The Palaeobotanist, **27**(2): 190-220, 1981.

SPORAE DISPERSAE OF SOME LOWER AND MIDDLE TRIASSIC SEDIMENTS FROM DAMODAR BASIN, INDIA

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ABSTRACT

There has been a gradual but definite change in the miofloral pattern from Permian through Triassic sediments in India, which is deduced after a careful circumscription as well as differentiation of organizations in *sporae dispersae*. The present study concerns the morphotaxonomy of dispersed pollen and spores in some Lower and Middle Triassic depositions in Damodar Valley. Forty-three genera and 76 species have been identified, out of which 4 genera and 17 species were found to be new. Among the newly proposed form genera, *Ringosporites* is a trilete spore having an equatorial crassitude and a polar or circumpolar distal thickening; *Novitasporites* has a trilete mark with bi- to multifurcate ray-ends and a perisporial covering; *Densostriapollis* accommodates non-saccate striated grains with an intexinal layer; *Goubinispora* is a girdling monosaccate pollen with striations on one face and partly separated exoexinal islands and strips on the other, and variously lobed monosaccus. Taxonomic position of some species have also been discussed. The qualitative significance of certain species forming diagnostic association has been pointed out.

Key-words — Palynology, Sporae dispersae, Damodar Valley, Lower and Middle Triassic (India).

साराँश

भारत में दामोदर बेसिन से अधर एवं मध्य ट्रायॅसिक अवसादों के विकरणित बीजाणु – रामशंकर तिवारी एवं विजया राणा

भारत में पर्मियन से ट्रायॅसिक युग तक के अवसादों से प्राप्त सूक्ष्म-वनस्पतिजात की प्रतिकृति में उत्तरोत्तर परन्तु निश्चित परिवर्तन हुआ है जिसे विकरणित बीजाणुओं के अवधानपूर्ण परिसीमन एवं संगठनों के विशिष्टीकरण के पश्चात् उपकलित किया गया है। प्रस्तुत अध्ययन दामोदर घाटी में कुछ अधर एवं मध्य ट्रॉयसिक निक्षेपणों में विद्यमान विकरणित बीजाणुओं एवं परागकणों की बाह्य-वर्गिकी से संबंधित है। तैंतालिस वंशों एवं 76 जातियों का अभिनिर्धारण किया गया है जिनमें 4 वंश एवं 17 जातियाँ नवीन हैं। नव-प्रस्तावित प्ररूप वंशों में **रिंगोस्पोराइटिस** एक मध्य रेखीय स्थूलता एवं ध्रुवीय अथवा परिध्रुवीय दूरस्थ स्थूलन से युक्त त्रिअरीय बीजाणु है; **नोविटास्पोराइटिस** में द्वि से बहुभाजित अरांत युक्त एक त्रिअरीय चिह्न तथा परिबीजाणविक चोल विद्यमान हैं; **डेन्सोस्ट्रियापॉलिस** के अंतर्गत् इन्टेक्साइनल पर्त युक्त अकोष्ठीय रेखित कण आते हैं; **गाउबिनिस्पोरा** वलययुक्त एक कोष्ठीय परागकण है जिसमें एक ओर धारियाँ हैं और दूसरी ओर आँशिक रूप से वियुक्त ऍक्सो-ऍक्साइनल द्वीप एवं पट्टियाँ हैं तथा इसका कोष्ठ विभिन्न पालियों वाला है। कुछ जातियों की वर्गीकीय स्थिति भी विवेचित की गई है। नैदानिक संगठन बनाने वाली कुछ जातियों के गुणात्मक महत्व को भी इंगित किया गया है।

INTRODUCTION

THE morphotaxonomy of dispersed miospores from the Triassic sediments in India, studied in some recent works (Bharadwaj & Srivastava, 1969; Kar, 1970; Banerji & Maheshwari, 1975; Maheshwari & Banerji, 1975 and Bharadwaj & Tiwari, 1977), provides significant information regarding new organizations in the spores and pollen grains. Quicker changes in palynological assemblages that have taken place after the Permo-Triassic transition shows diversified

morphologies. Fast incoming of new miofloral elements naturally involves morphographic complexity requiring their delimitations and comparisons. The Permian assemblages of India, being well known, form the basis of such comparisons.

This paper deals with the systematics of *sporae dispersae* in Lower and Middle Triassic sediments from Raniganj and East Bokaro coalfields, Damodar Basin, India. The quantitative analysis of miofloras found in these sediments were done by Tiwari (1979) and Bharadwaj, Tiwari and Anand-Prakash (1979), and the palynostratigraphic successions as well as miospore zones were also delimited by them.

The material consisted of the samples from three localities (for maps see Bharadwaj, Tiwari & Anand-Prakash, 1979).

Raniganj Coalfield, West Bengal

Locality 1 — Section in a tributary of Damodar River near Saburbandh Village, South of Damodar (Permian/Triassic).

Sample no S/ 11
Khaki-green shale
Sample no. S/ 10 } Lower Triassic
Khaki-green shale
Sample no. S/ 7
Carbonaceous shale } Upper Permian
Sample no. S/ 6
Carbonaceous shale

Bharadwaj, Tiwari and Anand-Prakash (1979) have studied the palynostratigraphy of this section and assigned the ages as given above. The specific delimitations of the constituents of this mioflora are given here.

Locality 2 — Bore-hole RD-1: Near Durgapur, District Burdwan, West Bengal.

Sample no. RD 1/4: Depth from the surface 532.48 m; light grey, coarse sandstone with coal streaks (Middle Triassic).

Sample no. RD 1/5: Depth from the surface 600·58 m; dark greenish-grey siltstone (Lower Triassic).

Tiwari (1979) has quantitatively analysed the Bore-hole no. RD-1, in which only the above two samples, RD 1/4 and RD 1/5, yielded the miospores. The age of the former was assigned Middle Triassic and that of the latter to be early Triassic. A detailed study has revealed the presence of a set of new forms which are being described here along with the *sporae dispersae*.

The sample no. RD 1/4 has been dated to be of Middle Triassic age; the " stratum typicum " for the new species found in this sample has been designated as Mahadeva Formation (=Supra-Panchet Formation) because this rock-lithology has been found above and in sequence to the Panchet Formation but is different from that. This contention is also supported by the palynological findings. In the eastern region of the Raniganj Coalfield, from where the core of Bore hole RD-1 has been procured, represents a rock succession of Panchet and Supra-Panchet (Mahadevas), the former representing Lower Triassic and the latter Middle Triassic and perhaps the Upper Triassic also. These formations in this part of the Raniganj Coalfield are hidden under surface and their palynological contents can now be correlated with the exposed ones elsewhere.

East Bokaro Coalfield, Bihar

Locality 3 — Section along Dhardharia Nala, West of Jurwa Village.

Sample no. Dh/1: Khaki Shale, Lower Triassic

Bharadwaj, Tiwari and Anand-Prakash (1979) have recovered a *Lunatisporites-Densoisporites-Lundbladispora*-rich assemblage in this sample, on the basis of which an Upper Panchet (late early Triassic) age has been assigned to it.

The maceration of the samples was done by usual method, treating them with hydrofluoric acid, nitric acid and potassium hydroxide of suitable strength.

SPORAE DISPERSAE

The various species encountered in the *sporae dispersae* have been listed and illustrated (figure numbers given in parenthesis). Only those species have been described or commented upon (with asterisk) which are new, emended, or combined with new taxa.

SPECIES ENCOUNTERED IN ASSEMBLAGES UNDER STUDY

Orbella Maljavkina, 1949

O. indica sp. nov. (Pl. 1, fig. 1)*.

Lundbladispora Balme emend. Playford, 1965

L. brevicula Balme, 1970 (Pl. 1, fig. 6); *L. raniganjensis* sp. nov. (Pl. 1, figs 2, 3, 5)*; *L. warti* sp. nov. (Pl. 1, fig. 4)*; *L.* sp. (Pl. 1, figs 7, 9)*.

Densoisporites Weyland & Krieger emend. Dettmann, 1963

D. playfordii Balme, 1970 (Pl. 1, fig. 8); *D. contactus* Bharadwaj & Tiwari, 1977 (Pl. 1, figs 11, 13).

Ringosporites gen. nov.

R. ringus sp. nov. (Pl. 1, figs 17, 20, 22)*, *R. fossulatus* (Balme) comb. nov. (Pl. 1, figs 16, 21, 23)*.

Potonieitriradites Bharadwaj & Sinha, 1969

P. sp. cf. *P. subtilis* Sinha, 1972 (Pl. 1, fig. 10)*.

Indotriradites Tiwari, 1964

I. cuspidus (Balme) Bharadwaj & Tiwari, 1977 (Pl. 1, figs 14, 18); *I. wargalensis* (Balme) Bharadwaj & Tiwari, 1977 (Pl. 1, fig. 15); *I. mammilatus* Bharadwaj & Tiwari, 1977 (Pl. 1, fig. 19).

Aratrisporites Leschik, 1955 emend. Klaus, 1960

A. fischeri Klaus, 1960.

Cyathidites Couper, 1953

C. australis Couper, 1953 (Pl. 1, fig. 12).

Novitasporites gen. nov.

N. triassicus sp. nov. (Pl. 1, figs 24, 25; Pl. 2, fig. 26)*; *N. triangularis* sp. nov. (Pl. 2, figs 27, 28, 33)*.

Granulatisporites Ibrahim, 1933 emend. Potonié & Kremp, 1954

Granulatisporites sp.

Lacinitriletes Venkatachala & Kar, 1965 emend. Tiwari & Singh, 1981

L. minutus Venkatachala & Kar, 1968 emend. Tiwari & Singh, 1981 (Pl. 2, fig. 31).

Lophotriletes (Naumova) Potonié & Kremp, 1954

L. rectus Bharadwaj & Salujha, 1964.

Microfoveolatispora Bharadwaj, 1962

M. foveolata Tiwari, 1965 emend. Tiwari & Singh, 1981 (Pl. 2, fig. 36).

Brevitriletes Bharadwaj & Srivastava, 1969 emend. Tiwari & Singh, 1981

B. communis Bharadwaj & Srivastava, 1969 emend. Tiwari & Singh 1981 (Pl. 2, fig. 44).

Cyclogranisporites Potonié & Kremp, 1954

C. gondwanensis Bharadwaj & Salujha, 1965 (Pl. 2, fig. 32).

Verrucosisporites Ibrahim emend. Smith *et al.*, 1964

V. narmianus Balme, 1970 (Pl. 2, fig. 34); *V. bosei* Maheshwari & Banerji, 1975 (Pl. 2, fig. 35); *V. triassicus* Bharadwaj & Tiwari, 1977 (Pl. 2, fig. 41).

Osmundacidites Couper, 1953

O. senectus Balme, 1963 (Pl. 2, fig. 38); *O. pilatus* sp. nov. (Pl. 2, fig. 30)*

Playfordiaspora Maheshwari & Banerji, 1975

P. cancellosa (Playford & Dettmann) Maheshwari & Banerji, 1975 (Pl. 3, fig. 52).

Thymospora Wilson & Venkatachala, 1963

T. gondwanensis Bharadwaj & Salujha, 1964.

Densostriapollis gen. nov.

D. damudicus sp. nov. (Pl. 2, figs 29, 37)*

Densipollenites Bharadwaj, 1962

D. densus Bharadwaj & Srivastava, 1969 (Pl. 2, fig. 39); *D. invisus* Bharadwaj & Salujha, 1964 (Pl. 2, fig. 43); *D. magnicorpus* sp. nov. (Pl. 3, figs 46, 50)*.

Callumispora Bharadwaj & Srivastava, 1969

C. gretensis (Balme & Hennelly) Bharadwaj & Srivastava, 1969 (Pl. 2, fig. 40);

C. fungosa (Balme) Bharadwaj & Srivastava, 1969 emend. Bharadwaj & Tiwari, 1977 (Pl. 2, fig. 42).

Weylandites Bharadwaj & Srivastava, 1969

W. circularis Bharadwaj & Srivastava, 1969 (Pl. 2, fig. 45).

Striomonosaccites Bharadwaj, 1962

S. ovatus Bharadwaj, 1962 (Pl. 3, fig. 53).

Parasaccites Bharadwaj & Tiwari, 1964

P. invasus Tiwari, 1968 (Pl. 3, fig. 51); *P. distinctus* Tiwari, 1965 (Pl. 3, fig. 48).

Goubinispora gen. nov.

G. indica sp. nov. (Pl. 4, figs 57, 58, 63)*; *G. morondavaensis* (Goubin) comb. nov. (Pl. 3, figs 54, 55)*.

Lueckisporites Potonié & Klaus, 1954

Lueckisporites sp.

Lunatisporites Leschik, 1955 emend. Bharadwaj, 1974

L. (*Taeniaesporites*) *noviaulensis* (Leschik, 1956) Scheuring, 1970 (Pl. 3, fig. 49); *L. rhombicus* Bharadwaj & Tiwari, 1977 (Pl. 3, fig. 47); *L.* (*Taeniaesporites*) *ovatus* (Goubin) Maheshwari & Banerji, 1975 (Pl. 4, fig. 60); *L. asansoliensis* sp. nov. (Pl. 4, figs 59, 61)*; *L. pellucidus* (Goubin) Maheshwari & Banerji, 1975 (Pl. 6, fig. 79).

Striapollenites Bharadwaj, 1962

S. monosaccoides sp. nov. (Pl. 4, fig. 56)*.

Rhizomaspora Wilson, 1962

R. costa Venkatachala & Kar, 1968 (Pl. 5, fig. 64); *R. triassica* sp. nov. (Pl. 5, figs 65, 71)*; *R.* sp. (Pl. 5, fig. 75)*.

Striatopodocarpites Sedova, 1956

S. gopadensis (Bharadwaj & Srivastava) comb. nov. (Pl. 5, fig. 66)*; *S. oblongatus* (Bose & Maheshwari) comb. nov. (Pl. 5, fig. 78)*; *S. crassistriatus* Lele & Srivastava, 1977; *S. labrus* Tiwari, 1965 (Pl. 6, fig. 87).

