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PALYNOLOGY OF THE JURASSIC SEDIMENTS OF WESTERN CANADA

Part I*) (Continued) Terrestrial Species

BY

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WITH PLATE 14—26, 18 FIGURES AND 1 CHART IN THE TEXT

b) Pollen of the Gymnospermae

Pollen of the Jurassic Gymnospermae exhibit sufficient morphological similarity to set them apart from all other groups.

By the close of the Paleozoic, pollen closely similar to that produced by recent members of the Abietineae had been evolved. Pollen of a type produced by *Tsuga* has been recorded from the Permian and grains similar to pollen of some species of the Cupressaceae and Taxodiaceae also occur in Permian sediments. Thus it appears reasonably certain that the Coniferales were firmly established by the end of the Paleozoic, many of the major families, and in particular the Abietineae, being already separated.

Pollen produced by the Cycadales, Bennettitales, Ginkgoales and Chlampydospermidae is abundant in the Upper Paleozoic and there can be little doubt that the major subdivisions of these classes were established at this time. The work of JANSONIUS & STAPLIN (1962) suggests that the Chlamydospermidae were probably derived relatively late in Paleozoic time from that group of pteridosperms producing proximally striate pollen grains. Comparative spore morphology suggests that these four classes are more closely to the Pteridospermidae than to the Coniferales.

Megafossil remains of the Taxaceae and Podocarpaceae have not been recorded from sediments older than the Rhaetic and pollen of these classes has not been recorded from pre-Jurassic sediments. *Platysaccus* which has been described as a podocarpaceous pollen genus, does not appear, on close examination, to be very similar morphologically to recent podocarpaceous pollen. A fuller discussion of these problems will be found in STAPLIN, POCOCK & JANSONIUS 1967.

Genus *Triangulopsis* DÖRING emend.

1961 *Triangulopsis discoidalis* DÖRING; p. 114, pl. 17, figs. 1—3, type species.

Diagnosis: Alete or trilete microspores. Laesurae, where present, are usually vestigial and have no germinal function. Amb triangular, sides straight to somewhat convex, apices blunt. Exine two-layered. Nexine relatively thin, smooth. Sexine relatively thick, smooth to granulose, never strongly ornamented. Three colpoid leptomata developed on the distal face more or less paralleling the sides of the grain which may, or may not, be flanked by thickened sexinal lips.

Discussion: DÖRING erected *Triangulopsis* as a genus of microplankton. As discussed on p. 74, the type species, *T. discoidalis*, is a plant pollen and the genus becomes a formgenus. Certain morphological

*) The previous chapters of Part I have been published in vol. 130, number 1—2 of Palaeontographica B.

characters suggest possible relationship with *Duplicisporites*, a characteristic Triassic genus (see p. 61) and *Inaperturopollenites* of the *I. australis* type (see p. 75). Dr. A. R. H. MARTIN, University of Sydney, (personal communication 6th December, 1963), suggests possible Araucariacian affinities for the genus.

Triangulopsis discoidalis DÖRING

Pl. 14, fig. 1, 5055 (2514b), slide 5 (40.0—119.7), P. N. 14102;fig. 2, 5055 (2514b), slide 5 (47.9—120.4); fig. 3, 5055 (2514b), slide 5 (33.7—120.3); fig. 4, 5055 (2514b), slide 5 (31.0—125.2), P. N. 14103; fig. 5, 5055 (2514b), slide 5 (34.6—121.1); fig. 6, 5055 (2514b), slide 4 (27.5—118.5); fig. 7, 2132, slide 3 (39.0—122.1); fig. 8, 2132, slide 1 (38.9—122.3), P. N. 14104.
1961 *Triangulopsis discoidalis* DÖRING; p. 114, pl. 7, figs. 1—3.

Description: Alete, or sometimes exhibiting a vestigial trilete scar consisting of faint raised ridges extending to the apices of the spore; exine two-layered; nexine about 1.5μ thick, smooth, tightly appressed to sexine; sexine 2.5μ thick; finely granulose to scabrate; amb triangular; sides convex; apical angles blunt, slightly rounded; three straight colpoid leptomata developed on the distal face, more or less paralleling the sides of the spore, extending from apex to apex but not meeting (see diagram); leptomata flanked by exinal thickenings that merge with the normal exine; colour orange-brown; equatorial diameter 52.0 (69.0) 87.0μ; length of leptomata 48.5μ (average).

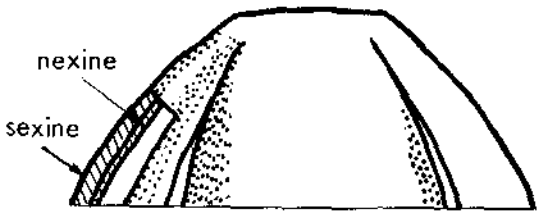


Fig. 40. Structure of *T. discoidalis*.

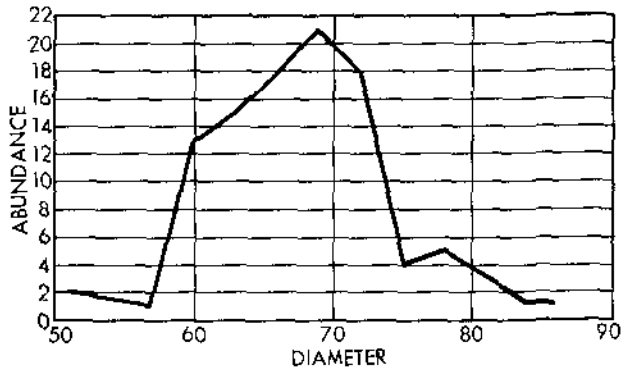


Fig. 41. Size range (based on a count of 200 grains).

Discussion: This species was described by DÖRING (1961) as a planktonic organism of unknown affinity. Clear three-rayed tetrad scars (Pl. 14, figs. 1, 2 and 7), together with the exine structure indicate that the grains are plant pollen. The grain shown in fig. 2 is one of the few encountered in the present study with exinal thinning over the area of the trilete scar, suggesting the possibility of the structure retaining some germinal function.

Triangulopsis minor n. sp.

Pl. 24, fig. 15, 404, slide 4 (46.2—125.1), P. N. 14105

Description: Alete; nexine about 1.0μ thick; smooth; tightly appressed to sexine; sexine 2.0μ thick; roughened to faintly rugulate; amb triangular; sides straight; apices rounded; three straight colpoid leptomata developed along the equatorial edge of the distal face, more or less paralleling the sides of the spore and extending from apex to apex but not meeting (see diagram for *T. discoidalis*); leptomate flanked by exinal thickenings up to 3.0μ wide that merge with the normal exine; equatorial diameter 44.0—47.3μ; length of leptomata approx. 30.8μ.

Discussion: Rare, but of fairly widespread occurrence in the Lower Vanguard and Upper Shaunavon. Smaller than *T. discoidalis*.

Triangulopsis sp. A

Pl. 14, fig. 12, 5055 (2514b), slide 5 (26.2—114.0), P. N. 14106

Description: Alete; exine two-layered; amb circular (grain spherical); nexine about 0.5μ thick; smooth; tightly appressed to sexine; sexine about 2.0μ thick; faintly granulose; three leptomata developed

around the periphery of the grain, each about 35.0μ long, flanked by parallel-sided lips about 2.0μ wide, colour orange-brown; equatorial diameter 55.0 (60.3) 68.2μ.

Discussion: Very similar, although smaller, grains have been found attached to *T. discoidalis* Döring and these grains are probably abortive spores. Pl. 10, fig. 10, 5055 (2514b), slide 5 (26.2—114.0) illustrates a two-layered spore assignable to *Inaperturopollenites australis* Cookson to which are attached a number of small grains. These grains are two-layered and some show slit-like leptomata. They are also interpreted as abortive spores. The presence of similar abortive spores attached to species of *Triangulopsis* and *Inaperturopollenites* suggests a possible botanical relationship between the plants that produced these grains.

Genus *Inaperturopollenites* Thomson & Pflug

Diagnosis: Pollen grains with no visible apertures. Amb circular. Exine one- or two-layered. In two-layered forms the nexine and sexine may be tightly appressed or the sexine may form a saccus enveloping the sexinal body. Surface smooth to granulose.

Discussion: The genus *Inaperturopollenites,* as used in this work, has very wide limits, including all more or less spherical pollen grains with minor ornament and lacking any apertures. The genus has little botanical significance.

Inaperturopollenites cf. *I. australis* (Cookson) n. comb.

Pl. 14, fig. 9, 5055 (2514a), slide 4 (30.9—119.8), P. N. 14107; fig. 11, 5055 (2514b), slide 5 (18.9—119.5), P. N. 14108; fig. 13, 5055 (2514a), slide 4 (30.5—118.8)

1947 *Araucariacites australis* Cooks.; p. 130, pl. 13, figs. 1—4.

Description: Saccate; germinal area not usually visible, but on some species a relatively circular area about 35.μ in diameter centred on the proximal pole shows exinal thinning and forms a tenuitas; rarely, this tenuitas may be traversed by a very faint trilete scar; central body circular to sub-circular; nexine about 0.5μ thick; smooth, tightly appressed to sexine over its proximal face; nexine and sexine firmly fused around the equator of the central body where a belt of exinal thickening up to 5.0μ wide is usually detectable; sexine 1.0—1.5μ thick; granulose, forming a more or less spherical saccus enveloping the central body; saccus shows little or no tendency to fold; colour yellow-brown; diameter of spore 80.0 (85.1) 92.0μ; diameter of central body 63.0 (70.7) 73.0μ.

Discussion: Similar in most respects to *A. australis* Cooks. but significantly larger in size. *I. turbatus* Balme is smaller, has a relatively smaller central body and folds readily. The species is transferred to the less restricted genus *Inaperturopollenites* pending further study of the group.

Inaperturopollenites turbatus Balme

Pl. 13, fig. 15, 2132, slide 3 (41.4—116.6) P. N. 14109; fig. 16, 2132, slide 3 (36.0—120.4)

1957 *Inaperturopollenites turbatus* Balme; p. 31, pl. 7, figs. 85—86, pl. 8, fig. 87.

Description: Saccate; central body circular to sub-circular in outline; usually somewhat folded; nexine about 0.5μ thick; smooth; sexine forms a loosely fitting saccus completely enveloping the central body; sexine 1.0—15.μ thick; granulose; central body appressed to saccus over one face, being firmly attached around the equator; no germinal apparatus visible; colour yellow-brown; diameter of spore 62.0 (70.4) 78.0μ; diameter of central body 44.0 (55.4) 66.0μ.

Discussion: Although these grains are slightly larger than those described by Balme there can be little doubt that they belong to the same species. Grains in which the central body has become torn away from the saccus show sexinal folds and thickening in a more or less circular band where nexine and sexine were tightly appressed. Small two-layered abortive spores have been observed attached to some spores of this species.

Genus *Paleoconiferus* Bolkh.

1952 *Paleoconiferus* Bolkhovitina.
1956 *Paleoconiferus asaccatus* Bolkh.; p. 85, pl. 13, figs. 150a—c, type species.

Diagnosis: Monosaccate pollen grains. Exine two-layered. Nexine very thin and usually indetectable. No visible apertures although a faint parallel-sided distal leptoma may be developed. Outline circular to broadly oval. Saccus only slightly inflated, somewhat distally pendant; finely infrareticulate with brochi not more than 2.5μ wide. Proximally saccus passes imperceptibly into a slightly inflated, circular infrapunctate cappa. Cappa separated from saccus by proximal lateral scars.

Discussion: Similar to *Protoconiferus*, differing from it principally in lacking a well developed sulcus. The central body is also much less pronounced in this genus. The small mesh reticulum of the saccus, together with the general aspect of the grains, suggests pertidospermous rather than coniferous affinities for members of this genus. Some of the grains recovered from male cones of Thuringia (e. g. Townrow, 1962, p. 32, fig. 6b) appear to be assignable to *Paleoconiferous*.

As with several other of Bolkhovitina's genera for saccate pollen grains, this genus was published in 1952 but not validated until 1956.

Paleoconiferous minor n. sp.

Pl. 15, fig. 1, 5055 (2514b), slide 5 (32.2—119.2); fig. 3, 5055 (2514a), slide 1 (32.6—117.4) Holotype, P. N. 14110

Description: Monosaccate; central body very obscure; circular; about 40.0μ in diameter; no sulcus developed; germination probably by distal leptoma; sexine differentiated into a somewhat distally pendant saccus which surrounds the distal face of the central body equatorially and is somewhat constricted at the longitudinal extremities of the central body, giving it a pseudo-bisaccate appearance; sacci almost uninflated; infrareticulate; brochi about 1.0μ wide; equatorially and proximally saccus merges imperceptibly into an infrapunctate cappa 2.5—3.5μ thick; colour pale brown;
Size range

A. 40.0—45.0μ	D. 52.8—60.0μ
B. 33.0—50.0μ	E. 75.2—83.0μ
C. —	

Discussion: Similar to *P. asaccatus* Bolkh. (1956) but smaller in size.

Paleoconiferus asaccatus Bolkh.

Pl. 16, fig. 1, 5055 (2514b), slide 4 (33.3—120.4), P. N. 14111; fig. 2, 5055 (2514b), slide 4 (27.2—120.3), P. N. 14112; Pl. 11, fig. 2, 5055 (2514b), slide 4 (26.6—113.6)
1956 *Paleoconiferus asaccatus* Bolkh.; p. 85, pl. 13, figs. 150a—c.

Description: Monosaccate; central body more or less circular in outline; nexine less than 0.5μ thick (exact thickness indeterminate); distal face of grain traversed by a very faint, parallel-sided leptoma up to 10.0μ wide which has no visible lips and extends the full length of the grain; leptoma punctate; saccus broadly oval in outline; wider than it is long; finely infrareticulate; elements of reticulum 1.0—1.5μ wide; cappa delineated from saccus by two narrow crescentic proximal-lateral scars each about 3.0μ wide, marking areas of adhesion of nexine and sexine; cappa infrapunctate, colour light yellow-brown.
Size range

A. 35.0 (49.0) 60.0μ	D. 53.0 (70.0) 80.0μ
B. 45.0 (50.0) 60.0μ	E. 85.0 (90.8) 96.0μ
C. 35.0 (36.5) 40.0μ	

Discussion: The measurements of the Canadian specimens are a little smaller, on average, than those from the U.S.S.R. but the size difference is too small to warrant the erection of a new species.

The species is easily recognizable on account of the presence of two lateral scars flanking the cappa and the absence of well defined distal germinal structures.

Genus *Protopicea* Bolkh.

1952 *Protopicea* Bolkh.
1956 *Protopicea cerina* Bolkh.; pp. 100—101, pl. 17, fig. 181, type species.

Diagnosis: Bisaccate pollen grains. Central body indistinct, more or less ovoid. Sacci strongly distally pendant inflated, infrareticulate, fringing and more or less enclosing a smooth capula. Capula smooth. No sulcus developed (germination by distal leptoma). Proximally sacci merge with a somewhat indistinct, slightly inflated, infrapunctate cappa which is externally smooth or scabrate.

Discussion: The above genus is employed in this work to include both species assigned to *Protopicea* and those assigned by Russian palynologists to the natural genus *Picea*, which cannot be validly employed as a genus for sporae dispersae.

Protopicae exilioides (Bolkh.) n. comb.

Pl. 15, fig. 4, 5055 (2514b), slide 4 (27.8—113.6); fig. 5, 5055 (2514a), slide 4 (20.3—119.2), P. N. 14113; fig. 6, 5055 (2514b), slide 5 (37.3—120.1), P. N. 14114; fig. 9, 5055 (2514a), slide 1 (31.9—118.4); fig. 8, 5055 (2514a), slide 4 (29.4—121.1); fig. 10, 5055 (2514a), slide 4 (36.8—120.1), P. N. 14115

1956 *Picea exilioides* Bolkh.; p. 103, pl. 17, figs. 186a—d.

Description: Bisaccate; central body very indistinct; ovoid; smooth; thickness indeterminate; equatorial outline of grain oval; sexine about 1.0μ thick; sacci distally pendant; infrareticulate; somewhat inflated; brochi of reticulum 2.0—2.5μ wide; larger on distal than on proximal side of sacci; sacci enclose the nexinal body distally and may meet and fuse along a narrow equatorial belt; sexine thinned and uninflated over the rounded area of the nexinal body enclosed by the sacci forming a capula which functions as a leptoma; capula smooth; finely punctate; proximally sacci merge into a somewhat inflated, infrapunctate cappa which is more or less circular in outline; colour pale brown.
Size range

A. E. 70.0 (73.2) 80.0μ	D. 45.0 (56.6) 70.0μ
B. 55.0 (62.5) 70.0μ	E. 98.0 (108.0) 125.0μ
C. 45.0 (51.3) 60.0μ	

Discussion: This species comprises grains of more or less ovoid shape with fringing, distally pendant sacci enclosing a distal capula. Pl. 11, fig. 5 illustrates the relationship between sacci and capula while figs. 9 and 10 show the form of the cappa. Pl. 11, fig. 6 illustrates what is probably a deviating, trisaccate grain of the same species.

Protopicea samoilovichiana (Rovn.) n. comb.

Pl. 15, fig. 11, 5055 (2514a), slide 1 (31.3—118,7), P. N. 14116

1961 *Picea samoilovichiana* Rovnina; p. 139, pl. 39, figs. 1a—c, 2a—c.

Description: Bisaccate; central body ovoid; wider than it is long; nexine less than 0.25μ thick; distal surface of central body obscured by enveloping sacci but the part visible appears to be thinned, suggesting the presence of a distal leptoma; sacci inflated; tightly enveloping the central body distalo-equatorially leaving only a small portion, centred on the distal pole, uncovered; sacci infrareticulate; brochi about 1.0μ wide; sexine of sacci infrareticulate; sexine of sacci 0.5—1.0μ thick; proximally sacci about against, and merge into, an infrapunctate cappa; cappa only slightly inflated; about 1.0μ thick; colour pale yellow.
Size range

A. 69.3μ	D. 38.0—39.0μ
B. 70.0μ	E. 79.2μ
C. 35.2—44.0μ	Thickness (uncompressed) 57.2μ

Genus *Protoconiferus* Bolkh.

1952 *Protoconiferus* Bolkh.; p. 109, pl. 1, fig. 2.
1956 *Protoconiferus flavus* Bolkh.; p. 86, pl. 13, fig. 152, type species.
1958 *Pteruchipollenites* Couper; p. 150.

Diagnosis: *Monosaccate, sulcate pollen grains. Outline circular, subcircular or broadly oval. Exine* two-layered. Nexine relatively thin, smooth to infrapuntcate. Sexine differentially thickened. Distal face traversed by a slit-like or elongate oval sulcus flanked by sexinal lips. On many species sulcus lies along the centre of a smooth to infrapunctate capula enclosed by the distal saccus bases. Saccus somewhat inflated; finely infrareticulate with brochi not more than 2.5μ wide; somewhat distally pendant. Circular to sub-circular, slightly inflated, infrapunctate to finely infrareticulate cappa developed over the proximal zole, usually separated from the saccus by proximal lateral scars.

Discussion: *Protoconiferus* was first proposed by Bolkhovitina in 1952 but, since no type species was cited, remaied a nomen ambignum until citation of type species in 1956. *Pteruchipollenites* was erected as an organ-genus for the pollen of the genus *Pteruchus* and related pteridosperms, and appears to be synonymous with *Protoconiefrous*. Since Protoconiferus was validated as a genus in 1956 it has priority over *Pteruchipollenites*. Species assigned to *Protoconiferus* are closely similar to spores obtained from male cones of *Pteruchus* and other pteridosperm genera and there can be little doubt that the grains have pteridosphermous and not, as the generic name suggests, coniferous affinities.

Protoconiferus gaussenianus n. sp.

Pl. 15, fig. 7, 5055 (2514b), slide 4 (23.5—119.6) Holotype, P. N. 14117

Description: Monosaccate; grains broadly oval in outline; central body circular; outline somewhat vadue; distal face of grain traversed by a longitudinal sulcus centred on the distal pole and extending the full length of the central body; sulcus parallel-sided; about 4.5μ wide; flanked by smooth lips about 4.0μ wide adjacent to the distal pole and tapering towards the longitudinal extremities; lips slightly convex towards the equator; central body enveloped proximo-equatorially by an infrareticulate saccus; brochi 1.0—2.0μ wide; sexine of saccus about 0.5μ thick; saccus slightly distally pendant; inflated; proximally saccus merges with inflated, infrapunctate cappa 27.5—33.0μ wide; colour yellow-brown.
Size range

A. 33.0μ	D. 66.0μ
B. 38.5μ	E. 80.3μ
C. 33.0—35.0μ	Thickness (compressed) 5.0μ

Discussion: Smaller and relatively shorter than *P. bolchovitinae*. Distal saccus bases are well developed in *P. bolchovitinae* but not clearly visible in *P. gaussenianus*.

Named for Professor H. Gaussen of Toulose, France.

Protoconiferus bolchovitinae n. sp.

Pl. 16, fig. 4, 5055 (2514a), slide 4 (30.8—120.7) Holotype, P. N. 14118

Description: Monosaccate; outline oval with more or less straight sides; central body circular in outline; slightly wider than it is long; nexine about 1.5μ thick; distal face traversed by a slit-like sulcus extending the full diameter of the central body; flanked by parallel-sided lips extending about 3.0μ on either side of the sulcus; distal saccus bases correspond to the outer edge of the sulcus lips; saccus extend about 8.0μ beyond the central body equatorially at the longitudinal extremities; saccus distally pendant; infrareticulate; brochi 1.5—2.5μ wide; sexine of sacci about 1.0μ thick; proximally saccus merges into an infrapunctate to finely infrareticulate cappa; cappa circular in outline; about 13.0μ in diameter and 2.0μ thick; colour pale yellow.

Size range

A. 49.5 (52.25) 55.0μ	D. 38.8 (40.5) 41.8μ
B. 50.6 (55.0) 59.4μ	E. 76.3 (78.3) 80.3μ
C. 30.3 (34.1) 37.4μ	

Discussion: Differs from *P. microsaccus* in possessing much wider brochi to the infrareticulation of the saccus. It is also slightly larger in size but in other respects is closely similar.

Named for Dr. N. A. BOLKHOVITINA of the Academy of Sciences of the U.S.S.R., Moscow.

Protoconiferus microsaccus (COUPER) n. comb.

Pl. 16, fig. 5, 5055 (2514b), slide 4 (20.7—122.1), P. N. 14119; fig. 6, 5055 (2514b), slide 5 (28.2—127.4); P. N. 14120; fig. 8, 5055 (2514b), slide 3 (33.0—116.8); fig. 9, 5055 (2514a), slide 1 (31.5—120.2)

1958 *Pteruchipollenites microsaccus* COUPER; p. 151, pl. 26, figs. 13—14.

1962 *Alisporites microsaccus* (COUPER) POCOCK; p. 61, pl. 9, fig. 139 (non fig. 138).

Description: Monosaccate; central body circular to sub-circular; not clearly delineated; nexine very thin (exact thickness indeterminate); sulcus narrow, slit-like extending the full diameter of the nexinal body; sulcus flanked by plano-convex to the equator; sulcus on some specimens shows a tendency to widen at the ends giving it a keyhole shape; lips about 4.5μ wide adjacent to the distal pole; sexine of saccus about 2.0μ thick; saccus circular to broadly oval in outline; wider than it is long; inflated and slightly distally pendant; finely infrareticulate; elements of reticulum spaced 1.0—1.5μ apart; cappa usually delineated by a pair of proximal lateral scars, crescentic in shape, convex toward the equator and about 3.5μ wide; cappa infrapunctate; inflated; colour light yellow-brown.

Size range

A. 46.2 (50.4) 55.0μ	D. 53.0 (65.7) 77.0μ
B. 49.0 (53.0) 55.0μ	E. 65.0 (71.0) 79.2μ
C. 30.0 (35.9) 40.7μ	Thickness (compressed) 6.0—13.5μ

Discussion: The prominent sulcus with well marked lips, the rather obscure central body and crescentic proximal lateral scars are characteristic.

Differs from *P. funarius* (NAUM.) BOLKH. mainly in its smaller dimensions.

Protoconiferus flavus BOLKH.

Pl. 16, fig. 7, 5055 (2514b), slide 3 (35.7—111.8), P. N. 14121

1956 *Protoconiferus flavus* BOLKH.; p. 86, pl. 13, fig. 152.

Description: *Monosaccate; central body circular to sub-circular; fairly clearly defined, nexine less* than 1.0μ thick; smooth; finely punctate; sulcus slit-like; about 2.0μ wide; extending the full diameter of the nexinal body; flanked by more or less parallel-sided lips about 3.0μ wide; sexine of saccus about 1.5μ thick; saccus circular in outline; inflated and slightly distally pendant; finely infrareticulate; elements of reticulum spaced about 0.5μ apart; cappa not very clearly delineated but is present as an inflated circular to oval are a bout 65μ in diameter centred on the proximal pole; cappa infrapunctate; faint crescentic proximal lateral scars are visible on well preserved specimens flanking the cappa; on distal face curved saccus bases, convex towards the equator, delineate a more or less fusiform capula; along saccus bases nexine and sexine are appressed over convex meniscus areas about 2.0μ wide; colour yellow-brown.

Size range

A. 70.4μ	D. 99.0μ
B. 88.0μ	E. 107.8μ
C. 46.2μ	Thickness (compressed) 10.0μ

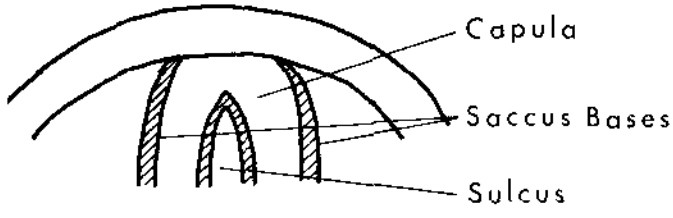


Fig. 42. Distal structure.

Discussion: Similar to *P.* cf. *P. funarius* (NAUM.) BOLKH. but larger in size with distal structures more clearly developed.

Protoconiferus funarius (BOLKH.) BOLKH.

Pl. 19, figs. 1—5, 5055 (2520b), slide 1A (38.3—123.2), P. N. 14122

1953 *Platysaccus funarius* BOLKH.; p. 73, pl. 11, figs. 2—3.
1956 *Protoconiferus funarius* (BOLKH.) BOLKH.; p. 86, pl. 13, figs. 151a—c.

Description: Bisaccate; central body oval; longer than it is wide; not well defined; nexine about 5.0μ thick; smooth; distal face traversed by a narrow, parallel-sided, leptoma 7.7μ wide; leptoma traversed along its centre line by a slit-like sulcus bounded by narrow, parallel-sided lips extending about 1.0μ on each side of the sulcus; sacci more or less semi-circular in outline; strongly distally pendant; enveloping the central body distalo-equatorially; infrareticulate; brochi 1.5 (3.6) 9.0μ wide with muri less than 0.5μ wide; proximally sacci merge into a well developed, infrapunctate cappa occupying the entire proximal hemisphere; colour pale yellow.
Size range

A. 71.5μ	D. 78.1μ
B. 93.5μ	E. 92.4μ
C. 45.1μ	Thickness of grain 59.0μ

Protoconiferus minor n. sp.

Pl. 24, fig. 13, 3717 (2154a), slide I (25.6—118.1) Holotype, P. N. 14123

Description: Bisaccate; utline almost circular; central body not clearly defined; distal polar area traversed by a longitudinal fold which probably marks the lips of a slit-like sulcus; fold extends about three-quarters of the length of the grain; parallel to the fold and equidistant from it on either side are two straight, parallel, sexinal thickenings marking the distal saccus bases; thickenings extend almost the full length of the grain and delineate a distal capula about 21.0μ wide; sacci relatively small and little inflated; distally attached, fringing the central body laterally; iinfrapunctate; proximally sacci merge with an uninflated cappa about 1.0μ thick; surface of cappa finely granulose; colour pale yellow.
Size range

A. approx. 20.0μ	D. 26.5—33.0μ
B. 37.4μ	E. approx. 38.5μ
C. 5.5—9.0μ	

Discussion: Differs from all other described species on account of its small size, very narrow sulcus and relatively wide capula.

Genus *Piceites* BOLKH.

