ACTA PALAEONTOLOGICA POLONICA
Vol. 26 1981 No. 3—4

MARTA WAKSMUNDZKA

PALYNOLOGICAL ANALYSIS OF LOWER CRETACEOUS SEDIMENTS FROM KUJAWY (POLAND)

WAKSMUNDZKA, M. Palynological analysis of Lower Cretaceous sediments from Kujawy (Poland). Acta Palaeont. Polonica, 26, 3/4, 257—280. April 1982 (1981).

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, Gleicheniditites, Clavifera, Ornamentifera, Baculatisporites, Uvaesporites, Trilites, Concavissimisporites, Trilobosporites, Lycopodiumsporites, Pinuspollenites, Vitreisporites, Podocarpites, Eucommiidites, Clavatipollenites, Sciadopitys-pollenites.*

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

Marta Waksmundzka, Zakład Stratygrafii, Tektoniki i Petrografii, Instytut Geologiczny, Rakowiecka 4, 00-975 Warszawa, Poland.

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), Raczyńska (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 Mamczar (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

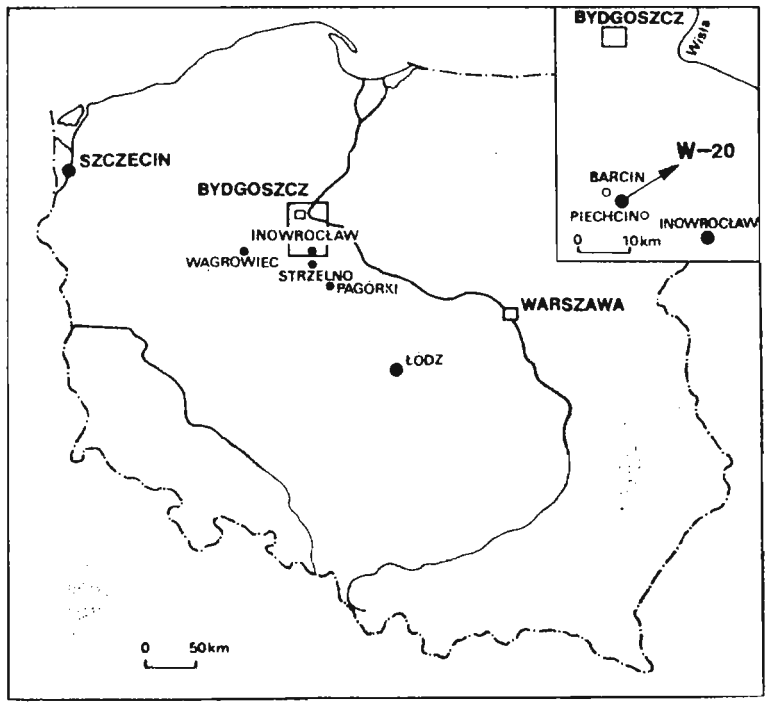


Fig. 1. Location of here discussed W-20 borehole and other boreholes that yielded materials for palynological studies of the Lower Cretaceous sediments of Poland (after Mamczar, modified); ● location of boreholes.

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 Ziembińska-Tworzydło (Geological Department, Warsaw University) whose help and suggestions are greatefully 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.

