

NEW MIOSPORE GENERA IN THE COALS OF BARAKAR STAGE (LOWER GONDWANA) OF INDIA

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ABSTRACT

In the present paper six new miospore genera found in the coals of Barakar Stage of India have been described. New morphographical characters and their hitherto unknown associations, have been determined. *Sriareticuloiditi* infrat. nov., has been proposed to accommodate the dissaccate miospore genera bearing reticuloid striations on the central body.

INTRODUCTION

A DETAILED study of large number of dispersed miospores in the Barakar Coals, from Korba Coalfield, M.P., and West Bokaro Coalfield, Bihar has revealed a number of new morphographical characters and their hitherto unknown associations. Out of these new forms, two monosaccate genera have already been described by Bharadwaj and Tiwari (1964), while the remaining ones are dealt with in the present paper. Prior to this, many workers like Virkki (1946), Ghosh, Chandoik & Sen (1947), Bhattacharya, Raychaudhury & Dutta (1957), Surange, Srivastava & Singh (1953), Guhasarkar (1956), Bhattacharya (1959), Banerjee (1958), Ganguly (1959), Das (1958) and Ghosh (1962), have also worked out the sporology of various sediments pertaining to the Barakar Stage and described some forms referable to some of the present genera. However, the miospores were mostly described as types and the generic delimitation as well as extensive comparisons were not attempted by these workers.

ACKNOWLEDGEMENTS

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SYSTEMATIC DESCRIPTION

Anteturma — *Sporites* H. Pot. 1893
Turma — *Zonales* (Benn. & Kidst.) Pot. 1956
Subturma — *Zonotriletes* Waltz 1935
Infraturma — *Cingulati* Pot. & Kl. 1954

Genus *Dentatispora* gen. nov.

Genotype — *Dentatispora indica* sp. nov.

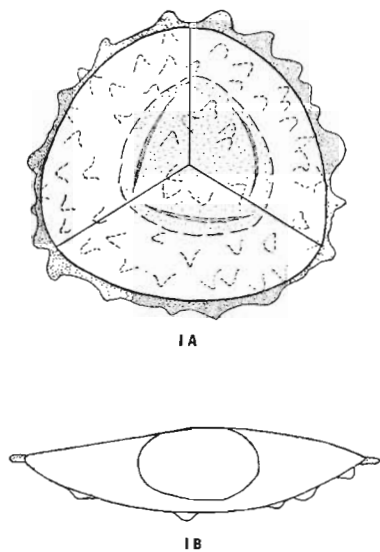
Generic Diagnosis — Subtriangular trilete bearing miospores with \pm crenate cingulum. Trilete rays reaching up to the inner margin of the cingulum. Body exine proximally intramicropunctate, without sculpture, distally ornamented with coni or verrucae of various shapes and sizes. Inner body generally present.

Generic Description — Miospores mostly subtriangular in overall shape, inter-radial sides being convex; central body \pm subtriangular with an equatorial, \pm crenate cingulum; Y-mark generally well-defined, rays reaching up to the equator of the body but never entering into the cingulum. Proximal exine of central body sculptureless, intramicropunctate; distal face ornamented with coni or verrucae of various shapes and sizes, of single or mixed type, either sparsely or closely placed or even partially confluent. Cingulum more or less thick, unevenly broad with a \pm smooth or tuberculate to spinose margin. A thin, subtriangular, generally folded inner body present.

Organization — Text-figs. 1A, B.

Comparison — In *Savitrissporites* Bhard. (1959), the cingulum is broader and thicker at the angles, the exine of the central body is glossy and inner body is absent unlike *Dentatispora* gen. nov. *Cirratriradites* Wils. & Coe differs from the present genus in

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TEXT-FIG. 1 — Organization of *Dentatispora* gen. nov. A, Proximal view; B, Meridional section.

having a thin zona with characteristically radiating, 'striated' pattern with micro-serrate margin. Moreover, *Cirratriletes* does not possess any conii or spinae on the body exine.

Hymenozonotriletes Naum., possesses a broad thin zona, and ornamental processes are disposed all over the body as well as on zona. *Galeatisporites* Pot. & Kr. differs from *Dentatispora* gen. nov., in having tubercles on the distal face, distinct contact area on the proximal face and in the absence of an inner body.

Gondisporites Bharad. (1962) possesses a thin zona or a ridge, Y-rays reaching up to the outer margin of the zona, and finely granulose, unstructured exine of the central body.

Monilospora Hacq. & Barss., differs fundamentally in having a thin flange with marginal thickening unlike the thick cingulum in *Dentatispora*, besides other details. *Clavisporis* Bharad. & Venkatach. (1962) though shows a cingulum somewhat like that of the present genus, it differs in having grana all over the spore and the club-shaped processes in the cingulum (see BHARAD. & VENKATACH. 1962, p. 35). *Monilospora* and *Clavisporis* are also geologically as well as geographically widely separated.

Derivation of Name — After dentate nature of cingulum.

Dentatispora indica sp. nov.

Pl. 1, Figs. 1, 2

Holotype — Pl. 1, Fig. 1.

Type Locality — India, (M.P.), Korba Coal-field, (511D, Bore-hole G-101), Barakar Stage.

