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Preliminary study of the Karroo palynology in the Mid-Zambezi Basin, Rhodesia

Falcon, R M S

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Genus: Virkkipollenites Lele, 1964

Type species: Virkkipollenites (Hymenozonotriletes) triangularis (Mehta) Lele, 1964, Plate 2: figure 15.

Synonyms: Corysitins (Semeilovich) Hart partim.

Diagnosis: Shape: Circular to sub-circular, or roundly triangular.

Central body: Outline variable; indistinct to distinct; rarely dense usually finely infra-micro-reticulate; trilete mark weak or invisible, rays equal or unequal in length with angles between rays often unequal.

Saccus: Equatorial attachment on the proximal side; whilst distal attachment is sub-equatorial; no peripheral folds occur associated with the distal saccus root. Saccus structure infra-reticulate; outline smooth or undulate, and surface flat or frilled.

Discussion: Virkkipollenites (figure c) is distinguished from Plicatipollenites (figure b) by the lack of distinct peripheral folds associated with the distal saccus attachment. The interpretation of the morphology is discussed in detail

by Lele, 1964 (p. 158). It is distinguished from the bilaterally symmetrical and striate monosaccates by lacking both these characteristics, and it is distinct from other radially symmetrical monosaccates in the same way as Plicatipollenites (see discussion on latter genus).

Distinction: Virkkipollenites is distinct from other Monosaccate genera in being radially symmetrical with dual saccus attachment, both equatorially and sub-equatorially placed; a trilete suture is usually present. It lacks striations on the central body, and peripheral saccus attachment folds.

Virkkipollenites obscurus Lele, 1964

Plate 14a: figures 6-8.

Holotype: V. obscurus Lele, 1964, Plate 2: figures 17, 18: Text:- figures 10, 13c.

Synonyms: Muskoisporites rotatus Balme and Hennelly, 1956.

Cordaitina balmei Hart, 1965.

Diagnosis: Outline circular to sub-circular; central body indistinct, circular to sub-circular; trilete mark indistinct to invisible with rays of the aperture about $\frac{1}{2}$ central body radius and equal to or unequal in length. Saccus narrow relative to the total diameter, about $\frac{1}{2}$ the radius. Distal saccus overlap narrow, zone of attachment usually indistinct; margin normally smooth and entire rarely frilled.



Description: Shape: Circular to sub-circular.
Central body: Obscure to faintly discernible, lighter in colour than saccus; circular to sub-circular in shape and finely infra-punctate to infra-vermiculate. Trilete suture usually absent or not visible, but when visible is asymmetrical with suture rays of uneven length and angle; $\frac{1}{4}$ to $\frac{1}{2}$ central body radius in length. Small irregular folds are characteristic of the proximal and distal zones.
Saccus: Relatively narrow, about $\frac{1}{4}$ total radius; and darker than central body, bearing dense infra-reticulation. Little tendency for pleating and frilling. Distal sacci attachment is difficult to define. Usually smooth-margined and flattened.
Dimensions (30 specimens): Total diameter: 95(120)155 μ; central body diameter: 65(75)88 μ.

Discussion: V. obscurus is distinguished from other species of this genus by its characteristic indistinct to invisible central body margin, distal saccus root and trilete suture.

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

Virkkipollenites radiatus (Hennelly, 1958)
Lele, 1964

Plate 14a: figures 4, 5.

Holotype: V. radiatus Hennelly, 1958, Plate 5: figure 10.

Diagnosis: Outline is circular, with roundly triangular and dense body, trilete suture faint, distal zone of saccus attachment obscure; saccus wide, about equal to central body radius or more; radial folds are common.



Description: Shape: Circular to sub-circular.

Central body: Distinctly roundly triangular and dense with indistinct to obscure trilete suture; exine is finely structured infra-punctate to infra-micro-reticulate.

Saccus: Proximal attachment is equatorial, distal attachment is obscure but is assumed to be sub-equatorial along the line from which the radial folds of the saccus emerge. Overlap is very narrow, width of saccus is $\frac{1}{4}$ or more total diameter;

saccus surface is frilled to fairly smooth with frequent radial folds; margin is undulating; saccus is circular in overall shape; but due to shape of the central body appears narrower at the triangular apices and wider interradially.

Dimensions (8 specimens): Total diameter: 75-105 μ; diameter of central body: 40-55 μ.

Discussion: V. radiatus differs from other species in having a dense central body. V. densus which also possesses this feature, has a round central body as opposed to the roundly triangular central body of V. radiatus.

Distinction: V. radiatus is distinguished by possessing a roundly triangular dense central body, wide radially folded and frilled saccus and dual saccus attachment.

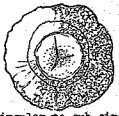
Stratigraphic range: Rare to common in Dwyka sediments; rare to absent in Black Shales and Coals; absent in Madumabisa Mudstones.

Virkkipollenites mehtae Lele, 1964

Plate 13: figures 3-6.

Holotype: V. mehtae Lele, 1964, Plate 2: figure 16, text-figure 9.

Diagnosis: Shape circular to sub-circular, with central body thin, outline usually distinct and circular; trilete rays indistinct, about ½ central body radius in length and often asymmetrical. Saccus ranges from ½ to equal to the central body radius; distal root distinct with a narrow overlap, saccus outline undulating, surface frilled.



Description: Shape: Circular to sub-circular.

Central body: Circular to sub-circular and usually distinct in outline (depending on plane of focus). Trilete mark is often indistinct but present, rays usually taper to a point terminally and are unequal and often asymmetrically separated. Length of rays varies from ½ to almost 2/3 the radius of the central body, the exine of the central body is very finely structured.

Saccus: Usually circular to sub-circular oval outline. Proximal attachment is equatorial and distal attachment sub-equatorial but within a narrow zone $\frac{1}{4}$ or less (radius of the central body) away from the margin. Width of saccus is about $\frac{1}{4}$ to 2/3 total diameter, with overlap narrow and approximately equal to $\frac{1}{4}$ or $\frac{1}{3}$ sacci width. Saccus surface is frilled and "pleated", and margin is undulating.

Dimensions (15 specimens): Total diameter: 76(81)85 μ; central body: 42(48)54 μ.

Discussion: *V. mehtae* is characterised by possessing a circular shape both of the central body and saccus. *V. triangularis* (Mehtae) Lele bears a triangular saccus with circular central body, whilst *V. obscurus* Lele possesses a very thin indistinct central body and a smooth unfrilled saccus structure. *V. densus* Lele and *V. radiatus* (Hennelly) Lele both have dense distinct central bodies.

