Discussion:

Hart (1965) regards this genus as amongst the first legitimate genera within the Striatiti. Balas (1966) does, however, mention that no photograph of the type species P. latissimum has been published, nor a completely full description. Despite this, the 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 keystone linity, and distinct sacci with more or less parallel-sided distal roots.


Plate 6: figures 1-2.

Holotype: *Punctiporites globus* Hart, 1960, Plate 1: figure 15.

Diagnosis:

Haploxyloecoid to slightly diploxyloecoid 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 1/6 or less 1/6 (central body).

Size total: 1-a; 49-65 μ; t-a (saccl): 28-40 μ; t-a (central body): 22-39 μ.
Description: Shape: Haploxylonoid to slightly diploxylonoid 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 length of the central body; lips are less than 2 μ wide, and become narrow with acute folds terminally.

Sacci: Equal to or greater than semicircular 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 1/2 μ (central body) in width.

Dimensions (8 specimens): Total 1-μ: 43-60 μ; t-μ (sacci): 34-45 μ; t-μ (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, 5-9 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 1-e (central body), parallel-sided distal roots.

Dimensions (20 specimens): Total l-a: 30-65 \( \mu \); total t-a (central body): 30-45 \( \mu \).
The form described here all possesses 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 sali.

These features are diagnostic characteristics of F. 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: F. diagonalis is distinct from other species in having oblique ribs, transversely oval central body and a narrow distal salus.

Stratigraphic range: Absent in Dryas; rare in Black Shales and Coals; common to abundant in Mammalina and Oolites.
Protohaploxylonopsis micros Hart, 1964

N.B. No clear photographs, refer to text-fig. 12 below.

Holotype: P. micros Hart, 1964, Plate 1: text-fig. 12.


Diagnosis: The outline is haploxylonoid, with circular central body. The proximal cap bears four to six longitudinal ribs in proximal 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 of the central body. Size 1-n: 35-45 μm; 2-n: 20-29 μm.

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 μm 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; intra-reticulation is moderate to fine; ascid with slight distal inclination.
Distal zone: Fairly narrow, ranging from 1/5 to 1/a central body; distal roots usually parallel to slightly convex.
Discussion: These forms are closely comparable to the forms found in Tanzanian Lower Coal Measures (Hart, 1965, 1964).
Distinction: P. micros is distinguished from other species on the basis of its small size and six rils.
Stratigraphic range: Absent in Dyka; very rare to rare in Black Shales and Coals; rare to common in Madumabisa Mudstones.
Protohaploxypinus areolatus (Balme and Hennelly) Hart em. Balme, 1966
Plate 8: figures 5-6.
Synonyms:

Protophyloxyphylum amygdalum (Balme and Hennelly) Hart, 1964, text: figure 10;

Protophyloxyphylum amygdalum (Balme and Hennelly) Hart, 1965; p. 9;

Protophyloxyphylum corysengis R. Potonie and Iale, 1961 partim (see Balme, 1956 p. 111).

Diagnosis (sensu Balme, 1966):

Shape: Is slightly diploxyloidal to haploxyloidal in outline; the central body may be clearly defined and usually slightly longitudinally oval; apical 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 1-1/5 l-a (central body) size: total l-a: 64-15 μm; total t-a: 46-76 μm.
Description: Shape: Haploxylonoid to slightly diploxylonoid.

Central body: Distinct, darker than saoci 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.

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

Distal sulcus: Narrow, about 1/2 to 1/5 1-μ (central body) and characteristically bordered by peripheral darkened folds below the distal saoci 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 1-a: 78-120 μ; t-a (central body): 45-70 μ; t-a (sacci): 48-85 μ.

Discussion: Originally L. amplus Balme and Henne1ly, embraced haploxylonid striae 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. goraleneia preferred to regard the diagnostic features of L. amplus as being:

a) A distinct central body with slight 1-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 1 to 1/5 1-a (central body). The forms encountered in the Rhodesian sediments conform best to the latter diagnosis (same Balme), although a range of intermediate forms exist which are for the present included tentatively within this species. See discussion.
under *P. coronatus*. Much more material is necessary to confine species limits.

