

ABSTRACT

Spores belonging to the Mesozoic form genus *Aequitriradites* Delcourt and Sprumont, emend. Cookson and Dettmann, are recorded from lower Upper Cretaceous sediments of northwestern Wyoming. Two new species, *A. ornatus* and *A. fimbriatus*, are described.

Occurrence of *Aequitriradites* in the Upper Cretaceous of Wyoming

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INTRODUCTION

The microspore genus *Aequitriradites* was described by Delcourt and Sprumont (1955) from the Belgian Wealden. Cookson and Dettmann (1961) emended the genus to include forms they had described earlier (1958) under *Cirratiradites* Wilson and Coe, a Paleozoic form genus. Cookson and Dettmann referred to the genus as emended a total of nine species, which occur in Rhaetic to Upper Cretaceous formations in Belgium, Sweden, Russia, eastern Australia, and doubtfully in France and England.

Additional species have been identified from the Ellerslie Formation (Lower Cretaceous) of western Canada (Pocock, in press), and from the Umia beds of Kutch (Lower Cretaceous) in western India (S. K. Roy, reported by Mohan, 1962). Representatives of the genus have also been noted in the Blairmore Formation (Lower Cretaceous) of Saskatchewan (Steeves, personal communication) and the Middle Cretaceous of Alaska (Pflug, personal communication). The only previously known Upper Cretaceous forms are those recorded from Russia by Bolkhovitina (1959): *A. verrucosus* (Cookson and Dettmann), *A. spinulosus* (Cookson and Dettmann), and *A. interruptus* (Bolkhovitina) Cookson and Dettmann.

In an unpublished study of the small spores of the Upper Cretaceous Frontier Formation in the Wind River Basin, northwestern Wyoming, the writer (1959) encountered several forms which he referred to a new genus. A resemblance to *Aequitriradites* Delcourt and Sprumont was noted. The descriptions and excellent illustrations of *Aequitriradites* of Cookson and Dettmann (1958, 1961) leave no doubt that the Wyoming forms are congeneric with those of eastern Australia.

The specimens described here are from two samples taken from the Frontier Formation at Little Horse Creek, seven miles north of Dubois, Sec. 1, T. 42 N., R. 107 W., Fremont County, Wyoming. Sample F-52 is from a coal bed, three feet in thickness, 206 to 209 feet above the base of the formation as defined by Love *et al.*

(1947). Sample F-45 is a soft, bentonitic, dark-gray shale 187 feet above the base of the formation. The Frontier Formation is considered to include Cenomanian, Turonian, and lowermost Coniacian in the Wind River Basin (Cobban and Reeside, 1952). It rests unconformably upon the Lower Cretaceous Mowry Shale.

ACKNOWLEDGMENTS

Grateful acknowledgment is extended to Mr. Stanley A. J. Pocock, Dr. Margaret W. Steeves, and Dr. Hans Pflug for discussions of their observations of *Aequitriradites*, to Mr. Jack D. Burgess for the loan of specimens, and to Dr. Karl R. Newman and Dr. John F. Grayson for critical reading of the manuscript.

SYSTEMATIC DESCRIPTIONS

Morphographic criteria and terminology used in this work are largely those of Potonié and Kremp (1954) and Potonié (1956).

Anteturma SPORITES Potonié, 1893

Turma ZONALES Bennie and Kidston,
emend. Potonié, 1956

Subturma ZONOTRILETES Waltz, 1935

Infraturma ZONATI Potonié and Kremp, 1954

Genus *Aequitriradites* Delcourt and Sprumont,
emend. Cookson and Dettmann, 1961

Type species: *A. dubius* Delcourt and Sprumont, 1955

Cookson and Dettmann's diagnosis: "Trilete microspores with a membranous zone. Laesurae distinct or only faintly represented, especially toward the proximal pole. Exine entire or perforated distally. When perforated, the opening is formed as the result of a natural exinous breakdown about the distal pole. Sculptural elements various."

