Triassic Plant Microfossils from a Shale within the Wollar Sandstone, N.S.W.

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Abstract — Fifteen species of microspores and pollen from a sample taken within the Wollar Sandstone, N.S.W. are described, seven as new species. A new species of megaspore is also described. Age relationships of the microflora are briefly discussed and it is proposed that the sample is of upper Scythian or lower Anisian age.


Introduction

The Wollar Sandstone, first described by Dulhunty (1937), is predominantly an arenaceous unit, probably non-marine, conformably overlying the Lithgow Coal Measures of the Goulburn and north-western Hunter valleys. It is conformably overlain by the carbonaceous shales and arenites of the Comiala Shale. It consists of a lower conglomeratic and shaly unit up to 400 ft. thick. This lower unit is characterized by a prominent conglomerate band with abundant green pebbles at the base, overlain by interbedded, red and green shales and siltstones. The shale and siltstone beds of this lower unit often contain abundant plant microfossils. The overlying unit consists of massive sandstone beds, with a few shale partings in the lower portion, increasing in content of mottled red shale and claystone in the upper part of the section.

Areally, the Wollar Sandstone extends from Uarbry in the north-west, along the Goulburn River valley to the south and to Murrurundi in the north-east. Surface mapping suggests that the Wollar Sandstone is at least partially correlatable with the Narrabeen Group in the north-western part of the Sydney Basin, but in view of the present information it is not possible to determine the relationship more exactly. As the Wollar Sandstone is one of the few units showing stratigraphic continuity with the sediments of the southern edge of the Great Artesian Basin and the northern edge of the Sydney Basin, its study will be advantageous in determining time relations between the two basins.

Techniques

The process of separation of the microfossils consisted of gently boiling the carbonate free, crushed sediment in commercial hydrofluoric acid (50-70%), washing in heated 10% hydrochloric acid, washing in warmed water and several washings in alcohol. The remaining organic and mineral residues were separated in a bromoform-alcohol mixture (S.G. 2.1), the organic residue being washed in alcohol and then in water. The residue was then mounted, unstained, in glycerine jelly.

Single specimen mounts were prepared by severing a small, usually rectangular piece of glycerine jelly containing the desired specimen from a rigidly set glycerine jelly smear of the preparation. The severed piece of glycerine jelly was transferred to a glass slide, melted and a cover slip applied.

Sample Material and Storage

Only one sample was examined during this study, being the only sample in a number of samples from the area to yield spores and pollen of this age. The sample was obtained from a small shale band intercepted in a seismic shot hole, L. H. Smart Exploration Ltd. S.P.A. 7 (150° 28' 30" E. 32° 14' 15" N). Unfortunately only a small amount of the sample was collected, sufficient for a single treatment. Slide numbers quoted in the text refer to slides lodged in the palynological collection of the Department of Geology and Geophysics, University of Sydney. Numerals following the slide numbers refer to the stage locations of individual specimens on Leitz Ortholux microscope No. 491309.
Systematic Palynology

The systematic framework initiated by Potonie and Kremp (1954) and subsequently modified by these authors and others, is followed. Morphological terminology follows Dettmann (1963), except where other authorities are cited.

Systematic Descriptions

**Anteturma Sporites H. Potonie 1893**

**Trurma Triletes Reinsch 1881**

**Genus Retusotriletes Naumova 1953**

Type species *Retusotriletes simplex* Naumova 1953; Upper Terrestrial Beds, Kaluga district, U.S.S.R.; Middle Devonian.

*Retusotriletes praetexta* sp. nov.

**Pl. 1, figs. 10, 11.**


Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens

Microspore, trilete, exhibiting curvaturae perfectae. Laesurae extend about three quarters radius, lipped, straight although distorted in some specimens (Pl. 1, fig. 11), occasionally accompanied by folds. Exine appears to be about 2 microns thick, covered with thickly set granula, individual elements being well rounded, 1-1.5 microns high, about 1.5 microns basal diameter.

Dimensions. 30 (34) 42 microns 10 specimens measured.

Comparisons

*Retusotriletes praetexta* sp. nov. differs from *R. domanicus* Naumova 1953 in size. It is distinguished from the specimen illustrated by Naumova as *Retusotriletes famenensis* (1953, Pl. 16, fig. 44) by its more thickly set sculpture. *Retusotriletes cipedeata* sp. nov. is differentiated by its very much finer sculpture. *Retusotriletes praetexta* sp. nov. differs similarly from *Polymorphisporites laevigatus* Alpern 1958. It is differentiated from

*Retusotriletes cipedeata* sp. nov.

**Pl. 1, fig. 3**


Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens

Microspore, trilete, exhibiting curvaturae perfectae. Laesurae extend almost two thirds radius, slightly sinuous in vicinity of proximal pole. Exine thin, covered with small granula, less than 1 micron basal diameter. Circular, slightly raised portion of the exine, in the vicinity of the proximal pole, exhibits a thickening of the sculpture. Contact faces usually extend to the equator.

Dimensions. 33 (39) 42 microns. 10 specimens measured.

