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SPORAE DISPERSAE OF THE BARAKAR SEDIMENTS FROM SOUTH KARANPURA COALFIELD, BIHAR, INDIA

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ABSTRACT

Results of a palynological study of some carbonaceous sediments from South Karanpura Coalfield, Bihar based upon 27 samples from 14 coalseams representing most of the coal deposits in this coalfield are presented. The *Sporae dispersae* have been referred to 52 miospore genera and 123 species. Four spore species, viz., *Potonieitriradites angustus*, *Striatites naditoliensis*, *Lahirites karanpuraensis* and *Platysaccus plicatus* have been described as new taxa, new names have been given to five species, and 37 new combinations have been proposed. The account includes comprehensive information regarding geological and geographical distribution of each genus treated in the text alongwith a list of its species.

Key-words — *Sporae dispersae*, Palynology, Barakar sediments, South Karanpura Coalfield (India).

सारांश

दक्षिण करनपुरा कोयला-क्षेत्र, बिहार, भारत से बाराकार अवसादों के विकरणित बीजाण – दिनेश चन्द्र भारद्वाज एवं अर्चना द्विवेदी (त्रिपाठी)

बिहार में दक्षिण करनपुरा कोयला-क्षेत्र के 14 कोयला-संस्तरों से एकत्रित तथा इस कोयला-क्षेत्र के अधिकाँश कोयला निक्षेपों का निरूपण करने वाले 27 नमूनों पर आधारित कुछ कार्बनमय अवसादों के परागाणविक अध्ययन के परिणामों को प्रस्तुत किया गया है। विकरणित बीजाणु 52 सूक्ष्मबीजाणु प्रजातियों तथा 123 जातियों से संबंधित किये गये हैं। चार बीजाणु जातियों अर्थात् पोटोनीट्राइरेडाइटिस एँगस्टस, स्ट्रिआटाइटिस नादिटोलियेन्सिस, लेहिराइटिस करनपुरेन्सिस एवं प्लेटिसेक्कस प्लिकेटस को नये वर्गकों के रूप में वर्णित किया गया है, पाँच जातियों को नये नामों से नामाँकित किया गया है तथा 37 नवीन संयोजन प्रस्तावित किये गये हैं। इस शोध-पत्र में प्रत्येक प्रजाति के अंतर्गत् एक सूची में इसकी सभी उल्लिखित जातियों की भौगोलिक एवं भूवैज्ञानिक वितरण संबंधी विस्तीर्ण जानकारी भी दी गई है।

INTRODUCTION

DURING the last two decades exhaustive palynological studies have been undertaken on one of the major coal bearing horizons of Indian Lower Gondwana, the Barakar Stage in the Damuda Series (Bharadwaj & Srivastava 1970, 1973; Bharadwaj & Anand-Prakash, 1972; Bharadwaj, Navale & Anand-Prakash, 1974; Bharadwaj & Tiwari, 1964b; Kar 1969a, 1969b, 1973; Navale & Tiwari, 1968; Tiwari, 1965, 1968, 1971, 1973a; Venkatachala & Kar, 1968a, 1968b; Srivastava & Anand-Prakash, 1973). South Karanpura Coalfield has also been investigated palynologically (Datta, 1957, 1964; De, 1960; Khan, 1962, 1964; Bandhyopadhyay, 1967; Bharadwaj & Tiwari, 1968; Lele & Kulkarni, 1969; Lele & Chandra, 1977; Bharadwaj & Anand-Prakash, 1972). However, no detailed account of sporae dispersae and palynostratigraphy has been published so far on this area. In the present paper a complete systematic account of *sporae dispersae* has been given which includes the circumscription of new species and the notable variations, if any, of already existing species. The palynostratigraphic aspect of the work has been published elsewhere (Bharadwaj & Dwivedi, 1978).

MATERIAL AND METHODS

The details of the samples studied from 14 coalseams of South Karanpura Coalfield, Bihar are given in Table 1, in which the samples are arranged stratigraphically from bottom to top.

The maceration of coal and shale samples were carried out by the usual technique, using commercial nitric acid and 10 per cent potassium hydroxide solution as suggested by Bharadwaj (1962) and Bharadwaj and Salujha (1964). In the case of shale samples a treatment with hydrofluoric acid was also done before nitric acid treatment.

SYSTEMATIC DESCRIPTION

The morphological classification recently proposed by Bharadwaj (1974, 1975) has been followed here which tends to be more phylogenetical than the morphographical systems in use.

The miospore assemblage from South Karanpura Coalfield comprises miospores with various types of non-tenuitate and tenuitate genera including trilete, monolete, sulcate, nonsaccate, saccate, and alete forms. The dispersed miospores show certain qualitative morphographical characters which are quantitatively variable. The miospores have been grouped utilizing the taxonomic value of these qualitative characters as well as their quantitative variation in their different combinations. During the morphographical study of miospore specimens, emphasis has been laid upon the association of the more usual characters. The circumscriptions of various genera are based upon the differences in the qualitative morphographic characteristic as exhibited by the miospores observed under the light microscope as suggested by Bharadwaj (1967). Within each such spore genus, various species have been distinguished either on the basis of minor qualitative variations in the particular genus or quantitative distinctions in morphographical features. Thus, while delimiting the genera and species every variation has been studied in a large number of specimens. In the

TABLE 1

Sl. no.	Coal seam or bed	Lithology and position	Thickness m	Lab sample no.	Registered locality no.	Miospores present (+) or absent (−)
1.	Talchir Sandstone	Sandstone	—	27	1231	—
		floor shale		4	1234	—
2.	Argada 'S' Seam	Interbedded shale	10·06	3	1234	+
		coal		2	1234	+
		Roof shale		1	1234	+
3.	Naditoli Seam	Coal	12·19	5	1229	+
4.	Seam above Naditoli	Coal	0·61	6	1235	+
5.	Argada 'B' Seam	Floor shale		8	1232 B	+
		coal	9·14	7	1232 B	+
6.	Argada 'A' Seam	Coal	7·92	9	1232 A	+
7.	Argada Seam	Floor shale		11	1240	+
		coal	21·34	10	1240	+
8.	Lower Sirka Seam	Floor shale		18	1233	+
		coal	3·05	17	1233	+
		Floor shale		16	1233	+
9.	Middle Sirka Seam	Coal	4·88	15	1233	+
		Roof shale		14	1233	+
10.	Upper Sirka Seam	Coal		13	1233	+
		Roof shale	2·74	12	1233	+
11.	Hathidari Seam	Coal	3·66	19	1238	+
12.	Lower Semana Seam	Coal	3·66	20	1239	+
		Floor shale		23	1216	+
13.	Lower Nakari Seam	Coal	4·88	22	1216	+
		Roof shale		21	1216	+
14.	Upper Nakari Seam	Coal		25	1236	+
		Roof shale	2·44	24	1236	+
15.	Kurse Seam	Coal	5·48	26	1237	+

following systematic account a classified listing of different species has been done with relevant remarks wherever thought to be necessary.

Anteturma — *Sporites* H. Potonié emend. Bharadwaj, 1974
Subanteturma — *Atenuitati* Bharadwaj, 1974
Turma — *Curvaturati* Bharadwaj, 1974
Subturma — *Cingulati* Potonié & Klaus, emend. Bharadwaj, 1974
Infrasubturma — *Exinaugeri* Bharadwaj, 1974

Genus — *Indotriradites* Tiwari, 1964

Type Species — Indotriradites korbaensis Tiwari, 1964.

Remarks — The occurrence of this genus is sporadic in the present assemblage. This genus includes the following species, known so far:

I. cuspidus (Balme) Bharadwaj & Tiwari (1977); Kockatea Shale, Geraldton Racecourse bore, 1465 ft (sample 44497) western Australia; Lower Triassic.

I. mamillatus Bharadwaj & Tiwari (1977); bore hole NCRD-6, Lab. sample no. 7, depth 123·5 m, Raniganj Coalfield, India; Maitur Formation; Lower Triassic.

I. saeptatus (Balme) Bharadwaj & Tiwari (1977); Geraldton, Racecourse bore, 1465 ft (sample 44497), western Australia; Lower Triassic.

I. congoensis Maheshwari & Bose (1969); Kibamba River, Lukuga Coalfield area, Congo; Permian.

I. korbaensis Tiwari (1964); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

I. rallus (Balme) Bharadwaj & Tiwari (1977); Wargal, West Pakistan; Salt Range, Chhidru Formation; Permian.

I. sparsus Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

I. surangei Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

I. varius Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

I. wargalensis (Balme) Bharadwaj & Tiwari (1977); Wargal, West Pakistan; Salt Range, Chhidru Formation; Permian.

Potonié (1970) believed *Indotriradites* to be an over macerated specimen of *Dentatispora* Tiwari (1964). However, the two genera are differentiated by the presence of a flange (zona) in the former and a cingulum in the latter. Playford and Helby (1968) considered the well-illustrated and fully described genus *Indotriradites* to be synonymous with the ill-described and poorly illustrated spore genus *Kraeuselisporites* Leschik (1955). Balme (1970) followed Playford and Helby in this respect. Recently, Scheuring (1974) has re-described and illustrated the type species as well as other species of *Kraeuselisporites* described by Leschik. The descriptive aspects made clear (Bharadwaj & Tiwari, 1977) are (i) the trilete rays are present but do not extend on to the zona, and (ii) the central body is acavate.

With the above clarification about the differences of these two genera, all those cavate species in which trilete rays extend on to the zona described under *Kraeuselisporites* are being transferred to *Indotriradites* as follows:

Indotriradites kuttungensis (Playford & Helby) comb. nov.

Synonym — Kraeuselisporites kuttungensis Playford & Helby, 1968.

Holotype — Playford & Helby, 1968, pl. 11, figs 6, 7.

Locus Typicus — New South Wales, Balickeria excavation; Italia Road Formation, sample A707.

Age — Carboniferous.

Indotriradites niger (Segroves) comb. nov.

Synonym — Kraeuselisporites niger Segroves, 1970.

Holotype — Segroves, 1970, pl. 9, fig. C.

Locus Typicus — Perth Basin, western Australia.

Age — Upper Permian.

Indotriradites enormis (Segroves) comb. nov.

Synonym — Kraeuselisporites enormis Segroves, 1970.

Holotype — Segroves, 1970, pl. 8, fig. C.

Locus Typicus — Perth Basin, western Australia.

Age — Upper Permian.

Indotriradites splendens (Balme & Hennelly) comb. nov.

Synonym — *Cirratriradites splendens* Balme & Hennelly, 1956; *C. australensis* Hart, 1963; *Kraeuselisporites splendens* Segroves, 1970.

Holotype — Balme and Hennelly, 1956, pl. 5, fig. 57.

Locus Typicus — Main Greta Seam, Hebburn no. 2 Colliery, Greta Coal Measures, New South Wales.

Age — Permian.

Distribution — Triassic — Australia, West Pakistan; Permian —Africa, Australia, India, West Pakistan; Permo-Carboniferous — Africa; Carboniferous — Australia.

Indotriradites sparsus Tiwari, 1965

Pl. 1, fig. 1

Holotype — Tiwari, 1965, pl. 3, fig. 59.

Description (8 specimens) — Subtriangular, size 65-89 μ. Central body 45-67 μ. Inner body 40-52 μ. Central body exine 5-10 μ thick, uniformly micropunctate, distal spines 4-6 μ long, 1·5-2·5 μ broad at the base; verrucae also present. Y-mark distinct, rays up to margin of flange, 40-53 μ long. Flange 10-20 μ broad, margin smooth to slightly wavy.

Indotriradites sp.

Pl. 1, fig. 2

Description (3 specimens) — Roundly triangular miospores with rounded apices and convex interapical sides. Size-range 74·5-93·0 μ. Central body distinct, 46-52 μ in size, with an inner body. Central body exine as well as zona covered with spinules, verrucae also present interspersed between spinules. Trilete mark distinct, rays 2-3 μ thick reaching up to the outer margin of the flange. Flange 7-32 μ broad, usually uniformly wide, sometimes width not uniform, membranous, margin of flange dentate.

Remarks — In all the species of the genus *Indotriradites* described so far, the central body exine is distally covered with coni and spines whereas in the presently studied specimens the central body exine is ornamented with spines, and verrucae interspersed between the spines. So also the zona is ornamented with spines and verrucae. Although these specimens show differences in the ornamentation, they have neither been assigned to any previously described species nor new species has been created due to insufficient number of specimens.

Genus — *Potonieitriradites* Bharadwaj & Sinha, 1969

Type Species — *Potonieitriradites barakarensis* Bharadwaj & Sinha, 1969.

Remarks — So far the following species have been described in this genus:

P. barakarensis Bharadwaj & Sinha (1969); Singrauli Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

P. tuberculatus Sinha (1972); Singrauli Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

Bose and Kar (1967) have described some miospores as new species under the genus *Indotriradites* from the Permian of Congo. In both the species, *I. mercenierii* and *I. renierii*, the morphographical characters described are the same. The difference in the two species as stated by Bose and Kar lies in the distal exine ornamentation being verrucose in the former and granulose to microverrucose in the latter. The morphographic characters together with the general organisation answer to the genus *Potonieitriradites* rather than to *Indotriradites*. Hence, these species have been transferred to *Potonieitriradites* as follows:

Potonieitriradites mercenierii (Bose & Kar) comb. nov.

Synonym — *Indotriradites mercenierii* Bose & Kar, 1967.

Holotype — Bose & Kar, 1967, pl. 2, fig. 16.

Locus Typicus — Assise des schistes noirs de la Lukuga Sondage 10.

Horizon & Age — Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

Potonieitriradites renierii (Bose & Kar) comb. nov.

Synonym — *Indotriradites renierii* Bose & Kar, 1967.

Holotype — Bose & Kar, 1967, pl. 2, fig. 18.

Locus Typicus — Assise des schistes noirs de la Lukuga, Sondage 10.

Horizon & Age — Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

Distribution — Permian — Africa, India; Permo-Carboniferous — Africa.

Potonieitriradites barakarensis Bharadwaj & Sinha, 1969

Pl. 1, figs 6-10

Synonym— Potonieitriradites subtilis Sinha, 1972.

Holotype — Bharadwaj & Sinha, 1969; pl. 1, fig. 1.

Description (15 specimens)— Subtriangular to subcircular, measuring 73·0-90·5 μ. Central body 48·5-62·0 μ, proximally microgranulose and distally granulose to verrucose, verrucae faint to distinct. Inner body subtriangular to subcircular, 33·5-46·0 μ, usually thin, smooth and laevigate, sometimes folds also present. Trilete rays thick-lipped, usually sinuous, rarely straight, up to the margin of zona. Zona thinner than the central body, subequatorially attached on both the faces, 19-25·5 μ wide, thickened at the inner margin forming an equatorial rim around the central body, margin of zona microdentate.

Remarks — The holotype of *Potonieitriradites subtilis* Sinha (1972) has been re-examined during the present study and found to be similar to *P. barakarensis* without any ornamentational differences. In both the cases, the central body exine is microgranulose proximally and finely granulose to verrucose distally. Hence, *P. subtilis* is treated as a synonym. All the specimens encountered in the present study show a close similarity in morphographical characters as well as general organisation with the holotype of the present species.

Potonieitriradites tuberculatus Sinha, 1972

Pl. 2, figs 13, 14

Holotype — Sinha, 1972, pl. 1, fig. 25.

Description (1 specimen) — Roundly triangular, size 77·5 μ. Central body 65 μ, proximally microgranulose distally bearing large number of warty processes measuring 2-8 μ and micropunctate. Inner body subtriangular, 43·5 μ, smooth. Trilete rays up to the margin of zona, straight. Zona thinner than the central body, subequatorially attached on both the faces, zona width not uniform. Warty processes present on zona also on distal face.

Potonieitriradites angustus sp. nov.

Pl. 2, figs 15-18

Holotype — Pl. 2, figs 15-17, size 85 μ, slide no. 5789.

Isotype — Pl. 2, fig. 18, size 77·5 μ, slide no. 5780.

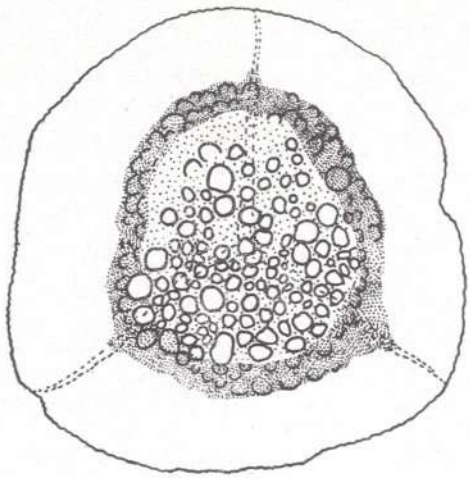
Locus Typicus — Argada Seam, South Karanpura Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Damuda Series, Lower Gondwana.

Diagnosis — Miospores triangular measuring 67·5-92·5 μ. Central body distinct conforming to the over-all shape of the miospore, central body exine proximally microgranulose and distally finely punctate and verrucose; verrucae confined to central body only. Inner body distinct, thin and structureless. Zona thin, subequatorially attached on both the sides.

Description (13 specimens) — Triangular miospores with broad rounded apices and convex sides. Central body distinct, triangular to subtriangular in shape measuring 46·5-74·0 μ. Central body exine proximally microgranulose and distally finely punctate (Pl. 2, fig. 16) and verrucose, verrucae very prominent, sparsely to densely distributed, confined to the central body only (Pl. 2, fig. 17) measuring 2-6 μ across the diameter (Text-fig. 1). Inner body distinct, subtriangular to subcircular in shape, 34·0-43·5 μ in size, thin, structureless and laevigate, sometimes folds present in the inner body (Pl. 2, fig. 18). Trilete mark distinct on the proximal face, rays usually sinuous, thick-lipped, reaching up to the margin of the zona. Zona thinner than the central body, 15·0-22·5 μ wide usually uniformly broad, margin microdentate, subequatorially attached on both the faces, zone of attachment thickened.

Comparison — In *P. angustus* sp. nov., the exine is microgranulose, proximally and finally punctate between small to very big verrucae distally which are confined to the central body only, while *P. barakarensis* Bharadwaj & Sinha (1969) has the proximal exine microgranulose and the distal



TEXT-FIG. 1 — Nature of ornamentation on the distal face in *Potonieitriradites angustus* sp. nov. — holotype × 1000.

exine granulose to verrucose, verrucae faint to distinct. *P. tuberculatus* Sinha (1972) has proximally microgranulose exine and distally large number of warty processes which are also present on the distal face of the zona. Hence, the present species differs from all the described species in the exine ornamentation and is proposed to be a new taxon.

Turma — *Noncurvaturati* Bharadwaj, 1974
Subturma — *Triquetri* Bharadwaj, 1974
Infrasubturma — *Abalti* Bhardwaj, 1974
Infraturma — *Brevipolaxi* Bharadwaj, 1974

Genus — *Indospora* Bharadwaj emend. de Jersey, 1968

Type Species — Indospora clara Bharadwaj, 1962.

Remarks — The spore genus *Indospora* described by Bharadwaj (1962) from the coals of the Raniganj Coalfield is qualitatively a characteristic genus of Raniganj Stage. De Jersey (1968) has emended the genus to include the species in which the projections at the angles of the spore are auriculate (*I. reticulata* de Jersey, 1968); instead of murate (*I. clara* Bharadwaj, 1962) and also the species having the exine ornamented with grana, coni and spinae (*I. reticulata* de Jersey, 1968; *Indospora* sp. Bharadwaj & Salujha, 1964).

In this genus the following species have been described so far:

I. reticulata de Jersey (1968); Climatis Sandstone, Bowen Basin, Queensland, Australia; Triassic.

I. clara Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

I. laevigata Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

I. maculata Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

I. boletus Peppers (1970); Cardif coals, Carbondale Formation, Illinois Basin, Illinois; Pennsylvanian; Carboniferous.

I. stewarti Peppers (1964); Trivoli Cyclothem, Illinois; Pennsylvanian; Carboniferous.

Distribution — Triassic — Australia; Permian — Australia, India, West Pakistan; Carboniferous — U.S.A., U.S.S.R.

Indospora clara Bharadwaj, 1962

Pl. 1, fig. 5

Holotype — Bharadwaj, 1962, pl. 3, fig. 54.

Description (2 specimens) — Triangular, 45·0-47·5 μ. Trilete rays ending shortly before the corners; labra thin, vertex low. Distally muri joining in a triradiate manner without any meshes. Exine 1 μ thick, sparsely verrucose, a few bacula interspersed between verrucae, truncate and 1·5-5·0 μ in length.

Remarks — This species is very rare in the present assemblage.

Genus — *Horriditriletes* Bharadwaj & Salujha, 1964

Type Species — Horriditriletes curvibaculosus Bharadwaj & Salujha, 1964.

Remarks — The presence of this genus has been observed throughout in the present assemblage and in some of the samples (coal of Argada 'A', Floor shale of Argada Seam, coal of Lower Sirka, Hathidari, Lower Semena, Lower Nakari, Upper Nakari & Kurse seams) this genus has acquired the highest percentage frequency and is represented by the following species:

H. brevis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

H. bulbosus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series; Permian.

Anderson (1977) has included similar miospores in the genus *Acanthotriletes* (pl. 38, fig. 38; pl. 40, figs 55, 59).

H. concavus Maheshwari (1969); Lufupa-Mushyashya confluence, South Katanga, Congo; Permian (Lower).

H. curvibaculosus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

Anderson (1977) has included similar forms under the genus *Acanthotriletes* (pl. 37, figs 23, 25; pl. 39, fig. 24; pl. 40, figs 39, 40; pl. 42, figs 34, 43, 45).

H. elegans Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

H. novus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series; Permian.

H. cf. *H. ramosus* (Balme & Hennelly) Bharadwaj & Salujha (1964); Proprietary Colliery, Collie, western Australia; Collie Horizon; Permian.

Anderson (1977) has reported similar forms under the genus *Acanthotriletes* (pl. 38, figs 28-33, 35-37, 39-49; pl. 40, figs 33, 34, 43, 48, 53, 56, 57, 58; pl. 42, figs 41, 42).

H. rampurensis Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series; Permian.

Anderson (1977) has described similar forms in the genus *Acanthotriletes* (pl. 41, figs 39, 46-52).

H. pathakheraensis Anand-Prakash (1972); Pathakhera Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

H. pseudoseptatus Sinha (1972); Singrauli Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series; Permian.

H. splendidus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series; Permian.

Distribution — Triassic — India; Permian — Africa, Australia, India, South America.

Horriditriletes curvibaculosus Bharadwaj & Salujha, 1964

Pl. 2, fig. 19

Holotype — Bharadwaj & Salujha, 1964, pl. 2, fig. 34.

Description (10 specimens) — Triangular with ± straight sides, 22-58 μ. Exine 1-2 μ thick. Trilete mark distinct sometimes open, rays 11-25 μ long. Exine baculate, bacula sparsely distributed, 2-7 μ long and 1-3 μ wide, uniformly broad with blunt tip, and curved. Number of bacula on the periphery 7-25.

Horriditriletes pseudoseptatus Sinha, 1972

Pl. 3, fig. 28

Holotype — Sinha, 1972, pl. 1, fig. 12.

Description (3 specimens) — Triangular with ± straight sides, 61-94 μ. Y-mark partially open, rays 15-25 μ long, simple. Exine ±2 μ thick, ornamentation baculate sometimes mixed with coni. Bacula 3-7 μ long and 2-4 μ broad at the base, with round or flat tip, evenly broad, and some of them septate. Number of processes at the periphery 34-46.

Horriditriletes rampurensis Tiwari, 1968

Pl. 2, fig. 20

Holotype — Tiwari, 1968, pl. 1, fig. 17.

Description (4 specimens) — Triangular, 32-45 μ. Y-mark distinct, sometimes ill-defined due to ornamentation, rays simple, up to 23 μ long. Exine 0·5-2 μ thick, covered with closely set 1-3 μ high and 1 μ broad bacula and 0·5 μ high and 1·0 μ broad coni. Number of processes 23-52 on the *extrema lineamenta.*

Infraturma — *Longipolaxi* Bharadwaj, 1974

Genus — *Lycopodiumsporites* Thiergart, 1938

Type Species — Lycopodiumsporites agathaecus (Potonié, 1934) Thiergart, 1938.

Remarks — All the noncurvaturate, reticulate miospores assigned, so far, in the genus *Reticulatisporites* have been transferred to *Lycopodiumsporites* as the former genus is shown to be cingulate by Neves (1964). It is a genus distributed in the Triassic sediments and even in younger horizons. In the Lower Gondwana of India, however, reticulate spores are very rare in occurrence and are reported only from Raniganj and Barakar stages. In the present assemblage this genus is not significant, as far as its percentage frequency is

concerned, but is worth mentioning for its morphographical characters.

In this genus, so far, the following species are known:

L. cuddalorensis Ramanujam (1966); Lignite of South Arcot District, Madras, India; Miocene, Neogene.

L. perplexus Potonié & Sah (1959); Cannanore Beach Malabar Coast, India; Miocene (Upper) or Pliocene, Neogene.

L. abundans Salujha, Kindra & Rehman (1972); Garo Hills, South Shillong, Assam, India; Palaeogene.

L. agathaecus Thiergart (1938); Geiseltal bei Mersbury, Grube Cecilie, Niederlansitzer; Eocene, Palaeogene.

L. bellus Sah & Kar (1969); Bore core no. 13, Kutch, Gujarat, India; Laki Series, Palaeocene-Eocene (Lower) Palaeogene.

L. crassireticulatus Sah (1967); Kundra, Rusizi Valley (Burundi) Africa; Eocene, Palaeogene.

L. elegans Salujha, Kindra & Rehman (1972); Garo Hills, South Shillong, Assam, India; Palaeogene.

L. exiguus Salujha, Kindra & Rehman (1972); Garo Hills, South Shillong, Assam, India; Palaeogene.

L. palaeocenicus Dutta & Sah (1970); Laitryngew, South Shillong Plateau, Assam, India; Jaintia Series, Lower Eocene, Palaeogene.

L. parvireticulatus Sah & Dutta (1966); Laitryngew, South Shillong Plateau, Assam, India; Eocene, Palaeogene.

L. speciosus Dutta & Sah (1970); Laitryngew, South Shillong Plateau, Assam, India; Jaintia Series, Lower Eocene, Palaeogene.

L. umstewensis Dutta & Sah (1970); Laitryngew, South Shillong Plateau, Assam, India; Jaintia Series, Lower Eocene, Palaeogene.

L. dentimuratus Brenner (1963); Maryland, U.S.A.; Potomac Group, Cretaceous.

L. elongatus Kemp (1970); Blackgang Chine, southern England; Albian, Cretaceous.

L. marginatus Singh (1964); Ellerslie member, Fort Angustus No. 1 Well, Mannville Group, East Central Alberta, Canada; Cretaceous.

L. novomaxicanum Drugg (1967); San Juan Basin, New Mexico, South America; Cretaceous.

L. pallidus Kumar (1973); Harad River, Narsinghpur District, Madhya Pradesh, India; Jabalpur Stage, Jabalpur Series, Cretaceous.

L. sinuosus Kumar (1973); Harad River, Narsinghpur District, Madhya Pradesh, India; Jabalpur Stage, Jabalpur Series, Cretaceous.

L. trambauensis Singh, Srivastava & Roy (1964); Trambau Kutch, Gujarat, India; Umia Stage, Cretaceous.

L. triarenatus Delcourt & Sprumont (1955); Hainaut, England; Wealdien, Cretaceous.

L. annotinoides Tralau (1968); Eriksdal, Fyledalen, Scania, Sweden; Bajocian and Bathonian, Jurassic.

L. baculatus Venkatachala, Kar & Raza (1969); Kutch, Gujarat, India; Katrol Series, Jurassic.

L. clavatoides (Couper) Tralau (1968); New Zealand; Jurassic.

L. densus Tralau (1968); Eriksdal, Fyledalen, Scania, Sweden; Bajocian and Bathonian, Jurassic.

L. dijerseyi Pocock (1970a); western Canada; Bajocian, Jurassic.

L. microreticulatus Pocock (1970a); western Canada; Bajocian, Jurassic.

L. paniculatoides Tralau (1968); Eriksdal, Fyledalen, Scania, Sweden; Bajocian and Bathonian, Jurassic.

L. pseudaphyllanthus Tralau (1968); Eriksdal, Fyledalen, Scania, Sweden; Bajocian and Bathonian, Jurassic.

L. scanicus Tralau (1968); Eriksdal, Fyledalen, Scania, Sweden; Bajocian and Bathonian, Jurassic.

L. subrotundus (Kara-Murza) Pocock (1970a); Yakootiya, Yakootsian region, U.S.S.R.; Jurassic (Middle).

Distribution — Neogene — India; Palaeogene — North America, Africa, India; Cretaceous — England, North America, India; Jurassic — Austria, North America, Norway, Sweden, Ceylon, India, West Pakistan; Triassic — Australia; Permian — U.S.S.R., India, Iraq.

Lycopodiumsporites sp. cf. *L. palaeocenicus* Dutta & Sah, 1970

Pl. 3, fig. 31

Holotype — Dutta & Sah, 1970, pl. 2, fig. 53.

Description (One specimen) — Triangular, 83·5 μ. Trilete rays 38 μ long, reaching 3/4 of the body radius. Exine ±4 μ thick, distally reticulate, meshes 4×5-5×14 μ in size, muri 1·5-3 μ thick.

Remarks — *Lycopodiumsporites palaeocenicus* Dutta & Sah (1970) is described from Lower Eocene. The miospore studied in the present assemblage compares well with this species in its organization but is bigger in size. For the reason that there is a wide gap in the age, it has been described as *Lycopodiumsporites* sp. cf. *L. palaeocenicus*. The miospore referred to as *Reticulatisporites* sp. by Bharadwaj (1962) and Bharadwaj, Sah and Tiwari (1965) also possesses the reticulation and organization similar to that of *Lycopodiumsporites*.

Genus — *Microbaculispora* Bharadwaj, 1962

Type Species — *Microbaculispora gondwanensis* Bharadwaj, 1962.

Remarks — *Microbaculispora* is a characteristic genus for Barakar Stage, and specially in the early Barakar, although its occurrence is also reported from Talchir and Raniganj stages. It occurs in most of the presently studied samples and its dominance is marked in Argada seam and Argada 'B' seam.

This genus includes the following species:

M. barakarensis Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

M. gondwanensis Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

M. indica Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

M. minutus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

M. tentula Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

M. variata Tiwari & Navale (1967); Coal sample no. 1912, Santa Caterina Coalfield, Brazil, South Africa; Lower Permian.

M. naumovae (Hart) Anderson (1977); Salisbury borehole, assemblage number 204, Lower Karroo, Africa; Upper Carboniferous.

M. novicus Gupta & Boozer (1969); Rock Lake Shale, Garnet Locality, Kansas; Stanton Formation, Pennsylvanian, Carboniferous.

Distribution — Permian — Africa, Antarctica, Australia, India, South America; Carboniferous — North America, Africa.

Microbaculispora gondwanensis Bharadwaj, 1962

Pl. 3, fig. 21

Holotype — Bharadwaj, 1962, pl. 2, fig. 33.

Description (16 specimens) — Triangular, various axes unequal, 72·0-92·5 μ. Exine 2-4 μ thick. Trilete rays straight up to corners, associated with secondary folds. Exine baculate, bacula small, 0·5-2 μ high and 0·5-1·5 μ broad with flat tip, densely distributed.

Remarks— The miospores described above resemble in all respects with the type specimen. In most of the specimens the various axes are unequal. However, in some specimens the size of bacula is 0·5-1·0 μ high and 0·5-1·0 μ broad, being similar to those in the species *Microbaculispora tentula*; otherwise these specimens have the same size-range as described in the description by Bharadwaj (1962).

Microbaculispora villosa (Balme & Hennelly) Bharadwaj, 1962

Pl. 3, fig. 22

Synonym — *Acanthotriletes villosus* Balme & Hennelly, 1956.

Holotype — Balme & Hennelly, 1956, pl. 3, fig. 38.

Description (5 specimens) — Triangular, 71·5-87·0 μ. Y-rays 37-48 μ long up to the corners, associated with secondary folds. Exine 2-3 μ thick, covered with closely set bacula. Bacula 1 × 1 μ with flat tip.

Microbaculispora barakarensis Tiwari, 1965

Pl. 3, fig. 23

Holotype — Bharadwaj & Tiwari, 1964b, pl. 1, fig. 8.

Description (2 specimens) — Triangular, 57·5-61·5 μ. Y-rays straight and thin; associated with secondary folds, 35-50 μ long up to the corners, labra thin. Exine 1·5 μ thick, covered with closely set 1-1·5 μ long and 1-3 μ broad truncate bacula.

Microbaculispora tentula Tiwari, 1965

Pl. 3, fig. 24

Synonym — *Microbaculispora minutus* Venkatachala & Kar, 1968a.

Holotype — Tiwari, 1965, pl. 2, fig. 35.