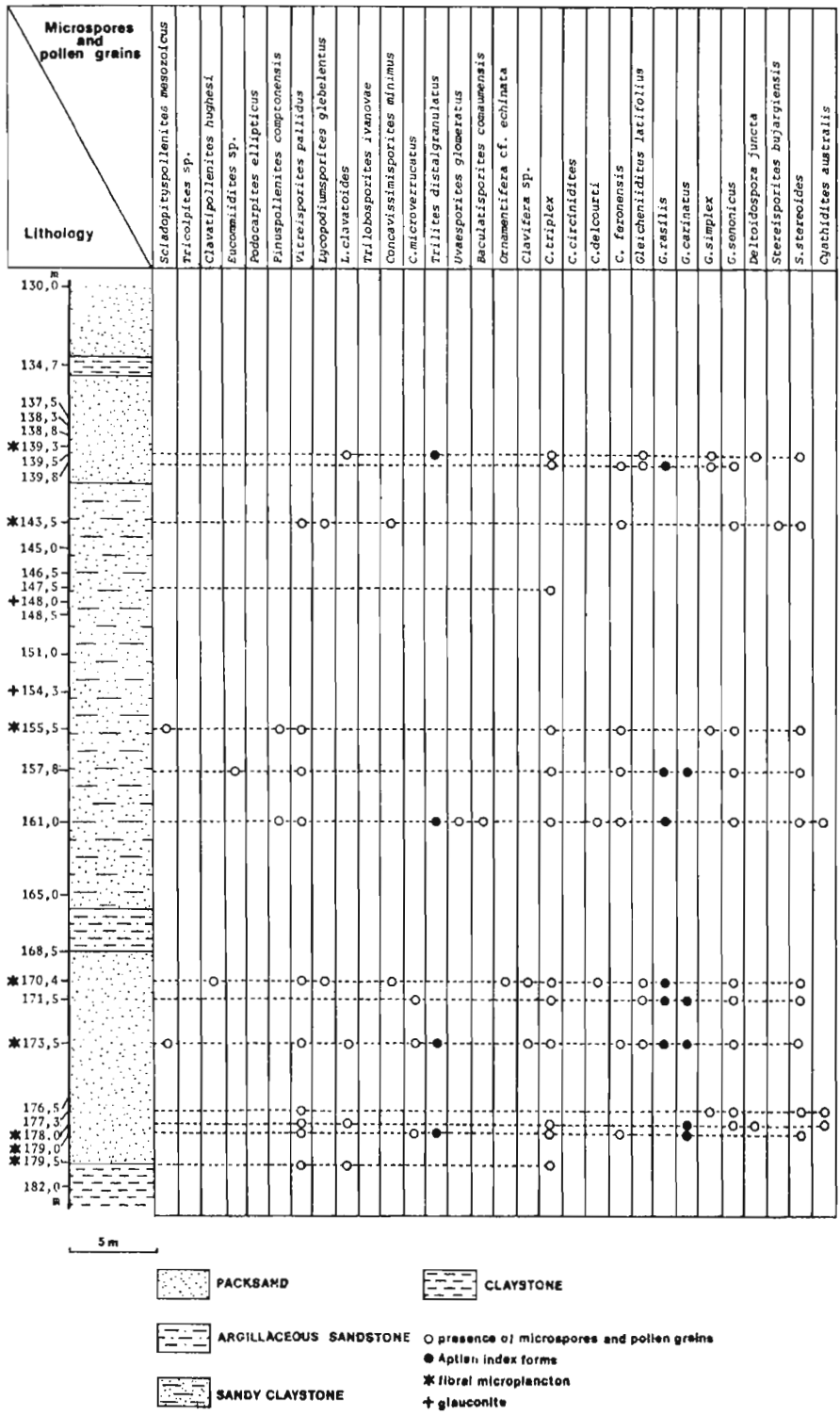
Table 1

Stratigraphical range of described species (after Döring 1964, 1965, 1966; Kemp 1970; Bolkhovitina 1953, 1968 and others, and after author's observations)

Species \ Stratigraphy	UJ	Be	V	H	Ba	Ap	Al	UC
Cyathidites australis	■	■	■	■	■	■	■	■
Stereisporites stereoides	■	■	■	■	■	■	■	■
S.bujargiensis	■	■	■	■	■	■	■	■
Deltoidospora juncta	■	■	■	■	■	■	■	■
Gleicheniidites senonicus	■	■	■	■	■	■	■	■
G.simplex	■	■	■	■	■	■	■	■
G.carinatus						■		
G.rasilis						■		
G.latifolius						■	■	
Clavifera feronensis		■	■	■	■ ■	■		
C.delcourti		■	■	■	■ ■	■		
C.circinidites		■	■	■	■	■	■	
C.triplex					■	■	■	
C.sp.						■		
Ornamentifera cf. *echinata*	■	■	■	■	■	■	■	■
Baculatisporites comaumensis	■	■	■	■	■	■	■	■
Uvaesporites glomeratus		■	■	■	■ ■	■		
Trilites distalgranulatus						■		
Concavissimisporites microver.		■	■	■	■ ■	■		
C.minimus		■	■	■	■ ■	■		
Trilobosporites ivanovae	■	■	■	■	■	■	■	■
Lycopodiumsporites clavatoides	■	■	■	■	■	■	■	■
L.glebelentus						■	■	
Vitreisporites pallidus	■	■	■	■	■	■	■	■
Pinuspollenites comptonensis	■	■	■	■	■	■	■	■
Podocarpites ellipticus	■	■	■	■	■	■	■	■
Eucommiidites sp.	■	■	■	■	■	■	■	■
Clavatipollenites hughesi					■	■	■	
Tricolpites sp.						■	■	■
Sciadopityspollenites mesozoicus		■	■	■ ■	■ ■	■	■ ■	■

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* (Potonié and Venitz) Pflug, 1953.

Stereisporites stereoides (Potonié and Venitz) Pflug, 1953
(pl. 19: 1)

1965. *Stereisporites stereoides* (Potonié and Venitz) Pflug; Schulz: 686, pl. 83: 1—3.

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

Description. — Trilete spores. Equatorial outline triangular, sides convex, angles rounded. Y-mark of straight, narrow rays. Exine on proximal and distal surfaces smooth. Proximal side of spore convex.

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.

Occurrence. — Poland (Kujawy): Aptian. Cosmpolitan: Triassic-Tertiary.

Stereisporites bujargiensis (Bolkhovitina) Schulz, 1966
(pl. 19:2)

1966. *Stereisporites bujargiensis* (Bolkhovitina) Schulz; Döring *et al.*: 81, pl. 2:13.

Material. — One well preserved specimen; WG.Z.Pal. MB1/25; depth 145 m.

Dimensions (in μm):

equatorial diameter	35
length of Y-rays	0.3 R
width of Y-rays	1
exine thickness	2—2.5

Description. —Spore of triangular equatorial outline, sides convex and angles rounded. Y-marks straight. Exine two-layered, internal layer smooth, external — slightly wavy.

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: 4*a*, *b*)

1958. *Lycopodiumsporites clavatoides* Couper: 132, pl. 15: 10—13.
1970. *Lycopodiumsporites clavatoides* Couper; Kemp: 89, pl. 12: 7—10.

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: 5*a*, *b*)

1970. *Lycopodiumsporites glebelentus* Kemp: 88, pl. 12: 1—6.
1972b. *Tappanispora loeblichi* Srivastava: 860, pl. 1: 1—12.

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. — Lycopodiacea.

Occurrence. — Poland (Kujawy): Aptian. Great Britain: Aptian-Albian.

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.
1966. *Osmundacidites wellmanii* Couper; Burger: 251, pl. 20: 3.
1975. *Baculatisporites comaumensis* (Cookson) Potonié; Filatoff: 59, pl. 9: 6, 7.

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

Dimensions (in μm):

	WG. Z. Pal. MB1/181
equatorial diameters	35
length of Y-rays	0.3 R
width of Y-rays	1
exine thickness	1.5

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.

