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

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Discussion: Hart (1965) regards this genus as amongst the first legitimate genera within the Striatiti. Balme (1966) does, however, mention that no photograph of the type species P. latissimus has been published, nor a completely full description. Despite this, this genus is widely used and accepted by western palynologists, and is therefore adopted here.

Distinction: This genus is distinct from other Striatiti genera on the basis of strong haploxylinity, and distinct sacci with more or less parallel-sided distal roots.

Protohaploxypinus globus (Hart, 1960) Hart, 1964

Plate 6: figures 1-2.

Holotype: Lunatisporites globus Hart, 1960, Plate 1: figure 15.

Diagnosis: Haploxylonoid to slightly diploxylonoid shape. The circular central body possesses a proximal cap with six longitudinal ribs in proximo-distal view. The central stria takes the form of a narrow longitudinal central sulcus. Sacci are equal to or greater than semi-circular in outline, and equal to or greater than the central body in size. The distal zone is $\frac{1}{4}$ or less l-a (central body). Size total: l-a; 49-65 µ; t-a (sacci): 28-40 µ; t-a (central body): 22-39 µ.



Description

Shape: Haploxyloncid to slightly diploxyloncid with longitudinal elongation.

Central body: Divided by narrow striae into 6-7 sub-parallel ribs, distinctly infra-punctate and narrowing terminally; 2-4 μ wide: the central striae is deepened, with lateral thickened dark margins to form a pronounced longitudinal central sulcus stretching the full l-a of the central body; lips are less than 2 μ wide, and become narrow with acute folds terminally.

Sacci: Equal t or greater than semi-circular in shape, equal to or greater than central body in size; moderate reticulation, lumen increasing in size terminally; sacci meet laterally, sometimes joining to form an inflated lateral bladder of up to 4 μ wide.

Distal sulcus: Narrow, equal to or less than ½ l-a (central body) in width.

Dimensions (8 specimens): Total l-a: 48-60μ; t-a (sacci): 34-45 μ; t-a (central body): 20-38 μ.



Description: Shape: Haploxylonoid, from spherical to sub-spherical, and oval (in slightly longitudinal or transverse directions).

Central body: Usually indistinct but darkened outline invariably indicate an oval shape in a transverse direction.

Proximal cap: Ribs usually indistinct but sub-parallel oblique in direction, variably thickened, 6-9 in number. Striae very narrow.

Sacci: Equal to or slightly less than hemispherical in shape and equal to or greater than central body in size; sacci distally inclined; infra-reticulation fine at base of roots, becoming moderately coarse laterally.

Distal sulcus: $\frac{1}{2}$ or less than l-a (central body), parallel-sided distal roots.

Dimensions (20 specimens): Total l-a: 30-65 μ; total t-a (central body): 30-45 μ.

Discussion: The forms described here all possess four common characteristics:

a) indistinct, transversely elongated central bodies;
b) oblique ribs;
c) closely similar lengths of t-a (central body); and
d) narrow distal sulci.

These features are diagnostic characteristics of P. diagonalis. However, variation in total l-a could result in a further possible division (not employed here) viz. spherical or transversely oval forms with total l-a of 29-45 µ may be distinguished from longitudinally oval forms with total l-a of 46-65 µ.

Distinction: P. diagonalis is distinct from other species in having oblique ribs, transversely oval central body and a narrow distal sulcus.

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

Protohaploxypinus microg Hart, 1964

N.B. No clear photographs, refer to text figure below.

Holotype: P. microg Hart, 1964, Plate 1: text: figure 12.

Synonyms: Striatopinites microg Hart, 1964.

Diagnosis: The outline is haploxylonoid, with circular central body. The proximal cap bears four to six longitudinal ribs in proximo-distal view. Sacci are a similar size or slightly less than the central body and semi-circular in shape. The distal zone is approximately one third l-a (central body). Size l-a 35-46 μ; t-a: 20-29 μ.



Description: Shape: Strongly haploxylonoid with elongation in the longitudinal direction.

Central body: Circular to sub-circular and sometimes indistinct.

Proximal cap: Divided into six ribs, parallel to sub-parallel, 2-4 μ wide, and separated by narrow striae.

Sacci: Approximately equal to semi-circular in shape and more or less the same size as the

central body; infra-reticulation is moderate to fine; sacci with slight distal inclination.

Distal zone: Fairly narrow, ranging from ½ to 1/5 l-a central body; distal roots usually parallel to slightly convex.

Dimensions (20 specimens): Total l-a: 40-48 µ; l-a (central body): 27-30 µ; l-a (sacci): 15-24 µ; t-a (central body): 26-38 µ; distal zone: 2-8 µ.

Discussion: These forms are closely comparable to the forms found in Tanzanian Lower Coal Measures (Hart, 1963, 1964).

Distinction: P. microps is distinguished from other species on the basis of its small size and six ribs.

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

Protohaploxypinus amplus (Balme and Hennelly) Hart em. Balme, 1966

Plate 8: figures 5-8.

Holotype: Lueckisporites amplus Balme and Hennelly, 1955, Plate 3: figures 24-26, non figures. 27-28.

Synonyms: Protohaploxypinus amplus (Balme and Hennelly) Hart, 1964, text: figure 10.
Striatopinites amplus (Balme and Hennelly) Hart, 1965, P. 9.
Protohaploxypinus goraiensis R. Potonie and Lele, 1961 partim (see Balme, 1956 p. 111).

Diagnosis (sensu Balme, 1966):

Shape: Is slightly diploxyloncid to haploxyloncid in outline; the central body may be clearly defined and usually slightly longitudinally oval; sacci are slightly larger and transversely wider than central body, with a tendency to develop transverse distal folds parallel to and below the distal roots. The distal zone is approximately 1-1/3 l-a (central body) size: total l-a: 84-13 µ; total t-a: 48-76 µ.



Description: Shape: Haploxyloncid to slightly diploxyloncid.

Central body: Distinct, darker than sacci and infra-punctate; circular to slightly oval in longitudinal or transverse direction.

Proximal cap: Divided into 9-12 ribs; sub-parallel, and 3-5 μ wide. Striae are narrow and often faint.

Sacci: Approximately semi-circular or slightly greater in shape than the central body and about the same size or slightly larger. Transverse width of the sacci is greater than that of the central body; infra-reticulation is moderately coarse towards the lateral margins, and marginal folding of the sacci is common. Sacci distally inclined.