Description (8 specimens) — Triangular miospores, 35·5-47·0 μ, with straight sides and roundly angular corners. Exine 1 μ thick, covered with closely set, less than 1 μ high and 1 μ wide bacula. Trilete mark distinct, rays thin, associated with narrow secondary folds reaching up to the corner, labra thin.

Remarks — The miospores encountered in the present assemblage resemble very closely with those described by Tiwari (1965) as *M. tentula*. Similar forms have been described by Venkatachala and Kar (1968a) under a new species, *Microbaculispora minutus*. The morphographical characters — size of the spores, nature and size of bacula and the trilete mark of *M. minutus* are the same as illustrated by Tiwari (1965) for the species *M. tentula*. Hence, the species *M. minutus* has been treated here as its synonym.

Genus — *Microfoveolatispora* Bharadwaj, 1962

Type Species — *Microfoveolatispora raniganjensis* Bharadwaj, 1962.

Remarks — The well-recognized genus *Microfoveolatispora* has been described from the coal of Raniganj Stage, Raniganj Coalfield. It is not very common in occurrence in the present samples.

This genus includes the following species known so far:

M. bokaroensis Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

M. directa (Balme & Hennelly) Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

M. foveolata Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Anderson (1977) has described similar miospores under the species *Microbaculispora labyrinthica* Anderson (1977).

M. indica Sinha (1972); Singrauli Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

M. raniganjensis Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

M. trisina (Balme & Hennelly) Bharadwaj (1962); Lithgow Seam, Kandos Colliery, western Coalfield, New South Wales; Permian.

Distribution — Permian — Africa, Australia, India.

Microfoveolatispora bokaroensis Tiwari, 1965

Pl. 3, fig. 29

Holotype — Tiwari, 1965, pl. 2, fig. 44.

Description (10 specimens) — Triangular to subtriangular, size 67-115 μ. Exine 2-4 μ thick, proximally laevigate, distally foveolate, foveolae ±1 μ across the diameter, uniformly distributed. Trilete rays ending just before the corners, 35-50 μ long and accompanied with folds.

Microfoveolatispora raniganjensis Bharadwaj, 1962

Pl. 3, fig. 26

Holotype — Bharadwaj, 1962, pl. 2, fig. 48.

Description (5 specimens) — Triangular, size 79·5-107·5 μ. Exine 1-2 μ thick. Y-rays reaching up to the margin, 40-70 μ long, accompanied with secondary folds. Exine foveolate, foveolae 1-3·5 μ across the diameter, muri up to 1 μ broad and high, uniformly distributed.

Remarks — The morphography and the organization of the presently studied specimens confirm the specific identification of the grains to be *M. raniganjensis* Bharadwaj (1962). However, the size of foveolae is larger in all specimens which is 1-3·5 μ than those described by Bharadwaj (1962) measuring 1 μ.

Microfoveolatispora indica Sinha, 1972

Pl. 3, fig. 25

Holotype — Sinha, 1972, pl. 1, fig. 23.

Description (2 specimens) — Triangular, size 42-45 μ. Exine less than 1 μ thick. Y-rays up to the corner, associated with secondary folds. Exine foveolate, foveolae 1 μ across diameter, muri thin, less than 1 μ, uniformly distributed. Central area of the spore dense.

Remarks — The size of the present miospores, however, is smaller than those of reported by Sinha (1972); besides, the grains have an inner denser area.

Genus — *Lacinitriletes* Venkatachala & Kar, 1965

Type Species — *Lacinitriletes badamensis* Venkatachala & Kar, 1965.

Remarks — The spore genus *Lacinitriletes* has been instituted by Venkatachala and Kar (1965) from the Upper Barakar Stage. The identity of the genus has been suspected by Maheshwari and Bose (1969) who have assigned the holotype (Venkatachala & Kar, 1965, pl. 1, fig. 8) of *Lacinitriletes* to *Leiotriletes*. Foster (1976) followed Bose and Maheshwari (1969) in this respect. However, none of the laevigate miospores proximally bearing a trilete mark in which the rays are associated with secondary folds, should be assigned to the genus *Leiotriletes*. In the original description and type specimen of *Leiotriletes* the secondary folds are absent. Further, the type specimens and the miospores encountered in the present study distinctly show the presence of laevigate exine, a character which definitely separates the genus *Lacinitriletes* from *Microbaculispora* contrary to the suggestion given by Maheshwari and Bose (1969).

In this genus the following species have been reported so far:

L. badamensis Venkatachala & Kar (1965); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Anderson (1977) has described similar forms under the species of *Microbaculispora* namely *M. virkkiae* Anderson (1977) and *M. plicata* (Maheshwari & Bose) Anderson, 1977.

L. minutus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Similar miospores are assigned by Anderson (1977) to the genus *Microbaculispora* and the species *M. directa* (Balme & Hennelly) Anderson (1977).

L. conatus Srivastava (1977); Sukri River Section, Near Gurtur Village, Auranga Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

It has been observed that *Lacinitriletes conatus* Srivastava (1977) includes some sculptured trilete forms. A re-examination of the holotype of *L. conatus* (Srivastava, 1977, pl. 3, fig. 16) clearly shows that the exine of the spore is sculptured with coni (1-1·5 μ high), a character of the genus *Lophotriletes* (Naumova) Potonié & Kremp, 1954. Hence, due to the sculptured exine the specimens described under this species cannot be referred to *Lacinitriletes* but instead should be incorporated in the species *Lophotriletes latiangulatus* Kar (1968a).

Distribution — Permian — Africa, India.

Lacinitriletes minutus Venkatachala & Kar, 1968a

Pl. 1, fig. 3

Holotype — Venkatachala & Kar, 1968a, pl. 2, fig. 33.

Description (6 specimens) — Triangular, size 33·5-38·0 μ. Exine less than 1 μ thick, without structure and sculpture. Y-rays up to the margin and associated with secondary folds.

Remarks — The presence of this species is regular, although in low percentage, in the studied samples.

Genus — *Brevitriletes* Bharadwaj & Srivastava, 1969

Type Species — Brevitriletes communis Bharadwaj & Srivastava, 1969b.

Remarks — Bharadwaj and Srivastava (1969b) have instituted the genus *Brevitriletes* from the Barakar coals of Talchir Coalfield, Orissa. Stratigraphically its presence is significant for the Lower Barakar palynoflora. This genus occurs frequently in the present assemblage and is a dominant genus in the coal of Argada 'B' seam as well as in the interbedded shale of Argada 'S' seam of South Karanpura Coalfield. Anderson (1977) has described similar forms (pl. 78, figs 1-21) under the genus *Apiculatisporis* species *A. bulliensis* (Hennelly) Anderson (1977).

So far, the following species have been described in this genus:

B. baculatus Sinha (1972); Jhingurdah Seam, Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

B. communis Bharadwaj & Srivastava (1969b); South Belanda Colliery, Talchir Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

B. crassus Sinha (1972); Jhingurdah Seam, Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

B. jhingurdahiensis Sinha (1972); Jhingurdah Seam, Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

B. levis (Balme & Hennelly) Bharadwaj & Srivastava (1969b); Main Seam Proprietary Colliery, western Australia; Collie horizon, Collie, Permian.

B. triangularis Kar & Bose (1976); Puits 1950, 3rd seam, Zaire; Assise a' couches de houille, Permian.

B. unicus (Tiwari) Bharadwaj & Srivastava (1969b); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

Distribution — Triassic — India; Permian — India, South America, Australia.

Brevitriletes levis (Balme & Hennelly) Bharadwaj & Srivastava, 1969b

Pl. 1, fig. 12

Synonym — *Apiculatisporites levis* Balme & Hennelly, 1956.

Lectotype — Balme & Hennelly, 1956, pl. 2, fig. 20.

Description (11 specimens) — Subcircular, 19·5-35·5 μ. Trilete rays reaching 3/4 of the body radius. Exine thin, spinose, spines 1 μ high with pointed apex, sparsely distributed.

Brevitriletes unicus (Tiwari) Bharadwaj & Srivastava, 1969b

Pl. 1, fig. 11

Synonym — *Horriditriletes unicus* Tiwari, 1965.

Holotype — Tiwari, 1965, pl. 1, fig. 30.

Description (7 specimens) — Triangular to sub-triangular, 38-60 μ. Trilete rays reaching 3/4 of the body radius. Exine thin, proximally smooth, distally spinose, spines 1-4 μ broad at the base and 1-5 μ high, roundly blunt and curved at the tip.

Genus — *Pseudoreticulatispora* Bharadwaj & Srivastava, 1969b

Type Species — *Pseudoreticulatispora barakarensis* Bharadwaj & Srivastava, 1969b.

Remarks — This genus is very rare in the present assemblage. So far only one species is known in this genus:

P. barakarensis Bharadwaj & Srivastava (1969b); Sohagpur Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

Synonym — *Verrucosisporites pseudoreticulatus* Balme & Hennelly, 1956, *P. pseudoreticulata* (Balme & Hennelly) Bharadwaj & Srivastava, 1969b.

A re-examination of the photographs illustrated by Balme and Hennelly (1956) shows that the size of the ornamentation in the miospores assigned to *P. pseudoreticulata* is similar to that of *P. barakarensis* Bharadwaj & Srivastava (1969b). Hence, the former is treated as the synonym of the latter.

The transference of *Verrucosisporites pseudoreticulatus* Balme & Hennelly to *Pseudoreticulatispora* has not been accepted by the Australian and African palynologists who continue to maintain it as a species of *Verrucosisporites*. Its recent illustration by Foster (1976) not only substantiate by SEM the punctatoreticuloid sculpture diagnostic of *Pseudoreticulatispora* but also that its sculpture is nowhere near that of *Verrucosisporites* (s.str.). However, Anderson (1977) has put the punctatoreticuloid spores in *Microbaculispora* which is equally unjustified. Segroves (1970, pl. 3, fig. K) has illustrated one specimen as *V. naumovae* which has punctatoreticuloid sculpture although the holotype (Hart, 1963, pl. 1, fig. 4) of *V. naumovae* is baculose and has been correctly transferred to *Microbaculispora* by Anderson (1977) but for his spore (pl. 57, fig. 19) which has punctatoreticuloid sculpture and thus is a specimen of *Pseudoreticulatispora*. On the other hand Anderson's *M. pseudoreticulata* has some specimens (pl. 56, figs 1, 2, 10-12) referable to *Pseudoreticulatispora barakarensis* Bharadwaj & Srivastava (1969b).

Distribution — Permian — Africa, Australia, India, South America; Upper Carboniferous — Africa.

Pseudoreticulatispora sp.

Pl. 3, fig. 33

Description (3 specimens) — Triangular, size 72·5-98·5 μ. Exine 2-4 μ thick, the exine ornamentation being punctate-reticulate forming a false reticulum due to closeness of flat-topped bacula. Trilete rays associated with folds, 34-54 μ long ending just before the corners, one of the ray-ends bifurcated, labra thick. Bacula nearly circular in surface view and 2·5-8 μ in diameter.

Remarks — A wide range in its size.

Subturma — *Nontriquetri* Bharadwaj, 1974
Infrasubturma — *Nonstructurati* Bharadwaj, 1974
Infraturma — *Sphaerae* Bharadwaj, 1974
Subinfraturma — *Nonaperculati* Bharadwaj, 1974

Genus — *Cyclogranisporites* Potonié & Kremp, 1954

Type Species — Cyclogranisporites leopoldii (Kremp) Potonié & Kremp, 1954.

Remarks — From the Indian Lower Gondwana horizons three species have been described by Bharadwaj and Salujha (1964) and Srivastava (1970). *C. gondwanensis* Bharadwaj & Salujha (1964) is a species reported from Raniganj Stage and exists there as an important species. The species *C. barakarensis* Srivastava (1970) has been described from Upper Barakar Stage of the Lower Permian of India and occurs as a significant unit there. In the present assemblage this genus is commonly represented and acquires dominancy in the coal of Middle Sirka seam and Kurse seam.

Following species have been described, so far, in this genus.

C. cacheutaensis Jain (1968); Minas de Petroleo, Mendoza, western Argentina; Cacheuta Formation, Triassic.

C. chalonerii Sarbadhikari (1972); Raniganj Coalfield, Bihar, India; Panchet Stage, Triassic.

C. congestus Leschik (1955); Neuwelt, Basel, Switzerland; Keuper, Triassic.

C. opressus Leschik (1955); Neuwelt, Basel, Switzerland; Keuper, Triassic.

C. triletus Kar (1970); Raniganj Coalfield, West Bengal, India; Panchet Stage, Triassic.

C. barakarensis Srivastava (1970); Talchir Coalfield, India; Barakar Stage, Damuda Series, Permian.

C. burethei Bose & Kar (1966); Mabuita and Mehibi, Congo; Assise des schistes noirs de la Walikale, Permian.

C. diversus Bose & Kar (1966); Mabuita and Mehibi, Congo; Assise des schistes noirs de la Walikale, Permian.

C. gondwanensis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

C. kabindiensis Kar & Bose (1967); Assise des schistes noirs de la Lukuga, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series; Permian.

C. micaceus (Imgrund) Potonié & Kremp (1955); Kaiping-Beiken Flöz 14, China; Unter Rotliegendes, Permian.

C. optimus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

C. plurigranus (Imgrund) Potonié & Kremp (1955); Flöz 3 and 4 Kaiping Becken, China; Unter Rotliegendes, Permian.

C. pressus (Imgrund) Potonié & Kremp (1955); Flöz 3 and 4, Kaiping-Becken, China; Unter Rotliegendes, Permian.

C. varius Singh (1964); Northern Iraq; Chia Zairi Formation, Permian.

C. aspersus (Imgrund) Potonié & Kremp (1955); Kaiping-Becken, Flöz 14, China; Stephanian, Carboniferous.

C. aureolus Artüz (1957); Alimolla, Sulu and Büyük, Turkey; Namurian, Westphalian A, Carboniferous.

C. aureus (Loose) Potonié & Kremp (1955); Flöz Bismark des Ruhrgebietes, Germany; Carboniferous.

C. breviradiatus Peppers (1970); Carbondale Formation, Illinois Basin; Pennsylvanian, Carboniferous.

C. carinatus Artüz (1957); Alimolla, Sulu and Büyük, Turkey; Namurian, Westphalian, Carboniferous.

C. densus Bhardwaj (1957); Grenzkohlen Seam, mine Labach Saar Pfalz, Germany; Westphalian, Stephanian, Carboniferous.

C. elatus Artüz (1957); Alimolla, Sulu and Büyük, Turkey; Namurian, Westphalian, Carboniferous.

C. flexuosus Playford (1962); Triungen, Spitsbergen; Carboniferous.

C. formosus Venkatachala & Bharadwaj (1964); Lothringen Saar-Pfalz Basin, Lothringen (Lorrain), France; Westphalian D, Carboniferous.

C. fuscus Venkatachala & Bharadwaj (1964); Lothringen Saar-Pfalz Basin, Lothringen (Lorrain), France; Westphalian D, Carboniferous.

C. grandiculus Venkatachala & Bharadwaj (1964); Lothringen Saar-Pfalz Basin, Lothringen (Lorrain), France; Westphalian D, Carboniferous.

C. granivarius Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

C. leopoldii Potonié & Kremp (1964); Ruhrkarbons, Germany; Carboniferous.

C. microgranus Bhardwaj (1957); Grenzkohlen Seam, mine Lebach Saar Pfalz, Germany; Westphalian, Stephanian, Carboniferous.

C. minutus Bhardwaj (1957); Wahlschied Seam, mine Golleborn Saar Pfalz, Germany; Westphalian, Stephanian, Carboniferous.

C. orbicularis (Kos.) Potonié & Kremp (1955); Unter McLeansbore Oberes McL.

Illinois, U.S.A.; Westphalian D, Stephanian, Carboniferous.

C. orbiculus Potonié & Kremp (1955); Flöz Baldur, Zeche Brassert, Ruhrgebiet, Ruhrkarbons, Germany; Westphalian B, Carboniferous.

C. ovatus (Knox) Potonié & Kremp (1955); Lower Dysart (Fife), Scotland; Westphalian A, Carboniferous.

C. parvigranus Venkatachala & Bharadwaj (1964); Lothringen-Saar Pfalz Basin, Lothringen (Lorrain), France; Westphalian D, Carboniferous.

C. parvipunctatus (Kos.) Bharadwaj (1957); Pittsburgh and Pomery Coals, Ohio; Pennsylvanian, Carboniferous.

C. parvulus Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

C. parvus Bhardwaj (1957); Grenzkohlen seam, mine Labach Saar Pfalz, Germany; Westphalian, Stephanian, Carboniferous.

C. patelliformis Menendez (1965); Quebradadel Carbon, Provincia de la Rioja, Argentina; Westphalian, Carboniferous.

C. pressoides Potonié & Kremp (1955); Flöz Baldur Zeche Brassert, Ruhrgebiet, Ruhrrkarbons, Germany; Westphalian B, Carboniferous.

C. provectus Potonié & Kremp (1955); Wayside Coal Bed, Johnson County, Illinois; Pennsylvanian, Carboniferous.

C. tenebrosus Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

C. triariculatus Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

C. tripapillatus Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

C. vagus (Kos.) Potonié & Kremp (1955); Shelbyville Coal Bed, Shelby County, Illinois; Pennsylvanian, Carboniferous.

C. amplus McGreger (1960); Melvilles Island, Canadian Arctic Archipelago, North America; Devonian.

C. leviradiatus Bharadwaj, Tiwari & Venkatachala (1971); New Albany Shale, Kentucky, U.S.A.; Famennian, Devonian.

C. plicatus Allen (1965); Mimerdalen, Central Diksonland, Spitsbergen; Emsian, Devonian.

C. retisimilis Riegel (1968); Stbr. Schiffahrth bei Lindar, Muhlenberg Schichten; Eifelian, Devonian.

C. rotundus Allen (1965); Russian Platform; Devonian.

Distribution — Triassic — England, Rumania, Switzerland, India, Libya, South America, West Pakistan; Permian — Germany, North America, U.S.S.R., Africa, India, Iraq, Libya, South America; Permo-Carboniferous — France, Africa; Carboniferous — France, Germany, North America, Poland, Scotland, Spitsbergen, Turkey, U.S.S.R., South America; Devonian — Germany, North America, Spitsbergen, U.S.S.R.

Cyclogranisporites gondwanensis Bharadwaj & Salujha (1964)

Pl. 1, fig. 4

Holotype — Bharadwaj & Salujha, 1964, pl. 1, fig. 19.

Description (9 specimens) — Circular to subcircular. Size 23·0-45·0 μ. Trilete rays 8-21 μ long, reaching 3/4 of the body radius. Exine less than 1 μ thick, microgranulose, grana less than 1 μ in size, uniformly and densely distributed.

Verrucosisporites (Ibrahim) emend. Smith, 1971

Type Species— *Verrucosisporites verrucosus* Ibrahim, 1933.

Remarks — The genus *Verrucosisporites* has been originally described by Ibrahim (1933) from the Carboniferous sediments of Germany. Thereafter Potonié and Kremp (1954), Smith and Mitarb (1964) and Smith (1971) have emended the genus. This genus is represented by a large number of species from all over the world ranging in age from Devonian to Tertiary, with very broad-based morphographic characters. In the present assemblage the genus is represented by only one species. Its occurrence is not consistent and does not show high percentage frequency anywhere.

So far the following species are known in this genus:

V. opimus Manum (1962); Spitsbergen; Tertiary.

V. pulvinulatoides Manum (1962); Spitsbergen; Tertiary.

V. septentrionalis Manum (1962); Spitsbergen; Tertiary.

V. rotundus Singh (1964); Imperial, Namao no. 1 Well, Ellerslie Member, Manville Group, East Central Canada; Aptian, Cretaceous.

V. carylensis Pocock (1970a); western Canada; Bajocian, Jurassic.

V. densus (Bolkhovitina) Pocock (1970a); Viluisk Basin, U.S.S.R.; Jurassic (Upper).

V. dubius Sah & Jain (1965); Sakarigalighat, Rajmahal Hills, Bihar, India; Jurassic.

V. eastendensis Pocock (1970a); western Canada; Bajocian, Jurassic.

V. manumii Bose (1961); Andoya, Norway; Jurassic.

V. minor Pocock (1970a); western Canada; Callovian, Jurassic.

V. staplinii Pocock (1970a); western Canada; Bajocian, Jurassic.

V. variabilis Pocock (1970a); western Canada; Callovian, Jurassic.

V. cameronii de Jersey (1962); Ipswich Coalfield, Queensland; Triassic.

V. carnarvonensis de Jersey & Hamilton (1967); Carnarvon Range, Queensland; Moolayember Formation, Triassic.

V. contactus Clarke (1965a); Worcestershire, England; Keuper, Triassic.

V. marginalis Leschik (1955); Neuewelt, Basal, Switzerland; Keuper, Triassic.

V. morulae Klaus (1960); Karn of the Alpine, Austria; Triassic.

V. narmianus Balme (1970); Surghar Range, West Pakistan; Mianwali Formation; Triassic.

V. opacus Leschik (1955); Neuewelt, Basel, Switzerland; Keuper, Triassic.

V. spissus Leschik (1955); Neuewelt, Basel, Switzerland; Keuper, Triassic.

V. triassicus Venkatachala, Beju & Kar (1968); Danubean (Moesian) Platform, Rumania; Buntsandstein Stage, Triassic.

V. tumulosus Leschik (1955); Neuewelt, Basel, Switzerland; Keuper, Triassic.

V. ambiplicatus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

V. conterminus Inosova, Shwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Isaevsian to Nikitovsian, Permian.

V. distinctus Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

V. diversus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. elegans Inosova, Shwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Slavajnskian, Permian.

V. gondwanensis Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

V. hispidus Inosova, Shwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Slavajnskian, Permian.

V. jenesis Reinhardt & Schmidt (1964 in Reinhardt, 1964); Tongrube des Zementwerkes Göschwitz bei Jena, Germany; Thuringen, Permian.

V. protumulosus Reinhardt & Schmidt (1964 in Reinhardt, 1964); Tongrube des Zementwerkes Göschwitz bei Jena, Germany; Thuringen, Permian.

V. varius Maheshwari (1967); Bansloi Valley, Santhal Pargana, Bihar, India; Barakar Stage, Damuda Series, Permian.

V. aspratilis Playford & Helby (1968); Italia Road Formation, Hunter Valley, New South Wales; Carboniferous.

V. baccatus Staplin (1960); Golata Formation, Alberta, Canada; Mississippian, Carboniferous.

V. compactus Habib (1966); Lower Kittaning Coal, western Pannsylvanian; Westphalian D, Allegheny Series, Carboniferous.

V. difficilis Potonié & Kremp (1955); Flöz Donar, Zeche Brassert, Ruhrgebiet, Ruhrkarbons, Germany; Westphalian C, Carboniferous.

V. donarii Potonié & Kremp (1955); Flöz Donar, Zeche Brassert, Ruhrgebiet, Ruhrkarbons, Germany; Westphalian B, Carboniferous.

V. eximius Playford (1962); Triungen, Spitsbergen; Carboniferous.

V. facierugosus (Loose) Butterworth & Williams (1954); Ruhr Coalfield, Germany; Westphalian B, Carboniferous.

V. gibbosus Ibrahim (1933); Flöz Aegir des Ruhrreviere, Germany; Carboniferous.

V. gobbette Playford (1962); Triungen, Spitsbergen; Carboniferous.

V. grandis McGreger (1960); Melville Island, Canadian Arctic Archipelago; Devonian to Lower Carboniferous.

V. grumosus Ibrahim (1933); Flöz Aegir des Ruhrreviers, Germany; Carboniferous.

V. gulthorlii Venkatachala & Bharadwaj (1964); Lothringen - Saar - Pfalz Basin, France; Westphalian D, Carboniferous.

V. italiensis Playford & Helby (1968); Italia Road Formation, Hunter Valley, New South Wales; Carboniferous.

V. maculosus Artüz (1957); Sulu and Büyük, Turkey; Westphalian D, Carboniferous.

V. magnus Venkatachala & Bharadwaj (1964); Lothringen - Saar - Pfalz Basin, France; Westphalian D, Carboniferous.

V. microverrucosus Ibrahim (1933); Aegir des Ruhrreviers, Germany; Carboniferous.

V. morulatus (Knox) Potonié & Kremp (1955); Kohlengruppe Limestone, Scotland; Unter Karbons.

V. nodosus Sullivan & Marshall (1966); Shale below the Blackbyre Limestone, Upper Sedimentary Group, Midland Valley, Scotland; Viséan, Carboniferous.

V. obscurus (Kos.) Potonié & Kremp (1956); New Heaven Coal Bed, Gallatin County, Illinois; Pennsylvanian, Carboniferous.

V. papillosus Ibrahim (1933); Flöz des Ruhrreviere, Germany; Carboniferous.

V. pergranulus (Alpern) Venkatachala & Bharadwaj (1964); Lorraine Basin, France; Westphalian D, Carboniferous.

V. pertenuis Venkatachala & Bharadwaj (1964); Lothringen - Saar - Pfalz Basin, France; Westphalian D, Carboniferous.

V. perverrucosus (Loose) Potonié & Kremp (1955); Ruhr Coalfield, Germany; Westphalian B, Carboniferous.

V. pseudothiessonii (Kos.) Potonié & Kremp (1956); Fulton County, Illinois; Pennsylvanian, Carboniferous.

V. scrobiculatus (Luber) Potonié & Kremp (1955); Karaganda Becken, U.S.S.R.; Viséan, Carboniferous.

V. triquetrus Ibrahim (1933); Flöz Aegir des Ruhrreviers, Germany; Carboniferous.

V. tuberculatus (Waltz) Potonié & Kremp (1955); Karaganda Becken, U.S.S.R.; Tournaisian and Viséan, Carboniferous.

V. tuberosus (Knox) Potonié & Kremp (1955); Kohlen-Gruppe Limestone, Scotland; Unter Karbon.

V. variabilis McGregor (1960); Melville Island, Canadian Arctic Archipelago, North America; Devonian to Lower Carboniferous.

V. variotuberculatus Potonié & Kremp (1955); Karaganda Becken, U.S.S.R.; Viséan, Carboniferous.

V. venustus Artüz (1957); Alimolla, Turkey; Namurian, Carboniferous.

V. verrucosus Ibrahim (1933); Flöz Aegir des Ruhrreviers, Germany; Carboniferous.

V. irregularis Bharadwaj, Tiwari & Venkatachala (1971); New Albany Shale, Kentucky, U.S.A.; Famennian, Devonian.

V. polygonalis Lenninger (1968); South West Eifel Klerfer beds, West Germany; Emsian, Devonian.

Bharadwaj and Tiwari (1977) have created a new species *Verrucosisporites densus* Bharadwaj & Tiwari (1977). However, Pocock (1970a) has already mentioned *V. densus* from U.S.S.R. The latter one, published earlier, got the priority and the former one becomes invalid. Hence, here a new name has been proposed for the miospores assigned to *Verrucosisporites densus* sensu Bharadwaj & Tiwari, 1977.

Verrucosisporites maiturensis nom. nov.

Synonym —*Verrucosisporites densus* Bharadwaj & Tiwari, 1977.

Holotype — Bharadwaj & Tiwari, 1977, pl. 2, fig. 33.

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

Horizon & Age — Maitur Formation, Lower Triassic.

Similar to the species *V. densus* Bharadwaj and Tiwari (1977) have described another new species *V. triassicus* from the Lower Triassic of Raniganj Coalfield, India. However, Venkatachala, Beju and Kar (1967) have already described *V. triassicus* from the Triassic of Rumania. The latter one, published earlier, got the priority and the former becomes invalid. Hence, the morphographical characters of the two species being different, a new name has been assigned to those miospores which were referred to *V. triassicus* sensu Bharadwaj and Tiwari (1977).

Verrucosisporites raniganjensis nom. nov.

Synonym — *Verrucosisporites triassicus* Bharadwaj & Tiwari, 1977.

Holotype — Bharadwaj & Tiwari, 1977, pl. 2, fig. 31.

Locus Typicus — Borehole, NCRD 6, sample no. 5, depth 86 m, Raniganj Coalfield, India.

Horizon & Age — Maitur Formation, Lower Triassic.

Distribution — Cretaceous — North America; Jurassic — North America, Norway, India, Israel; Triassic — Austria, England, Germany, Rumania, Switzerland, Africa,

Australia, India, Israel, Libya, South America, West Pakistan; Permian — Germany, U.S.S.R., Africa, Australia, India, Iraq, South America, West Pakistan; Permo-Carboniferous — France; Carboniferous — France, Germany, North America, Poland, Scotland, Turkey, U.S.S.R., Australia, Egypt; Devonian — Germany, North America, Egypt.

Verrucosisporites distinctus Tiwari, 1965

Pl. 3, fig. 32

Holotype — Tiwari, 1965, pl. 1, fig. 10.

Description (3 specimens) — Subcircular to subtriangular, 72·5-75·0 μ, trilete rays not prominent due to dense verrucae, reaching up to half of the body radius. Exine 1 μ thick, covered with closely distributed 1-1·5 μ verrucae.

Infraturma — *Nonsphaerae* Bharadwaj, 1974
Subinfraturma — *Circuli* Bharadwaj, 1974
Infrasubinfraturma — *Leti* Bharadwaj, 1974

Genus — *Insignisporites* Bharadwaj & Dwivedi, 1977

Type Species — *Insignisporites barakarensis* Bharadwaj & Dwivedi, 1977.

Remarks — Only one species has been reported in this genus so far:

I. barakarensis Bharadwaj & Dwivedi (1977); Hathidari Seam, South Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — India.

Insignisporites barakarensis Bharadwaj & Dwivedi, 1977

Pl. 3, figs 27, 30

Holotype — Bharadwaj & Dwivedi, 1977, pl. 1, figs 1, 2.

Description (70 specimens) — Circular to subtriangular, measuring 75-110 μ. Inner body distinct or indistinguishable. Exine 0·5-4·0 μ thick. Trilete mark may be open leaving a triangular rent, rays sometimes folded, thick and elevated, sinuous, reaching 1/2-3/4 spore radius, 20·0-45·0 μ long. Sometimes within the triangular rent of Y-mark a triangular rupture in the inner body also present. Exine unstructured but sculptured with grana and pila. Sculptural elements 1-4 μ across the diameter and 2-5 μ high, sometimes coalescing with each other. Processes densely distributed on distal face than on the proximal face. Number of sculptural elements in 36 square microns on distal face 1-16.

Subturma — *Acirculi* Bharadwaj, 1974
Infrasubinfraturma — *Agibberi* Bharadwaj, 1974

Genus — *Laevigatosporites* Ibrahim, 1933

Type Species — *Laevigatosporites vulgaris* Ibrahim, 1933.

Remarks — *Laevigatosporites* includes the laevigate monolete miospores. Venkatachala and Kar (1968a, 1968b) and Kar (1968a, 1969b) have assigned certain species to this genus from Indian Lower Gondwana. However, similar forms have also been reported under the genus *Latosporites* Potonié & Kremp (1954) (Bharadwaj, 1962; Salujha, 1965; Tiwari, 1965; Sinha, 1972). The difference in these two genera is only in the shape and that too depends on the lateral orientation of the miospore. Further typical forms of *Latosporites* have not been recorded from India which show a deeply curved equatorial outline. Hence, almost all the species observed in India are referable to *Laevigatosporites* Ibrahim (1933). The incidence of this genus is very common in the coal of Argada 'S' seam of the present study.

In this genus the following species have been known so far:

L. arcotensis Ramanujam (1967); South Arcot District, Madras, India; Miocene.

L. cognatus Sah & Kar (1969); Bore-core no. 13, Kutch, Gujarat, India; Laki Series, Palaeocene — Lower Eocene.

L. copiosus Salujha, Kindra & Rehman (1972); Garo Hills, South Shillong, Front Part Assam, India; Palaeogene.

L. dehiscens Takahashi (1961); Mittleres, Shinder yoshaku-Flöz der Ainoura-Schichten im Sasebokahlenfeld, Yoshinoura Grube, Provinz Nagasaki, Japan; Tertiary-Miocene.

L. discordatus Pflug (1953); Braunkohle von Wehminger bei Sarstedt, Hannover, Middle Europe; Tertiary.

L. gigantiformis Takahashi (1961); Mat suurasanjaku-Flöz der Yunoki-Schichten

der Sasebo-Schichten grouppe, Mittetsu-Mihasli-Grube, Sasebo-Kohlenfeld, Provinz Nagasaki, Japan; Tertiary-Miocene.

L. lakiensis Sah & Kar (1969); IM Borecore no. 15, Kutch, Gujarat, India; Laki Series, Palaeocene-Eocene (Lower).

L. anomalus Norton & Hall (1969); Hell Creek and Tullock Formation, Montana, U.S.A.; Cretaceous (Upper).

L. druggi Srivastava (1971); East Coulu locality lower member, Edmonton Formation, Alberta, Canada; Maestrichtian, Cretaceous.