Diagnosis — Size 58-75 μ . Subtriangular; central body distinct, thin, bearing a 8-12 μ broad, thick, uniformly developed crenate cingulum; Y-mark well-defined, rays slightly wavy, labra thick, vertex slightly raised. Proximally body exine finely intramicropunctate, distally sparsely arranged 2-8 $\mu \times$ 2-8 μ conii present.

Description — Miospore subtriangular in overall shape with convex sides and round, broad angles; holotype 73 μ in size. Central body distinct, thin, subtriangular, 63 μ in holotype. Y-mark well-defined, rays reaching up to the equatorial margin of the body, labra thick, vertex slightly raised, rays slightly wavy. Proximally the exine of the body finely intramicropunctate; distally 2-8 μ long and 2-8 μ broad at base, conical processes present. Thick, equatorial cingulum 8-12 μ wide, dentate in outline, \pm 30 conii around the equator. A distinct triangular inner body present, lying generally slightly away from the centre in flattened specimens.

Remarks — The nature of cingulum in this species is complete and uniform. The 'teeth' at the margin are fused at their bases and give a dentate appearance. The inner body mostly shows the semilunar folds and is slightly removed from the centre.

Other specimen referable to *Dentatispora* — Pl. 1, Fig. 3.

Infraturma — *Zonati* Pot. & Kr. 1954

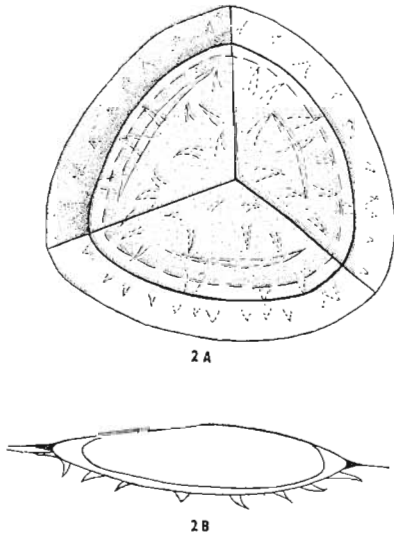
Genus *Indotriletes* gen. nov.

Genotype — *Indotriletes korbaensis* sp. nov.

Generic Diagnosis — Flanged, trilete miospores; flange thicker near its attachment zone while thinner in the remaining portion, having smooth to minutely serrate margin; central body thin-walled, proximally bearing a trilete mark, rays reaching up to the margin of the flange. Exine of the body intramicropunctate, proximally without ornamentation but distally covered with conii or spinae of various shapes and sizes. Inner body generally present.

Generic Description — Miospores generally subtriangular with convex inter-radial sides and broadly rounded corners. Central body distinct, thin-walled, bearing a trilete mark on the proximal face and a subequatorially attached flange. Flange almost uniformly broad around, thicker at the basal portion, i.e. in a region near its attachment with the central body, but thinner in rest of the area, margin smooth or minutely wavy, surface smooth or finely microgranulose in appearance. Exine of the central body mostly thin, intramicropunctate; Y-mark generally well marked, rays thin or thick lipped, straight or slightly wavy reaching up to the outer margin of the flange. Distal side of the central body bearing densely or sparsely disposed coni or spinae of various shapes, sizes and arrangements, sometimes fusing with each other; flange ornamented only rarely. Thin, triangular inner body, generally with semilunar folds, present in most of the specimens.

Organization — Text-figs. 2A, B.



TEXT-FIG. 2 — Organization of *Indotriradites* gen. nov. A, Proximal view; B, Meridional section.

Comparison — Although the present genus resembles *Cirratriradites* Wils. & Coe, in general organization, the two genera distinctly show different trends of variation among themselves. *Cirratriradites* includes the forms showing a tendency of intrapunctate, smooth or microgranulose nature of the body exine. On the other hand

Indotriradites gen. nov. shows a different trend in having coni or spinae on the distal side of the body exine. Thus, the main considerations to differentiate these genera, have been the differences in the sculpture as well as in the trends of variation exhibited by their species.

Indotriradites can also be compared to the sections B and C of *Densosporites* as interpreted by Bharadwaj and Venkatachala (1962, p. 32) but section B representing the genus *Cristatisporites* (Pot. & Kr.) Bharad. & Venkatach., does not possess a thin flange and section C assigned to *Lycospora*, though shows the general organization similar to *Indotriradites*, does not show the presence of spines or coni (see BHARAD. & VENKATACH. 1962, pp. 31-34).

Gondisporites Bharad. (1962) differs from *Indotriradites* gen. nov. in having granulose and not structured exine of the central body and in the absence of denser region at the base of the flange. In *Gondisporites* the flange tends to vary from a zona to a mere ridge.

Dentatispora gen. nov., described earlier differs from the present genus in having a thick, dentate cingulum unlike the thin, uniform flange of the present genus.

Some of the specimens described as *Cirratriradites splendens* by Balme & Henelly (1956, Pl. 5, FIGS. 58, 59) can be referred to the present genus. Spore type 41 described by Virkki (1946, Pl. 7, FIG. 103) also resembles the forms included in *Indotriradites* gen. nov. However, the presence of distal processes in it, is not given in the description by her (VIRKKI, 1946, p. 137). The species described under *Kraeuselisporites* by Jansonius (1962), should find a place under *Indotriradites* gen. nov.