Occurrence. — Poland (Kujawy): Aptian. Europe, North America: Upper Mesozoic.

Genus *Gleicheniidites* Ross emend. Bolkhovitina, 1968

Type species: Gleicheniidites senonicus Ross emend. Bolkhovitina, 1968.

Gleicheniidites senonicus Ross emend. Bolkhovitina, 1968
(pl. 20: 4, 5, 6)

1968. *Gleicheniidites senonicus* Ross emend. Bolkhovitina: 30, pl. 7: 1—38, pl. 8: 1—28.
1975. *Gleicheniidites senonicus* Ross emend. Bolkhovitina; Srivastava: 40, pl. 18: 7—15.
1975. *Gleicheniidites senonicus* Ross emend. Bolkhovitina; Filatoff: 63, pl. 12: 1, 2.

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):

equatorial diameters	22.5—34.2
length of Y-rays	R
width of Y-rays	1.5
exine thickness	1.0—1.5

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.

Gleichenidiites simplex Burger, 1966

(pl. 20: 1*a*, *b*)

1966. *Gleicheniidites simplex* Burger: 239, pl. 3:4.

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.

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

Gleicheniidites carinatus (Bolkhovitina) Bolkhovitina 1968

(pl. 20: 7)

1968. *Gleicheniidites carinatus* (Bolkhovitina) Bolkhovitina: 42, pl. 9: 15—23, pl. 10: 1—15.

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: 2*a*, *b*, 3)

1968. *Gleicheniidites rasilis* (Bolkhovitina) Bolkhovitina: 43, pl. 11: 1—7.

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	R
width of Y-rays	2.5—3
exine thickness	1.5—2

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: 1*a*, *b*, 2)

1965. *Gleicheniidites* (*?Triremisporites*) *latifolius* Döring: 30, pl. 6: 9, 10.
1968. *Gleicheniidites latifolius* Döring; Bolkhovitina: 41, pl. 9: 10—14.

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	R
width of Y-rays	2.5—3
exine thickness	1.5—2

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, 6*a*, *b*)

1965. *Gleicheniidites minor* (Döring) comb. nov.; Döring: 28, pl. 5: 9—11.
1966. *Gleicheniidites feronensis* (Delcourt and Sprumont) Delcourt and Sprumont; Burger: 238, pl. 5: 4*a*, *b*.
1968. *Gleicheniidites minor* Döring; Bolkhovitina: 44, pl. 11: 15—17.

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 near angles 0.5 near center of spore
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 Gleicheniceae, 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. delcourti* 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.

Occurrence. — Poland (Kujawy): Aptian. GDR (Mecklenburg): Wealden. USSR, Donbas: Lower Cretaceous.

Clavifera delcourti (Döring) comb. nov.

(pl. 22: 6)

1965. *Gleicheniidites delcourti* Döring: 29, pl. 18: 9, 10.

1968. *Gleicheniidites delcourti* 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 delcourti* Döring as a junior synonym of *G. feronensis* Sprumont and Delcourt. Such an opinion seems to be unjustified since as 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: 3*a*, *b*, 4)

1966. *Gleicheniidites circinidites* Cookson; Burger: 238. pl. 3: 1.

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.

Occurrence. — Poland (Kujawy): Aptian. England, Russian Platform, the Netherlands: Lower Cretaceous.

Clavifera triplex (Bolkhovitina) Bolkhovitina, 1966

(pl. 22: 4, 5, 7)

1968. *Clavifera triplex* (Bolkhovitina) Bolkhovitina: 46, pl. 11: 23—30, pl. 12: 1—15.
1970. *Clavifera triplex* (Bolkhovitina) Bolkhovitina; Kemp: 104, pl. 18: 13, 16, 17.

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.

Occurrence. — Poland (Kujawy): Aptian, USSR, Western Siberian Lowland: Hauterivian-Albian; Western Caucasus, Crimea: Hauterivian-Barremian; Russian Platform, Central Caucasus, Turkmenia, Uzbekistan: Aptian, Albian: Kazakhstan: Cenomanian-Senonian. England: Barremian-Middle Albian.

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.

Genus *Ornamentifera* Bolkhovitina, 1966

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

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

(pl. 23: 2*a*, *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.

Cyathidities australis Couper, 1953

(pl. 19: 7)

1958. *Cyathidites australis* Couper; Couper: 138, pl. 20: 8.

1971. *Cyathidites australis* Couper; Singh: 101, pl. 14: 9.

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

Description. — Spore of oval-triangular equatorial outline, sides straigth and rounded angles. Proximal and distal sides convex. Y-marks straight. Exine smooth.

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)

1973. *Trilobosporites invanovae* Batten: 414, pl. 15—18, pl. 65: 1—8, pl. 66: 1—9.

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

Dimensions (in μm):

	WG. Z. Pal. MB1/153;
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.

Occurrence. — Poland (Kujawy): Aptian. Romania: Albian. Russian Platform, North America: Upper Jurassic-Lower Cretaceous.

Genus *Trilites* Cookson *in* Couper, 1953

Type species: *Trilites tuberculiformis* Cookson, 1947.

Trilites distalgranulatus Couper, 1958

(pl. 23: 1*a*, *b*)

1958. *Trilites distalgranulatus* Couper: 149, pl. 25: 15, 16.
1973. *Trilites distalgranulatus* Couper: Mamczar: 173, pl. 1: 9, 10.

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: 8*a*, *b*)

1965. *Uvaesporites glomeratus* Döring: 39, pl. 9: 1—4, pl. 10: 3—7, pl. 11: 3—4.