Distinction: *V. mehtae* is distinct in having dual saccus attachment (equatorial and sub-equatorial), a circular saccus and central body, thin but distinct outline to central body and a frilled saccus.

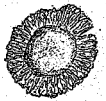
Stratigraphic range: Common in Dwyka; rare in Black Shales and Coals and absent in Madumabisa Mudstones.

Virkkipollenites densus Lele, 1964

Plate 13: figures 7-9.

Holotype: V. densus Lele, 1964, Plate 2: figures 19, 20, Text:- figures 11, 13d.

Diagnosis: Shape circular to roundly triangular, with central body dense, circular and infra-punctate. Trilete mark indistinct but present, with rays about ½ radius of central body. Saccus circular to roundly triangular in outline, frequently more than half the total radius in width. Distal overlap narrow, with invisible to indistinct distal saccus roots, saccus is normally frilled.



Description: Shape: Circular, sub-circular to oval, and roundly triangular.

Central body: Dense, distinct and circular in shape. Exine sculpture is laevigate to finely infra-punctate. Trilete suture usually present but indistinct, rays are thin and about ½ central body radius in length.

Saccus: Usually circular but may be roundly triangular to occasionally rhomboid, saccus width is about half the total diameter or more; with distal overlap equal to about ¼ or less central body radius. Distal saccus root sometimes indistinct, but can be defined by the point of attachment of radial saccus frills, outline is undulate to irregular due to frilling of saccus surface.

Dimensions (20 specimens): Total diameter: 60(72)88 μ; central body diameter: 38(48)55 μ.

Distinction: V. dengus is distinguished from other species by its circular dense central body, frilled saccus and dual saccus attachment.

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

Genus: Parasaccites Bharadwaj and Tiwari, 1964

Type species: Parasaccites korbaensis Bharadwaj and Tiwari, 1964.

Diagnosis: Shape: Circular to sub-circular and oval.

Central body: Fairly distinct to indistinct, lighter than saccus; sub-circular to oval, trilete suture may or may not be present.

Saccus: Proximally and distally attached along a similar sub-equatorial zone when seen in polar view. Saccus uniformly broad, dense and coarsely infra-reticulate.

Discussion: Parasaccites (figure 1) lacks central body striations, or peripheral folds along sacci roots; it is not bilaterally symmetrical in organisation and it has dual saccus attachment. The sacci roots are typically identical in shape and position, both proximally and distally. The closest genus to Parasaccites in morphological similarity is Virkkipollenites Lele, 1964 (figure c). However, the latter genus is distinct in having equatorial proximal saccus attachment and sub-equatorial distal saccus attachment.

Distinction: Parasaccites is distinct in being circular to oval, with the saccus attached sub-equatorially in para condition on both sides of the body and in possessing a clear to indistinct trilete suture, and no peripheral folds or striations.

Parasaccites species

Plate 14a: figures 1, 2.

Description: Shape: Circular to sub-circular, often distended into off-polar oval shapes due to size.

Central body: Very faint, thin, and light in colour compared to the dark, well-structured saccus; exine very fine, structured (infra-punctate or granulate); trilete suture not apparent in any specimens.

Saccus: Broad, thick, circular and distinct, with dark coarse regular infra-reticulation; proximal and distal attachment sub-equatorial apparently in the same position; saccus width is equal to or less than half total diameter; due to indistinct nature of central body outline, offlap is presumed to be the narrow zone in which the sacci infra-sculpture bears small, fine and regular collumellate elements; the saccus proper bears large lumen with radial elongation (1-3 μ).

Dimensions (10 specimens): Total maximum diameter: 120(145)185 μ; central body (indistinct) diameter: 85-130 μ.



Discussion: Due to the usually circular outline, radial-symmetry of the saccus, ill-defined central body and lack of a suture this species is distinct from most of the Congo forms. The closest species is P. diffusus Tiwari, 1965 (described by Bose and Maheshwari, 1968, Plate VIII: figure 4 and p. 41). However, P. diffusus has a narrow size range (140-160 u) and a thin wrinkled central body exine. The Rhodesian specimens include a large size variation, which with more material may prove separable into a number of species.

Distinction: Parasaccites sp. is distinct in possessing a very large size range, thin indistinct central body, a broad dark coarsely structured saccus, (equally thick all round). No sutures, and proximal and distal saccus attachment along a parallel sub-equatorial position.

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

Genus: Ellilasaccites Bose and Kar, 1966

Type species: Ellilasaccites ellilaensis Bose and Kar, 1966, Plate III: figures 1-3.

Diagnosis: Shape: Circular, sub-circular to slightly oval.

Central body: Usually dense, distinct, sub-circular to oval; exine granulose to laevigate. Trilete suture may or may not be present.

Saccus: Single saccus attachment on proximal surface, equatorial zone, distally saccus encloses the central body. Saccus infrareticulate; margin entire or slightly undulate; proximal attachment zone usually distinct, occasionally indistinct.

Discussion: Ellilasaccites (figure h) is distinguished from many monosaccate forms in being radially symmetrical (to slightly oval) lacking both striations on the central body and peripheral folds associated with the saccus attachment, and possessing a single (proximal) saccus root. It is closely comparable to Nuskoisporites (Potonie and Klaus) Lele, 1964 (figure a) in having single saccus attachment, but the latter genus

is distinguished by the presence of a limbus on the saccus margin. Endosporites (Wilson and Coe) Bharadwaj, 1962 possesses trilete rays that extend up to the equator of the central body. Florinites Schopf, Wilson and Bentall, 1944 (figure s) has a laevigate central body, a thin collumellate saccus with distal attachment and lacks a trilete suture on the central body, although vestigal remains may occur on the proximal saccus. Densipollenites Bharadwaj, 1962 (figure t) possesses distal saccus attachment, lacks haptotypic markings and is characterised by a dense and coarse sacci infra-reticulation resulting in limboid margins along the saccus equator and folds.

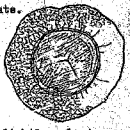
Distinction: Ellasaccites is distinct from other radio-symmetrical monosaccate genera in possessing a dense central body with granulose to laevigate exine and a single, proximally attached, equatorial saccus root. A trilete suture may or may not be present.

Ellisaccites ellisensis Bose and Kar, 1966

Plate 13: figures 10-12.

Holotype: E. ellisensis Bose and Kar, 1966, Plate III: figures 1-3.

Diagnosis: Outline is circular to sub-circular; central body circular to sub-circular, dense, distinct, exine granulate or laevigate. Trilete present. Proximal attachment of saccus to central body equatorial, distally saccus encloses central body completely. Saccus infra-reticulate.



