


**Description:** See Potonié (1931, 1960).

**Dimensions:** 12–13 μm in size (Potonié, 1931); 10–16 μm in size (Thomson & Pflug, 1953); 15–20 μm in size (Krutzsch & Vanhoorne, 1977); 13 X 15 μm in size (Thiele-Pfeiffer, 1980); 12.0–12.5 μm X 10.0–12.5 μm in equatorial view, 12.6–15.6 μm in polar view, exine 0.7–0.8 μm thick (Takahashi & Jux, 1982); less than 20 μm in size (Mohr, 1984); 7–17 μm in size (Nagy, 1985); 12–16 μm X 10–14.5 μm in size, exine 0.7–0.8 μm thick, width/length ratio: 0.77–0.94 (Takahashi & Jux, 1986); present specimens: 14–15 μm X 14–16 μm in equatorial view, 13 X 14 μm in polar view, exine 0.5–1.5 μm thick, width/length ratio: 0.938–1.0.

**Occurrence:** Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (Akk–10, OCH–04, and OCH–10).


**Remarks:** This species is closely similar to *Cyrillaceaepollenites minor* (Takahashi) Takahashi from the Santonian to Miocene of Japan, but differs by its thicker exine.

**Botanical affinity:** Cyrillaceae; *Cyrilla, Cliftonia, and Costaea.*

(203) ? *Cyrillaceaepollenites megaexactus* (Potonié) Potonié

Pl. 42, figs. 22a–b.


1951 *Pollenites brühlensis* Thomson, Potonié, Palaeontographica, B, 91, pl. 20, fig. 79.


**Description:** See Potonié(1931, 1960).

**Dimensions:** 20 μm in size (Potonié, 1931); 16–24 μm in size (Thomson & Pflug, 1953); 24 μm in size (Thiele-Pfeiffer, 1980); 17.3–20.0 μm in equatorial diameter, exine 0.5–1.2 μm thick (Takahashi & Jux, 1982); 22–24 μm in size (Mohr, 1984); 16–29 μm (mainly 17–20 μm) in size (Nagy, 1985); 16–22 μm in equatorial diameter, width/length ratio: 0.89–1.0 (Takahashi & Jux, 1986); present specimen: 23 μm in equatorial diameter, exine 1 μm thick.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH–02).


**Remarks:** In comparison with *Cyrillaceaepollenites exactus* (Potonié) Potonié *C. megaexactus* is larger.

**Botanical affinity:** Cyrillaceae; *Cyrilla, Cliftonia,* and *Costaea*.

**Genus:** *Echitricolpites* Da Silva Pares Regali, Uesugi & Da Silva Santos 1974.

**Type species:** *Echitricolpites communis* Da Silva Pares Regali et al. 1974.

(204) *Echitricolpites* sp. a
Pl. 39, fig. 20.

**Description:** Tricolpate pollen grain. Outline subcircular or spheroidal in equatorial view. Three colpi distinct, running from pole to pole, geniculus. Exine thin; ectexine echinate; spinules conical in shape, 0.5 - 1.5 μm high, distributed sparsely.

**Dimensions:** 26 X 23 μm in size, width/length ratio = 0.885.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-11).

**Remarks:** In comparison with *Echitricolpites communis* Da Silva Par. Reg. et al. from the Palaeocene of Brazil and *Echitricolpites* (al. *Tricolpopollenites*) *spinosus* (R. Potonié 1934) n. comb. from the Palaeogene of Germany, *Echitricolpites* sp. a is smaller in size and possesses smaller spinules.

**Botanical affinity:** Unknown.

(205) *Echitricolpites* sp. b

Pl. 39, fig. 21.

**Description:** Tricolpate pollen grain. Amb circular or spheroidal in equatorial view. Three colpi strong, converging to both poles. Exine 1 μm thick; ectexine echinate; spines small, less than 1 μm high.

**Dimensions:** 16 X 17+ μm in size, width/length ratio = 1.063.

**Occurrence:** Tokotan Formation in Oohishi area (OCH-02).

**Remarks:** Only one specimen was observed. The author is able to find no species comparable to the specimen.

**Botanical affinity:** Unknown.

**Genus:** *Engelhardtiodites* Potonié, Thomson & Thiergart 1950 ex Potonié 1960.

**Type species:** *Engelhardtiodites microcoryphaeus* (Potonié 1931) Potonié, Thomson & Thiergart 1950.

(206) *Engelhardtiodites microcoryphaeus* (Potonié) Potonié, Thomson & Thiergart

Pl. 45, figs. 6–9 (cf.).


Description: See Potonie (1931, 1960).

Dimensions: 19 μm in size (Potonie, 1931); ca. 18 μm in size (Potonie, Thomson & Thiergart, 1950); less than 18 μm in size (Thomson & Pflug, 1953); 15–17 μm in equatorial diameter, exine less than 1 μm thick (Takahashi & Jux, 1986); present specimens: 17–18 μm (20.5 μm: cf.) in size, exine thin, 0.5 μm thick.


Remarks: The present specimens are not enough in preservation. However, they belong to Engelhardtiooidites microcoryphaeus (Pot.) Pot., Thoms. & Thierg. which is smaller than Engelhardtioipollenites.

Botanical affinity: Juglandaceae, Engelharditia.


Type species: Erdtmanipollis pachysandroides Krutzsch 1962.

(207) Erdtmanipollis procumbentiformis (Samoilovitch) Krutzsch

Pl. 39, figs. 2a–c.

1961 Pachysandra procumbentiformis Samoilovitch, Trudy VNIIGRI, no. 177, p. 199, pl. 64, figs. 1a–d; pl. LXV, fig. 13.

1966 Erdtmanipollis procumbentiformis (Samoilovitch 1961) W. Kr. 1962a, Geologie, Jrg. 15, Beih. 55, p. 29.

Description: See Samoilovitch (1961).

Dimensions: 39.4–42.6 μm in diameter, exine ca. 4.0 μm thick, pores 2.5–3.0 μm in diameter (Samoilovitch, 1961); present specimen: 35 X 32 μm in diameter, muri-bacula: large 2.5–3 μm long, small 1.7–2 μm long.

Occurrence: Akkeshi Formation in Choboshi area (CHO–01).

Previous record: Upper Palaeocene, western Siberian lowland (USSR) (Samoilovitch, 1961).

Remarks: Only one specimen was observed. This coincides with *Erdtmanipollis procumbentiformis* from the upper Palaeocene of western Siberian lowland (USSR) in general morphological characters.

Botanical affinity: Buxaceae, *Pachysandra* or *Sarcococca*.


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

(208) *Fibulapollis pusillus* Takahashi
Pl. 35, figs. 13a–b; pl. 36, fig. 9.


Description: See Takahashi & Shimono (1982).

Dimensions: Length of the polar axis 16.5–23 μm; breadth of the polar projections 7–12 μm; length of equatorial projections 7–12 μm; breadth of equatorial projections 13–18 μm equatorial diameter 19.5–24.5 μm; a/b = 1.31–1.5; present specimens: 20–26 μm X 15–21 μm, width of equatorial projections 12–16 μm, a/b = 1.25–1.312.

Occurrence: Akkeshi and Tokotan Formations in Akkeshi and Ochiiishi areas (AKK–12 and OCH–04).

Previous record: Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

Remarks: Two specimens were observed. They are identified with *Fibulapollis pusillus* Takahashi from the Maastrichtian Miyadani-Gawa Formation of the Hida district (central Japan) in general morphological features.

Botanical affinity: Unknown.

(209) *Fibulapollis* sp. a
Pl. 35, figs. 7a–b.
Description: Pollen grain with three equatorially situated projections and with very slightly developed projection each on proximal and distal polar region.

Isopolar; both polar projections swelling very slightly, small conical. Equatorial projections small, triangular with rounded apex. Tricolpate; colpi extending full length of equatorial projections, extending a short distance onto polar projections.

Exine two-layered, foveolate-tectate; axillary endexinous costae developed, as much as 2 μm thick in the thickest part, extending full length of equatorial projections excepting apical regions, extending a short distance onto polar projections; ectexine as thick as endexine.

Dimensions: Length of the polar axis 22 μm; width of the polar projections 4–5 μm; length of the equatorial projections 12 μm; width of the equatorial projections 19 μm; equatorial diameter 25 μm; a/b = 1.157.

Occurrence: Akkeshi Formation in Akkeshi area (AKK–11).

Remarks: The only specimen differs from all other species of Fibulapollis.

Botanical affinity: Unknown.

(210) Fibulapollis sp. b
Pl. 36, figs. 6a–b.

Description: Pollen grain with three equatorially situated projections and with small projection each on proximal and distal polar region.

Subisopolar; both polar projections swelling slightly, small conical. Equatorial projections small, subtriangular with rounded apex. Tricolpate; colpi extending full length of equatorial projections, extending a short distance onto polar projections.

Exine two-layered, tectate-echinate; axillary endexinous costae very developed, as much as 4 μm thick in the thickest part, extending full length of equatorial projections excepting apical regions, extending a short distance onto polar projections.

Dimensions: Length of the polar axis 22 μm; width of the proximal polar projection 8 μm; width of the distal polar projections 6 μm; equatorial diameter 26 μm; length of the equatorial projections 12–14 μm; width of equatorial projections 13–15 μm; a/b = 1.466.

Occurrence: Akkeshi Formation in Akkeshi area (AKK–10).

Remarks: The single specimen with echinate sculptures was observed. The species could not be identified specifically.

Botanical affinity: Unknown.
(211) *Fibulapollis* sp. c  
Pl. 36, fig. 11.

**Descriptions:** Pollen grain with three equatorially situated projection and with small projection or swell each on proximal and distal polar region.  
Heteropolar; both polar projections swelling very slightly, small dome-shaped. Equatorial projections small, subtriangular with rounded apex. Tricolpate; colpi extending full length of equatorial projections, extending a short distance onto polar projections.

Exine two-layered, chagrenate; axillary endexinous costae somewhat developed, extending full length of equatorial projections excepting apical region, extending a short distance onto polar projections.

**Dimensions:** Length of the polar axis 26 μm; width of the polar projections 20 μm; equatorial diameter 33 μm; length of the equatorial projections 5 μm; width of the equatorial projections, 18.5 μm; a/b = 1.405.

**Occurrence:** Hamanaka-Oborogawa Formation in Akkeshi area (AKK-07).

**Remarks:** The only specimen observed differs from *Fibulapollis pusillus* Takahashi in general feature and size.

**Botanical affinity:** Unknown.

(212) ? *Fibulapollis* sp.  
Pl. 35, fig. 2.

**Remarks:** Whether the present specimen which is poorly preserved belongs to the genus *Fibulapollis* or not, is not decided.

**Dimensions:** Length of polar axis 30 μm; equatorial diameter 45 μm; length of the equatorial projections 20–25 μm; width of the equatorial projections, 20 μm; (a/b = 1.5).

