RELATIONES ANNUAE INSTITUTI GEOLOGICI PUBLICI HUNGARICI

A MAGYAR ÁLLAMI FÖLDTANI INTÉZET

ÉVI JELENTÉSE

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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II. RÉSZ (1989)

PALAEOECOLOGICAL INVESTIGATION IN ALGINIT FROM PLIOCENE CRATER LAKES

by

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UDC: 553.983:551.782.2(439)

Keywords: palaeoecology, Diatoma, Chrysophyceae, Phytolitaria, Botryococcus, oil shale, alginite, Pliocene

Alginite, as a kind of oil shale, is derivable mainly from algal remains. We have investigated diatomaceous alginite deposits of four crater lakes formed in the tuff rings of volcanoes operating 3 to 5 million years ago, drilled by boreholes in W Hungary.

The dominant species of the assemblage are limnobrackish, eutrophic, euryhaline periphyton species. Planktons play only a secondary role. The most common taxa belonged to the following genera: Anomoeoneis, Cocconeis, Cymbella, Fragilaria, Gomphonema, Navicula. Chrysophyceae cysts, planktonic algae like Botryococcus, Phytolitaria remains and siliceous spongae skeletons are characteristic elements in the assemblage.

The diatomaceous sediment of the crater lakes was deposited in shallow, stagnant water, with max. 3‰ salt content, i.e. oligohaline and c. pH 7.6. The shallow water was very rich in higher, onshore vegetation as shown by Phytolitaria remains. The temperature of the sedimentation basin was 10—12°C during Diatoma bloom, i.e. much higher than today.

On the basis of climate, water salt content, K/Ar radiometric data, diatoms characteristic for the Pliocene and extinct taxa the sediment was deposited during the Pliocene, in the last oligohaline, brackish phase of the Upper Pannonian, just before it became freshwater.

In the Pliocene lake system of the Carpathian basin basaltic volcanoes built tuff-rings around the craters in Western Hungary and in the Balaton Highlands about 3—5 million years ago. The craters were filled by water and these maars harbour alginite deposits.

Alginite is a kind of oil shale, made up mainly by algal remains. In Hungary, in the West there are four such maartype alginite deposits known (Fig. 1) (Á. JÁMBOR—G. SOLTI 1975). Inside the tuff-rings shallow lakes, rich in nutrients were born. Pollens, spores from the encircling rich marsh and mountain vegetation (E. NAGY 1978) remains of the temporarily blooming diatoms and *Botryococcus braunii* KÜTZ. algae filled up the lakes quite quickly.

In the shallow-water biotope a papery thin, lanimated rock, alginite was deposited. A single rock plate is equivalent to the period of a temporary algal bloom (Fig. 2) (G. SOLTI 1987, C. F. KNUTSON et al. 1986).

The crater lakes were separate units of quiet waters, their changes in microfloral assemblages were investigated in alginite sediments of borehole sequences (M. HAJÓS 1976, 1977):

Pula 3	2.0—36.8 m	12 samples
Gérce 1	55.0—85.0 m	13 samples
Egyházaskesző 5	39.0—40.0 m	5 samples
Várkesző 1	43.0—71.0 m	21 samples

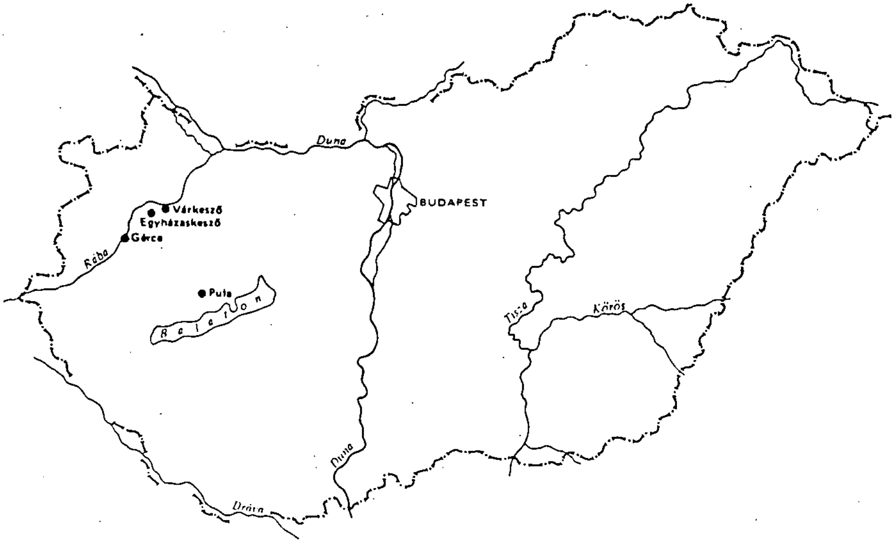

Fig. 1. Oil shale (alginite) occurrences in Hungary—maar type volcano with alginite. Pula, Gérce, Egyházaskesző, Várkesző (after G. SOLTI 1987)

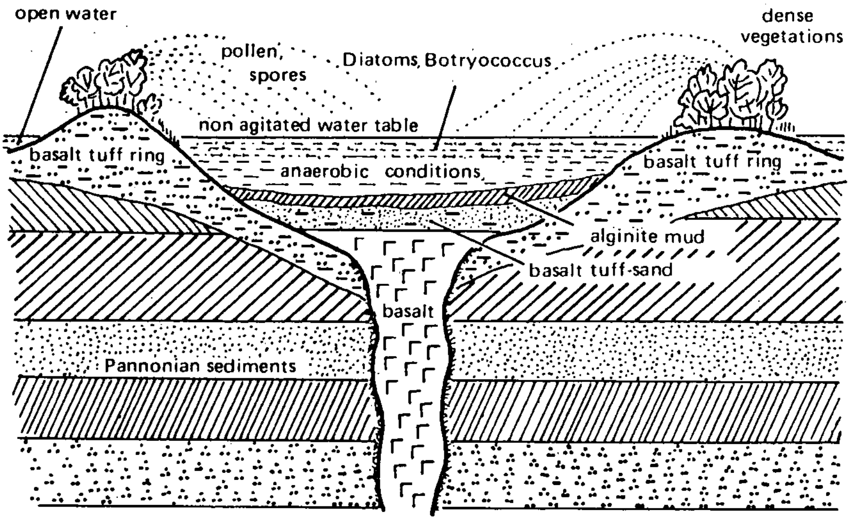

Fig. 2. Oil shale formation in a volcanic crater (after G. SOLTI 1987)

Sampling was not continuous but partly intermittent, partly spot. That is why ecological changes could be followed up mainly as tendencies, based on assemblage changes.

Rock samples were investigated after HCl, H_2SO_4 and HNO_3 treatment and sedimentation in distilled water. The diatom slides were made by using "Hyrax". The assemblage was evaluated in numbers and percentage.

The assemblages contained mainly diatom rests, unicellar siliceous cysts. Chrysophyceae, Phytolithariae from higher plants (M. HAJÓS 1968) and the spiculae of siliceous sponges Porifera, together with a lot of pollen, spores and the planctonic alga *Botryococcus braunii* KÜTZ. The palaeoecological and palaeogeographical situation was reconstructed based on diatoms.

When comparing occurrences it is striking that the diatom flora in all four sites appears and enriches gradually through participation of periphytic taxa during the initial phase of alginite deposition (Fig. 3). As life proceeded in the lake the species dominance changed significantly. Diatoms became extinct temporarily or finally, depending on eutrophisation in the lake. In the sequences clayey marl, dolomitic marl, carboniferous alginite, carboniferous bentonite and even top layers of the alginite are free of diatoms (Fig. 4).

Diatoms may have become extinct due to changes in sedimentation, pH or increased eutrophisation. Life in maars had only one cycle.

The diatom assemblage is well preserved, as to number of species and individuals those from Pula and Várkesző are the richest. On the base of changes in the assemblage we concluded 5—7 small changes in floral association, except the Egyházaskesző occurrence where the diatomaceous alginite layer is less than 2-m-thick. Changes in taxonal composition as to species and numbers at the sites Pula, Gérce, Várkesző it was strinking and reflected floral change e.g. the occurrence of *Scoliopleura peisonis* GRUN. reflecting increased salinity. In this case salinity my have exceeded 5‰, i.e. oligohaline (HUSTEDT 1930, p. 338), (G. SZEMES 1959, p. 333). In the Gérce sequence e.g. a different biofacies was indicated in the upper zones of the alginite sequence by mass occurrences of planktonic *Chaetoceros mülleri* LEMM. statospores.

Besides smaller local assemblage changes the four crater lakes in West Hungary seems to have existed near parallel in time and in their development. By using diatoms it was possible to reconstruct the general ecological conditions of that time.

The most striking feature of the assemblage is the rich diatoms association. From the detailed investigation of 51 samples 88 diatom species were found, using the nomenclature of VAN LAUDINGHAM (1967—1971). The ecological data were based on literature of recent species (F. HUSTEDT 1930). Except some species these diatoms exist even today. Pennatae are dominant. Shallow water, epiphytic species are characteristic, as Cocconeis, Cymbella, Achnantes, Gomphonema, Epithemia, Rhopalodia, etc. Benthic taxa belong to the genera Amphora, Achnantes, Navicula, Pinnularia, Epithemia, Gomphonema, Surirella.

Calcophylic species suggest that the water may have been calcareous.

The evaluation showed that the water may had a pH of 6.5—8.5, in average 7.6, i.e. slightly basic.

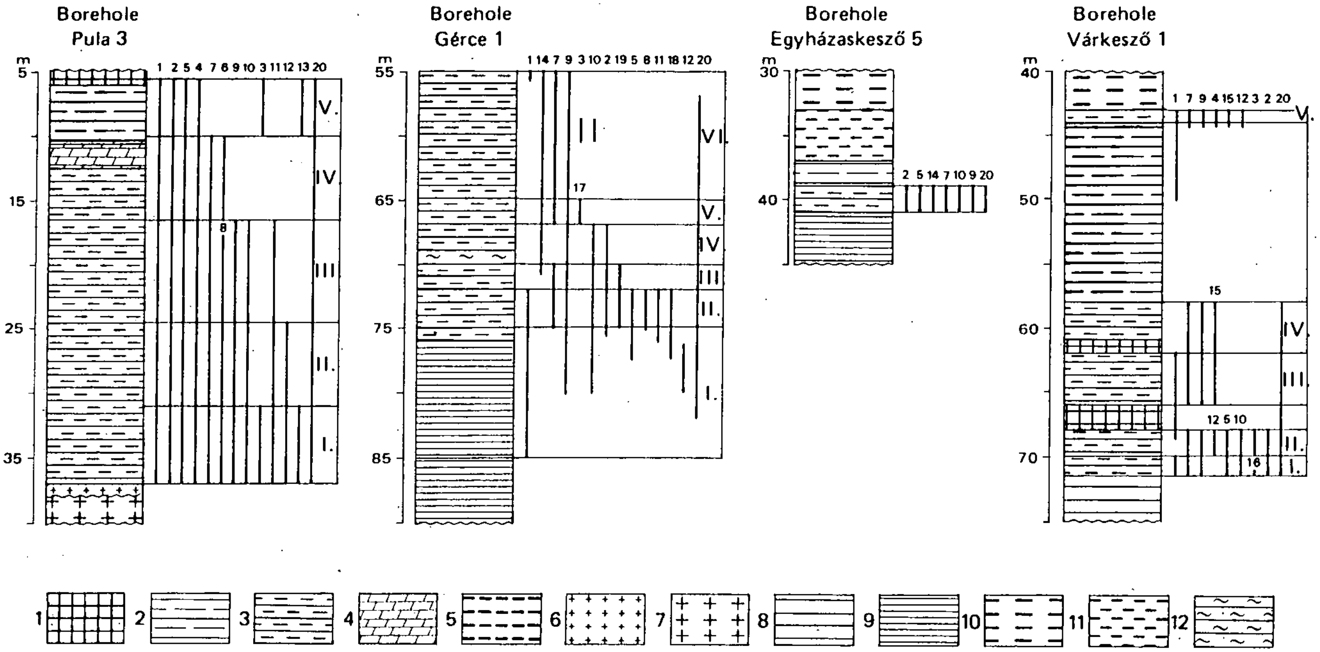

Fig. 3. Geological profiles and profiles of diatoms on the data of four boreholes