Description: Shape: Circular to slightly sub-circular.
Central body: Dense, distinct and circular in outline; exine is finely infra-punctate to laevigate a trilete suture is present, with rays extending half or less the central body radius, often irregular and asymmetrical and usually thin and tapering terminally.
Saccus: Broad, up to 2/3 total diameter in width; smooth to slightly undulate margin, and smooth to slightly radially folded surface;

proximal attachment is equatorial to sub-equatorial with a very narrow overlap, distally the saccus is seen to apparently cover the central body, (i.e. no distinct distal zone).

Dimensions (8 specimens): Total diameter: 95-115 μ; central body diameter: 58-65 μ.

Discussion: The Rhodesian specimens are slightly smaller than those found by Bose and Kar in the Congo, but otherwise are very comparable. E. ovatus Bose and Kar, 1966 is almost synonomous but is characterised by a light but distinct central body.

Distinction: E. elilaensis is distinguished by a dense central body with finely sculptured to laevigate exine; a trilete suture, and only proximal attachment of the saccus.

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

Genus: Florinites Schopf, Wilson and Bentall, 1944

Type species: Florinites anticuus Schopf.

Diagnosis: Shape: Circular to broadly oval in outline.

Central body: Circular to sub-circular with laevigate exine. No true trilete suture, but a vestigal form may be seen on the saccus (proximally).

Saccus: Almost entirely enclosing the central body; sacci attachment is sub-equatorial and distal, leaving a very small distal zone. When compressed the saccus is usually less folded than the central body.

Discussion: Florinites (figure 8) is distinct from other radio-symmetrical monosaccites in possessing a relatively small dense central body with a large finer infra-reticulate saccus and single attachment. Densipollenites is closely comparable but is distinguished by its coarse infra-reticulate saccus structure, limboid saccus margins and random sacci folds. Sahorisporites Sukh Dev is regarded as synonomous due to its characteristic radial folds of the distal side of the saccus and the similarity between the type species, S. indicus Sukh Dev and Florinites eremus Balme and Hennelly.

Distinction: Florinites is distinct in possessing a small dense laevigate central body, possibly a vestigal trilete suture on the proximal side of the saccus, and a large thin often radially folded saccus. A very small distal zone of attachment is present.

Florinites eremus Balme and Hennelly, 1955

Plate 14: figures 5, 6.

Holotype: F. eremus Balme and Hennelly, 1955, Plate 5: figures 45, 48: non 46-47.

Diagnosis: Shape is sub-circular to oval, with circular to sub-circular distinct central body; distal attachment zone of saccus is narrow, saccus is large, and frequently radially folded with coarse distinct infra-reticulation.



Description:

Shape: Sub-spherical, to oval, frequently folded or "crumpled".

Central body: Circular to sub-circular in outline, distinct and usually dense, no sutures are present.

Saccus: Large, thin, enveloping central body proximally with a narrow distal zone of attachment. Saccus surface often radially folded and margin undulate to smooth. Infra-reticulum fine but regular and dense and often radially elongate.

Dimensions (10 specimens): Total diameter: 64-125 μ; diameter of central body: 32-65 μ.

Discussion: This species may be synonomous with Sehorisporites indicus Sukh Dev, but the latter has a slightly larger size. The forms assigned by Balme and Hennelly (1955) include two specimens which may be regarded as Sulcatisporites (Plate 5: figures 46 and 47). Comparison is therefore made with the remaining forms (Plate 5: figures 45, 48).

Distinction: Florinites eremus is distinct in possessing a small dense central body, large, thin, finely infrareticulate saccus with radial folds, and single distal saccus attachment.

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

Genus: Densipollenites Bharadwaj, 1962

Type species: Densipollenites indicus Bharadwaj, 1962.

Diagnosis: Shape: Circular, sub-circular to oval, usually with a number of folds in the saccus.

Central body: Usually dark, dense and distinct, but may be indistinct; circular to sub-circular; no striations or apertures; exine densely granular to laevigate.

Saccus: Finely infra-reticulate on the one side (distal) and coarsely infra-reticulate on the other. Limboid margins are characteristic along the margin of the saccus and irregular folds. Attachment is sub-equatorial on one surface only.

Description: Densipollenites (figure t) is similar to Florinites Schopf, Wilson and Bentall (figure s) with a relatively small indistinct to dense central body, no apertures or striations and a large distally attached saccus. However, the latter genus has a small laevigate central body, and a large thin, much less densely structured saccus. Sehorisporites Sukh Dev is regarded by Hart, 1965 as synonomous and having priority over Densipollenites.

Segroves, 1969, however, remarks on the closer similarity of the type species of Sehorisporites to Florinites eremus Balme and Hennelly, thereby casting doubt on the usefulness of this genus.

Distinction: Densipollenites is distinct from other radio-symmetrical Monosaccate genera in possessing a single saccus root, a relatively small, dense distinct central body which lacks any apertures, and most characteristic of all a coarsely infra-reticulate saccus with limboid margins along the equator and sacci folds.

Densipollenites indicus Bharadwaj and Salujha

Plate 14: figures 7, 8, 9.

Holotype: D. indicus Bharadwaj, 1962, Plate 6: figures 103, 104.

Diagnosis: Circular to sub-circular outline; central body similar in shape, with outline marked in flattened specimens saccus usually folded and limboid along margins of folds and equator.



Description: Shape: Circular to sub-circular with frequent folding of the saccus when compressed and flattened.

Central body: Usually discernible, often darkened circular to sub-circular oval in shape; exine is densely but finely granulate; no haptotypic marks.

Saccus: Thickened with well-developed coarse infra-reticulation, lumen up to 2 μ wide and equi-dimensional; muri often thickened. At margins of folds and equator a thickened

limboid structure is characteristic (up to 4 μ wide). Saccus attachment is proximal (sensu Bharadwaj, 1962) with indistinct to distinct attachment zone. Distally saccus covers the central body completely.

Dimensions (8 specimens): Total diameter: 60-80 μ; central body diameter: 30-45 μ.

Discussion: The characteristic features of these species are the limboid margins on the saccus. Central bodies vary from distinct to almost indistinct. This range encompasses both the characteristics of D. rallus Segroves and D. indicus Bharadwaj. Segroves reports that no transitional forms were seen in Australia; however, all Rhodesian forms with limboid sacci have for practical reasons, been included under D. indicus.

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

Genus: Striomonosaccites Bharadwaj, 1962

Type species: Striomonosaccites ovatus Bharadwaj, 1962, Plate 7: figures 107-114.

Diagnosis: Shape: Circular to sub-circular.

Central body: Circular, thin-walled, with infra-micro-reticulate exine; proximal side bears a number of parallel to sub-parallel striations distal face is thinner and granulose.

