MARTA WAKSMUNDZKA

PALYNOLOGICAL ANALYSIS OF LOWER CRETACEOUS SEDIMENTS FROM KUJAWY (POLAND)


Age of the Lower Cretaceous sediments from Kujawy has been determined as Aptian on the basis of spores and pollen. Thirty forms of spores and pollen have been described. They represent the following genera: Cyathidites, Stereisporites, Deltoidospora, Gleichenidites, Clavifera, Ornamentifera, Buculatisporites, Uvaeospores, Trilites, Concaussimisporites, Trilobosporites, Lycopodiumsporites, Pinuspollenites, Vitreisporites, Podocarpites, Eucommidites, Clavatipollenites, Schadopityspollenites.

Key words: spores, pollen, stratigraphy, taxonomy, Poland.

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INTRODUCTION

The aim of the work was to precise the age of the Lower Cretaceous sediments (Barremian-Middle Albian) at Kujawy (Polish Lowlands) using palynological evidence. Lithology of these sediments has been studied by Marek (1964, 1968, 1969), Raczynska (1971), Wierzbowski et al (1978).

The material under study came from the W-20 borehole in the Piechcin-Barcin area in the Kujawy region of the Polish Lowlands (fig. 1). For lithology of the investigated rock series see Wierzbowski et al. (1978). The borehole has been drillen by the Geological Enterprise South, Cracow.

An attempt to determine precisely the age of the Barremian-Middle Albian sediments at Kujawy region by means of the palynological studies has been done by Manczkar (1966, 1975) (fig. 1). She considered these sediments as representing the Aptian on the basis of quantitative analysis.

Pollen grains and spores here described have been separated by means of flotation and Erdtman acetolysis methods and processing the samples in hydrofluoric acid. The specimens were observed in optical microscope in transmitted light and in SEM. This allowed observation of the morphology
Fig. 1. Location of here discussed W-20 borehole and other boreholes that yielded materials for palynological studies of the Lower Cretaceous sediments of Poland (after Mamczar, modified); ● location of boreholes.

of the spore and pollen walls and distinction of new features in those forms.

The scheme of palynological stratigraphy of the sediments studied was established basing upon the qualitative analysis only because of an extremely small frequency of the forms under study. The SEM photographs have been done by Mr. Romuald Wiśniewski (the Warsaw Polytechnic School).

The collection is stored in the Laboratory of Paleontology, Geological Department of the Warsaw University (abbreviated as WG. Z. Pal.).

Acknowledgements. — The present author is greatly indebted to Dr. Andrzej Wierzbowski (Geological Department, Warsaw University) who provided the material for investigation. This paper was prepared under the scientific guidance of Dr. Maria Ziemińska-Tworzydło (Geological Department, Warsaw University) whose help and suggestions are gratefully acknowledged.

STRATIGRAPHY

The sediments in the W-20 borehole are monotonous sandy-clayey series sometimes with glauconite contaminations. The investigated series distinguished by Wierzbowski et al. (1978) occur in the borehole at the depth of 180—71 m.
Stratigraphical range of described species (after Döring 1964, 1965, 1966; Kemp 1970; Bolkhovitina 1953, 1968 and others, and after author's observations)

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Table 2
Lithology and floral occurrence in the Aptian sector of profile of W-20 borehole
Large concentration of humus remnants occurs especially in the lower part of the profile at depths 179.5—155.5 m and 145.5—139.5 m. The species *Trilites distalgranulatus*, *Gleicheniidites carinatus*, and *G. rasilis* (tables 1 and 2) were noticed there which are the index forms of the Aptian (Bolkhovitina 1953, 1968; Couper 1958; Kemp 1970) (tables 1, 2). Hence the lower part of those sediments is assigned here to the Aptian (table 2). The presence of phytoplankton at depths 139.3 m, 155.5 m, 170.4 m, 173.5 m, 178 m, 179 m, and 179.5 m together with spores and pollen grains as well as glauconite contamination at depths 154 m and 148.5 m point to the brackish character of the environment.

### DESCRIPTION OF SPORES AND POLLEN GRAINS

**Genus Stereisporites** Pflug, 1953

*Type species: Stereisporites stereoides* (Ptonié and Venitz) Pflug, 1953.

*Stereisporites stereoides* (Ptonié and Venitz) Pflug, 1953

(Pl. 19: 1)


**Material.** — Twenty-four well preserved specimens; WG.Z.Pal. MB1/1—24; depths 139.5 m, 143.5 m, 155.5 m, 157.8 m, 170.4 m, 171.5 m, 173.5 m, 177.3 m, 179 m.

**Dimensions (in μm):**
- equatorial diameters: 18—28
- length of Y-rays: 0.3 R
- width of Y-rays: 1
- exine thickness: 0.75—1


**Remarks.** — There is a great divergence of opinions in the literature concerning the criteria of specific determination of the genus *Stereisporites*. Its species here described have been determined on the basis of papers by Döring, Krutzsch, Schulz and Timmermann (1968), because the representatives of *Stereisporites* described by the latter authors derive chiefly from areas of similar palaeogeographic environments (GDR — Mecklenburg).

**Botanical affinity.** — Sphagnum.


*Stereisporites bujargiensis* (Bolkhovitina) Schulz, 1966

(Pl. 19:2)


**Material.** — One well preserved specimen; WG.Z.Pal. MB1/25; depth 145 m.
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Dimensions (in µm):
- equatorial diameter 35
- length of Y-rays 0.3 R
- width of Y-rays 1
- exine thickness 2—2.5


Botanical affinity. — Sphagnum.

Occurrence. — Poland (Kujawy): Aptian; GDR (Mecklenburg): Lower Jurassic — Lower Cretaceous.