1949 *Aliferina falcata — flacciformis* MAL.; p. 101, pl. 30, fig. 9, type species.
1952 *Piceapites* BOLKHOVITINA; p. 110, pl. I, fig. 8.
1956 *Piceites (Aliferina) falcata — flacciformis* (MAL.) BOLKH.; p. 95, designation of type species.

Diagnosis: Monosaccate pollen grains. Exine two-layered. Nexine thin, usually finely punctate. Central body usually fairly well defined. Outline circular to broadly oval. Distal face of central body traversed by a parallel-sided, finely punctate sulcus extending almost the full length of the grain and flanked by sexinal lips. Saccus infrareticulate, somewhat inflated and distally pendant. Brochi small. Proximally saccus merges with a poorly defined, somewhat inflated, finely infrareticulate to infrapunctate cappa. No proximal lateral scars developed.

Discussion: Similar to *Paleoconiferus* but possessing a well developed, parallel-sided sulcus which is usually wider than that of *Protoconiferus*. Proximal lateral scars which occur on members of both of the above-mentioned genera are absent from species of *Piceites*.

Despite the name, there is no evidence that members of this genus were in any way related to *Picea*. The similarity to pollen of *Protoconiferus* and *Paleoconiferus* suggests that pteridosperm affinities are more probable.

Piceites townrowii n. sp.

Pl. 16, fig. 10, 5055 (2514b), slide 1 (36.6—113.8) Holotype, P. N. 14124

Description: Bisaccate; outline broadly oval; central body oval; longer than it is wide; nexine thickness indeterminate, probably less than 0.5μ; distal face traversed by a narrow longitudinal sulcus about 2.5μ wide; extending its full length and flanked by prominent, parallel-sided lips extending about 2.0μ on each side of the sulcus; distal saccus bases 3.0—5.0μ equatorially of, and parallel to, the lips of the sulcus; sacci semi-circular in outline; infrareticulate; brochi about 2.0μ wide; not very clearly defined; sexine about 0.5μ thick; proximally sacci merge with an inflated, infrapunctate cappa 1.0—1.5μ thick, 38.0μ wide and 74.8μ long; colour pale yellow.

Size range

A. 38.1—40.0μ	D. 70.0—80.0μ
B. 78.1—80.0μ	E. 80.0—108μ
C. 32.0 (40.6) 56.0μ	

Piceites latens Bolkh.

Pl. 17, fig. 1, 5055 (2514b), slide 2 (27.4—114.3); fig. 2, 5055 (2514b), slide 4 (39.9—121.2), P. N. 14125; fig. 5, 5055 (2514a), slide 1 (35.0—115.3); fig. 3, 5055 (2514b), slide 4 (37.0—124.4)

196 *Piceites latens* Bolkh.; p. 96, pl. 15, fig. 170.

Description: Monosaccate; central body more or less circular in outline; nexine less than 0.5μ thick; finely punctate; distal face of grain traversed by a parallel-sided sulcus which extends almost the full length of the nexinal body; flanked by lips 3.0—4.5μ wide which converge and meet around the ends of the sulcus; saccus 3.6μ circular to sub-circular in outline; slightly distally pendant; inflated; infrareticulate to infrapunctate; elements of reticulum 1.0μ wide at maximum; cappa not clearly delineated although it is present and somewhat inflated; it occupies a circular area about 40.0μ in diameter centred on the proximal pole over which the ornament is somewhat reduced; colour light yellow-brown.

Size range

A. 66.0 (90.0) 108.0μ	D. 80.0 (91.7) 103.0μ
B. 60.0 (80.0) 86.4μ	E. 82.0 (101.5) 122.0μ
C. 36.0 (41.0) 46.0μ	Thickness (compressed) 7.0 (14.5) 27.0μ

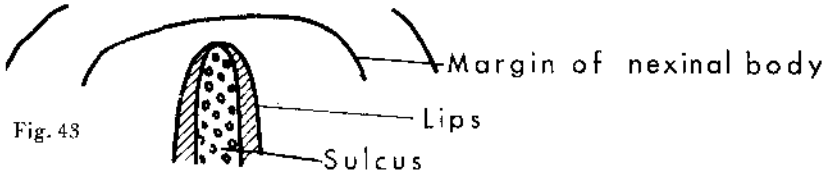


Fig. 43

Discussion: The almost circular outline, parallel-sided sulcus, very indistinct cappa and rather unclear nexinal body are characteristic of this species.

Morphologically similar to *Protoconiferus microsaccus* (Couper) n. comb. but considerably larger in size and having a relatively wider saccus.

Piceites pseudorotundiformis (Mal.) n. comb.

Pl. 17, fig. 4, 5055 (2514b), slide 1 (36.8—111.5), P. N. 14126

1961 *Picea pseudorotundiformis* Mal.; pp. 141—142, pl. 42, figs. 1a—b.

Description: Monosaccate; outline sub-circular; wider than it is long; central body more or less circular in outline; distal face of central body traversed by an infrapunctate strip of thinned sexine about

15.0μ wide forming a leptoma; nexine about 0.5μ thick; smooth; saccus almost divided by central body into two parts; distally pendant; infrareticulate; brochi about 1.0μ wide; sexine of saccus 0.5μ—1.0μ thick; saccus bases well defined; paralleling the equator; up to 5.0μ wide and narrowing towards the tips; proximally saccus merges with circular, infrapunctate cappa 1.0—2.0μ thick; colour pale yellow-brown.
Size range

A. 45.0—59.4μ	D. 55.0 (60.0) 68.0μ
B. 49.5—55.0μ	E. 62.7 (65.0) 75.0μ
C. 7.7 (10.0) 12.5μ	

Genus *Pityosporites* (Seward) Manum

1914 *Pityosporites antarcticus* Seward; p. 23, pl. 8, fig. 45, type species.
1954 *Pityosporites* (Sew.) Pot. & Klaus; p. 534.
1958 ? *Pinuspollenites* Raatz ex Potonié; p. 62.
1960 *Pityosporites* (Sew.) Manum; pp. 11—15, 1 pl., figs. 1—4.

Diagnosis: Bisaccate pollen grains. Exine two-layered. Nexine very thin, smooth. Distal face smooth, infrapunctate. Capula enclosed by distal saccus bases which are slightly convex towards the equator. Germination by distal leptoma. Sacci inflated, infrareticulate, brochi 1.0—3.0μ wide, strongly distally pendant. Sacci reach to, or slightly proximally of, the equator where they merge with a slightly inflated, infrapunctate cappa which is externally smooth to scabrate.

Discussion: Manum's re-description of the type species of *Pityosporites* has enabled a more precise generic diagnosis to be erected. The emendation of Potonié and Klaus is, as noted by Manum, unacceptable since it would exclude the type species from the genus.

Pinuspollenites Raatz (type species *P.* (al. *Pollenites) labdacus* (R. Pot., 1931, Raatz, 1937) may be a junior synonym of *Pityosporites* and is, in any case, an unsatisfactory genus since the original published description and figure of the type species is inadequate to permit satisfactory identification. Potonié's additional figures (1958, figs. 75—76) are also unsatisfactory since they do not appear to be the same grain as figured in 1931.

Pityosporites cf. *P. dividus* (Bolkh.) n. comb.

Pl. 16, fig. 3, 2119, slide 2 (32.7—120.1), P. N. 14128
1956 *Pinites dividus* Bolkh.; p. 109, pl. 20, fig. 199.

Description: Bisaccate; outline broadly oval; central body oval in outline; longer than it is wide; nexine 1.0μ thick; distal face of central body traversed by a rather ill defined,parallel-sided sulcus about 10.0μ wide, extending its full length; sacci more or less semi-circular in outline; infrareticulate; brochi 1.0—1.5μ wide; sexine less than 1.0μ thick; sacci slightly distally pendant; joined equatorially around the longitudinal ends of the central body by strips of inflated sexine up to 7.5μ wide; proximally sacci merge with inflated, infrapunctate cappa 75.0μ long, 47.5μ wide and up to 3.0μ thick; colour pale yellow.
Size range

A. 35.0 (41.1) 47.3μ	D. 61.0 (70.0) 88.0μ
B. 52.0 (64.5) 77.0μ	E. 81.0 (87.8) 94.6μ
C. 32.0 (35.0) 40.0μ	

Pityosporites divulgatus (Bolkh.) n. comb.

Pl. 17, fig. 10, 5055 (2514a), slide 1 (34.3—115.3), P. N. 14127; pl. 19, figs. 15—16, 304, slide 1 (37.2—125.8); pl. 18, fig. 10, 5055 (2514a), slide 3 (32.6—116.2)
1956 *Pinus divulgata* Bolkh.; p. 112, pl. 20, figs. 214a—c.

Description: Bisaccate; outline broadly oval; central body ovoid; width of grain shorter than length or breadth; nexine about 0.5μ thick; smooth; germination by distal leptoma; sacci distally pendant; infrareticulate; brochi closely spaced; about 1.0μ in width; sacci somewhat inflated; enveloping the central body

distalo-equatorially, the sacci being joined equatorially a strip of inflated sexine 2.0—3.0μ wide; proximally sacci merge with a slightly inflated cappa 1.5—2.0μ thick; colour pale yellow.
Size range

A. approx. 28.6μ
B. approx. 49.5μ
C. 17.6—22.0μ
D. approx. 35.2μ
E. 41.8—66.0μ
Thickness of central body (uncompressed) 18.7μ

Discussion: The proximal side of the sacci on this species has a very characteristic undulose appearance due to differential inflation. This feature is clearly visible on pl. 15, figs. 15—16.

Pityosporites similis Balme

Pl. 17, figs. 13—15, 5055 (2514a), slide 4 (32.4—121.1), P. N. 14129
1957 *Pityosporites similis* Balme; p. 36, pl. 10, figs. 108—109.

Description: Bisaccate; outline brodaly oval; central body spherical; nexine less than 0.25μ thick; smooth; exine of distal face thinned along a longitudinal strip flanked by the distal saccus bases, forming a finely punctate leptoma; leptoma about 13.0μ wide adjacent to the distal pole, narrowing to about 5.0μ at the longitudinal extremities; sacci inflated; distally pendant; crescentic in polar section; infrareticulate; brochi 1.0—1.5μ wide; sexine of sacci about 0.5μ thick; proximally sacci abut against and merge with a well developed, infrapunctate cappa; cappa fairly thin but marginal crests, about 3.5μ wide, are developed between the proximal saccus bases and the cappa; cappa 1.0μ thick; colour pale yellow-brown.
Size range

A. 31.0—35.2μ
B. 43.0—46.2μ
C. 14.3—17.6μ
D. 44.0—45.1μ
E. 48.4—56.0μ

Discussion: Appears to be identical to the species described by Balme except that the Australian specimens are described as lacking a well defined cappa. The illustrations of the Holotype and Paratype, however, appear to indicate that marginal crests are present.

Pityosporites nigraeformis (Bolkh.) n. comb.

Pl. 21, fig. 18, 2119, slide 20 (39.1—119.4), P. N. 14130
1953 *Pinuspollenites nigraeformis* Bolkh.; p. 86, pl. 13, figs. 5—6.

Description: Bisaccate; central body spherical to sub-spherical; slightly wider than it is long; nexine about 0.25μ thick; distal face traversed by a band of smooth thinned exine about 10.0μ wide enclosed by the distal saccus bases, forming a parallel-sided leptoma; longitudinal ends of leptoma merge with normal exine; sacci sub-circular in outline and somewhat flattened distalo-proximally; relatively small and strongly distally pendant; saccus bases well delineated; sexine of sacci infrareticulate; brochi about 1.5μ wide; proximally sacci abut against a strongly developed, inflated, circular cappa about 2.5μ thick which occupies the major part of the proximal hemisphere; surface roughened; colour yellow-brown.
Size range

A. approx. 30.8μ
B. approx. 28.6μ
C. approx. 19.8μ
D. approx. 22.0μ
E. approx. 55.0μ
Thickness (uncompressed) approx. 38.5μ

Genus *Pseudowalchia* Bolkh.

1949 *Orbicularia biangulina* Mal.; p. 105, pl. 36, fig. 2, type species.
1952 *Pseudowalchia* Bolkhovitina; p. 108, fig. 1, pl. 2, fig. 14.
1956 *Pseudowalchia biangulina* (Mal.) Bolkh.; p. 89, pl. 14, fig. 157, designation of type species.

Diagnosis: Monosoccate pollen grains. Central body spherical to sub-spherical traversed by a broad, well defined sulcus which extends almost its full diameter and may be parallel-sided or slightly keyhole-

shaped. Sulcus flanked by sexinal lips. Saccus relatively large and broadly oval, inflated, infrareticulate, merging proximally with a slightly inflated, rather indistinct, circular cappa. Brocci of reticulum 1.5—3.5μ wide. No proximal lateral scars developed.

Discussion: The relatively large saccus, enveloping a well defined central body traversed by a relatively wide, well defined distal sulcus is distinctive for this genus. The usually clearly defined reticulation of the saccus is also characteristic.

Grains of the above type have been recovered from male cones of *Ruhleostachys pseudoarticulatus* Roselt (see Townrow, 1962, pl. 34, fig. 7f). It is possible, however, that these grains possess leptomata rather than sulci. There is sufficient resemblance between the two forms to assume botanical affinity. It is probable, therefore, that *Pseudowalchia* is pteridospermous.

Pseudowalchia ovalis n. sp.

Pl. 18, fig. 1, 5055 (2514b), slide 5 (38.5—128.3) Holotype, P. N. 14131

Description: Monosaccate; central body ovoid; longer than it is wide; nexine about 0.5μ thick; smooth; distal face traversed by a sulcus which is slightly wider at its ends than at the distal pole (11.0μ wide at ends; 8.0μ wide at the distal pole); sulcus extends almost to the margin of the central body but does not traverse the saccus; sexine of sulcus smooth or very finely punctate; sulcus flanked by a pair of double convex lips 5.0μ wide adjacent to the distal pole and about 50.0μ long; saccus wider than it is long; broadly oval with more or less straight sides; infrareticulate; brochi of reticulum about 2.0μ wide; proximally saccus merges into an infrapunctate, somewhat inflated cappa which is not very clearly defined around its margins; colour pale yellow.

Size range

C. 41.0—44.0μ	A. 62.0—66.0μ
D. 48.0—60.5μ	B. 92.0—97.0μ
E. 38.0 (40.0) 44.0μ	

Pseudowalchia landesii n. sp.

Pl. 18, figs. 2 and 5, 5055 (2514b), slide 3 (38.8—116.4) Holotype, P. N. 14132; fig. 3, 5055 (2514b), slide 5 (30.2—115.2)

Description: Monosaccate; central body circular in outline; nexine about 0.5μ thick; smooth; distal face traversed by a parallel-sided sulcus 6.5μ wide; sulcus extends the full length of the nexinal body but does not traverse the saccus; sexine of sulcus punctate; flanked by rather faint, plano convex lips; lips about 4.0μ wide adjacent to the distal pole; saccus wider than it is long; broadly oval with more or less straight sides; infrareticulate; brochi of reticulum about 2.0μ wide; proximally saccus merges with a well defined, infrapunctate cappa; cappa bounded by a clearly defined scar where nexine and sexine are tightly appressed; reticulation shows a tendency towards radial distribution; colour pale yellow.

Size range

A. 38.5—45.4μ	D. 60.5—72.0μ
B. 44.0—50.4μ	E. 96.0—100.0μ (Holotype 96.0μ)
C. 41.8 (43.8) 45.6μ	

Discussion: Due to proximo-distal compression it is almost impossible to determine the exact relationships between the various internal structures shown by this species. Differs from *P. biangulina* (Mal.) Bolkh. (1956) in exhibiting no tendency towards bisaccate form. *P. biangulina* shows distinct invaginations of the saccus adjacent to the longitudinal extremities of the nexinal body.

Genus Platysaccus Naum. ex Pot. & Klaus

1939 (dated 1937) *Platysaccus* Naumova; p. 355, fig. 1.
1954 *Platysaccus papilionensis* Pot. & Klaus; p. 539, pl. 10, fig. 12, type species.

Diagnosis: Bisaccate pollen grains. Central body circular and relatively thick-walled, without any special structure or ornament. Sacci attached equatorially, relatively large and thin-walled, with fine reti-

culation which has distinct radial disposition. Ratio of total width to width of central body 3:1. Cappa somewhat inflated, infrapunctate, not heavily ornamented.

Discussion: The principal difference between pollen grains of the this genus and those assigned to *Podocarpidites* is that grains of *Platysaccus* lack a strongly developed, ornamented cappa.

The holotype of *P. papilionensis* may possess a striate cappa in which case the Jurassic species will have to be assigned to a different genus.

Platysaccus lopsiensis (Mal.) n. comb.

Pl. 18, fig. 6, 5055 (2514b), slide 4 (20.5—115.1), P. N. 14133; fig. 7, 5055 (2514b), slide 4 (24.7—119.0)
1961 *Podocarpus (Protopodocarpus* sect. *Eupodocarpus) lopsiensis* Mal.; p. 130, pl. 35, figs. 9a—b.

Description: Bisaccate; central body more or less spherical; slightly wider than it is long; nexine relatively thick (about 1.0μ); smooth; sacci distally pendant; very large compared with the nexinal body; inflated; infrareticulate; reticulation showing a strong tendency toward radial distribution; brochi of reticulum 2.0—3.0μ long and 1.0—2.0μ wide; on proximal face sacci merge into a punctate cappa 27.5μ wide which is centred on the proximal pole; cappa 2.5—3.0μ thick; infrareticulate distal saccus bases flank a broadly oval sulcus; sulcus 27.5 x 12.0μ; bordered by narrow (about 1.5μ wide), parallel-sided lips; colour of sacci pale yellow, nexinal body orange.

Size range

A. 27.5μ
B. 28.5μ
C. 35.2—36.3μ
D. 44.1μ
E. 85.5μ
Thickness of nexinal body (compressed) 6.0μ

Discussion: A very easily recognizable species on account of the very large sacci and the radial distribution of saccus reticulation.

Genus *Vitreisporites* (Leschik) Jansonius

1950 *Pityopollenites* Reissinger; p. 109, pl. 15, figs. 1—5, pl. 18, fig. 36.
1955 *Vitreisporites signatus* Lesch.; p. 53, pl. 8, fig. 10, type species.
1958 *Caytonipollenites* Couper; p. 149.
1962 *Vitreisporites* (Lesch.); Jans.; p. 55.

Diagnosis: Bisaccate pollen grains. Outline broadly oval. Exine two-layered. Central body smoothly oval to sub-circular. Distal face of central body traversed by a longitudinal sulcus or leptoma which is usually relatively wide and flanked by nexinal lips. Rarely sulcus may be reduced to a narrow slit but this is not a constant feature in any species. Sacci infrareticulate, inflated and somewhat distally pendant; equatorially attached; relatively large, usually more or less semi-circular. Proximally sacci merge with a circular to oval, somewhat inflated, infrapunctate cappa. Marginal crests may, or may not, be developed between the proximal saccus bases and the cappa.

Discussion: This genus includes grains of relatively small size similar to grains recovered from pollen sacs of *Caytonia* as well as larger, but morphologically similar, grains also probably produced by related pteridosperms. *Pityopollenites* lacks a validly published type species and is therefore nomen ambiguum and invalid. *Caytonipollenites* was erected as an organ-genus by Couper. When employed as a form-genus it becomes a junior synonym of *Vitreisporites*.

Vitreisporites jansonii n. sp.

Pl. 17, fig. 11, 5055 (2514b), slide 4 (42.3—119.3) Holotype, P. N. 14134

Description: Bisaccate; outline broadly oval with straight sides; central body appears to be distinctly angular in outline due to angular bend in the proximal saccus bases; distal face unclear but traces of a parallel-sided leptoma between the distal saccus bases are visible; sacci distally pendant; infrareticu-

late; the reticulation has a tendency toward radial distribution; brochi closely spaced, averaging 0.75μ apart; proximally sacci merge into an infrapunctate cappa which is well defined due to the development of proximal saccus bases; cappa slightly inflated; colour pale yellow.

Size range

A. 50.0—58.3μ (Holotype 50.0μ)
B. approx. 55.0μ (Holotype 55.0μ)
C. 44.0—45.6μ (Holotype 45.6μ)
D. 60.0—68.0μ (Holotype 68.2μ)
E. 96.8 (100.9) 105.0μ (Holotype 96.8μ)

Discussion: Almost identical to *Vitreisporites koenigswaldii* JANSONIUS in morphology but much larger in size. The unusual angular proximal saccus bases make it appear probable that the two species are organically related.

Named for Dr. J. JANSONIUS, Imperial Oil Limited, Calgary, Canada.

Vitreisporites jurassicus n. sp.

Pl. 18, fig. 8, 2132, slide 3 (38.9—124.3); pl. 24, fig. 9, 2132, slide 12 (26.3—111.3) Holotype, P. N. 14135

Description: Bisaccate; broadly oval with straight sides in outline; central body circular in outline; smooth to finely punctate; very thin (less than 0.25μ); smoothly oval capula developed on the distal face between convex saccus bases (convex to equator) which join around the longitudinal extremities of the nexinal body along a belt about 2.0μ wide; a broadly oval sulcus parallels the borders of the capula; sacci distally pendant; sexine about 0.5μ thick; infrareticulate with the reticulation showing radial distribution; elements of saccus reticulation spaced about 2.0μ apart, the individual brochi tending to be somewhat elongate radially; cappa fairly prominent; inflated (0.75μ thick); infrapunctate; colour pale yellow-brown.

Size range

A. 25.0 (31.2) 33.0μ
B. 20.0 (28.7) 42.0μ
C. 12.0 (16.1) 27.0μ
D. 24.0 (31.5) 42.0μ
E. 40.0 (48.5) 63.0μ
Thickness of nexinal body (uncompressed) 22.0μ

Discussion: Somewhat similar in morphology to *Vitreisporites pallidus* (REISS.) NILSSON but much larger in size and with an oval sulcus where the latter species has a parallel-sided leptoma.

Vitreisporites itunensis n. sp.

Pl. 18, fig. 14, 2132, slide 3 (33.3—125.9); fig. 12, 2132, slide 3 (33.2—125.8); fig. 24, 2132, slide 1 (44.6—127.5) Holotype, P. N. 14136

Description: Bisaccate; central body ovoid; longer than it is wide; nexine less than 0.25μ thick; smooth; equatorial outline oval, tapering somewhat towards the transverse ends; sacci distally attached and pendant; inflated; infrareticulate with brochi 0.5—1.0μ in diameter; enclosing, on the distal face, a more or less oval capula about 10.0μ wide which may be traversed by a parallel-sided sulcus about 3.0μ wide; sulcus extends full length of nexinal body and is flanked by very narrow (less than 0.5μ) parallel-sided lips; distal saccus bases narrow, crescentic in shape; convex towards the equator; proximally sacci merge into an infrapunctate, inflated cappa; cappa oval in outline and well defined; colour light brown.

Size range

A. 23.0 (24.0) 25.0μ
B. 30.0 (32.3) 35.0μ
C. 13.0 (14.8) 17.0μ
D. 26.0 (28.7) 35.0μ
E. 36.0 (40.7) 49.0μ

Discussion: Differs from *Vitreisporites jurassicus* n. sp. in possessing a more elongate central body and in the relatived smaller sacci.

Vitreisporites shaunavonensis n. sp.

Pl. 18, fig. 15, 404, slide 1 (47.3—112.8) Holotype, P. N. 14137

Description: Bisaccate; central body ovoid; longer than it is wide; distal face of central body traversed by a longitudinal sulcus 3.5—4.0μ wide; sulcus extends almost the full length of the central

body, narrowing towards its longitudinal extremities which are smoothly rounded; sulcus flanked by very narrow lips which lie between the sulcus and distal saccus bases; sacci semi-circular in outline; distally pendant; almost smooth to infrapunctate; proximally sacci merge with well developed, inflated, infrapunctate cappa; cappa oval in outline; 16.5μ long, 11.0μ wide and about 1.5μ thick; colour pale yellow.

Size range

A. 12.1μ
B. 13.2μ
C. 8.8μ
D. 13.2—14.3μ
E. approx. 23.1μ

Discussion: Possesses a relatively more strongly inflated cappa than *V. pallidus* Nilsson.

Vitreisporites shouldicei n. sp.

Pl. 18, fig. 21, 424, slide 1 (29.0—123.8) Holotype, P. N. 14138

Description: Bisaccate; central body oval in section; longer than it is wide; germination by distal leptoma; nexine very thin; distal sexine less than 0.25μ thick; punctate; sacci more or less oval in outline; inflated; distally pendant; infrareticulate; brochi less than 1.0μ wide; show tendency towards radial distribution; distal saccus bases poorly delineated; slightly convex towards the equator; proximally sacci terminate against a well developed cappa; cappa about 1.5μ thick; inflated; finely infrapunctate; oval in outline; longer than it is wide; colour pale yellow.

Size range

A. 12.0μ
B. 15.4μ
C. 8.0μ
D. 12.0—15.5μ
E. 25.3μ

Discussion: Distinguished from *V. pallidus* by the sacci being strongly distally pendant and set off from the central body.

Named for Mr. J. R. Shouldice, Imperial Oil Limited, Calgary.

Vitreisporites pallidus (Reiss.) Nilsson

Pl. 18, fig. 16, 424, slide 4 (39.8—122.0); fig. 17, 404, slide 2 (50.4—123.7); fig. 18, 2132, slide 3 (39.0—123.7); fig. 19, 1816, slide 1 (31.7—120.3), P. N. 14139; fig. 20, 1816, slide 4 (28.1—121.9); fig. 22, 424, slide 2 (30.5—126.5); fig. 25, 2258, slide 2 (26.8—121.2)
1938 *Pityosporites pallidus* Reiss.; p. 14.
1950 *Pityopollenites pallidus* Reiss.; p. 115, figs. 1—5.
1955 Pollen of *Masculostrobus* E. Carp. in Del. & Sprum.; p. 51, fig. 6.
1958 *Caytonipollenites pallidus* (Reiss.) Couper; pp. 149—150, pl. 26, figs. 7—8.
1958 *Vitreisorites pallidus* (Reiss.) Nilsson; pp. 77—78.

Description: Bisaccate; outline of grain oval; central body oval; longer than it is wide; distal face of central body traversed by a parallel-sided longitudinal leptoma, usually about 4.0μ wide but, rarely, very narrow (less than 1.0μ) and slit-like; leptoma bounded laterally by distal saccus bases; sacci more or less semi-circular in polar section; distally pendant; infrareticulate; brochi less than 1.0μ wide, showing a tendency towards radial distribution; proximally sacci merge with an oval, slightly inflated, infrapunctate cappa; laterally to the cappa marginal crests 1.0—1.5μ are frequently developed between the cappa and proximal saccus bases; colour pale yellow.

Size range

A. 8.0 (9.8) 11.0μ
B. 13.0 (15.8) 19.0μ
C. 9.0 (11.1) 14.0μ
D. 13.0 (15.7) 19.0μ
E. 23.0 (25.4) 28.0μ

Vitreisporites craigii n. sp.

Pl. 18, fig. 28, 2263, slide 1 (26.4—122.0) Holotype, P. N. 14140; fig. 27, 1967, slide 8 (31.9—123.8)

Description: Bisaccate; central body oval in outline; longer than it is wide; nexine less than 0.25μ thick; smooth; distal leptoma enclosed by rather indistinct saccus bases about 8.0μ apart; sexine of leptoma thin; punctate; sacci more or less semi- circular in outline; same length or slightly shorter than nexinal body; sexine of sacci about 0.5μ thick; inframicroreticulate; brochi less than 1.0μ wide; proximally sacci merge with a fairly well defined cappa; cappa infrapunctate; 13.0μ wide; outlined by the thickened, possibly folded, edge of nexinal body; colour pale yellow.

Size range

A. 15.4μ	D. 24.2μ
B. 26.4μ	E. 39.6μ
C. 16.5μ	

Discussion: Very similar to *V. pallidus* but considerably larger in size.
Named for Mr. J. Craig, Imperial Oil Limited, Calgary, Canada.

Genus *Podocarpidites* Cookson & Potonié

1947 *Podocarpidites ellipticus* Cooks.; p. 131, pl. 13, fig. 6, type species.
1958 *Podocarpidites ellipticus* Cook.; in Potonié; p. 68, designation of type species.