**Occurrence:** Tokotan Formation in Ochiishi area (OCH-03).

**Botanical affinity:** Unknown.

**Genus:** *Graminidites* Cookson 1947 ex Potonie 1960.

**type species:** *Graminidites media* Cookson 1947 ex Potonie 1960.

(213) *Graminidites* sp. a  
Pl. 46, figs. 7a–b.

**Description:** Monoporate pollen grain. Fígura spherical. Exine thin, finely
punctate, secondarily folded. A pore small, 2.5 μm in diameter, without annulus.

**Dimensions:** 36 X 30 μm in diameter.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH-04).

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

**Botanical affinity:** Gramineae.

(214) *Graminidites* sp. b

**Pl. 46, figs 8, 9.**

**Description:** Monoporate pollen grains. Outline more or less quadrate due to their transformation. Exine thin, finely punctate to chagrenate, crumpling secondarily. Pore small, 2-3 μm in diameter, without annulus.

**Dimensions:** 22-26 μm in diameter.

**Occurrence:** Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK-09 and OCH-05).

**Remarks:** Two specimens observed differ from *Graminidites punctatus* Krutzsch (1970) in having their thin exine and no annulus around the pore.

**Botanical affinity:** Gramineae.

(215) *Graminidites* sp.

**Pl. 46, fig. 10.**

**Description:** Monoporate pollen grain (?). Figura spherical. Exine thin, chagrenate, secondarily folded. Pore very small, 1.5 μm in diameter.

**Dimensions:** 16 μm in diameter.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-10).

**Remarks:** Only one specimen was encountered. Belonging to the genus *Graminidites* is uncertain.

**Botanical affinity:** ? Gramineae.


**Type species:** *Hemicorpus pulchrum* (Funkhouser 1961) Krutzsch 1970.

(216) *Hemicorpus trapeziforme* (Mtchedlishvili) Krutzsch

**Pl. 32, figs. 3a-c; pl. 33, figs. 4a-b.**

1961 *Mancorpus trapeziforme* Mtchedlishvili, in Samoilovitch et al., Trudy VNIIGRI,
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no. 177, p. 221, pl. 71, figs. 3a-d; pl. 62, fig. 6.


**Description:** See Mtchedlishvili in Samoilovitch et al. (1961) and Takahashi in Takahashi & Shimono (1982).

**Dimensions:** Height of pollen grain 26.1–34.3 μm; equatorial diameter 37.4–44.6 μm; length of body 21.7–29.4 μm; width of body 13.4–15.2 μm; length of equatorial projections 12.3–18.9 μm; width of equatorial projections 9.6–12.1 μm; exine 1.5 μm thick (Mtchedlishvili in Samoilovitch et al., 1961); length of polar axis 19–26 μm; length of developed polar projection 11–15 μm; length of equatorial projections 10–16 μm; equatorial diameter 32–40 μm; width of developed polar projection 13–20 μm; width of equatorial projections 9–12 μm; a/b = 2.11–2.5 (Takahashi & Shimono, 1982); present specimens: length of polar axis 30–32 μm; width of polar projection 13–14 μm; equatorial diameter 32–40 μm; length of equatorial projections 12–15 μm; width of equatorial diameter 12–13 μm; a/b = 2.23.

**Occurrence:** Akkeshi Formation in Akkeshi and Ochiishi areas (AKK–11 and OCH–09).

**Previous records:** Maastrichtian-Danian, western Siberian lowland (USSR) (Mtchedlishvili in Samoilovitch et al., 1961); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

**Remarks:** Two specimens which were found from the Akkeshi Formation are identifiable with *Hemicorpus trapeziforme* (Mtchedlishvili) Krutzsch in morphological features and size.

**Botanical affinity:** Unknown.

(217) ? *Hemicorpus* sp.

Pl. 33, figs. 5a–b.

**Description:** Pollen grain with three equatorial situated apical projections and one projection developed on one pole (?); triangular, with slightly concave sides in polar view.

Heteropolar (?); equatorial projections well-developed, but small in polar view. Tricolpate; colpi meridional, extending full length of equatorial pro-
jections. Axillary endexinous costae developed. Exine two-layered, tectate, ca. 2 μm thick.

**Dimensions**: 29 × 24 μm in diameter.

**Occurrence**: Akkeshi Formation in Ochiishi area (OCH−06).

**Remarks**: The present specimen looks to be *Cranwellia striata* (Couper) Srivastava, but possesses a somewhat swelled polar projection. Accordingly this is probably *Hemicorpus*.

**Botanical affinity**: Unknown.


**Type species**: *Integricorpus bellum* Mtchedlishvili 1961.

(218) *Integricorpus cf. bertillonites* (Funkhouser) Stanley

Pl. 33, figs. 6a−b; pl. 34, figs. 6a−b.

1961 *Aquilapollenites bertillonites* Funkhouser, Micropaleontology, vol. 7, no. 2, p. 196, pl. 2, figs. 5a−c.


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

**Dimensions**: From polar axis to tips of equatorial protrusions ca. 25 μm (Funkhouser, 1961); present specimens: equatorial diameter 34−42 μm; length of polar axis 21 μm; length of equatorial projections 11−12 μm; width of equatorial projections 10 μm; striae-muri 1.3−2 μm high; a/b = 3.0.

**Occurrence**: Akkeshi and Tokotan Formations in Ochiishi area (OCH−03 and OCH−06).

**Previous record**: Maastrichtian, Wyoming (USA) (Funkhouser, 1961).

**Remarks**: Two specimens in lateral and somewhat oblique views are identified with *Integricorpus bertillonites* (Funkhouser) Stanley in spite of smaller length of polar axis.

**Botanical affinity**: Unknown.

(219) *Integricorpus mtchedlishvili* (Srivastava) Takahashi

Pl. 32, figs. 8a−c; pl. 35, figs. 1a−b (cf.).
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1961 *Parviprojectus reticulatus* Mtchedlishvili, in Samoilovitch & Mtchedlishvili, Trudy VNIGRI, no. 177, p. 226, pl. 73, figs. 2a–c, 3; pl. LXII, fig. 10.


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

**Dimensions:** Polar axis 30.0–49.7 μm, average 42.5 μm; equatorial axis 19.0–27.2 μm, average 24.1 μm; length of the equatorial projections 9.7–15.6 μm; average 13.4 μm; breadth of equatorial projections 5.2–7.7 μm, average 6.3 μm (Mtchedlishvili, 1961); present specimens: length of polar axis 40–44 μm; width of polar projections 13–22 μm; equatorial diameter 35–40 μm; length of equatorial projections 14 μm; width of equatorial projections 6–8 μm; from polar axis to tips of equatorial projections ca. 20 μm; a/b = 4.4–5.0.

**Occurrence:** Akkeshi Formation in Akkeshi and Ochiishi areas (AKK-09 and OCH-08).

**Previous record:** Maastrichtian-Danian, western Siberian lowland (USSR) (Mtchedlishvili in Samoilovitch & Mtchedlishvili, 1961).

**Remarks:** One of the present specimens (pl. 32, figs. 8a–c) is closely similar to *Integricorpus mtchedlishvilii* (Srivastava) Takahashi, but the other (pl. 35, figs. 1a–b) is not firmly to belong to that.

**Botanical affinity:** Unknown.

(220) *Integricorpus cf. striatum* (Mtchedlishvili) Stanley

Pl. 34, figs. 3a–b.

1961 *Parviprojectus striatus* N. Mtchedlishvili, Samoilovitch et al., Trudy VNIGRI, no. 177, p. 225, pl. 73, figs. 1a–c.


**Description:** See Mtchedlishvili in Samoilovitch et al. (1961).

**Dimensions:** Length of pollen grain 46.0–46.6 μm; width of body 27.4–31.0
length of equatorial projections 9.7 \( \mu m \); width of equatorial projections 7.7–9.0 \( \mu m \); exine 2.0 \( \mu m \) thick (Mtchedlishvili, 1961); present specimen: length of polar axis 41 \( \mu m \); width of polar projections 21 \( \mu m \); equatorial diameter 40 \( \mu m \); length of equatorial projections 12 \( \mu m \); width of equatorial projections 10–11 \( \mu m \); a/b = 3.727.

**Occurrence**: Akkeshi Formation in Ochiishi area (OCH–08).

**Previous record**: Maastrichtian-Danian (?), northwest Siberian lowland (USSR) (Mtchedlishvili, 1961).

**Remarks**: Only one specimen was found. It is not sure that this belongs to *Integricorpus striatum* (Mtchedlishvili) Stanley, due to its poor preservation.

**Botanical affinity**: Unknown.

(221) *Integricorpus* sp. a

Pl. 34, figs. 5a–c.

**Description**: Pollen grain with three equatorial situated apical projections and with one projection each on the proximal and distal polar region; isopolar or subisopolar; equatorial projections small, triangular; tricolpate, colpi meridional across the equatorial projections, long, extending up to the polar regions. Exine 1.5–2 \( \mu m \) thick; ornamentation on body retipilate or tectate, equatorial projections smooth.

**Dimensions**: Length of polar axis 34 \( \mu m \); width of polar projection 16 \( \mu m \); equatorial diameter 28 \( \mu m \); length of equatorial projections 9 \( \mu m \); width of equatorial projections 8 \( \mu m \); a/b = 4.25.

**Occurrence**: Akkeshi Formation in Ochiishi area (OCH–08).

**Remarks**: A single specimen which is poorly preserved was observed.

**Botanical affinity**: Unknown.

(222) *Integricorpus* sp. b

Pl. 35, fig. 5.

**Description**: Pollen grain with three equatorial situated apical projections and with one projection each on the proximal and distal polar regions; isopolar; equatorial projections short with blund apices, base slightly constricted; three meridional colpi across the equatorial projections, long, reaching the polar regions. Exine 1 \( \mu m \) thick, tectate (?).

**Dimensions**: Length of polar axis 23 \( \mu m \); width of proximal polar projection 13 \( \mu m \); width of distal polar projection 10 \( \mu m \), equatorial projections 5 \( \mu m \);
width of equatorial projections 5 μm; a/b = 4.6.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-09).

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

**Botanical affinity:** Unknown.

**Genus:** *Intrabaculitricolporites* Kedves 1978.

**Type species:** *Intrabaculitricolporites porasper* (Pflug 1953) Kedves 1978.

(223) *Intrabaculitricolporites* cf. *consularis* (Takahashi)

*Takahashi & Jux consularis*

Pl. 42, fig. 19.

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


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

**Dimensions:** 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); 34 X 24 μm in size, exine 1 μm thick, width/length ratio: 0.705 (Takahashi & Sugiyama, 1990); present specimen: 23 X 14 μm in size, exine 1.5 μm thick (ectexine as thick as endexine), width/length ratio: 0.609.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH-10).