L. cacheutensis Jain (1968); Minas de Petroleo Mendoza, western Argentina; Cacheuta Formation, Triassic.

L. graniminimus Reinhardt & Schön (1967); Straubfurt, Thuringen, East Germany; Gervilleienschichten, Middle Buntsandstein, Triassic.

L. callosus Balme (1970); Salt Range, West Pakistan; Chhidru Formation, Permian.

L. colliensis (Balme & Hennelly) Venkatachala & Kar (1968a); Main Seam Proprietary Colliery, Collie, western Australia; Permian.

L. flexus Segroves (1970); Perth Basin, western Australia; Artinskian, Permian.

L. punctatus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

L. bilateralis (Loose) Schopf, Wilson & Bentall (1944); Flöz Bismarck des Rughrgebietes, Germany; Carboniferous.

L. costatus Alpern (1959); Morsbach (Lorraine) France; Autuno-Stephanien, Carboniferous.

L. crassus Peppers (1964); Henshaw Formation, Illinois Basin; Pennsylvanian, Carboniferous.

L. densus Alpern (1959); Sondage des Various (Decize), France; Stephanien (Moyen), Carboniferous.

L. desmoinensis (Wilson & Coe) Schopf, Wilson & Bentall (1944); What Cheer Clay Products Co. Mine, What Cheer Kookuk County, Iowa; Pennsylvanian, Des Moines Series, Carboniferous.

L. latus Kosanke (1950); Wabash County, Illinois; Pennsylvanian, Carboniferous.

L. major Venkatachala & Bharadwaj (1964); Falkenberg (Faulquemont) Colliery, Lothringen (Lorrain), France; Westphalian D, Carboniferous.

L. medius Kosanke (1950); Wabash County, Illinois; Pennsylvanian, Carboniferous.

L. minimus (Wilson & Coe) Schopf, Wilson & Bentall (1944); What Cheer Clay Product Co. Mine, What Cheer Kookuk County, Iowa; Pennsylvanian, Des Moines Series, Carboniferous.

L. minutus (Ibrahim) Schopf, Wilson & Bentall (1944); Flöz Aegir des Ruhrreviers, Germany; Carboniferous.

L. obscurus Kosanke (1950); Gallatin County, Illinois; Pennsylvanian, Carboniferous.

L. ovalis Kosanke (1950); Wabash County, Illinois; Pennsylvanian, Carboniferous.

L. papillatus Peppers (1964); Henshaw Formation, Illinois Basin; Pennsylvanian, Carboniferous.

L. pseudothiessenii Kosanke (1950); Fulton County, Illinois; Pennsylvanian, Carboniferous.

L. punctatus Kosanke (1950); Galatin County, Illinois; Pennsylvanian, Carboniferous.

L. robustus Kosanke (1950); Bond County, Illinois; Pennsylvanian, Carboniferous.

L. striatus Alpern (1959); Morsbach (Lorraine), France; Stephanien (Lower) Carboniferous.

L. (?) *tuberculatus* (Berry) Schopf, Wilson & Bentall (1944); Penning Coal, Rhea County, Tennessee; Carboniferous.

L. vulgaris Ibrahim (1933); Flöz Aegir des Ruhrreviers, Germany; Carboniferous.

Distribution — Neogene — Japan, India; Palaeogene — Japan, Spitsbergen, India; Cretaceous — England, North America; Jurassic — Sweden, India; Triassic —Germany, India, South America; Permian — Germany, North America, U.S.S.R., Africa, Australia, India, Iraq, West Pakistan; Permo-Carboniferous — France; Carboniferous — England, France, Germany, North America, Poland, Scotland, Turkey, U.S.S.R., Egypt; Devonian — Egypt.

Laevigatosporites vulgaris Ibrahim, 1933

Pl. 3, fig. 34

Holotype — Ibrahim, 1933, pl. 2, fig. 16.

Description (6 specimens) — Oval miospores. Size range $82 \times 63 - 91 \times 76$ μ. Monolete mark 48-66 μ long. Exine laevigate, less than 1 μ thick, folded at places.

Remarks — The incidence of this species is very common in coal of Argada 'S' Seam.

Infrasubinfraturma — *Gibberi* Bharadwaj, 1974

Genus — *Praecolpatites* Bharadwaj & Srivastava, 1969a

Type Species — Praecolpatites nidpurensis Bharadwaj & Srivastava, 1969a.

Remarks — This genus has not been found quantitatively significant in the present study.

This genus includes the following species known so far:

P. nidpurensis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic (Lower).

Anderson (1977) has described similar miospores (pl. 185, figs 2-14) in the genus *Gnetaceaepollenites* species *G. sinuosus* (Balme & Hennelly) Bharadwaj (1962).

P. sinuosus (Balme & Hennelly) Bharadwaj & Srivastava (1969a); Seam at 688 ft South Wallarch no. 5 bore, New South Wales; New Castle Stage, Permian.

Formerly similar forms have been described under the genus *Gnetaceaepollenites* Thiergart (1938) from the Lower Gondwana sediments of India and Australian Permian sediments. Considering Bharadwaj and Srivastava's diagnosis, the miospores assigned to the same species of the latter genus have been transferred to *Praecolpatites* as new combinations.

Praecolpatites acutus (Kar) comb. nov.

Synonym —Gnetaceaepollenites acutus Kar, 1968a.

Holotype — Kar, 1968a, pl. 4, fig. 90.

Locus Typicus— Bore-hole no. JK 5, Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Praecolpatites biplicatus (Kar) comb. nov.

Synonym — Gnetaceaepollenites biplicatus Kar, 1968a.

Holotype — Kar, 1968a, pl. 4, fig. 87.

Locus Typicus— Bore-hole no. JK 5, Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Praecolpatites pachydermatus (Kar) comb. nov.

Synonym — Gnetaceaepollenites pachydermatus Kar, 1968a.

Holotype — Kar, 1968a, pl. 4, fig. 89.

Locus Typicus— Bore-hole no. JK 5, Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Praecolpatites diffusus (Lele & Makada) comb. nov.

Synonym — Gnetaceaepollenites diffusus Lele & Makada, 1974.

Syntypes — Lele & Makada, 1974, pl. 3, figs 42, 43.

Locus Typicus — Misra Village, Jayanti Coalfield, Bihar, India.

Horizon & Age — Karharbari Formation, Lower Gondwana.

Distribution — Triassic — India; Permian Australia, India, West Pakistan; Permo-Carboniferous — France.

Praecolpatites punctatus (Venkatachala & Kar) comb. nov.

Pl. 3, fig. 35

Synonym — Gnetaceaepollenites punctatus Venkatachala & Kar, 1968a.

Holotype — Venkatachala & Kar, 1968a, pl. 10, fig. 178.

Locus Typicus — Badam, North Karanpura Basin, Bihar, India.

Horizon & Age — Bar akar Stage, Lower Gondwana.

Description (10 specimens) — Miospores bilaterally symmetrical in outline with rounded ends. Size-range 86-120×48-70 μ. Exine thick, dark brown, smooth and indistinctly intrapunctate structured. Distally bearing a narrow to wide, distinct, boat-shaped colpus, sometimes with thick margin. The longitudinal folds extend from one end to other along the longer axis associated with grooves running very close to each other, sometimes grooves absent. Exine without any striations.

Infrasubturma — *Structurati* Bharadwaj,1974
Infraturma — *Globi* Bharadwaj, 1974
Subinfraturma — *Cavati* Bharadwaj, 1974

Genus — *Densipollenites* Bharadwaj, 1962

Type Species — Densipollenites indicus Bharadwaj, 1962.

Remarks — In the present assemblage this genus is very scantily observed but qualitatively it is a noteworthy genus.

In this genus, so far, the following species are known:

D. densus Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

D. indicus Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

D. invisus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

D. minimus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

D. pullus Segroves (1969); Perth Basin, western Australia; Upper Permian.

Distribution — Triassic — India, South America; Permian — Africa, Australia, Antarctica, India, South America.

Densipollenites indicus Bharadwaj, 1962

Pl. 5, fig. 51

Holotype — Bharadwaj, 1962, pl. 6, fig. 103.

Description (1 specimen) — Monosaccate, subcircular, size 132·5 × 89·0 μ. Central body dense, subcircular, 67 × 45 μ. Saccus variously folded. Saccus intrareticulation fine to medium, muri thick.

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

Genus — *Tiwariasporis* Maheshwari & Kar, 1967

Type Species — Tiwariasporis flavatus Maheshwari & Kar, 1967.

Remarks— This genus is rather uncommon in the present assemblage and the following species have been reported so far in it.

T. flavatus Maheshwari & Kar (1967); North Karanpura Coalfield, Bihar, India; Permian.

T. gondwanensis (Tiwari) Maheshwari & Kar (1967); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

T. indicus Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

Srivastava (1970) has proposed a new taxonomic unit *T. gondwanensis* from the coals of Talchir Coalfield, India. However, Maheshwari and Kar (1967) have already made a new combination — *Tiwarisporis gondwanensis* (Tiwari) Maheshwari & Kar (1967) and therefore the name proposed by Srivastava (1970) becomes homonym. Hence, the specimens reported in *T. gondwanensis* sensu Srivastava (1970) have been assigned a new specific name.

Tiwariasporis novus nom. nov.

Synonym — Tiwariasporis gondwanensis Srivastava, 1970.

Holotype — Srivastava, 1970, pl. 2, fig. 22.

Locus Typicus — Deulbera Colliery, Talchir Coalfield, Orissa, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Distribution — Permian — Africa, India.

Tiwariasporis flavatus Maheshwari & Kar, 1967

Pl. 4, fig. 41

Holotype — Maheshwari & Kar, 1967, figs 1, 2.

Description (3 specimens) — Oval, 83·0-97·5 × 63-70 μ. Exine 3-4 μ thick, verrucose, verrucae closely placed, evenly distributed in linear rows forming 11-18 pseudostriations. Sometimes monolete mark seen.

Genus — *Weylandites* Bharadwaj & Srivastava, 1969a

Synonym — Paravittatina Balme, 1970.

Type Species — Weylandites indicus Bharadwaj & Srivastava, 1969a.

Remarks — It has been described originally from the Triassic sediments of Nidpur, India. Balme (1970) has created a new genus *Paravittatina* from Salt Range, West Pakistan to include the forms referable to *Decussatisporites lucifer* Bharadwaj & Salujha (1964). However, similar forms were given a new name — *Weylandites*, which was

published by Bharadwaj and Srivastava in 1969 and therefore the latter name has priority over the former. The forms described as *Decussatisporites lucifer* Bharadwaj & Salujha (1964) are similar to *Weylandites* in morphographical characters and therefore belong to this genus. Similar forms have also been reported from the Lower Gondwana of India and Africa which were assigned, so far, to the genus *Decussatisporites* Leschik (1955). The orientation of striations and the nature of the sulcus of these Lower Gondwana miospores, so far assigned to *Decussatisporites* are similar to those of *Weylandites*.

Anderson (1977) has referred similar forms (pl. 129, figs 32-36, 53, 55; pl. 130, figs 28, 30, 50, 53, 55, 56; pl. 131, figs 14-17) in the genus *Vittatina* Luber ex Jansonius (1962). However, the forms should be correctly placed under the genus *Weylandites* on the basis of morphographical features.

So far the following species are known in this genus:

W. bilateralis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

W. circularis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

W. indicus Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

W. irregularis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

W. minutus Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

In view of the above interpretation all the formerly described species from the Lower Gondwana assemblages under *Decussatisporites* have been transferred to the present genus, as given below:

Weylandites magmus (Bose & Kar) comb. nov.

Synonym — *Decussatisporites magmus* Bose & Kar, 1966.

Holotype — Bose & Kar, 1966, pl. 28, fig. 7.

Locus Typicus — Mehibi, Walikale region, Congo.

Horizon & Age — Assise des schistes Noirs de Walikale, Permian.

Weylandites kinduensis (Bose & Kar) comb. nov.

Synonym — *Decussatisporites kinduensis* Bose & Kar, 1966.

Holotype — Bose & Kar, 1966, pl. 34, fig. 15.

Locus Typicus — Main road Kindu-Kalima (km 28·3-5), Main road Kindu-Kalima (km 28·3-7), Congo.

Horizon & Age — Assise des schistes noirs de Walikale, Permian.

Weylandites obscurus (Tiwari) comb. nov.

Synonym — *Decussatisporites obscurus* Tiwari, 1968.

Holotype — Tiwari, 1968, pl. 8, fig. 93.

Locus Typicus — Ib-River Coalfield, Orissa, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Weylandites constrictus (Kar) comb. nov.

Synonym — *Decussatisporites constrictus* Kar, 1968a.

Holotype — Kar, 1968a, pl. 4, fig. 101.

Locus Typicus — Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Weylandites ovatus (Kar) comb. nov.

Synonym — *Decussatisporites ovatus* Kar, 1968a.

Holotype — Kar, 1968a, pl. 4, fig. 98.

Locus Typicus — Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Weylandites pilus (Venkatachala & Kar) comb. nov.

Synonym — *Decussatisporites pilus* Venkatachala & Kar, 1968a.

Holotype — Venkatachala & Kar, 1968a, pl. 10, fig. 185.

Locus Typicus — Badam, North Karanpura Basin, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Distribution — Triassic — India; Permian — Africa, India, West Pakistan.

Weylandites dubius (Venkatachala & Kar) comb. nov.

Pl. 4, fig. 38

Synonym — *Decussatisporites dubius* Venkatachala & Kar, 1968a.

Holotype — Venkatachala & Kar, 1968a, pl. 10, fig. 189.

Locus Typicus — Badam, North Karanpura Basin, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Description (3 specimens) — Subcircular, monosulcate grains. Size-range 41 × 43-75×80 μ. Exine ±1 μ thick. Horizontal striations 11 to many, vertical striations 4-5. Sulcus distinct, extending from one end to other with flapped lips, narrow in the middle and broad at the ends.

Weylandites lucifer (Bharadwaj & Salujha) Foster, 1976

Pl. 4, fig. 37

Holotype — Bharadwaj & Salujha, 1964, pl. 10, fig. 189.

Description (6 specimens) — Monosulcate, subcircular miospores. Size-range 75×68 105×85 μ. Horizontal striations 11-14 running parallel to each other on proximal side, 5-7 vertical striations along the longer sides of the sulcus distally. Sulcus usually ill defined. Specimens variously flatten.

Remarks — Following miospores described from the Lower Gondwana formations are also referred to this species.

Decussatisporites lucifer Bharadwaj & Salujha (1964) in Kar & Bose, 1967, pl. 11, fig. 8.

D. lucifer Bharadwaj & Salujha (1964) in Kar, 1968a, pl. 4, figs 102, 103

Infrasubinfraturma — *Noncorugati* Bharadwaj, 1975

Genus — *Divarisaccus* Venkatachala & Kar, 1966

Type Species — *Divarisaccus lelei* Venkatachala & Kar, 1966.

The following species have been described in this genus so far:

D. densus Maithy (1969); Daltonganj Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

D. lelei Venkatachala & Kar (1966); Jharia Coalfield, Bihar, India; Barren Measure sequence, Damuda Series, Permian.

D. ovatus Kar & Bose (1967); Assise des schistes noirs de la Lukuga Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

D. rimosus (Venkatachala & Kar) Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

D. scorteus Lele & Makada (1972); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

D. strangeri Bose & Kar (1966); Elila River, Fundi Sadi, Congo; Assise glaciaires et Periglaciaires, ? Permo-Carboniferous.

Distribution — Permian — U.S.S.R., Africa, India.

Divarisaccus lelei Venkatachala & Kar, 1966

Pl. 4, fig. 36

Holotype — Venkatachala & Kar, 1966, pl. 1, fig. 1.

Description (2 specimens) — Monosaccate, oval 160·0×92·5-165·0×92·5 μ in size. Central body horizontally oval, thin, 100× 67·5-105×80 μ, intramicroreticulate, Haptotypic mark absent. Proximally saccus equatorially attached, distal attachment being bilateral along the longer axis of the central body, attachment zones closely placed leaving a well-defined sulcus.

Subinfraturma — *Nonbilaterae* Bharadwaj, 1974

Genus — *Parasaccites* Bharadwaj & Tiwari, 1964a

Type Species — *Parasaccites korbaensis* Bharadwaj & Tiwari, 1964a.

Remarks — *Parasaccites* is a well established genus reported from Barakar sediments of Korba Coalfield, India. So far, more than 20 species have been described from various Lower Gondwana horizons — Talchir, Karharbari, and Barakar stages. Occurrence of a large number of species in Talchir and Barakar stages clearly indicates the diversities in the evolutionary processes as well as morphographical characters of this genus. The genus has been shown to be indicator of cold climate. Its presence along with *Callumispora* or together with other radial monosaccates and *Callumispora*

reveals the existence of colder climate (Bharadwaj, 1972).

Anderson (1977) has treated the monosaccate miospores on the basis of very broad morphographical characters. He has not given due importance to the exine character, body infold system and nature of saccus attachment. This has resulted in the dumping of various monosaccate forms. He has put all the monosaccate forms under the genus *Vestigisporites* which is not acceptable here. In the description also he has not mentioned various morphographic characters in detail which would have helped in differentiating varied genera and species within a genus. It is very difficult to identify them merely on the basis of illustrations.

So far the following species have been described in this genus:

P. bellus Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

P. bilateralis Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. densus Maheshwari (1967); near Bargo, Bansloi Valley, Santhal Parganas, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. densicorpus Lele (1975); Sample B9/662, Dudhi River Section, West Bokaro Coalfield, Bihar, India; Talchir Formation, Permian.

P. diffusus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. distinctus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. fimbriatus Maheshwari (1969); Lufupa-Mushyashya confluence, South Katanga, Congo; Permian.

P. invasus Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

P. irregularis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. karharbarensis Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. korbaensis Bharadwaj & Tiwari (1964a); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. longus Kar & Bose (1967); Assise des schistes noirs de la Lukuga, Lukuga, sondage 10, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

P. obscurus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. ovatus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

P. perfectus Bose & Maheshwari (1968); Luanda and Kabangu coal measures, South of Albertville, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

P. plicatus Lele & Makada (1972); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. radialis Lele & Maithy (1969); Johilla Coalfield, M.P., India; Karharbari Stage, Talchir Series, Permian.

P. radiplicatus Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. singrauliensis Sinha (1972); Singrauli Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. talchirensis Lele & Makada (1972); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

Distribution — Triassic — Australia; Permian — North America, U.S.S.R., Africa, Antarctica, Australia, India, South America; Permo-Carboniferous — Africa; Carboniferous — Australia.

Parasaccites bilateralis Tiwari, 1965

Pl. 4, fig. 42

Holotype — Bharadwaj & Tiwari, 1964a, pl. 2, fig. 12.

Description (7 specimens) — Monosaccate, size 115-130 × 72·5-85·0 μ. Central body outline not very distinct, apparently subcircular, exine thin. Haptotypic mark absent. Saccus attachment diffused, subequatorially attached on both the faces, leaving a subcircular saccus free area. Saccus narrow along the lateral sides than at the terminal sides. Saccus intrareticulation fine.

Parasaccites diffusus Tiwari, 1965

Pl. 4, fig. 44

Holotype — Bharadwaj & Tiwari, 1964a, pl. 2, fig. 11.

Description (1 specimen)— Subcircular, size 102·5×92·5 μ. Central body ill-defined, thin. Trilete mark not distinct. Saccus narrow, uniform, subequatorially attached on both the faces. Saccus intrareticulation fine.

Parasaccites obscurus Tiwari, 1965

Pl. 4, fig. 43

Holotype — Tiwari, 1965, pl. 4, fig. 75.

Description (3 specimens) — Subcircular, size range 90·0-117·5×77·5-102·5 μ. Central body outline obscure. Exine intramicroreticulate. Y-mark distinct to weakly discernible. Saccus attachment subequatorial on both the faces. Saccus intrareticulation fine.

Remarks — The miospores encountered in the present assemblage compare well with the original description of the holotype. However, one of these specimens has equatorially thickened body outline and so also the denser inter ray area than rest of the exine.

Parasaccites radiplicatus Maithy, 1965

Pl. 4, fig. 46

Holotype — Maithy, 1965, pl. 3, fig. 21.

Description (1 specimen) — Subcircular, size 150·0×132·5 μ. Central body ill-defined, apparently subcircular, denser than the saccus. Body exine intramicroreticulate without any haptotypic mark. Saccus with subequatorial attachment on both the faces and prominent radial folds emerging from the zone of saccus attachment, microreticulate.

Parasaccites densus Maheshwari (1967)

Pl. 4, fig. 45

Holotype — Maheshwari, 1967, pl. 2, fig. 23.

Description (3 specimens) — Circular to subcircular, size range 102·5-117·5×100-105 μ. Central body dense, conforms to the saccus in shape, 87·5-95·0×80-87·5 μ in size. Body exine intramicroreticulate. Trilete rays less than 1/2 the body radius long. Saccus intrareticulation fine.

Genus — *Virkkipollenites* Lele, 1964

Type Species — *Virkkipollenites triangularis* (Mehta) n. comb. Lele, 1964.

Remarks— The stratigraphical distribution of this genus ranges from Permo-Carboniferous to Permo-Triassic with its abundance in the Lower Permian. In the present assemblage it is a rare genus.

In this genus, so far the following species have been described:

V. astericus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Sequence, Damuda Series, Permian.

V. congoensis Bose & Kar (1966); Mabuita and Mahibi, Walikale region, Congo; Assise des schistes noirs de la Walikale, Permian.

V. corius Bose & Kar (1966); Elila River, near Fundi Sadi, Congo; Assise des schistes noirs de la Walikale, Permian.

V. densus Lele (1964); Goraia, South Rewa Gondwana Basin, Central India; Talchir Stage, Talchir Series, Permian.

V. katriensis Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Sequence, Damuda Series, Permian.

V. latisaccus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Sequence, Damuda Series, Permian.

V. mehtae Lele (1964); Goraia, South Rewa Gondwana Basin, Central India; Talchir Stage, Talchir Series, Permian.

V. obscurus Lele (1964); Goraia, South Rewa Gondwana Basin, Central India; Talchir Stage, Talchir Series, Permian.

V. orientalis Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

V. triangularis (Mehta) Lele (1964); Pali beds, South Rewa Gondwana Basin, India; Permian.

V. trigonalis Bose & Maheshwari (1966); Epulu River (Ituri) Congo; Younger to Assise des schistes noirs de la Walikale, Permian.

V. trilobatus Bose & Kar (1966); Bavilevile, Walikale region, Congo; Assise glaciaires et périglaciers, ? Permo-Carboniferous.

cf. *V. zonatus* Saksena (1971); Ganjra Nala beds, South Rewa Gondwana Basin, Central India; Permo-Carboniferous.

Distribution— Permian —U.S.S.R., Africa, India, West Pakistan; Permo-Carboniferous — Africa.

Virkkipollenites mehtae Lele, 1964

Pl. 4, fig. 40

Holotype — Lele, 1964, pl. 2, fig. 16.

Description (4 specimens) — Circular to subcircular, size 90×72 -79×72 μ. Central body subcircular to horizontally oval, 62 ×53 -77×62 μ. Exine intramicroreticulate. Y-mark visible, sometimes rays not equal. Saccus attachment equatorial on proximal side and subequatorial distally. Saccus width almost uniform.

Genus — *Plicatipollenites* Lele, 1864

Type Species — Plicatipollenites indicus Lele, 1964.

Remarks — From the available data, it is clear that the present genus exists in the sediments ranging from Talchir Stage to Barren Measures Stage of the Indian Lower Gondwana with its high percentage in Talchir and Karharbari stages. Quantitatively, this genus is not significant in the present assemblage.

Following species have been known so far in this genus:

P. bilateralis Maithy (1969); Daltonganj Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

P. densus Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

P. diffusus Lele (1964); Goraia, South Rewa Gondwana Basin, India; Talchir Stage, Talchir Series, Permian.

P. ganjraensis Saksena (1971); Ganjra Nalla beds, South Rewa Gondwana Basin, India; Permo-Carboniferous.

P. giganticus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

P. gondwanensis (Balme & Hennelly) Lele (1964); Big Ben Seam, Bloomfield Colliery, New South Wales; Tomago Stage, Permian.

P. indicus Lele (1964); Goraia, South Rewa Gondwana Basin, India; Talchir Stage, Talchir Series, Permian.

P. maculatus Lele & Karim (1971); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. magnus Tiwari (1965); Korba Coalfield, Madhya Pradesh, India; Barakar Stage, Damuda Series, Permian.

P. ovatus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

P. stigmatus Lele & Karim (1971); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. trigonalis Lele (1964); Goraia, South Rewa Gondwana Basin, India; Talchir Stage, Talchir Series, Permian.

Distribution — Permian — Africa, Australia, India, West Pakistan; Permo-Carboniferous — Africa.

Plicatipollenites gondwanensis (Balme & Hennelly) Lele, 1964

Pl. 5, fig. 48

Synonym — Nuskoisporites gondwanensis Balme & Hennelly, 1956.

Holotype — Balme & Hennelly, 1956, pl. 7, fig. 16.

Description (3 specimens) — Monosaccate, roundly triangular, size 82·5-87·5×85-95 μ. Central body circular, size 56-65×56-72·5 μ, exine intramicroreticulate, haptotypic mark not seen. Saccus attachment equatorial on proximal face but subequatorial on distal side, zone of attachment associated with folds forming a polygon pattern.

Plicatipollenites ovatus Kar, 1968a

Pl. 5, fig. 47

Holotype — Kar, 1968a, pl. 2, fig. 41.

Description (2 specimens) — Oval, monosaccate, size 162·5-182·5 × 130·0-132·5 μ. Central body subcircular, 95·0-97·5 ×80·0-82·5 μ in size, exine finely intramicroreticulate. Trilete mark distinct, sometimes distinct, rays unequal. Saccus 14-50 μ wide, proximally equatorially and distally subequatorially attached. Distal zone of saccus attachment associated with folds.

Remarks — In one of the specimens, however, distinct trilete mark is present whereas it has been described to be absent by Kar (1968a) in original description.

Genus — *Tuberisaccites* Lele & Makada, 1972

Type Species — Tuberisaccites varius Lele & Makada, 1972.

Remarks — In the present assemblage the genus is represented by only one species and quantitatively also very rare.

In the present genus so far the following species have been known:

T. jhingurdahiensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

T. lobatus Lele & Makada (1972); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

T. tuberculatus (Maheshwari) Lele & Makada (1972); Lufupa-Mushyashya Confluence, South Katanga, Congo; Permian.

T. varius Lele & Makada (1972); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

Distribution — Permian — Africa, India.

Tuberisaccites jhingurdahiensis Sinha, 1972

Pl. 4, fig. 39

Holotype — Sinha, 1972, pl. 3, fig. 42.

Description (2 specimens) — Monosaccate subcircular, size 91·0-97·5×80-85 μ. Central body subcircular, size 68×74-68×82 μ, proximally verrucose, distally bearing 2-4 tuber-like bodies. In one grain trilete mark visible on proximal side. Saccus attachment equatorial on proximal face and subequatorial on the distal. Saccus narrow, uniformly broad.

Infrasubturma — *Definiri* Bharadwaj, 1974
Infraturma — *Fossati* Bharadwaj, 1974
Subinfraturma — *Taeniati* Bharadwaj, 1974
Infrasubinfraturma — *Proximi* Bharadwaj, 1974
1. *Adistalae* Bharadwaj, 1974

Genus — *Lueckisporites* (Potonié & Klaus) Bharadwaj, 1974

Type Species — Lueckisporites virkkiae (Potonié & Klaus) emend. Klaus, 1963.

Remarks — Lueckisporites is a well-established genus described from northern hemisphere. Its presence has been recorded from the Lower Gondwana sediments of India also, and is reported to be characteristic miospore for the Barakar Stage. In the present assemblage it is represented with only one species, its incidence being inconsistent. Recently, Bharadwaj (1974) has emended this genus and gave generic diagnosis as follows (after Bharadwaj, 1974). " Disaccate miospores with the main body bearing one or more sulci on the proximal face lying over or parallel to the orientation of a nexinal monolete slit — when seen, and their ends reaching the zones of saccus attachment. Sulci separated from each other by tiniae of thick, structured or sculptured exine which has low edges often tending to curve in. Laterally and distally the two sacci well separated. No tenuitas distally ".

In this genus the following species have been recorded:

L. crickmayi Pocock (1970b); western Canada; Bajocian (Lower), Jurassic.

L. hallstattensis Singh (1965); Shale of Werfen, Hallstatt, Austria; Triassic (Lower).

L. interuptus (Jansonius) Singh (1965); Peace River area, western Canada; Triassic.

L. jansoni Singh (1965); Shale of Werfen, Hallstatt, Austria; Triassic (Lower).

L. junior Klaus (1960); Karn of the Alpine, Austria; Triassic (Upper).

L. klausii Singh (1965); Shale of Werfen, Hallstatt, Austria; Triassic (Lower).

L. krauseli (Leschik) Potonié (1958); Neuewell bei Basel, Germany; Schilfsandstein, Triassic.

L. monosaccoides Singh (1965); Shale of Werfen, Hallstatt, Austria; Triassic (Lower).

L. pallidus Singh (1965); Shale of Werfen, Hallstatt, Austria; Triassic (Lower).

L. rutheri Bharadwaj & Singh (1964); Lunz, Austria; Triasic (Upper).

L. tattooensis Jansonius (1962); Peace River area, western Canada; Toad/Grayling Formation (Scythian-Anisian), Triassic.

L. triassicus Clarke (1965a); Bromsgrove Hospital Quarry, Worcestershire, England; Keuper, Triassic.

L. agoulaensis Jardiné (1974); Sondage DILO no. 10, Gabon Africa; Serie de l'Agoula, membre Koumiki, Permian.

L. alatus Bharadwaj (1974); Unterste pflanzen fuehrende Schicht Butterloch, Bletterbach-Klammbei Kaltenbrunn (Fontana fredde), Austria; Grödner Sandstone, Older Upper Permian.

L. annosus Inosova, Schwartsman & Krusina (1974); Donetz Basin, U.S.S.R., Isaevsian-Kartamyshian, Upper Carboniferous-Lower Permian.

L. anticus Inosova, Schwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Isaevsian-Kartamyshian, Upper Carboniferous-Lower Permian.

L. angoulaensis Jardiné (1974); Sondage DILO no. 10, Gabon, Africa; Serie de l'Agoula, membre Koumiki, Permian.

L. crassus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

L. globosus Klaus (1963); Bletterbach-Klamm unweit von Kaltenbrunn (Fontana fredde),

Butterloch, Austria; Grödner Sadstein Unteres Ober-Perm.

L. heisseli (Klaus) Bharadwaj (1974); Bletterbach-Klamm bei Kattenbrunn (Fontana fredde), Unterste pflanzenfuehrende Schicht, Butterloch, Austria; Grödner Sandstein, Older Upper Permian.

L. hyalinus Schaarschmidt (1963); Nordende des Budinger Tunnels, Germany; Oberer Zechstein.

L. labdacus (Klaus) Bharadwaj (1974); Bletterbach-Klamm bei Kattenbrunn (Fontana fredde), Unterste pflanzenfuchrende Schicht, Butterloch, Austria; Grödner Sandstein, Ober Perm.

L. microgranulatus Klaus (1963); Bletterbach-Klamm bei Kattenbrunn (Fontana fredde), Butterloch, Austria; Grödner Sandstein, Ober Perm.

L. noviaulensis (Leschik) Potonié (1958); Neuhof bei Fulda, Germany; Salzton des Zechsteins.

L. nyakapendensis Hart (1960); Lower Coal Measures (K 2); Ketewaka-Mchuchuma Coalfield, Tanganyika, Africa; Permian (Lower).

L. ortisei (Klaus) Bharadwaj (1974); Bletterbach-Klamm bei Kattenbrunn (Fontana fredde), Unterste pflanzenfuchrende Schicht. Tonlage in Sandstein mit Pflanzenhaecksel, Butterloch, Austria; Grödner Sandstein, Older Upper Permian.

L. parvus (Klaus 1963); Bletterbach-Klamm unweit Kattenbrunn (Fontana fredde), Butterloch, Austria; Grödner Sandstein, Ober-Perm.

L. platysaccoides Schaarschmidt (1963); Nordende des Büdinger Tunels; Oberer Zechstein.

L. sewardi (Virkki) Potonié & Klaus (1954); New Castle, New South Wales; Permo-Carboniferous.

L. singhii Balme (1970); Salt Range, West Pakistan; Chhidru Formation, Permian.

L. singrauliensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

L. taeniaeformis Jardiné (1974); Sondage DILO no. 10, Gabon; Serie de l'Agoula, membre Koumiki, Permian.

L. virkkiae Potonié & Klaus (1954); Tonbänkchen im oberen Kalilager der Werra-Serie, Deustsche Solvay-werke, Borth, Germany; Werra-Serie, Permian.

