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MARTA WAKSMUNDZKA

LOWER CRETACEOUS MEGASPORES FROM NORTHERN POLAND

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Described are eight megaspore species from the Lower Cretaceous sediments of northern Poland, among them one new combination. The described taxa represent genera: *Minerisporites, Arcellites, Hughesisporites, Erlansonisporites, Verrutriletes* and *Trileites* (*Triletes*). The megaspore wall morphology has been examined in SEM.

K e y w o r d s: megaspores, wall morphology, Lower Cretaceous, Poland.

Marta Waksmundzka, Instytut Geologiczny, Zakład Stratygrafii, Tektoniki i Paleogeografii, ul. Rakowiecka 4, 00-975 Warszawa. *Received: December 1981.*

INTRODUCTION

The material studied comes from the following boreholes drilled by the Geological Institute in Pomerania (Northern Poland): Człuchów IG-2, Klosnowo IG-1 and Tuchola IG-1 (fig. 1).

The age of rocks (siltstones, claystones and sandstones; fig. 2) containing megaspores has been estimated as Valanginian-Hauterivian (Dembowska 1973, Ryll *et al.* 1977, Szyperko-Śliwczyńska *et al.* 1977). The megaspores have been here classified according to the artificial systematics by Potonié (1956).

The collection is stored in the Museum of the Geological Institute, Warszawa (abbreviated as IG). SEM micrographs have been taken in the Laboratory of Electron Microscopy, Nencki Institute of Experimental Biology, Polish Academy of Sciences, Warszawa.

Acknowledgements. — Thanks are due to Lidia Jakubowska (Geological Institute, Warszawa) for useful discussion and help in redaction of this paper.

I am especially indebted to Halina Majchrzak (Geological Institute) for making available the material for study, all micrographs and preliminary taxonomic determinations.

Fig. 1. Location of profiles with megaspores.

DESCRIPTION

Anteturma Proximegerminantes Potonié, 1970
Turma Triletes-Azonales (Reinsch, 1881) Potonié, 1970
Subturma Azonotriletes Luber, 1935
Infraturma Laevigati-Quasilaevigati (Bennie et Kidston, 1886) Potonié, 1970
Genus *Trileites* (Erdtmann 1945, 1947) Potonié, 1956
Trileites spurius (Dijkstra) Potonié, 1956
(pl. 51: 1)

1951. *Triletes spurius* Dijkstra: 9, pl. 2: 20.

1956. *Trileites (Triletes) spurius* (Dijkstra) Potonié; Potonié: 23.

Material. — Two specimens (IG MW 2/1, 2), good state of preservation; Człuchów IG-2, depth 1199,4—1206,4 m.

Dimensions:

megaspore diameter	900—975 μm
length of Y-rays	2/3 R
width of Y-rays	50—52 μm

Description. — Equatorial outline oval. Y-rays cylindrical, contact faces separated from the remaining part of spore by outlined arcuate lines. Granulations on exine surface visible under SEM.