I—VII. Changes in floral association. — *1. Botryococcus braunii* KÜTZ., *2. Cocconeis placentula* EHR., *C. v. euglypta* (EHR.) CL., *3. Melosira granulata* (EHR.) RALFS. *M. varians* AG., *4. Cyclotella compta* (EHR.) KÜTZ., *C. meneghiniana* KÜTZ., *5. Epithemia sorex* KÜTZ., *E. turgida* (EHR.) KÜTZ., *E. zebra* (EHR.) KÜTZ., *6. Gomphonema gracile* EHR., *G. lanceolatum Ag.*, *7. Anomoeoneis sphaerophora* (KÜTZ.) PFITZ., *A. costata* (KÜTZ.) HUST., *8. Cymatopleura solea* (BRÉB.) W. SM., *9. Navicula oblonga* KÜTZ., *N. halophila* (GRUN.) CL., *N. hungarica* GRUN., *N. radiosa* KÜTZ., *10. Fragilaria construens* (EHR.) GRUN., *F. v. venter* (EHR.) GRUN., *F. v. subsalina* HUST., *F. pinnata* EHR., *11. Rhopalodia gibba* (EHR.) O. MÜLL., *R. v. ventricosa* (EHR.) GRUN., *R. musculus* (KÜTZ) O. MÜLL., *12. Surirella ovata* KÜTZ., *S. biseriata* BRÉB., *S. v. bifrons* (EHR.) HUST. *13. Synedra ulna* (NITZSCH) EHR., *S. affinis* KÜTZ., *14. Nitzschia frustulum* (KÜTZ.) GRUN., *15. Scoliopleura peisonis* GRUN., 16. *Pinnularia viridis* (NITZSCH) EHR., *17. Chaetoceros muelleri* LEMM., *18. Cymbella ventricosa* AG., *C. cymbiformis* AG., *19. Coscinodiscus jámbori* HAJÓS, *Stephanodiscus* sp., *20. Chrysophyceae, Phytolithariae, Porifera.* — Lithological profile: *1.* Holocene—Pleistocene post maar sediments, *2.* alginite, *3.* diatomaceous alginite, *4.* dolomitic siltstone, *5.* basalt tuff-sand, *6.* basalt, *7.* basalt tuff, *8.* basalt tuffite, *9.* bentonite, *10.* bentonitic clay, *11.* marly alginite, *12.* alginite with organic matter

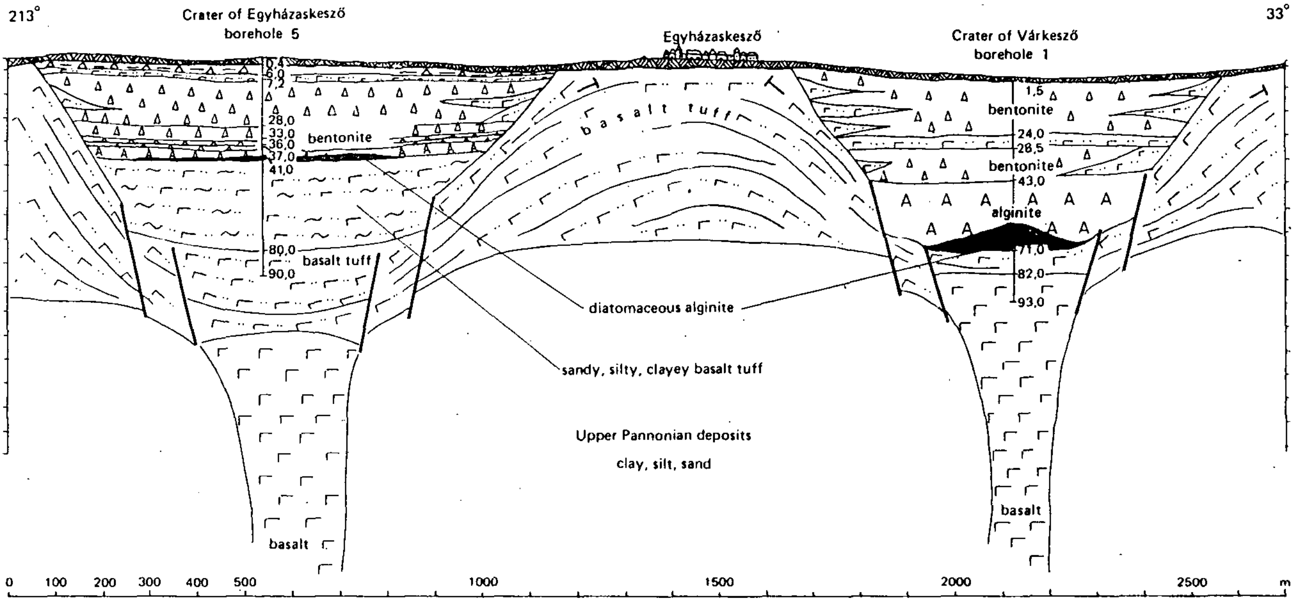

Fig. 4. Geological profile along the maar—tuff craters, Egyházaskesző, Várkesző (after G. SOLTI 1987)

Temperature may have been around 10—12°C. With regard to the season of diatom bloom which is early spring or late autumn, the area may have had a warm but temperate climate, collaborated by palynological investigations (E. NAGY 1978).

Euryhaline, detritic species occur en mass in the assemblage halophobic species are missing.

As to salinity one has to regard Hustedt's statement, i.e. by increasing salinity euryhaline limnobrackish species grow bigger, such as *Anomoeoneis sphaerophora, Fragilaria construens, F. pinnata* become shorter and broaden in the middle. According to data of A. REMANE—C. SCHLIEPPER (1958, p. 91) salinity may have been 3‰. In the view of REDEKE and KOLBE it may have been oligohaline limnobrackish with 0.5—3‰. Species suggesting limnobrack environment are *Diploneis ovalis, Navicula oblonga, Anomoeoneis sphaerophora, Epithemia sorex* and *E. turgida*, dominant in some samples.

Summarizing the palaeoecological and phylogenetic data of diatoms, the depositional basin was covered by shallow water of a few meters deep, during the examined period of sedimentation.

Similar assemblage of diatoms has been indicated in the Soviet literature (K. S. PORETZKIJ 1953, p. 63) on the basis of sediments found near the village Arzni in Armenia. PORETZKIJ has shown a great number of species being identical with the diatomaceous flora of the Hungarian Neogene (J. PANTOCSEK 1886—1905) and with the Upper Pliocene deposits of Germany (KRASSKE 1932, 1934), the latter from the regions of Hannover and Hessen, stating that the diatomaceous deposits at Arzni were formed during the Late Pliocene or, possibly, during the Quternary.

A similar, although late Pleistocene assemblage of diatoms has been reported from Trempealeau Valley in Wisconsin North America. (W. ANDREWS 1966).

Based on our microflora analyses we can state, in sum, that the examined section of sedimentation was formed in eutrophic, shallow, stagnant water with max. 3‰ salt content, i.e. oligohaline and a pH of about 7.6. The shallow water was very rich in onshore vegetation of higher order as shown also by the Phytolitaria remains. The temperature of water in the sedimentary basin was 10—12°C during the Diatoma bloom, i.e. the climate may have been warm temperate, much warmer than today.

According to the climate, the salt content of water, the K/Ar radiometric age dates and the species characteristic of the Pliocene, together with the extinct species, the drilled and studies diatomaceous formations must have deposited during the last, brackish-water, oligohaline phase of the Late Pannonian, just before it became freshwater. The numerical evaluation and comparison of diatoms of the four occurrences allow us to draw the conclusion that the environmental conditions of the concerned four crater lakes, although being of the same age, were not completely identical during the formation of alginite.

Acknowledgement

I express my due thanks to professor M. KRETZOI, Budapest, for his critical reviewing my manuscript and to Á. JÁMBOR and G. SOLTI for enabling me to use their samples.

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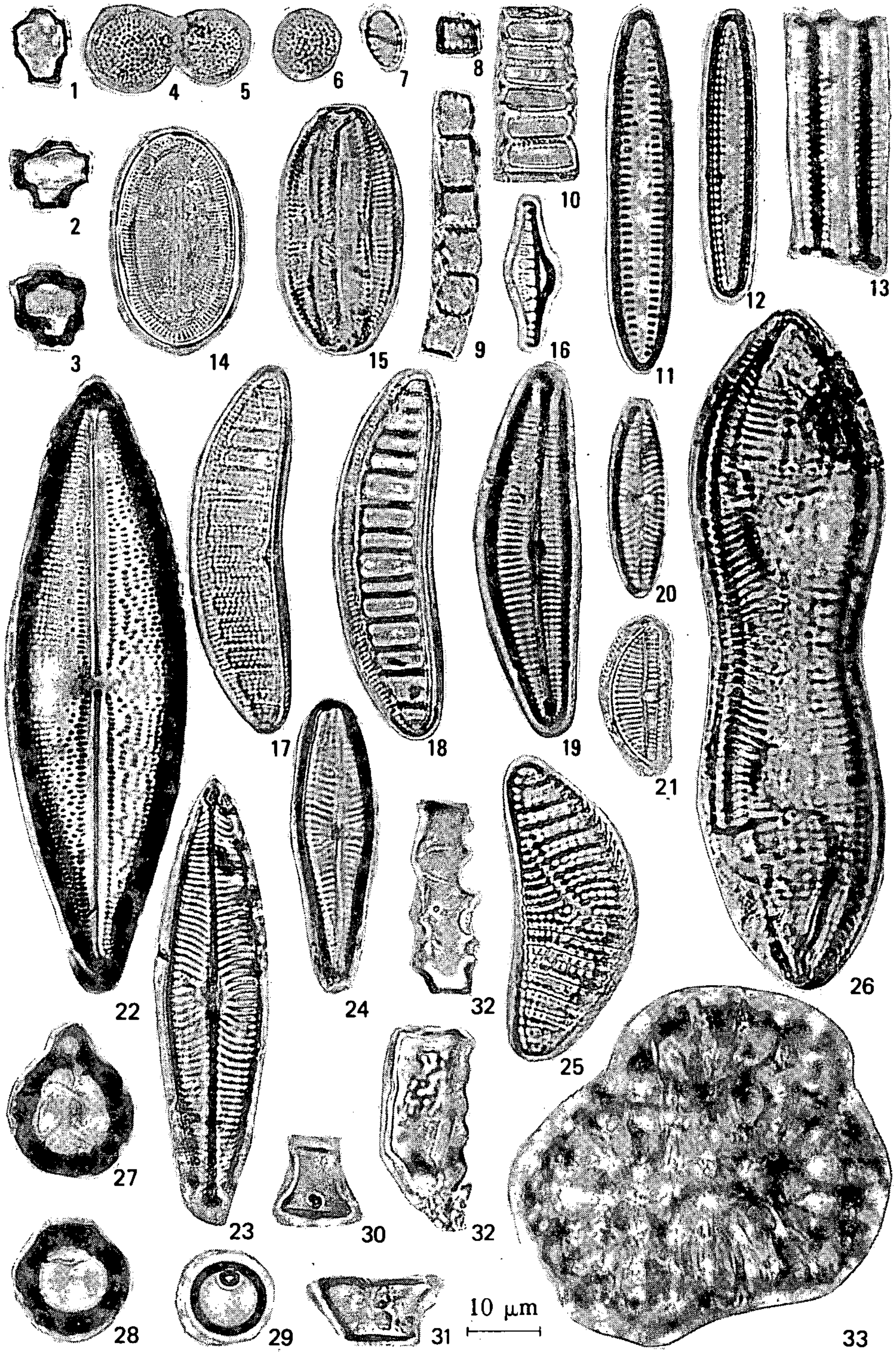
Plate I