Indotriradites korbaensis sp. nov.

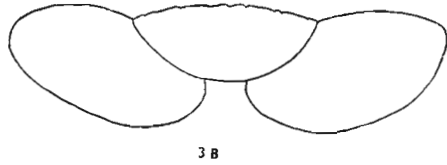
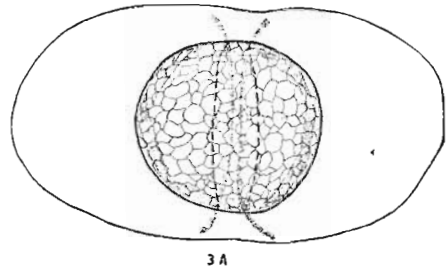
Pl. 1, Figs. 4, 4a, 5, 6

Holotype — Pl. 1, Figs. 4, 4a.

Type Locality — India (M.P.) Korba Coal-field [208 (II Seams)E, Bore-hole G-2], Barakar Stage.

Diagnosis — Known size 42-77 μ . Subtriangular; Y-mark distinct, rays thin or slightly thick lipped, straight to slightly wavy. Central body subtriangular, thin-walled; flange 7-13 μ broad with 2-4 μ broad thicker region. Distal side of the central body covered with closely set coni and spines. Inner body generally present.

Description — Holotype 71 μ . Miospores subtriangular with convex inter-radial sides and round, broad angles. Central body distinct, subtriangular, outline being \pm parallel to that of flange, 45 μ in holotype. Y-mark distinct, rays thin or slightly thick lipped, reaching almost up to the outer margin of the flange, straight or slightly wavy. Body exine thin, proximally without any ornamentation, distally covered with closely set 2-6 μ long \times 2-6 μ broad at the base, pointed coni and spines. Flange subequatorial in attachment, uniformly broad, thin except the 2-4 μ broad basal region, where dense, margin mostly smooth, rarely minutely wavy. No processes on the flange but the distal processes of the central body projecting out in the flange-region on flattening of the spore.



TEXT-FIG. 3 — Organization of *Korbapollenites* gen. nov. A, Proximal view; B, Meridional section.

Anteturma — *Pollenites* R. Pot. 1931

Turma — *Saccites* Erdtm. 1947

Subturma — *Disaccites* Cooks. 1947

Infraturma — *Striareticuloiditi* inf. nov.

Diagnosis of Infraturma — Disaccate pollen grains, central body bearing nearly polygonal areas bound by narrow grooves, resulting in a more or less reticuloid pattern of striations.

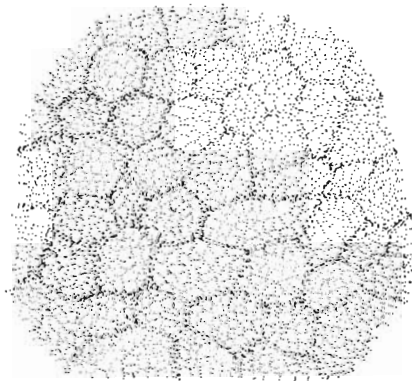
Genus *Korbapollenites* gen. nov.

Genotype — *Korbapollenites novus* sp. nov.

Generic Diagnosis — Disaccate pollen grains with bilateral to subcircular overall shape. Proximal face of central body bearing polygonal areas delimited by narrow grooves, forming a reticuloid pattern of striations. Body exine sculptureless, intramicropunctate, showing small secondary folds in the body wall regularly along the equatorial region, giving it a denser, border-like appearance. Sacci proximally equatorially attached but distally inclined to form a wide sulcus; intrareticulation fine, or coarse with finer meshes within the larger ones.

Generic Description — Pollen grains disaccate, generally showing a monosaccoid construction. Central body mostly circular, subcircular or oval, bearing faint to well-defined reticuloid striations; areas bound by striations being nearly polygonal. A large number of small folds occurring generally regularly along the periphery, forming a border-like denser narrow zone near the equatorial region of the central body.

Proximally the sacci continuous along the lateral sides of the central body, resulting in a monosaccoid appearance, distally inclined, lobes attached to the median region of the body along the lateral axis; sulcus broad to narrow, channel-shaped, mostly diffused; attachment zones arcuate generally with sacci infolded along them characteristically widening laterally as in the genus *Sulcatisporites* (Lesch.) Bharad. (BHARADWAJ, 1962; p. 98). Saccus intrareticulation fine and single or double in nature, in the latter case showing two types of reticulation, (i) coarser meshes being 3-8 μ wide containing (ii) 1-2 μ wide finer meshes within (TEXT-FIG. 4).



4

TEXT-FIG. 4 — Diagrammatic representation of the double intrareticulation in saccus.

Organization — The regular infolding-system in the body exine at the peripheral region suggests substantial curvature in the body wall, to adjust which on flattening such a folding seems to have resulted. Text-figs. 3A, B show the general plan of organization in *Korbapollenites* gen. nov.