Striatites Pant emend. Bharadwaj, 1962

S. subtilis Bharadwaj & Salujha, 1964 (Pl. 4, fig. 62); *S. panchetensis* sp. nov. (Pl. 6, figs 91, 94)*.

Faunipollenites Bharadwaj, 1962

F. varius Bharadwaj, 1962.

Verticipollenites Bharadwaj, 1962

V. secretus Bharadwaj, 1962 (Pl. 5, fig. 69).

Hindipollenites Bharadwaj, 1962

H. indicus Bharadwaj, 1962 (Pl. 6, fig. 81).

Crescentipollenites Bharadwaj, Tiwari & Kar, 1974

C. fuscus (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974 (Pl. 5, fig. 70); *C. bengalensis* (Maheshwari & Banerji, 1975) comb. nov. (Pl. 6, fig. 80)*; *C.* sp. (Pl. 5, fig. 68)*.

Chordasporites Klaus, 1960

C. raniganjensis Maheshwari & Banerji, 1975.

Cycadopites Wodehouse, 1933 ex Wilson & Webster, 1946

Cycadopites sp.

Satsangisaccites Bharadwaj & Srivastava, 1969

S. nidpurensis Bharadwaj & Srivastava, 1969 (Pl. 6, fig. 89).

Klausipollenites Jansonius, 1962

K. schaubergeri (Potonié & Klaus) Jansonius, 1962 (Pl. 5, fig. 76).

Falcisporites Leschik emend. Klaus, 1963

F. stabilis Balme, 1970 (Pl. 6, fig. 93).

Platysaccus Naumova ex Potonié & Klaus, 1954

P. queenslandi de Jersey, 1970
P. fuscus Goubin, 1965 (Pl. 6, fig. 82).

Cedripites Wodehouse, 1933

Cedripites sp.

Alisporites Daugherty emend. Nilsson, 1958

A. indicus Bharadwaj & Srivastava, 1969 (Pl. 6, fig. 84); *A. damudicus* sp. nov. (Pl. 6, figs 90, 92)*.

Cuneatisporites Leschik, 1955

C. mirabilis sp. nov. (Pl. 6, fig. 85; Pl. 5, fig. 73)*; *C.* sp. (Pl. 6, fig. 88)*.

Scheuringipollenites Tiwari, 1973

S. maximus (Hart) Tiwari, 1973 (Pl. 6, fig. 86)*.

Ibisporites Tiwari, 1968

I. diplosaccus Tiwari, 1968.

Pinuspollenites Raatz, 1937

P. thoracatus Balme, 1970.

Vitreisporites Leschik emend. Jansonius, 1962

V. pallidus Reissinger, 1940.

Araucariacites Cookson, 1947

A. australis Cookson, 1947 (Pl. 5, fig. 74).

Graminoides Goubin, 1965

G. sp. cf. *G. cernes* Goubin, 1965 (Pl. 5, fig. 67)*.

Pretricolpipollenites Danzé-Corsin & Laveine, 1963

P. bharadwajii Balme, 1970 (Pl. 5, fig. 72).

Pyramidosporites Segroves, 1967

P. racemosus Balme, 1970 (Pl. 5, fig. 77).

Inaperturopollenites Thomson & Pflug emend. Potonié, 1958

I. nebulosus Balme, 1970 (Pl. 6, fig. 83).

Pilasporites Balme & Hennelly emend. Tiwari & Navale, 1967

P. plurigenus Balme & Hennelly, 1956.

DESCRIPTION

Orbella Maljavkina, 1949

Type Species — *Orbella colliculoides* Maljavkina, 1949.

Orbella indica sp. nov.

Pl. 1, fig. 1; Text-fig. 1C

Holotype — Pl. 1, fig. 1, size 22 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member), Lower Triassic.

Diagnosis — Subcircular, 24-32 μm. Y-mark distinct, ray-ends with curvaturae, contact area distinct. Exine thin, infragranulose in structure, laevigate.

Comparison — In the nature of contact area these specimens could have been referred to *Hennellysporites* Tiwari, 1968, but the latter has indistinctly structured exine and a triangular, thickened polar area on the proximal side. *O. colliculoides* Maljavkina, 1949 has unstructured exine with weaker trilete rays.

Lundbladispora Balme emend. Playford, 1965

Type Species — *Lundbladispora willmotti* Balme, 1963.

Lundbladispora raniganjensis sp. nov.

Pl. 1, figs 2, 3, 5; Text-fig. 2D

Holotype — Pl. 1, fig. 3, size ± 60 μm.

Locus Typicus — Bore-hole, RD-1, sample no. 4, depth 532·8 m; Raniganj Coalfield, India.

Stratum Typicum — Mahadeva (Supra-Panchet) Formation, Middle Triassic.

Diagnosis — Cavate circulo-triangular, 53-76 μm in size. Y-mark usually distinct, lips slightly raised, sometimes simple, reaching up to cingulum forming incomplete curvaturae. Sculpture distal and equatorial consisting of sparse spines with bulbous bases having beak-like elongated apical portion, few coni. Processes 2-3 μm wide, at least 1-3 μm long. Cingulum thick, ± 4-8 μm wide having ornament on margin. Exoexine finely intrapunctate. Inner body 38-66 μm in size without papillae.

Comparison — *Lundbladispora willmotti* Balme, 1963 differs in being bigger, having indistinct laesurae, simple spines, and papillae on the intexine. Among the

comparable species, *L. brevicula* Balme, 1963 differs in having stronger, raised trilete rays, simple spines, and three papillae on the intexine; *L. obsoleta* Balme, 1970 has bigger, massive and closely set spines, and more pronounced cingulum. *L. baculata*, *L. densispinosa* and *L. microconata* (Bharadwaj & Tiwari, 1977) differ from the present species in the nature and arrangement of the ornamental processes.

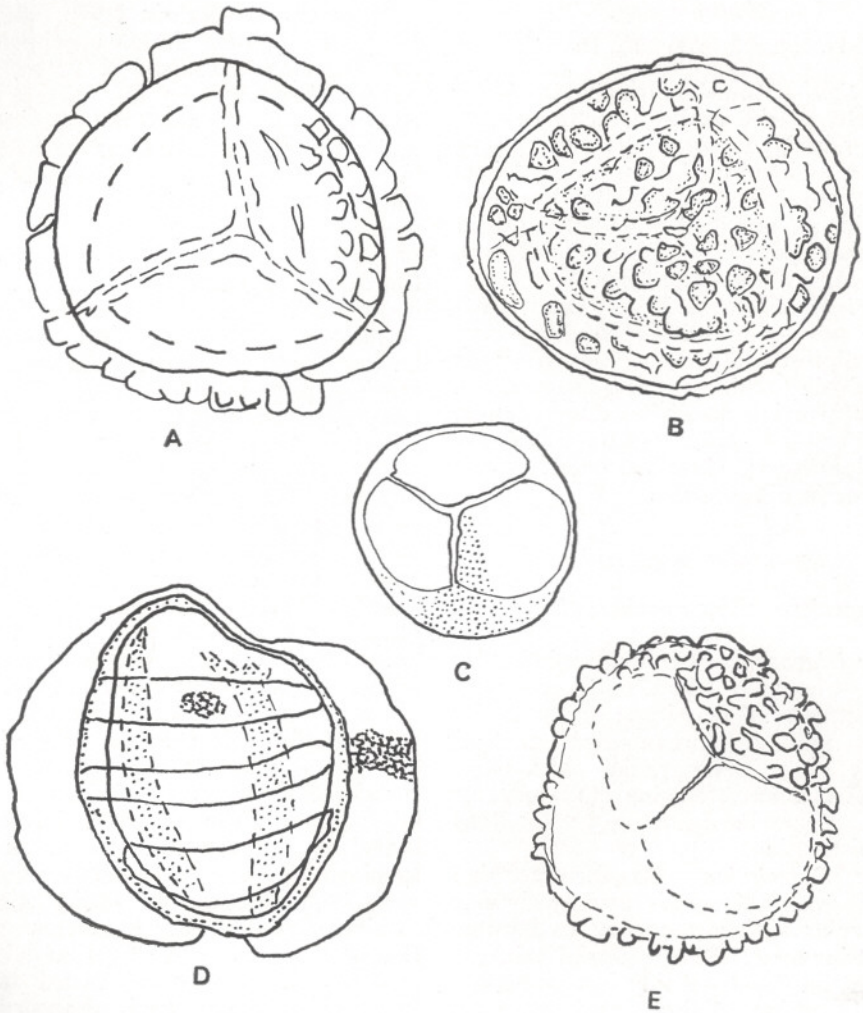
Lundbladispora warti sp. nov.

Pl. 1, fig. 4; Text-fig. 1A

Holotype — Pl. 1, fig. 4, size, 87 × 84 × 86 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.



TEXT-FIG. 1 — **A.** *Lundbladispora warti* sp. nov. showing wart-like nature of ornament; distal view. *ca* × 650. **B.** *Lundbladispora* sp. showing irregular pit-like meshes, distal view. *ca* × 700. **C.** *Orbella indica* sp. nov. Nature of exine and contact area. *ca* × 1400. **D.** *Lunatisporites asansoliensis* sp. nov. depicting a prominent rim around the body and semilunar folds at the distal line of saccus attachment. *ca* × 830. **E.** *Osmundacidites pilatus* sp. nov. Pila-like round headed sculpture with a few verrucae on the surface. *ca* × 760.

Diagnosis — Subtriangular, holotype 86 μm. Trilete rays prominent, 4 μm laesurae; proximally smooth distally having 4-10 μm wide, 4-7 μm high, massive wart-like, rounded, flat-topped to irregular processes. Cingulum thickened unevenly with projecting, partially fused warts. Innerbody thick, distinct, without papillae.

Comparison — This species differs from the so far known species of this genus in the nature of distal ornament.

Lundbladispora sp.

Pl. 1, figs 7, 9; Text-fig. 1B

Description — Roundly triangular, 60-72 μm; trilete mark weak, sometimes with slightly raised laesurae; contact area discernible. Cingulum 4-6 μm wide. Distal ornament consisting of mostly irregular, 3-7 μm wide pit-like meshes with 1 μm thick muri. Inner body 2/3 of the total size, well-defined, without papillae.

Comparison & Remarks — These specimens are unique in having irregular reticulate sculpture. However, the irregular nature of the sculpture also suggests a possibility of exine distortion due to fungal attack. Yet, in other characters and organization as well, these specimens answer to the generic diagnosis.

***Ringosporites* gen. nov.**

Type Species — *Ringosporites ringus* sp. nov.

Generic Diagnosis — Circular, subcircular to circulo-triangular trilete miospores with distal subequatorial crassitude or equatorial cingulum and a circumpolar annular thickening or a polar radial thickening. Trilete mark mostly forming curvaturae at ray-ends. Exine laevigate on proximal as well as distal side.

Generic Description — So far recorded size 28-40 μm. Miospores usually circular to subcircular with a tendency to become roundly triangular. Subequatorial thickening present on the distal side just along the equatorial outline, differentiated by L.O. analysis from the area curvaturae present on proximal side over this thickening. Thus, it is more a crassitudinal thickening rather than a cingulum (Text-figs 5, 6). In certain cases, however, the position is not very clear and the thickening appears to be ± equatorial. Trilete rays with somewhat thick laesurae and more so at terminal points where widened to form imperfect to perfect curvaturae. Subpolar annular thickening normally situated at ± midway between the equator and the pole. In certain specimens a polar, circular solid-mass-like thickening up to ± 1/3 of the total spore-size present. Exine basically laevigate having no projection at *extrema-lineamenta*, rarely chagrinate-look at surface depicted.

Comparison — Balme (1970, pl. 5, figs 1-5) has described similar specimens under *Nevesisporites* de Jersey & Paten, 1964 as *N. fossulatus* n. sp.; this group of miospores, however, does not find its place under the genus *Nevesisporites* because the latter has no polar or subpolar annular thickenings, the proximal exine is ornamented with granules, verrucae, spinules or bacula, and the curvaturae are absent (de Jersey & Paten, 1964, p. 8). Another comparable genus — *Polycingulatisporites* Simoncsics & Kedves, 1961 resembles in having annular rings; however, *Ringosporites* has only one ring or a polar thickening while *Polycingulatisporites* (Syn. *Neochomotriletes* Reinhardt, 1962) has two rings. Still major differentiating characters are the presence of radial fine striae, especially in the outer zone of the exine, and lack of arcuate rims at the ray-ends in the latter genus. These characters together make a different line of morphographic delimitation. Playford and Dettmann (1965) emended the generic diagnosis of *Polycingulatisporites* and made a number of new combinations of species known from USSR. The amendment, however, did not encompass the type species — *P. circulus* Simoncsics & Kedves, 1961, and all the more, the diagnosis has been enlarged to suit the accommodation for the specimens of apparently similar but not of the comparable morphography as has been originally described. It seems probable that the spores with distal annular rings represent a number of varied taxa and hence should be determined accordingly.

Among the other comparable genera *Taurocusporites* Stover, 1962 and *Coronatispora* Dettmann, 1963 are sculptured; *Staplinisporites* Pocock, 1962, *Annulispora* de Jersey, 1959 and *Distalanulisporites*

Klaus, 1960 are acingulate and without crassitude. From another genus — *Stereisporites* Pflug, 1953, *Ringosporites* gen. nov. differs in being mostly circular to subcircular in shape, having polar or subpolar thickenings, and being not thickened at the corners.

Ringosporites ringus sp. nov.

