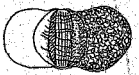
Dimensions (4 specimens): l-ax: 75-75µ; t-a: 45-55 µ.



Discussion: This species is assigned to Hamiapollenites on the basis of longitudinal and transverse ribs. However, no pre-existing species so far encountered takes into account the very conspicuous distal folds along the sacci roots.

Stratigraphic range: Very rare in the Mid- and Lower Madumabisa Mudstones only.

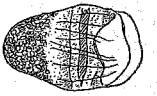
Hemiecollenites karrooensis Hart, 1964

Plate 11: figure 4.

Holotype: H. karrooensis Hart, 1964.

Synonyms: Minutisaccata karrooensis Hart, 1964.

Diagnosis: The proximal cap bears six longitudinal ribs in polar view. The central body is approximately circular, with a distal keel made up of a central transverse sulcus bounded by one transverse rib on either side.



Description: Shape: Haploxyloncid to weakly diploxyloncid.

Central body: Approximately circular to slightly (t-a) oval.

Proximal cap: Bears 6-10 irregular spaced but more or less parallel ribs, 2-4 μ wide.

Distal sulcus: Transverse distal sulcus, occasionally indistinct, 3-4 μ wide, stretching almost full breadth of the central body. One pair of striations on either side of the sulcus mark the pair of flanking transverse ribs.

Sacci: Smaller in size than the central body, and less than semi-circular in shape. Infra-reticulate collumela.

Dimensions (5 specimens): l-a: 45-75 µ; t-a: 34-48 µ.

Discussion: In diagnosis this form fits H. katrocensis Hart. However, due to the lack of more detailed original information and no photographic comparison, this species is only tentatively assigned.

Stratigraphic range: Absent in the Dwyka and Lower Black Shales and Coals; very rare in Upper Black Shales and Lower Madumabisa Mudstones.

Genus: Vittatina Luber ex Jansonius, 1962

Type species (designated by Jansonius, 1962): Vittatina subsaccata Samoilovich, 1953.

Synonyms: Striatoluberae Hart (1963a).
Paravittatina Balme, 1966.

Diagnosis: Striate pollens with very small sacci or lacking sacci altogether.
Shape: Usually haploxylonoid to slightly diploxylonoid when sacci are present.
Proximal cap: Longitudinal ribs conspicuously meet, fuse or crowd together terminally. When joined together in a continuous ribbon-like manner, the proximal longitudinal striations pass distally into transverse loops.
Distal zone: May be laevigate, granular, or transversely striated.

Discussion: Jansonius (1962) created a new infraturma, the Costati, to house striate forms (such as Vittatina) which possess small or much reduced rudimentary sacci. This therefore represented a transition group between striate species with, and those without, functional sacci. Hart (1964, 1965, 1966 and 1969) prefers to regard Vittatina (as diagnosed above) as a form-genus within the Striatiti due to its morphological links and close

physical co-existence with other genera within this infra-turma.

Balme (1966), however, regards the Vittatina group as Monocolpate and transfers it to the sub-turma Polyplicates. He further divides the form genus into 3 morphological categories, the Ephedripites-type, the V. subsaccata-type, and the non-saccate V. striata-type (i.e. Paravittatina). Whilst the opinions of Balme are strongly favoured, the species encountered within the Mid-Zambezi Valley are sufficiently varied in morphology to be better retained under the wider scope of Vittatina (sensu Jansonius and Hart). With the exception of V. africana, other forms are too rare to describe and evaluate with certainty within the present borehole. It is hoped that future work and material will allow for more precise generic and specific distinction.

Stratigraphic range: This genus is distinct from other Striatiti form genera on the basis of its rudimentary, or entire lack of sacci.

Vittatina africana Hart, 1966

Plate 11: figure 15.

Synonyms: Paravittatina lucifer (Kharadwaj and Salujha) Palme, 1966.

Diagnosis: A Striate pollen grain without sacci. The proximal cap bears 9 to 22 longitudinal ribs in polar view. These meet and coalesce in an orderly fashion forming a concentric pattern. The more lateral proximal ribs curve around the terminal parts and unite on the distal surface. Each terminal area is thereby marked by from 2 to seven distal transverse ribs, the inner rib being markedly wider than the others.

Description: Shape: Haploxylonoid without any evidence of sacci, longitudinally oval to roundly quadrilateral.

Exine: Thin and structureless intexine with lasvigate ribbed exo-exine. Ribs are 1-3 μ apart and 1-4 μ wide, coalescing to form ribbon-like loops from proximal surface onto the distal surface.

Proximal cap: Divided into 15-24 longitudinal ribs, mainly revolving around twin concentric points or a central inner rib. The lateral proximal ribs loop over the equatorial parts of the grain to become distal transverse ribs. When seen in compressed polar view two sets of ribs are obvious, the longitudinal set on the proximal surface and transverse set on the distal surface.

Distal surface: Both terminal distal areas show 4-6 transverse ribs, the innermost ribs being the widest (up to 5 μ) and longest.

Dimensions (25 specimens): l-a: 30(37)45 μ; (t-a): 29(33)39 μ.

Discussion: V. africana is separated from other species (in Africa) by size, the presence of two distal areas with terminal transverse ribs, variation of width of transverse ribs, and the numbers of dominant proximal and distal ribs.

Stratigraphic range: Absent in Dwyka and Black Shales; common to abundant in Lower and Mid-Madumabisa Mudstones.

Vittatina minima Jansonius, 1962

Plate 11: figures 16-21.

Holotype: V. minima Jansonius, 1962.

Diagnosis: This species is a non-disaccate Striatiti. The shape is blunted oval with long sides. The proximal cap is convex, with approximately 6 thick ribs and a continuous equatorial rim, whilst the distal surface is concave and laevigate.

At the terminal sections of the distal surface, along the base of the proximal cap, thickened solid or weakly inflated protrusions occur similar to rudimentary sacci.
(N.B. size: l-a: 20-30 μ; t-a: 14-20 μ).

Description: Shape: Roundly oval in l-a direction with blunted ends. The proximal side convex and the distal side strongly concave.

Proximal cap: Bears 8-12 longitudinal ribs usually parallel with some wedge-shaped. A continuous equatorial rib may be seen, which is not fused to the inner ribs; 1-3 μ wide; exo-exine infra-punctate.

Distal surface: Terminal distal sections give rise to distally inclined darkened solid structures which may be weakly inflated and infra-punctate in sculpture, 3-5 μ wide. Between these structures the concave distal surface is laevigate.

Dimensions (4 specimens): l-a: 16(25)25 μ; t-a: 12(15)20 μ.

Discussion: This form is tentatively assigned to V. minima, but varies in larger number of proximal striae and ribs.

Distinction: This species is distinct from other species of Vittatina by its small size, rudimentary sacci, and number of longitudinal ribs.

Stratigraphic range: Rare in the Mid- and Lower Madumabisa Mudstones only.

