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

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Discussion: The distinction between genera and species within the triangular forms of cingulati (bearing sculptural elements ranging from grani, micro-baculli, micro-verrucae to distinct baculli and verrucae) is often difficult and subjective. Small sculptural elements may not be distinguished easily and the transitions between the distinct forms is frequently difficult to delineate. It is hoped that extensive taxonomic and systematic research which is currently being conducted (J. Anderson, Ph.D. thesis) will improve the existing state of confusion.

The Rhodesian forms encountered within the present borehole core exhibit the characteristic transitional trends. Therefore only those forms which represent distinct end points (with features distinguishable from other groups) are described here. Granulatisporites tentula is tentatively recombined here in order to group similar sculptural elements together. All features of this group agree with Microbaculatisporites tentula but the sculptural elements are more granulate than baculate. Lacinitriletes minutus Venk. and Kar may well be synonomous, with distally concentrated micro-verrucate elements.

Granulatisporites granulatus Ibrahim may also be a junior synonym as it possesses fine, regularly spaced grani less than 1 µ apart. The sides are, however, more or less concave. G. parvus (Ibrahim) Potonie and Kremp, 1955 possesses bulging sides but similar ornamentation. G. trisinus Balme and Hennelly is larger and has a thick exine; whilst G. papillosus Hart, 1965 bears slightly larger grani (1-2 µ diameter).

Genus: Lophotriletes (Naumova) emended Potonie and Kremp, 1954

Type species (by subsequent designation): Lophotriletes gibbosus (Ibrahim) Potonie and Kremp, 1954.

Diagnosis: Apiculatisporis Potonie and Kremp, 1956 has a circular to sub-circular outline; whilst Acanthotriletes (Naumova) Potonie and Kremp has a triangular outline but spinate ornamentation.

Lophotriletes sp.

Plate 3: Figures 16, 17

Description: Shape: Triangular with broadly rounded apices, and straight to concave sides.

Trilete suture: Rays are straight, usually distinct, extend the full radius of the spore, and lack labra.

Exine: Thin, about 1 μ thick, bearing coarse, large coni, circular to sub-circular in plan, and coarsely conate (with rounded domes to sharp apices) in profile. Elements are fairly evenly spaced and occur both proximally and distally. Coni basal diameter: 2-4 μ; height: 2-6 μ; and 2-5 μ apart.

Dimension (8 specimens): Diameter: 42-52 μ.

Discussion: Lophotriletes sp. differs from Acanthotriletes tereteangulatus Balme and Hennelly due to the conate as opposed to spinate sculpture. Lophotriletes rarus Kharadwaj and Salujha is closest in comparison to the above species as both possess concave triangular outline, with irregularly spaced coni. L. rarus does possess a faint to distinct kyrtome, smaller size and smaller coni, and reduced proximal sculpture.
The Rhodesian forms vary greatly in size and some of the very small specimens do possess the features of L. rarus. These are extremely rare and warrant further investigation. The specimens described here are distinguished from the former group basically on size.



Distinction: Lophotriletes sp. is distinct from other species in being large, triangular, with concave sides and in possessing large coarse regularly distributed coni.

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

Genus: Microbaculatisspora Kharadwaj, 1962

Type species: Microbaculatispora gondwanensis Kharadwaj

Diagnosis: Triangular in outline with rounded apices and convex sides. Trilete rays are distinct and the labra thin and may form crested laesurae. Sculpture consists of uniformly spiral and even-sized baculli distally concentrated with a laevigate proximal contact area.

Microbaculatispora microndosus (Balme and Hennelly, 1956) nov. comb.

Plate 2: Figures 17-20

Holotype: Granulatisporites microndosus Balme and Hennelly, Pl. 1, figures 9, 10.

Diagnosis: Triangular outline, sides straight or slightly convex, trilete rays straight, extending full radius. Exine thin, distally ornamented with rounded microverruci about 2 μ in diameter, 2 μ high and 2-3 μ apart. Proximal surface is laevigate or with reduced sculpture.



Description: Shape: Triangular, sides straight to slightly convex; polar to off-polar compressions common.

Trilete suture: Rays are straight and extending the full spore radius, often associated with folds, labra often indistinct but may be present as thin raised folds.

Exine: Thin and often folded; bearing regularly spaced elements which are round in plan and may be parallel-sided and flat-topped (baculli) or semi-elongated and rounded (grani) in outline. Sculptural elements are about 1-2 μ in diameter, 1-2 μ high and 1-3 μ apart; concentrated distally and marginally on the proximal hemisphere, with reduced elements or laevigate contact area.

Dimensions (10 specimens): Diameter: 36-50 μ.

Discussion: M. microndosus is very similar to G. pavillosus Hart, 1965 in size, outline, suture length and sculpture. In the latter species, however, the sculptural elements are slightly smaller, 1-2 μ in basal diameter and 1-2 μ apart, and are not distally concentrated (sensu Hart, 1965 p. 152). It is suggested that

G. papillosus is a transition form and that although the dimorphic condition is not originally described, it may well exist. In this case this species would seem to be superfluous.

Distinction: M. micronodosus is distinct from other species in possessing distinct, round regular baculli and grani sculptural elements of about 2 μ in height, diameter and distance apart.

Stratigraphic range: Absent in Dwyka, very rare to rare in Black Shales and Coals; and rare to common in Madumabisa Mudstones, (particularly the Lower Horizons).

Genus: Acanthotriletes (Naumova) Potonié and Kremp, 1954

Type species (by subsequent designation): Acanthotriletes ciliatus (Knox) Potonié and Kremp, 1954.

Diagnosis: Triangular in outline; the sculpture consists of spini the height of which is greater than twice the basal diameter.

Acanthotriletes tereteangulatus Balme and Hennelly, 1956.

Plate 3: figures 14, 15.

Holotype: Acanthotriletes tereteangulatus Balme and Hennelly, 1956, Plate 2: figure 29.

Diagnosis: Outline is roundly triangular, with rounded apices and concave sides. Trilete rays are straight and extend almost to the equator. Sculpture consists of spini 1-4 μ high and about 2 μ in basal diameter, irregularly spaced.



Description: Shape: Triangular, with broadly rounded apices and concave sides.

Trilete suture: Rays are straight occasionally [illegible] rays and extend almost to the [illegible] margin (equator). No labra.