Bharadwaj (1974) has described a new taxonomic unit *Lueckisporites klausii*. However, Singh (1965) has already reported a new species, *Lueckisporites klausii* Singh, 1965 from Austria. Therefore the name proposed by Bharadwaj (1974) becomes the homonym of *L. klausii* Singh, 1965. Hence the specimens reported in *L. klausii* sensu Bharadwaj (1974) have been assigned a new specific name.

Lueckisporites potoniei nom. nov.

Synonym — *Lueckisporites klausii* Bharadwaj, 1974.

Holotype — Klaus, 1963, pl. 16, fig. 78.

Locus Typicus — Austria, Butterloch, Bletterbach-Klamm bei Kaltenbrunn (Fontana fredde). Unterste pflanzenhaecksel.

Horizon & Age — Groedner Sandstone, Older Upper Permian.

Distribution — Jurassic — North America; Triassic — Austria, England, Germany, North America, Australia, Libya, South America; Permian — Austria, England, France, Germany, Ireland, North America, U.S.S.R., Africa, Australia, India, Iraq, Libya, West Pakistan; Permo-Carboniferous — Poland, U.S.S.R.

Lueckisporites crassus Sinha, 1972

Pl. 5, fig. 49

Holotype — Sinha, 1972, pl. 5, fig. 63.

Description (3 specimens) — Subcircular, diploxylonoid, 80-83 × 59-65 μ in size. Central body thin leathery, laevigate, 52-73 × 57-58 μ in size, proximally divided into two ± equal halves forming a horizontal sulcus. Sacci less than hemispherical and almost equal to taeniae in size. Saccus attachment full length, leaving a linear 8-9 μ wide uncovered area free. Saccus intrareticulation fine. No tenuitas distally.

2. *Distalae* Bharadwaj, 1974

Genus — *Crescentipollenites* Bharadwaj, Tiwari & Kar, 1974

Synonym — *Lunatisporites* Leschik *sensu* Bharadwaj, 1962.

Type Species — *Crescentipollenites* (*Lunatisporites*) *fuscus* (Bharadwaj, 1962) Bharadwaj, Tiwari & Kar, 1974.

Remarks — This genus is also inconsistently represented in the present assemblage.

So far, the following species have been described in this genus:

C. asulcus (Bose & Kar) Bharadwaj, Tiwari & Kar (1974); Elila River, near Fundi Sadi, Zaire, Congo; Assise Glaciaires et périglaciaires, ? Permo-Carboniferous.

C. brevis (Bose & Kar) Bharadwaj, Tiwari & Kar (1974); Mabuita, Walikale region, Zaire, Congo; Assise des schistes noirs de la Walikale, Permian.

C. fuscus (Bharadwaj) Bharadwaj, Tiwari & Kar (1974); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

C. gondwanensis (Maheshwari) Bharadwaj, Tiwari & Kar (1974); Near Bargo, Bansloi Valley, Bihar, India; Barakar Stage, Damuda Series, Permian.

C. hirsutus (Kar) Bharadwaj, Tiwari & Kar (1974); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

C. notabilis (Tiwari) Bharadwaj, Tiwari & Kar (1974); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

C. santalensis (Maheshwari) Bharadwaj, Tiwari & Kar (1974); Near Bargo, Bansloi Valley, Bihar, India; Barakar Stage, Damuda Series, Permian.

C. talchirensis Lele (1975); Sample B 91662, Dudhi River Section, West Bokaro Coalfield, Bihar, India; Talchir Formation, Permian.

During the study it has been noticed that in the species *C. talchirensis* Lele (1975) and *C. limpidus* (Balme & Hennelly) Lele & Srivastava (1977) miospores having similar characters have been included. The re-examination of the holotype of *C. talchirensis* and the miospores to *C. limpidus* (Balme & Hennelly) Lele & Srivastava (1977) and the illustrations of Balme and Hennelly (1955) shows that both of them should be kept in one species instead of two. Hence, *C. talchirensis* being published earlier is retained and *C. limpidus* sensu Lele & Srivastava (1977) is treated as synonym of the former. Therefore, the present position of the two species, *C. talchirensis* Lele (1975) and *C. limpidus* (Balme & Hennelly) sensu Lele & Srivastava (1977) is as follows.

Crescentipollenites talchirensis Lele, 1975

Synonym — *Lueckisporites limpidus* Balme & Hennelly, 1955; *L. limpidus* (Balme & Hennelly) Potonié, 1958; *Crescentipollenites limpidus* (Balme & Hennelly) Lele & Srivastava, 1977.

Similar to the monosaccate miospores Anderson (1977) has treated the disaccate pollen grains on a very broad based morphography. He has not considered various morphographical features (for example nature of exine ornamentation, nature of central body striate or nonstriate, nature of sacci and their attachment) important in delimiting various genera. This has resulted in the dumping of all the striate and nonstriate-disaccate genera. He has referred all the striate and nonstriate-disaccate forms to the genus *Pityosporites* which is not acceptable here. The lack of detailed morphographical characters useful in differentiating various genera makes it difficult to separate them. Hence, an attempt has been made to distinguish the forms wherever possible on the basis of illustrations and the information given.

Distribution — Triassic — India, Libya; Permian — Africa, India.

Crescentipollenites fuscus (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974

Pl. 5, fig. 50

Synonym — *Lunatisporites fuscus* Bharadwaj, 1962.

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

Description (4 specimens)— Diploxylonoid, size-range 97·5-107·5 × 62·5-70·0 μ. Central body vertically oval with both ends pointed, 46-58 × 53-66 μ. Equatorial rim absent. Body exine intramicroreticulate, proximally horizontal striations 5-8, sometimes branched, without vertical partitions. Sacci hemispherical, saccus attachment full length, slightly convex, associated with semilunar folds leaving a 11-19 μ broad, straight to biconvex sulcus distally. Saccus intrareticulation fine.

Infraturma — *Ataeniati* Bharadwaj, 1974
Infrasubinfraturma — *Longiquataxi* Bharadwaj, 1974
1. *Rugati* Bharadwaj, 1974

Genus — *Striatites* Pant emend. Bharadwaj, 1962

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

Remarks — It is a well-established genus showing varied morphographic characters. So far, 25 species have been recorded from Indian Gondwana and a new one has been proposed in the present study. Its occurrence has been reported from throughout the Lower Gondwana sediments and even from the Triassic. In the Talchir and Karharbari stages, the number of species reported is less but it shoots up in the Barakar Stage revealing the great diversification within the genus during this time. In the present assemblage the genus exists throughout but does not attain dominancy anywhere.

So far the following 42 species are recorded from the world mioflora:

S. indicus Dev (1961); Sehora, Sher River, Narsinghpur District, M.P., India; Jabalpur Series, Jurassic.

S. duivenii Jansonius (1962); Peace River area, western Canada; Triassic (Lower).

S. jacobii Jansonius (1962); Peace River area, western Canada; Triassic (Lower).

S. kumaoensis Lakhanpal, Sah & Dube (1959); Brewery near Nainital, Krol Series, India; Krol Series, Triassic.

S. levistriatus Bharadwaj & Tiwari (1977); Bore hole NCRD-6, Lab Sample no. 5, depth 86 m, Raniganj Coalfield, India; Maitur Formation, Lower Triassic.

S. renisaccitus Lakhanpal, Sah & Dube (1959); Brewery, near Nainital, Krol Series, India; Krol Series, Triassic.

S. rugosus Jansonius (1962); Peace River area, western Canada; Triassic (Lower).

S. samoilovichii Jansonius (1962); Peace River area, western Canada; Triassic (Lower).

S. sidhiensis Jansonius (1962); Peace River area, western Canada; Triassic (Lower).

S. alius Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. angulistriatus Klaus (1963); Cuecenes bei St., Ubrich, Sudalpinen, Austria; Grödner Sandstein; Unteres, Ober Perm.

S. barakarensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. communis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. densus Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

S. distaliplicati Sarbadhikari (1972); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. flavatus Kar & Bose (1967); Assise des schistes noirs de la Lukuga, Sondage 10, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

S. ganjraensis Saksena (1971); Ganjra Nalla beds, South Rewa Gondwana Basin, Central India; Permo-Carboniferous.

S. gopalensis Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

S. haploxylonoides Maithy (1969); Daltonganj Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

S. implicatus Bose & Maheshwari (1968); Kabangu Coal Measures near Lake Tanganyika, South of Albertsville, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

S. incirus Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

S. irregularis Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. karharbarensis Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

S. marginalis Klaus (1963); Ruggaditsch, Untress Tonband in Grödner Sandstein, Sudalpinen, Austria; Grödner Sandstein; Unteres, Ober-Perm.

S. medius Lele & Makada (1974); Jayanti Coalfield, Bihar, India; Karharbari Formation, Talchir Series, Permian.

S. microcorpus Schaarschmidt (1963); Nordende des Budinger Tunnels, Germany; Oberer Zechstein.

S. minor Klaus (1963); Butterloch, Bletterbach Klamm bei Kattenbrunn (Fontana fredde), Südalpinen, Austria; Grödner Sandstein; Unteres, Ober-Perm.

S. notus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. noviaulensis (Leschik) Schaarschmidt (1963); Neuhof (Beifulda), Germany, Zechstein.

S. obtusus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. ornatus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. ovalis Schaarschmidt (1963); Sudende des Budinger Tunnels, Germany; Mittlerer Zechstein.

S. parvus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. rarostriatus Schaarschmidt (1963); Nordende des Budinger Tunnels, Germany; Oberer Zechstein.

S. reticuloidus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. rhombicus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. sewardii Pant (1955); New Castle, New South Wales, Australia; New Castle Stage, Permian.

S. solitus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. subtilis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. tectus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. tentulus Tiwari (1965); Korba Coalfield, M. P., India; Barakar Stage, Damuda Series, Permian.

S. varius Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

Distribution — Jurassic — India; Triassic — North America, India, Libya, South America; Permian — Austria, Germany, North America, Africa, Australia, India, Libya, West Pakistan.

Striatites communis Bharadwaj & Salujha, 1964

Pl. 5, fig. 54

Holotype — Bharadwaj & Salujha, 1964, pl. 7, fig. 105.

Description (4 specimens) — Disaccate, diploxylonoid pollen grains. Size-range 72-125×52-74 μ. Central body vertically oval, 43-47×40-46 μ, dense, without marginal rim; exine microverrucose, horizontal striations 7-9, simple to branched, vertical partitions absent. Saccus subspherical, bigger than the central body, attachment straight to slightly convex leaving 1-12 μ broad sulcus with converging sides. Saccus intrareticulation fine to medium, muri thin.

Striatites notus Bharadwaj & Salujha, 1964

Pl. 5, fig. 58

Holotype — Bharadwaj & Salujha, 1964, pl. 5, fig. 83.

Description (12 specimens) — Diploxylonoid, size-range 88·0-137·5×53-89 μ. Central body vertically oval to subcircular, 35-74×33-69 μ, dense to dark brown, equatorially surrounded by distinct marginal rim, proximally 6-14 horizontal striations, simple or branched, vertical partitions many, sometimes imparting reticuloid pattern. Exine microverrucose. Saccus subspherical, bigger than the central body. Saccus attachment full length, close to each other, straight to slightly convex, leaving a 1-6 μ broad saccus-free area. Saccus intrareticulation fine to medium, muri thin.

Remarks — In the present specimens, however, the central body varies in being dense to dark brown and in having more horizontal striations (6-14) than in those described by Bharadwaj and Salujha (1964) for this species.

Striatites solitus Bharadwaj & Salujha, 1964

Pl. 5, fig. 56

Holotype — Bharadwaj & Salujha, 1964, pl. 6, fig. 101.

Description (2 specimens) — ± Haploxylonoid, size-range 99·0-112·5×55-59 μ. Central body subcircular to vertically oval, 48-52×48-58 μ in size, dense and dark, equatorially thickened. Exine microverrucose; horizontal striations on proximal side 7-8, simple or branched, without vertical partitions. Sacci subspherical, distal attachment straight, full length, leaving 1-6 μ broad sulcus; saccus intrareticulation medium, muri thin.

Striatites reticuloidus Tiwari, 1965

Pl. 5, fig. 57

Holotype — Tiwari, 1965, pl. 6, fig. 217.

Description (2 specimens)— Diploxylonoid, size-range 102·5-127·5×65-75 μ. Central body subcircular to horizontally oval, 36-70 ×39-48 μ, thin; exine microverrucose,

equatorial rim distinct; horizontal striations on proximal face 5-8, branched or unbranched, vertical partitions many. Saccus subspherical, bigger than the central body, saccus attachment full length, slightly convex leaving a 6 μ wide biconvex sulcus; saccus intrareticulation fine.

Striatites tentulus Tiwari, 1965

Pl. 5, fig. 52

Holotype — Tiwari, 1965, pl. 6, fig. 120.

Description (1 specimen) — Diploxylonoid, size-range 87×49 μ. Central body subcircular, 50×40 μ, dense, brown, equatorial rim absent; exine microverrucose, proximally 10 branched horizontal striations, without vertical partitions. Saccus subspherical, attachment full length, straight; sulcus broad. Saccus intrareticulation fine, muri thin.

Striatites incirus Maithy, 1965

Pl. 5, fig. 55

Holotype — Maithy, 1965, pl. 5, fig. 34.

Description (1 specimen) — ± Haploxylonoid, size 112·5×77·5 μ. Central body subcircular, dark, 55×65 μ, without equatorial rim; exine microverrucose, 8 branched horizontal striations on proximal face, a few (7) vertical partitions. Sacci subspherical, attachment full length, close, straight. Saccus intrareticulation fine, muri thin.

Remarks — Only one specimen of this species has been found which agrees well with the original description of the holotype. However, in the present specimen the central body is not eccentric, whereas it has been described by Maithy (1965) to be so and it appears here that such a displacement of the central body is due to the unusual flattening of the spore.

Striatites alius Venkatachala & Kar, 1968a

Pl. 5, fig. 59

Holotype — Venkatachala & Kar, 1968a, pl. 6, fig. 91.

Description (1 specimen) — Diploxylonoid, size 43×30 μ. Central body subcircular, 23×21 μ, dense, without an equatorial rim; exine microverrucose; horizontal striations on proximal side 7, simple; vertical partitions absent. Saccus subspherical, attachment full length, sulcus 1 μ wide in the middle and diverging at the ends, saccus intrareticulation fine.

Striatites tectus Venkatachala & Kar, 1968a

Pl. 6, fig. 66

Holotype — Venkatachala & Kar, 1968a, pl. 6, fig. 96.

Description (1 specimen) — Diploxylonoid, size 100·0×57·5 μ. Central body vertically oval, dense, equatorial rim absent; horizontal striations 7, branched; vertical partitions absent. Saccus subspherical, bigger than the central body. Saccus attachment straight, full length, close, sulcus being narrow. Saccus intrareticulation fine, muri thin.

Striatites varius Kar, 1968a

Pl. 5, fig. 53

Holotype — Kar, 1968a, pl. 2, fig. 55.

Description (10 specimens) — Diploxylonoid, size-range 90-120×46-83 μ. Central body dense, dark, subcircular, 34-62×28-71 μ, without marginal rim; striations on the proximal side 4-9, simple to branched; vertical partitions absent. Saccus subspherical, bigger than the central body, saccus attachment full length, straight to slightly convex, leaving a 0·5-8·0 μ broad sulcus in the middle with diverging sides. Saccus intrareticulation fine to medium, muri thin.

Striatites gopalensis Srivastava, 1970

Pl. 6, fig. 65

Synonym — *Striatites barakarensis* Sinha, 1972.

Holotype — Srivastava, 1970, pl. 1, fig. 13.

Description (6 specimens) — Diploxylonoid, size-range 92·5-103·0×55-70 μ. Central body subcircular, 34-61×38-46 μ, dense, equatorial rim distinct, exine microverrucose, proximally 6-9 simple horizontal striations without vertical partitions. Saccus subspherical, bigger than the central body; saccus attachment full length, straight, sulcus 1-3 μ wide; intrareticulation fine to medium, muri thin.

Remarks — The miospores assigned to this species resemble the holotype in all

morphographical characters as well as general organization. Similar miospores have been reported from Singrauli Coalfield (M.P.), India by Sinha (1972) under a new species *S. barakarensis*. The re-examination of the holotype of *S. barakarensis* Sinha (1972) very well answer the specific identification to be *S. gopalensis* Srivastava (1970), and hence, the former species has been considered here to be a synonym of the latter.

Striatites naditoliensis sp. nov.

Pl. 6, figs 60-62

Holotype — Pl. 6, figs 60, 61, size 117·5 × 72·5 μ, slide no. 5757.

Isotype — Pl. 6, fig. 62; slide no. 5827.

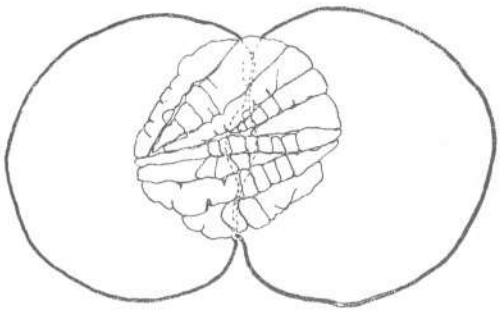
Locus Typicus — Naditoli Seam, South Karanpura Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

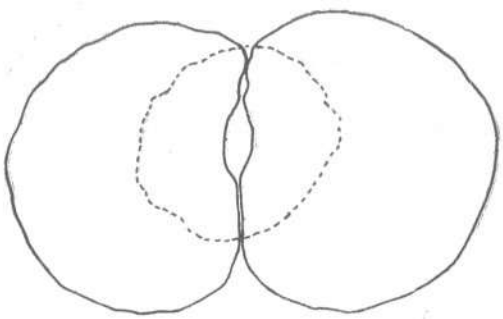
Diagnosis — Diploxylonoid pollen grains, ranging 69-140 × 56-105 μ in size. Central body dark brown, 29-70 × 32-75 μ in size. Horizontal striations 5-14 with 14 to indeterminate vertical partitions in between; exine microverrucose. Sulcus 1-12 μ broad, biconvex.

Description (16 specimens)— Disaccate, bilateral miospores. Central body circular to sub-circular, dark brown, without an equatorial rim. Central body proximally horizontally striated, striations 5-14, simple or branched with 14 to many vertical partitions inbetween (Text-fig. 2; Pl. 6, fig. 60). Proximally exine microverrucose. Sacci subspherical, diploxylonoid, proximally equatorially attached; distal attachment full length, straight at ends and convex in the middle leaving a partially biconvex (Text-fig. 3; Pl. 6, fig. 61), 1-12 μ wide sulcus. Distal saccus attachment not associated with folds. Saccus intrareticulation fine to medium, muri thin to thick.

Comparison — The present species, *S. naditoliensis* sp. nov., compares well with *S. karharbarensis* Maithy (1965) in the absence of equatorial rim in the central body and in the presence of horizontal striations along with vertical partitions. It differs, however, from the latter species in being smaller in size with a thick dark brown central body, and in the partially convex saccus attachment without folds. *S. irregularis* Tiwari (1965) and *S. incirus* Maithy (1965) differ from the present species in being haploxylonoid with lateral continuations and in the nature of saccus attachment.



TEXT-FIG. 2 — *Striatites naditoliensis* sp. nov. — holotype showing the nature of central body and striations on proximal face × 1000.



TEXT-FIG. 3 — *Striatites naditoliensis* sp. nov. — holotype showing the nature of distal saccus attachment and the distal sulcus × 1000.

Striatites sp.

Pl. 6, figs 63, 64

Description (2 specimens)— Disaccate, bilateral, diploxylonoid pollen grains, measuring 132·5-155·0 × 92·5-110·0 μ. Central body circular to subcircular, dense, 70-85 × 70-71 μ in size; equatorial rim present. Body exine laevigate to microverrucose. Proximally faintly striated, number of horizontal striations 6-7, simple or branched with many vertical partitions inbetween. Sacci subspherical bigger than the central body, diploxylonoid, proximally equatorially attached, laterally continuous although notched at the lateral ends. Distally sulcus

ill-defined, 8-14 μ wide, straight to slightly biconvex. Saccus intrareticulation medium, muri thick.

Remarks — *Striatites* sp. differs from all the species of *Striatites* in possessing an equatorial rim as well as vertical partitions, in having faint striations, ill-defined sulcus and lateral continuation with notches. It has not been possible to erect a new species due to lack of sufficient number of specimens.

Genus — *Striatopodocarpites* Soritsch & Sedova emend. Bharadwaj, 1962

Type Species — *Striatopodocarpites tojmensis* Sedova, 1956.

Remarks — Venkatachala and Kar (1964b) have not considered the genus *Striatopodocarpites* for the Indian species described by Bharadwaj and Salujha (1964, 1965a) and have included them under the genus *Strotersporites* Wilson (1962). *Strotersporites* Wilson emend. Klaus (1963) is confined to the disaccate species bearing a monolete slit on the proximal face. However, after the elucidation of taeniate pollen grains to be proximally sulcate by Bharadwaj (1974) and the presence of varyingly wide and long lighter space on the proximal face in the illustrative photographs of the genus *Strotersporites* Wilson (1962) suggests it to be a genus of striate-taeniate pollen grain. Hence, the aforesaid proposal does not stand. Further, Bose and Maheshwari (1968) have created a new genus *Gondwanipollenites* including disaccate-striate miospores invalidating Sedova's *Striatopodocarpites* on the probability that the original specimen of *S. tojmensis* Sedova (1956) may show characteristic features of *Lunatisporites*. Recently *Lunatisporites* Leschik (1955) has been reported to be synonym of *Taeniaesporites* Leschik (1955) and is characterized by the presence of strips where as *Striatopodocarpites tojmensis* bears striations. Moreover, a conditional genus is not a valid genus vide ICBN Article 34, Note 1. Hence *Striatopodocarpites* is a valid taxonomic unit.

Following species have been reported so far in this genus:

S. balmei Dev (1961): Sehora, Sher River, Narsinghpur District, M.P., India; Jabalpur Series, Jurassic.

S. gondwanensis Lakhanpal, Sah & Dube (1960); Brewery, near Nainital, India; Krol Series, Triassic.

S. nidpurensis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

S. pantii (Jansonius) Balme (1970); Peace River area, western Canada; Triassic.

S. bekangensis Jardiné (1974); Sondage DILO no. 2, Gabon; Serie de l'Agoula, membre Koumiki, Permian.

S. brevis Sinha (1972); Singrauli Coalfield, M. P., India; Barakar Stage, Damuda Series, Permian.

S. cancellatus (Balme & Hennelly) Clarke (1965b); Seam at 377 ft South Wallarah no. 5 Bore, New South Wales, Australia; New Castle Stage, Permian.

S. caricicostatus Clapham (1970); Flowerpot Formation, western Oklahoma; Permian.

S. concinus Inossova, Shwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Isaevsian, Slavajnskian, Upper Carboniferous to Lower Permian.

S. crassus Singh (1964); Atshan well, Chia Zairi Formation, Northern Iraq; Permian.

S. decorus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. diffusus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. emendatus Inossova, Shwartsman & Krusina (1974); Donetz basin, U.S.S.R.; Isaevsian-Slavjanskian, Carboniferous (Upper)— Permian (Lower).

S. labrus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. laudohaensis Sarbadhikari (1972); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. magnificus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. octostriatus Hart (1960); Ketewaka-Mchuchuma Coalfield, Tanganyika; Permian.

S. olsonii Clapham (1970); Flowerpot Formation, western Oklahoma; Permian.

S. ovalis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. subcircularis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. tojmensis Sedova (1956); North European part, U.S.S.R. & Pre-urals; Kungurian, Kazanian Stage, Permian.

S. venustus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. novicus Gupta & Boozer (1969); Rock Lake shale, Garnett Locality, Kansas; Stanton Formation, Pennsylvanian, Carboniferous.

Maheshwari (1967) and Kar (1968a) have described a number of species of *Strotersporites* of which the holotypes, illustrated by them, have been re-studied here and it has been observed that none of them possesses the monosulcus and taeniae on the proximal face of the central body which are the diagnostic features of the genus as interpreted here. Therefore, these species must be placed under the genus *Striatopodocarpites* as follows:

Striatopodocarpites ovatus (Maheshwari) comb. nov.

Synonym — *Strotersporites ovatus* Maheshwari, 1967.

Holotype — Maheshwari, 1967, pl. 7, fig. 58.

Locus Typicus — 3/4 mile south-east of Alubera, Bansloi Valley, Santhal Parganas, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Striatopodocarpites globosus (Maheshwari) comb. nov.

Synonym — *Strotersporites globosus* Maheshwari, 1967.

Holotype — Maheshwari, 1967, pl. 7, fig. 59.

Locus Typicus — Near Bargo, Bansloi Valley, Santhal Parganas, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Striatopodocarpites fusus (Maheshwari) comb. nov.

Synonym — *Lueckisporites fusus* Balme & Hennelly, 1955; *Strotersporites fusus* (Balme & Hennelly) Maheshwari, 1967

Holotype — Balme & Hennelly, 1955, pl. 1, fig. 7.

Locus Typicus — Cardiff Seam, Collie, western Australia.

Age — Permian.

Striatopodocarpites rotundus (Maheshwari) comb. nov.

Synonym — *Strotersporites rotundus* Maheshwari, 1967.

Holotype — Maheshwari, 1967, pl. 7, fig. 57.

Locus Typicus — Near Bargo, Bansloi Valley, Santhal Parganas, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Striatopodocarpites lentisaccus (Kar) comb. nov.

Synonym — *Strotersporites lentisaccus* Kar, 1968a.

Holotype — Kar, 1968a, pl. 3, fig. 69.

Locus Typicus — Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Striatopodocarpites plicatus (Kar) comb. nov.

Synonym — *Strotersporites plicatus* Kar, 1968a.

Holotype — Kar, 1968a, pl. 3, fig. 71.

Locus Typicus — Jharia Coalfield, Bihar, India.

Horizon & Age — Barren Measure Formation, Lower Gondwana.

Banerji and Maheshwari (1975) have described a new species *Gondwanipollenites multistriatus*. However, in view of present interpretation of the genus, *Gondwanipollenites* being invalid, and the characters of the miospores so far assigned to the species *G. multistriatus* being similar to those of *Striatopodocarpites* following new combination has been made.

Striatopodocarpites multistriatus (Banerji & Maheshwari) comb. nov.

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

Holotype — Banerji & Maheshwari, 1975, pl. 3, fig. 31.

Locus Typicus — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Distribution — Jurassic — India; Triassic — North America, Australia, India; Permian — England, North America, U.S.S.R., Africa, Antarctica, Australia, India, Iraq, West Pakistan; Carboniferous — North America, U.S.S.R., Egypt.

Striatopodocarpites decorus Bharadwaj & Salujha, 1964

Pl. 6, fig. 68

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

Description (1 specimen)— Haploxylonoid, 95×54 μ in size. Central body thin, somewhat rhomboidal, 56×50 μ in size. Exine intramicroreticulate, proximally 6 simple horizontal striations. Saccus hemispherical, proximally equatorially attached distally inclined forming a straight, uniformly broad ±5 μ wide, distinct sulcus; intrareticulation fine.

Striatopodocarpites magnificus Bharadwaj & Salujha, 1964

Pl. 6, fig. 69

Holotype — Bharadwaj & Salujha, 1964, pl. 10, fig. 143.

Description (8 specimen)— Haploxylonoid, size-range 117·5-170·0×87·5×110 μ. Central body subcircular to vertically oval, size-range 59-93×78-110 μ. Exine intramicroreticulate. Proximally horizontal striations 5-12, simple or branched. Sacci hemispherical, saccus height equal to body height, sometimes smaller than the central body. Saccus attachment straight full length, sulcus 4-12 μ wide. Saccus intrareticulation fine to mediumly coarse.

Striatopodocarpites tiwarii nom. nov.

Pl. 8, fig. 84

Synonym — *Striatopodocarpites crassus* Tiwari, 1965; *Striatopodocarpites perfectus* Maheshwari, 1967; *Gondwanipollenites crassus* (Tiwari) Bose & Maheshwari, 1968.

Holotype — Tiwari, 1965, pl. 7, fig. 151.

Locus Typicus — Pindra Seam, Datma Colliery, West Bokaro Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Description (3 specimens) — Diploxylonoid pollen grains. Size-range 117·5-132·5 ×76-83 μ. Central body circular to oval, distinct, dense 65-76 × 62-70 μ in size. Body exine intramicroreticulate, Proximally striated, 5-8 simple or branched horizontal striations converging at the ends, without any vertical partitions. Sacci more than semi-circular. Sometimes distal saccus attachment ill-defined. Sacci intramicroreticulation fine to medium.

Remarks — *Striatopodocarpites crassus* Tiwari (1965) is homonym of *Striatopodocarpites crassus* Singh (1964). As the latter name was published first, it gets the priority and the former one becomes invalid. Hence, a new name *S. tiwarii* has been given to the species *Striatopodocarpites crassus* Tiwari (1965).

The holotype of the species *Strotersporites perfectus* Maheshwari (1967) has been re-examined in the present study. It has been observed that the holotype specimen is very similar in morphographical features to those illustrated by Tiwari (1965) as *Striatopodocarpites crassus* and hence, it has been treated as a synonym of the above species.

Striatopodocarpites subcircularis Sinha, 1972

Pl. 6, fig. 67

Holotype — Sinha, 1972, pl. 7, fig. 100.

Description (8 specimens) — Diploxylonoid, size-range 88-142·5×62·5-89 μ. Central body circular to subcircular, 58-81 ×46-68 μ, proximally bearing 4-5 simple, horizontal striations, no vertical connections. Exine intramicroreticulate. Sacci more than hemispherical, distal saccus attachment straight, full length, sulcus very narrow. Saccus intrareticulation fine.

Striatopodocarpites ovalis Sinha, 1972

Pl. 7, fig. 78

Holotype — Sinha, 1972, pl. 7, fig. 98.

Description (5 specimens)— Diploxylonoid, size-range 75-97 ×60-75 μ. Central body vertically oval, 40·0-52·5×46-59 μ, intramicroreticulate, proximally 3-7 simple and distinct horizontal striations, no vertical partitions. Sacci hemispherical, proximally equatorially attached, distal attachment being straight, full length leaving a 1-9 μ broad

sulcus. Saccus intrareticulation fine to medium.

Remarks — The usual presence of an incomplete ring reported by Sinha (1972) is, however, absent in the specimens studied here.

Genus — *Lahirites* Bharadwaj, 1962

Type Species — *Lahirites raniganjensis* Bharadwaj, 1962.

In the present genus the following species have been illustrated so far:

L. triassicus Bharadwaj & Tiwari (1977); Bore hole NCRD-6, Lab sample no. 5, depth 86 m, Raniganj Coalfield, India; Maitur Formation, Lower Triassic.

L. barakarensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

L. bokaroensis Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

L. communis Bose & Maheshwari (1968); Kabangu and Luanda Coal Measures, South of Albertville, Congo; Assise des schistes noirs de la Lukuga, Lukuga Series, Permian.

L. fractus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

L. incertus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. kajorensis Salujha (1965); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. lepidus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. levicorpus Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

L. lungatooensis Venkatachala & Kar (1968c); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

L. minutus Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

L. naviculus Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

L. parvus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. raniganjensis Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. rarus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. reticuloidus Sinha (1972); Singrauli Coalfield, M.P, India; Barakar Stage, Damuda Series, Permian.

L. rhombicus Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

L. rotundus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

L. singrauliensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

L. singularis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

Distribution — Triassic — India, Libya; Permian — Africa, India, West Pakistan.

Lahirites raniganjensis Bharadwaj, 1962

Pl. 7, fig. 75

Holotype — Bharadwaj, 1962, pl. 12, fig. 172.

Description (1 specimen)— Diploxylonoid, size 102·5 × 46·0 μ. Central body subcircular, dense, 51 × 46 μ, marginal rim absent; proximally 10 branched horizontal striations with many vertical partitions. Exine intrapunctate, puncta distribution uniform. Sacci subspherical, saccus attachment straight, full length, sulcus 10 μ wide. Saccus intrareticulation fine.

Lahirites rarus Bharadwaj & Salujha, 1964

Pl. 7, fig. 74

Holotype — Bharadwaj & Salujha, 1964, pl. 9, fig. 128.

Description (22 specimens)— Diploxylonoid, size-range 71-130 × 51-98 μ. Central body usually dense, dark brown sometimes light brown, subcircular to vertically oval, 51-98 × 38-77 μ, without vertical partitions. Exine intrapunctate, puncta uniformly distributed. Sacci hemispherical, saccus attachment full length, attachment zones sometimes thickened. Sulcus ± straight, 0·5-10·0 μ wide. Saccus intrareticulation fine to medium, muri thick.

Lahirites minutus Venkatachala & Kar, 1968a

Pl. 7, fig. 73

Holotype — Venkatachala & Kar, 1968a, pl. 7, fig. 113.