Diagnosis: Bisaccate pollen grains. Central body circular to broadly oval. Exine two-layered. Nexine thin, smooth. Distal face traversed by a broad leptoma flanked by the distal saccus bases. Sacci variable in size, strongly inflated and always strongly distally pendant. Sacci infrareticulate, the reticulum frequently exhibiting radial disposition, more rarely convolute or roughened. Proximally sacci abut against, or merge with, a relatively thick inflated cappa. Cappa infrapunctate, usually roughened, granulose, radially wrinkled or convolute; rarely smooth. Cappa either surrounded by a thickened sexinal marginal crest or flanked by two thickened crests occupying the space between the cappa and proximal saccus bases, the latter not being defined by scars.

Discussion: The above diagnosis allows for considerable variation in saccus shape and size and also in general grain size and ornamentation. Pollen of recent species of *Podocarpus* and related genera exhibit considerable variation and there would seem to be little value in erecting a relatively large number of form-genera to classify morphologically gradational fossil pollen species.

Pollen assigned to *Podocarpidites* is very similar to that of recent podocarpaceous species and there can be little doubt as to its botanical affinity.

Podocarpidites rousei n. sp.

Pl. 19, figs. 6—7, 395, slide 3 (33.7—123.4) Holotype, P. N. 14141; figs. 10—11, 394, slide 1 (41.4—124.4)

Description: Bisaccate; central body more or less circular in outline; slightly wider than it is long; nexine about 1.0μ thick; smooth; distal face traversed by an almost parallel-sided sulcus which extends the full length of the central body; very slightly wider adjacent to the distal pole than at its extremities; sulcus flanked by parallel-sided lips 2.0—2.5μ wide; slightly convex towards the equator of the central body; sacci moderately inflated; relatively small; distally pendant; infrareticulate; brochi about 1.0μ wide; sexine of sacci 0.5μ thick; sacci differentially inflated around their edges, the equatorial edges being strongly convolute and the convolutions radially disposed; distal central area of sacci not inflated (see pl. 25, fig. 17); proximo-equatorially sacci merge with strongly developed, inflated cappa 2.0—2.5μ thick; equatorially, at the approximate centres of the proximal saccus bases, small rounded sexinal protrusions about 5.0μ long and 3.0μ wide are developed (see diagram); colour yellow.

Fig. 44. Illustrating sexinal potrusions.

Size range

A. 38.5 (40.5) 43.0μ
B. 34.0 (36.1) 39.0μ
C. 18.0 (19.1) 20.0μ
D. 25.0 (29.0) 34.0μ
E. 48.0 (50.5) 54.0μ

Discussion: Structure of these grains is similar to that of the pollen of some recent species of *Dacrydium* (e. g. *D. franklinii*). Note especially the uninflated distal portions of the sacci and the proximal equatorial sexinal protrusions.

Named for Professor G. E. Rouse, University of British Columbia, Canada.

Podocarpidites langii n. sp.

Pl. 19, figs. 8 and 12, 394, slide 3 (38.0—112.4) Holotype, P. N. 14142

Description: Bisaccate; central body circular in outline, 28.6μ in diameter; nexine very thin; smooth; distal face traversed by a longitudinal sulcus, flanked by parallel-sided lips which are convex towards the equator and also form the distal saccus bases; lips about 3.0μ wide; smooth; exine of sulcus smooth to finely punctate; sacci relatively small compared with central body, infrapunctate to finely infrareticulate; distally pendant; both proximal and distal faces of sacci exhibit radial folding; sexine of sacci about 0.25μ thick; proximally sacci abut against a well developed, strongly inflated cappa 38.5 x 33.0μ in size; margin of cappa about 2.5μ thick; sexine of cappa convolute with convolutions closely packed and about 1.5μ wide; infrapunctate; colour yellow-brown.

Size range

A. 38.5—37.4μ
B. 33.0—34.2μ
C. 13.2 (19.0) 24.2μ
D. 25.0 (30.5) 33.0μ
E. 55.7—60.5μ

Discussion: *P. rousei* n. sp. possesses less strongly developed and less strongly pendant sacci.

Named for the late W. D. Lang, pioneer of British Jurassic paleontology.

Podocarpidites wapellensis n. sp.

Pl. 19, fig. 9, 304, slide 1 (43.0—117.2) Holotype, P. N. 14143

Description: Bisaccate; central body circular in outline; nexine thin; smooth; exine of distal face thinned over an area flanked by the distal saccus bases to form a leptoma; leptoma 10.0μ wide adjacent to the distal pole, thinning towards the longitudinal extremities; sacci inflated; distally pendant; infrapunctate to finely infrareticulate; sexine about 0.5μ thick; sacci crescentic in polar section, enclosing much of the distal face; proximally the sacci are more inflated around the margins than at their centres; proximally sacci abut against and merge with a thick, infrapunctate cappa about 4.0μ thick; surface of cappa roughened; appears to be radially striate in section due to columnar exine structure; colour pale yellow.

Size range

A. 44.0—46.0μ
B. 28.6—30.0μ
C. 33.0—35.1μ
D. 20.9—30.8μ
E. 62.7—69.3μ
Thickness (uncompressed) 33.0μ

Discussion: *P. convolutes* is similar in general aspect and size but possesses strongly developed convolute ornamentation.

Podocarpidites unicus (Bolkh.) n. comb.

Pl. 19, figs. 13—14, 304, slide 1 (41.9—119.8) P. N. 14144; pl. 24, fig. 17, 406, slide 3 (33.5—126.4)
1956 *Podocarpus unica* Bolkh.; p. 124, pl. 23, figs. 229a—e.

Description: Bisaccate; central body ovoid; longer than it is wide; parallelsided leptoma about 10.0μ wide formed across distal face of central body where an area flanked by distal saccus bases shows thinned exine; sacci relatively large; longer than they are wide; inflated; infrareticulate; brochi of reticulum about 2.0μ wide; sexine of sacci less than 0.5μ thick; sacci distally pendant; radial folds about 2.5μ wide developed across the sacci; proximally sacci abut against well developed, inflated, infrapunctate cappa 1.5μ thick; externally granulose; central body yellow; sacci colourless to pale yellow.

Size range

A. 23.1μ
B. 39.6μ
C. 28.6—31.9μ
D. 52.8—55.0μ
E. 67.1μ

Podocarpidites florinii n. sp.

Pl. 18, fig. 23, 5055 (2514b), slide 4 (39.5—120.6) Holotype, P. N. 14145

Description: Bisaccate; central body circular; nexine about 2.0μ thick; smooth; distal face traversed by a parallel-sided leptoma about 15.0μ wide; bounded by the distal saccus bases; sexine covering leptoma smooth; sacci more or less semi-circular in outline; inframicroreticulate, inflated and distally pendant; brochi about 1.0μ part; sexine about 0.25μ thick; proximally sacci terminate rather abruptly against a strongly convolute, inflated cappa; convolutions about 1.5μ high and 2.0μ wide; margin of cappa well defined; crenulate; sacci radially folded at proximal and distal saccus bases; joined by narrow sexinal bands about 1.0μ wide around the margin of the cappa; central body yellow-brown; sacci pale yellow.

Size range

A. 31.9μ
B. 37.4μ
C. 21.0μ
D. 45.1μ
E. 60.5μ
Diameter of cappa 41.8μ
Thickness of grain (compressed) 7.0μ
Thickness of cappa (compressed) 3.0μ

Discussion: Differs from *P. convolutus* in lacking convolute ornamentation on the sacci being relatively longer.

Named for Professor R. Florin who has contributed more than any other worker to the elucidation of the fossil gymnosperms.

Podocarpidites convolutus n. sp.

Pl. 19, figs. 21—22, 4231, slide 2 (14.1—120.4) Holotype, P. N. 14146

Description: Bisaccate; central body circular in outline; nexine obscured by surface ornament; distal face traversed by an area of exinal thinning situated between the distal saccus bases, forming a leptoma about 10.0μ wide; slightly wider adjacent to distal pole than at its longitudinal extremities; sacci semi-circular in outline; relatively small; distally pendant; completely distally attached, the outer saccus bases being situated about 5.0μ distally of the equator; sacci somewhat more strongly inflated around their margins than at their centres; infrapunctate to finely infrareticulate; saccus bases convex towards the equator; proximally sacci abut against a strongly developed, inflated cappa; cappa closely convolute, each ridge being about 1.0μ wide; sexine of cappa 2.5μ thick; colour yellow.

Size range

A. 48.4—50.0μ
B. 49.5—54.0μ
C. 19.8—22.0μ
D. 55.0—67.5μ

Discussion: The overall convolute ornamentation is characteristic for this species.

Podocarpidites multicinus (Bolkh.) n. comb.

Pl. 20, figs. 1—2, 2119, slide 20 (42.2—117.9), P. N. 14147; fig. 3,1857, slide 5 (17.3—126.6)
1956 *Podocarpus multicina* Bolkh.; p. 121, pl. 22, fig. 221.

Description: Bisaccate; outline broadly oval; central body circular in outline; nexine about 0.5μ thick; smooth; capula somewhat thinned; smooth to finely punctate, forming a leptoma more or less corresponding to the distal face of the central body; sacci more or less seim-circular; infrareticulate; brochi 1.5—3.0μ wide with a slight tendency towards radial distribution close to the cappa; sexine about 0.5μ thick; slightly distally pendant; proximal and distal saccus bases convex towards the equator; proximally sacci merge with an inflated, infrapunctate cappa sexine of cappa about 2.5μ thick; colour pale yellow-brown.

Size range

A. 40.7—50.6μ
B. 44.0μ
C. 20.0—28.0μ
82.5—85.8μ
D. 41.8—46.2μ
E. Thickness (compressed) 10.0μ

Discussion: The sacci are not so strongly distally pendant as in most species of *Podocarpidites* but the radial saccus reticulation and strongly developed cappa are characteristic.

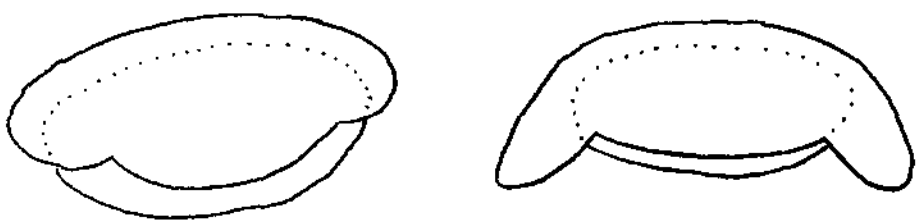
Podocarpidites arcticus n. sp.

Pl. 24, fig. 17, 3717 (2514a), slide 1 (27.0—117.6) Holotype, P. N. 14148; fig. 14, 3717 (2514a), slide 1 (29.5—118.8)

Description: Bisaccate; grain oval in outline; longer than it is wide; central body oval; longer than it is wide; a more or less parallel-sided longitudinal leptoma about 21.0μ wide and extending the full diameter of the central body developed on the distal face of the central body; over this area sexine much thinned; infrapunctate; frequently torn; nexine less than 0.5μ thick; smooth; sacci very much reduced and little inflated, forming rounded, distally pendant flaps attached to opposite sides of the strongly developed cappa; sacci infrapunctate; merge imperceptibly with inflated cappa; cappa 2.5—3.0μ thick with sexine up to 1.5μ thick; infrapunctate; externally smooth; colour yellow.

Size range

A. 41.8μ
B. 51.6—53.8μ
C. 11.0 (12.0) 15.0μ
D. 29.7 (33.0) 41.8μ
E. 45.1—50.0μ
Thickness (including sacci) 51.7μ
Thickness (excluding sacci) 29.7μ



Figs. 45, 46. Diagramatic sections through P. arcticus.

Discussion: The much reduced distally pendant sacci and ovoid central body are characteristic of this species.

Genus *Cedripites* Wodehouse

1933 *Cedripites eocenicus* Wodehouse; pp. 489—490, fig. 13.

Diagnosis: Bisaccate pollen grains with large well developed cappa. Sacci merge with cappa giving the impression that they connect across the proximal pole. Sacci strongly distally pendant and may, or may not, partially envelope the distal hemisphere.

Cedripites minor n. sp.

Pl. 24, fig. 16, 426, slide 6 (38.5—115.2) Holotype, P. N. 14149

Description: Bisaccate; central body ovoid, much wider than it is long; distal capula enclosed between more or less straight distal saccus bases; capula smooth, infrapunctate, germination by distal leptoma; sacci somewhat inflated, infrareticulate, with brochi less than 1.5μ wide, distally attached and distally pendant; proximally sacci merge into a large, inflated, infrapunctate cappa about 3.0μ thick which is externally smooth; colour pale yellow.

Size range

A. 40.7μ
B. 30.8μ
C. 14.3—16.8μ
D. 26.4—33.0μ
E. 55.0μ

Discussion: An extremely rare species confined to the Lower Jurassic.

Genus *Chordasporites* Klaus

1960 *Chordasporites singulichorda* Klaus; p. 158, pl. 33, fig. 45, type species.

Diagnosis: Bisaccate pollen grains. Central body ovoid, traversed distally by a longitudinal sulcus extending almost the full length of the grain. Sulcus may, or may not, be flanked by sexinal lips. A pair of lips, forming the distal saccus bases, enclose a distal, infrapunctate capula. Sacci inflated, infrareticulate, distally pendant. Proximally sacci merge with a somewhat inflated, usually poorly developed cappa which is traversed by a single transverse sexinal rib which passes over the proximal pole.

Discussion: This genus is here employed for a Jurassic bisaccate which is characterized by a single proximal transverse sexinal rib or band and a well developed distal longitudinal sulcus.

Chordasporites pseudostriatus (Kapytova) n. comb.

Pl. 16, fig. 11, 5055 (2514b), slide 4 (26.8—120.5), P. N. 14150

1963 *Florinites pseudostriatus* Kapytova; p. 67, pl. 1, figs. 5—6.

Description: Bisaccate; central body ovoid; much wider than it is long; nexine about 1.0μ thick; smooth; sulcus about 10.0μ wide extending the full length of the nexinal body; more or less parallel-sided but narrowing slightly towards the longitudinal extremities; flanked by narrow lips about 2.0μ wide adjacent to the distal pole and thinning towards the longitudinal extremities; sulcus and lips enclosed within an outer pair of lips forming an oval capula; capula 33.0μ wide adjacent to the distal pole; outer lips concavo-convex; convex towards the equator; 3.5μ wide adjacent to the distal pole and thinning towards the longitudinal extremities; sacci wider than they are long enveloping the nexinal body proximo- equatorially; infrapunctate to finely infrareticulate; brochi up to 1.0μ wide; reticulation slightly coarser at transverse extremities than at the proximal pole; sacci slightly distally pendant; cappa poorly developed; a single transverse rib about 10.0μ wide of somewhat thickened sexine crosses the pole and extends the full width of the nexinal body; colour pale yellow.

Size range

A. 69.0—91.0μ
B. 66.0—77.0μ
C. 39.0—51.7μ
D. 75.0—81.4μ
E. 93.0—120.0μ
Thickness (compressed) 8.0μ

Discussion: The proximal transverse ridge, large nexinal body and large grain size are distinctive. The species is tentatively included in the genus *Chordasporites* KLAUS (1960).

Genus *Lueckisporites* (POT. & KLAUS) JANSONIUS

1954 *Lueckisporites virkkiae* POT. & KLAUS; p. 531, pl. 10, fig. 3.
1962 *Lueckisporites* (POT. & KLAUS) JANSONIUS; pp. 60—61.

Diagnosis: Monosaccate to bisaccate pollen grains. Exine two-layered central body not always clearly defined; almost as long as the saccus in monosaccate grains. Distal face traversed by a sulcus or leptoma which may, or may not, be flanked by sexinal lips. Sacci merge proximally with a finely infrareticulate to infrapunctate cappa. Cappa split into two halves by a narrow laesura passing transversely across the proximal pole. Sacci or saccus distally pendant, somewhat inflated, finely infrareticulate, the reticulum showing no tendency to radial form.

Discussion: The genus is extended to include monosaccate grains in order to include the Jurassic species described hereafter. In actual fact this species could possibly be described as bisaccate, the sacci being joined by relatively wide bands of inflated, infrareticulate sexine passing around the longitudinal ends of the central body.

It was decided not to erect a new genus since it was an isolated species that appears to be related to Triassic species of the same genus. The laesurae splitting the cappa is much less prominent in the Jurassic than in Triassic species and the species described here probably marks almost the end point of the proximally striate saccate pollen grains. Species assigned to this genus are probably of pteridospermous affinity.

Lueckisporites crickmayi n. sp.

Pl. 17, fig. 9, 5055 (2514b), slide 3 (43.4—112.6); fig. 12, 5055 (2514b), slide 5 (45.6—115.4) Holotype, P. N. 14151; fig. 16, 5055 (2514b), slide 5 (21.3—119.2)
1962 *Orbicularia euspherica* MAL.; p. IX, fig. 3 (non pl. 46, figs. 3a—b & 4a—b).

Description: Monosaccate; central body more or less circular in outline; nexine very thin; exact thickness indeterminate; distal face traversed by a very faint sulcus 10.0—15.0μ wide extending almost the full length of the central body; sulcus broadly oval; flanked by convex-meniscus lips (convex to equator) 6.0μ wide; saccus broadly oval; inflated; wider than it is long; finely reticulate; elements of reticulum spaced about 0.5μ apart; cappa inflated, not sharply defined except in distorted specimens which may proximal lateral crescentic scars where nexine and sexine are appressed; saccus merges with cappa which is infrapunctate; cappa traversed by a transverse sexinal fold crossing the region of the proximal pole; sexine about 1.0μ thick; colour light yellow-brown.

Size range

A. 60.0 (65.6) 69.8μ
B. 57.6 (59.2) 60.0μ
C. 37.2 (40.6) 46.4μ
D. 72.0 (74.4) 76.8μ
E. 96.0 (101.1) 105.6μ
Thickness (compressed) 6.6 (10.9) 15.0μ

Discussion: The broadly oval outline, rather obscure central body and presence of a transverse proximal polar fold are characteristic. Examination of a large number of specimens indicates that the proximal polar fold is along a line of sexinal thinning which divides the cappa into two parts.

Named for Dr. C. H. CRICKMAY who pioneered paleontological studies of the Canadian Jurassic sediments.

Genus *Walchites* BOLKH.

1952 *Walchapites* BOLKH.; p. 110, pl. 2, fig. 13.
1956 *Walchites gradatus* BOLKH.; p. 88, pl. 13, fig. 156, type species.

Diagnosis: Monosaccate to bisaccate pollen grains. Outline oval to subcircular. Central body not clearly separable. Germination by distal leptoma, no sulcus developed. Saccus, or sacci, very narrow and

only very slightly inflated; developed as a distally pendant fringing structure to the central body. Saccus or sacci finely infrareticulate. No saccus bases developed, the sacci merging proximally with a very thin, poorly defined and scarcely inflated cappa.

Discussion: This genus includes saccate grains which lack well delineated sacci or germinal apparatus. The grains are usually smoothly broadly oval and easily recognizable on account of their lack of distinct delineation of morphological features.

Waldhites minor n. sp.

Pl. 19, figs. 19—20, 304, slide 1 (42.5—122.0); pl. 25, fig. 10, 3717, slide 1 (21.7—119.7) Holotype, P. N. 14152; fig. II, 2420, slide 1 (41.8—114.7)

Description: Bisaccate; outline smoothly oval; central body circular; not visible on most specimens; nexine about 0.25μ thick; smooth; exine thinned and finely punctate over a diffuse, more or less circular area of the distal face, forming a circular leptoma about 22.0μ wide; very rarely leptoma is traversed by a parallel-sided slit up to 10.0μ wide which extends almost the entire length of the grain, representing an area over which the sexine is absent due to splitting; sacci only slightly inflated; distally pendant; fringing the capula; infrareticulate; brochi 0.5—1.5μ wide; sexine less than 0.5μ thick; proximally sacci merge imperceptibly into finely infrapunctate cappa 1.2μ thick; colour pale yellow.

Size range

A. 35.2 (42.4) 54.0μ
B. 53.9 (56.2) 68.0μ
C. 10.0 (15.3) 24.0μ
D. 49.5 (56.0) 66.0μ
E. 59.4 (69.3) 76.0μ
Thickness (uncompressed) 25.0 (31.3) 39.0μ

Genus *Ovalipollis* (Krutzsch) emend.

1955 *Ovalipollis ovalis* Krutzsch; p. 70, pl. 1, fig. 2 (type species).
1955 *Unatextisporites* Leschik; p. 60.
1958 *Parvisaccites* Couper (in part); p. 154.
1958 *Chasmatosporites* Nilsson (in part); p. 51.
1960 *Ovalipollis* (Krutzsch) Klaus; p. 149—151.
1962 *Ovalipollis* (Krutzsch) Jansonius; p. 60.
1968 *Ovalipollis* (Krutzsch) Pocock & Jansonius; p. 158—161.

Diagnosis: Pollen grains. Monosulcate, asaccate, or with tulae. Distal face traversed by a longitudinal sulcus or leptoma which is usually narrowest at its midpoint. Amb oval to circular. Exine two-layered. Nexine relatively thin and smooth. Sexine differentially thickened. Distal face infrapunctate to infrareticulate, the reticulation tending to be coarser at the extremities. Relatively small, sightly inflated, distally pendant sacci may be developed flanking the sulcus. Proximally, sexine forms an infrabaculate cappa flanked by two smooth, oval, or elongate oval, areas of sexinal thinning (tenuitates). The tenuitates are always proximal and, on species with tulae, occupy the space between the cappa and the proximal tulae bases.

Ovaliollis bitorosa (Reissinger) n. comb.

Pl. 20, fig. 4, 5055 (2514a), slide 4 (30.5—121.8), P. N. 14153, Lectoholotype; fig. 5, 5055, slide 1 (34.6—115.0), P. N. 14154
1950 *Pollenites bitorosus* Reiss.; p. 116, pl. 17, figs. 25—30.

Description: Bisaccate; monosulcate; sulcus extending about three-quarters of length of grain; elongate oval in outline; flanked by more or less parallel-sided sexinal lips 2.0—3.0μ wide; amb circular; nexine relatively (approx. 1.0μ), smooth except over sulcus where it is thinned and finely punctate; sexine differentially thickened to form two relatively small, slightly inflated, distally attached sacci; sacci flank sulcus and coalesce around its ends; sexine of sacci infrareticulate and wrinkled, giving the grain a frilled appearance; proximally the sacci merge with an infrabaculate cappa 5.0—6.0μ thick; two crescentic proximal lateral tenuitates are developed parallel to the sulcus between the cappa and the proximal saccus bases; sexine is thinned and smooth over these areas; colour pale yellow.

Size range

A. 45.0 (62.0) 75.0μ
B. 57.0 (66.0) 69.0μ
C. 10.0 (23.0) 28.0μ
D. 68.0 (76.0) 80.0μ
E. 60.0 (74.0) 85.0μ
Length of sulcus 45.0—50.0μ
Width of sulcus 7.0μ approx.
Length of tenuitates 40.0—45.0μ
Width of tenuitates 5.0μ approx.
Spacing of elements of saccus reticulation 2.0—3.0μ

Discussion: Differs from *O. enigmatica* (COUPER) n. comb. in its larger size and relatively narrower sulcus. There can be little doubt as to the identity of these grains with REISSINGER's species. Since REISSINGER's holotypes are lost it is here proposed that the grain figures on pl. 16, fig. 4 of this paper (5055, slide 4, 30.5—121.8) be regarded as lecto-holotype.

Ovalipollis canadensis n. sp.

Pl. 20, fig. 6, 5055, slide 1 (30.6—118.2); fig. 7, 2258, slide 2 (39.3—125) Holotype, P N. 14155

Description: Bisaccate; monosulcate; sulcus extending to nexinal margin; relatively wide; keyhole-shaped; flanked by sexinal lips 2.0—3.0μ wide adjacent to the distal pole and thinning to almost nothing at the longitudinal extremities; amb blunted oval; nexine relatively thin (less than 1.0μ); smooth; sexine differentially thickened to form two relatively small, distally attached, slightly inflated sacci; sacci flank sulcus and coalesce around its ends; sexine of sacci finely infrareticulate; slightly wrinkled, the grain being almost smooth in outline; proximally sacci merge with an infrabaculate cappa about 3.0μ thick; two relatively broad plano-convex proximal lateral tenuitates (convex to the proximal pole) are developed parallel to the sulcus between the cappa and the proximal saccus bases; sexine is thinned and smooth over these areas; colour pale yellow.

Size range

A. 45.0—48.0μ (Holotype 48.0μ)
B. 63.0—65.0μ (Holotype 63.0μ)
C. 18.0μ approx. (Holotype indeterminate)
D. 68.0—73.0μ (Holotype 68.0μ)
E. 50.0—53.0μ (Holotype 53.0μ)
Length of tenuitates 39.0—45.0μ
Width of tenuitates 8:0—18.0μ
Length of sulcus 60.0—74.0μ
Width of sulcus 8.0—18.0μ
Spacing of elements of saccus reticulum 1.5—2.0μ

Discussion: Similar to *O. limbata* (MAL.) n. comb. but outline more rounded and sexine somewhat less wrinkled.

Ovalipollis enigmatica (COUPER) n. comb.

Pl. 20, figs. 8—9, 5055 (2514b), slide 4 (31.7—120.4), P. N. 14156; fig. 10, 5055 (2514a), slide 4 (30.1—118.4)

1958 *Parvisaccites enigmaticus* COUPER; p. 154, pl. 30, figs. 3—4.
1969 *Ovalipollis enigmatica* (COUPER) POCOCK & JANSONIUS; p. 162—163.

Description: Bisaccate; monosulcate; sulcus extending over three-quarters of diameter of grain; relatively wide; keyhole-shaped; sexinel lips narrow; widest opposite the distal pole (1.0μ) and thinning to almost nothing at the longitudinal extremities; amb sub-circular; nexine about 0.5μ thick; smooth; sexine differentially thickened to form two distally attached sacci slightly inflated, flanking sulcus and coalescing around its ends; sacci infrareticulate; wrinkled, giving the grain a somewhat radially frilled appearance; proximally sacci merge into an infrabaculate cappa 4.0—5.0μ thick; two crescentic proximal lateral tenuitates (convex to the proximal pole) are developed parallel to the sulcus between the cappa and proximal saccus bases; sexine much thinned and smooth over these areas; sexine over sulcus finely punctate; colour pale yellow-brown.

Size range

A. 47.0 (52.0) 57.0μ
B. 42.0 (49.0) 55.0μ
C. 15.0 (24.0) 30.0μ
D. 50.0 (57.0) 60.0μ
E. 57.0 (61.0) 66.0μ
Length of sulcus 45.0μ approx.
Width of sulcus 7.0μ approx.
Length of tenuitates 30.0—40.0μ
Width of tenuitates 8.0—15.0μ
Spacing of elements of saccus reticulum 0.75μ approx.

Discussion: The dimensions of the Canadian specimens are, on average, slightly larger than those recorded by COUPER from Britain but the difference is too slight to warrant the erection of a new species. *O. enigmatica* is smaller than *O. bitorosa* (REISS.) n. comb. and has a relatively wider sulcus. It is more rounded in outline than either *O. canadensis* n. sp. or *O. limbata* (MAL.) n. comb.

Ovalipollis limbata (MAL.) n. comb.

Pl. 20, fig. 12, 5055 (2514a), slide 1 (33.8—121.4), P. N. 14158; fig. 13, 5055 (2514b), slide 1 (34.6—119.5)

1959 *Quadreculina limbata* MAL.; p. 110, pl. 39, fig. 2.
1958 cf. *Chasmatosporites radiatus* NILSSON; p. 58, pl. 4, fig. 9.
1969 *Ovalipollis limbata* (MAL.) POCOCK & JANSONIUS; p. 163.

Description: Bisaccate; monosulcate; sulcus extending to within a few microns of the nexinal margin; relativey wide; keyhole-shaped, flanked by sexinal lips about 2.0μ wide, parallel-sided and completely surrounding the sulcus; amb more or less rectangular with rounded longitudinal sides; nexine thin (about 0.5μ); smooth; sexine differentially thickened to form two distally attached sacci; sacci slightly inflated; infrareticulate, wrinkled, giving the sacci a somewhat radially wrinkled appearance; sacci flank the sulcus and coalesce around its ends; proximally sacci merge into an infrabaculate cappa 4.0—5.0μ thick; two rounded proximal lateral tenuitates (almost invisible in distal polar aspect) are developed parallel to the sulcus between the cappa and proximal saccus bases; sexine much thinned and smooth over these areas; sexine over sulcus finely punctate; colour yellow-brown.