Comparisons

*Retusotriletes cipedeata* sp. nov. is distinguished from *R. praetexta* sp. nov. by the nature and size of the sculpture. *Retusotriletes mesozoicus* Klaus 1960 has smaller contact faces and lacks a definite sculpture.

Known stratigraphic range.

Only known occurrence in the Wollar Sandstone, upper portion.

*Retusotriletes sp.*

**Pl. 1, fig. 2**

Description of specimens

Microspore, trilete, exhibiting curvaturae imperfectae (Potonie and Kremp, 1955, p. 13). Amb circular with well developed line marking outer edge of contact faces, about 4 microns from the equator. Exine appears to be about 2 microns thick, covered with thickly set granula, individual elements being well rounded, 1-1.5 microns high, about 1.5 microns basal diameter.

Dimensions. 41-53 microns. 6 specimens measured.

Comparisons

*Retusotriletes praetexta* sp. nov. differs from *R. praetexta* sp. nov. by the nature and size of the sculpture. *Retusotriletes cipedeata* sp. nov. is differentiated by its very much finer sculpture. *Retusotriletes praetexta* sp. nov. bears some resemblance in both size and form to microspores separated from fertile remains of *Osmundopsis plelodora* Harris (1931, Pl. 12, fig. 7) and *Todites harisi* Harris (1931, Pl. 10, fig. 3).

Known stratigraphic range

Only known occurrence in the Wollar Sandstone, upper portion.

*Retusotriletes sp.*

**Pl. 1, fig. 2**

Description of specimens

Microspore, trilete, exhibiting curvaturae imperfectae (Potonie and Kremp, 1955, p. 13). Amb circular with well developed line marking outer edge of contact faces, about 4 microns from the equator. Exine appears to be about 2 microns thick, covered with thickly set granula, individual elements being well rounded, 1-1.5 microns high, about 1.5 microns basal diameter.

Dimensions. 41-53 microns. 6 specimens measured.

Comparisons

This species is similar in overall organization to *Retusotriletes oblitratus* Tschibrekova (1962, Pl. 3, fig. 8), but of smaller dimensions. It differs similarly from *Polymorphisporites laevigatus* Alpern 1958. It is differentiated from
R. mesozoicus Klaus 1960 by the curvaturae and the thicker exine.


Type species. Punctatisporites punctatus Ibrahim 1933; Aegir Seam, Ruhr, West Germany; Upper Carboniferous.

Punctatisporites sp.
Pl. 1, fig. 1

Description of specimens
Microspore, trilete. Amb circular, but often distorted due to folding. Laesurae extend about two thirds radius, lipped often accompanied by folds, up to 4 microns high. Exine about 2 microns thick, punctate (Potonie and Kremp, 1955, pp. 13–14), usually folded.

Dimensions. 65–82 microns. 5 specimens measured.

Comparisons
This species resembles Punctatisporites gretensis Balme and Hennelly 1956, but appears to differ by having a thinner exine and a smaller size range (possibly due to the restricted number of specimens measured).

Genus Cyathidites Couper 1953.

Type species. Cyathidites australis Couper 1953; Ohika Beds, New Zealand; Jurassic.

Remarks
The major morphological elements of some of the form genera representing triangular, trilete, smooth exine forms are set out on Table 1. All the forms are subject to some morphological overlap by other forms. This is most evident in the relationship of Deltoiospora Miner 1935 and Leiotriletes Nau­mova emend. Potonie and Kremp 1954. These forms are obviously similar and possibly synonymous. A further difficult association is that of Alsophilidites Cookson ex Potonie 1956, Cardioangulina Maljavinka emend. Potonie 1960 and Cyathidites Couper 1953. As the only morphological differences between the three forms are slight variations in the length of the laesurae it is difficult to justify retention of the three genera. Dettmann (1963, p. 22) has suggested that these genera are synonymous, indicating that Cyathidites Couper 1953 had priority as the other genera were not validated until 1956 and 1960 respectively.

Cyathidites breviradiatus sp. nov.
Pl. 1, fig. 4

Holotype. S.U.D.G. 1/SS 24, 21·4 122·0. Amb concave triangular, apices broad, well rounded. Laesurae distinct, less than half radius, lipped, almost straight but slightly sinuous in the vicinity of the proximal pole. Maximum dimensions, sides to apices, 39 microns.

Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens
Microspore, trilete, amb mostly markedly concave triangular, apices broad, well rounded. Laesurae usually lipped, less than half radius. Exine about 2 microns thick, smooth or faintly punctate. Tendency for the exine to tear away from the proximal pole, parallel to the sides, tearing along the laesurae.

Dimensions. 36 (40) 42. 10 specimens measured.

Comparisons
Cyathidites breviradiatus sp. nov. differs from previously described species of Cyathidites by having shorter laesurae. It is morphologically similar to the megaspore Nemejcisporites nemejci (Kalibova) Potonie and Kremp 1955, differing in size. Cyathidites breviradiatus sp. nov. is distinguished from Leiotriletes sphaerotriangulatus (Loose) Potonie and Kremp 1954 by the more concave shape and shorter laesurae. A similar form occurring in the upper Bulgo Sandstone and lower part of the Bald Hill Claystone to the south of Sydney, is slightly smaller, but otherwise morphologically indistinguishable.

