAM, T. (1860). Geological relations and probable age of several systems of rocks in Central India and Bengal. *Mem. geol. Surv. India.* **2**: 299-355.

IDEM (1893). A manual of Geology of India and Burma. *Geol. Surv. India, 2nd Edn.*: 1-208.

POTONIÉ, R. & KREMP, G. (1954). Die Gattungen der paläeozoichen Sporae dispersae und ihre Stratigraphie. *Geol. Jb.* **69**: 111-194.

REINHARDT, P. & SCHMITZ, W. (1965). Zür Kenntnis der Sporae dispersae des mitteldeutschen oberen Buntsandsteins. *Freiberger ForschHft.* C. **182**: 19-26.

SALUJHA, S. K. (1965). Miospore assemblage of seam IX of East Raniganj Coalfield (India). *Palaeobotanist.* **13** (3): 227-238.

SARBADHIKARI, T. R. (1972). Gondwana miospores from a Borehole in the Raniganj Coalfield, India. *Bull. geol. Min. metall. Soc. India.* **45**: 1-26.

SATSANGI, P. P., CHANDRA, A. & SINGH, G. (1968). Sporological analysis of the Panchet Series and its bearing on the Permian-Triassic transition. *Curr. Sci.* **37** (4): 116-117.

IDEM (1972). Sporological analysis of Panchet Series, Raniganj Coalfield and its bearing on Permo-Triassic transition. *Rec. geol. Surv. India.* **99** (2): 101-108.

SCHEURING, B. W. (1970). Palynologische und palynostratigraphische Untersuchungen des Keupers im Bölchentunnel (Solothurner Jura). *Schweiz. palaont. Abh.* **88**: 1-121.

SEDOVA, M. A. (1956). The definition of four genera of Disaccate striatiti. *Palynologic Translations.* **1**: 1-10 G. F. Hart, Sheffield.

SHRIVASTAVA, R. N. & PAWDE, M. B. (1962). Palynological study of Borehole R.O.I. (B) Ondal, West Bengal. *Rec. geol. Surv. India.* **91** (2): 369-384.

SITHOLEY, R. V. (1943). Plant remains from the Triassic of the Salt Range in the Punjab. *Proc. natn. Acad. Sci. India.* **13**: 300-327.

IDEM (1951). On the occurrence of two winged pollen in the Triassic rocks of the Salt Range Punjab. *Curr. Sci.* **20**: 266.

TRIPATHI, C. & SATSANGI, P. P. (1963). *Lystrosaurus* fauna of the Panchet Series of the Raniganj Coalfield. *Mem. geol. Surv. India.* **37**: 1-52.

TIWARI, R. S. (1964). New Miospore genera in the coals of Barakar Stage (Lower Gondwana) of India. *Palaeobotanist.* **13** (1): 250-259.

IDEM (1965). Miospore assemblage in some coals of Barakar Stage (Lower Gondwana) of India. *Ibid.* **13** (2): 168-214.

IDEM (1973). *Scheuringipollenites*, a new name for the Gondwana sporomorphs so far assigned to "*Sulcatisporites* LESCHIK, 1955". *Senckenberg. leth.* **54** (1): 105-117.

TIWARI, R. S. & NAVALE, G. K. B. (1967). Pollen and spore assemblage in some coals of Brazil. *Pollen spores.* **9** (3): 583-605.

VENKATACHALA, B. S. & KAR, R. K. (1964). Nomenclatural notes on *Striatopodocarpites* Sedova, 1956. *Palaeobotanist.* **12** (3): 313-314.

IDEM (1968a). Palynology of the Kathwai shales, Salt Range; West Pakistan-1. Shales 25 ft above the Talchir Boulder Bed. *Ibid.* **16** (2): 156-166.

IDEM (1968b). Palynology of the North Karanpura Basin, Bihar, India-2. Barakar exposures near Lungatoo, Hazaribagh District. *Ibid.* **16**: 258-269.

VISSCHER, H. (1966). Palaeobotany of the Mesophytic-3. Plant microfossils from the Upper Bunter of Hengelo, the Netherlands. *Acta bot. neerl.* **15**: 316-375.

VREDENBURG, E. (1910). Summary of the Geology of India. 2nd Edn. Calcutta.

EXPLANATION OF PLATES

PLATE 1

(All figures, unless otherwise stated, are × 500)

1-5. *Lundbladispora* sp. cf. *L. brevicula* Balme, 1963. Slide nos. B.S.I.P. 4674-6, 4675-2, 4670-8 (× 750), 4676-1 (Prox.), 4676-1 (Dist.).