Infra-turma: DISACCIATRILETI Leschik, 1956

Genus: Platysaccus Naumova ex R. Potonie and Klaus, 1954

Type species (designated by Potonie and Klaus): Platysaccus papilionis R. Potonie and Kremp.

Synonyms: Cuneatisporites Leschik, 1956.
Pityosporites (Seward, 1914) em Manum, 1960.

Diagnosis: (sensu Balme, 1966 p. 173)
Shape: Diploxyloncid.
Central body: Dense circular to sub-circular.
Sacci: Larger than central body, greater than semi-circular, with or without lateral bladders.
Distal sulcus: May or may not be present.

Discussion: Strongly diploxyloncid disacciatrileti are common in Permian sediments and their generic boundaries and species differentiations are difficult. For the purpose of this thesis a broad category (sensu Balme, 1966, based on de Jersey, 1962 and Playford and Dettman, 1965 and Clarke, 1965a) is adopted, embracing those forms diagnosed as above.

Pityosporites (as amended by Manum) was originally distinguished by some authors (e.g. Jansonius, 1962) from Platysaccus on the grounds of sacci size, presence or absence of lateral bladder and the position of the sacci roots. Hart (1964, 1965) regarded these two genera as

synonomous, and placed them under Pityosporites. However, the holotype of the type species of Pityosporites is inadequately illustrated and difficult to compare, and therefore the overall genus Platysaccus is preferred (see Segroves, 1969, p. 196, Balme, 1966, p. 73).

Cuneatisporites (Leschik) was retained separately by Bharadwaj (1962) due to the distinctly concave distal sacci roots and transversely oval central body. Hart (1965) and Clarke (1965) regard this as synonomous with Platysaccus.

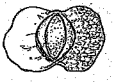
Distinction: Platysaccus is distinct from other Disaccoiatrileti genera on the basis of its moderate to strong diploxilinity, and distinct central body.

Platysaccus radialis (Leschik) Hart, 1965, nov. comb.

Plate 15: figures 1, 2.

Holotype: Cuneatisporites radialis Leschik, 1956.

Diagnosis: Moderately to slightly diploxylonoid in outline; central body is elongate in the transverse direction, and faintly granulate. Sacci are greater than semi-circular in shape, larger than the central body in size and with a tendency to elongation in the l-a direction. Distal zone is about ½ to ¾ l-a (central body), with distal roots coming close together laterally but not coalescing.



Description: Shape: Moderately diploxylonoid.

Central body: Fairly distinct to clearly distinct, oval with transverse elongation; faintly granular exine.

Sacci: Larger than central body in size, and greater than semi-circular in shape with characteristic elongation of the sacci in a longitudinal direction.

Sacci meet laterally and may or may not join to form narrow lateral bladders. Infrareticulation moderately coarse, lumen radially elongating from the sacci roots.

Distal sulcus: Distal roots of sacci are concave, meeting laterally and framing an oval-shaped sulcus with sharp lateral extremities. The sulcus is ~~1-½~~ 1-a (central body) or 10-14 μ wide in the middle.

Dimensions (6 specimens): Total l-a: 75-90 μ; l-a (sacci): 35-45 μ; l-a (central body): 25-30 μ; t-a (sacci): 48-54 μ; t-a (central body): 38-42 μ.

Discussion: P. radialis is very similar to P. imperspicuus (Andreyeva) Hart, 1965 and P. volatilis (Ishchenko) Hart, 1965, in that all three species exhibit similar degrees of diploxilinity, fusiform (concave) distal sulci, width of sulcus and length of distal

roots separating them (Hart, 1965a p. 57-59).

The specimens encountered within the Rhodesian material possess sufficient variation to fit all three diagnoses. Therefore, P. radialis is used to accommodate all such forms.

Distinction: P. radialis is distinct from other species due to its moderate diploxylinity, transversely oval central body and distinct concave distal sulcus.

Stratigraphic range: Rare to common throughout the stratigraphic column.

Platysaccus sp. cf. P. leschiki (Hart, 1960)
Hart, 1965

Plate 15: figure 3.

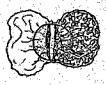
Description: Shape: Strongly to moderately diploxylonoid.

Central body: Dense, dark in colour and clearly distinguished in most specimens, circular to sub-circular (slight l-a elongation) in shape; surface finely to moderately infra-punctate.

Sacci: Much larger than central body, and greater than semi-circular in size; usually with minor radial folds issuing from the sacci roots. Moderate infra-reticulation; lateral bladders present, not much inflated, joining the sacci (1-3 μ wide); strong distal inclinations.

Distal sulcus: Distal roots distinct to obscure, parallel and stretching almost full width of the central body; peripheral folds under distal roots often present; distal sulcus very narrow when distinct, 1/5 less l-a (central body).

Dimensions (10 specimens): Total l-a: 75-105 µ; l-a (sacci): 32-45 µ; l-a (central body): 35-40 µ; t-a (sacci): 40-55 µ; t-a (central body): 28-35 µ.



Discussion: Specimens found in the Mid-Zambezi borehole core are usually smaller in size than those assigned to P. leschikii (see Hart, 1965, p. 60). However, in other respects the descriptions are similar. P. fuscus Goubin is regarded as a junior synonym.

Distinction: Platysaccus sp. cf. P. leschikii is distinct from other species due to its strong diploxyloncid outline and narrow distal zone.

Stratigraphic range: Absent to very rare in Dwyka; rare in Black Shales and Coals; and rare to common in Madumabisa Mudstones.

Genus: Alisporites Dougherty, 1941, amend. Wilson, 1958

Type species (by original monotypy): Alisporites onii Dougherty.

Diagnosis: Shape: Disaccate haploxylonoid to slightly diploxylonoid.

Central body: Circular to oval; no tetrad sutures present; proximal cap finely and uniformly structured.

Sacci: Large crescentic to hemispherical in shape, little distal inclination.

Distal zone: Thin, broad, about one quarter or more l-a (central body) in width, and lacking a well delineated sulcus.

Discussion: Balme (1966) discusses at length the long and varied history of the genus Alisporites since its original definition by Dougherty. Several emendations to restrict this genus have been attempted. These fall into two groups based on

a) Dougherty's broad concept (Rouse, 1960; de Jersey, 1962, 1964; Playford and Dettman, 1965, quoted by Balme, 1966), and

b) The morphology of the type species, D. onii Dougherty (Potonie and Kremp, 1954, and Klaus, 1963 - quoted by Balme, 1966). The latter

school of thought required the presence of a distal sulcus, which would imply close similarity to Falcisporites. Balme, in order to clarify the morphology of the type species, re-examined a sample from the stratus typicus (Chinle Formation) and was unable to establish with certainty the possession of a distal sulcus in specimens otherwise comparable in size and gross morphology to A. ovii. Balme therefore concurs with Wilson, 1958 and Bharadwaj, 1963 in their emendations which lack a defined distal sulcus.