1—3. *Chaetoceros muelleri* LEMM.
4—6. *Coscinodiscus jámbori* HAJÓS
7—9. *Fragilaria pinnata* EHR.
10. *F. construens* (EHR.) GRUN.
11—13. *F. estherae* HAJÓS
14. *Cocconeis placentula* EHR.
15. *Amphora ovalis* KÜTZ.
16. *Nitzschia sinuata* (THWAITES? W. SMITH.) GRUN. var. *tabellaria* GRUN.
17—18. *Epithemia zebra* (EHR.) KÜTZ.
19. *Cymbella austriaca* GRUN. var. *fossilis* PANT.
20. *N. hungarica* GRUN.
21. *Cymbella ventricosa* AG? (KÜTZ.) KÜTZ.
22. *Anomoeoneis costata* (KÜTZ.) HUST.
23. *Navicula radiosa* KÜTZ.
24. *Gomphonema lanceolatum* EHR.
25. *Epithemia turgida* (EHR.) KÜTZ. var. *westermannii* (EHR.) GRUN.
26. *Cymatopleura solea* (BRÉB.) W. SM.
27. *Carnegia johannis* AND.
28. *C. forcipata* FRENG.
29. *Clericia erinacea* FRENG.
30—32. Phytolithariae
33. *Botryococcus braunii* KÜTZ.
Fragment of the colony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SOME NEW THALLOPHYTA REMAINS FROM THE HUNGARIAN UPPER CRETACEOUS AND TERTIARY

by
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UDC:561.22:551.763+551.78

Keywords: biostratigraphy, Thallophyta, Upper Cretaceous, Palaeogene, Neogene, SEM data, Hungary

In the course of brown coal and bauxite explorations in Hungary, boreholes have penetrated rock sequences with microfloral remains, the detailed study of which seems very timely.

The present paper deals with four plant microfossil groups (Mycophyta, Prasinophyta, Clorophyta and Charophyta), which might play an important role in the forthcoming stratigraphical and palaeoecological studies.

Taxonomy

Divisio: Mycophyta (FUNGI)

In samples prepared for palynological examination fairly often contain spores of fungi, mycelia and hypha threads. They are frequent especially in and around the brown coal deposits and in fossil leaf-bearing beds, on the epidermis. The taxonomy of fossil fungi is far from being clear as yet, thus we are using an artificial taxonomical system. In this system, the way of the formation of the spores, the shape and the number of cells of the spore, the branching out of the hypha threads and the shape of the peritecha are of taxonomical value. On account of the phenomenon of convergency, these forms can be related only very rarely to recent fungi. Palaeomycological data are important, from a stratigraphical, palaeoecological and palaeoclimatological point of view, too.

The following taxa have been described so far:

Brachysporites pyriformis LANGE et SMITH 1975
Plate I, fig. 1

Occurrence: boreholes Nagytárkány Nt. 3400, 123.9—124.6 m and Nt. 3262, 146.0—146.8 m, Middle Eocene.

Desmidiospora willoughbyi (BRADLEY 1967) ETHRIDGE GLASS et al. 1986
Plate I, fig. 2

Occurrence: borehole Nagytárkány Nt. 3263, 146.0—146.8 m, Middle Eocene.

Dicellaesporites appendiculatus SHEFFY et DILCHER 1971
Plate I, fig. 3

Occurrence: borehole Nagytárkány Nt. 3400, 123.9—124.6 m, Middle Eocene.

Dicellaesporites levis SHEFFY et DILCHER 1971
Plate I, fig. 4

Occurrence: borehole Iharkút Ik. 2238, 93.0 and 361.6 m, Middle Eocene.

Dyadosporonites subovalis SHEFFY et DILCHER 1971
Plate I, fig. 5

Occurrence: borehole Nagytárkány Nt. 3263, 146.0—146.8 m, Middle Eocene.

Fusiformisporites rugosus SHEFFY et DILCHER 1971
Plate I, fig. 6

Occurrence: borehole Nagytárkány Nt. 3263, 146.0—146.8 m, Middle Eocene.

Inapertisporites ovalis SHEFFY et DILCHER 1971
Plate I, fig. 7

Occurrence: borehole Nagytárkány Nt. 3263, 146.0—146.8 m, Middle Eocene.

Inapertisporites nodulus SHEFFY et DILCHER 1971
Plate I, fig. 8

Occurrence: boreholes Nagytárkány Nt. 3263, 146.0—146.8 m, and Nt. 3400, 123.9—124.6 m, Middle Eocene.

Inapertisporites sp.
Plate I, fig. 9

Occurrence: borehole Iharkút Ik. 2238, 361.6 m, Middle Eocene.

Lacrimasporonites cupuliformis (SHEFFY et DILCHER 1971) ETHRIDGE GLASS et al. 1986

Plate I, fig. 10

Occurrence: borehole Nagytárkány Nt. 3263, 146.0—146.8 m, and Nt. 3400, 123.9—124.6 m, Middle Eocene.

Lacrimasporonites singularis SHEFFY et DILCHER 1971

Plate I, fig. 11

Occurrence: borehole Nagytárkány Nt. 3400, 123.9—124.6 m, Middle Eocene.

Lacrimasporonites laevis CLARCE 1965

Plate I, fig. 12

Occurrence: borehole Nagytárkány Nt. 3400, 123.9—124.6 m, Middle Eocene.

Lacrimasporonites sp.

Plate I, fig. 13

Occurrence: borehole Nagytárkány Nt. 3263, 148.5—148.9 m, Middle Eocene.

Meliolinites dilcheri DAGHLIAN 1978

Occurrence: boreholes Homokbödöge Hb. 11, 103.3—103.8 m, Middle Eocene, Németbánya Nb. 1392, 292.5—292.6 m, Upper Eocene.

Monosporisporonites abrutus SHEFFY et DILCHER 1971

Plate I, fig. 14

Occurrence: borehole Nagytárkány Nt. 3263, 148.5—148.9 m, Middle Eocene.

Multicellaesporites elongatus SHEFFY et DILCHER 1971

Plate I, fig. 15

Occurrence: borehole Nagytárkány Nt. 3400, 123.9—124.6 m, Middle Eocene.

Multicellaesporites attenuatus SHEFFY et DILCHER 1971
Plate I, fig. 16

Occurrence: borehole Nagytárkány Nt. 3400, 123.9—124.6 m, Middle Eocene.

Microthyrium microscopicum DESM. foss. (peritheca)
Plate I, fig. 17

Occurrence: borehole Berhida Bh. 3, 441.86—442.36 m, Miocene.

Ornatisporonites sp.
Plate I, fig. 18

Occurrence: borehole Iharkút Ik. 2238, 93.0 m, Middle Eocene.

Pleurosporonites hyalinus LANGE et SMITH 1971
Plate I, fig. 19

Occurrence: borehole Ajkarendek Ak. 32, 417.0 m, Darvastó Formation Middle Eocene.

Pluricellaesporites sp.
Plate I, fig. 20

Occurrence: borehole Nagytárkány Nt. 3559, 160.2—161.0 m, Middle Eocene.

Rosellinites areolatus (FRESENIUS et MAYER 1856) KIRCHHEIMER 1941
Plate II, figs. 1—2

The remnants of the peritheca could be observed on a tree trunk belonging to the family of Taxodiaceae.
Occurrence: borehole Tódebrő Td. 113, 116.2, Upper Pannonian.

Rosellinites congregatus (BECK 1882) MESCHINELLI 1892

Occurrence: borehole Berhida Bh. 3, 439.25—439.44 m, Miocene.

Stephanosporonites ovalis SHEFFY et DILCHER 1971
Plate I, fig. 21

Occurrence: borehole Nagytárkány Nt. 3263, 148.5—148.9 m, Middle Eocene.

Trematosphaerites lignitum (HEER 1863) MESCHINELLI 1892

Remnants of peritheca belonging to the Amphisphaeriaceae family, found on the epidermis of a gymnosperm leaf.

Occurrence: borehole Oroszlány O. 2433, 56.4 m, Oligocene.

Unicellaesporites sp.

Plate I, fig. 22

Occurrence: boreholes Nagytárkány Nt. 3559, 160.2—161.0 m and Nt. 3263, 148.5—148.9 m, Middle Eocene.

This association of spores of fungi recovered from the Middle Eocene layers is known from the following localities: Scotland, Eocene (EDWARDS 1922). Germany, Eocene (KRÄUSEL 1920, 1950, R. ROTONIE 1934, TIKGNER 1954). USA, Eocene (DILCHER 1963, 1965, ELSIK 1965, SHEFFY—DILCHER 1971, ELSIK—DILCHER 1974, ETHRIDGE GLASS—BROWN—ELSIK 1986). Australia, Eocene (LANGE—SMITH 1971).

From the palaeoecological and palaeoclimatological point of view, those species of the spore of this fungi association are to be considered that have recent equivalents or relatives. In our case, the most important ones are the species of the genus Lacrimasporonites. According to ETHRIDGE GLASS et al. (1986), the recent equivalents of the genus follow an epiphtyon or epiphyllous way of life and are saprophytes. They are members of the humid subtropical and tropical forest vegetation.

The taxon *Meliolinites dilcheri* DAGHLIAN can be related to the recent genus of Meliola, living under humid tropical climate. It is an epiphyllous, parasitic species. It is known from the following localities: Germany, Eocene (KOCH 1930). USA, Eocene (DILCHER 1965, DAGHLIAN 1978). India, Miocene (RAMANUJAM—RAO 1978, REDDY-RAMANUJAM—SRISAILAM 1982) and Holocene (PRASAD 1986). Australia, Miocene (SELKIRK 1975).

Divisio: Prasinophyta ROUND 1971
Ordo: Pterospermatales SCHILLER 1925
Familia: Cymatiosphaeraceae MÄDLER 1963
Genus: Schizosporis COOKSON et DETTMANN 1959

Schizosporis reticulatus COOKSON et DETTMANN 1959

Plate III, figs. 1—4

The taxon was treated by several authors, most of whom considered it to be a planctonic organism of unknown origin. BRENNER (1963) published high quality LO micrographs on the taxon. PIERCE (1976) rejected it as belonging to algae and wrote of "unknown relation". VAN GEEL (1979) assigned the genus to the family of Zygnemataceae. WINGATE (1980) described the structure of the taxon in details, mentioning pseudoreticula consisting of capsulae supplied with small pore-like apertures. TAPPAN (1980) assigned the genus to Prasinophyta. On the SEM micrographs of the author the capsulae constituting the pseudoreticulum and the slightly elevated pore regions are fairly well observable.