Description (1 specimen)— Diploxylonoid, measuring 44×32 μ. Central body dense, circular, 21×21 μ in size, without an equatorial rim; proximally horizontal striations 6, branched, without vertical connections. Exine intrapunctate, puncta evenly distributed. Sacci subspherical, distal saccus attachment straight, close, full-length. Sulcus 1·0 μ wide. Saccus intrareticulation fine.

Lahirites rhombicus Maithy, 1965

Pl. 7, fig. 77

Holotype — Maithy, 1965, pl. 5, fig. 35.

Description (6 specimens)— Diploxylonoid, 90-115×68-89 μ. Central body thin or dense, rhomboid, without any marginal rim, 38-62×50-66 μ, proximally 6-9 faint to distinct striations, mostly simple sometimes branched without vertical connections. Exine intrapunctate, puncta uniformly distributed. Sacci subspherical, saccus attachment straight to slightly convex, full-length. Sulcus straight, 0·5-19·0 μ wide, convex to dumbel-shaped. Saccus attachment sometimes associated with folds. Saccus intrareticulation fine.

Lahirites levicorpus Tiwari, 1968

Pl. 7, fig. 76

Holotype — Tiwari, 1968, pl. 5, fig. 56.

Description (15 specimens)— Diploxylonoid, size-range 81·0-142·5×58·0-82·5 μ. Central body mostly thin, circular, subcircular to vertically oval, 28-71×44-66 μ, with distinct marginal thickening; proximally horizontal striations 7-12, mostly branched, without any vertical connection. Exine intrapunctate, puncta evenly distributed. Sacci subcircular, saccus attachment ± straight, full-length, sulcus 1-9 μ wide. Saccus intrareticulation fine to medium.

Lahirites karanpuraensis sp. nov.

Pl. 7, figs 70-72

Holotype — Pl. 7, figs 70, 71, size 112·5×85·0 μ, slide no. 5793.

Isotype — Pl. 7, fig. 72, size 107·5×90·0 μ, slide no. 5776.

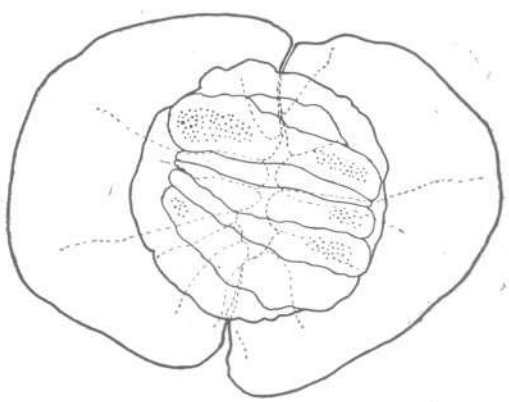
Locus Typicus — Argada Seam, South Karanpura Coalfield, Bihar.

Horizon & Age — Barakar Formation, Lower Gondwana.

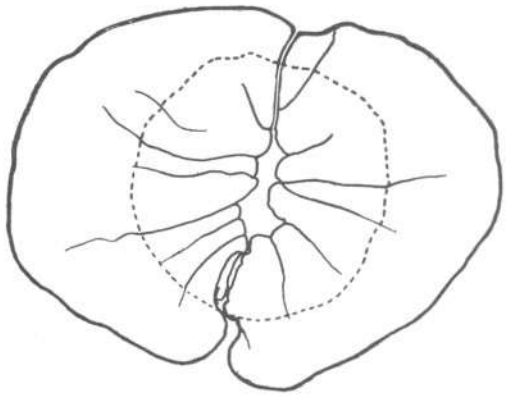
Diagnosis — Pollen grains diploxylonoid; central body dark brown, equatorial rim absent, horizontal striations branched 5-7 sometimes with few vertical partitions (13-17). Puncta distribution localised. Sulcus straight to partially biconvex, 1-10 μ wide.

Description (5 specimens) — Disaccate, bilateral pollen grains. Size range 107·5-127·5×67·5-90·0 μ. Central body dark brown, circular to vertically oval, without an equatorial rim, 35-70×48-60 μ; proximally horizontally striated, number of striations 5-7, branched sometimes with vertical partitions (13-17) inbetween. Exine intrapunctate, puncta distribution localised (Text-fig. 4; Pl. 7, fig. 70). Sacci hemispherical, saccus attachment full length, sometimes associated with radiating folds, straight at the sides and convex in the middle, distal sulcus 1-10 μ broad, straight to biconvex (Text-fig. 5; Pl. 7, fig. 71). Saccus leathery (Pl. 7, fig. 70), intrareticulation fine, muri thick.

Comparison — The present species differs from *L. incertus*, *L. rotundus*, *L. singularis* Bharadwaj & Salujha (1964), *L. fractus* Tiwari (1965) and *L. parvus* Bharadwaj & Salujha (1964) in lacking the equatorial rim. *L. raniganjensis* Bharadwaj (1962), *L. reticuloidus* Sinha (1972), *L. barakarensis* Sinha



TEXT-FIG. 4 — *Lahirites karanpuraensis* sp. nov. — holotype showing the nature of central body, striations and exine structure on proximal face × 750.



TEXT-FIG. 5 — *Lahirites karanpuraensis* sp. nov. — holotype showing the nature of distal saccus attachment and distal sulcus × 750.

(1972), *L. rarus* Bharadwaj & Salujha (1964), *L. bokaroensis* Tiwari (1965), *L. rhombicus* Maithy (1965), *L. minutus* Venkatachala & Kar (1968a), *L. lungatooensis* Venkatachala & Kar (1968), *L. communis* Bose & Maheshwari (1968) differ from *L. karanpuraensis* sp. nov. in having uniform distribution of puncta on the proximal face of the central body.

Remarks — In the present study it has been observed that the miospores included in the species *L. karanpuraensis* sp. nov. have similar morphographical features, for example, localised distribution of puncta, absence of equatorial rim, saccus attachment being straight to partially convex and the saccus being leathery with fine intrareticulation and thick muri. However, the vertical partitions in between the horizontal striations are present only in some specimens and are absent in others. Evidently the importance of vertical partitions for specific identification is questionable although it has been used by the former workers for delimiting the species. The validity of this character in taxonomy has yet to be proved. Hence, in the present study no importance has been attributed to this feature while creating the above species. Similar forms have also been observed by us in Korba Coalfield, Madhya Pradesh, India.

Genus — *Verticipollenites* Bharadwaj, 1962

Type Species — *Verticipollenites secretus* Bharadwaj, 1962.

Remarks — The occurrence of this genus is rare in our samples.

In this genus the following species have been described so far:

V. crassus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. debilis Venkatachala & Kar (1968a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

V. finitimus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. gibbosus Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. oblongus Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. secretus Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

V. subcircularis Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

Distribution — Triassic — India; Permian — India.

Verticipollenites secretus Bharadwaj, 1962

Pl. 7, fig. 82

Holotype — Bharadwaj, 1962, pl. 12, fig. 160.

Description (2 specimens)— Diploxylonoid, size-range 105-110×65·72·5 μ. Central body subcircular without an equatorial thickening, measuring 53-59 ×53-57 μ. Proximally simple horizontal striations 7-9 with many vertical connections. Exine microverrucose. Sacci subspherical pitcher-shaped, saccus attachment straight, partial, close. Sulcus 2-3 μ broad, straight. Saccus intrareticulation fine to medium.

Verticipollenites gibbosus Bharadwaj, 1962

Pl. 7, fig. 81

Holotype — Bharadwaj, 1962, pl. 12, fig. 174.

Distribution (2 specimens)— Diploxylonoid, size-range 100·0-127·5×56-75 μ. Central body subcircular, equatorially thickened, 45-54×50-57 μ. Proximally 7-8 simple or branched horizontal striations without any vertical connections. Exine

microverrucose. Saccus subspherical, pitcher-shaped, saccus attachment straight, close, partial, distal sulcus narrow and straight. Saccus intrareticulation fine.

Verticipollenites debilis Venkatachala & Kar, 1968a

Pl. 7, figs 79, 80

Holotype — Venkatachala & Kar, 1968a, pl. 6, fig. 100.

Description (7 specimens)— Diploxylonoid, size-range 42·0-142·5×29-95 μ. Central body circular to subcircular without an equatorial rim, measuring 20-65× 20-63 μ. Exine microverrucose, proximally 5-9 horizontal striations, simple, sometimes branched without vertical connections. Sacci subcircular, pitcher-shaped; saccus attachment straight, partial, sulcus 1-3 μ wide, linear. Saccus intrareticulation fine.

Genus — *Faunipollenites* Bharadwaj, 1962

Type Species — Faunipollenites varius Bharadwaj, 1962.

Remarks — Faunipollenites has been reported originally from the Raniganj Stage of Damuda Series. Later on, Hart (1964) and Balme (1970) have referred this as a synonym of *Protohaploxypinus* Samoilovich (1953). Kar (1968a, 1968b) and Venkatachala and Kar (1968a, 1968b, 1968c) have assigned similar forms from Indian sediments under the genus *Striatopiceites* Sedova (1956). However, the genera *Protohaploxypinus* as well as *Striatopiceites* are not correctly and fully known (Balme, 1970, p. 361; Zauer, 1965; Tiwari, 1974, p. 261) and from the available information it is clear that both the genera have distinct central body and the latter has a horizontal slit also. The genus *Faunipollenites*, on the other hand, does not have a marked central body and also lacks a monolete slit. Hence, it is reasonable to retain *Faunipollenites* as a distinct entity *sensu* Bharadwaj (1962).

So far the following species have been described in this genus:

F. gopadensis Bharadwaj & Srivastava (1969a); Nidpur, Sidhi District, M.P., India; Triassic.

F. bharadwajii Maheshwari (1967); Bansloi Valley, Santhal Parganas, Bihar, India; Barakar Stage, Damuda Series, Permian.

F. circumstriatitus Maheshwari (1969); Lufupa-Mushyashya confluence, South Katanga, Congo; Permian.

F. copiosus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

F. enigmatus Maheshwari (1969); Lufupa-Mushyashya confluence, South Katanga, Congo; Permian.

F. goraiensis (Potonié & Lele) Maithy (1965); Goraia Nalla, South Rewa Gondwana Basin, Central India; Talchir Stage, Damuda Series, Permian.

F. perexiguus Bharadwaj & Salujha (1965a); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

F. singrauliensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

F. varius Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

Distribution — Triassic — India; Permian — Africa, India, South America, West Pakistan.

Faunipollenites varius Bharadwaj, 1962

Pl. 8, fig. 91

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

Description (17 specimens)— Haploxylonoid, disaccate pollen grains, size-range 79·0-112·5×57-81 μ. Central body outline not distinct, appears to be subcircular to vertically oval. Exine intra-microreticulate, horizontal striations 5-12, simple or branched, faint to distinct. Sacci hemispherical, zone of saccus attachment indistinct. Sacci mediumly intramicroreticulate.

Faunipollenites bharadwajii Maheshwari, 1967

Pl. 8, fig. 95

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

Description (22 specimens)— Bilateral, haploxylonoid, measuring 112·5-155 ×63-130 μ. Central body outline not distinct, apparently subcircular to vertically oval. Exine intramicroreticulate, proximally horizontal striations 6-12, simple or branched, faint to distinct. Sacci hemispherical, zone of saccus attachment indis-

tinct. Sacci mediumly to coarsely intramicroreticulate.

Faunipollenites perexiguus Bharadwaj & Salujha, 1965a

Pl. 8, fig. 93

Holotype — Bharadwaj & Salujha, 1965a, pl. 2, fig. 42.

Description (8 specimens)— Bilateral, haploxylonoid, measuring 54-74×31-49 μ. Central body outline indistinct, apparently subcircular to vertically oval. Exine intramicroreticulate, horizontal striations 4-6, simple. Sacci ± hemispherical, zone of saccus attachment indistinct. Saccus intrareticulation fine to medium.

Faunipollenites enigmatus Maheshwari, 1969

Pl. 8, fig. 94

Holotype — Maheshwari, 1969, pl. 5, fig. 8.

Description (1 specimen)— Disaccate, haploxylonoid, size 110·0×72·5 μ. Central body outline indistinct, exine thin, intramicroreticulate, horizontal striations 15, branched. Sacci hemispherical, saccus attachment straight, full length, leaving a narrow sulcus distally. Saccus intrareticulation fine.

Faunipollenites circumstriatus Maheshwari, 1969

Pl. 8, fig. 83

Holotype — Maheshwari, 1969, pl. 6, fig. 1.

Description (4 specimens)— Haploxylonoid, disaccate, roundly bilateral, size-range 80-115×68-110 μ. Central body outline not very distinct, circular to vertically oval, horizontal striations 6-8 simple, marginally connected. Exine intramicroreticulate. Sacci hemispherical, small. Saccus attachment straight, full length. Distal sulcus 7-15 μ broad. Saccus intrareticulation fine to medium.

Faunipollenites singrauliensis Sinha, 1972

Pl. 8, fig. 92

Holotype — Sinha, 1972, pl. 7, fig. 105.

Description (6 specimens)— Disaccate, horizontally oval, haploxylonoid, size-range 84-120×67·5-80·0 μ. Body outline ill-defined, thin, horizontal striations 5-9, distinct, branched or simple. Sacci hemispherical, distal saccus attachment diffused, sulcus ill-defined; distally a median slit present. Saccus intrareticulation fine.

Genus — *Striapollenites* Bharadwaj, 1962

Type Species — Striapollenites saccatus Bharadwaj, 1962.

Remarks — In the present assemblage its occurrence is very rare.

Following species have been known in this genus so far:

S. obliquus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

S. saccatus Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

Distribution — Triassic — India; Permian — Africa, India.

Striapollenites obliquus Bharadwaj & Salujha, 1964

Pl. 8, fig. 85

Holotype — Bharadwaj & Salujha, 1964, pl. 11, fig. 155.

Description (4 specimens)— Diploxylonoid, size-range 97·5-115·0×62·5-80·0 μ. Central body thin, vertically oval, 42-58× 54-74 μ in size. Exine intramicroreticulate. Proximally 6-9, simple or branched, oblique striations. Sacci hemispherical, proximally equatorially attached, distal attachment full length; sulcus biconvex, 6-17 μ broad. Saccus intrareticulation fine to medium.

Genus — *Distriatites* Bharadwaj, 1962

Type Species — Distriatites bilateralis Bharadwaj, 1962.

Remarks — Bharadwaj (1962) has instituted the genus *Distriatites* from the coals of Raniganj Coalfield, Raniganj Stage, for the 'bilateral, pollen grains with a subcircular central body bearing a number of horizontal striations proximally and vertical striations distally in the saccus free region'. In the same year Wilson (1962) erected the

genus *Hamiapollenites* from the Flowerpot Formation, Greer County, Oklahoma, for " pollen bilateral bisaccate, tube cell circular in equatorial view, slightly oblate. . .proximal surface with 8 to 12 ribs oriented in long axial direction,. . .distal surface with 6 to 10 ribs oriented at right angles to the proximal . . ." So far these two genera were considered to be similar and the name *Hamiapollenites* was adopted by Hart (1964), Venkatachala and Kar (1968a, 1968b), Kar (1969a) and Balme (1970).

Tschudy and Kosanke (1966) have emended the diagnosis of the genus *Hamiapollenites* Wilson, as —" Bisaccate pollen grains; body circular to oval in proximo-distal orientation, somewhat elongate in equatorial view;. . .Proximal surface of body covered with 8 to 12 or more costae alternating with grooves that parallel the long axis of the grain. . .Distal surface may possess 1 to 10 bands or ribs at right angles to the proximal costae. Distal body exine between bands or ribs thin, and smooth to granular. . .".

A critical survey of the published literature covering the miospore genera *Distriatites* and *Hamiapollenites* has been done. The illustration from the Flowerpot Formation by Wilson (1962) does not indicate clearly the presence of ribs on the central body as has been stated in the description by him. In 1970, Clapham has again worked out the palynology of Flowerpot Formation, Oklahoma. In the illustrations given by him the taeniate nature of the central body is very distinct; same is the case in the specimens illustrated by Tschudy and Kosanke (1966), Playford and Dettman (1965), Jansonius (1962), Peppers (1964), Segroves (1969), Venkatachala and Kar (1968b), Balme (1970) and Jardiné (1974). Beside this, the illustrative photographs of the specimens assigned to the genus *Hamiapollenites* by the aforesaid authors and the text-figure given by Balme (1970) clearly indicate that in these specimens the distal exine has become thin at many a places revealing the polysulcate nature of the pollen grains. On the other hand in the forms referred as *Distriatites* Bharadwaj (1962) the central body is striated on both the faces and such a thinness of exine is not present, and hence are not sulcate (Bharadwaj & Salujha, 1964; Tiwari, 1965, 1973a; Venkatachala & Kar, 1968a, 1968c; Kar, 1969a; Maheshwari, 1967; Srivastava & Maheshwari, 1974; Tiwari & Anand-Prakash, 1974; Sinha, 1972).

Evidently, in the past, two types of plants must have been existing bearing the following two types of pollen grains: (i) in which the central body is simply striated on both proximal and distal faces; the distal ones at right angles to the proximal one and are not polysulcate-*Distriatites* Bharadwaj (1962), and (ii) in which the central body is proximally taeniate and distally polysulcate — *Hamiapollenites* Wilson (1962).

In this genus, so far, the following species have been described:

D. bilateralis Bharadwaj (1962); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

D. distinctus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

D. indicus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

D. insolitus Bharadwaj & Salujha (1964); Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

Distribution — Triassic — India; Permian — India.

Distriatites indicus Sinha, 1972

Pl. 8, fig. 86

Holotype — Sinha, 1972, pl. 8, fig. 10.

Description (9 specimens) — Disaccate, haploxylonoid, size-range 92·5-122·5 × 53-75 μ. Central body circular to vertically oval, thin, 44-72 × 58-75 μ with rounded ends. Proximally 5-11 simple horizontal striations and distally 2-4 vertical striations. Exine intramicroreticulate. Sacci smaller than the central body, less than hemispherical, proximally equatorially attached, distal attachment being diffused. Saccus intrareticulation fine.

Genus — *Rhizomaspora* Wilson, 1962

Type Species — Rhizomaspora radiata Wilson, 1962.

Remarks — It is a rare genus in the present assemblage. Hart (1964) has abandoned this genus by including *Rhizomaspora* type of grains in *Striatopodocarpites* without considering the differences in the exine character — intramicropunctate in the former and

intramicroreticulate in the latter as well as the presence of radiating folds in the saccus at body equator in *Rhizomaspora*. With the above differences in view both the genera are separate taxonomic unit and hence, Hart's (1964) transfers are not acceptable.

In this genus the following species have been recorded:

R. biharia Banerji & Maheshwari (1975); South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar, India; Panchet Group, Triassic.

R. costa Venkatachala & Kar (1968b); Kathwai shales, Salt range, West Pakistan; Permian.

R. delicata Jardiné, 1974; Sondage DILO no. 10, Gabon; Serie de l'Agoula, membre Koumiki, Permian.

R. divaricata Wilson (1962); Flowerpot Formation, Oklahoma; Guadalupean Series, Permian.

R. fimbriata Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

R. indica Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage; Damuda Series, Permian.

R. lemnisaccata Wilson (1962); Flowerpot Formation, Oklahoma; Guadalupean Series, Permian.

R. minutus Bose & Kar (1966); Elila River near Fundi Sadi, Congo; Assises glaciaire et périglaciares, Permo-Carboniferous.

R. monosulcata Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

R. radiata Wilson (1962); Flowerpot Formation, Oklahoma; Guadalupean Series, Permian.

R. singula Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian .

Distribution — Triassic — India; Permian — Ireland, North America, Africa, India, West Pakistan; Permo-Carboniferous — Africa; Carboniferous — North America.

Rhizomaspora indica Tiwari, 1965

Pl. 8, fig. 90

Holotype — Bharadwaj & Tiwari, 1965, pl. 2, fig. 24.

Diagnosis (7 specimens)— Disaccate pollen grain with monosaccoid construction of sacci. Size-range 97·5-132·5 × 72·5-97·5 μ. Central body dark brown, thick, circular to subcircular, 37-61 × 37-52 μ, without an equatorial rim. Body bearing polygonal areas forming reticuloid striations on the proximal face. Sacci subspherical, proximally zone of saccus attachment diffused, showing many radiating folds of saccus. Distal sulcus ill-defined, narrow. Sacci with broad lateral continuations and double intrareticulation.

Rhizomaspora sp.

Pl. 8, fig. 89

Description (3 specimens)— Miospores bilateral, disaccate, diploxylonoid, ranging in size from 92·5-102·5 × 85·0-92·5 μ. Central body dark brown, subcircular, measuring 50-63 × 54-62 μ without an equatorial thickening. Proximally incompletely striated by polygonal to rectangular areas, striations reticuloid to subparallel. Body exine finely intramicro punctate. On the proximal face minor radiating folds present in the saccus. Distal saccus attachment ill-defined, sulcus narrow. Saccus intrareticulation fine.

Remarks — Pollen grains described here are comparable to *Rhizomaspora singula* Tiwari (1965) but differ in lacking the equatorial rim in the central body, in being smaller in size and in having smaller body saccus ratio. It is because of these differences they are described here as *Rhizomaspora* sp.

Genus — *Primuspollenites* Tiwari, 1964

Type Species — Primuspollenites levis Tiwari, 1964.

Remarks — It is a well established genus reported from the Barakar Stage. So far it is known to occur only in the Barakar Stage of Damuda Series. In the present assemblage its presence is qualitatively significant but in low percentage.

Following species of the genus are known:

P. brevicorpus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. densus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. dicavus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. distinctus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
P. levis Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
P. linterus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
P. obscurus Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
P. ovatus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
P. singrauliensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — Africa, India; Permo-Carboniferous — India.

Primuspollenites levis Tiwari, 1964

Pl. 9, fig. 104

Holotype — Tiwari, 1964, pl. 1, fig. 9.

Description (7 specimens)— Diploxylonoid, size-range 77·5-100·0×73-90 μ. Central body vertically oval, without marginal rim. Body exine bearing faint to distinct polygonal areas forming reticuloid striations on proximal side. Sacci subcircular, saccus attachment full length, slightly convex leaving a ±11-13 μ wide biconvex sulcus. Saccus intrareticulation fine to medium.

Primuspollenites dicavus Tiwari, 1965

Pl. 9, fig. 101

Holotype — Tiwari, 1965, pl. 5, fig. 111.

Description (1 specimen)— Diploxylonoid, size 100×65 μ. Central body vertically oval, without an equatorial thickening, 42×46 μ in size, proximally bearing faint, small polygonal areas forming reticuloid striations. Sacci subspherical, distal attachment full length, zone of attachment accompanied with thickenings narrowing laterally resulting in a dumb-bell-shaped sulcus. Saccus intrareticulation fine.

Primuspollenites linterus Tiwari, 1965

Pl. 9, fig. 98

Holotype — Tiwari, 1965, pl. 6, fig. 114.

Description (1 specimen)— Diploxylonoid, size 115×75 μ. Central body 36×40 μ in size, dense, nearly subtriangular with one end narrower and the other broadly rounded, proximally bearing faint reticuloid striations. Sacci subspherical, distal attachment full length, linear and associated with folds, leaving a 8 μ broad sulcus. Sacci laterally continuous, notched at the lateral ends.

Primuspollenites obscurus Tiwari, 1965

Pl. 9, fig. 100

Holotype — Tiwari, 1965, pl. 5, fig. 110.

Description (10 specimens)— Diploxylonoid, size-range 83-110×57-88 μ. Central body outline ill-defined, appears to be vertically oval, thin without an equatorial rim, measuring 30-51×48-73 μ. Small to large, faint polygonal areas present on the proximal face of the central body forming reticuloid striations. Sacci subspherical, bigger than the central body; saccus attachment full length, ±straight, close, laterally meeting with each other. Sulcus 0·5-6·0 μ wide. Sacci finely intrareticulate.

Primuspollenites brevicorpus Sinha, 1972

Pl. 9, fig. 99

Holotype — Sinha, 1972, pl. 4, fig. 51.

Description (1 specimen)— Diploxylonoid, size 95×78 μ. Central body 35×45 μ, vertically oval, without an equatorial rim. Exine proximally marked with faint polygonal areas. Sacci subspherical, saccus attachment straight, full length, distally accompanied with thickenings. Sulcus narrow, straight, 0·5 μ broad. Sacci continuous laterally, intrareticulation fine.

Primuspollenites distinctus Sinha, 1972

Pl. 9, fig. 97

Holotype — Sinha, 1972, pl. 4, fig. 49.

Description (5 specimens)— Diploxylonoid, size-range 92·0-132·5×61·0-92·5 μ. Central body circular to subcircular, without an equatorial rim, 84-53×31-68 μ. Proximally marked with faint to distinct polygonal areas forming reticuloid striations. Sacci subcircular, saccus attachment full length, close; sulcus biconvex, narrow. Sacci laterally continuous but sometimes notched.

Primuspollenites ovatus Sinha, 1972

Pl. 9, fig. 96

Holotype — Sinha, 1972, pl. 4, fig. 53.

Description (8 specimens)— Diploxylonoid, size-range 80·0-112·5×60·0-87·5 μ. Central body vertically oval, sometimes with acute ends, without an equatorial rim, 34-60×43-66 μ, proximally bearing faint polygonal areas forming reticuloid striations. Sacci subcircular, bigger than the central body, laterally continuous. Saccus attachment ± straight, full length; sulcus 0·5-8·0 μ wide, zone of saccus attachment being thickened. Saccus intrareticulation fine.

Primuspollenites singrauliensis Sinha, 1972

Pl. 9, fig. 103

Holotype — Sinha, 1972, pl. 4, fig. 47.

Description (2 specimens)— Disaccate, bilateral, size-range 79-100 × 72-77 μ. Central body vertically oval, equatorially thickened, 46-50×58-63 μ, proximally bearing small, faint polygonal areas. Sacci subspherical, laterally continuous; saccus attachment straight, full length, close. Sulcus linear, narrow. Saccus intrareticulation fine to medium.

Primuspollenites sp.

Pl. 9, fig. 105

Description (3 specimens)— Disaccate, bilateral, 93·0-112·5×66-90 μ. Central body vertically oval without an equatorial thickening, 42-50×61-62 μ in size. Proximally polygonal areas present forming incomplete striations. Sacci subspherical, laterally continuous; distally saccus attachment ± straight, full length, leaving a 1-6 μ wide, straight to slightly convex sulcus. Saccus intrareticulation fine to medium.

Remarks — Presently studied specimens show the presence of polygonal areas on the proximal face of the central body, some of which coalesce to form incomplete striations. Due to the presence of this characteristic feature these specimens have not been assigned to the previously described species, and because of the limited number of specimens a new species has not been proposed.

Genus — *Schizopollis* Venkatachala & Kar, 1964a

Type Species — Schizopollis wodehousei Venkatachala & Kar, 1964a.

Remarks — In the present assemblage it is rarely observed. Following species have been recorded in this genus so far:

S. disaccoides Venkatachala & Kar (1964a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. distinctus Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. extremus Venkatachala & Kar (1964a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. jhingurdahiensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. rugosus Venkatachala & Kar (1968c); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

S. wodehousei Venkatachala & Kar (1964a); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Distribution — Triassic — Libya; Permian — Africa, India.

Schizopollis distinctus Sinha, 1972

Pl. 8, fig. 87

Holotype — Sinha, 1972, pl. 5, figs 68, 69.

Description (4 specimens)— Disaccate, haploxylonoid, size range 65-85×45-58 μ. Central body dense, subcircular, 44-73× 45-55 μ, proximally 6-7 simple or branched horizontal striations, ending before the body margin. Exine finely intramicropunctate, puncta distribution restricted. Sacci smaller in height than the central body, proximally equatorially attached, distally inclined leaving a 3-18 μ wide distal sulcus. Saccus intrareticulation fine.

Schizopollis sp.

Pl. 8, fig. 88

Description (2 specimens)— Pollen grains disaccate, haploxylonoid, 70×35-61×28 μ. Central body dark brown, 61×52-55× 34 μ in size, subcircular. Proximally 5-7 simple horizontal striations not reaching up to the central body margin thus leaving equatorial area all round the body, vertical

partitions many. Exine finely intramicropunctate. Sacci two in number, smaller than the central body, distal sulcus broad. Saccus intrareticulation fine.

Remarks — The miospores encountered here differ from all the species described so far in having distinct horizontal striations with vertical partitions on the proximal face of central body. Comparable forms have also been illustrated by Sinha (1972) as *Schizopollis* sp.

Genus — *Striasulcites* Venkatachala & Kar, 1968b

Type Species — Striasulcites tectus Venkatachala & Kar, 1968b.

Remarks — Morphographically this genus is noteworthy but its stratigraphical importance has not yet been established in the Lower Gondwana. It is a rare genus in the present assemblage.

So far only following two species have been described in this genus:

S. ovatus Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

S. tectus Venkatachala & Kar (1968b); Kathwai shales, Salt Range, West Pakistan; Permian.

Distribution — Permian — India, West Pakistan.

Striasulcites tectus Venkatachala & Kar, 1968b

Pl. 9, fig. 102

Holotype — Venkatachala & Kar, 1968b, pl. 6, fig. 61.

Description (6 specimens)— Pollen grains oval to subcircular. Size-range 67·0-107·5 ×80·0-107·5 μ. Central body proximally horizontally striated, number of striations 7-11, simple, branched, distally bearing a biconcave sulcus extending from one end to another. Exine microgranulose.

Striasulcites ovatus Venkatachala & Kar, 1968b

Pl. 9, fig. 108

Holotype — Venkatachala & Kar, 1968b, pl. 6, fig. 67.

Description (1 specimen)— Subcircular pollen grain, size 88×80 μ. Proximally 10 branched horizontal striations. Distally sulcus narrow at one end and broad at the other. Exine microgranulose.

Genus — *Distriamonocolpites* Bharadwaj & Sinha, 1969

Type Species — Distriamonocolpites ovalis Bharadwaj & Sinha, 1969.

Remarks — Quantitatively, in the present assemblage, it is not an important genus.

So far the following two species have been described in this genus:

D. circularis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

D. ovalis Bharadwaj & Sinha (1969); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — India.

Distriamonocolpites ovalis Bharadwaj & Sinha, 1969

Pl. 9, fig. 107

Holotype — Bharadwaj & Sinha, 1969, pl. 1, fig. 10.

Description (2 specimens)— Disaccate, vertically oval, size 75·0-77·5×86-100 μ. Distally bearing distinct biconcave sulcus from one end to the other. Exine intrapunctate, proximally bearing 9-12 horizontal simple striations, distally bearing 4-6 striations running parallel to the colpus.

2. *Arugulati* Bharadwaj, 1974

2.1. *Monosulcati* Bharadwaj, 1974

Genus — *Ginkgocycadophytus caperatus* (Lub.) Samoilovich, 1953

Type Species — Ginkgocycadophytus caperatus (Lub.) Samoilovich, 1953.

Remarks — This is not a significant genus as far as its frequency is concerned, but qualitatively its presence is noteworthy in the present assemblage.

In this genus, so far the following species have been recorded:

G. nitidus (Balme) De Jersey (1962); Carnarvon Basin, western Australia; Neocomian, Cretaceous.

G. asymetricus Kar & Sah (1970); Vemavaram, A.P., India; Jurassic (Upper).

G. crassimarginis (De Jersey) De Jersey (1962); Rosewood Coalfield, Queensland; Jurassic.

G. deterius (Balme) Dev (1961); Hill River-Jurein Bay area, Perth Basin, western Australia; Cockshell, Gully Sandstone, Jurassic (Lower).
G. srivastavae Kar & Sah (1970); Vemavaram, A.P., India; Jurassic (Upper).
G. adjectus De Jersey (1962); Ipswich Coalfield, Queensland; Triassic.
G. granulatus De Jersey (1962); Ipswich Coalfield, Queensland; Triassic.
G. africanus Maheshwari & Bose (1969); Kibamba River, Congo; Permian.
G. caperatus (Luber) Samoilvich (1953); village of Pokcha, Cherdyn area, western Cis-Urals; Artinskian, Permian.
G. cymbatus (Balme & Hennelly) Potonié & Lele (1961); Hornville Seam, Lower Split, Hebburn no. 1 Colliery, New South Wales, Australia; Permian.
G. korbaensis Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.
G. magnus Venkatachala & Kar (1968c); North Karanpura Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.
G. micropunctatus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Sequence, Damuda Series, Permian.
G. novus Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.
G. vetus (Balme & Hennelly) Tiwari (1965); Homeville Seam, Lower split, Hebburn no. 1 Colliery, New South Wales, Australia; Permian.

Distribution — Cretaceous — North America; Jurassic — Austria, Sweden, Australia, India; Triassic — Australia; Permian — Sweden, U.S.S.R., Africa, Australia, India, West Pakistan; Permo-Carboniferous — Africa; Carboniferous — U.S.S.R.

Ginkgocycadophytus novus Srivastava, 1970

Pl. 9, fig. 106

Holotype — Srivastava, 1970, pl. 2, fig. 25.