6-8. *Lundbladispora densispinosa* sp. nov. Slide nos. B.S.I.P. 4670-9; 4671-7 (Prox.), 4671-7 (Dist.).

9-11. *Lundbladispora microconata* sp. nov. Slide nos. B.S.I.P. 4675-3, 4673-11 (Holotype), 4675-1.

12-15. *Densoisporites playfordii* (Balme) Dettm. 1963. Slide nos. B.S.I.P. 4673-13, 4671-10, 4670-7, 4670-7 (× 1000).

PLATE 2

16. *Densoisporites* sp. Slide no. B.S.I.P. 4673-14.

17-21. *Densoisporites contactus* sp. nov. Slide nos. B.S.I.P. 4671-15, 4674-2, 4671-12 (Holotype), 4671-19; 4671-16.

22-26. *Indotriradites mamillatus* sp. nov. Slide nos. B.S.I.P. 4673-15, 4669-1 (Holotype), 4669-1 (× 1000), 4674-8, 4674-10.

27, 28. *Tigrisporites* sp. Slide nos. B.S.I.P. 4671-14, 4670-5.

29. *Lophotriletes minimus* Sal., 1965. Slide no. B.S.I.P. 4679-4.

30. *Cyathidites australis* Coup., 1953. Slide no. B.S.I.P. 4670-6.

31, 32. *Verrucosisporites triassicus* sp. nov. Slide nos. 4671-6 (Holotype), 4673-7.

PLATE 3

33-35. *Verrucosisporites densus* sp. nov. Slide nos. B.S.I.P. 4669-3 (Holotype), 4669-3 (× 1000), 4670-2.

36. Cf. *Lycopodiumsporites* sp. Slide no. B.S.I.P. 4671-2.

37, 38. *Lundbladispora baculata* sp. nov. Slide nos. B.S.I.P. 4671-11 (Holotype), 4674-9.

39. *Verrucosisporites narmianus* Balme, 1970. Slide no. B.S.I.P. 4672-1.

40-42. *Osmundacidites senectus* Balme, 1963. Slide nos. B.S.I.P. 4670-3, 4671-8, 4673-5.

PLATE 4

43, 44. *Callumispora fungosa* (Balme) Bharad. & Sriv., 1969. Slide nos. B.S.I.P. 4669-5, 4674-5.

45-49. *Playfordiaspora cancellosa* (Playf. & Dettm.) Maheshw. & Ban., 1975. Slide nos. B.S.I.P. 4674-7, 4673-8, 4671-17, 4673-16, 4673-17 (× 750).

PLATE 5

50. *Callumispora gretensis* (Balme & Henn.) Bharad. & Sriv., 1969. Slide no. B.S.I.P. 4669-2 (× 750).

51. *Callumispora* sp. Slide no. B.S.I.P. 4674-1.

52. *Densipollenites invisus* Bharad. & Sal., 1964. Slide no. B.S.I.P. 4680-3.

53-55. *Klausipollenites schaubergeri* (Pot. & Kl.) Jans., 1962. Slide nos. B.S.I.P. 4677-1, 4671-18, 4678-1.

56-62. *Lunatisporites rhombicus* sp. nov. Slide nos. B.S.I.P. 4673-3, 4669-4, 4673-9, 4670-1 (Holotype), 4674-3, 4673-6, 4671-19.