Exine: Thin, proximally and distally bearing predominantly spines and a few conas, 1-2 μ in basal diameter and rounded in plan; 3-4 μ high with narrow blunt or pointed apices. Sculptural elements irregularly spaced relative to one another, and 2-4 μ apart.

Dimensions (10 specimens): Diameter: 35-46 μ.

Distinction: A. tereteangulatus is distinct from other species in possessing a concave-sided triangular outline.

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

Acanthotrilates tereteangulatus Balme and Hennelly, forma minor forma nova

Plate 3: figures 10, 11.

Diagnosis: The outline, sculptural features and trilete suture are identical to A. tereteangulatus Balme and Hennelly. The size range is smaller (22-30 μ).



Description: Shape: Triangular, with usually concave and occasionally convex sides.

Trilete suture: Rays often indistinct, extending almost to periphery of spore. No labra seen.

Exine. Bears irregularly spaced spini distributed both proximally and distally. Spini about 1 μ thick basally, 2-4 μ high and 1-3 μ apart.

Dimensions (8 specimens): Diameter: 21-29 μ.

Discussion: This forma differs from A. tereteangulatus only in its size. This separation is proposed tentatively, and mainly for practical purposes but may be deemed unnecessary at a later stage.

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

Genus: Reinschospora Schopf, Wilson and Bentall, 1944

Type species: R. bellitas Bentall (in Schopf, Wilson and Bentall, 1944)

Diagnosis: Outline is triangular to roundly triangular, with convex, straight slightly concave or strongly concave sides. The trilete sperture is long, labra are indistinct to moderate; spore equator is surrounded by a fimbriate flange that has a maximum length interadially. The fimbriae or setae may not be united by a flange, but exist separately; and thus may be simple, bifuncating or pillate in shape.

Discussion: Playford (1963) and Segroves (1969) discuss Reinschospora and Diatomozonotriletes Naumova amend. Carboniferous miospores bearing baculli or coarse setae along the interradial equatorial zones, whilst those forms assigned to Reinschospora occur in the Upper Carboniferous and bear fine setae or fimbriae interadially. The Rhodesian forms are tentatively assigned to Reinschospora due to their similarity in structure.

Reinschospora sp.

Plate 3: figures 1-6

Description: Shape: Triangular to roundly triangular in overall outline. Apices are broadly to moderately rounded, and sides of the spore body proper are straight to slightly concave or convex.

Trilete suture: Rays extend almost to the margin of the spore; are straight to sinuous and are bordered by 3 µ high, narrow ribbon-like labra.

Exine: Equatorially an interradial or inter-apical flange bearing 10-12 fine spini within it exists. The flange width and length of spini shorten towards the apices. Alternatively, similar forms bear one row of 10-12 spini inter-apically without a distinct flange enclosing them. The proximal surface of the spore is laevigate, whilst the distal surface bears scattered small spini and coni, rounded in plan with sharply pointed apices.

Dimensions (6 specimens): Diameter: 26-35 µ; maximum flange width: 5 µ; equatorial spini height: 1-4 µ; basal diameter: 1 µ.



Discussion: R. plumsteadi Hart, 1963 differs in having 2 rows of interradial projections, whilst Diatomozonotriletes townrowii Segroves, 1970 bears a single row of 10-27 baculi in the place of the equator.

Genus: Neoraistrickia Potonié, 1956

Diagnosis: Trilete spores, triangular in outline with sculpture of pilli and baculli.

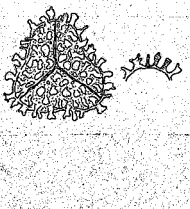
Synonyms: Acanthotriletes (Naumova) Potonié and Kremp, 1956 partim.
Horriditriletes Bharadwaj and Salujha, 1964.

Neoraistrickia ramosus (Balme and Hennelly) Hart, 1960, Plate 3: figures 18, 19.

Holotype: Acanthotriletes ramosus Balme and Hennelly, 1956, Plate 3: figure 39.

Synonym: Horriditriletes ramosus (Balme and Hennelly) Bharadwaj.

Diagnosis: Triangular in outline in rounded apices and slightly convex sides: Trilete rays extend almost to the equator; sculpture consists of coarse baculli or pilli which often bifuncate at the apices and occasionally join at the bases. Sculptural elements are 2-5 μ in basal diameter, 2-7 μ high and they are spaced irregularly and greater than their basal distance apart.



Description: Shape: Triangular with apices broadly rounded and sides straight to slightly convex or concave.

Trilete suture: Rays are usually thin, indistinct, extend about 2/3 or ¾ spore radius and are non-labrate.

Exine: 2 μ thick, finely granulate with well-spaced irregular large prominent pilli, and baculli, with occasional setae and spini. Processes are frequently jointed, and may bifurcate at the tips into 2 or 4 minor processes or join at their bases: length of processes: 4-10 μ; basal width: 2-6 μ; distance apart: 4-10 μ.

Dimensions (10 specimens): Diameter: 34(60)70 μ.

Discussion: The Rhodesian forms show a wide variety or coarse large sculptural elements and include a fairly wide size range which could possibly be divisible at some later date. Forms identical in all respects bar size to those originally described by Balme and Hennelly are included. This species is distinct from all other species by virtue of its sculptural elements.

Distinction: M. ramosus is distinct in possessing very large baculli and pilli coarsely and irregularly distributed.

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

Neoraistrickia sp.

Plate 3: figures 12, 13.

Description: Shape: Triangular, with apices bluntly rounded; sides straight to concave or slightly convex.

Trilete suture: Usually distinct, sometimes obscured by sculptural elements; rays straight extending $\frac{2}{3}$ spore radius, when open, the rays taper terminally. Lips of rays may be slightly swollen, but distinct labra not visible.

Exine: 1-2 μ thick, bearing predominently pilli with baculli and occasionally spini, irregularly distributed and well-spaced. Apices often swollen rounded or truncated, with parallel to concave sides. Length of processes: 2-4 μ; basal diameter: 0,5-1; apical diameter: 1,5-2 μ; width apart: 1-4 μ; 13-26 elements seen in outline. Occasionally

coulpture reduced proximally.
Inter-baculate space laevigate.
Dimensions (10 specimens): Diameter:
30(36)42 µ.



Discussion: Neoraistrickia congoensis Kar and Bose, 1967 is closely comparable to this species in all respects bar the predominantly baculate sculptural elements. These forms may well be assigned to this species: N. ramosus (Balme and Hennelly) Hart possesses coarse and often complex sculptural elements. N. abruptus (Andreyeva) Hart and N. multangulus (Andreyeva) Hart differ in having roundly triangular and strongly convex sides; whilst N. cornutus (Andreyeva) Hart may well be synonomous but is separated from N. congoensis and the Rhodesian forms on the basis of greater irregularity of distribution of the baculi.

