Palynomorphs from the Santonian Uge Member

According to his examination, exine of *Sequoia sempervirens*, *Glyptostrobus pensilis* and *Taxodium distichum* becomes thin in thickness in the annular ring as in *Cryptomeria japonica*.

The present specimens are identified with *Sequoiapollenites gracilis* Krutzsch from the early and middle Tertiary of middle Europe.

**Botanical affinity**: Taxodiaceae, *Sequoia*.

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**Sequoiapollenites sp. a**

*Pl. 56, fig. 2.*

**Description**: Small conifer pollen grain with a short ligula. Outline subcircular to oval in lateral view. Exine very thin, finely punctate to weakly granulate, with secondary folds. The grain possesses no annular ring which is provided with a short ligula (2.5 μm long), which is laevigate and tapers off swiftly.

**Measurements**: 31 X 26 μm in diameter.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Remarks**: A single specimen was found. This grain has no annular ring around a short ligula.

**Botanical affinity**: Taxodiaceae, *Metasequoia*.

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**Sequoiapollenites sp. b**

*Pl. 56, fig. 5.*

**Description**: Small conifer pollen grain with a long ligula. Outline somewhat oval in lateral view. Exine very thin, chagrenate, with secondary folds. The grain has a clear annular ring which is smooth in exine and the long ligula 8 μm long and 4 μm wide at base, somewhat punctate near base.

**Measurements**: 25 X 14 μm in diameter.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Remarks**: Only one specimen was observed. This is similar to *Sequoiapollenites megaligulus* Krutzsch (1971, p. 222, pl. 73, figs. 25–35) from the Oligo-Miocene of Germany, but differs by its form of the ligula and structure of the exine.

**Botanical affinity**: Taxodiaceae, *Sequoia*.

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**Sequoiapollenites sp. c**

*Pl. 59, fig. 8.*
Description: SEM photomicrograph. The grain is splitting. Exine finely uneven. A small ligula is situated on the middle of grain probably with an annular ring in polar view.

Measurements: 17.6 μm in diameter.

Occurrence: Uge Member, south of Kanuka (C 31).

Remarks: Only one specimen was observed. This is a small form with a ligula.

Botanical affinity: Taxodiaceae.

? Sequoiapollenites sp.
Pl. 55, figs. 11a–b.

Description: Outline rounded-triangular in polar view. The grain has a very small ligula-like process (2 μm long) (see fig. 11b). Exine very thin, less than 0.5 μm thick, laevigate. No annular ring.

Measurements: 15 X 15 μm in diameter.

Occurrence: Uge Member, north of Uge station (A)(C 33).

Remarks: Whether this specimen is the genus Sequoiapollenites or not, is not clear.

Botanical affinity: Unknown.

de Jersey 1964.

Type species: Vitreisporites signatus Leschik 1955.

Vitreisporites pallidus (Reissinger) Nilsson
Pl. 60, figs. 5–6; pl. 61, figs. 4–5.

1950 Pityosporites pallidus (Reissinger) Reissinger, Palaeontographica, 90, p. 109, pl. 15, figs. 1–5.
1957 Pityosporites pallidus Reissinger,  Balme, CSIRO, Coal Res. Sec., no. 25, p. 36–37, pl. 10, figs. 112, 113.
1958 Caytonipollenites pallidus (Reissinger) Couper, Palaeontographica, B, 103, Lfg. 4–6, p. 150, pl. 26, figs. 7–8.
1962 Vitreisporites pallidus (Reissinger) Nilsson, Pocock, Palaeontographica, B, 111,
Description: See Reissinger (1938) and Nilsson (1958).

Measurements: 18–34 μm in length (Reissinger, 1950); size range 20–38 μm (Couper, 1958); size range 25–30 μm (Nilsson, 1958); length of body 12–(17)–21 μm, breadth of bladders 6–(11)–13 μm, total breadth of grain 21–(30)–42 μm, length of bladders 9–(15)–19 μm, ratio length to breadth of body 1.2–(1.7)–2.6 (Pocock, 1962); grain size 22–29 μm central body 10–15 μm, air sacs 10 μm in height and 10–13 μm in width (Burger, 1966); overall breadth 21–(25)–33 μm, corpus breadth 7–(9)–10 μm, corpus length 10–(13)–15 μm, saccus breadth 11–(13)–17 μm, saccus length 10–(14)–18 μm (Kemp, 1970); 25–40 μm in overall length (Miki, 1972); total breadth of grain 25–38 μm, length of bladders 11–21 μm, breadth of bladders 7.5–16 μm, length of central body 14–21 μm, breadth of central body 7–16 μm (B. D. Tschudy,
1973); total width of grain 20–40 \( \mu m \), breadth of central body 6–18 \( \mu m \), length of central body 12–25 \( \mu m \), breadth of bladders 7–18 \( \mu m \), length of bladders 12–25 \( \mu m \) (Srivastava, 1975); 45 \( \mu m \) in size (Norvick & Burger, 1976); overall breadth of grain 25 \( \mu m \), breadth of central body 11, 6 \( \mu m \), length of central body 16 \( \mu m \), breadth of bladders 10, 4 \( \mu m \), length of bladders 16 \( \mu m \) (Takahashi, 1988); the present specimens: overall breadth of grain 38–49 \( \mu m \), overall length of grain 17–30 \( \mu m \), breadth of central body 8–15 \( \mu m \), length of central body 16, 5–27 \( \mu m \), breadth of bladders 15–20 \( \mu m \), length of bladders 23–30 \( \mu m \).

**Occurrence**: Uge Member, south of Kanuka (C 31), Uge (C 34), and cliff near private house, north of Uge station (C 6).

**Previous records**: Lower Jurassic (Lias) (Reissinger, 1938); Eocene (Reissinger, 1950); Mesozoic, western Australia (Balme, 1957); Middle Jurassic, Yorkshire (England); Aptian, Isle of Wight (England) (Couper, 1958); Lower Jurassic (Lias), Sweden (Nilsson, 1958); Early Cretaceous, western Canada plains (Pocock, 1962); Early Triassic, western Australia (Balme, 1958); Early Cretaceous, Maryland (U.S.A) (Brenner, 1963); Albian, east-central Alberta (Canada) (Singh, 1964); Upper Jurassic-middle Valanginian, the eastern Netherlands (Burger, 1966); middle Cretaceous, deep sea core, northeast of Cat Island, the Bahamas, West Indies (Habib, 1969); Aptian-Albian, southern England (Kemp, 1970); Santonian-lower Campanian, Kuji (Japan) (Miki, 1972); Coniacian, Futaba (Japan) (Miki, 1972); Cenomanian-Turonian, Hokkaido (Japan) (Miki, 1973), upper Campanian, north-central Montana (U.S.A) (B. D. Tschudy, 1973); Albian, Oklahoma (U.S.A) (Srivastava, 1975); Cenomanian, Bathurst Island, Northern Territory (Australia) (Norvick & Burger, 1976); Lower Cretaceous, Queensland (Australia) (Burger, 1980); Coniacian, Futaba (Japan) (Takahashi, 1988).

**Remarks**: *Vitreisporites pallidus* (Reissinger) Nilsson is similar to *Vitreisporites signatus* Leschik from the upper Triassic of Switzerland, but differs in having no Y-mark on the proximal pole.

**Botanical affinity**: Caytoniales, *Caytonanthus*.

**Gymnosperm-angiosperm incertae sedis**

**Genus Clavatipollenites** Couper 1958.

Type species: *Clavatipollenites hughesii* Couper 1958.

*Clavatipollenites variabilis* n. sp.
Description: Monosulcate pollen grains. Outline circular to sub-circular or oval in polar and lateral view. Sulcus broad 3–12 μm wide, extending full length of grain, gaping often in its central region and tapering slightly towards extremities; its margin ragged, fringed with clavate ornaments (2–3 μm high.
and 2–3 μm wide); sulcus frequently indistinct and represented as an area with coarser clavae or as an indeterminate tear in the exine. Exine consisting of inner unsculptured endexine ca. 0.5 μm thick and ectexine formed of baculate or clavate projections 1–1.5 μm long, which either remain discrete or fuse at their tips to form a microreticulum or a tectate exine; lumina of reticulum irregularly polygonal, 0.5–2 μm in diameter. Grain often folded. 

**Measurements:** 33–53 μm X 28–47 μm in diameter.

**SEM:** 24.7–28.2 μm X 22.9–24.1 μm in diameter.

**Occurrence:** Uge Member, south of Kanuka (C 31), cliff near private house, north of Uge station (C 6), and north of Uge station (C 15). 

**Holotype:** Pl. 80, figs. 3 a–b; 38 X 36 μm in diameter; clavate projections 1.5–2 μm high in sulcus and 1–1.5 μm high in the exine; tectate exine; lumina of reticulum 0.5–2 μm in diameter; slide C31-b. 

**Name derivation:** variabil-(is) (lat.) = vary, -able.

**Remarks:** The present specimens which occurred abundantly from the Uge Member, are closely similar to *Clavatipollenites tenellus* Phillips & Felix (1972, p. 466, pl. 15, figs. 19–21; Ward, 1986, pp. 28–29, pl. 1, figs. 11–12) from the Albian of Louisiana and Kansas (U.S.A.), but differ by the larger size. 

**Botanical affinity:** ? Chloranthaceae, (Ascarina).

**Genus Clavainaperturites** Van der Hammen & Wijmstra 1964.

**Type species:** *Clavainaperturites clavatus* Van der Hammen & Wijmstra 1964.

**Clavainaperturites** sp. a

Pl. 97, fig. 7.

**Description:** Inaperturate pollen grain with verrucate and clavate ornaments. Outline originally circular (?). Exine with verrucate, clavate elements, 1–2.5 μm high and 0.5–2 μm wide, secondary folded. 

**Measurements:** 54 X 42 μm in diameter. 

**Occurrence:** Uge Member, south of Kanuka (C 31). 

**Remarks:** A single specimen was observed. The authors cannot find a comparable species. 

**Botanical affinity:** Unknown.

**Clavainaperturites** sp. b

Pl. 97, fig. 8.
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**Description:** Inaperturate pollen grain with clavate and verrucate sculptures. Outline circular. Exine clavate and verrucate, 1 - 4 μm high and 0.5 - 6 μm in diameter; projections distributed relatively densely.

**Measurements:** 49 X 46 μm in diameter.

**Occurrence:** Uge Member, Uge (C 34).

**Remarks:** Only one specimen was encountered.

**Botanical affinity:** Unknown.

**Angiospermic pollen**

Genus *Arecipites* Wodehouse 1933.

Type species: *Arecipites punctatus* Wodehouse 1933.

*Arecipites pflugii* (Takahashi) Krutzsch

Pl. 86, fig. 16.


1979 *Arecipites pflugii* (Takahashi) Krutzsch, Takahashi & Kim, Palaeontographica, B, 170, p. 35, pl. 8, figs. 23, 28, 29.

**Description:** See Takahashi (1961).

**Measurements:** 18.5 - 34.5 μm in size, lumina of reticulum 1 - 3 μm in diameter, colpus less than 2 μm wide (Takahashi, 1961); 18 - 27 μm X 11.8 - 19.5 μm in size, exine 0.7 μm thick, lumina of reticulum until 1 μm in diameter, muri until 1.2 μm high (Takahashi & Kim, 1979); the present specimen: 35 X 19 μm in size, exine 1 μm thick, lumina of reticulum 1 - 3 μm in diameter, width/length ratio 0.543.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Previous records:** Palaeogene, West Japan (Takahashi, 1961); Campanian, Hokkaido (Japan) (Takahashi, 1964); early Miocene, Changgi (Korea) (Takahashi & Kim, 1979).

**Remarks:** The only specimen detected reveals all the characteristic features of *Arecipites pflugii* (Takahashi) Krutzsch.

**Botanical affinity:** ? Palmae.
**Arecipites** sp. a
Pl. 86, fig. 14.

**Description:** Monocolpate pollen grain. Amb elliptical or prolate in polar view. Colpus narrow, undulate. Exine finely reticulate; lumina of reticulum 0.5 μm ± in diameter.

**Measurements:** 28 X 17 μm in size.

**Width/length ratio:** 0.607.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** Only one specimen was observed.

**Botanical affinity:** ? Palmae.

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**Arecipites** sp. b
Pl. 86, fig. 15.

**Description:** Monocolpate pollen grain. Outline elliptical or prolate in polar view. Colpus very slender, straight. Exine thin, finely reticulate; lumina of reticulum 0.5–1 μm in diameter.

**Measurements:** 32 X 22 μm in size.

**Width/length ratio:** 0.687.

**Occurrence:** Uge Member, cliff near private house, north of Uge station (C 6).

**Remarks:** The only specimen observed differs from the formerly described species of *Arecipites*.

**Botanical affinity:** ? Palmae.

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**Arecipites** sp. c
Pl. 87, fig. 1.

**Description:** Monocolpate pollen grain. Outline elliptical or prolate with more or less pointed corners in polar view. Colpus slender, slightly curved, reaching both corners. Exine thin, 1 μm thick, finely reticulate; lumina of reticulum less than 0.5 μm in diameter.

**Measurements:** 26 X 13.5 μm in size.

**Width/length ratio:** 0.519.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** Only one specimen was found.

**Botanical affinity:** ? Palmae.
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*Arecipites* sp. d
Pl. 87, fig. 2.

**Description:** Monocolpate pollen grain. Amb elliptical or prolate with point-ed corners in polar view. Colpus frail, straight, reaching both corners. Exine finely reticulate; lumina of reticulum 1–1.5 μm in diameter; muri baculate, 1 μm high.

**Measurements:** 35 X 23 μm in size.

**Width/length ratio:** 0.657.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Remarks:** The only specimen observed is superficially similar to *Arecipites longicolpatus* Krutzsch (1970, p. 112, pl. 25, figs. 1–13), but differs in having broader form and weaker colpus.

**Botanical affinity:** ? Palmae.

*Arecipites* sp. e
Pl. 87, figs. 3–4.

**Description:** Monocolpate pollen grains. Outline broad-elliptical or prolate-subprolate in polar view. Colpus narrow, curved, almost reaching both corners. Exine reticulate; lumina of reticulum 1–4 μm in diameter; muri baculate, partially tectate, 1.5–2 μm high.

**Measurements:** 29–32 μm X 20–27 μm in size.

**Width/length ratio:** 0.689–0.843.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Remarks:** The grains resemble superficially *Arecipites oligocaenicus* Krutzsch (1970, p. 108, pl. 23, figs. 1–10) from the Oligocene of Germany, but differ in having larger reticulum and muri.

**Botanical affinity:** ? Palmae or ? Liliaceae.


Type species: *Artiopollis indivisus* Agasie 1969.

*Artiopollis cf. indivisus* Agasie
Pl. 95, figs. 5 a–c.