Saccus: Proximal attachment of saccus is sub-equatorial; proximal zone is small; distal section of saccus is free.

Discussion: Striomonosaccites (figure g) is distinguished from other Monosaccate genera by the possession of a striate proximal face on the central body. It is distinct from Distriomonosaccites Bharadwaj, 1962 as the latter genus bears longitudinal striations on both proximal and distal surfaces.

Mabuitasaccites Bose and Kar, 1962 (figure r) is a most distinctive genus and readily separated due to the presence of longitudinal striations on one surface of the central body and transverse striations on the other.

Distinction: Striomonosaccites is distinct from other striate monosaccate genera in having longitudinal striations on only one side of the central body.

Striomonosaccites sp.

Plate 14a: figures 9, 10.

Description: Shape: Circular to sub-circular.

Central body: Circular, sub-circular to oval when compressed. Outline distinct to rather indistinct; proximal face thickened into longitudinal ribs (6-8), usually separated by narrow parallel to sub-parallel striations, unbranched and occasionally wedge-shaped, extending full width of central body.

Saccus: Broad, evenly thickened all round, ½ to ¼ total diameter in width. Saccus attachment roots and attachment zones indistinct. Proximal root sub-equatorial, distal roots undiscernible. Infra-reticulation fine regular and equi-dimensional lumen.

Dimensions (8 specimens): Total radius: 35-65 μ; central body radius: 25-44 μ.



Discussion: The Rhodesian specimens include a variety of forms within the above descriptive limits. The size ranges are small, and the specimens are usually well-folded, particularly along the saccus margins. Good photographic specimens are extremely rare. In comparison with other African forms the Rhodesian species apparently have a number of features in common with Striomonosaccites brevis Bose and Kar, 1966, but differ in having an indistinct central body. S. triangularis Bose and Kar, 1966 is larger in size with triangular outline. S. ovatus Bharadwaj, 1962, and S. circularis are larger in size range with distinct attachment zones, and S. rotatus (Bharadwaj) Hart possess proximal and distal striations.

Distinction: Striomonosaccites sp. is a variable form category embracing radially symmetrical monosaccate specimens with distinct proximally-striated central bodies.

Stratigraphic range: Absent in Dwyka sediments; rare in Black Shales and Coals; and rare to common in Madumabisa Mudstones (Lk^5 in particular).

Group B - Bilaterally-Symmetrical Monosaccites

Genus: Potoniesporites Bharadwaj, 1962, emended Bharadwaj, 1964

Type species (by original designation): Potoniesporites novicus Bharadwaj, 1955.

Synonyms: Sahlnites Pant.

Diagnosis: Shape: Bilaterally symmetrical monosaccate, longitudinally oval; to sub-circular.

Central body: Circular to longitudinally oval, with proximal monolete aperture.

Saccus: Equatorially attached proximally and sub-equatorially attached distally. Peripheral folds associated with saccus attachment. Proximal and distal zones wide, normally following the outline of the central body to slightly bilateral. Saccus is bilaterally thickened with lateral constriction.

Discussion: Originally Potoniesporites Bharadwaj, 1955 (figure p) was described as a monosaccate possessing a single proximal attachment of the saccus. In 1964, Bharadwaj emended this to dual saccus attachment with the proximal root equatorially placed, and the distal root sub-equatorially placed. This new interpretation of the morphology has been reviewed by

Clarke (1965) and in some small measure by Segroves (1969) and Balme (1966).

Prior to 1964, Vestigiesporites (Balme and Hennelly) emended Hart, 1960 (figure j) was distinguished from Potoniesporites Bharadwaj, 1955 by possessing reduced lateral bladders connecting two opposite and enlarged sacci lobes giving a disaccate appearance. However, after the new emendation Potoniesporites was placed in synonomy with Vestigiesporites (by Bharadwaj, 1964), both forms now being bilaterally symmetrical monosaccates with dual saccus attachment. Balme (1966) and Segroves (1969), however, re-examined the original type species of Vestigiesporites and re-instated it as a form genus with a clear disaccate morphology bearing an occasional equatorial bridge of slightly detached to undetached exo-exine.

Potoniesporites is thus regarded as an elongated bilaterally symmetrical monosaccate with sacci slightly reduced laterally and a series of peripheral folds associated with the saccus attachment.

The saccus infra-structure in the Rhodesian forms is another factor employed in the practical separation of these genera.

Potonieisporites has no change in saccus infra-reticulation (see Plate 4: figure 2), whilst Vestigisporites (Plate 14: figure 10) displays clear differentiation between terminal and lateral saccus structure.

Cahenisaccites Bose and Kar, 1966 (figure n) is very similar to Potonieisporites in general morphology, the distinguishing feature being the superimposed para-condition of the sub-equatorially attached proximal and distal roots in polar view. Peripheral sacci attachment folds are lacking.

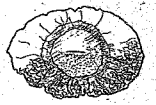
Distinction: Potonieisporites is distinguished by being bilaterally symmetrical in saccus organisation, lacking differentiation in saccus infra-structure and bearing a proximal monolete aperture, and possessing peripheral folds associated with the dual saccus attachment roots.

Potonieisporites novicus Bharadwaj, 1954

Plate 14: figures 1, 2.

Holotype: Potonieisporites novicus Bharadwaj, 1954, figure 10, 1955, Plate 2: figures 13, 14.

Diagnosis: Bilaterally symmetrical elongate oval outline; central body longitudinally oval with proximal monolete suture. Saccus equatorially attached proximally and distally, often with peripheral folds associated with distal saccus attachment.



Description: Shape: longitudinally oval with bilateral symmetry; central body; circular to sub-circular or slightly l-a oval and distinct. Proximal surface bears a distinct monolete suture, straight or slightly sinuous and $\frac{1}{2} - \frac{3}{4}$ l-a central body in length. Exine finely infra-punctate to infra-reticulate.

Saccus: Equatorially to sub-equatorially attached both proximally and distally; overlap very narrow. Distal saccus attachments usually associated with prominent regular sub-circular peripheral

folds. Proximal and distal zones circular to sub-circular. Saccus laterally constricted to form a narrow undifferentiated continuation of the terminally enlarged sacci; radial folds are usually present. Sacci root; saccus margin entire, smooth or slightly undulating; infra-sculpture is fine, dense infra-reticulation, lumen radially elongate.

Dimensions (15 specimens): Total l-a: 90(102)130 μ; total t-a: 62(74)90 μ; central body diameter: 50(58)74 μ; terminal width of sacous: 34-50 μ; lateral width of saccus: 8-16 μ.