Pl. 1, figs 17, 20, 22; Text-fig. 2B

Holotype — Pl. 1, fig. 17, size 38×40 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

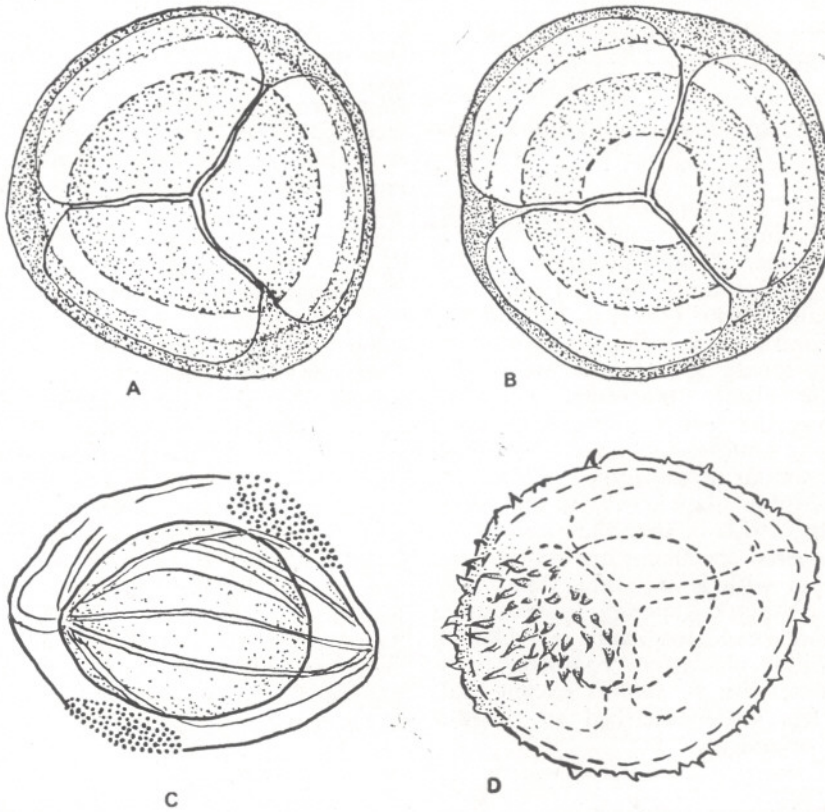
Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Subcircular to roundly subtriangular, 26-37 μm. Y-mark distinct, rays reaching almost 4/5 of the radius, leasurae thin, at times wavy, thickened and widened at end making incomplete to complete *area contagionis* over the crassitude. Subequatorial thickening 3-4 μm wide, distally situated immediately along the equatorial region, one annular ring (thickening) 3-5 μm wide, circum-polar, in ± midway of pole and the crassitude, surrounding thinner circular polar area in the centre. Exine on surfaces and *extrema lineamenta* laevigate.

Ringosporites fossulatus (Balme) comb. nov.

Pl. 1, figs 16, 21, 23; Text-fig. 2A

Synonym — *Nevesisporites fossulatus* Balme, 1970, pl. 3, figs 1-5.



TEXT-FIG. 2 — **A.** *Ringosporites fossulatus* (Balme) comb. nov.: Semidiagrammatic sketch showing nature of equatorial thickening, crassitude and polar thickenings; proximal view. **B.** *Ringosporites ringus* sp. nov.: Semidiagrammatic sketch showing contact area, equatorial thickening distal crassitude and a circumpolar ring; proximal view.: *ca* ×1250. **C.** *Densostriapollis damudicus* sp. nov.: Relatively big central body and a thick merging equatorial region depicted. *ca* × 800 **D.** *Lundbladispora raniganjensis* sp. nov. showing elongated apical protion of spines and their distribution; distal view. *ca*× 730.

Holotype — Balme, 1970, pl. 3, fig. 4, specimen no. 57789.

Locus Typicus — Field no. K 11-6C, Wargal, Salt Range.

Stratum Typicum — Chhidru Formation; Upper Permian.

Remarks — The presence of grana described by Balme (1970) on the proximal surface of this species is not confirmed by the study of similar specimens in the present material. Sometimes, roughened surface is noticed but no true grana are present. This species has a polar, circular thickening on distal face while the type species, *Ringosporites ringus* sp. nov., has a circumpolar annular thickening (for specific diagnosis ref. Balme, 1970, p. 335).

***Potonieitriradites* Bharadwaj & Sinha, 1969**

Holotype — *Potonieitriradites barakarensis* Bharadwaj & Sinha, 1969.

Potonieisporites sp. cf. *P. subtilis* Sinha, 1972

Pl. 1, fig. 10

Remarks — Cavate spores with an inner-body and a thin flange (zona) do not find their place under *Kraeuselisporites* Lesch. (1955) on the grounds put forward by Bharadwaj and Tiwari (1977, p. 30). *Indotriradites* Tiwari, 1964, although accommodates cavate-zonate spores, has spines or coni as the distal ornaments. *Potonieisporites*, on the other hand, includes smooth to granulose, or microverrucose spores with similar organization. However, inclusion of tuberculate spores in the latter genus (Sinha, 1972) is also undesirable.

The discovered specimens are subtriangular, 60-66 μm with 8 μm wide, thin zona, prominent Y-mark, spongy appearance, infragranulose exoexine and a distinct intexine. These characters conform, to a greater extent, with *P. subtilis* except that the latter has been described to possess 'granular' ornament.

***Novitasporites* gen. nov.**

Type Species — *Novitasporites triassicus* sp. nov.

Generic Diagnosis— Radially symmetrical, trilete spores with a psilate perisporial covering, psilate infrapunctate structured exine and bi- to multifurcate ends of the trilete rays in branching fashion.

Generic Description — Miospores mostly roundly triangular to subcircular. Trilete mark distinct with thin or thickened lips forming sharp suture, may be elevated. Body covered with a thin, hyaline, laevigate perisporial covering, extending beyond the equatorial line, unevenly broad, rarely distorted at places, not very loose in attachment. Body exine thick, unsculptured but faintly and indeterminately to distinctly structured — mainly having infrapunctation. The ray-ends bifurcate to multifurcate in variable fashion.

Comparison — Among the comparable genera, *Perotriletes* Erdtman *ex* Couper, 1953 is different in having sculptured exine and simple ray-ends. The present genus is non-cavate, hence differs from the cavate forms such as *Diaphanospora* Balme & Hassell, 1962, *Proprisporites* Neves, 1958 and *Hymenospora* Neves, 1961. The genus *Ricaspora* Bharadwaj & Salujha, 1964 recorded from Upper Permian of India does not possess furcate trilete rays and has a thinner, more or less unstructured exine.

Microlepidites Ross, 1949 shows bifurcation at the ray-ends but of a nature of *curvaturae imperfectae*; moreover, this genus does not have a perispore and laevigate exine. In the same way, *Divisisporites* Thomson (in Thomson & Pflug, 1953 emend. Potonié, 1956) exhibits the presence of fork-shaped ray-ends whose arms are longer than the ray itself and symmetrically recurved in the form of curvaturae; *Divisisporites* is also different in the absence of perisporial covering. *D. maximus* Pflug, 1953, however, shows comparable nature of the mark (Thomson & Pflug, 1953, pl. 1, figs 57, 58; p. 52) but probably contains an "endoexospore", and has no perispore, thus evidently does not come under the proposed circumscription of the genus *Novitasporites* gen. nov.

Novitasporites triassicus sp. nov.

Pl. 1, figs 24, 25; Pl. 2, fig. 26; Text-fig. 3A

Holotype — Pl. 2, fig. 26, size 96 μm.

Locus Typicus — Bore-hole, RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Circular to subcircular, size-range 96-120 μm. Y-mark prominent, laesurae 1-3 μm thick, suture distinct sometimes open; rays ± 2/3 radius long, splitting at ends into two to four raylets at one point or in the branching fashion. Exine 2-5 μm thick, infrapunctate, covered tightly with a hyaline, sculptureless and unstructured perisporial covering; perispore unevenly wide, usually 1-3 μm in width from the spore equator.

Remarks — The perisporial covering is identified by its uneven width and hyaline nature. There are certain specimens where this seems to have been dissolved resulting a simple non-perisporoid appearance to the spore which could lead to a mis-identification (also indicated by Balme, 1970, p. 36, in case of *Perotriletes*). However, the nature of trilete mark is so unique in case of *Novitasporites* that even without perisporial covering it could not be wrongly placed.

Novitasporites triangularis sp. nov.

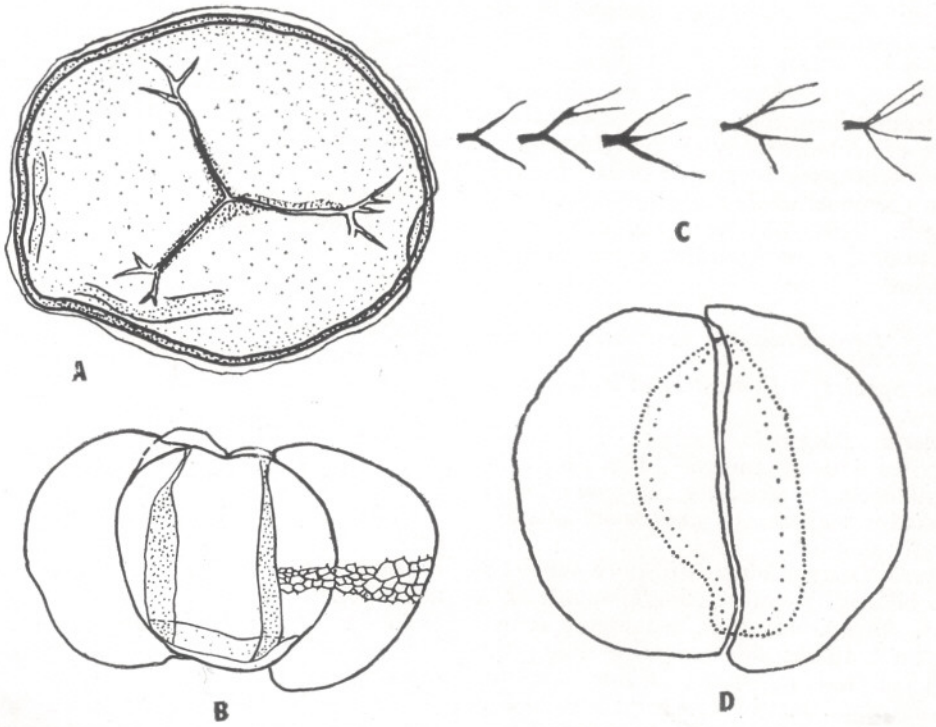
Pl. 2, figs 27, 28, 33

Holotype — Pl. 2, fig. 33, size 70 × 74 × 66 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Triangular to roundly triangular spores with slightly convex sides and broad round angles. Size-range 66-105 μm. Y-mark prominent, rays 3/4 radius long, with 1-4 μm thick lips and distinct linear suture; ray-ends bi- to tetrafurcate repeatedly or at one point. Perine distinct, up to 4 μm wide. Exine 2-4 μm thick, infrapunctate.



TEXT-FIG. 3 — **A.** *Novitasporites triassicus* sp. nov. Note the perine layer slightly broken at one place. The thick structured exine and multifurcate ends of the Y-rays are depicted. *ca* × 570. **C.** *Novitasporites* gen. nov. Diagrammatic sketch of variation in the nature of furcate tips of Y-mark, in the specimens observed. **B.** *Cuneatisporites mirabilis* sp. nov. showing the folds along the line of distal attachment, distal view. *ca* × 570. **D.** *Alisporites damudicus* sp. nov. exhibiting the thin elongated vertically oval body, narrow sulcus and sacci. *ca* × 580.

Remarks — *Novitasporites triangularis* is triangular while *N. triassicus* is circular to subcircular. Moreover, the former has longer trilete rays than the latter.

Osmundacidites Couper, 1953

Type Species — *Osmundacidites wellmanii* Couper, 1953.

Osmundacidites pilatus sp. nov.

Pl. 2, fig. 30; Text-fig. 1E

Holotype — Pl. 2, fig. 30, size 48×49 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Circular, 48 μm. Y-mark not prominent. Ornament consisting pila, 3·5 μm broad at base and up to 5 μm long and round-headed, intermixed with a few verrucae, closely placed all over the body. Exine 1 μm thick.

Comparison — *O. wellmanii* Couper 1953, and *O. senectus* Balme, 1963 are differentiated from this species on the basis of the nature of sculpture. With the inclusion of the present species having pila, in this genus, the generic circumscription has been enlarged. This, however, has been done because of the mixed sculpture on the same specimen.

Densostriapollis gen. nov.

Type Species — *Densostriapollis damudicus* sp. nov.

Generic Diagnosis — Alete, nonsaccate miospores with striations. Exine laevigate, infrapunctate in structure, at some places restrictedly scabrate to granulose; intexine generally distinct.

Generic Description — Miospore subcircular to bilaterally oval, having no mark or a saccus. Striations linear, converging at two ends, on both the sides, running along the length of the miospore. Exine smooth, finely intrapunctate in structure; restrictedly microgranulose appearance at *extrema lineamenta* also recorded. More or less circular area in the centre of the miospore seen in most of the specimens; this presumably the intexinal layer, being thin, and faint or sometimes distinct in outline.

Comparison — *Ephedripites* Bolkhovitina, 1953 does not possess an intexinal layer and hence is differentiated from the present genus. *Schizaeoisporites* Potonié, 1951 emend. Potonié, 1960 and *Cicatricosisporites* (Thomson & Pflug, 1953) *ex* Krutzsch, 1959 although apparently resemble the present genus, have monolete mark and no intexinal layer separated. Therefore these two genera are distinguishable from the present genus. *Polycolpites* Couper, 1953 is different in having colpi rather than striations on the body.

Densostriapollis damudicus sp. nov.

Pl. 2, figs 29, 37; Text-fig. 2C

Holotype — Pl. 2, fig. 37, size 62 × 42 μm.

Locus Typicus — Bore-hole RD-1, sample no. 4, depth 532·8 m; Raniganj Coalfield, India.

Stratum Typicum — Mahadeva (Supra-Panchet) Formation; Middle Triassic.

Diagnosis — Oval-subcircular to perfectly oval with round ends. Size-range 52-70 × 42-62 μm. Striations 4-7, unbranched. Exine thin, infrapunctate with granular appearance at the lateral side-ends of shorter axis. Intexinal layer clear in most of the specimens occupying 2/3 of the total area of the spore.

Densipollenites Bharadwaj, 1962

Type Species — *Densipollenites indicus* Bharadwaj, 1962.

Densipollenites magnicorpus sp. nov.

Pl. 3, figs 46, 50; Text-fig. 4A

Holotype — Pl. 3, fig. 46, size 115 × 108 μm.