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

Dimensions (in μm):

	WG. Z. Pal. MB1/186
equatorial diameter	52
length of Y-rays	R
width of Y-rays	0.5
exine thickness	1.5

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: 5*a*, *b*)

1964. *Maculatisporites microverrucatus* Döring: 110, pl. 2: 1—6.
1975. *Concavissimisporites microverrucatus* (Döring) Srivastava; Srivastava: 30.

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.
Occurrence. — Poland (Kujawy): Aptian. Northern German Lowlands: Wealden.

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

1970. *Concavissimisporites minimus* Herngreen: 298, pl. 2: 8—10.
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

Description. — See Herngreen (1970: 298).
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.

Botanical affinity. — *Cyathea* Smith, *Dicksonia* L'Herit, *Lygodium* Swartz (data after Dettmann, 1963).

Occurrence. — Poland (Kujawy): Aptian. France: Wealden.

Genus *Vitreisporites* (Leschik) Jansonius, 1962

Type species: *Vitreisporites signatus* Leschik, 1955.

Vitreisporites pallidus (Reissinger) Nilsson, 1958

(pl. 23: 4*a*, *b*)

1958. *Caytonipollenites pallidus* (Reissinger) Couper; Couper: 150, pl. 26: 7, 8.
1975. *Vitreisporites pallidus* (Reissinger) Nilsson; Srivastava: 8, pl. 36; 6.

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):

WG. Z. Pal. MB1/	164	157	156	158	159	155
Overall breadth of grain	22.5	23.5	25.2	27	30	32.4
Breadth of corpus	6	6	9	9	8.5	9
Breadth of saccus	10.5	10.5	9	12	8.5	12.6
Length of corpus	18	16.5	18	15	16.5	18
Length of saccus	18	16. 5	18	15	16.5	18

WG. Z. Pal. MB1/	162	167	166	161	160
	33	37.5	37.5	40.5	52.5
	12	12	7.5	15	24
continued	12	12	15	13.5	21
	15	23.5	18	22.5	30
	15	23.5	18	22.5	30

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.

Occurrence. — Poland (Kujawy): Aptian. Europe: Triassic-Cretaceous.

Genus *Podocarpites* Cookson *in* Couper, 1953

Type species: *Podocarpites ellipticus* Cookson, 1947.

Podocarpites ellipticus Cookson, 1947

(pl. 24: 1)

1962. *Podocarpites* sp. cf. *P. ellipticus* Cookson; Pocock: 65, pl. 10: 153—156.
1971. *Podocarpites* sp. cf. *P. ellipticus* Cookson; Singh: 162, pl. 22: 13.

Material. — One slightly deformed specimen, depth: 157.8 m.

Dimensions (in μm):

	WG. Z. Pal. MB1/180
Breadth of corpus	31
Breadth of saccus	35
Length of corpus	32
Length of saccus	24

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.

Occurrence. — Poland (Kujawy): Aptian. North America, western Australia: Jurassic-Lower Cretaceous. Iceland and Canada: Sinemurian-Berriasian.

Genus *Pinuspollenites* Raatz, 1937

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

Pinuspollenites comptonensis Kemp, 1970

(pl. 24: 2*a*, *b*)

1970. *Pinuspollenites comptonensis* Kemp: 15, pl. 24: 7—11.

Material. — Three well preserved specimens; depths: 155.5 m, 161 m.

Dimensions (in μm):

WG. Z. Pal. MB1/	185	183	184
Overall breadth of grain	70.5	72	75
Breadth of corpus	51	48	45
Breadth of saccus	37.5	28	30
Length of corpus	52.5	52	52
Length of saccus	49.5	54	30

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.

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

Genus *Sciadopityspollenites* Thiergart, 1937

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

Sciadopityspollenites mesozoicus (Couper) comb. nov.
(pl. 24: 3, 4, 5, 6)

1958. *Tsugopollenites mesozoicus* Couper: 155, pl. 30: 8—10.
1968. *Tsugopollenites mesozoicus* Couper; Tralau: 92, pl. 17: 3, 4.
1970. *Tsugopollenites mesozoicus* Couper; Kemp: 113, pl. 23: 9—15.

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 *Sciadopitypollenites* 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):

	WG. Z. Pal. MB1/154
length	35
width	25
exine thickness	2

Description. — Polen 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.

Genus *Clavatipollenites* Couper, 1958

Type species: *Clavatipollenites hughesi* Couper 1958.

Clavatipollenites hughesi Couper 1958
(pl. 23: 6*a*, *b*)

1958. *Clavatipollenites hughesi* Couper: 159, pl. 31: 19—22.
1968. *Clavatipollenites hughesi* Couper; Kemp: 426, pl. 80: 9—18.
1975. *Clavatipollenites hughesi* Couper; Srivastava: 83, pl. 38: 7—8.

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

Dimensions (in μm):

	WG. Z. Pal. MB1/174
width	15
length	20

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.

Occurrence. — Poland (Kujawy): Aptian. North America: Albian-L. Cenomanian. Great Britain: Barremian-Albian.

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):

	WG. Z. Pal. MB1/182
length	47
width	35

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

ARJANG, B. 1975. Die rhäto-jurassischen Floren des Irans und Afghanistans I (Die Microflora der rhäto-jurassischen Ablagerungen des Kermaner Beckens, Zent. Iran). — *Palaeontographica, B*, **152**, 85—148.

BALME, B. 1957. Spores and pollen grains from the Mesozoic of Western Australia. — *Coal Res. C.S.I.R.O., Ref. T.C.*, **25**, 48 pp.

BATTEN, D. J. 1973. Palynology of Early Cretaceous solid beds and associated strata. — *Palaeontology*, **16**, 2, 399—424.