1969 *Artiopollis indivisus* Agasie, Micropaleontology, 15, no. 1, p. 28, pl. 4, figs. 6–8.
Description: See Agasie (1969).
Measurements: Diameter of tetrad 27—(35)—46 μm, exine about 2.5—3 μm thick, lumina of reticulum about 0.5—1.5 μm in diameter, muri 0.5—1 μm wide (Agasie, 1969); the present specimen: 40 x 35 μm in diameter of tetrad, lumina of reticulum 1—3 μm in diameter, muri baculate-tectate, 1 μm high, each grain of the tetrad 28 x 23 μm in diameter.
Occurrence: Uge Member, south of Kanuka (C31).
Previous record: Early Late Cretaceous (Cenominian), Arizona (U.S.A.) (Agasie, 1969).
Remarks: A single specimen was observed. This is closely similar to Artiopollis indivisus Agasie from the early Late Cretaceous (Cenomanian) Dakota Sandstone of Arizona, but differs somewhat from the latter in its minute comparison of reticulum and muri.
Botanical affinity: Dicotyledonae.

Type species: Asteropollis asteroides Hedlund & Norris 1968.

*Asteropollis clavatus* (Phillips & Felix) Ward
Pl. 82, figs. 6-7.

1969 *Clavatipollenites* sp., Doyle, Jour. Arnold Arboretum, 50, no. 1, fig. 1-h.

Description: See Phillips & Felix (1972) and Ward (1986).
Measurements: 24—(27)—30 μm in equatorial diameter (holotype 25 μm), clavate projections 0.5—0.75 μm high (Phillips & Felix, 1972); 30 μm in diameter (Doyle, 1969); 25 μm in diameter (Ward, 1986); the present specimens: 27.7—30.6 μm X 19—23 μm in diameter, clavate-baculate projections in the triradiate zone 1.7—2.4 μm long.
Occurrence: Uge Member, south of Kanuka (C31).
Previous records: Upper Albian-lower Cenomanian, Atlantic coastal plain (U. S. A.) (Doyle, 1969); Albian, Louisiana (U.S.A.) (Phillips & Felix, 1972); Lower Cretaceous, Queensland (Australia) (Burger, 1980); Albian, Kansas (U.S.A.)
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**Remarks:** Ward (1986) stated that *Asteropollis clavatus* is treated as variants of *A. asteroides* and its oriodate sulcus ends of the triradiate zone are warranted as a specific distinction.

**Botanical affinity:** Unknown.

Genus *Callistopollenites* Srivastava 1969.


*Callistopollenites radiatostriatus* (Mtchedlishvili) Srivastava

Pl. 88, figs. 27 a–b.

1961 *Tricolporites radiatostriatus* Mtchedlishvili, Trudy VNIGRI, no. 177, p. 249–250, pl. 81, figs. 1 a–g, 2 a–b.

1965 *Tricolporo-pollenites radiatostriatus* (Mtchedlishvili) Bratzeva, Trudy Geol Inst., Acad. Sci. USSR, 129, pp. 26–27, pl. 10, figs. 4–8; pl. 11, figs. 1–7; pl. 12, figs. 1–6 (p.p.).


**Description:** See Mtchedlishvili in Samoilovitch & Mtchedlishvili (1961) and Srivastava (1969).

**Measurements:** 23.8–35.4 μm in diameter (Mtchedlishvili in Samoilovitch & Mtchedlishvili, 1961); 25–47 μm in equatorial diameter, 23–30 μm in length, exine 2–2.5 μm thick (Bratzeva, 1965); 30.4–36.0 μm in polar axis, 28.8–36.8 μm in equatorial axis (Srivastava, 1969); 24–39 μm in diameter, exine 2–2.5 μm thick (Chlonova, 1969); 38 X 33.5 μm in equatorial diameter, muri 1.7 μm high (Takahashi & Shimono, 1982); the present specimen: 36 X 32 μm in diameter, muri baculate, 1 μm high.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Previous records:** Maastrichtian-Danian, western Siberian lowland (Mtchedlishvili, 1961); Maastrichtian, Zeya-Bureya depression (Bratzeva, 1965, 1969;
Chlonova, 1969); Maastrichtian, Alberta (Canada) (Srivastava, 1969); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

**Remarks:** Hitherto, this species has been reported from the Maastrichtian of Canada, the Far East, western Siberian lowland and Japan, and this time was found first from the Santonian of Taneichi (Japan).

**Botanical affinity:** Unknown.

**Genus Cricotriporites Leidelmeyer 1966.**

Type species: *Cricotriporites guianensis* Leidelmeyer 1966.

*Cricotriporites* sp.

Pl. 95, fig. 8.

**Description:** Triporate pollen grain. Outline subcircular in polar view. Exine two-layered, secondary foleded; ektexine finely punctate on the surface; muri finely baculate in the optical section, 0.6 μm high; endexine thin, 0.5 μm thick. Pores circular, 6–6.5 μm in diameter and furnished with both an annulus and costae pori; thickness of annulus ca. 1–3 μm; one pore is placed subequatorially.

**Measurements:** 45 X 37 μm in equatorial diameter.

**Occurrence:** Uge Member, Uge harbor (A) (C 39).

**Remarks:** A single specimen was observed. This is much larger than *Criotriporites guianensis* Leidelmeyer from the early Eocene of British Guyana (1966, p.54, pl. 4, fig. 4), *C. anulatus* Takahashi & Jux (1989, p. 260, pl. 16, figs. 6–7) and *C. nigerianus* Takahashi & Jux from the Middle Tertiary of Nigeria (1989, pp. 260–261, pl. 16, figs. 10–16; pl. 38, figs. 1–2).

**Botanical affinity:** Unknown.

**Genus Cupulferoidaepollenites Potonié, Thomson & Thiergart 1950 ex Potonié 1960.**


*Cupulferoidaepollenites ditis* (Takahashi) Takahashi

Pl. 87, fig. 10, pl. 98, fig. 7.


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1979 *Cupuliferidaepollenites ditis* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 37, pl. 9, figs. 1–2.


**Description:** See Takahashi (1957).

**Measurements:** 15–47 μm in size (holotype 31.1 X 19.2 μm in size), width/length ratio: 0.4–0.8 (Takahashi, 1957; 25–30.7 μm X 16–20.2 μm in size, exine thin (Takahashi & Kim, 1979); 20.3 X 14.3 μm in size, exine thin, 0.7 μm in the pole area, width/length ratio: 0.7 (Takahashi, 1988); the present specimen: 29 X 16 μm in size, exine 0.7 μm in the pole area, width/length ratio: 0.55.

**Occurrence:** Uge Member, south of Kanuka (C31).

**Previous records:** Palaeogene and Miocene, Japan (Takahashi, 1957, 1961); Maastrichtian and Eocene, Oyubari-Hokkaido (Japan) (Takahashi, 1964); early and middle Miocene, Korea (Takahashi & Kim, 1979); Coniacian, Futaba (Japan) (Takahashi, 1988).

**Remarks:** This species appears abundantly in the Palaeogene of Japan. Here in the Uge Member, only one specimen was found.

**Botanical affinity:** Cupuliferae.

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**Cupuliferidaepollenites fallax** (Potonié) Potonié

Pl. 87, figs. 20–25; pl. 98, figs. 4, 8–10.


1951 *Cupuliferotipollenites fallax* Potonié, Palaeontographica, B, 91, pl. 20, fig. 66.


1979 *Cupuliferidaepollenites fallax* (Potonié) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 38, pl. 9, figs. 2 (?), 22–23.

Description: See Potonie (1934) and Thomson & Pflug (1953).

Measurements: 12–14 μm in size (Potonie, 1934); 13 μm in size (Potonie, 1951); 10–18 μm in size (Thomson & Pflug, 1953); 12–18 μm in size (Krutzsch & Vanhoorn, 1977); 11–13.5 μm X 6.7–8.2 μm in size, exine thin, 0.3–0.6 μm thick (Takahashi & Kim, 1979): 7.4 X 13.3 μm, width/length ratio: ca. 0.6 (Thiele-Pfeiffer, 1980); 11.7–14.4 μm X 5.0–7.7 μm in size, width/length ratio: 0.4–0.5 (Takahashi & Jux, 1982); 14 X 17 μm in size (Mohr, 1984); 12 μm in size (Kirchner, 1984); 10–17 μm in size (Nagy, 1985); 10–18 μm X 5–8 μm in size, width/length ratio: 0.4–0.5 (Takahashi & Jux, 1986); 11.4–18 μm X 6.6–11 μm in size, width/length ratio: 0.42–0.76 (Takahashi, 1988); 16 X 10 μm in size, width/length ratio: 0.625 (Takahashi & Jux, 1989); the present specimens: 16.5–19 μm X 9–11 μm in size (SEM: 12.8–15 μm X 7.3–10 μm in size).

Occurrence: Uge Member, south of Kanuka (C 31), cliff near private house, north of Uge station (C 6), north of Uge station (A) (C 33), and Uge harbor (C 17).

Previous records: Eocene, Geiseltal (Germany) (Potonie, 1934, 1951); Palaeocene-Pliocene, W. - Germany (Thomson & Pflug, 1953); Palaeogene-Miocene, West Japan (Takahashi, 1961); upper Landenian, Epinois and Loksbergen.
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(Belgium) (Krutzsch & Vanhoorn, 1977); middle Miocene, Yonil (Korea) (Takahasi & Kim, 1979); Miocene, Wackersdorf/Oberpfalz (W. -Germany) (Thieles-Pfeiffer, 1980); late Oligocene, Bergish land (W. -Germany) (Takahashi & Jux, 1982); late Miocene, Frechen and Fortuna Garsdorf (W. -Germany) (Mohr, 1984); late Oligocene, south Bavaria (W. -Germany) (Kirchner, 1984); Miocene, Hungary (Nagy, 1985); late Oligocene, St Augustin (W. -Germany) (Takahashi & Jux, 1986); Coniacian-Santonian, Futaba (Japan) (Takahashi, 1988); late Eocene to early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989).

Remarks: This species appears widely in the Tertiary of Europe and in the Palaeogene and Upper Cretaceous of Japan.

Botanical affinity: Regarding its botanical relationship, Leguminosae, Cupuliferae and other herbs are mentioned (Potonie, 1934; Thomson & Pflug, 1953; Nagy, 1985).

*Cupuliferoidaepollenites lanceolatus* n. sp.

Pl. 87, figs. 26-28; pl. 98, fig. 11 (cf.).

Description: Tricolpate pollen grains. Amb long-elliptical or perprolate in equatorial view. Three colpi narrow, running parallel from pole to pole. Exine two-layered, thin, 0.5-1 µm thick, laevigate or weakly intrabaculate.

Measurements: 19-23 µm X 6-10. 5 µm in size.

Width/length ratio: 0.315-0.5.

(SEM: 29.3 X 11 µm in size; width/length ratio: 0.375).

Occurrence: Uge Member, south of Kanuka (C 31).

Holotype: Pl. 87, fig. 27; 23 X 8.5 µm in size, exine 1 µm thick, very weakly intrabaculate; width/length ratio: ca. 0.37; slide C 31-b.

Name derivation: *lanceolatus* (lat.) = lanceolate.

Remarks: The present specimens resemble *Cupuliferoidaepollenites liblarensis* (Thomson 1950) Potonie 1960 and *Tricolpopollenites lanceolatus* Takahashi & Jux (1989, p. 408, pl. 12, figs. 2-4), but differ from *C. liblarensis* in being much narrow and longer form and from *T. lanceolatus* in having laevigate or weakly intrabaculate exine.

Botanical affinity: Unknown.

*Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi

Pl. 87, figs. 11-14; pl. 88, figs. 16-18;
pl. 97, figs. 9-10.
1957 *Tricolporopollenites vulgaris* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., 5, no. 4, p. 218, pl. 38, figs. 44–45; pl. 39, fig. 38.


1979 *Cupuliferoidaeapollenites vulgaris* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 37, pl. 9, figs. 7–8.

**Description:** See Takahashi (1957) and Takahashi & Kim (1979).

**Measurements:** 14–36 μm in size, exine less than 1 μm thick, width/length ratio: 0.4–0.8 (type 25 X 17.2 μm in size, exine 0.8 μm thick, width/length ratio: ca. 0.7) (Takahashi, 1957); 22–23, 6 μm X 12, 2–12, 6 μm in size, exine thin (Takahashi & Kim, 1979); the present specimens: 17–27 μm X 10–17 μm in size (SEM: 18.8–21 μm X 9.4 μm in size), exine 0.5–1 μm thick, more or less chagrenate, width/length ratio: 0.45–0.765.

**Occurrence:** Uge Member, south of Kanuka (C 31), north of Uge station (A) (C 33), and north of Uge station (C 15).

**Previous records:** Palaeogene, north and west Japan (Takahashi, 1957, 1961, 1964); middle Miocene, Yonil (Korea) (Takahashi & Kim, 1979).

**Remarks:** Morphologically the specimens appear to be closely comparable to those of *Cupuliferoidaeapollenites vulgaris* (Takahashi) Takahashi.

**Botanical affinity:** Cupuliferae.

**Genus Cyrillaceaepollenites** Mürriger & Pflug ex Potonie 1960.

**Type species:** *Cyrillaceaepollenites megaexactus* (Potonie 1931) Potonie 1960.

**Cyrillaceaepollenites minor** (Takahashi) Takahashi

Pl. 94, figs. 6–8.


1979 *Cyrillaceaepollenites minor* (Takahashi) Takahashi, Takahashi & Kim, Palaeonto-
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**Description:** See Takahashi (1961) and Takahashi & Kim (1979).

**Measurements:** 13.4–24.5 μm in size, exine less than 1 μm thick, width/length ratio: 0.8–1.0 (holotype ca. 17 μm in size) (Takahashi, 1961); 11–17.2 μm X 8–16 μm in size, exine 0.5–1.2 μm thick, width/length ratio: 0.75–0.88 (Takahashi & Kim, 1979); the present specimens: 13–18 μm X 12–17 μm in size, exine 0.5 μm thick, width/length ratio: 0.888–0.923.

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Previous records:** Palaeogene and Miocene, western Japan (Takahashi, 1961); Campanian to Maastrichtian and Eocene, Hokkaido (Japan) (Takahashi, 1964); middle Miocene, Yonil (Korea) (Takahashi & Kim, 1979).

**Remarks:** The minor form of *Cyrillaceaepollenites* is closely similar to *Cyrillaceaepollenites megaexactus* (Potonie, 1931) Potonie (1960) and *C. exactus* (Potonie, 1931) Potonie (1960) from the Tertiary of Middle Europe, but differs by its thinner exine.

**Botanical affinity:** Cyrillacea, *Cyrilla*.

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**Genus Fibulapollis** Chlonova 1961 emend. Stanley 1970.

**Type species:** *Fibulapollis mirificus* (Chlonova 1957) Chlonova 1961.

**Fibulapollis enodatus** (Chlonova) Takahashi

Pl. 85, figs. 8–9; pl. 86, figs. 1–5.


**Description:** See Chlonova (1961).

**Measurements:** 45–(57)–69 μm in size (Chlonova, 1961); the present specimens: 29–45 μm X 28–43 μm in diameter (37–52 μm in length of a side in polar view), exine striate or net-like, muri baculate-tectate, 1–2 μm high.

