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BADENIAN (MIDDLE MIOCENE) CALCAREOUS NANNOFOSSILS FROM PÂGLIŞA (CLUJ DISTRICT): BIOSTRATIGRAPHICAL IMPORTANCE

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ABSTRACT. The calcareous nannofossils from the Middle Miocene (Badenian) formations from Pâglişa (Cluj district) are typical for the Lower and Middle Badenian, respectivelly Moravian and Wielician (or Langhian). The detailed study of the calcareous nannofossils from the Pâglişa section revealed the presence of the nannoplankton assemblages belonging to the NN5 and NN6 zones. They have been remarked 40 species of calcareous nannofossils. There are mentioned especially the most representative species and their biostratigraphical significance.

KEYWORDS: Middle Miocene (Badenian), calcareous nannofossils, biostratigraphy, Pâglişa, Transylvanian Basin.

LOCATION

We analysed the calcareous nannofossils from the former tuff quarry from Peşterii Valley – Pâglişa (Cluj district). It is situated at about 60 km from Cluj-Napoca, on the road between Pănticeni and Dăbâca localities (Fig. 1). Peşterii Valley is situated east from Pâglişa, the road with the old quarry begin from the western border of the village.

GEOLOGICAL SETTING

In the studied area there are natural and artificial outcrops of Miocene sedimentary formations represented by the Hida Formation. The Hida Formation (Ottnangian) contains an alternance of marls and sandstones with lenticular interbedded conglomerates. These deposits outcrop on the right side of Peşterii Valley, Morăului Valley and Pâglişei Valley, being represented by polygene microconglomerates, sandstones, sands, clays and sandy marls. The upper part of that formation, respectivelly the contact with the Dej Formation do not outcrop on the Peşterii Valley section.

The Dej Formation (Early Badenian) (Popescu, 1970) is transgressivelly disposed on the Hida Formation.

On the Peşterii Valley section the lithologic sequences of this formation contain an alternance of tuffs and *Globigerina* marls with an about 40 m vertical extent (Tab. 1).

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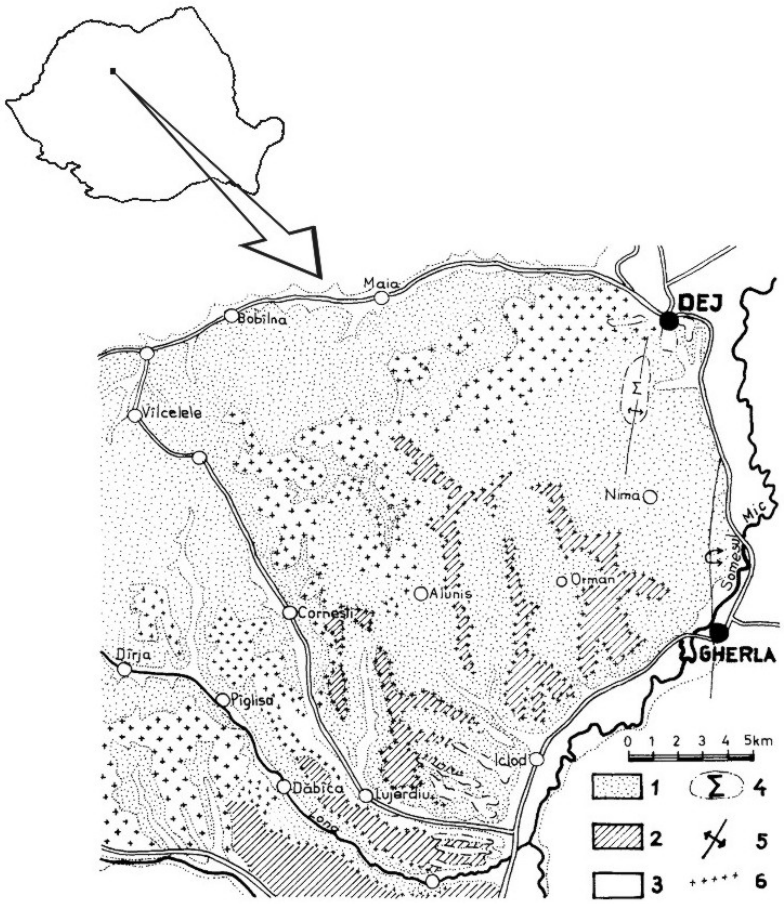