**Distinction:** *P. enflus* is distinct from other species by its size, distal transverse peripheral folds below second root, a usually distinct central body and a relatively narrow distal sulcus.

**Stratigraphic range:** Rare to common in Deyka, Black Shales and Coals, and Mackenzie Miststones.
Protohaploxylon sp. cf. P. koraiensis (R. Fotomie and Lele)

Plate 7: figures 1-7.

Description: Shape: Strongly haploxylonid, 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 8 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).

Sacri: Less than semi-circular in shape; equal to or slightly less in size than the central body. Transverse axis length of sacri is less than or equal to that of a central body. Sacri infra-reticulation is very coarse and dense (see Plate 7, No. 2 - Form 636) with lumen tending to radially elongate in shape from the sacri roots. Sacri join laterally, and are distally inclined.
Distal sulcus: Very narrow, 1/5 or less 1-a (central body) - the latter distance presumed by termination of striæ. Distal sacoid roots parallel and dimensions (8 specimens): total l-a: 80-130 µ; total t-a: 90-140 µ.

Distinction: P. sp. cf. P. gorniensis 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 (1965) 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. gorniensis Potonié and Lele which is strongly haploxylonoid with a very narrow distal sulcus, 1/5 or less 1-a (central body) and seven or more ribs (sensu Potonié and Lele). Hart amended this to include forms bearing 7-8 ribs, followed by Balme's amendment to include 8-12 ribs.

b) P. amplus (Balme and Hennesly) 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 1/5 of a central body.
Hart confined the species to include
forms bearing 10-12 ribs and
Segroves (1969) 7-10 ribs.
Beloe (1966) in his Salt Range thesis,
emphasizes the overlapping features
of these two species and therefore
distinguishes them as follows:

<table>
<thead>
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<th>P. amplus</th>
<th>P. goralensis</th>
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| Shape          | Haploxylonoid to slightly diploxylo-
                 | noid.                                 | Haploxylonoid (almost spherical)      |
| Central body   | Distinct (slightly 1-a) oval.          | Indistinct (slightly t-a) oval.       |
| Sacid distal   | Often with peripheral folds.           | No peripheral sacid folds.            |
| roots          |                                        |                                       |
| Distal zone    | 1-1/5 1-a (central body).              | Less than 1/5 central body.           |

The forms encountered in the Mid-Zambezi
Valley are divided according to Beloe's
distinction (see P. amplus). Those
forms assigned to cf. P. goralensis
appear to fulfill the diagnostic
characteristics fully, but insufficient
photographic comparison prevents
absolute naming.
Protohaploxylon limpidum (Balme and Hennelly)
Segroves, 1969

Plate 6: Figures 3-5.

Holotype: Disaekisporites limpidus Balme and Hennelly, 1955, Plate 3: figure 29-32.

Synonym: Tasmanisporites discurrens Iessik, 1959, Plate 5: figure 34.

Protohaploxylon sewarji (Virki, 1959)
Hart, 1964, Plate 11: text - figure 11.

Protohaploxylon limpidum (Balme and Hennelly) Balme, 1966, Plate 10: figures 1-3.

Diagnosis: Sena Segroves, 1969.

Description: Shape: Haploxylonid, 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 1-a (central body).

Sacii: Semi-circular, distally inclined and not laterally joined; distal sulcus is less than 1/5 1-a (central body) and parallel-sided. Size, total 1-a: 55-85 μ; 1-a (central body): 35-60 μ.
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 mm 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).
Discussion: Due to the loss of the original holotype specimens (Virkki, 1939, figure 2a) which Hart assigned to i. seawardii, the holotype of Laeckesporites linearis Balsam and Kennally has been accepted.
Description:

**Shape:** Haploxyloconid to slightly diploloxyloconid.

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

**Proximal cap:** 6–9 ribs, sub-parallel to wedge-shaped; 2–4 cm 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. sawardii*, the holotype of *Jasckiapites lignidus* Reine and Kennelly 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. 123) 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 Dykes; rare to common in Black Shales and Coals; rare to common in Madumabisa Maustones.
Protoceratysculina sp. A.