**Occurrence:** Uge Member, south of Kanuka (C 31) and Uge (C 34).

**Remarks:** The Uge specimens are more of less smaller than the Chlonova’s specimens, but seem identical to *Fibulapollis* (al. *Accuratipollis*) *enodatus*
(Chlonova) Takahashi 1982.

**Botanical affinity:** Santalaceae or Loranthaceae.

*Fibulapollis evanidus* (Chlonova) Takahashi

Pl. 85, figs. 1–7.


**Description:** See Chlonova (1961).

**Measurements:** 23–(27)–34 μm in size (Chlonova, 1961); the present specimens: 32–40 μm in overall length in lateral view, 22–31 μm in height, 15–20 μm in width of wings, 15–22 μm in length of wings, exine finely reticulate, lumina 0.5–3 μm, muri baculate-tectate, 1–2 μm high.

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Previous records:** Late Upper Cretaceous, western Siberian lowland (Chlonova, 1961); Santonian-early Campanian, Kuji (Japan) (Miki, 1972).


**Botanical affinity:** Santalaceae or Loranthaceae.

Genus *Foveotricolpites* Pierce 1961.

Type species: *Foveotricolpites sphaeroides* Pierce 1961.

*Foveotricolpites concinnus* Singh

Pl. 91, fig. 16.


1986 *Foveotricolpites concinnus* Singh 1971, Ward, Palaeontographica, B, 202, Lfg. 1–6, p. 40, pl. 8, figs. 21, 22.

**Description:** See Singh (1971).

**Measurements:** 25–33 μm in polar axis, 14–25 μm in equatorial diameter
(Singh, 1971); 35 X 18 μm in size, lumina 0.3–1.5 μm in diameter (Ward, 1986); the present specimen: 37 X 18 μm in size, muri baculate-tectate, 1.5 μm high, lumina of reticulum 0.5–1.5 μm in diameter; width/length ratio: 0.486.

**Occurrence:** Uge Member, Uge (C 34).

**Previous records:** Middle to upper Albian, Alberta (Canada) (Singh, 1971); middle Albian to Cenomanian, Kansas (U. S. A.) (Ward, 1986).

**Remarks:** Only one specimen was observed. This seems to be comparable to *Foveotricolpites concinnus* Singh (1971).

**Botanical affinity:** Unknown.

**Foveotricolpites fastidiosus** n. sp.

Pl. 93, fig. 6; pl. 94, figs. 1 a–b.

**Description:** Tricolporate pollen grains. Figura ellipsoidal or prolate in lateral view and more or less triangular in oblique view. Three conspicuous margocolpi radially symmetrical, converging at the poles; margo 1.7–2.0 μm thick. Exine foveolate; lumina 0.5–5 μm in diameter or length, circular, elliptical, elongate in form, muri baculate-tectate, 1 μm in width, 1.5 μm high on the sides and 2 μm high on the poles.

**Measurements:** 61–69 μm X 44–48 μm in size.

**Width/length ratio:** 0.72.

**Occurrence:** Uge Member, Uge harbor (A) (C 39) and Uge harbor (B) (C 40).

**Holotype:** Pl. 94, figs. 1 a–b; 61 X 44 μm in size, colpus with margo (2 μm in thickness); exine foveolate; foveolae circular, elliptical and elongate in form, 0.5–4.5 μm in diameter or length; muri baculate-tectate, 1.5 (side)–2 (pole) μm high; width/length ratio: 0.72; slide C 39–a.

**Name derivation:** fastidiosus (lat.) = feeling, loathing.

**Remarks:** This new species is a large form of *Foveotricolpites* Pierce (1961). The specimens differ from *Foveotricolpites globosus* n. sp. in form.

**Botanical affinity:** Unknown.

**Foveotricolpites globosus** n. sp.

Pl. 92, figs. 1 a–b, 5, 6 a–b; pl. 93, figs. 4–5.

**Description:** Tricolpate pollen grains. Outline circular to subcircular or oval in lateral and polar views. Three conspicuous colpi radially symmetrical, converging at/near the poles. Exine foveolate; foveolae circular, elliptical, elongate etc. in form, 0.5–3 μm in diameter or length developing largely in the
middle areas of the mesocolpia and finely along the colpi; ectexine in optical section intrabaculate or tectate on the sides, 1–1.2 μm high and baculate or tectate on the polar areas, 1.5–2 μm high.

**Measurements:** 40–(51) μm X 34–49 μm in size.

**Width/length ratio:** 0.833–0.93.

**Occurrence:** Uge Member, Uge harbor (C 17), south of Kanuka (C 31), and north of Uge station (A) (C 33).

**Holotype:** Pl. 92, figs. 1a–b; 43 X 40 μm in size; exine foveolate; foveolae circular, elliptical, elongate (straight or curved) etc. in form, 0.5–2.5 μm in diameter or length; muri baculate on the poles, 1.5 μm high and intrabaculate on the sides, 1 μm thick; width/length ratio: 0.93; slide C33–a.

**Name derivation:** *globosus* (lat.) = spherical, globe-shaped.

**Remarks:** The specimens differ from *Foveotricolpites sphaeroides* Pierce (1961) with a rounded shape in size of the grain.

**Botanical affinity:** Unknown.

*Foveotricolpites* sp. a

Pl. 89, fig. 6.

**Description:** Tricolpate pollen grain. Figura ellipsoidal or perprolate in lateral view. Three colpi narrow, converging at the poles. Exine foveolate; foveolae scattered, circular in form; ectexine intrarugulate, 0.5 μm thick. Both the poles more or less pointed.

**Measurements:** 29 X 14 μm in size.

**Width/length ratio:** 0.48.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** A single specimen was found.

**Botanical affinity:** Unknown.

*Foveotricolpites* sp. b

Pl. 100, fig. 11.

**Description:** Tricolpate pollen grain. Figura ellipsoidal or subprolate in equatorial view. Three colpi radially symmetrical, converging at the poles. Exine foveolate; foveolae less than 0.5 μm in diameter.

**Measurements:** 17.7 X 14 μm in size.

**Width/length ratio:** 0.79.

**Occurrence:** Uge Member, south of Kanuka (C 31).
Remarks: Only one specimen was observed.
Botanical affinity: Unknown.

Genus *Foveotricolporites* Pierce 1961.
Type species: *Foveotricolporites rhombohedralis* Pierce 1961.

*Foveotricolporites* cf. *elegantulus* Takahashi & Jux
Pl. 94, figs. 17 a–b.

1982 *Foveotricolporites elegantulus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., 23, no. 1, p. 53, pl. 6, figs. 9–10; pl. 9, fig. 6.

Description: See Takahashi & Jux (1982).
Measurements: 49.5–56.0 μm long and 24.0–26.0 μm wide (holotype 50 X 26 μm in size), exine 1.5–3.0 μm thick, endexine 0.7–0.8 μm thick, width/length ratio: 0.4–0.5 (Takahashi & Jux, 1982); 39–44 μm (polar axis) X 19–21 μm (equatorial axis), exine 1.2–2.4 μm thick, width/length ratio: 0.43–0.54; the present specimen: 45 X 30 μm in size; exine foveolate; lumina 0.5 μm ± in diameter; baculate-tectate ectexine 1.5 μm thick; width/length ratio: 0.666.
Occurrence: Uge Member, north of Uge station (A)(C 33).
Previous records: Late Oligocene, Bergish land (W. - Germany) (Takahashi & Jux, 1982); late Oligocene, St. Augustin (W. - Germany) (Takahashi & Jux, 1986).
Remarks: The present specimen is somewhat wider than the original specimens of the Bergish land (W. - Germany).
Botanical affinity: Unknown.

*Foveotricolporites gloriosus* n. sp.
Pl. 95, figs. 1–2.

Description: Tricolporate pollen grains. Figura spheroidal to suboblate in equatorial view. Three conspicuous margocolpi radially symmetrical, converging at the polar areas (apocolpia); margo 2–3 μm wide; equatorial pores lalongate. Exine foveolate and fossulate; foveolae 0.5–1 μm in diameter, fossulae elongate and curved-elongate, up to 2.5 μm long; muri tectate, 2
μm high; endexine smooth, 1.5 μm thick on the apocolpia. Large foveolae and fossulae being distributed in the middle parts of the mesocolpia and finer along/near the margocolpi and apocolpia.

**Measurements**: 35 (polar axis) X 38–40 (equatorial axis) μm in size.

**Width/length ratio**: 1.085–1.143.

**Occurrence**: Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Holotype**: Pl. 95, figs. 2 a–c; 35 (polar axis) X 40 (equatorial axis) μm in size; exine foveolate and fossulate; foveolae and fossulae developing very well in the middle parts of the mesocolpia; muri tectate, 2 μm thick; width/length ratio: 1.143; slide C 33–a.

**Name derivation**: *gloriosus* (lat.) = famous, glorious.

**Remarks**: The specimens are superficially similar to *Foveotricolporites foveolatus* Takahashi (1977) from the lower Tertiary Concepcion Formation of central Chile and *Foveotricolporites voluminosus* Guzmán (1967) from the lower and middle Eocene of the Tibú area of Colombia, but differ from *F. foveolatus* and *F. voluminosus* in having larger grain size and different form of the lumina of foveolae and fossulae.

**Botanical affinity**: Unknown.

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*Foveotricolporites grandiformis* n. sp.

Pl. 95, figs. 3–4.

**Description**: Tricolporate pollen grains. Figura broad-ellipsoidal or subprolate in equatorial view. Three conspicuous colpi narrow, radially symmetrical, converging at or near the poles; equatorial pores meridionally elongated.

Exine foveolate; foveolae circular in form, 0.5–1 μm in diameter, large in the middle parts of the mesocolpia and small along/near the colpi; muri baculate-tectate, 0.5–1 μm thick on the sides and 1.5 μm thick on the apocolpia.

**Measurements**: 50–54 μm in polar axis and 41–46 μm in equatorial axis.

**Width/length ratio**: 0.82–0.852.

**Occurrence**: Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Holotype**: Pl. 95, fig. 3; 54 X 46 μm in size; exine foveolate; foveolae 0.5–1 μm in diameter, large on the middle parts of the mesocolpia and small along/near the colpi; muri baculate-tectate, 0.5 μm thick on the equatorial area and 1.5 μm thick on the apocolpia; width/length ratio: 0.852; slide C 31–c.

**Name derivation**: *grandis* (lat.) = large, great; *forma* (lat.) = form, shape,
Remarks: *Foveotricolporites grandiformis* n. sp. differs from *Foveotricolporites elegantulus* Takahashi & Jux and *F. gloriosus* n. sp. in its grain size, colpi, and equatorial pores.  
**Botanical affinity:** Unknown.

? *Foveotricolporites* sp.  
Pl. 98, fig. 13.

**Description:** Tricolporate (?) pollen grain. Outline rounded-triangular in polar view. Three colpi straight, radially symmetrical, converging near the poles; pores lalongate (?). Exine finely foveolate; foveolae developing in the middle parts of the mesocolpia.  
**Measurements:** 14 X 12.3 μm in diameter.  
**Occurrence:** Uge Member, south of Kanuka (C 31).  
**Remarks:** Only one specimen was observed by the SEM. This is showed as a picture of the polar view and much smaller than *Foveotricolporites gloriosus* n. sp.  
**Botanical affinity:** Unknown.

**Genus Gothanipollis** Krutzsch 1959.  
**Type species:** *Gothanipollis gothanii* Krutzsch 1959.

*Gothanipollis* sp.  
Pl. 96, figs. 1–2.

**Description:** Syncolporate pollen grains with slightly concave or convex triangular amb. Germinal only weakly developed at radial corners; vestibulum (?) present at the corners. Exine thin, less than 1 μm thick, chagrenate, partially finely punctate; in the polar areas with distinct flat arci-like differentiation—"cushion"—; these cushions 4–5 μm in width.  
**Measurements:** 30–31 μm X 27–28 μm in size.  
**Occurrence:** Uge Member, Uge harbor (C 17) and north of Uge station (A) (C 33).  
**Remarks:** Only two specimens were encountered. These are not identified below generic level.  
**Botanical affinity:** Potonié (1966) compared with Loranthaceae *Taxillus kaempferi* by Ikuse (1956, pl. 67, figs. 191–193) and with *Amylotheca* by Cookson.
Type species: *Graminidites media* Cookson 1947 ex Potonie 1960.

*Graminidites cf. laevigatus* Krutzsch
Pl. 95, fig. 7.

1986 *Graminidites laevigatus* Krutzsch, Takahashi & Jux, Bull. Fac Liberal Arts, Naga-
1989 *Graminidites laevigatus* Krutzsch, Takahashi & Jux, Bull. Fac Liberal Arts, Naga-
saki Univ., Nat. Sci., 29, no. 2, pp. 392–393, pl. 8, fig. 17.

**Description**: See Krutzsch (1970).

**Measurements**: ~ 28 μm in size, pore 2–3 μm in diameter, annulus 1.5–2.5
μm wide, exine up to 1.5 μm thick (Krutzsch, 1970); 25–30 μm in diameter, pore 1.7–3 μm in diameter, annulus 1.5 μm wide, exine 0.5–1 μm thick (Ta-
akashi & Jux, 1986); 31 X 29 μm in diameter, pore 3 μm in diameter, includ-
ing annulus 6.5 μm in diameter, exine 0.5 μm thick (Takahashi & Jux, 1989);
the present specimen: 22 X 21–19 μm in diameter, pore 2 μm in diameter, an-
nulus weak.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Remarks**: Two grains appeared together. These are somewhat smaller than
the formerly described specimens of *G. laevigatus* and have a weak annulus.

**Botanical affinity**: Gramineae.

*Graminidites* sp.
Pl. 95, fig. 6.

**Description**: Monoporate pollen grain. Figura spherical. Exine very thin,
finely punctate, secondary folded. Pore small, 1.5 μm in diameter, with no
annulus.

**Measurements**: 24 X 23 μm in diameter.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Remarks**: Only one specimen was observed. This differs from *Graminidites
punctatus* Krutzsch (1970, p. 56, pl. 3, figs. 18–25), *G. micropunctatus* Krut-
zsch (1970, pp. 56, 58, pl. 4, figs. 1–8), and *G. crassipunctatus* Krutzsch
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(1970, pp. 58, 60, pl. 4, figs. 21–26) in having no annulus.

Botanical affinity: Gramineae.


*Hammenia* sp.
Pl. 91, fig. la.

**Description:** Stephanocolpoidate isopolar pollen grain. Figura spherical. Exine finely reticulate; muri baculate-tectate, 1.5 μm high. Four colpi broad, straight, relatively short.

**Measurements:** 30 × 27 μm in size.

**Width/length ratio:** 0.9.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** A single stephanocolpoidate pollen grain was found. Ward (1986) instituted the genus *Hammenia* based on *Stephanocolpites fredericksburgensis* Hedlund & Norris (1968). Van der Hammen (1954, 1956) proposed the genus *Stephanocolpites*, but designated a recent pollen grain of *Lycopus europaeus* (Labiatae) as the type specimen. Accordingly, the genus *Stephanocolpites* is invalid nomenclaturally.