Remarks: *Aequitriradites* differs from *Styxisporites* Cookson and Dettmann in the presence of ornaments on the proximal surface and in the extension of the trilete rays onto the zona. *Cirratiradites* Wilson and Coe bears distal foveae in contrast to the distal perforation found in many specimens of *Aequitriradites*.

Occurrence: Wealden; Hainaut, Belgium. Lias, Lower and Upper Cretaceous; Russia. Rhaetic; Bjuv, Sweden. Lower Cretaceous; eastern Australia. Purbeck (?); France and England. Lower Cretaceous; western India. Lower Cretaceous; western Canada. Middle Cretaceous; Alaska. Upper Cretaceous; Montana and Wyoming.

***Aequitriradites ornatus* Upshaw, new species**

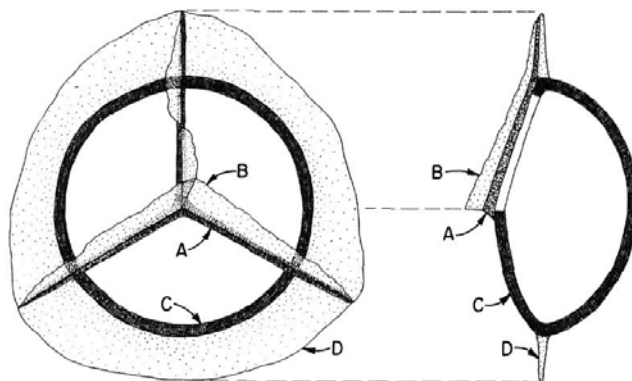
Plate 1, figures 1-6, 9-14; text-figure 1

Description: Spores are radial, trilete, zonate, broadly rounded to subtriangular in equatorial outline. The central body is circular. The zona is smooth to infragranulose, translucent to transparent, membranous, smooth to finely serrate at its outer edge, and broadest at the ends of the laesurae. The central body is ornamented by densely arranged projecting elements, ranging from low verrucae to thick spines, which are rounded to subpolygonal in cross section. In many specimens there is a large, somewhat excentric perforation in the distal spore wall. The laesurae are distinct and ridged, and the ridges extend to the outer margin of the zona. Thin, membranous muri surmount the laesurae along their entire length. The muri are highest at their juncture at the proximal pole. The spore wall is thick and body folds are not common.

Dimensions (based on 12 specimens):

| | |
|------------------------------|---------------------|
| Max. outside dimension | 64.0 to 102.0 μ |
| Central body diameter | 47.0 to 72.0 μ |
| Width of zona | 4.0 to 19.0 μ |
| Ornament length | 1.0 to 7.5 μ |
| Ornament breadth | 1.5 to 4.0 μ |
| Distal perforation | None to 31.0 μ |
| Max. height of laesural muri | 3.5 to 7.5 μ |
| Width of laesural ridge | 1.5 to 6.0 μ |
| Wall thickness | 2.1 to 3.8 μ |

Holotype: Plate 1, figures 9-11. Slide F-52-G-1: 114.0 \times 17.2 (Ortholux coordinates).



TEXT-FIGURE 1

Diagrammatic sketch of *Aequitriradites ornatus*, excluding ornamentation. A, ridged laesura; B, membranous murus surmounting laesural ridge; C, wall of central spore body; D, membranous zona.

Remarks: The name is based on the prominent ornamentation of the species. *A. ornatus* is similar in general aspect to both *A. verrucosus* (Cookson and Dettmann) and *A. spinulosus* (Cookson and Dettmann), but differs from both in the ridged nature of the laesurae, the membranous muri surmounting the laesural ridges, and the distinctly circular body. Specimens of *A. ornatus* may appear alete in the polar area when viewed from the distal side (plate 1, figures 1-2). The thick spore coat and heavy ornamentation prevent a clear view of the proximal surface. Reversal of the slide, however, reveals the laesurae on the proximal face. The membranous muri along the laesural ridges (text-figure 1) are difficult to see and to photograph, but careful study revealed their presence on every specimen examined.