The distinction between Alisporites and Platysaccus Naumova ex R. Potonie and Klaus is based on degree of diploxilinity; Sulcatisporites Bharadwaj is characterised by the possession of a distinct narrow distal transverse sulcus. Pinuspollenites Raatz, Cedripites Wodehouse and Podocarpites Cookson all possess varying degrees of diploxilinity and strong distal inclination of the sacci. Vesicaspora (Schemel) possesses lateral bladders. Vitreisporites Leschik possesses a very small size.

Distinction: Alisporites is distinct from other Disaccatrileti genera in possessing a haploxylonoid to slightly diploxylonoid

outline and a broad unstructured distal zone, with little distal inclination of sacci.

Alisporites sp. cf. A. plicatus Jizba

Plate 15: figure 4.

Description: Shape: Haploxylonoid to slightly diploxylonoid, elongated in a longitudinal direction.

Central body: Sub-circular with slight t-a elongation, distinct in outline, especially dense terminally in the area of sacci overlap; less clearly delineated laterally; proximal cap infra-punctate to infra-reticulate.

Sacci: Equal to or slightly greater than semi-circular in shape, slightly elongated longitudinally, and equal to or larger than central body in size. Little distal inclination. Some specimens show thin lateral connection between sacci, but lack true lateral bladders. Sacci infra-reticulate, lumen increasing in size and becoming radially elongated from sacci roots.

Distal zone: Sacci distal roots parallel-sided to slightly convex and well delineated; framing a broad distal zone ½-⅔ l-a (central body) in width. No distinct transverse distal sulci.

Dimensions (20 specimens): Total l-a:
50(60)65 µ; l-a (central body):
24(28)35 µ; l-a (sacci):
24(25)30 µ; t-a (central body):
31(36)42 µ; t-a (sacci):
26(33)44 µ.

Discussion: Alisporites sp. cf. A. plicatus seems to be very closely comparable to a form by this name and encountered by Segroves (1969) in the Perth Basin, Western Australia. The problem of naming this species is markedly hindered by lack of adequate photographic comparison, but on basic descriptive comparisons, the Rhodesian forms differ from A. opii Dougherty on the basis of smaller size range: A. lunata (Kara Murza) Hart bears a narrow distal zone with a transverse narrow sulcus. A. perinulgenus (Andreyeva) Hart would seem to be fairly closely comparable in having strongly convex distal sacci roots and a broad distal zone (2/3 l-a central body), but it is also said to possess a narrow distal transverse sulcus. Segroves (1969) remarks on the

similarity between A. nuthallensis Clarke and A. plicatus Jizba.

Distinction: Alisporites sp. cf. A. plicatus is distinguished from other species on the basis of size range, distinct central body, clearly demarcated slightly convex, distal sacci roots and relative width of the distal sulcus.

Stratigraphic range: Absent to rare in Dwyka; rare to common in Black Shales and Coals; and common in Madumabisa Mudstones.

Alisporites gracilis Segroves

Plate 15: figure 5.

Holotype: A. gracilis Segroves, 1969, Plate 6: figures H-J.

Synonyms: A. landiana Balme, 1966.

Diagnosis: Haploxylonoid usually longitudinally oval in shape. Central body sub-circular to t-a oval, usually indistinct. Sacci crescentic to semi-circular in polar view, with occasional lateral bladders. Little distal inclination; distal zone parallel-sided; ¼-⅓ l-a (central body) very thin.

Description: Shape: Haploxylonoid, longitudinally oval to sub-rectangular.

Central body: Indistinct, sub-circular to transversely oval; proximal infra-punctate and often bearing small irregular folds.

Sacci: Equal to or smaller than central body in size, less than semi-circular in shape and not prominently distally inclined. Lateral

connections between sacci are occasionally present but the inflated bladders were not encountered.

Distal zone: Distal sacci roots parallel and relatively indistinct; distal zone broad, about $\frac{2}{3}$ l-a (central body). Occasional haphazard ruptures faintly visible.

Dimensions (15 specimens): Total l-a: 72(82)115 μ; l-a (central body): 45(53)58 μ; l-a (sacci): 24(28)35 μ; t-a (central body): 50(55)65 μ; t-a (sacci): 45(55)65 μ.

Discussion: A similar form was illustrated but not adequately described by Potonié and Lele (1961, Plate 3: figure 82); A. landigna Balme, 1966 is regarded as closely similar, the only minor difference being the tendency to longitudinal elongation of the central body as opposed to the generally transverse elongation of the Rhodesian specimens.

Distinction: Alisporites gracilis is distinct from other species due to the large size range, indistinct central body and very broad distal zone.

Stratigraphic range: Rare in Dwyka; common in Black Shales and Coals; and rare in Madumabisa Mudstones.

Alisporites tenuicorpus Balme

Plate 15: figures 6, 7.

Holotype: Alisporites tenuicorpus Balme, 1966, Plate 15: figures 1-4.

Diagnosis: Nearly haploxyloncid; central body circular to slightly oval with thin proximal exine; sacci crescentic with a slight distal inclination; infra-reticulate with lumen about 1 μ in diameter. Distal zone oval, maximum breadth about $\frac{2}{3}$ l-a (central body) and thin and translucent; sometimes faint peripheral interinal folds below the sacci roots occur.

Description: Shape: Haploxyloncid, longitudinally oval to sub-rectangular.

Central body: Usually indistinct, thin and circular to sub-circular in shape; proximal surface finely infra-punctate.

Sacci: Semi-circular in shape and equal to or slightly less than the central body in size; well-separated laterally, with slight to moderate distal inclination. Infra-reticulation coarse.

to medium with distinct, equi-dimensional 5-6-sided lumen, 1-3 μ in diameter.

Distal zone: Distal sacci roots, parallel to slightly convex and often distinct; faint peripheral folding occasionally associated with distal sacci roots. Oblique compression folds, [illegible]quently distort entire pollen grains. Distal zone broad, in polar view about ½ to ⅔ l-a (central body), thin and sculptureless.

Dimensions (20 specimens): Total l-a: 40(50)58 μ; l-a (central body): 25(28)34 μ; l-a (sacci): 18(21)24 μ; t-a (central body): 27(30)38 μ; t-a (sacci): 28(32)40 μ.

Discussion: This form species is similar to A. tenuicorpus described by Balme from the Salt Range, the main difference lying in the slightly larger size range and larger sacci infra-reticulation in the Rhodesian specimens. A. perindulgemus (Andreyeva) Hart possesses a narrow transverse distal sulcus dissecting

the broad (2/3 l-a central body) distal zone and strongly convex distal roots. A. inderrasensis Segroves has strong distal inclination.

Distinction: Alisporites tenuicornus is distinct from other species in being haploxylonoid, with a wide distal zone separating distinctly infrasculptured sacci.

Stratigraphic range: Rare to common in Dwyka; rare in Black Shales and Coals; and absent to very rare in Madumabisa Mudstones.