Fig. 1. Location and geological map (after Saulea et al., 1968) of the studied area.
Legend: 1. Lower and Middle Badenian deposits; 2. Upper Badenian deposits; 3. Quaternary deposits; 4. Salt dyapir; 5. Antincline axe; 6. Tuff levels.

The tuffs horizons are delimited on west by the Pâglişei Valley, on east by the Corneşti Valley, on north by the Borcău Brook and on south they are extended to the Dăbâca locality. They occur on a large area on Peşterii Valley, Morăului Valley, Pâglişei Valley and Rea Valley.

The tuffs are dominated by vitroclastic and cristaloclastic petrofacies on the base of the section while in the upper part, the vitro-cristaloclastic type dominate. Szabo (1999) mentioned a tetrasequential volcanoclastic succesion.

In the upper part of the formation marine – lagunar deposits with compact fine and grob marls, clays and rarely sandstones and fine sands belonging to the Mireş Formation (Middle – Upper Badenian) (Upper Langhian – Lower Serravalian) occur. Lentiliform interbedded of white compact gypsum, with a width of 70 – 80 cm also occur. The marls with evaporites occur in the upper part of the Peşterii Valley and in the tuff quarry (Szabo, 1999).

BADENIAN CALCAREOUS NANNOFOSSILS ASSEMBLAGES: GENERAL CONSIDERATIONS AND RESULTS FROM PÂGLIŞA

The calcareous nannoplankton assemblages, typical for Lower and Middle Badenian (or Langhian) - Moravian and Wielician belong to NN5 - *Sphenolithus heteromorphus* and NN6 – *Discoaster exilis* zones (after Martini's zonation, 1971).

Within the entire Central Paratethys, Badenian starts with the NN5 zone, while Langhian starts with the upper part of the NN4 – *Helicosphaera ampliaperta*. The Upper Badenian was correlated with Serravalian up to the medium levels of the latter. It is considered that Kossovian can be correlated either with the NN6 and part of the NN7 zone or with the NN6 zone (Rögl, 1996, 1997; Mărunțeanu, 1991; Mărunțeanu & Chira, 1998; Chira, 1999; Chira & Mărunțeanu, 2000; Mărunțeanu et al., 2000; Mészáros, 1991, 1995; Nicorici & Mészáros, 1994, a. o.).

The NN5 – *Sphenolithus heteromorphus* zone was defined by Bramlette & Wilcoxon (1967) between the last occurrence of *Helicosphaera ampliaperta* and the last occurrence of *Sphenolithus heteromorphus*. It is noticeable the domination of *Discoaster deflandrei* species within the lower part of the zone. The elliptical forms of *Calcidiscus macintyrei* and *Calcidiscus leptoporus centrovalis* become common and, within the upper part of the zone, the first occurrence of *Triquetrorhabdulus rugosus* is noted.

Bukry (1973) mentioned the first occurrence of *Sphenolithus abies* within the *Sphenolithus heteromorphus* zone. The first forms of *Reticulofenestra pseudoumbilicus* are noticed in this zone.

The NN5 zone has also the following subzones (Mărunțeanu & Chira, 1998; Mărunțeanu et al., 2000):

- NN5a: the *Geminilithella rotula* (= *Calcidiscus annula*) subzone;
- NN5b: the *Helicosphaera wallichii* subzone.