Occurrence: Upper Cretaceous, Frontier Formation, samples F-45 and F-52, Little Horse Creek section, Fremont County, Wyoming. The species is not common in either sample and constitutes less than one per cent of either microfossil assemblage.

Specimens of *A. ornatus* have also been noted (Burgess, personal communication) in the Frontier Formation at Soap Creek, Sections 35 and 36, T. 6 S., R. 33 E., Big

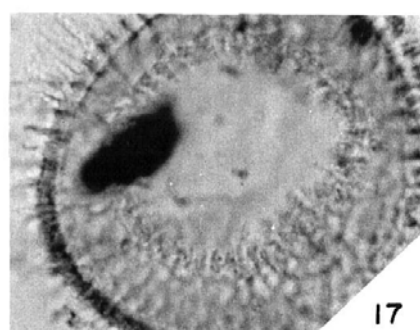
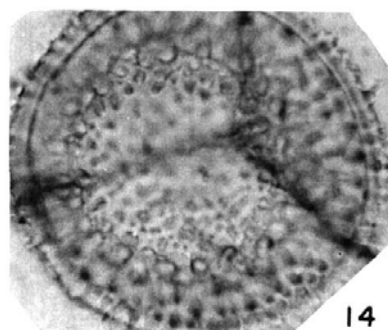
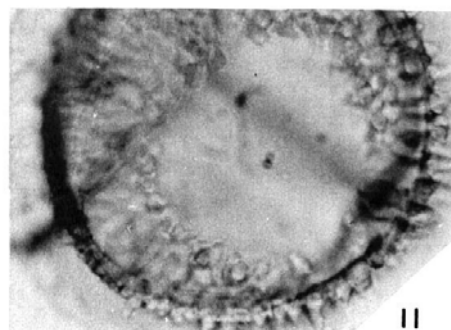
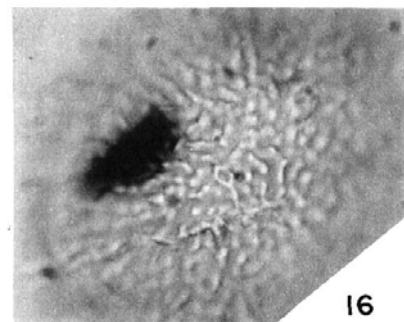
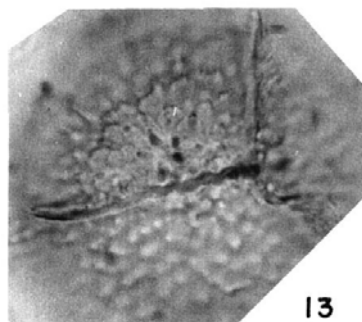
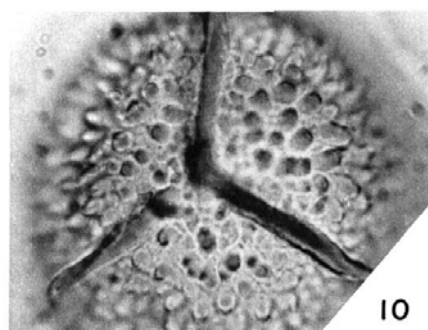
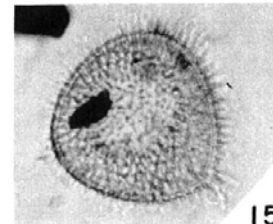
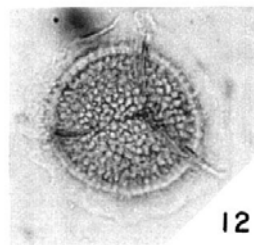
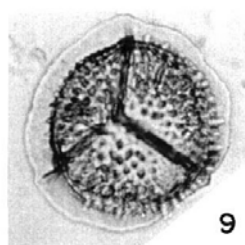
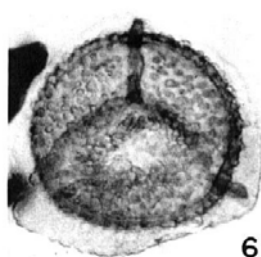
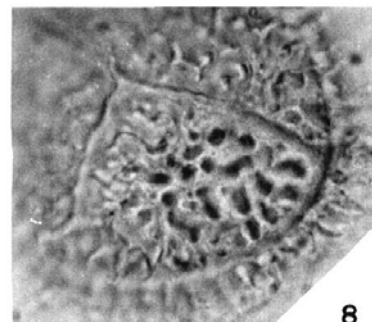
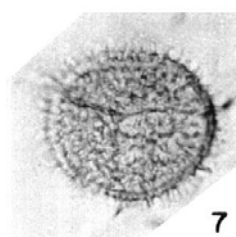
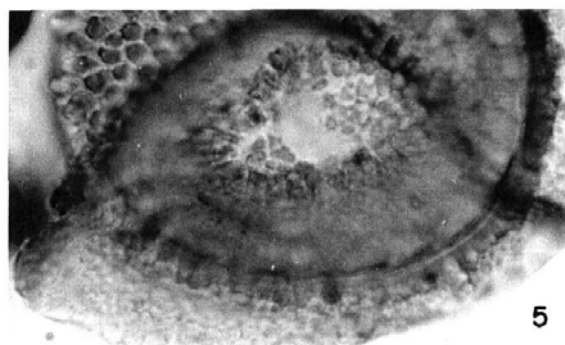
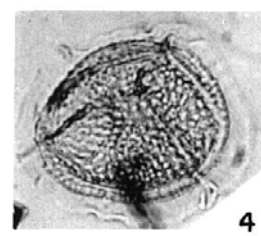
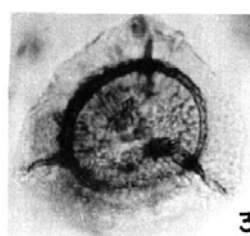
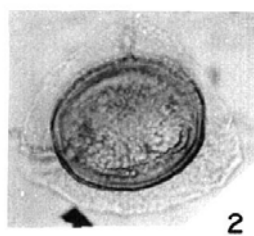
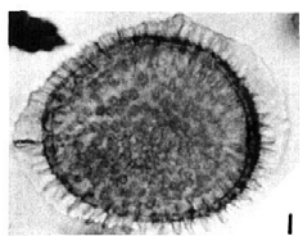
PLATE 1