Locus Typicus — Sample no. S/ 7, section near Saburbandh Village, south of Damodar River; Raniganj Coalfield, India.

Stratum Typicum — Raniganj Formation; Upper Permian.

Diagnosis — Subcircular; central body big and dark brown, well-defined occupying 2/3 or more of the total pollen area, usually excentric. Saccus with few folds, thick muri and narrow meshes. Limbus not clearly defined but peripheral region thicker without a line of demarcation.

Comparison — *D. indicus* Bharadwaj 1962, *D. densus* Bharadwaj & Srivastava, 1969, *D. pullus* Segroves, 1969 and *D. brevis* Lele & Srivastava, 1977 — all these species with well-defined central body differ from the present species in possessing smaller central body in relation to the saccus. Other species of the genus have faintly visible to ill-defined body, hence different.

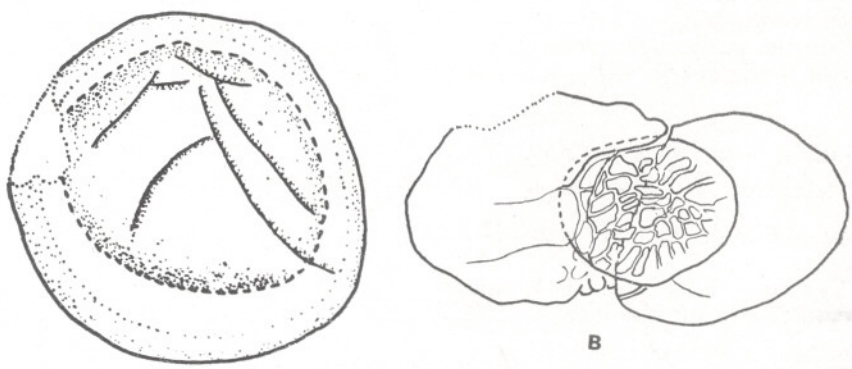
Goubinispora gen. nov.

Type Species — *Goubinispora indica* sp. nov.

Generic Diagnosis — Radially to bilaterally symmetrical, girdling monosaccate pollen. Central body circular to oval, distinct or indistinct; on one side having faint and indeterminate to clearly marked striations, on other side bearing " islands " and " strips " of partly separated exoexine — structurally comparable to the saccus. Saccus intrareticulate, mostly uneven in width, incipiently to markedly polylobed, usually equatorially attached at striate-side and variously encroaching the body — subequatorially on the other side.

Description — Pollen grains studied under this group are usually circular or subcircular; rarely circulo-triangular or bilaterally oval forms are also present. The tendency of the saccus to form lobes, 2 to 5 in number, distally pendate in nature and also with uniform width, is very important character. Beside the striations (well-defined or faint) the body is finely intrareticulate, but the opposite side bears irregular islands or even belts of exoexine which are more or less leathery like the saccus with thick muri but, of course, fine meshes. This clearly suggests that a partial and irregular separation of exoexine from intexine in the body polar regions has also taken place, as at the equatorial region to form saccus. The saccus shows variation in coarseness and the arrangement of intrareticulation.

Comparison — The genus *Striomonosaccites* Bharadwaj, 1962 resembles the present genus in being monosaccate and having striations on one polar face. However, in the former the saccus is unlobed, more or less uniformly wide and the exoexine is not at all separated as seen at the polar regions. In *Goubinispora* the " strips " and " islands " of exoexine on one of the sides indicate an intermediate stage between the condition of completely enveloping saccus (as in *Densipollenites*) Bharadwaj, 1962; *Bharadwajiapollis* Kar, 1969) on one hand and no tendency of exoexinal separation (as in *Striomonosaccites*) on the other. *Crustaesporites* Leschik (1956), as described originally, is trisaccate and has bands of thickened exine; in this respect it shows certain resemblance with the present genus but the former has no distal lobing of saccus, no exoexinal islands as well as no typical striations (see Goubin, 1965, p. 1421). Jansonius (1962) emended the diagnosis of this genus circumscribing it as a monosaccate pollen having slight distal encroachment of the saccus with



TEXT-FIG. 4 — **A.** *Densipollenites magnicorpus* sp. nov. Relatively big central body and a thick merging equatorial region depicted. *ca*× 430. **B.** *Rhizomaspora triassicus* sp. nov. Nature of reticuloid striations on the central body. *ca*× 425.

TEXT-FIG. 5 — **A.** *Goubinispora morondavensis* (Goubin) comb. nov. Nature of central body and striations; proximal view. **B.** Exoexinal islands and strips on central body in distal view and pattern of reticulation, some of the islands and saccus.

primary thickening and secondary folds along the zone of saccus attachment. There is no exoexinal covering on the distal face. These characters too, differentiate the genus *Crustaesporites* from *Goubinispora* gen. nov. *Distriomonosaccites* Bharadwaj, 1962 is different in having striations on both the polar areas. *Mahudapollenites* Bandyopadhyay, 1972 differs in having distinct striations on both the faces of the central body. Except for the tendency of polysaccate organization, *Mahudapollenites* resembles *Distriomonosaccites*.

Reconstruction — The saccus in *Goubinispora* gen. nov. is attached at ± equatorial region on one side but in varying degrees encroaches the subequatorial area on the other. The distal islands of exoexine are partly developed and not fully blown. A generalized reconstruction is given in Text-fig. 6A-C on the basis of the observation of a number of specimens showing variation.

Goubinispora indica sp. nov.

Pl. 4, figs 57, 58, 63; Text-fig. 6A, B

Holotype — Pl. 4, fig. 58, size 144·5 × 192·5 μm.

Locus Typicus — Bore-hole RD-1, sample no. 4, depth 532·48 m; Raniganj Coalfield, India.

Stratum Typicum — Mahadeva (Supra-Panchet) Formation; Middle Triassic.

Diagnosis — Pollen grains big, 90-198 μm, circular to subcircular with lobed appearance of the outline. Central body 45-130 μm, thin, usually distinct, sometimes indistinct, proximally bearing 12-22 simple, rarely forked striations, distinct, or not well-defined but determined only at places, distally small or big subcircular to irregular patches (islands) or elongated strips of exoexine 18-36 μm wide, bearing intrareticulate structure. Saccus fully developed equatorially, distinctly lobed, pendant distally and encroaching in the form of lobes subequatorially on distal region reaching 10-35 μm inside the body equator but never covering the same entirely; intrareticulation of saccus coarse, muri 1-2 μm thick, meshes 5-12 μm wide, polygonal with mostly wavy muri.

Remarks — This species is characterized by coarse reticulation of the saccus having wavy muri binding polygonal, big meshes. Besides, the lobing in most of the specimens is very distinct and the distal encroachment of saccus is through lobes.

Goubinispora morondavensis (Goubin) comb. nov.

Pl. 3, figs 54, 55; Text-fig. 5A, B

Synonym — *Striomonosaccites morondavensis* Goubin, 1965.

Holotype — Goubin, 1965, Pl. 1, fig. 5.

Paratype — Goubin, 1965, Pl. 1, fig. 6.

Locus Typicus — LD I, 1960 m, Morondava Basin, Madagascar.

Age — Middle Triassic.

Emended Diagnosis — Subcircular with lobing tendency of saccus; 107-170 μm. Central body thin, distinct, 50-95 μm bearing faint to distinct 10-20 striations. Distally saccus lobes encroach the body entering 10-20 μm inside the body equator. At Distal polar region, islands of exoexine irregular, in between them the body exine finely intrareticulate. Saccus irregular in width, lobing at outline and distally, finely intrareticulate, meshes 1-2 μm, muri 1 μm thick, straight.

Comparison — *G. india* the type species, differs from *G. morondavensis* in having coarse reticulation of saccus with broader meshes and thicker wavy muri.

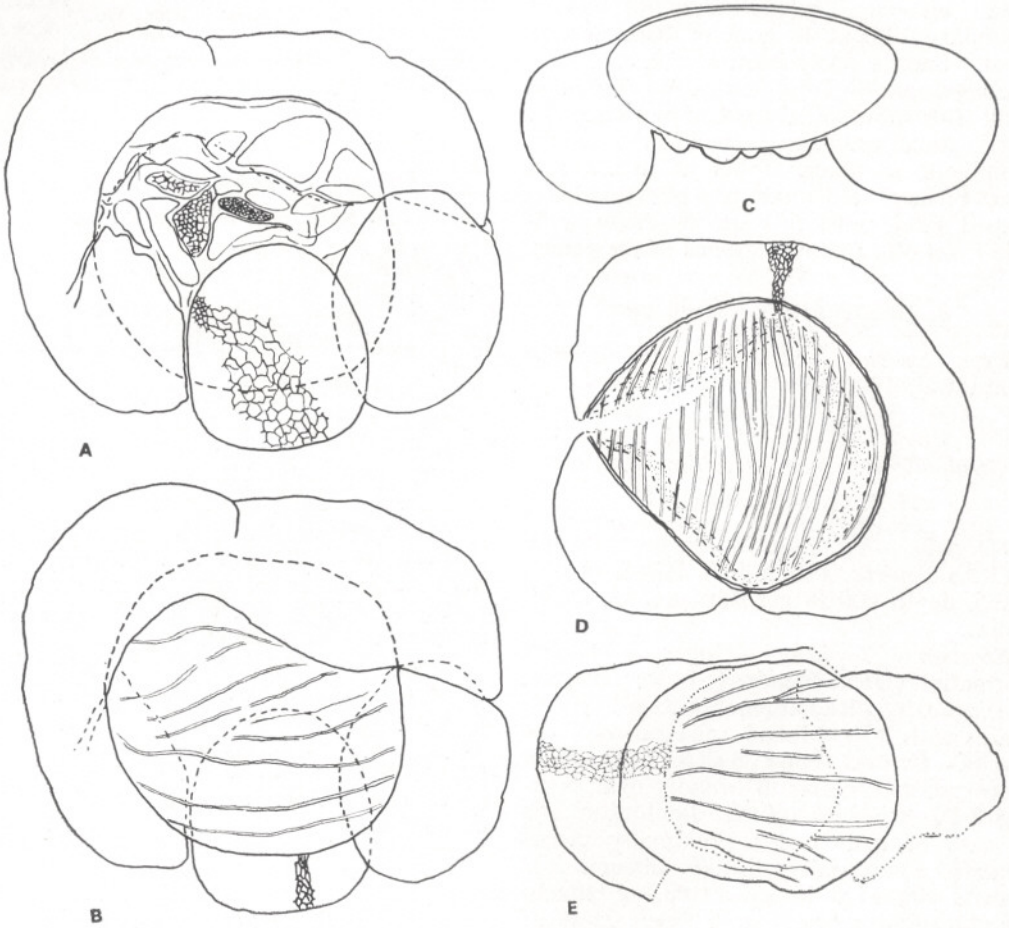
Lunatisporites Leschik, 1955 emend. Bharadwaj, 1974

Type Species — *Lunatisporites acutus* Leschik, 1955.

Lunatisporites asansoliensis sp. nov.

Pl. 4, figs 59, 61; Text-fig. 1D

Holotype — Pl. 4, fig. 59, size 66 × 60 μm.



TEXT-FIG. 6 — **A.** *Goubinispora indica* sp. nov. Nature of ' islands ' of exoexine on central body in distal view and pattern of reticulation in some of the islands and a part of saccus lob. *ca* × 475. **B.** *Goubinispora indica* sp. nov. Nature of lobing in saccus and striations on central body; proximal view. **C.** *Goubinispora* gen. nov. Meridional section showing un-uniformly blown saccus, the nature of distal exoexinal islands and the central body. **D.** *Striapollenites monosaccoides* sp. nov. showing biconvex tendency of the distal saccus free area, proximal striations and nature of saccus. Proximal view. *ca* × 620. **E.** *Striatites panchetensis* sp. nov. showing the tendency of striations, nature of central body and the saccus. *ca* × 800.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Mainly haplo- to slightly diploxylonoid pollen. Central body vertically elongated with trepazoid tendency of shape, 43 × 54 μm in holotype, equatorial rim 3-6 μm thick alround the body; number of taeniae observed 3-4, finely intrapunctate. Sacci somewhat kidney-shaped, laterally slightly apart from each other, apparently not fully blown, forming 15-27 μm wide distal biconvex sulcus with prominent secondary folds at the zone of distal attachment. Saccus finely intrareticulate.

Comparison — The vertically elongated body with rhomboidal tendency of shape, a thick equatorial rim around the body, prominent semilunar folds at attachment zones of sacci, and small, less-blown kidney-shaped sacci make this species distinguishable from other known species of the genus.

Striapollenites Bharadwaj, 1962

Type Species — *Striapollenites saccatus* Bharadwaj, 1962.

Striapollenites monosaccoides sp. nov.

Pl. 4, fig. 56; Text-fig. 6D

Holotype — Pl. 4, fig. 56, size 96 × 84 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Radial monosaccoid pollen grains with 3 or 4 lobed appearance of the saccus. Central body distinct, 66 μm in holotype, subcircular to broadly oval, bearing 8-20 striations, along the longer axis in case of oval body; proximally saccus attached equatorially, distally subequatorial with a somewhat biconvex type of attachment leaving a broad area free. Zone of attachment distinct, may be thickened. Saccus intrareticulation fine.

Comparison & Remarks — Basically the genus *Striapollenites* was proposed to accommodate disaccate, vertically striated pollen (Bharadwaj, 1962). A group of pollen, however, shows lobed monosaccoid construction of sacci but with a biconvex type (disaccate type) of distal saccus-free area. Such specimens have been also illustrated by Bharadwaj (1962, pl. 22, figs 276-278) which now find their place in *S. monosaccoides* sp. nov.; *S. saccatus* Bharadwaj, 1962 is distinctly disaccate with vertically elongate central body. From the species of *Striomonosaccites* Bharadwaj, 1962, the present species differs in having biconvex tendency of the distal saccus free area. In the former it is circular — a typical monosaccate type.

Rhizomaspora Wilson, 1962

Type Species — *Rhizomaspora radiata* Wilson, 1962.