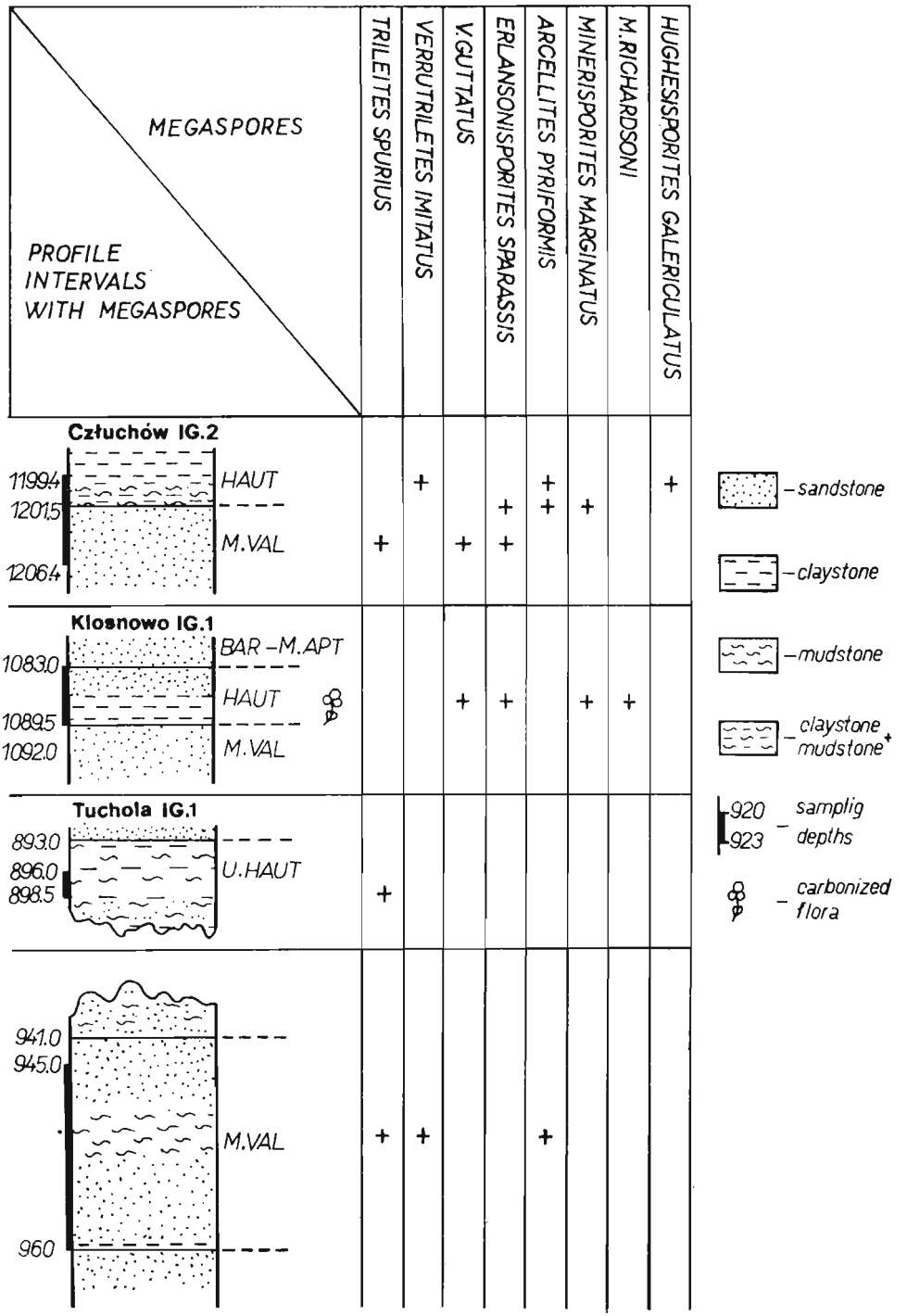

Fig. 2. Fragments of profiles with megaspores.

Remarks. — All the spores studied differ from the holotype described by Dijkstra (1951): pl. 9) in narrower trilete mark.

Occurrence. — Poland: Lower Cretaceous (Człuchów). Holland: Weald.

Botanical affinity. — Unknown.

Infraturma Apiculati (Bennie et Kidston, 1886) Potonié, 1956
Genus *Verrutriletes* (Vander Hammen, 1954) Potonié, 1956
Verrutriletes imitatus (Dijkstra) comb. nov.

(pl. 48: 1*a*—*d*, 2)

1959. *Triletes imitatus* Dijkstra: 12, pl. 1. 1a, 1b, 2.

Material. — Four specimens (IG MW 2/3—6), good state of preservation; Człuchów IG-2, depth 1199.4—1201 m, Tuchola IG-1, depth 945.0—960 m.

Dimensions:

megaspore diameter	625—746 μm
length of Y-rays	R
width of Y-rays	30 μm
verrucae diameter	25—30 μm

Description. — Equatorial outline oval. Y-rays in form of convex listes. Arcuate ridges delicately outlined. Exine ornamented over the whole surface except the contact areas. Ornamentation particularly well visible in SEM in form of reddish-brown, shining verrucae irregularly spaced (scattered) on the megaspore surface. Exine surface granular.

Remarks. — Characteristic verrucate ornamentation allows to include the megaspores in question into the genus *Verrutriletes* proposed by Potonié (1956). These forms are comparable to *V. carbunculus* (Dijkstra) Potonié but differ from the latter in being less spherical and showing surface covered more regularly with verrucae. Marcinkiewicz's (1979) opinion of the verrucae as "fungi-like structures" will be discussed separately.

Occurrence. — Poland: Lower Cretaceous (Tuchola, Człuchów). Holland: Weald.

Botanical affinity. — According to Potonié (1967) the spores classified to *Verrutriletes* are comparable to megaspores classified to *Isoëtes*.

Verrutriletes guttatus Marcinkiewicz, 1971

(pl. 49: 1*abd*)

1971. *Verrutriletes guttatus* Marcinkiewicz: 33, pl. 5: 4—8; pl. 6: 1—6.

Material. — Two specimens (IG MW 2/7, 8), one well preserved and one damaged; Człuchów IG-2, depth 1199.4—1206.4 m, Klosnowo IG-1, depth 1083—1089.5 m.

Dimensions:

megaspore diameter	490 μm
length of Y-rays	2/3 R
width of Y-rays	30 μm
verrucae diameter	6—60 μm

Description. — See Marcinkiewicz (1971: 33).

