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Palynology of Middle Tertiary lacustrine deposits
from the Jos Plateau, Nigeria

Kiyoshi TAKAHASHI* and Ulrich JUX**

(Received October 21, 1988)

Abstract

A carbonaceous clay bed, containing fossil leaves and resting on deeply weathered granite in the Sabon Gida tin mine (Jos Plateau, Central Nigeria), was palynologically investigated. A total of 147 species of palynomorphs were noted and described, among them are the following new forms: Fagraeapollis reticulatus n. gen. et sp., Malpighiaceoidites periporifer n. gen. et sp., Inaperturopollenites rugosus n. sp., I. minimus n. sp., Perforotricolpites lanceolatus n. sp., P. nigerianus n. sp., Ranunculacidites contaminatus n. sp., Cupuliferoidaepollenites josensis n. sp., Striatopollis nigericus n. sp., S. variabilis n. sp., Euphorbiacites africanus n. sp., Faguspollenite globosus n. sp., Intrabaculitricolporites rotundiporus n. sp., I. affinis n. sp., I. rugoporus n. sp., Bomacacidites africanus n. sp., Striatocolporites ovuliformis n. sp., Foveotricolporites tenuiexinus n. sp., Graminidites minor n. sp., Psilodiporites rotundus n. sp., Triatriopollenites conscularis n. sp., Triporopollenites subrotundus n. sp., Triorites scabrus n. sp., Cricotriporites anulatus n. sp., C. nigerianus n. sp., Subtri­poropollenites reticulatus n. sp., Ulimipollenites semiundulosus n. sp., Chenopodipollis dispersus n. sp., Tetradomonoporites typhinus n. sp., Polyadopollenites sculptus n. sp. and P. indecorus n. sp.


Several species had to be indicated by open nomenclature as done with Gemmatosporis sp. a, G. sp. b, Cupuliferoidaepollenites sp. a, C. sp. b, Retitrescolpites sp. a, R. sp. b.

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Cupuliferopollenites sp. a, C. sp. b, Tricolporopollenites sp. a, T. sp. b, Intrabaculitricolporites sp. a, I. sp. b, I. sp. c, Striatocolporites sp. a, S. sp. b, S. sp. c, Rhoipites sp. a, R. sp. b, R. sp. c, R. sp. d, R. sp. e, Graminidites sp. a and G. sp. b.

The remaining sixty-five identified species underline a Middle Tertiary age of the palynomorph assemblage from the clay bed mentioned above. The stratigraphic age may be even confined to the Late Oligocene until Early Miocene.

From the regional geologic features and both the sedimentologic and palynologic data it can be concluded that the Jos Plateau was already drained by meandering sloughs which had dissected the lateritic surface by the end of the Paleogene. Then, a rich vegetation, obviously arranged in associations according to existing relief and humidity of the ground, framed the swampy depressions of the Jos Plateau.

Introduction

The central part of northern Nigeria is marked by the Jos Plateau, which has an altitude of more than 1000 m (fig. 1). Due to its topographic position and favourable climatic conditions this mountaneous area is drained radially, either northward into the Chad Basin (Yobe, Komaduguga Gana) or southward into Atlantic Ocean via Gongola (Benue catchment area) or Kaduna (Niger catchment area). This pattern is obviously inherited from a Late Cretaceous paleogeography.

Igneous and metamorphic rocks of various ages share in the composition of a rather complex structure of the basement, which is exposed in the rugged scenery of deeply dissected mountains and otherwise buried below lava flows or alluvial deposits.

Fig. 1. Location of the Jos Plateau in Nigeria, West Africa.
of wide plains and broad valleys.

Most conspicuous are the Younger Granites, which intruded the old Pre-Cambrian to Early Paleozoic crystalline basement during the Jurassic, after a period of extensive acid volcanism, ring faulting and block subsidence (MacLeod, Turner & Wright, 1971). Mesozoic sediments are unknown on the Jos Plateau, although the Cretaceous sea invaded both Niger and Benue Basins. It is quite evident that the eruption of acid volcanics and the emplacement of the non-orogenic Younger Granites was succeeded by long lasting processes of subaerial weathering and denudation initiating the major morphological features of the region. By this the Younger Granites were carved out to surmount the plateau and to form local

Fig. 2. Geologic map of Sabon Gida area; Bukuru Ring Complex. Jos Plateau (modified from MacLeod et al. 1971).
watershed areas. Along the slopes of the hills and in the adjacent depressions unconsolidated detrital material such as clay, sand or gravel was collected by the action of streams and small rivers. Nevertheless, the course of erosion and sedimentation was periodically interrupted by volcanic activities during the Tertiary and Quaternary. Generally, Older Basalts are, however, almost completely decomposed and not easily recognized under this thick overburden of lateritic ironstones. From this and the intercalated clastic sediments the stratigraphic term “Fluviovolcanic Series” derived (Falconer, 1921). Contrary to this, younger basaltic lava flows which can be traced to well preserved cones, are easily recognized. They filled up broad valleys after the plateau had developed its recent morphologic features.

After all, neither the periods of pronounced volcanic activities nor the phases of extended laterite development during Tertiary times are yet satisfactorily dated. In relative terms it deals about the following events, in sequence already outlined by Turner (in MacLeod et al., 1971):

1) After the Jurassic granites were emplaced an initial cycle of erosion produced a pre-Older Basalt surface.
2) Then, fluviatile and lacustrine deposits were accumulated but later on buried over large areas by the Older Basalts.
3) It followed a period of favourable climatic conditions for deep weathering together with the development of thick laterite crusts.
4) Subsequently, in a new erosional cycle broad valleys were carved into laterized surface and partially filled by limnic sediments.
5) Finally some of these depressions gathered the flows of basaltic lavas after the plateau had almost achieved its present-day topography. A mild lateritization once more acted upon subaerial surfaces.

It is generally assumed that the main period of laterite formation, resulting in the decomposition of the Older Basalts, too, correlates somewhat with the extended sheet of lateritic ironstone in northern Nigeria. There, the characteristic remnant of an old, regionally exhumed land surface, which further north submerges below the Pleistocene Chad Formation, rests on fluviatile Kerri Kerri Sandstones. This thick clastic sequence is believed to be of an Early Tertiary age. So far, however, the biostratigraphic indication that most intensive lateritization eventuated during the Paleogene is only supported by unpublished data concerning palynologic investigations of some lignites and carbonaceous clays (by Shell-B. P. Petroleum Development Co.). The samples in question were recovered from below basalts in a filled valley which is flanked by eroded laterites some 50 km south of Sabon Gida (to the south of Rop). Dispersed palynomorphs identified from these alluvials suggested an Oligocene to Mid-Miocene age (MacLeod at al., 1971).
Previous palynologic investigation

Not much information is available at all in respect to the biostratigraphic distribution of palynomorphs in Tertiary sediments of Northern Nigeria, i. e. the Jos Plateau. In Niger and Mali the Paleogene section of the Iullemmeden Basin commences with clay-, marl- and limestones. Certain beds contain marine microfossils which refer to the Paleocene (Boudouresque et al., 1982). During the Eocene, the facies changed drastically to rather marginal marine conditions of sedimentation, immediately noticeable by the deposition of clayey sediments (palygorskite) and ferruginous (Fe-, Mn-oxides) beds. On top of this rests a sequence symptomatically correlated with the continental Terminal of Kilian (1931; Lang et al., 1986).

In the arenaceous and pelitic horizons of supposed Eocene age micro- and macrofossils were encountered and in the northern part of the basin even carbonaceous and lignitic partings (Lang et al., 1986). With these remains the status of the onset of the Continental Terminal might be substantiated stratigraphically, at least in the Iullemmeden basin (Boudouresque et al., 1982). Among the palynomorphs *Echiperiporites icacinoides* Sal.-Chebold. and *Cicatricosisporites dorogensis* Pot. & Gell. together with *Chenolophonidites costatus*, *Striatopollis bellus* and *Bomabacacidites* sp. were claimed to reveal a Middle Eocene savanna, but, elsewhere, *C. dorogensis* is a rather reliable index-fossil of Eocene-Middle Oligocene deposits (Takahashi & Jux, 1982). A tropical mangrove swamp, vaguely dated with Eocene-Miocene appears to be reflected palynologically (*Spinozonocolpites echinatus* Muller) at the base of the Gwandu Formation in Nigeria (Kogbe & Sowunmi, 1975; Kogbe, 1979), the latter being correlated with both the Continental Terminal (Boudouresque et al., 1982) and the Kerri-Kerri Formation (Kogbe, 1981).

Palynomorphs are not easily recovered from the clastic sequence of the Gwandu Formation, but some peaty lenses which were located in a borehole at Kaloye (Iullemmeden Basin, Nigeria), yielded tricolporate and monoporate grains which perhaps derived from the vegetation of swampy, riverine and tropical forests (Kogbe & Sowunmi, 1975): *Zonocostites ramonae* Germeraad et al., *Spinizonocolpites echinatus* Muller, *Monoporites annulatus* v. d. Hammen, *Retitricolporites irregularis* v. d. Hammen & Wymstra, *Tetraocolporopollenites* sp. together with unidentified pollen grains which may refer to *Mauritia*, *Arenga*, *Kentia*, *Uapaca* and *Ravenea*. In spite of the fact that only 70% of this assemblage could be classified systematically a dominance of dicotyledons (50%) is revealed. Conifers appear to be missing whereas monocotyledons and pteridophytes were recognized (each group with ca. 10%). From the species announced the Gwandu Formation can of course only be
dated in general terms: Eocene to Miocene.

The fluviatile Kerri-Kerri Formation, mentioned already above, rests unconformably on folded Cretaceous sediments (Matheis, 1975). Fossils are missing in the gritty of sandy sequence which includes only few whitish or purplish clay beds. Nevertheless, in a borehole, which penetrated the formation in northeastern Nigeria (Duku), some coal was obtained and palynologically examined (Shell-B. P. Petroleum Development Co.) to display a doubtful Paleocene age at least (Carter et al., 1963). Hampered by the arguments of some field geologists (Carter, 1963; Burke, 1970; Dessauvagie, 1975) favouring a much younger age (Miocene to Pliocene), palynologic reinvestigation of carbonaceous intercalations (Adegoke et al., 1978) maintained and supported a Paleocene age for the lower Kerri-Kerri Formation. Among the assemblage of palynomorphs, consisting of monocolpates (20–40%), monoporate (1–4%), tricolpates and tricolporates (30–50%), inaperturates (5–10%) as well as spores (5–10%), certain forms were registered as reliable index fossils: Mauritiidites crassibaculatus v. H. – Kl. (1–12%), Monocolpites marginatus v. d. Hammen (0–4%), Proxapertites operculatus (0–10%), Costatricolporites reticulatus Wymstra (5–10%). Other forms mentioned (Adegoke et al., 1978 in Kogbe, 1981) are Cranwellipollis gombeensis v. d. Chene & Adegoke and Syncolporites corrugatus v. d. Chene & Adegoke. The lateritic crust on top of the Kerri-Keri Formation is likely to be synchronous with the ferruginous horizons capping or replacing the fluvio-volcanic series of the Jos Plateau. As it deals with a regional phenomenon the lower and upper stratigraphic boundaries of the “Ironstone Formation” (=Siderolithique du Tertiaire, Continental Terminale, main laterite crust) may differ somewhat from place to place. Therefore the assignment of a Neogene, end-Tertiary (Durotoye, 1975) or even post-Eocene to pre-Quaternary age respectively (Lang et al., 1983), which all may be reasonably explained by both epeirogenetic and paleoclimatic events (Boudouresque et al., 1982), need further biostratigraphic support.

Sedimentary sequence in Sabon Gida mine

The biotite granites of the Jos-Bukuru complex are well known to be tin bearing. Due to the shallow, recently unroofed structures and the advanced alluvial concentration of ores within the conine of the massif (Buchanan et al., 1971). Therefore, abundant placers of cassiterite and columbite were mined along the river, the N’gell draining the Sabon Gida area included (fig. 2). Present production of tin, although considerably reduced is performed by open-cast methods from beneath a rather thick detrital overburden and follows lacustrine depressions or buried stream channels of
Fig. 3 Grey clay with impressions of leaves which still yield part of their preserved cuticles, southwest of Major Porter, Jos Plateau.

former drainage systems.

The Sabon Gida South granite, which has undergone particular deep decomposition and greisenization is exposed in the mine. Its deeply weathered, rugged surface has an overburden of unsorted gravels and gritty clays, which are covered by a conspicuous bed (ca. 30 cm) of a dark silty clay. This rock breaks readily when dried into thin, finely laminated layers which expose well preserved impressions of simple leaves with entire margins, oval and ovate shapes, rounded or acute bases and tips (fig. 3). The cuticles are preserved. It is this horizon from where the samples for palynologic investigation were taken. In the subsequent tables some properties of this dark clay are listed.

Granulometric characteristics: Coarse sand (5.8%), fine sand (3.1%), coarse silt (2.6%), medium silt (6.4%), fine silt (15.4%), and clay (66.1%).

Mineralogical composition: Quartz, clay minerals of the kaolin group (halloysite, metahalloysite).

Main elements (EDAX): Al, Si, S, Ti, Fe.

Combustible components: 6.3%

$\delta^{13}$C of organic carbon (PDB): $-29.5\%$

Moist conditions are necessary for the stability of halloysite which is formed as a product of weathered igneous rocks in a substrate with low pH due to the presence of humic acids. The occurrence of this typical exogene mineral fits well with the
Ferruginous sand

Grey, gritty clays

Dark clay bed

Weathered biotite-granite

Fig. 4  Schematic stratigraphic column of the sedimentary sequence above the basement in Sabon Gida Mine. The palynomorphs described in this paper come from the "dark clay bed".

lacustrine sedimentary environment. When dehydrated not as well ordered structures, metahalloysite, are formed.

The dark clay bed is overlain by a sequence of sands with intercalated grey and brown gritty clays. On top of this and below a disturbed overburden (mining activities) streaks and layers of an indurated reddish-brown sand, perhaps partially lateritic, may yet be exposed (fig. 4).

Systematic description of palynomorphs

Anteturma Sporites H. Potonié 1893.


Subturma Azonotrilets Luber 1935.


Leiotriletes maxoides Krutzsch maxoides

Pl. 1, figs. 1-4.


1966 *Leiotriletes maxoides* W. Kr. 1962 *maxoides* W. Kr. 1962, Roch & Schuler, Ser. Geol. Belg., Prof. Paper. 11, p. 5, Fig. 6.7

1976 *Leiotriletes maxoides* Krutzsch 1962a ssp. *maxoides* Krutzsch 1962, Thiele-Pfeiffer, Palaeontographica, B. 174, Lfg. 4 – 6, S. 103 – 104, Taf. 1, Fig. 1, 2 – 4 u. 5 – 6.

1980 *Leiotriletes maxoides* Krutzsch 1962c *maxoides* Krutzsch 1962c, Mohr, Palaeontographica, B. 191, Lfg. 1 – 4, S. 37 – 38, Taf. 1, Fig. 1.


**Diagnostic characters:** Trilete, laevigate spores; equatorial contour rounded-triangular with rounded corners. Exospore two-layered, 1.5 – 2.5 μm thick. Ectexine is thicker than endexine. Y-mark mostly with lips, often with pseudotoroide claws at end. Trilete laesurae straight, extending a half to two thirds the distance to the periphery.

**Measurements:** 60 – 66 μm in equatorial diameter.

**Stratigraphical range:** Middle Europe (Eocene to Late Miocene or Pliocene) and West Europe (Oligocene).

Czechoslovakia: Oligo-Miocene (South Bohemia).

Hungary: Early Eocene (Southern Bakony: Úrkút); Middle Eocene (Northern Bakony: Dúdar, Balinka, Hársküt); Miocene-Pliocene (Eger, Fót, Pápa, Alsóvadasz, Szilavasrad, Nógrádszakál, Vajta).

Germany: Late Oligocene (Lausitz); Miocene (Wackersdorf/Oberpfalz); Late Miocene (Lower Rhine valley).

Belgium: Oligocene (Henis)

**Remarks:** The present specimens belong to *Leiotriletes maxoides* Krutzsch *maxoides* and differ from *Leiotriletes maxoides* Krutzsch *maximus* (Pflug) Krutzsch in size and form of the Y-mark.

**Botanical affinity:** Schizaeaceae, *Lygodium*.

*Leiotriletes maxoides* Krutzsch *minoris* Krutzsch

Pl. 2, fig. 2.

1962 *Leiotriletes maxoides* Krutzsch *minoris* Krutzsch, Atlas, Lfg. I, S. 16, Taf. 1, Fig. 2 – 8.


1984 *Leiotriletes maxoides* Krutzsch 1962a *minoris* Krutzsch 1962a, Kirchner, Palaeontographica, B, 192, Lfg. 4 – 6, S. 91, Taf. 1, Fig. 2.

1985 *Leiotriletes maxoides* W. Kr. 1962 ssp. *minoris* W. Kr. 1962, Nagy, Geol. Hung., Ser, Palaeont., Fasc. 47, p. 79, pl. XV, Fig. 5 – 6.


**Diagnostic characters:** Trilete, laevigate spore; contour somewhat triangular with convex sides and rounded corners. Trilete lasurae straight, gaping, extending two-thirds the distance to the periphery. Exine two-layered, 1 µm thick; endexine thin.

**Measurements:** 55 X 43 µm in diameter.

**Stratigraphic range:** Middle Europe (Late Oligocene-Pliocene), Southeast Asia (Eocene) and Japan (Miocene).

Germany: Late Oligocene or ? Early Miocene (borehole Bernheide); Late Oligocene (St. Augustin and Upper Bavaria); Miocene (Tessin); Late Tertiary (Neubrandenburg).

Czechoslovakia: Oligo-Miocene (South Bohemia).

Hungary: Miocene-Pliocene (Eger, Fót, Püspökhatvan, Papa, Litke, Nógrádszakál, Szokolya, Hida, Alsóvadász, Megyaszó).

Japan: Miocene (Iki).

Indonesia: Eocene (Yogyakarta-Java).

**Remarks:** The specimens belonging to *Leiotriletes maxoides* Kr. *minoris* Kr. differ from *L. maxoides* Kr. *maximus* (Pf.) Kr. and *L. maxoides* Kr. *maxoides* in size, form of the Y-mark and thickness of the exine.

**Botanical affinity:** Schizaeaceae, *Lygodium*.

**Genus Deltoidospora** Miner 1935 ex R. Potonie 1956.

Type species: *Deltoidospora hallii* Miner 1935.

*Deltoidospora* sp.

Pl. 1, fig. 5.

**Description:** Trilete spore; equatorial contour triangular with more or less deltoide corners and more or less concave sides. Exospore smooth, two-layered, 1.5 µm thick; endexine thinner than ectexine. Trilete lasurae straight, gaping, extending two-thirds the distance to the equatorial corners.
Measurements: 58 μm in equatorial diameter.
Remarks: The present specimen is similar to the Jurassic species *Deltoidospora psilastoma* Rouse from the Kootney Formation in British Columbia (Canada), notwithstanding it is referred to *Deltoidospora* sp. only.

Type species: *Triplanosporites sinuosus* Pflug 1953.

*Triplanosporites sinuosus* Pflug
Pl. 1, fig. 7.

1953 *Triplanosporites sinuosus* Pflug, Thomson & Pflug, Palaeontographica, B, 94, S. 58, Taf. 3, Fig. 5 – 6 (p. p.)

Diagnostic characters: Triplane, trilete spore: polar axis longer than equatorial axis. Distal pole more acute than proximal pole. Trilete mark straight. Exospore laevigate, two-layered, 1.5 μm thick; endexospore thin.
Measurements: 58 μm in length of polar axis.
48 μm in length of equatorial axis.

Stratigraphical range: Middle Europe (Paleocene to Early Miocene) and Japan (Upper Cretaceous).

Germany: Paleocene (Wehmingen near Sarstedt); Paleocene-Early Eocene (Antweiler, Helmstedt); Late Eocene-Early Oligocene (Borken); Middle Oligocene-Early Miocene (Emma near Marxheim, Frielendorf); Late Oligocene (St. Augustin).
Japan: Maastrichtian (Hida).

Remarks: The present specimen is somewhat larger than those presented by Krutzsch as *T. sinuosus* (44–56 μm in size); furthermore the exine of *T. sinuosus* is thinner than of *T. sinomaxoides*.
Botanical affinity: Schizaeaceae, *Lygodium*.
**Triplanosporites** sp.

Pl. 2, fig. 1.

*Description:* Triplane, trilete spore, polar axis shorter than equatorial axis. Distal pole more or less rounded; proximal pole slightly acute. Trilete laesurae straight. Exospore smooth, two-layered, 1.5 μm thick on the sides and 3 μm thick on the proximal pole. Endexospore thin.

*Measurements:* 44 μm in length of polar axis.

51 μm in breadth.

*Remarks:* Specific identification of the single specimen appears to be not reasonable.

*Botanical affinity:* Schizaeaceae, *Lygodium*.

**Genus** *Hydrosporis* Krutzsch 1962.

Type species: *Hydrosporis azollaensis* Krutzsch 1962.

*Hydrosporis* cf. *levis* Krutzsch

Pl. 1, fig. 6.

1962 *Hydrosporis levis* Krutzsch, Atlas, Lfg. I, S. 66, Taf. 26, Fig. 1 - 38.


1984 *Hydrosporis levis* Krutzsch 1962c, Mohr, Palaeontographica, B, Lfg. 1 - 4, S. 41, Taf. 1, Fig. 9.1 u. 9.2.

1985 *Hydrosporis levis* W. Krutzsch 1962, Nagy, Geol. Hung., Fasc. 47, p. 126, pl. LV, Fig. 16 - 17.

*Diagnostic characters:* Small trilete spore; equatorial contour subtriangular with convex sides and rounded corners. Exine chagrenate, two-layered, 0.7 μm thick. Y-mark with more or less swollen lips (ca. 1 μm wide) which almost reach to the equatorial margin.

*Measurements:* 16 μm in equatorial diameter.

*Stratigraphical range:* Middle Europe (Tertiary).

Germany: Late Oligocene (Lausitz); Early Miocene? (Schlechtenwegen).

Czechoslovakia: Pliocene (Hodonin).

Hungary: Eocene (Dorog); Miocene (Tököl).

*Remarks:* This small trilete spore belongs most likely to *Hydrosporis levis* Krutzsch (1962).

*Botanical affinity:* Salviniaeceae, *Salvinia* or *Azolla*. 
Infraturma Murornati Potonié & Kremp 1954.
Genus *Foveosporites* Balme 1957.
Type species: *Foveosporites canalis* Balme 1957.