Rhizomaspora triassica sp. nov.

Pl. 5, figs 65, 71; Text-fig. 4B

Holotype — Pl. 5, fig. 65, size 120·0 × 89·5 μm.

Locus Typicus — Bore-hole RD-1, sample no. 4, depth 532·48 m; Raniganj Coalfield, India.

Stratum Typicum — Mahadeva (Supra-Panchet) Formation; Middle Triassic.

Diagnosis — Diploxylonoid with big sacci. Central body subcircular to oval, 57 × 54 μm in holotype, thin, distinct, bearing distinct, reticuloid striations on the proximal side. Distally the saccus-free-area narrow. Laterally sacci close to each other. Intrareticulation of sacci coarse with 2-3 μm wide meshes, and thick muri.

Comparison — *R. triassica* sp. nov. differs from *R. costa* Venkatachala & Kar, 1968 in having thinner central body, bigger size range, and coarser saccus reticulation. *R. biharia* Maheshwari & Banerji, 1975 is also small with oval body having biconvex, well-defined sulcus.

Rhizomaspora sp.

Pl. 5, fig. 75

Description — Diploxylonoid, 118 × 66 μm. Central body subcircular, 63 × 53 μm. Reticuloid striations subparallel, brick-work pattern in the centre, irregular towards periphery of the central, body. Distal

saccus-free- area ± straight, 24 μm wide, secondary folds present along the saccus attachment zone. Sacci spherical, laterally widely apart, with medium to coarse intra-reticulation.

Comparison — Rhizomaspora biharia Maheshwari & Banerji, 1975 has biconvex sulcus and laterally close sacci; *R. costa* Venkatachala & Kar, 1968 possesses a narrow ill-defined sulcus and laterally close sacci. *R. divericata* Wilson, 1962 resembles in the nature of subparallel ribs but is smaller and has much bigger sacci in comparison to the central body. *R. singula* Tiwari, 1965 although possesses subparallel striations, differs in having smaller sacci, bigger body with equatorial rim, and laterally close or even continuous sacci.

Striatopodocarpites Sedova, 1956

Type Species — Striatopodocarpites tojmensis Sedova, 1956.

Remarks — Lunatisporites Leschik, 1955 incorporates *Taeniaesporites* Leschik, 1955 as a synonym on the basis of similarities in organization, nature of taeniae and other characters (Scheuring, 1970; Bharadwaj & Tiwari, 1977). The species with lunar folds along the saccus roots, earlier described under *Lunatisporites*, have now been accommodated in *Crescentipollenites* Bharadwaj, Tiwari & Kar, 1974 (Bharadwaj & Tiwari, 1977, p. 39). Their inclusion in '*Gondwanipollenites*' by Maheshwari and Banerji (1975, p. 164) is not acceptable because of the distinctive nature of the lunar folds along the zone of saccus attachment at the distal side of the body in them; these folds, although secondary in nature, are formed due to organizational construction of the body and definitely are not formed at random. The researches on *Lunatisporites* (Scheuring, 1970) have now established, beyond doubt, that *Striatopodocarpites* is not a synonym of *Lunatisporites*.

Striatopodocarpites gopadensis
(Bharadwaj & Srivastava) comb. nov.

Pl. 5, fig. 66

Synonym — Lunatisporites gopadensis Bharadwaj & Srivastava, 1969.

Holotype — Bharadwaj & Srivastava, 1969, pl. 25, fig. 29.

Locus Typicus — Nidpur, Sidhi District, Madhya Pradesh, India.

Age — Triassic (?Upper).

Remarks — The specimens assigned to this species by Bharadwaj and Srivastava (1969, pl. 25, figs 29-31) do not possess taeniate body, hence they do not belong to the genus *Lunatisporites*. They neither show the presence of lunar folds at the zone of saccus attachment and therefore are not referable to *Crescentipollenites*. This new combination is proposed here in view of the characters of this species answering to the generic circumscription of *Striatopodocarpites*.

Striatopodocarpites oblongatus
(Bose & Maheshwari, 1968) comb. nov.

Pl. 5, fig. 78

Synonym — Gondwanipollenites oblongatus Bose & Maheshwari, 1968.

Holotype — Bose & Maheshwari, 1968, pl. XX, fig. 1, size 192 × 168 μm.

Locus Typicus — Luanda, after the fall (about 3·56 m thick exposure in river bed).

Age — Permian

Remarks — Striatopodocarpites being an acceptably well-defined genus very well accommodates this species, hence transferred here.

Striatites Pant emend. Bharadwaj, 1962

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

Striatites panchetensis sp. nov.

Pl. 6, figs 91, 94; Text-fig. 6E

Holotype — Pl. 6, fig. 94, size 72×48 μm.

Locus Typicus — Bore-hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Somewhat diploxylonoid, with small sacci, 72-108 μm. Central body ± circular, thick, 44-65 μm, smooth to microverrucose bearing 5-7 horizontal striations, no vertical partition; tendency of taeniae formation at places. No equatorial rim. Sacci narrow, distally leaving not well-marked, wide area free, laterally connected

with each other by 1-2 μm wide strips, finely intrareticulate.

Comparison & Remarks — Among the comparable species, *S. communis* Bharadwaj & Salujha, 1964 differs in having thinner central body and a well-defined biconvex sulcus; *S. densus* Maithy, 1965 although possess a dense, rim-less body, has much bigger sacci. As mentioned above, a tendency of striations to appear as taeniae at places has been noticed in this species. This trend in striate pollen found in the Triassic sediments has been marked in other species too.

Crescentipollenites Bharadwaj, Tiwari & Kar, 1974

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

Crescentipollenites bengalensis (Maheshwari & Banerji, 1975) comb. nov.

Pl. 6, fig. 80

Synonym — *Gondwanipollenites bengalensis* Maheshwari & Banerji, 1975.

Holotype — Maheshwari & Banerji, 1975, pl. 5, fig. 73, size 55 × 87·5 μm,

Locus Typicus — North-western branch of Nonia Nala, East of Kumarpur, District, Burdwan, West Bengal.

Stratum Typicum — Maitur Formation, Lower Triassic.

Description & Remarks — Size 84 × 42 μm. Central body vertically oval, 36 × 42 μm. Horizontal striations 7, some bifurcated. Distal sulcus 22 μm wide, laterally 15 μm apart sacci. Lunar folds present along the zone of saccus attachment. By virtue of the presence of lunar folds at the saccus attachment zones, this species has been transferred here to the genus *Crescentipollenites*.

Crescentipollenites sp.

Pl. 5, fig. 68

Description & Remarks — Haploxylonoid, 78 × 54 μm. Central body rhomboidal, distinct thick, 57 × 48 μm bearing 5 faint horizontal striations, semilunar folds at the zones of sacci attachment distinct, 5-8·5 μm wide. Distal sulcus 31 μm wide in the centre, more or less straight. Sacci less than hemispherical, laterally 18 μm apart, finely intrareticulate.

This specimen is not comparable with any of the known species.

***Alisporites* Daugherty emend. Nilsson, 1958**

Type Species — *Alisporites opii* Daugherty, 1941.

Alisporites damudicus sp. nov.

Pl. 6, figs 90, 92; Text-fig. 3D

Holotype — Pl. 6, fig. 90, size 90 × 97·5 μm.

Locus Typicus — Bore-hole RD-1, sample no. 4, depth 532·48 m; Raniganj Coalfield, India.

Stratum Typicum — Mahadeva (Supra-Panchet) Formation; Middle Triassic.

Diagnosis — Subcircular pollen with notched lateral sides. Central body apparently vertically oval, thin, without a marked out line. Sacci reniform, narrow, laterally rounded and distally close to each other, finely intrareticulate.

Comparison — *Alisporites opii* Daugherty, 1941 has a distinct body and subspherical sacci. *A. landianus* Balme, 1970 is bilateral with wider sulcus and broader sacci. Other species of this genus also do not possess the reniform sacci.

***Cuneatisporites* Leschik, 1955**

Type Species — *Cuneatisporites radialis* Leschik, 1955.

Cuneatisporites mirabilis sp. nov.

Pl. 5, fig. 73; Pl. 6, fig. 85; Text-fig. 3C

Holotype — Pl. 6, fig. 85, size 96 × 56·5 μm.

Locus Typicus — Bore hole RD-1, sample no. 5, depth 600·58 m; Raniganj Coalfield, India.

Stratum Typicum — Upper Panchet Formation (Deoli Member); Lower Triassic.

Diagnosis — Slightly diploxylonoid; 96 × 54 μm. Central body big, subcircular, dense, 52 × 52 μm, finely intramicropunctate. Sacci hemispherical, distal sulcus slightly biconvex, 32 μm wide, zone of saccus attachment well-defined, associated with semilunar folds, laterally 24 μm apart. Intrareticulation of sacci coarse.

Comparison — Among the comparable species — having circular central body — *C. circularis* Kar & Bose, 1976 has a ledged central body; *C. fundiensis* Bose & Kar, 1966 has also a big subcircular sulcus and laterally continuous sacci; *C. rotatus* Lele & Kulkarni, 1969 possesses a narrow sulcus, without folds at the attachment zones.

Cuneatisporites sp.

Pl. 6, fig. 88

Description & Remarks — Disaccate, diploxylonoid pollen with vertically oval to rhomboidal central body. Distal sulcus well-defined, biconvex, 10-26 μm wide. Sacci with coarse intrareticulation meshes 6-12 μm wide. The coarseness of the saccus intrareticulation, although normally a diagnostic feature, seems to be secondary in nature in these specimens.

***Graminoides* Goubin, 1965**

Type Species — *Graminoides cernes* Goubin, 1965.

Graminoides sp. cf. *G. cernes* Goubin, 1965

Pl. 5, fig. 67

Description — Circular, 65 μm. Exine thick, dark brown, thickness not defined at equator. Exine bearing wrinkles to rugulae all over the body. Pore not clear.

Remarks — The specimens assigned to *G. cernes* by Goubin, 1965 have a pore and 3 μm thick exine while the present specimen does not have any of these characters. In the nature of rugulae, however, they are similar.

OCCURRENCE OF SPECIES AND QUALITATIVE COMPOSITION

The distribution of various species is shown in Table 1. The materials from three localities are not sequential in continuity with respect to each other, therefore it is not intended here to discuss the succession of the miofloras; yet the occurrence of some of the important species, individually as well as in group, needs a qualitative assessment for comparison and relative positioning of the recovered miofloras.

Locality 1 — Saburbandh Village, section in a Tributary of Damodar River, South of Damodar River, East Raniganj Coalfield.

Sample no. S/6 and S/7 — The samples are carbonaceous shales and contain the species as shown in Table 1.

This composition of species clearly indicates its affinities with the uppermost miofloral zone of Raniganj Formation in this region; the prominence of striate-disaccate and *Densipollenites* spp. is a strong proof for such conclusion (Tiwari, 1977, 1979; Table 2). The rare occurrence of *Lundbladispora brevicula*, *Indotriradites cuspidus*, *Graminoides* sp. is a record of new coming elements and, hence, this mioflora becomes close to Raniganj/Panchet boundary. Lithological observations in the field also support this conclusion.

Sample no. S/10 and S/11 — These samples are khaki-green shales and were collected from the lowermost sequence of such lithology, just above the Upper Permian carbonaceous sediments (i.e. sample no. S/6 & S/7); obviously they represent the lowermost strata (Maitur Member) in the Panchet Formation (Lower Triassic). The distribution of species significant for the mioflora in sample no. S/10 and S/11 is shown in Table 1.

Quantitatively, at the generic level the genera *Striatopodocarpites*, *Lunatisporites*, *Verrucosisporites* and *Lundbladispora* are abundant (Table 2). Qualitatively, at the specific level, the composition is similar to that of other Lower Triassic sediments from this region (Bharadwaj & Tiwari, 1977). It is therefore concluded that at the Permo-Triassic boundary, in this region, the predominance of a certain striate-disaccate genera — a characteristic feature of the Upper Permian — continues in the Lower Triassic sediments but at the same time there is a definite qualitative change at the specific level and a sudden incoming of cavate triletes.

Locality 2 — Bore hole RD/1 near Durgapur, East Raniganj Coalfield. The bore-hole has been put near the eastern limits of East Raniganj Coalfield and is separated from Saburbandh region (discussed above as locality 2) by about 100 km.

Sample no. RD 1/5 — Depth from the surface 600·58 m. Dark-greenish grey siltstone.