Distinction: Neoraistrickia sp. is distinct in possessing a strongly triangular outline with concave sides, and small, sparce irregularly distributed pilli.

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

Genus: Reticulatisporites Potonie and Kremp, 1954

Type species (by original designation): R. reticulatus Ibrahim, 1933

Diagnosis: Circular in outline; trilete suture is present; exine bears strong reticulate ornamentation covering both proximal and distal faces.

Discussion: Dictyotriletes (Naumova) Potonie and Kremp, 1955 is often confused with Reticulatisporites as both possess strong reticulation. However, the type species of the former genus has low muri and dimorphic ornamentation (laevigate proximal surface, ornamented distal surface). These features are not included in the generic diagnosis, so strictly speaking the only difference between the two genera is the height of the muri. As the rare Rhodesian specimens appear to be evenly ornamentated over the entire surface with darkened relatively high narrow muri, the genus Reticulatisporites is retained.

Reticulatisporites compactus (Luber and Waltz, 1941) Hart, 1965

Plate 2: figure 8.

Holotype Zonaletes compactus Luber and Waltz, 1941, Plate XIII: figure 210.

Diagnosis: Circular to oval in outline. Trilete rays extend less than ½ radius and have thin labra. Lumen are distinct and the muri form a polygonal pattern (5-6 angles).



Description: Shape: Circular to sub-circular.
Trilete suture: Indistinct, but where discernible are about 1/3 radius of body, with thin raised and darkened labra.
Exine: Lumen are distinct, muri darkened, narrow and up to 3 μ high, 1 μ or less broad and joined forming polygonal lumen (5-7 angles). Lumen 2-5 μ broad.
Dimension (4 specimens): Diameter: 26-36 μ.

Stratigraphic range: Rare in Dwyka; absent in remaining sediments.

Genus: Baculatisporites Thomas and Pflug, 1953

Synonym: Crolebaculisporites Bharadwaj, 1955

Diagnosis: Apiculate trilete spores which are circular in outline, bearing baculate or setate sculptural elements.

Baculatisporites sp. cf. B. Bharadwaji Hart, 1965

Plate 2: figure 7.

Description: Shape: Circular to sub-circular, frequently folded.

Trilete suture: Indistinct, but where discernible is about $\frac{2}{3}$ spore radius.

Exine: Thin (0,5-1 μ thick) bearing narrow short pilli or seti regularly disposed over the entire surface; height of elements is about 1,5 to 2 μ and basal width 0,5-1 μ, the basal diameter usually equals the apical diameter. Elements usually 2 μ apart.

Dimensions (8 specimens): Diameter: 45-82 μ.



Discussion: Reculatisporites sp. cf. R. bharadwaji is assigned due to the similar size range and sculptural features; however, due to the usually folded and indistinctly featured forms of this pollen, the nesing may be amended.

Distinction: R. sp. cf. R. bharadwaj is distinct from other species by possessing a characteristic shape of pilli and sculpture and indistinct trilete sutures.

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

Genus: Verrucosisporites Ibrahim, amended Smith and Butterworth, 1964.

Type species: Verrucosisporites verrucosus Ibrahim.

Diagnosis: Circular to sub-circular outline with a trilete suture; sculpture is verrucate; verrucae are usually closely set, larger and irregular in comparison to grani; height of verrucae is truncate; but the shape is variable in profile, from about parallel-sided to slightly rounded or tapering. In plan the verrucae may be irregular in outline, round, polygonal, elongated or indented.

Verrucosisporites parmatus Balme and Hennelly, 1956

Plate 2: figures 26, 27.

Holotype: Verrucosisporites parmatus Balme and Hennelly, 1956, Plate 5: figures 51, 52.

Diagnosis: Circular to sub-circular outline; trilete rays straight, extending to margin of spore, with a distinct proximal area; exine thin, distally ornamented by rounded verrucae 2-5 μ in basal diameter, about 2 μ high and 3-4 μ apart. Laevigate proximal surface, (size 32-52 μ).



Description: Shape: Circular to sub-circular in outline.
Trilete suture: Straight, usually distinct, extending full radius of the spore; up to 4 μ wide when open, but closing to a sharp apex terminally; sides of open rays without labra and frequently slightly scalloped or slightly sinuous.
Exine: Distinct laevigate to faintly granulate proximal surface, with verrucate distal surface. Curvaturae may be present proximally; verrucae coarse rounded, irregularly spaced, 2-4 μ in basal diameter, up to 2 μ high and 2-4 μ apart.
Dimensions (10 specimens): Diameter: 25-44 μ.

Discussion: Apiculatisporis levis Balme and Hennelly differs from V. parmatus in possessing smaller conate sculptural elements. Other verrucosisporites species lack a laevigate proximal contact area.

Distinction: V. parmatus is distinct from other species in possessing a smaller size, verrucate sculptural elements and a proximal contact area.

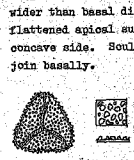
Stratigraphic range: Rare in Dwyka sediments; very rare in Black Shales and Coals; absent in Madumabisa Mudstones.

Verrucosisporites naumovai Hart, 1963

Plate 2: figures 24, 25.

Holotype: Verrucosisporites naumovai Hart

Diagnosis: Roundly triangular in outline, with convex sides, trilete sutures extend almost the complete radius. Sculpture consists of large verrucae or pilli with apical diameter wider than basal diameter; rounded or flattened apical surface and straight or concave side. Sculptural elements do not join basally.



Description: Shape: Roundly triangular, with blunted well-rounded apices and slightly convex sides.

Trilete sutures: More or less straight, extending almost to the margin and associated with exinal folds. Labra are indistinct and usually absent.

Exine: Sculpture consists of large simple verrucate, baculate or pillate elements which may have an apical diameter equal to or greater than basal diameter, rounded or truncated apices and parallel, narrowing or concave sides. The elements occur fairly regularly over the proximal

and distal surfaces, but are irregularly spaced relative to one another; sculptural elements:- basal diameter: 2-3 μ; height: 2-3 μ; space between 2-3 μ.

Dimension (5 specimens): Diameter: 45-65 μ.