Genus Lycopodiumsporites Thiergart in Delcourt et Sprumont, 1955

Type species: Lycopodiumsporites agathoecus (Potonié) Thiergart in Delcourt et Sprumont, 1955.

Lycopodiumsporites clavatoides Couper, 1958
(pl. 19: 4a, b)


Material. — Four well preserved specimens; WG.Z.Pal. MB1/142, 143, 144, 145; depths: 139.5 m, 173.5 m, 178 m, 179.5 m.

Dimensions (in µm):
- equatorial diameters 23.5—36
- length of Y-rays 0.7 R
- width of Y-rays 1.5
- exine thickness 1.5—2.5

Description. — See Couper (1958: 132).

Remarks. — The Polish specimens of L. clavatoides differ neither from the holotype described from the Lower Jurassic sediments (Couper 1958) nor from specimens described by Kemp (1970) from Aptian and Albian.

Botanical affinity. — Lycopodiaceae.

Occurrence. — Poland (Kujawy): Aptian. Europe: Jurassic — Lower Cretaceous.

Lycopodiumsporites glebelentus Kemp, 1970
(pl. 19: 5a, b)


Material. — Two well preserved specimens. WG. Z. Pal. MB1/146, 147; depth: 143.5 m, 170.4 m.

Dimensions (in µm):
- equatorial diameters 37; 38
- length of Y-rays R
- width of Y-rays 1—1.5
- exine thickness 1.5

Description. — See Kemp (1970: 88).

Botanical affinity. — Lycopodiaceae.

Genus *Baculatisporites* Pflug et Thomson, 1953

*Type species:* *Baculatisporites primarius* (Wolff) Pflug et Thomson, 1953 = *Sporites primarius* Wolff, 1934.

*Baculatisporites comaumensis* (Cookson) Potonié, 1956

(pl. 19: 6)

1957. *Osmundacidites comaumensis* (Cookson) Potonié; Balme: 25, pl. 4: 54—56.


1975. *Baculatisporites comaumensis* (Cookson) Potonié; Filatoff: 59, pl. 9: 6, 7.

*Material.* — One badly preserved specimen, depth 161 m.

*Dimensions (in μm):*

<table>
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<th>Parameter</th>
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<td>0.3 R</td>
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<td>width of Y-rays</td>
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<tr>
<td>exine thickness</td>
<td>1.5</td>
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*Description.* — Trilete spores almost round in general outline. Exine thin, covered with baculate sculpture. Baculae about 2 μm high and 1.5 μm wide. Ornamentation occurs both on the proximal and distal sides. Y-rays short and poorly visible among the sculptured elements.

*Botanical affinity.* — Osmundaceae.


(pl. 20: 4, 5, 6)


*Material.* — Twenty-five well preserved specimens; WG. Z. Pal. MB1/26—49; depths: 139.8 m, 143.5 m, 155.5 m, 157.8 m, 161 m, 170.4 m, 173.5 m, 177.3 m, 178 m.

*Dimensions (in μm):*

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<td>exine thickness</td>
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*Description.* — See Bolkhovitina (1968: 38). In SEM the distal part of spore was clearly visible. Most of the distal spore surface is occupied by smooth exine folds generally resembling the triradiate mark situated on the proximal side. Width of folds is about 1 μm.
Remarks. — The form differs from *Gleicheniidites simplex* in larger dimensions and greater width of exine thickening in interradial region.

*Botanical affinity.* — Gleicheniaceae.

*Occurrence.* — Poland (Kujawy): Aptian. Cosmopolitan: Jurassic-Middle Palaeogene.

**Gleicheniidites simplex** Burger, 1966

(pl. 20: 1a, b)


*Material.* — Three well preserved specimens; WG. Z. Pal. MB1/50, 51, 52; depths: 139.5 m, 177.3 m.

*Dimensions (in μm):*
- equatorial diameters: 27—37.8
- length of Y-rays: R
- width of Y-rays: 1 near angles, 0.5 near centre of spore
- exine thickness: 1.5—2

*Description.* — See Burger (1966:239).

*Remarks.* — These spores resemble those of recent *Diplopterygium farinosum* (Bolkhovitina 1968: pl. 3: 5—21). See also remarks about *Gleicheniidites senonicus*.

*Botanical affinity.* — Gleicheniaceae.


**Gleicheniidites carinatus** (Bolkhovitina) Bolkhovitina 1968

(pl. 20: 7)


*Material.* — Six well preserved specimens; WG. Z. Pal. MB1/53—58; depths: 157.8 m, 171.5 m, 173.5 m, 178 m, 179 m.

*Dimensions (in μm):*
- equatorial diameters: 34.5—46.5
- length of Y-rays: R
- width of Y-rays: 1
- exine thickness: 1.5—2

*Description.* — See Bolkhovitina (1968: 42).

*Remarks.* — *Gleicheniidites carinatus* differs from *G. senonicus* in broader, distinctly trapezoidal equatorial exine thickenings in interradial region.

*Botanical affinity.* — Gleicheniaceae.

*Occurrence.* — Poland (Kujawy) and central part of the Russian Platform: Aptian. Eastern part of Western Siberia: Aptian-Cenomanian; Western Siberia: Barremian-Hauterivian.

**Gleicheniidites rasilis** (Bolkhovitina) Bolkhovitina, 1968

(pl. 20: 2a, b, 3)


*Material.* — Ten well preserved specimens; WG. Z. Pal. MB1/123—132; depths: 139.8 m, 157.8 m, 161 m, 170.4 m, 171.5 m, 173.5 m.
Dimensions (in μm):
- equatorial diameters 30–52.5
- length of Y-rays 1.5–2
- width of Y-rays 2.5–3
- exine thickness

Description. — See Bolkhovitina (1968: 43). In SEM the strongly convex distal part of spore was observed. In central part of the distal spore surface there are exine folds resembling in general outline the Y-mark situated on proximal side. Folds are of about uniform width (7 μm) all over their length.