Discussion: Species differentiation in Potonieisporites is somewhat inadequate (Balme, 1966, p. 106). The Rhodesian forms described above conform most closely to P. novicus in description, although the sizes are somewhat smaller. P. neglectus R. Potonie and Lele, 1961 is very comparable, but the latter authors retain this species on the basis of its polygonal central body and pronounced bilateral symmetry. P. lelei Maheshwari, 1967 is the closest Congo form both in

size and structure. This may be regarded as synonomous. A large variety of forms exists in the Congo (9 species - see Bose and Maheshwari, 1968, p. 50). Their differentiation is based on various peripheral fold patterns, and shape of the central body. The Rhodesian forms include most of the variations noted by the Congo authors, but no purpose is seen in separating these apparently transitional forms too finely, therefore for the present purpose four forms are tentatively separated here:

P. novicus Bharadwaj for forms bearing a sub-circular distal zone with sub-circular peripheral folds;

P. thomasi (Faut, 1955) nov. comb., distal zone (with peripheral folds) is rectangular and $\frac{1}{3}$-$\frac{1}{2}$ l-a central body; monolete aperture is $\frac{2}{3}$-l (radius of central body).

P. hennellyi (Hart, 1960) nov. comb. distal zone is t-a oval and about $\frac{1}{2}$ l-a central body; aperture is shorter.

P. granulatus Bose and Kar, 1966; distinct and thick distal folds (semi-crescentic to polygonal in form) give rise to a rhomboid distal zone.

Distinction: P. novicus is distinct in possessing bilateral symmetry, with equatorial to sub-equatorial saccus attachment and circular peripheral folds associated with the distal attachment. The distal zone is circular to sub-circular. Monolete suture varies ½ - ¾ l-a central body.

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

Potonieisporites granulatus Bose and Kar, 1966

Plate 14a: figures 11, 12.

Holotype: P. granulatus Bose and Kar, 1966, Plate VIII: figure 3.

Diagnosis: Outline oval, central body sub-circular, distinct, granulose. Monolete suture usually well-defined, may be indistinct. Saccus bilaterally arranged, with equatorially attached proximal root, crescentic peripheral folds occur around the monolete suture.



Description: Shape: Elongate oval.

Central body: Distinct, rhomboid to trapezoid in shape; exine finely granulate, monolete suture sinuous, tending to split laterally $\frac{1}{3}$ l-a central body.

Saccus: Bilaterally symmetrical with narrower lateral portions, and broad terminal lobes. Proximal attachment apparently equatorial, distal attachment sub-equatorial (sensu Ehsanullah, 1964). Peripheral folds

irregular, 4-6 overlapping terminally, fairly thick and framing a polygonal attachment zone. Saccus surface smooth, margin entire and slightly undulate. Infra-reticulation is fine, regular and evenly distributed all round.

Dimensions (8 specimens): Total l-a: 90-135 μ; total t-a: 85-96 μ; central body diameter: 62-78 μ; lateral saccus width: 11-22 μ; terminal saccus width: 25-30 μ.

Discussion: This general diagnosis may well include the previous species described in this thesis, however, this form species is slightly amended here to retain those bilateral monosaccates bearing granulate central bodies, with short monolete sutures and irregular peripheral folds (4-6 in number) which frame polygonal attachment zones. This may prove to be a superfluous species when further work is conducted on this genus, but for the present it represents a useful basic taxon. P. densus Bose and Maheshwari is very similar in all respects, bar a dense infra-micro-reticulate central body. If the interpretation of the central body exine is incorrect, this form may well be synonomous.

Distinction: P. granulatus is distinct from other species in possessing a trapezoid or rhomboid granulate central body, an irregular polygonal attachment zone framed by 4-6 peripheral folds, a short $\frac{1}{8}$ l-s (central body) monolete suture and bilateral saccous organisation.

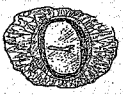
Stratigraphic range: Rare to common in Dwyka; rare in Black Shales and Coals; absent in Madumabisa Shales.

Potoniesporites hennellyi (Hart, 1960) nov. comb.

Plate 14: figure 4.

Holotype: Vestigisporites hennellyi Hart, 1960, Plate 2: figure 20.

Diagnosis: Elongate oval in outline, with circular to sub-circular central body; sacous is bilateral with continuous narrower lateral portions. Distal zone is equal to or less than ½ l-a (central body).



Description: Shape: Elongate oval.

Central body: Circular or sub-circular to slightly l-a or t-a oval, distinct, usually dense; monolete aperture is usually ½ l-a central body long and may have a vestigal ray marking the third in a trilete suture.

Sacous: Terminally enlarged, laterally reduced, but sacous infra-sculpture and structure continuous throughout. Radial folds or frills often present,

margin smooth to undulate, infra-sculpture regular dense and radially elongate proximal and distal attachment lines sub-circular to transversely oval; framed by dense peripheral folds distally.

Dimensions (8 specimens): Total l-a: 80-110 μ; total t-a: 55-70 μ; central body diameter: 50-58 μ; lateral saccus width: 6-9 μ; terminal saccus width: 24-45 μ.

Discussion: P. hennellyi was originally assigned to the Disaccitrilleti by Hart. It is here amended to the bilateral monosaccates (Group B) due to its essentially Monosaccate form.

Distinction: P. hennellyi is distinguished from other species by the presence of a transversely oval distal sulcus, and monolete suture ½ or less l-a (central body) in length.

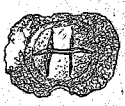
Stratigraphic range: Rare to common in Dwyka; rare in Black Shales and Coals; and absent in Madumabisa Mudstones.

Potoniaisporites thomasi (Pant, 1955) nov. comb.

Plate 14: figure 3.

Holotype: P. thomasi Pant, 1955, Plate 19: figure 1.

Diagnosis: Elongate oval in outline with circular to slight l-a or t-a oval central body. Saccus shows bilateral symmetry with narrow lateral continuation. Monolete aperture extends $\frac{2}{3}$ or more l-a central body, distal zone is narrow, parallel and $\frac{1}{3}$-2/3 l-a central body wide.



Description: Shape: Longitudinally oval with bilateral symmetry.

Central body: Circular to slightly t-a or l-a oval, dense and distinct; exine finely infra-punctate. Monolete suture extends more than $\frac{2}{3}$ l-a central body, and may possess darkened lips.

Saccus: Bilaterally symmetrical with lateral sections narrower but not structurally differentiated from terminal sections. Equatorial attachment proximally, but bilateral attachment distally the latter associated with

darkened crescentic peripheral folds. Distal zone rectangular and ~~1-1~~ 1-a central body in width; proximal zone circular. Saccus surface smooth to slightly radially folded; margin entire and smooth. Infra-sculpture fairly coarse, radially-elongated infra-reticulation.