Genus: Sulcatisporites Leschik emended Bharadwaj, 1962

Type species (by original designation): Sulcatisporites interpositus Leschik.

Diagnosis: Shape: Haploxylonoid, oval to circular outline in polar view.

Central body: Faintly discernible, usually indistinct; thin-walled, shape undefined.

Sacci: Distally inclined infolded in a characteristic way; exine medium to coarsely infrareticulate.

Distal zone: Narrow slit-like sulcus.

Discussion: Sulcatisporites as originally described by Leschik was indistinguishable from Alisporites Dougherty emend. Wilson and some authors (Jansonius, 1962 and Potonie, 1958) regarded them as synonomous. However, Bharadwaj (1962) examined the form and emended the diagnosis, on the basis of type morphology, to include a more circular shape, indistinct central body, more distally inclined sacci, and characteristically, a very narrow distal sulcus along which the sacci are almost touching. This

implies the presence of lateral bladders where the central body may be distinguished as being transversely shorter than the sacci e.g. in S. ovatus. These characteristics clearly differentiate this form genus from Alisporites which possesses, amongst other features, a broad distal zone and lacks a sulcus. Vesicaspora Schemel is distinct in being smaller, with lateral bladders, a distinct and circular central body and a wide distal zone. As emended by Wilson and Venkatachala, 1963, Vesicaspora retains the characteristic lateral bladders but the distal sulcus varies from fusiform, irregular to slit-like in outline. This latter diagnosis overlaps the characteristics assigned to Sulcatisporites in part and is therefore regarded in this sense as a partial synonym. For the purpose of this thesis Vesicaspora (sensu Schemel)is retained (with a wide distal zone) in order to clearly distinguish forms assigned to Sulcatisporites.

Distinction: Sulcatisporites is distinct from other Disacciatrileti genera by possessing a haploxylonoid outline, an indistinct central body and a very narrow distal sulcus.

Sulcatisporites ovatus Balme and Hennelly

Plate 15: figures 8, 9.

Holotype: Florinites ovatus Balme and Hennelly, 1955, Plate 5: figures 49-52.

Synonyms: Vesicaspora ovatus (Balme and Hennelly) Hart, 1960.
Sulcatisporites ovatus (Balme and Hennelly) Bharadwaj, 1962.
Non Alisporites ovatus (Balme and Hennelly) Jansonius, 1962.

Diagnosis: Haploxylonoid oval in outline. Central body occasionally circular, normally transversely oval and indistinct or forming a darkened area in the centre of the spore. Sacci crescentic to semi-circular in outline, finely infra-reticulate and distally inclined. Narrow lateral bladders join the sacci. Distal zone is occupied by a narrow parallel-sided sulcus, often becoming obscured due to sacci overlap.

Description: Shape: Circular to longitudinally oval and strongly haploxylonoid.

Central body: Usually indistinct, but often a darkened area indicates the shape outline rarely circular, usually transversely oval.

Sacci: Greater than or equal to semi-circular in shape; and larger than or equal to central body in size; infra-reticulation evenly distributed and moderate to fine, sacci are not clearly delineated due to indistinct nature of central body.

Distal zone: Very narrow, occupied by a parallel-sided distal sulcus which is slit-like, 1/5 l-a (central body) or almost disappears w' ı sacci overlap.

Dimensions (20 specimens): Total l-a: 48(60)65 μ; total t-a: 38(48)55 μ.

Discussion: Sulcatisporites ovatus is a distinct Permian form which has been recombined in a number of genera due to individual authors interpretations of the importance of the lateral bladders - e.g. the

monosaccate form or the disaccate form with a narrow distal sulcus. Jansonius included under this species name forms with broader distal zones, whilst Hart grouped these forms under the genus Vesicaspora due to the presence of lateral bladders.

The Rhodesian specimens are regarded to be sufficiently distinct by possessing a narrow distal sulcus to warrant assignment to the genus, Sulcatisporites.

Distinction: Sulcatisporites ovatus is distinct from other genera on the basis of smaller size range, transversely elongated central body and slit-like distal sulcus.

Stratigraphic range: Rare to common throughout the borehole core.

Sulcatisporites splendens Leschik, 1956

Plate 15: figures 10-11.

Holotype: Sulcatisporites splendens Leschik, 1956, Plate 22: figure 10.

Diagnosis: Shape is haploxylonoid oval to almost rectangular, the central body is transversely oval and sacci are semi-circular in outline, distally inclined and often poeeess lateral bladders. Distal sulcus is about ¼ or less l-a (central body) with occasional sacci overlaps, parallel-sided or concave broadening laterally. (Size: total l-a: 41(63)90 µ; total t-a: 31(51)70 µ).

Description: Shape: Haploxylonoid, longitudinally oval to almost rectangular.

Central body: Fairly indistinct to discernible, with darkened outline often more obvious terminally than laterally; transversely oval slightly.

Sacci: Semi-circular in shape, often slightly longitudinally elongate and larger than central body in size. Sacci distally inclined with narrow lateral sacci

connections forming lateral bladders which are often indistinct in width. Infrareticulation darkened, fairly coarse and regular, lumen more or less equi-dimensional and polygonal (1-3 μ in diameter).

Distal zone: Distal sacci roots are parallel seldom stretching the full width of the pollen grain and are usually distinct in outline. Distal sulcus varies from $\frac{1}{4}$ l-a (central body) to slit-like. In many cases sacci overlap, particularly in the central regions, thereby giving a false convex shape to the sulcus.

Dimensions (20 specimens): Total l-a: 54(70)90 μ; total t-a: 38(45)65 μ.

Discussion: Vesicaspora milvaeus (Balme and Hennelly) Hart is very similar to S. splendens, but possess a more distinct central body, less transversely oval in shape and smaller sacci, relative to the central body. S. splendens is also characteristically more elongately oval to rectangular in outline. S. ovatus is smaller in size range and is usually more circular in outline.

Distinction: S. splendens is distinct from other Sulcatisporites species due to its elongate shape, medium size range and its transversely elongated central body which is darkened in outline.

Stratigraphic range: Absent in Dwyka; rare to common in Black Shales and Coals; rare to common in Madumabisa Mudstones.

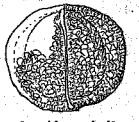
Sulcatisporites potoniei (Lakhanpal, Saluja and Dube) Hart, 1965

Plate 15: figures 16-18.

Holotype: Pityosporites potoniei Lakhanpal, Saluja and Dube, 1960, Plate 2: figure 18.

Synonyms: Vesicaspora maxima Hart, 1960.

Diagnosis: Shape is haploxylonoid, rounded to transversely oval. Central body is usually indistinct but is circular to oval in a t-a direction; sacci semi-circular distally inclined and bearing a coarse infra-reticulum. Lateral bladders are narrow but indistinct, due to the thickness of the sacci exine. Distal sulcus parallel-sided and very narrow and does not always extend to the lateral margin.