*Foveosporites canalis* Balme
Pl. 3, figs. 1 a-b.


*Diagnostic characters:* Trilete spore with subtriangular equatorial contour. Trilete mark straight, with more or less swollen lips, almost reaching to the equator. Exospore sculptured by very small pore-like lumina, which are often connected and irregularly distributed. The foveo-luminal pattern is rather widely spaced.

*Measurements:* 36 X 32 µm in equatorial diameter.
Exospore 2 µm thick on the sides and 1 µm thick along the corners.
Foveolate lumina 1 µm in diameter.

*Stratigraphical range:* Early Cretaceous in West Australia (Murphy Shaft near Donnybrook).

*Remarks:* *Foveosporites* differs from *Foveotriletes* as the latter has a foveolate exine without connections between the lumina. The present specimen is identical with *Foveosporites canalis* Balme from the Early Cretaceous of West Australia.

*Botanical affinity:* Lycopodiaceae, *Lycopodium*.

Turma Monoletes Ibrahim 1933.
Subturma Azonomonoletes Luber 1935.
Infraturma Laevigatomoleti Dybova & Jachowicz 1957.
Genus *Laevigatosporites* Ibrahim 1933.
Type species: *Laevigatosporites vulgaris* (Ibrahim 1932) Ibrahim 1933.

*Laevigatosporites josensis* n. sp.
Pl. 2, figs. 3 - 5.

*Diagnostic description:* Monolete spore which has the shape of a bean in equatorial view. Spore wall laevigate, two-layered, without perispore, 2 - 3 µm thick, on the side of the dehiscence 2 - 4 µm thick; endexospore thin. The face of the furrow is straight or slightly convex, whereas the dehiscence is long and somewhat swollen.

*Measurements:* 76 - 80 µm in length and 56 - 61 µm in width.
Width / length ratio: 0.73 – 0.79.

**Holotype:** Pl. 2, fig. 3; 80 X 59 μm in size; spore wall laevigate, two-layered, 3 μm thick (ectexine 2.5 μm thick and endexine 0.5 μm thick); width/ length ratio: 0.737; no. of sample: Jos 1 – 1 (GN 5321).

**Name derivation:** After the Jos Plateau.

**Remarks:** The present monoletite spores are rather large and characterized by the psilate wall of *Laevigatosporites*. They are similar to the Miocene species, *Laevigatosporites gigantiformis* Takahashi (1961, p. 289, Taf. 16, Fig. 3; 73.6 – 90.7 μm in size) from the Yunoki Formation of the Sasebo Group (Nagasaki, Japan) as well as the Middle Eocene species, *Laevigatosporites pseudodiscordatus* Krutzsch (1959, p. 196, Taf. 39, Fig. 432; 50 – 80 μm in size), from the Geiseltal (GDR), but concerning the thickness of the spore wall they differ from both of them.

**Botanical affinity:** Polypodiaceae.

*Laeavigatosporites discordatus* Pflug

Pl. 2, fig. 6.

1953 *Laeavigatosporites discordatus* Pflug, Thomson & Pflug, Palaeographica, B, 94, p. 59, Taf. 3, Fig. 39–44.


1966 *Laeavigatosporites discordatus* Pflug, Srivastava, Pollen et Spores, vol. 8, no. 3, p. 514, pl. III, Fig. 17; pl. IV, Fig. 1.


1973 *Laeavigatosporites discordatus* Pf. 1953, Kedves, Studia Biol. Hung., 12, p. 62, pl. XXI, Fig. 1 – 2.

1985 *Laeavigatosporites discordatus* Pflug 1953, Nagy, Geol. Hung., Fasc. 47, p. 113, pl. XLVI, Fig. 1 – 2.


**Diagnostic characters:** In polar view the monoletite spore has an oval appearance. The wall is psilate, two-layered and 2.5 μm thick; endexospore thin. A short dehiscence mark extends straight and is framed by distinct lips.

**Measurements:** 75 μm in length and 60 μm in width.

Width / length ratio: 0.8.

**Stratigraphical range:** Paleocene to Miocene in Middle Europe and Late Cretaceous
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Germany: Paleocene (Wehmingen near Sarstedt); Middle Eocene (Messel);
Late Eocene-Early Oligocene (Kettig); Middle Oligocene (Torgau); Late
Oligocene (St. Augustin).
Hungary: Middle Eocene (Northern Bakony: Dudar, Balinka); Miocene (Fót,
Szokolya).
West Canada: Upper Cretaceous (South Alberta); Maastrichtian (Scollard);
Eocene (West British Columbia: Third Beach, Terminal Dock).
Remarks: By shape, size and dehiscence furrow the present example matches L.
discordatus Pflug. It differs from Laevigatosporites pseudodiscordatus Krutzsch
because of the shorter dehiscence furrow, the thicker wall, and the mode of the
dehiscence lips.
Botanical affinity: Polypodiaceae.

Laevigatosporites cf. nitidus (Mamczar) Krutzsch nitidus
Pl. 4, fig. 1.

Trzeciorzedu w Polsce Tom III, p. 197, Tab. I, Fig. 9.
IV und V, p. 149–150, Taf. 53, Fig. 4 –12 (cf.).
1973 Laevigatosporites nitidus (Mamczar 1960) W. Kr. 1967c subsp. nitidus, Kedves,
Studia Biol. Hung., 12, p. 62, pl. XX, Fig. 7, 9.
1977 Laevigatosporites nitidus (Mamczar 1960) W. Kr. 1967, Krutzsch & Vanhoorne,
Palaeontographica, B, 163, Lfg. 1 – 4, p. 19–20, Taf. 9, Fig. 2 – 3.
1985 Laevigatosporites nitidus (Mamczar 1960) W. Kr. 1967, Nagy, Geol. Hung., p. 114,
pl. XLVI, Fig. 9 –10.
Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 64–65, Taf. 7, Fig. 8;
Taf. 8, Fig. 7 –10.

Diagnostic characters: Monoletate spore with oval or bean-shaped contour in equatorial
view. Exospore laevigate, two-layered, 1.3 μm thick. Dehiscence furrow more or
less swollen, moderately long.
Measurements: 60 μm in length and 41 μm in width.
Width / length ratio: 0.68.
Stratigraphical range: Eocene-Pliocene in Middle Europe and Miocene-Pliocene in
East Europe.
Germany: Early Eocene (Bornstedt); Late Eocene-Early Oligocene (Borken);
Late Oligocene (St. Augustin); Miocene (Machendorf, Welzow); Pliocene (Berga, Görsbach, Wallensen).

Belgium: Early Eocene (Epinois, Loksbergen).

Hungary: Early Eocene (Northern Bakony: Zire; southern Bakony: Úrkút); Middle Eocene (Northern Bakony: Dudar, Balinka; Mór Graben: Mór; southern Bakony: Halimba); Late Eocene (Southern Bakony: Halimba); Early Oligocene (Northern Bakony: Dudar; Mór Graben: Fehérvárcsurgó); Middle Miocene (Alsóvadász, Szokolya).

Poland: Miocene (Central Poland); Pliocene (Warsaw).

Remarks: Nagy (1985) pointed out that Krutzsch (1967) too readily used Mamczar’s misprinted name *nutidus* on the table (Tab. I, Fig. 9) disregarding his text.

Botanical affinity: Polypodiaceae.

*Laevigatosporites nitidus* (Mamczar) Krutzsch *crassicoides* Krutzsch

Pl. 4, fig. 2.

1967 *Laevigatosporites nitidus crassicoides* Kr., Atlas, Lfg. IV & V, p. 150, Taf. 53, Fig. 13–15.

Diagnostic characters: Monolete spore. In equatorial view outline bean-shaped with a dehiscence furrow along the concave side. Exospore smooth, translucent, two-layered, 3 μm thick; at the dehiscence area the exine is thicker (ca. 5 μm thick). Dehiscence furrow relatively long.

Measurements: 56 μm long and 39 μm wide.

Width/length ratio: 0.696.

Stratigraphic range: Miocene in Middle Europe.

Germany: Early Miocene (Kasekow).

Remarks: Compared with *Laevigatosporites nitidus* (Mamczar) Kr. *nitidus* and *L. haardti* (Pot. & Ven.) Th. & Pf. *crassicus* Kr., the Nigerian specimen differs either in the thickness of the exospore or in the larger size.

Botanical affinity: Polypodiaceae.

*Laevigatosporites javanicus* Takahashi

Pl. 3, figs. 2–4; pl. 4, figs. 3–6.

**Diagnostic characters:** Monolete spore. Outline bean-shaped (reniform) in equatorial and oval in polar view. Exine smooth, two-layered, 0.5 – 1 μm thick. Dehiscence mark moderately long, straight, sometimes gaping.

**Measurements:** Grain size 39 – 50 μm X 25 – 37 μm.

Width / length ratio: 0.58 – 0.78.

**Remarks:** The specimens, which are fairly common in the sample, are alike *Laevigatosporites javanicus* Takahashi which was described from the Eocene Nanggulan Formation of Java.

**Botanical affinity:** Polypodiaceae.

*Laevigatosporites haardti* (Potonié & Venitz) Thomson & Pflug

*haardtioides* Krutzsch

Pl. 5, fig. 1.

1967 *Laevigatosporites haardti haardtioides* Krutzsch, Atlas, Lfg. IV & V, p. 148, Taf. 52, Fig. 22 – 25.


**Diagnostic character:** Monolete spore. Outline oval in more or less oblique view. Exospore smooth, two-layered, 1 μm thick, folded. Dehiscence furrow straight, gaping, moderately long, with lips.

**Measurements:** 46 μm in length and 39 μm in width.

Width/length ratio: 0.847.

**Stratigraphic range:** Oligocene to Pliocene in Middle Europe.

- Germany: Late Oligocene (St. Augustin); Early Miocene (Tanndorf-Seidewitz; borehole Groß-Köris); Pliocene (Werra).
- Czechoslovakia: Miocene (South Bohemia: Mydlovary).

**Remarks:** The specimen from the Jos Plateau with its oval contour, matches very well *Laevigatosporites haardti haardtioides* Krutzsch from the Middle and Late Tertiary of Middle Europe.

**Botanical affinity:** Polypodiaceae.

*Laevigatosporites haardti* (Potonié & Venitz) Thomson & Pflug

*crassicus* Krutzsch

Pl. 4, fig. 7.
1967 *Laevigatosporites haardti crassicus* Krutzsch, Atlas, Lfg. IV & V, S. 149, Taf. 53, Fig. 1 – 3.

**Diagnostic characters:** Monolete spore with a bean-shaped or reniform outline in equatorial sight. Exospore laevigate, two-layered, 1 μm thick. Dehiscence mark moderately long, curved, with ca. 4 μm thick lips. Face of dehiscence concave. **Measurements:** 41 μm in length and 28 μm in width.

**Width / length ratio:** 0.68.

**Stratigraphic range:** Late Oligocene in Germany (borehole Spremberg).

**Remarks:** The specimen can be separated from *L. haardti haardti* and *L. haardti haardtioides* by its dehiscence mark with the reinforced lips.

**Botanical affinity:** Polypodiaceae.

*Laevigatosporites oviformis* n. sp.

Pl. 3, figs. 5 – 6.

**Diagnosis:** Monolete spore with an elliptical or wide oval contour in polar view. Dehiscence furrow straight, relatively short, sometimes gaping, always exposing swollen lips. Exospore smooth, two-layered, 1.3–1.5 μm thick; ectexine double as thick as endexine.

**Measurements:** 37—46 μm in length and 33–35 μm in width.

**Width / length ratio:** 0.76–0.89.

**Holotype:** Pl. 3, fig. 5; 37 μm in length and 33 μm in width; exine psilate, two-layered, 1.3 μm thick, ectexine is 0.9 μm and endexine is 0.4 μm thick; width / length ratio: 0.89; no. of sample; Jos 1 –13 (GN 5333).

**Name derivation:** ovum = egg (lat.); formis = shaped like (lat.). The epithet *oviformis* describes specifically the oval form of the spore.

**Remarks:** This form-species is rather rarely found. It appears to be similar to *Laevigatosporites ovatus* Wilson & Webster (1946) from the Paleocene Fort Union Formation in Montana (USA) as well as *Laevigatosporites ovoideus* Takahashi (1961) from the Miocene Yunoki Formation of the Sasebo coal-field in Nagasaki (Japan), but *L. oviformis* always exposes its dehiscence furrow with swollen lips.

**Botanical affinity:** Polypodiaceae.

Infraturma Sculptatomonoleti Dybova & Jachowitz 1957.


**Type species:** *Verrucatosporites alienus* (Potonié 1931) Thomson & Pflug 1953.
Verrucatosporites alienus (Potonié) Thomson & Pflug
Pl. 4, figs. 9 a-b.

1931 *Sporites alienus* Potonié, Z. Braunkohle, H. 170, Jg. 30, S. 556, Fig. 1.
1951 *Polypodiaceae-sp. alienus* R. Potonié, Palaeontographica, B, 91, Taf. 20, Fig. 5.
1952 *Monoradiato-sporites cf. alienus* R. Potonié & Venitz, Mürriger & Pflug, Notizbl. Hess. L. - A. Bodenforsch., (VI), 3, S. 57, 61, 63, Taf. 11, Fig. 11, 15 (p. p.).
1953 *Verrucatosporites alienus* (R. Potonié) Thomson & Pflug, Palaeontographica, B, 94, S. 60, Taf. 3, Fig. 47-48 (p. p.).
1959 *Verrucatosporites perversrucatus* (Couper) Krutzsch, Geologie, Jg. 8, Beih. 21/22, S. 205.
1962 *Verrucatosporites miyahisae* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D. Geol., 12, no. 1, pp. 12-13, Taf. 2, Fig. 6-12.
1980 *Verrucatosporites alienus* (R. Potonié 1931) Thomson & Pflug 1953, Thiele-Pfeiffer, Palaeontographica, B, 174, S. 113, Taf. 5, Fig. 6-8.
1984 *Verrucatosporites alienus* Krutzsch 1967, Mohr, Palaeontographica, B, 191, S. 52, Taf. 5, Fig. 5 und 6.
1984 *Verrucatosporites alienus* (R. Potonié, 1931) Thomson & Pflug 1953, Kirchner, Palaeontographica, B, 192, S. 96-97, Taf. 2, Fig. 7.
1985 *Polypodiisporites alienus* (R. Pot. 1931) Nagy 1973, Geol. Hung., Ser. Paleont., Fasc. 47, p. 119, Pl. XLIX, Fig. 22; pl. L, Fig. 1.
1986 *Verrucatosporites alienus* (R. Potonié) Thomson & Pflug, Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 66-68, Taf. 7, Fig. 9; Taf. 9, Fig. 5-9.

Diagnostic characters: Monolet spore with a bean-shaped or reniform contour in equatorial sight. Exine (endexine) 1 μm thick; ornamentation verrucate. Verrucae are sparsely distributed, 3 - 7 μm thick and 2 - 2.5 μm high. Dehiscence mark long; face of the dehiscence rather convex.

Measurements: 41 μm in length and 30 μm in width.
Width / length ratio: 0.73.
**Stratigraphic range:** Late Oligocene-Pliocene in Middle Europe, Early Miocene in New Zealand and Eocene in Japan.

**Germany:** Late Oligocene (Sachsen: borehole Spremberg 5; Hessen: Maxheim; borehole Düben-Bad; borehole Schlitz 1; oberbayerische Faltenmolasse; St. Augustin); Early Miocene (Seidewitz, borehole Groß-Köris 1); Middle Miocene (Lausitz, Klettwitz); Miocene (Ville, Brandenburg, Sachsen: borehole Pessen 1; Muskau; Order near Wackersdorf / Oberpfalz); Late Miocene to Early Pliocene (Frechen, Garsdorf).

**Hungary:** Late Oligocene (Mör Graben: Fehérvárcsurgó); Miocene (Mecseck Mts.).

**Czechoslovakia:** Miocene (South Bohemia).

**New Zealand:** Early Miocene (N. Auckland: Coopers Beach, Parengarenga Harbour).

**Japan:** Eocene (Ishizuchi).

**Remarks:** *V. alienus* (Pot.) Th. & Pf., rather common in the Middle-Late Tertiary of Middle Europe, was only recognized in one specimen of the Jos assemblage.

**Botanical affinity:** Polypodiaceae.

*Verrucatosporites favus* (Potonié) Thomson & Pflug *pseudosecundus* (Krutzsch) Krutzsch

Pl. 3, fig. 7

1953 *Reticuloidosporites secundus* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, S. 60–61, Taf. 4, Fig. 10 (p. p.).

1967 *Verrucatosporites favus pseudosecundus* (W. Kr. 1959b) Krutzsch, Atlas, Lfg. IV & V, S. 186, 188, Taf. 69, Fig. 7–14.

1986 *Verrucatosporites favus* (R. Potonié) Thomson & Pflug *pseudosecundus* (Krutzsch) Krutzsch, Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, p. 69, Taf. 7, Fig. 10a-b; Taf. 9, Fig. 3–4.

**Diagnostic characters:** Monolete spore with bean-shaped or reniform contour in equatorial view. The sculpture of the exine consists of smooth warts (verrucae). Exine two-layered, 1.5 μm thick. Face of the spore along the dehiscence somewhat concave. Dehiscence furrow long, moderately curved.

**Measurements:** 69 μm in length and 45.5 μm in width.

Width / length ratio: 0.659.

**Stratigraphic range:** Late Oligocene-Miocene in Middle Europe.

**Germany:** Late Oligocene (St. Augustin); Early Miocene (NW-Sachsen:
borehole Liemehna 1); Miocene (Ville; Sachsen: borehole Wolkenberg UNL 17).

Czechoslovakia: Middle Miocene (borehole Göllnitz 3).

Remarks: *V. favus pseudosecundus* is distinguishable from all other subspecies of *V. favus* by its prostrate verrucate sculpture.

Botanical affinity: Polypodiaceae.

*Verrucatosporites favus* (Potonie) Thomson & Pflug cf. *magnus* Krutzsch

Pl. 3, fig. 6.

1967 *Verrucatosporites favus magnus* Krutzsch. Atlas, Lfg. IV & V, S. 184, 186, Taf. 68, Fig. 9–12.

Diagnostic characters: Monolete spore; equatorial contour almost circular or very broadly elliptical. Exospore delicately verrucate, two-layered, 3 μm thick; warts (verrucae) low, 1 μm high and 2–4 μm wide. Dehiscence mark straight, moderately short. Face of dehiscence somewhat convex.

Measurements: 71 μm long and 64 μm wide.

Width / length ratio: 0.9.

Stratigraphic range: Middle Eocene-Miocene in Middle Europe.

Germany: Middle Eocene (Geiseltal); Miocene (Ville, Kartierungsbohrung OL).

Remarks: The Jos specimen is more circular than the holotype of *V. favus magnus*.

Botanical affinity: Polypodiaceae.

Genus Gemmatosporis Krutzsch 1959.

Type species: *Gemmatosporis gemmaticoides* Krutzsch 1959.

*Gemmatosporis* sp. a.

Pl. 4, fig. 8.

Description: Monolete spore. Outline bean-shaped or reniform in equatorial sight. Exine smooth, two-layered, with some small knobs (verrucae or gemmae) on the dehiscence side. Dehiscence furrow curved, moderately long.

Measurements: 38 X 23 μm in size.

Width / length ratio: 0.6.

Verrucae or gemmae 1–2 μm high and 2–3 μm wide.

Remarks: As only one specimen was recognized, more specific identification was
omitted.

**Botanical affinity:** Polypodiaceae, *Pyrrosia*.

*Gemmatosporis* sp. b  
Pl. 3, fig. 8.

*Description:* Monolete spore, bean-shaped in equatorial view. Exospore three-layered, 2.2–2.5 μm thick, sculptured by small warts (verrcae or gemmae) in a somewhat loose arrangement. Rather tight dehiscence mark extends in a long line along the straight side of the spore.

*Measurements:* 87 μm in length and 60 μm in width.

Width / length ratio: 0.689.

Verrucae or gemmae 1 – 3 μm high and 1 – 2 μm thick.

*Remarks:* Only one specimen was found.

**Botanical affinity:** Polypodiaceae, *Pyrrosia*.


Type species: *Reticulosporis miocenicus* (Selling 1944) Krutzsch 1959.

*? Reticulosporis* sp.  
Pl. 8, fig. 1.

*Description:* Monolete (?) spore with an oval contour in approximately equatorial view. Exospore 1.5 – 2 μm thick, completely covered by a regular, alveolate reticulum; large muri 2 – 3 μm high. Dehiscence furrow obscure.

*Measurements:* Size of the specimen 65 X 38 μm.

Diameter of the lumina in the reticulum 2 – 5 μm.

Width / length ratio: 0.58.

*Remarks:* Due to the obscure dehiscence mark it is questionable, whether the present spore belongs to the genus *Reticulosporis* or not. Potonié (1966) and Strivastava (1971) consider *Reticulosporis* Krutzsch (1959) as a junior synonym of *Microfoveolatosporis* Krutzsch (1959).

**Botanical affinity:** Unknown.


Type species: *Perinomonoletes pliocaenicus* Krutzsch 1967.
Palynology of Middle Tertiary lacustrine deposits

"Perinomonoletes" tropicalis Salard
Pl. 12, figs. 8–12; pl. 13, figs. 5–7;
pl. 14, figs. 6–9; pl. 32, figs. 1–4.

1975 Perinomonoletes tropicalis Salard, Rev. Micropaléont., vol. 18, no. 2, p. 109, pl. 3,
figs. 13–14 et 15–16.

Diagnostic characters: (?) Monolete spore. Contour without perine elliptical or oval,
often with a small projection in one long axis which resembles a bottle-neck.
Dehiscence mark is invisible. Exine of central body laevigate, one-layered, thin,
less than $0.5 \mu m$ thick. Perine ornate, extravermiculate, tuberculate or baculate,
with rounded verrucate, echinate or fringed processes. The extensions are either
elongated or arranged parallel to be long axis of the spore. They are $2–4.5 \mu m$
high and $3–8 \mu m$ thick and project over the exine.
Measurements: Spore size is $18–30 \mu m \times 15–23 \mu m$ perine included. $13–24 \mu m \times$
$10–16.5 \mu m$ without it.

Stratigraphic range: Tertiary in Cameroons.