Remarks. — The specimen studied shows verrucae of maximum diameter concentrated in radial part of equatorial zone whereas on the specimens described by Marcinkiewicz (1971) verrucae of maximum diameter are scattered over the entire surface of megaspore. *V. guttatus* differs from *V. imitatus* in more triangular equa-

torial outline of spore and distinct differentiation of verrucae diameter. See also remarks on *V. imitatus*.

Occurrence. — Poland: Lower Cretaceous (Człuchów, Tuchola); Lower Rhaetian (Polish Lowlands).

Botanical affinity. — See botanical affinity of *V. imitatus*.

Infraturma Murornati Potonié et Kremp, 1954
Genus *Erlansonisporites* Potonié, 1956
Erlansonisporites sparassis (Murray) Potonié, 1956
(pl. 51: *2ab*, *3abc*)

1939. *Triletes sparassis* Murray: 480, 483, fig. 3.
1956. *Erlansonisporites sparassis* (Murray) Potonié; Potonié: 47.
1961. *Triletes sparassis* Murray; Harris: 57, pl. 18: A—D.
1980. *Erlansonisporites sparassis* (Murray) Potonié; Marcinkiewicz: 85, pl. 20: 4, 5, pl. 21: 7.

Material. — Ten specimens (IG MW 2/9—18, good preservation state; Człuchów IG-2, depth 1199.4—1206.4 m, Klosnowo IG-1, depth 1083—1089.5 m.

Dimensions:

megaspore diameter	470—600 μm
length of Y-rays	2/3 R
height of lamellae on proximal side	50—51 μm
height of lamellae on distal side	28—30 μm
width of lumina	30—60 μm
width of muri	8—10 μm

Description. — See Harris (1961: 57).

Remarks. — I agree with Harris (1961) that morphologic differentiation of the species in question (pl. 51: *2ab*, *3abc*) is a result of maceration process which may cause softening, swelling or distension of lamellae of reticulum and of the entire megaspore.

Occurrence. — Poland: Pliensbachian-Bajocian (Polish Lowlands); Bathonian (Grójec); Lower Cretaceous (Człuchów, Klosnowo). England: Aalenian-Bathonian. Bornholm: Middle Jurassic. GDR: Lower Toarcian. USA: Aptian, Middle Albian.

Botanical affinity. — According to Harris (1961) frequency of tetrads in sediments investigated by him suggests association of *Erlansonisporites* with the genus *Selaginella*.

Subturma Lagenotriletes Potonié et Kremp, 1954
Infraturma Trifoliati, Barbati Potonié, 1970
Genus *Hughesisporites* Potonié, 1956
Hughesisporites galericulatus (Dijkstra) Potonié, 1956
(pl. 51: *4abc*)

1951. *Triletes galericulatus*; Dijkstra: 14, pl. 2: 16; pl. 3: 5.
1956. *Hughesisporites galericulatus* (Dijkstra) Potonié; Potonié: 71, pl. 9: 92, 93.
1959. *Triletes galericulatus* Dijkstra; Dijkstra: 13, pl. 1: 7, 8.

Material. — One specimen (IG MW 2/383), good state of preservation; Człuchów IG-2, depth 1194.5—1199.4 m.

Dimensions:

megaspore diameter	310 μm
length of Y-rays	R
height of Y-rays	20 μm
width of Y-rays	30 μm
length of spines near Y mark	up to 100 μm
width of spines (at base) near Y mark	up to 20 μm

Description. — Equatorial outline of spore triangular-oval. Y-rays convex. Outline of arcuate ridges invisible. Exine on distal surface smooth but on proximal surface ornamented in places. Sculpture elements occur in the central part of spore in interradial zone and are developed in form of spines. Spine bases (see pl. 51: 4b, c) are either isolated one from another or fused, top are, however, always isolated, oriented toward the spore axis.

Remarks. — *H. galericulatus* has been classified to the *Lagenicula* group (Dijkstra 1951), the latter being characterized by the presence of gula. This classification has been questioned by Hughes (1955), who has noticed that some spines making the so-called gula are isolated one from another. The observations were done both on his own specimens and on those described previously by Dijkstra (1951). Potonié (1970) has classified *H. galericulatus* to the infraturma Trifoliati, Barbati. The opinions of Hughes and Potonié are confirmed by data obtained by the present author. Scanning electron microscope images show clearly that the ornamentation elements in form of spines are always isolated in the upper part which excludes the possibility of existence of gula.

Occurrence. — Poland: Lower Cretaceous (Człuchów). Holland: Weald.

Botanical affinity. — Unknown.