Distal sulcus: Narrow, about ½ to 1/5 l-a (central body) and characteristically bordered by peripheral darkened folds below the distal sacci roots; sulcus is parallel-sided to slightly concave, peripheral folds are thick centrally (2-5 μ wide) thinning towards the lateral margin.

Dimensions (8 specimens): Total l-a: 78-120 μ; t-a (central body): 45-70 μ; t-a (sacci): 48-85 μ.

Discussion: Originally L. amplus Balme and Hennelly, embraced haploxyloncid striate forms varying from 84-131 μ in total length; with a thin central body bearing often indistinct striae on the proximal cap. The sacci were slightly larger than central body and finely infra-reticulate. Hart (1964) confined to this species those forms bearing 10-12 ribs and Segroves (1969) those bearing 7-10 ribs. Balme, 1966, however, in distinguishing the species P. goraiensis preferred to regard the diagnostic features of P. amplus as being:

a) A distinct central body with slight l-a elongation.
b) Slight diploxilinity with t-a (sacci) just greater than t-a (central body).
c) Usually transverse distal folds below distal roots of sacci and
d) A distal zone of ¼ to 1/5 l-a (central body). The forms encountered in the Rhodesian sediments conform best to the latter diagnosis (sensu Balme), although a range of intermediate forms exist which are for the present included tentatively within this species. See discussion

under P. goreiensis. Much more material is necessary to confine species limits.

Distinction: P. amplus is distinct from other species by its size, distal transverse peripheral folds below sacci roots, a usually distinct central body and a relatively narrow distal sulcus.

Stratigraphic range: Rare to common in Dwyka; Black Shales and Coals, and Madumbisa Mudstones.

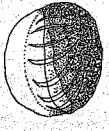
Protohaploxypinus sp. cf. P. goraiensis (R. Potonie and Lele)

Plate 7: figures 1-7.

Description: Shape: Strongly haploxylonoid, circular to slightly transversely central body, indistinct, but assumed elongate oval (t-a direction).

Proximal cap: Bears six to eight thick longitudinal ribs, 4 to 6 μ wide, coarsely infra-reticulate; striae are prominent, and 2-4 μ broad. Striae may be parallel and fairly regular in width, or the central longitudinal striae may be straight with those on either side curving to an increasing degree towards the lateral margin (see Plate 7, Fig. 3 - Form 637).

Sacci: Less than semi-circular in shape; equal to or slightly less in size than the central body. Transverse axis length of sacci is less than or equal to that of a central body. Sacci infra-reticulation is very coarse and dense (see Plate 7, Nos. 2 - Form 636) with lumen tending to radially elongate in shape from the sacci roots. Sacci join laterally, and are distally inclined.



Distal sulcus: Very narrow, 1/5 or less l-a (central body) - the latter distance presumed by termination of striae. Distal sacci roots parallel and dimensions (8 specimens): total l-a: 86-130 μ; total t-a: 90-140 μ.

Distinction: P. sp. cf. P. goraiensis is distinct from other species by its distinctly spherical outline in polar view, indistinct central body, very narrow distal sulcus, and very large size.

Discussion: Balme (1966) discusses the abundance of large striate haploxylonoid pollen grains in Permian Gondwana sediments and their nomenclatorial problems. Hart (1964, 1965a) allows two species to accommodate forms ranging in size from 85 μ to 130 μ - viz.

a) P. goraiensis Potonie and Lele which is strongly haploxylonoid with a very narrow distal sulcus, 1/5 or less l-a (central body) and seven or more ribs (sensu Potonie and Lele). Hart amended this to include forms bearing 7-8 ribs, followed by Balme's amendation to include 8-12 ribs.

b) P. asplus (Balme and Hennelly) was originally a very broad form species amended by Hart to include slightly

diploxylonoid forms, with faint striae and ribs and a distal sulcus of less than ½ l-a central body. Hart confined the species to inclusa forms bearing 10-12 ribs and Segroves (1969) 7-10 ribs.

Balme (1966) in his Salt Range thesis, emphasizes the overlapping features of these two species and therefore distinguishes them as follows:

	P. amplus	P. goraiensis
Shape	Haploxylonoid to slightly diploxylonoid.	Haploxylonoid (almost spherical)
Central body	Distinct (slightly l-a) oval.	Indistinct (slightly t-a) oval.
Sacci distal roots	Often with peripheral folds.	No peripheral sacci folds.
Distal zone	⅓-1/5 l-a (central body).	Less than 1/5 central body.

The forms encountered in the Mid-Zambezi Valley are divided according to Balme's distinction (see P. amplus). Those forms assigned to cf. P. goraiensis appear to fulfil the diagnostic characteristics fully, but insufficient photographic comparison prevents absolute naming.

Protohaploxypinus limpidus (Balme and Hennelly) Segroves, 1969

Plate 6: figures 3-5.

Holotype: Lueckisporites limpidus Balme and Hennelly, 1955, Plate 3: figures 29-32.

Synonyms: Taeniaesporites discurrens Leschik, 1959, Plate 5: figure 34.
Protohaploxypinus sewardi (Virkki, 1938) Hart, 1964, Plate 1: text - figure 11.
Protohaploxypinus limpidus (Balme and Hennelly) Balme, 1966, Plate 10: figures 1-3.

Diagnosis: Sensu Segroves, 1969.



Description: Shape: Haploxylonoid, with sub-circular, indistinct central body.

Proximal cap: Is divided into 4-7 (usually 5) longitudinal ribs, often cap is inflated and usually has with prominent longitudinal folds stretching full l-a (central body).

Sacci: Semi-circular, distally inclined and not laterally joined; distal sulcus is less than 1/5 l-a (central body) and parallel-sided. Size, total l-a: 55-85 µ; t-a (central body): 36-60 µ.

Description: Shape: Haploxyloncid to slightly diploxyloncid.

Central body: Circular to slightly longitudinally oval, fairly indistinct in most specimens.

Proximal cap: 6-8 ribs, sup-parallel to wedge-shaped; 2-4 μ wide; striae distinct and narrow; longitudinal folds are common across the length of cap.

Sacci: Equal to or slightly greater than central body in size; equal to or slightly greater than semi-circular in shape; distally inclined with a fairly broad infra-reticulation; sacci may overlap laterally but do not join.