Discussion: V. naumovai originally described by Hart from Tanzania, is larger in size with more closely spaced sculptural elements; the Rhodesian forms overlap the features attributable to this species but do possess a lower size range.

V. pseudoreticulatus Balme and Hennelly possesses sculptural elements coalescing at their bases; V. parmatus Balme and Hennelly has a distinct contact area whilst in V. trisectus the outline is circular and the sculpture densely spaced small verrucae.

Distinction: V. naumovai is distinct in being roundly triangular, and possessing simple, large discreet and separate verrucate - pillate sculptural elements.

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

Verrucosisporites sp. cf. V. pseudoreticulatus Balme and Hennelly, 1956

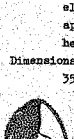
Plate 2: figures 21-23.

Description: Shape: Roundly triangular, with rounded apices and convex sides.

Trilete suture: Rays straight and extending almost to the margin of the spore. Darkened, thin labra are frequently associated with the rays, together with exinal folding.

Exine: Thin, bearing densely but evenly spaced regular verrucae which often join and anastomose at their bases to form a coarse "pseudoreticulum". Proximal face often shows reduced sculpture. Verrucae are usually polygonal in plan with characteristic pale dots seen centrally on each element; in profile elements may be flat-topped or rounded, and bear parallel, sloping or concave sides - i.e. mostly verrucae with pillate or baculate elements. Sculptural elements apical diameter: 1-2,5 µ; height: 0,5-2 µ; 0,25-0 µ apart.

Dimensions (10 specimens): Diameter: 35(40)48 µ.



Discussion: The Rhodesian forms are closely comparable to the Australian forms in every respect bar size - the mean size of the latter is 81 μ, and the former 45 μ. Sculptural elements are particularly similar. However, only a tentative assignation is made due to the *size discrepancy*. *V. waovai* differs due to separate and more widely spaced sculptural elements. These do not join so profusely and lack regular polygonal outlines characteristic of *V. pseudoreticulatus*.

V. trisectus Balme and Hennelly, 1956 is circular in outline, and bears larger semi-spherical verrucae.

Distinction: *V. sp. cf. V. pseudoreticulatus* is distinct in bearing a roundly triangular outline, and regular, polygonal, anastomosing verrucae.

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

Verrucosisporites sp. A.

Plate 2: figures 28-30.

Description: Shape: Circular in general outline, characteristic folding in half results in an oval outline with pointed ends and darkened on one side; random and parallel folding also occurs.

Trilete suture: Indistinct, where discernible rays are narrow, ½ to entire spore radius in length, with thin dark labra.

Exine: Thin, bearing densely spaced verrucae, semi-circular to angular in plan, and truncated and low in outline. A pseudo-reticulum is apparent. Verrucae are 1-2 μ in basal width, and less than 1 μ high.

Dimensions (8 specimens): Diameter: 42-60 μ.



Discussion: V. sp. A. is very similar to V. trisectus Balme and Hennelly in that the trilete rays may be very long, and the exine dense with closely spaced usually semi-circular verrucae of varying sizes. The Rhodesian forms are, however, smaller in size with generally smaller verrucae. They differ from V. pseudoreticulatus Balme and Hennelly in being circular in outline.

Distinction: V. sp. A. is distinct in being circular to sub-circular, with characteristic folding, and small closely spaced semi-spherical to semi-angular low verrucae.

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

Verrucosisporites sp. B.

Plate 2: figures 31, 32.

Description: Shape: Circular to roundly triangular, frequently randomly folded and torn.

Trilete suture: About $\frac{2}{3}$ to entire radius of spore in length; narrow and indistinct when closed, peeling backwards and revealing a broad triangular opening when open. Labra very thin darkened lips framing suture.

Exine: Bears large verrucae, semi-angular to irregularly rounded and elongated in plan, the narrow white exposed outline forms a regular reticulate pattern. In outline the verrucae are generally very flattened with softly rounded domes. Verrucae basal diameter: 2-5 μ; height: 1 μ or less; and less than 1 μ apart.

Dimension (6 specimens): Diameter: 34-55 μ.



Discussion: V. sp. B. is similar to V. pseudoreticulatus Balme and Hennelly but it has a smaller size with larger verrucae and no anastomosing between them. V. triesectus Balme and Hennelly is larger than the Rhodesian forms but is otherwise comparable to the present specimens.

Distinction: V. sp. B. is distinct in bearing large semi-angular low-domed verrucae.

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

Turma: ZONALES (Bennie and Kidston, 1886) R. Potonie, 1956

Sub-turma: ZONOTRILETES Waltz, 1935

Infra-turma: ZONATI Potonie and Kremp, 1954

Genus: Cirratriradites (Wilson and Coe) Potonie and Kremp, 1935

Type species (by original designation): C. maculatus Wilson and Coe, 1940.

Diagnosis: Zonate trilete spores with continuous equatorial flanges and radial wedge-shaped thickenings on the zona; flat-topped verrucae, coni and grani are also sculptural elements associated with the spore body and usually irregularly spaced and may be distally concentrated. Body ornamentation may also be laevigate or punctate.

Discussion: Kraeuselisporites Leschik emend. Jansonius, 1962 has been discussed at length by Dettman (1963), Balme (1966) and Playford (1962) et al. It is characteristically a Triassic genus bearing a number of features common to Cirratriradites and including cavate and acavate forms. The latter genus is a common Devonian and Carboniferous form. For the purpose of this thesis all forms possessing the above diagnosis are included in

Cirratriradites, following the Permian systematics of Hart, 1965, (although both genera would appear to be synonomous and only divisible by age). Indotriradites Tiwari is considered (Balme, 1966) to be synonomous with Kraeuselisporites, but if splitting were to occur Indotriradites would include cavate forms and Kraeuselisporites the acavate forms. Hymenozonotriletes Naumova, 1953 includes a large group of cavate forms most of which are re-assignable. Richardson (p. 218, in Tschudy and Scott, 1969) regards this genus as including coarse forms with a distinct pseudosaccus with a series of irregular to sub-circular pits in the pseudosaccus wall. These forms are characteristically Devonian to Carboniferous.

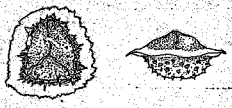
Distinction: Cirratriradites is distinct in possessing a roundly triangular outline with a broad thin continuous equatorial flange.

Cirratriradites africanensis Hart, 1963

Plate 4: figures 1-7.