Comparison — The present genus differs from all the striated pollen grains in having no regularly horizontal striations. *Potonieisporites* (Bhard.) Bharad. (1964) bears a monolete mark and lacks reticuloid striations on the proximal face of the body, thus differs from the present genus. *Fimbriaesporites* Lesch. (1959), and *Rhizomaspora* Wilson (1962), though show the presence of reticuloid striations, lack the peripheral secondary foldings in the body and infoldings of the sacci in the distal attachment region. *Barakarites* Bharad. & Tiwari (1964), too bears reticuloid striations on the body, but differs in being typically monosaccate in construction of the saccus and in its distal attachment, and also bears a trilete mark apart from other details.

Derivation of name — After the type locality — Korba Coalfield (M.P.) India.

Korbapollenites novus sp. nov.

Pl. 1, Figs. 7, 8

Holotype — Pl. 1, Fig. 7.

Type Locality — India (M.P.) Korba Coalfield [202 (II Seam)E, Bore-hole R-34], Barakar Stage.

Diagnosis — Known size-range 110-160 μ \times 100-138 μ . Bilaterally oval to subcircular in overall shape. Central body \pm circular, thin, distinct, known size-range 65-78 μ ; faint to well-defined reticuloid striations, areas being \pm polygonal, 2-6 μ wide. Exine thin, infoldings at the peripheral region regular, 5-10 μ broad; sacci hemispherical, lateral continuations wide; distal inclination of sacci-lobes prominent; zones of distal attachment hardly discernible; sulcus wide, almost diffused; sacci infolding generally present along the distal zones of attachment. Intrareticulation double.

Description — Pollen grains subcircular to bilaterally oval, monosaccoid. Holotype 152 \times 106 μ ; central body circular to subcircular, 77 μ in holotype, thin, outline well marked; reticuloid striations binding nearly-polygonal, thin areas of 2-6 μ size. Peripheral infolding of exine distinct, folds many, 5-10 μ broad forming a ring like

infolding system relatively thicker in appearance; distal channel generally wide, attachment zones being hardly discernible, straight to slightly convex, 22-30 μ apart in the centre; sacci lobes infolded in the median region generally forming two characteristic folds along the lateral axis of the central body; lateral continuations of the sacci prominent, usually with constrictions, generally narrower than the span of sacci at terminal sides. Saccus intrareticulation double in nature, coarser being rarely ill-defined, forming 3-8 μ broad meshes, containing finer intrareticulation, occasionally apparently fine.

Genus *Primuspollenites* gen. nov.

Genotype — *Primuspollenites levis* sp. nov.

Generic Diagnosis — Oval to bilateral, disaccate pollen grains. Central body bearing proximally nearly polygonal areas, bound by narrow grooves, resulting in a reticuloid pattern of striations. Body exine intramicropunctate. Sacci generally encroaching the body a little proximally with diffused zone of attachment, distally inclined and forming a definite sulcus, distal zones of saccus attachment distinct and full length along the lateral axis of the central body. Sacci continuous laterally, with or without distinct lateral notches, or even completely notched; fine to coarsely intrareticulate, or even with double intrareticulation.

Generic Description — Pollen grains disaccate, generally bilateral, occasionally ovalish in overall shape due to lateral continuations of sacci. Central body thin- or thick-walled, mostly well-defined, rarely with diffused outline; mostly vertically oval or rhomboidal, sometimes subcircular in shape, proximal face bearing faint to well-defined, nearly polygonal, small areas delimited by narrow grooves, forming a reticuloid pattern of striations (TEXT-FIG. 6). Body exine intramicropunctate; no sculpture. Sacci generally slightly invading the body proximally from all the sides, thus attached subequatorially, attachment zone being completely diffused; distal inclination of saccus well marked, forming a narrow to wide, convex or sometimes boat-shaped distal sulcus; zones of saccus attachment full length, distinct, accompanied by characteristic well marked thickening (TEXT-FIG. 5). Lateral positions of sacci variable, continuations being with or without notches, or forming completely demarcated two sacci

lobes. Saccus structure fine to coarsely intrareticulate, sometimes indistinctly or distinctly doubly intrareticulate, giving an appearance of coarse skeleton associated with finer intrareticulation.

Organization — Text-figs. 5A, B.

Comparison — Among the disaccate pollen grains, *Cuneatisporites* Lesch., *Platysaccus* Pot. & Kl., *Lueckisporites* Pot. & Kl. and other non-striated genera lack striations. *Striatites* (Pant) Bharad., *Lahirites* Bharad., *Lunatisporites* (Lesch.) Bharad., *Striatopodocarpites* (Soritch. & Sed.) Bharad., *Verticillipollenites* Bharad., and *Hindipollenites* Bharad. (1962), show the presence of definite, complete horizontal striations which may be, in some cases, interconnected by vertical partitions but never forming a regular network of reticuloid striations as in the present genus. Thus, all the striated and non-striated genera differ from the present genus in this respect apart from other morphographical details. *Kosankeisporites* Bhard. (1955) possesses structureless body exine, few zig-zag *rugulae* but not reticuloid type of striations. Diagnosis of *Fimbriaesporites* Lesch. (1959) as given by Bharadwaj (1962) says that the proximal face of central body in *Fimbriaesporites* shows the presence

of polygonal areas or reticuloid striations but the exine is microverrucose and apparently structureless. Moreover, the present genus shows a tendency to possess a thickening along the distal zone of saccus attachment, thus differs from *Fimbriaesporites* all the more. *Rhizomaspora* Wilson (1962), although shows intramicropunctate structure in the body and 'radiating or diverting ribs', differs from the present genus in having generally a dense, \pm circular central body and ill-defined distal sulcus.