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

Type species: Kurtzipites trispissatus Anderson 1960.

(224) Kurtzipites cf. mirificus (Chlonova) Srivastava
Pl. 36, figs. 7a–c, 10.


Description: See Chlonova (1957, 1961).
Dimensions: 20 – 27 μm in diameter, average 23 μm (Chlonova, 1960); 17 – 30 μm in size, average 26 μm, exine 1 – 1.5 μm thick (Chlonova, 1961); present specimens: length of polar axis 26 – 32 μm; equatorial diameter 29.5 – 31 μm; length of equatorial projections 9 – 17 μm; width of equatorial projections 19 – 22 μm; a/b = 1.368 – 1.454.
Occurrence: Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK–12 and OCH–04).
Remarks: Srivastava (1981) described or catalogued seven valid species of Kurtzipites and stated as follows: there is no doubt that Fibulapollis mirificus belongs to the genus Kurtzipites but it cannot be distinguished objectively from other Kurtzipites species. However, Kurtzipites mirificus (Chlonova) Srivastava differs from five species of Kurtzipites with various sculptures and is similar to K. circularis (Norton 1969) Srivastava (1981) with smooth exine. Inasmuch as K. mirificus is showed only in equatorial view and K. circularis only in polar view, it is difficult to decide, whether both species are same
or not.

**Botanical affinity:** Unknown.

(225) *? Kurtztpites* sp. a  
Pl. 39, figs. 3a–b.

**Description:** Tricolporate or tricolporate (?) pollen grain; outline triangular with slightly convex sides and slightly rounded apices in polar view. Exine thin, two-layered, chagrenate. Three colpi meridional, short, extending 1/3 the amb radius.

**Dimensions:** 40 µm in diameter.

**Occurrence** Tokotan Formation in Ochiishi area (OCH–05).

**Remarks:** Only one specimen was encountered. It is doubt whether this belongs to the genus *Kurtztpites*.

**Botanical affinity** Unknown.

(226) *? Kurtztpites* sp. b  
Pl. 39, figs. 19a–b.

**Description:** Tricolporate or tricolpate (?) pollen grain. Outline triangular with slightly convex or concave sides and rounded corners. Exine thin, chagrenate. Three colpi meridional, slender, extending a half the amb radius.

**Dimensions:** 30 µm in diameter.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH–03).

**Remarks:** Only one specimen was observed. Whether this belongs to the genus *Kurtztpites* or not is unexplained.

**Botanical affinity:** Unknown.

**Genus:** *Liliacidites* Couper 1953.

**Type species:** *Liliacidites haitangataensis* Couper 1953.

(227) *Liliacidites cf. variegatus* Couper  
Pl. 30, fig. 12.


1966 *Liliacidites variegatus* Couper 1953, Srivastava, Pollen et spores, vol. 8, no. 3, p. 525, pl. 4, figs. 15, 16.

1967 *Liliacidites variegatus* Couper 1953, Drugg, Palaeontographica, B, 120, p. 7, fig. 23.


1969 *Liliacidites variegatus* Couper 1953, Norton & Hall, Palaeontographica, B, 125, Lfg. 1–3, pp. 35–36, pl. 5, fig. 2.


1973 *Liliacidites variegatus* Couper 1953, B. D. Tschudy, Geol. Surv. Prof. Paper 770, p. 20, pl. 8, fig. 12; tab. 1, no. 55.

**Description:** See Couper (1953).

**Dimensions:** 26–(29)–36 μm long, 16–(22)–26 μm wide, exine ca. 1.5 μm thick; lumen of reticulum up to 2 μm across at centre of grain (but usually only ca. 1 μm), less than 1 μm at ends of grain (Couper, 1953); 26–36 μm (Rouse, 1957); length 22 μm, width 14 μm (Srivastava, 1966); 35–45 μm in size (Drugg, 1967); 26–28 μm long, 23–25 μm wide, lumina to 2 μm across (Norton & Hall, 1969); 25.0–39.0 μm long (versus 26.0 to 36.0 μm), 14.0–26.0 μm wide (versus 16.0 to 26.0 μm) (Chmura, 1972); present specimen: 36 X 19 μm in size, muri baculate, 1 μm high, width/length ratio: 0.528.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH–02).

**Previous records:** Upper Cretaceous-lower Oligocene, New Zealand (Couper, 1953); Santonian, western Canada (Rouse, 1957); Maastrichtian-lower + middle Miocene, New Zealand (Couper, 1960); Maastrichtian, Scollard (Alberta, Canada) (Srivastava, 1966); Maastrichtian-Danian, Escarpado Canyon (California, USA) (Drugg, 1967); Palaeocene, Taxas (USA) (Elsik, 1968); Upper Cretaceous (Maastrichtian), Montana (USA) (Norton & Hall, 1969); Maastrichtian, Drumheller (Alberta, Canada) (Srivastava, 1969); Upper Cretaceous (Campanian + Maastrichtian), San Joaquin Valley (California, USA) (Chmura, 1972); Upper Campanian, North-Central Montana (USA) (B. D. Tschudy, 1973).

**Remarks:** *Liliacidites variegatus* Couper occurs in the Campanian to Palaeocene in the North Hemisphere and in the Upper Cretaceous to Miocene in the South Hemisphere.

**Botanical affinity:** Possibly Liliaceae.
Genus: *Momipites* Wodehouse 1933.

Type species: *Momipites coryloides* Wodehouse 1933.

(228) *Momipites constatus* (Takahashi) Takahashi

Pl. 44, fig. 1; pl. 45, fig. 1 (cf.).


1979 *Momipites constatus* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 51, pl. 17, figs. 11–15; pl. 18, fig. 7.


Description: See Takahashi (1961).

Dimensions: 18–35.5 μm in size, exine less than 1 μm thick (Takahashi, 1961); ca. 18–37 μm in size, exine less than 1 μm thick (Takahashi, 1964); 20.8–36 μm in diameter, exine 1 μm thick (Takahashi & Kim, 1979); 17–19 μm in equatorial diameter, exine less than 1 μm thick (Takahashi & Jux, 1982); present specimens: 27–30 μm in equatorial diameter, exine 0.5 μm thick.

Occurrence: Akkeshi Formation in Akkeshi and Choboshi areas (AKK – 12 and CHO – 01).

Previous records: Palaeogene and Miocene, West Japan (Takahashi, 1961); Upper Cretaceous, Yubari coal-field (Hokkaido, Japan) (Takahashi, 1964); lower and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Palaeogene, Bergish Land (W. Germany) (Takahashi & Jux, 1982).

Remarks: *Momipites constatus* (Takahashi) Takahashi is closely similar to *M. coryloides* Wodehouse, but differs in having more or less thinner exine.

Botanical affinity: Betulaceae.


(229) *Monocolpopollenites intrabaculatus* Takahashi

Pl. 30, fig. 7.
336  K. Takahashi


1979  Monocolpopollenites intrabaculatus  Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 35, pl. 8, fig. 24.


Description: See Takahashi (1961).

Dimensions: 19.6–45 µm in size, exine 0.5–2 µm thick, colpus up to 2.5 µm wide (Takahashi, 1961); 28 X 20.3 µm in size, exine 1 µm thick (Takahashi & Kim, 1979); 20–22 µm X 10–11 µm in size, exine 0.5–1 µm thick, colpus up to 2 µm wide, width/length ratio: 0.48–0.55 (Takahashi & Jux, 1986); 23 X 15 µm in size, exine 1 µm thick, colpus ca. 1.5 µm wide, width/length ratio: 0.65; present specimen: 24 X 16 µm in size, exine 0.5 µm thick, width/length ratio: 0.641.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-05).

Previous records: Palaeogene, West Japan (Takahashi, 1961); lower Miocene, Changgi (Korea) (Takahashi & Kim, 1979); late Oligocene, St. Augustin (W. Germany) (Takahashi & Jux, 1986); late Eocene-early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989).

Remarks: This species is monocolpate pollen and possesses intrabaculate exine.

Botanical affinity: Palmae.

(230) Monocolpopollenites kyushuensis Takahashi

Pl. 30, figs. 8–11.


1979  Monocolpopollenites cf. kyushuensis  Takahashi,  Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 36, pl. 8, figs. 26–27.

Description: See Takahashi (1961).

Dimensions: 14–33.2 \( \mu \text{m} \) in size, exine up to 1.5 \( \mu \text{m} \) thick (Takahashi, 1961); 18–30 \( \mu \text{m} \times 7–18 \mu \text{m} \) in size (Miki, 1972); 23–29.8 \( \mu \text{m} \times 14–15 \mu \text{m} \) in size, exine 0.8–1 \( \mu \text{m} \) thick (Takahashi & Kim, 1979); 23.5–25 \( \mu \text{m} \times 12–13 \mu \text{m} \) in size, exine thin (Takahashi & Shimono, 1982); 30 \( \times 15 \mu \text{m} \) in size, exine 0.5 \( \mu \text{m} \) thick, width/length ratio: 0.5 (Takahashi & Sugiyama, 1990); present specimens: 18–23 \( \mu \text{m} \times 8–15 \mu \text{m} \) in size, exine thin, width/length ratio: 0.421–0.681.

Occurrence: Hamanaka-Oborogawa and Akkeshi Formations in Akkeshi area (AKK-05, AKK-07, and AKK-10).

Previous records: Palaeogene and Miocene, West Japan (Takahashi, 1961); Campanian to Palaeogene, Yubari coal-field (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); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).

Remarks: The present specimens belong surely to Monocolpopollenites kyushuensis Takahashi. This species occurs in the Santonian to Miocene of Japan.

Botanical affinity: Palmae.


Type species: Orbiculapollis globosus (Chlonova 1957) Chlonova 1961.

(231) Orbiculapollis globosus (Chlonova) Chlonova
Pl. 37, figs. 1, 2.

1961 Triporina globosa N. Mtchedlishvili, Samoilovitch & Mtchedlishvili, Trudy VNIGRI, no. 177, pp. 244–246, pl. 80, figs. 2a–c, 3a–b.


**Description:** See Chlonova (1957, 1961).

**Dimensions:** 26–39.5 \(\mu\)m in size (average 32 \(\mu\)m) (Chlonova, 1960); 26–39.5 \(\mu\)m in size (average 31.5 \(\mu\)m), exine 1 \(\mu\)m thick (Chlonova, 1961); 28–35 \(\mu\)m in diameter, length of polar axis 24–25 \(\mu\)m, exine 1 \(\mu\)m thick (Bratzeva, 1965); ca. 26 \(\mu\)m in equatorial diameter, exine 0.5 \(\mu\)m thick (Takahashi, 1970); 28–37.5 \(\mu\)m in diameter, length of polar projection 25–27 \(\mu\)m, width 18–21 \(\mu\)m, exine 1 \(\mu\)m thick (Krassilov et al., 1988); present specimens: 42–46 \(\mu\)m X 39–43 \(\mu\)m in equatorial diameter, wings 4–12 \(\mu\)m wide, 4.5–7 \(\mu\)m long.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-09 and AKK-11).