Known stratigraphic range
Wollar Sandstone, upper portion and upper Narrabeen Group.


Type species. Granulatisporites granulatus Ibrahim 1933; Aegir Seam, Ruhr, West Germany; Upper Carboniferous.

Granulatisporites sp. cf. G. trisinus Balme and Hennelly 1956
Pl. 1, figs. 12, 13

Description of specimens
Microspore, trilete, amb triangular, sides straight or slightly convex, apices rounded. Laesurae usually straight but accompanied by folds, rather than lipped which assume sinuous paths, reaching almost to the equator. Exine about 2 microns thick, covered with granula,
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1-1-5 microns in basal diameter, 1 micron high, 1.5 microns apart but irregularly spaced.

**Dimensions.** 62-79 microns. 4 specimens measured.

**Comparisons**

These specimens differ from *Granulatisporites trisinus* Balme and Hennelly 1956 of the underlying Lithgow Coal Measures only by their slightly more prominent sculpture. They are distinctly excluded from the genus *Microfoveolatispora* Bharadwaj 1960, despite Bharadwaj's proposition of designating *G. trisinus* Balme and Hennelly 1956 to his new genus (Bharadwaj, 1960, p. 82), by the very distinct granula. The possibility of these forms resulting from reworking of older sediments has been considered, but the problem is difficult to resolve in view of the excellent preservation and the absence of other forms characteristic of the Permian Lithgow Coal Measures.

*Granulatisporites* sp.

Pl. 1, fig. 6

**Description of specimens**

Microspores, trilete, amb triangular, sides convex, apices rounded. Laesurae slightly sinuous near the proximal pole, raised, lipped, reaching almost to the equator. Exine 3 microns thick, covered with irregularly shaped granula, 0.5-1 micron apart.

**Dimensions.** 31-35 microns. 4 specimens measured.

**Comparisons**

This species is not unlike *Granulatisporites parvus* (Ibrahim) Potonie and Kremp 1955, although it has slightly larger sculptural elements.

*Genus Osmundacidites* Couper 1953.

Type species. *Osmundacidites wellmanii* Couper 1953; Ohika Beds, New Zealand; Jurassic.

**Remarks**

*Osmundacidites* as defined by Couper (1953) is at least partly synonymous with *Cyclogranatisporites* Potonie and Kremp 1954. Balme (1963) has briefly discussed the merits of retention of *Osmundacidites*, mentioning the diversity of the sculpture as a possible means of delineating the two genera. The forms encountered in the Wollar Sandstone are characterized by this diversity of sculpture, even on single specimens.

*Osmundacidites* sp. cf. *O. wellmanii*

Couper 1953

Pl. 1, figs. 7-9

**Description of specimens**

Microspore, trilete, amb circular but often irregular due to sculpture or folding. Laesurae straight, extending about two thirds radius, path frequently interrupted by sculptural elements. Exine about 2 microns thick, covered with scattered coni (the term coni is used here in the sense of Potonie and Kremp 1953, p. 14) and granula, which are often irregular, thickly set on the distal surface, thinning on the proximal surface approaching the laesurae, although scarcely diminishing in size. Granula (often irregular verrucae) 1.5 microns high, 2 microns basal diameter, occasionally pointed to form spinulae. Folding of the exine is quite common.

**Dimensions.** 31-62 microns. 50 specimens measured.

**Comparisons**

*Osmundacidites* sp. cf. *O. wellmanii* is distinguished from *Osmundacidites wellmanii* Couper 1953 only by the slightly shorter laesurae. It is slightly smaller than *Osmundacidites senectus* Balme 1963 and is larger and has slightly longer laesurae than *O. alpinus* Klaus 1960. *Osmundacidites parvus* de Jersey 1960 is slightly smaller, has longer laesurae and more regular sculptural elements than *Osmundacidites* sp. cf. *O. wellmanii*.

**Known stratigraphic range**

*Osmundacidites wellmanii* Couper 1953 occurs abundantly throughout Mesozoic sediments.


Type species. *Kraeuselisporites dentatus* Leschik 1955; Schilfsandstein (Reed Sandstone), Switzerland; Upper Triassic.

*Kraeuselisporites diferens* sp. nov.

Pl. 2, figs. 23-27

**Holotype.** S.U.D.G. 1/SS 6. Amb almost circular (Pl. 2, figs. 24, 25), diameter 56 microns. Exoexine markedly thickened and detached from intexine in equatorial regions. Distal and equatorial sculpture consists of irregular spinae and coni, proximal surface showing development of low well rounded rugulae in equatorial regions, less well developed towards the proximal pole. Laesurae extend to the inner margin of the lateral equatorial exoexine, slightly sinuous.