Occurrence: boreholes Káptalanfa Kf. 1, 686.4 and 622.9 m, Kf. 2, 805.0 and 800.7 m; Gyepükaján Gy. 12, 528.6 m (dominant) and 500. 8 m, as well as in sample 21 of the comparative section of the Ármin shaft of the Ajka coal mine. All the samples are Upper Cretaceous and belong to the Ajka Formation.

Divisio: Chlorophyta PASCHER 1914
Ordo: Dasycladales PASCHER 1931
Familia: Dasycladaceae KÜTZIG 1843
Tribus: Neomerinae (PIA 1927) BASSOULLET et al. 1979
Genus: Neomeris (LAMOUROUX 1816) DELOFFRE 1970

Neomeris arenularia MUNIER-CHALMAS 1899

Occurrence: borehole Farkasgyepü Fgy. 15, 154.0—154.2 m, Eocene.

Tribus: Cymopoliinae (PIA 1927) BASSOULLET et al. 1979
Genus: Cymopolia LAMOUROUX 1816

Cymopolia elongata (DEFRANCE 1825) MUNIER-CHALMAS 1877

Occurrence: borehole Farkasgyepü Fgy. 15, 154.0—154.2 m. Eocene.

Familia: Acetabulariaceae HAUCK 1884
Tribus: Acetabularieae DESCAISNE 1842
Genus: Acicularia D'ARCHIAC 1843

Acicularia (Briardina) transsylvana BÁNYAI et MORELLET 1936
Plate IV., figs. 1—6

Occurrence: boreholes Mány Má. 311, 25.0—25.6 m, Sarmatian, upper part of the Kozárd Stage; Pusztamiske Pm. 2 at 49.9 m, Sarmatian; Küngős Kü.1, 288.7, 288.8 and 291.0 m, Sarmatian; Rákos delta, exposure, top of the Upper Badenian; Pusztamiske Pm. 3, 14.7—14.8 m, Sarmatian; Ősi Ő. 11, 103.6—104.4 m, Sarmatian.

Ordo: Caulerpales SETCHELL 1929
Familia: Udoteaceae (ENDLICHER) AGARDH 1888
Genus: Ovulites LAMARCK 1816

Ovulites margaritula LAMARCK 1816

Occurrence: borehole Farkasgyepü Fgy. 15, 154.0—154.2 m, Eocene.

Divisio: Charophyta MIGULA 1890
Classis: Charophyceae G. M. SMITH 1938
Ordo: Charales LINDLEY 1836
Familia: Characeae RICHARD 1815
Subfamilia: Charoideae (LEONHARDI 1863) ROBINSON 1906
Genus: Nitellopsis HY 1889
Subgenus: Tectochara L. et N. GRAMBAST 1954

Nitellopsis (Tectochara) meriani (L. et N. GRAMBAST 1954) L. GRAMBAST et SOUILÉ-MÄRSCHE 1972
Plate VI, figs. 1—3

Stratigraphical distribution: Middle "Ludian"—Pliocene.

Occurrence: Switzerland, Oligocene, *Stephanochara ungeri—Chara notata* zone; Miocene, *Rantzieniella nitida* zone (MOJON et al. 1985). France, Oligocene (GRAMBAST 1962, GRAMBAST—PAUL 1966, FEIST-CASTEL 1971, 1977, TOURAINE 1971, CARBONNEL et al. 1972, FEIST—RINGEADE 1977, EL HASSANE CHELLAI et al. 1982, RIVELINE 1986). Austria, Pliocene (PAPP 1951). Turkey, Oligocene—Miocene (MÄDLER—STAESCHE 1979). Romania, Upper Cretaceous—Pliocene (IVA et al. 1970, PAPAIANOPOL et al. 1987). Hungary, boreholes Iharkút Ik. 2237, 58.9 and 70.4 m, Ik. 2238, 202.0 m, Csabdi Csb. 1, 147.0 and 149.7 m, Oligocene; Komját 8, 113.5—116.5 m, Upper Pannonian; Nyirád Nyt. 1, 74.5—74.7 m, Upper Badenian; Szombathely II, 830.1—831.0 m, Upper Pannonian.

Nitellopsis (Tectochara) gayeri (RÁSKY 1945) MÄDLER 1955

Stratigraphical distribution: Upper Oligocene.

Occurrence: Hungary, boreholes Pusztavám 425, 270.0 m (RÁSKY 1945), Iharkút Ik. 2237, 58.9 m, Csabdi Csb. 1, 147.0—149.7 m, Oligocene.

Nitellopsis (Tectochara) huangi (LU 1945) GRAMBAST et SOULIÉ-MÄRSCHE 1972
Plate VII, figs. 11—13

Stratigraphical distribution: Upper Oligocene—Upper Miocene, from the *Stephanochara ungeri* zone upwards.

Occurrence: borehole Pusztamiske Pm. 1, 13.3 m, Sarmatian.

Genus: Harrisichara GRAMBAST 1977

Harrisichara sparnaciensis GRAMBAST 1977

Stratigraphical distribution: uppermost Lower Eocene (GRAMBAST 1977, RIVELINE 1986).

Occurrence: Csordakút opencast mine, freshwater limestone and calcareous marl, Middle Eocene.

Harrisichara vasiformis (REID et GROVES 1921) GRAMBAST 1957

Plate VI, figs. 4—5

Stratigraphical distribution: Upper Eocene, *Harrisichara vasiformis—tuberculata* zone.

Occurrence: Great Britain, Upper Eocene (REID—GROVES 1921, RIVELINE 1984). France, Upper Eocene (GRAMBAST 1962, FEIST-CASTEL 1971, 1975, FEIST—RINGEADE 1977). Hungary, Csordakút opencast mine, freshwater limestone, calcareous marl, Middle Eocene.

Genus: Peckichara GRAMBAST 1957

Peckichara coronata (PECK et RECKER 1948) GRAMBAST 1957

Plate VII, fig. 1

Stratigraphical distribution: Eocene (WANG ZHEN 1978, IVA et al. 1970).

Occurrence: Csirdakút opencast mine freshwater limestone, calcareous marl, Middle Eocene.

Genus: Stephanochara GRAMBAST 1957

Stephanochara vectensis (GROVES 1926) GRAMBAST 1958

Plate VI, figs. 7—8

Stratigraphical distribution: uppermost Upper Eocene, *Stephanochara vectensis* zone.

Occurrence: Great Britain, Upper Eocene (GROVES 1926). France, Upper Eocene (RIVELINE 1986). Hungary, borehole Iharkút Ik. 2238, 202.0 m, Oligocene.

Stephanochara ungeri FEIST-CASTEL 1977

Stratigraphical distribution: Oligocene—Pliocene *Stephanochara ungeri* zone.

Occurrence: France, Upper Oligocene (RIVELINE 1986) .Austria, Pliocene (PAPP 1951). Hungary, borehole Berhida Bh. 3, 370.0 m, Upper Badenian.

Genus: Rhabdochara MÄDLER 1955 emend GRAMBAST 1957

Rhabdochara langeri (ETTINGSCH. 1872) MÄDLER 1955
Plate VI, figs. 9—10

Stratigraphical distribution: Upper Oligocene—Miocene, from the *Chara notata* zone upwards (RIVELINE 1986).

Occurrence: Yugoslavia, Oligocene (ETTINGHAUSEN 1872). France, from the Upper Oligocene (FEIST-CASTEL—RINGEADE 1977, GRAMBAST 1958, 1972). Germany, Upper Oligocene—Miocene (SCHWARZ 1985, 1988, MÄDLER 1955, KNOBLOCH 1975). Turkey, Eocene (MÄDLER—STAESCHE 1979). China, Middle Eocene (*Rhabdochara kisgyonensis* WANG SHUI et al. 1982). Romania, Upper Eocene—Upper Oligocene (IVA et al. 1970). Hungary, RÁSKY (1952) published similar gyrogonite from the core sample from borehole Kisgyón 6, 43.0—44.8 m, under the name of *Kosmogyra kisgyonensis* n. sp. (p. 43). GRAMBAST assigned this species to the genus Rhabdochara. The species *Kosmogyra szepesfalvyi* in. sp. was published as deriving from borehole Síkvölgy 432 at Tatabánya, 29.5 m, from Upper Oligocene layers and has been assigned by MÄDLER (1955, p. 300), provisionally, to the taxon of *Rhabdochara langeri.* Further occurrence: boreholes Iharkút Ik. 2238, 202.0 m, Németbánya Nb. 1392, 292.5—292.6 m, Oligocene.

Rhabdochara major GRAMBAST et PAUL 1965

Stratigraphical distribution: Upper Oligocene, Rhabdochara major zone.

Occurrence: France, Upper Oligocene (GRAMBAST—PAUL 1966, RIVELINE 1984, 1986, FEIST—RINGEADE 1977, FEIST-CASTEL1977). Switzerland, Oligocene, (KISSLING 1974, *Stephanochara ungeri* and *Chara notata* zones, Upper Oligocene, MOJON et al. 1985). Germany, Oligocene (FEIST-CASTEL 1977, SCHWARZ 1984, 1988). Spain, upper part of Auversian—Bartonian (ANADON—FEIST 1981). Hungary, boreholes Iharkút Ik. 2237, 70.4 m, Ik. 2238, 202.0 m, Oligocene.

Genus: Microchara GRAMBAST 1959

Microchara laevigata GRAMBAST et GUTIERREZ 1977
Plate V, figs. 2, 3, 5

Stratigraphical distribution: Upper Cretaceous.

Occurrence: boreholes Somlóvásárhely Sv. 1, 1368.2 and 1380.5 m (dominant), Nemeshany Nh. 1, 675.5—675.6 m, Ajka Formation Upper Cretaceous.

Genus: Chara VAILLANT 1719

Chara notata GRAMBAST et PAUL 1965
Plate VII, figs. 8—10

Stratigraphical distribution: Upper Oligocene—Miocene, *Chara notata* zone.

Occurrence: France, Upper Oligocene (GRAMBAST—PAUL 1966, CASTEL 1968, GRAMBAST 1972, FEIST—CASTEL 1977). Switzerland, Oligocene—Miocene, *Chara notata* and *Rantzieniella nitida* zones (MOWAHED-AWAL 1970, MOJON et al. 1985, BERGER 1983). Germany, Miocene (STRAUB 1952), Upper Oligocene (MÄDLER 1955, SCHWARZ 1984, 1985, 1988). Czechoslovakia, Neogene (KNOBLOCH 1975). Turkey, Tertiary (MÄDLER—STAESCHE 1979). China, Tertiary (WANG SHUI 1961). Hungary, boreholes Iharkút Ik. 2238, 202.0 m, Ik. 2237, 70.4 m, Oligocene; Várpalota V. 133, 222.85—226.3 m, Ottnangian.

Chara molassica STRAUB 1952
Plate VII, figs. 2—4

Stratigraphical distribution: Upper Eocene—Miocene

Occurrence: boreholes Berhida Bh. 3, 370.0 m, Nyirád Nyt. 1, 74.5—74.7 m, Upper Badenian; Pusztamiske Pm. 1, 13.3 Sarmatian.

Chara sadleri UNGER 1850—1852
Plate VII, figs. 5—7

Stratigraphical distribution: Middle Miocene.

Occurrence: borehole Nyirád Nyt. 1, 74.5—74.7 m, Upper Badenian.

Genus: Mesochara GRAMBAST 1962

Mesochara symmetrica (PECK) GRAMBAST 1962

Stratigraphical distribution: Upper Cretaceous.

Occurrence: borehole Somlóvásárhely Sv. 1, 1368.2 and 1380.5 m, Ajka Formation, Upper Cretaceous.