Holotype: Cirratriradites splendens forma africanensis Hart, 1963, Plate I: figure 8.

Diagnosis: Triangular outline, with continuous equatorial zone; central body without favolae; sculpture consists of small dense coni and grani, concentrated more prominently on the distal surface.



Description: Shape: Sub-circular to roundly triangular; distal face of spore hemispherical and proximal face flattened pyramidal.

Trilete suture: Rays faint to indistinct, straight to sinuous, and extending to inner edge of zona (i.e. on central body only). Thin, narrow, raised labra in the form of lips often frame the sutures, about 1-3 μ wide, highest at the proximal pole.

Exine: The cavate or scavate nature of the spores in this species is difficult to assess due to the ornamental nature of the exine. Zona is continuous equatorially, $\frac{1}{4}$-$\frac{1}{3}$ width of spore radius, and has a thin almost indistinct jagged margin. Outer 2/3 of zona transparent to translucent, inner $\frac{1}{3}$ or $\frac{1}{4}$ is darkened and usually contains narrow radially arranged separated pointed rods. Exine on

proximal surface of spore body is finely granulate, occasionally with small, well-spaced darkened grani or coni; distally the exine bears numerous random small coni or grani, 1-2 μ in basal diameter and 1-2 μ in height, and 2 μ or less apart. Exine sculpture between elements is granulate.

Dimensions (18 speci s): Total diameter: 40(55)75 μ; spore body diameter: 40-55 μ.

Discussion: Cirratriradites australensis Hart, 1963 is distinct from the above species in possessing well-spaced and larger coni; E. ornatus (Luber and Valts) Hart and C. splendens (Balme and Hennelly) amend. Hart, 1963 bear tuberculate and verrucate processes respectively on the spore body. Kraeuselisporites niger Segroves is closely comparable in that the proximal body exine is micro-reticulate with grani, verrucae, cones and spines distally. These sculptural elements are, however, confined to an area near the inner margin of the zona on the distal face. Indotriradites korbaensis Tiwari appears to differ only in having coarser and more sharply pointed sculptural elements.

whilst Indotriradites gercenierii Kar and Bose from the Congo is closely comparable in all features bar small verrucate sculpture. This may be considered synonomous.

Indotriradites reniformis Kar and Bose, 1967 possess granulose-micro-verracose sculpture on the distal surface. The Rhodesian specimens are fairly variable within the above diagnosis, thereby including a number of the above form species. Further division as followed by the Indian authors in the Congo is deemed premature at this stage.

Distinction: Cirratriradites africanensis is distinct from other species in bearing coni and grani predominantly concentrated distally.

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

Infra-turma: CINGULATI Potonie and Klaus

Genus: Zinjispora (Hart, 1963) Hart, 1965

Type species: Zinjisporites zonalis (el. Zinjispora) Hart, 1963, text - figure 8, Plate 1: figure K.

Diagnosis: Circular to roundly triangular in outline; trilete sutures extend almost to the spore equator (periphery of the central body). Sculpture consists of elements that coalesce at their bases to form dual, treble, or multiple processes with serrated crests, rarely singular. Ornamentation is concentrated around the equator where the compound elements fuse at their bases to form an almost continuous zone; the resulting structure is termed a "pseudo-cingulum".

Distinction: The equatorial concentration of multiple elements distinguishes this genus from others. Lukugaspories Kar and Bose, 1967 is an Azonotrilete form bearing laevigate proximal exine and a strongly spinate distal exine. Dentatispora Tiwari, 1964 is cingulate and cavate, with laevigate proximal exine and baculate distal exine. The problems of cavate and acavate forms in the genus Zinjispora is not discussed by Hart; therefore those forms assigned to this genus in this thesis are done so on the grounds of sculptural elements only. The pseudo-cingulate group is very

varied and diverse and awaits a comprehensive delimitation of species and morphological analysis.

Zlutiispora bullata (Balme and Hennelly) Hart, 1965

Plate 4: figures 11, 12.

Synonym: Verrucosisporites bullatus Balme and Hennelly, 1956, Plate 4: figure 46.

Diagnosis: Roundly triangular spore, with a distinct central body. Trilete sutures straight, indistinct, extending to margin of the central body. Sculptural elements on central body and pseudo-cingulum consist of bulbous elements constricted at their bases (pilli).



x 600

Description: Shape: Roundly triangular to sub-circular; sides strongly convex.

Trilete suture: Rays are indistinct, straight, non-labrate and extend to spore body margin.

Exine: Faintly granulate between the processes, exinal processes are distinct and separate, rounded, dark and bulbous basally constricted; proximally and distally well-separated and unjoined;

equatorially these bulbous elements are joined along their bases and "necks", and are more concentrated in number: basal diameter 1-2 μ; apical diameter: 2-5 μ; height: 3-4 μ.

Dimension (8 specimens): Diameter: 38-58 μ.

Distinction: Z. bullata is distinct from other species by its pillate sculpture and equatorial pseudo-cingulum composed of these elements more densely spaced and joined.

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

Zinjispora eccensis Hart, 1965

Plate 4: figures 15, 16.

Holotype: Zinjisporites eccensis Hart, 1965, Plate 1: figure 12.

Diagnosis: Circular to roundly triangular in outline, with an indistinct central body. Trilete sutures are straight and extend the complete radius of the central body and often onto the pseudo-cingulum. The sculptural elements are densely spaced and very rarely simgular. 45-55 individual elements are seen marginally.

Description: Shape: Roundly triangular with convex sides; an indistinct inner central body is often seen, illustrating the cavate nature of these forms. Proximal hemisphere is raised and pyramidal, the distal rounded and semi-spherical.

Trilete suture: Is distinct, darkened and raised, and extends almost onto the pseudocingulum. It may be straight or slightly sinuous.

Exine: Covered in densely spaced small apiculate elements with sharp apices. Sculpture is slightly reduced proximally, but dense distally and fuse and dense equatorially. Elements are spinate in shape, 1 μ or less in basal diameter; 2-3 μ high and 0,25 μ or less apart proximally and distally. Equatorially these elements are fused about half their length.

Dimension (20 specimens): Diameter: 31(44)58 μ.



Discussion: The Rhodesian specimens are most distinctive in their relatively small size and hedge-hog like sculpture. Photographically the holotype is not clear and therefore not absolutely comparable, but in descriptive analysis this form species agrees with Z. eccensis. It may, however, be divisible at a later date.