Plate 8: figures 1-4.

Description: Shape: Haploxylonoid, 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 stria is deepened and widened to form a narrow sulcus (a vestigial monoietate aperture). This is bordered by thin darkened folds (labra) and it stretches approximately 2/3 to 3/4 l-a (central body).

Saccul: Semi-circular in shape, equal to or smaller than central body in size and often meeting laterally to form a continuous lateral bladder 4-5 μ thick. Saccul is fairly densely and coarsely infra-reticulate, and distally inclined.

Distal sulcus: About 1/4 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. sepius* (Selme and Hennelly) Hart (sensu Hart 1964) and Segroves (1969); *non* Selme (1965). 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 assignment to *P. sp. A.* is preferred. More detailed work on other sediments will enlarge on this species' potential stratigraphic importance.

**Distinctions:** *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 Maimambisa Mudstones.
Protoharpaxypites sp. B.

Plate 6, figures 12-17.

Description: Shape: Haploxyloïd, 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-riaticulate, 2-5 µ wide.

Saoci: 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 saoci alone not necessarily distally inclined; saoci structure finely infra-riaticulate; saoci may be joined by an equatorial strip bearing a similar infra-structure.
Distal exilus: Does not exist. But distal zone includes almost the entire central body. Distal surface; 1=a (central body) as opposed to 1-a (total) is almost 4:5.

Dimensions (6 specimens): Total 1-a; 75-110 µ; total 1-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 Striatobistites; but this latter form is diplloxylonoid, with scans usually hemispherical and smaller than the central body in outline. P. anglicensis (Sedova) Hart, 1964 possesses a wide distal zone (2/3 1-a central body) and 6-8 proximal longitudinal ribs which distinguish it from P.? sp. 2.
**Distinction:** Ex. Sp. B. is distinguished from other species by its very narrow saccl, strong 1-a elongation and very wide distal zone.

**Stratigraphic Range:** Absent to very rare in Drykan, rare to common in Bland Shales and Coleas; and absent to very rare in Medusahisa Mudstones.
Genus: Striatonodocarpites Zoritschova and Sedova ex Sedova emended Hart, 1964

Type species (by original designation): Striatonodocarpites sedonai Sedova.

Euclidiosporites Deschik, 1956 partim.
Diploxylonides Potonié and Klaus, 1954 partim.
Brutisporites Koumova partim.
Stratenerispores Wilson, 1963.
Hosomaspores Wilson, 1963.
Hindinocarrites Bharadwaj, 1962.

Diagnosis: Shape: Strongly to moderately diploxylonoid.
Central body: Circular to oval.
Proximal cap: More than four longitudinal ribs.
Saccol: Distinctly larger than central body in size, greater than 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 Sederov (1956) and later amended by Hart (1964). However, the genus *Striataea* Hans (1955) is in strong synonymy and is also valid, but due to loss of the type species the former genus is preferably adopted. Amongst others, Hart also puts in synonymy the genera *Tertiary pollenites Bharadwaj*, *Jahirites Bharadwaj* and *Hindipollenites Bharadwaj*. These are primarily diploxylocecid *Striataea* with minor variations in rib structure.

Distinction: This genus is distinguished from other *Striataea* by:

a) Strong diploxylinity.

b) Sacoid greater than semi-circular.

c) Cooperatively small central body.
Diagnosis:
Descriptions. Hennelly, 1955, Plate 21 figure 11. Pissacete Striatitilorw with moderate diploxilinity, circular central body, six proximal ribs (sense Hart) and a narrow (1/5 1-a (central body)) distal sulcus.
Length: 40(54)70 a; 1-a (central body; 21(27)32a.

**Description:**
Shape: Moderately diploxylonoid.
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.
Saccii: 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 1 to 1/5 1-a (central body).


Distinction: This species is distinct from other forms of the genus on the basis of degree of diploxility, i.e., low ratio of t-a (C.B.): t-a (sacol); 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-Madumablea Mudstones.
Striatopodocarpites octostriatus (Hart, 1950) here emended

Plate 10: figures 1-6.