[BOLKHOVITINA, N. A.] БОЛХОВИТИНА, Н. А. 1953. Спорово-пыльцевая характеристика меловых отложений центральных областей СССР. — *Тр. ГИН АН СССР*, **145**, 148 pp.

— 1968. Споры глейхеневых папоротников и их стратиграфическое значение. — *Ibidem*, **186**, 116 pp.

BURGER, D. 1966. Palynology of Uppermost Jurassic and Lowermost Cretaceous strata in the eastern Netherlands. — *Leid. Geol. Meded.*, **35**, 211—276.

COUPER, R. A. 1958. British Mesozoic microspores and pollen grains — a systematic and stratigraphic study. — *Palaeontographica, B*, **103**, 75—179.

DEAK, M. H. 1964. Contribution à l'étude Palynologique de groupe d'argiles à Munieria de l'étage Aptien. — *Acta Bot. Hungarica*, **10**, 95—126.

DELCOURT, A. F., DETTMANN, M. E. and HUGHES, N. F. 1963. Revision of some Lower Cretaceous miospores from Belgium and France. — *Palaeontology*, **6**, 2, 282—292.

DETTMANN, M. E. 1963. Upper Mesozoic microfloras from south-eastern Australia. — *Proc. Roy. Soc. Victoria*, **77**, 148 pp.

DÖRING, H. 1964. Trilete Sporen aus dem Oberen Jura und dem Wealden Norddeutschlands. — *Geologie*, **13**, 9, 1099—1129.

— 1965. Die Sporenpaläontologische Gilderung des Wealden in Westmecklenburg (Struktur Werle). — *Ibidem*, **14**, 47, 118 pp.

— 1966. Sporenstratigraphischer Vergleich zwischen dem Wealden Norddeutschlands und Südenglands. — *Ibidem*, **15**, 55, 102—129.

— , KRUTZSCH, W., SCHULZ, E. and TIMMERMANN, E. 1966. Über einige neue Subformgenera der Sporengattung Stereisporites Th. and Pf. aus dem Mesozoikum und Alttertiar Mitteleuropas. — *Ibidem*, **15**, 55, 72—89.

ERDTMAN, G. 1965. Pollen and spores morphology and plant taxonomy Gymnospermae, Bryophyta (text). — 191 pp. Almquist and Wiksells Stockholm.

FILATOFF, J. 1975. Jurassic palynology of the Perth Basin, Western Australia. — *Palaeontographica, B*, **54**, 114 pp.

HERNGREEN, G. W. 1971. Palynology of a Wealden section (Lower Cretaceous) in the "Carriere de Longueville" the Boulonnais (France). — *Rev. Paleobot. Palyn.*, **12**, 271—302.

HUGHES, N. F. and MOODY-STUART, J. C. 1969. A methods of stratigraphic correlation using Early Cretaceous miospores. — *Palaeontology*, **12**, 1, 81—111.

— , DREWRY, G. E. and LAING, J. F. 1979. Barremian earliest angiosperm pollen. — *Ibidem*, **22**, 2—23.

JANSONIUS, J. 1962. Palynology of Permian and Triassic sediments, Peace River area, western Canada. — *Palaeontographica, B*, **110**, 35—98.

KEMP, E. M. 1968. Probably angiosperm pollen from British Barremian to Albian strata. — *Palaeontology*, **11**, 421—434.

— 1970. Aptian and Albian miospores from Southern England. — *Palaeontographica, B*, **131**, 73—143.

MAMCZAR, J. 1966. Stratygrafia palinologiczna warstw z pogranicza jury i kredy na Kujawach. — *Kwart. Geol.*, **10**, 1, 118—127.

— 1973. Stratygrafia osadów barrem-alb środkowy na terenie Niżu Polskiego na podstawie mikrospor.— Proc. 3rd Intern. Palynol. Cont., 172—175, Nauka, Moskwa.

MAREK, S. 1964. Szkic paleogeograficzny i stratygraficzny dolnej kredy na Niżu Polskim. — *Kwart. Geol.*, **8**, 2, 282—290.

— 1964. Zarys stratygrafii dolnej kredy Niecki Brzeżnej. — *Ibidem*, **12**, 2, 345—366.

— 1969. Zarys stratygrafii dolnej kredy Kujaw. — *Ibidem*, **13**, 1, 139—154.

— , RACZYŃSKA, A. 1970. Kreda dolna (obszar pozakarpacki). Geologia i surowce mineralne Polski. — *Biul. IG*, **251**, 479—499.

NORRIS, G. 1967. Spores and pollen from the Lower Colorado Group (Albian-?Cenomanian) of Central Alberta. — *Palaeontographica, B*, **120**, 75—115.

PACLATOVÁ, B. 1971. Palynological study of Angiospermae from the Perue Formation (Albian-Cenomanian) of Bohemia. — *Sb. Geol. Ved. Paleontologia Rada P*, **13**, 105—145.

POCOCK, S. A. J. 1962. Microfloral analysis and age determination of strata at the Cretaceous boundary in the Western Canada plains. — *Palaeontographica, B*, **111**, 95 pp.

RACZYŃSKA, A. 1971. Zarys stratygrafii dolnej kredy w Niecce Mogileńskiej. — *Kwart. Geol.*, **15**, 1, 120 pp.

— 1979. Stratygrafia i rozwój litofacjalny młodszej kredy dolnej na Niżu Polskim. — *Prace IG*, **89**, 78 pp.

SINGH, C. 1964. Microflora of the Lower Cretaceous Mannville Group, east-central Alberta. — *Bull. Res. Coun. Alberta*, **15**, 238 pp.

— 1971. Lower Cretaceous microflora of the Peace River area, north-western Alberta. — *Ibidem*, **28**, 542 pp.