Genus: Amblyochara GRAMBAST 1962

Amblyochara beguiana GRAMBAST 1962
Plate V, figs. 1, 4.

Stratigraphical distribution: Upper Cretaceous.

Occurrence: boreholes Somlóvásárhely Sv. 1, 1368.2 and 1380.5 m, Nemeshany Nh. 1, 675.5—675.6 m, Ajka Formation, Upper Cretaceous.

Subfamilia: Nitelloidae AL BRAUN ap. MIGULA
Genus: Sphaerochara MÄDLER 1952 em. HORN AF RANTZIEN et GRAMBAST 1962

Sphaerochara hirmeri (RÁSKAY 1945) MÄDLER 1955

Plate VI, fig. 6

Stratigraphical distribution: Upper Eocene—Upper Oligocene, *Stephanochara vectensis—Stephanochara ungeri* zone.

Occurrence: France, Oligocene (CASTEL—REILLE 1968, CASTEL—GRAMBAST 1969, FEIST-CASTEL 1971, CARBONNEL et al. 1972, RIVELINE 1986). Spain, Upper Oligocene, *Stephanochara vectensis—Stephanochara pinguis* zone (CANUDO et al. 1988). Switzerland, Oligocene (KISSLING 1974, BERGER 1986). Great Britain, Upper Eocene (RIVELINE 1986). Hungary, boreholes Iharkút Ik. 2238, 202.0 m, Csabdi Csb. 1, 147.0 and 149.7 m, Oligocene.

Sphaerochara parvula (REID—GROVES 1921) GRAMBAST 1958

Plate VI, figs. 11—12

Stratigraphical distribution: Upper Eocene, upper part of the *Gyrogona tuberosa* zone.

Occurrence: Great Britain, Upper Eocene, lower Headon Beds (REID—GROVES 1921, GROVES 1926, GRAMBAST 1958, FEIST-CASTEL 1977, RIVELINE 1984, RIVELINE et al. 1987). Switzerland, Lower Oligocene (KISSLING 1974). Germany, Oligocene (STRAUB 1952, MÄDLER 1955, SCHWARZ 1988). Hungary, borehole Bakonybél Bb. 16, 113.4—116.4 m, Upper Eocene.

Sphaerochara ulmensis (STRAUB 1952) GRAMBAST 1962

Stratigraphical distribution: Oligocene—Miocene (STRAUB 1952, MÄDLER 1955, SCHWARZ 1985, 1988).

Occurrence: Hungary, borehole Berhida Bh. 3, 370.0 m, Upper Badenian.

Familia: Raskyellaceae GRAMBAST 1957
Genus: Raskyella L. et. N. GRAMBAST 1954 em L. GRAMBAST 1962

Raskyella vadaszi (RÁSKY 1945) L. et N. GRAMBAST 1954

Stratigraphical distribution: Upper Eocene (Marisenien), *Raskyella vadaszi* (RIVELINE 1986) zone.

Occurrence: France, Upper Eocene (GRAMBAST 1962, 1972, RIVELINE 1986). Spain, Upper Eocene (ANADON—FEIST 1981). Hungary, Upper Eocene, Gánt (RÁSKY 1945, BIGNOT et al. 1985, RIVELINE 1986).

Apart from the remnants of Charophyta gyrogonite, the section of the Csordakút Middle Eocene freshwater limestone and calcareous marl abounds in stem fragments of Characeae preserved in fairly good state (Plate VII, figs. 14—15). Their exact assignment, however, would be only possible if they were found in direct association with the gyrogonites.

For palaeoecological interpretation, the Charophytes preferring clear water offer information, in the first place, concerning the salinity and the depth of the water. In literature, the taxa *Nitellopsis (Tectochara) meriani* and *Sphaerochara ulmensis* are considered as indicative of limnic environment. The species *Harrisichara sparnaciensis*, *Harrisichara vasiformis* and *Peckichara coronata* can be assigned to them with high probability because they were found in limestone and calcareous marl layers of freshwater origin, containing planktonic organisms of freshwater plant origin. The Late Cretaceous species of *Microchara laevigata*, *Mesochara symmetrica* and *Amblyochara beguiana* were also found in limnic layers. The species *Raskyella vadaszi* and *Rhabdochara major* are, undoubtedly, of brackish water origin.

Recent Charophytes are known to occur down to 30 m of water depth. Charophyta gyrogonites found together with a fauna indicating a deeper-water environment are neccessarily allochtonous.

There was nobody engaged in studying the Tertiary Charophyta gyrogonites in Hungary since the publication of RÁSKY in 1959. The revision of the taxa described by RÁSKY can be found in some French (L. GRAMBAST 1956, 1962, 1968 and 1972) and German (MÄDLER 1955, NÖTZOLD 1975) publications.

The comprehensive revision of RÁSKY's rich collection, carefully guarded in the Botanical Collection of the Hungarian Natural History Museum, as well as the investigation of more recent finds are considered as a future task.

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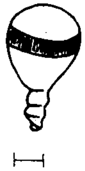
Plate I

1. *Brachysporites pyriformis* LANGE et SMITH 1975
2. *Desmidiospora willoughbyi* (BRADLEY 1967) ETHRIDGE GLASS et al. 1986
3. *Dicellaesporites appendiculatus* SHEFFY et DILCHER 1971
4. *Dicellaesporites levis* SHEFFY et DILCHER 1971
5. *Dyadosporonites subovalis* SHEFFY et DILCHER 1971
6. *Fusiformisporites rugosus* SHEFFY et DILCHER 1971
7. *Inapertisporites ovalis* SHEFFY et DILCHER 1971
8. *Inapertisporites nodulus* SHEFFY et DILCHER 1971
9. *Inapertisporites* sp.
10. *Lacrimasporonites cupuliformis* (SHEFFY et DILCHER 1971) ETHRIDGE GLASS et al. 1986
11. *Lacrimasporonites singularis* SHEFFY et DILCHER 1971
12. *Lacrimasporonites laevis* CLARCE 1965
13. *Lacrimasporonites* sp.
14. *Monosporisporonites abrutus* SHEFFY et DILCHER 1971
15. *Multicellaesporites elongatus* SHEFFY et DILCHER 1971
16. *Multicellaesporites attenuatus* SHEFFY et DILCHER 1971
17. *Microthyrium microscopium* DESM. foss.
18. *Ornatisporonites* sp.
19. *Pleurosporonites hyalinus* LANGE et SMITH 1971
20. *Pluricellaesporites* sp.
21. *Stephanosporonites ovalis* SHEFFY et DILCHER 1971
22. *Unicellaesporites* sp.

Dimension: 10 μm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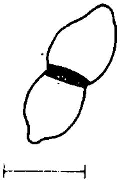
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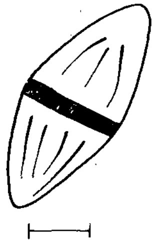
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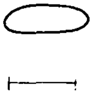
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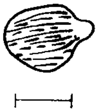
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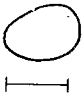
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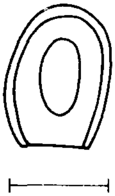
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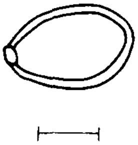
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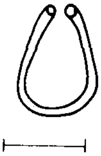
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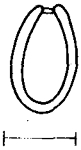
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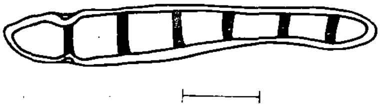
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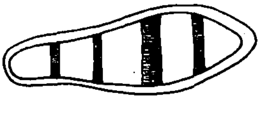
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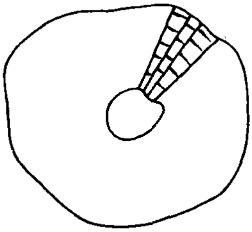
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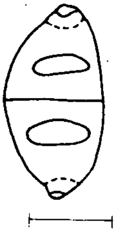
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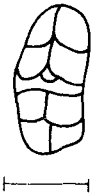
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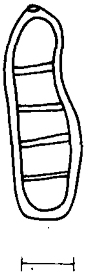
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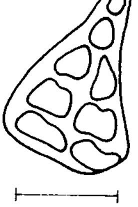
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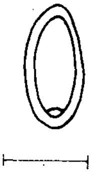
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Plate II

1—2. *Rosellinites areolatus* (FRESENIUS et MEYER) KIRCHEIMER
Borehole Tódebrő Tb. 113, 116.2 m, Upper Pannonian

1.: 5X
2.: 15X

1

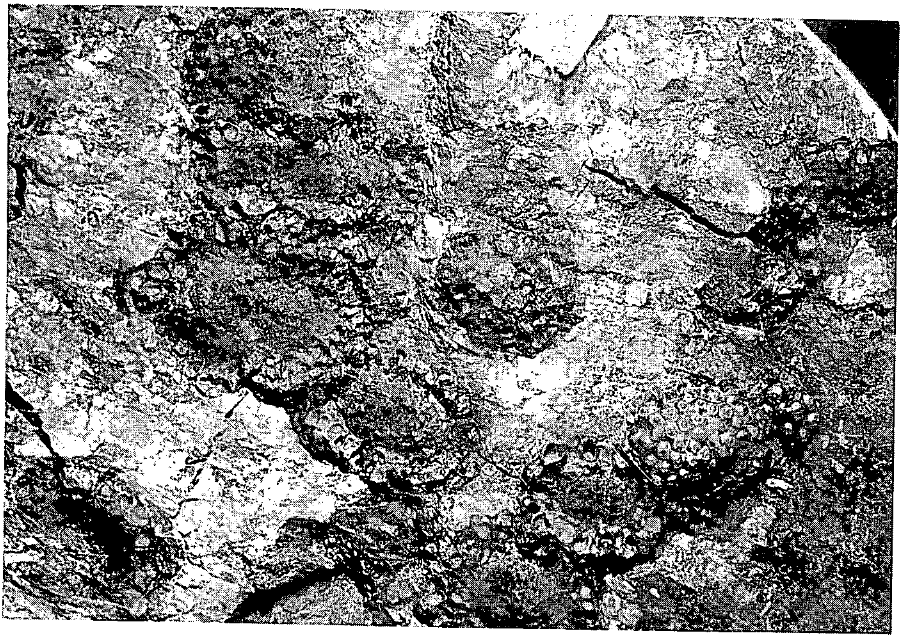

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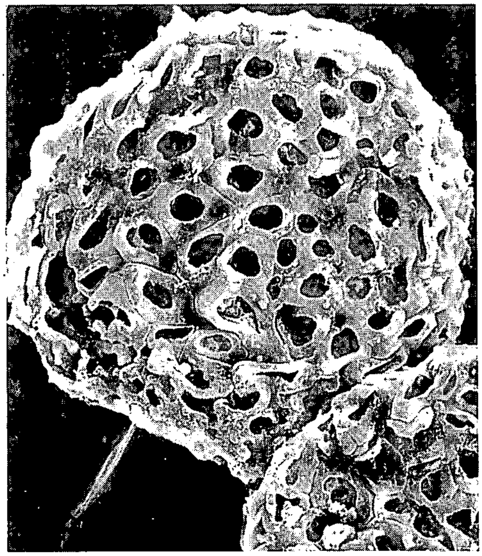
Plate III

1—4. *Schizosporis reticulatus* COOKSON et DETTMANN 1959
Borehole Gyepükaján 12, 528.6 m, Upper Cretaceous
2. Capsulae with pores