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

Diagnosis: Strongly diplacylonoid, circular central body, and a proximal cap bearing 8 longitudinal ribs and minor transverse striae. Distal sulcus is narrow, ½ l-a (central body). N.B. size range 65-95 μ (total l-a).

Shape: Strongly diplacyonoid.
Central body: Circular to sub-circular with slight 1-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-slime 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 sulcous: Narrow, 1-1/3 or less 1-a (central body), parallel sided.

Dimensions (10 specimens): Total 1-a: 85-100 μ.

Discussion: *Labilites ranganjeepia* Bharadwaj, 1962 was created to accommodate diploxyloonid striate genera bearing numerous transverse and longitudinal striae, amongst other features. Hart recombined the form into the genus *Striatopoulosporella* and amended the diagnosis to contain 10-ribbed forms with transverse and longitudinal striae.
S. octostriatus Hart, 1960 was created earlier to house 3-ribbed forms, without transverse striae. However, Segroves (1969) points out the presence of such striations in the photographs of S. octostriatus Hart, 1960. L. ranigenensis 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. legnascens (Wilson) Hart, 1964 appears to be very similar but is larger in size.

S. ramsa (Bharadwaj and Saluja) 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. hacostriatum* is distinct from other species in having 8 longitudinal ribs, minor transverse striae, strong dipleurallity, 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 Madagascan Maestrichtas.
Striatocraspedites rana (Bharadwaj and Saluja)
Balme, 1966


Holotype: Labyrinthites rana Bharadwaj and Saluja, 1964.

Diagnosis: Diplloxylonoid, 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 ½ 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 diploxylonoid.
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 sulci: Approximately 3 to 4
l-a (central body) in polar
view; distal sulcal roots
are parallel and clearly
delineated.
Dimensions (6 specimens): Total l-a:
70-105 μ; t-a asec: 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
amendment of S. octostriatus in this
thesis to include forms with minor
transverse striae and a marginal crest,
these specimens lacking transverse
striae are here referred to the broad
concept of S. rarus as amended by
Balme. The Rhodesian forms assigned
to S. rarus also appear to possess a
lower degree of diploxinility and a
tendency to transversely elongated
central bodies in comparison to
S. octostriatus; larger size distinguishes it from S. cancellatus.
Distinction: *S. varia* is distinct in having 6 sub-parallel ribs; and marginal crest around proximal cap, and a distal sulcus of approximately ⅓ (= central body).

Stratigraphic range: Absent in Dwyka sediments; very rare to rare in Black Shales and Coals; rare to common in Ndumu and Mulstones.
Striatoocarpirites sp. cf. S. fusus (Hennelly and
Hennelly) Potonié, 1958

Plate 9: figures 4-11.

Holotype: Luxembourgites fusus Belme and
Hennelly, 1955, Plate 1: figures 6-10.

Synonym: S. globus Xeschik, 1959

Diagnosis: Discocystidiform, strongly diploxy-
lonoid with a circular central body.
Striations and ribs are indistinct.
The distal zone is very narrow (~1/2-3
(central body)) associ 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 associ.
Proximal cap: Bears usually indistinct
ribs (where discernible they
number 6-9) all parallel to
sub-parallel and sinusoid and
closely spaced; occasionally
short irregular transverse
striations give an apparent
"zig-zag" appearance to the
proximal cap.

Saccii: 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.
distinct lateral bladders, but sacculae meet and tend to overlap at lateral proximodistal junction.

**Distal sulci**: Very narrow, approximately 1/10 t-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 (saccii): 30-40 μ; distal sulci: 1-3 μ.

**Discussion**: These forms may well be attributable to *S. cancellatus* (Balsaw and Neelley) Hart on the grounds of size range and general morphology. However, due to their greater degree of dioxidility, often indistinct and sinuous ribs, the frequent short transverse striations
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 (sacchi): 30-40 µ distal sulcus: 1-3 µ.