**Botanical affinity:** Chloranthaceae (?).


*Ilexpollenites claviger* Takahashi n. comb.
Pl. 93, fig. 9.


**Description:** See Takahashi (1961).

**Measurements:** 21–32.8 μm in size, top of clava 2–4.7 μm in diameter, clavae 3–4.5 μm high, height of clavae less than 1/10 (or 1/12) of maximal diameter of the grain (Takahashi, 1961); the present specimen: 26 μm in diameter, clavae
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2 µm high, 1 µm wide.

Occurrence: Uge Member, Uge harbor (C 17).

Previous record: Palaeogene to Miocene, western Japan (Takahashi, 1961).

Remarks: Only one specimen was observed in polar view. This is identified with Ilexpollenites (al. Tricolporopollenites) claviger (Takahashi) n. comb.

Botanical affinity: Aquifoliaceae.

Ilexpollenites miniclavatus n. sp.
Pl. 93, figs. 7-8.

Description: Tricolporate pollen grains. Figura subprolate or spherical in equatorial view. Three colpi radially symmetrical, converging near the poles; equatorial pores slightly lalongate. Exine finely clavate; small clavae 1 µm high.

Measurements: 20-21 µm in polar axis and 18-21 µm in equatorial axis.

Width/length ratio: 0.857-1.05.

Occurrence: Uge Member, south of Kanuka (C 31).

Holotype: Pl. 93, figs. 8 a-b; 21 X 18 µm in size, exine finely clavate; clavae small, 1 µm high; three equatorial pores slightly lalongate; width/length ratio: 0.875; slide C 31-b.

Name derivation: minus (lat.) = small; clavatus (lat.) = clubshaped, clavate.

Remarks: Ilexpollenites miniclavatus n. sp. is closely similar to Ilexpollenites (al. Tricolporopollenites) tertiarius (Takahashi, 1961) Takahashi (1963) from the Palaeogene and Miocene of western Japan and the lower and middle Miocene of Korea, but differs in having smaller head of the clavae and rounded endoporus.

Botanical affinity: Aquifoliaceae.

Ilexpollenites minus n. sp.
Pl. 93, figs. 10-11.

Description: Tricolporate pollen grains. Figura broad-ellipsoidal or subprolate in equatorial view. Three colpi radially symmetrical, running parallel to pole; equatorial pores round. Exine clavate; clavae 0.5-2 µm high.

Measurements: 18-20 µm X 15-17 µm in size.

Width/length ratio: 0.83-0.85.

Occurrence: Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).
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**Holotype:** Pl. 93, fig. 10; 18 X 15 µm in size; exine clavate; clavae small, 0.5–1.5 µm high; width/length ratio: 0.833; slide C 31–c.

**Name derivation:** minus (lat.) = small.

**Remarks:** The specimens which were found rarely resemble *Ilexpollenites miniclavatus* n. sp. (in this paper, pl. 93, figs. 7 a–b, 8 a–b). but differ in having larger clavae and round endoporus.

**Botanical affinity:** Aquifoliaceae.


*Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux consularis

Pl. 94, fig. 2.


1979 *Tricolporopollenites consularis* Takahashi subsp. *consularis*, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 41, pl. 10, figs. 9 (cf.), 10–27; pl. 11, fig. 2.


**Description:** See Takahashi (1961) and Takahashi & Jux (1989).

**Measurements:** 20.7–40.7 µm in size (holotype 30 µm in size), exine less than 1.5 µm thick (Takahashi, 1961); 22–37.5 µm X 13–23.5 µm in size, exine 0.6–1.2 µm thick, width/length ratio: 0.56–0.75 (Takahashi & Kim, 1979); 34 µm in polar axis X 18 µm in equatorial axis, exine 1.2 µm thick, width/length ratio: 0.53 (Takahashi & Jux, 1986); 23–29 µm in length, 16–21 µm in width, exine 1.5 µm thick, width/length ratio: 0.69–0.72 (Takahashi & Jux, 1989); the present specimen: 34 X 24 µm in size, exine 1 µm thick, width/length ratio: 0.705.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** Palaeogene and Miocene, western Japan (Takahashi, 1961); lower and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); late Oligocene, St. Augustin (W. Germany) (Takahashi & Jux, 1986); middle Tertiary, Jos (Nigeria) (Takahashi & Jux, 1989).
Remarks: Morphologically this specimen appears to be closely comparable to those of *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux consularis.


**Genus Monocolpopollenites** Pflug & Thomson 1953.

**Type species:** *Monocolpopollenites tranquillus* (Potonié 1934) Thomson & Pflug 1953.

*Monocolpopollenites kyushuensis* Takahashi

Pl. 86, fig. 12.


1979 *Monocolpopollenites cf. kyushuensis* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 36, pl. 8, figs. 26–27.


**Description:** See Takahashi (1961).

**Measurements:** 14–33, 2 μm in size, exine up to 1.5 μm thick (Takahashi, 1961); 18–30 μm X 7–18 μm in size (Miki, 1972); 23–29, 8 μm X 14–15 μm in size, exine 0.8–1 μm thick (Takahashi & Kim, 1979); 23.5–25 μm X 12–13 μm in size, exine thin (Takahashi & Shimono, 1982); the present specimen: 30 X 15 μm in size, exine 0.5 μm thick; width/length ratio: 0.5.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** Palaeogene and Miocene, western Japan (Takahashi, 1961); Campanian to Palaeogene, Hokkaido (Japan) (Takahashi, 1964); Santonian and lower Campanian, Kuji (Japan) (Miki, 1972); lower and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

**Remarks:** This specimen belongs sufficiently to *Monocolpopollenites kyushuensis*, notwithstanding it has a thinner exine.

**Botanical affinity:** Palmae.

Type species: *Nyssapollenites pseudocruciatus* (Potonié 1931) Thiergart 1937.

*Nyssapollenites pseudocruciatus* (Potonié) Thiergart

Pl. 94, figs. 4 a—b.

1931 *Pollenites pseudocruciatus* Potonié, Z. Braunkohle, H. 16, 30 Jg., p. 332, pl. 1, fig. 10.

Description: See Potonié (1931, 1960).

Measurements: Ca. 20 μm in size (Potonié, 1931); 24.5 μm in size (Potonié, 1934); 27—30 μm in size (Thiergart, 1937); 15—30 μm in size (Thomson & Pflug, 1953); 18—30 μm in size, exine about 1 μm thick (Nagy, 1969); 21.5—27.5 μm X 17—27.3 μm in size, exine 0.9—1.2 μm thick (Takahashi & Jux, 1982); 30—38 μm X 30—35 μm in size (Mohr, 1984); 21—29 μm in polar axis and 17—27 μm in equatorial axis, exine 1—1.5 μm thick, width/length ratio: 0.8—1.0 (Takahashi & Jux, 1986); the present specimen: 21 X 23 μm in size, exine 1 μm thick.

Occurrence: Uge Member, north of Uge station (A) (C 33).

Previous records: Eocene, Geiseltal (Germany) (Potonié, 1931); Miocene, Niederlausitz (Germany) (Thiergart, 1937); Palaeocene-lower Miocene, Germany (Thomson & Pflug, 1953); lower and middle Miocene, Hungary (Nagy, 1969); middle Oligocene, Bergish land (W. -Germany) (Takahashi & Jux, 1982); Miocene-Pliocene, Frachen and Fortuna Garsdorf (W. -Germany) (Mohr, 1984); late Oligocene, St. Augustin (W. -Germany) (Takahashi & Jux, 1986).

Remarks: Morphologically this specimen is identified with *Nyssapollenites*
pseudocruciatus (Potonié, 1931) Thiergart 1937.

**Botanical affinity:** Nyssaceae, *Nyssa.*


**Type species:** *Phimopollenites pannosus* (Dettmann & Playford 1968) Dettmann 1973.

*Phimopollenites pannosus* (Dettmann & Playford) Dettmann

Pl. 91, figs. 1 b, 2.


**Description:** See Dettmann & Playford (1968) and Dettmann (1973).

**Measurements:** Equatorial diameter $9-(17)-25 \mu m$ and polar diameter $13-(22)-28 \mu m$, inner nexine $0.75 \mu m$ thick, columellate sexine $0.5-0.75 \mu m$ thick, columellae ca. $0.4 \mu m$ high; muri $0.2-0.3 \mu m$ wide, polygonal to elongated lumina up to $0.6 \mu m$ diameter (Dettmann, 1973); $20 \mu m$ in equatorial diameter (Srivastava, 1975); the present specimens: fig. 1 b–$20 \times 19 \mu m$ in size, muri baculate-tectate, $1 \mu m$ high; fig. 2–$20 \mu m$ in equatorial diameter, exine $0.5 \mu m$ thick, lumina less than $0.5 \mu m$ in diameter

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Previous records:** Albian-Turonian, Australia (Dettmann & Playford, 1968; Dettmann, 1973); Albian, Oklahoma (U. S. A.) (Srivastava, 1975); Albian, Kansasu (U. S. A.) (Ward, 1986).

**Remarks:** The specimens which have operculoid membranes with very small free-standing columellae seem distinctly identical to *Phimopollenites pannosus* (Dettmann & Playford 1968) Dettmann 1973.

**Botanical affinity:** Unknown.

*Phimopollenites* sp.

Pl. 87, fig. 19.
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**Description:** Tricolpoidate pollen grain. Figura ellipsoidal or prolate in equatorial view. Three colpi slender, running parallel each other, with granulate or punctate ornamentations on the colpi margins. Exine smooth, very thin.

**Measurements:** 20 X 12 µm in size.

**Width/length ratio:** 0.6.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Remarks:** This tricolpoidate pollen grain is comparable with *Phimopollenites pannosus* (Dettmann & Playford) Dettmann (1973) from the lower Cretaceous of Australia, but differs by its smooth exine.

**Botanical affinity:** Unknown.

*Genus Potamogetonacidites* Sah 1967.

*Type species:* *Potamogetonacidites cenozoicus* Sah 1967.

*Potamogetonacidites senonicus* n. sp.

**Pl. 79, figs. 10–12.**

**Description:** Inapertuate pollen grains. Figura circular to subcircular or oval in outline. Exine finely reticulate, with secondary crumples; lumina of reticulum circular, triangular, polygonal etc. in form, 1–3 µm in diameter; muri baculate-clavate-verrucate, partially tectate, 1–1.2 µm high.

**Occurrence:** Uge Member, south of Kanuka (C 31) and cliff near a private house, north of Uge station (C 6).

**Holotype:** Pl. 79, fig. 12; 33 X 32 µm in diameter, exine finely reticulate, lumina variable (circular, triangular, polygonal etc.) in form, 1–1.2 µm in diameter, muri baculate-verrucate, tectate, 1 µm high; slide C 6–d.

**Name derivation:** *senonicus* = from the stratigraphic term Senonian.

**Remarks:** The Uge specimens are closely similar to *Potamogetonacidites difficilis* Takahashi (Takahashi & Kim, 1979, p. 35, pl. 8, figs. 15–21; Takahashi & Jux, 1982, pp. 37–38, pl. 4, figs. 11–12; Takahashi & Jux, 1986, p. 87, pl. 11, figs. 13–15) from the Changgi and Yonil Groups of Kores and middle and late Oligocene of rhine land (W. Germany) and *Potamogetonacidites paluster* (Manten) Mohr (Manten, 1958, p. 461, fig. 5; Mohr, 1984, pp. 60–61, pl. 7, figs. 12.1 and 12.2) from the Miocene browncoal, southern Limburg (Netherlands) and the Miocene and Pliocene, Frechen (W. Germany), but differ from *P. difficilis* in having larger grain size and baculate-clavate-verrucate (tectate) muri, and from *P. paluster* in having larger grain size, wider
lumina, and different muri.

**Botanical affinity:** Potamogetonaceae, *Potamogeton.*


**Type species:** *Quercoidites henrici* (Potonié 1931) Potonié 1960.

*Quercoidites cf. henrici* (Potonié) Potonié

Pl. 87, fig. 17.

1951 *Quercopollenites henrici* R. Pot., Palaeontographica, B, 91, pl. 20, fig. 62.
1953 *Tricolpopollenites henrici* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, p. 95, pl. 11, figs. 30–42.
1984 *Tricolpopollenites henrici* (R. Potonié 1931) Thomson & Pflug 1953, Kirchner, Palaeontographica, B, 192, pp. 116–117, pl. 6, figs. 11a–c.

**Description:** 35–38 μm in size (Potonié, 1931); 30–50 μm in size, exine ca. 2 μm thick, width/length ratio: 0.5–0.7 (Thomson & Pflug, 1953); 21 X 36 μm in size, width/length ratio: 0.6 (Thiele-Pfeiffer, 1980); 30–50 μm in size, exine 1.5–2 μm thick, width/length ratio: 0.5–0.7 (Takahashi & Jux, 1986); 33–48 μm X 20–26 μm in size, exine 0.5–1.5 μm thick, width/length ratio: 0.5–0.73 (Takahashi & Jux, 1989); the present specimen: 31 X 23 μm in size, exine 1 μm thick, width/length ratio: 0.74.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** Miocene, Oberlausitz (Germany) (Potonié, 1931); Eocene-Miocene, Germany (Thomson & Pflug, 1953); Miocene, Oberpfalz (W. -Germany) (Thiele-Pfeiffer, 1980); Miocene, Rhine land (W. -Germany) (Mohr, 1984); late Oligocene, upper Bavaria (W. -Germany) (Kirchner, 1984); late Oli-
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Remarks: This species appears very rarely in the Uge Member. The specimen is larger than *Q. microhenrici* (Potonié) Potonié.
Botanical affinity: Fagaceae, *Quercus*.

*Quercoidites umiensis* (Takahashi) Takahashi
Pl. 87, figs. 5–9, 15; pl. 98, fig. 3.

1979 *Quercoidites umiensis* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 38, pl. 9, figs. 3–5, 24.

Description: See Takahashi (1957) and Takahashi & Kim (1979).
Measurements: 18–37 μm in size, exine 0.4–1.3 μm thick, width/length ratio: 0.4–0.8 (holotype: 33.5 X 21 μm in size, exine 1 μm thick, width/length ratio ca. 0.6) (Takahashi, 1957); ca. 31.5 μm in size, exine ca. 1.3 μm thick, width/length ratio: 0.63 (Takahashi, 1964); 16.5–29.8 μm X 10–18 μm in size, exine ±1 μm thick (Takahashi & Kim, 1979); 24 X 14.4 μm in size, exine 0.9–1 μm thick, width/length ratio: 0.6 (Takahashi & Shimono, 1982); the present specimens: 22–34 μm X 12–23 μm in size, exine 0.5–1.5 μm thick, width/length ratio: 0.48–0.67 (SEM: 26.8 X 13.5 μm in size, width/length ratio: 0.5).
Occurrence: Uge Member, south of Kanuka (C 31), north fo Uge station (A) (C 33), and Uge harbor (B) (C 40).
Previous records: Palaeogene and Miocene, western Japan (Takahashi, 1957, 1961); Campanian and Eocene, Hokkaido (Japan) (Takahashi, 1964); early and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Ma astrichtian, Hida (Japan) (Takahashi & Shimono, 1982).
Remarks: In general morphological characters the present specimens from the Uge Member cannot be distinguished from *Quercoidites umiensis* (Takahashi) Takahashi which was formerly described from the Campanian to Miocene of Japan and from the Miocene of Korea.
Botanical affinity: Fagaceae, Quercus.