Distinction: Z. eccensis is distinct in possessing densely spaced sculptural elements.

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

Zinjisporn zonalis Hart, 1965

Plate 4: figures 13, 14.

Holotype: Zinjispcrites zonalis Hart, 1964, Plate 1: figure 11.

Diagnosis: Roundly triangular in outline with a distinct central body, trilete sutures straight and do not extend onto pseudo-cingulum. Sculptural elements are not densely spaced, occurring as single or dual elements on the polar regions of the central body and usually multiple elements around the equator. Between 35 and 55 individual elements are observed around the margin.



Description: Shape: Sub-circular to roundly triangular, with sides strongly convex; an inner body is occasionally seen in cavate forms.

Trilete sutures: Distinct to indistinct, darkened, raised, straight and extending to the spore body margin, sometimes framed by thin narrow dark lip-like labra.

Exine: Proximally may be granulate and slightly reduced in sculptural *elements*. Whilst distally large rounded separate and distinct conate and verrucate elements occur, often anastomosing at their bases; fine granulate ornamentation exists between the elements. Equatorially these processes fuse to form a denser conglomeration of elements or a "pseudo-cingulum". Elements are usually simple and unbranched although equatorially the fusion of their bases may extend more than

half way up their length giving rise to a pseudo-flange. Processes 2-4 μ in plan and up to 7 μ in length, 36-50 seen in outline.

Dimension (20 specimens): Diameter: 34(45)58 μ.

Distinction: *Z. zonalis* is distinct from other species in possessing usually simple unbranched sculptural elements which are joined into multiple, flanged elements equatorially.

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

Genus: Densosporites (Berry) Potonié and Kremp, 1954

Type species: Densosporites covensis Berry, 1937

Diagnosis: Circular to roundly triangular in outline; with distinct or indistinct trilete suture; ornamentation is laevigate, granulate, punctate, or spinate. Structure includes a thin wedge-shaped body, with a distinct equatorial thickening or cingulum.

Discussion: The Rhodesian forms are tentatively assigned to this genus on the basis of the broad thick cingulum; the structure of the central body is, however, not thin. Lycospora Schopf, Wilson and Bentall is generally smaller in size but may be a more suitable genus. Densosporites Weyland and Krieger and Lumbladispora Balme are described by Chaloner (in Tschudy and Scott, 1969, p. 299) as possibly cavate, saccate and having mesosporous wall structure. Aratrisporites Leschik bears a monolete mark, whilst Crassispora Bharadwaj, 1957 has a dark equatorial crassitude in the form of a ring structure.

Densosporites sp.

Plate 4: figures 17-19.

Description: Shape: Roundly triangular, with apices bluntly to sharply rounded; sides are almost straight to convex. Inner body not seen.

Trilete suture: Distinct, extending to inner margin of cingulum framed by thickened, sausage-like labra up to 8 μ wide and 5 μ high.

Exine: Proximal exine is coarsely granulate to finely reticulate, distal exine is coarsely granulate with irregular large verrucae up to 8 μ in basal diameter and 3 μ high. Cingulum is dark, dense and infra-punctate with smooth to slightly undulate margin; 6-8 μ thick, and 3-8 μ wide; less than ½ total spore radius. Cingulum usually equally broad all round, but occasionally thickened apically and slightly reduced interradially.

Dimensions (15 specimens): Diameter: 45(56)84 μ.



Distinction: Densosporites sp. is distinct from all other cingulate species in having relatively large size, dense cingulum and labra, and coarse granulate proximal exine, with coarse verrucate exine distally.

Stratigraphic range: Absent in all beds bar the upper levels of the Black Shales and Coals.

Infra-turma: CAVATI I.U.M.P., 1962

Genus: Gondisporites Bharadwaj, 1962

Type species: Gondisporites raniganiensis Bharadwaj, 1962.

Diagnosis: Roundly triangular to sub-circular in outline; denticulate thin zona or ridge surrounding sub-equatorially a large central body which has a small inner body; the spore body (bar the zona or ridge) is doubly sculptured with granulate surface bearing spini or baculli. Zona or ridge is thin, transparent and dentate. Inner body is small, sac-like and a darker colour than the enveloping spore body.

Discussion: Cirratriradites is similar except that it is apparently acavate, and does not possess marked double sculpture on the body exine; Endosporites has no external ornamentation and no zona (the saccus is collumellate). Grandispora has no zona and is geographically and stratigraphically far removed. (Gondisporites is described from the Upper Permian of India, whilst Grandispora is typically Carboniferous). Hymenozonotriletes and Vallatisporites have no fringe-like processes in the zona and are both typically Carboniferous.

Distinction: Gondisporites is a cavate trilete spore with an inner body, double sculpture on the cava and a zona or ridge equatorially attached.

Gondisporites sp. cf. G. wrystaatensis (Hart) Hart, 1965

Plate 4: figures 8-10.

Description: Shape: Roundly triangular, sides strongly convex.

Trilete suture: Usually distinct, straight to sinuous extending to edge of zona, across cava. Labra indistinct sometimes present in the form of narrow raised parallel lips.

Exine: Zona is narrow, translucent along the outer edges becoming darker inwardly, and has a dentate margin. Zona width is less than $\frac{1}{4}$ radius of spore and has finely granulate sculpture with occasional spini. Cava exine is equally finely granulate, with regularly dispersed spini, 1-1,5 μ in basal diameter, 3-4 μ high, sharply pointed; and 2-4 μ apart. Proximal sculpture slightly reduced.

Dimension (6 specimens): Total diameter: 30-48 μ; central body diameter: 20-26 μ.



Discussion: G. sp. is closest to G. vrystaatensis but insufficient photographic comparison of the holotype is available.
G. ranigangensis Bharadwaj, 1962 is larger in size with granulate and baculate exine sculptures.

Distinction: G. sp. is typically cavate, with a trilete suture extending into the cava, and double sculpture covering the spore.

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

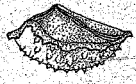
Gondisporites novus sp. nova

Plate 4: figures 20-22.

Holotype: Plate 4: figure 20.

Diagnosis: Roundly triangular to sub-circular outline, with trilete sutures prominent and extending onto the cava and zona. Inner central body usually indistinct; zona equatorially attached around cava; exine of zona and cava basically granulate, with coarse, short dense conate elements distally concentrated.





Description: Shape: Roundly triangular, frequently compressed into rhomboid and rectangular outlines; sides strongly convex.