Distal sulcus: Narrow, parallel-sided and less than 1/5 l-a (central body).

Dimensions (20 specimens): Total l-a: 62-80 μ; t-a: 40-45 μ.

Discussion: Due to the loss of the original holotype specimens (Virkki, 1938, figure 2a) which Hart assigned to L. sewardi, the holotype of Lueckisporites virkkiae Balme and Hennelly has been accepted

Description: Shape: Haploxylonoid to slightly diploxylonoid.

Central body: Circular to slightly longitudinally oval, fairly indistinct in most specimens.

Proximal cap: 6-8 ribs, sub-parallel to wedge-shaped; 2-4 μ wide; striae distinct and narrow; longitudinal folds are common across the length of cap.

Sacci: Equal to or slightly greater than central body in size; equal to or slightly greater than semi-circular in shape; distally inclined with a fairly broad infra-reticulation; sacci may overlap laterally but do not join.

Distal sulcus: Narrow, parallel-sided and less than 1/5 l-a (central body).

Dimensions (20 specimens): Total l-a: 62-80 μ; t-a: 40-45 μ.

Discussion: Due to the loss of the original holotype specimens (Virkki, 1938, figure 2a) which Hart assigned to P. sewardi, the holotype of Lueckisporites limpidus Balme and Hennelly has been accepted

as the neotype (Hart, 1964, 1965, Segroves, 1969, Balme, 1966). Diagnoses vary (compare Hart, 1965, p. 28, Segroves, p. 199, Balme, p. 108) but that of Segroves is accepted here as being more fully descriptive than Hart and closer to the Rhodesian forms than Balme's Salt Range forms. Variation between Segroves' forms and the forms described here is basically one of a narrower size range. Other concepts of this species vary in number of ribs and relative width of the distal sulcus.

Distinction: P. limpidus is distinct from other species in its size, indistinct rounded central body and narrow distal sulcus.

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

Protohaploxypinus sp. A.

Plate 8: figures 1-4.

Description: Shape: Haploxyloncid, with a longitudinal elongate, rectangular outline in polar view.

Central body: Indistinct, with a faint rectangular shape and transversely elongate.

Proximal cap: Bears approximately 10 indistinct striae, parallel to sub-parallel and narrow (less than 1 μ) one central proximal longitudinal striae is deepened and widened to form a narrow sulcus (a vestigial monolete aperture). This is bordered by thin darkened folds (labra) and it stretches approximately 2/3 to ¾ l-a (central body).

Sacci: Semi-circular in shape, equal to or smaller than central body in size and often meeting laterally to form a continuous lateral bladder 4-8 μ thick. Sacci fairly densely and coarsely infra-reticulate, and distally inclined.

Distal sulcus: About ¼ l-a (central body).

Dimensions (8 specimens): Total l-a: 90-110 μ; total t-a: 55-75 μ.

Discussion: *P. sp. A.* is closely similar in size range and overall outline to *P. simplus* (Balme and Hennelly) Hart (sensu Hart (1964) and Segroves (1969); non Balme (1966)). However, the central proximal longitudinal sulcus is distinct and diagnostic in the Rhodesian forms. *P. globus* possesses a similar central proximal longitudinal groove, but is distinguished by its distinct central body and proximal striae, and smaller size range.

The Rhodesian forms are so distinct, and are found almost solely in Dwyka sediments, that a tentative assignation to *P. sp. A.* is preferred. More detailed work on other sediments will enlarge on this species' potential stratigraphic importance.



Distinction: *P. sp. A.* is distinct from other species by the presence of a distinct, dark-rimmed proximal longitudinal sulcus, indistinct central body and striae, broad distal sulcus and large size range.

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

Protohaploxypinus sp. B.

Plate 6; figures 12-17.

Description: Shape: Haploxylonoid; longitudinally elongate with smoothly curving lateral sides and sharply rounded terminal sides.

Central body: Indistinct, flattened and approximately rectangular in shape.

Proximal cap: Possesses usually 12 clearly delineated striae with parallel to sub-parallel ribs; occasionally wedge-shaped; usually regular and narrowing to finite ends at terminal extremities; ribs distinctly infra-granulate or finely infra-reticulate, 2-5 μ wide.

Sacci: Very small relative to central body and far less than semi-spherical in shape; equatorially joined terminally; pollen grains characteristically folded back in a distal direction but sacci alone not necessarily distally inclined; sacci structure finely infra-reticulate; sacci may be joined by an equatorial strip bearing a similar infra-structure.

Distal sulcus: Does not exist, but distal zone includes almost the entire central body distal surface; l-a (central body) as opposed to l-a (total) is almost 4 : 5.

Dimensions (8 specimens): Total l-a: 75-110 μ; total t-a (i.e. of central body): 55-70 μ.



Discussion: These forms are assigned to the genus Protohaploxypinus by their general haploxylonoid outline. The wide distal and proximal zones is characteristic of Striatoabietites, but this latter form is diploxylonoid, with sacci usually hemispherical and smaller than the central body in outline. P. suchonensis (Sedova) Hart, 1964 possesses a wide distal zone (2/3 l-a central body) and 6-8 proximal longitudinal ribs which distinguish it from P. sp. B.

Distinction: Tr. sp. B. is distinguished from other species by its very narrow sacci, strong l-a elongation and very wide distal sone.

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

Genus: Striatopodocarpites Zoritscheva and Sedova ex Sedova emended Hart, 1964

Type species (by original designation): Striatopodocarpites toidensis Sedova.

Synonyms: Striatites Pant, 1955 partim.
Taeniaesporites Leschik, 1956 partim.
Lueckisporites Potonie and Klaus, 1954 partim.
Rhytisaccus Naumova partim.
Strotersporites Wilson, 1963.
Rhizomaspora Wilson, 1963.
Verticipollenites Bharadwaj, 1962.
Labirites Bharadwaj, 1962.
Hindipollenites Bharadwaj, 1962.

Diagnosis: Shape: Strongly to moderately diploxylonoid.
Central body: Circular to oval.
Proximal cap: More than four longitudinal ribs.
Sacci: Distinctly larger than central body in size, greater the semi-circular in shape; and occasionally uniting to form narrow lateral bladders.
Distal roots: Length is less than diameter of central body along the transverse axis.