Genus Retitrescolpites Sah 1967.
Type species: Retitrescolpites typicus Sah 1967.

Retitrescolpites pseudoazemae n. sp.
Pl. 89, figs. 9–10.

Description: Tricolpate pollen grains. Figura subprolate to spheroidal in equatorial and polar views. Three colpi relatively short, radially symmetrical, not reaching poles. Exine reticulate or retipilariate; lumina of reticulum polygonal to irregularly shaped, 1.5–5 μm in diameter; muri baculate, semitectate, 1.8–2.5 μm high.

Measurements: 30 X 23 μm in size; 29 X 29 μm in equatorial diameter.
Width/length ratio: ca. 0.77–1.0.

Occurrence: Uge Member, north of Uge station (C15) and Uge harbor (C17).

Holotype: Pl. 89, figs. 9 a–b: 30 X 23 μm in size, exine reticulate or retipilariate; lumina polygonal, 1.5–3.5 μm in diameter; muri baculate, semitectate, 2.5 μm high; width/length ratio: 0.766; slide C17–d.

Name derivation: pseudo (gr.) = false; after the similarity to Retitrescolpites azemae Ward (1986).

Remarks: Retitrescolpites pseudoazemae n. sp. is closely similar to R. azemae Ward (1986, p. 44, pl. 10, figs. 9–10) from the Kiowa Formation (Albian) of Kansas (U. S. A.), but differs in having shorter and narrower colpi and larger muri.

Botanical affinity: Oleaceae.

Genus Rhoipites Wodehouse 1933.
Type species: Rhoipites bradleyi Wodehouse 1933.

Rhoipites kitakamiensis n. sp.
Pl. 94, figs. 12–16; pl. 101, figs. 1–2, 7.

Description: Tricolporate pollen grains. Figura subprolate to spheroidal in equatorial and polar views. Three colpi conspicuous, radially symmetrical, almost reaching the poles; costa colpi developing, 1–2 μm wide; equatorial pores lalongate. Exine finely reticulate, intrabaculate or tectate, 1–3.5 μm thick; meshes larger in the mesocolpia and become finer in the apocolpia and
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near the costa colpi margins.

**Measurements:** 24–27 μm X 21–24 μm in size (equatorial view).
24–29 μm X 22–27 μm in equatorial diameter (polar view).
Width/length ratio: 0.78–1.0.
(SEM: 11–19 μm X 14–15.7 μm in size; width/length ratio: 0.98–1.27).

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Holotype:** Pl. 94, figs. 12 a–b; 24 X 23 μm in size, exine finely reticulate, intrabaculate or tectate, 1.7 μm thick; lumina 0.5–1 μm in diameter; equatorial pores lalongate; costa colpi 1 μm wide; slide C 31–b.

**Name derivation:** After the Kitakami region.

**Remarks:** Srivastava (1969) instituted the genus *Rousea* for the tricolpate pollen with reticulations larger in mesocolpia becoming smaller at colpi margins and apocolpia. Ward (1986) distinguished the genus *Satishia* with brochi of unequal size from the genera *Tricolpites* Cookson ex Couper emend. Poto- nié (1960) and *Rousea* Srivastava (1969). As the above-mentioned instances, the present tricolporate specimens with larger brochi in the mesocolpia and smaller at colpi margins and the apocolpia may be separated from the genus *Rhoipites* Wodehouse (1933) in such case.

**Botanical affinity:** Unknown.

*Rhoipites minus* Takahashi & Jux

Pl. 94, figs. 11 a–b.


**Description:** See Takahashi & Jux (1986).

**Measurements:** 12–21.5 μm (polar axis) X 10, 3–20.5 μm (equatorial axis), exine 0.5–1.2 μm thick, lumina less than 1 μm in diameter, width/length ratio: 0.7–1.0 (Takahashi & Jux, 1986); 14–20 μm X 12–18 μm in size, exine 1–1.5 μm thick, lumina 0.5–1 μm in diameter, width/length ratio: 0.85–1.0 (Takahashi & Jux, 1989); 9.8–13.7 μm X 7.4–17.2 μm in size, exine less than
1 \( \mu \text{m} \) thick, lumina less than 1 \( \mu \text{m} \) in diameter, width/length ratio: 0.7 – 1.05 (Takahashi, 1988); the present specimen: 15 X 12 \( \mu \text{m} \) in size, exine 0.5 \( \mu \text{m} \) thick, lumina less than 0.5 \( \mu \text{m} \) in diameter, width/length ratio: 0.8.

**Occurrence:** Uge Member, Uge harbor (C 17).

**Previous records:** Late Oligocene, St. Augustin (F. - Germany) (Takahashi & Jux, 1986); Coniacian-Santonian, Futaba (Japan) (Takahashi, 1988); middle Tertiary, Jos (Nigeria) (Takahashi & Jux, 1989).

**Remarks:** Only one specimen was found. This is undoubtedly identical with *Rhoipites minus* Takahashi & Jux (1986).

**Botanical affinity:** Unknown.

? *Rhoipites* sp.

Pl. 94, fig. 9.

**Description:** Tricolpoarte (?) pollen grain. Figura oval in oblique view. Three colpi radially symmetrical, converging towards the poles. Exine very finely reticulate; lumina less than 0.5 \( \mu \text{m} \) in diameter; muri baculate-tectate, 1 \( \mu \text{m} \) high.

**Measurements:** 21 X 14 \( \mu \text{m} \) in diameter (in oblique view).

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** A single specimen was observed.

**Botanical affinity:** Unknown.

**Genus Rousea** Srivastava 1969.

**Type species:** *Rousea subtilis* Srivastava 1969.

*Rousea elegantula* n. sp.

Pl. 91, figs. 11 a – b.

**Description:** Tricolpate pollen grains. Figura spheroidal in polar view. Three colpi conspicuous, radially symmetrical, converging near the poles, splitting. Exine finely reticulate; lumina larger in the mesocolpia (1 \( \mu \text{m} \) or more in diameter) and smaller near the colpi margins and in the apocolpia (0.5 \( \mu \text{m} \) or less in diameter); muri baculate-tectate, 1 \( \mu \text{m} \) high.

**Measurements:** 45 – 47 \( \mu \text{m} \) X 50 – 51 \( \mu \text{m} \) in equatorial diameter.

**Occurrence:** Uge Member, north of Uge station (C 15).

**Holotype:** Pl. 91, figs. 11 a – b; 47 X 51 \( \mu \text{m} \) in equatorial diameter, exine finely reticulate; lumina larger in the mesocolpia (1 \( \mu \text{m} \) or more in diameter) and
smaller near the colpi and in the apocolpia (0.5 \mu m or less in diameter); muri baculate-tectate, 1 \mu m high; slide C 15–d.

**Name derivation:** *elegantulus* (lat.) = very elegant.

**Remarks:** *Rousea elegantula* n. sp. is superficially similar to *Rousea subtilis* Srivastava (1969, p. 53, pl. 1, fig. 7) from the Maastrichtian Edmonton Formation of Alberta (Canada), but can be distinguished by its finer reticulations at mesocolpia and smaller muri.

**Botanical affinity:** Salicaceae.

*Rousea cf. prosimilis* (Norris) Srivastava

Pl. 89, figs. 5 a–b.


**Description:** See Norris (1967).

**Measurements:** 13–25 \mu m (holotype 19 \mu m) in polar diameter, 9–18 \mu m (holotype 13 \mu m) in equatorial diameter, exine 0, 25–1 \mu m thick, length/width ratio: 1.3/1–1, 9/1 (holotype 1, 5/1) (Norris, 1967); 19–22 \mu m in polar axis X 12–18 \mu m in equatorial diameter (Ward, 1986); the present specimen: 26 X 18 \mu m in size; lumina 0.5–2 \mu m in diameter; muri baculate-tectate, 1.5 \mu m high.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** Middle to late Albian, Alberta (Canada) (Norris, 1967); Albian, Kansas (U. S. A.) (Ward, 1986).

**Remarks:** Only a single specimen was observed. Morphologically this may be identified with *Rousea prosimilis* (Norris) Srivastava (1975).

**Botanical affinity:** Salicaceae.

*Rousea reticosa* n. sp.

Pl. 89, figs. 1–3.

**Description:** Tricolpate pollen grains. Figura prolate to subprolate in equatorial view and spheroidal (?) in polar view. Three colpi conspicuous, relatively slender, radially symmetrical, converging towards the poles, often gap­ing. Exine two-layered, finely reticulate; lumina larger at mesocolpia (0.5–
2 \(\mu m\) in diameter) and smaller or invisible along colpi and at apocolpia; muri baculate-tectate only in the mesocolpia, 1 \(\mu m\) high; exine smooth along/near the colpi and in the apocolpia, 0.5 \(\mu m\) thick.

**Measurements:** 27—28 \(\mu m\) X 20—21 \(\mu m\) in size.

25 \(\mu m\) (in polar view).

Width/length ratio: 0.714—0.777.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Holotype:** Pl. 89, figs. 1 a—b; 28 X 20 \(\mu m\) in size; exine finely reticulate; lumina circular to elongate in form, developing only in the mesocolpia, 0.5—2 \(\mu m\) in diameter, invisible along/near the colpi and in the apocolpia; muri baculate-tectate only in the mesocolpia, 1 \(\mu m\) high; exine smooth along the colpi and in the apocolpia, 0.5 \(\mu m\) thick.

**Name derivation:** reticosus = net-like.

**Remarks:** *Rousea reticosa* n. sp. can be distinguished from *Rousea prosimilis* (Norris) Sirvastava (1975) by its development and distribution of lumina and muri.

**Botanical affinity:** Unknown.

*Rousea triangulata* n. sp.

Pl. 91, figs. 12—15;

pl. 92, figs. 4 a—b.

**Descripition:** Tricolpate pollen grains. Figura triangular in polar and oblique views. Three colpi straight, radially symmetrical, converging towards the poles; costa colpi strongly developed, 1—2 \(\mu m\) wide in colpi margin. Exine finely reticulate; lumina circular, elongate, vermiculate in forma, larger in mesocolpia (0.5—3 \(\mu m\) in diameter or length) and becoming smaller or almost smooth towards colpi margins and apocolpia; muri baculate or semitectate, 1.2—3 \(\mu m\) high, developing only in the middle areas of the mesocolpia in which reticulations developed.

**Measurements:** 29—40 \(\mu m\) X 27—35 \(\mu m\) in diameter.

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Holotype:** Pl. 92, figs. 4 a—b; 40 X 35 \(\mu m\) in diameter; costa colpi strongly developing, 2 \(\mu m\) wide; exine finely reticulate; lumina circular, elongate, vermiculate in form, 0.5—3 \(\mu m\) in size, larger in the middle areas of the mesocolpia and becoming smaller towards the colpi and apocolpia; muri baculate or semitectate, up to 1.5 \(\mu m\) high, up to 1 \(\mu m\) wide; slide C 31—b.
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**Name derivation:** *triangulatus* (lat.) = triangular.

**Remarks:** *Rousea triangulata* n. sp. is closely similar to *Rousea ugensis* n. sp., but differs by its strong costa colpi and different development of the muri.

**Botanical affinity:** Unknown.

*Rousea ugensis* n. sp.

Pl. 92, figs. 2–3.

**Description:** Tricolpate pollen grains. Amb triangular in polar view and sub-circular in equatorial view. Three colpi radially symmetrical, converging towards the poles; costa colpi weakly developing, 1 \( \mu \text{m} \) wide. Exine finely reticulate; lumina circular, polygonal, vermiculate in form, larger in middle areas of mesocolpia (0.5–4 \( \mu \text{m} \) in diameter or length), very fine or smooth near/along colpus margins, and finely foveolate in apocolpia; muri baculate-tectate, 1.5 \( \mu \text{m} \) high.

**Measurements:** 41 \( \mu \text{m} \) (in polar axis) X 44 \( \mu \text{m} \) (in equatorial axis).

35 X 36 \( \mu \text{m} \) in equatorial diameter.

Width/length ratio: 1.073.

**Occurrence:** Uge Member, cliff near a private house, north of Uge station (C 6) and Uge harbor (A) (C 39).

**Holotype:** Pl. 92, figs. 2 a–b; 41 X 44 \( \mu \text{m} \) in size; costa colpi weakly developed, 1 \( \mu \text{m} \) wide; exine finely reticulate; lumina circular, polygonal, vermiculate in form, larger in the mesocolpia, 0.5–4 \( \mu \text{m} \) in diameter or length, very small or smooth along/near the colpi, and finely foveolate in the apocolpia; muri baculate-tectate, 1.5 \( \mu \text{m} \) high; width/length ratio: 1.073; slide C 39–a.

**Name derivation:** After the locality name Uge.

**Remarks:** *Rousea ugensis* n. sp. differs from *R. triangulata* n. sp. in having thinner costa colpi and different tectate muri.

**Botanical affinity:** Unknown.

*Rousea sp.*

Pl. 93, figs. 3 a–b.

**Description:** Tricolpate pollen grain. Amb triangular in polar view. Three colpi conspicuous, radially symmetrical, converging near the poles; costa colpi weakly developing, 1 \( \mu \text{m} \) wide. Exine finely reticulate; lumina circular, polygonal, vermiculate in form, larger in mesocolpia (0.5–3 \( \mu \text{m} \) in diameter or length) along/near colpi and rather striate in apocolpia; muri simpli-
baculate in the middle areas of the mesocolpia, 2 μm high and becoming gradually tectate towards the colpi.

**Measurements:** 45 X 39 μm in diameter.

**Occurrence:** Uge Member, cliff near a private house, north of Uge station (C6).

**Remarks:** A single specimen which was found from the Uge Member, is similar to *Rousea triangulata* n sp. and *R. ugensis* n. sp., but differs by its peculiar reticulation and muri.

**Botanical affinity:** Unknown.

\[ ? Rousea sp. \]

Pl. 101, fig. 4.

**Description:** Tricolpate pollen grain. Figura oval in slightly oblique view. Three colpi radially symmetrical, converging towards the poles. Exine reticulate and foveolate; lumina circular and polygonal in form, larger in mesocolpia, smaller (foveola-like) near colpi and in apocolpia.

**Measurements:** 18, 7 X 15, 7 μm in size.

  Width/length ratio: 0.84.

**Occurrence:** Uge Member, south of Kanuka (C31).

**Remarks:** Only one specimen was observed with the scanning electronic microscope.

**Botanical affinity:** Unknown.

**Genus Satishia** Ward 1986.

**Type species:** *Satishia glyceia* Ward 1986.


*Satishia cf. compacta* (Norton) Ward

Pl. 90, fig. 22.