1.: SEM 600X
2—3.: SEM 2000X
4.: SEM 4000X



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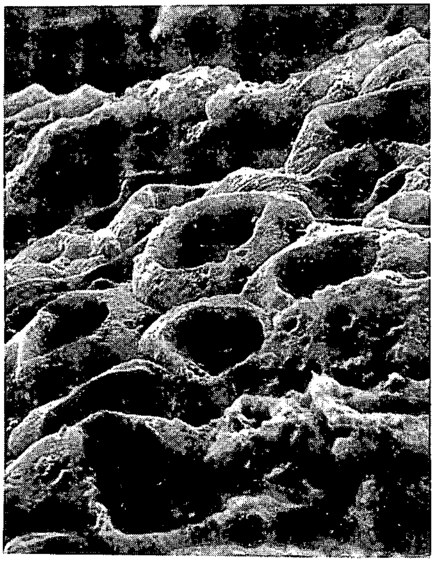

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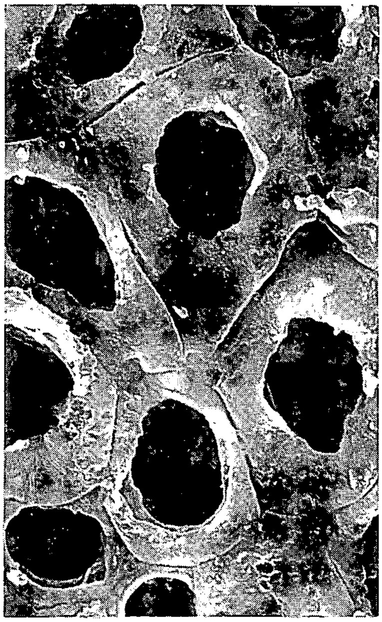

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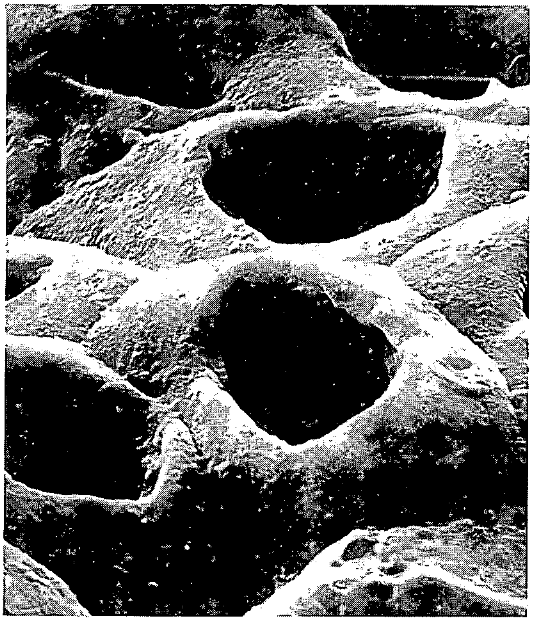

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Plate IV

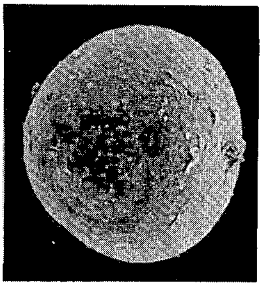
1—6. *Acicularia (Briardina) transsylvana* BÁNYAI et MORELLET 1936
  1. Borehole Pusztamiske Pm. 2, 49.9 m, Sarmatian
  2. Spore, closed
  3—4. Spore, open
  5. Spore, broken into two halves
  6. Structure of the spore wall

1.: 5X

2—5.: SEM 100X

6.: SEM 1000X

1



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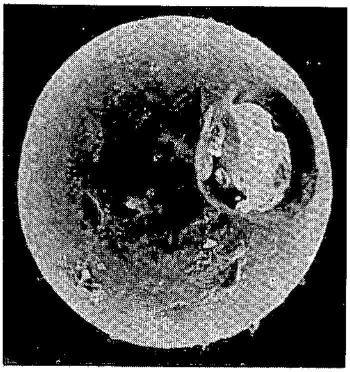

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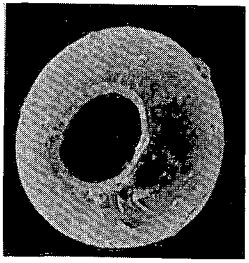

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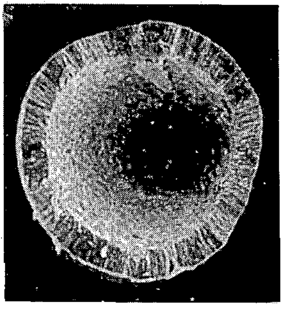

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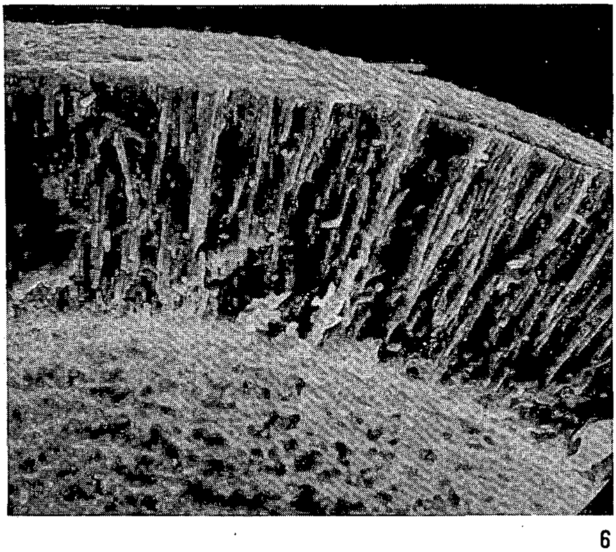

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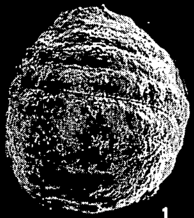
Plate V

1.,4. *Amblyochara beguiana* GRAMBAST 1962
Borehole Somlóvásárhely Sv. 1, 1368.2 m, Upper Cretaceous
2.,3.,5. *Microchara laevigata* GRAMBASt et GUTIERREZ 1977
Borehole Somlóvásárhely Sv. 1, 1380.5 m, Upper Cretaceous

1.: SEM 40X
2—5.: SEM 100X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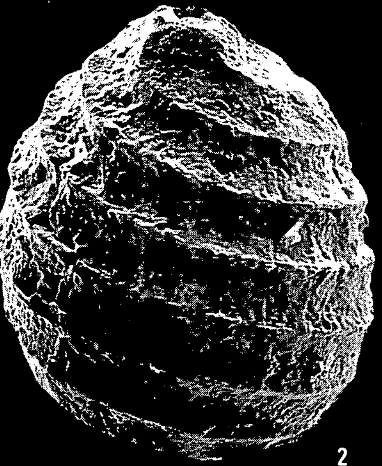
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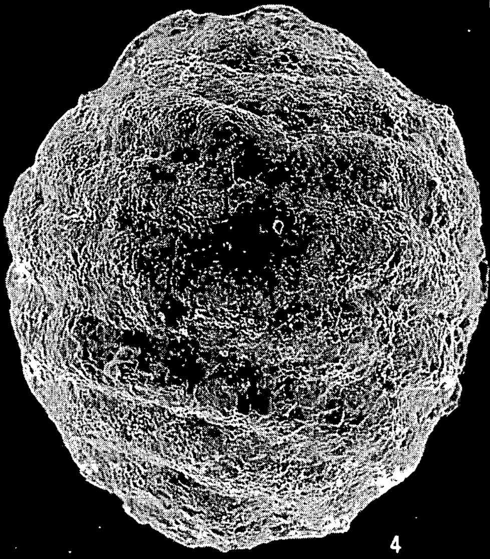
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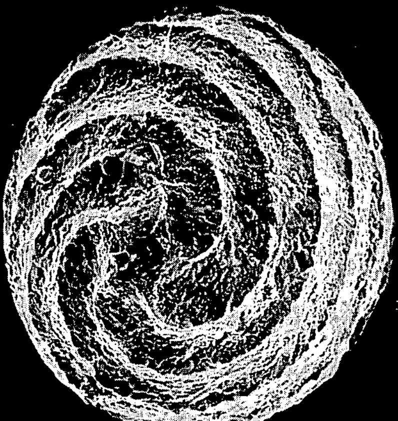
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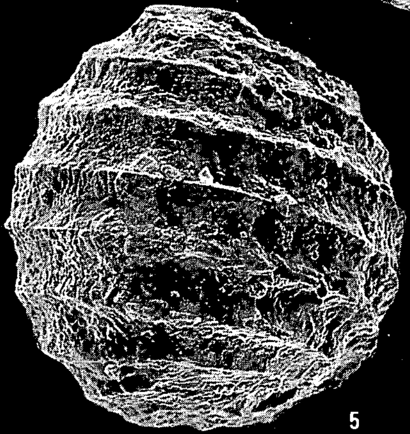
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Plate VI

1—3. *Nitellopsis (Tectochara) meriani* (L. et N. GRAMBAST 1954)
L. GRAMBAST et SOULIÉ-MÄRSCHE 1972
Borehole Iharkút Ik. 2237, 70.4 m, Oligocene
1. Lateral side
2. Apical part
3. Basal part

4—5. *Harrisichara vasiformis* (REID et GROVES 1921) GRAMBASt 1957
Csordakút open-cast mine, Eocene
4. Lateral side
5. Apical part

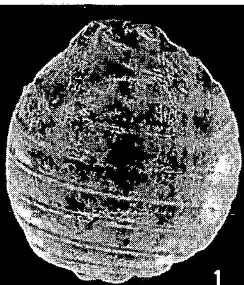
6. *Sphaerochara hirmeri* (RÁSKY 1945) MÄDLER 1955
Borehole Iharkút Ik. 2238, 202.0 m, Oligocene
Lateral side

7—8. *Stephanochara vectensis* (GROVES 1927) GRAMBAST 1958
Borehole Iharkút Ik. 2238, 202.0 m, Oligocene
7. Lateral side
8. Apical part

9—10. *Rhabdochara langeri* (ETTINGS 1872) MÄDLER 1955
Borehole Iharkút Ik. 2238, 202.0 m, Oligocene
9. Lateral side
10. Basal part

11—12. *Sphaerochara parvula* (REID et GROVES 1921) GRAMBAST 1958
Borehole Bakonybél Bb. 16, 113.4—116.4 m, Upper Eocene
11. Lateral side
12. Basal part