TABLE 1 — DISTRIBUTION OF MIOSPORE SPECIES IN THE SAMPLES FROM SABURBANDH NALA, BORE-HOLE RD-1 (RANIGANJ COALFIELD) AND DHARDHARIA NALA (WEST BOKARO COALFIELD)

Miospore species	Raniganj Coalfield						West Bokaro Coalfield
	Saburbandh Nala				Bore-hole RD-1		
Sample No.	S/6	S/7	S/10	S/11	RD 1/5+RD 1/4		Dhardharia Nala Dh/1
Graminoides sp. cf. *G. cornus*	+						
Rhizomaspora costa	+						
Lophotriletes rectus	+						+
Thymospora gondwanensis	+						+
Brevitriletes communis	+	+					
Densipollenites densus	+	+					
Densipollenites invisus	+	+					
Lahirites	+	+					
Striatites subtilis	+	+					
Verticipollenites secretus	+	+					
Hindipollenites indicus	+	+					
Ibisporites diplosaccus	+	+					
Striatopodocarpites crassistriatus	+	+					
Parasaccites invasus	+	+				+	
Crescentipollenites bengalensis	+	+			+	+	+
Striatopodocarpites labrus	+	+	+	+		+	
Crescentipollenites fuscus	+	+	+	+		+	+
Faunipollenites varius	+	+	+	+		+	+
Striatopodocarpites oblongatus	+	+	+	+	+	+	+
Scheuringipollenites maximus	+	+	+	+	+	+	+
Lundbladispora brevicula		+	+	+			
Rhizomaspora triassica		+				+	
Densipollenites magnicorpus		+					
Indotriradites cuspidus		+			+		+
Pyramidosporites racemosus			+	+			+
Aratrisporites fischeri			+	+			
Callumispora fungosa			+	+			
Verrucosisporites bosei			+	+	+		
Verrucosisporites triassicus			+	+	+		
Lunatisporites pellucidus			+	+	+		+
Playfordiaspora cancellosa			+	+	+		
Lunatisporites asansoliensis			+	+	+		+
Verrucosisporites narmianus			+		+		
Lunatisporites noviaulensis			+		+		+
Lunatisporites rhombicus			+	+		+	+
Chordasporites raniganjensis			+	+	+	+	+
Alisporites indicus			+	+	+	+	+
Cuneatisporites sp.			+	+	–	+	
Lundbladispora raniganjensis			+	+	+		+
Callumispora gretensis			+	+	+	+	+
Cuneatisporites mirabilis			+		+		+
Densoisporites contactus				+	+	+	+
Densoisporites playfordi				+	+	+	+
Klausipollenites schaubergeri				+	+	+	
Indotriradites mammilatus				+	+		+
Lundbladispora sp.					+		+
Inaperturopollenites nebulosus				+	+		+
Indotriradites wargalensis					+		+
Orbella indica					+		
Lundbladispora warti					+		
Ringosporites ringus					+		
Potonieitriradites cf. *P. subtilis*					+		
Microfoveolatispora foveolata					+		
Lacinitriletes minutus					+		
Brevitriletes communis					+		

TABLE 1 — DISTRIBUTION OF MIOSPORE SPECIES IN THE SAMPLES FROM SABURBANDH NALA, BORE-HOLE RD-1 (RANIGANJ COALFIELD) AND DHARDHARIA NALA (WEST BOKARO COALFIELD) — *Contd*

Miospore species	Raniganj Coalfield					West Bokaro Coalfield
	Saburbandh Nala				Bore-hole RD-1	
Sample No.	S/6	S/7	S/10	S/11	RD 1/5+RD 1/4	Dhardharia Nala Dh/1
Osmundacidites pilatus					+	
Weylandites circularis					+	
Lunatisporites ovatus					+	
Rhizomaspora sp.					+	
Striapollenites monosaccoides					+	
Striatopodocarpites gopadensis					+	
Striatites panchetensis					+	
Falcisporites stabilis					+	
Araucariacites australis					+	
Ringosporites fossulatus					+ +	
Cyathidites australis					+ +	
Novitasporites triangularis					+ +	
N. triassicus					+ +	+
Cyclogranisporites gondwanensis					+ +	+
Praeticolpipollenites bharadwajii					+ +	+
Goubinispora indica					+ +	
G. morondavensis					+ +	
Platysaccus queenslandi					+ +	
Pinuspollenites thoracatus					+ +	
Densostriapollis damudicus					+	
Parasaccites distinctus					+	
Vitreisporites pallidus					+	
Pilasporites plurigenus						+

Quantitatively, the genera *Lunatisporites*, *Osmundacidites*, and *Verrucosisporites* are important (Table 2). The species recorded here are comparable with those found in Sample no. Dh/1, to a greater extent. However, the presence of the species of *Ringosporites*, *Novitasporites*, *Verrucosisporites*, *Playfordiaspora*, *Weylandites*, *Goubinispora*, *Satsangisaccites*, *Klausipollenites*, *Falcisporites*, *Pinuspollenites*, *Araucariacites*, give a qualitative differentiation to the mioflora of sample RD 1/5 and also an younger aspect than the Dh/1 mioflora. This mioflora, on the whole, represents a late Lower Triassic assemblage.

Sample no. RD 1/4 — Depth from the surface 532·48 m. Light grey, coarse sandstone with coalstreaks. This sample, being 68·10 m above the sample no. RD 1/5, contains a qualitatively as well as quantitatively distinct mioflora having less diversified or even missing representation of the species belonging to the important genera — *Lundbladispora*, *Densoisporites*, *Indotriradites*, *Verrucosisporites*, *Osmundacidites*, *Playfordiaspora*, and *Lunatisporites*. On the other hand, *Densostriapollis*, *Parasaccites*, and *Vitreisporites* are exclusively present in this sample (Table 1). The more significant record is the prominence of *Goubinispora*, *Pretricolpipollenites*, *Novitasporites*, *Densostriapollis*, *Ringosporites*, *Densoisporites* and *Cedripites* in comparison to that in sample RD 1/5.

This change in kind and also in number of a set of miospore taxa, amounts to a significant miofloral alteration, hence supports the view that the mioflora of RD 1/4 is an indicator of Middle Triassic age (see Tiwari, 1979). Since this sample is younger to sample RD 1/5, lithologically different and palynologically identifiable, it has been assigned to Mahadeva (Supra-Panchet) Formation.

Locality 3 — Dhardharia Nala, West Bokaro Coalfield, Sample no. Dh/1. Dhardharia Nala originates from Lugu Hill in West Bokaro Coalfield and cuts across

TABLE 2 — RELATIVE ABUNDANCE OF IMPORTANT MIOSPORE GENERA IN THE ASSEMBLAGES UNDER STUDY

(* rare; ** common; *** abundant; **** prominent).

MIOSPORE GENERA	RANIGANJ COALFIELD			WEST BOKARO COALFIELD	
Sample	S/6+S/7	S/10+S/11	RD 1/5	RD 1/4	Dh/1
Hindipollenites	***				
Verticipollenites	***				
Densipollenites	***				*
Thymospora	*				
Striatites	***			*	
Faunipollenites	***	**		*	***
Crescentipollenites	***	**	**	*	***
Striatopodocarpites	****	***	***	**	**
Indotriradites	*	*	***		***
Lundbladispora	*	****	***		***
Lunatisporites		****	****	**	****
Verrucosisporites		****	***		
Chordasporites		***	*		***
Callumispora		***	*	*	***
Alisporites		**	*	*	***
Osmundacidites		**	***	***	***
Klausipollenites		**	*	***	
Playfordiaspora		**	*		*
?Aratrisporites		*	**		
Densoisporites		*	*		* ?
Pyramidosporites		*			*
Pretricolpipollenites			**	****	*
Ringosporites			**	***	
Novitasporites			*	***	
Goubinispora			*	***	
Falcisporites			*		
Densostriapollis				***	
Vitreisporites				*	
Weylandites				*	*
Cedripitys				*	*

Supra-Panchet (Lower Triassic), and Upper Raniganj (Upper Permian) formations. At the base of this hill (West of Jurwa Village), red shale, khaki shale and mica sandstone of Panchet Formation are exposed. Sample no. Dh/1, from which the sporae dispersae have been described here, is a khaki shale, the bed is exposed quite above the Raniganj-Panchet boundary and represents Upper Panchet Formation.

Table 1 exhibits the presence of following important species in this bed which characterize the assemblage to be of early Triassic age (Upper Panchet Formation; Deoli Member): *Lundbladispora brevicula*, *L. raniganjensis*, *Densoisporites playfordi*, *D. contactus*, *Indotriradites wargalensis*, *I. mammilatus*, *Osmundacidites senectus*, *Callumispora gretensis*, *Lunatisporites noviaulensis*, *L. rhombicus*, *L. asansoliensis*, *L. pellucidus*, *Chordasporites raniganjensis*, *Pretricolpipollenites bharadwajii*, *Pyramidosporites racemosus*.

Some species, such as *Lophotriletes rectus*, *Cyclogranisporites gondwanensis*, *Thymospora gondwanensis*, *Striatopodocarpites oblongatus*, *Crescentipollenites fuscus*, *Scheuringipollenites maximus* are the Upper Permian (Raniganj Formation) elements which continue to be present in this assemblage also. Obviously this mioflora shows the preponderance of *Lunatisporites* and *Densoisporites* species (Taeniate and cingulate-zonate forms; Table 2). In the presence of *Lunatisporites* it resembles the mioflora from sample group 2 (NP-9, NP-1 & NP-2) of Nonia Nala section (Banerji & Maheshwari, 1974) and Assemblage I (samples 5, 7) from Bore-hole NCRD-6 in Dishergarh block of Raniganj Coalfield (Bharadwaj & Tiwari, 1977). From the latter, however, it differs in the paucity of *Verrucosisporites*. In the

Salt Range (Balme, 1970), the Narmia Member and Mittiwali Member (Mainwali Formation; Lower Triassic) have maximum specific resemblance with the present mioflora.

It is, therefore, concluded that khaki shales immediately below the red shale, at the base of Lugu Hill in West Bokaro Coalfield are middle to late Lower Triassic; qualitatively and quantitatively, this is younger to sample nos. S/10 and S/11 and older to RD 1/5 mioflora discussed above (Tables 1, 2).

CONCLUSIONS

On the basis of the analysis the following observations have been surmised.

1. The upper reaches of Raniganj Formation in the middle region of Raniganj Coalfield is characterized by the dominance and diversification of striate-disaccate and *Densipollenites* species and paucity of zonate-cingulate (cavate), *Verrucosisporites*, *Callumispora*, *Lunatisporites* species, along with the absence of certain significant species given in Table 1 (S/6, S/7), which are diagnostic of the younger horizons.

2. The lowermost mioflora of Triassic in this region (Table 1, S/10, S/11), though still exhibits quantitative dominance of striate-disaccates, records a decline in diversity of this group. The proliferation of cingulate-zonate species is very significant; along with this, impressive occurrence of *Verrucosisporites*, *Callumispora*, non-striate-disaccate, *Lunatisporites*, *Pyramidosporites racemosus*, *Playfordiaspora cancellosa* and *Aratriporites fischeri* is further added to this change. The absence of *Densipollenites* spp. is not insignificant.

3. The Lower Triassic khaki-green shale analysed here from West Bokaro Coalfield is closely comparable with that of Saburbandh (S/10, S/11) in qualitative composition of species but for that the former has a predominance of *Lunatisporites* rather than *Striatopodocarpites* of the latter. Specifically also, the West Bokaro mioflora (Dh/1) is relatively younger to the Saburbandh (S/10 & S/11) mioflora.

4. Bore hole RD-1 represents the Triassic formations in the far-eastern region of Raniganj Coalfield. RD 1/5 seems to be the culmination of the Lower Triassic mioflora — discussed here as well as the other so far known assemblages in this region, on account of its qualitative completeness in kinds of species characteristic for Lower Triassic (Table 1); this is also true due to the introduction of new elements, although rare — as normally

TABLE 3 — RELATIVE POSITIONING OF MIOSPORE ASSEMBLAGES DESCRIBED HERE

	Formation/ Member	West Bokaro Coalfield (near Lugu Hill) Khaki green shale just below red shale	Raniganj Coalfield South of Damodar River (central region) Saburbandh	Raniganj Coalfield Bore hole RD-1 Far eastern region, near Durgapur
Middle Triassic (early)	Mahadeva (Supra-Panchet)			Miospore-Assemblage in Sample RD 1/4
Lower Triassic	PANCHET Deoli Member	Miospore Assemblage in Sample Dh/1		Miospore Assemblage in Sample RD 1/5
	PANCHET Maitur Member		Miospore Assemblage in Sample S/10 & S/11	
Upper Permian (late)	Raniganj Fm.		Miospore Assemblage in Sample S/6 & S/7	

expected, such as *Ringosporites fossulatus*, *R. ringus*, *Novitasporites triassicus*, *N. triangularis*, *Goubinispora indica*, *G. morondavensis*, *Satsangisaccites* spp., *Falcisporites stabilis*, *Pinuspollenites thoracatus*, *Pretricolpipollenites bharadwajii*.

In the diversification and dominance of *Lunatisporites* spp. this flora is similar to that from West Bokaro (Dh/1) but the above listed newer elements give it a relatively younger aspect with respect to the latter.

5. The Bore-hole Sample RD 1/4 has the prominence of those rare taxa which — as listed above — were newly introduced in RD 1/5 (Table 2). There is considerable decline of *Lunatisporites*, cingulate-zonates, striates, and apiculates. The outstanding prominence of *Goubinispora*, *Pretricolpipollenites*, *Densostriapollis*, *Ringosporites* and *Novitasporites* separates this flora from the so far known Lower Triassic (Panchet Formation) assemblages, and hence assigned to Middle Triassic (cf. Goubin, 1970). This strata being sequential to Panchet Formation, has been designated as Mahadeva (Supra-Panchet) Formation.

The relative positioning of the miofloras studied here is as given in Table 3.

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EXPLANATION OF PLATES

PLATE 1

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

1. *Orbella indica* sp. nov., slide no. BSIP 5636 (Holotype). ×900.
2, 3, 5. *Lundbladispora raniganjensis* sp. nov., slide nos BSIP 5638, 5640 (Holotype), 5639.
4. *Lundbladispora warti* sp. nov., slide no. BSIP 5639 (Holotype).
6. *Lundbladispora brevicula* Balme, 1970, slide no. BSIP 5947.
7, 9. *Lundbladispora* sp., slide nos BSIP 5638, 5640.
8. *Densoisporites playfordii* Balme, 1970, slide no. BSIP 5641.
10. *Potonieitriradites* sp. cf. *P. subtilis* Sinha, 1972, slide no. BSIP 5636.
11, 13. *Densoisporites contactus* Bharadwaj & Tiwari, 1977, slide no. BSIP 5946.
12. *Cyathidites australis*, Couper, 1953, slide no. BSIP 5639.
14, 18. *Indotriradites cuspidus* (Balme) Bharadwaj & Tiwari, 1977, slide nos BSIP 5636, 5638.

15. *Indotriradites wargalensis* (Balme) Bharadwaj & Tiwari, 1977, slide no. BSIP 5636.
16, 21, 23. *Ringosporites fossulatus* (Balme) comb. nov., slide nos BSIP 5638 5639.
17, 20, 22. *Ringosporites ringus* sp. nov., slide nos BSIP 5642 (Holotype), 5641, 5636.
19. *Indotriradites mammilatus* Bharadwaj & Tiwari, 1977, slide no. BSIP 5640.
24, 25. *Novitasporites triassicus* sp. nov., slide nos BSIP 5630, 5629.