Discussion: The generic name Striatopodocarpites was published legitimately by Sedova (1956) and later amended by Hart (1964). However, the genus Striatites Pant (1955) is in strong synonomy and is also valid, but due to loss of the type species the former genus is preferably adopted. Amongst others, Hart also puts in synonomy the genera Verticipollenites Bharadwaj, Labirites Bharadwaj and Hindipollenites Bharadwaj. These are primarily diploxylonoid Striatiti with minor variations in rib structure.

Distinction: This genus is distinguished from other Striatiti by:

a) Strong diploxinity.

b) Sacci greater than semi-circular.

c) Comperatively small central body.

Striatopodocarpites cancellatus (Balme and Hennelly, 1955) Hart, 1964

Plate 9: figures 1-3.

Holotype: Lueckisporites cancellatus Balme and Hennelly, 1955, Plate 2: figure 11.

Diagnosis: Disaccate Striatiti form with moderate diploxilinity, circular central body, six proximal ribs (sensu Hart) and a narrow (1/5 l-a (central body)) distal sulcus.
Length: 40(54)70 µ; l-a (central body): 21(27)32µ.



Description: Shape: Moderately diploxyloncid.
Central body: Circular to sub-circular when folded.
Proximal cap: Bears six parallel ribs, 2-3 µ wide and separated by narrow striae (1 µ) stretching the width of the proximal cap. Ribs narrow towards the lateral extremities.
Sacci: Larger than central body in size, greater or equal to semi-circle in shape and strongly distally inclined; structure thin and finely infra-reticulate.

Distal sulcus: Distal roots parallel to sub-parallel; distal sulcus narrow, about ¼ to 1/5 l-a (central body).

Dimensions (20 specimens): Total length: 38-55 µ; l-a (central body) 18-25µ; t-a (central body): 18-23 µ; t-a (sacci): 20-35 µ.

Distinction: This species is distinct from other forms of the genus on the basis of degree of diploxilinity. (i.e. low ratio of t-a (C.B.): t-a (sacci)); number of ribs, narrow distal sulcus and size range.

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

Striatopodocarpites octoetriatus (Hart, 1960) here emended

Plate 10: figures 1-6.

Synonyms: Lahirites raniganjensis Bharadwaj, 1962.
Striatopodocarpites raniganjensis (Bharadwaj) Hart, 1964.
Striatopodocarpites limniscocata (Wilson) Hart, 1964 partim.

Holotype: Striatopodocarpites octostriatus Hart, 1960 (Plate 1: figure 6).

Diagnosis: Strongly diploxylonoid, circular central body, and a proximal cap bearing 8 longitudinal ribs and minor transverse striae. Distal sulcus is narrow, ⅓ l-a (central body). N.B. size range 65-95 μ (total l-a).



Description: Shape: Strongly diploxylonoid.
Central body: Circular to sub-circular with slight l-a elongation.
Proximal cap: Bears 7-8 ribs, irregularly thickened, diverging and tapering and varying in width from 2-5 μ. Often fairly widely separated (1-3 μ) by striae. Exo-exine dark and apparently unstructured; very

faint irregularly spaced transverse striae are frequently seen dissecting the main ribs. A dark marginal crest around the proximal cap is often present.

Sacci: Greater in size than the central body, larger than semi-circular in shape, sub-spherical, distinctly separated laterally and distally inclined. Infrareticulation rather coarse. No lateral bladders present, and sacci do not meet.

Distal sulcus: Narrow, $\frac{1}{4}$-$1/5$ or less l-a (central body), parallel sided.

Dimensions (10 specimens): Total l-a: 85-100 μ.

Discussion: Lahirites ravigarjensis Bharadwaj, 1962 was created to accommodate diploxylonoid striate genera bearing numerous transverse and longitudinal striae, amongst other features. Hart recombined the form into the genus Striatopodocarpites and amended the diagnosis to contain 10-ribbed forms with transverse and longitudinal striae.

S. octostriatus Hart, 1960 was created earlier to house 8-ribbed forms, without transverse striae. However, Segroves (1969) points out the presence of such striations in the photographs of S. octostriatus Hart, 1960. L. ranisenjensis and S. octostriatus are therefore apparently indistinguishable on these grounds. The forms described here therefore conform to both diagnoses (sensu Hart) in part, and as such S. octostriatus is regarded as having priority.

S. leguisaccata (Wilson) Hart, 1964 appears to be very similar but is larger in size.

S. rarus (Bharadwaj and Salujha) Balme, 1956 is also regarded as very similar but possesses 5-9 ribs, no transverse striae and a marginal crest to the proximal cap.

The forms found in the Mid-Zambezi Valley are therefore assigned to S. octostriatus on the grounds of size range, number of ribs, and narrow distal sulcus. The faint transverse striations are assumed to be a newly regarded feature not described originally but visible in photographs of the holotype and paratype.

Distinction: S. octostriatus is distinct from other species in having 8 longitudinal ribs, minor transverse striae, strong diplexilinity, narrow distal sulcus and a thick marginal crest.

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

Striatopodocarpites rarus (Bharadwaj and Salujha) Balme, 1966

Plate 9: figures 12-15.

Holotype: Lebirites rarus Bharadwaj and Salujha, 1964.

Diagnosis: Diploxyloncid, with circular central body. Proximal cap bears 5-9 ribs, narrowly separated, parallel to wedge-shaped. Narrow marginal crest present at base of proximal cap. Sacci large, distally inclined; distal sulcus about ¾ l-a (central body), parallel sided, sometimes with peripheral folds along distal roots. N.B. size range 74-99 µ total l-a.

Description: Shape: Moderately diploxyloncid.

Central body: Circular to sub-circular or slightly transversely oval; clearly infra-punctate on proximal surface; usually distinct in outline.

Proximal cap: Divided into six major ribs, semi-parallel to parallel, narrowing terminally; a dark marginal crest around the periphery of the proximal cap usually present.

Sacci: Greater in size than central body, larger than semi-circular with fairly coarse infra-reticulation. Sacci do not meet laterally, and no lateral bladders present.



Distal sulcus: Approximately ¼ to ⅓ l-a (central body) in polar view; distal sacci roots are parallel and clearly delineated.