Size range

A. 50.0—65.0μ
B. 64.0—69.0μ
C. 22.0—27.0μ
D. 70.0—75.0μ
E. 56.0—77.0μ
Length of sulcus 65.0μ approx.
Width of sulcus 10.0—20.0μ
Length of tenuitates 40.0 approx.
Width of tenuitates approx. 10.0μ (estimated)

Discussion: Measurements of the tenuitates in this species are extremely difficult since the structures are developed almost in the longitudinal polar plane and are obscured in both proximal and distal polar aspects.

O. limbata has a less rounded amb than *O. canadensis* n. sp.

Ovalipollis findlaterensis n. sp.

Pl. 20, fig. 14, 5055 (2514a), slide 1 (32.0—115.7) Holotype, P. N. 14159; fig. 15, 5055 (2514a), slide 4 (32.1—118.9)

Description: Bisaccate; monosulcate; sulcus extending about three-quarters length of grain; sexinal lips to sulcus very narrow (less than 0.5μ); parallel-sided; sulcus widest at distal pole; narrowing towards longitudinal extremities; lips smoothly convex; amb more or less rectangular with rounded longitudinal sides; nexine thin (exact thickness indeterminate); smooth; sexine somewhat differentiated into two very slightly inflated, finely infrareticulate sacci; sacci flank sulcus and coalesce around its ends; proximally merge into a slightly differentiated, infrabaculate cappa; cappa about 2.0μ thick; two more or less straight proximal lateral tenuitates with associated curved sexinal folds, parallel the sulcus between the cappa and the proximal saccus bases; sexine over sulcus finely punctate; colour pale yellow.

Size range

A. 44.0μ (Holotype)
B. 50.0—57.0μ (Holotype 57.0μ)
C. 20.0—22.0μ (Holotype 22.0μ)
D. 58.0—61.0μ (Holotype 58.0μ)
E. 50.0—51.0 (Holotype 50.0)
Length of sulcus 40.0μ approx.
Width of sulcus 8.0μ approx.
Length of tenuitates 40.0μ approx.
Width of tenuitates ?8.0μ (with lips)
Spacing of elements of saccus reticulum 1.0μ

Discussion: Smaller than *O. bitorosa* (Reiss.) n. comb. and lacks the keyhole-shaped sulcus of *O. limbata* (Mal.) n. comb. This very rare species differs from all previously described in having sexinal lips to the tenuitates. These structures are situated closer to the proximal pole than on any other described species (see pl. 16, fig. 15). They appear to be morphologically related to the proximal crescentic scars seen on some of the bisaccate grains, illustrated on fig. 12, and could possibly provide a link between the bisaccates and *Ovalipollis*.

Ovalipollis minor n. sp.

Pl. 21, figs. 1—2, 2258, slide 2 (35.1—122.5) Holotype, P. N. 14160

Description: Saccate; monosulcate; sulcus extending two-thirds to three-quarters of length of grain; sexinal lips to sulcus not visible (either very narrow or absent); sulcus widest at distal pole, narrowing gradually and regularly towards tips; amb smoothly oval; nexine thin and smooth (exact thickness indeterminate); sexine slightly inflated, flanking and coalescing around the ends of the sulcus to form a finely infrareticulate saccus; on proximal face sexine reticulation becomes finer, but no distinct cappa is developed parallel to the sulcus and about half-way between the outer margins of the sulcus and the proximal pole; tenuitates slit-like and smoothly curved; colour pale yellow.

Size range

A. 22.0—23.0μ (Holotype 22.0μ)
B. 38.0μ approx. (Holotype 38.0μ)
C. 8.0—11.0μ (Holotype 11.0μ)
D. 40.0—45.0μ (Holotype 40.0μ)
E. 25.0—28.0μ (Holotype 25.0μ)
Length of sulcus 21.0μ approx.
Width of sulcus 4.0μ approx.
Length of tenuitates 25.0μ approx.
Width of tenuitates 2.0μ approx.
Spacing of elements of saccus reticulum 1.0μ approx.

Discussion: Its small size and the slit-like nature of the tenuitates are characteristic. The curved, slit-like tenuitates are morphologically similar to the proximal so-called colpi on species of *Eucommiidites*, *and also to the tenuitates present on some recent cycad pollen.*

Genus *Cerebropollenites* Nilsson

1958 *Tsugaepollenites mesozoicus* Couper; p. 155, pl. 30, fig. 8 (type species).
1958 *Cerebropollenites* Nilsson; p. 72.

Diagnosis: Pollen grains; saccate sub-spherical, spherical, spheroidal or ovid. Comprising a smooth central body enveloped more or less tightly by a strongly convolute relatively thin, finely punctate, sexinal saccus. Convolution may be reduced over the distal face and absent over an area of variable shape which forms a leptoma centred on the distal pole.

Discussion: This genus differs from *Zonalapollenites* Pflug in including species with more strongly convolute sacci and less differentiation between proximal and distal sculpture.

The characterization of grains assigned to this genus is extremely difficult. The strongly convolule saccus normally obscures the central body to such an extent as to make significant features invisible. The saccus itself is extremely variable, particularly with respect to inflation and degree of compaction of convolution, but these variations appear to have no systematic significance.

Size range distribution curves for Jurassic grains assigned to to *Cerebropollenites* show a series of sharp peaks instead of a normal distribution pattern indicating that the conventional practice of assigning all

Jurassic grains of the genus *C. mesozoicus* (Couper) Nilsson is oversimplification. On the basis of size range, character of saccus and, as far as possible, structure of the germinal area, four species of *Cerebropollenites* have been described in this work. These species are based upon study of one-hundred-and-fifty specimens, an inadequate number on which to base any final conclusions. The ultimate decision as to whether these species can be maintained must await detailed study of at least one hundred specimens assigned to each from more than one locality and stratigraphic horizon.

The terminology used in describing *Cerebropollenites* depends, in part, upon the assumption that the germinal apparatus is distal. Some grains of *Cerebropollenites* possess what appears to be a tetrad scar on the central body underlying the area of sexinal thinning (Pocock, 1962, pl. 12, fig. 179). By analogy with trilete spores this suggests the possibility that the germinal apparatus is actually proximal. Similar triradiate scars have been infrequently observed in preparations of pollen of species of *Tsuga*. The solution to this problem must await the discovery of unbroken tetrads of *Cerebropollenites*.

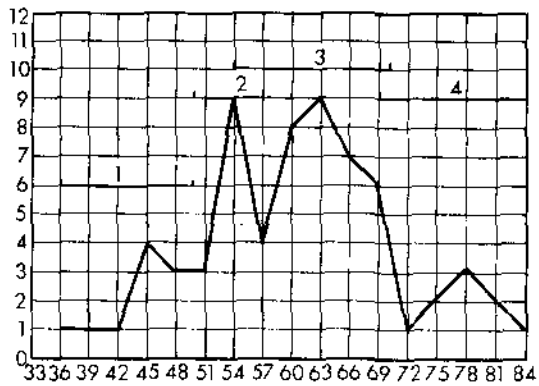


Fig. 47. Size range distribution of *Cerebropollenites* species based upon 150 specimens. 1. *C. carlylensis;* 2. *C. mesozoicus;* 3. *C. macroverrucosus;* 4. *C. findlaterensis.*

Cerebropollenites mesozoicus (Couper) Nilsson

Pl. 21, figs. 9 and 12, 4231, slide 1 (21.3—115.4); fig. 11, P. N. 14161; 5055 (2514a), slide 1 (31.5—119.5); fig. 15, 5055 (2514a), slide 4 (34.0—120.0); figs. 16—17, 4231, slide 2 (12.4—117.6)

1954 *Pollenites macroserratus* Thierg.; in Rogalska; p. 20, pl. 9, figs. 5—6.

(non) 1949 *Pollenites macroserratus* Thierg.; p. 17, pl. 2, fig. 19).

1958 *Tsugaepollenites mesozoicus* Couper; p. 155, pl. 30, fig. 8, Holotype.

1958 *Cerebropollenites mesozoicus* (Couper) Nilsson; p. 72, pl. 6, figs. 10 and 12, non fig. 11.

Description: Saccate; spherical to sub-spherical; central body obscure; thin; probably smooth; saccus completely envelopes central body; strongly convolute and little inflated although, rarely, specimens are encountered in which portions of the saccus are strongly inflated; convolution much reduced or absent over a more or less circular area surrounding the distal pole; area 20.0—40.0μ wide, frequently, but not always, surrounded by a fringe of somewhat more inflated sexine; sexine also tends to be somewhat more inflated and more strongly convolute around the equator; convolutions 3.0 (5.0) 7.0μ wide; closely packed; rounded: 3.0 (5.0) 8.0μ high at the equator; sexine infrapunctate; surface scabrate; colour pale yellow to yellow-brown; equatorial diameter 50.0 (54.0) 60.0μ.

Discussion: Differs from *C. carlylensis* n. sp. mainly on account of its larger size range, there being very little overlap between the two species. *C. macroverrucosus* n. sp. is generally larger than *C. mesozoicus* (Couper) Nilsson although there is considerable overlap between extremes of the two species. The ovoid shape of the former species as opposed to the spherical form of the latter is normally distinctive.

Cerebropollenites carlylensis n. sp.

Pl. 21, fig. 13, 1816, slide 5 (34.8—110.3); fig. 14, 1816, slide 4 (37.2—120.9) Holotype, P. N. 14162; fig. 10, 2119, slide 2 (31.7—120.1)

Description: Saccate; spherical to sub-spherical; central body spherical; nexine thin; smooth; sexine forms a strongly convolute saccus completely enveloping the central body; ornamentation either much reduced or absent over a more or less circular area centred on the distal pole; area averages 16.0μ wide

and is frequently, but not always, surrounded by a fringe of inflated sexine; sexine is also frequently more inflated and more strongly convolute around the equator than over the remainder of the grain; proximal convolution often somewhat reduced; convolutions 1.5 (2.6) 4.0μ wide and 2.0—3.0μ high at the equator; closely packed; equatorial sexine may be inflated 2.0—6.0μ beyond the central body; sexine finely infrapunctate; externally smooth; colour pale yellow; equatorial diameter 36.0 (45.0) 50.0μ.

Discussion: Smaller than *C. mesozoic* (Couper) Nilsson in all respects. Fig. 10 shows an abnormal grain included with *T. carlylensis* n. sp. on the basis of size but with abnormally large processes.

Cerebropollenites macroverrucosus (Thierg.) n. comb.

Pl. 21, fig. 3, 4231, slide 2 (19.5—125.4); fig. 4, 2132, slide 3 (31.4—114.6); figs. 5—6, 4231, slide 1 (18.5—121.6), P. N. 14163

1949 *Pollenites macroverrucosus* Thierg.; p. 17, pl. 2, fig. 19.
1962 *Tsugaepollenites mesozoicus* Couper; in Pocock, 1962; pl. 12, fig. 179.

Description: Saccate; ovoid to sub-spherical; nexine about 0.5μ thick; smooth; central body smoothly ovoid to spherical; distal face of central body traversed by a sulcus about half its length; sulcus flanked by parallel-sided nexinal lips which are smoothly curved, convex toward the equator and meeting around the longitudinal ends of the sulcus; lips about 4.0μ wide, formed by nexinal outfolding towards the equator; central body overlain by a strongly convolute sexinal saccus; ornamentation reduced or absent over an elongate area surrounding the sulcus; both sulcus and sexine are frequently distorted or torn; sexine more inflated and frequently more strongly convolute around the equator than over the remainder of the grain; ornamentation frequently somewhat reduced over the proximal face; convolutions 2.0 (4.75) 8.0μ wide and 2.0 (2.6) 3.5μ high; rounded; sexine infrapunctate; externally smooth to scabrate; colour yellow-brown; equatorial diameter 54.0 (63.0) 70.0μ.

Discussion: The ovoid shape and longitudinal distal sulcus distinguishes this species from all others. Grains exhibiting triradiate scars (pl. 17, fig. 4) are rarely found as deviating grains in this species. As mentioned previously, the significance of this structure is unknown.

Cerebropollenites findlaterensis n. sp.

Pl. 21, fig. 7, 5055 (2514a), slide 4 (34.1—120.0) Holotype, P. N. 14164

Description: Spherical to sub-spherical; saccate; central body spherical; much obscured by strong convolutions of the saccus; nexine thin; saccus completely envelopes central body; sexinal ornamentation absent or very much reduced over a more or less circular area about 30.0μ in diameter centred on the distal and equatorial sexine somewhat inflated and very strongly convolute; proximal sexine less inflated; convolutions 3.0 (4.8) 8.0μ wide and 2.0—4.0μ high at the equator; rounded; very closely packed; sexine infrapunctate; externally smooth; colour amber; equatorial diameter 69.0 (78.0) 90.0μ.

Discussion: The largest species of *Tsugaepollenites* recorded from the Canadian Jurassic. The circular outline combined with large size distinguishes it from all other species. The very strongly developed convolution of the saccus and obscure central body also appear to be characteristic.

Genus *Exesipollenites* (Balme) emend.

1953 *Inaperturopollenites* Thoms. & Pflug (in part); p. 66.
1957 *Exesipollenites tumulus* Balme; p. 39, pl. 11, fig. 123, type species.
1958 *Spheripollenites* Couper; p. 159.

Diagnosis: Pollen grains. Exine two-layered. Nexinal body circular to oval in cross section, smooth to faintly granulose. Distal pole usually marked by a circular area of exinal thinning, probably a leptoma. Sexine smooth, infrapunctate or infracanaliculate.

Exesipollenites tumulus Balme

Pl. 23, fig. 1, 3788 (1758), slide 1 (27.9—124.5); fig. 5, 3788 (1758), slide 1 (35.9—111.7), P. N. 14165; figs. 2—3, 3788 (1758), slide 3 (37.3—123.7); fig. 8, 3788 (1603—1608), slide 3 (36.4—115.7)

1957 *Exesipollenites tumulus* Balme; p. 39, pl. 11, fig. 123.

Description: Pollen grains; amb circular, oval or sub-triangular; exine two-layered; nexine less than 0.5μ thick; smooth; distal pole marked by a circular area of thinning 3.5—5.0μ in diameter surrounded by a circular area of darker nexine about 15.0μ in diameter which gradually becomes lighter and merges into the equatorial nexine; there is apparently no thickening over this darker area which is the area over which the distal nexine and sexine are in close contact; sexine less than 1.0μ thick loosely enveloping the nexinal body; short radial rods extend from the apices of the grain about 5.0μ towards the proximal pole; these rods mark lines of attachment of proximal nexine and sexine; the nexinal body sometimes folds along lines joining the apices of the central body resulting in grains with an apparently triangular central body and a spurious trilete scar; sexine smooth apart from the occasional presence of a few scattered granules; it is penetrated by the distal 'leptoma'; grains pale yellow to colourless; equatorial diameter 24.0 (33.0) 41.0μ; diameter of central body 14.0 (19.0) 23.0μ.

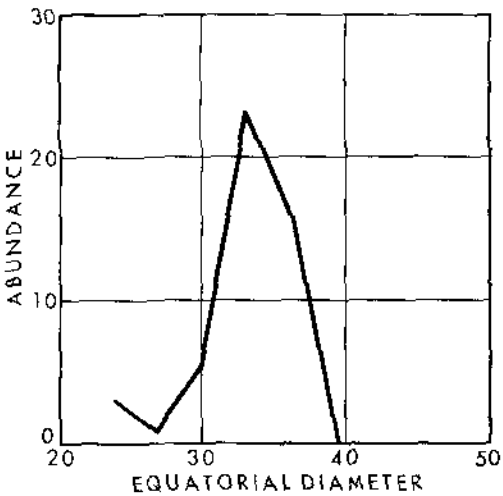


Fig. 48. Size distribution (based on 150 grains).

Discussion: These grains are difficult to interpret due, in part, to the unusual structure and to the fact that complete specimens are extremely rare. The grains described above are excellently preserved and the structural interpretation appears reasonably accurate. The interpretation of distal and proximal aspect is, however, not completely certain. The pore is interpreted as being distal and the three apical rods as representing a vestigial trilete dehiscence mark. The grains have not been encountered in tetrads and the interpretation is, therefore, uncertain. The following diagrams illustrate the method of folding of the central body.

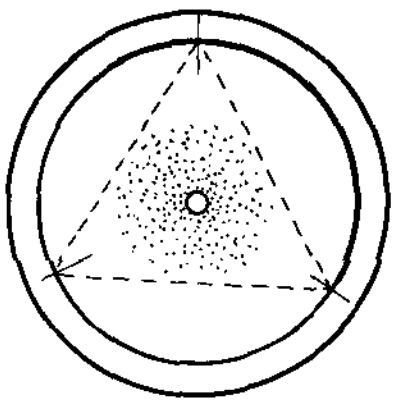


Fig. 49

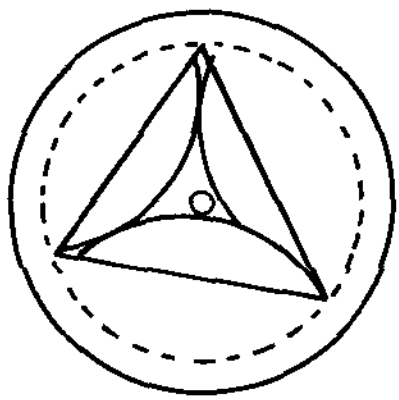


Fig. 50

Method of folding in *Exesipollenites tumulus* Balme, Fig. 49, shows an unfolded grain. A, A′ and A″ indicate the short rod-like structures where the intexine is firmly attached to the exoexine. The straight broken lines joining A to A′, A′ to A″ to A are the lines along which the central body folds towards the

distal pole which is indicated on the diagrams by a small circle representing the distal leptoma. Fig. 50 represents a folded grain and shows the circular central body folded in towards the distal pole along three lines of folding. It illustrates the development of spurious laesurae and a false triangular central body. The broken circle indicates the original position of the central body before folding.

Exesipollenites laevigatus n. sp.

Pl. 22, fig. 4, 4102 (1439—50), slide 1 (28.3—117.3); figs. 5—6, 4102 (1839—50), slide 6 (28.5—120.2) Holotype, P. N. 14166; fig. 5 fig. 17, 4102 (1439—50), slide 2 (23.0—122.1)

Destription: Spherical; usually with a circular distal polar leptoma about 3.0μ in diameter; exine two- or three-layered; 1.0—1.5μ thick; nexine less than 0.25μ thick; smooth; sexine about 1.0μ thick; tightly appressed to nexine; faintly infrapunctate; externally smooth; on well preserved grains a very thin (less than 0.25μ) membranous, perisporal layer carrying scattered small spherical granules less than 0.5μ in diameter may envelope the grain; on many specimens this layer is so reduced as to be invisible under the highest magnification of the optical microscope, only the granules being visible; about 5% of the grains encountered in well preserved assemblages are in tetrads; colour pale yellow; equatorial diameter 15.0 (21.0) 28.5μ.

Discussion: These grains occur sporadically in Middle and Upper Jurassic assemblages. Very large numbers of extremely wehh preserved grains occur in the Upper Gravelbourg plant beds in the Yarbo-Findlater area, including fragments of sporangia carrying clusters of pollen grains. The grains in such clusters are embedded in a mass of diffuse, transparent material which is crowded with irregularly distributed, small, spherical granules. This material is the source of the membranous outer layer and granules observed on grains of this species and indicates that the layer is a true perispore.

Comparison of *E. laevigatus* with the pollen of *Juniperus horizontalis* reveals some striking similarities. Graphs of size rang distribution (see diagram) are almost identical. The shape and structure of the grains, including exine thickness and infrapunctation, correspond closely (compare figures of *E. laevigatus* with those of the pollen of *J. horizontalis*, pl. 18, figs. 3, 7, 8 & 10). The pollen of *J. horizontalis* frequently possesses a granulose perispore formed in an identical manner to that of *E. laevigatus*. The principal observable difference between the two species is that the leptoma in *J. horizontalis* is much smaller (approx. 1.0μ) than that of *E. laevigatus* (approx. 3.0μ). The similarities between the two species appear to be sufficiently close to indicate some botanical relationship and it is possible that *E. laevigatus* was produced by a species of the Cupressaceae.

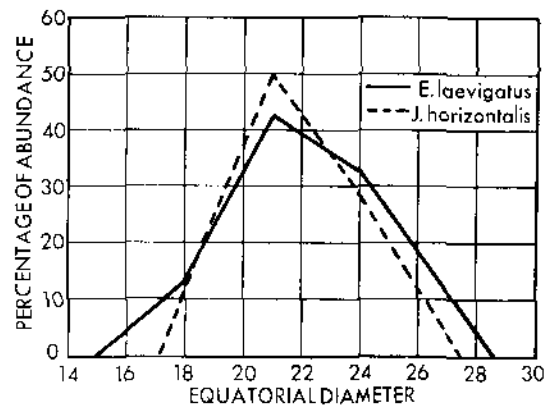


Fig. 51. *E. laevigatus* and *J. horizontalis*. Size distribution (based on 200 grains of each species).

Exesipollenites scabratus (Couper) n. comb.

Pl. 22, figs. 11—12, 5055 (2514b), slide 5 (40.1—110.8), P. N. 14167; fig. 14, 5055 (2514b), slide 1 (26.0—119.2); figs. 15A—D, 5055 (2514b), slide 1 (33.6—114.7)

1958 *Spheripollenites scabratus* Couper; p. 158, pl. 31, figs. 12—14.

Description: Aporate; nexine about 0.25μ thick; internally smooth; sexine finely infracanaliculate with anastomosing canals; externally smooth; amb circular; sexine differentially thinned over more or less

circular areas about 5.0μ in diameter to form tenuitates; the tenuitates, probably functioning as a leptoma, is centred on the distal pole whilst other, frequently less well developed, tenuitates occur towards the equator of the grain on either proximal or distal faces; small rounded granules up to 1.5μ in diameter are frequently attached, either as single grains or in clusters, randomly over the outer surface of the grain; colour yellow-brown; equatorial diameter 23.0 (32.4) 36.0μ.

Discussion: COUPER describes *S. scabratus* as scabrate, but then states "in optical section edge of grain appears smooth". From this statement and an examination of published figures it appears probable that the ornamentation is internal. If this is the case the species described above is *S. scabratus* COUPER. *E. scabratus* differs from *E. tumulus* BALME in possessing internally canaliculate ornament not present in the latter species.

Exesipollenites saccatus n. sp.

Pl. 22, fig. 16, 5055 (2514b), slide 5 (19.8—120.2) Holotype, P. N. 14168

Description: Saccate; no apertures visible, but germination presumably by distal leptoma; central body spherical; smooth; nexine about 1.5μ thick; sexine forms a very thin (approx. 25.0μ) enveloping saccus attached to the distal hemisphere of the central body; area of attachment infrapunctate; sexine faintly scabrate; saccus circular in outline; inflated; central body brown; saccus colourless; equatorial diameter of central body 25.3μ equatorial diameter of saccus 39.6—40.7μ.

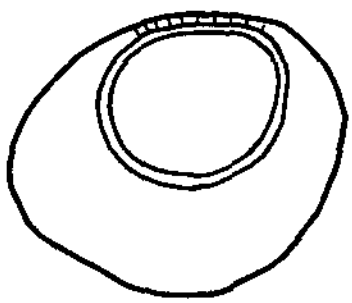


Fig. 52. Section through *E. saccatus*.

Discussion: Similar to *Perinopollenites elatoides* COUPER (1958) but with thinner saccus and thicker central body. It is also similar to pollen of the recent *Fitzroya*, a member of the Cupressaceae. It is considered a needless complication to include morphologically similar saccate and asaccate grains in separate form-genera, since many recent, closely related, gymnospermous species are known to produce either saccate or non-saccate pollen.

Exesipollenites sp. A

Pl. 22, figs. 21—22, 2258, slide 2 (39.6—122.2), P. N. 14169

Description: Spherical; exine two-layered; nexine about 0.5μ thick; internally smooth to scabrate; sexine about the same thickness; infrapunctate; surface smooth; may carry scattered small granules attached to the surface which may represent a reduced perine; no germinal apparatus visible; colour yellow-brown; equatorial diameter 20.0—22.0μ.

Pollen of other genera inserted for comparison with *Exesipollenites*.

Classopollis classoides PFLUG

Pl. 22, fig. 1, 2288, slide 1 (29.0—132.2)

Description: Polar view of a swollen grain in which the central body has become detached from the sexine. Included for comparison with saccate species of *Exesipollenites*. Equatorial diameter 34.0—40.0μ; diameter of central body 23.0—25.0μ.

(?) *Cerebropollenites* sp.

Pl. 122, fig. 2, 2119, slide 20 (24.8—121.0)

Description: Saccate; monoporate; central body spherical; nexine about 0.5μ thick; scabrate; circular pore 5.5μ in diameter, centred on the distal pole; central body enveloped in a large saccus; sexine about 1.0μ thick, finely infrapunctate, convolute, particularly around the equator; central body firmly attached to the saccus over its distal face, the area of attachment being marked by sexinal folds paralleling the equator of the distal face of the central body; colour yellow-brown; equatorial diameter 60.—72.0μ; diameter of central body 29.7—33.0μ.

Discussion: This species comprises a central body of *Exesipollenites* type enclosed in an enveloping saccus which, in the absence of a clear central body, would be assigned to *Cerebropollenites*. This type of central body enclosed in a saccus which may, or may not, be ornamented, has been recorded from many Jurassic preparations.

Genus *Classopollis* (Pflug) Pocock & Jansonius

1950 Conifer pollen, Reissinger; p. 114, pl. 14, figs. 15—16.
1953 *Classopollis classoides* Pflug; p. 91, pl. 16, figs. 29—31, type species.
1961 *Classopollis classoides* (Pflug) Pocock & Jansonius; p. 443, pl. 1, figs. 1—9.
1963 *Classopollenites* Danzé—Corsin & Laveine; p. 105.

Diagnosis: Distally monoporate pollen grains. Ovoid, spherical or acorn-shaped; circular to oval in equatorial section. Exine two-layered. Sexine absent, or more probably much reduced, over a circular area surrounding the distal pole and over a triangular area with its centre at the proximal pole. Nexine frequently carries a reduced trilete scar, which has no germinal function, at the proximal pole. Exine always ornamented by striations in a band or girdle surrounding the equator and usually showing an abrupt twist at one point. This band usually, but not always, marks a band of sexinal thickening.

Discussion: There can be little doubt that *Classopollis* pollen is produced by species of the *Cheirolepidae*, the commonest species, *C. classoides*, being the pollen of *Cheirolepis muensteri* (Schenk) Schimper. Chaloner (1962) suggests that *C. classoides* may have been produced by two different species of *Cheirolepis* (p. 23) but it appears doubtful that two different plant species would produce morphologically identical pollen of such complex structure. Fragments of sporangium, indistinguishable from those of *C. muensteri* with *Classopollis classoides* attached have been recovered from the Upper Gravelbourg (Upper Bajocian) coal penetrated in the Findlater Potash well and in the shafts of the International Potash Company's Yarbo mine shaft in southeastern Saskatchewan (see pl. 21, figs. 12—16). In addition to the sporangia these beds also yielded a few isolated leaves of the type illustrated by Chaloner from the Rhaeto-Liassic cores of the Henfield boring in England (pl. 2, figs. 5—7). They also yielded a large number of fragments of leaf cuticle which showed, on their abaxial surfaces, stomatal apparatus apparently identical to that of *Cheirolepis* of the *C. muensteri* type (see pl. 35, figs. 1 & 3). Since the apparatus on the Canadian specimens has five to six subsidiary cells instead of the four to five typical of *C. muensteri*, the species are probably not the same.

Classopollis classoides Pflug

Pl. 23, fig. 9, 887, slide 1 (29.3—116.2), P. N. 14170; fig. 17, 5055 (2514a), slide 4 (29.5—119.5); fig. 12, 2258, slide 4 (35.4—123.2)
1953 *Classopollis classoides* Pflug; p. 91, pl. 16, figs. 29—31 (for fuller synonymy see Pocock & Jansonius, 1961).