Remarks: Whether the specimens are monolete or not, is doubtful. Notwithstanding
identification with Perinomonoletes tropicalis Salard from the Tertiary of Cameroons
is apparent. Although the laesura is obscure. The ornamentation of the perine
resembles closely such recent ferns with monolete spores as Dryopteridaceae
(Dryopteris, Polystichum, or Acrorumohra) and Aspidiaceae (Clenitopsis or Tec-
taria).

Botanical affinity: Affinity to monolete spores is not clear.

Anteturma Pollenites R. Potonié 1931.
Turma Aletes Ibrahim 1933.
Infraturma Psilanapiti Erdtman 1947.
Genus Inaperturopollenites Pflug & Thomson 1953 emend. R. Potonié
Type species: Inaperturopollenites dubius (R. Potonié & Venitz 1934) Thomson &
Pflug 1953.

Inaperturopollenites rugosus n. sp.
Pl. 7, figs. 6–7.

Diagnosis: Inaperturate pollen of originally spherical shape. Exine laevigate or
slightly chagrenate, very thin, less than 0.5 μm thick, one-layered, always strongly folded.

**Measurements:** 15–19 μm X 13–17 μm in diameter.

**Holotype:** Pl. 7, fig. 6; size 19 X 17 μm (diameter); exine more or less chagrenate, thin, one-layered. No. of sample: Jos 1–2 (GN 5322).

**Derivation of name:** rugosus (lat.) = wrinkled.

**Remarks:** Such inaperturate pollen with these strongly folded exines were rarely encountered. *I. rugosus* n. sp. is comparable with the smaller *I. parvus* Takahashi from the Late Oligocene of St. Augustin (West-Germany) and the Miocene of West Japan and Korea. The former differs from the latter in its delicate and strongly folded exine.

**Botanical affinity:** Unknown.

"Inaperturopolenites minimus" n. sp.

**Pl. 7, figs. 17–23.**

**Diagnosis:** Inaperturate pollen with approximately circular contour. Thin exine often folded; more or less chagrenate or very fine punctate, 0.5–0.8 μm thick, one-layered.

**Measurements:** 12–17 μm X 11–16 μm in diameter.

**Holotype:** Pl. 7, fig. 22; size 13 X 11 μm (diameter); exine slightly chagrenate, 0.7 μm thick, one-layered, moderately folded; no. of sample: Jos 1–1 (GN 5321).

**Name derivation:** minimus (lat.) = the smallest.

**Remarks:** This new species is the smallest yet known among inaperturate pollen grains with psilate exines. The difference in size separates from *I. parvus* Takahashi (1963).

**Botanical affinity:** Unknown.

Genus *Psophosphaera* Naumova 1937 ex Bolchovitina 1953.

Type species: *Psophosphaera tenuis* Naumova ex Bolchovitina 1953.

*Psophosphaera pseudotsugoides* Krutzsch

**Pl. 7, figs. 24a-b.**

1971 *Psophosphaera pseudotsugoides* Krutzsch, Atlas, Lfg. VI, S. 192, Taf. 61, Fig. 1–6.


**Diagnostic characters:** Inaperturate pollen, initially of spherical or oval shape. Exine laevigate, two-layered, 1.5 μm thick, somewhat crumpled; ectexine double as thick as endexine. Germinal structure obscure.

**Measurements:** 77 μm in diameter.

**Stratigraphic range:** Middle Oligocene-Pliocene in Middle Europe and Late Cretaceous (Coniacian) in Japan.

- Germany: Middle Oligocene (borehole Spremberg-Frankfurt); Late Oligocene (St. Augustin); Early Miocene (borehole Altranft 4), clay quarry Freiemoulde); Middle Miocene (MöbiskrUGE); Pliocene (South Harz: clay quarry Berga).
- Czechoslovakia: Early Pliocene (Hondonin).
- Japan: Coniacian (Tamayama, Kasamatsu).

**Remarks:** *P. pseudotsugoides* Krutzsch, which is a rather common species in the Tertiary of Middle Europe, occurs rarely within the Jos assemblage.

**Botanical affinity:** Larix or Pseudotsuga.

*Genus Cupressacites* Bolchovitina 1956.

Type species: *Cupressacites russeus* Bolchovitina 1956.

*Cupressacites cuspidataeformis* (Zaklinskaja) Krutzsch

Pl. 7, figs. 8–15.


1971 *Cupressacites cuspidataeformis* (Zaklinskaja) Krutzsch, Atlas, Lfg. VI, S. 196, Taf. 62, Fig. 9–18.


1986 *Cupressacites cuspidataeformis* (Zaklinskaja) Krutzsch, Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol 26, no. 2, pp. 78–79, Taf. 11, Fig. 10–11; Taf. 12, Fig. 2.

**Diagnostic characters:** Inaperturate pollen of originally spherical shape. Exine chagrenate to finely punctate, 0.5–1.5 μm thick, ? one-layered.
Measurements: 18—27 μm X 17—26 μm in diameter.

Stratigraphic range: Late Cretaceous in West Asia (USSR) and Middle Oligocene-Pliocene in Middle Europe.

USSR: Late Cretaceous (Pavloder Irtysh Basin—Paramonovka).
Germany: Middle Oligocene (Bergisches Land: Bergisch Gladbach); Late Oligocene (St. Augustin); Miocene (borehole Bernheide 1).
Czechoslovakia: Miocene (Hidas).

Remarks: All specimens are very similar to those figured by Krutzsch (1971), but some of them do have an exine thicker than 1 μm.

Botanical affinity: Cupressaceae.

Infraturma Granulonapiti Cookson 1947.
Genus Araucariacites Cookson 1947 ex Couper 1953.
Type species: Araucariacites australis Cookson 1947 ex Couper 1953.

Araucariacites australis Cookson ex Couper
Pl. 7, figs. 1—5.

1968 Araucariacites australis Cookson, Muller, Micropaleont., vol. 14, no. 1, p. 10, pl. 2, fig. 10.
1980 Araucariacites australis Cookson, Burger, BMR Bull., 189, p. 64, pl. 17, fig. 4.

Diagnostic characters: Inaperturate pollen of initially spherical or oval shape. Exine thin, 0.5—1 μm thick, delicately granulated or punctated, generally crumpled.

Measurements: 31—48 μm X 31—42 μm in diameter.

Stratigraphic range:
Tertiary in the Kerguelen Archipelago (Waterfall gorge near Port Leanne d’Arc).
Jurassic (Buller Gorge-West Coast, Carvey Creek coal-field), Early Cretaceous (Liverpool State mine—Rewanui), Late Cretaceous (Morly area, Star Opencast, McLean’s no. 5 Opencast, Linton no. 1 mine, Linton no. 6 Opencast, Linton no. 3 mine (north and south), Morley no. 3 Opencast) and
Early Oligocene (Linton no. 6 Opencast, Borchwood mine, Junction Wairaki R. —Gibraltar Burn) of New Zealand.

Early Cretaceous (Surat basin) and Paleocene (Princetown ara-Victoria) of Australia.

Late Cretaceous-Eocene (Sarawak) of Malaysia.

Late Cretaceous (Coniacian and Santonian) (Kitazawa, Kasamatsu, near Obisa River) of Japan.

Remarks: The Jos specimens are the smallest so far encountered of Araucariacites australis Cookson ex Couper, which range from 39—93 μm according to Cookson’s original description.

Botanical affinity: Araucariaceae.


Genus Smilacipites Wodehouse 1933.

Type species: Smilacipites echinatus Wodehouse 1933.

Smilacipites echinatus Wodehouse

Pl. 20, figs. 2—5.


Diagnostic characters: Inaperturate pollen of originally spherical shape with a circular or oval contour. Exine thin, 0.5—1 μm thick, smooth or delicately punctated. Projections of sharp, irregularly arranged spines vary from 1 μm to 3.5 μm in length and from 1 μm to 4.5 μm in proximal width.

Measurements: 20—25 μm in diameter (without spine).

25—29 μm in diameter (with spines).

Stratigraphic range: Eocene in North America and Indonesia.

U. S. A.: Eocene (Colorado).

Indonesia: Eocene (Yogyakarta-Java).

Remarks: Wodehouse (1933) described specimens with fine to vaguely granular or even smooth exines.

Botanical affinity: The assignment of S. echinatus to the genus Smilax is doubtful.


Type species: Clavainaperturites clavatus v. d. Hammen & Wymstra 1964.
Clavainaperturites cf. clavatus v. d. Hammen & Wymstra
Pl. 19, fig. 6.


Diagnostic characters: Inaperturate pollen of global shape with a clavate sculputre. Exine intectate, with crowded clavate projections; pila 1 – 1.5 \(\mu\)m in diameter and 1.5 – 3 \(\mu\)m in length.

Measurements: 38 X 28 \(\mu\)m in diameter.

Stratigraphic range: Oligocene in British-Guiana (pollen zone E of Mombaka area, Kwakwani).

Remarks: Only one specimen was recognized. It is similar to the holotype C. clavatus, but the clavate sculpture of the Jos specimen appears to consist of somewhat larger elements than exposed by the South America one.

Botanical affinity: Unknown.

Infraturma Circumpollini (Pflug 1953) Klaus 1960.
Type species: Classites capucinii González Guzmán 1967.

? Classites sp.
Pl. 17, fig. 16.

Description: Inaperturate (?) pollen of global shape. Exine psilate, three (?)-layered, 2.2 \(\mu\)m thick, with a ca. 1 \(\mu\)m thick belt along the “equatorial periphery” of one hemisphere. On the proximal side no reduced scar is to be noticed.

Measurements: 13 X 12.5 \(\mu\)m in “equatorial” diameter.

Remarks: Only one specimen was encountered. Its assignment to the genus Classites is doubtful, due to the uncertainties of both the three(?)-layered exine and the structure of the (trilete ?) scar.

Botanical affinity: Unknown.

Infraturma Reticulonapiti (Erdtman 1947) Vimal 1952.
Type species: Retipilonapites arcotense Ramanujam 1966.

Retipilonapites sp.
Pl. 19, figs. 7 a-b.
Description: Inaperturate pollen of oval shape and retipilate sculpture. The interreticular wall are composed of an arrangement of small granulate or verrucate warts together with some baculate or echinate pila (3 – 4 μm long). The lumina of the reticulum vary from 2.5 μm to 6 μm in diameter.

Measurements: 33 X 30 μm in diameter.

Remarks: Only one specimen was observed, which apparently belongs to the genus Retipilonaapites Ramanujam. It differs from R. arcotense Ramanujam (1966, p. 154, pl. 1, fig. 2), which was described from Miocene lignites of Madras (South Arcot district), India, in the sizes of the pila as well as the lumina of the reticulum.

Botanical affinity: Unknown.

Genus Fagraceapollis n. gen.
Type species: Fagraceapollis reticulatus n. gen. et sp.

Diagnosis: Inaperturate pollen with suprareticulate ("tectate reticulate") ornamentation. Ectexine coarsely reticulate; tectum with big verrucate, baculate or clavate processes. Endexine thin, with a sculpture of small baculate or granulate elements. Ectexine attached to endexine by columnar structures. These accomplish verrucate, baculate or clavate tecta and can be noted under suitable microscopic foci as circular pattern in the walls of the reticulum.

Name derivation: From the recent genus Fagracea (Loganiaceae) which honours the memory of J. T. Fagraeus.

Remarks: The genus Fagraceapollis is erected for non-aperturate suprareticulate pollen which are characterized by a widely spaced reticulum of the ectexine, a fine sculptured endexine and columnar joints between ectexine and endexine. It differs from Retipollenites González Guzmán, 1967, because the reticulum does not insert a basal layer but closely resembles the pollen of recent Fagracea (Loganiaceae).

Fagraceapollis reticulatus n. sp.
Pl. 8, figs. 2 – 3; pl. 9, figs. 1 – 2;
pl. 32, figs. 5 – 6.

Diagnosis: Inaperturate pollen of originally globular shape. Ectexine coarsely reticulated (suprareticulate); tectum sporadically with big verrucate, baculate or clavate processes. Many pillars form a connection between ectexine and endexine; at places their club-shaped tips compose verrucate, baculate or clavate processes on the tectum.

Measurements: 56–61 μm X 55–61 μm in total diameter.
50–56 μm in diameter of the inner body.
1.5–2 μm thickness of the interreticular walls.
2.5–12 μm lumina of reticulum.
3–4 μm height of the pillars.
2–4 μm length of verrucate or baculate processes.

_Holotype:_ Pl. 9, figs. 1 a–d; 60 X 55 μm in diameter, 53 μm in diameter of the inner body; lumina of the reticulum 3–12 μm in diameter; wall of the reticulum 2 μm in thickness and 1.5–2 μm in radial extension; pillars 4 μm high; no. of sample: Jos 1–1 (GN 5321).

_Derivation of name:_ reticulatus (lat.) = netlike.

_Remarks:_ The present inaperturate pollen closely resembles with its suprareticulate exine _Fagraea sasakii_ Hay of the family Loganiaceae. Accordingly, the generic name _Fagraeapollis_ was selected.

_Botanical affinity:_ Loganiaceae, _Fagraea._

_Subturma Monocolpates_ Iversen & Troels-Smith 1950.


_Type species:_ _Magnolipollis neogenicus_ Krutzsch 1970.

_Magnolipollis graciliexinus_ Krutzsch

Pl. 4, figs. 10–11.

1970 _Magnolipollis graciliexinus_ Krutzsch, Atlas, Lfg. VII, S. 128, Taf. 30, Fig. 1–11.

_Diagnostic characters:_ Monosulcate pollen of fusiform or ellipsoidal shape. Exine smooth, thin, 1.5 μm thick, two-layered, slightly folded or burst. Sulcus somewhat swollen, gently curved.

_Measurements:_ 70–72 μm in length.
42–45 μm in width.

_Width / length ratio:_ 0.58–0.64.

_Stratigraphic range:_ Eocene-Pliocene in Middle Europe.

_Germany:_ Eocene (Geiseltal); Middle Miocene (Muskau; Klettwitz, Helene bei Finkenheerd / Frankfurt a. O.); Pliocene (clay quarry Rüterberg/Elbe).

_Remarks:_ The specimens are in shape, size and sculpture identical with _Magnolipollis graciliexinus_ Krutzsch 1970.

_Botanical affinity:_ Magnoliaceae.
Magnolipollis micropunctatus Krutzsch

Pl. 5, fig. 2.

1970 Magnolipollis micropunctatus Krutzsch, Atlas, Lfg. VII, S. 126, Taf. 29, Fig. 1–10.

Diagnostic characters: Monosulcate pollen of broad oval shape in lateral view. Exine two-layered, delicately punctated or intrabaculated, 1 μm thick, slightly folded. Sulcus slender and slightly curved.

Measurements: 58 X 33 μm in size.

Width / length ratio: 0.58.

Stratigraphic range: Oligocene-Early Miocene in Middle Europe.

Germany: Middle Oligocene (borehole Wassermannsdorf bei Berlin); Late Oligocene (Bockwitz bei Borna, borehole Spremberg 5); Early Miocene (borehole Oberlausitz).

Remarks: M. micropunctatus Kr. differs from Magnolipollis graciliexinus Kr. in both sculpture and structure of the exine and from M. neogenicus Kr. in the delicate and thinner structure of the exine.

Botanical affinity: Magnoliaceae.

Subturma Triptyches Naumova 1939.


Type species: Perfotricolpites digitatus González Guzmán 1967.

Perfotricolpites lanceolatus n. sp.

Pl. 5, fig. 7; pl. 6, figs. 3–4.

Diagnosis: Tricolpate pollen of ellipsoidal or fusiform shape and rounded poles in equatorial view. The three radially symmetrical colpi are long, conspicuous, rather wide, gaping, and extend parallel to converge at the poles. Ectexine thicker than endexine. Endexine 0.5 μm thick on the sides and 1 μm thick in apocolpia; columellae digitate, 1.5–2 μm long on the sides and 3–4.5 μm long in the polar areas. Sculpture of exine exhibits psilate-scabrate structure in optical section, granulate or reticulate in surface view; granule or lumina generally 0.5 μm in width but 1–2 μm thick in polar areas.

Measurements: 73–82 μm in length.

37–42 μm in width.

Width / length ratio: 0.45–0.58.
Holotype: Pl. 6, fig. 3; 79 X 39 \( \mu \)m in size; sculpture of exine psilate-scabrate in optical section, granulate or reticulate (lumina 0.5 \( \mu \)m) in surface view; columellae digitate, 1.5 \( \mu \)m long on the sides, 3 – 4 \( \mu \)m long in apocolpia; width / length ratio: 0.49; no. of specimen: Jos 1 – 3 (GN 5323).

Name derivation: From the shape of the pollen, lanceolatus (lat.) = like the head of a lance.

Remarks: Apparently the Jos specimens belong to the genus *Perfortricolpites* González Guzmán 1967, but relationship on specific level is quite uncertain. They obviously bear little resemblance to *Perfortricolpites digitatus* González Guzmán (1967, p. 34, pl. VI, figs. I-If) from the Early-Middle Eocene in Columbia.

Botanical affinity: Referring to the genus *Merremia* (Convolvulaceae) is conceivably possible.

*Perfortricolpites nigerianus* n. sp.

Pl. 6, figs. 1 – 2.

Diagnosis: Tricolpate pollen of ellipsoidal or fusiform shape exhibiting rounded apices in equatorial view. Three long and radially symmetrical colpi are rather conspicuous, as they gape widely (1 – 1.5 \( \mu \)m wide) and extend almost parallel to the poles. Ectexine thicker than endexine. Endexine 1 \( \mu \)m thick; columellae digitate in apocolpia (5.5 – 11 \( \mu \)m thick); intrabaculate on the sides (2.5 \( \mu \)m thick). Sculpture of exine of psilate-scabrate structure in optical section, however, granulate or reticulate on the outer surface; granule or lumina ca. 1 \( \mu \)m (or less) in diameter. Areolate ornamentation is either irregularly arranged within the mesocolpia or in a row along the inner borders of the colpi (3 – 6 \( \mu \)m in diameter).

Measurements: 95 – 100 \( \mu \)m in length.

47 – 55 \( \mu \)m in width.

Width / length ratio: 0.47 – 0.58.

Holotype: Pl. 6, figs. 1 a-c; 100 X 47 \( \mu \)m in size; columellae digitate, 9 – 11 \( \mu \)m long in the polar areas; intrabaculate, 2.5 \( \mu \)m thick on the sides. Sculpture of exine psilate. Areolae lined up along the borders of the colpi, however rather irregularly within the mesocolpia, 3 – 6 \( \mu \)m in diameter. No. of specimen: Jos 1 – 3 (GN 5323).

Derivation of name: From the Federal Republic of Nigeria.

Remarks: A comparable species is unknown to the authors. Although the genus *Areolipollis* displays an areolate ornamentation, it is structurally a two colporate to two colpate (?) pollen grain.

Botanical affinity: Unknown.
Genus *Peregrinipollis* Clarke 1966.

Type species: *Peregrinipollis nigericus* Clarke 1966.

*Peregrinipollis nigericus* Clarke

Pl. 12, figs. 4 - 7; pl. 13, figs. 1 - 4; pl. 14, figs. 1 - 5;
pl. 33, figs. 2 - 3; pl. 34, figs. 1 - 2.

1968 *Peregrinipollis nigericus* Clarke, Clarke & Frederiksen, Grana Palynol., vol. 8, no. 1, pp. 216-217, pl. 5, fig. 8.

**Diagnostic characters:** Tricolpate pollen of subspherical to subprolate outlook. Mesocolpia with coarsely reticulate sculpture; lumina of reticulum 3 - 16 μm in diameter. Colpi distinct in both polar and equatorial sight, however, indistinct in oblique view; they extend from pole to pole and are delimited by the reticulate sculpture of their rims. Walls of reticulum arise to 2 - 5 μm with rodlike muri of 2 - 5 μm width. A thin inner layer (endexine) is apparently attached to the reticulum by short rods (1 - 2 μm wide and 1 - 2 μm high). Apocolpia are without reticulum but covered by bacula and clavae of 0.5 - 1.5 μm thickness and 2 - 3 μm height.

**Measurements:** 42 - 53 μm in length.

35 - 48 μm in width.

Width / length ratio: 0.8 - 0.95.

**Previous record:** Late Tertiary of Nigeria.

**Remarks:** Clarke (1966) described *Peregrinipollis nigericus* from Late Tertiary sediments off the southwestern coast of Nigeria. All the specimens from the Jos Plateau (central Nigeria) differ somewhat in the sculpture of the apocolpia, but in view of Clarke's figures the ornamentation of the specimens is actually very much alike.

**Botanical affinity:** Unknown, however, *Brachystegia* (subfamily Caesalpinioideae, family Leguminosae) might be related whereas this is not the case with *Afzelia* of the same subfamily.


Type species: *Ranunculacidites communis* Sah 1967.

*Ranunculacidites contaminatus* n. sp.

Pl. 22, figs. 1 - 4.

**Diagnosis:** Tricolpate pollen of globular shape and circular to subcircular contour in
polar view. Colpi usually deep with thin membranes inside them (1 - 1.2 μm thick) which are separated to form plugs of 1.5 - 2 μm width; margins of the colpi punctated. Sculpture of exine chagrenate to smooth except the punctate margins of the colpi. Structure of the exine is somewhat intrabaculate. Exine within the equatorial zones of the colpi 2.2 - 3 μm thick.

Measurements: 18 - 27 μm X 18 - 26 μm in diameter.

Holotype: Pl. 22, fig. 1; 25 X 26 μm in size; exine 1 μm thick and separated to form a plug. Sculpture intrabaculate except punctate margins of the colpi. Operculum conspicuous. No. of sample: Jos 1 - 3 (GN 5323).

Name derivation: contaminatus (lat.) = impure.

Remarks: The genus Ranunculacidites Sah is characterized by three operculicolpi, by which other genera are easily distinguished. R. contaminatus n. sp. differs from R. communis Sah in having both a chagrenate to smooth and faintly intrabaculate exine.

Botanical affinity: Tricolpate pollen grains provided with a plug (operculum), are to be noticed among Labiatae, Ranunculaceae or Punicaceae.

Genus Marginipollis Clarke & Fredriksen 1968.

Type species: Marginipollis concinnus Clarke & Fredriksen 1968.

Marginipollis cf. concinnus Clarke & Fredriksen

Pl. 22, fig. 5.

1968 Marginipollis concinnus Clarke & Fredriksen, Grana palynol., vol. 8, no. 1, p. 211, pl. 2, figs. 3 -10.

Diagnostic characters: Tricolpate pollen of prolate shape. Margins of the colpi smooth and thickened to 1 - 2 μm in the equatorial zone of the grain. Mesocolpial exine covered by warts or blisters which are elongated toward the poles; these sculptural elements are also 1 - 4 μm high. Exine thickened in the apical zones 1.5 - 2 μm.