Dimensions (6 specimens): Total l-a: 70-105 µ; t-a sacci: 40-54 µ; t-a (central body): 30-40 µ.

Discussion: The general description (diagnosis) of S. rarus (sensu Balme, 1966) is very similar to S. octostriatus Hart with the exception of a marginal crest in the former and only 8 ribs in the latter species. Due to the tentative emendation of S. octostriatus in this thesis to include forms with minor transverse striae and a marginal crest, those specimens lacking transverse striae are here referred to the broad concept of S. rarus as emended by Balme. The Rhodesian forms assigned to S. rarus also appear to possess a lower degree of diploxilinity and a tendency to transversely elongated central bodies in comparison to S. octostriatus. Larger size distinguishes it from S. cancellatus.

Distinction:	S. varus is distinct in having 6 sub-parallel ribs, and marginal crest around proximal cap, and a distal sulcus of approximately ⅓ l-a (central body).
Stratigraphic range:	Absent in Dwyka sediments; very rare to rare in Black Shales and Coals; rare to common in Madumabisa Mudstones.

Striatopodocarpites sp. cf. S. fusus (Balme and Hennelly) Potonie, 1958

Plate 9: figures 4-11.

Holotype: Lueckisporites fusus Balme and Hennelly, 1955, Plate 1: figures 6-10.

Synonyms: S. globus Lesbik, 1959

Diagnosis: Disaccate striatiti, strongly diploxylonoid with a circular central body. Striations and ribs are indistinct. The distal zone is very narrow ($\frac{1}{4}$ len (central body)) sacci much larger than central body, with a fine internal reticulum.

Description: Shape: Strongly diploxylonoid.

Central body: Circular to sub-circular, and often dark as opposed to the very light coloured sacci.

Proximal cap: Bears usually indistinct ribs (where discernible they number 6-9) all parallel to sub-parallel and sinuous and closely spaced; occasionally short irregular transverse striations give an apparent "zig-zag" appearance to the proximal cap.

Sacci: Larger than central body in size and almost circular in shape; frequently folded or slightly compressed but with distinct distal inclination; very thin and finely infra-reticulate. No

distinct lateral bladders, but sacci meet and tend to overlap at lateral proximo-distal junction.

Distal sulcus: Very narrow, approximately 1/10 l-a (central body) distal roots parallel, tending to sinuous, extending full transverse width of the central body. Peripheral folds are sometimes present.

Dimensions (10 specimens): Total l-a: 40-60 μ; diameter (central body): 20-25 μ; t-a (sacci): 30-40 μ distal sulcus: 1-3 μ.



Discussion: These forms may well be attributable to S. cancellatus (Balme and Hennelly) Hart on the grounds of size range and general morphology. However, due to their greater degree of diplorilinity, often indistinct and sinuous ribs, the frequent short transverse striations

distinct lateral bladders, but sacci meet and tend to overlap at latoral proximo-distal junction.

Distal sulcus: Very narrow, approximately 1/10 l-a (central body) distal roots parallel, tending to sinuous, extending full transverse width of the central body. Peripheral folds are sometimes present.

Dimensions (10 specimens): Total l-a: 40-60 μ; diameter (central body): 20-25 μ; t-a (sacci): 30-40 μ distal sulcus: 1-3 μ.



Discussion: These forms may well be attributable to S. cancellatus (Balme and Hennelly) Hart on the grounds of size range and general morphology. However, due to their greater degree of diploxilinity, often indistinct and sinuous ribs, the frequent short transverse striations

and extremely narrow distal sulcus, with frequent meeting of sacci laterally, they are tentatively compared to S. fusus. S. gondwanensis (em Hart) bears 10 longitudinal ribs and is larger, whilst S. octostriatus Hart shows no transverse striations and is also differentiated on size. S. phaseatus (Balme and Hennelly) Hart has distinct attachment lines along the distal roots with lateral bladders. S. secretus (Bharadwaj) Hart is much larger with short distal roots.

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

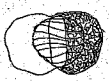
Strietopodocarpites sp. cf. S. communis (Wilson, 1962) Hart, 1964

Plate 9: figures 16-17.

Holotype: Stroterisporites communis Wilson, 1962.

Synonym: Fastigisporites physema Wilson, 1962.

Diagnosis: Moderately to strongly diploxylonoid; proximal cap bears 10-14 finely punctate longitudinal ribs; sacci reniform; distal zone less than ¼ l-a (central body).



Description: Shape: Slightly to moderately diploxylonoid.

Central body: Circular to sub-circular, to rhomboid.

Proximal cap: Bears 10 distinct, clearly punctate ribs, sub-parallel to slightly oblique; 2-4 μ wide and narrowly separated by striae 1-2 μ wide. A narrow thickened proximal crest lies at the base of the proximal cap.

Sacci: Just larger or almost equal to central body in size, and equal to or greater than semi-circular

in shape. Sacci possess a very coarse infra-reticulum; lumen (brochi) 2-4 μ in diameter and radially elongating and increasing in size from the roots. Sacci meet laterally, but no inflated bladders are obvious.

Distal sulcus: Approximately ¼ l-a (central body) diffuse due to merging of sacci distal roots onto central body. Exo-exine grades gradually from coarsely infra-reticulate on sacci to coarsely punctate framing an apparently laevigate distal sulcus.

Dimensions (6 specimens): Total l-a: 95-130 μ; diameter (central body): 40-50 μ; t-a (sacci): 43-55 μ.

Distinction: S. sp. cf. communis is distinct from other species on the grounds of possessing 10 longitudinal proximal ribs, no transverse striations, and a very coarse infra-reticulum on the sacci.

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

Striatopodocarpites sp. A.

Plate 10: figures 7-11.

Description: Shape: Slightly diploxylonoid to haploxylonoid (possibly due to characteristic sacci folding).

Central body: Circular to sub-circular fairly indistinct.

Proximal cap: Divided irregularly and haphazardly into approximately 9-10 longitudinal ribs, sub-parallel, simuous, or wedge-shaped; with numerous distinct short transverse striations dividing the major ribs into square, rhomboid and polygonal units. Exo-exine structure is dark, dense and difficult to analyse. Striations are narrow (1 μ or less).