**Previous records:** Danian-Palaeocene, West Siberia (USSR) (Chlonova, 1957); Danian-lower Palaeocene, Chulymo-Enisesk (USSR) (Chlonova, 1960); upper Upper Cretaceous, western Siberian lowland (Chlonova, 1961); Maastrichtian, Zeisko-Bureinsk (USSR) (Bratzeva, 1965); Maastrichtian (?), Nishibetsu (Hokkaido, Japan) (Takahashi, 1970); Upper Cretaceous-Palaeogene, Kuril Islands (USSR) (Krassilov et al, 1988).

**Remarks:** The present specimens are not well in preservation, but belong undoubtedly to *Orbiculapollis globosus* (Chlonova) Chlonova. This species appears in Maastrichtian or Maastrichtian-Danian in many cases.

**Botanical affinity:** Unknown.

(232) *Orbiculapollis minutus* (Mtchedlishvili) Krutzsch

Pl. 36, figs. 14a–b; pl. 37, fig. 3.

1961 *Triporina globosa* Chlonova (1957) forma *minuta* N. Mtchedlishvili, Somoilovitch et al., Trudy VNIGRI, no. 177, p. 246, pl. 80, figs. 4a–b, 5a–b.


**Description:** See Mtchedlishvili in Samoilovitch et al. (1961).

**Dimensions:** 14.2–(15.2)–16.5 \(\mu\)m in diameter, length of polar axis 21.7–(23.1)–24.2 \(\mu\)m, pores 11.2–14.5 \(\mu\)m in length and 3.8–5.7 \(\mu\)m in width (Mtchedlishvili in Samoilovitch et al., 1961); \(a/b = 1.59\) (Takahashi & Shimono, 1982); present...
specimens: 26–28 μm X 26–27 μm in diameter, equatorial projections 10–11 μm long.

**Occurrence:** Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK-12 and OCH-04).

**Previous record:** Maastrichtian, western Siberian lowland (USSR) (Mtchedlishvili in Samoilovitch et al., 1961).

**Remarks:** The present specimens possess more or less longer equatorial projections than *Orbiculapollis globosus* (Chlonova) Chlonova. They are identified with *Orbiculapollis minutus* (Mtchedlishvili) Krutzsch by their morphological features.

**Botanical affinity:** Unknown.

**Genus:** *Paraalnipollenites* Hills & Wallace 1969.

**Type species:** *Paraalnipollenites confusus* (Zaklinskaja 1963) Hills & Wallace 1969.

(233) *Paraalnipollenites confusus* (Zaklinskaja) Hills & Wallace

Pl. 45, figs. 14a–b; pl. 46, figs. 2 (cf.)–5.


1967 *Triatriopollenites confusus* Zaklinskaja, Bratzeva, Rev. Palaeobot. Palynol., 2, p. 122, pl. 1, fig. F.


**Description:** See Zaklinskaja (1963) and Hills & Wallace (1969).

**Dimensions:** 30–40 μm in diameter (Zaklinskaja, 1963); 22–32 μm in diameter (hypotypes: 26–31 μm in size) (Hills & Wallace, 1969); 23 μm in size, pores 3–4 (Konzalova, 1971); present specimens: 25–31 μm in diameter, exine thin, up to 1.5 μm thick.

**Occurrence:** Akkeshi and Tokotan Formations in Ochiishi area (OCH–02, OCH–03, OCH–04 and OCH–06).

**Previous records:** Palaeocene, Zhezdinsk suite, Karakengirsk subsuite of K. B. Nikiforov (USSR) (Zaklinskaja, 1963); Maastrichtian, Zeya-Bureya (USSR)
(Bratzeva, 1967); Maastrichtian and Palaeocene, Canadian arctic (Hills & Wallace, 1969); Lower-Middle Turonian, North Bohemia (Konzalova, 1971).

**Remarks:** Hills & Wallace (1969) proposed the new form genus *Paraalinopollenites* for *Triatriopollenites confusus* Zaklinskaja (1963). *Paraalinopollenites* has arci and false pores. Such morphological characters distinguish it from *Polyvestibulopollenites*, *Triatriopollenites* and *Casuarinidites*.

**Botanical affinity:** Zaklinskaja (1963) compared with pollen of *Casuarina*.


**Type species:** *Pentapollenites pentangulus* (Pflug 1953) Krutzsch 1958.

(234) *Pentapollenites manifestus* Takahashi & Shimono

Pl. 35, fig. 6.


**Description:** See Takahashi & Shimono (1982).

**Dimensions:** Length of polar axis 22–29 μm; breadth of developed polar projection 12–18 μm; length of equatorial projections 7–14 μm; breadth of equatorial projections 13–19 μm; equatorial diameter 28–40 μm; semicircularly protruded apical regions 8–13 μm × 5–7 μm; a/b = 1.53–1.79; present specimen: length of polar axis 23.5 μm; width of developed polar projection 1.5 μm; length of equatorial projections 6–11 μm; width of equatorial projections 12–15 μm; equatorial diameter 30 μm; a/b = 1.566.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK–12).

**Previous record:** Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

**Remarks:** Only one specimen was found. Notwithstanding this has relatively weakly protruded apical regions of the equatorial projections, this belongs firmly to *Pentapollenites manifestus* Takahashi & Shimono (1982).

**Botanical affinity:** Unknown.

(235) *Pentapollenites minus* n. sp.

Pl. 34, figs. 7a–b (cf.); pl. 36, figs. 4, 5a–b.

**Description:** Pollen grains with three equatorially situated apical projections and one projection each on proximal and distal polar region.
Isopolar; proximal and distal polar projections small with rounded apex. Equatorial projections small with broad base and gradually tapered apex. Tricolpate; colpi extending entire length of equatorial projections and extending only a short distance onto of grain.

Exine two-layered; axillary endexinous costae poorly developed; ectexine thin, smooth or punctate.

In polar view: grain triangular, with extended corners, with concave sides; outer ends of equatorial projections slightly flattened in plane parallel to polar axis.

Size range: Length of the polar axis 18–23 µm; width of the polar projections 8–10 µm; length of the equatorial projections 5–10 µm; width of the equatorial projections 11–16 µm; equatorial diameter 13–25 µm; a/b = 1.636.

Occurrence: Tokotan Formation in Ochiishi area (OCH-02 and OCH-05).

Holotype: Pl. 36, figs. 5a–b; exine smooth; length of the polar axis 18 µm; width of the polar projections 9 µm; length of the equatorial projections 5–8 µm; width of the equatorial projections 11 µm; equatorial diameter 17 µm; a/b = 1.636; Tokotan Formation in Ochiishi area (OCH-05); slide No. GN 5639.

Name derivation: minus (lat.)=less, smaller.

Comparison: The present specimens are closely similar to *Pentapollenites miser* Takahashi (1982) from the Maastrichtian Miyadanigawa Formation in the Hida district, central Japan, but differ in being smaller in size and in having smooth exine (except pl. 34, figs. 7a–b (cf.))

Botanical affinity: Unknown.

(236) *Pentapollenites miser* Takahashi

Pl. 36, figs. 3a–b.


Description: See Takahashi in Takahashi & Shimono (1982)

Dimensions: Length of polar axis 20–22.6 µm; breadth of polar projections 7–12.5 µm; length of equatorial projections 5–7.5 µm; breadth of equatorial projections 13 µm; equatorial diameter 20–26.5 µm; a/b = 1.69–1.77 (Takahashi, 1982); present specimen: length of polar axis 22 µm; width of polar projections 10–12 µm; length of equatorial projections 5–8 µm; width of equatorial projections 13 µm; equatorial diameter 25 µm; a/b = 1.692.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-12).
Previous record: Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

Remarks: A single specimen was observed. This has finely granulated exine and is referable to *Pentapollenites miser* Takahashi by its morphological characters.

Botanical affinity: Unknown.

(237) *Pentapollenites normalis* Takahashi & Shimono

Pl. 32, figs. 4a–b, 6; pl. 33, figs. 3a–c; pl. 35, figs. 8a–b; pl. 36, figs. 1, 2.


Description: See Takahashi & Shimono (1982).

Dimensions: Length of polar axis 24.5–37 μm; breadth of polar projections 10–18 μm; length of equatorial projections 8–11 μm; breadth of equatorial projections 10–18 μm; equatorial diameter 22.5–36.7 μm; a/b = 1.59–1.69 (Takahashi & Shimono, 1982); length of polar axis 23.5–36 μm; length of equatorial projections 8–10 μm; width of equatorial projections 8–10 μm (Krassilov et al., 1988); present specimens: length of polar axis 22–31 μm; width of polar projections 10–14 μm; length of equatorial projections 5–9 μm; width of equatorial projections 12–19 μm; equatorial diameter 23–31 μm; a/b = 1.666–1.769.

Occurrence: Yamanaka-Oborogawa, Akkeshi, and Tokotan Formations in Akkeshi and Ochiishi areas (AKK-05, AKK-07, AKK-10, AKK-11, and OCH-05).

Previous records: Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982); Upper Cretaceous-Palaeogene, Kuril Islands (USSR) (Krassilov et al., 1988).

Remarks: Many specimens were found. They are identified with *Pentapollenites normalis* Takahashi & Shimono (1982) from the Maastrichtian Miyadangawa Formation in the Hida district, central Japan by their form, size, and ratio of body (a)/projection (b).

Botanical affinity: Unknown.

(238) *Pentapollenites* sp.
Description: Pollen grain with three equatorially situated apical projections and with one polar projection on each apocolpium.

Isopolar (or subisopolar); proximal and distal polar projections somewhat developed, equal in length and width, with rounded apices. Three equatorial projections poorly developed, tapering from the broad base to the apex; three meridional colpi across equatorial projections, long, narrow, extending at most only a half distance onto body.

Exine two-layered; axillary endexinous costae poorly developed; ectexine thin, with fine granula or conical spines; granula or spines distributing somewhat densely.

Size range: Length of the polar axis 25 μm; width of the polar projections 8 μm; length of the equatorial projections 10 μm; width of the equatorial projections 14 μm; equatorial diameter 21 μm; a/b =1.785.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-09).

Remarks: A single specimen was observed. The polar body is rather similar to that of Aquilapollenites, on the contrary. The form of the equatorial projections is that of Pentapollenites. The author could not identify it specifically.

Botanical affinity: Unknown.

(239) ? Pentapollenites sp. a

Description: Pollen grain with three equatorially situated projections and with one polar projection on each apocolpium.