Remarks. — The form differs from *Gleicheniidites carinatus* in size and distinctly lens-like shape of thickening in interradial region.

Botanical affinity. — Gleicheniaceae.

Occurrence. — Poland (Kujawy): Aptian. USSR, Moscow area and Central Ural Mts: Aptian; Western Siberia: Hauterivian-Barremian; central and eastern parts of Western Siberia: Aptian-Turonian.

*Gleicheniidites latifolius* Döring, 1965

(pl. 21: 1a, 2)

1965. *Gleicheniidites (TTriremisporites) latifolius* Döring: 30, pl. 6: 9, 10.

Material. — Five well preserved specimens; WG. Z. Pal. MB1/59, 60, 61, 62, 63; depths: 139.5 m, 139.8 m, 170.4 m, 171.5 m, 173.5 m.

Dimensions (in μm):
- equatorial diameters 33–45
- length of Y-rays 1.5–2
- width of Y-rays 2.5–3
- exine thickness

Description. — See Bolkhovitina (1968: 41). In SEM, the distal part of spore was observed. Exine folds occur in central part of the distal surface of spore which resemble in general outline the Y-mark situated on proximal side. The folds are about equal width, 7 μm wide more or less over their whole length.

Remarks. — The form differs from *Gleicheniidites rasilis* in size and more trapezoidal thickenings of exine in interradial region.

Botanical affinity. — Gleicheniaceae.

Occurrence. — Poland (Kujawy): Aptian. GDR (Mecklenburg): Wealden. USSR, Donbas: Lower Cretaceous; eastern part of the Urals: Hauterivian-Santonian; Russian Platform: Barremian-Aptian; Western Siberia: Aptian-Cenomanian; Kazakhstan: Upper Cretaceous; Western and Southern Siberia: Paleogene.

Genus *Clavifera* Bolkhovitina, 1966

*Type species:* *Clavifera triplex* (Bolkhovitina) Bolkhovitina, 1966.

*Clavifera feronensis* (Delcourt and Sprumont) comb. nov.

(pl. 21: 5, 6a, b)

1966. *Gleicheniidites feromensis* (Delcourt and Sprumont) Delcourt and Sprumont; Burger: 238, pl. 5: 4a, b.
Material. — Fifteen well preserved specimens; WG. Z. Pal. MB1/64—77; depths: 139.8 m, 143.5 m, 155.5 m, 157.8 m, 161 m, 173.5 m.

Dimensions (in µm):
- equatorial diameters: 35—48.4
- length of Y-rays: R
- width of Y-rays: 2
- exine thickness: 1.5—2

Description. — See Bolkhovitina (1968: 44). In SEM, the convex, granulated distal part of spore is visible. In central part of the distal surface of the spore the smooth exine folds occur that generally resemble the Y-mark situated on the proximal side. The folds vary in width: 5.3 µm near centre of distal surface up to 6.5 µm near the angles.

Remarks. — Among the spores representing family Gleicheniaceae, in the present paper two genera have been distinguished after Bolkhovitina (1968) that differ from each other in shape of the equatorial exine thickening: Gleicheniitides Ross (equatorial thickening in interradial region) and Clavifera Bolkhovitina (equatorial thickening in radial and interradial regions). Contrary to Bolkhovitina (1968), the present author assigned here Gleicheniidites feronensis and G. delcourtii to the genus Clavifera Bolkhovitina because of the presence of distinct equatorial thickenings in radial regions. For similar reasons it is proposed here to assign Gleicheniidites circinidites Burger 1966 to Clavifera (differences from Gleicheniidites — see below).

Botanical affinity. — Gleicheniaceae.


Clavifera delcourtii (Döring) comb. nov.

(pl. 22: 6)

1965. Gleicheniidites delcourtii Döring: 29, pl. 18: 9, 10.
1968. Gleicheniidites delcourtii Döring; Bolkhovitina: 45, pl. 11: 18, 19.

Material. — Two well preserved specimens; WG. Z. Pal. MB1/78, 79; depths: 161 m, 170.4 m.

Dimensions (in µm):
- equatorial diameters: 45; 50
- length of Y-rays: R
- width of Y-rays: 2
- exine thickness: 1.5—2

Description. — See Bolkhovitina (1968: 45).

Remarks. — Burger (1966) considers Gleicheniidites delcourtii Döring as a junior synonym of G. ferontensis Sprumont and Delcourt. Such an opinion seems to be unjustified since at least three character differing those forms can be mentioned: the general equatorial outline, the shape of angles, and the degree of waving of external edge of the equatorial thickening.

Occurrence. — Poland (Kujawy): Aptian. GDR (Mecklenburg), southern Belgium: Wealden.

Clavifera circinidites (Cookson) comb. nov.

(pl. 21: 3a, b, 4)


Material. — Two well preserved specimens; WG. Z. Pal. MB1/80, 81; depths: 157.8 m, 161 m.
Dimensions (in μm):

- equatorial diameters: 40; 50
- length of Y-rays: R
- width of Y-rays: 1.5
- exine thickness: 1.5—2

Description. — See Burger (1966: 238). In SEM, the strongly convex, granular distal part of spore was observed. Smooth folds of exine occur in central part of the distal surface of spore. They resemble the Y-mark situated on proximal side. The folds narrow from the centre of spore (10 μm in width) toward the angles (5 μm in width).

Remarks. — The form differs from Clavifera feronensis in its concave sides, larger dimensions and smaller width of the contact surface (see p. 266).