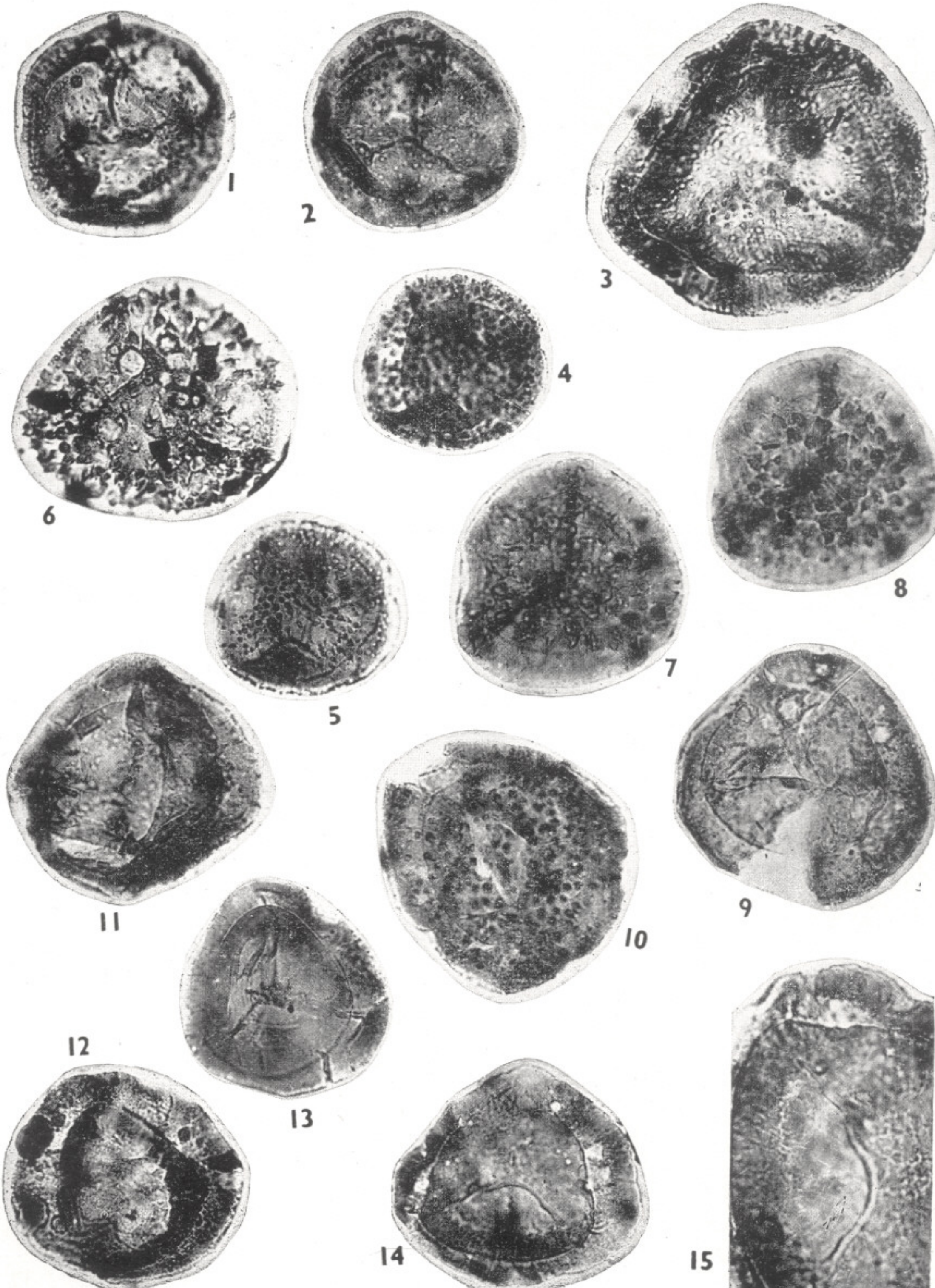
63. *Lunatisporites diffusus* sp. nov. Slide no. B.S.I.P. 4678-2.

PLATE 6

64-66. *Lunatisporites diffusus* sp. nov. Slide nos. B.S.I.P. 4673-4 (Holotype), 4673-10, 4677-2.

67. *Faunipollenites parvus* Tiw., 1965. Slide no. B.S.I.P.4680-1.