**Type Locality.** L. H. Smart Exploration Ltd. S.P.A. 7.
Description of specimens

Microspore, trilete. Amb circular to rounded triangular. Zona always well developed although it has not been possible to detect the extent of exoexinal detachment in distal or proximal regions. Laesurae slightly simous, lipped, extending to the inner margin of the zona. Sculptural elements often absent from proximal face although low rugulae sometimes occur. Distal and equatorial sculpture strongly developed, consisting of closely packed coni and verrucae with irregular bases, coalescing in basal portions to show a rugulate pattern in low focus. Coni 1–4.5 microns in length, 1–3 microns basal diameter. Some specimens, including the holotype (Pl. 2, fig. 24), show weakly defined markings suggesting an extension of the laesurae across the zona.

Dimensions. Total diameter 39 (46.5) 56 microns. Width of zona 3.5 (4.5) 7 microns. 16 specimens measured.

Comparisons

Kraeuselisporites differens sp. nov. differs from K. cooksonae (Klaus) Dettmann 1963, K. cuspidus Balme 1963 and K. major (Cookson and Dettmann) Dettmann 1963 in size. Kraeuselisporites linearis (Cookson and Dettmann) Dettmann 1963 (which appears to be very similar to the specimen illustrated as Cirratriiradiates splendens, Balme and Hennelly 1956, Pl. 5, fig. 7) and K. saeptatus Balme 1963 have a different sculpture from K. differens sp. nov. It appears that a gradation exists between those specimens resembling K. spinosus Jansonius 1962 and the more typical specimens of K. differens sp. nov. as illustrated. It would be possible to regard the end members of this gradation as K. sp. cf. K. spinosus. K. differens sp. nov. differs from the species of Kraeuselisporites described by Leschik (1955) in the density and type of sculpture and generally well marked laesurae. Although very similar K. apiculatus Jansonius 1962 may be differentiated by its more regular sculptural elements and slightly larger size.

Known stratigraphic range

Only known occurrence in Wollar Sandstone, upper portion.

Turma Monoletes Ibrahim 1933

Genus Polypodiisporites Potonié and Gelletich ex Potonié 1956.

Type species. Polypodiisporites favus (Potonié) Potonié and Gelletich 1933; Geiseltal Seam, Geisel Valley, Germany; Middle Eocene.

Polypodiisporites ipsviciensis (de Jersey)

Playford and Dettmann 1965

Pl. 1, fig. 4

Description of specimens

Microspores monolete. Amb circular to oval, irregular due to sculpture. Laesurae indistinct, usually obscured by sculpture. Exine about 1.5 microns thick, covered with irregular verrucae, sometimes surmounted by spinae, bases coalescing to give rugulate pattern in low focus. Verrucae 2 microns high, up to 2.5 microns basal diameter. Spinae and occasional coni 1.5 microns high, basal diameter up to 1.5 microns.

Dimensions. 23 (26) 31 microns. 10 specimens measured.

Remarks

As mentioned by de Jersey (1962), a large proportion of the specimens examined appeared monolete. However, several specimens do exhibit a monolete mark, confirming the identification as Polypodiisporites ipsviciensis.

Known stratigraphic range

Polypodiisporites ipsviciensis first appears in the upper part of the Narrabeen Group in N.S.W., extending into the Lower Jurassic. It is found extensively throughout Middle and Upper Triassic sediments in eastern Australia.


Type species. Aratrisporites parvispinosus Leschik 1955; Seam 2, Schilfsandstein (Reed Sandstone), Neuwelt, Switzerland; Upper Triassic.

Aratrisporites goulburniensis sp. nov.

Pl. 1, figs. 14–16

Holotype. S.U.D.G. 1/SS 12. Amb disrupted oval (Pl. 1, fig. 14), overall length (Measurement A) 38 microns. Laesura distinctly lipped, slightly simous, extend into detached exoexine. Exine granulate between coni and spinae, sculptural elements well developed distally and equatorially, diminishing on proximal surface.

Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens

Microspore, usually cavate, monolete. Amb oval generally conforming to margin of intexine. Laesurae seldom straight, usually lipped, 1–2 microns wide, slightly raised and may extend into the exoexine laterally. Intexine possibly attached to exoexine on proximal surface, at
Fig. 1a
Shows exploded view of internal structure of Aratrisporites.

Fig. 1b
Shows measurement plan of Aratrisporites
A. Overall length of grain exclusive of sculptural elements.
B. Maximum length of detached intexine.
C. Maximum breadth of grain exclusive of sculptural elements.
D. Maximum breadth of detached intexine.

Known stratigraphic range

Only known from the Wollar Sandstone, upper portion.

Aratrisporites wollariensis sp. nov.
Pl. 1, figs. 17–19
Holotype. S.U.D.G. 1/SS 10, 12·2 120·7. Amb almost oval (Pl. 1, fig. 17), overall length (Measurement A) 31 microns. Cavate nature of exoexine illustrated by folded intexine. Spinae and coni on exoexine about 1 micron basal diameter, 1 micron high, often surmounted by hairlike projections about 2 microns long, 1/5 microns wide.

Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens

Microspore, sometimes cavate, monolete. Amb usually oval, often pointed at lateral extremities. Exoexine about, not always visibly detached from intexine. Laesura does not always extend to the lateral edge of the intexine and is usually sinuous. Laesura normally lipped, thickenings up to 1 micron in width, the entire proximal face in vicinity of the laesura being arched. Many specimens are observed compressed in a plane slightly oblique to the proximo-distal plane, exhibiting the original boat like shape. Very commonly the intexine is folded. The exoexine, which thins noticeably in the vicinity of the laesura, is covered with fine spinae, coni and granula, most thickly set in the equatorial regions.

Dimensions. See text fig. 1.
A. 28 (33) 42 microns B. 24 (28) 35 microns
C. 22 (27) 30 microns D. 19 (23) 25 microns
50 specimens measured.

Comparisons

Aratrisporites wollariensis sp. nov. is easily distinguished from A. goulburniensis sp. nov. by the size of its sculptural elements. Aratrisporites granulatus (Klaus) Playford and Dettmann 1965 as described by Klaus (1960) is slightly larger and has a granulate sculpture. Aratrisporites paraspinosus Klaus 1960 is slightly larger and has more prominent sculpture. Aratrisporites wollariensis sp. nov. differs from A. coryliseminis Klaus 1960 in size and nature of the sculpture although the specimen illustrated by Playford and Dettmann (1965, Pl. 15, fig. 41) as A. coryliseminis appears somewhat similar. Those specimens of Aratrisporites wollariensis sp. nov. which are not evidently cavate could be assigned to Punctatosporites Ibrahim 1933.
Remarks

Aratrisporites wollariensis sp. nov. is the dominant form (66%) occurring in the sample. Several almost complete microsporangia, yielding this species, were encountered in the preparation residue, some being stuck to clumps of Nathorstisporites pulcherrima sp. nov. It is possible that these two forms are associated in a strobilis of the Lycostrobus Nathorst type.

Known stratigraphic range

Known from the upper portion of the Wollar Sandstone, very abundant in the Collaroy Claystone, also encountered in Hawkesbury Sandstone.

Aratrisporites sp.

Pl. 2, fig. 20

Description of specimens

Microspores, caveate, monotetrate. Amb ovoid. Latesura almost straight, extending almost to the outer edge of the lateral exoexine. Exoexine usually quite transparent, bearing spinae up to 4 microns long, ½ micron wide. Sculptural elements thin out and diminish in size on the proximal face. Intexine often folded.

Dimensions. See text fig. 1.

A. 30 microns, B. 25 microns, C. 24 microns, D. 18 microns. 1 specimen measured.

Comparisons

This species differs from Aratrisporites gouldburniensis sp. nov. and A. wollariensis sp. nov. by the size and type of sculptural elements. It is smaller than Aratrisporites fimbriatus (Klaus) Playford and Dettmann 1965 and has a thinner exoexine. It is not possible to distinguish this specimen from microspores of Cylostrobus Helby and Martin 1965, several specimens of which are illustrated (Pl. 2, figs 21, 22).

Known stratigraphic range

A single specimen has been encountered in the upper portion of the Wollar Sandstone. It is one of the dominant forms in the upper part of the Collaroy Claystone and Gosford Formation to the immediate north of Sydney. It is also encountered in the Hawkesbury Sandstone.

Anteturma Pollenites R. Potonie 1931

Turma Saccites Erdtman 1947

Genus Alisporites Daugherty 1941.

Type species. Alisporites opii Daugherty 1941; Chinle Formation; Arizona, U.S.A.; Upper Triassic.

Remarks

Considerable confusion exists at present concerning the taxonomy of fossil bisaccate pollen, in particular those forms morphologically similar to Alisporites Daugherty 1941. The original inadequate description of Alisporites opii Daugherty 1941 has led to a long history of reinterpretation of Alisporites. (Potonie and Kremp 1956, Rouse 1959, de Jersey 1962, Janssens 1962 and Maedler 1964). Examination of material from the Chinle Formation suggests that the holotype may not be characteristic of the population concerned so that re-examination of the original material, if possible, is warranted. I regard Alisporites to be confined to forms displaying a distal colpus (anacolpate, Erdtmann and Straka 1961), synonymous with Sulcatisporites Leschk 1955 and Pteruchipollenites Couper 1958.

Alisporites townrovii sp. nov.

Pl. 2, figs. 29-32, 34, 35

Holotype. S.U.D.G. 1/SS 13, 21-4 120-0. Specimen compressed laterally (Pl. 2, fig. 34). Overall length 99 microns. Corpus distinctly broader than deep, reticulation strongly developed. Colpus distinct, lipped, reaching almost to the proximal cap. Small exoexine “bridge” crosses colpus.

Type Locality. L. H. Smart Exploration Ltd. S.P.A. 7.