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**Description:** See Norton & Hall (1969).

**Measurements:** 25–35 μm X 20–30 μm in size, lumina of reticulum 1 μm in diameter, muri 0.5 μm wide (Norton & Hall, 1969); the present specimen: 38 X 25 μm in size, lumina of reticulum less than 1 μm in diameter, muri less than 0.7 μm high; width/length ratio: 0.658.

**Occurrence:** Uge Member, Uge harbor (B) (C 40).

**Previous record:** Maastrichtian, Montana (U. S. A.) (Norton & Hall, 1969).

**Remarks:** The present specimen is somewhat larger in size and narrower than the Norton & Hall’s original specimen.

**Botanical affinity:** Unknown.

*Satishia glyceia* Ward

Pl. 89, figs. 8 a–b.


**Description:** See Ward (1986).

**Measurements:** Equatorial diameter 26–34 μm, nexine 0.3 μm thick, sexine 1.3–0.4 μm thick, muri 0.8–1.2 μm wide, lumina 1.3–2.8 μm in size, grading to 0.5 μm in size toward colpi margins (Ward, 1986); the present specimen: 27 μm in polar axis X 28 μm in equatorial axis, lumina 1–2.5 μm in diameter, muri baculate-tectate, 1 μm high.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Previous record:** Albian, Kansas (U. S. A.) (Ward, 1986).

**Remarks:** Morphologically the specimen from the Uge Member coincides with *Satishia glyceia* Ward (1986).

**Botanical affinity:** Unknown.

*Satishia pomposa* n. sp.

Pl. 93, figs. 1–2.

**Description:** Tricolpate pollen grains. Figura spheroidal in equatorial view and round-triangular in polar view. Three colpi conspicuous, radially symmetrical, running parallel or converging at the poles; costa colpi developing, 1.5–2 μm wide. Exine reticulate; lumina circular, triangular, polygonal and elongate in form, 0.5–4 μm in diameter or length, coarsely sculptured on meridian, finely sculptured or smooth on colpi margins; muri duplibaculate-
tectate, 1.5–2 µm high.

**Measurements:** 38 X 48 µm in size.

53 X 49 µm in diameter.

Width/length ratio: 1.263.

**Occurrence:** Uge Member, Uge harbor (A) (C 39).

**Holotype:** Pl. 93, fig. 2; 53 X 49 µm in diameter; exine reticulate; lumina circular, triangular and elongate in form, 0.5–3 µm in diameter or length, coarsely sculptured in mesocolpia and smooth near colpi margins; muri dupli-baculate-tectate, 1.5–2 µm high; slide C39-a.

**Name derivation:** *pomposus* (lat.) = pompous.

**Remarks:** The authors cannot find a species comparable with the present specimens. Accordingly, they describe them as a new species of *Satishia*.

**Botanical affinity:** Unknown.

*Satishia triformis* n. sp.

Pl. 90, figs. 18–19.

**Description:** Tricolpate pollen grains. Amb triangular in polar view. Three colpi conspicuous, radially symmetrical, converging towards the poles; costa colpi developed, 2.5–3 µm wide. Exine very finely reticulate; lumina circular in form, less than 0.5 µm in diameter, distributing in mesocolpia and apocolpia, and smooth near/along colpi margins; muri baculate-tectate, 1.5–1.7 µm high.

**Measurements:** 27–28 µm X 26–28 µm in diameter.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Holotype:** Pl. 90, figs. 18 a–b; 27 X 26 µm in diameter; exine finely reticulate in the mesocolpia and apocolpia, smooth along/near the colpi margins; muri baculate-tectate, 1.7 µm high; costa colpi developed, 2.5–3 µm wide; slide C33-b.

**Name derivation:** *triformis* (lat.) = three-formed, having three forms.

**Remarks:** *Satishia triformis* n. sp. can be distinguished from *S. glyceia* Ward (1986) from the Albian Kiowa Formation of Kansas (U. S. A.) and *Tricolpites explanata* (Anderson) Drugg (1967) from the Maastrichtian to Danian Upper Moreno Formation of California in having comparatively a very small meshed reticulum and the well developed tectate muri.

**Botanical affinity:** Unknown.

*Satishia uniformis* n. sp.
**Palynomorphs from the Santonian Uge Member**

Pl. 99, fig. 5; pl. 100, figs. 5–7.

**Description:** Tricolpate pollen grains. Figura broad-ellipsoidal or subprolate in equatorial view. Three colpi radially symmetrical, converging towards the poles. Exine reticulate; lumina circular, polygonal, and elongate in form, larger in mesocolpia and apocolpia, and smaller or smooth along/near colpi margins; muri invisible due to the SEM photomicrographs.

**Measurements:** 11.4–17.3 µm in polar axis.

10–14.7 µm in equatorial axis.

Width/length ratio: 0.847–0.88.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Holotype:** Pl. 100, fig. 6; 16.7 X 14.7 µm in size; exine reticulate; lumina larger in mesocolpia and apocolpia, and finer or smooth along/near colpi margins; width/length ratio: 0.88; locality C 31, SEM: no. 12.

**Name derivation:** *uniformis* (lat.) = having one form, simple.

**Remarks:** The specimens observed with the scanning electronic microscope are named the new epithet *Satishia uniformis*.

**Botanical affinity:** Salicaceae (?).

*Satishia* sp. a

Pl. 90, fig. 20.

**Description:** Tricolpate pollen grain. Amb triangular in polar view. Three colpi radially symmetrical, converging towards the poles. Exine two-layered, finely reticulate; lumina variable in form, less than 0.5–2.5 µm in diameter, coarsely sculptured on meridian and finely sculptured on colpi margins; muri baculate on meridian, partially semitectate near colpi, 1.5 µm high.

**Measurements:** 30 X 26 µm.

**Occurrence:** Uge Member, Uge (C 34).

**Remarks:** A single specimen was observed. This is similar to *Satishia triformis* n. sp. and *Satishia* sp. b, but differs from *S. triformis* in having coarser lumina of the reticulum and entirely tectated exine, and from *S. sp. b* by its smaller grain size and no sculpture of striae.

**Botanical affinity:** Unknown.

*Satishia* sp. b

Pl. 90, fig. 23.
Description: Tricolpate pollen grain. Figura spheroidal in oblique view. Three colpi radially symmetrical, converging towards the poles. Exine reticulate on meridian and striate on colpi margins and apocolpia; lumina of reticulum circular and vermiculate in form, 0.5–4 μm in diameter or length; muri baculate on meridian and tectate near colpi, 1.5 μm high.

Measurements: 35 X 34 μm in diameter.

Occurrence: Uge Member, cliff near a private house, north of Uge station (C 6).

Remarks: Only one specimen was encountered.

Botanical affinity: Unknown.

*Satishia* sp. c

Pl. 100, fig. 9.

Description: Tricolpate pollen grain. Figura broad-ellipsoidal or subprolate in equatorial view. Three colpi rather linder, radially symmetrical, converging towards the poles. Exine coarsely reticulate on mesocolpia and apocolpia, finely reticulate along colpi margins.

Measurements: 10.5 X 8.8 μm in size.

Width/length ratio: 0.838.

Occurrence: Uge Member, south of Kanuka (C 31).

Remarks: A very small specimen with brochi of unequal size was found.

Botanical affinity: Unknown.

*Satishia* sp. d

Pl. 100, fig. 10.

Description: Tricolpate pollen grain. Figura spheroidal in equatorial view.

Three colpi radially symmetrical, converging towards the poles; costa colpi developed. Exine reticulate; lumina coarsely sculptured in mesocolpia and apocolpia, and finely sculptured along costa colpi.

Measurements: 25.3 X 24.7 μm in size.

Width/length ratio: 0.976.

Occurrence: Uge Member, south of Kanuka (C 31).

Remarks: Only one specimen was found.

Botanical affinity: Unknown.

Genus *Striatopollis* Krutzsch 1959.
Type species: *Striatopollis sarstedtensis* Krutzsch 1959.

*Striatopollis striatellus* (Takahashi) Takahashi

Pl. 87, fig. 16.


1979 *Striatopollis striatellus* (Takahashi) Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 39, pl. 9, figs. 25–29.


**Description**: See Takahashi (1961) and Takahashi & Kim (1979).

**Measurements**: 24–37 μm in size, exine ca. 1 μm ± thick (Takahashi, 1961); 22–37 μm X 14–28 μm in size, exine 0.8–1.3 μm thick, widht/length ratio: 0.54–0.77 (Takahashi & Kim, 1979); 19–24 μm X 12.5–17 μm in size, exine thin, width/length ratio: 0.65–0.7 (Takahashi & Shimono, 1982); 24–37 μm (in length) X 16–21 μm (in width), exine 1–2 μm thick, width/length ratio: 0.54–0.72 (Takahashi & Jux, 1986); 22–23 μm X 5–17 μm in size, exine 0.7–0.8 μm thick, width/length ratio: 0.45–0.69 (Takahashi & Jux, 1989): 25–30 μm X 11–14 μm in size, exine less than 1 μm thick, width/length ratio: 0.44–0.47 (Takahashi & Jux, 1989); the present specimen: 35 X 15 μm in size, exine 0.5 μm thick, width/length ratio: 0.43.

**Occurrence**: Uge Member, north of Uge station (A) (C 33).

**Previous record**: Palaeogene and Miocene, western Japan (Takahashi, 1961); early and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982); late Oligocene, St. Augustin (W. Germany) (Takahashi & Jux, 1986); middle Tertiary, Jos (Nigeria) (Takahashi & Jux, 1989); late Eocene to early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989).
Remarks: In general morphological characters the specimen from the Uge Member cannot be distinguished from Striatopollis striatellus (Takahashi) Takahashi from the Upper Cretaceous and Tertiary of Japan.

Botanical affinity: Unknown.

Genus Subtriporopollenites Pflug & Thomson 1953.
Type species: Subtriporopollenites anulatus Pflug & Thomson subsp. anulatus.

Subtriporopollenites kyushuensis Takahashi

Pl. 95, fig. 9.

1979 Subtriporopollenites kyushuensis Takahashi, Palaeontographica, B, 170, Lfg. 1–3, pp. 54–55, pl. 17, figs. 22–24; pl. 18, figs. 5–6.

Description: See Takahashi (1961).

Measurements: Ca. 23–41 μm in size, exine up to 1 μm thick (Takahashi, 1961); ca. 34.5 μm in size, exine very thin (Takahashi, 1964); 24.5–39.7 μm in equatorial diameter, exine 0.5–1 μm thick (Takahashi & Kim, 1979); 20–32 μm in equatorial diameter, exine thin (Takahashi & Shimono, 1982); the present specimen: 34 X 29 μm in size, exine thin, pores 3.5 μm in diameter.

Occurrence: Uge Member, south of Kanuka (C 31).

Previous records: Palaeogene and Miocene, western Japan (Takahashi, 1961); Companian and Eocene, Hokkaido (Japan) (Takahashi, 1964); early and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

Remarks: A single specimen was found. This is identical with Subtriporopollenites kyushuensis Takahashi (1961).

Botanical affinity: Juglandaceae.

Type species: Symplocacites sibiricus Mtchedlishvili 1961.

Symplocacites micropunctatus n. sp.
Pl. 96, figs. 3–8; pl. 101, fig. 8.

**Description:** Tricolpate pollen grains. Amb triangular with convex or straight sides in polar view. Three colpi narrow, slender slit-like, converging at the poles; colpi margins straight, not thickened. Three pores equatorial with atrium (?), distributed on the corners, often tearing off in equatorial areas. Exine two-layered, very thin, 0.5–1.5 \( \mu m \) thick, chagrenate or finely punctate.

**Measurements:** 27–37 \( \mu m \) X 27–36 \( \mu m \) in diameter.

29.4 X 25.9 \( \mu m \) in diameter (SEM).

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Holotype:** Pl. 96, figs. 5 a–b; 29 X 27 \( \mu m \) in diameter; exine 0.7 \( \mu m \) thick, chagrenate; sides straight or slightly convex; pores equatorial, with atrium (?); colpi narrow, converging at the poles; slide C 33–b.

**Name derivation:** micros (gr.) = small; punctatus (lat.) = punctate, punctated.

**Remarks:** The present specimens can be distinguished from *Symplocacites sibiricus* Mchedlishvili (1961, pl. 64, figs. 3 a–c) and *Symplocacites microreticulatus* n. sp. by their finely punctate or chagrenate exine.

**Botanical affinity:** Symplocaceae (?)

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*Symplocacites microreticulatus* n. sp.

Pl. 96, figs. 10–11; pl. 97, figs. 1–4.

**Description:** Tricolpate pollen grains. Figura triangular with convex or straight sides in polar view. Three colpi narrow, slender, converging towards or at the poles. Three pores equatorial, with atrium (?), slightly lalongate. Exine two: layered, finely reticulate; lumina of reticulum circular or elongate in form, 0.5–2 \( \mu m \) in diameter or length; muri baculate-tectate, 0.5–1.5 \( \mu m \) high.

**Measurements:** 30–38 \( \mu m \) X 26–37 \( \mu m \) in diameter.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Holotype:** Pl. 96, figs. 10 a–b; 35 X 30 \( \mu m \) in diameter; exine finely reticulate; lumina 0.5 \( \mu m \pm \) in diameter; muri baculate-tectate, 0.5 \( \mu m \) high; slide C 33–b.

**Name derivation:** mikros (gr.) = small; reticulatus (lat.) = net-like, reticulated.

**Remarks:** *Symplocacites microreticulatus* n. sp. is compared with *Symplocacites sibiricus* Mchedlishvili (1961), but differs by its baculate-tectate muri and reticulated apocolpia.
Botanical affinity: Symplocaceae (?).

? *Symplocacites* sp.
Pl. 96, figs. 9 a–b.

Description: Tricolpate (?) pollen grain. Amb triangular with slightly convex sides in polar view. Three colpi narrow, radially symmetrical, converging towards the poles. Pores indistinct. Exine very thin, chagrenate, secondarily folded.

Measurements: 43 X 42 μm in diameter.

Occurrence: Uge Member, south of Kanuka (C 31).

Remarks: A single specimen was found. Whether this is *Symplocacites* or not, is not clear.

Botanical affinity: Unknown.

Genus *Tricolpites* Cookson 1947 ex Couper 1953

Type species: *Tricolpites reticulatus* Cookson 1947 ex Couper 1953.

*Tricolpites ellipsoideus* n. sp.
Pl. 90, figs. 13–17; pl. 91, figs. 3–4, 6–9;
pl. 99, figs. 1–4.

Description: Tricolpate pollen grains. Figura prolate to subprolate in equatorial view. Three distinct colpi rather narrow, running parallel, and converging slightly towards the poles. Exine finely reticulate; lumina of reticulum 0.5–1.5 μm in diameter; muri finely baculate, partially tectate, 0.5–1 μm high.

Measurements: 14–27 μm in polar axis.
10–20 μm in equatorial axis.
Width/length ratio: 0.583–0.85.