Spores of this species described by Burger (1966) are about 43 μm in size, while these of specimens described above are larger.

Botanical affinity. — Gleicheniaceae.


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Clavifera tripexus (Bolkhovitina) Bolkhovitina, 1966
(pl. 22: 4, 5, 7)

Material. — Forty one well preserved specimens; WG. Z. Pal. MB1/82—121; depths: 139.5 m, 139.8 m, 147.5 m, 155.5 m, 157.5 m, 161 m, 170.4 m, 171.5 m, 173.5 m, 178 m, 179 m, 179.5 m.

Dimensions (in μm):

- equatorial diameters: 34.5—57
- length of Y-rays: R
- width of Y-rays: 2
- exine thickness: 1.5—2

Description. — See Bolkhovitina (1968: 46). In SEM, the convex distal part of spore was observed. Three folds of exine occur in central part of the distal spore surface, which resemble in general aspect the Y-mark situated on the proximal side. Folds near the centre of the distal side are about 3.7 μm wide and widen up to 8.6 μm near the angles, resembling in shape the equatorial thickenings of exine in radial region. In addition to the above folds there are thickening of exine about 4.6 μm wide in interradial regions of the distal surface.

Botanical affinity. — Gleicheniaceae.


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Clavifera sp.
(pl. 22: 1, 2, 3)

Material. — Three well preserved specimens; WG. Z. Pal. MB1/134, 135, 136; depths: 155.5 m, 157.8 m, 170.4 m.
Dimensions (in µm):

- equatorial diameters: 26–38
- length of Y-rays: R
- width of Y-rays: 1.2
- exine thickness: 1.5–2

**Description.**—Equatorial outline of spore triangular, sides strongly concave, angles rounded, protruding. Broad, bipartite thickening occurs around the equator narrowed to 3–4 µm in the central part of interradial region. At its maximal width, the thickening attains up to 6 µm, near the angles up to 1 µm and in the radial parts has the shape of 2 µm wide auricles. Exine folds present on the distal surface, parallel to the Y-mark rays. The latter distinct. Exine surface smooth. In SEM, granulation visible on the proximal side of spore.

**Remarks.**—The specimens described are assigned to *Clavifera* because of the presence of equatorial thickening of exine both in radial and interradial regions (see remarks on *Clavifera feronensis*). Bipartity of the equatorial thickening of exine in interradial region does not impair the assignment as it is the character of minor importance.

**Botanical affinity.**—Gleicheniaceae.

**Occurrence.**—Poland (Kujawy): Aptian.

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**Genus Ornamentifera Bolkhovitina, 1966**

**Type species:** *Ornamentifera echinata* (Bolkhovitina) Bolkhovitina, 1966.

**Ornamentifera cf. echinata** (Bolkhovitina) Bolkhovitina, 1966

(pl. 23: 2a, b)

**Material.**—One well preserved specimen; depth 170.4 m.

**Dimensions (in µm):**

WG. Z. Pal. MB1/176

- equatorial diameters: 35
- length of Y-rays: 0.7 R
- width of Y-rays: 1
- exine thickness: 1 in radial region
  
  2 in interradial region

**Description.**—Spore of triangular equatorial outline, sides straight or slightly concave, angles rounded. Equatorial thickenings of exine in interradial regions attain 6 µm in width. Outer edges of thickenings smooth, internal ones also smooth and slightly bent toward the centre of spore. Distal surface of spore convex. Distal exine folds about 1.5 µm wide run parallel to the Y-mark rays. The latter straight, not very distinct. Exine ornamented: sculpture elements in form of granules 2 µm in diameter. Exine thickness increases from 1 µm in radial regions up to 2 µm in the interradial ones.

**Remarks.**—Mamczar (1973) assigned a similar specimen to *Ornamentifera echinata*. But, the specimen described by this author as well as the one here described differ from the holotype of *Ornamentifera echinata* (see Bolkhovitina, 1968) in the presence of equatorial thickenings of exine in interradial region. This is an essential difference and Mamczar’s classification cannot be maintained.

**Botanical affinity.**—Gleicheniaceae.

**Occurrence.**—Poland (Kujawy): Aptian.
Genus *Cyathidites* Couper, 1953

*Type species*: *Cyathidites australis* Couper, 1953.

*Cyathidites australis* Couper, 1953

(pl. 19: 7)


*Material.* Five well preserved specimens; WG. Z. Pal. MB1/137, 138, 139, 140, 141; depths: 161 m, 177.3 m, 178 m.

*Dimensions (in μm):*

- equatorial diameters: 49.5—90.5
- length of Y-rays: 0.6R
- width of Y-rays: 2
- exine thickness: 1.5—2.5


*Botanical affinity.* Cyathaceae or Dicksoniaceae.

*Occurrence.* Poland (Kujawy): Aptian. Widely distributed all over the world except Canada: Jurassic-Cretaceous.

Genus *Trilobosporites* (Pant) Potonié, 1956

*Type species*: *Trilobosporites hannonicus* (Delcourt et Sprumont) Potonié, 1956.

*Trilobosporites ivanovae* Batten, 1973

(pl.19:8)


*Material.* One well preserved specimen; depth: 173.5 m.

*Dimensions (in μm):*

- equatorial diameters: 54
- length of Y-rays: 0.7 R
- width of Y-rays: 1.5
- exine thickness: 2

*Description.* See Batten (1973: 414).

*Botanical affinity.* Filicales — incertae sedis.

*Occurrence.* Poland (Kujawy): Aptian. Europe: Jurassic-Cretaceous.

Genus *Deltoidospora* (Miner) Potonié, 1956

*Type species*: *Deltoidospora hallii* Miner, 1935.