Dimensions (10 specimens): Total l-a: 75-90 µ; total t-a: 50-65 µ; central body diameter: 45-58 µ; lateral saccus width: 8-12 µ; terminal saccus width: 32-48 µ.

Discussion: The closest form so far described in Africa is P. congoensis Bose and Maheshwari, 1968 bearing two vertical and two horizontal folds. The latter folds are not well represented in the Rhodesian specimens.

Distinction: P. thomasi is distinguished by the bilateral symmetry of the saccus, circular proximal attachment zone, and rectangular distal attachment zone.

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

Genus: Vestigisporites (Balme and Hennelly) Hart, 1960

Type species: Vestigisporites gondwanensis (Mehta, 1954) Hart, 1960.

Diagnosis: Shape: Longitudinally oval, occasionally slightly diploxylonoid in outline.

Central body: Is circular to sub-circular, with a monolete aperture on proximal surface.

Saccus: Terminal "sacci" are swollen and united laterally by slightly to moderately inflated lateral bladders. Sacci are strongly distally inclined. Saccus infra-structure may or may not be differentiated in lateral and terminal portions.

Discussion: Differentiation between Vestigisporites (figure j) and Potonieisporites (Bharadwaj) emended Bharadwaj, 1964 (figure p) has been the subject of some controversy (Clarke, 1965; Bharadwaj, 1964; Hart, 1960, 1965; Segroves, 1969 et al). The originating authors (Balme and Hennelly, 1956, p. 95) suggested Vestigisporites to be a disaccate form distinguished by its monolete suture. Hart (1960) amended the form suggesting that the lateral bladders conformed to a monosaccate condition, but with disaccate symmetry - thereby

approximating it to Potonieisporites. Hart (1965) then placed it under the infra-turma Disacoitrileti, intimating a disaccate condition. Latterly, Segroves (1969) re-examined the type material and states that the genus "is clearly disaccate with occasionally an equatorial bridge of undetached to slightly detached exo-exine". The sacci are strongly distally inclined and the central body bears an indistinct monolete suture.

For the purpose of this thesis, the diagnosis is slightly emended to include these forms bearing sacci with the infra-structure laterally and terminally differentiated thereby conforming to the disaccate condition. The Rhodesian forms, however, possess wider lateral bladders than the type species. They are therefore regarded as monosaccate in basic organisation and retained in this infra-turma.

Potonieisporites (Bharadwaj) Bharadwaj, 1964 (figure p) is distinguished by lacking saccus differentiation and possessing peripheral sacci folds; Caheniasaccites Bose and Kar (figure n) lacks a monolete suture and saccus differentiation.

Distinction: Vestigisporites is distinguished by possessing bilateral symmetry with strong disaccate tendencies, and differentiated saccus and lateral bladder infra-structure.

Vestigisporites sp.

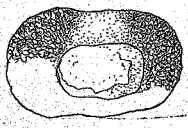
Plate 14: figure 10.

Description: Shape: Elongate oval to almost rectangular and disaccate (haploxylonoid).

Central body: (Usually missing in the rare specimens seen), apparently elongate oval conforming to general outline.

Saccus: Uniformly broad all round but with marked differentiation in saccus infra-sculpture between the terminal and lateral sections. Laterally, the infra-sculpture is granulate, whilst terminally a distinct, dark, coarse infra-reticulation is present; lumen radially elongate and up to 2 x 8 μ in size. Proximal and distal saccus attachment equatorial to sub-equatorial. Lateral width of saccus: 25-34 μ; terminal width of saccus: 30-38 μ.

Dimensions (6 specimens): Total l-a: 140-185 μ; total t-a: 90-125 μ.



Discussion: Vestigisporites sp. is a rare element of particular interest in the oldest inter-glacial sediments; very rare traces are noticed in younger sediments (K^0-K^1). Although almost invariably broken and lacking a central body, this form is phyllogenetically important due to its monosaccate condition, but very distinct differentiation of the saccus infra-sculpture into a disaccate condition. No comparative forms have been published so far to the author's knowledge. Potoniesporites spp. are characterised by peripheral folds associated with the saccus attachment, and Cahenisaccites spp. have no differentiation in saccus infra-sculpture.

Distinction: Vestigisporites sp. is distinct in possessing coarse infra-reticulation on terminal sections of saccus, and fine infra-granulation laterally; elongate oval shape and dual saccus attachment.

Stratigraphic range: Rare in Dwyka sediments; absent in Black Shales and Coals; and Madumabisa Mudstones.

Genus: Caheniasaccites Bose and Kar, 1966

Type species: Caheniasaccites flavatus Bose and Kar, 1966, Plate XXVI, figures 4-5.

Diagnosis: Shape: Disaccate in appearance but Monosaccate in structure with longitudinally oval outline.

Central body: Distinct, longitudinally oval to sub-circular, with infra-micro-reticulate exine.

Saccus: Well-developed, typically constricted giving a bilateral appearance; "lateral bladders" joining the terminal swollen portions are well-developed (6-25 μ thick): (there is apparently no differentiation in saccus infra-structure between the lateral and terminal sections). Saccus is radially arranged, with a smooth to highly frilled margin. Sacci roots proximally and distally sub-equatorial and superimposed; framing longitudinally oval to sub-circular distal and proximal zones conforming to the shape of the central body.

Discussion: The bilateral appearance of Caheniasaccites (figure n) distinguishes this genus from all other monosaccate forms found in central Southern Africa except for

Vestigisporites (Balme and Hennelly) Hart (figure j) and Potoniesporites Bharadwaj, 1964 (figure p). In the case of Vestigisporites, distinction of this genus is based on the presence of a monolete suture, central body with granulose exine and different form of saccus attachment to the body i.e. similar to the disaccate condition with two terminal sacci and a mere bridge of detached saccus exine laterally joining them to form lateral bladders. These may or may not be differentiated in infra-structure from the true sacci. Bharadwaj (1964) and Bose and Kar (1966) are, however, of the opinion that certain species erected by Hart within his emended form of Vestigisporites should rather by assigned to Cahenisaccites due to the l-a oval central body and para condition of saccus attachment with a distinct sulcus. See discussion of Vestigisporites. See Plate 14: figure 10 and 11 for comparison. Potoniesporites has a monolete suture and distinct peripheral folds associated with the saccus attachment. Also sacci roots are equatorially attached proximally and sub-equatorially attached distally.

Valisaccites Bose and Kar, 1966 is a disaccate Disaccoiatrileti found in the Congo very similar to Caheniasaccites in basic form.