Description (1 specimen)— Miospore spindle-shaped with narrow and rounded ends, measuring 58×32 μ. Monosulcate, sulcus extends from one end to other end, narrow in the middle and broad at the ends. Exine finely intrapunctate.

Infrasubinfraturma — *Breviquataxi* Bharadwaj, 1974

Genus — *Platysaccus* Naumova emend. Potonié & Klaus, 1954

Type Species — Platysaccus papilionis Potonié & Klaus, 1954.

Remarks — In the present assemblage its incidence is sporadic. In this genus the following species have been described hitherto:

P. decora Bolkhovitina (1953); Chulema Enisian Basin, Central region of the U.S.S.R.; Cenomanian, Cretaceous.
P. densus (Venkatachala) Kumar (1973); Pat River Section near Bhuj, Kutch, Gujarat District, India; Bhuj Series, Cretaceous.
P. gracilenta Bolkhovitina (1953); Chulema Enisian Basin, Central region of the U.S.S.R.; Cenomanian, Cretaceous.
P. kainarensis Bolkhovitina (1953); Chulema Enisian Basin, Central region of the U.S.S.R.; Cenomanian, Cretaceous.
P. kazakhstaensis Bolkhovitina (1953); Chulema Enisian Basin, Central region of the U.S.S.R.; Cenomanian, Cretaceous.
P. macrophyllaeformis Bolkhovitina (1953); Chulema Enisian Basin, Central region of the U.S.S.R.; Cenomanian, Cretaceous.
P. megasaccus Brenner (1963); Maryland, U.S.A.; Potomac Group, Cretaceous.
P. radiatus Kimyai (1966); Raritan Formation, New Jersey; Cretaceous (Upper).
P. indicus Sah & Jain (1965); Rajmahal Hills, Bihar, India; Jurassic.
P. lopsinensis Pocock (1970b); western Siberia; Jurassic.
P. cacheutensis Jain (1968); Minas de Petroleo, Mendoza, western Argentina; Cacheuta Formation, Triassic.
P. crassimarginatus Lakhanpal, Sah & Dube (1959); Brewery near Nainital, India; Krol Series, Triassic.
P. fascus Goubin (1965); Morandava Basin, Madagascar; Triassic (Lower).
P. queenslandi De Jersey (1962); Ipswich Coalfield, Queensland, Australia; Triassic.
P. tenuis Lakhanpal, Sah & Dube (1959); Brewery near Nainital, India; Krol Series, Triassic.
P. densicorpus Anand-Prakash (1972); Pench Kanhan Coalfield, M.P, India; Barakar Stage, Damuda Series, Permian.
P. densus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measure Stage, Damuda Series, Permian.

P. hingirensis Tiwari (1968); Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.
P. katriensis Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measures Stage, Damuda Series, Permian.
P. leschiki Hart (1960); Lower Coal Measure (K2) Ketewaka-Mchuchuma Coalfield, Tanganyika; Permian.
P. ovatus Maithy (1965); Giridih Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.
P. papilionis Potonié & Klaus (1954); Salzberg Hallstatt Cheristine — Horizont Schwingheim-Querschlag Kernsalz aus dem grauen Kerngebirge, Germany; Permian.
P. praevius Goubin (1965); Morandava Basin, Madagascar, Permian (Upper).
P. umbrosus Leschik (1956); Neuhof (bei Fulda) Germany; Zechsteins.
P. graneus Ischenko (1952); western part of Donetz Basin, U.S.S.R.; Carboniferous.
P. saarensis (Bha·dwaj) Jizba (1962); Saar Region Germany; Carboniferous.
P. trinus Ischenko (1952); western part of Donetz Basin, U.S.S.R.; Carboniferous (Middle).
P. volaticus Ischenko (1952); western part of Donetz Basin, U.S.S.R.; Carboniferous (Middle).
P. volatilis Ischenko (1952); western part of Donetz Basin, U.S.S.R.; Carboniferous (Middle).

Distribution — Cretaceous — North America, U.S.S.R., India; Jurassic — North America, India, Madagascar; Triassic — Austria, England, North America, Rumania, Australia, India, Libya, Madagascar, South America, West Pakistan; Permian — Austria, England, France, Germany, North America, U.S.S.R., Africa, Australia, India, Iraq, Libya, Madagascar; Carboniferous — Germany, U.S.S.R.

Platysaccus papilionis Potonié & Klaus, 1954

Pl. 10, fig. 115

Holotype — Potonié & Klaus, 1954, pl. 10, fig. 12.

Description (2 specimens)— Diploxylonoid, size-range 85-97·5×60-62 μ. Central body thick, vertically oval, size 23-31 ×30-34 μ without marginal rim. Exine microverrucose. Sacci subcircular, saccus attachment straight, close, full length; sulcus narrow, linear. Sacci notched but continuous laterally, lateral continuation 4·0-6·5 μ wide. Saccus intrareticulation fine.

Platysaccus ovatus Maithy, 1965

Pl. 10, fig. 116

Holotype — Maithy, 1965, pl. 6, fig. 42.

Description (2 specimens)— Diploxylonoid, size-range 100·0-107·5×75·0-87·5 μ. Central body vertically oval, measuring 22-23×40-53 μ, without an equatorial rim, exine laevigate. Sacci subcircular, twice bigger than the central body; saccus attachment straight, full length, leaving a narrow sulcus on distal side. Sacci notched laterally but continuous. Saccus intrareticulation fine.

Platysaccus densicorpus Anand-Prakash, 1972

Pl. 10, fig. 117

Holotype — Anand-Prakash, 1972, pl. 2, fig. 14.

Description (12 specimens) — Diploxylonoid, size-range 92·5-102·5×55-88 μ. Central body circular, subcircular to vertically oval, dense, measuring 28-43×35-48 μ, without equatorial rim. Proximally exine faintly to distinctly microverrucose, without any striations. Sacci subspherical, saccus attachment ± straight, full length, close; sulcus 0·5-1 μ broad, ± straight. Saccus intrareticulation fine to medium.

Platysaccus plicatus sp. nov.

Pl. 10, figs 113, 114

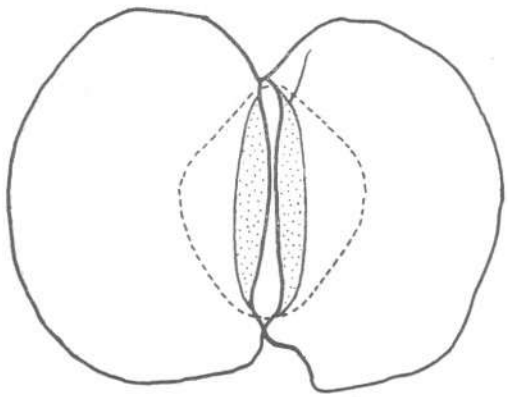
Holotype — Pl. 10, fig. 113, size 87·5× 68·0 μ, slide no. 5805.

Isotype — Pl. 10, fig. 114, size 87×66 μ, slide no. 5795.

Locus Typicus — South Karanpura Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Diagnosis — Diploxylonoid pollen grains. Size-range 85·0-107·5×57·5-77·5 μ. Central body vertically oval, 30-45×39-55 μ. Exine laevigate to finely verrucose. Sacci subcircular, saccus attachment ± straight, associated with folds. Sulcus narrow,



TEXT-FIG. 6 — *Platysaccus plicatus* sp. nov. — holotype showing the nature of saccus attachment and the distal sulcus × 1000.

Description (12 specimens)—Pollen grains disaccate, bilateral diploxylonoid. Central body distinct, always vertically oval without an equatorial rim. Proximally exine laevigate to finely microverrucose, without any striations. Sacci bigger than the central body, subcircular, notched at both the lateral sides. Saccus attachment ± straight, full length, close and thickened (Text-fig. 6), distal sulcus narrow, ± straight, 0·5-2·0 μ broad. Saccus intrareticulation fine to medium.

Comparison — *Platysaccus higirensis* Tiwari (1968) has usually thinner body and laevigate exine. *P. leschiki* Hart (1960) has thin and very small central body as compared to the size of the sacci. The present species resembles *P. ovatus* Maithy (1965) and *P. papilionis* Potonié & Klaus (1954) in having microverrucose exine and vertically oval central body but can be differentiated by the distal saccus attachment zones which are thickened and well-defined.

Genus — *Aurangapollenites* Srivastava, 1977

Type Species — *Aurangapollenites gurturiensis* Srivastava, 1977.

Remarks — This is a newly introduced genus and only one species is described in it.

A. gurturiensis Srivastava (1977); Sukri River Section, near Gutur Village, Auranga Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — India.

Aurangapollenites brevizonatus (Tiwari) comb. nov.

Pl. 10, fig. 118

Synonym — *Platysaccus brevizonatus* Tiwari, 1968.

Holotype — Tiwari, 1968, pl. 8, fig. 85.

Locus Typicus — Hingir-Rampur Seam, Pit no. 11, Ib-River Coalfield, Orissa, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Description (1 specimen)— Diploxylonoid, 96×69 μ. Central body vertically oval, 38×47 μ with an equatorial rim. Exine microverrucose. Sacci pitcher-shaped due to partial attachment of saccus distally, zone of saccus attachment thickened, sulcus close, 0·5 μ broad, straight. Saccus intrareticulation fine to medium.

Remarks — Some of the miospores recovered from Lower Gondwana of India were referred to the species *Platysaccus brevizonatus* Tiwari (1968). The morphographical characters of these pollen grains are similar to those described for the genus *Aurangapollenites* Srivastava (1977). Hence, a new combination *Aurangapollenites brevizonatus* (Tiwari) has been made to incorporate the miospores so far assigned to *Platysaccus brevizonatus* Tiwari (1968).

Genus — *Potonieisporites* Bharadwaj emend. Bharadwaj, 1964

Type Species — *Potonieisporites novicus* Bharadwaj, 1954.

Remarks — The occurrence of this genus is very rare quantitatively in the present mioflora. In this genus the following species have been described:

P. bisaccoidus Kar, Kieser & Jain (1972); Libya; Triassic.

P. amonoletus Kar, Kieser & Jain (1972); Libya; Permian.

P. balmei (Hart) Segroves (1969); Mchuchuma River Valley, Ketewaka-Mchuchuma Coalfield, Tanganyika; Permian.

P. barrelis Tiwari (1965); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. bilateralis Singh (1964); Atshan well, Chia Zairi Formation, northern Iraq; Permian.

P. concinnus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. congoensis Bose & Maheshwari (1968); Kabangu and Luanda Coal Measures near lake Tanganyika, South of Albertville, Congo; Assie des schistes noirs de la Lukuga Series, Permian.

P. densicorpus Anand-Prakash (1972); Pench-Kanhan Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

P. densus Maheshwari (1967); Near Bargo, Bansloi Valley, Santhal Parganas, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. distinctus Bose & Maheshwari (1968); Kabangu, Luanda Coal Measures near Tanganyika, South of Albertville, Congo; Assie des schistes noirs de la Lukuga, Lukuga Series, Permian.

P. grandis Tschudy & Kosanke (1966); Wolfcamp, Texas; Permian.

P. granulatus Bose & Kar (1966); Elila River near Fundi Sadi, Congo; Assise glaciaires et périglaciaires, ?Permo-Carboniferous.

P. jayantiensis Lele & Karim (1971); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. lelei Maheshwari (1967); near Bargo, Bansloi Valley, Santhal Parganas, Bihar, India; Barakar Stage, Damuda Series, Permian.

P. magnus Lele & Karim (1971); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

P. neglectus Potonié & Lele (1961); Goraia, South Rewa Gondwana Basin, India; Talchir Stage, Talchir Series, Permian.

P. raniganjensis Kar (1969b); North Karanpura Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

P. rimosus Inosova, Schwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Isaevsian Slavajnian, Permian.

P. simplex Wilson (1962); Flowerpot Formation, Oklahoma; Guadalupean Series, Permian.

P. solidus Inosova, Schwartsman & Krusina (1974); Donetz Basin, U.S.S.R.; Isaevsian, Slavajnian, Permian.

P. talchirensis Srivastava (1970); Talcher Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

P. triangulatus Tiwari (1965); Korba Coalfield, M. P., India; Barakar Stage, Damuda Series, Permian.

P. novicus Bharadwaj (1954); Labachgrube bei Breitenbach, Pfalz, Germany; Stephanian, Carboniferous.

P. versus Gupta & Boozer (1969); Rock Lake Shale, Garnett Locality, Kansas; Stanton, Formation, Pennsylvanian, Carboniferous.

Lele (1975) has made a new combination *Potonieisporites monosaccoides* (Bose & Maheshwari) Lele (1975) on the basis of morphographic characters. However, he has not mentioned the holotype, locus typicus and horizon and age. Therefore, according to ICBN Article no. 33 it is invalid. Hence, at present a new combination has been made giving the full details.

Potonieisporites monosaccoides (Bose & Maheshwari) comb. nov.

Synonym — Potonieisporites monosaccoides (Bose & Maheshwari) Lele, 1975.

Limitisporites monosaccoides Bose & Maheshwari, 1968

Holotype — Bose & Maheshwari, 1968, pl. 16, fig. 4.

Locus Typicus — Kabangu, middle tributary near lake Tanganyika, south of Albertville, Congo.

Horizon & Age — Lukuga Series, Permian.

Distribution — Triassic — Libya; Permian — England, France, North America, U.S.S.R., Africa, Australia, India, Iraq, Libya, South America, West Pakistan; Permo-Carboniferous — France, Germany, North America, Africa; Carboniferous — France, Germany, North America, U.S.S.R.

Potonieisporites lelei Maheshwari, 1967

Pl. 10, fig. 109

Holotype — Maheshwari, 1967, pl. 4, fig. 31.

Description (1 specimen) — Bilateral, monosaccate, size 142·5×112·5 μ. Central body subcircular, 75×65 μ in size. Proximally monolete mark present. Exine intramicroreticulate. Proximally saccus equatorially and distally subequatorially attached, along the distal saccus attachment circular body infold system present. Saccus wide along the longer axis than along the shorter axis of the spore.

Genus — *Cuneatisporites* Leschik, 1955

Type Species — Cuneatisporites radialis Leschik, 1955.

Remarks — In the present assemblage this genus is not very common. So far the following species have been described in this genus:

C. radialis Leschik (1955); Neuewelt, bei Basel, Switzerland; Keuper, Triassic.

C. reticulata Kar, Kieser & Jain (1972); Libya; Triassic.

C. albus Kar & Bose (1976); Old puits 1950, 1st seam, Zaire; Assise à couches de houille, Permian.

C. asulcus Kar & Bose (1976); Puits Christine, 1st seam, Zaire; Assise à couches de houille, Permian.

C. circularis Kar & Bose (1976); Puits 1950, 3rd Seam, Zaire; Assise à couches de houille, Permian.

C. exiguus Salujha (1965); East Raniganj Coalfield, Bihar, India; Raniganj Stage, Damuda Series, Permian.

C. rarus Kar (1968a); Jharia Coalfield, Bihar, India; Barren Measures Sequence, Damuda Series, Permian.

C. densus Maithy (1969); Daltonganj Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

C. indicus Maithy (1966); Daltonganj Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

C. flavatus Bose & Kar (1966); Elila River near Fundi Sadi, Congo; Assises glaciaires et périglaciaires, ?Permo-Carboniferous.

C. fundiensis Bose & Kar (1966); Elila River, near Fundi Sadi, Congo; Assises glaciaires et périglaciaires, ?Permo-Carboniferous.

C. majus Saksena (1971); Ganjra Nalla beds, South Rewa Gondwana Basin, Central India; Permo-Carboniferous.

C. obscurus Bose & Kar (1966); Elila River near Fundi Sadi, Congo; Assises glaciaires et périglaciaires, ?Permo-Carboniferous.

C. rotatus Lele & Kulkarni (1969); South Karanpura Coalfield, Bihar, India; Karharbari Stage, Talchir Series, Permian.

C. royalensis Saksena (1971); Ganjra Nalla beds, South Rewa Gondwana Basin, Central India; Permo-Carboniferous.

Distribution — Triassic — Switzerland, India, Libya, South America; Permian — Africa, India; Permo-Carboniferous — Africa.

Cuneatisporites exiguus Salujha, 1965

Pl. 10, fig. 112

Holotype — Salujha, 1965, pl. 1, fig. 20.

Description (2 specimens)— Diploxylonoid, size-range 94·0-102·5×63-80 μ. Central body vertically oval, equatorially thickened, measuring 43-51×61-65 μ. Exine intramicroreticulate, without any striations. Sacci subspherical, without lateral continuation; distal attachment full length, straight, leaving a broad sulcus. Saccus intrareticulation fine to medium.

Cuneatisporites majus Saksena, 1971

Pl. 10, fig. 110

Holotype — Saksena, 1971, pl. 7, fig. 80.

Description (4 specimens)— Diploxylonoid, size-range 110-120×87·5-95·0 μ. Central body vertically oval without any equatorial rim, measuring 42-60×54-80 μ. Body exine intramicroreticulate. Sacci bigger than the central body, subspherical, distal attachment straight, full length, close, forming linear, narrow sulcus, attachment area being thickened. Saccus intrareticulation double.

Cuneatisporites royalensis Saksena, 1971

Pl. 10, fig. 111

Holotype — Saksena, 1971, pl. 6, fig. 72.

Description (2 specimens)— Diploxylonoid, size-range 90-93×63-75 μ. Central body distinct, vertically oval without equatorial rim, 31-36×35-51 μ in size. Exine intramicroreticulate without any striations. Sacci subcircular, bigger than the central body, distal attachment full length, ± straight and associated with folds, sulcus 2 μ broad ± straight. Sacci finely intramicroreticulate.

Genus — *Paravesicaspora* Klaus, 1963

Type Species — Paravesicaspora (al. *Sulcatisporites*) *splendens* Leschik, 1956.

Remarks — The genus *Vesicaspora* Schemel emend. Wilson & Venkatachala (1963) has been diagnosed as: "Pollen grain bilateral, oval to circular in polar view; central body spherical, not discernible in many cases in distal polar view, distinct when viewed in lateral, oblique, and proximal polar positions; exposed portions of central body laevigate to finely granulose; saccus oval to circular in proximal or distal views, laevigate in surface view, infrareti-

culate, enveloping the central body in equatorial region, proximal cap and sulcus area free, saccus distally inclined in oblique and lateral compressions; sulcus fusiform or irregular in outline, extending almost across central body at right angles to the long axis of the grain" (after Wilson & Venkatachala, 1963).

According to Klaus (1963) the diagnosis of the genus *Paravesicaspora* is as follows (freely translated from German): " Bisaccate spores with oval outline, without slit like exine differentiation in the proximal side of the body. Central body in equatorial section diagonally oval, i.e. its longer axis falls with the transverse axis of the body altogether.

The diagonally oval outline of the central body approaches to clear rhomboidal shape. The distal attachments of the sacci run in the transverse axis, mostly the furrow being free, and whose ends are not spindle-shaped but are rounded. In typical cases the furrow-borders are narrowly placed in the middle than at the end of the furrow. Usually the furrow-line runs parallel so as to make a long stretched ellipse (elliptical area). Exoexine dorsally coarsely infragranulose to reticulate. Sacci opposite, with a tendency to incline distally, haploxylonoid, covering the distal face excepting the furrow. In the equatorial section the saccus showing connection with a coarser infrabaculose part of the body ".

In both the aforesaid genera most of the characters are similar. In *Vesicaspora*, however, the saccus attachment is not along the full length of the central body, whereas in *Paravesicaspora* the attachment is along the full length of the central body on the distal face. This feature, separating the two genera under discussion and not given much attention so far, however, is very significant in being an organizational difference, and hence it is necessary to assign those miospores to *Paravesicaspora* which have saccus attachment along the full length of the central body on the distal face. The genus *Vesicaspora* should include only those specimens which show subcircular to ovalish saccus free area having attachment shorter than the vertical axis of the central body.

In this genus the following species have been recorded so far:

P. planderovae Visscher (1966); Hengelo, Netherland; Upper Bunter; Triassic.

P. splendens (Leschik) Klaus (1963); Neuhof bei Fulda, southern Alpine, Austria; Permian.

It was also observed here that the species described under the genus *Vesicaspora* by various workers from the Lower Gondwana sediments of India should actually be assigned to the genus *Paravesicaspora* considering the aforesaid character. Hence, the following transfers have been made:

Paravesicaspora indica (Tiwari) comb. nov.

Synonym — *Vesicaspora indica* Tiwari, 1965.

Holotype — Tiwari, 1965, pl. 8, fig. 173.

Locus Typicus — Topa Village Quarry, West Bokaro Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Paravesicaspora distincta (Tiwari) comb. nov.

Synonym — *Vesicaspora distincta* Tiwari, 1965.

Holotype — Tiwari, 1965, pl. 8, fig. 172.

Locus Typicus — Pindra Seam, Pindra Ramgarh Colliery, West Bokaro Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Paravesicaspora luteus (Salujha) comb. nov.

Synonym — *Vesicaspora luteus* Salujha, 1965.

Holotype — Salujha, 1965, pl. 2, fig. 33.

Locus Typicus — Upper Kajora Seam, Jaipuria Kajora Colliery, Raniganj Coalfield, Bihar, India.

Horizon & Age — Raniganj Formation, Lower Gondwana.

Distribution — Triassic — South America; Permian — Austria, France, Africa, India, Iraq, South America; Permo-Carboniferous — Netherland, North America.

Paravesicaspora obliqua (Singh) comb. nov.

Pl. 10, fig. 119; Pl. 11, fig. 121

Synonym — *Vesicaspora obliqua* Singh, 1964.

Holotype — Singh, 1964, pl. 46, fig. 12,

Locus Typicus — Atshan Well, Chia Zairi Formation, northern Iraq.

Age — Upper Permian.

Description (6 specimens)— Disaccate, bilateral, haploxylonoid pollen grains, size-range 75-140×67·5-80 μ. Central body more or less fusiform, equatorially thickend than the rest, size-range 52·5-75×69-87·5 μ. Exine intramicroreticulate. Sacci hemispherical, saccus attachment full length, straight to slightly convex, sometimes ill-defined. Sulcus broad, 17·5-35·0 μ. Saccus intrareticulation fine to coarse.

Paravesicaspora indica (Tiwari) comb. nov.

Pl. 11, fig. 120

Synonym — *Vesicaspora indica* Tiwari, 1965.

Holotype — Tiwari, 1965, pl. 8, fig. 73.

Locus Typicus — Topa Village Quarry, West Bokaro Coalfield, Bihar, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Description (12 specimens)— Bilateral, disaccate, haploxylonoid pollen grains, 72-150×63-117·5 μ in size. Central body equatorially dense, circular to vertically oval with broad rounded ends, measuring 37-75×60·0-117·5 μ. Exine intramicroreticulate. Sacci hemispherical or less than hemispherical, saccus attachment proximally equatorial with narrow lateral continuations distally inclined forming a narrow to broad sulcus, sometimes sulcus ill-defined. Saccus intrareticulation fine to medium.

Paravesicaspora brevis (Sinha) comb. nov.

Pl. 11, fig. 122

Synonym — *Vesicaspora brevis* Sinha, 1972.

Holotype — Sinha, 1972, pl. 8, fig. 114.

Locus Typicus — Bore hole no. NCSJ-4, Sample no. 83, Jhingurdah Seam, Singrauli Coalfield, Madhya Pradesh, India.

Horizon & Age — Barakar Formation, Lower Gondwana.

Description (2 specimens)— Miospores haploxylonoid, bilaterally oval, size 37·5-57·5×53·5-36 μ. Central body horizontally oval, 20·0×33·5 μ, thin. Exine intramicroreticulate. Sacci hemispherical continuous laterally, distally inclined forming an ill-defined sulcus, finely intramicroreticulate.

Paravesicaspora ovata (Balme & Hennelly) comb. nov.

Pl. 11, fig. 123

Synonym — *Florinites ovatus* Balme & Hennelly, 1955; *Sulcatisporites ovatus* Bharadwaj, 1962; *Vesicaspora ovata* (Balme & Hennelly) Hart, 1960.

Holotype — Balme & Hennelly, 1955, pl. 5, fig. 49.

Locus Typicus — Seam at 174 ft no. 6 bore, north-east basin, Collie, western Australia.

Age — Permian.

Description (2 specimens)— Miospores bilateral, disaccate, haploxylonoid, measuring 65-72×51-68 μ. Central body thin, sometimes equatorially denser than the rest, vertically oval, measuring 27-45×51-68 μ. Exine intramicroreticulate. Sacci hemispherical, bigger than the central body, proximally equatorially attached and distally inclined to form a ± straight sulcus. Saccus intrareticulation fine.

Paravesicaspora sulcata (Hart) comb. nov.

Pl. 11, fig. 124

Synonym — *Vesicaspora sulcata* Hart, 1960.

Holotype — Hart, 1960, pl. 2, fig. 25.

Locus Typicus — Mchuchuma River Valley, good coal of C.S. 6 of Mc. Kinlay, Tanganyika, Africa.

Age — Lower Permian.

Description (6 specimens)— Pollen grains disaccate, subcircular to horizontally oval, haploxylonoid, measuring 74-94×63-80 μ. Central body thin, measuring 30-50×63-80 μ with rounded ends, without an equatorial rim. Exine intramicroreticulate. Sacci hemispherical, sometimes less than hemispherical, distal attachment full length, straight, leaving a uniform 8-20 μ wide sulcus; lateral continuations very narrow or absent. Saccus intrareticulation fine to medium.

Remarks — These specimens differ in being subcircular to horizontally oval in shape and in having unthickened saccus attachment zones.

Genus — *Ibisporites* Tiwari, 1968

Type Species — *Ibisporites diplosaccus* Tiwari, 1968.

So far only the following two species have been described in this genus:

I. diplosaccus Tiwari (1965); Ib-River Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

I. jhingurdahiensis Sinha (1972); Singrauli Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — India.

Ibisporites diplosaccus Tiwari, 1968

Pl. 11, fig. 126

Holotype — Tiwari, 1968, pl. 6, fig. 67.

Description (6 specimens)— Diploxylonoid, size-range 100·0-112·5×67·0-57·5 μ. Central body thin, indistinct to faintly defined, apparently vertically oval, 38-58 ×58-70 μ in size. Exine intramicroreticulate. Sacci hemispherical, sometimes laterally continuous, distal attachment ill-defined. Saccus intramicroreticulation fine to medium.

Ibisporites jhingurdahiensis Sinha, 1972

Pl. 11, fig. 125

Holotype — Sinha, 1972, pl. 8, fig. 118.

Description (11 specimens)— Diploxylonoid, size-range 100-125×70·0-102·5 μ. Central body faintly defined, vertically oval, 45-62×63-90 μ in size. Exine intramicroreticulate. Sacci hemispherical laterally continuous, distal attachment straight and full length leaving a narrow sulcus. Sacci with fine to medium intrareticulation.

Genus — *Scheuringipollenites* Tiwari, 1973b

Type Species — Scheuringipollenites maximus (Hart) Tiwari, 1973b.

Remarks — In the present assemblage this genus has acquired the dominance in some of the samples while in others it exists as a subdominant unit.

In this genus the following species have been recorded so far.

S. royii (Bharadwaj & Srivastava) Tiwari (1973b); Nidpur, Sidhi District, M.P., India; Lower Triassic.

S. triassicus (Bharadwaj & Srivastava) Tiwari (1973b); Nidpur, Sidhi District, M.P., India; Lower Triassic.

S. barakarensis (Tiwari) Tiwari (1973b); 202 (II seam) E_3 Bore-hole R-34, Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

S. maximus (Hart) Tiwari (1973b); Coal 3 ft above C.S. 12 of Mc Kinlay, Mchuchuma River Valley, Lower Measures K_2, Ketewaka-Mchuchuma Coalfield, Tanganyika; Ecca Series, Permian.

S. tentulus (Tiwari) Tiwari (1973b); Pit no. 11, Hingir Rampur Seam, Ib-River Coalfield, Orissa, India; Barakar Stage, Damuda Series, Permian.

Tiwari (1973b) has pointed out that *Sulcatisporites* Leschik (1955) includes disaccate miospores having distinct central body and a mono- or bilete slit on it. The miospores described from Gondwana miofloras so far assigned to *Sulcatisporites* lack the above characters and instead they show indistinct central body and absence of any mark on it. Therefore, he has proposed a new name *Scheuringipollenites* to include such Gondwana forms. However, Sinha (1972) and Kar and Bose (1976) have described similar miospores under the genus *Sulcatisporites* whereas they should be assigned to *Scheuringipollenites*. Hence, the following new combinations have been made.

Scheuringipollenites minutus (Sinha) comb. nov.

Synonym — Sulcatisporites minutus Sinha, 1972.

Holotype — Sinha, 1972, pl. 8, fig. 117.

Locus Typicus — Bore hole no. NCSJ-4, sample no. 122, Jhingurdah Seam, Singrauli Coalfield, M.P., India.

Horizon & Age — Barakar Stage, Damuda Series, Permian.

Scheuringipollenites bellus (Kar & Bose) comb. nov.

Synonym — Sulcatisporites bellus Kar & Bose, 1976.

Holotype — Kar & Bose, 1976, pl. 10, fig. 3.

Locus Typicus — Puits christine, 1st seam, Zaire.

Horizon & Age — Assise à couches de houille, Permian.

Distribution — Permian — Africa, India, South America, West Pakistan; Permo-Carboniferous — Africa.

Scheuringipollenites maximus (Hart) Tiwari, 1973b

Pl. 11, fig. 129

Holotype — Hart, 1960, pl. 3, fig. 33.

Description (12 specimens)— Disaccate, circular to subcircular, 68·0-127·5×68-125 μ in size. Central body thin, outline almost ill-defined. Sacci less than hemispherical, proximally encroaching the central body, inclined distally coming close to each other in the middle region and widening apart laterally. Distal sulcus not distinct, sacci associated with characteristic foldings along the meeting lines of sacci distally. Sacci finely intrareticulate, muri less than 1 μ thick.

Scheuringipollenites barakarensis (Tiwari) Tiwari, 1973b

Pl. 11, fig. 127

Holotype — Tiwari, 1965, pl. 8, fig. 176.

Description (87 specimens)— Disaccate bilateral, horizontally oval in outline, 55-150×45-125 μ in size. Central body thin, outline almost indistinct. Sacci ± hemispherical proximally encroaching the central body, distally inclined, close in the middle and widening apart laterally, characteristic vertical infoldings of sacci absent on the distal face. Saccus intrareticulation fine, apparently double, muri thin.

Scheuringipollenites tentulus (Tiwari) Tiwari, 1973b

Pl. 11, fig. 128

Holotype — Tiwari, 1968, pl. 7, fig. 81.

Description (26 specimens)— Bilateral, vertically oval along the sulcus line, 32·5-130·0×37·5-137·5 μ in size. Central body thin, outline almost ill-defined. Sacci proximally encroaching the body, distally inclined, close along the vertical median region widening apart laterally, usually associated with the prominent saccus infoldings. Distal sulcus indistinct. Saccus intrareticulation fine to medium, muri ± 1 μ broad.

Subturma — *Polaesulcati* Bharadwaj, 1974
Infrasubturma — *Orbiculati* Bharadwaj, 1974
Infraturma — *Proximisulculati* Bharadwaj, 1974

Genus — *Illinites* Kosanke emend. Potonié & Kremp, 1954

Type Species — *Illinites unicus* Kosanke, 1950.

Remarks — *Illinites* has been described with five species from the Talchir and Barakar stages of Indian Lower Gondwana. This genus is scarcely observed in the samples studied here. Bharadwaj (1974) while commenting upon the genus *Illinites* opines that this genus proximally bears a ring sulculus and distally it is atenuitate.

So far the following species have been described in this genus:

I. bentzi (Klaus) Klaus (1963); Deutsche Solvay, Werke Borth. Tonbänk chen im Oberen Kalilager de Werra Serie; Werra Serie, Zechetein I.

I. disectus (Hart) Srivastava (1970); Ketewaka-M chuchuma River Valley, Tanganyika; Permian.

I. gamsi Klaus (1963); Grödner Sandstein, Guecenes in Grödnertal bei st., Austria; Kattenbrunn (Fontana Fredde) Unteres Ober-Perm.

I. klausi Clarke (1965b); Kimberly, Nottinghamshire, England; Permian (Upper).

I. notus Lele & Karim (1971); Jayanti Coalfield, Bihar, India; Talchir Stage, Talchir Series, Permian.

I. novus (Tiwari) Srivastava (1970); Korba Coalfield, M.P., India; Barakar Stage, Damuda Series, Permian.

I. parvus Klaus (1963); Ruggadistsch, Hohlweg bei Gehöft des Hernn Sepp. Oberranch, Austria; Grödner Sandstein, Unteres Ober-Perm.

I. pemphicus Klaus (1963); Cuecenes im Grödnertal bei St. Ulrich (Ortisei), Austria; Grödner Sandstein; Ober-Perm.

I. purus Leschik (1956); Neuhof (Bei fulda) Germany; Zechsteins.

I. spectabilis Leschik (1956); Neuhof (Bei fulda) Germany; Zechsteins.

I. delasauceai Grebe & Schweitzer (1962); Schwingheim Querschlag, Christina-Horizont, Salzberg Hallstatt, Germany; Zechsteins.