Discussion: These forms may well be attributable to S. cancellatus (Baës and Hennelly) Hart on the grounds of size range and general morphology. However, due to their greater degree of diploailinity, often indistinct and sinuous ribs, the frequent short transverse striations...
and extremely narrow distal sulcus, with frequent meeting of each laterally; they are tentatively compared to S. fusa. S. kondapanensis (en Hart) bears 10 longitudinal ribs and is larger, whilst S. ortestriatus Hart shows no transverse striations and is also differentiated in size. S. phalanae (Bain and Hennelly) Hart has distinct attachment lines along the distal roots with lateral bladders. S. securata (Dharmadwaj) Hart is much larger with short distal roots. Absent in Deyka; rare to common in Black Shales and Coals; common in Lower and Mid-Madumabisa Mudstones.
Stratopodocerites sp. of S. ophidioides (Wilson, 1962)
Hart, 1964
Plate 9: figures 16-17.
Holotype: Stratopodocerites communis Wilson, 1962.
Diagnosiss: Moderately to strongly diploxylonid; proximal cap bears 10-14 finely punctate longitudinal ribs; sacci reniform; distal zone less than 1/2 a (central body).

Description: Shape: Slightly to moderately diploxylonid.
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.
Sacii: 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-reticula; lumen (brooch) 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 1/3 of (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. of. 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 sac: Divided irregularly and haphazardly into approximately 9-10 longitudinal ribs, sub-parallel, sinuous, 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 µm or less).

Sacchi: Larger than central body in size, and greater than semi-circular in shape (longitudinally extended); medium to very coarsely infrareticulate, with characteristic short dense folding in a radial direction from the central body outwards. Proximal and distal roots are very indistinct; sacchi apparently join or overlap on their lateral equatorial margin, but do not form inflated lateral bladders.
Distal sulcus: Approximately ½ or less.
1-a central body: often indistinct, but tending to concave.
Dimensions (3 specimens): Total l-ar
80-110 μ; t-a (central body):
30-45 μ; t-a (sac); 35-70 μ.

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

S. shahwanensis (Iahhabpal, Sah. and Dube) Hart, 1960, S. ranilwansa (Bharadwa) Hart, S. secreta (Bharadwa) Hart and S. indicus (Bharadwa) Hart all show greater diploxylinity 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:** Striatonodocarites sp. A, is separated on the basis of slight diplostep thinness; 9-10 distinct ribs narrowly separated; distinct haphazard, short transverse striae; indistinct distal sulcus approximately 1-2 (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 Mafikengian Sandstones.
Gaftavia Taeniaeaporitea. - Entodandophora. 1962

Type species (by original designation): Taeniaeaporites kreneselli Leschik,

Stratites Part, 1955 partim.
Inakensporites Leschik partim.

Diagnosis: Shape: Diplolxonoid to haploxylonoid. Central body: Circular to oval in t-a or 1-a direction.
Proximal cap: Three to five major ribs, with occasional subsidiary ribs. Striae are notably wide, exposing the underlying intexina.
Distal zone: Greater than or equal to 1/2 a (central body).

Discussion: As commented upon by Balme (1966), Hart (1965) and others, much confusion arose originally when Inakensporites Leschik (type sp. L. acutus) and Taeniaeaporites Leschik (type sp. T. kreneselli 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 Inakensporites be abandoned.
Tennissporites has been discussed by a number of authors, e.g. Jansonius (1962), Hart (1964) and Salme (1965, 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 Salme (1966), warns on the occurrence of subsidiary striae.

Diploxility and haplooxility are regarded by these authors as not feasibly separable.

**Distinction:**

Tennissporites is distinct from other Striatitites genera in having wide striae separating the ribs, and in having more than one but less than five major striae.

Tennissporites has only one wide striae separating two ribs.
Taeniaceaporites sp., cf. T. novaebacciai Leschik, 1956

Plate II: figures 9-10.

Holotype: Taeniaceaporites novaebacciai Leschik, 1956.


Description: Discoid, strictite, form bearing widely spaced ribs.

Shape: Haploxylooid or slightly diploxylooid (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.

Sacoid: 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 root increasing in size outwards. Sacoids tend to distal inclinations.
Distal sulcus: Approximately \( \frac{1}{4} \) i-a (central body), whilst the proximal zone is greater than \( \frac{1}{2} \) i-a (central body).