The original authors differentiate this genus on "the presence of lateral ridges only on sides perpendicular to shorter axis of central body without any regular fold and vermiculated exine of central body". This genus is therefore considered to be disaccate in form. Vesicaspora Schemel is also a disaccate Disaccoiatrileti genus bearing lateral bladders. Distinction between this genus and Caheniasaccites is based on the basically bilateral saccus attachment and distal inclination of sacci in Vesicaspora. The latter genus also lacks radial folding and frilling of the saccus.

Distinction: Caheniasaccites is distinct in having an elongated oval shape with slightly constricted lateral portions of the saccus. Saccus attachment conforms to the outline of the central body and is not bilateral. Saccus infrareticulation is not differentiated and a monolete suture is lacking.

Caheniasaccites sp.

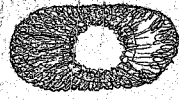
Plate 14: figure 11.

Description: Shape: Longitudinally oval to haploxyloncid bisaccate.

Central body: Faintly discernible to distinct, circular to sub-circular, no trilete suture. Central bodies frequently missing in Rhodesian forms.

Saccus: Bilaterally symmetrical in arrangement, with extended swollen lobes "terminally" joined by narrower, constricted sections laterally. Saccus infra-sculpture is dark and coarse, and continues all round with no lateral differentiation. Margin is crenulate to undulate and saccus surface is usually well folded and frilled radially. Proximal and distal attachments are distinct, sub-equatorial and superimposed, leaving circular to sub-circular distal and proximal zones. Lateral portion of saccus: 16-24 µ wide; terminal portions: 50-65 µ wide.

Dimensions (8 specimens): Total l-a: 150-185 µ; total t-a: 75-94 µ; central body diameter: 54-70 µ.



Discussion: Caheniasaccites sp. is comparable to C. ovatus Bose and Kar, 1966 from the Congo, but lack of good specimens for better comparison and a larger size in the Rhodesian forms precludes a definite naming of these forms. However, the circular proximal and distal zones are common to both, and serve to differentiate these forms from C. flavatus Bose and Kar and C. elongatus Bose and Kar.

Distinction: Caheniasaccites sp. is distinct in possessing bilaterally symmetrical organisation of the saccus, with lateral constrictions bearing the same infra-structure as the terminal portions; a circular central body with circular superimposed sub-equatorial saccus roots; and no sutures or peripheral folds associated with the saccus attachment.

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

Turma: PLICATES Naumova, 1937

Sub-turma: PRAECOLPATES Potonie and Kremp, 1954

Infra-turma: PRAECOLPATI Potonie and Kremp, 1954

Genus: Marsupipollenites Balme and Hennelly, 1956

Type species: Marsupipollenites triradiatus Balme and Hennelly.

Diagnosis: Praecolpati in which the proximal aperture is trilete.

Discussion: As discussed by Segroves (1969, p. 70) Balme and Hennelly originally included in this form genus most Monocolpate pollen grains bearing a tetrad scar. Hart then assigned this group to the Praecolpati. Four species were initially assigned to this genus, three of which have been placed under other genera. M. sinuosus under Gnetaceaepollenites, and M. scutatus and M. fasciolatus under various genera Vittatina, Pakhapites and Schopfipollenites. (Pakhapites Hart, 1965 is inaperturate but bears striations, and Schopfipollenites Potonie and Kremp has a dilete aperture). The Rhodesian forms with trilete apertures and with or without striae are all included in this genus under M. triradiatus.

The Congo Plicates are divided into polyplicates and striatocolpates, and may be summarised as follows:

Decussatisporites Leschik, 1955 is a striate monocolpate form with horizontal and vertical striae, whilst Fusacolpites Bose and Kar, 1966 is possibly synonomous with Pakhapites Hart in possessing only horizontal striations but may be distinguished by its more distinct colpus. Boutakoffites Bose and Kar, 1966 is also a polyplicate form bearing horizontal striations, but an outer zona-like rim structure surrounds the spore equatorially. Enhedripites Bolkovitina is a single oval horizontally striated form usually lacking a colpus. Welwitschiapites Bolkhovitina, which is synonomous with Tiwariasporis Simplex (Maheshwari and Lele), bears horizontal striations, and a thick exine with infra-punctation or small sculptural elements. Many of these genera are difficult to justify, and photographs and descriptions are inadequate. Rhodesian striate forms (such as seen in Plate 11: figure [illegible] are for the present retained in Vittatina till further work can be conducted.

Marsupipollenites triradiatus forma triradiatus
Balme and Hennelly, 1956

Plate 5: figures 26, 27 and 28.

Holotype: Marsupipollenites triradiatus Balme and Hennelly, 1956, Plate 2: figures 29-35.

Diagnosis: Oval in outline, with two exinal folds bordering the transverse sulcus which extends to the lateral margin on the proximal face; a small trilete aperture occurs; sculpture consists of flattened verrucae or grani, or a shagrate texture is apparent.



Description: Shape: Circular to sub-circular in expanded grains, sub-circular to oval in unexpanded grains.

Colpus: Monocolpate with very broad almost circular shape in expanded grains, oval in unexpanded grains bordered by two exinal folds extending full width of grains in unexpanded specimens.

Trilete: Usually present, rays may be of equal length ranging from 3-10 μ in length.

Exine: 1-2 µ thick appearing sculptured or shagrate, but usually densely infra-reticulate or infra-punctate.

Dimensions (20 specimens): t-a: 20(33)44 µ; l-a: 34(45)48 µ.

Discussion: Marsupipollenites triradiatus forma triradiatus differs from M. triradiatus forma striatus in lacking striae.

Distinction: Marsupipollenites triradiatus forma triradiatus is distinct from other Plicate species in possessing a single colpus, a trilete aperture and lacking striations.

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

Marsupipollenites triradiatus forma striatus Balme and Hennelly, 1956

Plate 5: figure 33.

Holotype: Marsupipollenites triradiatus forma striatus Balme and Hennelly, 1956, Plate 2: figures 36-37.

Diagnosis: Oval outline with distinct folds bordering the transverse distal sulcus; trilete aperture present on proximal face. Sculpture on proximal face consists of curved striae and ribs that tend to parallel the sutures of the trilete aperture.



Description: Shape: Circular to sub-circular in expanded grains, sub-circular to oval in unexpanded grains.

Colpus: Monocolpate; exinal folds may extend full length of pollen when unexpanded.

Trilete: Rays usually present, often indistinct but discernible. 2-5 μ long and occasionally unequal in length.

Exine: 1-2 μ thick and infra-punctate to infra-reticulate; striae occur on proximal face, often faint, sub-parallel to oblique, varying in number. Ribs about 1-3 μ wide, separated by narrow striae.