Subturma: Pyrobolotriletes Potonié, 1956
Genus: *Arcellites* (Miner, 1935) Ellis and Tschudy, 1964
Arcellites pyriformis (Dijkstra) Potter, 1963
(pl. 49: 2*ab*)

1951. *Triletes pyriformis* Dijkstra: 14, pl. 2: 9.
1955. *Pyrobolospora pyriformis* (Dijkstra) Hughes: 209, pl. 11: 1, 2.
1963. *Arcellites pyriformis* (Dijkstra) Potter: 228.

Material. — Four specimens (IG MW 2/19—22), good state of preservation; Człuchów IG-2, depth 1194.5—1199.4 m; 1199.4—1206.4 m; Tuchola IG-1, depth 945—960 m.

Dimensions:

total megaspore lengths	650	700	700	750 μm
height of gula	350	350	225	250 μm
megaspore width	500	490	625	590 μm
diameter of appendages	20—50 μm			

Description. — See Hughes (1955: 209).

Occurrence. — Poland: Lower Cretaceous (Człuchów, Tuchola). England: Weald. Holland: Weald.

Botanical affinity. — According to Hughes (1955) the genus *Arcellites* is associated with a group of aquatic ferns which is proved by the existence of appendages on the surface. According to Singh (1964) the affinity of *Arcellites* to aquatic ferns

(Salviniales or Marsiliales) is proved by location of Y mark under the gula appendages and large quantity of hollow appendages on the megaspore surface which enabled its buoyancy. Tschudy (1976) classifies this genus within the family Marsiliaceae.

Turma: Triletes-Zonales (Bennie et Kidston, 1886 von Ibrahim) Potonié, 1970

Subturma: Zonotriletes Waltz, 1935

Infraturma: Zonati Potonié et Kremp, 1954

Genus: *Minerisporites* Potonié, 1956

Minerisporites marginatus (Dijkstra) Potonié, 1956

(pl. 50: 1*abcd*)

1951. *Triletes marginatus* Dijkstra: 13, pl. 3: 11.
1956. *Minerisporites marginatus* (Dijkstra) Potonié: 68.
1969. cf. *Minerisporites marginatus* (Dijkstra) Potonié; Batten: 343, pl. 65: 9—20; pl. 66: 1—4; pl. 67: 11, 12.
1971. *Minerisporites marginatus* (Dijkstra) Potonié; Singh: 219, pl. 37: 9.

Material. — 355 specimens (IG MW 2/23—378), good state of preservation; Człuchów IG-2, depth 1199.4—1206.4 m, Klosnowo IG-1, depth 1083—1089.5 m.

Dimensions:

megaspore diameter	175—350 μm
length of Y-rays	R
height of Y-rays	5—10 μm
width of equatorial zone	40—60 μm
width of lumina of reticulum	6—10 μm
height of spines forming at crossings of reticulum ridges	2—4 μm

Description. — See Batten (1969: 343). Perforation of exine, walls of reticulum and of spines located at junction points of the particular reticulum ridges are clearly observable in scanning electron microscope (pl. 50: 1*d*).

Remarks. — The megaspore decribed differs from *M. richardsoni* in more oval shape, lack of auriculae in radial region of equatorial zone and less distinct ornamentation near Y-mark.

This species was first stated in the Lower Cretaceous of Polish Lowlands by Mamczar (*in press*).

Occurrence. — Poland: Lower Cretaceous (Człuchów, Klosnowo). England: Weald. Holland: Weald; Southern Australia: Weald. USA: Aptian, Middle Albian.

Botanical affinity. — According to Singh (1964) there is an affinity between all the species representing the genus *Minerisporites* and the family Selaginellaceae.

Minerisporites richardsoni (Murray) Potonié, 1956

(pl. 50: 2*abcd*)

1939. *Triletes richardsoni* Murray. 482, 485, fig. 9.
1956. *Minerisporites richardsoni* (Murray) Potonié; Marcinkiewicz: 38, pl. 17: 6, 7; pl. 18: 1—6.

Material. — Four specimens (IG MW 2/379—382), good state of preservation: Klosnowo IG-1, depth 1083—1089.5 m.

Dimensions:

megaspore diameter	320—380 μm
length of Y-rays	R
height of Y-rays	28—32 μm
width of equatorial zone in radial region	20—22 μm
width of equatorial zone in interradial region	48—50 μm
width of lumina of reticulum	5—20 μm
height of spines forming ridge at junction points of reticulum	2—4 μm

Description. — See Harris (1961: 46). Similarly as in the case of *M. marginatus*, perforation of exine, reticulum walls and of spines located at junction points of the particular reticulum ridges are observable in SEM (pl. 50: 2*d*).

Remarks. — See *M. marginatus*.

Occurrence. — Poland: Pliensbachian-Upper Toarcian (Polish Lowlands); Lower Cretaceous (Klosnowo). England: Jurassic.