Description: Shape: Haploxylonoid, markedly circular to sub-circular.

Central body: Usually undiscernible but circular to sub-circular or slightly t-a oval. Proximal surface grades almost imperceptably into the sacci.

Sacci: Semi-circular or less in outline and equal to larger than central body in size. Infra-reticulatic is characteristically coarse dark and evenly distributed, possessing medium to large equi-dimensional rounded to polygonal lumen (1-3 μ in diameter). Width of sacci exo-exine is relatively thick, 2-4 μ wide giving occasionally a limboid margin. Sacci are distally inclined.

Distal sulcus: Distal sacci roots are distinct, parallel and frame a very narrow slit-like sulcus. This ranges from 1/5 l-a central body to a mere visible slit, with sacci frequently overlapping.

Dimensions (20 specimens): Total l-at 60(88)125 μ; total t-a: 48(70)90 μ.

Discussion: G. institutus Balme, 1966 appears to be very similar in all respects bar the small size of the lumen (less than 1 μ in diameter).

Distinction: S. potoniei is distinct from other species in possessing a rounded outline, indistinct central body (not darkened in outline) densely infra-reticulated sacci (often with limboid margin) and a larger size range.

Stratigraphic range: Absent in Dwyka sediments; common in Black Shales and Coals; common to rare in Madumbisa Mudstones.

Genus: Vesicaspora Schemel, 1951

Type species: Vesicaspora wilsonii Schemel, 1951.

Diagnosis: Shape: Haploxylonoid.
Central body: Circular and distinct, laevigate to granulate; lacking a proximal aperture.
Sacci: Possess lateral bladders, fairly distinct to very thin.
Distal zone: Wide, fusiform.

Discussion: Vesicaspora (Schemel) was originally described as an uncommon Carboniferous form and diagnosed as above. Schemel implied a Monosaccate condition (by including distinct lateral bladders) but did not state this. Wilson and Venkatachala (1963) maintain that Vesicaspora is Monosaccate and that the distal inclination of the "saccus" ends is caused by oblique compression. However, as discussed by Kosanke (1969, in Aspects of Palynology, p. 250) some species only possess a thin equatorial connection between the sacci, and distal inclination is still obvious. Although opposite sacci, which are connected laterally to form a continuous equatorial chamber, do comprise a Monosaccate condition, it is considered here that the Rhodesian specimens exhibit sufficient variation in lateral bladder width

and sacci distal inclination to warrant inclusion in this Disaccate group. See discussion on Sulcatisporites. Platysaccus differs in being diploxyloncid in outline, whilst Alisporites lacks lateral bladders and has distinct distal sacci roots.

Distinction: Vesicaspora is distinguished from other Disaccidtriletl genera by its haploxyloncid outline, distinct central body, broad distal zone and lateral bladders.

Vesicaspora sp. A.

Plate 15: figures 12-13, 15.

Description: Shape: Haploxylonoid to very faintly diploxylonoid, usually longitudinally oval.

Central body: Well outlined and distinct, usually darker than sacci and dense, with coarse infra-punctate or infra-reticulate sculpture on exine. Sub-circular to longitudinally oval in shape.

Sacci: Well inflated terminally, and continuous laterally by the equatorial detachment of lateral bladders varying in depth from 1 to 5 μ. Central body exo-exine merges imperceptably into detached sacci exo-exine both proximally and distally, so sacci roots are difficult to define. Sacci exine is thin, and bears a distinct infra-reticulation of fine to fairly coarse lumen, elongating radially from the sacci detachment outwards. (Lumen up to 1 x 3 μ in dimension). Laterally the infra-reticulation is somewhat reduced but not markedly changed. Sacci often seen distally inclined.

Distal zone: Indistinct but broad; exine structureless to very finely sculptured. Random transverse (distal) tears running across central body and into sacci exine are occasionally discernible.

Dimensions (10 specimens): Total l-a: 60(75)108 μ; total t-a: 40(45)70 μ; l-a (central body): 40(50)68 μ; t-a (central body): 38(40)60 μ.

Discussion: As mentioned under generic discussion, this form species may well be regarded as Monosaccate; however, due to its disaccate characteristic of distal inclination, and its bilateral condition with varying width of lateral bladders it is tentatively assigned to the Disacciatriletl. Future work on more material may enlighten the structure and position of this species which will then facilitate the proposal of a new specific name.

Stratigraphic range: Absent in Dwyka sediments, rare to common in Upper Black Shales and Coals; and rare in Lower Madumabisa Mudstones.

Vesicaspora sp. B.

Plate 15: figure 14.

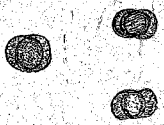
Description: Shape: Haploxylonoid to slightly diploxylonoid and sub-circular to slightly l-a oval.

Central body: Very distinct, usually dark and circular to sub-circular infra-punctate to infra reticulate proximal exine.

Sacci: Are equal to or less than semi-circular in shape, and equal to or less than central body in size. Sacci exo-exine detaches indistinctly (but basically sub-equatorially) from the central body exo-exine: Reticulation is fine and regular. Sacci show slight distal inclination. Sacci are laterally continuous by means of narrow lateral bladders up to 2 μ wide.

Distal zone: Distal sacci roots are also indistinct, but in the sub-equatorial region, leaving a wide, structureless distal zone.

Dimensions (8 specimens): Total l-a: 30(35)41 µ; total t-a: 20(25)35 µ; l-a (central body): 20-26 µ; t-a (central body): 19-25 µ.



Discussion: The general morphology of this species fits the form genus Vitreisporites Leschik amend. Jansonius in that there is a small size range, haploxylonoid to slightly diploxylonoid outline and no clear distal sulcus, although a structureless aperturoid area (leptoma) was sometimes visible (as

noted by Townrow, 1962, quoted in Balme, 1966, p. 146). V. pallidus Reissinger is, however, distinct from Vesicaspora sp. B in being smaller in size with a distinct distal "sulcus" of ½ l-a (central body). The Rhodesian form species is therefore tentatively assigned to Vesicaspora Schemel due to its rather unique dense central body, lack of clearly defined distal roots and narrow but characteristic lateral bladders - Alisporites inderraensis Segroves, 1969 has certain features in common but has strong distally inclined sacci bearing coarse infra-reticulation. Alisporites parvus de Jersey has a tenuitas, whilst Vitreisporites koonigswaldii Jansonius is distinct in having a narrow distal zone, rounder outline and an angular bend in the proximal roots of the sacci.

Stratigraphic range: Absent in Dwyka; absent in Black Shales and Coals; rare to common in Lower Madumabisa Mudstones.

Infra-turma: DISACCITRILETI Leschik, 1956

Genus: Jugasporites Leschik, 1956

Type species: Jugasporites delasauosi (Potonie and Klaus, 1954) Leschik, 1956.