Description of specimens

Pollen, bisaccate, anacolpate. Amb haploxyloendoid (Pl. 2, fig. 28), sacci offset and converging distally. Corpus normally longer than broad, ranging to the reverse; as deep as long, but varying; sacci as deep as corpus. Colpus distinct and lipped, lips 1-2 microns wide, usually extending almost to the proximal surface. A distal exoexine “bridge” often crosses the colpus. In most cases this structure springs from the area of detachment of the saccus exoexine from the intexine. Reticulation strongly developed on sacci and corpus, sacci lumina 1-2 microns in diameter, muri about 1 micron thick. Corpus lumina 1-2 microns diameter, muri about ½ micron thick.

Dimensions. See text fig. 2.

L.C. 30 (49) 63 microns, B.C. 28 (43) 56 microns, D.C. 39 (50) 56 microns, L.S. 30 (47) 64 microns, B.S. 31 (35) 45 microns, D.S. 40 (44) 55 microns, O.L. 55 (80) 110 microns. 50 specimens measured in polar view.
Comparisons

Alisporites townrovii sp. nov. differs from Pteruchipollenites thomasii Cooper 1958 in that it has a strongly lipped colpus, very strongly developed sculpture and often shows a “bridge” over the colpus. It differs from Alisporilis australis de Jersey 1962 and Pityosporites nigracristatus Hennelly 1958 in similar fashion. A structure similar to the distal “bridge” of Alisporites townrovii is exhibited by specimens of Alisporites occurring in Middle and Upper Triassic sediments of eastern Australia. This structure appears to be proximally situated, reminiscent of the structure described by Klaus for Chordasporites Klaus 1960.

Known stratigraphic range

Known only from the Wollar Sandstone, upper portion.


Type species. Platysaccus papilionis Potonié and Klaus 1954; Cristiana horizon, Salzberg Hallstatt, Austria; Permian—Triassic.

Remarks

The emendation of the genus Platysaccus Naumova 1937 by Potonié and Klaus 1954, although valid, appears to me to have strayed somewhat from the original concept of Naumova, which although not well described in words, is illustrated by sketches of three species. Cuneatisporites Leschik 1955 is very similar to Platysaccus as emended by Potonié and Klaus and Platysaccus as illustrated by Naumova (1937, fig. 1). However, the holotype of Cuneatisporites radialis Leschik 1955 displays a weakly developed, small trilete mark on the proximal surface of the corpus.

? Platysaccus sp.

Pl. 2, fig. 33, text fig. 3

Description of specimens

Pollen, bisaccate, anacolpate (only seen in one specimen). Overall shape strongly diploxylonoid, sacci converging slightly in distal direction. Corpus usually rounded or slightly longer than broad. Depth of corpus not determined. Colpus appears to extend full length of corpus, not noticeably lipped (text fig. 3). Saccus sculpture distinctly reticulate,

Fig. 2

Shows measurement plan of Alisporites townrovii sp. nov.

C.B.—Corpus breadth
C.L.—Corpus length
C.D.—Corpus depth
O.L.—Overall length

S.B.—Saccus breadth
S.L.—Saccus length
S.D.—Saccus depth

Fig. 3

Shows a sketch of the distal view of a colpate specimen of ? Platysaccus (S.U.D.G. 1/Y 39.0 119.5) exhibiting area of attached exoexine and intexine (stippled area) in relation to sacci colpus.
lumina 2.5–4 microns diameter, muri slightly less than 1 micron. Corpus either faintly reticulate with very fine muri becoming smooth in the vicinity of the colpus, or smooth.

**Dimensions**


**Comparisons**

The presence of the colpus in one of the specimens, suggests similarity to *Alisporites* specimens which occur in the assemblage. The specimens differ from *Platysaccus papilionis* Potonie and Klaus 1954 by lacking radially stretched lumina. They are similar to *Platysaccus queenslandi* de Jersey 1962, distinguished only by the occurrence of the colpus on a single specimen.

**MEGASPORE**

*Anteturma* Sporites H. Potonie 1893

*Turma* Triletes Reinsch 1881

Genus * Nathorstisporites* Jung 1958.

Type species. *Nathorstisporites hopliticus* Jung 1958; *Zamites-Thaumatopteris* Zones, Nuremberg, West Germany; Lower Jurassic.

*Nathorstisporites pulcherrima* sp. nov.

Pl. 3, figs. 38–41

**Holotype.** S.U.D.G. 1/SS 25, 33-7 126-5. Specimen compressed in plane containing the polar axis (Pl. 3, fig. 39), equatorial diameter 530 microns, polar diameter 548 microns. Laesurae reach almost to the equator, accompanied by thickly set capilli. Limit of proximal face shown by line of exoexinous elevation accompanied by spinae. Capilli up to 200 microns in length, 40 microns basal diameter, branch irregularly, branches often joined by thin membranes. Spinae on distal surface up to 100 microns long, 10 microns basal diameter, irregularly spaced, about 50 microns apart.