The *Discoaster exilis* (NN6) zone was defined by Hay (1970) (emend. Martini, 1974) between the last occurrence of *Sphenolithus heteromorphus* – the first occurrence of *Discoaster kugleri* and/or the last occurrence of *Cyclicargolithus floridanus*. *C. floridanus* is less abundent near the upper part of the zone and it is replaced by the abundent *Reticulofenestra pseudoumbilicus.*

The calcareous nannoplankton determined from Pâglişa section (Peşterii Valley), belongs to the NN5 and NN6 zones and contains about 40 species (Tab 2).

By analyzing the species distribution of the 34 samples, we have noticed, the occurrence of *Discoaster brouweri* (Pl. III, fig. 4) in sample 12 as well as the form *Helicosphaera wallichii* (Pl. I, figs. 6a, 6b) in sample 19 within the first half of the lower part of the section. The two taxa occur almost simultaneously in the upper part of Dej Formation, respectively the upper part of the NN5 zone.

We have also noticed the even earlier occurrence of *Sphenolithus abies* species in sample 2 and *Triquetrorhabdulus cf. farnsworthii* (Pl. III, fig. 7) and/or *Triquetrorhabdulus rugosus* (samples 3/9) (PL. III, fig. 6) which would belong to the same bioevent, corresponding to the upper part of the NN5 zone. Also, *Helicosphaera walbersdorfensis* (Pl. I, figs. 5a, 5b) shows up from sample 1b on.

Considering the possible division of the NN5 zone in subzone NN5a (*Geminilithella rotula* = *Calcidiscus annula*) and NN5b (*Helicosphaera wallichii*) (Mărunțeanu in Mărunțeanu et al., 2000) we can see that the *Calcidiscus annula*

species (Pl. II, figs. 1a, 1b) appears in the entire profile and *Helicosphaera wallichii* only in sample 19. The occurrence of the latter, as well as the abundance of *Discoaster broweri* indicates the proximity of the NN5 - NN6 zone boundary.

Frequent discoasters appear in sample 25. In samples 31, 32, 33, the assemblages with *Discoaster broweri*, *Reticulofenestra pseudoumbilicus* and *Reticulofenestra gelida* prevail.

Discoaster exilis (Pl. III, fig. 1) appears from sample 2 up to the penultimate one (33).

Its first occurrence was noticed from the bottom of the NN5 zone (Moravian) on. Wielician is correlated with the upper part of the NN5 zone and the lower part of the NN6 zone (possibly beginning with the first occurrence of *Discoaster brouweri*).

Kossovian generally correspond to the largest part of the NN6 zone, its upper boundary being influenced by the dissappearance of *Cyclicargolithus floridanus*. *Sphenolithus heteromorphus* (Pl. I, figs. 1a, 1b) – index species for NN5 – shows up to the sample 29, inclusively. In the last sample it is not noticed anymore. Here, we frequently notice *D. brouweri*, *S. abies*, *T. rugosus*, *H. walbersdorfensis*, *H. wallichii* and, sometimes, *C. leptoporus* (Pl.II, fig. 7) and *C. macintyrei* (PL. II, fig. 4).

Discoaster brouweri, *Reticulofenestra pseudoumbilicus* and *Reticulofenestra gelida* prevail in sample 32. All these species show together with the NN6 zone index – *Discoaster exilis*.

Obviously, the NN6 zone starts at least from sample 31. We have to mention the fact that there was no *Discoaster deflandrei*, regarded as dominant within the basis of NN5.

Triquetrorhabdulus rugosus occurs frequently from sample 9 on and its first occurrence is considered to be the upper part of the NN5 zone.

From the bottom of the Pâglişa profile up to its top we have frequently come across *Cyclicargolithus floridanus* (Pl. II, figs. 5a, 5b).

Calcareous dinoflagellates represented by thoracospherids are also sometimes present in the investigated samples.

CONCLUSIONS

The deposits belonging to the Dej Formation from the Pâglişa Valley contain calcareous nannoplankton assemblages belonging to NN5 and NN6 zones (partim).