1—6., 9.: SEM 30X
7—8.: SEM 80X
10.: SEM 100X
11—12.: SEM 200X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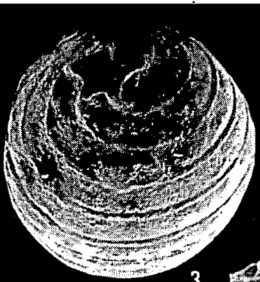
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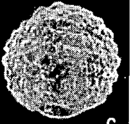
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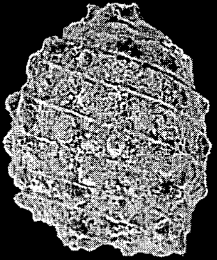
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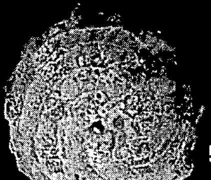
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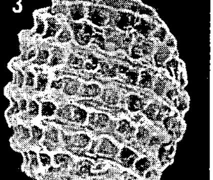
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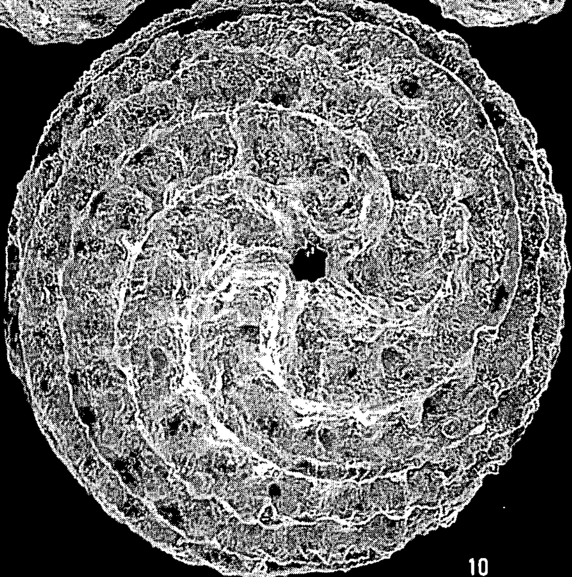
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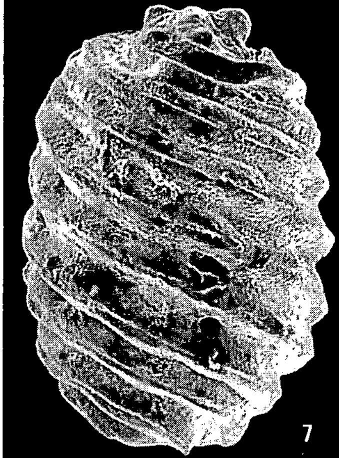
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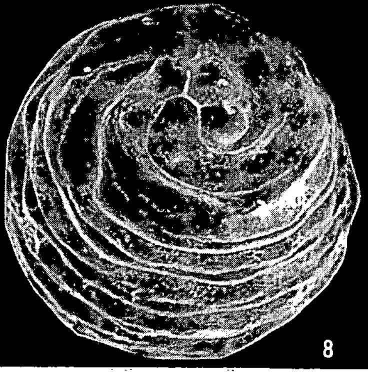
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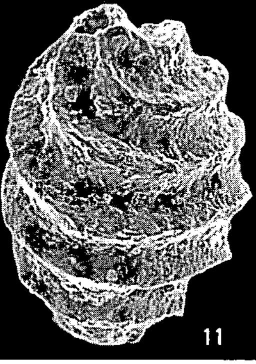
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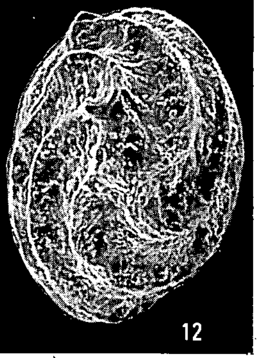
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Plate VII

1. *Peckichara coronata* (PECK et RECKER 1948) GRAMBAST 1957
Csordakút open-cast mine, Middle Eocene
Lateral side

2—4. *Chara molassica* STRAUB 1952
Borehole Nyirád Nyt. 1, 74.5—74.7 m, Upper Badenian
2. Lateral side
3. Apical part
4. Basal part

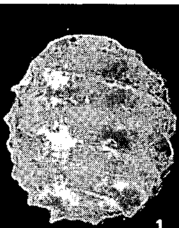
5—7. *Chara sadleri* UNGER 1850—1852
Borehole Nyirád Nyt. 1, 74.5—74.7 m, Upper Badenian
5. Lateral side
6. Apical part
7. Basal part

8—10. *Chara notata* GRAMBAST et PAUL 1965
Borehole Iharkút Ik. 2237, 70,4 m, Oligocene
8. Lateral side
9. Apical part
10. Basal part

11—13. *Nitellopsis (Tectochara) huangi* (LU 1945) GRAMBAST et SOULIÉ-MÄRSCHE 1972
Borehole Pusztamiske Pm. 1, 13.3 m, Sarmatian
11. Lateral side
12. Apical part
13. Basal part

14—15. *Charophyta* sp.
Csordakút open-cast mine, Eocene

1—13.: SEM 30X
14—15.: 3X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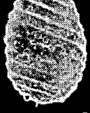
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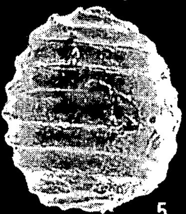
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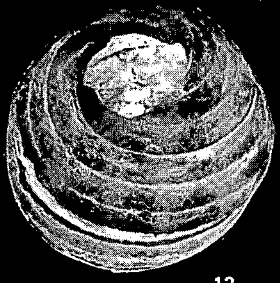
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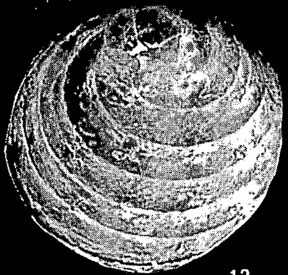
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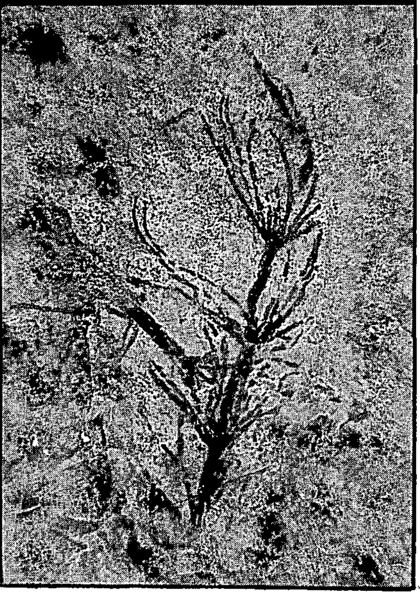
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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II. RÉSZ (1989)

PALYNOSTRATIGRAPHY OF THE RENDEK MEMBER OF THE POLÁNY MARL FORMATION

by
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During the XXIst Micropalaeontological Colloquium organized in Hungary, 1989, a detailed presentation, as well as a biostratigraphical evaluation of several Senonian lithostratigraphical units of the Transdanubian Central Range is to be prepared, including the nannoplankton-, sporomorph-, and Foraminifera assemblages of the Rendek Member of the Polány Marl Formation.

The authors aim at presenting the stratigraphical position of the Rendek Member within the Hungarian Senonian, its palynozonation and sporomorphs, as well as introducing 3 new morphogenera of Normapolles and 16 new morphospecies, putting forward the combination of 2 morphospecies and the emendation of 1 morphogenus.

In the course of the XXIst International Micropalaeontological Colloquium to be held in Budapest, 1989, the sporomorph assemblages of the Rendek Member of the Polány Marl Formation are to be presented among the Senonian formations of the Transdanubian Central Range, opened by deep drillings transsecting this member that were deepened in the course of coal prospecting. Apart from the palynostratigraphical relations the authors aim at presenting the palaeontological description of sporomorphs taxa that were introduced in the palynological reports of recent studies as "nomen nudum".

Description of the Rendek Member and its place within the Senonian sequence

The Senonian formations of the Transdanubian Central Range can assigned, in a genetical sequence, to the following units:

— Polány Marl Formation,

— Ugod Limestone Formation (possibly an isochronous facies of a part, or all of the Jákó Marl Formation),

— Jákó Marl Formation,

— Csehbánya Formation (possibly an isochronous facies of a part, or all of the Ajka Coal Formation),

— Ajka Coal Formation.

The sequence comprising the above lithostratigraphical units is separated from the rest of the Hungarian Senonian formations, on account of the basic differences attested, under the name of "Central Range"-type.

The Polány Marl Formation is the youngest, thickest and most wide spreaded representative of the Transdanubian Central Range's Senonian deposits. This formation was described first as a lithostratigraphical unit by F. HAUER (1862). Its most up-to-date and detailed presentation as well as a critical history of its research was published in the studies of J. HAAS (1979) and J. HAAS et al. (1984).

The first adequate description of the members of the lower section within the Polány Marl Formation was given by J. HAAS (1979, p. 110). He propesed the separation of the Rendek Member under this name (J. HAAS et al. 1984 p. 154). The description of the member was mainly based on surface outcrops and boreholes around the town Sümeg, referring at some places to occurrences in the Northern Bakony as well. The denomination of the member was put forward, referring to exposures situated at the side of the Rendek Mt. On the basis of the investigation of borehole sections and exposures in the vicinity of Magyarpolány, we can complement the description of the member in the followings:

Under the term Rendek Member of the Polány Marl Formation we understand a part of the lower section of the Formation consisting of gray, laminated, thin bedded platy claymarl, silty claymarl and clayey limestone, less frequently, of calcareous marls with 5—10-cm-thick clay intercalations, alternating with limestones. Its underlaying bed is either the Jákó Marl Formation or the Ugod Limestone Formation, its overlying bed is composed of, according to evidences yielded by boreholes Magyarpolány Mp. 37 and Mp. 42, intraclastic limestone or authigenous-brecciated limestone. It is appearing in the vicinity of the Ugod Limestone Formation, and even as interfingered with the latter, around Sümeg J. HAAS (1984).

The $CaCO_3$ content of the calcareous marl, argillaceous limestone beds of the Rendek Member is ranging from 60 to 95%. About half of the non-carbonate fraction is within the grain-size range of clay and silt. On the bedding planes, quite often we can observe nodular structural elements, worm, tracks and bioturbation.

The characteristic rock texture is biomicrite, biopelmicrite.

The depositonal environment of formation might have been, according to J. HAAS (1984), the sub-wave level of the submarine slope that was still adequately lighted (a depth of 10—30 m). Palynological investigations can support this statement, adding that the open sea environment does not imply, at the same time, a great distance from the shores as well.

The pertaining palaeontological study is by no means completed as yet. The nannoflora of the Magyarpolány outcrop was investigated by L. FÉLEGYHÁZY (in GÓCZÁN et al. 1989), the Foraminifera fauna was studied by I. BODROGI and E. BODNÁR (in GÓCZÁN et al. 1989). Previously, not separated from the Polány Marl Formation in general, S. JASKÓ (1935), L. MAJZON (1964) and M. SIDÓ (1963) had studied the microfossils. The palaeontological evidence of the exposures around Sümeg were studied by J. HAAS and E. JOCHA-EDELÉNYI (1984), the molluscs were investigated by L. CZABALAY (1964). The palynostratigraphical division was carried out by F. GÓCZÁN (1964, 1973) and, more recently, Á. SIEGL-FARKAS (1983, 1986).

The biostratigraphical assignment of the member as based on different groups of fossils, and studied at different levels of elaboration, is not yet unanimougly settled. The lower part of the Magyarpolány outcrop, located opposite to the church of the village, was assigned on the basis of the nannoflora to the *Quadrum sissinghii* (CC21) nannozone of the Middle Campanian by L. FÉLEGYHÁZY (in GÓCZÁN et al. 1989). The plankton foraminifers denote the taxonal zone *Globotruncana ventricosa* (revised by I. BODROGI), corresponding fairly well to the assignment of the nannoflora. Microfaunal investigations performed on thin sections from the same layer by E. BODNÁR seemingly do not exclude a dating to the beginning of the calcarata taxonal zone (lower part of the Upper Campanian) either.

The Inoceramus fauna collected from another exposure of a ditch at Magyarpolány (non covered by concrete), has been assigned by L. MÓRA-CZABALAY to the Upper Campanian substage.

Playnological investigations were performed on borehole core samples, both in the environs of Sümeg and at Magyarpolány. These boreholes transsected the whole member, about 80 m thick, which can be classified into the triangularis—spatiosus and the bajtayi—lenneri palynological dominance zones (zones "E" and "F") of the Upper Campanian. Based on the palynostratigraphical evidence obtained from the sequence transsected by borehole Sp. 2 it seems that the sequence of the member can range into the Lower Maastrichtian substage as well. *Parapachidiscus neubergicus* (SCHLOTTHEIM), collected from the Sümeg municipal quarry, from rocks overlying the Rendek Member, and determined by I. NOSZKY Jr., as a zone-marker Ammonites of the Lower Maastrichtian, can verify the belonging of this member to the Upper Campanian substage. On the basis of the studies performed so far, the time of sedimentation for the rocks constituting the Rendek Member can be put, accepting the bipartite character of the stage Campanian, to the Upper Campanian substage. (Fig. 1).