Measurements: 48 X 24 μm in size.

Previous record: Late Tertiary of Nigeria.

Remarks: M. concinnus Clarke & Fredriksen was at first detected in Late Tertiary sediments off the southeast coast of Nigeria. This pollen has got a remarkable sculptture of longitudinal knobs or warts along the margins of the colpi and the mesocolpial zones. The Jos psecimens are comparable with M. concinnus, but they have a somewhat different ornamentation of the mesocolpia.

Botanical affinity: It is likely that Barringtonia (Lecythidaceae) is related to this pollen.

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

*Quercoidites henrici* (Potonie) Potonié
Pl. 22, figs. 7–8, 10–11.

1931 *Pollenites henrici* Potonié, Z. Braunkohle, H. 16, 30 Jg., S. 332, Tab. 2, Fig. 19.
1950 *Quercoidites henrici* (R. Pot.) Pot., Thoms. & Thierg., Geol Jb., 65, S. 54, Taf. 3, Fig. 22–23.
1951 *Quercoidites henrici* (R. Pot.), Palaeontographica, B, 91, Taf. 20, Fig. 62.
1953 *Tricolpopollenites henrici* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, S. 95, Taf. 11, Fig. 30–42.
1980 *Tricolpopollenites henrici* (R. Potonie 1931) Thomson & Pflug 1953, Thiele-Pfeiffer, Palaeontographica, B, 174, S. 142, Taf. 11, Fig. 1–2.
1984 *Tricolpopollenites henrici* (R. Potonie 1931) Thomson & Pflug 1953, Kirchner, Palaeontographica, B, 192, S. 116–117, Taf. 6, Fig. 11a–c.

*Diagnostic characters:* Tricolpate pollen. Figura ellipsoidal or spindle-shaped with rounded poles in equatorial view. Three narrow colpi radially symmetrical, extend almost parallel to the apices. Exine intrabaculate, 0.5–1.5 μm thick; ectexine double as thick as endexine.

*Measurements:* 33–48 μm X 20–26 μm in size.

Width / length ratio: 0.5–0.73.

*Stratigraphic range:* Paleocene to Pliocene in Middle Europe.

Germany: Paleocene (wehmingen); Middle Eocene-Late Eocene (Messel bei Darmstadt); Late Eocene-Early Oligocene (Hessen), Oligocene (Hessen); Late Oligocene (oberbayerische Faltenmolasse, Marxheim); Miocene (Oberpfalz, Lower Rhine valley, Hessen); Pliocene (Frankfurt-Rödelheim, Frankfurt-Niederrad); Pliocene / Pleistocene (Wolfskehlen).

*Remarks:* *Q. henrici* (Potonié) Potonié is larger than *Q. microhenrici* (Potonié) Potonié.

*Botanical affinity:* Quercus.
Quercoidites microhenrici (Potonié) Potonié

Pl. 22, figs. 12, 15–16.

1931 *Pollenites microhenrici* Potonié, Sitz. Ber. Ges. Naturf. Fr. Nr. 1 – 3, S. 26, Taf. 1, Fig. 19c.


1951 *Quercipoll. microhenrici* R. Pot., Palaeontographica, B, 91, Taf. 20, Fig. 63–64.

1953 *Tricolpopollenites microhenrici* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, S. 96, Taf. 11, Fig. 62–110.


1984 *Tricolpopollenites microhenrici* (R. Potonié 1931) Thomson & Pflug 1953, Mohr, Palaeontographica, B, 191, S. 76. Taf. 11, Fig. 10. 1–10.2; Taf. 12, Fig. 1.1–1.2.

1984 *Tricolpopollenites microhenrici* (R. Potonié 1931) Thomson & Pflug 1953, Kirchner, Palaeontographica, B, 192, S. 117, Taf. 6, fig. 12a–b.


**Diagnostic characters:** Tricolpate pollen of ellipsoidal or prolate shape in equatorial sight. Exine intrabaculate, 0.5–1.7 μm thick; ectexine double as thick as endexine. Colpi narrow, radially symmetrical, extending parallel to the poles.

**Measurements:** 21–29 μm X 14–20 μm in size.

Width/length ratio: 0.58–0.69.

**Stratigraphic range:** Paleocene to Pleistocene in Middle Europe.

Germany: Paleocene (Wehmingen); Paleocene-Early Eocene (Antweiler, Helmstedt); Middle Eocene (Helmstedt); Middle Eocene-Late Eocene (Messel bei Darmstadt); Late Eocene-Early Oligocene (Hessen); Middle Oligocene (Bergisch Gladbach); Oligocene (Hessen); Miocene (Hessen, Lower Rhine valley); Pliocene (Frankfurt-Rödelheim, Dornassenheim, Frankfurt-Niederrad, Langendiebach, Wallensen); Pliocene/Pleistocene (Hessen).

**Remarks:** This species is smaller than *Q. henrici*.

**Botanical affinity:** Quercus.

Genus *Cupuliferoidaepollenites* Potonié, Thomson & Thiergart 1950
Palynology of Middle Tertiary lacustrine deposits

ex Potonié 1960.


*Cupuliferoidaepollenites cf. liblarensis* (Thomson) Potonié

Pl. 22, fig. 19.

1950 *Pollenites liblarensis* Thomson, Potonié, Thomson & Thiergart, Geol. Jb., 65, S. 55, Taf. 5, Fig. 26–27.


1960 *Cupuliferoidaepollenites liblarensis* (Thomson) Potonié, Beih. Geol. Jb., 39, S. 92, Taf. 6, Fig. 94.


1986 *Cupuliferoidaepollenites liblarensis* (Thomson) Potonié, Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 131–132, Taf. 22, Fig. 22; Taf. 27, Fig. 14.

**Diagnostic characters:** Tricolpate pollen. Figura ellipsoidal or perprolate with rounded poles in equatorial view. Three narrow colpi arranged in radial symmetry from pole to pole. Exine of faintly intrabaculate structure 0.5 μm thick.

**Measurements:** 21 X 9.5 μm in size.

Width / length ratio: 0.45.

**Stratigraphic range:** Paleocene to Pleistocene in Middle and West Europe.

France: Late Paleocene (Menat).

Germany: Middle Eocene (Helmstedt); Middle Eocene-Late Eocene (Messel bei
Darmstad); Late Eocene-Early Oligocene (Hessen); Middle Oligocene (Bergisch Gladbach); Oligocene (Hessen); Late Oligocene (oberbayerische Faltenmolasse); Miocene (Hessen, Lower Rhine valley; Oberpfalz); Pliocene (Hessen); Pliocene/Pleistocene (Hessen).

Hungary: Early Eocene (Halimba); Middle Eocene (Dorog, Dudar etc.); Late Eocene (Budakeszi, Csillaghégy, Mátyás); Miocene-Pliocene (Mecsek Mts.).

Remarks: The Jos specimens have thinner exines and somewhat elongated bodies when compared with typical examples of Cupuliferoidaepollenites liblarensis.

Botanical affinity: Cupuliferae.

Cupuliferoidaepollenites josensis n. sp.
Pl. 22, figs. 13–14.

Diagnosis: Tricolpate pollen of oval or prolate shape with rounded poles in equatorial view. The three narrow colpi are rather conspicuous and converge towards the poles. Exine thin, 0.5 μm thick, two-layered; ectexine faintly intrabaculate whereas endexine is smooth; ectexine double as thick as endexine.

Measurements: 29–30 μm in length.
15–17 μm in width.
Width / length ratio: 0.5–0.58.

Holotype: Pl. 22, fig. 14; 29 X 17 μm in size; exine somewhat of intrabaculate structure, 0.5 μm thick; width/length ratio: 0.586; no. of specimen: Jos 1–6 (GN 5326).

Derivation of name: From the city of Jos in Central Nigeria.

Remarks: The new species resembles Cupuliferoidaepollenites liblarensis (Thomson) Potonié, but differs in size and structure of the exine.

Botanical affinity: Cupuliferae.

Cupuliferoidaepollenites sp. a
Pl. 22, fig. 9.

Description: Tricolpate pollen. Figura ellipsoidal or prolate with rounded poles in equatorial view. The three narrow colpi are conspicuous and extend from pole to pole. Exine thin, 1 μm thick, two-layered and of faintly intrabaculate structure; ectexine as thick as endexine.

Measurements: 40 X 28 μm in seze.
Width / length ratio: 0.7.
Remarks: The large variety of *Cupuliferidaepollenites* from Jos is comparable with *C. henrici*, although it has a rather thin intrabaculate exine.

*Botanical affinity: Quercus.*

*Cupuliferidaepollenites* sp. b

Pl. 22, fig. 20.

*Description:* Tricolpate pollen. Figura ellipsoidal or prolate with rounded poles in equatorial view. The three narrow colpi extend from pole to pole where they converge. Exine smooth and thin; two-layered, 0.5 μm thick in equatorial zone and 1 μm thick around the apices; ectexine as thick as endexine.

*Measurements:* 37 X 24 μm in size.

Width / length ratio: 0.65.

*Remarks:* Only one specimen with a smooth two-layered exine was found which is therefore not specifically identified below generic level.

*Botanical affinity:* Cupuliferae.

Genus *Tricolpopollenites* Pflug & Thomson 1953.


*Tricolpopollenites pseudoeuphorii* Pflug

Pl. 22, fig. 6.

1953 *Tricolpopollenites pseudoeuphorii* Pflug. Thomson & Pflug. Palaeontographica, B, 94, S. 97, Taf. 11, Fig. 163—164.


*Diagnostic characters:* Tricolpate pollen. Figura ellipsoidal or prolate with rounded apices in equatorial view. Three narrow colpi appear to converge towards the poles. Exine punctate on its outer surface, but baculate in optical section, 1 μm thick.

*Measurements:* 34 X 24 μm in size.

Width / length ratio: 0.7.

*Stratigraphic range:* Middle Eocene to Late Oligocene in Middle Europe.

Germany: Middle Eocene (Helmstedt); Late Oligocene (St. Augustin).

*Remarks:* Only one specimen was observed with baculate sculpture which is alike *T. pseudoeuphorii* Pflug.

*Botanical affinity:* Unknown.
Tricolpopollenites cf. *minutus* González Guzmán n. comb.
Pl. 22, figs. 17–18.

1967 *Psilatricolpites minutus* González Guzmán, B. J. Brill, Leiden, p. 27, pl. I, Figs. 2–2 e.

**Diagnostic characters:** Tricolpate pollen of ellipsoidal to broad-ellipsoidal or prolate to subprolate shape and rounded apices. The three narrow colpi are quite distinctly lined towards the poles. Exine chagrenate or psilate, two-layered, 0.5–1.5 μm thick.

**Measurements:** 21–24 μm X 14–19 μm in size.

**Width / length ratio:** 0.66–0.79.

**Previous records:** South America (Middle Eocene) and Africa (Middle Eocene).

- Colombia: Middle Eocene (Tibú area).
- Nigeria: Middle Eocene (Gbekebo).

**Remarks:** Van der Hammen (1956, p. 88) defined the subgenus *Psilatricolpites* with in the genus *Tricolpites* Erdtman 1947, he presented *Tricolpites* (*Psilatricolpites*) *incomptus* v. d. Hammen 1956 as subgenotype by selecting the pollen of recent *Bartsia santalinaefolia* (HBK) BEMTH. (Scrophulariaceae) as the type-specimen. Pierce (1961) promoted the subgenus *Psilatricolpites* to a separate form-genus based on *Psilatricolpites incomptus* (v. d. Hammen) Pierce as type species. V. d. Hammen and Wymstra (1964) proposed *Psilatricolpites clarissimus* (v. d. H.) as lectotype. Potonié (1966, p. 163) again referred to another type species: *Psilatricolpites psilatus* Pierce 1961. After all, *Psilatricolpites* Pierce is nomenclaturally invalid and the designation of *P. clarissimus* and *P. psilatus* as type species contradicts the ICBN.

**Botanical affinity:** Cupuliferae (?)

*Tricolpopollenites densus* Pflug
Pl. 22, figs. 21–22.

1953 *Tricolpopollenites densus* Pflug, Thomson & Pflug, Palaeontographica, B, 94, S. 96, Taf. 11, Fig. 55–58.

**Diagnostic characters:** Tricolpate pollen. Figura spheroidal with circular to subcircular contour in subpolar view. The three conspicuous colpi are slender and gaping;
they almost reach the poles. Exine thin, 1−1.5 μm thick, two-layered, intrabaculate; ectexine is double as thick as endexine.

**Measurements:** 24−33 μm in diameter.

**Stratigraphic range:** Paleocene to Early Oligocene in Middle Europe.

- Germany: Paleocene-Early Eocene (Helmstedt); Middle Eocene-Late Eocene (Messel near Darmstadt); Late Eocene-Early Oligocene (Borken).

**Remarks:** The present specimens are identical with *Tricolpopollenites densus* Pflug from the Paleocene of Germany.

**Botanical affinity:** Unknown.


*Psilabrevitricolpites rotundus* Van Hoeken-Klinkenberg

Pl. 28, figs. 19−24.


**Diagnostic characters:** Brevitricolpate pollen grains of circular to subcircular contour in polar sight. The three colpi are short and noticeable framed by the enlarged endexine (costae colpi: 3−3.5 μm thick). Exine thin, 0.5−2 μm thick, delicately punctate or faintly intrabaculate; ectexine as thick as endexine.

**Measurements:** 15−24 μm X 14−22 μm in diameter.

**Previous record:** Africa (Middle Eocene).

- Nigeria: Middle Eocene (Gbkebebo).

**Remarks:** The present specimens are identified with *Psilabrevitricolpites rotundus* Van Hoeken-Klinkenberg from the Middle Eocene sediments of the borehole Gbkebebo−1, Nigeria.

**Botanical affinity:** Unknown.


Type species: *Retitrescolpites typicus* Sah 1967.

*Retitrescolpites typicus* Sah

Pl. 18, figs. 2−4; pl. 34, fig. 4.

Diagnostic characters: Tricolpate and almost fossaperturate pollen of globular shape when looked upon apices. The three colpi are long and arranged in radial symmetry; they gape and extend near to the poles where they converge. Exine well stratified, 1.5–2.5 μm thick (except muri); sculpture of outer exine reticulate and retipilate; lumina of irregular configuration but generally polygonal with sinuous walls (1.5–7.5 μm in diameter); muri prominent and of baculate or clavate composition (3–4.5 μm high).


Previous record: Africa (Late Neogene).

Burundi: Late Neogene (Kundava in the Rusiz valley).

Remarks: Sah (1967) described nine different species of Retitrescolpites from the Late Neogene of Burundi (Africa). The Jos specimens are somewhat smaller in composition to those of Burundi; in fact they match R. splendus Sah and R. decipiens Sah, but differ from R. splendus in size and shape and from R. decipiens in shape and ornamentation.

Botanical affinity: Oleaceae, Jasminum and Schrebera.

Retitrescolpites sp. a
Pl. 18, figs. 1 a–b.

Description: Tricolpate pollen of ellipsoidal or subprolate shape in equatorial view. Three narrow colpi are quite conspicuous and arranged in radial symmetry. Exine stratified, 2 μm thick, reticulate and retipilate; lumina irregularly formed and with sinuous walls, 2–5 μm in diameter; muri baculate or clavate, 2–3 μm high.

Measurements: 58 X 44 μm in size.

Remarks: Only one specimen was observed which is somewhat similar to R. splendus Sah (1967, pl. V, fig. 33) from the Late Neogene of Burundi (Africa).

Botanical affinity: Oleaceae.

Retitrescolpites sp. b
Pl. 30, figs. 1 a–b.

Description: Tricolpate pollen. Figura spheroidal in equatorial view. The three narrow colpi are more or less indistinct and converge towards the apices. Exine well stratified, 2 μm thick, reticulate; lumina of varying shapes but all polygonal, 2–3.5 μm in diameter; ornamentation in optical section tectate or baculate, 2 μm high.
Measurements: 39 X 35 μm in size.
Remarks: Only one specimen was observed which is quite similar to R. bellus Sah (1967, p. 61, pl. VI, figs. 25–26) except the longer colpi, thicker exine and larger meshes of the reticulum.
Botanical affinity: Oleaceae.

Type species: Tricolpites reticulatus Cookson 1947 ex Couper 1953.

Tricolpites cf. microreticulatus Belsky, Boltenhagen & Potonié
Pl. 22, figs. 23a–b.

1965 Tricolpites microreticulatus Belsky, Boltenhagen & Potonié, Paläont. Z., Band 39, Nr. 1/2, pp. 75–76, Taf. 12, Fig. 8, 9.

Diagnostic characters: Tricolpate pollen of subcircular contour in polar view. Three distinct colpi gaping, converging towards the poles. Exine of minute reticulated sculpture, two-layered, 1.5 μm thick and of intrabaculate structure; ectexine as thick as endexine.
Measurements: 22 μm in equatorial diameter.
Previous record: Africa (Santonian to Maastrichtian).
Remarks: Only one specimen was observed which is somewhat smaller than the specimens from the Late Cretaceous of Gabon, but otherwise quite alike.
Botanical affinity: Salix or Platanus.

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

Striatopollis nigericus n. sp.
Pl. 23, figs. 1–9; pl. 24, fig. 8;
pl. 34, fig. 5; pl 35, fig. 1–3.

Diagnosis: Tricolpate pollen grains. Figura ellipsoidal or prolate with acute apices. The three narrow colpi are rather distinct and symmetrically arranged along their course to the poles where they converge. Wall two-layered, 1–2.5 μm thick; outer layer as thick as inner one, with a coarse striate sculpture; the ribs (width ca. 0.5
μm) have an extrapunctate composition and are grouped in a distance of 0.5 – 1 μm parallel or almost meridionally to each other.

**Measurements:** 55–70 μm in length.

31–50 μm in width.

Width / length ratio: 0.56–0.71.

**Holotype:** Pl. 23, fig. 1; 60 X 35 μm in size; outer layer 1 μm thick; ribs (striae) with extrapunctate sculpture, extending from pole to pole, ca. 1 μm wide, ca. 0.5 μm apart from each other; width/length ratio: 0.58; no. of specimen: Jos 1 – 4 (GN 5324).

**Name derivation:** From the Federal Republic of Nigeria.

**Remarks:** The new species is similar to *Striatopollis bellus* Sah (1967, pl. V, figs. 15, 17) and *Striatopollis* (al. *Striatocolpites*) *catatumbus* González Guzmán n. comb. (González Guzmán, 1967, p. 30, pl. VIII, figs. 7 – 7 d), but differs from *S. bellus* in having longer colpi and coarser ribs and from *S. catatumbus* in the more slender shape and the coarse ribs.

Van der Hammen (1956) described *Tricolpites* (*Striatocolpites*) *virgulatus* as a subgenotype, indicating the pollen of recent *Acer platanoides* L. (Aceraceae) as type specimen. González Guzmán (1967) raised this subgenus to generic rank by acquisition of the nomenclatural type *Striatocolpites catatumbus* González Guzmán (1967, p. 30, pl. VIII, figs. 7 – 7 d). Nevertheless, the genus *Striatocolpites* was not validly published.

**Botanical affinity:** Sah (1967) suggested a solanaceous affinity, but Solanaceae pollen are furnished with three-(four)-colporate furrows. Germeraad, Hopping & Muller (1968) suggested closer affinity with the genus *Crudia* (Fabaceae).

**Striatopollis variabilis** n. sp.

Pl. 24, figs. 1 – 3, 7, 9 – 10;
pl. 25, fig. 1.

**Diagnosis:** Tricolpate pollen grains. Figura ellipsoidal or prolate with pointed or hemispherical poles in equatorial view. Three colpi rather slender, radially symmetrical, converging towards poles. Exine finely striate; striae in wavy or vortical patterns arranged; columellae simple or with tectate and baculate muri. 1 – 1.5 μm high.

**Measurements:** 42–58 μm in length.

23–36 μm width.

Width / length ratio: 0.54–0.74

**Holotype:** Pl. 24, fig. 2; 53 X 34 μm in size; exine finely striate, tectate or baculate,
1.5 μm high; width/length ratio: 0.64; no. of specimen: Jos 1–15 (GN 5335).

**Derivation of name:** variabilis (lat.) = changeable; in respect to the striate pattern of this species.

**Remarks:** The new species differs from *Striatopollis nigericus* in both the delicate striae and their variable arrangements.

**Botanical affinity:** Fabaceae.

*Striatopollis catatumbus* González Guzmán n. comb.

Pl. 24, figs. 4–6, pl. 35, figs. 4–5.

1967 *Striatricolpites catatumbus* González Guzmán, E. J. Brill, Leiden, p. 30, pl. VIII, figs. 7–7d.

1968 *Striatricolpites catatumbus* González Guzmán, Germeraad, Hopping & Muller, Rev. Palaeobot. palynol., vol. 6, no. 3/4, pp. 319–320, pl. XII, fig. 4.

**Diagnostic characters:** Tricolpate pollen grains of ellipsoidal or prolate shape with pointed or hemispherical pole cap in equatorial view. The three colpi are narrow, symmetrically arranged and converge at the poles. Exine rather coarsely ribbed; striae 1.2–2 μm thick, sometimes extrapunctate, extending from pole to pole.

**Measurements:** 43–50 μm X 28–33 μm in size.

Width/length ratio: 0.54–0.73

**Previous records:** North South America and Africa (Eocene to Pleistocene).

Venezuela: Early-Middle Eocene (Icotea, Rubio Road); Middle-Late Eocene (Prevención); Miocene (Maracaibo).

Trinidad: Miocene-Pliocene (Catshill–Ortoire).

Colombia: Early Eocene-Early Miocene (Paz del Rio); Late Eocene-Early Miocene (Chafurray); Middle Eocene (Tibú).

Nigeria: Early Eocene-Late Eocene (Ovim Bende); Middle Eocene-Early Miocene (Benin West); Eocene-Early Miocene (Imo River); Early Miocene-Pleistocene (Lubara Creek).

**Remarks:** The genus *Striatricolpites* is nomenclaturally invalid and the name has to be replaced by *Striatopollis*.

**Botanical affinity:** Fabaceae, Crudia etc.

*Striatopollis striatellus* (Takahashi) Takahashi

Pl. 24, figs. 11–13; pl. 35, figs. 6–8.