Description: Spherical, ovoid or acorn-shaped; circular in equatorial section; monoporate with a circular distal pore 12.0—15.0μ in diameter; exine two-layered; nexine about 1.0μ thick, laevigate, continuous over the entire spore surface and frequently showing a small trilete scar which does not function as a germinal aperture; laesurae, where present, not more than 3.0μ long; sexine 1.0—2.0μ thick, divisible into two distinct zones, a wider zone enveloping the proximal hemisphere and a narrower zone forming a belt of sexine averaging 5.0μ in width, surrounding the distal pore; the distal belt is separated from the sexine of the proximal hemisphere by a narrow band of exinal thinning, effecting both nexine and sexine, slightly distal of the equator (this forms the "Rimula" of Pflug); the sexine of the proximal face is much reduced

over a triangular area surrounding the proximal pole; four or more annular bands of sexinal thickening which may, or may not, be pronounced, form a belt averaging 9.0μ in width surrounding the equator: this belt is slightly helicoidal in disposition and shows a sharp twist at one point; sexine radially infrapunctate, the structure being particularly noticeable around the equator; surface of grain smooth to granulose, rarely microreticulate; colour pale yellow to amber; polar diameter 18.0 (23.0) 24.0μ; equatorial diameter 18.0 (27.0) 36.0μ.

Discussion: A detailed discussion of the taxonomy of this species is to be found in Pocock & Jansonius (1961) and Chaloner (1962). The botanical affinities of *Classopollis* have been discussed in some detail by Harris (1957), Chaloner (1962) and, to a lesser extent, by Pocock & Jansonius (1961). The two last-mentioned publications contain bibliographies of the principal publications concerning the genus.

When well preserved, *Classopollis classoides* is easily recognizable and even specimens from which the sexine is missing may be readily identified providing they are not folded (pl. 24, fig. 7). Folded specimens may easily be mistaken for monosulcate, or even tricolpate, pollen grains.

Classopollis itunensis Pocock

Pl. 23, fig. 21, 2132, slide 1 (40.2—127.9) Holotype, P. N. 14171; fig. 23, 5055 (2514a), slide 4 (34.3—117.6); fig. 17, 5055 (2514a), slide 3 (34.7—121.8); fig. 15, 2119, slide 2 (37.4—110.6); fig. 16, 5055 (2514a), slide 1 (33.8—115.2)
1962 *Classopollis itunensis* Pocock; pp. 71—72, pl. 11, figs. 176—177, pl. 12, fig. 178.

Description: Distally monoporate; sub-circular to oval in polar outline; circular in equatorial section; exine two-layered; nexine smooth; continuous over the entire area of the grain; frequently shows a trilete slit at the proximal pole; sexine infrapunctate to infrareticulate; brochi of reticulum 1.0—2.0μ wide; sexine divisible into two zones; a wider zone enveloping the proximal hemisphere and a narrower zone forming a belt of sexine 5.0—8.0μ wide surrounding the thinned exine of the distal pore; distal and proximal zones separated by a narrow band of sexinal thinning somewhat distal to the equator termed the "Rimula" by Pflug; the sexine of the proximal hemisphere is absent, or more probably much reduced, over a more or less triangular area surrounding the proximal pole; four to eight bands of sexinal thickening which

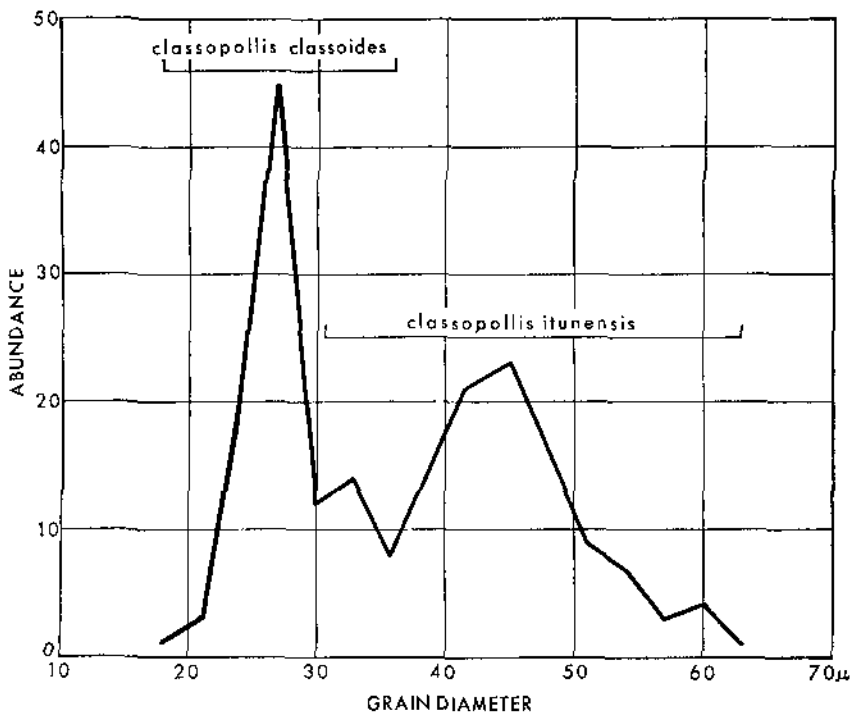


Fig. 53. *C. classoides* plus *C. itunensis*. Size distribution.

may, or may not, be pronounced, form a belt 11.0—12.0μ wide surrounding the equator; as with all species of *Classopollis* this belt shows a sharp sigmoidal twist at one point; colour amber; equatorial diameter 31.0 (45.0) 63.0μ.

Discussion: This species was originally described as operculate. This has proved to be incorrect. The structure misinterpreted as an operculum is an internal body which is circular in cross section. When present it is oriented with its long axis along the polar axis of the grain. The thick sexine of this species has rendered detailed study of the structure impossible but it appears to possess grooves parallel to the long axis (pl. 23, fig. 23). The significance of the structure is unknown. Pl. 25, figs. 1—3 show grains which have well developed proximal slits in place of the normal triangular thinning. Although probably deviant structures, this feature has not been observed on any other *Classopollis* species.

Classopollis minor Pocock & Jansonius

Pl. 24, figs. 17, 21 and 22, 2119, slide 1 (35.6—119.3), P. N. 14303, Holotype; figs. 18—20, three other typical grains.

1950 "Conifer pollen" Reissinger; p. 114, pl. 14, figs. 21—28, pl. 18, figs. 33a—e.
1953 "Siegelsum N. Typus" Pflug; pl. 17, figs. 38—40.
1954 "Cheirolepidaceae Group II" Rogalska; p. 23, pl. 11, figs. 4—6.

Description: Pollen grains; oval to circular in polar section, circular in equatorial section; exine two-layered; nexine thin; laevigate; sexine thicker (1.0—3.0), divisible into two zones; one zone envelopes the proximal hemisphere but for a triangular aperture at the proximal pole, 5.0—7.0μ in diameter, through which the intexine is exposed; the other sexinal zone envelopes the distal hemisphere and carries a circular aperture above 4.0μ in diameter at the distal pole; where the nexine is exposed, forming a distal pore; this zone meets the sexine of the proximal hemisphere approximately at the equator and is separated from it by a very narrow band where the sexine is absent or very much thinned; this band of thinning is relatively less well developed than in *Classopollis classoides* Pflug; ornament of sexine internally canaliculate; sexine of proximal hemisphere thickened in the equatorial area, forming a girdle about 6.0μ wide, ornamented by about ten parallel canals within the exine which show a break at one point; a second series of similar canals is developed parallel to each side of the triangular proximal sexinal aperture; these canals are truncated by the equatorial girdle; distal sexine ornamented by a series of radially disposed pits which are frequently united at the surface giving the appearance of microreticulate ornamentation; grains usually deep yellow-brown in colour; equatorial diameter 21.0 (25.0) 27.0μ (holotype 25.0μ); polar diameter 21.0 (22.0) 24.0μ (holotype 22.0μ).

Discussion: These grains are smaller than those of other described species of *Classopollis* and the striation around the proximal aperture makes them very distinctive. The grains are usually seen in polar view and tetrads are rare.

Classopollis findlaterensis n. sp.

Pl. 23, figs. 11 and 13, 5055 (2520), slide 1 (28.5—117.7) Holotype, P. N. 14172; fig. 11, 887, slide 1 (39.8—121.7); figs. 18—20, 1816, slide 3 (37.8—120.2)

Description: Pollen grains; ?distally monoporate; amb more or less circular; nexine about 1.5μ thick; scabrate; nexinal body sub-spherical; pronounced sigmoidal invagination of nexine developed more or less coincident with, and parallel to, the sexinal striation (see diagram); sexine about 5.0μ thick at the equator, thinning to less than 1.0μ at the poles; finely infrareticulate; loosely attached to nexine particularly at the equator where there may be a gap of up to 4.0μ between nexine and sexine; a broad equatorial girdle of sexinal thickening about 14.0μ wide encircles the equator; girdle carries internally canaliculate ornament consisting of eleven to twelve equatorial ridges which may branch and may become broken into a string of elongate, flat-topped verrucae; ornamentation shows a sharp sigmoidal twist at approximately the centre point of one face, a feature of all species of the genus; colour yellow-brown; equatorial diameter 44.2μ; polar diameter 40.8μ; nexinal body 42.0 x 36.0μ; diameter of elements of sexine reticulum 0.5μ.

Discussion: Similar to *C. belloyensis* POCOCK & JANSONIUS (1961) in general aspect but somewhat larger in size and with a thinner, looser sexine.

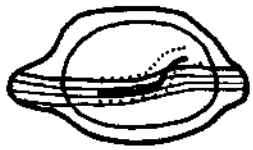


Fig. 54. *Structure* of *C. findlaterensis* n. sp.

Genus *Concentrisporites* WALL emend.

1965 *Concentrisporites hallei* (NILSSON) WALL; p. 166.

Diagnosis: Saccate pollen grains. Central body spherical to ovoid or fusiform, smooth to subgranulose, either monosulcate or possessing a strong tendency to split into two, more or less equal, parts. Central body attached to the saccus around its equator. Saccus very thin, transparent, smooth to granulose, circular to ovoid.

Discussion: Species of this genus are normally very easy to recognize. In a few instances confusion with *Perinopollenites* COUPER is possible but well preserved grains belonging to the latter genus are monoporate and it is very rare to encounter a specimen of *Concentrisporites* that does not show either a well developed sulcus or same sign of splitting of the central body.

Concentrisporites sulcatus (ROGALSKA) n. comb.

Pl. 26, figs. 1 and 3, 5055 (2514b), slide 1 (27.5—119.8), P. N. 14173; fig. 2, 2258, slide 2 (41.8—122.2); fig. 4, 2132, slide 2 (35.0—115.9)
1945 *Pollenites sulcatus* ROGALSKA; p. 46, pl. 11, fig. 12.

Description: Pollen grains; saccate; exine two-layered; nexine about 0.5μ thick; central body monosulcate, sulcus parallel-sided, extending full length of central body and flanked by raised nexinal lips; lips convex towards the equator, about 5.0μ wide adjacent to the distal pole; a further pair of lips, formed by a nexinal infolding towards the distal pole, occur equatorially of the sulcus lips and more or less parallel them; these lips are somewhat shorter and more irregular than the lips to the sulcus; central body oval in outline; sexine very thin and transparent, less than 0.25μ thick, forming a distally pendant saccus which envelopes the central body and is attached to it around its equator; sexine finely and evenly granulose; nexine orange-brown; sexine colourless; nexine 54 x 30 (42 x 39) 54 x 45μ; sexine 38 x 27 (48 x 48) 45 x 66μ.

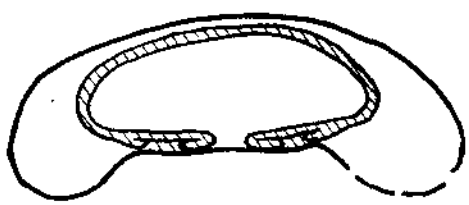


Fig. 55

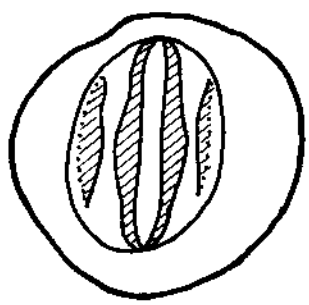


Fig. 56

Discussion: Isolated central bodies of this species would be somewhat similar to species of *Bennettiteaepollenites*, differing from them in being single instead of two-layered.

Concentrisporites pseudosulcatus (BRICHE, DANZÉ-CORSIN & LAVEINE) n. comb.

Pl. 26, fig. 5, 4231, slide 1 (26.0—118.9), P. N. 14174; fig. 6, 2132, slide 1 (41.3—123.0); fig. 7, 4231, slide 1 (15.0—116.5); fig. 8, 2119, slide 1 (37.0—124.5); fig. 9, 2119, slide 1 (38.3—119.3)
1958 (?) *Perinopollenites elatoides* COUPER; p. 27, figs. 9 & 11, non fig. 10.
1958 (P) *Equisetosporites hallei* NILSSON; pl. 5, fig. 20, non fig. 21.

1962 *Monosulcites minimum* COOKSON; in POCOCK; pl. 13, figs. 207—208, non fig. 206.
1963 *Perinopollenites pseudosulcatus* BRICHE, DANZÉ—CORSIN & LAVEINE; p. 90, pl. 8, fig. 8.

Description: Grains comprise a spherical to sub-spherical, smooth central body less than 0.5μ thick enveloped by a loose circular to sub-circular sub-granulose saccus; central body possesses a plane of weakness which causes it to split readily into two hemispheres; this is almost certainly of germinal significance; normally the two hemispheres remain partially joined and when, as frequently occurs, the margins of the split become folded back, the central body takes on a spurious monosulcate appearance; isolated central bodies are frequent and in the absence of complete specimens, could not be distinguished from species of *Schizosporis* COOKSON & DETTMANN; saccus colourless; central body yellow; size range 28.0 (35.0) 45.0 x 42.0 (47.0) 50.μ.

Discussion: When perfectly preserved these grains show little trace of the plane of weakness around the central body (pl. 22, fig. 5). Such grains are, however, very rare and in the vast majority of specmines the central body more or less split into two equal parts (pl. 22, figs. 6—9). Similar grains have been found attached to sporangial fragments and associated with leaves of *Ptilophyllum montanense* FONTAINE, a cycadophyte species from lower Albian sediments in western Canada.

Genus *Latensina* ALPERN

non 1953 *Zonaletes (Latensina)* LÜBER.; in SAMOILOVICH; p. 32.
1958 *Latensina trileta* ALPERN; in ALPERN et al.; p. 86, pl. 2, fig. 55, type species.

Diagnosis: Monosaccate pollen grains with sub-circular to sub-triangular outline. Proximal pole marked by a trilete mark with relatively short commissures, or with a triangular scar which probably results from distortion of a trilete mark. Central body enveloped distalo-equatorially by an infrareticulate to infrapunctate saccus which is strongly inflated equatorially to form a relatively broad girdle. Saccus smooth to convolute, the ornamentation showing a strong tendency to radial distribution.

Discussion: The name *Latensina* was probably applied by LÜBER to a spore illustration although the author has been unable to locate the original reference. SAMOILOVICH used it in 1953, citing the original reference for the type species of her genus *Cordaitina* as *Zonaletes (Latensina) uralensis* LÜBER, in LÜBER & WALTZ, although in that work the name *Latensina* is not used. In all probability there was no formal citation of a type species for *Latensina* and the name was, at that time, nomen ambiguum. ALPERN (in ALPERN et al, 1958) formally described and named one species under the generic name *Latensina*. In doing this he validated the name, his species becoming type for the genus.

Latensina mesozoica n. sp.

Pl. 19, figs. 17—18, 430, slide 2 (40.7—118.8) Holotype, P. N. 14175

Description: Monosaccate; outline sub-triangular to sub-circular; proximal polar area marked by a triangular opening 5.5μ wide which probably represents a gaping trilete aperture; central body enveloped distalo-equatorially by a convolute sexinal saccus; saccus inflated around the equatorial margin to form a broad girdle 6.5—8.0μ wide; saccus infrareticulate; surface convolute, convolutions very low; smooth and closely packed over distal face with tendency to radial distribution; saccus only slightly inflated; proximal face smooth; colour yellow-brown; equatorial diameter (grain) 31.9—37.4μ; equatorial diameter (central body) 18.7—37.4μ; thickness 12.2μ.

Discussion: This species corresponds fairly well to ALPERN's concept of *Latensina* and is the highest occurrence so far recorded.

Genus *Cycadopites* (WODEHOUSE) ex WILSON & WEBSTER

1933 *Cycadopites* WODEHOUSE; p. 483.
1946 *Cycadopites follicularis* WILSON & WEBSTER; p. 274, fig. 7, type species.
1947 *Monosulcites* COOKSON; p. 134.

1953 *Monosulcites* (COOKSON) COUPER; p. 65.
1958 *Monosulcites* (COOKSON) POTONIÉ; p. 95 (citation of holotype).
1963 *Cycadopollenites* DANZÉ—CORSIN & LAVEINE; p. 108.

Diagnosis: Fusiform or ovoid pollen grains. Normally two-layered. Surface smooth to sub-granulose. Monosulcate, the sulcus longitudinal and extending the full length, or almost the full length, of the grain. Sulcus may taper towards both ends or may be narrowest at the distal pole, widening towards the extremities giving it a keyhole shape; it may, or may not, be flanked by raised sexinal lips.

Discussion: The two genera *Cycadopites* and *Monosulcites* are grouped together in this work. As diagnosed above, the genus also includes, either completely or in part, a number of other less well defined genera for monosulcate sporae dispersae.

Cycadopites nitidus (BALME) n. comb.

Pl. 26, fig. 12, 100, slide 1 (40.9—120.4); fig. 15, 1816, slide 4 (22.4—111.4), P. N. 14176; fig. 16, 100, slide 4 (46.3—127.8); fig. 17; 100, slide 4 (42.8—111.3); fig. 18, 100, slide 1 (35.3—123.1)
1958 *Entylissa nitidus* BALME; p. 30, pl. 6, fig. 6, figs. 78—80.
1962 *Monosulcites* sp. K JANSONIUS; p. 79, pl. 16, figs. 28—30.

Description: Amb fusiform, longitudinal ends somewhat rounded; exine probably two-layered; distal face traversed by a longitudinal sulcus flanked by lips 2.0—3.0μ wide, thinning towards the longitudinal extremities; exine smooth; colour yellow; size range 30.0 (39.0) 45.0 x 18.0 (27.0) 39.0μ.

Discussion: Slightly larger, on average, than BALME's specimens but otherwise appear to be identical and the size difference is not sufficient to warrent the erection of a separate species. A very long-ranging species, at least Triassic to Cretaceous.

Cycadopites cf. *C. typicus* (MAL.) n. comb.

Pl. 26, fig. 18, 100, slide 1 (35.3—123.1); fig. 25, 4231, slide 1 (25.0—120.9), P. N. 14177
1949 *Retectina glabra* cf. *typica* MAL.; p. 117, pl. 44, fig. 11.
1953 *Ginkgo typica* (MAL.) BOLKH.; p. 62, pl. 10, figs. 3—4.

Description: Amb oval to fusiform; ends rounded or almost sharp; nexine thin; exact thickness indeterminate; tightly appressed to sexine; sexine about 1.0μ thick, smooth to slightly roughened; distal face traversed by a narrow, parallel-sided slit-like, longitudinal sulcus extending to the inner nexinal margin; sulcus flanked by very low, inconspicuous, raised lips up to 3.0μ wide and narrowing towards their tips; colour yellow; size range 30.8—34.0 x 15.0—16.5μ.

Discussion: Slightly shorter than the Russian species, otherwise appears to be identical.

Cycadopites minimus (COOKS.) n. comb.

Pl. 26, figs. 21—22, 2258, slide 2 (41.0—122.1), P. N. 14178; fig. 23, 75, slide 2 (44.9—118.6); 2258, slide 2 (36.6—124.0); fig. 26, 75, slide 3 (39.0—125.7); fig. 27, 2258, slide 2 (41.1—123.1); fig. 28, 424, slide 2 (34.9—120.0)
1947 *Monosulcites minimus* COOKSON; p. 135, pl. 15, figs. 47—50.
1953 *Ginkgo mutabilis?* (NAUM.) BOLK.; p. 63, pl. 10, fig. 7.

Description: Amb oval with almost straight sides; fusiform in side view; longitudinal ends rounded; exine two-layered; nexine less than 0.25μ thick; sexine about 0.5μ thick; transparent and smooth; distal face traversed by a broad longitudinal sulcus with parallel sides and rounded ends; sulcus flanked by lips 2.0—3.0μ wide adjacent to the distal pole and thinning to nothing at the longitudinal extremities; colour pale yellow-brown; length 28.5 (29.5) 30.0μ; width approx. 14.0μ; thickness 13.0—14.0μ.

Discussion: Detailed examination of a large number of grains has led the author to believe that the difference in outline between rounded and fusiform elongate forms of more or less the same size is a result of orientation and is nota valid basis for specific separation.

Cycadopites deterius (Balme) n. comb. var. *majus* Sukh Dev

Pl. 24, fig. 17, 1978, slide 2 (38.6—118.2), P. N. 14179

1959 *Ginkgocycadophytus deterius* (Balme) var. *majus* Sukh Dev; p. 52, pl. 7, fig. 61.

Description: Sulcus extending full length of grain; widest at its extremities; margins frequently overlap adjacent to the distal pole; outline of grain fusiform; exine single-layered; smooth; about 1.2μ thick; colour brown; size range 38.3 x 44.0μ.

Discussion: Very rare in the Canadian Jurassic but included for comparison with similar grains from Jurassic strata in other localities. Despite its general form the single-layered, relatively thin exine suggests that its botanical affinities may not be gymnospermous.

Cycadopites jansonii n. sp.

Pl. 26, fig. 10, 1816, slide 1 (18.5—123.3), P. N. 14180; fig. 15, 1816, slide 4 (22.4—111.4)

1953 *Ginkgo parva* Bolkh.; (in part) p. 63, pl. 10, figs. 5—6.

1962 *Monosulcites* sp. K Jansonius; p. 79, pl. 16, figs. 28—30.

Description: Fusiform; exine about 1.5μ thick; two-layered; nexine smooth; tightly appressed to sexine; sexine smooth; distal face traversed by a pair of longitudinal lips extending the full length of the grain; lips double convex; formed by an exinal outfolding towards the equator; lips 3.0 (4.6) 6.6μ wide adjacent to the distal pole, thinning towards the longitudinal extremities; lips enclose a longitudinal sulcus centred on the distal pole; sulcus widest at its longitudinal extremities, 4.0 6.0) 10.0μ, narrowing towards the distal pole, 2.0 (3.3) 5.0μ; colour yellow to yellow-brown; size range 33.0 (40.6) 54.0 x 23.0 (28.0) 36.0μ.

Holotype: 3010, slide 2 (37.0—115.6). Illustrated in Jansonius, 1962, pl. 16, fig. 30.

Discussion: This species includes those forms described by Jansonius (1962) as *Monosulcites* sp. K. It also includes the larger size range of forms included by Bolkhovitina in *Ginkgo parva* (1953).

Cycadopites parvus (Bolkh.) n. comb.

Pl. 26, fig. 11, 2132, slide 3 (44.0—117.9), P. N. 14181

non 1947 *Monosulcites minimus* Cookson; p. 135, pl. 15, figs. 57—50.

1953 *Ginkgo parva* Bolk.; p. 63, pl. 10, figs. 5—6.

1962 *Monosulcites minimus* Cookson; in Pocock, 1962, p. 77, pl. 13, fig. 206.

Description: Fusiform; exine two-layered; nexine less than 0.25μ thick; smooth; sexine less than 1.0μ thick; smooth; finely infrapunctate, nexine and sexine tightly appressed; distal face traversed by a pair of lips extending the full length of the grain; lips formed by an outfolding of exine towards the equator; lips double convex; 4.0 (4.7) 6.0μ wide adjacent to the distal pole; lips enclose a distal longitudinal sulcoid leptoma; leptoma widest at the longitudinal extremities (approx. 4.0μ) and thinning towards the distal pole (approx. 1.0μ); colour yellow to yellow-brown; size range 30.0 (32.0) 37.0 x 18.0 (19.8) 23.0μ.

Discussion: The size range of this species is somewhat restricted to remove the larger specimens which appear to form a definite size group and are treated as a separate taxon.

Cycadopites sp. A

Pl. 26, fig. 19, 894C, slide E (30.3—117.7), P. N. 14182

Description: Monosulcate; outline oval; sulcus about 5.0μ wide, parallel-sided and extending the full length of the grain; ends rounded; prominent sexinal lips developed 3.0—4.0μ equatorially from the edges of the sulcus and more or less parallel to them; lips 4.0—5.0μ wide and outwardly directed, convex towards the equator, extending over three-quarters the length of the grain; nexine thin, exact thickness indeterminate; sexine about 1.0μ thick; scabrate; colour yellow; size range 40.0—47.0μ x 25.3—27.5μ.

Cycadopites sp. B

Pl. 26. fig. 20, 404, slide 2 (47.3—121.6)

Description: Grain ovoid, smoothly rounded; distal face traversed by a wide longitudinal sulcus, wider at its extremities than at the pole; ends smoothly rounded; no lips to sulcus; nexine thin, exact thickness indeterminate, smooth, tightly appressed to sexine; sexine about 1.5μ thick, extremely regularly granulose; granules smooth, rounded, about 0.5μ in diameter and spaced about 1.5μ apart; sexine otherwise smooth; colour pale yellow; size range 30.8—19.8μ.

Discussion: Very rare species that may, or may not, have Cycadalean affinities. It may possibly be a planktonic organism similar to *Rugidinium undulatum* n. sp.

(?) *Cycadopites* sp. C

Pl. 26, fig. 38, 424, slide 1 (26.9—125.5), P. N. 14184

Description: Monosulcate; sulcus extending full length of grain, narrower at distal pole than at the longitudinal extremities; flanked by planoconvex lips, covx towards the distal pole; 4.0—5.5μ wide and 47.0—50.0μ long; amb oval, grain flattened ovoids; exine single-layered; smooth; transparent; colour pale yellow; size range 66.0—75.0μ x 38.5—42.0μ.

Discussion: A very rare species that may belong to *Cycadopites* or may be the central body of a species of *Membranipollenites*.

Genus *Eucommiidites* (Erdtman) Hughes

1948 *Tricolpites (Eucommiidites) troedssonii* Erdtman; p. 267, type species.
1957 *Trifossopollenites* (in part) Rouse; p. 372.
1958 *Eucommiidites* (Erdtman) Couper; p. 160.
1961 *Ecommiidites* (Erdtman) Hughes; p. 293.
1964 *Eucommiidipollenites* Levet—Carette; p. 120.

Diagnosis: Pollen grains with one well developed, distally placed sulcus and two well marked proximal furrows parallel to the longer axis. Grains are elongated-elliptical in equatorial outline, not symm metrical about their axes, the surface carrying the sulcus being more flattened.

Eucommiidites troedssonii Erdtman

Pl. 26, fig. 33, 400, slide I (42.7—113.6); fig. 34, 404, slide 4 (36.3—121.8); pl. 25, figs. 1—2, 2119, slide 2 (29.5—121.4), P. N. 14185

1948 *Tricolpites (Eucommiidites) troedssonii* Erdtman; p. 267.

Description: Sub-spherical to ovoid (amb sub-circular to oval); exine two-layered; nexine less than 0,5μ thick; smooth; sexine about 1.0μ thick; smooth; amorphous to faintly infrapunctate; tightly appressed to nexine; distal face traversed by a longitudinal ends rounded; on the proximal surface two crescentic tenuitates flank the sulcus and parallel the equator; tenuitates variable in width, averaging 2.0μ; may join around the longitudinal ends of the grain to form a single, cintinuous 'ring furrow'; colour pale yellow; size range 28.0 (32.0) 35.0 x 24.0 (28.0) 30.0μ.

Discussion: There has been considerable discussion and some controversy regarding the affinities of *Eucommiidites*. The possibility of angiosperm affinity suggested by Erdtman (1948) and Rouse (1957 and 1959) has been convicingly refuted by Couper (1958) and Hughes (1962). The presence of proximal tenuitates and 'ring furrow' has been discussed in some detail and the feature has been compared, not very convincingly, with the 'rimula' of *Classopollis*. The presence of a distal sulcoid aperture together with flanking proximal tenuitates, or a ring furrow, is not unique. All species of *Ovalipollis* possess proximal lateral tenuitates. Many grains of pollen of the recent species *Dioon edule* Lindl. are strikingly similar to *Eucommiidites*, possessing both a distal keyhole-shaped sulcus and a distal 'ring furrow'.