Trilete suture: Indistinct to darkened and distinct; suture narrow but often slightly open, sinuous, framed by thin narrow lip-like labra; extends over cava onto zona, bifurcating into short arcuate curvatures.

Exine: Proximal exine of cava and zona finely granulate to micro-reticulate; distal exine equally finely granulate with irregularly but densely spaced, coarse, broad based coni bearing sharp spices; basal diameter: 3-4 μ; height: 3-4 μ, distance apart: 1-4 μ; sculptural elements particularly dense near junction with zona. Zona less than ¼ spore radius wide (6-10 μ), margin relatively smooth to slightly undulate, slightly transparent along the outer 2-4 μ of the margin, becoming denser inwardly.

Dimension (6 specimens): Diameter: 54-94 µ.

Discussion: Gondisporites novus differs from G. raniganjensis by being smaller in size. Also G. rangantensis bears baculate sculptural elements amongst the fine granulate exine. G. vrystaatensis (Hart) Hart, 1965 is smaller and bears small slender spini.

Distinction: G. novus is distinct from other specimens in possessing coarse broad-based coni, distally concentrated.

Stratigraphic range: Absent in all beds except for the Black Shales and Coals where these forms are rare.

Ante-turma: SPORITES H. Potonie, 1893

Turma: MONOLETES Ibrahim, 1933

Sub-turma: AZONOMONOLETES Luber, 1935

Genus: Laevigatosporites Ibrahim ex. Sch.-sf, Wilson and Bentall, 1944 ex. Alpern, Doubinger and Liabeuf, 1970.

Type species: L. vulgaris (Ibrahim) Ibrahim.

Discussion: The genus Laevigatosporites is considered in the sense of Alpern, Doubinger a- Liabeuf, but the species used are of the original authors. This gen embraces Latosporites (Potonie and Kremp. 1954) and Lunulasporites Wilson, 1962.

Laevigatosporites colliensis (Balme and Hennelly) Bharadwaj, 1962

Plate 3: figure 20.

Synonyms: Laevigatosporites vulgaris forma colliensis Balme and Hennelly, 1956, Plate I: 1-5.
Latosporites colliensis (Balme and Hennelly) Bharadwaj, 1962, Plate 4: 72-74, Plate 5: 75-76.



Holotype: Balme and Hennelly, 1956, Plate I: figure 1.

Description: Shape: Elongate to roundly oval in polar view, with proximal flattening and distal depth in lateral view.

Trilete suture: Extending ½ to 2/3 longitudinal axis, thin labra frame the distinct suture in most specimens.

Exine: Thin, laevigate to finely granulate, sometimes folded, often parallel to long axis.

Dimensions (15 specimens): l-a: 70-95 μ; t-a: 65-80 μ.

Discussion: L. flexus (Segroves, 1970) possesses a distinctly concave proximal face with a pronounced convex distal face. L. callosus (Balme, 1967) shows a thick rigid exine with a "callus-like thickening" on its distal surface. L. desmoinensis (Schopf, Wilson and Bentall) overlaps in size range; whilst Leiosoccites colliensis (Bharadwaj and Hennelly) Bharadwaj, has the deeper polar axial length and is therefore in part agreement with this grouping. For ease and simplification in later emendation, all laevigate forms of this size range (50-100 μ) have been included in this species. In terms of

the new I.C.M.P. grouping of Alpern, et al., Laevigatosporites vulgaris medius is synonomous.

Distinction: Laevigatosporites colliensis is distinct in being a laevigate or infra-punctate monolete spore in the size range 50-100 µm

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

L. sp. 1.

Plate 3: figures 21, 22.

Description: Shape: Roundly oval to sub-circular.

Trilete suture: Extends ⅔ l-a of the spore with occasional exinal folds (parallel to suture) bifurcating at both ends. One or two parallel folds perpendicular to the suture appear to be characteristic.

Exine: Thin, 1-2 µ; shagrate, laevigate to faintly micro-granulate.

Dimensions (10 specimens): l-a: 20-34 µ; t-a: 15-25 µ.



Remarks: This is unlike Schizosporis scissus (Balme and Hennelly) Hart, 1965 and S. gondwanensis Hart, 1965 due to the relatively thicker exine, shorter suture, and occasionally micro-granulate sculpture. It is distinct from other Laevigatosporites species by its small size.

Genus: Punctatosporites Ibrahim, 1933

Type species: P. minutus Ibrahim.

Remark: This genus is proposed by Alpern, Doubinger and Lisbeur (1970) to include forms with punctate, gramulate and conate sculpture. The genus Granulatosporites Imgrund, 1960 therefore becomes a synonym.

Punctatosporites granulatus Imgrund, 1960

Plate 3: figures 23, 24 and 25.

Synonyms: Punctatosporites granulatus (Ibrahim, 1933).
Punctatosporites rotundatus (Ibrahim, 1933).
Punctatosporites minutus (Ibrahim) Potonie and Kremp, 1954, Plate 19: 439-41.
Punctatosporites cf. P. minutus (Ibrahim) in Balme, 1967, Plate 6: 1-3.
Tuberculatosporites modicus Balme and Hennelly, 1956, Plate 1: 10-13 (partim).

Description: Shape: Circular to roundly oval.
Trilete suture: $\frac{1}{2}$ to $\frac{3}{4}$ l-a, with no labra visible.
Exine: A relatively thick wall is apparent, which may be a pseudo-cingulum in terms of Alpern et al., but which is regarded as simple here. Sculpture small and distinctly granulate, micro-verrucose, or conate (where elements' height does not exceed basal diameter).



Dimensions (10 specimens): l-a: 25-35 µ;
t-a: 18-24 µ.

Discussion: Punctatosporites sp. (Bose and Kar, 1966) appears to be closely similar, whilst the two Punctatosporites (Merattisporites) species mentioned by Balme (P. scabratus Couper and P. walkomi de Jersey) are regarded by that author (1964) as being tentatively synonomous, their only distinction being faint or distinct, granulate sculpture. Many species have been described, all characterised by small size and granulate sculpture, and discriminated between by minor size and sculptural differences. (Balme, 1964). Alpern, Doubinger and Liabeuf (1970) base their species differentiation on three degrees of granulation.

1. Punctate exine - e.g. P. minutus,
   L. punctatus.
2. Microgranulate exine - e.g. P. granifer.
3. Granulate (or Conate) exine - e.g.
   P. granulatus,
   P. rotundus.