**Type Locality.** L. H. Smart Exploration Ltd. S.P.A. 7.

**Description of specimens**

Megaspores, trilete, circular to rounded triangular in polar view. In equatorial view distal surface is rounded, proximal surface distinctly pyramidal, surfaces usually delineated by exoexine elevation. Laesurae extend about ¼ radius, lipped, lips up to 35 microns wide, often raised, particularly in the vicinity of the proximal pole. Lips surrounded and thickly set with capilli. Capilli up to 200 microns in length, usually thickened and branching towards the top, terminating in blunt, somewhat broadened processes. Individual capilli exhibit a membrane between the branches, or several branches may be joined by membrane. Capilli often packed with small microspores, dominantly *Aratrisporites wollariensis* sp. nov. Spines are irregularly disposed on the distal surface. There are many different forms of elements occurring on the specimens examined, some of which are illustrated on text fig. 4. A mixture of these sculptural elements usually occurs on individual specimens.

![Fig. 4](image_url)

Shows some of the variation of sculptural elements encountered on the distal surface of specimens of *Nathorstisporites pulcherrima* sp. nov.
Dimensions

Oxidized specimens
Equatorial diameter 372–593 microns
Polar diameter 391–548 microns
50 specimens measured.

Unoxidized specimens
Equatorial diameter 298–419 microns
Polar diameter 280–372 microns
20 specimens measured.

Comparisons

*Nathorstisporites pulcherrima* sp. nov. is differentiated from *N. hopliticus* Jung 1958 and *N. reticulatus* Dettmann 1961 by the well developed sculptural elements of the distal surface. It differs from *N. flagellulatus* Dettmann 1961 in size, being smaller, having capilli on the proximal surface in large quantity, and the size and type of sculptural elements on the distal surface.

Known stratigraphic range

*Nathorstisporites pulcherrima* sp. nov. first appears in the upper part of the Collaroy Claystone, is particularly abundant in this sample from the Wollar Sandstone and occurs extensively in Triassic sediments of the Great Artesian Basin in N.S.W.

Discussion

The percentage distribution of forms in the microflora, based on a count of 1000 specimens is as follows:

<table>
<thead>
<tr>
<th>Form</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alisporites townrovii</td>
<td>5.0%</td>
</tr>
<tr>
<td>Aratrisporites goulburniensis</td>
<td>0.3%</td>
</tr>
<tr>
<td>Aratrisporites wollariensis</td>
<td>66.3%</td>
</tr>
<tr>
<td>Granulatisporites sp.</td>
<td>0.1%</td>
</tr>
<tr>
<td>Kraeuselisporites differens</td>
<td>0.1%</td>
</tr>
<tr>
<td>Leiotriletes sp.</td>
<td>0.1%</td>
</tr>
<tr>
<td>Osmundacidites sp. cf. O. senectus</td>
<td>0.2%</td>
</tr>
<tr>
<td>Osmundacidites sp. cf. O. wellmanii</td>
<td>14.0%</td>
</tr>
<tr>
<td>? Platysaccus sp.</td>
<td>0.2%</td>
</tr>
<tr>
<td>Polypodisporites ipsaviensis</td>
<td>0.1%</td>
</tr>
<tr>
<td>Punctatisporites sp.</td>
<td>1.1%</td>
</tr>
<tr>
<td>Retusotriletes clipeata</td>
<td>0.3%</td>
</tr>
<tr>
<td>Retusotriletes praetexta</td>
<td>1.0%</td>
</tr>
<tr>
<td>Unidentified specimens</td>
<td>11.2%</td>
</tr>
</tbody>
</table>

The absence of *Taeniaesporeites* and *Lundbladispora* forms in this assemblage would suggest that the microflora was younger than that microflora from the Scythian Kockatea Shale of Western Australia (Balme 1963) and its eastern Australian equivalents. The dominance of *Aratrisporites* is to be noted as this genus appears to be an important, biostratigraphic form. In the northern part of the Perth Basin, Western Australia, it is first encountered in the uppermost portion of the Kockatea Shale, presumably uppermost Scythian in age, becoming quite prominent in the overlying Woodada Formation (Mr. B. E. Balme, pers. comm.). In western Europe it is first encountered in probable upper Scythian, attaining some prominence in the Muschelkalk and its equivalents (Dr. W. Klaus and Dr. K. Maedler, pers. comm.). In western Canada it makes its first appearance in the upper portions of the Toad/Grayling Formation, regarded as probable Anisian (Dr. J. Jansonius, pers. comm.). *Aratrisporites* forms (*Zonomonoletes tschalychevii*) have been reported from the Kranovetno horizon of the continental Pereborskoi Formation in the northern Urals. Tschalychev and Varyukhina (1962) regard these occurrences as lower Triassic, assigning them to the Indrsk stage.

In the Sydney Basin *Aratrisporites* first appears in the Collaroy Claystone and the uppermost portions of the Bulgo Sandstone of the Narrabeen Group. It attains maximum representation in the microfloras of the uppermost Narrabeen Group, gradually decreasing in prominence throughout the overlying Hawkesbury Sandstone and Wlanamatta Shale. In view of this information it is suggested that this microflora encountered in a sample from the Wollar Sandstone is equivalent to the microfloras occurring in the uppermost Narrabeen Group or lower Hawkesbury Sandstone and that it is probably upper Scythian or lower Anisian in age.