Isopolar; proximal and distal polar projections more or less well-developed with rounded apex, ellipsoidal in shape. Equatorial projections very poorly developed, with broad base and apex; three meridional colpi across equatorial projections, extending for a short distance onto body.

Exine two-layered; axillary endexinous costae poorly developed, as much as 1.5 μm thick, extending one half (?) the distance to apices of equatorial projections, only a short distance onto body of grain; ectexine thin, granulate; spines on the apical regions of equatorial projections lined up in one meridional file (?) in equatorial view, but smooth on both polar regions.

Size range: Length of the polar axis 23 μm; width of the polar projections 11 μm; length of the equatorial projections 5—7 μm; width of the equatorial pro-
jections $11-16 \mu m$; equatorial diameter $18 \mu m$; $a/b = 1.533$.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-05).

**Remarks:** Only one specimen was found. This has only three very poorly developed equatorial projections and belongs probably to the genus *Penta-pollenites*.

**Botanical affinity:** Unknown.

(240) ? *Penta-pollenites* sp. b

Pl. 35, figs. 12a—c.

**Description:** Pollen grain with three equatorially situated apical projections and one polar projection on each apocolpium.

Subisopolar; proximal and distal polar projections poorly developed with rounded apex. Equatorial projections poorly developed, with broad base and rounded apex; three meridional colpi across equatorial projections, long, narrow, extending for a short distance onto body.

Exine two-layered; axillary endexinous costae well-developed, as much as $4 \mu m$ thick; ectexine thin, striate.

**Size range:** Length of the polar axis $19 \mu m$; width of the polar projections $10-12 \mu m$; length of the equatorial projections $7 \mu m$; width of the polar projections $11 \mu m$; equatorial diameter $24 \mu m$; $a/b = 1.727$.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-10).

**Remarks:** Only one specimen was encountered. The author has first found a pollen grain with striate exine which seems to belong to the genus *Penta-pollenites*.

**Botanical affinity:** Unknown.

(241) ? *Penta-pollenites* sp. c

Pl. 35, fig. 4.

**Description:** Pollen grain with three equatorially situated projections and with one polar projection on each apocolpium (?).

Heteropolar; proximal polar projection more or less developed and distal polar projection poorly developed; both projections with rounded apex. Equatorial projections somewhat developed, with broad base and rounded apex; three meridional colpi across equatorial projections, long, narrow, extending for a short distance onto body.

Exine two-layered; axillary endexinous costae poorly developed, as much
as 1.5 μm thick, extending one half the distance onto body of grain; ectexine thin, finely granulate.

**Size range:** Length of the polar axis 17 μm; width of the polar projections 10 μm; length of the equatorial projections 7 μm; width of the equatorial projections 10 μm; equatorial diameter 22 μm; a/b = 1.7.

**Occurrence:** Akkeshi Formation in Akkeshi area (AKK-11).

**Remarks:** The only specimen observed belongs unsatisfactorily to the genus *Pentapollenites*, as the case may be, to the genus *Hemicorpus*.

**Botanical affinity:** Unknown.

(242) *Pentapollenites* sp. d

Pl. 36, figs. 8a–b.

**Description:** Pollen grain with three equatorially situated projections and with one polar projection on each apocolpium.

Isopolar; proximal and distal polar projections somewhat developed with rounded apex. Equatorial projections very poorly developed, with broad base and apex; three meridional colpi across equatorial projections, extending for a short distance onto body.

Exine two-layered; axillary endexinous costae poorly developed, as much as 2 μm thick, extending one half to one-fourths the distance to apices of equatorial projections, only a short distance onto body of grain; ectexine thin, striate.

**Size range:** Length of the polar axis 31 μm; width of the polar projections 10 μm; length of the equatorial projections 6–7 μm; width of the equatorial projections 19 μm; equatorial diameter 23 μm; a/b = 1.631.

**Occurrence:** Akkeshi Formation in Ochiishi area (OCH-09).

**Remarks:** Only one specimen was observed. This is compared with *Pentapollenites* sp. a (pl. 35, figs. 11a–b) in shape and *Pentapollenites* sp. b (pl. 35, figs. 12a–c) in ornamentation, but differs from *Pentapollenites* sp. a in size and ornamentation and from *Pentapollenites* sp. b in size and shape of grain.

**Botanical affinity:** Unknown.

**Genus:** *Persicarioipollis* Krutzsch 1962.

**Type species:** *Persicarioipollis meuseli* Krutzsch 1962.

(243) *Persicarioipollis rarus* n. sp.

Pl. 38, figs. 13a–b; pl. 39, figs. 1a–b.
Description: Multiporate pollen grains. Outline circular to subcircular. Surface with reticulum palisades with a covering reticulum. Net polygonal; lumina 2–5 μm in diameter. Muri baculate, 2 μm high. Pores small, circular, 3 μm in diameter, distributing sporadically and strongly variable in number. Endexine thin, smooth.


Occurrence: Akkeshi Formation in Ochiishi area (OCR-08 and OCR-09).

Holotype: Pl. 39, figs. 1a–b; 30 X 27 μm in diameter; net polygonal, 2–4 μm in diameter; pores circular, 3 μm in diameter; muri baculate, 2 μm high; Akkeshi Formation in Ochiishi area (OCH-08); slide No. GN 5665.

Name derivation: rarus (lat.)=rare, few in number, extraordinary.

Comparison: The specimens are very similar to Periporopollenites porulosus Takahashi (1962) (=Persicarioipollenites porulosus n. comb.) from the Eocene Myojin Formation at Naose and Kuma in Ishizuchi (Shikoku, Japan) and Persicarioipollenites persicarioides Krutzsch from the Palaeogene of Middle Europe, but differ from P. porulosus in having smaller lumina of reticulum and from P. persicarioides in possessing higher palisade parenchyma (valli) and muri.

Botanical affinity: Polygonaceae, Persicaria.

Genus: Polyatriopollenites Pflug 1953.

Type species: Polyatriopollenites stellatus (Potonie 1931) Pflug 1953.

(244) Polyatriopollenites polyergus (Takahashi) Takahashi
Pl. 43, fig. 10.


1979 Polyatriopollenites polyergus (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 59, pl. 22, figs. 7–11.

Description: See Takahashi (1961).

Dimensions: Ca. 26–46 μm in size, exine 1–1.5 μm thick (Takahashi, 1961); 27–34.2 μm in equatorial diameter, exine 1 μm thick (Takahashi in Takahashi & Kim, 1979); present specimen: 27 μm in diameter, exine 1 μm thick.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-10).

Previous records: Eocene, West Japan (Takahashi, 1961, 1962); Lower-Middle
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Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979).

Remarks: The specimen is a polyporate (five) pollen grain with straight sides, atrium, and no annulus. This is referred distinctly to Polyatriopollenites polyceras (Takahashi, 1961) Takahashi (1979).

Botanical affinity: Juglandaceae, Pterocarya.


Type species: Polyvestibulopollenites verus (Potonie 1931) Thomson & Pflug 1953.

(245) Polyvestibulopollenites eminens Takahashi

Pl. 43, figs. 11–15.

1979 Polyvestibulopollenites eminens Takahashi, Takahashi & Kim, Palaeontographica, B. 170, p. 58, pl. 21, figs. 9–15.

Description: See Takahashi (1961).

Dimension: 19–32.4 μm in size, exine less than 1μm thick (Takahashi, 1961); 24.5–27 μm in size, exine up to 1.3 μm thick (Takahashi, 1964); 21–32 μm in equatorial diameter, exine thin (Takahashi & Kim, 1979); 22–25.5 μm in equatorial diameter, exine thin (Takahashi & Shimono, 1982); present specimens: 18–23 μm in equatorial diameter, exine thin.


Previous records: Palaeogene and Miocene, West Japan (Takahashi, 1961); Eocene, Ishizuchi (Japan) (Takahashi, 1962); Campanian, Maastrichtian and Eocene, Yubari coal-field (Hokkaido, Japan) (Takahashi, 1964); Lower and Middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).
Remarks: Formerly the author used the genera *Polyvestibulopollenites, Alnus,* and *Alnipollenites.* The generic name *Alnipollenites* was not validly published in 1932 for lack of a generic diagnosis and is an obligate junior synonym of *Polyvestibulopollenites,* which has the same type species.


Type species: *Potamogetonacidites cenozoicus* Sah 1967.

(246) *Potamogetonacidites difficilis* Takahashi
Pl. 30, fig. 16.

1979 *Potamogetonacidites difficilis* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 35, pl. 8, figs. 15–21.

Description: See Takahashi in Takahashi & Kim (1979).

Dimensions: 19–27 μm in diameter; exine thin, reticulate; muri 0.6–1 μm high (Takahashi in Takahashi & Kim, 1979); 30–31.5 μm X 25–27 μm in size (Takahashi & Jux, 1982); 27–29 μm in diameter; exine thin, intectate-reticulate; lumina of reticulum polygonal, up to 3 μm wide; muri baculate-gemmate, 0.5–1.2 μm high (Takahashi & Jux, 1986); present specimen: 27 X 16 μm in size, lumina of reticulum 0.5–3 μm in diameter; muri baculate-verrucate, up to 2 μm high.

Occurrence: Tokotan Formation in Ochiishi area (OCH-03).

Previous records: Lower and Middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Palaeogene, Bergish Land (W-Germany) (Takahashi & Jux, 1982); late Oligocene, St. Augustin (W-Germany) (Takahashi & Jux, 1986).

Remarks: This species is distinguishable from *Potamogetonacidites paluster* (Manten) Mohr by its size of grain and width of lumina of reticulum.

Botanical affinity: Potamogetonaceae.

Genus: *Proteacidites* Cookson 1950 ex Couper 1953.
Type species: *Proteacidites adenanthoides* Cookson 1950.
(247) *Proteacidites tumidiporus* Samoilovitch var. *ecollariatus*
Samoilovitch
Pl. 46, figs. 6a-b.

1961 *Proteacidites tumidiporus* Samoilovitch var. *ecollariatus* Samoilovitch, Samoilovitch et al., Trudy VNIGRI, no. 177, p. 171, pl. 52, figs. 1a-b.

**Description:** See Samoilovitch in Samoilovitch et al. (1961).

**Dimensions:** 36.9 µm in equatorial diameter; pores 11.2–12.2 µm in diameter; aperture ca. 7 µm in diameter; exine 1.3 µm thick (Samoilovitch in Samoilovitch et al., 1961); 30–40 µm in equatorial diameter; diameter of apertures 9.6–12 µm; sexine about 1.3–1.6 µm thick; lumina about 1 µm wide (Srivastava, 1969); present specimen: 35 X 33.5 µm in diameter; pores with annulus exine 11–15 µm in diameter; aperture 8 µm in diameter; lumina less than 2 µm wide.