Remarks — Along with *Primuspollenites*, pollen grains are also found in the present assemblage which are referred to *Rhizomaspora* Wilson, and *Fimbriaesporites* Lesch. *Rhizomaspora* Wilson and *Primuspollenites* gen. nov., though share the presence of reticuloid striations and structured exine of the body, differ in that the former has a diffused sulcus and the latter shows the presence of well-defined sulcus, a tendency to have thickenings along the zones of saccus attachment. Apart from that, the difference in the trends of variation exhibited by the species of these genera, is also confirmatory of their being different.

Derivation of name — Latin *Primus* meaning foremost.

Primuspollenites levis sp. nov.

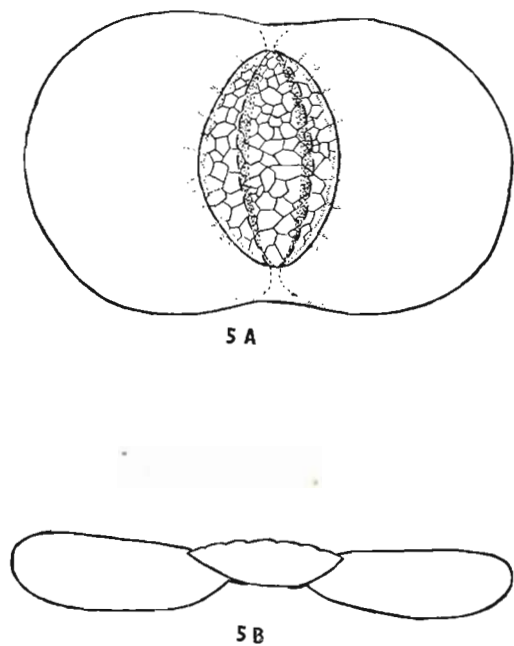
Pl. 1, Fig. 9

Holotype — Pl. 1, Fig. 9.

Type Locality — India (M.P.) Korba Coalfield [202 (II Seam)E; Bore-hole R-34], Barakar Stage.

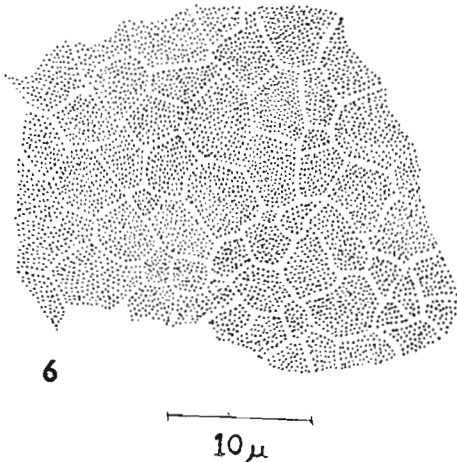
Diagnosis — Known size 94-165 μ . Bilateral; central body vertically oval, distinct and thin-walled, 52 \times 74 μ in holotype; reticuloid striations faint to well marked, polygonal areas being 1-6 μ in size. Distal channel biconvex 10-30 μ wide; sacchi lobes either continuous laterally with shallow to deep notches or just meeting; saccus hemispherical or more than hemispherical, doubly intrareticulate.

Description — Pollen grains bilateral to subcircular in overall shape, the size-range being 94-165 $\mu \times$ 59-158 μ . Holotype 154 \times 106 μ . Central body vertically biconvex with narrow ends, 30-63 $\mu \times$ 44-93 μ in size, distinct; exine thin. Saccus attachment generally subequatorial on proximal side, apparently invading the central body about 2-4 μ from all sides, attachment zone being completely ill-defined; distally



TEXT-FIG. 5 — Organization of *Primuspollenites* gen. nov. A, Proximal view; B, Meridional section.

lobes inclined to form a well-defined convex sulcus. Laterally, sacci either continuous or if separate coming close to each other: in the former case width of lateral continuations being up to $30\ \mu$ ($10\ \mu$ in holotype) and showing the presence of shallow notches. Intrareticulation of saccus double in nature, the coarser meshes measuring $3-8\ \mu$, containing finer, $1-2\ \mu$ wide meshes (distinct in holotype).



TEXT-FIG. 6 — Nature of reticuloid striations in *Primuspollenites* gen. nov. A semidiagrammatic, camera lucida drawing.

Genus *Direticuloidispora* gen. nov.

Genotype — *Direticuloidispora indica* sp. nov.

Generic Diagnosis — Disaccate pollen grains. Central body bearing nearly polygonal areas bound by narrow grooves, resulting in a reticuloid pattern of striations, both on proximal as well as distal saccus-free areas. Body exine intramicropunctate. Sacci inclined distally to form a definite sulcus, the zones of distal attachment being distinct and full length in relation to the vertical axis of the central body. Sacci continuous laterally with or without distinct notches or even completely notched. Intrareticulation of sacci fine, coarse or double in nature.