Diagnosis: Shape: Haploxyloncid to diploxyloncid in outline.

Central body: Is circular to oval (longitudinally or transversely). Proximal hemisphere possesses a central dilete suture.

Sacci: Various in size and shape, but is connected laterally to form lateral bladders.

Discussion: Hart (1965) does not accept the amendation of this form genus by Mamun (1960).

Distinction: Jugasporites is distinct from other Disaccitrileti genera by possessing a dilete suture.

Jugasporites sp.

Plate 11: figures 27-28.

Description: Shape: Haploxyloncid to slightly diploxyloncid, longitudinally oval.

Central body: Circular to sub-circular and dense; very finely infra-punctate, and bearing a proximal dilete suture. Arms of suture stretch almost the

full l-a of the central body and are slightly bent centrally. When open, a rudimentary third arm to the suture is apparent pointing laterally.

Sacci: Terminally inflated but bearing relatively wide lateral bladders (1-4 μ wide) with similar but reduced structure in comparison to the sacci. Proximal attachment is subequatorial, but distal roots are concave and shorter than the transverse width of the central body.

Distal zone: Distal zone is framed by concave sacci roots, forming an oval sulcus, wider centrally than laterally.

Dimensions (4 specimens): Total l-a: 35-38 μ; total t-a: 24-27 μ; l-a (central body): 22-25 μ; l-a (sacci): 23-25 μ; t-a (central body): 21-24 μ.

Discussion: This species is rare, but of stratigraphic interest. It may well be a small as yet immature grain of a larger type, but the open aperture (in the illustrated specimen) suggests maturity. A disacoate condition is adhered to due to slight differential structure in sacci and lateral bladders, and distinct convex but close distal sacci roots.

Stratigraphic range: It is only encountered (and rarely) in the Lower Madumabisa Mudstones.

Genus: Illinites Kosanke, 1950

Type species: Illinites unicus Kosanke, 1950.

Diagnosis: Shape: Haploxylonoid to diploxylonoid outline.

Central body: Circular or oval with a slight l-a or t-a elongation. Proximal hemisphere possesses a central trilete aperture; the exine is laevigate, punctate or finely granulate. The sutures of the trilete aperture may be of unequal length.

Distinction: Illinites is distinct from other Disaccitrileti genera in possessing a proximal trilete suture and lacking true lateral bladders.

Illinites unicus Kosanke, 1950

Plate 11: figures 31-32.

Holotype: Illinites unicus Kosanke, 1950, Plate 1: figure 3.

Diagnosis: Haploxylonoid in outline; central body is circular or with slight t-a elongation with a finely granulate sculpture.

The trilete aperture bears a shorter (transverse) arm to the other two. The sacci are semi-circular or less in shape and about the same size as central body. Sacci roots have attachment lines (or peripheral folds associated with them), which frame a distal zone approximately ½ or less l-a (central body) in width.

Description: Shape: Haploxylonoid, oval in an l-a direction.

Central body: Distinct, usually dark and dense and circular to sub-circular in outline; proximal exine infra-punctate, and bearing a central trilete suture which is often indistinct. Arms of the suture are relatively equal to slightly unequal in length.

Sacci: Semi-circular in outline, and approximately the same size as central body. Infra-reticulation is distinct and fairly coarse, with lumen elongating radially from sacci roots. Distal inclination is not apparent and lateral bladders are lacking, although sacci exines may be joined.

Distal zone: Distal sacci roots are parallel to sub-parallel and are associated with darkened peripheral folds at attachment lines. These frame a distal zone about ½-⅔ l-a central body.

Dimensions (6 specimens): Total l-a: 50-75 μ; total t-a: 40-44 μ; l-a (central body): 35-42 μ; t-a (central body): 40-42 μ.

Distinction: Illinites unicus is distinct from other species by being haploxylonoid in outline, and by the size range and width of the distal zone.

Stratigraphic range: Rare in Dwyka, rare to absent in Black Shales and Coals; and absent in Madumabisa Mudstones.

Genus: Limitisporites Leschik, 1956, Potonie, 1958

Type species (by subsequent designation): Limitisporites monstruosus (Luber and Valts, 1941) Hart.

Synonyms: Pemphygaletes Luber and Valts, 1941 partim.
Sahinites Pant, 1955 partim.
Vestigisporites Balme and Hennelly, 1955 partim.
Labiisporites Leschik, 1956 partim.

Diagnosis: Shape: Haploxylonoid to diploxylonoid.
Central body: Circular with slight elongation, t-a or l-a oval; proximal hemisphere bears a monolete aperture.
Sacci: Various, but inflated lateral bladders do not occur, although the sacci exo-exine may join laterally.

Distinction: Limitisporites is distinct from other genera by the monolete suture and lack of lateral bladders.

Limitisporites monstruosus (Luber and Waltz)
Hart, 1965

Holotype: L. monstruosus Luber and Waltz, 1941, Plate 12: figure 202.

Diagnosis: Haploxylonoid outline, with circular central body, sacci about semi-circular in shape and slightly smaller than central body, possibly with attachment lines. Distal zone is about ½ l-a (central body).

Description: Shape: Haploxylonoid to slightly diploxylonoid; longitudinally oval.

Central body: Distinct, dark and circular to slightly l-a or t-a oval. Proximal surface bears a monolete suture ¼ to ½ the l-a central body; suture distinct and tending to be sinuous. Exine infra-punctate to infra-reticulate, and 1-2 u thick.

Sacci: Semi-circular in outline, and equal to or slightly smaller than central body in size. Sacci thin and tending to show radial folding from sacci roots. No wide lateral bladders encountered, but 1-2 u wide lateral connections often serve to join the sacci. Strong distal inclination does not occur.

Distal zone: Distal sacci roots are parallel to sub-parallel and occasionally indistinct, although distal peripheral folds associated with the sacci are occasionally seen. Distal zone is about ½ or less 1-a (central body).

Dimensions (8 specimens): Total 1-a: 75-105 µ; 1-a (central body): 54-60 µ; 1-a (sacci): 35-50 µ; t-a (central body): 45-60 µ; t-a (sacci): 45-60 µ.

Discussion: Hart (1965) places L. rectus Leschik, 1956 in synonomy with this form species; Segroves, 1969, however, cautions against this due to the possibility of L. monstruosus possessing a thinner proximal exine to central body and in possibly lacking lateral bladders, as seen in the original illustrations. L. rectus Leschik also includes trilete forms which in this thesis are assigned to Illinites Kosanke. The Rhodesian forms come closer to the diagnosis of L. monstruosus and are thus assigned.

Distinction: L. monstruosus is distinct from other species in being usually haploxyloncid, with a relatively short monolete suture and a distal zone of about ½ 1-a central body.

Stratigraphic range: Rare to common in Dwyka; rare in Black Shales and Coals; rare to absent in Madumabisa Mudstones.