68. *Faunipollenites varius* Bharad.. 1962. Slide no. B.S.I.P. 4680-7.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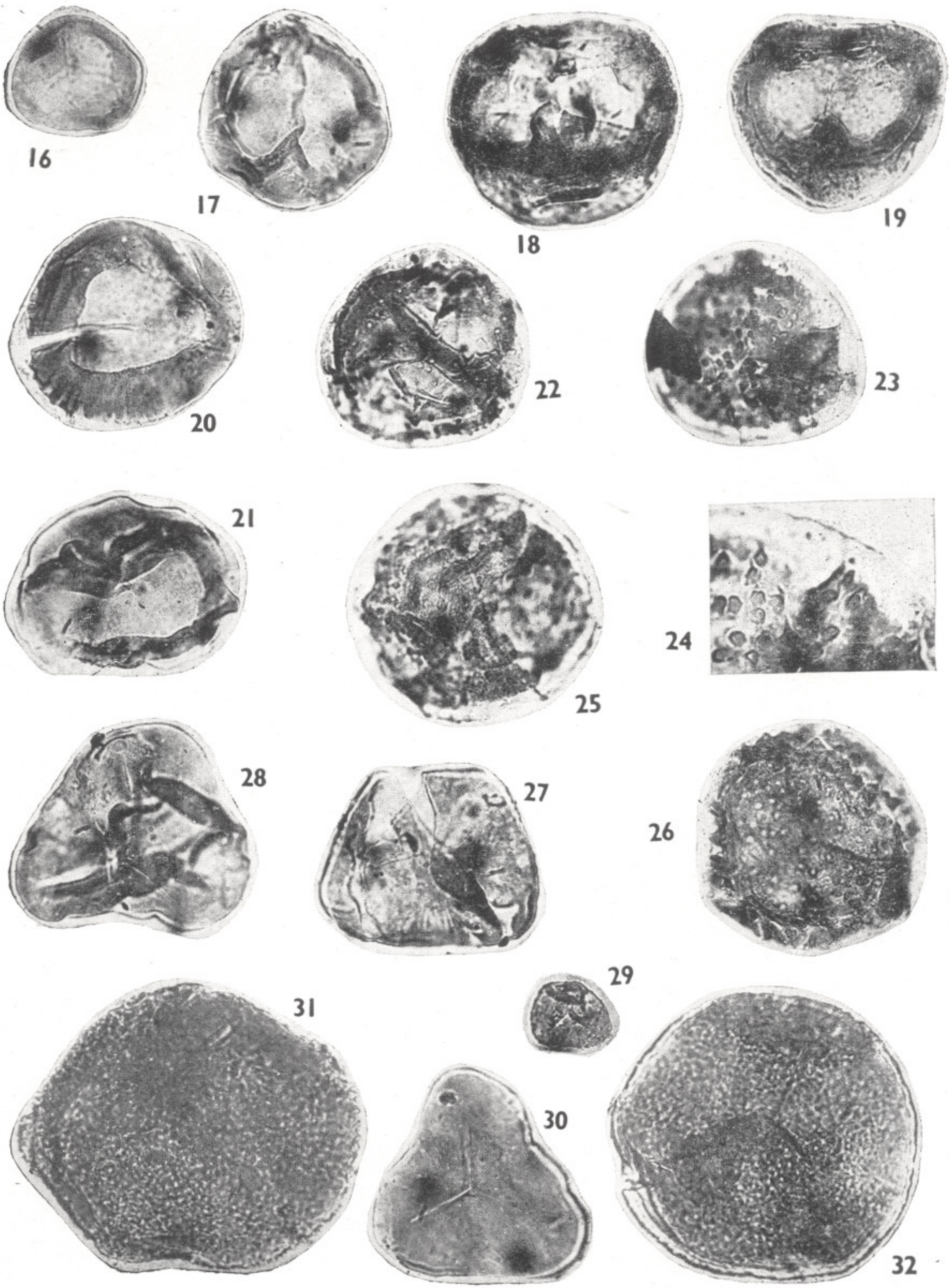
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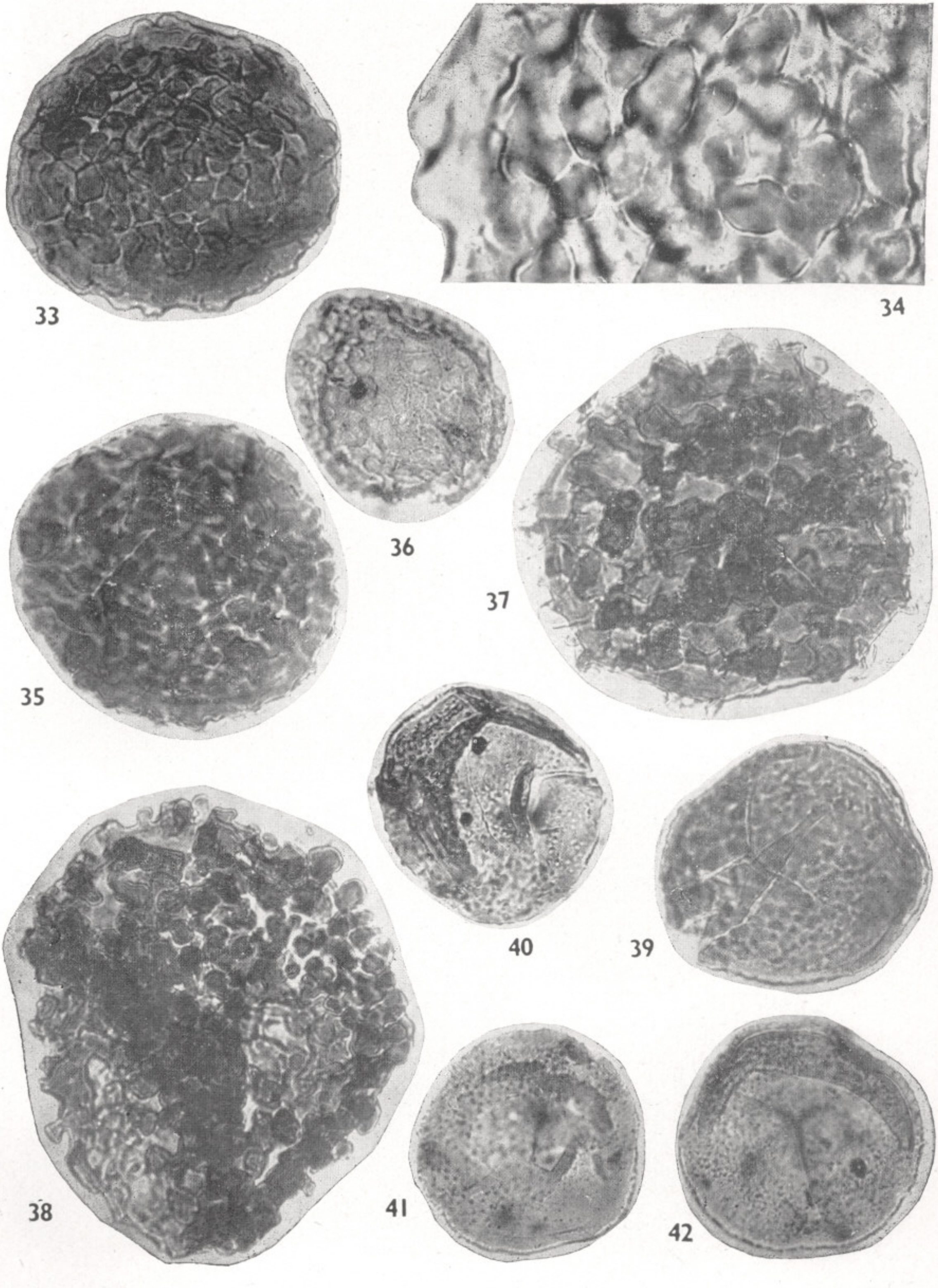
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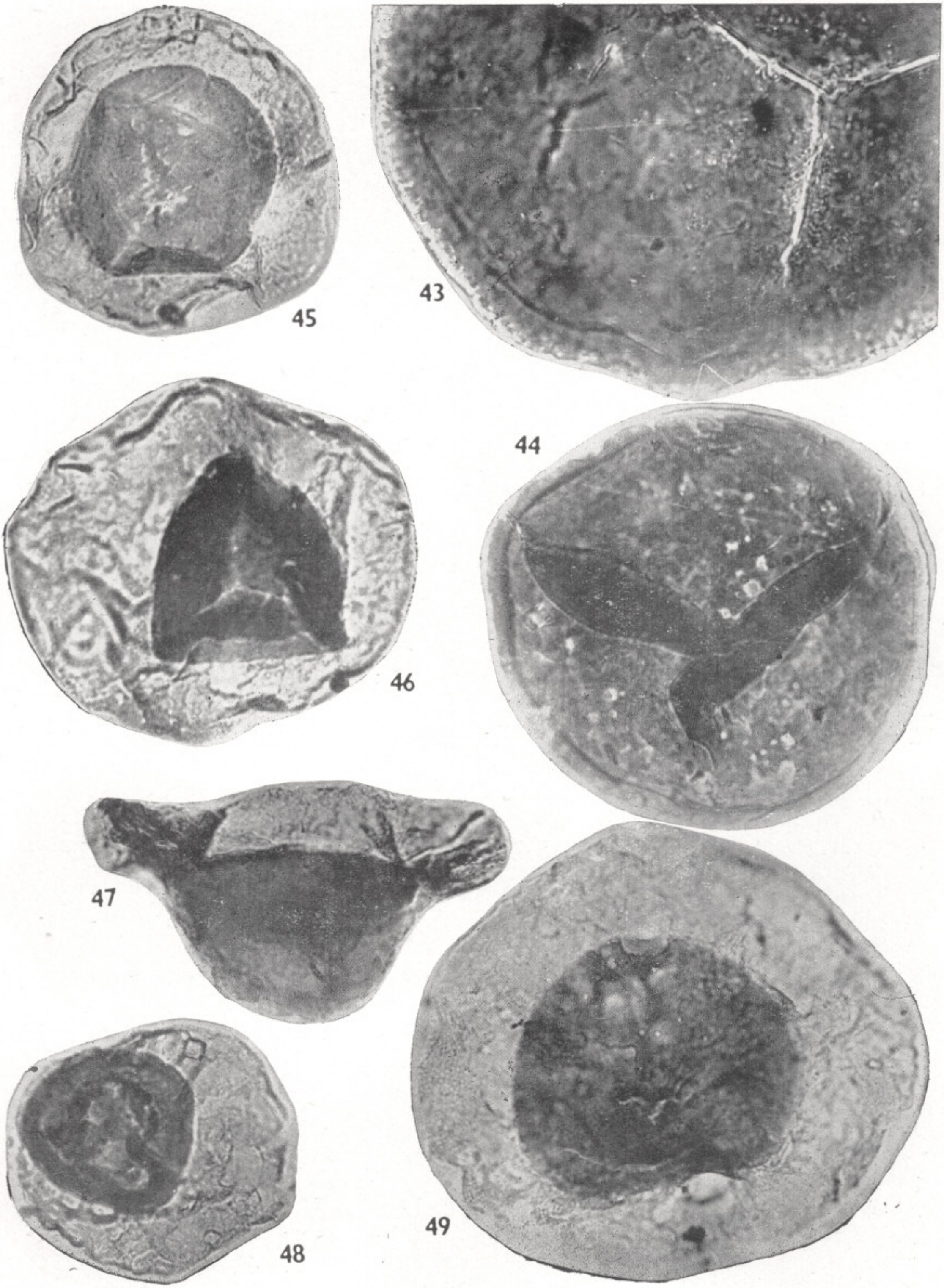