Sacci: Larger than central body in size, and greater than semi-circular in shape (longitudinally extended); medium to very coarsely infra-reticulate, with characteristic short dense folding in a radial direction from the central body outwards. Proximal and distal roots are very indistinct; sacci apparently join or overlap on their lateral equatorial margin, but do not form inflated lateral bladders.



Distal sulcus: Approximately ¼ or less l-a central body; often indistinct, but tending to concave.

Dimensions (3 *specimens*): Total l-a: 80-110 μ; t-a (central body): 30-45 μ; t-a (*sacci*): 35-70 μ.

Discussion: S. octostriatus as here amended is distinct from these forms on the grounds of greater diploxilinity, 8 distinct ribs, indistinct transverse striations, and very narrow, parallel-sided distal sulcus; also the central body is distinct and often bears a thickened marginal crest at the base of the proximal cap.

S. gondwanensis (Lakhanpal, Sah. and Dube) Hart, 1960, S. ranizanjensis (Bharadwaj) Hart, S. secretus (Bharadwaj) Hart and S. indicus (Bharadwaj) Hart all show greater diploxilinity and greater distinction in central body and distal sulcus outlines. Due to difficulty in ascertaining the true morphology (too dense) in these forms, the refinements based on central body criteria are not applicable, and thus a closer comparison is not possible.

Distinction: Striatopodocarpites sp. A. is separated on the basis of slight diploxylinity; 9-10 distinct ribs narrowly separated; distinct haphazard short transverse striae; indistinct distal sulcus approximately ½ I-a (central body), concave; and sacci meeting laterally with darkened distinctive radial folding.

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

Genus: Taeniaesporites Leschik emended Jansonius, 1962

Type species (by original designation): Taeniaesporites krauseli Leschik.

Synonyms: Ineckisporites Potonie and Klaus, 1954 partim.
Striatites Pant, 1955 partim.
Lunatisporites Leschik partim.

Diagnosis: Shape: Diploxyloncid to haploxyloncid.
Central body: Circular to oval in t-a or l-a direction.
Proximal cap: Three to five major ribs with occasional subsidiary ribs. Striae are notably wide exposing the underlying intexine.
Distal zone: Greater than or equal to $\frac{1}{2}$ l-a (central body).

Discussion: As commented upon by Balme (1966), Hart (1965) and others, much confusion arose originally when Lunatisporites Leschik (type sp. L. acutus) and Taeniaesporites Leschik (type sp. T. krauseli Leschik) were simultaneously proposed. The type species were subsequently regarded as identical. Due to the lack of clarification of L. acutus, Balme proposed that the genus Lunatisporites be abandoned.

Taeniaesporites has been discussed by a number of authors, e.g. Jansonius (1962), Hart (1964) and Balme (1963, 1966). The concept as proposed by Jansonius (1962) is preferred, but with reservations regarding the number of proximal striae. Three to five ribs are diagnostic but Klaus (1962), quoted by Balme (1966), warns on the occurrence of subsidiary striae. Diploxilinity and haploxilinity are regarded by these authors as not feasibly separable.

Distinction: Taeniaesporites is distinct from other Striatiti genera in having wide striae separating the ribs, and in having more than one but less than five major striae.

Leuckisporites has only one wide striae separting two ribs.

Taeniaesporites sp. cf. T. noviaulensis Leschik, 1956

Plate 11: figures 9-10.

Holotype: Taeniaesporites noviaulensis Leschik, 1956.

Synonyms: Taeniaesporites noviaundi Jansonius, 1962 partim.

Description: Diasacate striatiti form bearing widely spaced ribs.

Shape: Haploxylonoid to slightly diploxylonoid (more obvious in folded specimens).

Central body: Longitudinally oval.

Proximal cap: Divided into 4 major ribs about 6-9 μ wide and 2-4 μ apart. The exo-exine is finely infra-reticulate, whilst the intexine is thin and structureless.

Sacci: Crescentic in polar view, greater or equal to a semi-circle; and larger or the same size as the central body. Infra-reticulate with finer radially elongated lumen nearer roots increasing in size outwards. Sacci tend to distal inclination.

Distal sulcus: Approximately ½ l-a (central body), whilst the proximal zone is greater than ½ l-a (central body).

Dimensions (4 specimens): Total l-a: 45-80 µ; t-a (sacci): 25-48 µ; t-a (central body): 23-44 µ.



Discussion: Due to the rarity of Taeniaesporites specimens in the samples, the morphology has not been fully investigated. Therefore these forms have been tentatively assigned to T. noviaulensis - sensu Jansonius, 1962 (partim), Hart, 1965 (insufficient data) and Balme (1966) on the grounds of wide distal zone, usually greater than semi-circular sacci, elongated central body and general size range. The widely spaced and broad ribs preclude these rare forms from other striatiti species.

Taeniaesporites is shown by Hart (1965) to be an essentially northern hemisphere genus. However, in his palynologic

biozones of the Karroo, South Africa, (1967) Hart includes T. africana (Hart MS) in his Upper Permian Striatiti Zone. No description or photographs could be found to enlarge on his drawing, therefore no specific comparisons with the present specimens could be drawn. Other Southern Hemisphere occurrences are quoted in Lower Triassic sediments (Balme, 1963, Goubin, 1965).

This rare occurrence of the genus in Mid-Zambezi Valley sediments is therefore indicative of Upper Permian - Lower Triassic age, and as such is stratigraphically important.

Genus: Striatoabietites Zoricheva and Sedova ex Sedova, amended Hart, 1964

Type species (by original designation): Striatoabietites brickii Sedova.

Synonyms: Lueckisporites Potonie and Klaus, 1954 partim.
Pemphygaletes Luber and Valts, 1961 partim.
Protodiploxypinus Samoilovich, 1953 partim.

Diagnosis: Shape: Diploxylonoid.
Central body: Circular to oval (l-a direction).
Proximal cap: 6 or more ribs.
Sacci: Smaller than central body in size, t-a (sacci) is approximately equal to t-a (central body), shape is semi-circular.
Distal roots: Equal to or little less than t-a (central body).
Distal zone: Wide, equal to or greater than ½ l-a (central body).

Discussion: Hart (1964, 1956) draws attention to the validity of the genus following on a clarifying publication of Sedova, 1956.

Distinction: This genus is distinct from other diploxylonoid Striatiti genera on the basis of smaller sacci relative to the central body, sizes, numberous ribs, and wide distal zone.