Generic Description — Pollen grains disaccate, generally bilaterally ovoidal in overall shape with lateral continuations of sacci. Central body well-defined, vertically oval, rhomboidal, subcircular or subtriangular in shape. Proximal saccus-free area of the

body bearing faint to well-defined, nearly polygonal (rarely subparallel) small areas bound by narrow grooves, forming a reticuloid pattern of striations. Similar reticuloid striations also present on the distal saccus-free area. Body exine thin to thick, intramicropunctate without any sculpture. Proximally sacci equatorially attached or invading the body a little from all the sides; attachment zones being completely ill-defined. Distal inclination of sacci well marked, forming narrow to wide, convex to boat-shaped, definite distal sulcus. Distal zones of sacci attachment full length, well-defined, generally accompanied by narrow thickenings, lateral continuations of sacci variable, i.e. narrow to wide, with or without notches; rarely two lobes of sacci lie adjacent to each other laterally, having no lateral continuations. Saccus intrareticulation fine to coarse, sometimes distinctly or indistinctly double, the coarser meshes being associated with the finer ones.

Comparison — Non-striated genera like *Cuneatisporites* Lesch. *Platysaccus* Pot. & Kl., and others differ from the present genus in having no striations on the central body. The striated genera like *Striatites* (Pant) Bharad., *Lahirites* Bharad., *Lunatisporites* (Lesch.) Bharad., *Striatopodocarpites* (Soritsch. & Sed.) Bharad., and other similar forms bear definite horizontal striations with or without vertical partitions on the proximal face of the central body, which never form a reticuloid pattern. *Distriomono-saccites* Bharad. (1962) although possesses striations on both faces of central body, differs in being typically a monosaccate genus, in having simple or forked longitudinal striations which never form a reticuloid pattern, and in the absence of distal channel, apart from other details. *Distriatites* Bharad. (1962) although possesses striations on both the faces of the body, differs in having simple horizontal striations proximally and vertical striations distally, and in having ill-defined, wider distal sulcus.

Among the miospore genera having reticuloid pattern of striations, *Korbapollenites* gen. nov., shows only the proximal network of striations, peripheral fold-system of body exine and ill-defined narrower distal sulcus. *Rhizomaspora* Wilson, has reticuloid striations only on proximal face and indistinct narrow sulcus. *Fimbriaesporites* Lesch., apart from having microverrucose, unstructured exine, bears the reticuloid striations only on the

proximal face of central body and thus differs from the present genus. *Primuspollenites* gen. nov., resembles the present genus in general organization and other characters but the former lacks reticuloid striations on the distal saccus-free area, thus it is quite different from the latter.

Organization — Similar as Text-figs. 5A, B for general plan.

Derivation of name — Due to the presence of reticuloid pattern of striations on both the saccus-free faces of the central body.

Direticuloidispora indica sp. nov.

Pl. 1, Fig. 10

Holotype — Pl. 1, Fig. 10.

Type Locality — India (M.P.) Korba Coal-field [202 (II Seam)E; Bore-hole R-34], Barakar Stage.

Diagnosis — Bilaterally ovoidal. Central body vertically oval to rhomboidal with narrow lateral ends, thin to mediumly thick, distinct, $39-48 \mu \times 55-65 \mu$ in size. Small polygonal areas (known size $1-4 \mu$) on saccus-free areas of proximal and distal faces of the central body present; distal sulcus convex, $18-27 \mu$ wide in the middle. Sacci laterally continuous, with $15-19 \mu$ wide continuations, shallow notches generally present. Intrareticulation indistinctly double in nature, apparently fine.

Description — Known size $131-135 \mu \times 96-100 \mu$. Holotype $135 \times 100 \mu$. Pollen grains with laterally continuous sacci. Central body distinct, vertically oval to rhomboidal with narrow, \pm pointed lateral ends. Size of central body in holotype $48 \times 65 \mu$. Exine thin to mediumly thick, finely intramicropunctate; no sculpture. Proximal as well as distal saccus-free area bearing \pm polygonal, small areas delimited by narrow grooves resulting in a reticuloid pattern of striations. Proximal polygonal areas equal or slightly bigger than those of distal face; $1-3 \mu$ wide in holotype. Sacci slightly encroaching the body on proximal face with diffused zone of attachment but distally inclined to form definite convex sulcus; sulcus width in holotype 27μ . Zones of distal attachment prominent, appearing as a $3-4 \mu$ wide thickened region. Lateral continuation of sacci wide $\pm 15 \mu$ in holotype generally slightly notched. Sacci \pm hemispherical in shape apparently finely intrareticulate, finer meshes being $0.5-1.5 \mu$

in size. Double intrareticulation not very distinct but apparent in some cases.