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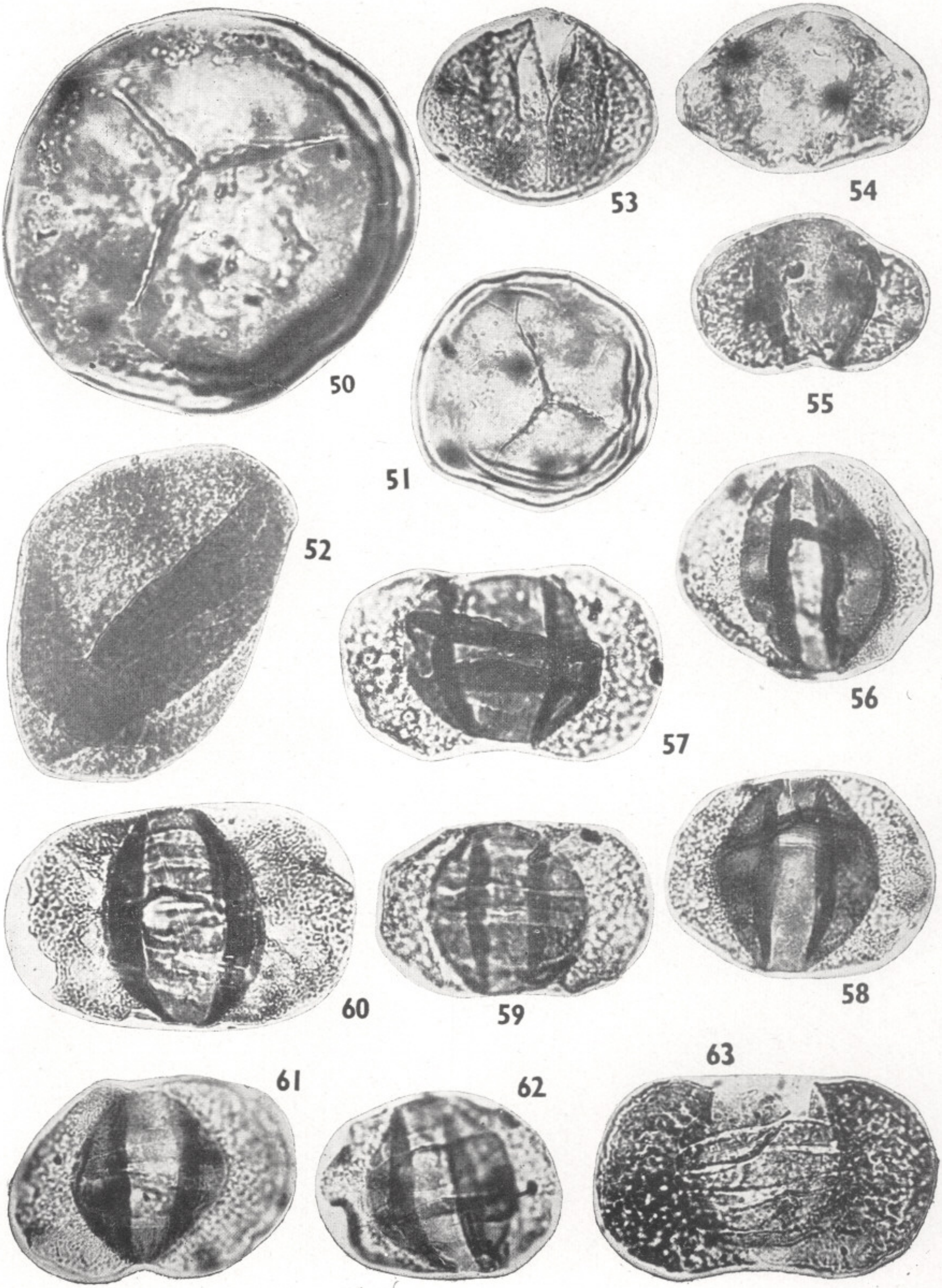
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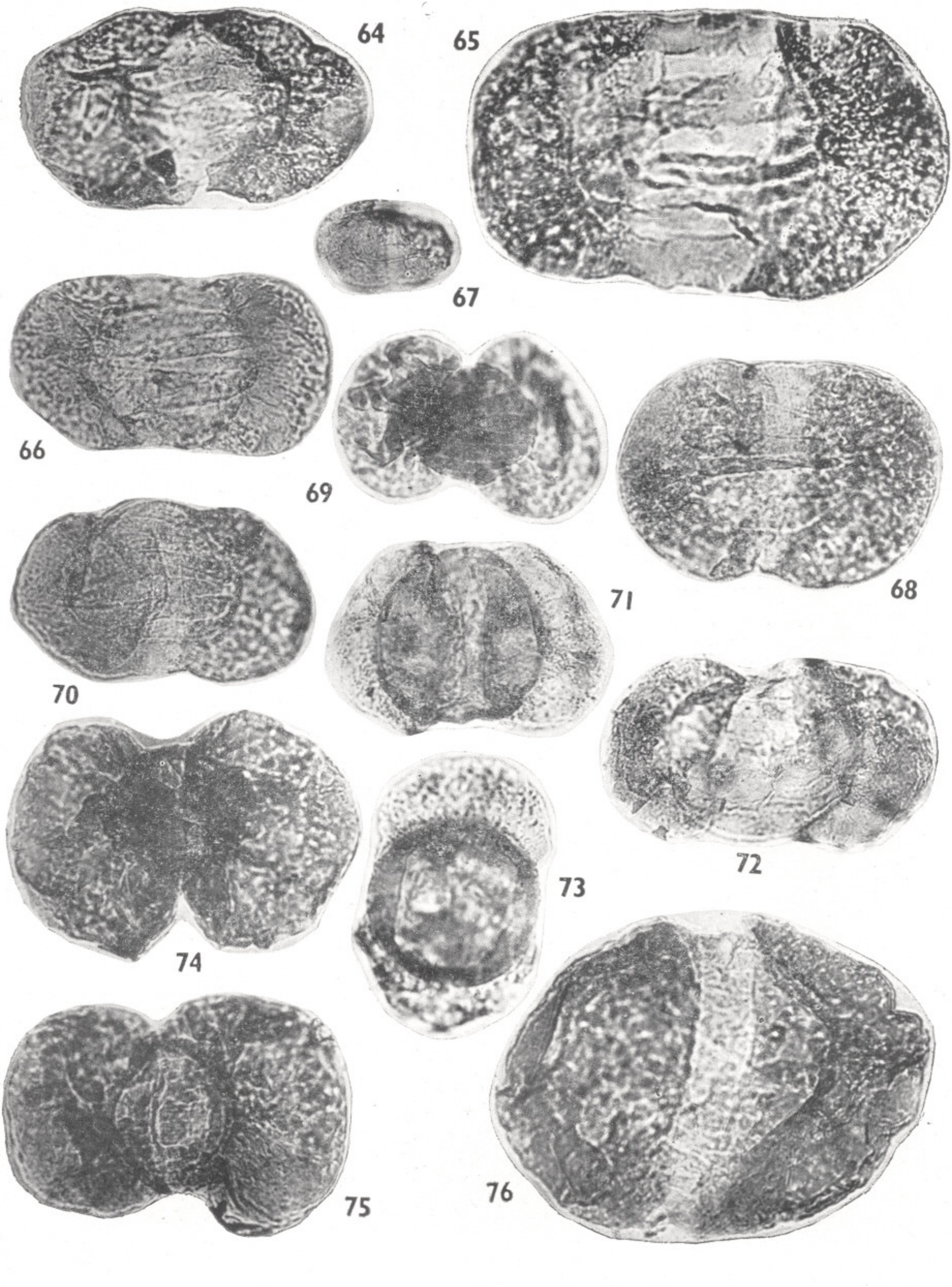
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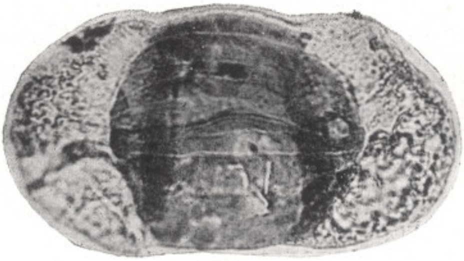