On this basis some specimens included in this species may be classified as P. granifer (with a micro-granulate exine) and some regrouped as P. rotundus (granulate and conate exine).

Tuberculatosporites modicus (Balme and Hennelly) partim, includes circular to oval specimens whose exines bear cones, spines and verrucae which infrequently "fuse to form a sub-reticulum". This species would, on the basis of ornamentation cover part of Punctatosporites rotundus (cones), Thymospora (verrucae) and Spinosporites (spini). At this point of study it is considered premature to re-assign the existing forms in Africa to these of Alpern et al., due mainly to lack of sufficient description in the available literature and comparative forms in Africa. The species included here, therefore are all included temporarily under P. granulatus prior to future amendation.

Distinction: Those forms assigned to P. granulatus are distinct from other monolete forms in possessing granulate or finely conate sculpture.

Stratigraphic range: P. granulatus is absent in Dwyka, very rare in Upper Black Shales and Coals; and common in Madumabisa Mudstones.

Genus: Spinosporites Alpern, 1958

Synonyms: Tuberculatosporites Imgrund in Potonie and Kremp, 1956.

Remarks: Spinosporites is regarded by Alpern, Doubinger and Lladeuf as a minor genus, with spinate elements. It is partly synonomous with Tuberculatosporites on the basis of spore sculpture - (spinal).

Spinosporites sp.

Plate 3: figures 26, 27.

Description: Shape: Reniform, elongate oval.

Trilete suture: $\frac{1}{2}$ l-a, often indistinct, non-labrate.

Exine: Thin, 1-2 u thick; sculpture is spinate with minor coni; elements are sharply pointed at the apex, height is greater than (or equal to) basal diameter. 22-28 elements are seen in outline.

Dimensions (10 specimens): l-a: 28-42 µ
t-a: 18-28 µ.



Discussion: This species is unlike Tuberculatosporites mocsaus Balme and Hennelly in that the outline is reniform as opposed to circular or generally oval. The ornamentation agrees in both.

Distinction: Spinosporites sp. is distinct in possessing spinate sculptural elements, and a reniform shape.

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

Genus: Thymospora Wilson and Venkatachala, 1963

Type species: T. thiessenii (Kosanke, 1943) Wilson and Venkatachala, 1963.

Synonyms: Verrucosisporites (Knox, 1950) Potonie and Kremp, 1954.
Polypodiisporites R. Potonie and Gelletich ex R. Potonie, 1956.
Reticuloidosporites Pflug, 1953.

Thymospora thiessenii (Kosanke, 1943) Wilson and Venkatachala, 1963

Plate 3: figure 28.

Synonyms: T. thiessenii in Alpern Doubinger, and Lisbeuf, Plate 4: 25-32.

Description: Shape: Roundly oval.

Trilete suture: $\frac{1}{2}$ l-a, no labra visible.

Exine: Uniformly covered by medium coarse irregular truncated verruci, 2-3 μ in height and 2-4 μ diameter; 25-35 elements in outline, usually individual but occasionally joined by thin reticulating "threads". The sculpture gives rise to an apparent pseudo-infrareticulate pattern.

Dimensions (15 specimens): l-a: 28-42 μ; t-a: 20-32 μ.



Discussion: This species is apparently similar to the somewhat indistinct photographs of Alpern et al., on the basis of individual verrucae and the negative pseudo-reticulum. Balme (1967) describes Polypodiisporites mutabilis (Balme) as possibly truncated and polygonal verrucae "closely and evenly spaced so that the surface of the exine appears negatively reticulate". In this case the species in question possess larger verrucae. Tuberculatosporites modicus (Balme and Hennelly) partim broadly embraces this species but the present specimens appear to be larger than those of Balme (1956, Plate I: 10-13).

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

Thymospora pseudothiessenii (Kosanke, 1950) Wilson and Venkatachala, 1963

Plate 3: figures 29-35.

Synonyms: T. pseudothiessenii in Alpern, Doubinger and Liabeuf, 1970, Plate 2: Verrucosisporites cicatricosus Balme and Hennelly (partim) 1956, Plate 1: 14-18.

Description:

Shape: Circular, roundly oval, (pear-shaped) a symmetrically oval.

Trilete suture: Usually indistinct, ½-2/3 l-a.

Exine: Apparent pseudo-cingulum composed of irregular truncated, rounded or pointed verrucae, fused to varying degrees to form irregular elongated plates. The overall effect ranges from coarsely verrucate to apico-verrucate and corrugate.

Dimensions (20 specimens): l-a: 18-34 µ; t-a: 16-24 µ.



Discussion: The degree of ornamentation varies from finely reticulate or verruco-reticulate to very coarse rugulate ornamentation. The feature common to all these forms is the verrucate pseudo-cingulum seen in most cases. Alpern et al., regard this condition to be sufficient for re-classification into the verrucate-pseudo-cingulate form genus. More detailed sub-division would be possible on the basis of size and form of verrucae, and size and shape of the spores, but poor photographs and inadequate descriptions of the forms in the available literature preclude this.

Very little has been described and photographed in Gondwanaland on this group of Monoletes, and almost nothing in the basins in Central Southern Africa. Therefore the species T. pseudothiesseni is for the present taken to include the forms mentioned above.

Distinction: Thymospora pseudothiesseni is distinct in possessing a coarsely reticulate to rugulate exine giving rise to a pseudo-cingulum in many cases.

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

Sub-turma: DISACCITES Cookson, 1947

a. Infra-turma STRIATITI Pant, 1954

Genus: Protohaploxypinus Samoilovich, emended Hart, 1964

Type species (by original designation): Protohaploxypinus latissimus (Luber) Samoilovich.

Synonyms: Lueckisporites Potonie and Klaus, 1954 partim.
Lunatisporites Leschik, 1956.
Striatites Pant, 1956.
Taeniaesporites Leschik, 1956 partim.
Faunipollenites Bharadwaj, 1963.

Diagnosis: Shape: Disaccate and haploxylonoid or slightly diploxylonoid.
Central body: Circular to oval in l-a (longitudinal axis) or t-a (transverse axis) direction.
Proximal cap: Thin, infra-reticulate with four or more longitudinal ribs.
Sacci: Semi-circular, and greater or less than semi-circular.
Distal root: Length equal to or slightly less than t-a (central body).
Distal zone: Less than or equal to 2/3 l-a (central body) and parallel-sided.

Author Falcon R M S (Rosemary Margaret Sarah)
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