Aequitriradites ornatus Upshaw, n. sp.

1-6, 1, paratype, 90 μ , \times 400; 2, paratype, 68 μ , \times 400; 3, paratype, 76 μ , \times 400; 4, paratype, 79 μ , \times 400; 9-14 5-6, paratype, 83 μ ; 5, \times 1000; 6, \times 400; 9-11, holotype, 72 μ ; 9, \times 400; 10-11, \times 1000; 12-14, paratype; 68 μ ; 12, \times 400; 13-14, \times 1000.

Aequitriradites fimbriatus Upshaw, n. sp.

7-8, 7-8, paratype, 71 μ ; 7, \times 400; 8, \times 1000; 15-17, holotype, 76 μ ; 15, \times 400; 16-17, \times 1000.



Horn County, Montana. The specimens are from a sample taken 220 feet above the base of the formation.

A. ornatus occurs in samples of the Mesaverde Formation from Sec. 3, T. 17 N., R. 90 W., Carbon County, Wyoming, but the possibility of redeposition makes it inadvisable at present to extend the range of the species to the late Upper Cretaceous.

***Aequitriradites fimbriatus* Upshaw, new species**
Plate 1, figures 7-8, 15-17

Description: Spores are radial, trilete, zonate, broadly rounded to subtriangular in equatorial outline. The zona is membranous, transparent, fragile, discontinuous, its remnants being supported by long, slender, equatorial spines. The zona is broadest at the ends of the laesurae. The central body is ornamented by densely arranged spines which may be laterally united at the base to form short, narrow, vermiculate ridges. The spines are short in the polar areas and become progressively longer toward the equator. In many specimens there is a large, somewhat excentric perforation in the distal spore wall. The laesurae are indistinct to distinct, simple to ridged. The laesural ridges, when present, do not exceed 1.0 μ in width and they may or may not bear thin, low, membranous muri. The spore wall is thick and body folds are not common.