Diagnostic characters: Tricolpate pollen of ellipsoidal or prolate shape with pointed or hemispherical pole cap in equatorial view. The three colpi are quite conspicuous; they converge at the poles. Exine two-layered, $0.7 - 0.8 \mu m$ thick, very finely striate (intrabaculate); striae arranged in various patterns.

**Measurements:** $22 - 23 \mu m \times 5 - 17 \mu m$ in size.

Width / length ratio: $0.45 - 0.69$.

**Stratigraphic range:** Late Eocene to Middle Miocene in the Far East and Late Oligocene in Middle Europe.

Japan: Late Eocene-Early Miocene (Asakura, Sakito, Karatsu, Kasuya, Kokura, Chikuho, Sasebo).

Korea: Miocene (Changgi, Yonil).

Germany: Late Oligocene (St. Augustin).

Remarks: The specimens represent a rather small species of the genus *Striatopollis*, however, they are larger than *Striatopollis sarstedtensis* Krutzsch from Wehmingen / Sarstedt (Niedersachsen).

**Botanical affinity:** Unknown.


Genus *Scabrastephanocolpites* Van der Hammen & Garcia de Mutis 1965.

Type species: *Scabrastephanocolpites scabratus* Van der Hammen & Garcia de Mutis 1965.

*Scabrastephanocolpites cf. scabratus* Van der Hammen & Garcia de Mutis

Pl. 21, fig. 11.

1965 *Scabrastephanocolpites scabratus* Van der Hammen & Garcia de Mutis, Leidse Geol. Meded., vol. 35, p. 110, fig. 11.

Diagnostic characters: A stephanocolpate pollen of circular contour in polar view. Five colpi symmetrically arranged, relatively short, conspicuous and almost extending halfway to the poles. Exine two-layered, $1.7 \mu m$ thick, scabrate; ectexine in-
trabaculate; endexine smooth; ectexine double as thick as endexine.  
**Measurements:** 35.5 X 35 μm in equatorial diameter.  
**Previous record:** Colombia (South America): Paleocene.  
**Remarks:** Only one specimen was observed. This almost totally corresponds with *Scabrastephanocolpites scabratus*.

The genus *Stephanocolpites* van der Hammen (1954) with its type species *Stephanocolpites communis* v. d. H. (1956) was founded on the pollen of recent *Lycopus europaeus* (Labiatae) and is of course nomenclaturally invalid. The genus *Polycolpites* Couper 1953 emend. Srivastava 1966 is furnished with more than six colpi and differs accordingly from the genus *Scabrastephanocolpites*.  
**Botanical affinity:** Labiatae.

Subturama Ptychotriporines Naumova 1939.  
Type species: *Cupuliferoipollenites pusillus* (Potonie 1934) Potonie 1960.

*Cupuliferoipollenites ovuliformis* Takahashi  
Pl. 29, figs. 6 a-b.  

1979 *Cupuliferoipollenites ovuliformis* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1 – 3, pp. 44–45, pl. 12, figs. 8 –24.  

**Diagnostic characters:** Tricolporate pollen of oval or prolate shape with hemispherical pole cap in equatorial view. Three narrow colpi with round pores, conspicuous, radially symmetrical, converging in almost parallel position at the poles. Exine two-layered, 1.5 μm thick, laevigate.  
**Measurements:** 24 X 17 μm in size.  
Width / length ratio: 0.71.  
**Previous records:** Early-Middle Miocene in the Far East.  
Korea: Early-Middle Miocene (Changgi, Yonil).  
Korea Strait (submarine): Middle Miocene (2155.6 m and 2268.7 m in depth).  
**Remarks:** The only specimen detected reveals all the characteristic features of *Cupuliferoipollenites ovuliformis*.  
**Botanical affinity:** Unknown.

*Cupuliferoipollenites sp. a*
Description: Tricolporate pollen of broad-ellipsoidal or subprolate shape with hemispherical polar cap in equatorial view. Three narrow colpi with meridionally elongated pores, rather robust, radially symmetrical, converging at the poles. Exine smooth, two-layered, 1.5 \( \mu \text{m} \) thick; ectexine double as thick as endexine.

Measurements: 36 X 31 \( \mu \text{m} \) in size.

Width / length ratio: 0.86.

Remarks: Only one specimen is recorded which is rather similar to Cupuliferoipollenites prolongatus Takahashi (Takahashi & Kim, 1979, p. 44, pl 11. figs. 30–31) from the Middle Miocene Yonil Group of Korea, but differs because of its small size and stout proportion.

Botanical affinity: Unknown.

\textit{Cupuliferoipollenites} sp. b

Pl. 29, figs. 22a–b.

Description: Tricolporate pollen of broad-oval or subprolate shape with subhemispherical polar cap in equatorial view. Three broad colpi, symmetrically arranged, with lalongated pores. Exine chagrenate, two-layered, 1.5 \( \mu \text{m} \) thick; ectexine as thick as endexine.

Measurements: 20 X 16 \( \mu \text{m} \) in size.

Width / length ratio: 0.8.

Remarks: The only specimen detected is quite similar to Cupuliferoipollenites pusillus (Potonié) Potonié from the Tertiary in Europe with the exception of its broader proportion.

Botanical affinity: Unknown.

Genus \textit{Tricolporopollenites} Pflug & Thomson 1953.

Type species: \textit{Tricolporopollenites dolium} (Potonié 1931) Thomson & Pflug 1953.

\textit{Tricolporopollenites sphaeroideus} Takahashi & Jux

Pl. 28, fig. 8.

1986 \textit{Tricolporopollenites sphaeroideus} Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 158–159, Taf. 24, Fig. 27; Taf. 25, Fig. 7.

Diagnostic characters: Tricolporate pollen of globular shape in equatorial view. Three
narrow colpi with round ora converge in symmetrical arrangement at the apices. Exine chagrenate, 1 μm thick.

**Measurements:** 23 X 25 μm in size.

**Previous record:** Late Oligocene of West Germany (St. Augustin).

**Remarks:** The single specimen found corresponds in shape, sculpture and structure with *Tricolporopollenites sphaeroideus* Takahashi & Jux.

**Botanical affinity:** Unknown.

*Tricolporopollenites protensus* Takahashi n. comb.

Pl. 29, figs. 7 – 8.

1979 *Cupuliferoipollenites protensus* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1 – 3, p. 44, pl. 12, figs. 1 – 7.

**Diagnostic character:** Tricolporate pollen grains. Figura ellipsoidal or subprolate to prolate with pointed or hemispherical polar cap in equatorial view. The three narrow colpi extend in symmetrical, parallel arrangement towards the poles where they converge. Pores are meridionally elongated. Exine laevigate or weakly chagrenate, two-layered, 1 – 1.5 μm thick; ectexine double as thick as endexine.

**Measurements:** 19 – 25 μm X 14 – 19 μm in size.

**Width / length ratio:** 0.73 – 0.76.

**Previous record:** Middle Miocene (Yonil) of Korea.

**Remarks:** The generic indication *Cupuliferoipollenites* was made for Korean specimens with smooth exine and meridionally elongated ora by Takahashi (1979). This designation is now replaced by *Tricolporopollenites*, because three lalongated ora are diagnostic features of the genus *Cupuliferoipollenites*.

**Botanical affinity:** ? Cupuliferae.

*Tricolporopollenites* sp. a

Pl. 28, fig. 25.

**Description:** Tricolporate pollen of circular contour in apical sight. The three large colpi are furnished by a small, rounded ora and connect with the poles. Exine chgrenate, two-layered, 3 μm thick; ectexine three times thicker than endexine.

**Measurements:** 19 X 22 μm in equatorial diameter.

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

**Botanical affinity:** Unknown.

*Tricolporopollenites* sp. b

Pl. 29, fig. 23.
Description: Tricolporate pollen grain. Figura spheroidal in oblique view. Three slender colpi, radially symmetrical but gaping, converge at the apices, all of them furnished with a small round ora. Exine two-layered, chagrenate, weakly intrabaculate, 0.8 μm thick.

Measurements: 15 μm in diameter in oblique view.

Remarks: The single specimen was not identifiable below generic level.

Botanical affinity: Unknown.


*Euphorbiacites africanus* n. sp.

Pl. 26, figs. 2–6.

Diagnosis: Tricolporate pollen of oval to broad-ellipsoidal or prolate to subprolate shape with pointed or hemispherical apices. Three conspicuous colpi, which extend more or less parallel in radial symmetry to the polles. Caverna deep. Large circular pores are slightly elongated meridionally. Exine finely punctate or delicately rugulate in surface view, however, of tectate and becule structure in optical section, 1 μm thick.

Measurements: 40–53 μm in length.

31–40 μm in width.

Width / length ratio: 0.65–0.8.

Holotype: Pl. 26, fig. 4; 49 X 34 μm in size; pores somewhat meridionally elongated; exine tectate and baculate, 1 μm thick; Width / length ratio: 0.69; no. of specimen: Jos 1–15 (GN 5335).

Derivation of name: *africanus* — from the continent Africa.

Remarks: The new species is similar to *Euphorbiacites* (al. *Tricolporopollenites*) *wallensenensis* (Pflug) Sung & Lee (Thomson & Pflug, 1953, p. 103, Taf. 13, Fig. 1–4) from the Middle-Late Pliocene in Wallensen (Germany), *Euphorbiacites reticulatus* Li, Sung & Li (1978, pp. 33–34, pl. 10, figs. 29–31) from the Eocene-Early Oligocene in the Yingcheng region of Hubei, China and *Euphorbiacites* sp. (Takahashi, 1982, p. 316, pl. 50, fig. 31) from the Eocene Nanggulan Formation in the Yogyakarta region, central Java, but differs from all of them because of its smaller bacula and tecta in the sculpture of the exine.

Botanical affinity: Euphorbiaceae.

? *Euphorbiacites* sp.

Pl. 29, figs. 1a-b.
Description: Globular tricolporate pollen grain. With relatively short colpi in radial symmetrical arrangement. Exine four (?)-layered, 3.5 \( \mu \text{m} \) thick, finely punctate on the outer surface; ectexine baculate. Ora slightly elongated equatorially.

Measurements: 26 X 26 \( \mu \text{m} \) in equatorial diameter.

Remarks: The single specimen is very similar to the genus Euphorbiacites. Botanical affinity: ? Euphorbiaceae.

Type species: Faguspollenites verus Raatz 1937.

**Faguspollenites globosus** n. sp.
Pl. 26, figs. 7-10.

Diagnosis: Tricolporate pollen of spherical shape. Three narrow colpi moderately short and with large, round pores in radial symmetry. Exine two-layered, finely punctate on outer surface but intrabaculate in optical section, 1 – 2.5 \( \mu \text{m} \) thick.

Measurements: 38 – 49 \( \mu \text{m} \) in length.

38 – 45 \( \mu \text{m} \) in width.

Width / length ratio: 0.92 – 1.0 or ( > 1.0 ).

Holotype: Pl. 26, figs. 8 a–b; 42 \( \mu \text{m} \) in equatorial diameter; exine intrabaculate, 1 \( \mu \text{m} \) thick; pores large, circular; no. of specimen: Jos 1 – 8 (GN 5328).

Name derivation: globosus (lat.) = globular.

Remarks: The Jos specimens are similar to the European Faguspollenites verus Raatz as well as the Korean Faguspollenites koraiensis Takahashi and Faguspollenites sphaericus Takahashi, but they differ from F. verus in their larger size, from F. koraiensis in their sculpture and intrabaculate structure, and again F. sphaericus in a larger size.

Botanical affinity: Fagaceae, Fagus.

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

**Intrabaculitricolporites rotundiporosus** n. sp.
pl. 27, figs. 1 – 9; pl. 28, fig. 11;
pl. 29, fig. 15.

Diagnosis: Tricolporate pollen of globular shape. Three narrow colpi, rather tenuous, radially symmetrical, converge at the apices; pores large and rounded eventually somewhat oblongated equatorially. Exine two-layered, 1 – 2.5 \( \mu \text{m} \) thick; ectexine
intrabaculate or intrarugulate; endexine smooth; ectexine double as thick as endexine.

**Measurements:** 26–27 μm in length.
22–35 μm in width.
Width / length ratio: 0.85–1.0 (>1.0).

**Holotype:** Pl. 27, figs. 6 a–b; 26 X 22 μm in size; exine intrabaculate, 1.5 μm thick; pores large and circular; width / length ratio: 0.85; no. of specimen: Jos 1–1 (GN 5321).

**Name derivation:** rotundus (lat.) = rounded, circular; porosus (lat.) = the quality of being porous.

**Remarks:** The new species is rather similar to both *Faguspollenites sphaericus* Takahashi (Takahashi & Kim, 1979, p. 46, pl. 15, figs. 1–5) from the Miocene Changgi and Yonil Groups of Korea and *Faguspollenites* (al. Tricolporopollenites) *nagatoensis* Takahashi n. comb. (1961, p. 328, Taf. 26, Fig. 1–3) from the Eocene to Miocene of West Japan, but differs from *F. sphaericus* in a thicker and intrabaculate exine and from *F. nagatoensis* in its smaller size and thicker exine.

**Botanical affinity:** Unknown.

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*Intrabaculitricolporites affinis* n. sp.
Pl. 27, figs. 10a–b; pl. 28, figs. 5–7, 9–10, 12–13; pl. 29, figs. 2–3; pl. 38, fig. 3.

**Diagnosis:** Tricolporate pollen with a round-triangular contour in equatorial view. The three distinct colpi are rather narrow and extend in radial symmetry to the apices, where they converge. Pores are slightly elongated equatorially. Exine twolayered, 1 – 2 μm thick; ectexine intrabaculate; endexine smooth; ectexine double as thick as endexine.

**Measurements:** 21–31 μm in length.
20–26 μm in width.
Width / length ratio: 0.85–1.0.

**Holotype:** Pl. 28, figs. 6 a–b; 28.5 X 26 μm in equatorial diameter; exine twolayered, 1.5 μm thick; intrabaculate ectexine two times thicker than smooth endexine. Pores elliptical in equatorial direction. No. of specimen: Jos 1–1 (GN5321).

**Derivation of name:** affinis (lat.) = adjacent or related

**Remarks:** The new species is very similar to *Intrabaculitricolporites rotundiporosus* n. sp., but is invariably furnished with rather elliptical pores.

**Botanical affinity:** Unknown.
Intrabaculitricolporites cf. zolyomii Kedves
Pl. 28, fig. 1.

1978 Intrabaculitricolporites zolyomii Kedves, Studia Biol. Hung., vol. 15, pp. 64–65, pl. XII, Figs. 28–30; Fig. 25.

Diagnostic characters: Tricolporate pollen grain. Figura subellipsoidal or subprolate in equatorial view. The three narrow colpi converge in radial symmetry at the apices and provide a cavium in each apocolpium. Exine two-layered, 1.8 μm thick; ectexine intrabaculate; endexine weakly intrabaculate; both layers of equal thickness. Pores equatorially lalongated.
Measurements: 17 X 14 μm in size.

Width / length ratio: 0.82.

Previous record: Middle Europe (Early Eocene).
Hungary: Early Eocene (Southern Bakony: Úrkút).
Remarks: Kedves (1978) considered Tricolporopollenites praestans Takahashi (1962, p. 16, Taf. 4, Fig. 48–53) from the Eocene Myojin Formation in Ishizuchi to be a synonym of Intrabaculitricolporites zolyomii Kedves. This species is, however, subject of dispute as it is furnished with lalongate pores and also smaller in size.
Botanical affinity: Unknown.

Intrabaculitricolporites cf. quinetii Kedves
Pl. 28, figs. 17a–b.


Diagnostic characters: Tricolporate pollen grain. Figura ellipsoidal or prolate in equatorial view. Three prominent colpi extend in radial symmetry from pole to pole; caverna deep. Pores round, somewhat meridionally elongated. Exine two-layered, 2.5 μm thick in equatorial zone, 3.5 μm thick at the apices; ectexine intrabaculate, much thicker than endexine; endexine slightly intrabaculate.
Measurements: 34 X 22 μm in size.

Width / length ratio: 0.65.

Previous record: South-East Asia (Tertiary)
Viet Nam: Tertiary (Blao).
Remarks: A diagnostic feature of this species is the thick intrabaculate exine.
Botanical affinity: Unknown.
Intrabaculitricolporites rugoporosus n. sp.
Pl. 29, figs. 16-20.

Diagnosis: Tricolporate pollen of broad-ellipsoidal to spherical or subprolate to spheroidal shape. Three conspicuous colpi are rather deep and extend symmetrically to the apices where they converge. A cavium is developed in each apocolpium. Exine two-layered, 1 - 1.5 μm thick, intrabaculate; ectexine as thick as endexine. Pores equatorially lengthened (lalongate), a fine punctate ornamentation may occur around the pores.

Measurements: 17 - 18 μm in length.

15 - 18 μm in width.

Width / length ratio: 0.88 - 1.0.

Holotype: Pl. 29, fig. 16; 18 X 17 μm in size; exine two-layered, intrabaculate, 1.5 μm thick; pores lalongate; width / length ratio: 0.94; no. of specimen: Jos 1 - 4 (GN 5324).

Derivation of name: rugosus (lat.) = wrinkled; porosus (lat.) = quality of being porous.

Remarks: The new species is similar to Intrabaculitricolporites affinis n. sp., but differs in its smaller size and intrabaculate exine-structure.

Botanical affinity: Unknown.

Intrabaculitricolporites consularis Takahashi n. comb. consularis n. comb.
Pl. 29, figs. 4 - 5.

1961 Tricolporopollenites consularis Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 323, Taf. 24, Fig. 55-56 (pro parte).

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.


Diagnostic characters: Tricolporate pollen of oval or prolate shape in equatorial view. Three conspicuous colpi, extending in radial symmetry and parallel to each other towards the apices where they converge. Equatorial pores meridionally lengthened. Exine two-layered, intrabaculate, 1.5 μm thick; ectexine double as thick as endexine.

Measurements: 23 - 29 μm in length.

16 - 21 μm in width.
Width / length ratio: 0.69 - 0.72.

Stratigraphic range: Paleogene to Miocene in the Far East and Late Oligocene in Middle Europe.

Japan: Eocene (Miike, Asakura, Kasuya, Ube); Early Oligocene (Kyuragi, Kasuya, Sakito); Middle Oligocene (Onga, Kokura, Nishiichi); Early Miocene (Sasebo).

Korea: Early-Middle Miocene (Changgi, Yonil).

Germany: Late Oligocene (St. Augustin).

Remarks: Tricolporopollenites consularis Takahashi (1961) was differentiated by Takahashi (1979) into two subspecies, T. consularis consularis and T. consularis globularis. Kedves (1978) erected the genus Intrabaculitricolporites for a tricolporate pollen with an intrabaculate exine. Accordingly T. consularis consularis is transferred to the genus Intrabaculitricolporites Kedves.


Intrabaculitricolporites consularis Takahashi n. comb. globularis Takahashi n. comb.

Pl. 28, figs. 14-16.

1961 Tricolporopollenites consularis Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 323, Taf. 24, Fig. 53-54 (pro parte).

1979 Tricolporopollenites consularis Takahashi subsp. globularis Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1 - 3, p. 41, pl. 10, figs. 28-30; pl. 11, fig. 1, 3-10.

Diagnosis: Tricolporate pollen grains. Figura broad-ellipsoidal or subprolate in equatorial view. Three conspicuous colpi leading in symmetrical arrangement to the poles; caverna rather deep. Equatorial pores meridionally elongated. Exine two-layered, intrabaculate, 1 - 1.5 μm thick on equatorial side, 1.5 - 2.5 μm thick in apocolpia; ectexine double as thick as endexine or of same thickness.

Measurements: 28 - 31 μm in length.

23 - 25.5 μm in width.

Width / length ratio: 0.74 - 0.91.

Stratigraphic range: Paleogene and Miocene in the Far East.

Japan: Early Oligocene (Sakito); Early Miocene (Sasebo).

Korea: Middle Miocene (Yonil).

Remarks: Due to the intrabaculate structure of the exine Tricolporopollenites consularis globularis is now transferred to the genus Intrabaculitricolporites Kedves.

Intrabaculitricolporites sp. a  
Pl. 27, fig. 12.

Description: Tricolporate pollen of spheroidal shape in equatorial view. The three prominent colpi converge at the apices. Equatorial pores somewhat elongated equatorially. Exine two-layered, 2 $\mu$m thick, intrabaculate; ectexine three times as thick as endexine.

Measurements: 39 X 36 $\mu$m in size.

Width / length ratio: 0.923.

Remarks: This specimen is similar to Intrabaculitricolporites cf. quinetii Kedves (pl. 28, figs. 17a—b in this paper), but differs in its broader shape, the thinner exine and the elongated pores.

Botanical affinity: Unknown.

Intrabaculitricolporites sp. b  
Pl. 28, figs. 2 a—b.

Description: Tricolporate pollen of globular shape in approximately polar view. Three rather short colpi slender, radially symmetrical, converging at the poles. Exine two-layered, 0.5 $\mu$m thick, intrabaculate. Pores small and round.

Measurements: 12 X 11 $\mu$m in nearly equatorial diameter.

Remarks: The very small specimen resembles Cyrillaceaepollenites exactus (Pot.) Pot., although the exine is intrabaculate.

Botanical affinity: Unknown.

Intrabaculitricolporites sp. c  
Pl. 28, figs. 18a—b.

Description: Tricolporate pollen grain. Figura ellipsoidal or prolate with pointed pole cap in equatorial view. Three distinct colpi radially symmetrical, converging at the poles. Equatorial pores elongated (lalongate), 5 $\mu$m long. Exine three-layered (1 : 2 : 1), 2.5 $\mu$m thick; ectexine intrabaculate.

Measurements: 32 X 21 $\mu$m in size.

Width / length ratio: 0.656.

Remarks: This specimen looks like Intrabaculitricolporites cf. quinetii Kedves (pl. 28, figs. 17a—b in this paper), but differs in the three-layered exine and the lalongate pores.

Botanical affinity: Unknown.

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

*Cyrillaceaepollenites exactus* (Potonie) Potonie

Pl. 28, figs. 3 – 4, 26 (cf.); pl. 29, fig. 21.