I. tectus (Leschik) Clarke (1965b); Neuhof (Bei fulda), Germany; Zechsteins.

I. tener Leschik (1956); Neuhof (bei Fulda) Germany; Zechsteins.

I. elegans Kosanke (1950); Wabash County, Illinois; Pennsylvanian, Carboniferous.

I. goldi Helby (1966); Wegzum Langenecker Grat, Su döstlich Hinsweiller, Pfalzer Berg-

land, Deutschland; Obere Breitenbacher Schichten, Stefen C, Carboniferous.

I. unicus Kosanke (1950); Wabash County, Illinois; Pennsylvanian, Carboniferous.

Distribution — Triassic — Austria, Libya; Permian — Austria, England, Germany, North America, Poland, Africa, India, Libya, South America; Carboniferous — Germany, Poland, North America, U.S.S.R.

Illinites delasaucei (Potonié & Klaus) Grebe & Schweitzer, 1962

Pl. 12, fig. 134

Holotype — Potonié & Klaus, 1954, pl. 10, fig. 6.

Description (2 specimens)— Disaccate, haploxylonoid, size-range 77-79 × 51-60 μ. Central body subcircular, thin, 54 × 49-51 μ, microverrucose, proximally bearing a 'monolete mark'. Sacci hemispherical, proximal attachment equatorial, distally inclined with straight, full length attachment. Distally saccus free area indistinct and not thin. Sacci with narrow lateral continuation.

Infraturma — *Approximisulcati* Bharadwaj, 1974

Genus — *Barakarites* Bharadwaj & Tiwari, 1964a

Type Species — Barakarites indicus Bharadwaj & Tiwari, 1964a.

Remarks — Barakarites has originally been described from the coals of Barakar Stage. Qualitatively this genus is characteristic for the Upper Barakar Stage and Barren Measures Stage of Damuda Series. The genus has shown marked morphographical diversity in the Barakar Stage miofloras. It is, however, very rare in the present assemblage.

Segroves (1969) believes that an annular tenuitas is present on the distal face of the central body in the marginal zone. Recently Balme (Bharadwaj, 1974) has also pointed out the presence of circumsulcus or sulculus which lies distally between the ring of saccus attachment and the circular reticuloid exined polar area.

Anderson (1977) has included miospores similar to the genus *Barakarites* in the genus *Vestigisporites* species *V. rotatus* (Balme & Hennelly) Anderson, 1977 (pl. 113, figs 1-11, 13-35; pl. 114, figs 1-23; pl. 115, figs 1-15; pl. 117, figs 2, 3, 5-9, 13; pl. 118, figs 1-14; pl. 119, figs 1, 3-5-12; pl. 120, figs 1-8).

The following species are known so far under this genus:

B. crassus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. decorus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. densicorpus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. densus Bose & Kar (1966); Mabuita and Mehibi, Walikale region, Congo; Assise des schistes noirs de la Walikale, Permian.

B. dubius Venkatachala & Kar (1968b); Kathwai shales Salt Range, West Pakistan; Permian.

B. glabrus Venkatachala & Kar (1968a); Lungatoo, North Karanpura Basin, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. gondwanensis Maithy (1965); Giridih Coalfield, India; Karharbari Stage, Talchir Series, Permian.

B. implicatus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. indicus Bharadwaj & Tiwari (1964a); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

B. triquetrus Tiwari (1965); West Bokaro Coalfield, Bihar, India; Barakar Stage, Damuda Series, Permian.

Distribution — Permian — Africa, Australia, India, South America, West Pakistan.

Barakarites decorus Tiwari, 1965

Pl. 12, fig. 132

Holotype — Bharadwaj & Tiwari, 1964, pl. 1, fig. 4.

Description (2 specimens)— Miospores subcircular to subtriangular, measuring 123·5-135 μ. Central body subtriangular, 100-112 μ in size. Trilete rays thin reaching half the body radius, trilete mark sometimes open. Exine marked by small polygonal areas. Saccus attachment equatorial proximally and subequatorial distally, uniformly broad; saccus with radiating folds and wavy outlines, finely intramicroreticulate. Inner-body-like region distinctly seen due to circumsulcus — a thinner circular zone along the body equatorial region.

Remarks — The grains show the presence of circumsulcus on the distal face of the central body below the saccus attachment zone.

Barakarites triquetrus Tiwari, 1965

Pl. 12, fig. 131

Holotype — Bharadwaj & Tiwari, 1964a, pl. 1, fig. 3.

Description (2 specimens)— Miospores subtriangular, 125-131·5 μ in size. Central body outline subcircular, measuring 95-98·5 μ. Trilete rays reaching 1/2 body radius; polygonal areas on the exine 3-10 μ in size. Saccus subequatorially attached, narrower at the inner radial sides and broader at the point of the trilete rays, finely intrareticulate, "inner body" like region distinct having thinner area around it.

Barakarites indicus Bharadwaj & Tiwari, 1964a

Pl. 12, fig. 133

Holotype — Bharadwaj & Tiwari, 1964a, pl. 1, fig. 1.

Description (2 specimens)— Subtriangular, size-range 113·5-125 μ. Central body thin, conforming to the saccus shape, measuring 82·0-86·5 μ. Trilete rays thin, reaching 1/2 body radius. Exine intramicropunctate marked by polygonal areas on proximal side, size of areas being 4-10 μ. Saccus proximally equatorially and distally subequatorially attached, uniformly broad, saccus 2-3 μ thick with peripheral zone finely intramicroreticulate. Inner body like region distinct with thinner area around it.

Remarks — The miospores show the circumsulcus on the distal face of the central body below the saccus attachment zone.

Barakarites implicatus Tiwari, 1965

Pl. 12, fig. 130

Holotype — Tiwari, 1965, pl. 3, fig. 66.

Description (2 specimens)— Pollen grains broadly subtriangular, 125·0-127·5 μ in size. Central body subcircular, 95·0-107·5 μ in size. Trilete mark indistinct. Exine marked by small polygonal areas on proximal face. Saccus attachment equatorial proximally and subequatorial distally, uniformly broad, finely intramicroreticulate. Inner body like region distally seen due to circumsulcus — a thinner circular zone along the body equatorial region.

INCERTAE SEDIS

Genus — *Pilasporites* Balme & Hennelly emend. Tiwari & Navale, 1967

Pilasporites brevis Sinha, 1969

Pl. 12, fig. 135

Holotype — Sinha, 1969, pl. 1, fig. 12.

Description (2 specimens)— Subcircular, alete, measuring 31-39 × 39-42 μ. Exine thin up to ±1 μ thick, laevigate to microgranulose, sometimes few folds also present.

Genus — *Leiosphaeridia* Eisenack emend. Downie & Sarjeant, 1963

Leiosphaeridia talchirensis Lele & Karim, 1971

Pl. 12, fig. 136

Holotype — Lele & Karim, 1971, pl. 3, fig. 37.

Description (1 specimen)— Thin, subcircular, measuring 45 × 47 μ, without a haptotypic mark. Exine smooth, strongly irregularly folded.

Genus—*Hemisphaerium* Hemer & Nygreen, 1967

Hemisphaerium singrauliensis Sinha, 1969

Pl. 12, fig. 137

Holotype — Sinha, 1969, pl. 1, fig. 7.

Description (1 specimen)— Subcircular, measuring 85 × 69 μ. Exine ± 1 μ thick, indistinctly sculptured, without a haptotypic mark, pore or striations. Exinal folds also absent. Extrema lineamenta of the miospore smooth.

Hemisphaerium signum Hemer & Nygreen, 1967

Pl. 12, fig. 138

Holotype — Hemer & Nygreen, 1967, pl. 2, fig. 4.

Description (1 specimen)— Subcircular, alete, measuring 75·0 × 67·5 μ. Exine 2 μ thick, laevigate to indistinctly structured,

exine folded, fold with tapering ends. Extrema lineamenta smooth.

Genus — *Hindisporis* Bharadwaj & Sinha, 1969

Hindisporis senii Bharadwaj & Sinha, 1969

Pl. 12, fig. 139

Holotype — Bharadwaj & Sinha, 1969, pl. 2, figs 18, 19.

Description (2 specimens)— Alete, circular to subcircular, size range 70-92·5 × 67·5-70·0 μ. Body circular to subcircular denser than the enveloping membrane, measuring 63 × 60-60 × 52 μ. Exine smooth without any striations. A thin membrane covers the whole body, loosely attached on one side forming zig-zag pattern, microgranulose and wrinkled on the other side.

Genus — *Botryococcus* Kutzing, 1849

Botryococcus sp.

Pl. 12, fig. 140

Description (25 specimens)— Microfossils circular, subcircular to subtriangular in outline in the form of colony ranging in size from 56 × 64-165 × 177 μ. Each colony consisting of small lobes, each lobe measuring from 5-7 μ in size. The lobes in the colonial form show the reticulate nature and in surface show pit-like circular to elongate and narrow aperture.

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EXPLANATION OF PLATES

(All photomicrographs. × 500 unless otherwise stated)

PLATE 1

1. *Indotriradites sparsus* Tiwari, 1965, slide no. 5809.
2. *I.* sp., slide no. 5781.
3. *Lacinitriletes minutus* Venkatachala & Kar, 1968a, slide no. 5808.
4. *Cyclogranisporites gondwanensis* Bharadwaj & Salujha, 1964, slide no. 5802.
5. *Indospora clara* Bharadwaj, 1962, slide no. 5270.

6-10. *Potonieitriradites barakarensis* Bharadwaj & Sinha, 1969, slide nos 4110, 5789, 3070.

6. Holotype of *Potonieitriradites subtilis* Sinha, 1972; synonym of *P. barakarensis* Bharadwaj & Sihna, 1969 (Sinha, 1972, pl. 1, fig. 27) — proximal face, trilete mark in focus.
7. Distal face of the same specimen showing granulose to verrucose exine.
9. Holotype of *Potonieitriradites barakarensis* (Bharadwaj & Sinha, 1969, pl. 1, fig. 1) — proximal face, trilete mark in focus.
10. Distal face of the same specimen, granulose to verrucose exine in focus.
11. *Brevitriletes unicus* (Tiwari) Bharadwaj & Srivastava, 1969b, slide no. 5830.
12. *B. levis* (Balme & Hennelly) Bharadwaj & Srivastava, 1969b, slide no. 5807.

PLATE 2

13,14. *Potonieitriradites tuberculatus* Sinha, 1972, slide no. 5782.

13. Proximal face, trilete mark and microgranulose exine in focus.
14. Distal face of the same specimen, warty processes on central body as well as on zona in focus.

15-18. *Potonieitriradites angustus* sp. nov., slide nos 5789, 5780.

15. Holotype — proximal face, trilete mark in focus.
16. Distal face of the same specimen, fine punctate exine in focus.
17. Distal face of the same specimen, verrucae in focus.
18. Isotype — proximal face.
19. *Horriditriletes curvibaculosus* Bharadwaj & Salujha, 1964, slide no. 5828.
20. *H. rampurensis* Tiwari, 1968, slide no. 5275.

PLATE 3

21. *Microbaculispora gondwanensis* Bharadwaj, 1962, slide no. 5772.
22. *M. villosa* (Balme & Hennelly) Bharadwaj, 1962, slide no. 5778.
23. *M. barakarensis* Tiwari, 1965, slide no. 5809.
24. *M. tentula* Tiwari, 1965, slide no. 5272.
25. *Microfoveolatispora indica* Sinha, 1972, slide no. 5829.
26. *M. raniganjensis* Bharadwaj, 1962, slide no. 5271.

27,30. *Insignisporites barakarensis* Bharadwaj & Dwivedi, 1977, slide nos 5280, 5268.

28. *Horriditriletes pseudoseptatus* Sinha 1972, slide no. 5812.
29. *Microfoveolatispora bokaroensis* Tiwari, 1965, slide no. 5812.
31. *Lycopodiumsporites* cf. *Palaeocenicus* Dutta & Sah, 1970, slide no. 5755.
32. *Verrucosisporites distinctus* Tiwari, 1965, slide no. 5815.
33. *Pseudoreticulatispora barakarensis* Bharadwaj & Srivastava, 1969b, slide no. 5785.
34. *Laevigatosporites vulgaris* Balme & Hennelly, 1956, slide no. 5757.
35. *Praecolpatites punctatus* (Venkatachala & Kar) comb. nov., slide no. 5826.

PLATE 4

36. *Divarisaccus lelei* Venkatachala & Kar, 1966, slide no. 5769.
37. *Weylandites lucifer* (Bharadwaj & Salujha) comb. nov., slide no. 5763.
38. *W. dubius* (Venkatachala & Kar) comb. nov., slide no. 5777.
39. *Tuberisaccites jhingurdahiensis* Sinha, 1972, slide no. 5818.
40. *Virkkipollenites mehtae* Lele, 1964, slide no. 5812.
41. *Tiwariasporis flavatus* (Tiwari) Maheshwari & Kar, 1967, slide no. 5269.
42. *Parasaccites bilateralis* Tiwari, 1965, slide no. 5747.
43. *P. obscurus* Tiwari, 1965, slide no. 5766.
44. *P. diffusus* Tiwari, 1965, slide no. 5823.
45. *P. densus* Maheshwari, 1967, slide no. 5792.
46. *P. radiplicatus* Maithy, 1965, slide no. 5770.

PLATE 5

47. *Plicatipollenites ovatus* Kar, 1968a, slide no. 5817.
48. *P. gondwanensis* (Balme & Hennelly) Lele, 1964, slide no. 5744.
49. *Lueckisporites crassus* Sinha, 1972, slide no. 5761.
50. *Crescentipollenites fuscus* (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974, slide no. 5775.
51. *Densipollenites indicus* Bharadwaj, 1962, slide no. 5799.
52. *Striatites tentulus* Tiwari, 1965, slide no. 5820.
53. *S. varius* Kar, 1968a, slide no. 5268.
54. *S. communis* Bharadwaj & Salujha, 1964, slide no. 5814.
55. *S. incirus* Maithy, 1965, slide no. 5797.
56. *S. solitus* Bharadwaj & Salujha, 1964, slide no. 5753.
57. *S. reticuloidus* Tiwari, 1965, slide no. 5764.
58. *S. notus* Bharadwaj & Salujha, 1964, slide no. 5805.
59. *S. alius* Venkatachala & Kar, 1968a, slide no. 5756.

PLATE 6

60-62. *Striatites naditoliensis* sp. nov., slide nos 5757, 5827.
60. Holotype — proximal face showing nature of striation.
61. Distal face of the same specimen showing partially biconvex sulcus.
62. Isotype.
63,64. *S.* sp., slide no. 5813.
63. Proximal view showing striations.
64. Distal view of the same specimen showing oval distal sulcus.
65. *S. gopalensis* Srivastava, 1970, slide no. 5811.
66. *S. tectus* Venkatachala & Kar, 1968a, slide no. 5765.
67. *Striatopodocarpites subcircularis* Sinha, 1972, slide no. 5817.
68. *S. decorus* Bharadwaj & Salujha, 1964, slide no. 5804.
69. *S. magnificus* Bharadwaj & Salujha, 1964, slide no. 5764.

PLATE 7

70-72. *Lahirites karanpuraensis* sp. nov., slide nos 5793, 5776.
70. Holotype — proximal face showing restricted puncta distribution.
71. Distal face of the same specimen showing nature of saccus attachment and partially biconvex sulcus.
72. Isotype.
73. *L. minutus* Venkatachala & Kar, 1968a, slide no. 5809.
74. *L. rarus* Bharadwaj & Salujha, 1964, slide no. 5768.
75. *L. raniganjensis* Bharadwaj, 1962, slide no. 5760.
76. *L. levicorpus* Srivastava, 1972, slide no. 5277.
77. *L. rhombicus* Maithy, 1965, slide no. 5269.
78. *Striatopodocarpites ovalis* Sinha, 1972, slide no. 5748.
79,80. *Verticipollenites debilis* Venkatachala & Kar, 1968a, slide nos 5774, 5798.
81. *V. gibbosus* Bharadwaj, 1962, slide no. 5815.
82. *V. secretus* Bharadwaj, 1962, slide no. 5270.

PLATE 8

83. *Faunipollenites circumstriatus* Maheshwari, 1969 slide no. 5817.
84. *Striatopodocarpites tiwarii* nom. nov., slide no. 5816.
85. *Striapollenites obliquus* Bharadwaj & Salujha, 1964, slide no. 5773.
86. *Distriatites indicus* Sinha, 1972, slide no. 5758.
87. *Schizopollis distinctus* Venkatachala & Kar, 1966, slide no. 5798.
88. *S.* sp., slide no. 5806.
89. *Rhizomaspora* sp., slide no. 5768.
90. *R. indica* Tiwari, 1965, slide no. 5752.
91. *Faunipollenites varius* Bharadwaj, 1962, slide no. 5766.
92. *F. singrauliensis* Sinha, 1972, slide no. 5762.
93. *F. perexiguus* Bharadwaj & Salujha, 1965a, slide no. 5763.
94. *F. enigmatus* Maheshwari, 1969, slide no. 5760.
95. *F. bharadwajii* Maheshwari, 1967, slide no. 5750.

PLATE 9

96. *Primuspollenites ovatus Tiwari*, 1965, slide no. 5791.
97. *P. distinctus* Sinha, 1972, slide no. 5794.
98. *P. linterus* Tiwari, 1965, slide no. 5787.
99. *P. brevicorpus* Sinha, 1972, slide no. 5788.
100. *P. obscurus* Tiwari, 1965, slide no. 5784.
101. *P. dicavus* Tiwari, 1965, slide no. 5804.
102. *Striasulcites tectus* Venkatachala & Kar, 1968b, slide no. 5779.
103. *P. singrauliensis* Sinha, 1972, slide no. 5785.
104. *P. levis* Tiwari, 1965, slide no. 5745.
105. *P.* sp., slide no. 5783.
106. *Ginkgocycadophytus novus* Srivastava, 1970, slide no. 5800.
107. *Distriamonocolpites ovalis* Bharadwaj & Sinha, 1969, slide no. 5821.
108. *Striasulcites ovatus* Venkatachala & Kar, 1968b, slide no. 5822.

PLATE 10

109. *Potonieisporites lelei* Maheshwari, 1967, slide no. 5759.
110. *Cuneatisporites majus* Saksena, 1971, slide no. 5803.
111. *C. royalensis* Saksena, 1971, slide no. 5803.
112. *C. exiguus* Saksena, 1971, slide no. 5754.
113,114. *Platysaccus plicatus* sp. nov., slide nos 5805, 5795.
113. Holotype.
114. Isotype.
115. *P. papilionis* Potonié & Kremp, 1954, slide no. 5790.
116. *P. ovatus* Maithy, 1965, slide no. 5749.
117. *P. densicorpus* Anand-Prakash, 1972, slide no. 5810.
118. *Aurangapollenites brevizonatus* (Tiwari) comb. nov., slide no. 5807.
119. *Paravesicaspora obliqua* (Singh) comb. nov., slide no. 5819.

PLATE 11

120. *Paravesicaspora indica* (Tiwari) comb. nov., slide no. 5819.
121. *P. obliqua* (Singh) comb. nov., slide no. 5819.
122. *P. brevis* (Sinha) comb. nov., slide no. 5823.
123. *P. ovata* (Balme & Hennelly) comb. nov., slide no. 5765.
124. *P. sulcata* (Hart) comb. nov., slide no. 5825.
125. *Ibisporites jhingurdahiensis* Sinha, 1972, slide no. 5790.
126. *I. diplosaccus* Tiwari, 1968, slide no. 5804.
127. *Scheuringipollenites barakarensis* Tiwari, 1973b, slide no. 5765.
128. *S. tentulus* Tiwari, 1973b, slide no. 5746.
129. *S. maximus* Tiwari, 1973b, slide no. 5751.

PLATE 12

130. *Barakarites implicatus* Tiwari, 1965, slide no. 5767.
131. *B. triquetrus* Tiwari, 1965, slide no. 5801.
132. *B. decorus* Tiwari, 1965, slide no. 5788.
133. *B. indica* Tiwari, 1965, slide no. 5275.
134. *Illinites delasaucei* (Potonié & Klaus) Grebe & Schweitzer, 1962; slide no. 5272.
135. *Pilasporites brevis* Sinha, 1969, slide no. 5748.
136. *Leiosphaeridia talchirensis* Lele & Karim, 1971, slide no. 5824.
137. *Hemisphaerium singrauliensis* Sinha, 1969, slide no. 5268.
138. *Hemisphaerium signum* Hemer & Nygreen, 1967, slide no. 5771.
139. *Hindisporis senii* Bharadwaj & Sinha, 1969, slide no. 5271.
140. *Botryococcus* sp., slide no. 5796.

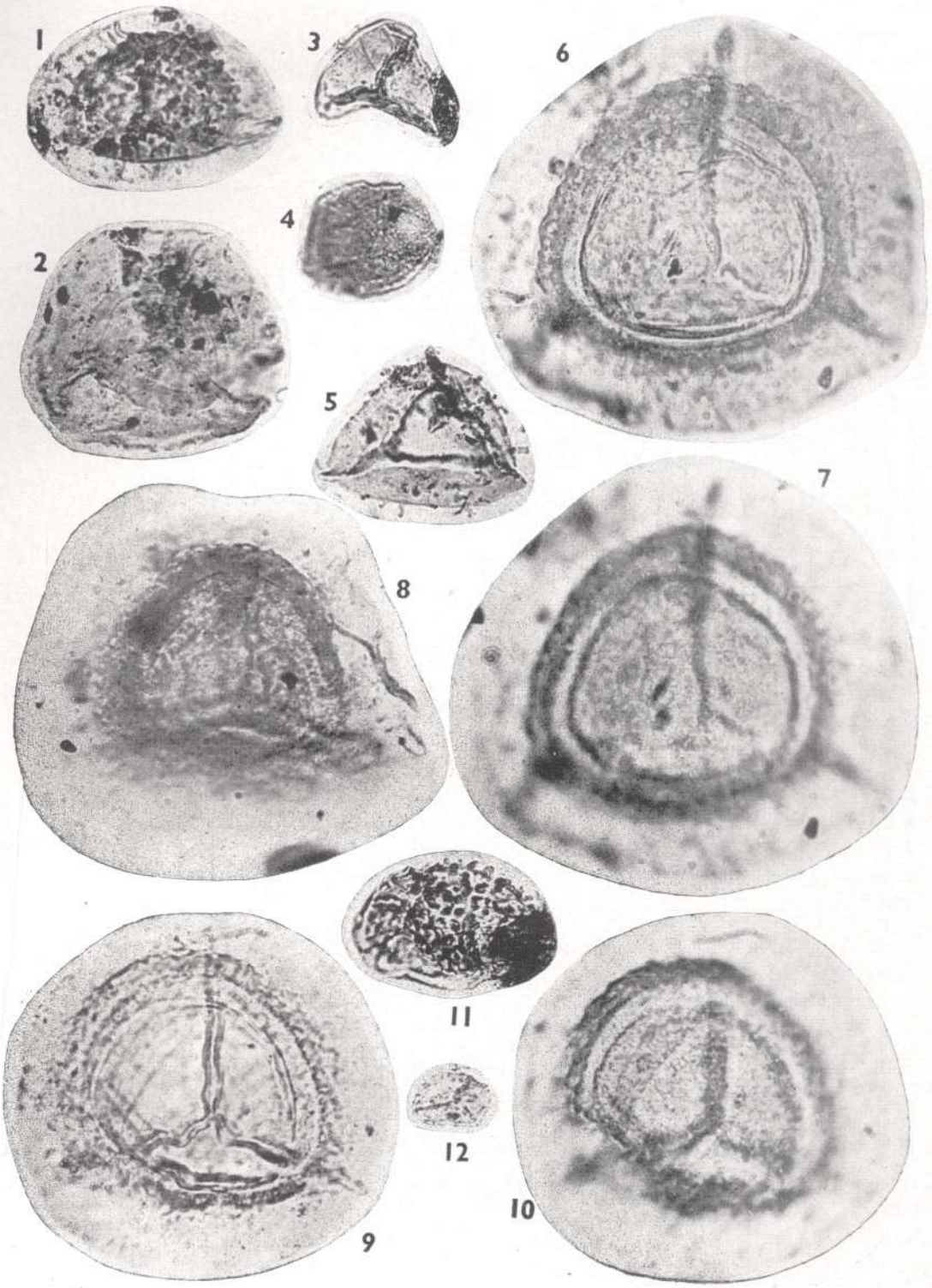
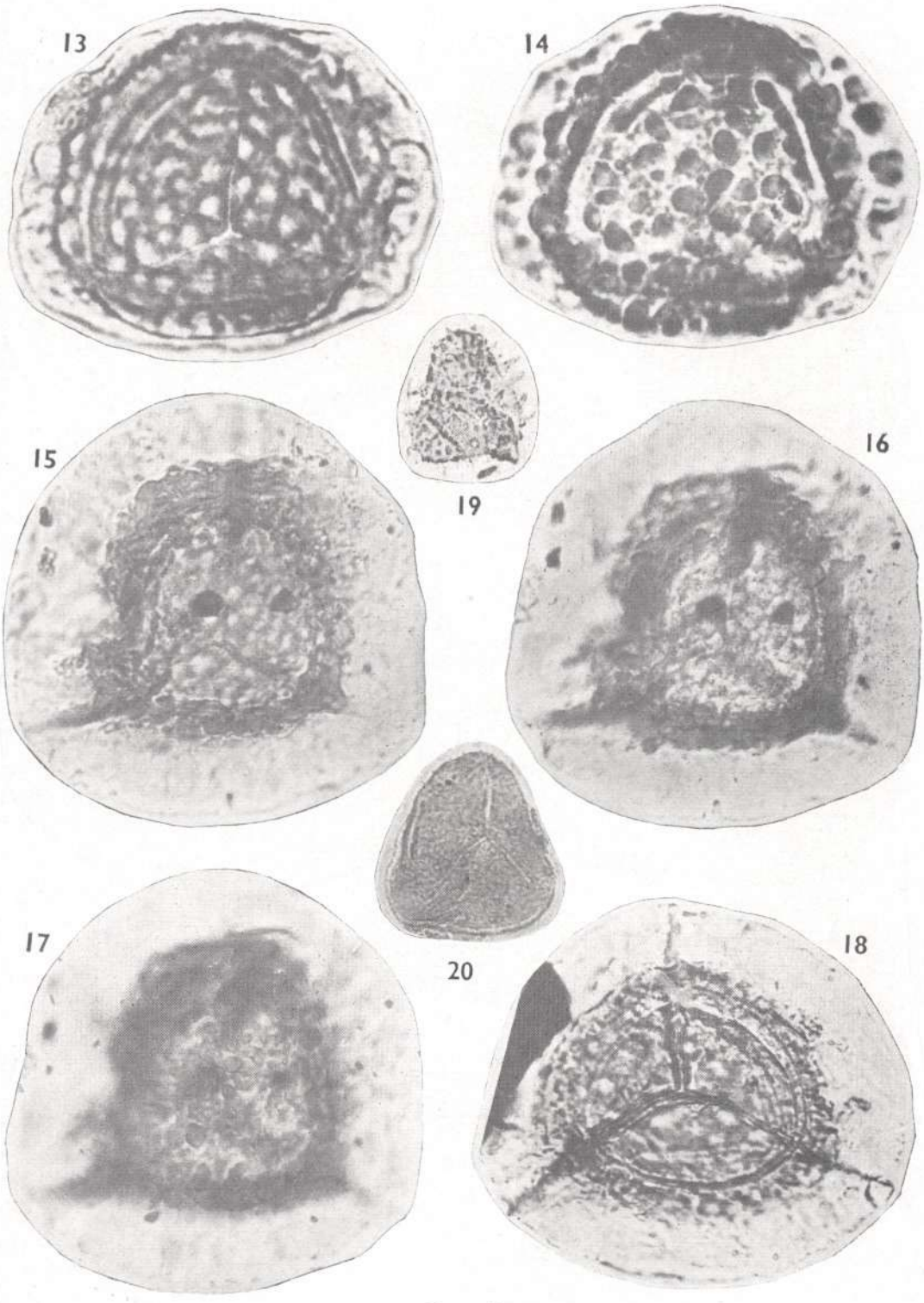


PLATE 1



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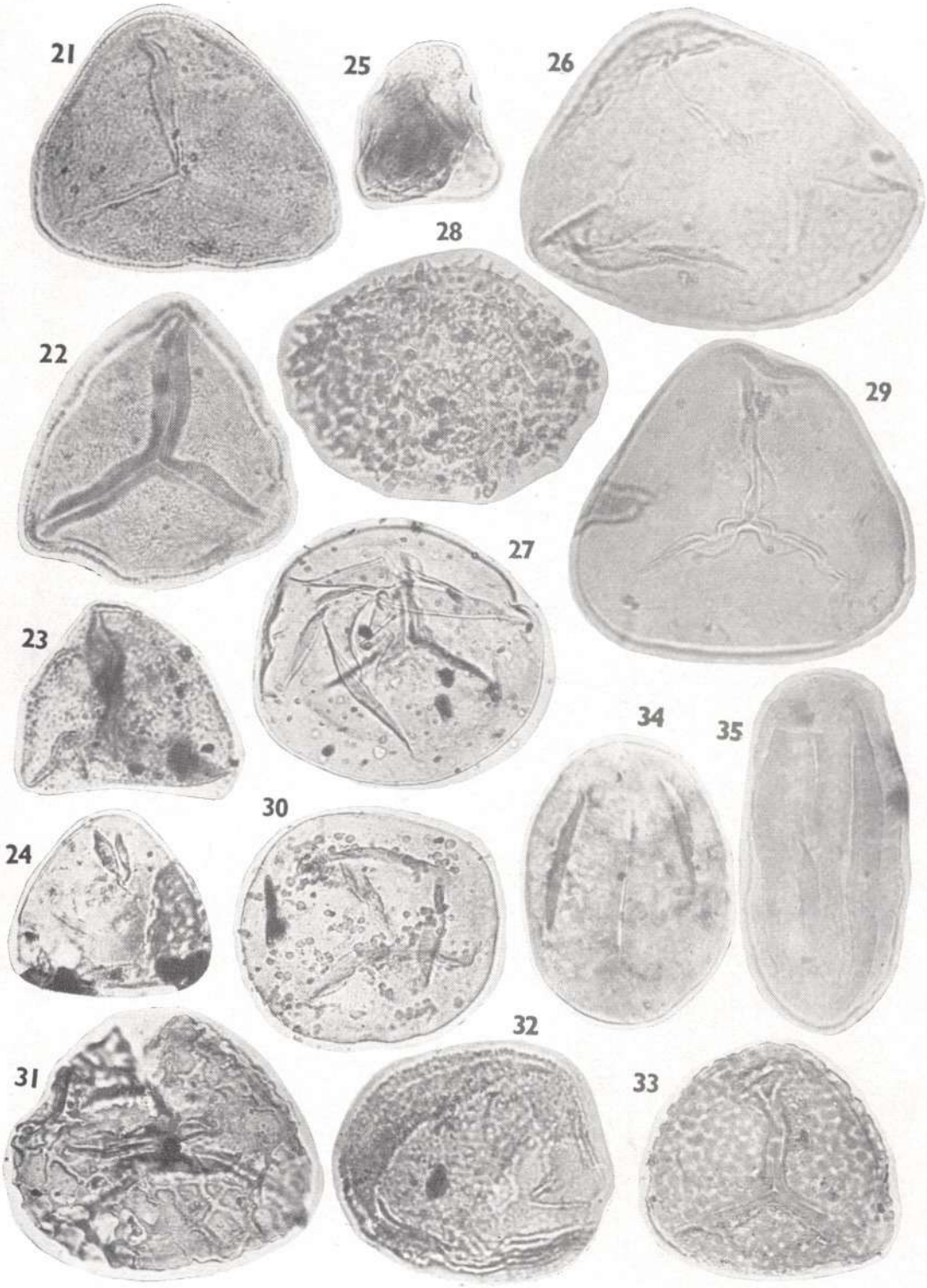