Turma — *Aletes* Ibr. 1933

Subturma — *Azonaletes* (Luber) Pot. & Kr. 1954

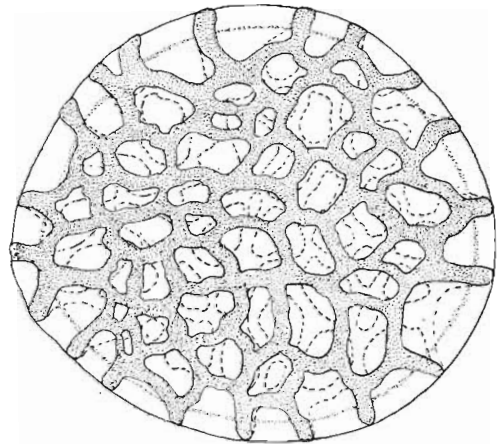
Infraturma — *Reticulonapiti* (Erdtm.) Vimal 1952

Genus *Maculatasporites* gen. nov.

Genotype — *Maculatasporites indicus* sp. nov.

Generic Diagnosis — Circular to subtriangular, alete miospores bearing reticulation all over the body.

Generic Description — Miospores circular, subcircular or roundly subtriangular in overall shape. No mark or striations present. Reticulation present all over the body, muri evenly or unevenly broad, enclosing narrow to wide meshes, shape of the meshes varying from regular, nearly polygonal to irregular, circular or narrow elongated area-like. In the flattened specimens, muri appearing as small projections at the peripheral region, in continuation with the body outline, thus resulting in a wavy or smooth outline of the miospore depending upon the high or low nature of the muri (see TEXT-FIG. 7).



TEXT-FIG. 7 — Diagrammatic sketch in the meridional plane of *Maculatasporites* gen. nov.

Comparison — *Reticulatisporites* (Ibr.) Pot. & Kr., differs from the present genus in having a distinct, trilete mark. *Reticulatasporites* (Ibr.) Pot. & Kr. (1954), although resembles the present genus in the absence

of any mark and in the presence of reticulum, differs in having coarser meshes enclosing finer meshes with thinner muri inbetween. Moreover, the muri of the neighbouring meshes are generally arranged to form somewhat continuous arch shaped muri which, many a times lie parallel to the body equator while in *Maculatasporites* gen. nov., they are nearly polygonal in arrangement, projecting at the equator appearing in continuation with body outline. *Dictyotriletes* (Naum.) Pot. & Kr., also differs from the present genus in having a trilete mark and in showing the reticulation only on the distal face.

Leschik created a new genus in the year 1955 giving it the name *Reticulatasporites* (LESCH., 1955; p. 29) which is invalid in view of the fact that same name has been given by Ibrahim in 1933 to a miospore genus discussed above (also see POT. & KR. 1955; p. 29). Figures 21 and 24 (PL. 3) given by Leschik (1955), although poorly photographed, show some resemblances with the present genus.

Derivation of name — Latin *Macula* meaning reticulum.

Maculatasporites indicus sp. nov.

Pl. 1, Figs. 11, 12

Holotype — Pl. 1, Fig. 11.

Type Locality — India (M.P.) Korba Coalfield [495(C); Bore-hole G-44]; Barakar Stage.

Diagnosis — Size 40-65 μ . Subcircular to roundly subtriangular; meshes of the reticulum 1-5 μ broad, of various shapes and sizes; muri massive, 1-4 μ broad; equatorial extension 3-7 μ wide. Outline smooth to slightly wavy.