Botanical affinity. — *M. richardsoni* was classified so far to the *Selaginella* among other due to small quantity of megaspores in macrosporangia. Marcinkiewicz (1971) assigned this megaspore to the genus *Lepidostrobus* because fragment of the macrosporangium of *M. richardsoni* contained 6 megaspores. This author has compared *M. richardsoni* with *Thomsonia phyllica*, previously classified to the genus *Selanginella* and then, by Harris (1961), to the genus *Lepidostrobus*. Both, the shape of macrosporangium and large quantity of megaspores (25) within it, resembling those of *Lepidostrobus*, have served to Harris for the change of botanical affinity of *Thomsonia phyllica*. As to *M. richardsoni*, however, a fragmentary macrosporangium of unknown shape and size and partially preserved contents hardly could justified its affiliation to the genus *Lepidostrobus*. According to Singh (1964) all *Minerisporites* correspond to family Selaginellaceae.

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MARTA WAKSMUNDZKA

DOLNOKREDOWE MEGASPORY Z PÓŁNOCNEJ POLSKI

Streszczenie

Zespół zawiera ponad 10 gatunków, z których opisano tu osiem, w tym jedną nową kombinację — *Verrutriletes imitatus* (Dijkstra). Spośród nich tylko *Minerisporites marginatus* był notowany z kredy Polski (Mamczar *in press*), a pozostałe były bądź na tym terenie nieznane, bądź znajdowane w starszych osadach. Wyodrębniono nowe cechy charakteryzujące morfologię ścian na podstawie obserwacji w SEM.

EXPLANATION OF THE PLATES 48—51

Plate 48

1, 2. *Verrutriletes imitatus* (Dijkstra) comb. nov. 1 specimen No IG MW 2/3, Człuchów IG-1, 1199—1201 m: *a* proximal surface; *b* distal surface; *c* proximal surface, SEM; *d* exine fragment, SEM. 2 specimen No IG MW 2/4, Tuchola IG-1, 945—960 m: proximal surface, in transmitted light.

1*a*, 1*b*, 1*c*, 2×100; 1*d* ×500

Plate 49

1. *Verrutriletes guttatus* Marcinkiewicz, specimen No IG MW 2/7, Człuchów IG-2, 1199.4—1206 m: 1*a* proximal surface; 1*b* distal surface; 1*c* proximal surface, SEM; 1*d* exine fragment, SEM.
2. *Arcellites pyriformis* (Dijkstra) Potter, specimen No IG MW 2/19, Człuchów IG-2, 1194.5—1199.4 m: 2*a* lateral surface, 2*b* lateral surface, SEM.

1*a*, 1*b*, 2*a*, 2*b* ×100; 1*c* ×120; 1*d* ×500

Plate 50

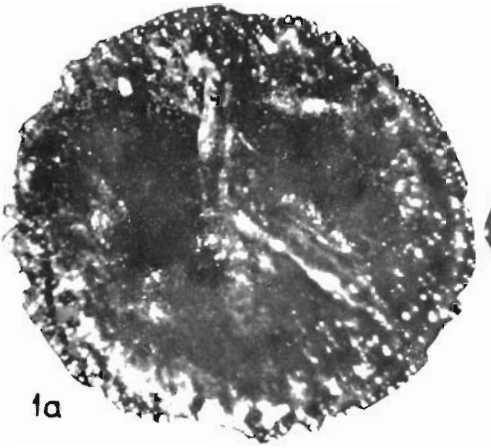
1. *Minerisporites marginatus* (Dijkstra) Potonié, specimen No IG MW 2/23, Klosnowo IG-1, 1083—1089.5 m: 1*a* proximal surface; 1*b* distal surface; 1*c* distal surface, SEM; 1*d* exine fragment, SEM.
2. *Minerisporites richardsoni* (Murray) Potonié, specimen No IG MW 2/379, Klosnowo IG-1, 1083—1089.5 m: 2*a* proximal surface; 2*b* distal surface; 2*c* proximal surface, SEM; 2*d* exine fragment, SEM.

1*a*, 1*b*, 2*a*, 2*b* ×100; 2*c* ×160; 1*c* ×220; 1*d* ×500; 2*d* ×1000

Plate 51

1. *Trileites* (*Triletes*) *spurius* (Dijkstra) Potonié, specimen No IG MW 2/1, Człuchów IG-2, 1199.4—1206.4 m; proximal surface.
2, 3. *Erlansonisporites sparassis* (Murray) Potonié, 1 specimen No IG MW 2/18, Klosnowo IG-1, 1083—1089.5 m: 2*a* lateral surface; 2*b* lateral surface SEM. 3 specimen No IG MW 2/19, Klosnowo IG-1, 1083—1089.5 m: 3a proximal view; 3b distal view; 3c distal view, SEM.
4. *Hughesisporites galericulatus* (Dijkstra) Potonié, specimen No IG MW 2/383, Człuchów IG-2, 1194.5—1199,4 m: 4*a* lateral surface; 4*b* lateral surface, SEM; 4*c* proximal surface, SEM.