*Deltoidospora juncta* (Kara-Murza) Singh, 1964

(pl.19:3)

1971. *Deltoidospora juncta* (Kara-Murza); Singh: 118, pl. 16: 10—11.

*Material.* Two well preserved specimens; WG. Z. Pal. MB1/187, 188; depths: 139.5 m, 178 m.
Dimensions (in μm):

**equatorial diameters** 22.5; 27
**length of Y-rays** R
**width of Y-rays** 1.5
**exine thickness** 0.5—1.5

*Description.*—Spores of triangular equatorial outline, sides concave, angles rounded. On distal surface of the spore, in the radial regions, there are exine folds forming sectors perpendicular to the spore radius. The folds distanced approximately 6 μm from the tops. Y-marks straight, distinct, located on a thickening.

*Botanical affinity.*—Uncertain.


**Genus Trilites** Cookson in Couper, 1953

*Type species:* *Trilites tuberculiformis* Cookson, 1947.

**Trilites distalgranulatus** Couper, 1958

(pl. 23: 1a, b)


*Material.*—Five well preserved specimens; WG. Z. Pal. MB1/148, 149, 150, 151, 152; depths: 139.5 m, 173.5 m, 179 m.

Dimensions (in μm):

**equatorial diameters** 21.6—30
**length of Y-rays** R
**width of Y-rays** 1
**exine thickness** 1.5

*Description.*—See Couper (1958: 149).

*Botanical affinity.*—Unknown.

*Occurrence.*—Poland (Kujawy) and Great Britain: Aptian.

**Genus Uvaesporites** Döring, 1965

*Type species:* *Uvaesporites glomeratus* Döring, 1965.

**Uvaesporites glomeratus** Döring, 1965

(pl. 22: 8a, b)


*Material.*—One well preserved specimen; depth: 161 m.

Dimensions (in μm):

<table>
<thead>
<tr>
<th></th>
<th>WG. Z. Pal. MB1/186</th>
</tr>
</thead>
<tbody>
<tr>
<td>equatorial diameter</td>
<td>52</td>
</tr>
<tr>
<td>length of Y-rays</td>
<td>R</td>
</tr>
<tr>
<td>width of Y-rays</td>
<td>0.5</td>
</tr>
<tr>
<td>exine thickness</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Description. — See Döring (1965: 39).

Botanical affinity. — Uncertain.

Occurrence. — Poland (Kujawy): Aptian. GDR (Mecklenburg): Wealden.

Genus Concavissimisporites (Delcourt et Sprumont) Delcourt, Dettmann et Hughes, 1963

Type species: Concavissimisporites verrucosus (Delcourt et Sprumont) Delcourt, Dettmann et Hughes, 1963.

Concavissimisporites microverrucatus (Döring) Srivastava, 1975
(pl. 23: 5a, b)


Material. — Three well preserved specimens; WG. Z. Pal. MB1/169, 170, 171; depths: 171.5 m, 173.5 m, 179 m.

Dimensions (in µm):
- equatorial diameter: 33—36
- length of Y-rays: 0.8 R
- width of Y-rays: 1
- exine thickness: 2

Description. — See Döring (1964: 1101).

Remarks. — Majority of spores of this species described by Döring (1964) range in size from 50 µm to 80 µm, whereas these found in the investigated material are smaller. Srivastava (1975) considered Maculatisporites Döring, 1964 as the junior synonym of Concavissimisporites Delcourt et Hughes, 1963. The differences in sculpture that prompted Döring to erect a new genus cannot be considered as of the generic value.

Botanical affinity. — Unknown.


Concavissimisporites minimus Herngreen, 1970
(pl. 23: 3a, b)


Material. — One well preserved specimen and one damaged specimen; WG. Z. Pal. MB1/173, 172; depths: 143.5 m, 170.4 m.

Dimensions (in µm):
- equatorial diameter: 22.5; 27
- length of Y-rays: R
- width of Y-rays: 1.5
- exine thickness: 1.5—3


Remarks. — In the description of holotype, Herngreen points to the equatorial
thickening of exine in interradial regions. They are hardly visible in the specimen under study.


Genus _Vitreisporites_ (Leschik) Jansonius, 1962

_Type species:_ _Vitreisporites signatus_ Leschik, 1955.

_Vitreisporites pallidus_ (Reissinger) Nilsson, 1958  
(pl. 23: 4a, b)

1958. _Cyatnipollenites pallidus_ (Reissinger) Couper; Couper: 150, pl. 26: 7, 8.  

Material. — Fourteen well preserved specimens; WG. Z. Pal. 155—168; depths: 143.4 m, 155.5 m, 157.8 m, 161 m, 170.4 m, 173.5 m, 177.3 m, 178 m, 179 m, 179.5 m.

Dimensions (in μm):

<table>
<thead>
<tr>
<th></th>
<th>164</th>
<th>157</th>
<th>156</th>
<th>158</th>
<th>159</th>
<th>155</th>
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</thead>
<tbody>
<tr>
<td>Overall breadth of grain</td>
<td>22.5</td>
<td>23.5</td>
<td>25.2</td>
<td>27</td>
<td>30</td>
<td>32.4</td>
</tr>
<tr>
<td>Breadth of corpus</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>8.5</td>
<td>9</td>
</tr>
<tr>
<td>Breadth of saccus</td>
<td>10.5</td>
<td>10.5</td>
<td>9</td>
<td>12</td>
<td>8.5</td>
<td>12.6</td>
</tr>
<tr>
<td>Length of corpus</td>
<td>18</td>
<td>16.5</td>
<td>18</td>
<td>15</td>
<td>16.5</td>
<td>18</td>
</tr>
<tr>
<td>Length of saccus</td>
<td>18</td>
<td>16.5</td>
<td>18</td>
<td>15</td>
<td>16.5</td>
<td>18</td>
</tr>
</tbody>
</table>

WG. Z. Pal. MB1/ 164

<table>
<thead>
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<th></th>
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<th>167</th>
<th>166</th>
<th>161</th>
<th>160</th>
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</thead>
<tbody>
<tr>
<td>33</td>
<td>37.5</td>
<td>37.5</td>
<td>40.5</td>
<td>52.5</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>7.5</td>
<td>15</td>
<td>24</td>
<td></td>
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<th>21</th>
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<tr>
<td>15</td>
<td>23.5</td>
<td>18</td>
<td>22.5</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>23.5</td>
<td>18</td>
<td>22.5</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Description. — See Couper (1958: 150).