PLATE 2

26. *Novitasporites triassicus* sp. nov., slide no. BSIP 5627 (Holotype).
27, 28, 33. *Novitasporites triangularis* sp. nov., slide nos BSIP 5626, 5636, 5626 (Holotype).
29, 37. *Densostriapollis damudicus* sp. nov., slide nos BSIP 5623, 5626 (Holotype).
30. *Osmundacidites pilatus* sp. nov., slide no. BSIP 5641 (Holotype).
31. *Lacinitriletes minutus* Venkatachala & Kar emend. Tiwari & Singh, 1981, slide no. BSIP 5640.
32. *Cyclogranisporites gondwanensis* Bharadwaj & Salujha, 1965, slide no. BSIP 5625.
34. *Verrucosisporites narmianus* Balme, 1970, slide no. BSIP 5643.
35. *Verrucosisporites bosei* Maheshwari & Banerji, 1975, slide no. BSIP 5640.
36. *Microfoveolatispora foveolata* Tiwari, 1965 emend. Tiwari & Singh, 1981, slide no. BSIP 5643.
38. *Osmundacidites senectus* Balme, 1963, slide no. BSIP 5629.
39. *Densipollenites densus* Bharadwaj & Srivastava, 1969, slide no. BSIP 5948.
40. *Callumispora gretensis* (Balme & Hennelly) Bharadwaj & Srivastava, 1969, slide no. BSIP 5947.
41. *Verrucosisporites triassicus* Bharadwaj & Tiwari, 1977, slide no. BSIP 5638.
42. *Callumispora fungosa* (Balme) Bharadwaj & Srivastava, 1969 emend. Bharadwaj & Tiwari, 1977, slide no. BSIP 5947.
43. *Densipollenites invisus* Bharadwaj & Salujha, 1964, slide no. BSIP 5948.
44. *Brevitriletes communis* Bharadwaj & Srivastava, 1969 emend. Tiwari & Singh, 1981, slide no. BSIP 5640.
45. *Weylandites circularis* Bharadwaj & Srivastava, 1969, slide no. BSIP 5650.

PLATE 3

46, 50. *Densipollenites magnicorpus* sp. nov., slide nos BSIP 5948 (Holotype), 5948.
47. *Lunatisporites rhombicus* Bharadwaj & Tiwari, 1977, slide no. BSIP 5639.
48. *Parasaccites distinctus* Tiwari, 1965, slide no. BSIP 5625.
49. *Lunatisporites noviaulensis* (Leschik, 1956) Scheuring, 1970 slide no. BSIP 5643.
51. *Parasaccites invasus* Tiwari, 1968, slide no. BSIP 5649.
52. *Playfordiaspora cancellosa* (Playford & Dettmann) Maheshwari & Banerji, 1975, slide no. BSIP 5641.
53. *Striomonosaccites ovatus* Bharadwaj, 1962, slide no. BSIP 5636.
54, 55. *Goubinispora morondavensis* (Goubin) comb. nov., slide no. 5631.

PLATE 4

56. *Striapollenites monosaccoides* sp. nov., slide no. BSIP 5641 (Holotype).
57, 58, 63. *Goubinispora indica* sp. nov., slide nos BSIP 5631, 5632 (Holotype), 5631.
59, 61. *Lunatisporites asansoliensis* sp. nov., slide nos BSIP 5637 (Holotype), 5638.
60. *Lunatisporites* (*Taeniaesporites*) *ovatus* (Goubin) Maheshwari & Banerji, 1975, slide no. BSIP 5642.
62. *Striatites subtilis* Bharadwaj & Salujha, 1964, slide no. BSIP 5948.

PLATE 5

64. *Rhizomaspora costa* Venkatachala & Kar, 1968, slide no. BSIP 5948.
65, 71. *Rhizomaspora triassica* sp. nov., slide nos BSIP 5629 (Holotype), 5632.
66. *Striatopodocarpites gopadensis* (Bharadwaj & Srivastava) comb. nov., slide no. BSIP 5639.
67. *Graminoides* sp. cf. *G. cernes* Goubin, 1965, slide no. BSIP 5949.
68. *Crescentipollenites* sp., slide no. BSIP 5636.
69. *Verticipollenites secretus* Bharadwaj, 1962, slide no. BSIP 5948.
70. *Crescentipollenites fuscus* Balme, 1970, slide no. BSIP 5948.
72. *Pretricolpipollenites bharadwajii* Balme, 1970, slide no. BSIP 5626.
73. *Cuneatisporites mirabilis* sp. nov., slide no. BSIP 5946.
74. *Araucariacites australis* Cookson, 1947, slide no. BSIP 5636.
75. *Rhizomaspora* sp., slide no. BSIP 5638.
76. *Klausipollenites schaubergeri* (Potonié & Klaus) Jansonius, 1962, slide no. BSIP 5641.
77. *Pyramidosporites racemosus* Balme, 1970, slide no. BSIP 5947.
78. *Striatopodocarpites oblongatus* (Bose & Maheshwari) comb. nov., slide no. BSIP 5637.

PLATE 6

79. *Lunatisporites pellucidus* (Goubin) Maheshwari & Banerji, 1975, slide no. BSIP 5636.
80. *Crescentipollenites bengalensis* (Maheshwari & Banerji) Comb. nov., slide no. BSIP 5637.
81. *Hindipollenites indicus* Bharadwaj, 1962, slide no. BSIP 5948.
82. *Platysaccus fuscus* Goubin, 1965, slide no. BSIP 5643.
83. *Inaperturopollenites nebulosus* Balme, 1970, slide no. BSIP 5641.
84. *Alisporites indicus* Bharadwaj & Srivastava, 1969, slide no. BSIP 5644.
85. *Cuneatisporites mirabilis* sp. nov., slide no. BSIP 5638 (Holotype).
86. *Scheuringipollenites maximus* (Hart) Tiwari, 1973, slide no. BSIP 5949.
87. *Striatopodocarpites labrus* Tiwari, 1965, slide no. BSIP 5949.
88. *Cuneatisporites* sp., slide no. BSIP 5947.
89. *Satsangisaccites nidpurensis* Bharadwaj & Srivastava, 1969, slide no. BSIP 5640.
90, 92. *Alisporites damudicus* sp. nov., slide nos BSIP 5631 (Holotype), 5636.
91, 94. *Striatites panchetensis* sp. nov., slide nos BSIP 5636 (Holotype), 5643.
93. *Falcisporites stabilis* Balme, 1970, slide no. BSIP 5636.

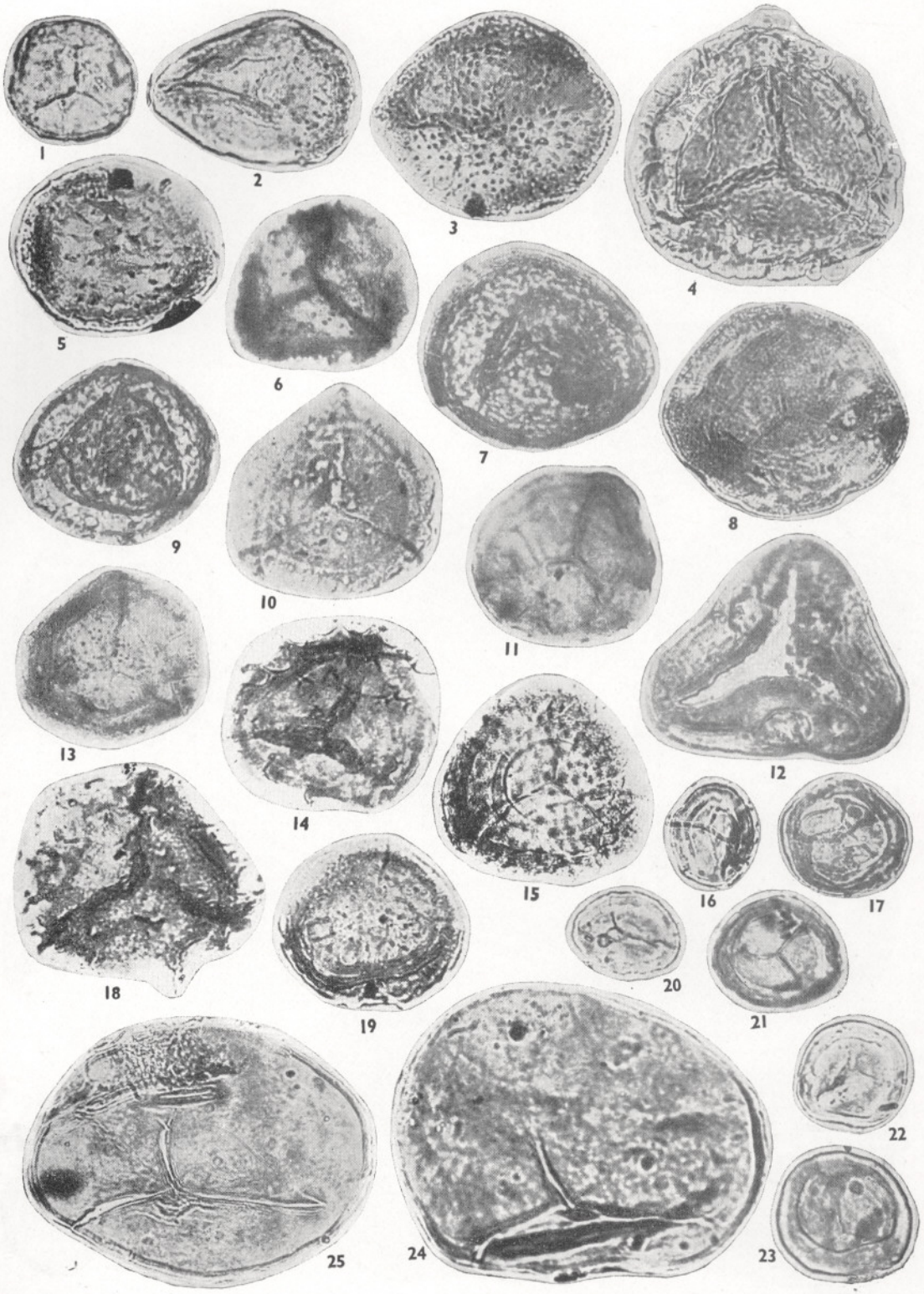
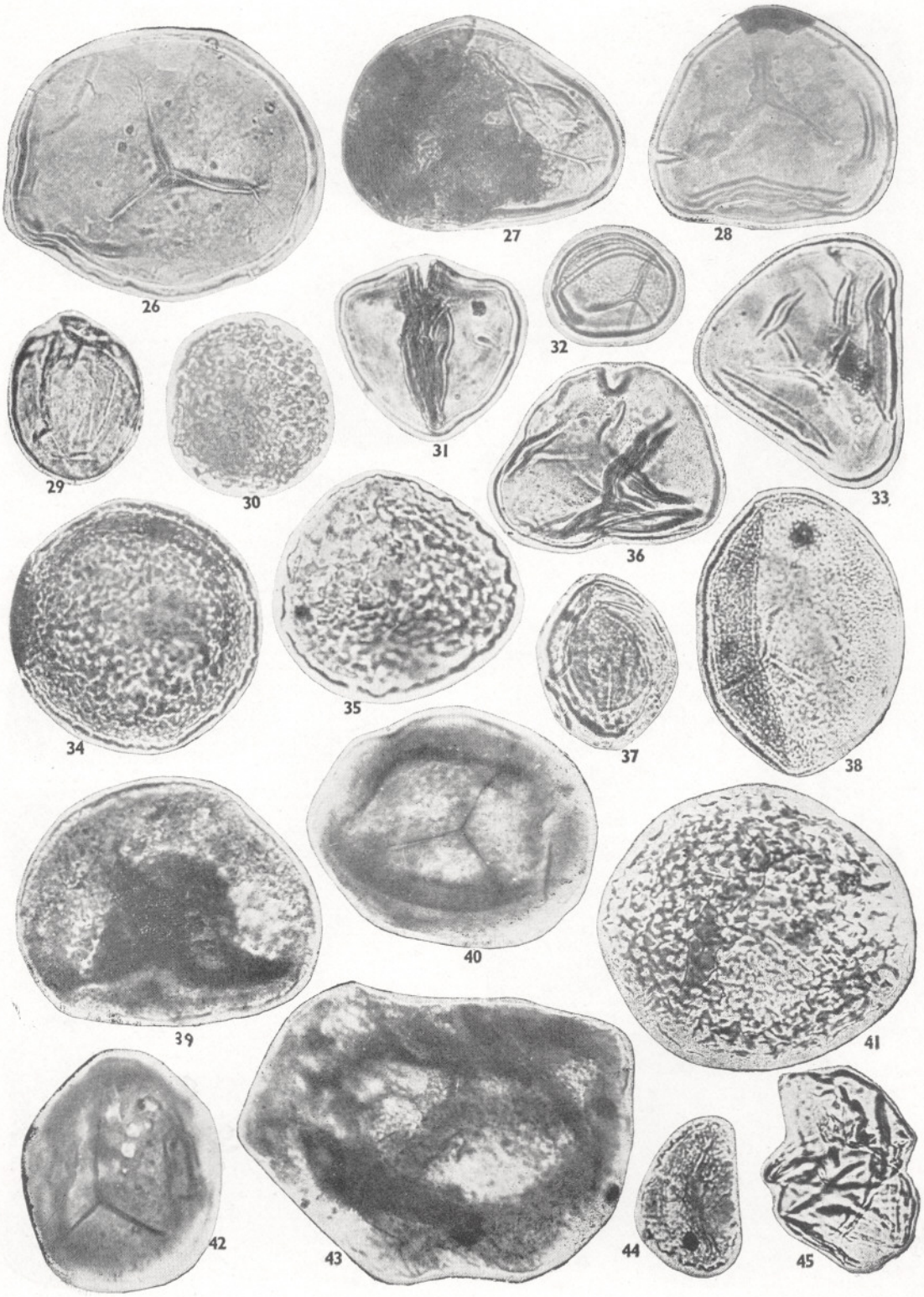