**Occurrence:** Akkeshi Formation in Choboshi area (CHO-01).

**Previous records:** Maastrichtian-Danian, western Siberian lowland (USSR) (Samoilovitch in Samoilovitch et al., 1961); Maastrichtian, Drumheller (Canada) (Srivastava, 1969).

**Remarks:** *Proteacidites tumidiporus* var. *ecollariatus* can be distinguished from *P. tumidiporus* in outline, size of body and pores, and thinner annulus.

**Botanical affinity:** Proteaceae.

**Genus:** *Pseudointegricorpus* Takahashi 1982.

**Type species:** *Pseudointegricorpus novacolpites* (Funkhouser 1961) Takahashi 1982.

(248) ? *Pseudointegricorpus* sp.
Pl. 34, figs. 4a-b.

**Description:** Pollen grain with three equatorially situated apical projections and with one polar projection on each apocolpium.

Subisopolar; one pole somewhat narrow with more or less conical apex; other pole broad with rounded apex.

Equatorial projections small, triangular in equatorial view; three meridional colpi across equatorial projections long, narrow, reaching near polar regions; equatorial colpi (?) visible.
Endexinous thickenings developed. Ornamentation of the central body reticulate; lumen of reticulum 0.5 – 1 \( \mu m \) in diameter; muri baculate, up to 1 \( \mu m \) high. Ornamentation of the equatorial projections striate; striae running parallel to equator.

**Size range:** Length of the polar axis 32 \( \mu m \); width of the polar projections 16 \( \mu m \); length of the equatorial projections 5 – 6 \( \mu m \); width of the equatorial projections 10 \( \mu m \); equatorial diameter 27 \( \mu m \); \( a/b = 3.2 \).

**Occurrence:** Akkehsi Formation in Akkeshi area (AKK—10).

**Remarks:** Only one specimen was found. This is probably referred to *Pseudoointegricorpus*, but cannot be identified specifically.

**Botanical affinity:** Unknown.

**Genus:** *Quercoidites* Potonié, Thomson & Thiergart 1950 ex Potonié 1960.

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

(249) *Quercoidites umiensis* (Takahashi) Takahashi

Pl. 39, figs. 4, 5.


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


1990 *Quercoidites umiensis* (Takahashi) Takahashi, Takahashi & Sugiyama, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 30, no. 2, p. 325, pl. 87, figs. 5–9, 15; pl. 98, fig. 3.

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

**Dimensions:** 18 – 37 \( \mu m \) in size, exine 0.4 – 1.3 \( \mu m \) thick, width/length ratio: 0.4 – 0.8 (holotype: 33.5 X 21 \( \mu m \) in size, exine 1 \( \mu m \) thick, width/length ratio: ca. 0.6) (Takahashi, 1957); ca. 31.5 \( \mu m \) in size, exine ca. 1.3 \( \mu m \) thick, width/length ratio: 0.63 (Takahashi, 1964); 16.5 – 29.8 \( \mu m \) X 10 – 18 \( \mu m \) in size, exine \( \pm 1 \mu m \) thick (Takahashi & Kim, 1979); 24 X 14.4 \( \mu m \) in size, exine 0.9 – 1 \( \mu m \) thick, width/length ratio: 0.6 (Takahashi & Shimono, 1982); 22 – 34 \( \mu m \) X 12 – 23 \( \mu m \)
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 (Takahashi & Sugiyama, 1990); present specimens: 24 – 34 μm X 15 – 18 μm in size, exine 1 – 1.3 μm thick, width/length ratio: 0.529 – 0.625.

**Occurrence**: Akkeshi and Tokotan Formations in Ochiishi area (OCR – 02 and OCH – 09).

**Previous records**: Palaeogene and Miocene, western Japan (Takahashi, 1957, 1961, 1962, 1963); Campanian and Eocene, Yubari coal-field (Hokkaido, Japan) (Takahashi, 1964); early and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).

**Remarks**: Hitherto, *Quercoidites umiensis* (Takahashi, 1957) Takahashi (1979) was found from the Santonican to Miocene of Japan and from the Miocene of Korea. This species flourished extremely in the Palaeogene of Japan.

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

**Genus**: *Retitrescolpites* Sah 1967.

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

(250) *Retitrescolpites* sp.

Pl. 41, figs. 2a – b.

**Description**: Tricolpate pollen grain. Figura prolate in somewhat oblique view. Three colpi radially symmetrical, not reaching poles. Exine reticulate or retipilariate; lumina of reticulum polygonal, 2 – 3 μm in diameter; muri baculate, tectate, 2 μm high.

**Dimensions**: 29 X 21 μm in size, width/length ratio: 0.724.

**Occurrence**: Hamanaka-Oborogawa Formations in Akkeshi area (AKK – 07).

**Remarks**: A single specimen which was found from the Hamanaka-Oborogawa Formations in Akkeshi area, is similar to *Retitrescolpites pseudoazemae* Takahashi & Sugiyama from the Santonian Uge Member of the Taneichi Formation, northeast Japan, but differs by its shape of grain.

**Botanical affinity**: Oleaceae.

**Genus**: *Rhoipites* Wodehouse 1933.

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

(251) *Rhoipites* cf. minus Takahashi & Jux


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

**Dimensions:** 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); 9.8–13.7 μm X 7.4–17.2 μm in size, exine less than 1 μm thick, lumina less than 1 μm in diameter, width/length ratio: 0.7–1.05 (Takahashi, 1988); 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, 1986); 15 X 12 μm in size, exine 0.5 μm thick, lumina less than 0.5 μm in diameter, width/length ratio: 0.8 (Takahashi & Sugiyama, 1990); present specimen: 18 X 18 μm in size; lumina 0.5–2 μm in diameter; muri baculate-tectate, 1 μm high; width/length ratio: 1.0.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH-04).

**Previous records:** Late Oligocene, St. Augustin (W. Germany) (Takahashi & Jux, 1986); Coniacian-Santonian, Futaba (Japan) (Takahashi, 1988); middle Tertiary, Jos (Nigeria) (Takahashi & Jux, 1989); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).

**Remarks:** In general morphological features excepting somewhat coarser lumina of reticulum the present specimen is closely similar to *Rhoipites minus* Takahashi & Jux (1986) from the late Oligocene sediments at St. Augustin of West Germany.

**Botanical affinity:** Unknown.

(252) *Rhoipites* sp. a

Pl. 42, fig. 23.

**Description:** Tricolporate pollen grain. Figura suboblate in equatorial view. Three colpi conspicuous, radially symmetrical, reaching the poles; costa colpi
developing, 1.5—2 \( \mu \text{m} \) wide; equatorial pores round or somewhat meridionally extended. Exine finely reticulate, tectate, 2 \( \mu \text{m} \) thick; lumina of reticulum less than 0.5 \( \mu \text{m} \) in diameter.

**Dimensions:** 21 \( \mu \text{m} \) (polar axis) X 25.5 \( \mu \text{m} \) (equatorial diameter); width/length ratio: 1.214.

**Occurrence:** Akkeshi Formation in Choboshi area (CHO-01).

**Remarks:** A single specimen was observed. The author could not determine its specific name.

**Botanical affinity:** Unknown.

**(253) Rhoipites sp. b**

Pl. 42, fig. 32.

**Description:** Tricolporate pollen grain. Figura perprolate in equatorial view. Three colpi radially symmetrical, converging towards the poles. Exine very finely reticulate: lumina of reticulum less than 0.5 \( \mu \text{m} \) in diameter; muri tectate (?). Equatorial pores lalongate.

**Dimensions:** 29 X 13 \( \mu \text{m} \) in size; width/length ratio: 0.448.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH-03).

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

**Botanical affinity:** Unknown.

**(254) Rhoipites sp. c**

Pl. 43, figs. 1a—b.

**Description:** Tricolporate pollen grain. Figura prolate in equatorial view. Three colpi conspicuous, radially symmetrical, converging towards the poles. Equatorial pores meridionally extended. Exine finely reticulate; muri bacular, semitectate, 2 \( \mu \text{m} \) high.

**Dimensions:** 32 \( \mu \text{m} \) (polar axis) X 21 \( \mu \text{m} \) (equatorial diameter); width/length ratio: 0.656.

**Occurrence:** Akkeshi Formation in Choboshi area (CHO-01).

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

**Botanical affinity:** Unknown.

**Genus:** **Rousea** Srivastava 1969.

**Type species:** **Rousea subtilis** Srivastava 1969.
(255) *Rousea* sp.
Pl. 40, figs. 32a—b.

**Description:** Tricolpate pollen grain. Figura spherical in polar view. Three colpi conspicuous, radially symmetrical, converging near the poles, splitting. Exine finely reticulate; lumina of reticulum larger in the mesocolpia and smaller near the colpi margins and in the apocolpia; muri baculate-tectate partially, 2–3 μm high.

**Dimensions:** 30 X 25 μm in diameter.

**Occurrence:** Tokotan Formation in Ochiishi area (OCH–05).

**Remarks:** Only one specimen was observed. This is similar to *Rousea doylei* Singh (1983), but differs in having no costa bordering the colpi margins and finer lumina in the mesocolpia.

**Botanical affinity:** Unknown.

**Genus:** *Satishia* Ward 1986.

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

(256) *Satishia* sp.
Pl. 41, figs. 1a—b, 3a—b.

**Description:** Tricolpate pollen grains. Figura spherical in equatorial view. Three colpi conspicuous, radially symmetrical, converging towards the poles; costae colpi developing, 1 μm wide. Exine reticulate; lumina polygonal and circular in shape, 0.5–4 μm in diameter; coarsely sculptured on meridian, finely sculptured on colpi margins; muri tectate, 0.7–2 μm high.

**Dimensions:** 22 μm (polar axis) X 20 μm (equatorial diameter); width/length ratio: 0.909.

**Occurrence:** Akkeshi and Tokotan Formations in Ochiishi area (OCH–05 and OCH–09).

**Remarks:** Two specimens was observed. The author cannot determine their specific epithet.

**Botanical affinity:** Unknown.

**Genus:** *Scollardia* Srivastava 1966.

**Type species:** *Scollardia trapaformis* Srivastava 1966.

(257) *Scollardia nortoni* Srivastava
1966 Scollardia nortoni Srivastava, Pollen et spores, vol. 8, no. 3, p. 545, pl. 10, figs. 1, 6, 8-10, 13, 14.

Description: See Srivastava (1966).
Dimensions: Equatorial diameter 30 μm (holotype); equatorial axis from the tip of one equatorial protrusion to the tip of the other 40 to 50 μm (Srivastava, 1966); present specimen: 52 X 40 μm in diameter; exine striate, 1.5 μm thick without muri; muri baculate, partially tectate, 1.5 μm high.
Occurrence: Tokotan Formation in Ochiishi area (OCH-05).
Previous record: Maastrichtian, Scollard (Alberta, Canada) (Srivastava, 1966).
Remarks: Only one pollen grain was found. The specimen cannot be distinguished from Scollardia nortoni Srivastava (1966) from the Maastrichtian Edmonton Formation near Scollard (Alberta, Canada) in morphological characters.
Botanical affinity: Unknown.