SMITH, A. H. V. and BUTTERWORTH, M. A. 1967. Miospores in the coal seams of the Carboniferous of Great Britain. — *Spec. Pap. Paleontology*, **1**, 324 pp.

SRIVASTAVA, S. 1972*a*. Systematic description of some spores from the Edmonton Formation (Maestrichtian), Alberta, Canada. — *Palaeontographica, B*, **139**, 46 pp.

1972*b*. *Tappanispora loeblichii* n.gen., n.sp., from the Kiamichi Formation (Albian) of Texas. — *J. Paleont.*, **46**, 6, 859—860.

— 1975. Miospores from the Federichburg group (Albian) of the Southern United States. — *Paleobiol. Cont.*, **6**, 2, 1—119.
— 1978. Cretaceous spore-pollen floras: A global evolution. — *Biol. Mem.*, **3**, **1**, 130 pp.
TRALAU, H. 1968. Botanical investigations into the fossil flora of Eriksdal in Fyledalen, Scania. — *Sver. Geol. Und.*, **62**, 4.
WALKER, J. 1976. Evolutionary significance of the exine in the pollen of primitive angiosperms, 251—308. *In*: J. Ferguson, J. Müller (eds.), The Evolutionary Significance of the Exine. — *Linnean Society Symp. Ser.*, **1**, v-ix, 591 pp. Linnean Society of London, Academic Press, London.
WIERZBOWSKI, A., KUTEK, J., MATYJA, B., KUBIATOWICZ, W. 1978. Opracowanie biostratygrafii z elementami petrografii z wierceń realizowanych na złożu Piechcin-Barcin. — Archiwum Zakładu Prac Geologicznych, Warszawa, nr 344 (unpublished manuscript).

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 wierceniu W-20 (fig. 1), w okolicy Barcina. Występujące w wierceniu 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 145.5 m i 139.5 m. Zaobserwowano tam obecność gatunków *Trilites distalgranulatus*, *Gleicheniidites carinatus*, *Gleicheniidites rasilis*, które są przewodnie dla aptu (Bolkhovitina 1953, 1968; Couper 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 osadów.

EXPLANATION OF THE PLATES 19—24

Plate 19

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.
6. *Baculatisporites comaumensis* (Cookson) Potonié; depth: 161 m; WG. Z. Pal. MB1/181.
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. MB/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. MB 1/37; distal view.
2. *Gleicheniidites latifolius* Döring; × 750; depth: 139.8 m; WG. Z. Pal. MB 1/60; *a* proximal view, *b* distal view.
3. *Clavifera circinidites* (Cookson) comb. nov.; × 750; depth: 161 m; WG. Z. Pal. MB1/81; *a* proximal view, *b* distal view.
4. *Clavifera circinidites* (Cookson) comb. nov.; SEM; × 1125; depth: 157.8 m; WG. Z. Pal. MB1/80; distal view.
5. *Clavifera 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.