1931 *Pollenites exactus* Potonie. Sitz. Ber. Ges. Naturf. Fr. Nr. 1 – 3, S. 26, Taf. 1, Fig. 46b².
1951 *Castaneoipollenites exactus* Potonie. Palaeontographica, B, 91, Taf. 20, Fig. 74-77.
1953 *Tricolporopollenites megaexactus* (Potonie) Thomson & Pflug subsp. *exactus* (Potonie) Thomson & Pflug, Palaeontographica, B, 94, S. 100–101, Taf. 12, Fig. 87–92.
1953 *Tricolporopollenites megaexactus* (Potonie) Thomson & Pflug, Palaeontographica, B, 94, S. 100–101, Taf. 12, Fig. 87–92.
1960 *Psilatricolporites megaexactus* (Th. & Pf. 1953) Roche et Schuler, Prof. Paper, no. 11, p. 21.
1976 *Psilatricolporites megaexactus* (Th. & Pf. 1953) Roche et Schuler, Prof. Paper, no. 11, p. 21.
1977 *Tricolporopollenites exactus* (Potonie) Thomson & Pflug, Krutzsch & Vanhoorne, Palaeontographica, B, 163, S. 71, Taf. 29, Fig. 51–53.

*Diagnostic characters:* Tricolporate pollen of globular shape. The three slender colpi converge in symmetrical arrangement at the poles. Pores small, somewhat lalongate. Exine laevigate, two-layered, 0.5–1.5 μm thick.

*Measurements:* 13–13.5 μm X 11–13.5 μm in size.

With / length ratio: 0.85–1.0.

*Stratigraphic range:* Late Paleocene to Pliocene in Middle Europe.

Germany: Middle Eocene (Helmstedt); Late Eocene to Early Oligocene (Hessen); Middle Oligocene (Bergisch Gladbach); Oligocene (Hessen); Late Oligocene (St. Augustin); Miocene (Hessen, Rhineland).

Belgium: Late Paleocene (Epinois, Locksbergen); Oligocene (Henis).

Hungary: Early Eocene (Halimba); Middle Eocene (Lábatlan, Tatabánya, Oroszlány, Iszkkeaszentgyörgy, Dudar); Late Eocene (Budakeszi, Csillaghegy, Mátyás Hill); Miocene (Fót, Püspökhatvan).

*Botanical affinity: Cyrillaceae, Cyrilla.*

*Cyrillaceaepollenites megaexactus* (Potonie) Potonie

Pl. 29, figs. 9–10a, 11–14.

1950 *Pollenites cingulum* Potonie *brühlensis* Thomson, Potonie, Thomson & Thiergart, Geol. Jb., 65, S. 56, Taf. B, Fig. 31–33.
1951 *Pollenites brühlensis* Thomson, Potonie, Palaeontographica, B, 91, Taf. 20, Fig. 79.
1960 *Cyrillaceaepollenites* (al. *Pollenites*) *megaexactus* (R. Pot.) Potonie, Beih. Geol. Jb., 39, S. 102, Taf. 6, Fig. 115.
1976 *Psilatricolporites megaexactus* (Th. et Pf. 1953) *brühlensis* (Th. et Pf. 1953), Roche & Schuler, Prof. Paper, no. 11, p. 21, pl. IX, fig. 9.

*Diagnostic characters:* Tricolporate pollen grains. Figura spheroidal in equatorial view. The three slender colpi are quite conspicuous and converge in radial symmetry at the poles, often with geniculus. Exine laevigate to chagrenate, two-layered, 0.5 –1.5 \( \mu \)m thick. Equatorial pores somewhat lalongate.

*Measurements:* 16–23 \( \mu \)m X 14–20 \( \mu \)m in size.

Width / length ratio: 0.87–0.95.

*Stratigraphic range:* Paleocene to Pliocene in Middle Europe.

Germany: Paleocene-Early Eocene (Niedersachsen); Middle Eocene-Late
Palynology of Middle Tertiary lacustrine deposits

Eocene (Messel near Darmstadt); Late Eocene-Early Oligocene (Hessen); Middle Oligocene (Bergisch Gladbach); Miocene (Oberpfalz, Hessen, Rhineland); Miocene-Pliocene (Rhineland).

Hungary: Early Eocene (Halimba); Middle Eocene (Dorog, Lábatlan, Tatabánya, Oroslány, Íszkaszentgyörgy, Várpalota, Duder); Late Eocene (Budakesz, Csillaghegy; Mátyás Hill); Miocene (Fót, Eger, Nógrászakál, Rákoskeresztúr).

Belgium: Early Oligocene (Henis).

Remarks: C. megaexactus looks like C. exactus, but the former is larger than the later.

Botanical affinity: Cyrillaceae, Cyrilla.

Type species: Margocolporites tsukadai Ramanujam 1966.

Margocolporites vanwijhei Germeraad, Hopping & Muller
Pl. 19, figs. 1a–b.


Diagnostic characters: Tricolporate pollen grain of almost circular contour in polar sight. Margocolpus broad, embracing 18–20 μm of the near-equatorial circumference, gradually tapering towards apices, baculate (1.5 μm long) and framed by a strengthened wall (margo, 2–3 μm in width). Round endexinous pores, 5 μm in diameter. Endexine 0.5–1 μm thick; columella 2.5 μm high; mesocolpium tectate-reticulate; lumina 2–2.5 μm wide at equator, 1–1.5 μm wide at apices.

Measurements: 49 X 47 μm in equatorial diameters.

Previous records: Caribbean: Middle Eocene-Pleistocene; Nigeria: Late Eocene-Oligocene; Borneo: Late Eocene-Pleistocene.

Remarks: The single specimen which was observed is very similar to the pollen of Caesalpinia coriaria Wildenow (Fabaceae).

Botanical affinity: Fabaceae (Leguminosae), Caesalpinia.

Genus Bombacacidites Couper 1960.
Type species: Bombacacidites bombaxoides Couper 1960.

Bombacacidites africanus n. sp.
Pl. 19, figs. 2–3; pl. 34, fig. 3.
Diagnosis: Tricolporate, brevicolpate pollen of triangular contour but rounded corners and straight or slightly concave sides in polar view. Three short, costate colpi (20 μm long) ectexinous, slightly protruding; costae 2 μm wide. The three rounded equatorial pores are placed in the middle of the sides. Wall two-layered, reticulate (reti-pilate); meshes are wider near to the colpi and in the central region of the pollen grain. Lumina of the reticulum 2 – 5 μm in the central region. The sculpture of the colpi is composed of punctae (1 μm) on the sides of intrabaculate (or tectate) baculae and pilate (1 – 2 μm) on the apocolpia (1 – 1.5 μm).

Measurements: 54–57 μm X 54–55 μm in equatorial diameters.

Holotype: Pl. 19, figs. 2 a–b; 55 X 57 μm in equatorial diameters; coarsely reticulate in the central region, 2 – 5 μm in diameter; finely reticulate to punctate, 1 ± μm in diameter; muri on the sides baculate, 2 μm long; structure on apocolpia intrabaculate (or tectate), 1 – 1.5 μm thick; no. of specimen: Jos 1 – 6 (GN 5326).

Derivation of name: From the continent Africa.

Remarks: The new species is somewhat alike to B. annae (v. d. Hammen) Leidelmeyer from the Paleocene of the Caribbean area, B. bombaxoides Couper from the Oligocene to Miocene of New Zealand, B. (al. Tiliaepollenites) reticulatus (J. J. Groot & C. R. Groot) Srivastava from the Paleocene of Maryland and from the Paleocene Oak Hill Member of the Naheola Formation of Alabama as well as the pollen of recent Bombax ceiba Linnaeus.

Botanical affinity: Bombacaceae, Bombax.

Genus Brevitricolpites González Guzmán 1967.

Type species: Brevitricolpites variabilis González Gezmán 1967.

? Brevitricolpites sp.

Pl. 21, figs. 10a–b.

Description: Tricolporate pollen of circular contour in approximately polar view. The three straight colpi are very short (9 μm long) and symmetrically placed to each other; pores (costa pori) equatorially elongated, 10 μm long, 2 μm wide. Exine two-layered, 1.5 μm thick, delicately punctate; ectexine as thick as endexine.

Measurements: 30 μm in nearly equatorial diameter.

Remarks: The single specimen, although exhibiting all characteristic features of the genus (short colpi, lalongate costa pori), could not be identified specifically.

Botanical affinity: Rutaceae.

Type species: *Striatocolporites grandis* Ramanujam 1966.

*Striatocolporites ovuliformis* n. sp.

Pl. 25, figs. 2 - 7; pl. 36, figs. 1 - 3.

**Diagnosis:** Three-zonicolporate pollen of circular to subcircular contour in polar or oblique sight. The three slender colpi are quite distinct, always gaping and converging at the apices. Equatorial pores large and rounded. Exine striate; striae simple; muri baculate, 1.2 - 2.5 µm long.

**Measurements:** 42 - 50 µm X 31 - 44 µm in equatorial or oblique diameter.

**Holotype:** Pl. 25, figs. 4 a - b; 45 X 41 µm in equatorial diameter; exine finely striate; muri baculate, 1.5 µm long; pores large, round, ca. 7 µm in diameter; no. of specimen: Jos 1 - 11 (GN 5331).

**Name derivation:** ovulum (lat. dim.) = small egg; forma (lat.) = figure, shape.

**Remarks:** The new species is smaller than *Striatocolporites grandis* Ramanujam from Miocene lignites of the South Arcot district in Madras (India).

**Botanical affinity:** Leguminosae (*Bauhinia*) or Gentianaceae (*Grawfurdia*, *Gentiana*).

*Striatocolporites cf. striatulus* Takahashi & Jux n. comb.

Pl. 25, figs. 10a - b.

1982 *Striatricolporites striatulus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 23, no. 1, pl 51, Taf. 6, Fig. 4 - 5.

1986 *Striatricolporites striatulus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, p. 162, Taf. 26, Fig. 1, 2 (cf.).

**Diagnostic characters:** Tricolporate pollen grain of broad-ellipsoidal to subprolate shape in equatorial sight. The three distinct colpi are symmetrically arranged and converge at the apices; geniculus always developed. Exine two-layered, 1.5 µm thick, finely striate, intrabaculate; ectexine double as thich as endexine. Circular pores slightly elongate equatorially.

**Measurements:** 27 X 22 µm in size.

**Width / length ratio:** 0.81.

**Previous records:** Middle Europe (Middle Oligocene to Late Oligocene).

Germany: Middle Oligocene (Bergisch Gladbach); Late Oligocene (St. Augustin).
Remarks: The authors (1982, 1986) combined the species *striatulus* originally with the genus *Striaticolporites* v. d. Hammen 1956 ex Leidelmeyer 1966, which, however, is invalid according to the laws of nomenclature. Accordingly the valid genus *Striatoeolporites* Ramanujam 1966 is adopted herewith.

*Botanical affinity:* Aceraceae (*Acer*), Anacardiaceae (*Rhus, Buchanania*), Cucurbitaceae (*Actinostemma, Gymnostemma*), and Gentianaceae (*Crawfurdia*) etc. produce tricolporate pollen grains with striated sculptures.

**Striatoeolporites** sp. a
Pl. 25, fig. 8.

*Description:* Tricolporate pollen of elliptical shape with pointed pole cap in equatorial view. The three slender colpi are conspicuous and converge at the poles; the pores are meridionally elongated. Exine finely striated, some striae are forked; muri 0.5 μm long.

*Measurements*: 39 X 24 μm in size.

Width / length ratio: 0.615.

*Remarks:* Only one specimen was observed.

*Botanical affinity:* Same as *S. striatulus* Takahashi & Jux.

**Striatoeolporites** sp. b
Pl. 25, figs. 9 a–b.

*Description:* Tricolporate pollen grain. Figura ellipsoidal or prolate with pointed pole cap in equatorial view. Three distinct colpi in symmetrical arrangement converge at the poles. Exine finely striate with some forked striae, intrabaculate, 1 μm thick. Pores round.

*Measurements:* 35 X 23 μm in size.

Width / length ratio: 0.657.

*Remarks:* One specimen was observed only.

*Botanical affinity:* Aceraceae (*Acer*).

**Striatoeolporites** sp. c
Pl. 26, fig. 1.

*Description:* Tricolporate pollen with broad-elliptical or oval contour in equatorial sight. Three slender colpi are quite conspicuous and extend symmetrically to the poles where they converge. Exine finely striate; muri 1.2 μm long. Pores equatorial-
ly elongated.

*Measurements:* 30 X 25 µm in size.

*Width / length ratio:* 0.83.

*Remarks:* Only one specimen was observed.

*Botanical affinity:* Aceraceae or Gentianaceae.

**Genus Rhoipites** Wodehouse 1933.

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

*Rhoipites mirus* Takahashi & Jux

*Pl. 30, fig. 6; pl. 31, fig. 9.*


*Diagnostic characters:* Tricolporate pollen grains. Figura prolate to subprolate in equatorial view. Three slender colpi distinct, parallel to each other on the sides and converging at the poles. Pores meridionally elongated. Exine two-layered, finely reticulate, 0.5–1 µm in diameter, intrabaculate; muri baculate, 1 µm long.

*Measurements:* 19–20 µm X 15 µm in size.

*Width / length ratio:* 0.75–0.789.

*Previous records:* Middle Europe (Middle-Late Oligocene).

Germany: Middle Oligocene (Bergisch Gladbach); Late Oligocene (St. Augustin).

*Remarks:* The two specimens, which were recognized, are identical with *R. mirus* Takahashi & Jux.

*Botanical affinity:* Unknown.

*Rhoipites minus* Takahashi & Jux

*Pl. 30, figs. 10–11; pl. 31, figs. 5–8;
pl. 38, fig. 6.*


*Diagnostic characters:* Tricolporate pollen of spheroidal to ovoidal shape in equatorial and polar views. Three slender colpi radially symmetrical, converging at the poles;
geniculus may be developed. Exine two-layered, intrabaculate or intrarugulate, 1
- 1.5 μm thick; surface finely reticulate; lumina 0.5 - 1 μm in diameter. Pores small,
round or slightly elongated equatorially.

Measurements: 14 - 20 μm X 12 - 18 μm in size.

Width / length ratio: 0.85 - 1.0.

Previous record: Middle Europe (Late Oligocene).

Germany: Late Oligocene (St. Augustin).

Remarks: The specimens match with Rhoipites minus Takahashi & Jux from the Late
Oligocene of St. Augustin.

Botanical affinity: Unknown.

Rhoipites cf. finitus González Guzmán n. comb.

Pl. 29, fig. 25; pl. 30, fig. 7.

1967 Retitricolporites finitus González Guzmán. E. J. Brill, Leiden, p. 40, pl. X, figs. 4 -
4 b.

Diagnosis: Tricolpoarte pollen grains. Figura prolate or subprolate in equatorial view.
Three narrow colpi conspicuous, radially symmetrical, converging at the poles. Ex-
ine finely reticulate; lumina 0.5 - 3 μm in diameter; muri baculate or tectate 1 - 1.5
μm long. Pores round, relatively large.

Measurements: 25 - 29 μm X 19 μm in size.

Width / length ratio: 0.655 - 0.76.

Previous record: South America (Early Eocene to Middle Eocene).

Colombia: Early Eocene to Middle Eocene (Tibú).

Remarks: Retitricolporites (v. d. Hammen) v. d. Hamman & Wymstra 1964 was
elevated to generic rank by v. d. Hammen & Wymstra (1964). Genotype was pro-
posed to be R. normalis which, however, is the pollen of recent Viburnum
triphyllum Benth (Caprifoliaceae). Ultimately, Retitricolporites guianensis v. d.
Hammen & Wymstra was offered as a lectogenotype, a designation of a type species
which, however, is nomenclaturally invalid.

The present specimens likely refer to Rhoipites (al. Retitricolporites) finitus
González Guzmán n. comb.

Botanical affinity: Caprifoliaceae (Viburnum).

Rhoipites cf. rugatus Kedves n. comb.

Pl. 30, figs. 4 - 5.

**Diagnosis:** Tricolporate pollen of subprolate to spheroidal shape in equatorial view. Three prominent colpi with lalongate pores converge symmetrically at the apices. Exine finely reticulate; muri or tectatum 0.7 – 1 μm high; lumina of reticulum 1 – 2 μm in diameter.

**Measurements:** 33 – 40 μm X 30 – 32 μm in size.

**Width / length ratio:** 0.8 – 0.9.

**Previous record:** Southeast Asia (Tertiary).

**Viet Nam:** Tertiary.

**Remarks:** The specimens resemble Rhoipites (al. Retitricolporites) rugatus Kedves and may refer to it.

**Botanical affinity:** Dicotyledonopsida.

*Rhoipites* sp. a

Pl. 30, figs. 2 – 3.

**Description:** Tricolporate pollen of spheroidal shape in equatorial view. Three conspicuous and broad colpi with rounded (?) and large pores, radially symmetrical, converge at the poles. Exine coarsely reticulate; muri baculate, 2.4 – 4 μm long; lumina of reticulum 1 – 5 μm in diameter.

**Measurements:** 35 – 50 μm X 32 – 45 μm in size.

**Width / length ratio:** 0.9

**Remarks:** The specimens are similar to Rhoipites (al. Retitricolporites) pflugi Kedves n. comb. from the Early Eocene of Ürkút, Hungary, but contrast with broader colpi and longer muri.

**Botanical affinity:** Unknown (Dicotyledonopsida).

*Rhoipites* sp. b

Pl. 31, fig. 1.

**Description:** Tricolporate pollen grain. Figura ellipsoidal or prolate in equatorial sight. Three narrow colpi conspicuous, orderly placed, with lalongate pores. Exine very finely reticulate; lumina 0.5 – 1 μm in diameter; structure intrabaculate, 1.5 μm thick.

**Measurements:** 40 X 27 μm in size.

**Width / length ratio:** 0.675.

**Remarks:** The specimen resembles Rhoipites (al. Retitricolporites) manumi Kedves.
n. comb. from the Early Eocene of Úrkút, Hungary, but differs in its smaller size and intrabaculate exine.

*Botanical affinity:* Unknown (Dicotyledonopsida).

**Rhoipites sp. c**

Pl. 31, fig. 2.

*Description:* Tricolporate pollen grain. Figura ellipsoidal or prolate with hemispherical pole cap in equatorial view. The three distinct colpi are symmetrically arranged and furnished with large, rounded pores. Exine finely reticulate; lumina 0.5–1 μm in diameter; structure intrabaculate, 1 μm thick.

*Measurements:* 37 X 27 μm in size.

*Width / length ratio:* 0.73.

*Remarks:* *Rhoipites* sp. b (pl. 31, fig. 1) from Jos, Nigeria, is somewhat alike the difference in shape of both in pollen grain and pores.

*Botanical affinity:* Unknown (Dicotyledonopsida).

**Rhoipites sp. d**

Pl. 31, figs. 3 a–b.

*Description:* Tricolporate pollen grain. Figura broad-ellipsoidal or subprolate in equatorial view. Three conspicuous colpi with lalongate pores are symmetrically placed. Exine 1.7 μm thick, reticulate; endexine smooth.

*Measurements:* 27 X 23 μm in size.

*Width / length ratio:* 0.85.

*Remarks:* A single specimen was encountered, which could not be identified specifically.

*Botanical affinity:* Unknown (Dicotyledonopsida).

**Rhoipites sp. e**

Pl. 29, fig. 10a.

*Description:* Tricolporate pollen of spheroidal shape in equatorial view. The three feeble colpi are orderly placed and furnished with somewhat elongated pores meridionally. Sculpture finely reticulate; lumina ca. 2 μm in diameter; tectate, 1.2 μm high.

*Measurements:* 18 X 17 μm in size.

*Width / length ratio:* 0.94.
Remarks: A single specimen was observed.

Botanical affinity: Unknown (Dicotyledonopsida).

Genus Foveotricolporites Pierce 1961.

Type species: Foveotricolporites rhombohedralis Pierce 1961.

Foveotricolporites tenuiexinus n. sp.
Pl. 30, figs. 8 - 9; pl. 38, fig. 4.

Diagnosis: Tricolporate pollen grains. Figura spheroidal to subprolate in equatorial view. Three conspicuous colpi radially symmetrical, converging at the poles. Exine foveolate; lumina 0.5–1 μm in diameter; muri baculate or tectate, 0.5–1 μm high. Pores round or equatorially elongated.

Measurements: 36 X 30–34 μm in size.

Width / length ratio: 0.83–0.94.

Holotype: Pl. 30, figs. 9 a–b; size 36 X 30 μm; foveolate; lumina 0.5–1 μm in diameter; muri baculate to tectate, 1 μm high; width / length ratio: 0.83; no. of specimen: Jos 1–15 (GN 5335).

Derivation of name: tenuis (lat.) = thin, weak; exinus from extimus (lat.) = external, here external membrane (exine).

Remarks: The new species resembles Foveotricolporites marginatus González Guzmán, F. voluminosus González Guzmán from the Eocene in the Tibú area, Colombia and F. rhombohedralis Pierce from the Lower Late Cretaceous of Minnesota (U.S.A.), but differs most of all in its thinner exine, besides that the first has no margo colpi and the second is larger in size.

Botanical affinity: Unknown (Dicotyledonopsida).

Foveotricolporites sp.
Pl. 29, figs. 24a–b.

Description: Tricolporate pollen of broad-ellipsoidal or subprolate shape. Three distinct colpi converge in radial symmetry at the poles. Sculpture of exine foveolate; wall two-layered, 2 μm thick; ectexine intrarugulate; endexine smooth to chagrenate; ectexine double as thick as endexine. Pores round and small.

Measurements: 51 X 40 μm in size.

Width / length ratio: 0.78.

Remarks: The single specimen encountered is rather large and for the time being not comparable with other species of the genus.
Botanical affinity: Unknown (Dicotyledonopsida).

Genus *Favitricolporites* Sah 1967.
Type species: *Favitricolporites eminens* Sah 1967.

*Favitricolporites* cf. *retiformis* Sah
Pl. 31, figs. 4 a-b.


*Diagnostic characters:* Tricolporate pollen grain. Figura suboblate or broadly triangular in polar view. Three conspicuous colpi with lalongate ora, enuimarginate, radially symmetrical, converging towards the poles. Exine reticulate; lumina $1 \pm \mu m$ in diameter; murus or tectum $1.5 \mu m$ high; endexine $0.7 \mu m$ thick.

*Measurements:* 25 $X$ 22 $\mu m$ in size.

*Remarks:* The specimen is quite referable to *Favitricolporites retiformis* Sah from the Late Neogene of the Rusizi valley (Burundi).

Botanical affinity: Unknown.


Genus *Tetracolporites* Couper 1953.
Type species: *Tetracolporites oamaruensis* Couper 1953.

*Tetracolporites* cf. *kivuensis* Sah
Pl. 5, fig. 3.

1967 *Tetracolporites kivuensis* Sah, Mus. Roy. l'Afrique Cent., Terv., Belg. Ann., Ser. in 8°, Sci. Geol., no. 57, pp. 97-98, pl. IX, fig. 8-9; Fig. 31.