The argumentation is based on: the presence of the index fossil *Sphenolithus heteromorphus* (from the sample nr. 1 to 30) and the abundant presence of the discoasterids: *Discoaster exilis* – the index species for NN6, and *D. brouweri*, a. o. species that indicate the presence of NN6 zone in the upper part of the section from Pâglişa (samples 31 – 34).

To conclude, within the Pâglişa profile, we determined 40 calcareous nannofossils species. Only 13 of these have been mentioned before (Mészáros in Mészáros & Şuraru, 1991). These deposits have been considered belonging only to NN5 zone (Mészáros in Mészáros & Şuraru, 1991).

The nannofossils assemblages allowed us to attribute the investigated deposits from the Dej Formation to the NN5 and to the NN6 (partim) zones. Due to the existence of Wielician gypsum over the deposits successions attributed to Dej

Formation we can conclude that the gypsum could be enclosed within the NN6 zone.

Tab. 2.

The distribution of the calcareous nannofossils, at Pâglişa
(in systematical order, after Young & Bown, 1997).

NANNOFOSSIL SPECIES samples	Moravian 1 –30	Wielician 31 –34
Helicosphaera carteri (WALLICH, 1877) KAMPTNER (1954)	X	X
Helicosphaera walbersdorfensis MÜLLER (1974)	X	X
Helicosphaera wallichii (LOHMANN, 1902) OKADA & MCINTYRE (1977)	X	X
Pontosphaera multipora (KAMPTNER, 1948) ROTH (1970)	X	X
Syracosphaera histrica KAMPTNER (1941)	X	X
Rhabdosphaera procera MARTINI (1969)	X	
Rhabdosphaera pannonica BALDI-BEKE (1960)	X	X
Rhabdosphaera sicca STRADNER in BACHMANN et al., 1963	X	
Rhabdosphaera poculi (BONA & KERNERNE SUMEGI 1964) MÜLLER (1974)	X	
Rhabdosphaera claviger MURRAY & BLACKMAN (1898)	X	X
Cyclicargolithus floridanus (ROTH & HAY *in* HAY *et al*., 1967) BUKRY (1971)	X	X
Cyclicargolithus abisectus (MÜLLER, 1970) WISE (1973)	X	
Reticulofenestra pseudoumbilicus (GARTNER, 1967) GARTNER (1969)	X	X
Reticulofenestra gelida (GEITZENAUER, 1972) BACKMAN (1978)	X	X
Reticulofenestra minuta ROTH (1970)	X	X
Reticulofenestra minutula (GARTNER, 1967) HAQ & BERGGREN (1978)	X	
Coccolithus miopelagicus BUKRY (1971)	X	X
Coccolithus pelagicus (WALLICH, 1877) SCHILLER (1930)	X	
Calcidiscus leptoporus (MURRAY & BLACKMAN, 1898) LOEBLICH & TAPPAN (1978)	X	X
Calcidiscus macintyrei (BUKRY & BRAMLETTE, 1969) LOEBLICH & TAPPAN (1978)	X	X
Calcidiscus cf. *pataecus* GARTNER (1967)		X
Geminilithella rotula (KAMPTNER, 1956) BACKMAN (1980)	X	X
Umbilicosphaera jafari MÜLLER (1974)	X	X
Holodiscolithus macroporus (DEFLANDRE *in* DEFLANDRE & FERT, 1954) ROTH (1970)	X	X
Braarudosphaera bigelowii (GRAN & BRAARUD, 1935) DEFLANDRE (1947)	X	X
Micrantolithus vesper DEFLANDRE *in* DEFLANDRE & FERT (1954)	X	
Discoaster variabilis MARTINI & BRAMLETTE (1963)	X	X
Discoaster exilis MARTINI & BRAMLETTE (1963)	X	X
Discoaster musicus STRADNER (1959)	X	X
Discoaster deflandrei BRAMLETTE & RIEDEL (1954)	X	
Discoaster brouweri TAN (1927) emended BRAMLETTE & RIEDEL (1954)	X	X
Discoaster cf. *bellus* BUKRY & PERCIVAL (1971)		X
Triquetrorhabdulus farnsworthii LIPPS (1969)	X	
Triquetrorhabdulus rugosus BRAMLETTE & WILCOXON (1967)	X	X
Triquetrorhabdulus sp.	X	
Sphenolithus heteromorphus DEFLANDRE (1953)	X	
Sphenolithus abies DEFLANDRE *in* DEFLANDRE & FERT (1954)	X	X
Sphenolithus neoabies BUKRY & BRAMLETTE (1969)	X	
Sphenolithus moriformis (BRÖNNIMANN & STRADNER, 1960) BRAMLETTE & WILCOXON (1967)	X	X
Thoracosphaera sp.	X	X