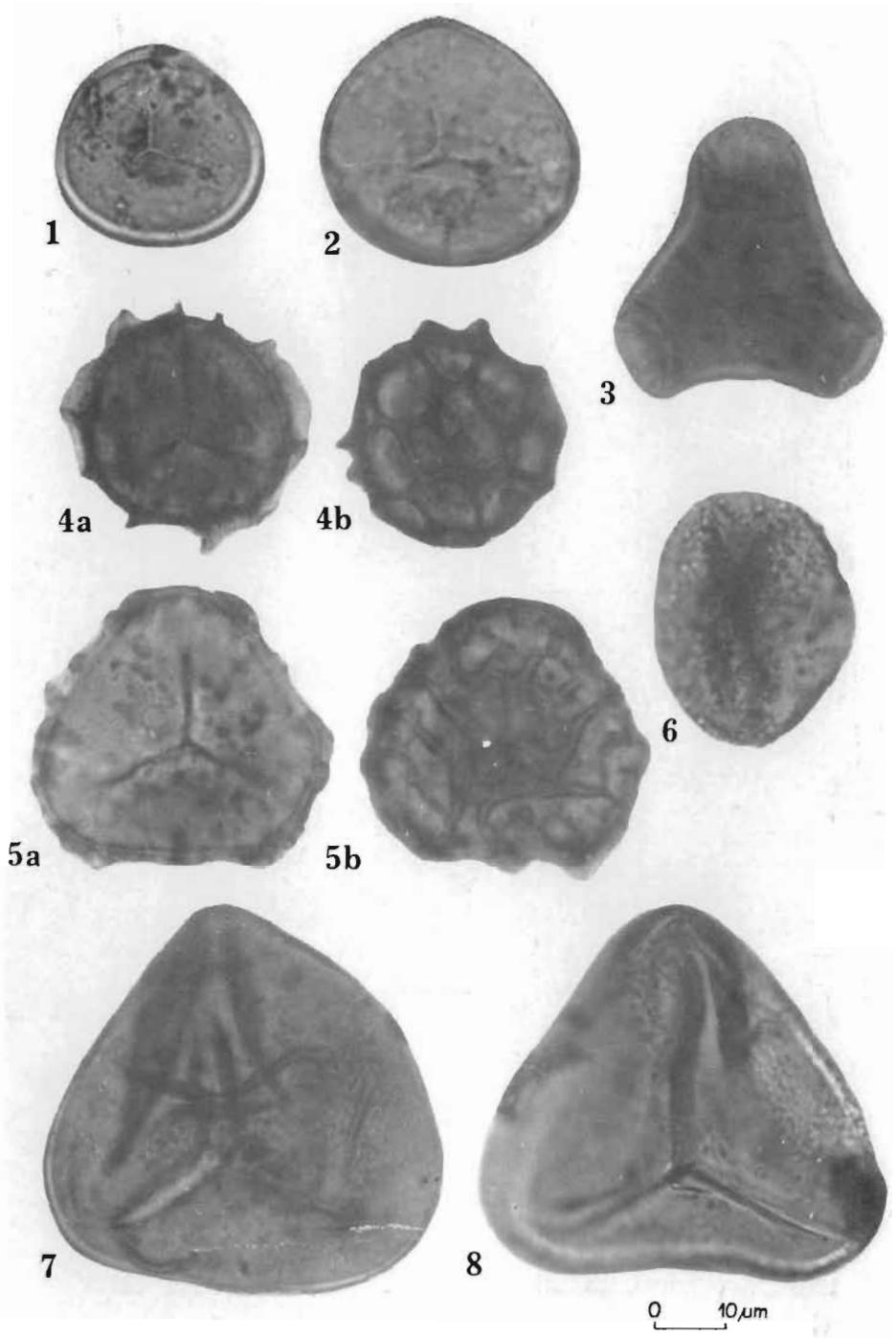
Plate 23

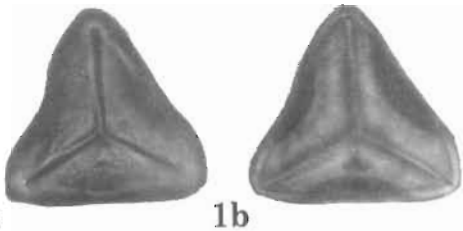
1. *Trilites distalgranulatus* Couper; depth 179 m; WG. Z. Pal. MB1/152; *a* proximal view, *b* distal view.
2. *Ornamentifera* cf. *echinata* (Bolkhovitina) Bolkhovitina; depth: 170.4 m; WG. Z. Pal. MB1/176; *a* distal view, *b* proximal view.
3. *Concavissimisporites minimus* Herngreen; depth: 143.5 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. MB1/169; *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. *Sciadopityspolennites 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.