Dimensions (4 specimens): Total 1- at 45-80 mm; i-a (sacii): 25-40 mm; i-a (central body): 25-44 mm.

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

Psammosaurites is shown by Hart (1965) to be an essentially northern hemisphere genus. However, in his palynology
biozones of the Karroo, South Africa, (1967) Hart includes T. africana (Hart MB) in his Upper Permian Striatiti Zone. No description or photographs could be found to enhance his drawing, therefore no specific comparisons with the present specimens could be drawn. Other Southern Hemisphere occurrences are quoted in Lower Triassic sediments (Balme, 1953; Goubin, 1965).

This rare occurrence of the genus in Mid-Zambez Valley sediments is therefore indicative of Upper Permian - Lower Triassic age, and as such is stratigraphically important.
Genus: *Striatitiites* Zorichev and Sedova ex Sedova, amended Hart, 1964

Type species (by original designation): *Striatitiites brickii* Sedova.

*Pemphycalites* Ibar and Vala, 1951 partim.
*Protodiploxylon* Samoilovich, 1955 partim.

Diagnosis: Shape: Diplloxylonoid.
Central body: Circular to oval (1-a direction).
Proximal caps: 6 or more ribs.
Socii: Smaller than central body in size, t-a (soci) is approximately equal to t-a (central body), shape is semi-circular.
Distal rosette: Equal to or little less than t-a (central body).
Distal zone: Wide, equal to or greater than 1-a (central body).


Distinction: This genus is distinct from other diplloxylonoid *Striatiti* genera on the basis of smaller socii relative to the central body, sizes, numerous ribs, and wide distal zone.
Striatocubletites multistriatus (Balme and Hennelly)

Plate II: figures 7-8.

Holotype: Inoakyntites multistriatus Balme and Hennelly, 1955 partim.

Diagnosis: The shape of the specimen is characteristically diploxylonoid, with the central body longitudinally oval. The proximal cap shows 12 to 15 longitudinal ribs in polar view. The distal zone is greater than 1.8 times the central body and the central ribs 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 mm 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 sacral roots.

Distal zone: Approximately 2/3 to 1/2

1-a (central body).

Dimensions (8 specimens): Total 1-a:
50(63)75 μ; 1-a (central body):
40(44)50 μ; t-a (central body):
34(38)42 μ; distal zone:
24(25)30 μ.

Discussion: Middle and Kellaway gave a fairly wide description for the type species, some forms of which have already been reassigned (Segroves, 1969) to other genera (e.g. Vittatina (inver ex Wilson) for sub-saccate forms). Hart amended the diagnosis which is retained here. This species is a relatively rare form in the Mid-Zambesi Valley, and is usually folded semi-laterally.
Distinctions: This species is distinct from other forms on the basis of size, distal zone, number of longitudinal striations, and shape of saccus.

Stratigraphic range: Absent in Doyle; very rare in Black Shales and Coals; and rare to occasional in Lower and Mid-Mississippian limestones.

Type species (original designation): *Jacekisporites virkiiae* R. Potonie and Klaus, 1954.

Synonym: *Striatites* Pant, 1955 partim.

Diagnosis:
- **Shape:** Diplloxylonoid.
- **Central body:** Circular or oval, (1-a) direction.
- **Proximal cap:** Two longitudinal ribs separated by one stria stretching across the entire cap.
- **Sacci:** Approximately semi-circular, distally inclined.
- **Distal rosette:** Length less than 1-a (central body).
- **Distal zone:** Less or equal to \( \frac{1}{2} \) 1-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, *J. virkiiae* R. Potonie and Klaus, 1954.
Distinction: *Ikebisporites* is distinct from other Striata gena by possessing one longitudinal stria thereby dividing the proximal cap in two. *Corisacciites* Sarrôves possesses this feature, but it is distinguished due to the conspicuous separation, by a narrow sulcus, of acoli from the exo-exine on the central body's proximal cap. Also the acoli and central body show similar infra-micro-structure while *Ikebisporites* where structure differs.