Striatosabitites multistriatus (Balme and Hennelly) Hart, 1964.

Plate 11: figures 7-8.

Holotype: Inaplosporites multistriatus Balme and Hennelly, 1955 partim.

Diagnosis: The shape of the specimens is characteristically diploxylonoid, with the central body longitudinally oval. The proximal cap shows 12 to 16 longitudinal ribs in polar view. The distal zone is greater than ½ l-a (central body) and the distal roots do not reach the lateral equatorial margin. Sacci are distally inclined and smaller in size than the central body.

Description: Shape: Disaccate diploxylonoid to slightly haploxylonoid, with sacci characteristically smaller than central body.

Central body: Roundly oval in the longitudinal direction.

Proximal cap: Bears 8-12 ribs, narrowly separated, 1-3 μ wide; parallel to one another and narrowing to finite ends at their terminal extremities.

Sacci: Relatively much smaller in size than central body, less than or

equal to semi-circular in shape and proximally equatorially attached, with strong distal inclination. Fine to fairly coarse infra-reticulation not markedly changed at sacci roots.

Distal zone: Approximately 2/3 to ¾ l-a (central body).

Dimensions (8 specimens): Total l-a: 50(63)75 µ; l-a (central body): 40(44)50 µ; t-a (central body): 34(38)42 µ; distal zone: 24(25)30 µ.



Discussion: Balme and Hennelly gave a fairly wide description for the type species some forms of which have already been re-assigned (Segroves, 1969) to other genera (e.g. Vittatina (Luber ex Wilson) for sub-saccate forms). Hart amended the diagnosis which is retained here. This species is a relatively rare form in the Mid-Zambezi Valley, and is usually folded semi-laterally.

Distinction: This species is distinct from other forms on the basis of size, distal zone, number of longitudinal striations and shape of sacci.

Stratigraphic range: Absent in Dwyka; very rare in Black Shales and Coals; and rare to occasional in Lower and Mid-Madumabisa Mudstones.

Genus: Lueckisporites R. Potonie and Klaus amended Klaus, 1963

Type species (original designation): Lueckisporites virkkiae R. Potonie and Klaus, 1954.

Synonyms: Striatites Pant, 1955 partim.

Diagnosis: Shape: Diploxylonoid.
Central body: Circular or oval, (l-a) directions.
Proximal cap: Two longitudinal ribs separated by one striation stretching across the entire cap.
Sacci: Approximately semi-circular, distally inclined.
Distal roots: Length less than ½-a (central body).
Distal zone: Less or equal to ½ l-a (central body).

Discussion: Although originally inclusive of multi-striate forms (Potonie, 1958), Jansonius (1962) amended the diagnosis to include only the forms with a proximal cap split in two parts. This is identical to the original type species, L. virkkiae R. Potonie and Klaus, 1954.

Distinction: Lueckisporites is distinct from other Striatiti genera by possessing one longitudinal striation thereby dividing the proximal cap in two. Corisaccites Segroves possesses this feature, but it is distinguished due to the conspicuous separation, by a narrow sulcus, of sacci from the exo-exine on the central body's proximal cap. Also the sacci and central body show similar infra-microreticulate structure unlike Lueckisporites where structure differs.

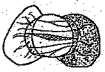
Infrapacollenites Goubin, 1965 is a complex spore regarded by Goubin as polysaccate, but by Balme as complex disaccate striate pollen grain "in which sacci are not markedly inflated" and the central body possesses two to four ribs. Although sacci margins are distinct, proximal cap on central body and sacci exo-exines once more are structurally similar.

Lueckisporites nyakapendensis (Hart, 1960) Hart, 1969

Plate 11: figures 1-4.

Holotype: L. nyakapendensis (Hart) Hart, 1969, Plate 1: figure 21.

Diagnosis: Moderately to strongly diploxylonoid, with a central body characteristically longitudinally oval. The pair of ribs is dissected by a narrow striation stretching the entire length of the central body. Sacci are crescentic, equal to or greater than a semi-circle, and t-a (sacci) may be the same or greater than t-a (central body). The distal zone is approximately ½ or less l-a (central body).



Description: Shape: Faintly to strongly diploxylonoid.
Central body: Longitudinally oval, exo-exine finely granulate.
Proximal cap: Bears one longitudinal striation, 1-4 μ wide, which stretches across the t-a diameter of the central body. Occasionally subsidiary striations, 2 or 3, are found faintly dissecting the two major ribs.

Proximal zone: Usually about 2/3 or $\frac{3}{4}$ l-a (central body).

Sacci: Distinct from the central body in being darker, and well defined. Sculpture is laevigate (waxy) to shagrenate, whilst sculpture is coarsely infra-punctate tending to infra-reticulate or infra-shagrenate. Sacci shape is larger than semi-circular in polar view, although variable in folded specimens and in size is usually smaller than or equal to the central body. The t-a (sacci) is a slightly greater than or equal to t-a (central body). Sacci proximally and distally attached, with distal inclination.

Proximal and distal roots: Usually concave but difficult to ascertain in folded specimens.

Distal zone: Usually relatively narrow ranging from 1/10-$\frac{1}{4}$ l-a (central body) but usually less than $\frac{1}{4}$ l-a (central body).

Dimensions (10 specimens): Total l-a: 54-95 µ; t-a (CB): 30-60 µ; t-a (CB): 28-45 µ; l-a (sacci): 15-35 µ; t-a (sacci): 29-45 µ.

Discussion: The distinction between *L. virrkiae* Potonie and Klaus and *L. nyakapendensis* is practically and numerically difficult due to insufficient data.

Of the former, Specimen 1001 could, for example, well be termed *L. virrkiae*, based on less diploxiiinity, rounder central body, wide proximal longitudinal sulcus, convex distal roots and a distal zone greater than ½ l-a central body. However, the variations of *L. nyakapendensis* discussed by Hart (1969) overlap most of these features.

L. sinshii Balme, 1966 is distinct in having a poorly defined, jagged longitudinal proximal striation, whilst *L. tattoosensis* Jansonius, 1962 bears relatively small sacci which are less than semi-circular in shape.

The specimens encountered within the Mid-Zambezi Valley are, on the grounds of gross morphology, all assigned to *L. nyakapendensis*. These forms do, however, appear to be of a smaller mean size, and exhibit subsidiary proximal longitudinal striae in fairly frequent cases (as opposed to Hart's "very rare", 1969, p. 28).