Sub-turma: MONOSACCITES (Chitaley, 1951)
Potonie and Kremp, 1954

Supra-generic sub-division of the Monosaccites has been discussed under systematics (Chapter 4 section 3). For the purpose of this thesis two major divisions are recognised and informally named (following Balme, 1966) viz:

Group A - Radiosymmetrical forms, and
Group B - Bilaterally symmetrical forms.

In terms of generic sub-division, the approach followed is that of the Indian authors (Lele, 1964; Bose and Kar, 1966, 1967; Lele and Maithy, 1964; Kar and Bose, 1967; Bose and Maheshwari, 1968, et al). This is due to the fact that the forms encountered in India and particularly in the Congo, and described by the above authors, are extremely numerous and are the most morphologically diverse of known Permo-Carboniferous Monosaccate assemblages. The Rhodesian forms, although less in variety, compare very closely with them. Criticism concerning the sub-divisions based on minor diagnostic features may be levied, but in terms of practical application they are considered suitable for the present purpose. This may facilitate easier lumping together or splitting of taxa when a more universally acceptable Monosaccate classification is proposed.

Forms from other parts of Gondwanaland (South Africa, Australia, South America, etc.) are synonomous with some of the Indian-Congo forms but are far less diverse. Certain of these other genera

Explanation to text-figure 4-9 and Range Chart: Polar and equatorial views (diagrammatic) of the major Monosaccates encountered in Southern Africa. (Re-drawn from Bose and Kar 1966, Bose and Maheshwari 1966, Schopf, Wilson and Bentall 1944, Hart 1965, Lele 1964, etc.)

a. Nuskoisporites Pot. and Klaus emend. Lele 1964 (for comparison) a.

b. Plicatipollenites Lele 1964 b.

c. Virkkipollenites Lele 1964 c.

d. Kibambaites Bose and Kar 1967 d.

e. Katangaites Bose and Kar 1967 e.

f. Barakarites Bharadwaj and Tiwari 1964 (sensu Balme) f.

g. Punctasaccites Bose and Kar 1966 g.

h. Ellilasaccites Bose and Kar 1966 h.

i. Varlamoffites Bose and Kar 1966 i.

j. Vestigisporites (Balme and Hennelly) Hart 1960 j.

k. Passaufsaccites Bose and Kar 1966 k.

l. Parasaccites Bharadwaj and Tiwari 1964 l.

m. Crucisaccites Lele and Maithy 1964 m.

n. Caheniasaccites Bose and Kar 1966 n.

o. Divarisaccus Venkatachala and Kar 1966 o.

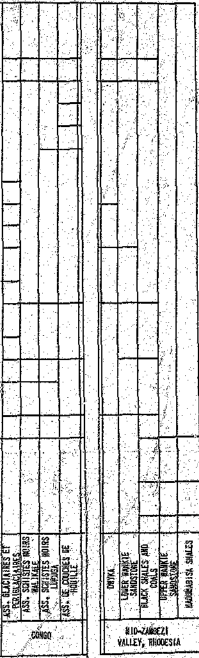
p. Potonieisporites Bharadwaj 1964 p.

q. Striomonosaccites Bharadwaj 1962 q.

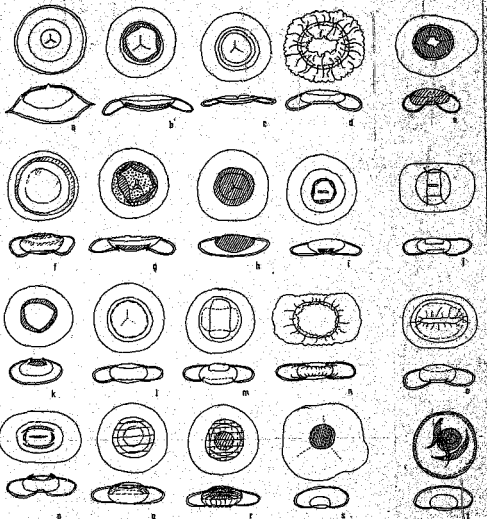
r. Mabuitasaccites Bose and Kar 1966 r.

s. Florinites Schopf, Wilson and Bentall 1944 s.

t. Densipollenites Bharadwaj 1962 t.



TEXT-FIGURE: MAJOR MONOSACCATE GENERA - 4-9



are considered too comprehensive (e.g. Cordaitina Samoilovich emended Hart), and are regarded by some authors (Bose and Kar, 1966, etc.) as supra-generic in level. Also frequently the species erected within these genera (in particular Cordaitina) are basically those with Northern Hemisphere holotypes. It is considered (Lele, 1964, Lele and Maithy, 1965) that most Gondwanaland genera are probably morphologically different, and are certainly the products of a different macrofloral assemblage to that contemporaneous in the Northern Hemisphere. Due to this, comparison with Northern Hemisphere holotypes may not be feasible.

It is beyond the scope of this thesis to consider the problems in synonomy between the Northern and Southern Hemisphere disopore forms. This could represent an interesting task for the future. It is therefore proposed to confine the generic and specific approach basically to that of the Indian authors, but supplemented by certain ubiquitous genera originating in Europe and found widely distributed in the Permian (e.g. Florinites, Schopf, Wilson and Bentall).

To facilitate generic comparison, the Monosaccate forms found in Central Southern Africa are drawn in Text:- figure 4-9, and to illustrate the importance of this major group, the comparative stratigraphic ranges of the individual genera in the Congo and Mid-Zambezi Valley, Rhodesia are shown.

Group A - Radiosymmetrical Monosaccites

Genus: Plicatipollenites Lele, 1964

Type species: Plicatipollenites indicus Lele, 1964.

Synonyms: Nuskoisporites Potonie and Klaus, 1954 partim.
Cordaitina Samoilovich amended Hart, 1965 partim.

Diagnosis: Shape: Circular to sub-circular and roundly triangular.
Central body: Variable in shape, not necessarily coinciding with overall outline; distinct to indistinct; trilete aperture not always present, whilst rays and angles between may vary in length and degree, appearing asymmetrical.
Saccus: Proximal attachment at the equator, distal attachment somewhat within a narrow sub-equatorial zone; distal roots always associated with darkened regular to polygonal peripheral folds; saccus deflated, infra-reticulate; with a flat to frilled structure.

Discussion: Prior to 1964 when Lele proposed this genus, Southern Hemisphere Monosaccites bearing the above description had been assigned, often reluctantly, to Nuskoisporites Potonie and Klaus, 1954, (Balme and Hennelly, 1956; Pierart, 1959; Hoeg and Bose, 1960; Potonie and Lele, 1961 and Bharadwaj, 1962 et al). This was a typically Northern Hemisphere form characteristic of Permian and Triassic sediments of Austria, and differed both in basic morphology and stratigraphic range (when compared to the Southern Hemisphere counterparts). Lele (1964) attempted a resolution of this "heterogeneous taxon" and proposed the genera Plicatipollenites, and Virkkipollenites whilst amending Nuskoisporites to include only limboid forms bearing thin, proximally attached sacci (see text - figure 4-9, figures a, b and c). The latter remains a Northern Hemisphere Permo-Triassic genus and the former two remain typical of Gondwanaland Permo-Carboniferous times. Virkkipollenites (figure c) differs from Pliostipollenites (figure b) in lacking distal peripheral folds associated with the [illegible] roots. Both are characterised by possession of proximal and distal roots in equatorial to sub-equatorial zones.