*Gebelinacollenites* Gounin, 1965 is a complex spore regarded by Gounin as polyadate, but by Balme as complex dinae, while *Gebelinacollenites* is striae pollen grain in which acoli are not markedly inflated and the central body possesses two to four ribs. Although acoli margins are distinct, proximal cap on central body and acoli exo-exines once more are structurally similar.
Lepticephalites nyakapendengia (Hart, 1969) Hart, 1969

Plate II: Figures 1-4.


Plate 1: figure 21.

Diagnosis: Moderately to strongly diploxylonoid, with a central body characterized: longitudinally oval. The pair of ribs is dissected by a narrow striation stretching the entire length of the central body. Sacii are crescentic, equal to or greater than a semicircle, and t-a (sacai) may be the same or greater than t-a (central body). The distal zone is approximately \( \frac{1}{2} \) or less 1-a (central body).

Description: Shape: Palty to strongly diploxylonoid.

Central body: Longitudinally oval, exo-exinie finely granulate.

Proximal cup: Bears no longitudinal striation, 1-4 a 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 ≈ 1-a (central body).

Sacci: Distinct from the central body in being darker, and well defined. Sculpture is laevigate (waxy) to shagrenerate, whilst sculpture is coarsely infra-punctate tending to infra-reticulate or infra-shagrenerate. 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 1/10-1 1-a (central body) but usually less than 1 1-a (central body).

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

Of the former, Specimen 1001 could for example, well be termed *L. virkinsiae*, based on less diploxiinity, rounder central body, wide proximal longitudinal sulcus, convex distal roots and a distal zone greater than \( \frac{1}{2} \)-a central body. However, the variations of *L. prekapsendensis* discussed by Hart (1969) overlap most of these features.

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

The specimens encountered within the Mid-Zambesi Valley are, on the grounds of gross morphology, all assigned to *L. prekapsendensis*. 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 range: Absent in Dwyka and Black Shales and Coals; rare to common in Lower Hadarabina Marnstones, and common to abundant in Mid-Hadarabina Marnstones.
Genus: *Guttulascollenites* Goubin, 1965

Type species (original designation): *Guttulascollenites harmonicus* Goubin exended 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-spherical 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:** *Guttulascollenites* was assigned by Goubin (1965) to the Polysacitri, infra-turmu Globosaciti (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 tetrasaccate 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 saccos. In terms of Balme's interpretation of the morphology the distinction between Guttulapollenites and Incohiscaccites 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.
Guttularpollenites hannonicus Goubin


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-e), 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 intine. 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 Ear, 1967, Balme, 1966, etc.) Balm’s interpretation of the morphology has been followed here.

The Mid-Zambesi 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 S. hanoelica.

Stratigraphic range: Absent in all but the Lower and Mid-Madumabisa Mudstones, where it is fairly abundant.
**Genus:** Hamiapollenites Wilson, 1962

**Type species:** Hamiapollenites eacottus Wilson.

**Synonyms:**
- Distritites Sharawaj, 1962.
- Striatesaccites Tisba, 1962.

**Diagnosis:**
- Shape: Diplolyonoid.
- 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.
- Sacii: 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 Haeipollenites), Hart (1964, 1965a), Playford and Dettmann (1965), Tschudy and Kosanke (1965) and briefly by Segroves (1969) and Balme (1966). A comprehensive list of synonyms appears in Playford and Dettmann (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 Segovias, 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 *Hamiapollenites* 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:** *Hamiapollenites* is distinct from other *Disacocate Striatiti* forms by possessing transverse as well as longitudinal ribs.
**Plate 11: figures 5, 6.**

**Description:** Dissacate eastristi with transverse distal ribs.

**Shape:** Haploxylonoid to slightly diploxylonoid.

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

**Proximal cap:** Bears 6-12 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 1/4 t-a (central body).

**Sacii:** Terminal attachment with no obvious distal inclination; distal roots concave and bounded by parallel darkened peripheral folds. Sacii equal to or larger than central body in relative size; greater than semi-spherical in shape and bearing a coarse reticulum with large lumina (2-4 μ diameter) radially inclined at the roots.