Dimensions (based on 7 specimens):

| | |
|------------------------------|--------------------|
| Max. outside dimension | 71.0 to 76.0 μ |
| Central body diameter | 54.0 to 55.0 μ |
| Width of zona | 7.5 to 12.5 μ |
| Ornament length | 2.0 to 5.5 μ |
| Ornament breadth | 1.5 to 2.1 μ |
| Distal perforation | None to 30.0 μ |
| Max. height of laesural muri | None to 3.0 μ |
| Width of laesural ridge | None to 1.0 μ |
| Wall thickness | 2.0 to 2.5 μ |

Holotype: Plate 1, figures 15-17. Slide F-52-G-1: 119.6 \times 15.8 (Ortholux coordinates).

Remarks: The name is based on the characteristic appearance of the zona. *A. fimbriatus* differs from other species of the genus in the nature of the zona and in the appearance of the surface ornaments in plan view. The species, however, is quite variable in the prominence of the body ornaments, in size, and in the nature of the laesurae. Further subdivision may be possible as additional material becomes available for study.

Occurrence: Upper Cretaceous, Frontier Formation, sample F-52, Little Horse Creek section, Fremont County, Wyoming. The species is not common and constitutes less than one per cent of the microfossil assemblage.

ASSOCIATED MICROFOSSILS

Sample F-45, a dark-gray shale, contains abundant spores, pollen grains, dinoflagellates and hystrichosphaerids. It is apparently a shallow-water, near-shore,

marine deposit. The assemblage is 45 per cent microplankton and 55 per cent spores and pollen as determined from a count of 300 specimens. Plant microfossils include inaperturate, bivesiculate and tricolpate pollen grains, and more than 18 genera of small spores including *Cicatricosisporites*, *Appendicisporites*, *Gleichenioidites*, *Lycopodiumsporites* and *Taurocusporites*.

Sample F-52, a coal, contains abundant spores and pollen grains. Pollen grains include inaperturate, bivesiculate, polyaplicate and tricolpate types. Small spores of more than 25 genera are present, including *Cicatricosisporites*, *Appendicisporites*, *Lycopodiumsporites*, *Taurocusporites*, *Perotrilites*, *Reticulosporis*, *Gleichenioidites*, and several which are probably new.

TYPES

The slides containing the holotypes and paratypes of *Aequitriradites ornatus* and *Aequitriradites fimbriatus* are currently in the writer's care and will be permanently deposited in the paleontological type collection of the Department of Geology, University of Missouri, Columbia, Missouri.

Two sets of coordinates are given below for each specimen. The first gives the values of vertical and horizontal readings on a Leitz Ortholux microscope equipped with a standard mechanical stage. The second set of values gives the distance in millimeters, vertical and horizontal, to the specimen from a + inscribed on the slide above and to the right of the cover slip.

***Aequitriradites ornatus* Upshaw, n. sp.**

| TYPE | SLIDE | COORDINATES | | PLATE 1, FIGURES |
|----------|-----------|---------------------|--------------------|---------------------|
| | | ORTHOLUX | FROM + | |
| Holotype | F-52-G-1 | 114.0 \times 17.2 | 15.8 \times 6.8 | 9-11 |
| Paratype | F-52-G-1 | 109.0 \times 26.1 | 20.9 \times 15.6 | 4 |
| Paratype | F-52-G-12 | 111.8 \times 20.5 | 18.0 \times 11.2 | 5-6 |
| Paratype | F-52-F-2 | 121.6 \times 10.7 | 7.8 \times 4.9 | 3 |
| Paratype | F-52-G-5 | 120.7 \times 35.4 | 9.1 \times 22.4 | 1 |
| Paratype | F-52-G-4 | 109.6 \times 25.6 | 20.2 \times 15.7 | 2 |
| Paratype | F-52-H-7 | 124.6 \times 28.2 | 5.3 \times 19.3 | 12-14 |
| Paratype | F-45-C-2 | 108.4 \times 32.0 | 21.2 \times 20.9 | None |