*Diagnostic characters:* Tetracolporate pollen of quadrangular contour and straight or slightly convex sides in polar sight. Four fairly long colpi with distinctly lalongate ora. Exine two-layered, $4 \mu m$ thick, smooth.

*Measurements:* 68 $X$ 67 $\mu m$ in equatorial diameter.

*Previous record:* Burundi (Africa): Late Neogene.

*Remarks:* The only specimen observed is a large species of the genus *Tetracolporites* Couper 1953 which closely resembles *T. kivuensis* Sah from the Late Neogene of Burundi.

Botanical affinity: Unknown (? Guttiferae).
**Tetracolporites ixeroides** Couper

Pl. 5, figs. 4 a-b.


**Diagnostic characters:** Tetracolporate pollen of quadrangular contour and straight sides in polar sight. Four rather short colpi with rounded (?) ora which only expand half of the apical region. Exine double as thick as endexine.

**Measurements:** 33 X 34 μm in equatorial diameter.

**Previous record:** New Zealand (Early Oligocene to Middle Miocene).

**Remarks:** The specimen is identical with *Tetracolporites ixeroides* Couper, although the holotype from New Zealand (Couper, 1960, pl. 10, fig. 12) has convex and the Jos specimen straight sides.

**Botanical affinity:** Unknown.

*Tetracolporites* sp.

Pl. 21, figs. 12a-b.

**Description:** Tetracolporate pollen grain. Figure spheroidal in oblique view. Four very slender, narrow colpi 35–38 μm long, radially symmetrical and parallel to each other. Exine smooth and thick (4 μm). Ora equatorially elongate, 22–25 μm long X 8–9 μm wide, margin of ora somewhat diffuse.

**Measurements:** 72 X 65 μm in size.

**Width / length ratio:** 0.9.

**Remarks:** This is perhaps the largest specimen of the genus *Tetracolporites* which clearly demonstrates four slender colpi and four equatorially elongated (elongate) ora.

**Botanical affinity:** Unknown.

Genus *Tetracolporopollenites* Pflug & Thomson 1953.

Type species: *Tetracolporopollenites sapooides* Pflug & Thomson 1953.

*Tetracolporopollenites obscurus* Pflug & Thomson

Pl. 31, figs. 10a-b.

1969 *Sapotaceoidaepollenites obscurus* (Pf. & Thoms. 1953) Nagy, MAFI, Evk., 52, Fas. 2, pp. 448–449, pl. L, Fig. 15.


1985 *Sapotaceoidaepollenites obscurus* (Pf. & Th. 1953) Nagy 1969, Geol. Hung., Ser. Palaeont., Fas. 47, p. 192, pl. CIX, Fig. 7–10.


**Diagnostic characters:** Tetracolporate pollen of broad-ellipsoidal or subprolate shape. Four narrow and conspicuous colpi symmetrically converge at the apices. Surface of exine chagrenate; wall two-layered, 2 μm thick; ectexine slightly intrabaculate and endexine smooth; ectexine as thick as endexine. Geminal pores lalongate.

**Measurements:** 26 x 21 μm in size.

Width / length ratio: 0.8.

**Stratigraphic range:** Middle Eocene to Pliocene in Middle Europe and Eocene in Southeast Asia.

Germany: Middle Eocene (Niedersachsen); Middle Eocene to Late Eocene (Messel near Darmstedt); Late Eocene to Early Oligocene (Hessen); Middle Oligocene (Bergisch Gladbach); Miocene (Lower Rhine Valley).

Hungary: Early Eocene (Southern Bakony-Ürkút); Middle Eocene (Northern Bakony-Dudar, Balinka); Miocene (Eger, Főt, Püspökhatvan, Puszakiafalau, Alsóvadász, Zengővárkony, Komló, Litke, Tengelic, Nógrádszakál, Tab, Hidas, Szokolya); Pliocene (Alsóvadász).

Java: Eocene (Yogyakarta).

**Remarks:** The single specimen observed is a small variety of *T. obscurus* Pflug & Thomson. *Sapotaceoidaepollenites* Potonié, Thomson & Thiergart (1950) was incorrectly established for lack of a diagnosis. It became, however, a valid genus after R. Potonié (1960) distinguished type species and gave a clear description of *Sapotaceoidaepollenites*. Nevertheless it is a junior synonym of *Tetracolporopollenites*. *Botanical affinity:* Sapotaceae.

*Tetracolporopollenites laevigatus* Salard-Cheboldaeff n. comb.

Pl. 31, figs. 11–12.

Diagnosis: Tetracolporate pollen grain. Figura spheroidal in equatorial view. Four narrow and conspicuous colpi, with equatorially elongated ora. Exine two-layered, laevigate or chagrenate, 1.5 μm thick; ectexine double as thick as endexine.

Measurements: 29—33 μm in length.
27.5—29 μm in width.
Width / length ratio: 0.878—0.95.

Previous record: Cameroons: Early Miocene (Kwa-Kwa).

Remarks: The specimens in question are alike Psilastephanocolporites laevigatus Salard-Cheboldaeff from the Early Miocene of the Cameroons. However, there is no doubt that the species is furnished with four distinct furrows and pores and thus has to be combined with the genus Tetracolporopollenites Pflug & Thomson 1953.

Botanical affinity: Sapotaceae or Meliaceae.

Tetracolporopollenites kirchheimeri (Reissinger) Pflug & Thomson
Pl. 31, figs. 13—14.

1950 Pollenites kirchheimeri Reissinger, Palaeontographica, B. 90, S. 119, Taf. 18, Fig. 62.
1953 Tetracolporopollenites kirchheimeri (Reissinger) Pflug & Thomson, Thomson & Pflug, Palaeontographica, B. 94, S. 109—110, Taf. 15, Fig. 13—21.
1969 Sapotaceoidae pollenites kirchheimeri (Th. & Pf. 1953) Nagy, MAFI, Evk., 52, Fas. 2, p. 450, pl. 50, Fig. 20
1985 Sapotaceoidae pollenites kirchheimeri (Reiss. 1950) Nagy, Geol. Hung., Ser. Palaeont., Fas. 47, p. 191, pl. CVIII, Fig. 27.

Diagnostic characters: Tetracolporate pollen of broad-ellipsoidal or subprolate shape. Four narrow and conspicuous colpi with equatorially elongate ora are arranged in radial symmetry parallel to each other. Exine two-layered, chagrenate, 1—1.5 μm thick; ectexine as thick as endexine.

Measurements: 33—35 μm in length.
28—30 μm in width.
Width / length ratio: 0.85—0.86.

Stratigraphic range: Paleocene to Miocene in Middle Europe.

Germany: Paleocene-Early Eocene (Helmstedt); Late Eocene-Early Oligocene (Borken); Late Oligocene-Early Miocene (Eschweiler); Middle Oligocene-Early Miocene (Ville).

Hungary: Middle Eocene (Northern Bakony—Balinka; southern Bakony—Halimba); Late Eocene (Northern Bakony—Balinka); Miocene (Zengővarkony, Várpalota, Szokola, Zilváváred, Nógrádszakál).
Remarks: The spheroidal specimens match very well in all diagnostic features with *T. kirchheimeri* (Reissinger) Pf. & Th.

Botanical affinity: Sapotaceae.

*Tetracolporopollenites cf. sapoides* Pflug & Thomson

Pl. 31, fig. 15.

1953 *Tetracolporopollenites sapoides* Pf. & Th., Thomson & Pflug, Palaeontographica, B, 94, S. 110, Taf. 15, Fig. 6–12.


Diagnostic characters: Tetracolporate pollen grains. Figura broad-ellipsoidal or subprolate in equatorial view. Four distinct colpi in radial symmetrical position and parallel to each other, converging at the apices. Exine two-layered, more or less intrarugulate, 1 µm thick, ectexine as thick as endexine. Germinal pores round or slightly lalongate.

Measurements: 35 X 30 µm in size.

Width / length ratio: 0.857.

Stratigraphic range: Early Eocene to Miocene in Middle Europe.

Germany: Middle Eocene (Helmstedt); Late Eocene-Early Oligocene (Borken); Miocene (Ville).

Hungary: Early Eocene (Northern Bakony—Zirc; southern Bakony—Úrkút); Middle Eocene (Northern Bakony—Dudar, Balinka; Mór Graben—Mór; Vertes—Czákbereny); Miocene (Eger, Zengővárkony, Nógrádszakál, Várpalota, Szokolya, Cserhátszentiván).

Remarks: A single specimen was observed.

Botanical affinity: Sapotaceae.

*Tetracolporopollenites africanus* Sah n. comb.

Pl. 31, figs. 16–18.


Diagnostic characters: Tetracolporate pollen grains. Figura subprolate in equatorial view. Four rather long and narrow colpi with rounded ora, conspicuous, in sym-
metrical and parallel arrangement. Exine two-layered, laevigate or chagrenate, 1 – 1.5 μm thick; ectexine as thick as endexine. Germinal pores round or slightly lalongated.

**Measurements:**
- 30–33 μm in length.
- 23–25 μm in width.
- Width / length ratio: 0.75–0.8.

*Previous record:* Burundi (Africa): Late Neogene (Rusizi valley).

*Remarks:* The specimens refer to *Sapotaceoidae pollenites africanus* Sah and have to be combined with the genus *Tetracolporopollenites* Pflug & Thomson 1953.

*Botanical affinity:* Sapotaceae.


**Type species:** *Polybrevicolporites cephalus* Venkatachala & Kar 1969.

*Polybrevicolporites* sp.

Pl. 5, figs. 6 a–c.

*Description:* Polycolporate pollen grain. Figura subcircular in oblique view. Five relatively short colpi converging at the apices. Pores well developed, large, round, 3.5 μm in diameter. Exine 4.5 μm thick, chagrenate.

*Measurements:* 35.5 μm in diameter.

*Remarks:* Only one specimen was observed.

*Botanical affinity:* Unknown.


**Type species:** *Polygalacidites clarus* Sah & Dutta 1966.

*Polygalacidites* sp.

Pl. 5, figs. 5 a–b.


*Measurements:* 31 X 34 μm in diameter.

*Remarks:* The single specimen encountered contrasts with *Polygalacidites clarus* Sah & Dutta (1966) from Assam and *P. speciosus* Takahashi (1982) from Java in both the number of colpi and the synora.

*Botanical affinity:* Polygalaceae, *Polygala.*
Grarinidites cf. subtiliglobosus (Trevisan) Krutzsch
Pl. 15, fig. 1.

1967 Monoporopollenites subtiliglobosus Trevisan, Palaeontographica Litalica, 62 (N. S. 32), p. 49, 63, pl. XXXIII, figs. 6 a–f.


Diagnostic characters: Monoporate pollen of globular or oval shape, disregarding secondary folds. Exine intrabaculate, 0.5 \( \mu \text{m} \) thick; sculpture finely punctate. Pore round, 2.5 \( \mu \text{m} \) in diameter, with 1.5 \( \mu \text{m} \) wide annulus.

Measurements: 34 X 35 \( \mu \text{m} \) in diameter.

Stratigraphic range: Late Oligocene to Plio-Pleistocene in Middle Europe.

Germany: Late Oligocene (Oberbayerische Faltenmolasse; St. Augustin); Middle Miocene (Klettwitz); Miocene-Pliocene (Rhine land); Pliocene (Elbe; Wetterau); Plio-Pleistocene (Buchenau).

Italy: Late Miocene (Gabbro / Toscana).

Poland: Late Miocene (Rypin).

South Bohemia: Pliocene.

Remarks: The single specimen, which was encountered, has a rather narrow annulus around the pore.

Botanical affinity: Gramineae.

Grarinidites cf. neogenicus Krutzsch
Pl. 15, fig. 5.


Diagnostic characters: Monoporate pollen grain. Figura oval with a pore (1.5 \( \mu \text{m} \) in diameter) which is framed by a 2.5 \( \mu \text{m} \) wide annulus. Exine chagrenate, 0.5 \( \mu \text{m} \) thick, deformed by secondary folds.

Measurements: 27 X 20 \( \mu \text{m} \) in diameter.
Stratigraphic range: Miocene to Pliocene in Middle Europe.

Germany: Early Miocene (Wolkenberg); Miocene-Pliocene (Klettwitz, NW-Sachsen); Pliocene (Rüterberg / Elbe).

Remarks: The specimen differs slightly in thickness and sculpture of the wall from the holotype, which was described from the Pliocene of Rüterberg / Elbe (Germany).

Botanical affinity: Gramineae.

**Graminidites gracilis** Krutzsch

Pl. 15, fig. 10.

1970 *Graminidites gracilis* Krutzsch, Atlas, Lfg. VII, S. 58, Taf. 4, Fig. 12–20.

Diagnostic characters: Monoporate pollen grain. Figura spheroidal with a germinal porus (= os) of 1.5 μm in diameter which is framed by an annulus of 2 – 2.2 μm width. Exine finely punctate, 0.5 μm thick but deformed by secondary folds.

Measurements: 16 X 16 μm in diameter.

Stratigraphic range: Miocene to Plio-Pleistocene in Middle Europe.

Germany: Miocene (Fürstenwald, Göllnitz, Ville); Late Miocene (Konin); Plio-Pleistocene (Kaltensundheim/Rhön).

Remarks: Only one specimen was found.

Botanical affinity: Gramineae.

**Graminidites minor** n. sp.

Pl. 15, figs. 2 – 4, 6 – 9, 11–12.

Diagnosis: Monoporate pollen grains. Figura spheroidal to oval. Exine two-layered, chagrenate to finely punctate, 0.5 – 1 μm thick. Pore small, circular, 2 – 3.5 μm in diameter, without annulus.


Holotype: Pl. 15, fig. 3; size 25 X 24 μm in diameter; exine chagrenate, 1 μm thick; pore circular, 3 μm in diameter; no. of specimen: Jos 1 – 3 (GN 5323).

Name derivation: minor (lat.) = lesser in size.

Remarks: These specimens are rather small and unlike most other species without an annulus around the pore.

Botanical affinity: Gramineae.

*Graminidites sp. a*
Description: Monoporate pollen grain. Figura oval. Exine laevigate, 0.5 \( \mu m \) thick. Pore small, 2.3 \( \mu m \) in diameter, without annulus.

Measurements: 12 X 9 \( \mu m \) in diameter.

Remarks: The only specimen observed is unusually small and has a pore without annulus.

Botanical affinity: Gramineae.

**Graminidites** sp. b
(no figure)

Description: Monoporate pollen grain. Figura spheroidal. Exine chagrenate, thin. Pore circular, 4 \( \mu m \) in diameter; a feeble annulus is developed.

Measurements: 25 X 21 \( \mu m \) in diameter.

Remarks: The only specimen observed differs from *G. laevigatus* and *G. oligocaenus* in both a larger pore and a narrower annulus.

Botanical affinity: Gramineae.


Type species: *Echigraminidites moravicus* Krutzsch 1970.

**Echigraminidites** sp.

Pl. 20, figs. 6 a–b.

Description: Monoporate pollen of oval shape. Exine thin with a loose echinate sculpture; spines: 3 –3.5 \( \mu m \) long and 2.5 \( \mu m \) wide. Pore small, 3 \( \mu m \) in diameter, with conspicuous annulus.

Measurements: 25 X 21 \( \mu m \) in diameter.

Remarks: The only specimen observed is similar to *Echigraminidites moravicus* Kr. from the Early Pliocene of Hodonin, CSSR, but differs in its larger spines.

Botanical affinity: Unknown.


Type species: *Psilodiporites hammenii* Varma & Rawat 1963.

**Psilodiporites rotundus** n. sp.

Pl. 15, figs. 14–15.
**Diagnosis:** Diporate pollen of circular to subcircular contour. Exine two-layered, 0.5 – 1 μm thick; ectexine somewhat intrarugulate; endexine chagrenate; ectexine as thick as endexine. Two pores 2 – 3 μm diameter, with an annulus of 1 – 1.5 μm width.

**Measurements:** 22 – 23 μm X 21 – 22 μm in diameter.

**Holotype:** Pl. 15, figs. 14a–b; size 23 X 21 μm in diameter; exine 1 μm thick; ectexine slightly intrarugulate; endexine chagrenate; ectexine as thick as endexine; pores of 2 – 2.5 μm in diameter with an annulus of 1.2 – 1.5 μm width; no. of specimen: Jos 1 – 1 (GN 5321).

**Derivation of name:** rotundus (lat.) = round.

**Remarks:** When Varma & Rawat (1963) instituted the genus *Psilodiporites* they attributed six new species to it. All of these are barrel-shaped diporate pollen grains which do not match the new species from Jos / Nigeria. *Diatriopollis consimilis* Weyland & Takahashi (1961), although apparently similar, is a diporate pollen and furnished with an atrium.

**Botanical affinity:** ? Moraceae.

*Psilodiporites minimus* v. d. Hammen & Wymstra

Pl. 15, figs. 17–22.


**Diagnostic characters:** Diporate pollen with a circular to subcircular contour. Exine thin (0.5 μm) and psilate. The two pores are small, (1 – 3 μm in diameter) and without annulus or atrium.

**Measurements:** 12 – 16 μm in length.

11 – 15 μm in width.

**Previous record:** Early Miocene of Georgetown, Brit. Guiana (South America).

**Remarks:** The Jos specimens are rather small but definitely referable to *P. minimus*. **Botanical affinity:** ? Moraceae.

*Psilodiporites* sp.

Pl. 15, figs. 16a–b.

**Description:** Diporate pollen with a subcircular contour. Exine thin, 0.5 μm thick, psilate and deformed by secondary folds. The two pores are large (3 μm in diameter) and furnished with strong annuli (2.5 – 3 μm wide).
Measurements: 24 µm in diameter.
Remarks: The only specimen found could not be related to a known species.
Botanical affinity: Unknown.

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

Triatriopollenites josensis n. sp.
Pl. 15, figs. 23–32.

Diagnosis: Triporate pollen with circular to subcircular equatorial contour. Exine relatively thick (1.5 – 2 µm midway between ora; 3 – 3.5 µm thick around the ora) with tumescence and atrium but neither labrum nor vestibulum; sculpture of exine intrabaculate or intrarugulate; endexine smooth; ectexine double as thick as endexine. Three moderately large pores, 1.5 – 3 µm wide, 3 – 5 µm deep.
Holotype: Pl. 15, fig. 28; 30 X 30 µm in equatorial diameter; exine 2 µm thick; ectexine intrabaculate; endexine smooth; surface of exine punctate, coarsely punctate around central area; no. of specimen: Jos 1 – 15 (GN 5335).
Derivation of name: After the Jos Plateau.
Remarks: The new species differs from all previously described ones.
Botanical affinity: Unknown.

Triatriopollenites sp.
Pl. 16, fig. 8.

Description: Triporate pollen grain. Figura subcircular in outline. Exine chagrenate, 1.2 µm thick midway between the pores and 3 µm thick around the pores; annulus and atrium indistinct.
Measurements: 26 µm in equatorial diameter.
Remarks: Only one specimen was found.
Botanical affinity: Unknown.

Genus Triporopollenites Pflug & Thomson 1953.
Type species: Triporopollenites coryloides Pflug 1953.

Triporopollenites subrotundus n. sp.
Pl. 17, figs. 2 – 10.
Diagnosis: Triporate pollen with circular to subcircular contour. Exine thin, 0.5 – 1 μm thick, chagrenate to finely punctate or weakly intrabaculate to intrarugulate; without labrum, atrium, and annulus. Three pores small, circular, 1.5 – 2 μm in diameter; one pore may be located subequatorially.

Measurements: 17 – 21 μm X 15 – 18 μm in equatorial diameter.

Holotype: Pl. 17, fig. 3; 17 X 16 μm in equatorial diameter; exine weakly intrarugulate, 1 μm thick; without labrum, atrium, and annulus; one pore subequatorial; no. of specimen: Jos 1 – 8 (GN 5328).

Name derivation: sub (lat. prefix) = somewhat, slightly; rotundus (lat.) = rounded.

Remarks: The new species has similarities with Triporopollenites megagranifer (R. Pot.) Pflug & Thomson, T. coryloides Pflug, and T. labraferus (R. Pot.) Pflug & Thomson from the Tertiary of Middle Europe. However, it differs from the first in the smaller size and thinner exine, from the second besides the smaller size in its circular to subcircular outline and from the third in both the structure and the sculpture of the exine.

Botanical affinity: Moraceae.

Triporopollenites parvus Sah

Pl. 16, fig. 5.


Diagnostic characters: Triporate pollen of round-triangular shape as manifested by distinctly convex sides. Exine chagrenate, 1 μm thick. Apertures poroid, surrounded by a thickened exine (annulus); one pore subequatorial.

Measurements: 28 μm in equatorial diameter.

Previous record: Late Neogene in Burundi (Africa).

Remarks: The species can be separated from Triporopollenites megagranifer (R. Pot.) Pflug & Thomson and Triporopollenites coryloides Pflug, both from the Tertiary of Middle Europe by its comparatively thin exine and the always present annulus.

Botanical affinity: Betulaceae.


Type species: Triorites magnificus Cookson 1950.

Triorites scabratus n. sp.
Diagnosis: Triporate pollen with a triangular to subcircular contour due to convex sides and rounded corners. Exine two-layered, 0.7-1.2 \( \mu m \) thick, chagrenate to weakly intrabaculate, commonly crumpled during fossilization. Apertures poroid, situated at the equatorial corners, 5 - 8 \( \mu m \) in diameter.

Measurements: 28-29 \( \mu m \) X 26-27 \( \mu m \) in equatorial diameter.

Holotype: Pl. 16, fig. 3; 29 X 27 \( \mu m \) in equatorial diameter; exine chagrenate, 1.2 \( \mu m \) thick; pore large, circular, 5 - 5.2 \( \mu m \) in diameter; no. of specimen: Jos 1 - 10 (GN 5330).

Derivation of name: scabrosus (lat.) = rough.

Remarks: The new species is almost alike *Triporopollenites chnosus* Partridge (Stover & Partidge, 1973, p. 269, pl. 21, figs. 6 a-b) from the Late Eocene to Miocene (Lower *Nothofagidites asperus* zone-*Triporopollenites bellus* zone) of Victoria, Australia, but differs in its smaller size.

Botanical affinity: Unknown.

Genus *Cricotriporites* Leidelmeyer 1966.

Type species: *Cricotriporites guianensis* Leidelmeyer 1966.

*Cricotriporites anulatus* n. sp.

Pl. 16, figs. 6 - 7.