1×60; 2*a*, 2*b*, 3*a*, 3*b*, 3*c*, 4*a* ×80; 4*b* ×106; 4*c* ×400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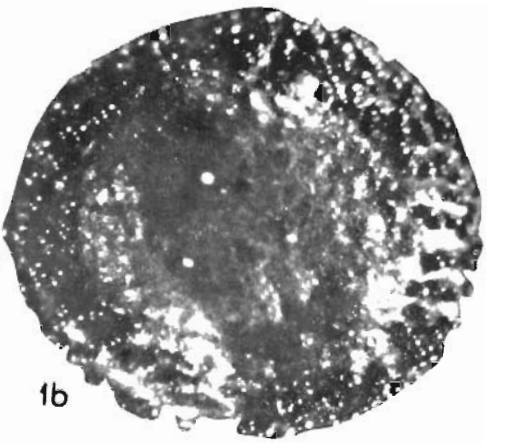
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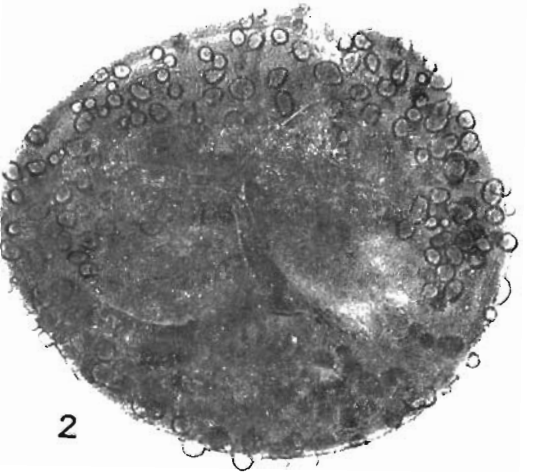
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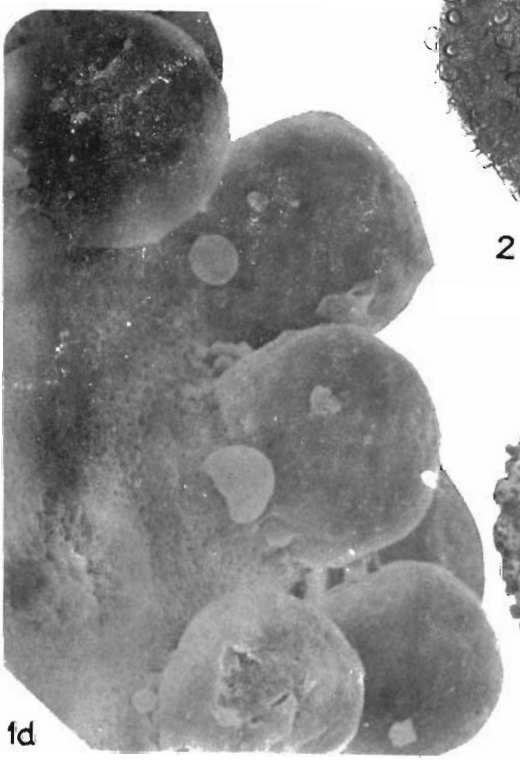
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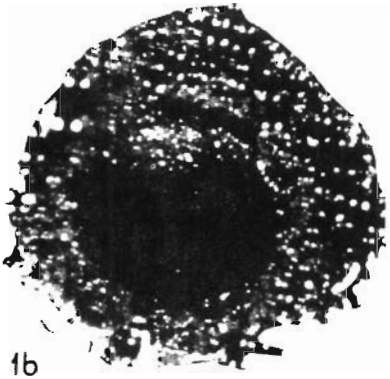
1c



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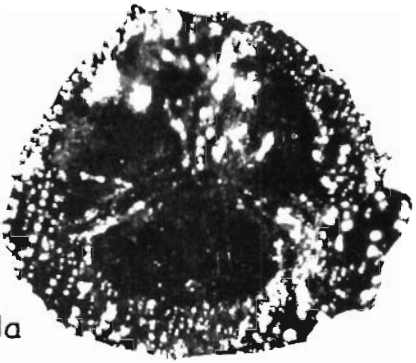
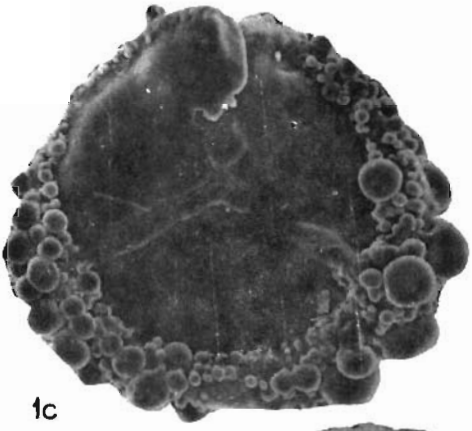