Dimensions (8 specimens): t-a: 20-26 u; l-a: 26-38 u.

Distinction: Marsupipollenites triradiatus forma striatus differs from other Marsupipollenites species in possessing horizontal proximal striae.

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

Tricolpollenites sp.

Plate 5: figures 24, 25.

Description: Shape: Circular to oval, irregular.

Colpus: Very broad, sub-circular to oval, saucer-like. Exinal folds when slightly expanded do not reach margin of pollen.

Trilete: Faint but usually discernible. Rays may be unequal, extending 3-8 µ.

Exine: A thickened or darkened equatorial rim is found, thinnest laterally along the equator and slightly thickened terminally on the exinal folds. Along this rim exine appears to be coarsely structured or infra-punctate, whilst the remainder of the proximal and distal exine appears to be finely infra-punctate or infra-reticulate and much lighter in colour.

Dimensions (8 specimens): l-a: 25-49 µ; t-a: 38-58 µ.

Discussion: This rimmed variety may well be an erosional product, but the constant appearance of these forms is thought to warrant tentative sub-division.



Distinction: Marsupipollenites sp. is distinct from other species in possessing a rimmed outline structurally different and darkened to the remainder of the pollen.

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

Sub-turma: MONOCOLPATES (Wodehouse, 1935) Wilson and Webster

Genus: Cycadopites (Wodehouse, 1935) Wilson and Webster, 1946

Type species: Cycadopites follicularis Wilson and Webster.

Diagnosis: Ellipsoidal to oval; furrow extending total length of grain, open at ends, usually closed in the middle by furrow edges overlapping in shrinkage.

Discussion: See Jansonius, 1962, p. 80 for synonomy list. A few encountered in Hart's 1965 classification and Congo authors are included below:

Ginkgocycadophytus Samoilovich, 1953.
Entylissa (Naumova) Potonie and Kremp, 1954.

Cycadopites cymbatus (Balme and Hennelly) Hart, 1965

Plate 5: figures 31, 32.

Holotype: Entylissa cymbatus Balme and Hennelly, 1956, Plate 3: figures 53-56.

Diagnosis: Outline is elliptical, with distinct l-a elongation such that l-a: t-a is 2:1 the furrow may be open but is usually closed; colpus (or sulcus) is slit-like and often hidden by overlapping exine, and is slightly wider laterally than centrally. Lateral margins are parabolic, sculpture granulate.



Description: Shape: Elongate oval to fusiform; lateral margins are acute to sharply rounded.

Colpus: Distally placed, distinct colpus extends the entire longitudinal width of the pollen. It is usually slit-like and parallel or overlapping; but when slightly expanded is broader marginally than centrally.

Exine: Thin, less than 1 u and finely structured (infra-punctate).

Dimensions (10 specimens): l-a: 20-35 u; t-a: 45-70 u.

Distinction: Cycadopites cymbatus is distinct in possessing a slit-like colpus and longitudinally oval outline.

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

Crosadopites nevesi (Hart, 1964) Hart, 1965

Plate 5: figures 29, 30.

Holotype: Glukkocrosadopites nevesi Hart, 1965, Plate 1: figure 1.

Diagnosis: Outline is circular to slightly l-a elongated. Degree of roundness is between 0,6 and 1,1 $\left(\text{i.e. } \frac{l-a}{l-a} \times 100\right)$: colpus is wider at its extremities than at its centre, and extends the full length of the longitudinal width. Colpus is up to $\frac{1}{3}$ width of pollen. Sculpture is granulate.



Description:

Shape: Is strongly circular to slightly sub-circular; lateral margins are rounded.

Colpus: Distinct, narrower centrally than laterally and extends full longitudinal width of the grain. Central width varies 1/5-$\frac{1}{3}$ of l-a width depending on compression.

Exine: Fairly coarsely structured. Apparently granulate, but under higher magnification (x 1 000) densely infra-punctate.

Dimensions (6 specimens): 1-at 40-54 u; 1-at 42-55 u.

Discussion: Cycadopites vetus Balme and Hennelly less rounded, and slightly smaller, but may well be partly synonomous with this species due to the general overlap in features.

Distinction: Cycadopites nevesi is distinct by its degree of roundness, granulate sculpture and size.

Sub-turma: TETRADITES Cookson, 1947

Genus: Quadrisporites Hennelly, 1958

Type species: Quadrisporites horridus Hennelly, 1959.

Diagnosis: Square or rhomboidal obligate tetrad. Individual spores apparently alete, and sculptured with grani, pilli or baculli.

Quadrisporites sp. cf. Q. horridus Hennelly

Plate 5: figures 20-23.

Description: Shape: An obligate rhomboid or squarely arranged tetrad; individual spores approximately spherical and lacking any germinal aperture. Joined by usually thick translucent bands 3-4 μ wide which terminate at the four indented "corners", of the tetrad. Individual spores may be sunken externally to give an "X" appearance.





Exine: Less than 1 μ thick; distal face of spores varying, (possibly due to erosion) from laevigate, finely infrapunctate to minutely conate or distinctly granulate.

Dimensions: (6 specimens): Tetrad diameter: 25-48 μ; equatorial diameter of spores: 18-28 μ.

Discussion: The Rhodesian specimens closely resemble Q. horridus Hennelly, but are generally smaller in size and have very variable exinal sculpture.

Distinction: Quadrisporites sp. cf. Q. horridus is distinct in possessing a tetrad arranged body with rhomboid outline.

Stratigraphic range: Rare to very rare in Dwyka; absent in remaining stratigraphic sequences.

Sub-turma: AZONALETES Luber, 1935

Infra-turma: PSILONAPITI Erdtman, 1947

Genus: Pilaspora (al. Pilasporites) Balme and Hennelly, 1956

Type species: Pilasporites calculus Balme and Hennelly.

Diagnosis: Circular, sub-circular to oval outline; lacking haptotypic markings, although exine may be irregularly ruptured, exine smooth, granulate or microreticulate.

Pilaspora calculus Balme and Hennelly, 1956

Plate 5: figures 1, 2.

Holotype: Pilasporites calculus Balme and Hennelly, 1956, Plate 3: figures 60-64.

Diagnosis: Circular outline; exine differentially thickened on one hemisphere. Sculpture laevigate, granulate or finely reticulate.



Description: Shape: Circular to sub-circular with occasional compressional folding.

Exine: Devoid of any true haptotypic markings; random rupturing resulting in splitting of

Author Falcon R M S (Rosemary Margaret Sarah)
Name of thesis Preliminary Study Of The Karroo Palynology In The Mid-zambezi Basin, Rhodesia. 1972

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