Stratigraphic ranges: Absent in Dwyka and Black Shales and Coals; rare to common in Lower Madumabisa Mudstones, and common to abundant in Mid-Madumabisa Mudstones.

Genus: Guttulapollenites Goubin, 1965

Type species (original designation): Guttulapollenites hannonicus Goubin emended Balme, 1966.

Diagnosis:

Shape: Globose, circular haploxylonoid to slightly diploxylonoid.

Central body: Circular to oval.

Proximal cap: Dissected into two, three or four transverse ribs.

Sacci: Disaccate, sacci semi-sphorical and distally detached, usually covering distal surface. Sacci margins sharply distinguished. Structure of sacci identical to that of the exo-exine of the proximal cap.

Discussion: Guttulapollenites was assigned by Goubin (1965) to the Polysacciti, infra-turma Globosacciti (Goubin, 1965). Within this taxon the genera were divided on the number of sacci occurring in more than one plane. Venkatachala, Goubin and Kar (1967), in amending this genus also regarded it as a tetrasacoate to multi-saccate pollen.

Balme (1966) believes it to be more convenient to regard Guttulapollenites as a disaccate, striate pollen grain in which the sacci are not markedly enlarged. The central body is regarded as possessing a thickened proximal cap divided into 2, 3 or 4 ribs. This confusion may be due to the great similarity between sacci exo-exine and proximal cap exo-exine according to Balme's structural analysis. (The earlier authors regarded the central body as indistinct and the surrounding similarly structured "bulges" as numerous sacci.)

Corisaccites Venkatachala and Kar, 1966 is distinct from Guttulapollenites on the basis of less spheroidal morphology and in the Western Australian forms (Segroves, 1969) by the presence of a narrow gap separating the proximal cap and saccus. In terms of Balme's interpretation of the morphology the distinction between Guttulapollenites and Lueckisporites appears to be the latter's less clear delimitation of the sacci outlines and the lack of any structural similarity between the proximal zone exo-exine and the sacci exo-exine.

Guttulapollenites hannonicus Goubin

Plate 11: figures 11-13.

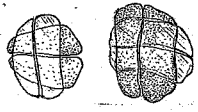
Holotype: Guttulapollenites hannonicus Goubin, 1965.

Diagnosis: (sensu Balme (1966)):

Shape: Disaccate, haploxylonoid circular.

Proximal cap: Dissected by longitudinal striae into 3-4 wide ribs.

Sacci: Almost hemispherical in polar view, detached distally, and covering almost the entire distal surface. A narrow distal sulcus divides the sacci.



Description: Shape: Circular haploxylonoid to slightly diploxylonoid.

Central body: Circular to elongate oval (t-a), and dissected, proximally into two sometimes three or four wide ribs. Exo-exine appears coarsely to finely infra-punctate to infra-reticulate.

Sacci: Appear transversely oval to almost lenticular in polar view, detached distally and nearly covering the distal surface. Exo-exine similar to that of the proximal cap. A narrow distal sulcus separates the sacci, 1-3 μ wide, exposing thin intexine. Sacci not greatly enlarged.

Dimensions (20 specimens): Diameter: 35(49)55 μ; width of sacci: 15-25 μ.

Discussion: The structure of this highly distinctive genus has been variably discussed (Goubin, 1965, Venkatachala, Goubin and Kar, 1967, Balme, 1966, etc.) Balme's interpretation of the morphology has been followed here.

The Mid-Zambezi specimens exhibit variable numbers of striae (2-4) and are very small in size. However, due to the exo-exinal structure and gross morphology, this species is provisionally retained under G. hannonicus.

Stratigraphic range: Absent in all but the Lower and Mid-Madumabisa Mudstones, where it is fairly abundant.

Genus: Hamiapollenites Wilson, 1962

Type species: Hamiapollenites saccatus Wilson.

Synonyms: Distriatites Bharadwaj, 1962.
Striatosaccites Jizba, 1962.
Minutiesaccata Hart, 1965a.

Diagnosis: Shape: Diploxylonoid.
Central body: Longitudinal ribs and striae cross the proximal and lateral surfaces of the cap, whilst one to several transverse ribs, or one keel, run across the distal surface.
Sacci: Small, relatively smaller than central body in size and attached terminally so that the distal zone is wide.

Discussion: Hamiapollenites has been described and discussed by Jansonius (1962 - under Hamipollenites), Hart (1964, 1965a) Playford and Dettman (1965), Tschudy and Kosanke (1966) and briefly by Segroves (1969) and Balme (1966). A comprehensive list of synonomies appears in Playford and Dettman (1965, quoted by Balme, 1966).

This form genus is not an abundant constituent of the Southern Hemisphere in Permian times but is reported to occur in Tanzania (Hart, 1956) and in Western Australia (Segroves, 1969). The original diagnosis and that

favoured by Hart, requires that the diploxylonoid shape, with sacci smaller than central body in size, be diagnostic. Balme and Segroves, however, state that the sacci attached to forms they encountered exhibit a large variation in size, from smaller to greater than the central body. Similarly the Hemiapollenites specimens encountered in the Mid-Zambezi Valley tend to be variable, i.e. haploxylonoid to slightly diploxylonoid with sacci ranging from equal to or only slightly smaller than the central body.

Distinction: Hemiapollenites is distinct from other Disacoate Striatiti forms by possessing transverse as well as longitudinal ribs.

Hamiapollenites sp. A.

Plate 11: figures 5, 6.

Description: Disaccate striatiti with transverse distal ribs.

Shape: Haploxylonoid to slightly diploxylonoid.

Central body: Circular to slightly oval in (t-a) direction.

Proximal cap: Bears 8-12 longitudinal ribs 1-5 μ wide some almost parallel, others tending to be diagonal.

Distal zone: Bears 6-7 transverse ribs 1-3 μ wide, all parallel and extending the width of the t-a (central body). Width is about ½ t-a (central body).

Sacci: Terminal attachment with no obvious distal inclination; distal roots concave and bounded by parallel darkened peripheral folds. Sacci equal to or larger than central body in relative size, greater than semi-spherical in shape and bearing a coarse intra-reticulum with large lumen (1-2 μ diameter) radially inclined at the roots.

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