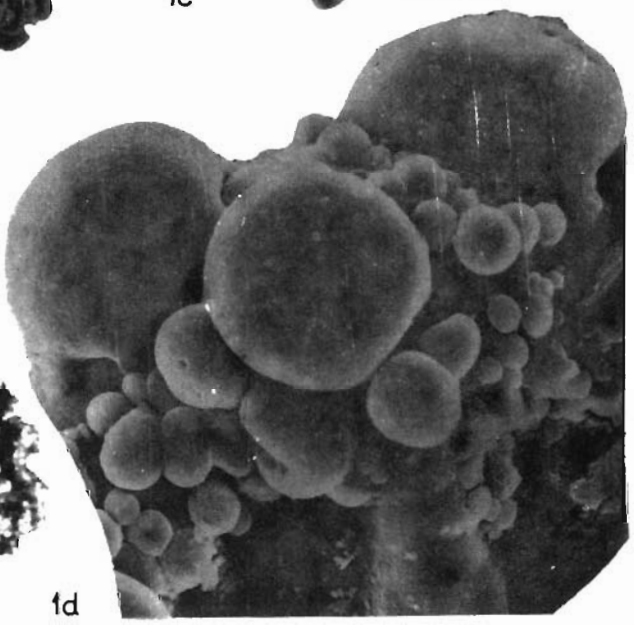
1a

2b

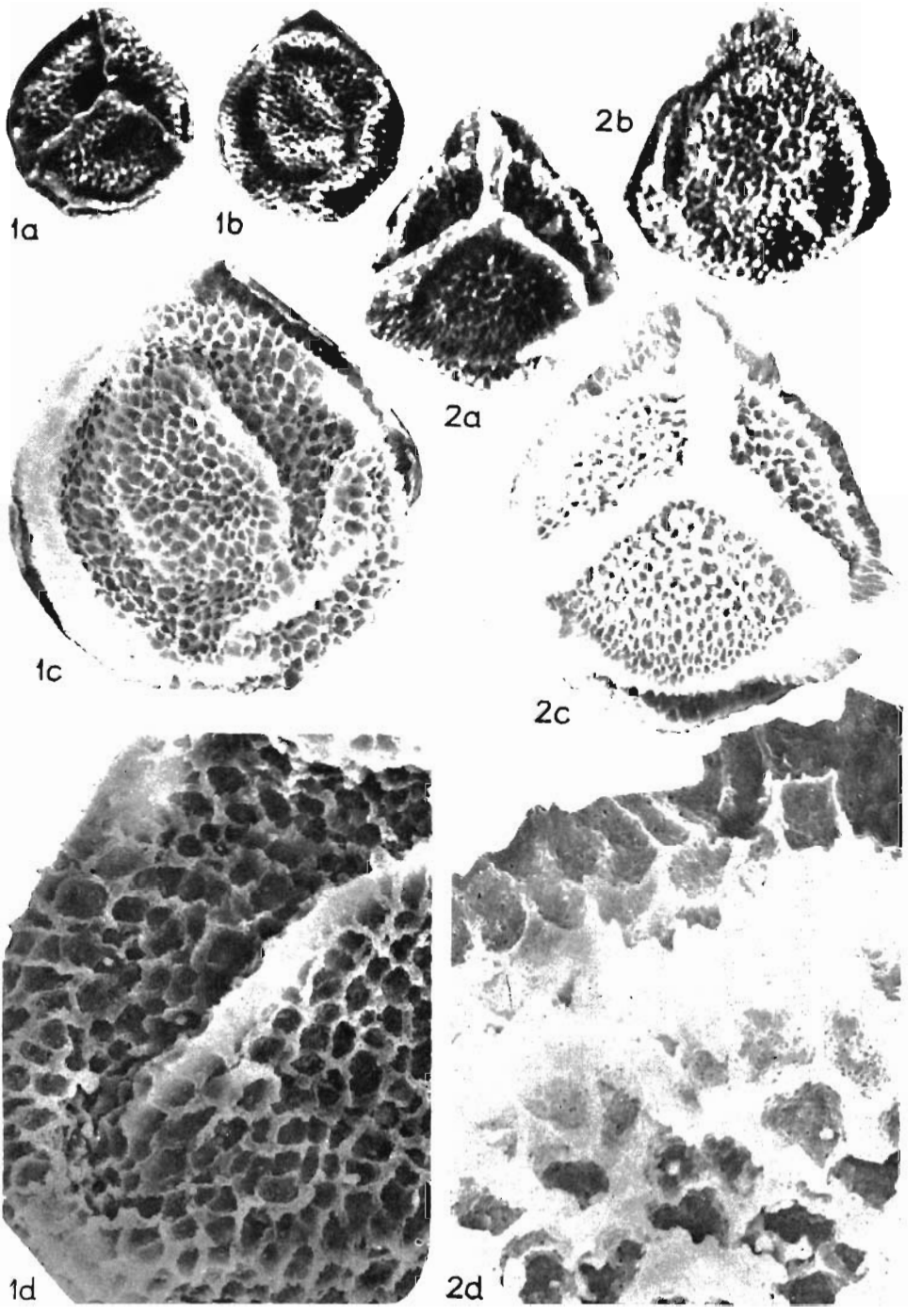