Occurrence: Uge Member, south of Kanuka (C 31), north of Uge station (A) (C 33), cliff near a private house, north of Uge station (C 6), and Uge harbor (C 17).

Holotype: Pl. 90, fig. 17; 23 X 17 μm in size; exine finely reticulate; lumina 0.5–1 μm in diameter; muri baculate, partially tectate, 1 μm high; width/length ratio: 0.739; slide C 31–c.

Name derivation: *ellipsoideus* = ellipsoidal.

Tricolpites ellipsoideus n. sp. differs from T. retiformis, T. ellipticus, and T. minutireticulosus by its baculate-tectate muri distributed densely, from T. microretiformis by its larger grain size, from T. microreticulatus in possessing baculate-tectate muri and ellipsoidal form, from T. reticosus in having finely reticulated exine.

Botanical affinity: Salicaceae, Salix.

Tricolpites ellipticus Takahashi & Jux
Pl. 91, fig. 5.

1986 Tricolpites ellipticus Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., 26, no. 2, pp. 139-140, pl. 22, figs. 36-41; pl. 23, fig. 6.

Description: See Takahashi & Jux (1982).
Measurements: 14.0–17.0 μm in length, 8.0–11.5 μm in width, exine 0.6–1.0 μm thick, width/length ratio: 0.6–0.7 (Takahashi & Jux, 1982); 16–20.5 μm in length, 10–16 μm in width, exine 0.8–1.3 μm thick, width/length ratio: 0.61–0.78 (Takahashi & Jux, 1986); the present specimen: 21 X 14 μm in size, exine intrabaculate, 1 μm thick, width/length ratio: 0.666.
Occurrence: Uge Member, south of Kanuka (C 31).
Previous records: Middle Oligocene, Bergish land (W. - Germany) (Takahashi & Jux, 1982); late Oligocene, St. Augustin (W. - Germany) (Takahashi & Jux, 1986).
Remarks: A single specimen was observed. This is identical morphologically with Tricolpites ellipticus Takahashi & Jux (1982).
Botanical affinity: Salicaceae, probably Salix.

Tricolpites nemejcii Pacltova
Pl. 89, figs. 4 a–b; pl. 90, fig. 21 (cf.).

Description: See Pacltova (1971).

Measurements: 23−28 µm in polar axis, 16−23 µm in equatorial diameter (Pacletova, 1971); 25−38 µm in polar axis, 16−26 µm in equatorial diameter, nexine about 1.6 µm thick, sexine about 1.2 µm thick (Ward, 1986); the present specimens: 30−34 µm in polar axis, 16−23 µm in equatorial diameter, exine finely reticulate; lumina of reticulum less than 0.5 µm in diameter; muri partially baculate, tectate, 1.2−2 µm high; width/length ratio: 0.533−0.676.

Occurrence: Uge Member, north of Uge station (A) (C 33).

Previous records: Lower Cenomanian - ? Albian, Bohemia (Czechoslovakia) (Pacletova, 1971); Albian, Kansas (U. S. A.) (Ward, 1986).

Remarks: The Uge specimens are compared morphologically to *Tricolpites nemejci* Pacltova (1971).

Botanical affinity: Unknown.

*Tricolpites oviformis* n. sp.

Pl. 89, figs. 11−15; pl. 101, figs. 3, 5−6.

Description: Tricolpate pollen grains. Figura oval or spheroidal in polar and equatorial views. Three colpi slender, converging towards the poles. Exine reticulate; lumina of reticulum polygonal and vermiculate high in form, 0.5−3 µm in diameter; muri simplibaculate, tectate, 0.5−2.5 µm high.

Measurements: 21−30 µm X 21−28 µm in size.

Width/length ratio: 1.0 or more.

Occurrence: Uge Member, south fo Kanuka (C 31) and Uge harbor (C 17).

Holotype: Pl. 89, fig. 11; 26 X 27 µm in size; exine reticulate; lumina 0.5−2.5 µm in diameter; muri simplibaculate, partially tectate, 0.5−2 µm high; width/length ratio: 1.038; slide C 17−e.

Name derivation: *ovum* (lat.) = egg; *forma* (lat.) = form, shape.

Remarks: *Tricolpites oviformis* is closely similar to *Tricolpites reticosus* Takahashi (1979, p. 40, pl. 10, figs. 1−4) from the Miocene of Korea, but differs by its coarser reticulation and wider simplibaculate to tectate muri.

Botanical affinity: Salicaceae.

*Tricolpites retiformis* (Pflug & Thomson) Takahashi & Jux
1953 *Tricolpopollenites retiformis* Pflug & Thomson, Thomson & Pflug, Palaeontographica, B, 94, p. 97, pl. 11, figs. 59–61.


1984 *Tricolpopollenites retiformis* Thomson & Pflug 1953, Mohr, Palaeontographica, B, 191, p. 77, pl. 12, figs. 9.1 and 9.2.


**Description:** See Thomson & Pflug (1953) and Takahashi & Jux (1982).

**Measurements:** 15–30 μm in size (Thomson & Pflug, 1953); 13 X 20 μm in size, lumina of reticulum 0.5–1 (1–1.5) μm, width/length ratio: 0.66 (Thiele-Pfeiffer, 1980); 19.0 μm X 13.0 μm in size, muri 0.6 μm high, width/length ratio: 0.68 (Takahashi & Jux, 1982); 20 X 14 μm in size (Mohr, 1984); 15–26 μm in length, 12–18 μm in width, muri 0.8–1 μm high, lumina less than 2 μm in diameter (Takahashi & Jux, 1986); 15.4–23 μm X 11.5–14.4 μm in size, lumina 1–2 μm in diameter, muri 1.1–2 μm high, width/length ratio: 0.52–0.67 (Takahashi & Jux, 1989); the present specimens: 24–31 μm X 14–19 μm in size, lumina 1–2.5 μm in diameter, muri 1 μm high, width/length ratio: 0.577–0.68.

**Occurrence:** Uge Member, south of Kanuka (C 31), north of Uge station (A) (C 33), and cliff near a private house, north of Uge station (C 6).

**Previous records:** Tertiary, W. - Germany (Thomson & Pflug, 1953); Miocene, Oberpfalz (W. - Germany) (Thiele-Pfeiffer, 1980); middle Oligocene Bergish land (W. - Germany) (Takahashi & Jux, 1982); Neogene, Rhine land (W. - Germany) (Mohr, 1984); late Oligocene, St. Augustin (W. - Germany) (Takahashi & Jux, 1986); Coniacian to Santonian, Futaba (Japan) (Takahashi, 1988); late Eocene to early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989).

**Remarks:** *Tricolpites retiformis* (Pflug & Thomson, 1953) Takahashi & Jux (1982) possesses stronger and wider muri than those of *Tricolpites ellipsoideus* n. sp.
Botanical affinity: Salicaceae, *Salix*.

*Tricolpites sphaeroides* n. sp.

Pl. 90, figs. 2–12; pl. 99, figs. 6–12; pl. 100, fig. 8.

Description: Tricolpate pollen grains. Figura spheroidal or oval in polar, equatorial, and oblique views. Three colpi slender, radially symmetrical, somewhat converging towards the poles. Exine two-layered, finely reticulate; lumina of reticulum circular or elongate in form, 0.5–(3) μm in diameter; muri finely baculate-tectate, 0.5–1.5 μm high.

Measurements: 15–26 μm X 17–26 μm in size.

Width/length ratio: 0.78–1.33.

(SEM: 10.7–19.3 μm X 9.3–14.7 μm in size; width/length ratio: 0.754–1.073).

Occurrence: Uge Member, south of Kanuka (C 31) and north of Uge station (A)(C 33).

Holotype: Pl. 90, figs. 3 a–b; 23 X 24 μm in size; exine finely reticulate; lumina 0.5 μm ±; muri finely baculate-tectate, 1 μm high; width/length ratio: 1.043; slide C 31–b.

Name derivation: *sphaeroides* = spheroidal.

Remarks: *Tricolpites sphaeroides* n. sp. shows some similarity in form and ornamentation to the pollen of *Tricolpites sphaericus* Takahashi (1988) from the Coniacian to Santonian Futaba Group (Japan) and *Tricolpites mitis* Ward (1986) from the Albian Cheyenne Sandstone of Kansas (U. S. A.), but differs from *T. sphaericus* in its larger grain size and from *T. mitis* by its somewhat larger grain size and reticulations.

Botanical affinity: Salicaceae, *Salix*.

*Tricolpites rudis* Takahashi n. comb.

Pl. 91, fig. 17; pl. 92, fig. 7.


Description: See Takahashi (1961).
**Measurements:** Ca. 26.6–52.5 μm in size, exine up to 2 μm thick, width/length ratio: 0.6–1.0 (Takahashi, 1961); 33–42 μm in size (Takahashi, 1964); the present specimens: 38–43 μm X 33–39 μm in size, muri baculate-tectate, 1–1.5 μm high, lumina 0.5–1 μm in diameter, width/length ratio: 0.767–1.026.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Previous records:** Palaeogene, western Japan (Takahashi, 1961); Eocene, Hokkaido (Japan) (Takahashi, 1984).

**Remarks:** *Tricolpopollenites rudis* Takahashi with reticulate exine naturally must belong to the genus *Tricolpites* Cookson ex Couper emend. Belsky, Boltonhagen & Potonié (1965).

**Botanical affinity:** Unknown.

*Tricolpites vulgaris* (Pierce) Srivastava

Pl. 90, fig. 1.


1976 *Retitricolpites vulgaris* Pierce, Norris, Palaeontographica, B, 120, Lfg. 1–4, p. 108, pl. 17, figs. 20–24.


**Description:** See Pierce (1961) and Srivastava (1969).

**Measurements:** 21 X 21.5 μm in size, 26 μm in diameter, exine ca. 1.5 μm thick (Pierce, 1961); 17–29 μm in equatorial diameter, 15–31 μm in polar diameter, ratio polar diameter/equatorial diameter 1.0/1–1.4/1 (Norris, 1967); 17–37.6 μm in equatorial diameter (Srivastava, 1969); 21–31 μm X 20–29 μm in size (Singh, 1971); 21–26 μm in diameter (Srivastava, 1975); 29 X 24–29 μm in size, nexine about 0.5 μm, sexine about 1.0 μm, muri 1.0 μm wide, lumina 0.1–1.0 μm in diameter (Ward, 1986); the present specimen: 35 X 30 μm in size, lumina 0.5 μm ± in diameter, baculate, 0.5 μm high, width/length ratio: 0.857.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** ? Cenomanian, Minnesota (U. S. A.) (Pierce, 1961); Albian–?
Cenomanian, Alberta (Canada) (Norris, 1967); Maastrichtian, Alberta (Canada) (Srivastava, 1969); Albian, Oklahoma (U. S. A.) (Srivastava, 1975); Albian, Kansas (U. S. A.) (Ward, 1986).

**Remarks:** A single specimen was observed. This seems identical to *Tricolpites vulgaris* (Pierce) Srivastava (1969).

**Botanical affinity:** According to Pierce (1961) and Srivastava (1969), morphological comparisons indicate the affinity of *Tricolpites vulgaris* with the extant genera *Corylopsis* and *Hamamelis*.

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**Tricolpites** sp.

Pl. 89, fig. 16.

**Description:** Tricolpate pollen grain. Figura ellipsoidal or subprolate in equatorial view. Three colpi slender, converging at the poles; one colpus geniculate. Exine reticulate; lumina of reticulum polygonal and vermiculate in form; 2.5–3 μm in diameter or length; muri simplibaculate or partially semitectate, 2–2.5 μm high.

**Measurements:** 35 X 28 μm in size.

**Occurrence:** Uge Member, Uge (C 34).

**Remarks:** A single grain with longer muri was observed. The authors cannot determine its specific epithet.

**Botanical affinity:** Unknown.

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? *Tricolpites* sp.

Pl. 91, fig. 10.

**Description:** Tricolpate (?) pollen grain. Figura spheroidal in slightly oblique view. Three colpi conspicuous, converging at the poles. Exine finely reticulate; lumina very small; muri tectate, thin.

**Measurements:** 10.5 μm in diameter.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** Only one specimen was found.

**Botanical affinity:** Unknown.

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**Genus Tricolpopollenites** Pflug & Thomson 1953,

Palynomorphs from the Santonian Uge Member

*Tricolpopollenites asper* Pflug & Thomson
Pl. 88, figs. 3 a–b, 12, 15; pl. 98, fig. 5.

1953 *Tricolpopollenites asper* Pflug & Thomson, Thomson & Pflug, Palaeontographica, B, 94, p. 96, pl. 11, figs. 43–49.

1980 *Tricolpopollenites asper* Thomson & Pflug, Thiele-Pfeiffer, Palaeontographica, B, 174, p. 143, pl. 11, figs. 8–12.

1984 *Tricolpopollenites asper* Thomson & Pflug 1953, Mohr, Palaeontographica, B, 191, p. 76, pl. 12, figs. 2, 1 and 2, 2.

1984 *Tricolpopollenites asper* Thomson & Pflug 1953, Kirchner, Palaeontographica, B, 192, p. 117, pl. 6, figs. 13 a–b.


**Description:** See Thomson & Pflug (1953).

**Measurements:** 25–40 μm in size, width/length ratio: 0.8–1.0 (Thomson & Pflug, 1953); 30 X 22 μm in size (Mohr, 1984); 25–40 μm in size (Kirchner, 1984); 25–28 μm in size, exine 1.5–2 μm thick, width/length ratio: 0.8–1.0 (Takahashi & Jux, 1986); the present specimens: 23–25 X 20–22 μm in size, 26 μm in diameter (in polar view), width/length ratio: 0.87–0.88, (SEM: 32.9 X 26.5 μm in size, width/length ratio: 0.805).

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous records:** Eocene to Pliocene, W. - Germany (Thomson & Pflug, 1953; Thiele-Pfeiffer, 1980; Mohr, 1984; Kirchner, 1984); late Oligocene, St. Augustin (W. - Germany) (Takahashi & Jux, 1986).

**Remarks:** The present specimens belong firmly to *Tricolpopollenites asper* Pflug & Thomson (1953). This species appears in the Tertiary of Middle Europe.

**Botanical affinity:** Fagaceae, *Quercus*.

*Tricolpopollenites cf. augustinensis* Takahashi & Jux
Pl. 88, fig. 24.


**Description:** See Takahashi & Jux (1986).

**Measurements:** 26–30 μm in length X 20.5–23 μm in width, ectexine laevigate, endexine intrabaculate, width/length ratio: 0.73–0.88 (Takahashi & Jux, 1986);
the present specimen: 30 X 19 µm in size, exine 1 µm thick, ectexine laevigate, endexine intrabaculate, width/length ratio: 0.633.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Previous record:** Late Oligocene, St. Augustin (W. - Germany) (Takahashi & Jux, 1986).

**Remarks:** *Tricolpopollenites augustinensis* is a Tertiary species of W. - Germany. Its distribution is not yet distinct.

**Botanical affinity:** Unknown.

*Tricolpopollenites baculatus* n. sp.