***Aequitriradites fimbriatus* Upshaw, n. sp.**

| TYPE | SLIDE | COORDINATES | | PLATE 1, FIGURES |
|----------|----------|---------------------|--------------------|---------------------|
| | | ORTHOLUX | FROM + | |
| Holotype | F-52-G-1 | 119.6 \times 15.8 | 10.2 \times 5.5 | 15-17 |
| Paratype | F-52-G-2 | 119.6 \times 27.6 | 10.0 \times 17.6 | 7-8 |

REFERENCES

- BOLKHOVITINA, N. A.
1959 - *Spore-pollen complexes of the Mesozoic deposits of the Vilyuyk depression and their stratigraphic significance.* Acad. Sci. U. S. S. R., Geol. Inst., Proc., no. 24, pp. 1-185, pls. 1-8 [Russian].

AEQUITRIRADITES IN WYOMING

- COBBAN, W. A., and REESIDE, J. B., JR.
1952 - *Frontier Formation, Wyoming and adjacent areas*. Amer. Assoc. Petrol. Geol., Bull., vol. 36, no. 10, pp. 1913-1961, text-figs. 1-4.
- COOKSON, ISABEL C., and DETTMANN, MARY E.
1958 - *Some trilete spores from Upper Mesozoic deposits in the eastern Australian region*. Roy. Soc. Victoria, Proc., vol. 70, pt. 2, pp. 95-128, pls. 14-19, text-fig. 1.
1961 - *Reappraisal of the Mesozoic microspore genus Aequitriradites*. Palaeontology, vol. 4, pt. 3, pp. 425-427, pl. 52.
- DELCOURT, A., and SPRUMONT, G.
1955 - *Les spores et grains de pollen du wealdien du Hainaut*. Soc. Belg. Géol., Mém., n. ser., no. 5, pp. 1-73, pls. 1-4, text-figs. 1-15.
- LANTZ, J.
1958 - *Étude des spores et pollens d'un échantillon purbeckien de l'île d'Oléron*. Revue Micropal., vol. 1, no. 1, pp. 33-37, pl. 1.
- LOVE, J. D., TOURTELOT, H. A., JOHNSON, C. O., THOMPSON, R. M., SHARKEY, H. H. R., and ZAPP, A. D.
1947 - *Stratigraphic sections of Mesozoic rocks in central Wyoming*. Wyoming Geol. Survey, Bull. no. 38, pp. 1-59.
- MALYAVKINA, V. S.
1949 - *Determinator of spores and pollen. Jurassic - Cretaceous*. V. N. I. G. R. I., Trudy, n. ser., no. 33, pp. 1-137, pls. 1-51 [Russian].
- MOHAN, K.
1962 - *News Reports. India*. Micropaleontology, vol. 8, no. 2, p. 278.
- POCOCK, S. A. J.
In press - *Microfloral analysis and age determination of strata at the Jurassic-Cretaceous boundary in the western Canada plains*. Paläontographica, Abt. B.
- POTONIE, R.
1956 - *Synopsis der Gattungen der Sporae dispersae. Teil I - Sporites*. Geol. Jahrb., suppl. 23, pp. 1-103, pls. 1-11.
- POTONIE, R., and KREMP, G.
1954 - *Die Gattungen der paläozoischen Sporae dispersae und ihre Stratigraphie*. Geol. Jahrb., vol. 69, pp. 111-194, pls. 4-20, text-figs. 1-5.
- UPSHAW, C. F.
1959 - *Palynology of the Frontier Formation, northwestern Wind River Basin, Wyoming*. Unpublished dissertation, Univ. Missouri, Columbia, Mo., pp. 1-458.