Genus: Smilacipites Wodehouse 1933.
Type species: Smilacipites echinatus Wodehouse 1933.

(258) Smilacipites sp.
Pl. 46, fig. 11.

Description: Inaperturate pollen grain. Figura spherical. Exine thin, provided with conical spines and verrucae moderately arranged; sculptural elements 1-2 μm high.
Dimensions: 36 X 30 μm in diameter.
Occurrence: Akkeshi Formation in Akkeshi area (AKK-10).
Remarks: It appeared to be unreasonable to identify the single specimen specifically.
Botanical affinity: Liliaceae, Smilax.

Type species: Spinainaperturites recurvatus Pierce 1961.

(259) Spinainaperturites sp.
Pl. 46, figs. 13a-b.
Description: Inaperturate pollen grain; spherical in form. Exine thin; sculpturing of moderately abundant recurved and straight spines 3–5 µm long.

Dimensions: 40 X 37 µm (including sculpture) in diameter.

Occurrence: Akkeshi Formation in Ochiishi area (OCH-06).

Remarks: Only one specimen was observed. This is different from the genus *Similacipites* by its larger spines.

Botanical affinity: Unknown.


Type species: *Striatocolporites grandis* Ramanujam 1966.

Description: See Takahashi & Jux (1982)

Dimensions: 20.0–22.8 µm (polar axis) and 15.5–18.3 µm (equatorial axis); exine ca. 1.5 µm thick; width/length ratio: 0.8 (Takahashi & Jux, 1982); 19.5–26.5 µm (polar axis) X 13–18 µm (equatorial axis); exine 1–1.5 µm thick; width/length ratio: 0.63–0.74 (Takahashi & Jux, 1986); 27 X 22 µm in size; exine 1.5 µm thick width/length ratio: 0.81 (Takahashi & Jux, 1989); present specimen: 20 X 14 µm in size; exine 0.5 µm thick; width/length ratio: 0.7.

Occurrence: Tokotan Formation in Ochiishi area (OCH-03).

Previous records: Palaeogene, Bergish Land (W-Germany) (Takahashi & Jux, 1982); late Oligocene, St. Augustin (W-Germany) (Takahashi & Jux, 1986); middle Tertiary, Los (Nigeria) (Takahashi & Jux, 1989).

Remarks: The single specimen with striate sculpture is small in size. This belongs probably to *Stratocolporites* (al. *Striatocolporites*) *striatulus* Takahashi & Jux (1982).

Botanical affinity: Unknown.
(261) Striatocolporites sp. a
Pl. 42, fig. 33.

Description: Tricolorate pollen grain. Amb subcircular to rounded-triangular in polar view. Three distinct colpi arranged symmetrically, converging towards the poles. Exine two-layered, 2.5 \( \mu m \) thick, finely striate; equatorial pores elongate meridionally.

Dimensions: 31 X 29 \( \mu m \) in diameter.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-05).

Remarks: The single specimen is not well in preservation. The author cannot determine its species epithet.

Botanical affinity: Unknown.

(262) Striatocolporites sp. b
Pl. 43, figs. 2a—b.

Description: Tricolporate pollen grain. Outline subcircular in polar view. Three colpi conspicuous, narrow, radially symmetrical, converging towards the poles. Exine two-layered (?), striate; muri tectate, 2 \( \mu m \) high. Equatorial pores elongate meridionally.

Dimensions: 25 X 26 \( \mu m \) in diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH-04).

Remarks: Only one specimen was found.

Botanical affinity: Unknown.

Type species: Striatopollis sarstedtensis Krutzsch 1959.

(263) Striatopollis striatellus (Takahashi) Takahashi
Pl. 40, figs. 27—29.

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

Dimensions: 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, width/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); 35 X 15 μm in size, exine 0.5 μm thick, width/length ratio: 0.43 (Takahashi & Sugiyama, 1990); present specimens: 20–32 μm X 14–18 μm in size, exine 1–1.5 μm thick, width/length ratio: 0.563–0.8.

Occurrence: Akkeshi and Tokotan Formations in Choboshi and Ochiishi areas (CHO-O1 and OCH-04).

Previous records: 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 & early Oligocene, Fayum Oasis (Egypt) (Takahashi & Jux, 1989); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).

Remarks: In general morphological characters the present specimens cannot be distinguished from Striatopollis striatellus (Takahashi) Takahashi from the Upper Cretaceous and Tertiary of Japan.

Botanical affinity: Unknown.
Description: Tricolpate pollen grain. Figura spherical in polar view. Three colpi slender, narrow, radially symmetrical, converging at the poles. Exine finely striate, tectate, $1 \mu m$ thick.

Dimensions: $27 \times 23 \mu m$ in equatorial diameter.

Occurrence: Akkeshi Formation in Ochiishi area (OCH-06).

Remarks: The specimen is not well in preservation, because the exine is crumpled by secondary folds.

Botanical affinity: Unknown.

(265) *Striatopollis* sp. b

Pl. 40, fig. 25.

Description: Tricolpate pollen grain. Figura spherical in polar view. Three colpi slender, narrow, converging towards the poles. Exine two-layered, thin, finely striate and partially punctate.

Dimensions: $19 \times 18.5 \mu m$ in diameter, width/length ratio: 0.974.

Occurrence: Akkeshi Formation in Ochiishi area (OCH-06).

Remarks: Only one specimen was observed.

Botanical affinity: Unknown.

(266) *Striatopollis* sp. c

Pl. 40, fig. 26.

Description: Tricolpate pollen grain. Figura broad-ellipsoidal in equatorial view. Three colpi indistinct, slender, narrow. Exine two-layered, $0.5 \mu m$ thick, finely striate but completely striated.

Dimensions: $36 \mu m$ in polar axis and $29 \mu m$ in equatorial axis; width/length ratio: 0.806.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-11).

Remarks: Only one specimen was found. This is not well in preservation.

Botanical affinity: Unknown.

Genus: *Subtriporopollenites* Pflug & Thomson 1953.

Type species: *Subtriporopollenites anulatus* Pflug & Thomson subsp. *anulatus*
Pl. 45, figs. 13a–b, 19.

1979 *Subtriporopollenites kyushuensis* Takahashi & Kim, Palaeontographica, B, 170, pp. 54–55, pl. 17, figs. 22–24; pl. 18, figs. 5–6.

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

**Dimensions:** Ca. 23–41 \( \mu m \) in size, exine up to 1 \( \mu m \) thick (Takahashi, 1961); ca. 34.5 \( \mu m \) in size, exine very thin (Takahashi, 1964); 24.5–39.7 \( \mu m \) in equatorial diameter, exine 0.5–1 \( \mu m \) thick (Takahashi & Kim, 1979); 20–32 \( \mu m \) in equatorial diameter, exine thin (Takahashi & Shimono, 1982); 34 X 29 \( \mu m \) in size, exine thin, pores 3.5 \( \mu m \) in diameter; present specimens: 20–30 \( \mu m \) X 27–34 \( \mu m \) in diameter, exine up to 1 \( \mu m \) thick.

**Occurrence:** Akkeshi and Tokotan Formations in Ochiishi area (OCH–05 and OCH–09).

**Previous records:** Palaeogene and Miocene, western Japan (Takahashi, 1961, 1962, 1963); Campanian and Eocene, Yubari coalfield (Hokkaido, Japan) (Takahashi, 1964); early and middle Miocene, Changgi and Yonil (Korea) (Takahashi & Kim, 1979); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).

**Remarks:** Only two specimens were found. They are referable undoubtedly to *Subtriporopollenites kyushuensis* Takahashi (1961) in general morphological characters.

**Botanical affinity:** Juglandaceae.

(268) *Subtriporopollenites minor* n. sp.
Pl. 45, figs. 15–18.
Description: Triporate pollen grains. Outline subcircular in polar view and elliptical due to folds. Three pores very small, round; at least a pore placed equatorially and the others subequatorially, without labrum and anulus. Exine thin, 0.5–1 µm thick, laevigate to smooth, crumpled and deformed by secondary folds.


Occurrence: Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK–05, OCH–02, and OCH–03).

Holotype: Pl. 45, fig. 16; 14 X 13 µm in diameter; exine thin, laevigate; pores small, round; Tokotan Formation in Ochiishi area (OCH–02); slide No. GN 5583.

Name derivation: minor (lat.) = less, smaller.

Comparison: Subtriporopollenites minor n. sp. is similar to Subtriporopollenites anulatus Pflug & Thomson subsp. nanus Pflug & Thomson (1953) from the Palaeocene to early Eocene of Antweiler graben (Germany) and Subtriporopollenites minutulus Takahashi (1982) from the Eocene Nanggulan Formation in the Yogyakarta region, central Java, but differs from S. anulatus nanus in having much thinner exine and from S. minutulus in possessing laevigate to smooth exine.

Botanical affinity: Moraceae etc.

(269) Subtriporopollenites sp.
Pl. 45, fig. 20.

Description: Triporate pollen grain. Outline rounded-triangular in polar view. Three pores round; one pore equatorial and two pores subequatorial. Exine 3 µm thick, chagrenate, deformed by secondary folds.

Dimensions: 26 µm in equatorial diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH–05).

Remarks: Only one specimen was observed.

Botanical affinity: ? Moraceae etc.


(270) ? Symplocoipollenites sp.
Pl. 38, figs. 1a–c.
Description: Triporate, tricolpate pollen grain (?). Outline elliptical. Exine striate and punctate; muri tectate, 1.4 \( \mu m \) high. Three colpi indistinct.

Dimensions: 32 X 24 \( \mu m \) in diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH-03).

Remarks: It is very doubtful that the present specimen is *Symplocoipollenites*.

Botanical affinity: Unknown.


Type species: *Triatriopollenites rurensis* Pflug & Thomson 1953.

(271) *Triatriopollenites mirabilis* Takahashi
Pl. 44, fig. 2.


Description: See Takahashi (1961).

Dimensions: 20 – 32 \( \mu m \) in size, exine very thin (Takahashi, 1961); present specimen: 27 \( \mu m \) in size, exine 0.5 \( \mu m \) thick, no. anulus.

Occurrence: Tokotan Formation in Ochiishi area (OCH-02).

Previous record: Early Oligocene, western Japan (Takahashi, 1961).


Botanical affinity: Probably Myricaceae.

(272) *Triatriopollenites* sp. a
Pl. 44, fig. 3.

Description: Triporate pollen grain. Outline triangular with strongly convex sides in polar view. Three pores equatorial, with globular anulus, weak atrium, and labrum. Exine 1 \( \mu m \) thick on the side, chagrenate, crumpled by secondary folds.