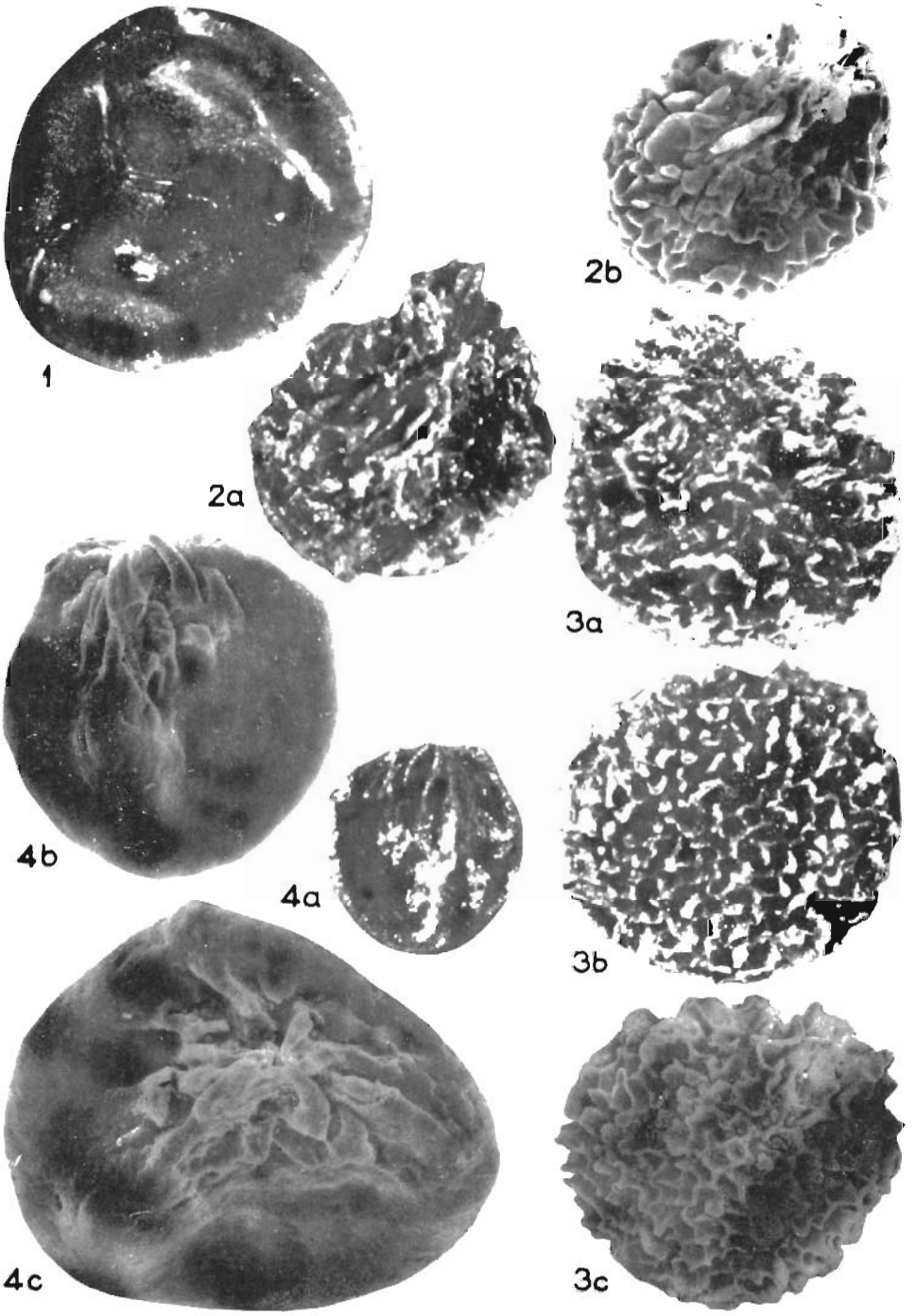
1c

2a



1d


1a
1b
2a
2b
1c
2c
1d
2d


1
2a
2b
3a
3b
3c
4a
4b
4c