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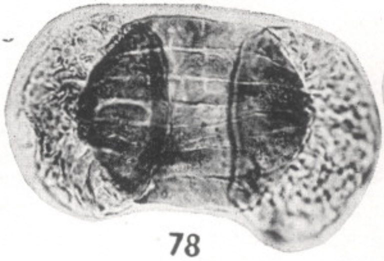
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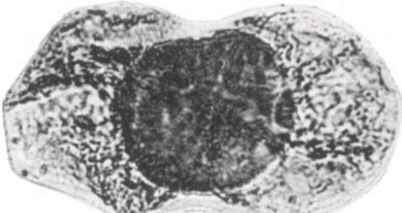
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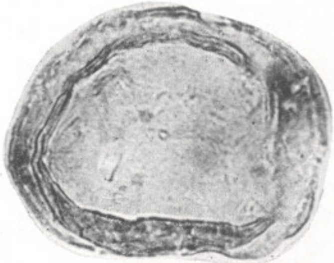
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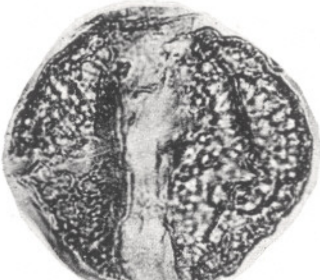
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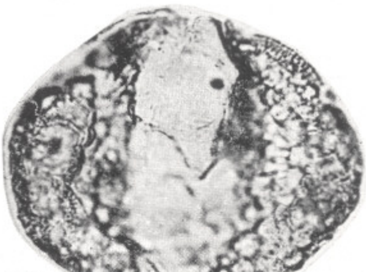
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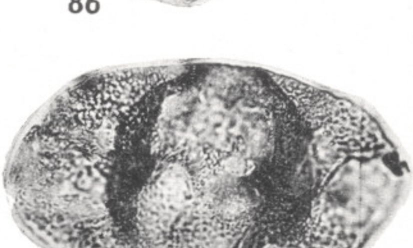
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69. *Striatites varius* Kar, 1968. Slide no. B.S.I.P. 4680-4.