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References


Explanation of Plates

**PLATE 1**
(Magnification × 500)

**Fig. 1.** *Punctatisporites* sp. S.U.D.G. 1/SS 17.

**Fig. 2.** *Retusotriletes* sp. S.U.D.G. 1/SS 8, 23·7 118·3.

**Fig. 3.** *Retusotriletes clipeata* sp. nov. Holotype. S.U.D.G. 1/SS 7, 27·4 125·2.

**Fig. 4.** *Polypodisporites tpsivicensis* Playford and Dettmann, 1965. S.U.D.G. 1/SS 3, 22·8 117·7.

**Fig. 5.** *Cyathidites breviflavus* sp. nov. Holotype. S.U.D.G. 1/SS 24.

**Fig. 6.** *Granulatisporites* sp. S.U.D.G. 1/Y, 31·0 125·5.

**Figs. 7–9.** *Osmundacidites* sp. cf. *O. wellmanii* Couper 1953.

- **Fig. 7:** S.U.D.G. 1/1, 29·0 113·9.
- **Fig. 8:** S.U.D.G. 1/SS 21, 18·6 116·5.
- **Fig. 9:** S.U.D.G. 1/SS 22, 27·7 122·9.

**Figs. 10–11.** *Retusotriletes praetexta* sp. nov.

- **Fig. 10:** Holotype, S.U.D.G. 1/SS 2.
- **Fig. 11:** Shows slightly distorted specimen: S.U.D.G. 1/SS 29.

**Figs. 12–13.** *Granulatisporites* sp. cf. *G. trisinus* Balme and Hennelly, 1956.

- **Fig. 12:** S.U.D.G. 1/SS 1, 24·5 117·7.
- **Fig. 13:** S.U.D.G. 1/SS 1, 24·0 117·9.

**Figs. 14–16.** *Aratrisporites goulburniensis* sp. nov.

- **Fig. 14:** Holotype, S.U.D.G. 1/SS 12.
- **Fig. 15:** S.U.D.G. 1/SS 23, 35·5 126·4.
- **Fig. 16:** Shows end view: S.U.D.G. 1/SS 18, 23·2 122·4.

**Figs. 17–19.** *Aratrisporites wollariensis* sp. nov.

- **Fig. 17:** Holotype, S.U.D.G. 1/SS 10, 12·2 120·7.
- **Fig. 18:** Shows folded intine: S.U.D.G. 1/SS 5, 35·0 116·1.
- **Fig. 19:** S.U.D.G. 1/2, 34·6 110·0.

**PLATE 2**
(Magnification × 500)

**Fig. 20.** *Aratrisporites* sp. S.U.D.G. 1/X, 29·2 130·0.

**Figs. 21–22.** Microspores of *Cystostrobus sydneyensis* Helby and Martin, 1965.

**Figs. 23–27.** *Kraeuselisporites differens* sp. nov.

- **Fig. 23:** Shows partial tetrad: S.U.D.G. 1/1, 42·7 118·4.
- **Fig. 24:** Holotype, proximal focus, S.U.D.G. 1/SS 4.
- **Fig. 25:** Holotype, distal focus.
- **Fig. 26:** Proximal focus: S.U.D.G. 1/SS 4.
- **Fig. 27:** Distal focus: S.U.D.G. 1/SS 4.

**Figs. 28–32.** *Alisporites townrovii* sp. nov.

- **Fig. 28:** S.U.D.G. 1/SS 15.
- **Fig. 29:** S.U.D.G. 1/SS 14, 15·7 119·2.
- **Fig. 30:** S.U.D.G. 1/SS 19, 35·4 121·0.
- **Fig. 31:** Shows "bridge" in almost equatorial position: S.U.D.G. 1/SS 11, 12·4 114·0.
- **Fig. 32:** Shows well developed, distal "bridge": S.U.D.G. 1/2, 21·9 118·9.

**Fig. 33.** *Platysaccus* sp. S.U.D.G. 1/2, 25·2 116·3.

**Figs. 34–35.** *Alisporites townrovii* sp. nov.

- **Fig. 34:** Holotype, S.U.D.G. 1/SS 13, 21·4 120·0.
- **Fig. 35:** S.U.D.G. 1/SS 9.

**PLATE 3**

**Figs. 36–41.** *Nathorstisporites pulcherrima* sp. nov. × 100.

- **Fig. 36:** Holotype, S.U.D.G. 1/SS 25, 33·7 126·5.
- **Fig. 37:** Shows nature of distal sculptural elements: S.U.D.G. 1/SS 28.
- **Fig. 38:** Shows proximal view with laesurae and sculptural elements on exoeinal thickening delineating contact face: S.U.D.G. 1/SS 30.
- **Fig. 39:** Unoxidized specimen in proximal view—distal plane—silhouette: S.U.D.G. 1/SS 29.
- **Fig. 40:** Silhouette, polar plane: S.U.D.G. 1/SS 27.
- **Fig. 41:** S.U.D.G. 1/SS 28.

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