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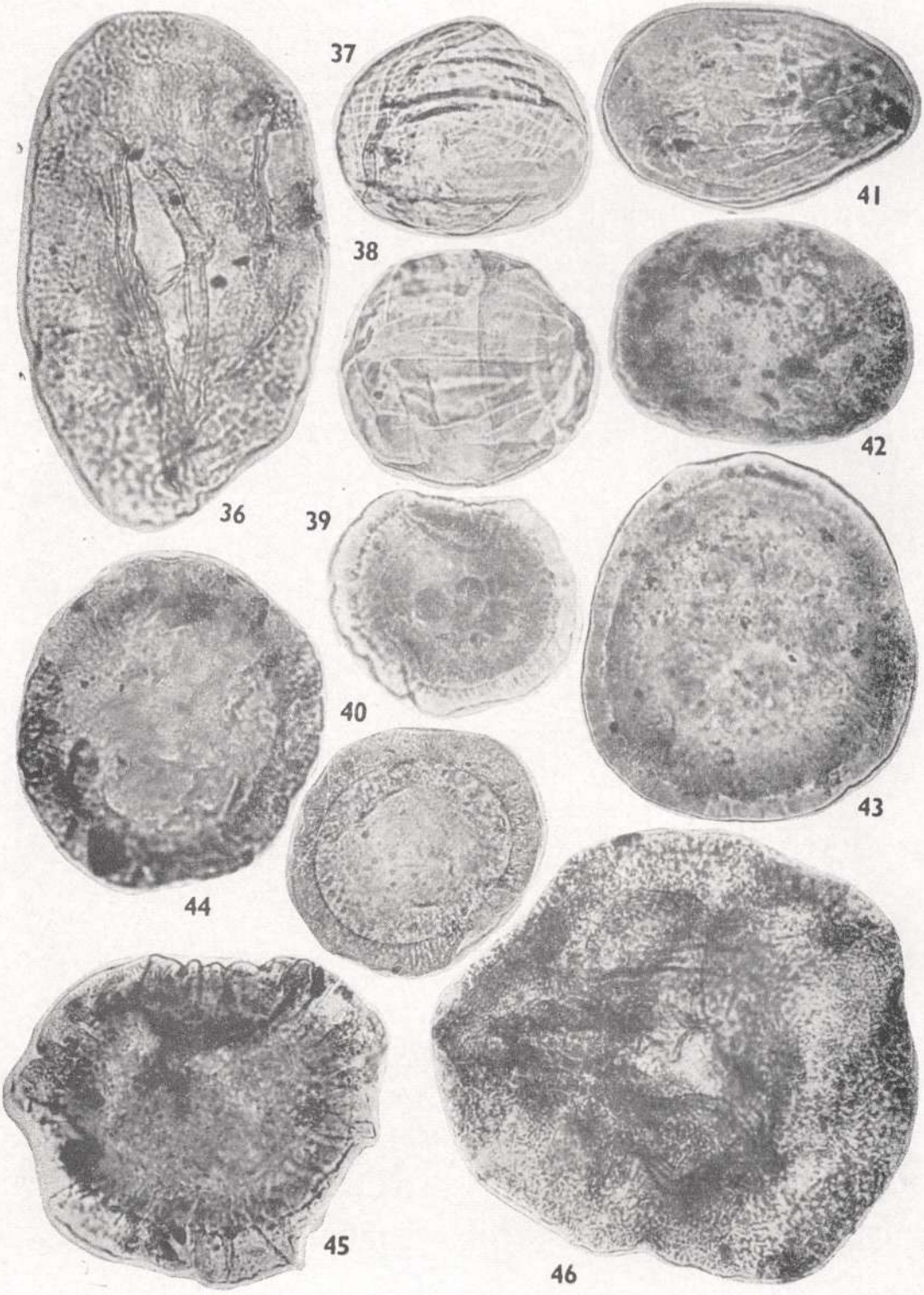

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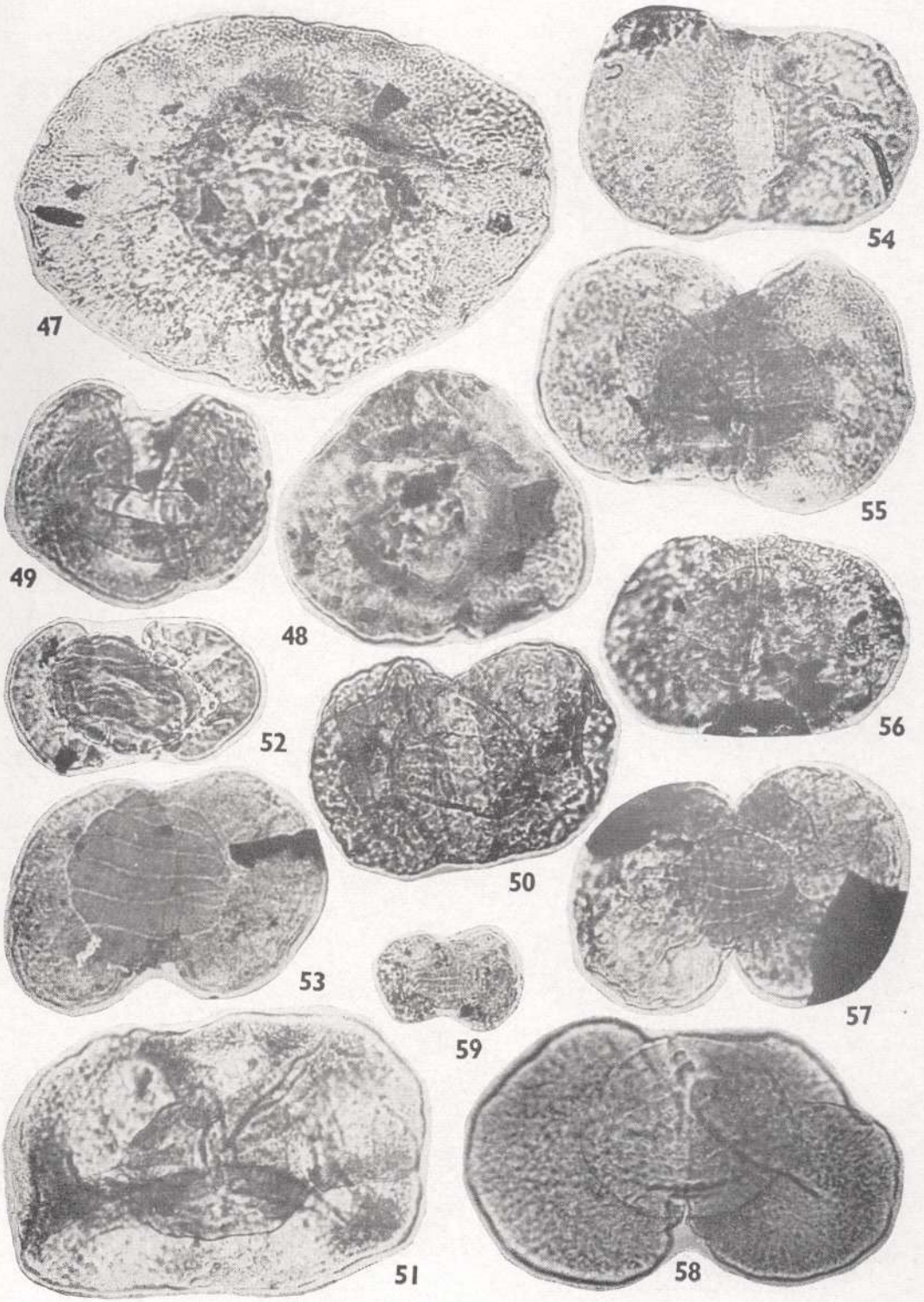

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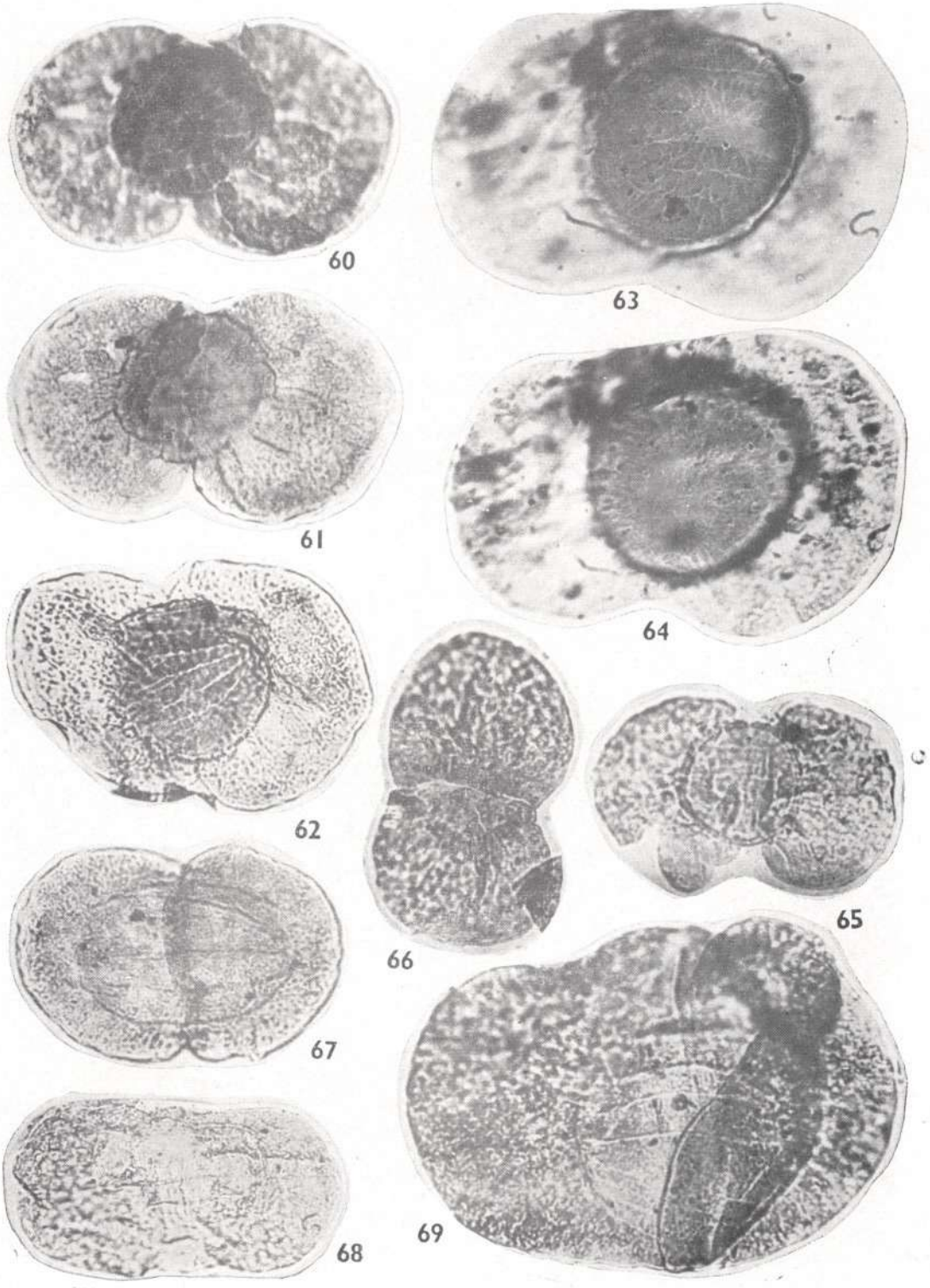

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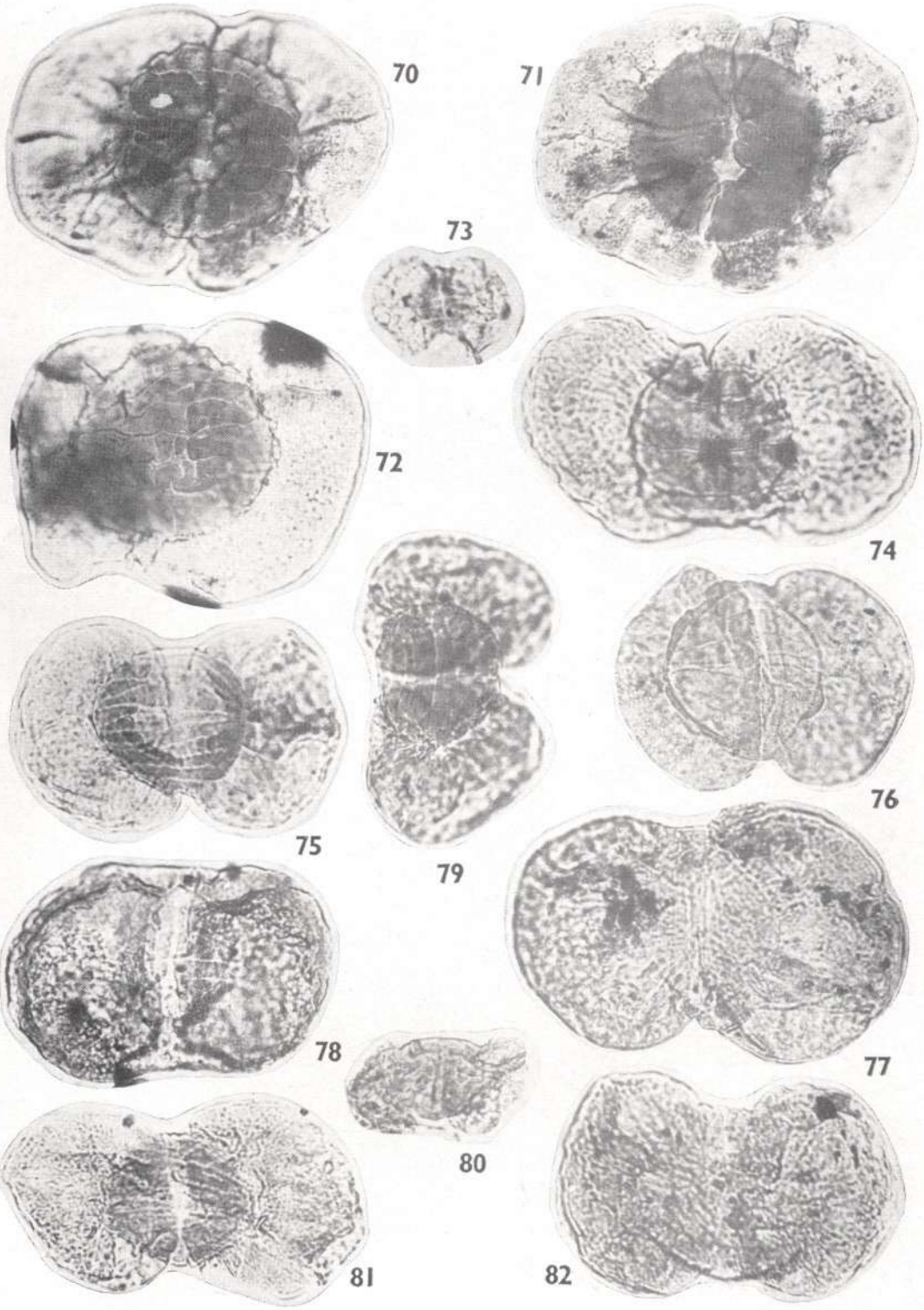

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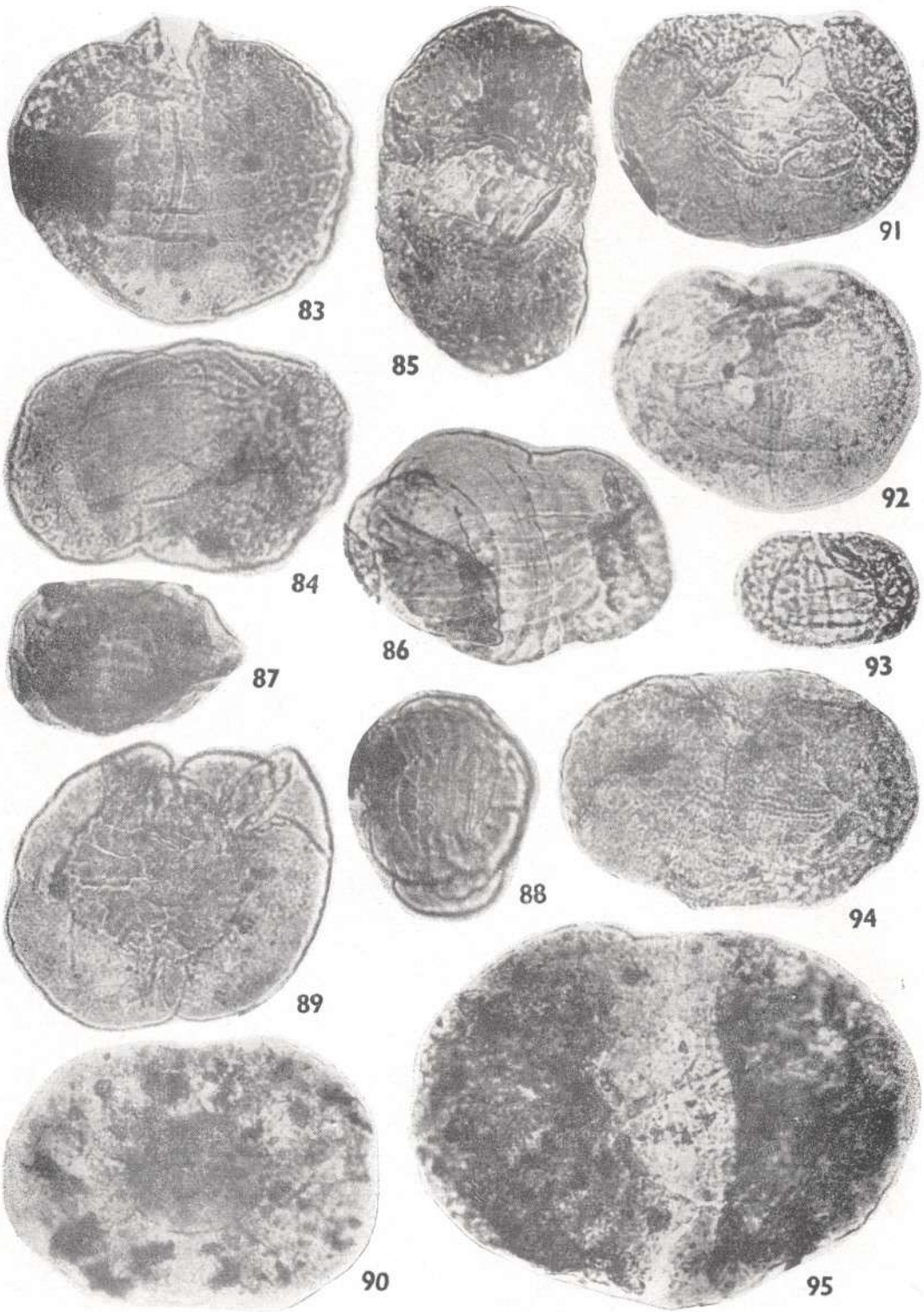

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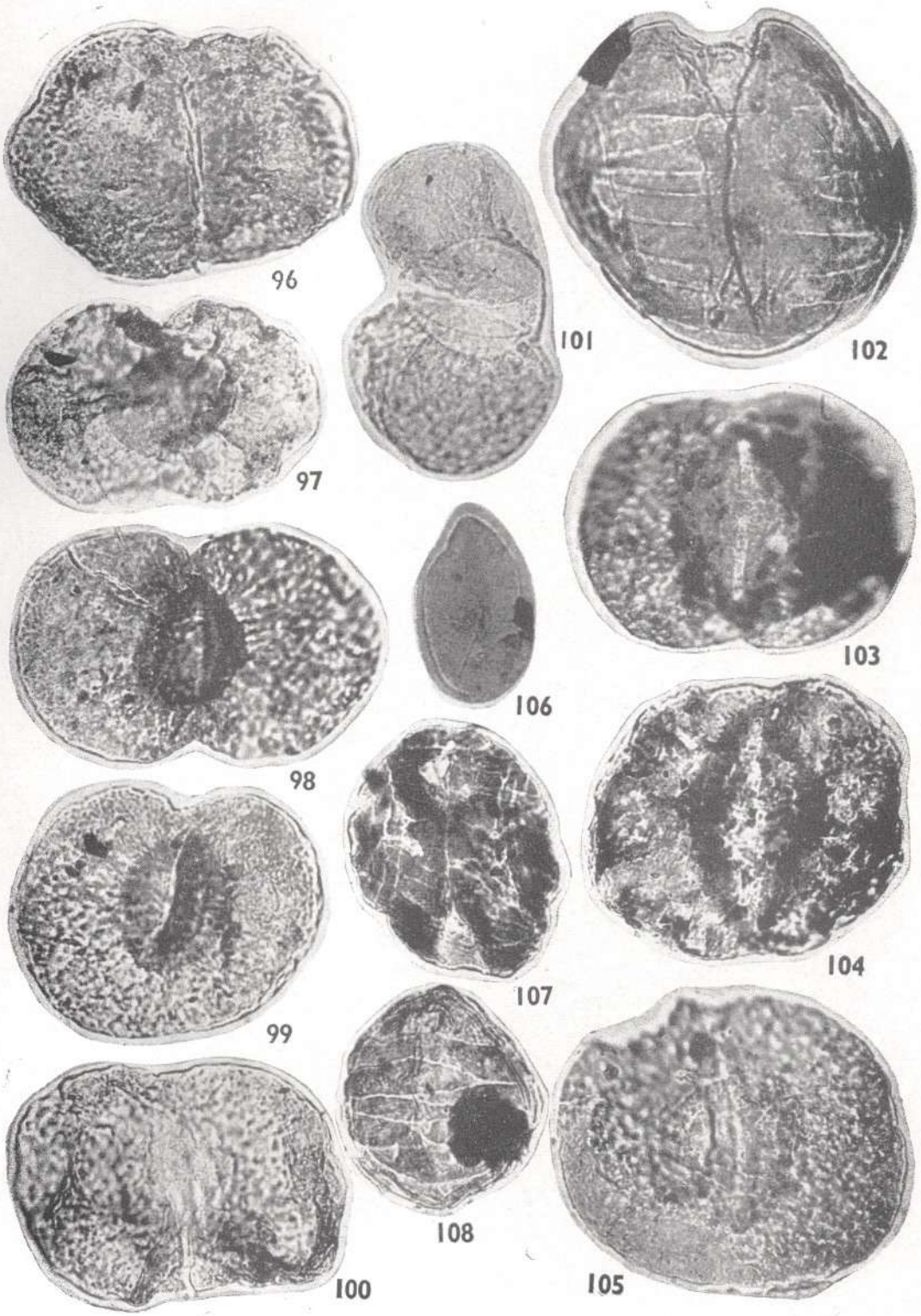

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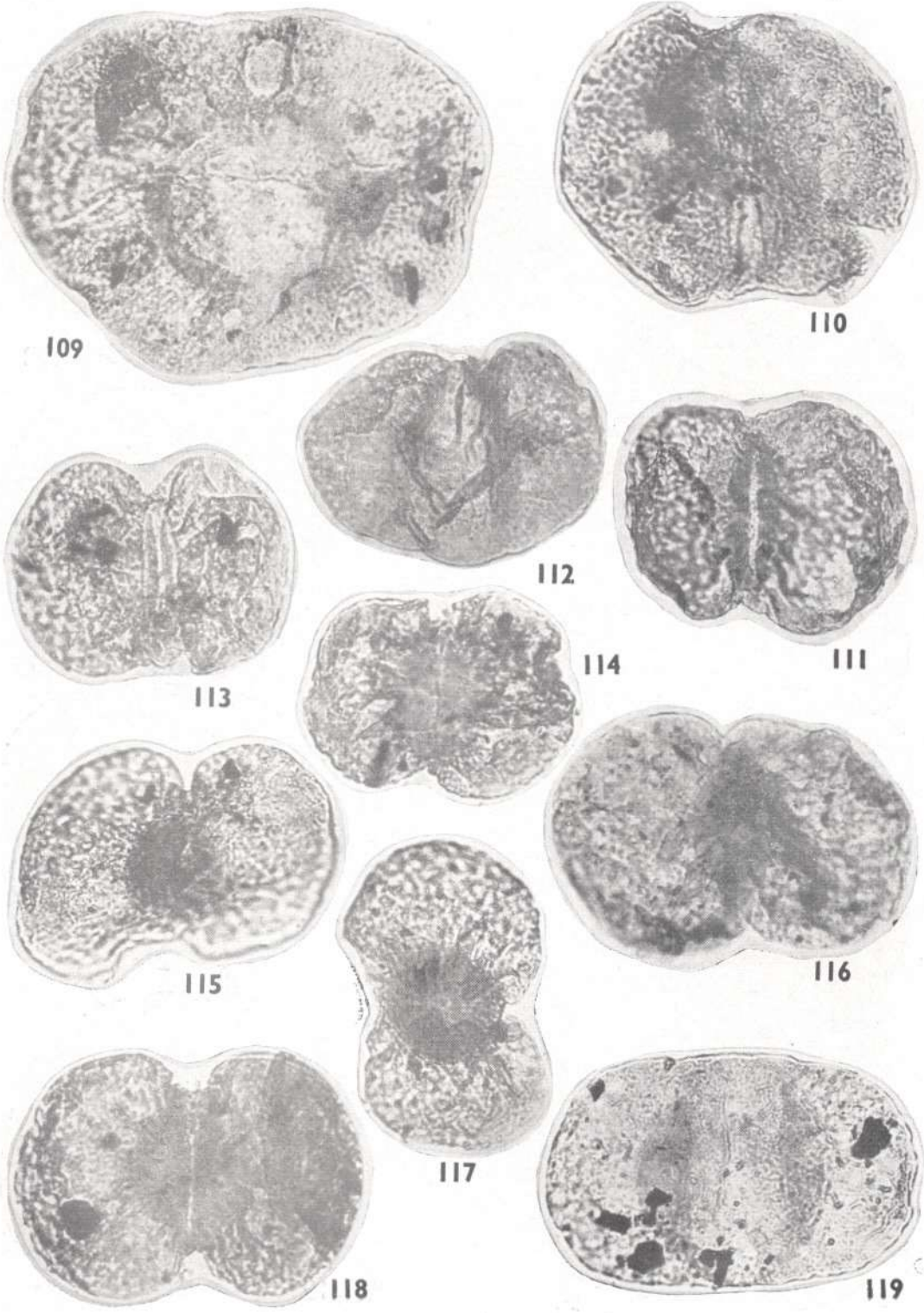

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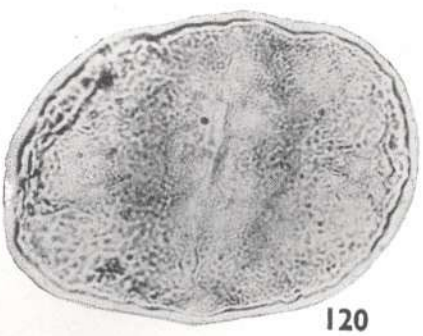
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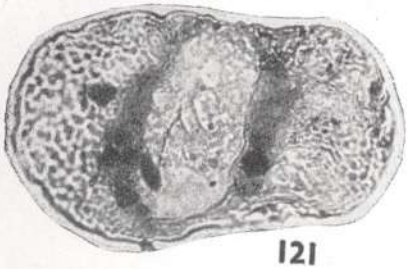
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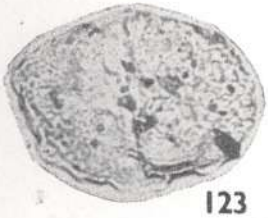
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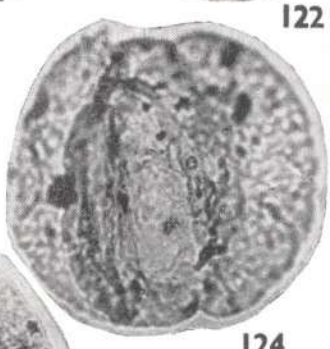
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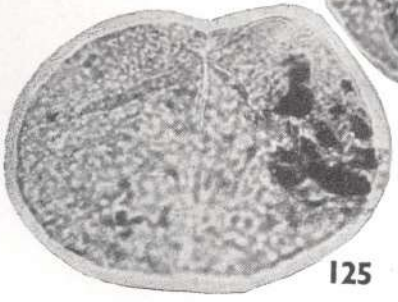
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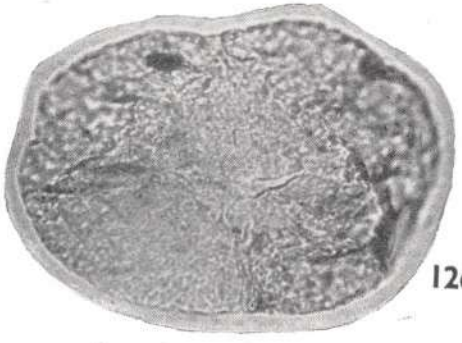
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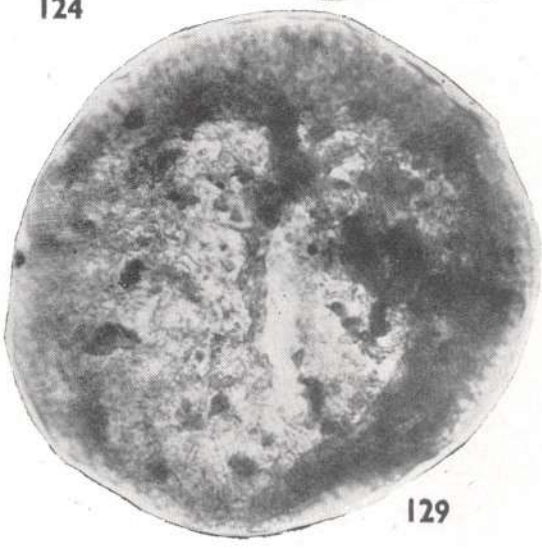
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PLATE 11

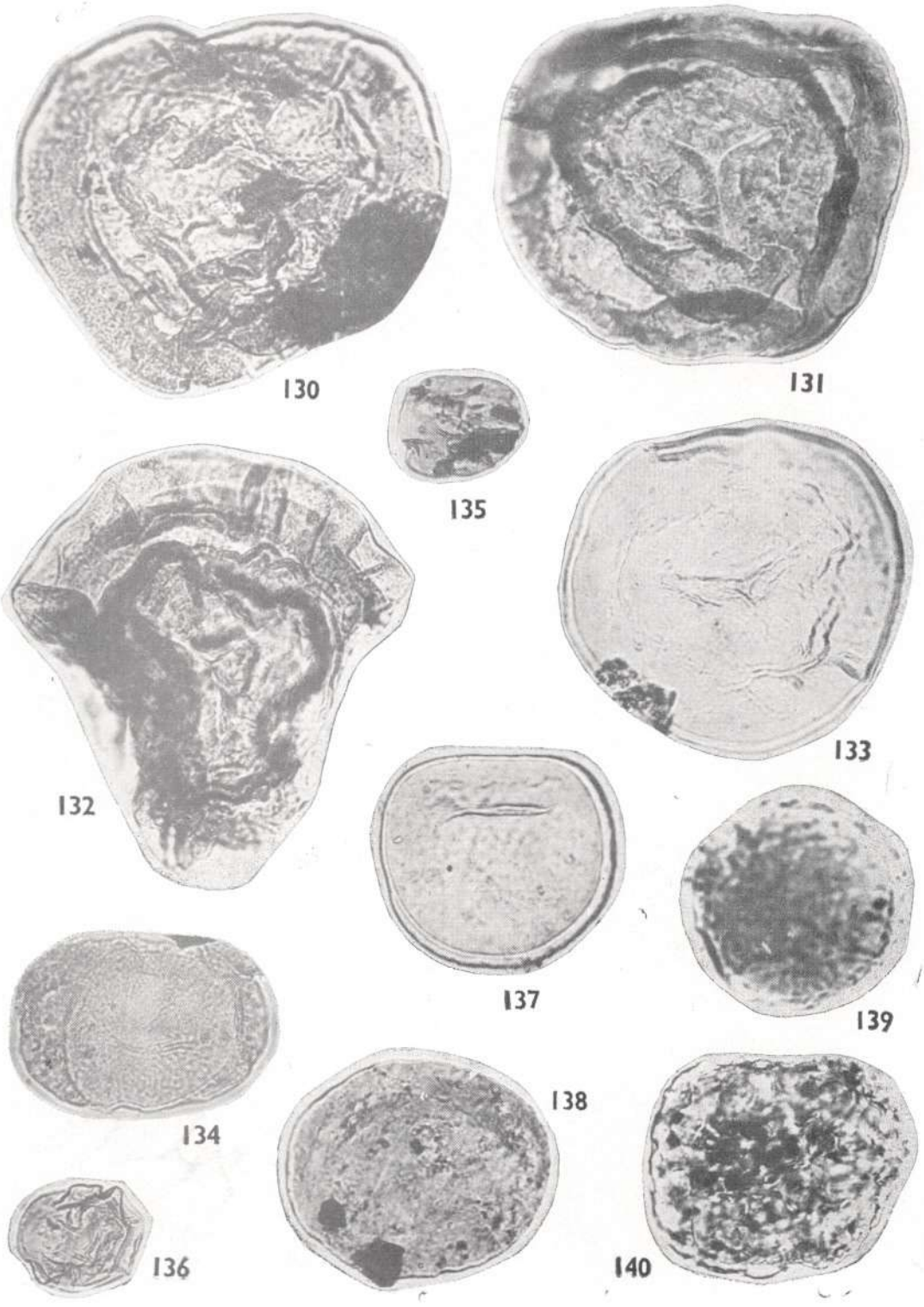

PLATE 12