70. *Striatopodocarpites decorus* Bharad. & Sal., 1964. Slide no. B.S.I.P. 4680-5.

71-73. *Striatites levistriatus* sp. nov. Slide nos. 4671-20, 4671-4 (Holotype) 4671-21.

74, 75. *Rhizomaspora* sp. Slide nos. B.S.I.P. 4671-5, 4680-2.

76. *Faunipollenites bharadwajii* Maheshw., 1962. Slide no. B.S.I.P. 4671-1.

PLATE 7

77, 78. *Lahirites triassicus* sp. nov. Slide nos. B.S.I.P. 4671-3, 4671-13 (Holotype).

79. *Crescentipollenites fuscus* (Bharad.) Bharad., Tiw. & Kar, 1974. Slide no. B.S.I.P. 4679-1.

80. *Verticipollenites* sp. Slide no. B.S.I.P. 4679-2.

81, 82. *Verticipollenites finitimus* Bharad. & Salujha, 1964. Slide nos. B.S.I.P. 4680-7, 4680-6.

83, 84. *Platysaccus fuscus* Goubin, 1965. Slide nos. B.S.I.P. 4670-4, 4671-9.

85. *Weylandites indicus* Bharad. & Sriv., 1969. Slide no. B.S.I.P. 4679-3.

86, 87. *Alisporites grobus* sp. nov. Slide no. B.S.I.P. 4673-2 (Holotype) 4673-1.

88. *Alisporites* sp. Slide no. B.S.I.P. 4674-4.

89-91. *Inaperturopollenites nebulosus* Balme, 1970. Slide nos. B.S.I.P. 4678-3, 4673-12, 4675-4.