Diagnosis: Triporate pollen of circular to subcircular contour. Exine two-layered, chagrenate, 1 - 1.2 \( \mu m \) thick. Pores oval and furnished with both an annulus and costae pori; size of pore 2.5 - 3 \( \mu m \) in diameter; thickness of annulus 2 - 3 \( \mu m \).

Measurements: 25-26 \( \mu m \) in equatorial diameter.

Holotype: Pl. 16, figs. 6 a-b; size 26 X 26 \( \mu m \) in equatorial diameter; exine chagrenate, 1 \( \mu m \) thick; pores 2.5 \( \mu m \) in diameter, annulus 3 \( \mu m \) wide; no. of specimen: Jos 1 - 12 (GN 5332).

Derivation of name: anulatus (lat.) = provided with a ring.

Remarks: The new species is quite similar to *Cricotriporites guianensis* Leidelmeyer from the Early Eocene of British Guyana except its somewhat larger size and more prominent annulus.

Botanical affinity: Unknown.

*Cricotriporites nigerianus* n. sp.

Pl. 16, figs. 10-16; pl. 38, figs. 1 - 2.
Diagnosis: Triporate pollen garins. Figura circular to subcircular in outline. Exine two-layered, weakly intrarugulate, 0.5–1.5 μm thick; sculpture of exine chagrenate or very finely punctate. Pores oval, 2–5 μm in diameter and provided with both a weak annulus and costae pori, annulus 4–6 μm in diameter; one pore is placed subequatorially.

Measurements: 19–28 μm X 19–21 μm in diameter.

Holotype: Pl. 16, fig. 11; 23 X 21 μm in diameter; exine 0.5 μm thick, weakly intrarugulate; surface of exine very finely punctate; annulus indistinct; pores 4–5 μm in diameter; annulus 5–6 μm in diameter; no. of specimen: Jos 1–4 (GN 5324).

Name derivation: After the Federal Republic of Nigeria.

Remarks: The new species is somewhat alike Cricotriporites guianensis Leidelmeyer from the Lower Eocene of British Guyana, although it has larger pores with less prominent annuli.

Botanical affinity: Unknown.

Genus Trivestibulopollenites Pflug 1953.
Type species: Trivestibulopollenites butuloides Pflug 1953.

Trivestibulopollenites sp.
Pl. 16, figs. 9 a-b.

Description: Triporate pollen with a circular outline. Exine punctate, 1.2 μm thick; tectatum 0.5 μm thick; vestibulum developed but neither labrum nor annulus present. Pores large and equatorially placed 3–4 μm in diameter.

Measurements: 28 X 27.5 μm in equatorial diameter.

Remarks: The only specimen observed could not be identified specifically.

Botanical affinity: Unknown.

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

Subtriporopollenites rotundiporifer n. sp.
Pl. 16, figs. 1–2.

Diagnosis: Triporate pollen of circular to oval outline. All pores except possibly one are placed subequatorially, rather large, 4–7 μm in diameter. Exine two-layered, 1.5–2 μm thick, finely punctate to rugulate; ectexine intrabaculate; endexine
smooth; ectexine as thick as endexine.

**Measurements:** 38 µm X 32–34 µm in diameter.

**Holotype:** Pl. 16, fig. 2; 38 X 34 µm in diameter; exine finely rugulate; ectexine intrabaculate; endexine smooth; ectexine as thick as endexine; pores 4 µm in diameter; no. of specimen: Jos 1 – 3 (GN 5323).

**Derivation of name:** rotundus (lat.) = round, porifer from porus + ferre (lat.) = having pores.

**Remarks:** The new species resembles Subtriporopollenites intraconstans Pflug and S. villosus Pflug from the Palaeogene of Germany, however, differences do exist in the sizes as well as in the structures and sculptures of the exines.

**Botanical affinity:** ? Juglandaceae.

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**Genus Subtriporopollis** Sah 1967.

**Type species:** *Subtriporopollis tenuis* Sah 1967.

*Subtriporopollis reticulatus* n. sp.

Pl. 16, figs. 17–18.

**Diagnosis:** Triporate pollen of circular outline. Pores relatively large, round, 3 – 6 µm in diameter, equatorially placed; annulus present. Sculpture of exine reticulate; lumina of reticulum 1 – 3 µm in diameter; tectum or muri 1 µm high; endexine smooth, 0.5 – 1 µm thick.

**Measurements:** 29–32 µm X 29–30 µm in equatorial diameter.

**Holotype:** Pl. 16, figs. 18a-b; 32 X 30 µm in equatorial diameter; ectexine reticulate; lumina 1 – 2 µm in diameter; muri baculate, 1 µm long; endexine smooth, 0.5 µm thick; no. of specimen: Jos 1 – 8 (GN 5328).

**Derivation of name:** reticulatus (lat.) = like a net or network.

**Remarks:** The new species somewhat resembles both *Subtriporopollis tenuis* Sah (1967, pp. 119–120, pl. X, fig. 16) and *S. rotundus* Sah (1967, p. 120, pl. X, figs. 17–10) from the Late Neogene of the Rusizi valley, Burundi, however, the sizes of the pollen and their pores are not alike. *Tiliaepollenites tropicus* Takahashi (1982, pp. 322–323, pl. 53, figs. 23–24) from the Eocene of Yogyakarta, Java is also smaller than *Subtrioropollis reticulatus* n. sp.

**Botanical affinity:** Unknown.

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**Genus Anacolosidites** Cookson & Pike 1954.

**Typoe species:** *Anacolosidites luteoides* Cookson & Pike 1954.
Anacolosidites sp.
Pl. 17, fig. 20.

Description: Hexaporate pollen with a rounded triangular equatorial contour and concave sides. Three pores are placed in pairs at the corners of each face; pores circular, $2 - 2.2 \mu m$ in diameter. Exine thin, $0.5 \mu m$ thick, psilate.

Measurements: $16 \mu m$ in equatorial diameter.

Remarks: The Jos specimen resembles both Anacolosidites luteoides Cookson & Pike (1954, p. 207, pl. 1, figs. 47–50) from the Eocene of Birregurra, Victoria, Australia and Anacolosidites sp. (Muller, 1968, p. 18, pl. 4, fig. 8) from the Paleocene Plateau Sandstone Formation in Sarawak, Malaysia, but differs from the first in its smaller size and thinner exine and from the second in its larger pores and psilate exine.

Botanical affinity: Oleaceae, Anacolosa, Cathedra, and Ptychopetalum.

Type species: Retitriporites curvimurati Ramanujam 1966.

Retitriporites sp.
Pl. 17, figs. 21–22.

Description: Triporate pollen grains. Contour triangular with convex sides and rounded corners. Exine $2.5 \mu m$ thick, reticulate; walls of reticulum in polygonal arrangement; lumina $1 - 4 \mu m$ in diameter; muri clavate or tectate, $1.5 - 2 \mu m$ long. Pores circular, $4.5 \mu m$ in diameter.

Measurements: $35 - 39 \mu m$ in diameter.

Remarks: Two specimens were only observed.

Botanical affinity: Unknown.

Type species: Echitriporites trianguliformis Van Hoeken-Klinkenberg 1964.

Echitriporites sp.
Pl. 20, figs. 1 a-b.

Description: Triporate pollen grain. Figura circular in outline. Exine $1 \mu m$ thick; sculpture punctate as well as echinate; spines $2.5 \mu m$ long. Three circular pores (ca. $2 \mu m$ in diameter) with annulus.
Measurements: 22 X 18 µm in diameter.
Remarks: Only one specimen was encountered. Van der Hammen (1956) proposed as a subgenotype Triporites (Echitriporites) argutus Van der Hammen which is the pollen of recent Campanula rotundifolia L. (Campanulaceae), thereafter, however, van Hoeken-Klinkenberg (1964) defined validly a new taxon of generic rank with the type species, Echitriporites trianguliformis van Hoeken-Klinkenberg from the Late Cretaceous of Nigeria.
Botanical affinity: Icacinaceae, Iodes.

Genus Tetraporopollenites Frantz 1960.
Type species: Tetraporopollenites lohsensis Frantz 1960.

Tetraporopollenites sp.
Pl. 17, figs. 19a-b.

Description: Tetraporate pollen of rectangular contour with straight or slightly convex sides. Exine thin, 1 µm thick, chagrenate, crumbled during fossilization. Four pores are placed somewhat depressed at the corners of the pollen.
Measurements: 18 X 15 µm in diameter.
Remarks: A single specimen was observed.
Botanical affinity: Unknown.

Genus Ulmipollenites Wolff 1934.
Type species: Ulmipollenites undulosus Wolff 1934.

Ulmipollenites semiundulosus n. sp.
Pl. 17, figs. 11-16.

Diagnosis: Polyporate (4 – 5) pollen of polygonal contour with rounded corners and convex sides. Exine finely rugulate to undulate or somewhat chagrenate, 1 – 1.5 µm thick. Four to five round pores are placed at the corners, one pore perhaps subequatorial. There are no labra, atria or annuli.
Measurements: 22 – 27 µm in equatorial diameter.
Holotype: Pl. 17, fig. 16; 25.5 µm in equatorial diameter; exine finely rugulate, 1.5 µm thick; four pores, one of them subequatorially placed. No. of specimen: Jos 1 – 3 (GN 5323).
Derivation of name: semi (lat.) = half; undulosus (lat.) = having a wavy form.

Remarks: The new specimens with their faint undulated sculpture are quite similar to Ultrapollenites undulosus Wolff from the Pliocene of Dettingen a. M., although their exine is even more delicately sculptured.
Botanical affinity: Ulmaceae, Ulmus.

Type species: Carpinuspollis carpinoides (Pflug 1953) Takahashi 1979.

Carpinuspollis sp.
Pl. 17, figs. 17–18.

Description: Pentaporate pollen with rounded-polygonal contour and straight or convex sides. Exine two-layered, chagrenate, 1–1.5 μm thick. Five circular pores, without labra, atria or annuli; one or two pores may be located subequatorially.
Measurements: 24–29 μm in equatorial diameter.
Remarks: The genus Carpinipites was established by Srivastava (1966) on the type species Carpinipites ancipites (Wodehouse) Srivastava. This genus is defined as a triporate or tetrporate pollen comparable to those of Carpinus. Afterwards, the genus Carpinuspollis was introduced by Takahashi (1979) on type species Carpinuspollis carpinoides (Pflug) Takahashi, notwithstanding, Nagy (1985) indicated Carpinus pollen with three to six pores from the Hungarian Neogene as Carpinipites carpinoides (Pflug, 1953) n. c.
Botanical affinity: Betulaceae.


? Multiporopollenites sp.
Pl. 17, figs. 23a-b.

Description: Polyperiporate pollen of rounded rectangular outline. Exine three-layered, finely rugulate, 1.8 μm thick; ectexine intrarugulate; endexine smooth; ectexine as thick as endexine. Seven pores rather randomly situated, 4.5–5.5 μm in diameter; annuli weakly developed, 1–1.5 μm wide; without labrum and atrium.
Measurements: 34 X 32 μm in diameter.
Remarks: Only one specimen was found.

Botanical affinity: Unknown.

Genus Malpighiaceoidites n. gen.
Type species: Malpighiaceoidites periporifer n. gen. et sp.

Diagnosis: Periporate pollen of spheroidal shape; circular to tetragonal or quinquangular in outline. Exine four-layered (?), 2–3.5 μm thick, surface of exine chagrenate or finely rugulate; with thin and narrow streaks or pseudocolpi. Five to nine pores with very weak annuli variably distributed, 1.5–3 μm in diameter.

Size: 27–30 μm in diameter.

Derivation of generic name: After a family of tropical plants (Malpighiaceae) which got its name from the Italian physiologist and anatomist Marcello Malpighi (1694).

Remarks: The present specimens are very closely similar to the pollen of recent Malpighiaceae, especially the genus Tristellateia.

Malpighiaceoidites periporifer n. sp.

Pl. 20, figs. 7–14.

Diagnostic description: Periporate (or pantoporate) pollen of circular to subcircular outline. Exine four-layered (?), 2–3.5 μm thick, chagrenate to finely rugulate, with some narrow lineal streaks or pseudocolpi. Five to nine germinal pores variably distributed, 1.5–3 μm in diameter and with very weak annuli (1–1.5 μm wide).

Measurements: 27–30 μm X 25.5–30 μm in diameter.

Holotype: Pl. 20, figs. 11a-b; 26 X 28 μm in diameter; exine chagrenate, 3 μm thick; five to six (?) pores 2–3 μm in diameter; with lineal streaks or pseudocolpi. No. of specimen: Jos 1–9 (GN 5329).

Derivation of name: peri (gr.) = around; porifer (lat.) = porus and ferre = having pores.

Remarks: Many figures of Malpighiaceae pollen (et Perisyncolporites) which came from the Tertiary of Senegal were published by Medus (1975). These pollen are very similar to the present Jos specimens.

Botanical affinity: Malpighiaceae.

Type species: Calystegiapollis thuringiacus Krutzsch 1966.

Calystegiapollis sp.
Pl. 19, figs. 4 a-b.

**Description:** Periporate pollen of circular outline. Exine 2 \( \mu m \) thick, thinning out towards the apices and sculptured by closely spaced radial baculi; these appendages are thicker developed outward the center where they fuse into a tectum; surface of exine minutely punctate. Twelve pores which are placed in wide elongated or linear depressions (=demicolpi), 11–17 \( \mu m \) long and 4 – 7 \( \mu m \) wide.

**Measurements:** 45 X 45 \( \mu m \) in diameter.

**Remarks:** The only specimen observed differs from *Calystegiapollis thuringiacus* Krutzsch in the size as well as the thickness of the tectum.

**Botanical affinity:** Conovulaceae, *Calystegia, Evolvulus, Hewittia* etc.

**Genus Sindorapollis** Krutzsch 1969.


*Sindorapollis* sp.

Pl. 19, fig. 5.

**Description:** Diplodemicolpate-paraporate pollen of pentagonal outline in oblique view. Three pairs of pore-bearing demicolpi, rather long and narrow (17–20 \( \mu m \) long x 2 \( \mu m \) wide). Sculpture of exine minutely punctate; wall baculate to densely clavate; sculptural elements are 2 \( \mu m \) long.

**Measurements:** 42 X 37 \( \mu m \) in diameter.

**Remarks:** The single specimen is comparable with *Sindorapollis psilatus* (Mtchedl.) Krutzsch from the Senonian of the Western Siberian Lowlands, USSR and *Sindorapollis nataliae* Salard-Cheboldaeff n. comb. from the Oligocene to Early Miocene of the Cameroons. *S. psilatus* possesses three pairs of pores at the equatorial ends of the demicolpi and *S. nataliae* is covered by a reticulate sculpture.

**Botanical affinity:** Caesalpiniaceae, *Sindora*.

**Genus Graniperipollis** Krutzsch 1966.

Type species: *Graniperipollis bohemicus* Krutzsch 1966.

*Graniperipollis* sp.

Pl. 21, figs. 2 a-b.

**Description:** Periporate pollen of circular outline. Surface of exine sculptured by small, densely-arranged granula; wall two-layered, 1.7 \( \mu m \) thick; ectexine intrabaculate-
like, 1 μm thick. Pores round or polygonal, 3 – 7 μm in diameter.  
**Measurements:** 25 X 25 μm in diameter.  
**Remarks:** The single specimen differs from *Graniperipollis bohemicus* Krutzsch of the Late Santonian of South Bohemia in its larger size as well as the variable shapes and dimensions of its pori.  
**Botanical affinity:** ? Buxaceae.


*Chenopodipollis dispersus* n. sp.  
Pl. 21, figs. 3 – 8.

**Diagnosis:** Periporate (panporate) pollen of circular to subcircular contour. Exine two-layered, 0.5 – 2 μm thick, psilate. Pores round, 2 – 3 μm in diameter; the number of pores is quite variable, 18 – 40 (?).  
**Measurements:** 16 – 23 μm X 15 – 21 μm in diameter.  
**Holotype:** Pl. 21, figs. 5 a-b; 17.5 X 17 μm in diameter; exine 1 μm thick, psilate; pores circular, 2.5 μm in diameter; number of pores ca. 22; no. of specimen: Jos 1 – 3 (GN 5323).  
**Name derivation:** dispersus (lat.) = scattered.  
**Remarks:** The new species resembles *Chenopodipollis* (al. *Polyporina*) *fragilis* (Harris) Krutzsch from the Middle Paleocene of Dilwy Bay, Victoria, Australia, but differs in its smaller size, the smaller pores and the thinner exine.  
**Botanical affinity:** Chenopodiaceae.

Genus *Perisicarioipollis* Krutzsch 1962.  
Type species: *Perisicarioipollis meuseli* Krutzsch 1962.

*Perisicarioipollis* sp.  
Pl. 21, figs. 9 a-c.

**Description:** Periporate (multiporate) pollen with triangular outline. Sculpture consists of a distinct reticulum; this is composed of baculi-structured valli; lumina of reticulum 2.5 – 6 μm in diameter; muri baculate to clavate, 2 μm high. Pores small, circular, 1.5 – 2 μm in diameter. Layer of inner wall distinctly smooth.  
**Measurements:** 42 μm in diameter.  
**Remarks:** Only one specimen was found.  
**Botanical affinity:** Polygonaceae, *Polygonum*.
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Subuturma Tetradites Cookson 1947.
Type species: Tetradomonoporites typhoides Krutzsch 1970.

Tetradomonoporites typhinus n. sp.
Pl. 11, fig. 7; pl. 12, figs. 1 – 3;
pl. 36, fig. 6.

**Diagnosis:** Tetradomonoporate pollen of vesicular outline. Each bladder-like pollen grain is furnished with one pore. Location of germinal pores near to the sutures of the vesicles, ca. 2.5 μm in diameter, rather indistinct. Surface of exine reticate, with OL pattern, finely punctate within the lumina; exine two-layered, 1.5–2.5 μm thick; ectexine tectate, 1–1.5 μm thick; endexine intrabaculate, 0.5–1 μm thick. **Measurements:** Tetrads: 34–45 μm in diameter. Individual vesicles: 19–25 μm in diameter. **Holotype:** Pl. 12, fig. 1; tetrad 40 X 33 μm in diameter; vesicles 19–23 μm in diameter; exine 2 μm thick; tectum 1.2 μm thick; surface of exine reticate, with OL pattern, finely punctate within lumina; endexine intrabaculate; one pores on each of the vesicles; no. of specimen: Jos 1 – 6 (GN 5326). **Name derivation:** typhinus (gr.) = after the genus Typha. **Remarks:** The new species is somewhat similar to Tetradomonoporites typhoides Krutzsch from the Late Pliocene of Germany, but differs in its thicker wall, dissimilar sculpture, and other pore position. **Botanical affinity:** Typhaceae, Typha.

Subturma Polyadites Pant 1954.
Genus Polyadopollenites Pflug & Thomson 1953.
Type species: Polyadopollenites multipartitus Pflug 1953.

Polyadopollenites sculptus n. sp.
Pl. 10, figs. 1 – 4; pl. 11, figs. 1 – 3;
pl. 36, figs. 4 – 5; pl. 37, figs. 1 – 3.

**Diagnosis:** Polyad pollen grains. Figura circular to subcircular or oval in outline. Eight to fourteen vesicles form a polyad pollen grain. Surface of exine reticate (OL pattern), finely punctate within the lumina; wall two-layered, 1.2–3 μm thick; ectexine either tectate or columellate to psilate with verrucate processes, 1–2 μm thick; endexine somewhat intrabaculate or smooth, 0.5–1 μm thick. No germinal
porus visible.

**Measurements:** Polyads: 46–57 μm X 40–53 μm in diameter.

Individual vesicles: 20–27 μm X 15–22 μm in diameter.

**Holotype:** Pl. 10, figs. 4 a-b; 49 X 47 μm in diameter; composed of twelve vesicles pollen grains; individual grains 20–26 μm X 15–19 μm in diameter; exine 2 μm thick; ectexine tectate or psilate with verrucate processes; endexine somewhat intrabaculate to smooth; surface of exine reticulate (OL pattern), finely punctate within the lumina of the reticulum; no. of specimen: Jos 1–3 (GN 5323).

**Name derivation:** *sculptus* (lat.) = carved.

**Remarks:** *Polyadopollenites sculptus* n. sp. is comparable with the following species:
1) *Polyadopollenites multipartitus* Pflug (1953, p. 112, Taf. 15, Fig. 65–66), polyads: 50–80 μm in diameter; individual grains: 12–25 μm in diameter, 12–26 vesicles; Late Eocene-Early Oligocene, Borken, Germany.

2) *Acacia myriosporites* Cookson (1954, p. 55, pl. 1, figs. 1, 5–8), polyads: circular: 37–43 μm in diameter; oblong: 37–61 μm X 35–59 μm in diameter; individual grains: 8–16 vesicles; Miocene-Upper Pliocene, Victoria, Australia.

3) *Acacia octosporites* Cookson (1954, p. 55, pl. 1, figs. 2–4), polyads: circular: 21–27 μm in diameter; oblong: 32 X 37 μm in diameter; individual grains: 8 vesicles; Late Pliocene, Grange Burn near Hamilton, Victoria, Australia.

4) *Polyadopollenites várpalotaensis* Nagy (1962, p. 156, pl. 3, figs. 4, 7), polyads: 30 X 20 μm in diameter; individual grains: 16 vesicles; Middle Miocene, Hungary.

5) *Polyadopollenites granulatus* Sah (1967, pp. 142–143, pl. XII, figs. 3–4), polyads: 104–110 μm in diameter; Neogene, Burundi, Africa.

6) *Acacia-Parkia* (Medus, 1975, p. 570, pl. 9, figs. 6, 7, 9, 10, 14), polyads (82 X 69 μm in diameter); Tertiary, Senegal.

7) *Polyadopollenites vancampoi* Salard-Cheboldaeff (1978, pp. 253–254, pl. VII, figs. 6 a-b); polyds: 60 X 45 μm in diameter; individual garins: 16–18 μm in diameter, 16 vesicles; Late Eocene to Early Miocene, Cameroons.

**Botanical affinity:** Leguminosae, *Adenathera.*

*Polyadopollenites indecorus* n. sp.

Pl. 11, figs. 4 – 6; pl. 37, figs. 4 – 7.

**Diagnosis:** Polyad pollen of subcircular to oval outline. Eleven to twelve vesicles forming a polyad pollen grain. Exine two-layered, 1 μm thick, laevigate. No germinal porus visible.

**Measurements:** Polyads: 37–43 μm X 32–36 μm in diameter.