*Pl. 88, figs. 25–26.*

**Description:** Tricolpate pollen grains. Figura prolate to subprolate in equatorial view. Three colpi slender, radially symmetrical, converging towards the poles. Exine two-layered; ectexine baculate, tectate, 1.7–2.5 µm high on the sides, 2.2–3 µm high on the poles; endexine smooth.

**Measurements:** 42–43 µm X 27–37 µm in size.

Width/length ratio: 0.64–0.86.

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (C 15).

**Holotype:** Pl. 88, fig. 25; 43 X 37 µm in size; exine two-layered; ectexine baculate-tectate, 1.7 µm high on the sides and 2.2 µm high on the poles; endexine smooth; width/length ratio: 0.86; slide C 31-b.

**Name derivation:** *baculatus* = baculate.

**Remarks:** This new species is morphologically similar to *Tricolpopollenites pseudoeuphorii* Pflug (1953, p. 97, pl. 11, figs. 163–164) from the Eocene of W.-Germany, but differs in having its larger grain size and higher baculate-tectate sculpture.

**Botanical affinity:** Unknown.

*Tricolpopollenites chikushiensis* Takahashi *grandiformis* Takahashi

*Pl. 88, figs. 1–2.*


Palynomorphs from the Santonian Uge Member

Sci., Kyushu Univ., Ser. D, Geol., 14, no. 2, p. 147, pl. 21, fig. 7.

Description: See Takahashi (1961).

Measurements: 26–43.5 μm in size, exine 0.8–2 μm thick, width/length ratio: 0.8–1 (Takahashi, 1961); the present specimens: 26–36 μm X 24–30 μm in size, exine 1–2 μm thick, width/length ratio: 0.83–0.92.

Occurrence: Uge Member, Uge (C 34) and cliff near a private house, north of Uge station (C 6).

Previous records: Palaeogene, western Japan (Takahashi, 1961); Eocene, Ishizuchi (Japan) (Takahashi, 1962); Oligocene, Waku (Japan) (Takahashi, 1963).

Remarks: Tricolpopollenites chikushiensis Takahashi grandiformis Takahashi is larger than T. chikushiensis Takahashi chikushiensis.

Botanical affinity: Unknown.

Tricolpopollenites cf. pseudoeuphorii Pflug
Pl. 88, fig. 22.

1953 Tricolpopollenites pseudoeuphorii Pflug, Thomson & Pflug, Palaeontographcia, B, 94, p. 97, pl. 11, figs. 163–164.


Description: See Thomson & Pflug (1953).

Measurements: 25–35 μm in size, baculate sculpture up to 2 μm high (Thomson & Pflug, 1961); 20.3 X 12 μm in size, width/length ratio: 0.59 (Takahashi & Jux, 1986); 34 X 24 μm in size, exine 1 μm thick, width/length ratio: 0.7; the present specimen: 24 X 20 μm in size, exine baculate, 1 μm high on the sides, 2 μm high on the poles, width/length ratio: 0.833.

Occurrence: Uge Member, north of Uge station (A) (C 33).


Remarks: A single specimen was found. This is rather subprolate in form and somewhat wider than the formerly described specimens. Nevertheless, it seems identical to Tricolpopollenites pseudoeuphorii Pflug (1953).

Botanical affinity: Unknown.
Tricolpopollenites subasper Takahashi

Pl. 88, figs. 4–11, 13–14; pl. 98, figs. 6, 12.


**Description:** See Takahashi (1957).

**Measurements:** 14–25 μm in size, exine less than 1 μm thick (0.6–0.8 μm thick), width/length ratio: ca. 0.8–1.0 (type: 23 X 18.4 μm in size, exine 0.6 μm thick, width/length ratio: 0.8) (Takahashi, 1957); 17–18 μm in length X 15–16 μm in width, 20–21 μm in diameter (in polar view), exine 1–1.5 μm thick, width/length ratio: 0.83–1.0 (Takahashi & Jux, 1986); 20 μm in diameter, exine thin (Takahashi & Jux, 1989); the present specimens: 16–25 μm X 14–23 μm in size, exine 0.5–1 μm thick, width/length ratio: 0.85–1.15.

**Occurrence:** Uge Member, south of Kanuka (C 31) and north of Uge station (A) (C 33).

**Previous records:** Eocene, western Japan (Takahashi, 1957, 1961); late Oligocene, St. Augustin (W.-Germany) (Takahashi & Jux, 1986); late Eocene to early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989).

**Remarks:** The specimens which were found in the Uge Member, are undoubtedly *Tricolpopollenites subasper* Takahashi (1957).

**Botanical affinity:** Probably Cupuliferae.

Genus *Tricolporopollenites* Pflug & Thomson 1953.

Type species: *Tricolporopollenites dolium* (Potonié 1931) Thomson & Pflug 1953.

*Tricolporopollenites* sp. a

Pl. 94, fig. 3.

**Description:** Tricolporate pollen grain. Amb triangular in polar view. Three colpi weak, short; equatorial pores round (?). Exine two-layered, chagrenate, 0.5 μm thick.
Palynomorphs from the Santonian Uge Member

**Measurements:** 26 X 23 μm in diameter.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Remarks:** Only one specimen which is not in enough preservation, was observed.

**Botanical affinity:** Unknown.

Tricolporopollenites sp. b
Pl. 94, figs. 5 a-b.

**Description:** Tricolporate pollen grain. Amb round-triangular in polar view. Three colpi conspicuous, radially symmetrical, converging at the poles; equatorial pores lalongate (?). Exine thin, punctate.

**Measurements:** 21 X 22 μm in diameter.

**Occurrence:** Uge Member, north of Uge station (A) (C 33).

**Remarks:** A single specimen was encountered.

**Botanical affinity:** Unknown.

Tricolporopollenites sp. c
Pl. 94, fig. 10.

**Description:** Tricolporate pollen grain. Figura spheroidal in oblique view. Three colpi slender, converging towards the poles; equatorial pores round. Exine finely punctate on surface; muri finely baculate, 0.5 μm high.

**Measurements:** 17 X 16 μm in size.

**Width/length ratio:** ca. 0.94.

**Occurrence:** Uge Member, south of Kanuka (C 31).

**Remarks:** Only one specimen was found.

**Botanical affinity:** Unknown.

Phytoplankton

Genus *Ascodinium* Cookson & Eisenack 1960.

**Type species:** *Ascodinium acrophorum* Cookson & Eisenack 1960.

*Ascodinium* sp.
Pl. 102, fig. 8.

**Description:** Shell oval in outline, with a short, blunt apical horn and a short,
pointed antapical horn situated on one side of the middle line. A broad girdle is indicated slightly. Capsule spherical (?). Shell membrane smooth.

**Measurements**: 62 µm in length and 44 µm in width.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Remarks**: A single specimen was observed. This is somewhat narrower than *Ascodinium acrophorum* Cookson & Eisenack (1960) from the (?) upper Albian-Cenomanian of Australia.

**Genus** *Cymatiosphaera* O. Wetzel 1933 emend. Deflandre 1954.

**Type species**: *Cymatiosphaera radiata* O. Wetzel 1933.

*Cymatiosphaera reticulosa* Takahashi

Pl. 102, figs. 5 a–b.


**Description**: See Takahashi (1964).

**Measurements**: 18.6–21.4 µm in diameter, length of spines 2.3–3.7 µm (holotype: 18.6 µm in diameter, maximum width of networks 6.5–7.5 µm) (Takahashi, 1964); 12.3–15 µm in diameter, width of networks 4.2–5.7 µm, spines 1.8–2.3 µm in length, wall 0.7 µm thick (Takahashi, 1971); the present specimen: 21 X 17.5 µm in diameter, exine 1.2 µm thick, net-wall undulate; muri with spines arised at the junctions of net-ridges, 2–3 µm high.

**Occurrence**: Uge Member, south of Kanuka (C 31).

**Previous records**: Oligocene, Joban (Japan) (Takahashi, 1964); Pleistocene, Ariake Sea (Japan) (Takahashi, 1971).

**Remarks**: The Uge specimen is identical with *Cymatiosphaera reticulosa* Takahashi (1964) with undulate net-wall and spines arised at the junctions of net-ridges.

*Cymatiosphaera* sp. a

Pl. 102, figs. 4 a–b.

**Description**: Shell sphaeroidal, thick-walled (2.5 µm thick), and with 14 polygonal fields (13 µm in diameter) divided by the somewhat undulate line.
Palynomorphs from the Santonian Uge Member

Measurements: 27 X 26 \( \mu m \) in diameter.

Occurrence: Uge Member, cliff near a private house, north of Uge station (C 6).

Remarks: Only one specimen was found. The authors cannot find a species comparable with it.

_Cymatosphaera_ sp. b
Pl. 102, figs. 6–7.

Description: Shell spheroidal to oval, thick-walled (2.2–3 \( \mu m \) thick), and with 12–14 polygonal fields divided by the straight or curved line. Muri of reticulum baculate, arising at the junctions of net-ridges.

Measurements: 37 X 25–34 \( \mu m \) in diameter.

Lumina of reticulum: 15–18 \( \mu m \) in diameter.

Muri of reticulum: 4–6 \( \mu m \) long.

Occurrence: Uge Member, north of Uge station (B) (C 36).

Remarks: Two specimens were found. They are similar to _Cymatosphaera parva_ Sarjeant (1959) from the Upper Jurassic of Yorkshire (England) and _C. primitiva_ W. Wetzel (1966) from the Lias of South Germany, but differ from _C. parva_ in having their larger grain size and the lower number of polygonal fields and from _C. primitiva_ in possessing their much smaller grain size.


_Pterospermella cf. aureolata_ (Cookson & Eisenack) Eisenack
Pl. 102, fig. 1.


Description: See Cookson & Eisenack (1958) and Eisenack (1972).

Measurements: Overall diameter 109–208 \( \mu m \), body 62–109 \( \mu m \), ratio of wing...
to body 1.4 - 2 : 1 (Cookson & Eisenack, 1958); the present specimen: overall diameter 159 X 140 \( \mu m \), body 70 X 65 \( \mu m \) in diameter, exine 8 - 12 \( \mu m \) thick.

**Occurrence:** Uge Member, north of Uge station (B) (C 36).

**Previous records:** Lower and Upper Cretaceous (Aptian-Lower Turonian) of Australia (Cookson & Eisenack, 1958, 1971); Eocene, NW Germany (Morgenroth, 1966; Klumpp, 1953); Oligocene, W.-Germany (Weiler, 1956; Maier, 1959).

**Remarks:** A single specimen with a large equatorial wing was found. This is identified approximately with *Pterospermella aureolata* (Cookson & Eisenack) Eisenack (1972) by its grain size and form of the equatorial wing and central body.

**Botanical affinity:** Prasinophyceae, Pterospermataceae.

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**Pterospermella cf. australiensis** (Deflandre & Cookson) Eisenack

Pl. 102, fig. 3.


**Description:** See Deflandre & Cookson (1955).

**Measurements:** Diameter of shell 10 - 18 \( \mu m \), overall diameter 25 - 33 \( \mu m \), ratio of shell to wing 2.4 - 3.3 (Deflandre & Cookson, 1955); diameter of body about 12 \( \mu m \), flange with 8 - 10 \( \mu m \) (Stanley, 1965); the present specimen: overall diameter 33 X 23 \( \mu m \), body 21 X 15 \( \mu m \), exine 1.5 \( \mu m \) thick, width of wing 6 \( \mu m \).

**Occurrence:** Uge Member, Uge (C 34).

**Previous records:** Lower Cretaceous, New South Wales (Australia) (Deflandre & Cookson, 1955); Paleocene, South Dakota (U. S. A.) (Stanley, 1965); Albian-Cenomanian, Western Australia (Cookson & Eisenack, 1971).

**Remarks:** Only one specimen was encountered. This resembles very well *Pterospermella australiensis* (Deflandre & Cookson, 1955) Eisenack (1973) in its grain size and form.

**Botanical affinity:** Prasinophyceae, Pterospermataceae.
Palynomorphs from the Santonian Uge Member

*Pterospermella* sp.
Pl. 102, fig. 2.

**Description:** Central body oval in polar view, provided with a large undulat-ing and radially folded equatorial wing. The radial folds of wing spine-like, about 15 in number. The equatorial wing is circular. Surface of shell smooth or chagrenate.

**Measurements:** Overall diameter: more than 85 μm.
- Diameter of central body: 20 X 15 μm.
- Width of wing: more than 40 μm.

**Occurrence:** Uge Member, north of Uge station (C15).

**Remarks:** A full observation is difficult, because two pollen grains are piled up. However, a pollen grain on *Pterospermella* is discriminated satisfactorily.

**Botanical affinity:** Prasinophyceae, Pterospermataceae.

I*ncertae sedis*


**Type species:** *Ovoidites ligneolus* (Potonié 1931) Potonié 1951.

**? Ovoidites** sp.
Pl. 87, figs. 29 a–b.

**Description:** Figura ellipsoidal or prolate in equatorial view. Exine thin, 1.5 μm thick, with foveolate and vermiculate sculptures on middle sides of grain and rather smooth on the polar sides; lumina 0.5–3.5 μm in diameter or length. No colpus.

**Measurements:** 90 X 59 μm in size.
- Width/length ratio: 0.655.

**Occurrence:** Uge Member, Uge harbor (A) (C39).

**Remarks:** Only one specimen was found. This is different from *Ovoidites elongatus* (Hunger) Krutzsch and *O. microligneolus* Krutzsch by its characteristic sculpture.

**Botanical affinity:** Unknown.
References


Palynomorphs from the Santonian Uge Member

pp., pls. 1–39.


Palynomorphs from the Santonian Uge Member 599-664, pls. 16-44.


1–10.


Palynomorphs from the Santonian Uge Member

9 pls.; IV (1966), 72, 244 pp., 15 pls.; V (1970), 87, 222 pp., 24 pls.


pl. 38–39.


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Explanation of plate 1
(All figures magnified X 1000 unless otherwise mentioned)

Figs. 1 – 3. *Leiotriletes giganteus* n. sp.
Fig. 1: holotype, slide C 31—b, X 800; figs. 2, 3: slide C 31—b, X 600.

Figs. 4, 5. *Leiotriletes rotundiformis* (Maljavkina) Chlonova
X 800; fig. 4: slide C 31—b; fig. 5: slide C 17—d.

Figs. 6 a—b. *Leiotriletes cf.* convexiformis Chlonova
Slide C 17—e.
Explanation of plate 2
(All figures magnified X 1000 unless otherwise mentioned)

Fig. 1. *Cyathidites splendens* Harris
X 600, slide C40-b.

Figs. 2 - 4. *Leiotriletes giganticus* n. sp.
X 800: figs. 2, 4: slide C31-b; fig. 3: slide C33-a.

Fig. 5. *Leiotriletes cf. rotundiformis* (Maljavkina) Chlonova
X 800, slide: C31-b.

Figs. 6 a–b. *Monoleiotriletes gracilis* Krutzsch
Slide C33-a.