Remarks. — There is no Y-mark in the proximal side of corpus in the investigated specimens as well as in the ones studied by Jansonius (1962).

Botanical affinity. — _Cyatoniales.


Genus _Podocarpites_ Cookson in Couper, 1953

_Type species:_ _Podocarpites ellipticus_ Cookson, 1947.

_Podocarpites ellipticus_ Cookson, 1947  
(pl. 24: 1)

Material. — One slightly deformed specimen, depth: 157.8 m.
Dimensions (in µm):

<table>
<thead>
<tr>
<th></th>
<th>WG. Z. Pal. MB1/180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth of corpus</td>
<td>31</td>
</tr>
<tr>
<td>Breadth of saccus</td>
<td>35</td>
</tr>
<tr>
<td>Length of corpus</td>
<td>32</td>
</tr>
<tr>
<td>Length of saccus</td>
<td>24</td>
</tr>
</tbody>
</table>

Description. — Disaccate pollen grain. In polar view equatorial outline irregularly oval, slightly elongated. Grain corpus rounded in outline. Sacci narrowed at the base, accreted to the corpus along straight line shorter than the corpus diameter. Sacci cover 3/4 of distal surface of the corpus. Tenuitas between them with exine of well visible reticulate structure. The exine structure on sacci in the form of a distinct reticulation with lumina in shape of elongated polygons radiating from the accretion line of sacci toward their centers. In the central parts of sacci the polygons are more regular, 1—2 µm wide.

Remarks. — Pocock (1962), Singh (1964, 1971), Norvis (1967) have described specimens very similar to Podocarpites ellipticus as Podocarpites cf. ellipticus. Those specimens are larger (maximum 6 µm) than the holotype. This difference is unimportant, however, and all those specimens can be assigned to Podocarpites ellipticus without any doubt.

Botanical affinity. — Podocarpaceae.


Genus Pinuspollenites Raatz, 1937

Type species: Pinuspollenites labdacus (Potonié) Raatz, 1937.

Pinuspollenites comptonensis Kemp, 1970
(pl. 24: 2a, b)


Material. — Three well preserved specimens; depths: 155.5 m, 161 m.
Dimensions (in µm):

<table>
<thead>
<tr>
<th></th>
<th>WG. Z. Pal. MB1/183</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall breadth of grain</td>
<td>185</td>
</tr>
<tr>
<td>Breadth of corpus</td>
<td>70.5</td>
</tr>
<tr>
<td>Breadth of saccus</td>
<td>51</td>
</tr>
<tr>
<td>Length of corpus</td>
<td>37.5</td>
</tr>
<tr>
<td>Length of saccus</td>
<td>52.5</td>
</tr>
</tbody>
</table>

Description. — See Kemp (1970: 115).

Remarks. — Kemp (1970) erected a new species, P. comptonensis to include the Jurassic and Lower Cretaceous disaccate pollen grains that strongly resemble the Tertiary species Abietinaepollenites microalatus Potonié. In Kemp's opinion it is not advisable to unite the Jurassic and Lower Cretaceous forms with the Tertiary ones.

Botanical affinity. — Family Pinaceae.

Genus *Sciadopityspollenites* Thiergart, 1937

*Type species:* *Sciadopityspollenites serratus* (Potonie) Thiergart, 1937.

*Sciadopityspollenites mesozoicus* (Couper) comb. nov.

(pl. 24: 3, 4, 5, 6)


**Material.**—Three well preserved specimens; WG. Z. Pal. MB1/183, 184, 185; depths: 155.5 m, 173.5 m, 178 m.

Dimensions (in μm):
- diameter of pollen grains 55—60

**Description.**—Pollen grain of elongated-oval outline. Exine covered with verrucate sculpture. Particular ornamentation elements are isolated and exhibit various dimensions. Larger elements 2 μm up to 6 μm in diameter, occur on the proximal side. Verrucae that occur on the latter side are less rounded. In SEM, the additional isolated clavate elements located on verrucae are observed (about 0.5 μm in diameter).

**Remarks.**—The main difference between the genera *Sciadopityspollenites* and *Tsugopollenites* concerns the presence of additional clavi on verrucae and lack of the equatorial vellum in the former genus. SEM micrographs (pl. 24: 3, 5, 6) revealed the presence of clavate elements and lack of the equatorial vellum. It seems probable that the specimens assigned by Couper (1958) and Kemp (1970) to *Tsugopollenites mesozoicus* lack the equatorial vellum as it is the case in the form here described. The problem of the presence of clavate elements on verrucae in specimens described by Couper and by Kemp remains open as these papers do not provide the SEM micrographs.

**Botanical affinity.**—Family Taxodiaceae.

**Occurrence.**—Poland (Kujawy): Aptian. Europe: Wealden-Tertiary.

Genus *Eucommiidites* Couper, 1958

*Type species:* *Eucommiidites troedsoni* Erdtman, 1948.