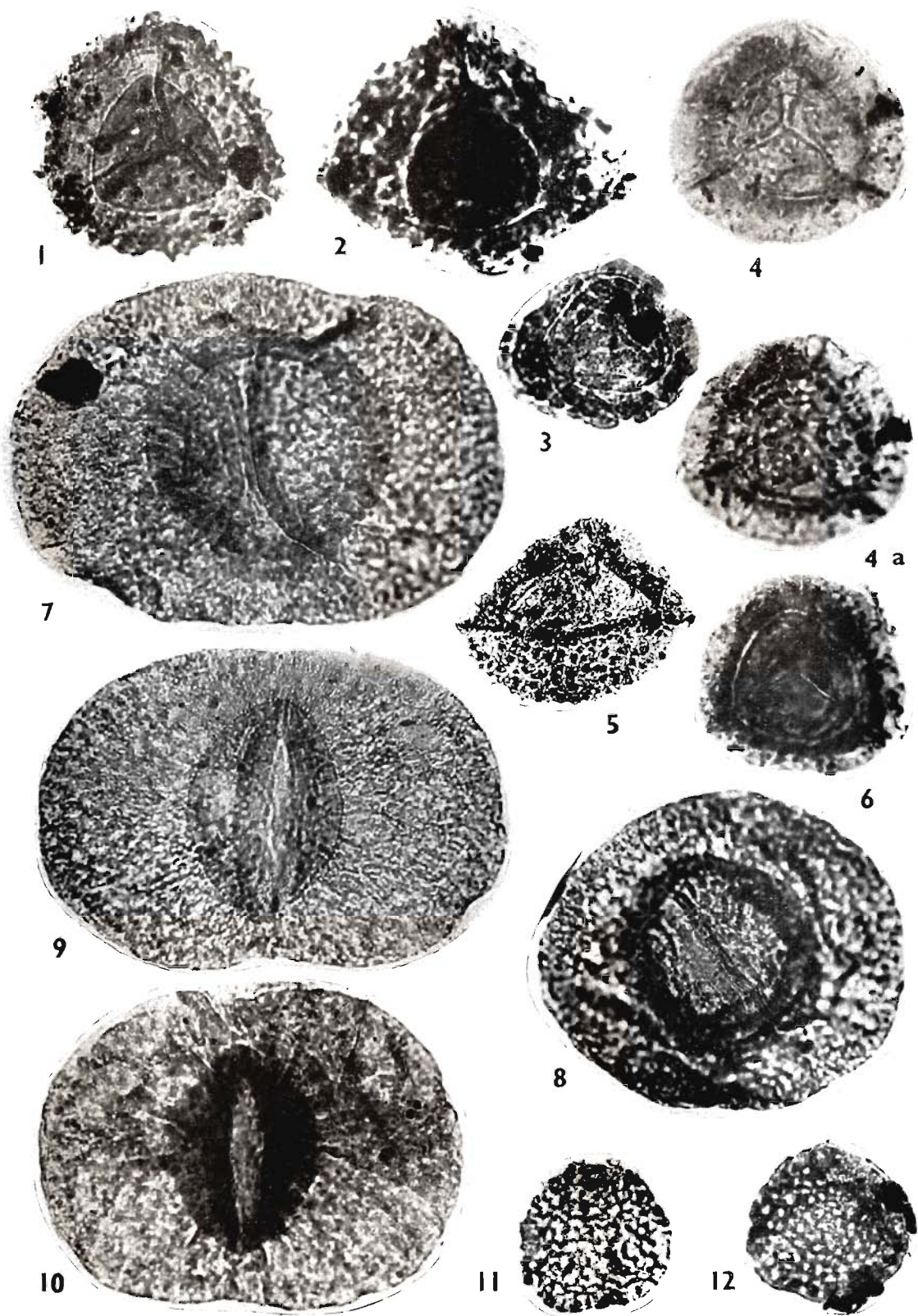
Description — Holotype 52 μ . Miospores generally circular or subcircular, rarely roundly subtriangular. Reticulum complete, on both the faces, regular to somewhat irregular, small subcircular to elongated areas; muri dark brown in colour, projecting prominently at the equator giving it a wavy appearance; connecting muri appearing as thinner, uniform extension.

DISCUSSION

The detailed taxonomic study of the dispersed miospores has revealed a number of new organizations and associations of morphographical characters in the miospore genera.

The monosaccoidal construction of sacci in disaccate grains has been a problem in the study of disaccate pollen grains and some genera, having lateral continuations ('lateral connectives' or 'lateral union of sacci' — terms used by several workers) of sacci, have often caused confusion regarding their place in the classification. Study by Bharadwaj (1962, 1964) as well as the present study of disaccate grains, (striated and non-striated forms in general and forms with reticuloid striations in particular) reveals that the monosaccate construction may border on disaccate organization in extreme cases and *vice versa*. In normally disaccate genera, the monosaccoid constructions usually show a depression or notch in the lateral continuation of the saccus.

Another important character, notable in some of the saccate grains, is the nature of saccus intrareticulation. Mostly the intrareticulation of saccus is complete and fine to mediumly coarse, rarely very coarse. In some specimens of Raniganj Stage, Bharadwaj (1962, p. 73) suspected double intrareticulation i.e. larger meshes within which finer reticulation exists. This phenomenon is a matter of common occurrence in some of the miospore genera of Barakar Stage e.g. *Primuspollenites* gen. nov. and *Korbapollenites* gen. nov. The double intrareticulation in some specimens is very distinct, the coarser meshes being 3-8 μ broad and distinct, bearing very fine meshes within. In some overmacerated specimens this character becomes clearer. In such cases, the finer meshes, enclosed in coarser ones, disappear due to the stronger acid reaction and only the coarser meshes of the reticulation remain as a skeleton or coarser network in the saccus. In others, the muri of coarser meshes become gradually ill-defined and merge with the surrounding area; in other words they are not sharply visible but apparently present, better seen in high power objective. In still other cases, the reticulation is uniformly fine. However, at the present juncture, it is very difficult to give much importance to this character because it is necessary to see the effect of differential maceration or to study the microsections of a saccus of this type, before coming to any conclusion. In the present work this character has been recorded after as careful a study as possible with the conventional methods.



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EXPLANATION OF PLATE 1

(All figures are 500 ×)

- 1, 2. *Dentatispora indica* gen. et sp. nov.; photos 313/38 (Holotype), 357/10.
3. *Dentatispora* sp.; photo 356/19.
- 4, 4a. *Indotrivadites korbaensis* gen. et sp. nov.; photos 286/37, 286/38 (Holotype).
- 4, Proximal view, 4a, Distal view.
- 5, 6. *Indotrivadites korbaensis*; photos 350/29, 287/8. 5, Laterally compressed specimen.
- 7, 8. *Korbapollenites novus* gen. et sp. nov.; photos 289/70 (Holotype), 289/6.
9. *Primuspollenites novus* gen. et sp. nov.; photo 221/26 (Holotype).
10. *Direticuloidispora indica* gen. et sp. nov.; photo 289/32 (Holotype).
- 11, 12. *Maculatasporites indicus* gen. et sp. nov.; photos 348/14 (Holotype), 358/4.