1
2
3
4a
4b
5a
5b
6
7
8
0 10 µm



1a 1b

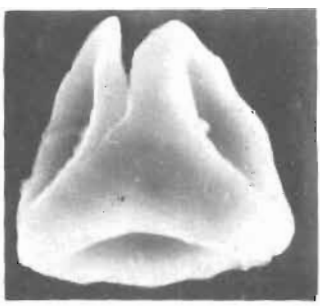
2a

2b

3

5

4



6

7

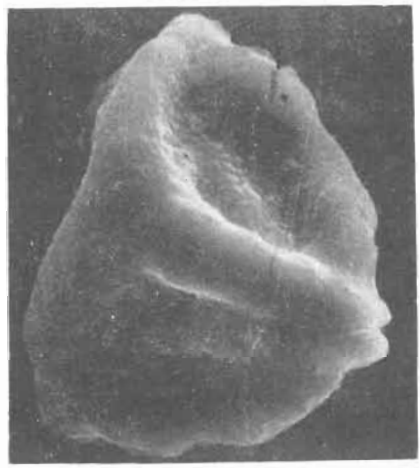
1

2a 2b

2c

3a

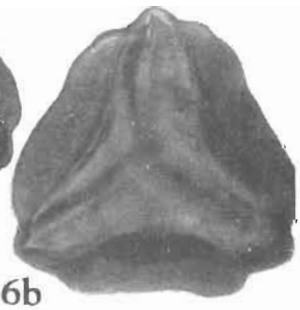
3b



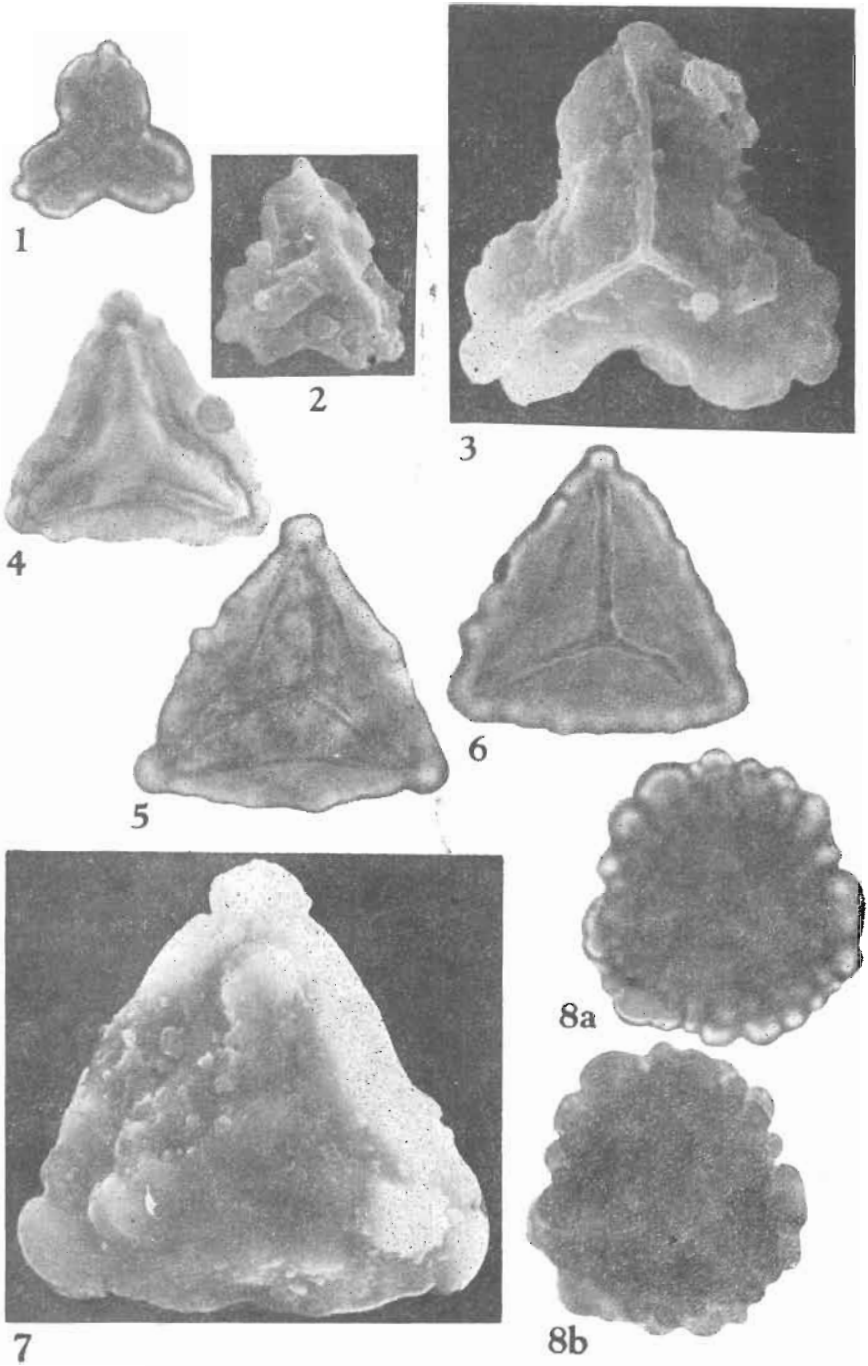
4

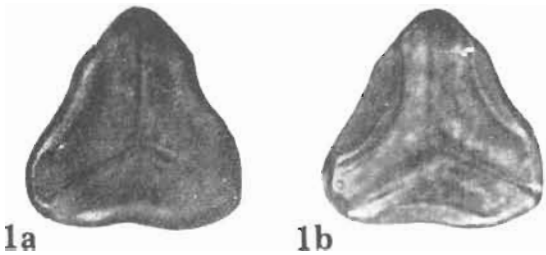
5

6a

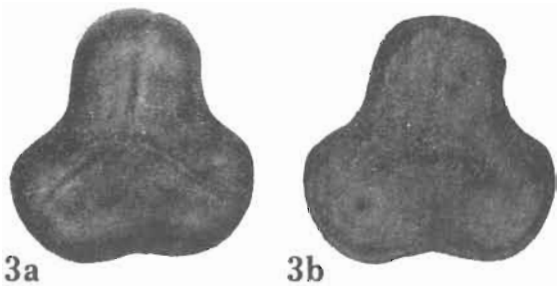


6b


1
2
3
4
5
6
7
8a
8b


1a
1b


2a


3a
3b


2b

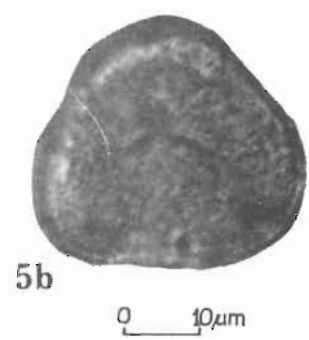

4a
4b

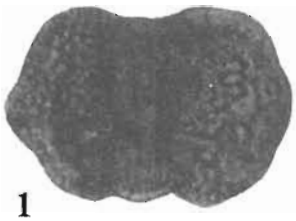

5a


6a
6b

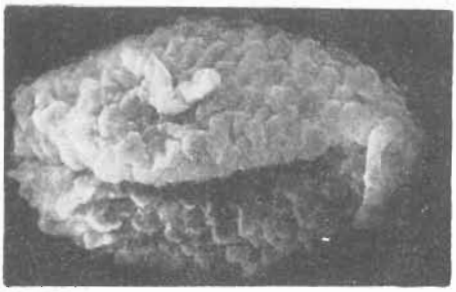

7

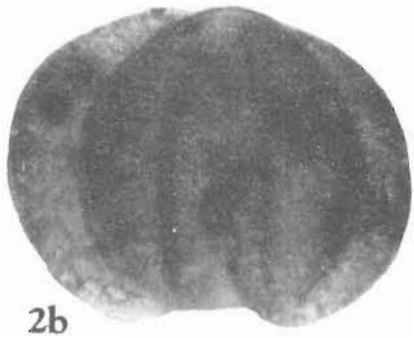

8

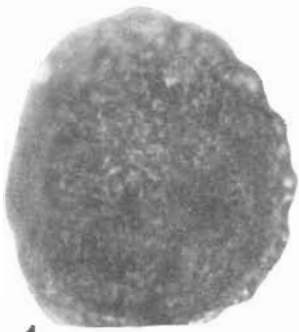

5b
0 10µm

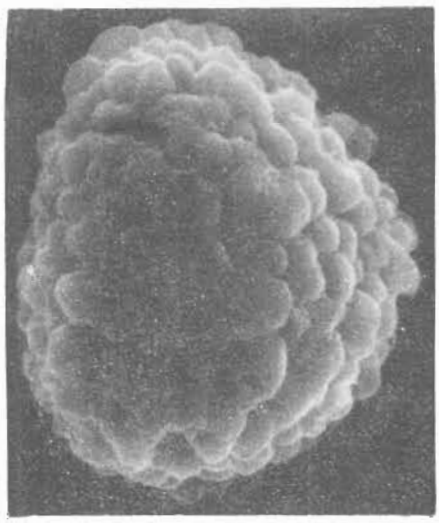

1


2a


3


2b


4


6

5