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Plate I:Fig.:

1 - *Sphenolithus heteromorphus* Deflandre. 1a - NII; 1b - N+; x 2000
2 - *Sphenolithus neoabies* Deflandre. 2a - NII, 2b – N+; x 2000.
3 - *Sphenolithus* cf. *neoabies* Bukry & Bramlette 3a - NII, 3b - N+; x 2000.
4 - *Sphenolithus moriformis* (Brönnimann & Stradner) Bramlette & Wilcoxon, *Coccolithus pelagicus* (Wallich) Schiller. 4a - NII, 4b - N+; x 2000.
5 - *Helicosphaera walbersdorfensis* Müller. 5a - NII, 5b - N+; x 2000.
6 - *Helicosphaera wallichii* (Lohmann) Okada & McIntyre. 6a - NII, 6b - N+; x 2000.

Plate II:Fig.:

1 - *Geminilithella rotula* (Kamptner) Backman (= *Calcidiscus annula* (Cohen)). 1a - NII, 1b - N+; x 2000.
2 - *Cyclicargolithus floridanus* (Roth & Hay) Bukry. 2a - NII, 2b - N+; x 2000.
3 - *Umbilicosphaera jafari* Müller. 3a - NII, 3b - N+; x 2000.
4 - *Calcidiscus* cf*. macintyrei* (Bukry & Bramlette) Loeblich & Tappan. NII; x 2000.
5 - *Calcidiscus* cf. *pataecus* Gartner. NII; x 2000.
6 - *Cyclicargolithus* cf. *abisectus* (Müller) Wise. 6a - NII, 6b - N+; x 2000.
7 - *Calcidiscus leptoporus* (Murray & Blackman) Loeblich & Tappan. 7a - NII, 7b - N+; x 2000.