Genus *Chasmatosporites* (Nilsson 1958) Pocock & Jansonius

Type species: *Chasmatosporites major* Nilsson 1958, p. 54, pl. 3, fig. 10—15 (holotype fig. 12).

Diagnosis: Monosulcate pollen sub-spherical or ovoid; amb smooth, sub-circular to oval; in compressed state lenticular, sometimes concavo-convex with the distal (?) side flattened or slightly concave. Exine relatively thick, distinctly two-layered; sexine thick, internally with a pronounced columellar layer; columellae arranged in short muri, leaving between them short sinuous canali that form an internal more or less vermiculate pattern similar to that in *Classopollis*, or an irregular infrareticulum; the sexine is appressed to the nexine which is thinner but distinct underneath the columellar layer. The exinal pattern is coarse on one side (proximal?); the other side shows a usually indistinctly delineated circular to oval area of approx. 1/2—3/4 of the total diameter in which the exine is noticeably thinner and smooth, with a much finer pattern, possibly representing a leptoma or sulcoid area; a distinct pore or sulcus not developed.

Chasmatosporites canadensis n. sp.

Pl. 26, fig. 35, 5055 (2514b), slide 1 (26.0—119.1) Holotype, P. N. 14186; fig. 36, 394, slide A (37.2—112.8)

Description: Amb circular; lenticular in side view; exine two-layered; nexine about 1.0μ thick; infrapunctate; surface smooth to scabrate; distal face traversed by a rather indistinct parallel-sided sulcus; sulcus 5.5μ wide, extending about two-thirds diameter of the grain; ends bluntly rounded; no lips developed; colour yellow-brown; equatorial diameter 45.0 (50.0) 65.0μ; length of sulcus approx. 39.0μ.

Discussion: A typical cycadalean grain.

Chasmatosporites stelckii n. sp.

Pl. 26, fig. 37, 2182, slide 1 (27.4—118.3) Holotype, P. N. 14187

Description: Amb broadly oval; exine two-layered; nexine very thin (exact thickness indeterminate); tightly appressed to sexine; sexine 1.0μ thick; scabrate; distal face traversed by two more or less parallel exinal folds enclosing a rather poorly defined leptoma; folds form two lips directed towards the distal pole; lips about 2.0μ wide adjacent to the distal pole, ending 2.0—3.0μ from the equatorial margin of the grain; leptoma averages 4.0μ in width and merges with the distal exine at its extremities; colour pale yellow; size range 37.2 x 29.4μ (average).

Discussion: Very rare but of interest because of their almost certain affinity with the cycads. They are morphologically very close to pollen of the recent *Encephalartos altensteinii* Lehman.

Genus *Ginkgoretectina* Maljowkina

1953 *Ginkgoretectina punctata* Mal.; p. 136, pl. 1, fig. 20, type species.
1968 *Ginkgoretectinapollenites* Danzé—Corsin & Laveine; p. 109.

Diagnosis: Monosulcate pollen grains, oval to fusiform in outline. Sulcus may be well developed, extending almost the full length of the grain, tapering towards the ends or keyhole-shaped, or may comprise an elongate, longitudinal leptoma flanked by a pair of sexinal lips of varying length. Exine two-layered, infrapunctate or infrareticulate.

Discussion: Differs from *Cycadopites* in including only species with infrapunctate to infrareticulate exines.

Ginkgoretectina ferréi n. sp.

Pl. 26, figs. 40—41, 2250, slide 1 (37.2—124.4) Holotype, P. N. 14188

Description: Oovoid; exine two-layered; nexine very thin; smooth; sexine less than 0.5μ thick; reticulate; brochi about 1.0μ in diameter; distal face traversed by a pair of longitudinal lips extending the full length of the grain; lips about 2.0μ wide adjacent to the distal pole, thinning towards their tips; lips

formed by an exinal outfolding towards the equator; lips probably enclose a longitudinal sulcoid leptoma, *but this is obscure on the grains examined; colourless; size range 19.8 x 15.4μ.*

Discussion: Probably of cycad affinity.

Named for Professor F. YVETTE DE FERRÉ, Faculté de Sciences, Toulouse, France.

Ginkgoretectina couperii (POCOCK) n. comb.

Pl. 26, fig. 39, 1816, slide 9 (40.0—121.8), P. N. 14189

1962 *Clavatipollenites couperii* POCOCK; p. 74, pl. 12, figs. 190—192, pl. 13, fig. 193

Description: Monosulcate; sulcus extending almost the full length of the grain; elongate oval; flanked by crescentic lips 3.0—3.5μ wide adjacent to the distal pole; convex towards the equator; amb smoothly oval; nexine about 0.25μ thick; sexine 0.5μ thick; infrapunctate; surface of grain smooth; colour pale yellow; size range 29.0 (32.0) 36.0μ x 24.0 (26.0) 27.0μ; thickness approx. 18.0μ.

Discussion: Detailed examination of further specimens and the availability of comparative material has indicated that the above species has gymnospermous, and not angiospermous, affinities. It does not appear to be closely related to COUPER's species *Clavatipollenites hughesii.*

Genus *Bennettiteaepollenites* (THIERG. ex POTONIÉ) emend.

1949 *Bennettiteae-pollenites lucifer* THIERG.; p. 10, pl. 3, fig. 5, type species.

1958 *Bennettiteaepollenites* THIERG. ex POT.; p. 86, pl. 10, figs. 114—116, diagnosis and assignment of type species.

Diagnosis: Monosulcate pollen grains. Shape flattened ovoid. Exine two-layered. Nexine relatively thin, smooth. Sexine infrapunctate. Distal face traversed by two pairs of longitudinal lips, the inner pair flanking a sulcoid leptoma. Inner pair of lips formed by sexinal infolding towards the equator, flanked by a further pair of lips folded away from the equator.

Discussion: Abundant well preserved specimens from the Canadian Middle Jurassic indicate that *Bennettiteaepollenites* possesses four sexinal folds and not three as stated by POTONIÉ. These are analogous with the inner and outer pairs of distal lips seen on some saccate grains. The apparent presence of only three lips on some grains is the result of flattening by forces acting at an angle to the polar axis.

The date of validity of this genus is 1958 since THIERGART published no generic diagnosis and assigned no type species.

Bennettiteaepollenites canadensis n. sp.

Pl. 23, figs. 3—4, 2132, slide 12 (32.1—126.5) Holotype, P. N. 14190

Description: Flattened ovoid; longitudinal ends blunt; sides rounded; exine two-layered; nexine thin (exact thickness indeterminate); smooth; sexine about 1.0μ thick; infrapunctate; externally smooth; tightly appressed to nexine; distal face traversed by two pairs of lips; inner lips formed by an exinal outfolding in the direction of the equator; lips about 2.0μ wide and more or less parallel-sided, extending to within 2.0—5.0μ of the longitudinal extremities of the grain; inner lips enclose a more or less keyhole-shaped sulcoid leptoma which includes, centred on the distal pole, an oval apertuer 3.0 x 1.5μ in size (see diagram); outer lips formed by outfoldings of exine in the direction of the distal pole; plano-convex in shape (convex towards the equator); extending the full length of the grain; lips each 3.0μ wide at their widest part; outer lips enclose a more or less rectangular area of the distal face extending its full length and 10.0μ wide; flanking the outer lips are two crescentic equatorial extensions, each about 1.5μ wide which appear to consist of sexinal inflations and possibly represent rudimentary sacci; grain size 33.0 x 29.0μ thickness 7.0μ (compressed).

Discussion: A rare species of *Bennettiteaepollenites* of special interest in possessing small equatorial inflations which appear to be rudimentary sacci. The two sets of distal lips, the keyhole-shaped sulcoid tenuitates and the infrapunctate sexine suggest a gymnosperm affinity for the grains. The very distinctive morphology cannot be matched with the pollen of any recent or known fossil plant species.

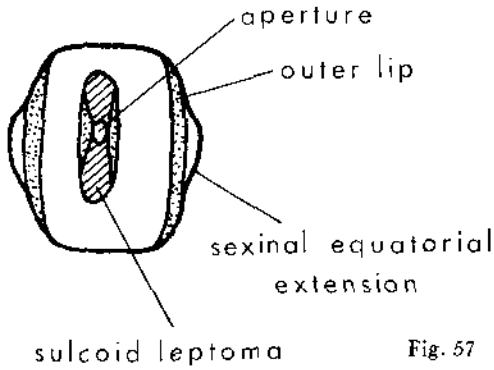


Fig. 57

Bennettiteacpollenites lucifer THIERG.

Pl. 23, figs. 5—6, 2132, slide 19 (35.9—120.9), P. N. 14191; fig. 7, 2132, slide 12 (33.5—125.3); figs. 8—9, 2132, slide 19 (35.5—124.1); fig. 10, 2132, slide 19 (29.9—122.3); fig. 11, 2132, slide 12 (40.6—125.9)

1949 *Bennettiteae-pollenites lucifer* THIERG.; p. 10, pl. 3, fig. 5.

Description: Shape flattened ovoid; exine two-layered; nexine less than 0.25μ thick; smooth; sexine less than 0.5μ thick; infrapunctate; externally smooth; tightly appressed to nexine; proximal face smooth; distal face traversed by two pairs of longitudinal lips; inner pair of lips 1.0—2.5μ wide adjacent to the distal pole and ending 1.0—3.0μ from the longitudinal extremities; this pair of lips is formed by an exinal outfolding towards the equator and encloses a somewhat thinned area of exine 2.5—6.0μ wide which forms a longitudinal sulcoid leptoma; leptoma may be either parallel-sided or may be wider adjacent to the distal pole; second pair of lips situated equatorially and somewhat proximally of the first pair; crescentic in shape; their edges are more or less parallel to the edges of the grain; 2.5—4.0μ wide at their mid-points; ending about 6.0μ from the longitudinal extremities; outer lips formed by an exinal outfolding away from the equator; on a few grains the tips of adjacent folds, one from each pair, may fuse producing what appear to be subsidiary tenuitates flanking the leptoma; size range 25.0 (28.2) 32.0 x 38.0 (40.2) 43.0μ.

Discussion: Although *B. lucifer* THIERG. was described as possessing three parallel folds, there can be little doubt from the photograph of the holotype that four folds are actually present and that the Canadian grains belong to this species. The infrapunctate exine structure and the presence of a longitudinal sulcoid leptoma with two sets of flanking lips is strongly suggestive of gymnospermous affinity.

Bennettiteaepollenites shaunavonensis n. sp.

Pl. 23, fig. 12, 1967, slide 9 (36.4—121.9) Holotype, P. N. 14192

Description: Shape flattened ovoid, relatively wide with flattened longitudinal ends; distal face traversed by somewhat keyhole-shaped sulcus extending almost full length of the grain; flanked by low, smooth, parallel-sided lips about 1.5μ wide extending almost the full length of the sulcus but not joining around the longitudinal ends; exine two-layered; nex ne thin, smooth, sexine about 1.0μ thick; infrareticulate; externally smooth to scabrate; two additional lips developed parallel to the sulcus and flanking it about 10.0μ on either side; outer lips each about 22.0μ long and 3.5μ wide at their mid-points; smoothly curved and arising from a straight base; outer lips formed as a sexinal outfolding away from the equator; colour pale yellow; size range 30.0 (32.0) 36.0μ x 20.0 (23.1) 25.0μ.

Discussion: This species is similar to *B. canadensis* in shape, differing from it in having a larger sulcus and in lacking rudimentary sacci. It differs from *B. lucifer* in its smaller size and in possessing flattened longitudinal ends.

List and location of samples

Sample No.	Depth	Formation	Floral Zone or Stage
Royalite DeWinton #2 13—24—21—1W5M			
1—18	7670	Dalhousie Sand	U. Barremian
1—19	7673	Dalhousie Sand	U. Barremian
1—20	7680	Kootenay-Formation	Neocomian to $J3^3$
1—21	7683	Kootenay-Formation	Neocomian to $J3^3$
1—22	7686	Kootenay-Formation	Neocomian to $J3^3$
1—23	7689	Kootenay-Formation	Neocomian to $J3^3$
1—24	7692	Kootenay-Formation	Neocomian to $J3^3$
1—25	7695	Fernie Formation	J2—J3
1—26	7699	Fernie Formation	J2—J3
1—27	7702	Fernie Formation	J2—J3
1—28	7705	Fernie Formation	J2—J3
1—29	7708	Fernie Formation	J2—J3
1—30	7711	Fernie Formation	J2—J3
1—31	7714	Fernie Formation	J2—J3
1—32	7717	Fernie Formation	J2—J3
Imperial Grassy Lake #3 2—35—10—13W4M			
75	3041	Sawtooth Formation	$J2^2$
74	3038	Sawtooth Formation	$J2^2$
Royalite DeWinton #1 14—16—21—1W5M			
87	8310	Fernie Formation	$J2^2$
100	8265—75	Fernie Formation	$J3^2$
104	8222—27	Fernie Formation	$J3^3$
108	8206	Fernie Formation	$J3^3$
Imperial Tidewater Carlyle #1 16—23—7—3W2M			
230	3031	Upper Vanguard	$J3^3$
232	3155	Middle Vanguard	$J3^2$
237	3189	Lower Vanguard	$J3^1$
238	3227	Lower Vanguard	$J3^1$
Imperial Tidewater Wapella 4—3 4—3—15—1W2M			
299	2144	Basal Cretaceous	Crl^3
301	2198	Lower Vanguard	$J3^1$
302	2202	Lower Vanguard	$J3^1$
303	2206	Lower Vanguard	$J3^1$
304	2210	Lower Vanguard	$J3^1$
305	2216	Lower Vanguard	$J3^1$
307	2227	Lower Vanguard	$J3^1$
308	2233	Lower Vanguard	$J3^1$
309	2247	Lower Vanguard	$J3^1$
310	2330	Upper Shaunavon	$J2^2$
311	2333—42	Upper Shaunavon	$J2^2$
312	2348—49	Upper Shaunavon	$J2^2$
313	2351	Upper Shaunavon	$J2^2$
315	2364	Upper Shaunavon	$J2^2$
316	2388	Upper Shaunavon	$J2^2$
317	2381	Upper Shaunavon	$J2^2$
318	*2395—98*	*Upper Shaunavon*	$J2^2$
Tidewater Eastend Crown #1 15—11—6—20W3M			
392	4678—81	Upper Shaunavon	$J2^2$
393	4680—84	Upper Shaunavon	$J2^2$
394	4688	Upper Shaunavon	$J2^2$
395	4691	Upper Shaunavon	$J2^2$
396	4693—99	Upper Shaunavon	$J2^2$
397	4713—14	Upper Shaunavon	$J2^2$
398	4721—22	Upper Shaunavon	$J2^2$
399	4728—34	Lower Shaunavon	$J2^2$
400	4750—60	Lower Shaunavon	$J2^2$
402	*4807*	*Lower Shaunavon*	$J2^2$
403	4813—18	Lower Shaunavon	$J2^2$
404	4820	Lower Shaunavon	$J2^2$
405	4821	Lower Shaunavon	$J2^2$
406	4826—27	Lower Shaunavon	$J2^2$
407	4858—63	Gravelbourg Formation	$J2^1$—$J1^3$
408	4867—69	Gravelbourg Formation	$J2^1$—$J1^3$
409	4881	Gravelbourg Formation	$J2^1$—$J1^3$
410	4907—08	Watrous Formation	$J1^?$
411	4915	Watrous Formation	$J1^?$
412	4910	Watrous Formation	$J1^?$
Tidewater Davidson Crown #1 13—4—27—28W2M			
423	2427—30	Lower Gravelbourg	$J1^3$
424	2437—40	Lower Gravelbourg	$J1^3$
425	2457—59	Watrous	$J1^?$
426	2504—06	Watrous Formation	$J1^?$
428	2558	Watrous Formation	$J1^?$
429	2563	Watrous Formation	$J1^?$
430	2563	Watrous Formation	$J1^?$
431	2639—40	Watrous Formation	$J1^?$
432	2650—60	Watrous Formation	$J1^?$
Imperial Calvan Doig River 27—21—88—17W6M			
652	3548—50	Fernie Formation	J3
654	3560—62	Fernie Formation	J3
656	3625—30	Nordegg Formation	$J1^3$
Imperial Clairmont #1 16—25—72—5W6M			
849	5587—95	Nikanassin	$J3^3$
850	5617—30	Fernie Formation	$J3^{1-2}$
854	5689—99	Wanham Sand	$J2^2$
855	5707—14	Fernie Formation	$J2^2$
857	5731—41	Fernie Formation	J2
858	5761—71	Fernie Formation	J2
859	5781	Fernie Formation	J2
860	5819—20	Fernie Formation	J2
861	5839—45	Nordegg Formation	$J1^3$
863	5875—84	Nordegg Formation	J1
Imperial Belloy #12—14 12—14—78—1W6M			
887	3240	Fernie Formation	$J3^3$
Imperial Birtle 1—27—17—26W1M			
1807	1299—1304	Upper Vanguard	$J3^3$
1808	1304—09	Upper Vanguard	$J3^3$
1809	1309—14	Upper Vanguard	$J3^3$
1810	1393—98	Middle Vanguard	$J3^2$
1811	1398—1403	Lower Vanguard	$J3^1$
Imperial Foxwarren 16—32—19—27W1M			
1812	1458—63		$J3^1$
1815	1477—82		$J2^2$

Sample No.	Depth	Formation	Floral Zone or Stage
Imperial Tidewater Carlyle 10—23—7—3W2M			
1816	3032—34	Upper Vanguard	$J3^3$
Imperial Tidewater Broadview 14—17—15—4W2M			
1821	2455—60	Lower Vanguard	$J3^1$
1822	2466—68	Lower Vanguard	$J3^1$
1823	2481—86	Lower Vanguard	$J3^1$
1824	2489—94	Lower Vanguard	$J3^1$
1825	2494—99	Lower Vanguard	$J3^1$
1826	2499—2504	Lower Vanguard	$J3^1$
Imperial Warmley 14—24—10—6W2M			
1828	3623—25	Upper Shaunavon	$J2^2$
1829	3623—33	Upper Shaunavon	$J2^2$
Imp. E.T.A.C. North Portal 12—29—1—5W2M			
1838	4475—77		$J1^3$
Tidewater Imperial Hillesden Crown #1 5—30—15—5W2M			
1839	3388—93		$J1^3$
1840	3393—98		$J1^3$
1841	4316—21		$J1^3$
Imperial Cowessess 4—13—18—6W2M			
1845	2172—73	Lower Vanguard	$J3^1$
Imperial Royalite H. B. Auburton 1—2—5—1W2M			
1846	3323—24		
1847	3356—59		
Tidewater Imperial Climax 6—10—3—18W3M			
1849	4490—95	Lower Gravelbourg	$J1^3$
1850	4521—26	Lower Gravelbourg	$J1^3$
Imperial Tidewater Driscoll Lake 6—34—7—13W3M			
1851	4230—35	Upper Vanguard	$J3^3$
1852	4249—54	Upper Vanguard	
1853	4254—59	Upper Vanguard	
1854	4264—69	Upper Vanguard	
1855	4536—41	Upper Shaunavon	$J2^2$
1856	4576—80	Upper Shaunavon	
Imperial Tidewater Admiral 4—1—9—16W3M			
1857	4000—05	Upper Vanguard	$J3^3$
1858	4243—71	Middle Vanguard	$J3^2$
1860	4277—82	Middle Vanguard	$J3^2$
Imp. et al Val Marie 16—23—4—13W3M			
1863	4044—48	Upper Shaunavon	$J2^2$
1864	4062—67	Upper Shaunavon	$J2^2$
1865	4091—95		
Calvan Imperial Cdn. Dev. Jackpot Lake 11—23—8—26W3M			
1866	4820—22	Shaunavon Formation	$J2^2$
Imperial Dahinda 10—23—10—23W2M			
1867	4226—30	Lower Gravelbourg	$J1^3$
1868	4242—47	Lower Gravelbourg	$J1^3$
1869	4262—66	Upper Watrous	$J1^3$
1870	4282—87	Upper Watrous	$J1^3$
1871	4307—12	Upper Watrous	$J1^3$

Sample No.	Depth	Formation	Floral Zone or Stage
Imperial Tidewater Avonhurst 1—29—19—16W2M			
1872	2608—13	Upper Shaunavon	$J2^2$
Norcanols Radville 16—36—5—19W2M			
1874	3917—22	Middle Vanguard	$J3^2$
1875	4505—10	Lower Gravelbourg	$J1^3$
Imperial Cynthia South 13—5—51—11W5M			
1948	7450—60	Barren	
1949	7480—90	Lower Fernie	$J2^2$
1950	7670—80	Barren	
Tidewater North Wapella 14—22—15—1W2M			
1956	2120—25	Lower Vanguard	$J3^1$
1957	2140—45	Lower Vanguard	$J3^1$
1958	2160—65	Lower Vanguard	$J3^1$
1959	2180—85	Lower Vanguard	$J3^1$
1960	2197—2202	Lower Vanguard	$J3^1$
1961	2225—30	Lower Vanguard	$J3^1$
1962	2230—36	Lower Vanguard	$J3^1$
1963	2250—55	Lower Vanguard	$J3^1$
1964	2359—64	Lower Shaunavon	$J2^2$
1965	2364—69	Lower Shaunavon	$J2^2$
1966	2374—79	Lower Shaunavon	$J2^2$
1967	2414—19	Lower Shaunavon	$J2^2$
1968	2424—29	Gravelbourg Formation	$J2^1$ & $J1^3$
1969	2444—49	Watrous Formation	$J3^?$
Tidewater Rush Lake 13—5—18—10W3M			
1970	3410—15	Lower Vanguard	$J3^1$
1971	3430—35	Lower Vanguard	$J3^1$
1972	3440—45	Lower Vanguard	$J3^1$
1973	3460—64	Lower Vanguard	$J3^1$
1974	3480—85	Lower Vanguard	$J3^1$
1975	3500—05	Lower Vanguard	$J3^1$
1976	3530—35	Lower Vanguard	$J3^1$
1977	3555—60	Lower Vanguard	$J3^1$
Tidewater Eastend Crown #1 15—11—6—20W3M			
1978	4640—45	Lower Vanguard	$J3^1$
1979	4693—98	Lower Vanguard	$J3^1$
1980	4670—84	Lower Vanguard	$J3^1$
1981	4710—15	Upper Shaunavon	$J2^2$
1982	4820—25	Lower Shaunavon	$J2^2$
1983	4858—63	Upper Gravelbourg	$J2^1$
1984	4905—10	Lower Gravelbourg	$J1^3$
Calvan Cdn. Dev. Imperial Jackpot Lake 11—23—8—26W3M			
2115	4990—95	Upper Gravelbourg	$J2^1$
Tidewater Southey 4—29—22—18W2M			
2116	2162—67	Lower Cretaceous	Crl^3
2117	2225—30	Upper Gravelbourg	$J2^1$
2118	2240—45	Upper Gravelbourg	$J2^1$
2119	2270—79	Lower Gravelbourg	$J2^1$
2120	2310—15	Upper Gravelbourg	$J1^3$
Imperial Tidewater Avonhurst 1—29—19—16W2M			
2121	2525—30	Lower Vanguard	$J3^1$
2122	2558—62	Lower Vanguard	$J3^1$

Sample No.	Depth	Formation	Floral Zone or Stage
2122A	2615—20	Upper Shaunavon	$J2^2$
2123	2635—40	Upper Shaunavon	$J2^2$
2124	2655—60	Lower Shaunavon	$J2^2$
2125	2683—88	Lower Shaunavon	$J2^2$
2126	2745—48	Upper Gravelbourg	$J2^1$
Dilman Lindley 14—3—18—26W2M			
2127	2995—3000	Lower Vanguard	$J3^1$
2128	3030—3035	Upper Shaunavon	$J2^2$
2129	3043—48		$J2^2$
Tidewater Ituma 6—11—25—12W2M			
2130	2120—25	Upper Gravelbourg	$J2^1$
2131	2135—40	Upper Gravelbourg	$J2^1$
2132	2175—79	Upper Gravelbourg	$J2^1$
Tidewater Bender 13—11—12—5W2M			
2133	3197—3202	Lower Vanguard	$J3^1$
2134	3385—90	Upper Shaunavon	$J2^2$
2135	3420—25	Upper Shaunavon	$J2^2$
Tidewater Arbury 13—15—25—18W2M			
2138	1980—85	Upper Gravelbourg	$J2^2$
2139	2060—65	Lower Gravelbourg	$J1^3$
Imperial Royalite H. B. Northgate 4—36—1—2W2M			
2140	3990—95	Lower Vanguard	$J3^1$
Sohio Baysel Montague Lake 11—19—5—28W2M			
2141	4899—4904	Lower Vanguard	$J3^1$
2142	5275—80	Lower Gravelbourg	$J1^3$
Shell Old Wives 16—36—5—19W2M			
2143	4190—95	Upper Shaunavon	$J2^2$
Imperial Royalite Auburton 1—2—5—1W2M			
2146	3510—15	Upper Gravelbourg	$J2^1$
Imperial Tidewater Broadview 14—17—15—3W2M			
2147	2665—70	Upper Gravelbourg	$J2^1$
Imperial Manor 4—8—7—1W2M			
2208	3876	Watrous	$J1^?$
2211	3881	Watrous	$J1^?$
Withehorse Cayuga 14—31—3—30W1M			
2214	3447	Watrous	$J1^?$
2217	3457	Watrous	$J1^?$
Precision Queen City 6—31—6—1W2M			
2222	3924	Watrous	$J1^?$
Socony St. Antoine 5—11—6—32W1M			
2224	3560	Watrous	$J1^?$
2226	3576	Watrous	$J1^?$
Imperial Seymour 4—19—3—31W1M			
2228	3553	Watrous	$J1^?$
2230	3668	Watrous	$J1^?$
Williamson Nottingham 6—17—4—32W1M			
2235	3763	Watrous	$J1^?$

Sample No.	Depth	Formation	Floral Zone or Stage
Tidewater Shaunavon 13—4—8—18W3M			
2240	4391—96	Upper Vanguard	$J3^3$
2241	4435—40	Middle Vanguard	$J3^2$
2242	4615—20	Lower Vanguard	$J3^1$
2243	4805—10	Upper Gravelbourg	$J2^1$
2244	4915—20	Lower Gravelbourg	$J1^3$
2245	4665—70	Upper Shaunavon	$J2^2$
Amurex Albercan McCloud 15—12—10—27W3M			
2247	3725—30	Lower Vanguard	$J3^1$
2248	3742—47	Lower Vanguard	$J3^1$
2249	3810—15	Lower Vanguard	$J3^1$
2250	3810—15	Lower Vanguard	$J3^1$
Coop Cypress Hills #1 14—2—3—25W3M			
2252	4835—40	Lower Vanguard	$J3^1$
Tidewater Success 14—30—12—9W3M			
2254	3195—99	Lower Vanguard	$J3^1$
2255	3340—45	Lower Vanguard	$J3^1$
Tidewater Vanguard 14—30—17—9W3M			
2257	3715—20	Lower Vanguard	$J3^1$
Tidewater South Shackleton 1—5—19W3M			
2258	3010—15	Lower Vanguard	$J3^1$
2259	3040—45	Lower Vanguard	$J3^1$
Socony Midway #1 14—6—15—19W3M			
2263	3465—70	Lower Vanguard	$J3^1$
2264	3490—95	Lower Vanguard	$J3^1$
Tidewater Rush Lake 3—36—19—11W3M			
2266	3410—15	Lower Vanguard	$J3^1$
Tidewater Johnstone Lake #1 9—20—12—2W3M			
2270	3870—75	Lower Vanguard	$J3^1$
Texaco Battle Creek 14—11—5—29W3M			
2272	4865—70	Lower Vanguard	$J3^1$
Mount Minnes 54°9′N 120°03′W			
For details of sampling see Ziegler & Pocock 1960			
Dome Supertest et al Bain 12—9—3—4W4M			
2417	3732—37	Swift Formation	$J3^{2-3}$
2418	3747—52	Swift Formation	$J3^{2-3}$
2419	3777—80	Rierdon Formation	$J3^1$
2420	3797—98	Sawtooth Formation	$J2^2$
Imperial Warmley 14—24—10—6W2M			
2428	3745—50	Lower Shaunavon	$J2^2$
Imperial Tidewater Oakshela 13—25—16—6W2M			
2429	2384—87	Shaunavon	$J2^2$
Tidewater Southey 4—29—22—18W2M			
2430	2207—12	Barren	
Amurex Canso. Coutts #1 10—33—15—27W3M			
2435	3266—70	Lower Vanguard	$J3^1$

Sample No.	Depth	Formation	Floral Zone or Stage
Anglo Amer. Grid Oil Crane Lake 13—28—12—23W3M			
2436	3528—30	Lower Shaunavon	J^2
Imperial et al Val Marie 16—23—4—13W3M			
2437	3870—75	Lower Vanguard	J^1
Imperial Grassy Lake #2 16—6—10—13W4M			
2638	3000—05	Rierdon Formation	J^1
2639	3060—65	Sawtooth Formation	J^2
2640	3065—70	Sawtooth Formation	J^2
2641	3075—79	Sawtooth Formation	J^2
Imperial Purple Springs 13—11—10—15W4M			
2642	3090—95	Rierdon	J^1
2643	3110—15	Rierdon	J^1
Socony Granum #1 1—25—11—26W4M			
2644	6550—55	Rierdon	J^1
2645	6565—67	Rierdon	J^1
2646	6547—49	Rierdon	J^1
2647	6559—63	Sawtooth	J^2
2648	6580—83	Sawtooth	J^2
Imperial Scope 13—24—12—15W4M			
2649	3180—85	Rierdon	J^1
Barnsdall Wilson # 14—16—17—25W4M			
2650	6065—70	Sawtooth	J^2
2651	6100—04	Sawtooth	J^2
2652	6140—45	Sawtooth	J^2
2653	6166—70	Sawtooth	J^2
Royalite DeWinton #21 14—16—21—1W5M			
2654	8270—75	Fernie Formation	J^3
2655	8280—85	Fernie Formation	J^3
2656	8290—93	Fernie Formation	J^3
	6937—40	Rierdon Formation	J^1
	6944—45	Rierdon Formation	J^1
	6949—50	Rierdon Formation	J^1
	6954—55	Rierdon Formation	J^1
	6955—60	Rierdon Formation	J^1
	6964—65	Sawtooth Formation	J^2
	6969—70	Sawtooth Formation	J^2
	6973—74	Sawtooth Formation	J^2
	6978—82	Sawtooth Formation	J^2
	6989—90	Sawtooth Formation	J^2
	6992—93	Sawtooth Formation	J^2
3732	6995—7000	Sawtooth Formation	J^2
International Yarbo #17 1—24—20—33W1M			
4102	1255—1300	Basal Cretaceous	Crl^3
	1326—33	Lower Vanguard	J^1
	1366—71	Barren	J^1
	1400—11	Upper Gravelbourg	J^1
	1411—16	Upper Gravelbourg	J^1
	1416—29	Upper Gravelbourg	J^1
	1417—22	Upper Gravelbourg	J^1
	1427—32	Upper Gravelbourg	J^1
	1439—50	Upper Gravelbourg	J^1
	1450—53	Upper Watrous	$J1^3$
Imperial Findlater (Potash) 16—10—21—25W2M			
5055	2238	Basal Cretaceous	Crl^3
	2245	Basal Cretaceous	Crl^3
	2253	Basal Cretaceous	Crl^3
	2254	Basal Cretaceous	Crl^3
	2506	Basal Cretaceous	Crl^3
	2511	Upper Gravelbourg	J^1
	2514	Upper Gravelbourg	J^1
	2520	Upper Gravelbourg	J^1
	2540	Upper Gravelbourg	J^1
Imperial Paddle River 5—17—56—8W5M			
	5144	Fernie Formation	J^3
Amurex. Canso. No. 1—4 4—36—11—26W5M			
2433	3610—15	Upper Shaunavon	J^2
2434	3625—30	Upper Shaunavon	J^2
Imperial Belloy #1 15—34—77—1W6M			
3527	3370	Fernie Formation	
3527	3377	Fernie Formation	
Isolated spot samples			
140°00′—65°00′			
	Jurassic		$J^?$
137°00′—66°00′			
	Middle Jurassic		J2
135°00′—65°50′			
	Middle Jurassic		J^2
135°50′—65°30′			
	Jurassic		$J^?$

Chart 1. Jurassic Ranges of Terrestrial species in Canada.