A number of similar genera were proposed subsequently, due to the possibly valid view that generic distinction based on presence or absence of peripheral folds along sacci roots was unreliable (Bharadwaj and Tiwari, 1964). Distinctions based on (1) proximal or distal, or (2) proximal and distal saccus attachment were preferred (Bose and Kar, 1966 et al). In the forms with dual sacci attachment the following genera were proposed:

Parasaccites Bharadwaj and Tiwari, 1964 (figure 1) which possesses sub-equatorial attachment of both roots i.e. superimposed in polar view. Some authors (Segroves, 1969) have regarded this as synonomous with Virkkipollenites and Plicatipollenites but the Indian authors retain this genus. Cordaitina Samoilovich emended Hart, 1965, was also changed to include all Monosaccates with proximal and distal equatorially attached sacci; however, this genus has been regarded as "supra-generic" (Bose and Kar, 1966), and not entirely in agreement with the type species which in any event is a Northern Hemisphere form.

Cannanoropollis Potonie and Sah,ja, 1960 is synonomous with Parasaccites and would have priority over the former but for the uncertainty regarding the geological age and stratigraphic range of its type species. Barakarites Bharadwaj and Tiwari, 1964 (figure f) has dual saccus attachment but is retained as a distinct genus by possessing an "inner body" within the "central body". Segroves (1969) interprets this morphology as the result of a characteristic annular tenuitas in the sub-equatorial zone of the central body. Rascanites Balme and Hennelly, 1956 is regarded as a poorly defined genus encompassing miospores with dual equatorially attached, undulating to lobate sacci. Punctasaccites Rose and Kar, 1966 (figure g) has dual saccus attachment but is characterised by a punctate central body with trilete aperture and a distal peripheral fold system. Crucisaccites Lele and Maithy, 1964 (figure m) and Stellapollenites Lele, 1965 are amphilateral with mutually reversing attachment roots i.e. longitudinal proximal zone and transverse distal zone. Crucisaccites is retained.

Divarisaccus Venkatachala and Kar, 1966 (figure c) possesses equatorial proximal saccus attachment, but distally the saccus is attached sub-equatorially in such a manner that the distal zone is bilateral and with or without a distinct sulcus.

Kilmbaites Bose and Kar, 1967 (figure d) is similar to Divarisaccus in that proximal saccus attachment is equatorial and distal attachment forms a transverse sulcus. This, however, is not bilateral, but rounded to almost rectangular. The saccus is characteristically radially folded and very frilled. Katangaites Bose and Kar, 1967 (figure e) has a very dense central body bearing little infra-structure or sculpture, and dual saccus attachment.

The following genera differ from Pliocatipollenites in being bilateral in organisation:-

Vestisisporites (Balme and Hennelly) Hart, 1965 (figure j), Caheniasaccites Bose and Kar, 1966 (figure n), and Potonieisporites Bharadwaj, 1962 (figure p). Whilst the following genera lack dual saccus attachment (it is either proximal or distal):-

Elilasaccites Bose and Kar, 1966, Varlamoffites Bose and Kar, 1966, Passauisaccites Bose and Kar, 1966, Florinites Schopf, Wilson and Bentall, 1944, and Densipollenites Bharadwaj, 1962. Striomonosaccites Bharadwaj, 1962 (figure g) and Mabuitisaccites Bose and Kar (figure r) both have striate central bodies.

Distinction: Plicatipollenites is distinct from other Monosaccate genera in possessing dual equatorial to sub-equatorial saccus attachments, strong peripheral folds associated with the distal sacci root, and usually a trilete aperture. It lacks strong punctate sculpture on the central body.

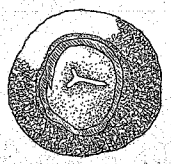
Plicatipollenites indicus Lele, 1964

Plate 12: figures 1-7; Plate 13: figures 1. 2.

Holotype: Lele, 1964, Plate 1: figure 7.

Synonyms: Nuskoisporites gondwanensis Balme and Hennelly, 1955 partim.
Nuskoisporites triangularis Potonie and Lele, 1961.
Cordaitina triangularis (Mehta) Hart, 1965.

Diagnosis: Outline of grain circular to sub-circular with a distinct central body possessing an outline corresponding to overall outline. Trilete suture usually weak, with asymmetrical angles and lengths of arms; extending from ½-2/3 central body radius; ray ends taper or are blunt. Sacous relatively narrow, approximately ½-¾ total radius; overlap usually less than ½ radius. Well-developed peripheral folds occur usually circular, situated equatorially or sub-equatorially.



Description: Shape: Circular to sub-circular, with entire smooth margins.

Central body: Circular to sub-circular, distinct usually darkened equatorially and, infra-punctate to finely infra-reticulate. Proximal aperture is trilete almost invariably present and asymmetrical in angles and length of rays. These extend ½-2/3 central body radius, and may be thin or thick (1-3 μ wide) and terminally blunt or tapering.

Saccus: Usually unfrilled, smooth margined and flattened proximo-distally; attached sub-equatorially, with approximate width ½ to ⅔ total radius. Overlap is less than ½ total radius and varies from nil to ½ width of overlap. Peripheral folds are invariably present and are usually smoothly and continuously circular, although occasionally compressed to minor angular irregularities. They follow the central body margin in outline and may or may not be in contact with this; thickness varies from 2-8 μ wide.

Dimensions (30 specimens): Total diameter: 75(120)135 μ; central body diameter: 61(85)105 μ.

Discussion: Numbers of spores with similar features to those described above have been included under Nuskoisporites gondwanensis Balme and Hennelly, e.g. by Balme (1952, 1956) and Pierart (1960). However, N. gondwanensis, emended by Lele to the genus Plicatipollenites, is regarded by that author as a distinct form due to (1) a typically angular, polygonal peripheral fold system which is situated well away from the central body margin, (2) the trilete rays are about equal and often indistinct, (3) the saccus is wider than in P. indicus (⅓ total radius). The Rhodesian specimens show a wide variety of infold positions (see Plate 12), but all conform more closely to the diagnosis of P. indicus than P. gondwanensis.

Distinction: Plicatipollenites indicus is distinct from other species in possessing dual saccus attachment, a large size, distinct circular infold system, and usually unequal and asymmetrical rays on the trilete suture.

Stratigraphic range: Common to abundant in Dwyka sediments; rare to absent in Black Shales and Coals; absent in Madumabisa Mudstones.