*Eucommiidites sp.*

(pl. 23: 8)

**Material.**—One well preserved specimen; depth: 161 m.

Dimensions (in μm):  
- length 35  
- width 25  
- exine thickness 2

**Description.**—Pollen grain elongated ellipsoidal in the equatorial region. Main sulcus, rounded at its terminations, runs parallel to the longer axis of flattened part of grain. It does not reach polar regions. Two additional, weakly visible lateral
sulci run parallel to the central sulcus. They result from a secondary waving of exine. Exine smooth, bilayered.

**Remarks.**—Erdtman (1948) in his classification of pollen and spores joined Eucommiidites with Tricolpites, the latter genus typical for Angiospermae. It was not quite sure whether the sulci of pollen of Eucommiidites are comparable to those of pollen of true Angiospermae. The problem was solved by finding pollen grains of Eucommiidites in micropylar canal and in pollen chamber of undoubtful Gymnospermae associated with Gnetales (Brenner 1963). Hence Tricolpites, with three sulci, should be assigned to the Angiospermae while Eucommiidites, with one distinct sulcus located on distal side, to the Gymnospermae.

**Botanical affinity.**—Gymnospermae.

**Occurrence.**—Poland (Kujawy): Aptian.

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**Genus Clavatipollenites Couper, 1958**

*Type species:* Clavatipollenites hughesi Couper 1958.

**Clavatipollenites hughesi Couper 1958**

(pl. 23: 6a, b)


**Material.**—One well preserved specimen; depth: 161 m.

**Dimensions (in μm):**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>width</td>
<td>15</td>
</tr>
<tr>
<td>length</td>
<td>20</td>
</tr>
</tbody>
</table>

**Description.**—See Kemp (1968: 426).

**Remarks.**—Contrary to the holotype, the specimens studied here expose the length of sculpture elements in the equatorial and polar regions. Kemp (1968) regards *C. hughesi* as the first representative of Angiospermae because of the presence of a partial tectum. Walker (1976) maintains that the species in question represents a specialised form of Angiospermae mainly because of its small size and rather rounded and not lenticular shape. It is one of the few representatives of Angiospermae in the material under study.

**Botanical affinity.**—Angiospermae.


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**Genus Tricolpites (Cookson in Couper) Potonié, 1960**

*Type species:* Tricolpites reticulatus Cookson, 1947.

**Tricolpites sp.**

(pl. 23: 7)

**Material.**—One well preserved specimen; depth: 161 m.
Dimensions (in μm):

<table>
<thead>
<tr>
<th>WG. Z. Pal. MB1/182</th>
</tr>
</thead>
<tbody>
<tr>
<td>length 47</td>
</tr>
<tr>
<td>width 35</td>
</tr>
</tbody>
</table>

**Description.** — Pollen grain of elongated oval outline. Three sulci run parallel to longer axis of grain. Sulci long, narrow attain almost the polar regions. Exine (bilayered) ornamented. Elements of clavate sculpture about 1.5 μm high and 1 μm wide. Upper parts of clavi closely adhere to one another and form a network with oval-polygonal lumina. Lumina diameter ranges from 1 μm near polar regions to 0.5 μm in other regions.

**Remarks.** — *Tricolpites* sp. is similar to *Tricolpites nemejci* (Paclatová 1971). It differs, however, from the latter form in slightly larger dimensions (*T. nemejci* — 25 μm × 18 μm). This size difference (almost twofold) makes impossible assignment of this form to *T. nemejci*.

**Botanical affinity.** — Angiospermae.

**Occurrence.** — Poland (Kujawy): Aptian.

**REFERENCES**


MARTA WAKSMUNDZKA

ANALIZA PALINOLOGICZNA OSADÓW DOLNEJ KREDY Z KUJAW

Streszczenie

Badana seria warstw, wyróżniona przez Wierzbowskiego et al. (1978) mieści się pomiędzy 180 m a 71 m głębokości w wierceńiu W-20 (fig. 1), w okolicy Barcina. Występujące w wierceńiu osady reprezentowane są przez monotonną serię piaszczysto-ilastą, niekiedy z wkładkami glaukonitu.

Duża koncentracja szczątków humusowych występuje przede wszystkim w dolnej części profilu na głębokościach 179,5 m—155,5 m i 139,5 m. Zobserwowano tam obecność gatunków Trilites distalgranulatus, Gleicheniidites carinatus, Gleicheniidites rasilis, które są przewodnie dla aptu (Bolkhovitina 1953, 1968; Cooper 1958; Kemp 1970) (tabela 1, 2). W związku z tym dolną część badanych osadów zaliczam do aptu (tabela 2).

Mikroplankton roślinny występujący w głębokościach 139,3 m, 155,5 m, 170,4 m, 173,5 m, 178 m, 179 m, 179.5 m wraz ze sporami i ziarnami pyłku oraz wkładki glaukonitu na głębokościach 154 m i 148,5 m świadczą o brakicznym charakterze środowiska sedymentacji omawianych osad.
1. *Stereisporites stereoides* (Potonié and Venitz) Pflug; depth: 170.4 m; WG. Z. Pal. MB1/15; proximal view.

2. *Stereisporites bujargiensis* (Bolkhovitina) Schulz; depth: 145.0; WG. Z. Pal. MB1/25; proximal view.

3. *Deltoidospora juncta* (Kara-Murza) Singh; depth: 139.5 m; WG. Z. Pal. MB1/187; proximal view.

4. *Lycopodiumsporites clavatoides* Couper; depth 139.5 m; WG. Z. Pal. MB1/142; a proximal view, b distal view.

5. *Lycopodiumsporites glebelentus* Kemp; depth: 170.4 m; WG. Z. Pal. MB1/147; a proximal and b distal views.


7. *Cyathidites australis* Couper; depth: 178.0 m; WG. Z. Pal. MB1/140; proximal view.