	$J1^2$	$J1^3$	$J2^1$	$J2^2$	$J3^1$	$J3^2$	$J3^3$
Callialasporites dampieri (BALME) SUKH DEV.		×	×	×	×	×	×
C. trilobatus (BALME) SUKH DEV		×	×	×	×	×	×
Classopollis classoides PFLUG	×	×	×	×	×	×	×
Latensina mesozoica n. sp.	×						
Obtusisporis canadensis n. sp.	×	×		×	×	×	×
Botryococcus luteus TRAVERSE		×		×	×		
Cedripites minor n. sp.		×					
Ceratosporites jurassicus n. sp.		×					
C. rotundiformis (KARA-MURZA) n. comb.		×	×		×		
C. varispinosus n. sp.		×					
Classopollis itunensis POCOCK		×	×	×		×	×
Concavissimisporites subgranulosus (COUPER) n. comb.		×					
C. trichopunctatus (THIERG.) n. comb.		×					
Cycadopites typicus (MAL.) n. comb.		×		×			
Deltoidospora australis (COUPER) n. comb. var. *rimalis* BALME		×					
D. gradatus (MAL.) n. comb.		×	×	×		×	×
D. lineatus (BOLKH.) n. comb.		×	×				
D. minor (COUPER) n. comb.		×	×			×	×
Dictyotriletes crateris (BALME) n. comb.		×	×		×		×
Exesipollenites scabratus (COUPER) n. comb.		×	×	×	×	×	×
E. tumulus BALME		×	×		×		×
Gleicheniidites delicatus (BOLKH.) n. comb.		×		×			
Inaperturopollenites turbatus BALME		×	×				
Lycopodiumsporites pseudoannotinus NILSSON		×	×	×	×		
Murospora bicollateralis (ROG.) n. comb.		×	×				
M. jurassica n. sp.		×					
M. minor n. sp.		×					
Obtusisporis sp. C		×					
Ovalipollis minor n. sp.		×			×		
Perotriletes variabilis (MAL.) n. comb.		×					
Todisporites rotundiformis (MAL.) n. comb.		×	×				
Verrucosisporites densus (BOLKH.) n. comb.		×	×				
Vitreisporites pallidus (REISS.) NILSSON		×	×	×	×		×
V. shouldicei n. sp.		×					
Acanthotriletes midwayensis n. sp.			×		×		×
Bennettiteaepollenites canadensis n. sp.			×				
B. lucifer THIERG.			×				
Calamospora mesozoica COUPER			×				
Callialasporites crenulatus n. sp.			×		×		
Cerebropollenites carlylensis n. sp.			×	×		×	×
C. findlaterensis n. sp.			×				
C. mesozoicus (COUPER) NILSSON			×				×
C. macroverrucatus (THIERG.) n. comb.			×				
Classopollis findlaterensis n. sp.			×				×
C. minor POCOCK & JANSONIUS			×				
Chasmatosporites stelckii n. sp.			×			×	
Chardasporites pseudostriatus (KAPYTOVA) n. comb.			×				
Concavissimisporites delcourtii n. sp.			×				
C. southeyensis n. sp.			×				
Concentrisporites pseudosulcatus (BRICKE, DANZÉ-CORSIN & LAVEINE) n. comb.			×				
C. sulcatus (ROG.) n. comb.			×		×		
Converrucosisporites hughesii n. sp.			×				
Corrugatisporites amplectiformis (KARA-MURZA) n. comb.			×		×		
C. anagrammensis (KARA-MURZA) n. comb.			×		×		
C. curvus (BOLKH.) n. comb.			×				
Cycadopites parvus (BOLKH.) n. comb.			×				
Deltoidospora barrissii (COUPER) n. comb.			×				

	J1[2]	J1[3]	J2[1]	J2[2]	J3[1]	J3[2]	J3[3]
Dictyotriletes arkellii n. sp.			×				
Distalanulisporites incertus (Bolkh.) n. comb.			×		×		
D. spurius (Bolkh.) n. comb.			×				
Eucommiidites troedssonii Erdtman			×	×			
Exesipollenites laevigatus n. sp.			×				
E. Saccatus n. sp.			×				
Gleicheniidites nilssonii n. sp.			×				
Harrisispora equiexinus (Couper) n. comb.			×		×		
Inaperturopollenites dettmannii n. sp.			×				
Lueckisporites crickmayi n. sp.			×				
Lycopodiacidites baculatus Pocock			×		×	×	×
L. irregularis n. sp.			×				×
Lycopodiumsporites dejerseyi n. sp.			×				
L. microreticulatus n. sp.			×				
L. subrotundus (Kara-Murza)			×	×			×
Manumia verrucata n. sp.			×				
Matthesisporites tumulosus Döring			×		×		
Obtusisporis laevigata n. sp.			×				
Osmundacidites cf. *O. senectus* Balme			×				
Ovalipollis bitorosa (Reiss.) n. comb.			×				
O. canadensis n. sp.			×		×		
O. enigmatica (Couper) n. comb.			×				
O. findlaterensis n. sp.			×				
O. limbata n. sp.			×				
Paleoconiferus asaccatus Bolkh.			×	×			×
Paleoconiferus minor n. sp.			×				
Piceites latens Bolkh.			×				
P. pseudorotundiformis (Mal.) n. comb.			×				
P. townrowii n. sp.			×				
Pityosporites cf. *P. dividuus* (Bolkh.) n. comb.			×				
P. divulgatus (Bolkh.) n. comb.			×	×	×		
P. similis Balme			×				
Platysaccus lopsinensis (Mal.) n. comb.			×				×
Podocarpidites convolutus n. sp.			×	×	×		
Podocarpidites florinii n. sp.			×				
P. multicinus (Bolkh.) n. comb.			×	×			
Protoconiferus bolchovitinae n. sp.			×				
P. flavus Bolkh.			×				
P. funarius (Bolkh.) Bolkh.			×				
P. gaussenianus n. sp.			×				
P. microsaccus (Couper) n. comb.			×	×			
Protopicea exilioides (Bolkh.) n. comb.			×				
P. samoilovichiana (Rovn.) n. comb.			×				
Pseudowalchia landesii n. sp.			×	×			
P. ovalis n. sp.			×				
Podocarpidites convolutus n. sp.			×	×	×		
Triangulopsis discoidalis Döring			×	×	×		
T. sp. A.			×				
Tigrisporites cf. *T. halliensis* Klaus			×				
Trilobosporites jurassicus n. sp.			×				
Verrucosisporites staplinii n. sp.			×				
Vitreisporites itunensis n. sp.			×			×	×
V. jansonii n. sp.			×				
V. jurassicus n. sp.			×	×			
Walchites minor n. sp.			×				
Baculatisporites truncatus (Cookson) Balme				×	×		
Chasmatosporites canadensis n. sp.				×			
Chasmatosporites stelckii n. sp.				×			×
Cycadopites nitidus (Balme) n. comb.				×			
Dettmannites ornatus			×				

	J1²	J1³	J2¹	J2²	J3¹	J3²	J3³
Endosporites jurassicus n. sp.				×			
Obtusisporis juncta (KARA-MURZA) n. comb.				×	×		
Podocarpidites langii n. sp.				×			
P. rousei n. sp.				×			
P. unicus (BOLKH.) n. comb.				×			
Triangulopsis minor n. sp.				×			
Verrucosisporites eastendensis n. sp.				×			
Bellisporites pallescens (BOLKH.) n. comb.					×		
Bennettiteaepollenites shaunavonensis n. sp.					×		
Callialasporites infrapunctatus (LANTZ.) n. comb.					×		×
C. minor n. sp.					×		
C. verrucosus n. sp.					×		
Ceratosporites dettmanii n. sp.					×	×	
C. utriculosus (KRASN.) n. comb.					×		
Gleicheniidites sp. A.					×		
Gleicheniidites sp. B.					×		
Gleicheniidites sp. D.					×		
Converrucosisporites congragatus (BOLKH.) n. comb.					×		
C. minor n. sp.					×		
Cycadopites cf. *C. deterius* (BALME) n. comb. var. *majus* SUKH DEV.					×		
Deltoidospora perpusillus (BOLKH.) n. comb.					×		
D. turgidirimosus (BOLKH.) n. comb.					×		
Distalanulisporites schulzii n. sp.					×		
Duplicisporites sp. A.					×		
Ginkgorectina ferrei n. sp.					×		
Gleicheniidites granulatus GRIG.					×		
G. umbonatus (BOLKH.) n. comb.					×		
Granulatisporites jurassicus (BOLKH.) n. comb.					×		
Harrisispora subsimplex (BOLKH.) n. comb.					×		
Lycopodiacidites spinatus n. sp.					×		×
Manumia irregularis n. sp.					×		
Obtusisporis concavus n. sp.					×		
O. convexus n. sp.					×		
O. corniculata (BOLKH.) n. comb.					×		
O. reticulata n. sp.					×		
Osmundacidites wellmanii COUPER					×	×	×
Pilosisporites brevipapillosus COUPER					×		
Podocarpidites wapelloensis n. sp.					×		
Reticulatisporites utriger (BOLKH.) n. comb.					×		
Staplinisporites jurassicus n. sp.					×		
Undulatisporites pflugii n. sp.					×		
Verrucosisporites minor n. sp.					×		
V. variabilis n. sp.					×		
Anapiculatisporites cooksonii n. sp.						×	
Reticulatisporites jurassicus n. sp.						×	×
Acanthotriletes subgranulatus (COUPER) n. comb.							×
Corrugatisporites wallii n. sp.							×
Couperisporites jurassicus n. sp.							×
Ginkgoretectina couperii (POCOCK) n. comb.							×
Murospora mesozoica POCOCK							×

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ZHANG, CHUN-BIN — See CHUN-BIN, ZHANG.

Index to species

Plate Descriptions

Plate 14

Fig. 12 Scale 'C'. All others Scale 'B'

Figs. 1—8.	*Triangulopsis discoidalis* Döring. Specimens showing trilete dehiscence scars (figs. 1 & 2). Fig. 2 shows very rare example of gaping commissures. Figs. 3, 4, 7 & 8 do not show dehiscence scars; fig. 4 shows the leptomata paralleling the equator very well. Figs. 5 & 6 illustrate two folded grains having a spurious sulcate appearance.
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Plate 15

Figs. 1 & 3 Scale 'B'. All others Scale 'A'

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Plate 16

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Plate 17

All Scale B

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Figs. 1—13, Scale B. Figs. 14—26, Scale A. Figs. 27—28, Scale C

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All Scale B

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Plate 22

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Plate 23

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Fig. 14.	*Classopollis classoides* PFLUG. Typical tetrad.
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Figs. 17, 23.	*Classopollis itunensis* POCOCK. Typical tetrads.
Fig. 21.	*Classopollis itunensis* POCOCK. Holotype.
Fig. 22.	*Classopollis classoides* PFUG. Fragments of pollen sac with grains attached.
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Plate 24

Figure 9, Scale C. All others, Scale B

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Plate 25

Figs. 2, 6, 9 & 12, Scale B. All others Scale C

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Plate 26

Figs. 1, 22, 27, & 39—41 Scale 'C'. All others Scale 'B'

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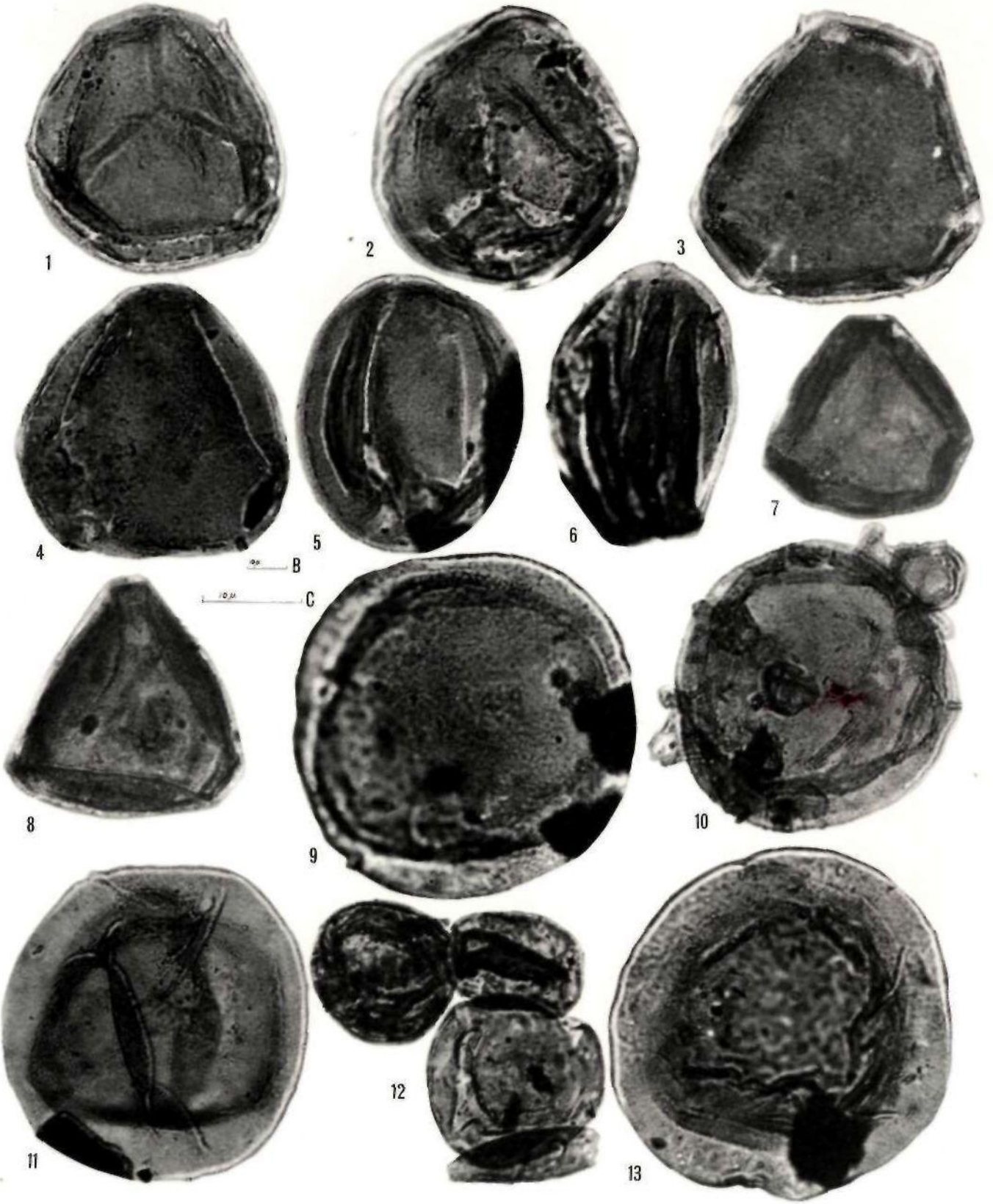
Fig. 14.	*Bennettiteaepollenites lucifer* Thierg. Typical grain.
Fig. 29—32.	*Classopollis* spp. Folded grains, nor formally described in the text, mimicing monosulcate pollen.



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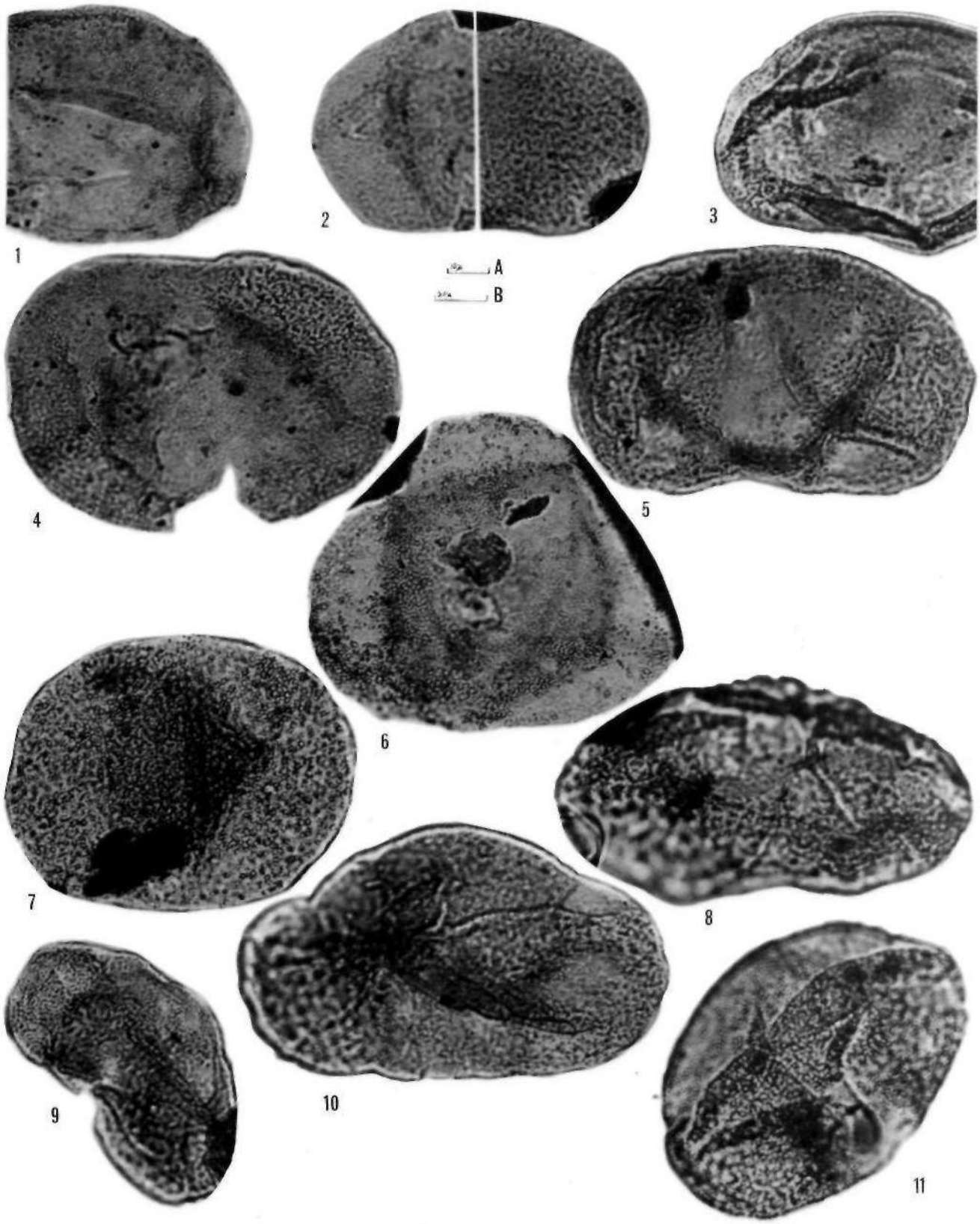

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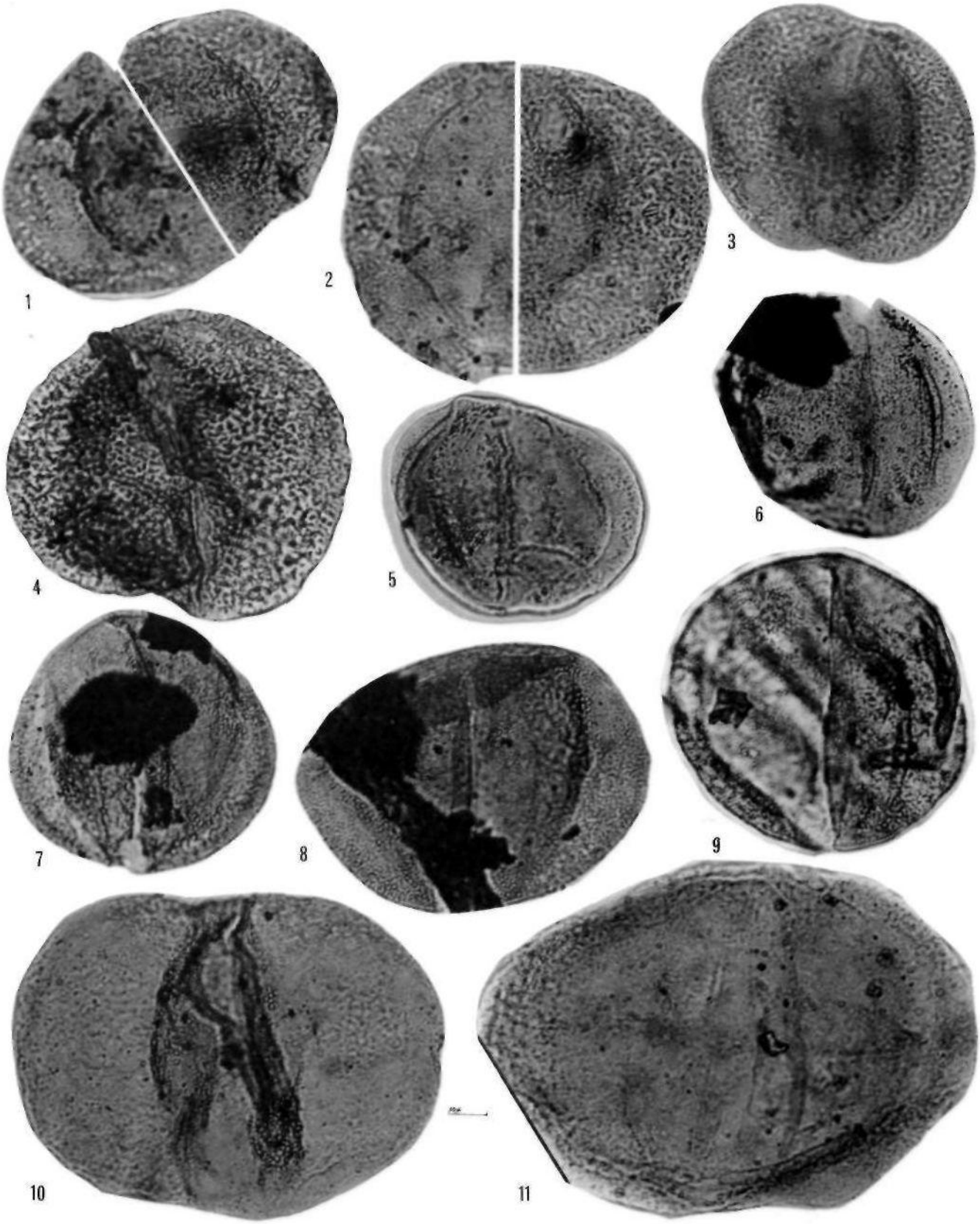