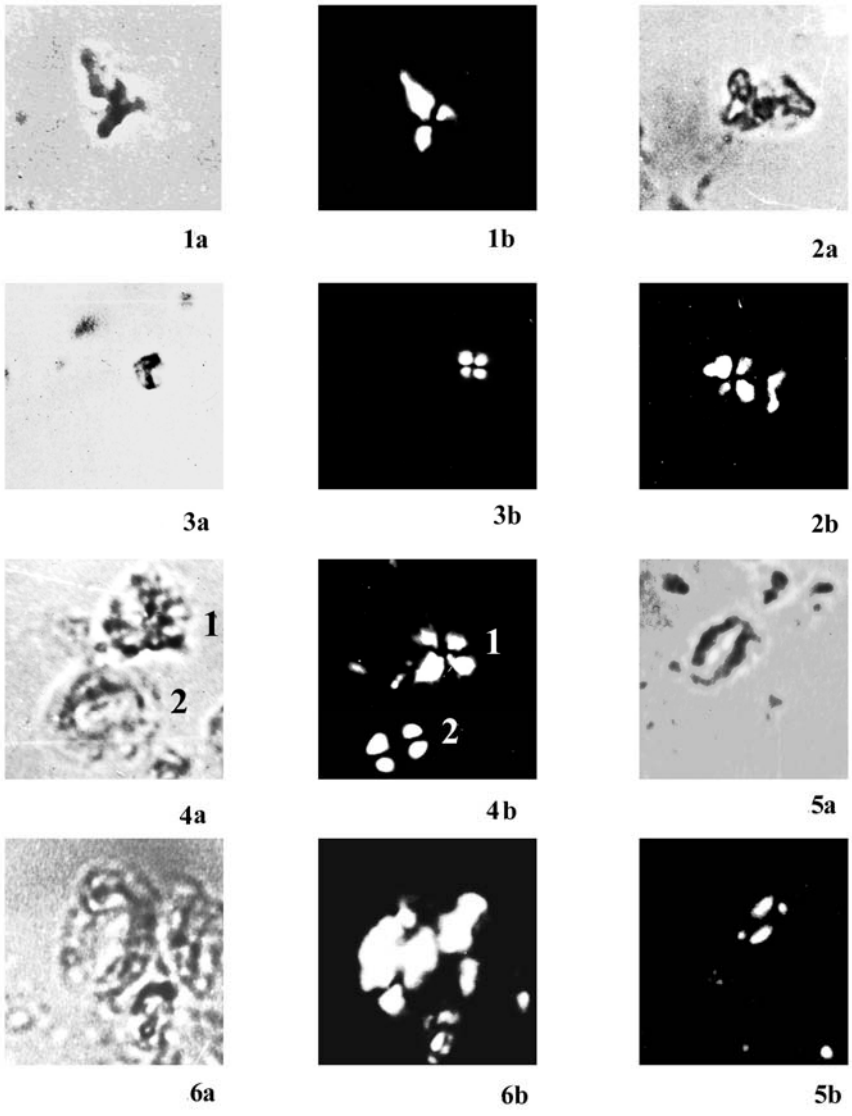
Plate III:Fig.:

1 - *Discoaster exilis* Martini & Bramlette NII; x 2000.
2 - *Discoaster variabilis* Martini & Bramlette. NII; x 2000.
3 - *Discoaster musicus* Stradner. NII; x 2000.
4 - *Discoaster brouwerii* Tan emend. Bramlette & Riedel. NII; x 2000.
5 - *Micrantolithus vesper* Deflandre in Deflandre & Fert. 5a - NII, 5b - N+; x 2000.
6 - *Triquetrorhabdulus rugosus* Bramlette & Wilcoxon. NII; x 2000.
7 - *Triquetrorhabdulus* cf. *farnsworthii* Lipps. NII; x 2000.
8 - *Reticulofenestra minuta* Roth. 8a - NII, 8b - N+; x 2000.
9 – *Thoracosphaera* sp. 9a - NII, 9b - N+; x 2000.

Plate IV:Fig.:

1 - *Rhabdosphaera procera* Martini. NII; x 2000.
2 - *Rhabdosphaera poculi* (Bóna & Kernerné) Müller. 2a - NII, 2b - N+; x 2000.
3 - *Rhabdosphaera pannonica* Baldi – Beke. NII; x 2000.
4 - *Syracosphaera histrica* Kamptner. 4a - NII, 4b - N+; x 2000.
5 - *Pontosphaera multipora* (Kamptner). 5a - NII, 5b - N+; x 2000.
6 - *Braarudosphaera bigelowii* (Gran & Braarud) Deflandre. 6a - NII, 6b - N+; x 2000.
7 - *Coccolithus miopelagicus* Bukry. 7a - NII, 7b N+; x 2000.