8. *Trilobosporites ivanovae* Batten; depth: 173.5 m; WG. Z. Pal. MB1/153; proximal view.

All specimens × 1000

Plate 20

1. *Gleicheniidites simplex* Burger; × 1000; depth: 139.5 m; WG. Z. Pal. MB1/50; a proximal view, b distal view.

2. *Gleicheniidites rasilis* (Bolkhovitina) Bolkhovitina; × 1000; depth: 157.8 m; WG. Z. Pal. MB1/126; a proximal view, b distal view.

3. *Gleicheniidites rasilis* (Bolkhovitina) Bolkhovitina; SEM; × 1500; depth: 157.8 m; distal view.

4. *Gleicheniidites senonicus* (Ross) Bolkhovitina; × 1000; depth: 155.5 m; WG. Z. Pal. MB1/29; proximal view.

5. *Gleicheniidites senonicus* (Ross) Bolkhovitina; SEM; × 1500; depth: 157.8 m; WG. Z. Pal. MB1/32; distal view.

6. *Gleicheniidites senonicus* (Ross) Bolkhovitina; SEM; × 1000; depth: 161 m; WG. Z. Pal. ME/191; distal view.

7. *Gleicheniidites carinatus* (Bolkhovitina) Bolkhovitina; × 1000; depth: 171.5 m; WG. Z. Pal. MB1/54; proximal view.

Plate 21

1. *Gleicheniidites latifolius* Döring; SEM; × 1125; depth: 173.5 m; WG. Z. Pal. MB1/37; distal view.

2. *Gleicheniidites latifolius* Döring; × 750; depth: 139.8 m; WG. Z. Pal. MB1/60; a proximal view, b distal view.

3. *Claviferaceae circinidites* (Cookson) comb. nov.; × 750; depth: 161 m; WG. Z. Pal. MB1/81; a proximal view, b distal view.

4. *Claviferaceae circiniidites* (Cookson) comb. nov.; SEM; × 1125; depth: 157.8 m; WG. Z. Pal. MB1/80; distal view.

5. *Claviferaceae feronensis* (Delcourt and Sprumont) comb. nov.; SEM; × 1125; depth:
173.5 m; WG. Z. Pal. MB1/75; distal view.
6. Clavifera feronensis Delcourt and Sprumont comb. nov.; × 750; depth: 161 m; WG. Z. Pal. MB1/73; a proximal view, b distal view.

Plate 22

1. Clavifera sp.; × 800; depth: 170.4 m; WG. Z. Pal. MB1/134; proximal view.
2. Clavifera sp.; SEM; × 800; depth: 155.5 m; WG. Z. Pal. MB1/135; distal view.
3. Clavifera sp.; SEM; × 1200; depth: 157.8 m; WG. Z. Pal. MB1/136; proximal view.
4. Clavifera triplex (Bolkhovitina) Bolkhovitina; × 800; depth: 170.4 m; WG. Z. Pal. MB1/106; distal view.
5. Clavifera triplex (Bolkhovitina) Bolkhovitina; × 800; depth: 155.5 m; WG. Z. Pal. MB1/90; proximal view.
6. Clavifera delcourti (Döring) comb. nov.; × 800; depth: 161 m; WG. Z. Pal. MB1/78; proximal view.
7. Clavifera triplex (Bolkhovitina) Bolkhovitina; SEM; × 1200; depth: 157.8 m; WG. Z. Pal. MB1/97; distal view.
8. Uvaesporites glomeratus Döring; × 800; depth: 161.0 m; WG. Z. Pal. MB1/186; a proximal view, b distal view.

Plate 23

1. Trilites distalgranulatus Couper; depth 179 m; WG. Z. Pal. MB1/152; a proximal view, b distal view.
2. Ornamentifera cf. echinata (Bolkhovitina) Bolkhovitina; depth: 170.4 m; WG. Z. Pal. MB1/176; a distal view, b proximal view.
3. Concavissimisporites minimus Herngreen; depth: 143.5 m; WG. Z. Pal. MB1/172; a proximal view, b distal view.
4. Vitreisporites pallidus (Reissinger) Nilsson; depth: 139.5 m; WG. Z. Pal. MB1/156; a proximal view, b distal view.
5. Concavissimisporites microverrucatus (Döring) Srivastava; depth: 171.5 m; WG. Z. Pal. MB1/159; a proximal view, b distal view.
6. Clavatipollenites hughesi (Couper) Kemp; depth: 161 m; WG. Z. Pal. MB1/174; a proximal view, b distal view.
7. Tricolpites sp.; depth: 161 m; WG. Z. Pal. MB1/182.
8. Eucommiidites sp.; depth: 161 m, WG. Z. Pal. MB1/154. All specimens × 1000

Plate 24

1. Podocarpites ellipticus Cookson; × 800; depth: 155.5 m; WG. Z. Pal. MB1/180; distal view.
2. Pinuspollenites comptonensis Kemp; × 800; depth: 155.5; WG. Z. Pal. MB1/183; a distal view, b proximal view.
3. Sciadopityspollenites mesozoicus (Couper) comb. nov.; SEM; × 800; depth: 155.5 m; WG. Z. Pal. MB1/177.
4. Sciadopityspollenites mesozoicus (Couper) comb. nov.; × 800; depth: 178.0 m; WG. Z. Pal. MB1/179.
5. Sciadopityspollenites mesozoicus (Couper) comb. nov.; SEM; × 1200; depth: 173.5 m; WG. Z. Pal. MB1/178.
6. Sciadopityspollenites mesozoicus (Couper) comb. nov.; SEM; × 2400; depth: 173.5 m; WG. Z. Pal. MB1/178; exine.