Dimensions: 25 \( \mu m \) in equatorial diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH-13).

Remarks: The single specimen is similar to *Triatriopollenites excelsus* (Pot.) Thomson & Pflug *turgidus* Pflug from the Palaeocene to Eocene of W. Germany, but differs by its weak atrium and chagrenate exine.
Botanical affinity: Probably Myricaceae.

(273) *Triariopollenites* sp. b
Pl. 44, fig. 4.

Description: Triporate pollen grain. Outline triangular with convex sides and rounded corners in polar view. Three pores round, with atrium and somewhat weak labrum, without anulus; one pore subequatorial and two pores equatorial. Exine 1 μm thick, chagrenate, crumpled by secondary folds.

Dimensions: 22 μm in equatorial diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH-04).

Remarks: Only one specimen was found. The author cannot determine its specific epithet.

Botanical affinity: Probably Myricaceae.

(274) *Triariopollenites* sp. c
Pl. 44, figs. 5a—b.

Description: Triporate pollen grain. Outline triangular with strongly convex or rather bent sides in polar view. Three pores small, round; one pore subequatorial; with atrium and weak anulus. Exine thin, 0.5 μm thick, smooth, folded secondarily.

Dimensions: 22 μm in equatorial diameter.

Occurrence: Tokotan Formation in Ochiishi area (OCH-04).

Remarks: Only one specimen was observed. The author cannot decide its species name.

Botanical affinity: Probably Myricaceae.


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

(275) *Tricolpites ellipticus* Takahashi & Jux
Pl. 42, figs. 2, 4.


Description: See Takahashi & Jux (1982).
Dimensions: 14.0–17.0 \( \mu m \) in length, 8.0–11.5 \( \mu m \) in width, exine 0.6–1.0 \( \mu m \) thick, width/length ratio: 0.6–0.7 (Takahashi & Jux, 1982); 16–20.5 \( \mu m \) in length, 10–16 \( \mu m \) in width, exine 0.8–1.3 \( \mu m \) thick, width/length ratio: 0.61–0.78 (Takahashi & Jux, 1986); 21 X 14 \( \mu m \) in size, exine intrabaculate, 1 \( \mu m \) thick, width/length ratio: 0.666; present specimens: 18–20 \( \mu m \) in length X 13–15 \( \mu m \) in width, exine very finely reticulate; muri baculate, 0.5 \( \mu m \) high; width/length ratio: 0.722–0.75.
Occurrence: Tokotan Formation in Ochiishi area (OCH–03).
Previous records: Middle Oligocene, Bergish land (W.-Germany) (Takahashi & Jux, 1982); late Oligocene, St. Augustin (W.-Germany) (Takahashi & Jux, 1989); Santonian, Taneichi (Japan) (Takahashi & Sugiyama, 1990).
Remarks: Two specimens were observed. They are identical with *Tricolpites ellipticus* Takahashi & Jux (1982) in general morphological characters.
Botanical affinity: Salicaceae, probably *Salix*.

(276) *Tricolpites hokkaidoanus* n. sp.
Pl. 40, figs. 9, 31; pl. 41, figs. 4, 14.

Description: Tricolpate pollen grains. Figura ellipsoidal or prolate to subprolate in equatorial view. Three distinct colpi rather narrow, running parallel, and converging towards the poles. Exine finely reticulate; lumina of reticulum less than 0.5 \( \mu m \) diameter; muri baculate to tectate, 0.5–1 \( \mu m \) high.
Dimensions: 20–25 \( \mu m \) in length X 15–18 \( \mu m \) in width; width/length ratio: 0.72–0.783.
Occurrence: Tokotan Formation in Ochiishi area (OCH–02, OCH–04, and OCH–10).
Holotype: Pl. 40, fig. 31; 24 X 18 \( \mu m \) in size; exine very finely reticulate; lumina of reticulum less than 0.5 \( \mu m \) in diameter; muri baculate-tectate, 1 \( \mu m \) high; width/length ratio: 0.75; Tokotan Formation in Ochiishi area (OCH–04); slide No. GN 5621.
Name derivation: From Hokkaido district.
Comparison: Morphologically the grains of *Tricolpites hokkaidoanus* n. sp. are closely comparable to those of *Tricolpites ellipsoideus* Takahashi & Sugiyama, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 30, no. 2, p. 341, pl. 91, fig. 5.
yama (1990) from the Santonian Uge Member of the Taneichi Formation at Taneichi, northeast Japan, but the former has much finer reticulum than the latter.

**Botanical affinity:** Salicaceae, *Salix*.

(277) *Tricolpites intrabaculatus* n. sp.

Pl. 41, figs. 19a–b, 25–27.

**Description:** Tricolpate pollen grains. Figura ellipsoidal or prolate in equatorial view and spherical in polar or oblique view. Three distinct colpi conspicuous, running parallel or converging towards the poles, often with endexinous thickenings under the rims of colpi (costae, 1–2 μm thick). Exine finely reticulate; lumina of reticulum less than 1 μm in diameter; ectexine intrabaculate or tectate, 1–1.5 μm; endexine smooth, 0.5–1 μm thick.

**Dimensions:** 21 X 15 μm in size in equatorial view; 19–23 μm X 20.5–23 μm in size in polar or oblique view; width/length ratio: 0.714–1.025.

**Occurrence:** Akkeshi Formation in Ochiishi area (OCH-06 and OCH-09). Holotype: Pl. 41, figs. 26a–b; 19 X 21 μm in oblique view; costae colpi 2 μm thick; exine finely reticulate; lumina of reticulum less than 0.5 μm in diameter; ectexine intrabaculate or tectate, 1.5 μm thick; endexine smooth, 0.5 μm thick; Akkeshi Formation in Ochiishi area (OCH-09); slide No. GN 5685.

**Name derivation:** *Intra* (lat.) = within; *baculatus* (lat.) = baculate, rod-shaped.

**Comparison:** These pollen grains do not compare with any of the fossil species of *Tricolpites*, because they have the particular exine structure and costae colpi.

**Botanical affinity:** Salicaceae, *Salix*.

(278) *Tricolpites minutiretiformis* (Takahashi) Takahashi

Pl. 41, figs. 7 (cf.), 10–13, 15–17, 22; pl. 42, figs. 1, 3.


Description: See Takahashi (1964).

Dimensions: 19.3–29 μm in size, exine 1–1.5 μm thick, width/length ratio: 0.7–more than 1.0 (Takahashi, 1964); 15–26 μm X 12–20 μm in size (Miki, 1972); 17.5 X 14.5 μm in size and 19 μm in size, exine 0.5–1 μm thick (Takahashi & Shimono, 1982); present specimens: 15–23 μm (polar axis) X 13–19 μm (equatorial axis), 15–26 μm in diameter in polar view; muri baculate-tectate, 1–1.5 μm high.

Occurrence: Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK -11, OCH -02, OCH -03, OCH -04, OCH -05, and OCH -09).

Previous records: Campanian and Maastrichtian, Yubari coalfield (Hokkaido, Japan) (Takahashi, 1964); lower Senonian, Kuji (Japan) (Miki, 1972); Maastrichtian, Hida (Japan) (Takahashi & Shimono, 1982).

Remarks: Hitherto, Tricolpites minutiretiformis (Takahashi) Takahashi occurred only in the Senonian and Maastrichtian of Japan.

Botanical affinity: Salix or Platanus.

(279) Tricolpites retiformis (Pflug & Thomson) Takahashi & Jux
Pl. 41, figs. 5, 6, 8, 9, 23, 24; pl. 42, figs. 6–15.

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).

Dimensions: 15–30 μm in size (Thomson & Pflug, 1953); 13 X 20 μm in size, lumina of reticulum 0.5–1 (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
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(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, width/length ratio: 0.52–0.67 (Takahashi & Jux, 1989); 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 (Takahashi & Sugiyama, 1990); present specimens: 15–27 μm (polar axis) X 9–20 μm (equatorial axis) in size, lumina less than 0.5 μm in diameter; muri baculate-partially tectate, 0.5–1.5 μm high.

Occurrence: Akkeshi and Tokotan Formation in Akkeshi and Ochiishi areas (AKK-09, AKK-11, AKK-12, OCH-02, OCH-03, OCH-04, OCH-06, and OCH-09).


Remarks: This species possesses stronger and wider muri than those of Tricolpites ellipsoideus Takahashi & Sugiyama (1990).

Botanical affinity: Salicaceae, Salix.

(280) Tricolpites sphaericus Takahashi
Pl. 41, figs. 18, 20, 21; pl. 42, figs. 5a–b.


Description: See Takahashi (1988).

Dimensions: 11.5–17.5 μm X 9.6–16 μm in size, exine 0.4–0.7 μm thick, lumina less than 0.5 μm in diameter, width/length ratio: 0.78–0.99 (Takahashi, 1988); present specimens: 16–21 μm X 14–20 μm in size; exine thin; muri tectate, 0.5–1 μm high; width/length ratio: 0.833–0.952.

Occurrence: Akkeshi and Tokotan Formations in Akkeshi and Ochiishi areas (AKK-10, OCH-02, and OCH-05).

Previous record: Coniacian to Santonian, Futaba (Japan) (Takahashi, 1988).

Remarks: The present specimens are referable to Tricolpites sphaericus Takahashi (1988) from the Kasamatsu and Tamayama Formations of the Futaba Group in general morphological characters.

Botanical affinity: Salicaceae, Salix.


(281) *Tricolpopollenites akkeshiensis* n. sp.

Pl. 40, figs. 15–18.

Description: Tricolpate pollen grains. Figura prolate in equatorial view. Three colpi conspicuous, running parallel, and converging to the poles. Exine thin, less than 0.5 \( \mu m \) thick, chagrenate.

Dimensions: Grain size 19–20 \( \mu m \) X 12–15 \( \mu m \), width/length ratio: 0.632–0.75.

Occurrence: Akkeshi Formation in Akkeshi area (AKK-05 and AKK-10).

Holotype: Pl. 40, fig. 17; 19 X 12 \( \mu m \) in size; exine thin, chagrenate; Akkeshi Formation in Akkeshi area (AKK-05); slide No. GN 5502.

Name derivation: From Akkeshi town.

Comparisons: The present specimens are closely similar to *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi and *Cupuliferoidaepollenites fallax* (Potonie) Potonie, but differ from *C. vulgaris* in having thinner exine and from *C. fallax* in possessing larger grain size and chagrenate exine.

Botanical affinity: Cupuliferae.

(282) *Tricolpopollenites meinohamensis* Takahashi rotundus Takahashi

Pl. 40, figs. 3, 4, 6, 7.


1979 *Tricolpopollenites meinohamensis* Takahashi rotundus Takahashi, Takahashi & Kim, Palaeontographica, B,170, p.39, pl. 9, figs. 10–13, 15.