Plate I



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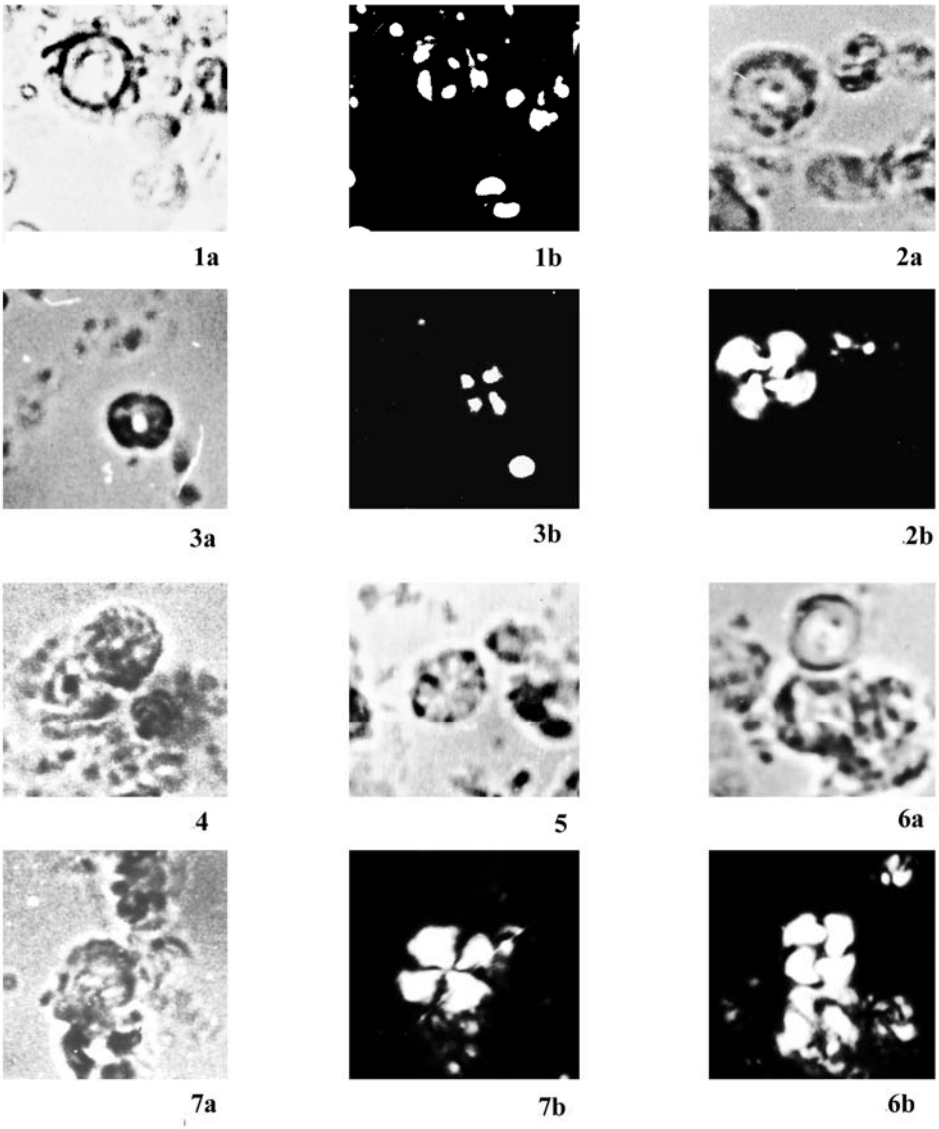

Plate III

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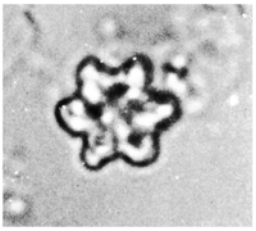

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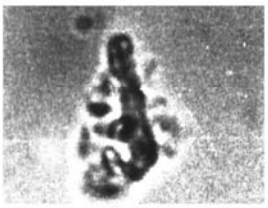

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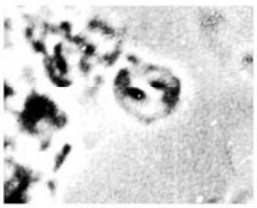

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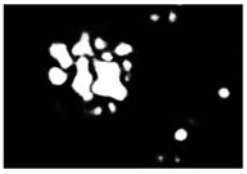

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Plate IV