PLATE 1



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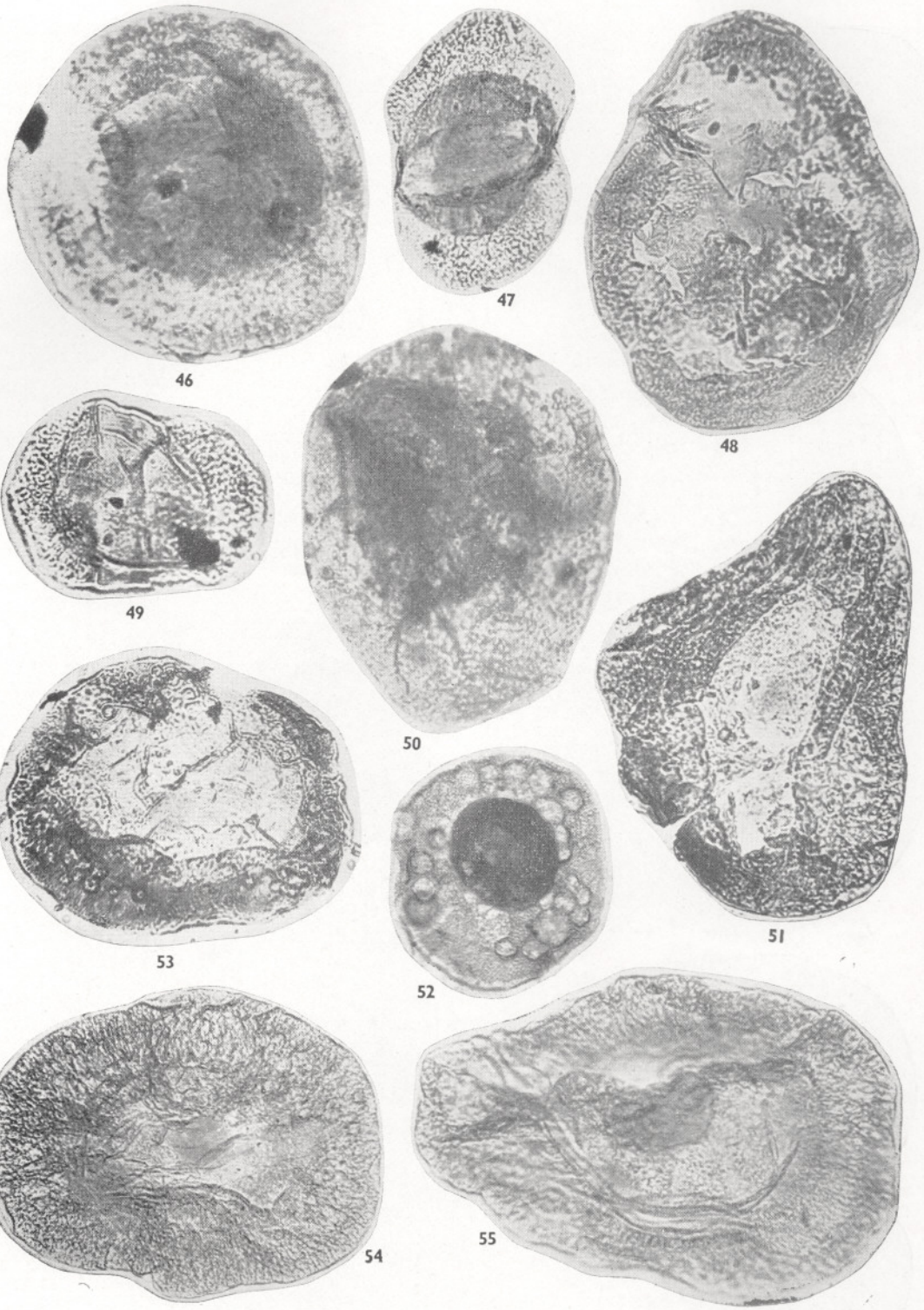

PLATE 3

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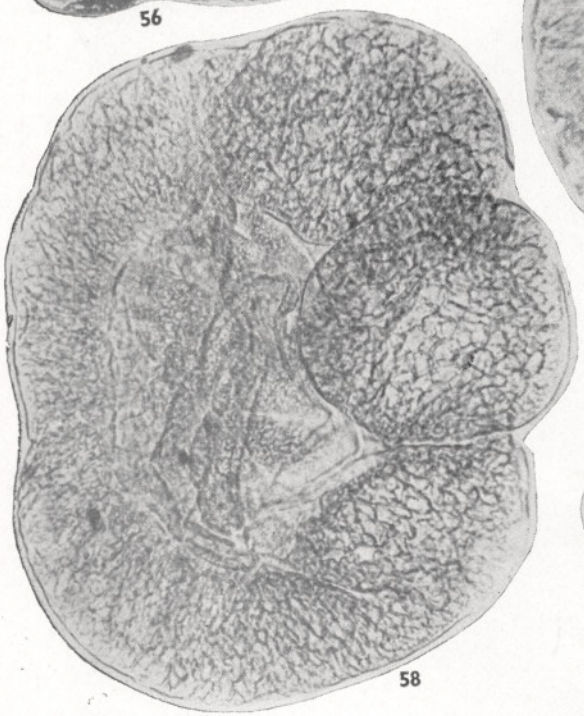

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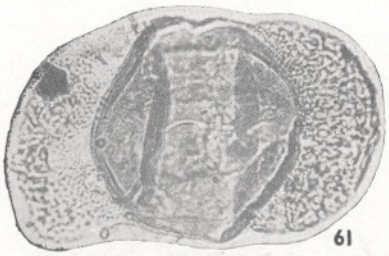

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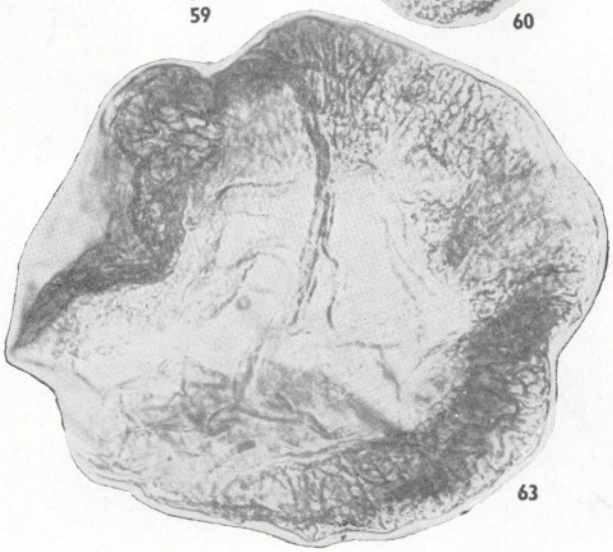

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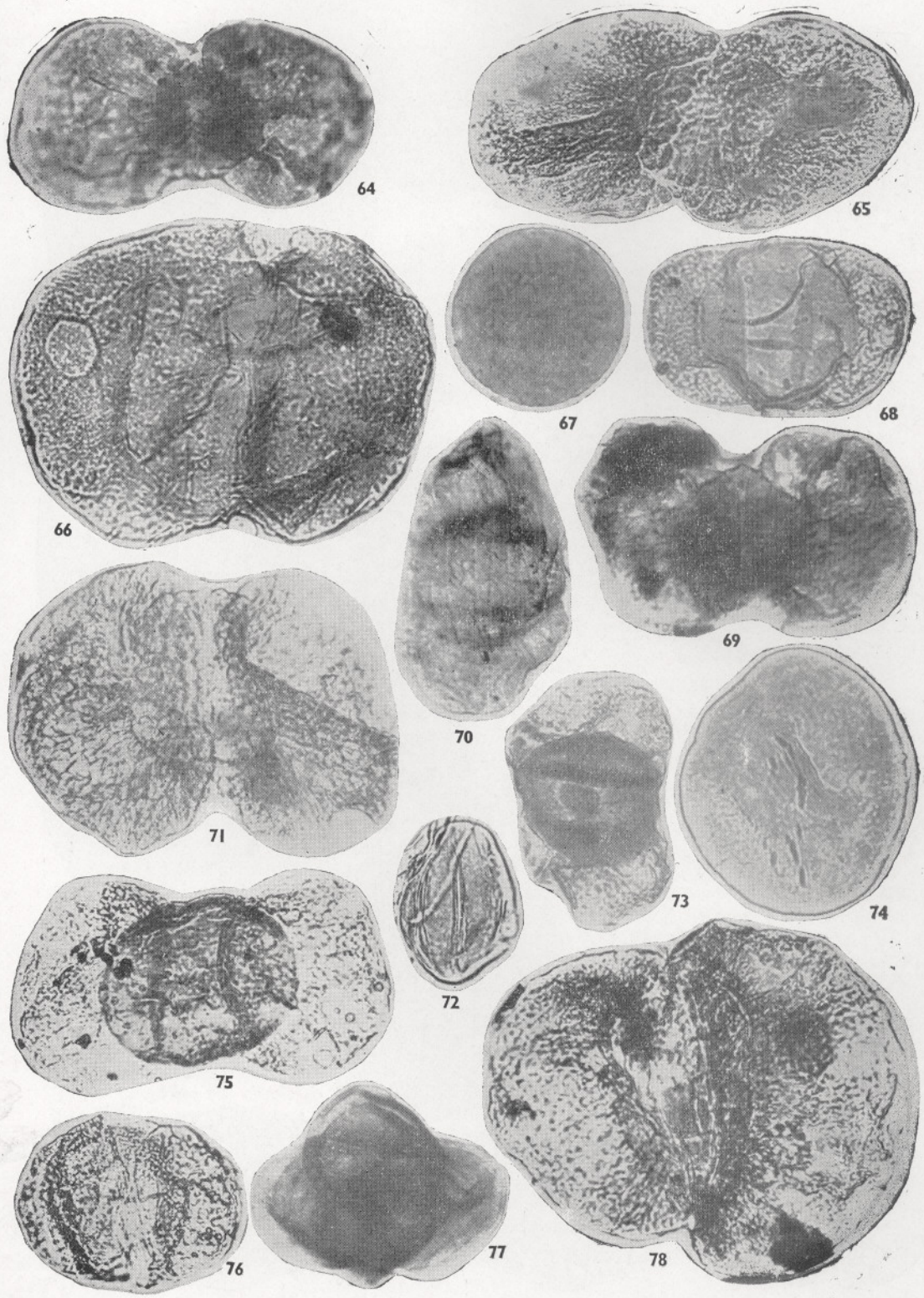
PLATE 4



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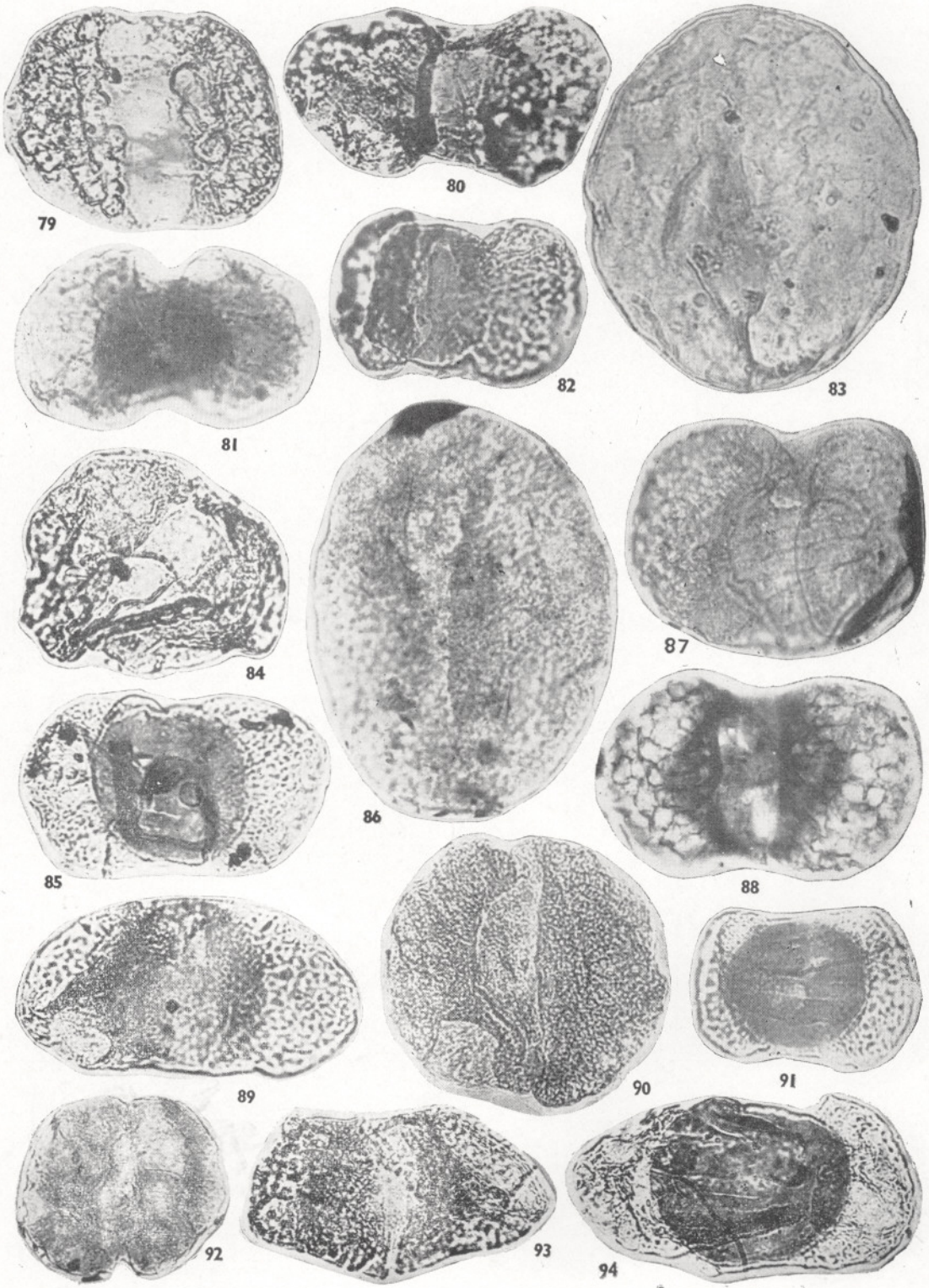

PLATE 6