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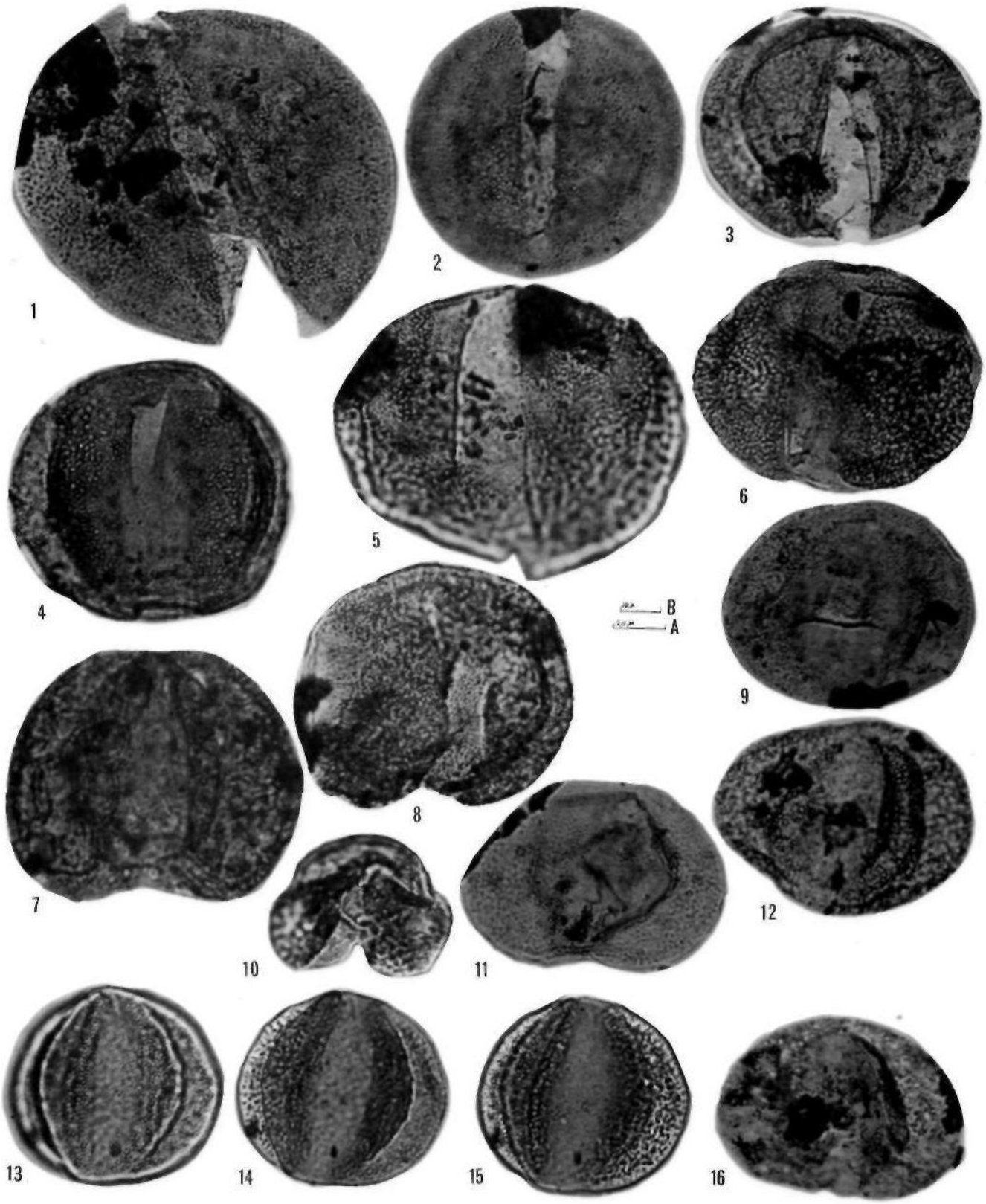

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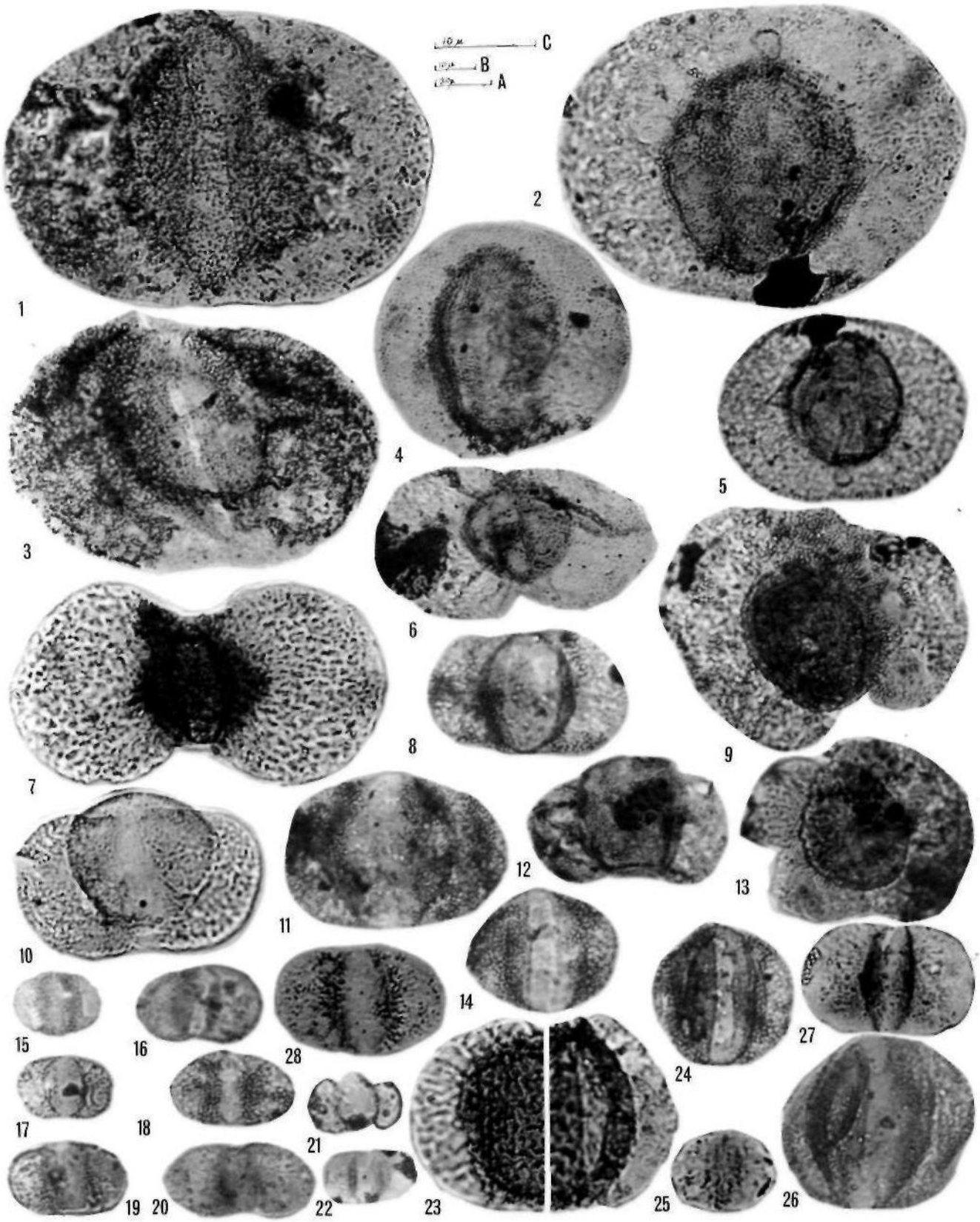

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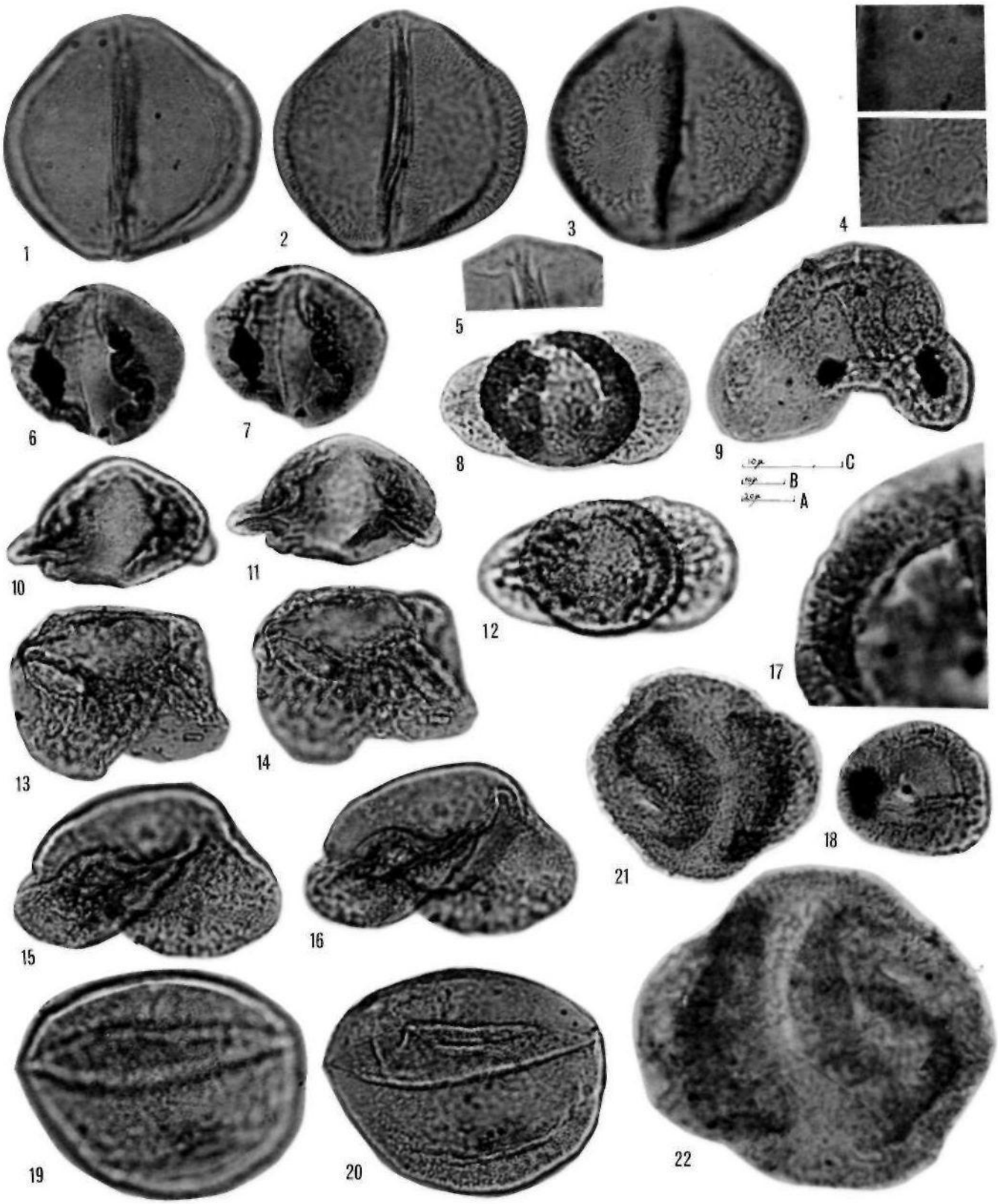

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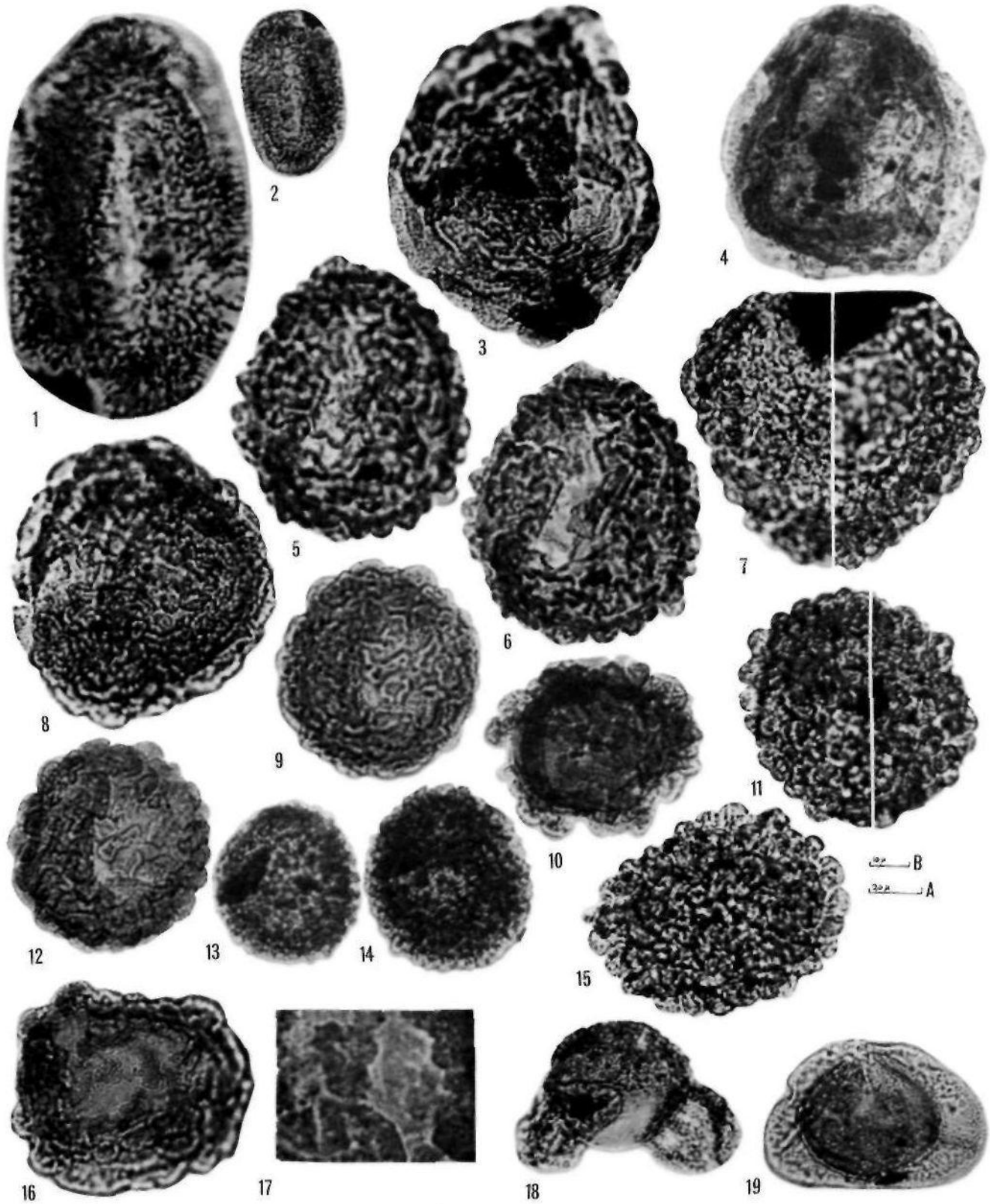

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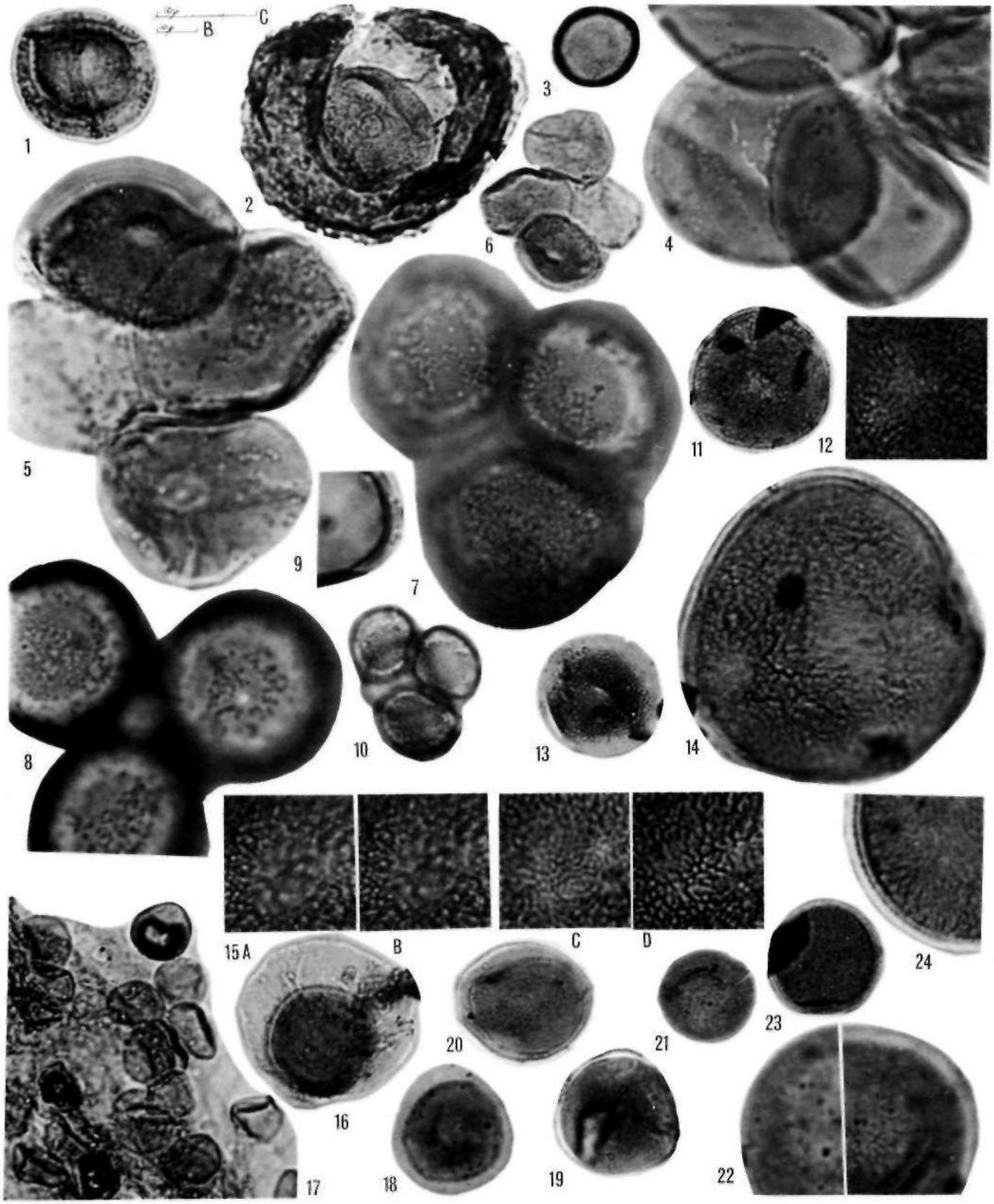

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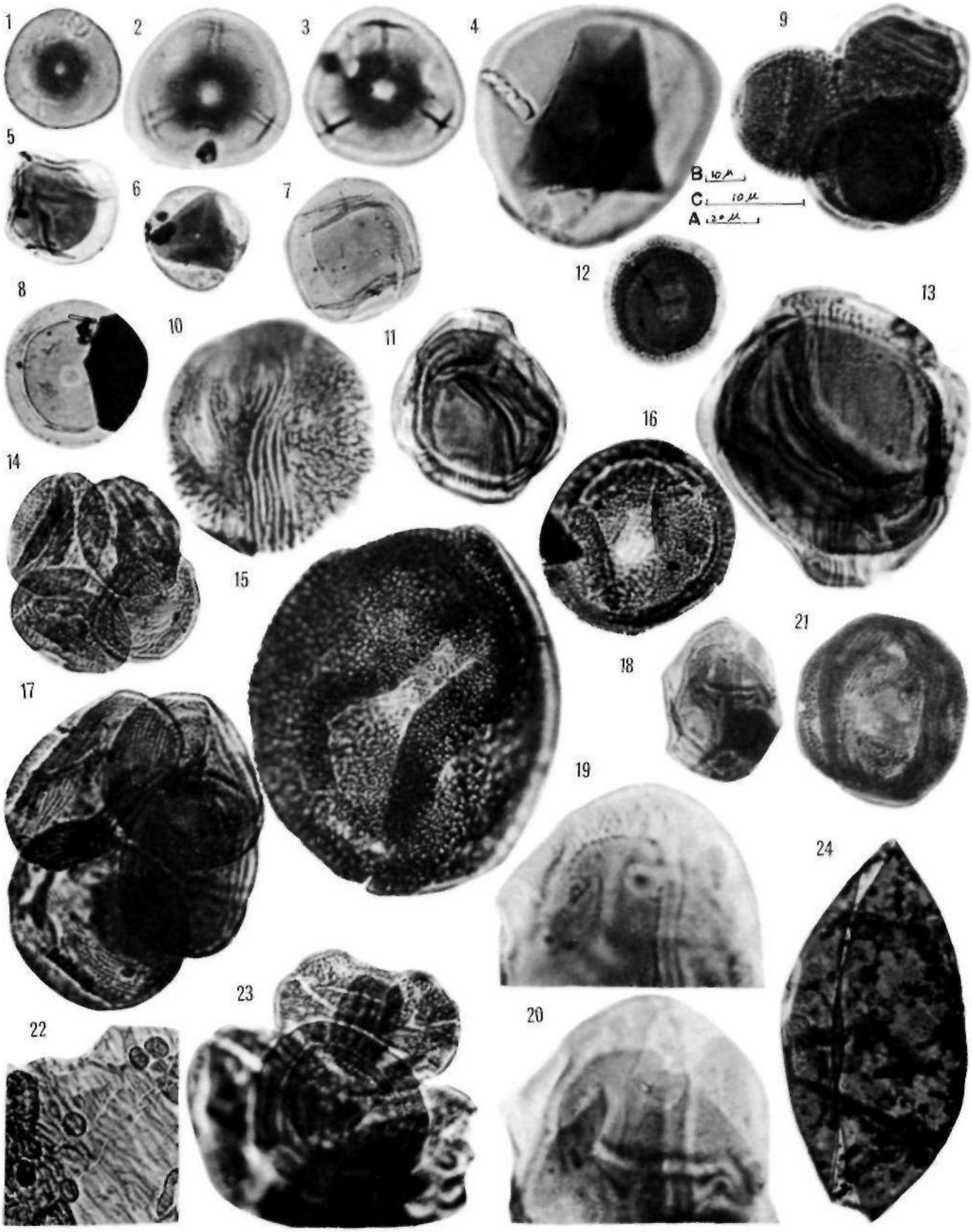

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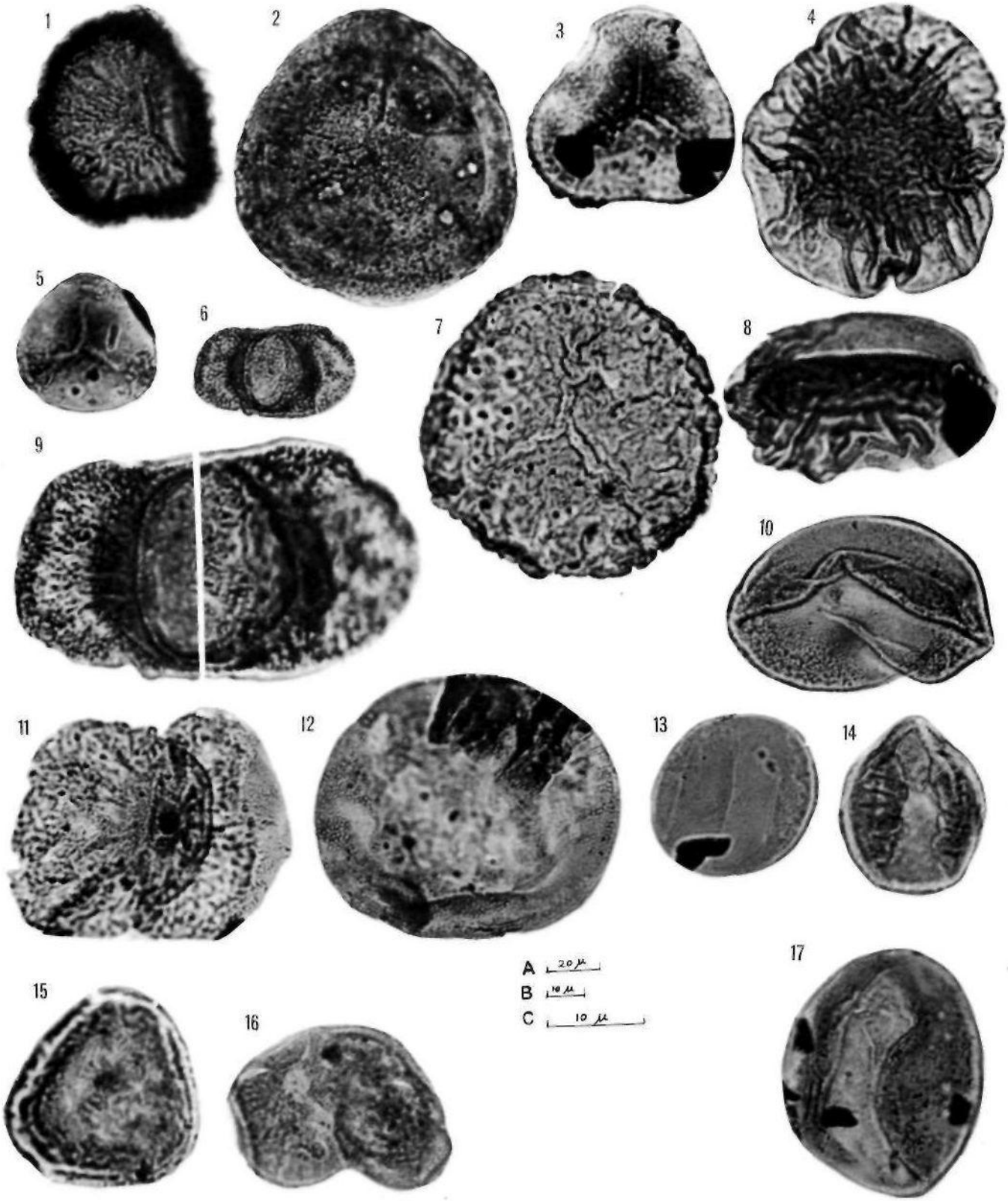

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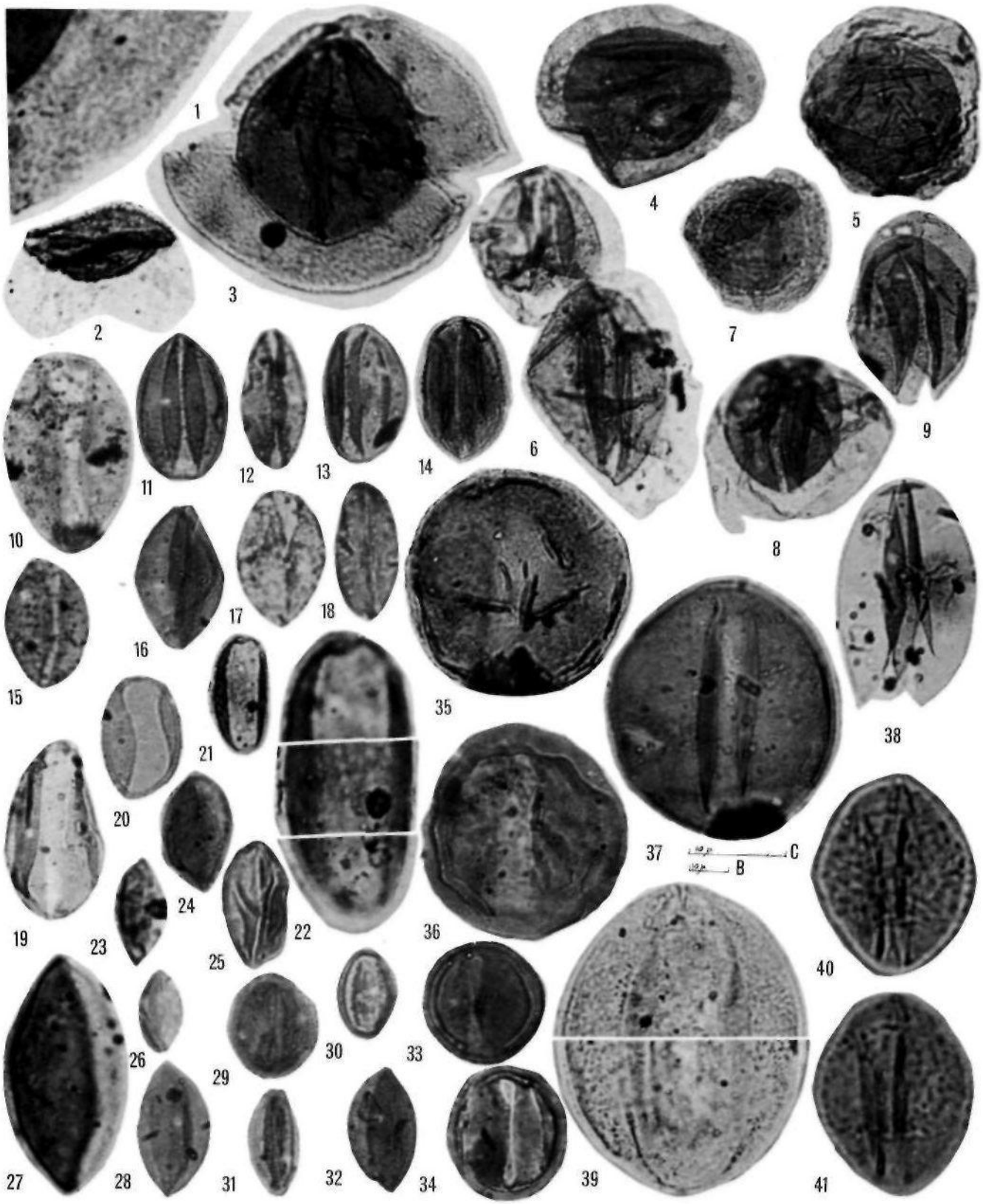

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