The Rendek member yielded, so far, the following sporomorph taxa: *Cymatiosphaera* sp., *Dinogymnium denticulatum* (ALBERTI 1959) EVITT et al. 1967, *Dinogymnium cretaceum* (DEFL. 1935) EVITT et al. 1967, *Bikolisporites toratus* (WEYL. et GR. 1953) Sriv. 1975, *Devecserisporites campanicus* Á. SIEGL-FARKAS 1986, *Echinatisporites maastrichticus* n. sp. GÓCZÁN, *Gleicheniidites senonicus* (ROSS 1969) BOLCH. 1968 f. minor, *Plicifera delicata* (BOLCH. 1953) BOLCH. 1968, *Polypodiaceoisporites* cf. *stockmarrii* KEDVES 1980, *Trilites* cf. *asolidus* W. Kr. 1959b, *Vadaszisporites urkuticus* (DEÁK 1965) DEÁK et COMBAZ 1967, *Coronatipollis* cf. *coronatus* (GÓCZÁN 1964) nov. comb., *Coronatipollis corpulentus* nov. sp., *Coronatipollis proprius* nov. gen et. sp., *Coronatipollis* div. sp., *Cuneipollis cuneolis* nov. gen. et sp., *Endopollis latiporus* GÓCZÁN 1967, *Hungaropollis nodosus* nov. sp., *Hungaropollis rectilineus* nov. sp., *Hungaropollis hollossyi* nov. sp., *Hungaropollis* div. sp., *Intercalaripollis polanyensis* nov.

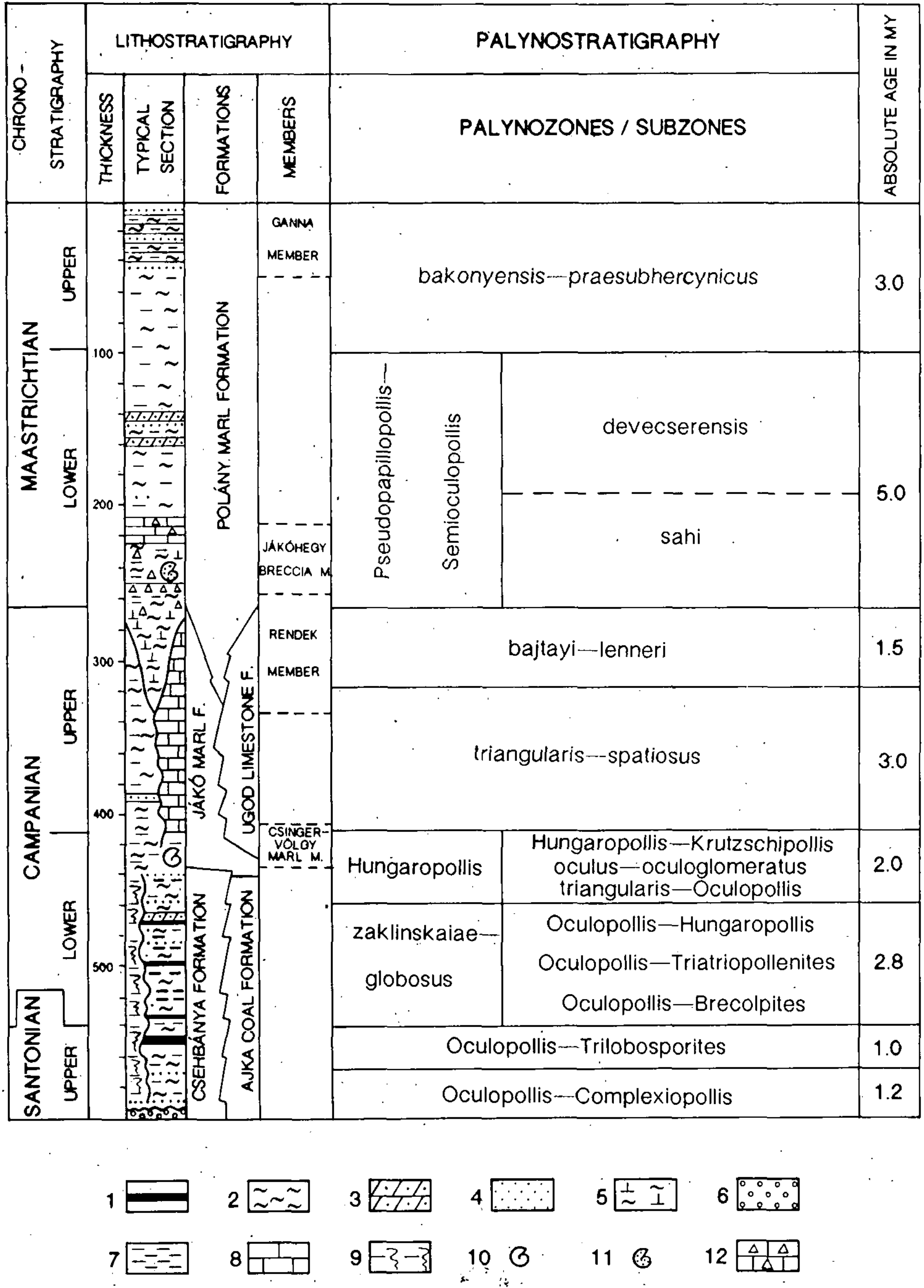

Fig. 1. Stratigraphical division of the Senonian layers of the Transdanubian Central Range
1. Coal, *2.* marl, *3.* sandstone, *4.* sand, *5.* calcareous marl, *6.* conglomerate, *7.* clay, *8.* limestone, *9.* variegated clay, *10. Placenticeras polyopsis*, *11. Parapachydiscus neubergicus*, *Inoceramus balticus*, *12.* authigeneous breccia

gen. et sp., *Krutzschipollis crassis* (GÓCZÁN 1964) GÓCZÁN 1967, *Krutzschipollis elegans* nov. sp., *Krutzschipollis magnoporus* GÓCZÁN 1967, *Krutzschipollis rotondus* nov. sp., *Krutzschipollis spatiosus* GÓCZÁN 1967, *Krutzschipollis* div. sp., *Longanulipollis arcuatus* nov. sp., *Longanulipollis bajtayi* (GÓCZÁN 1964) GÓCZÁN 1967, *Longanulipollis elegans* (GÓCZÁN 1964) GÓCZÁN 1967, *Longanulipollis fornicatus* n. sp., *Longanulipollis longianulus* (GÓCZÁN 1964) GÓCZÁN 1967, *Longanulipollis monstruosus* nov. sp., *Longanulipollis polanyensis* nov. sp., *Magnoporopollis krutzschii* KEDVES et HERNGREEN 1980, *Oculopollis campanicus* n. sp., *Oculopollis* div. sp., *Plicapollis hungaricus* n. sp., *Pseudopapillopollis simplex* n. sp., *Semioculopollis coronatiformis* nov. sp., *Semioculopollis daniensis* KEDVES 1979, *Semioculopollis minimus* (GÓCZÁN 1964) GÓCZÁN et al. 1967, *Subtriporopollenites anulatus* TH. et PF. 1953, *Suemegipollis triangularis* GÓCZÁN 1964, *Suemegipollis germanicus* W. KR. 1973, *Triporopollenites robustus* PF. 1953a subf. sp. *robustus*, *Trudopollis* cf. *hojrupensis* KEDVES 1979, *Trudopollis lativerrucatus* KEDVES et HERNGREEN 1980, *Trudopollis minimus* (GÓCZÁN 1964) nov. comb., *Trudopollis triangulus* KEDVES et HERNGREEN 1980, *Vacuopollis* cf. *percentus* Pf. 1953b.

From among the taxa enumerated, we are presenting here the detailed descreption of the following forms: (The measurable and computable features used in the descriptions are summarized on Fig. 2.)

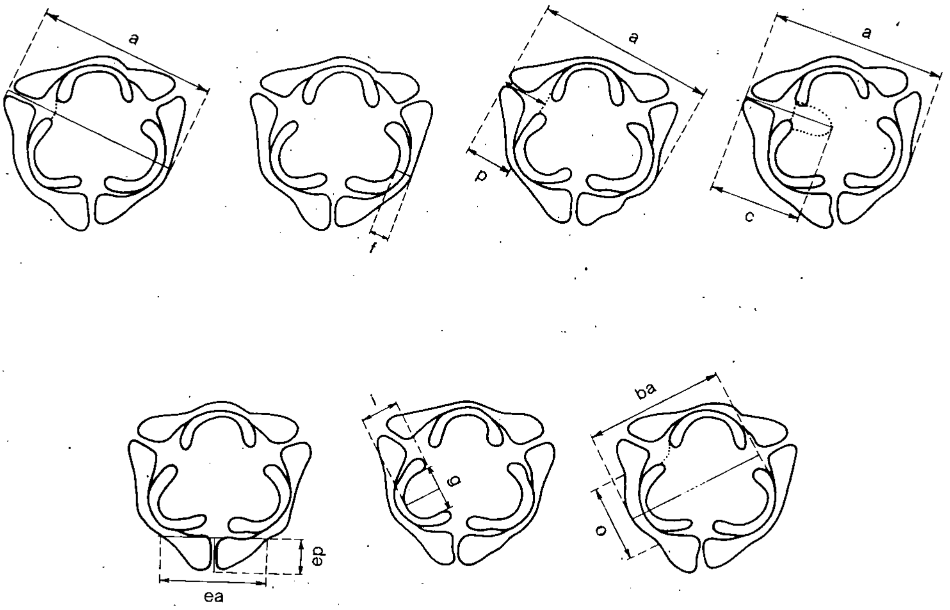

Fig. 2. The measurable and calculable features of the taxa described
a = Maximum diameter, *f* = wall thickness, *p/a* = pore channel index, *c/a* = cuneus index, *ep/ea* = anulus index, *i/g* = nexine curvature index, *o/ba* = grain curvature index

Cuneipollis nov. gen.

Genus typus: *Cuneipollis cuneolis* nov. gen. et sp.
Derivatio nominis: named after its characteristic cuneus.

Genus diagnosis: A Normapolles pollen with triangular exterior contour in the E-plane, a trifolium-like interior contour, a wall thicker than 1 μm, sculpture of the surface is maculate and three germinal apertures. The exterior wall is always thinner than the interior one. Their thickness ratio is 1:2 or more. There is no oculus present. In the pore region we find a beak-form elongated ectanulus. The exoporus is brevicolpat. The aperture is asymmetrical. The structure of the endogerminaliae is represented by the connection of the centripetally thickened, stubbed endanulus and the deep cuneuses.

Differential diagnosis: The form Cuneipollis nov. gen. is seemingly nearest to the genera Trudopollis PF. 1953b and Hofkeripollenites KEDVES et HERNGREEN 1980. It differs from the Trudopollis PF. 1953b in its characteristic deep cuneus, while it can be separated well from the Hofkeripollenites KEDVES et HERNGREEN 1980 on the basis of its centripetally thickened, stub-like endanulus.

Remark: Generally, Normapolles grains of medium-large size (25—40 μm), occurring mainly in the Upper Campanian and the Lower Maastrichtian with deep cuneus and stub-like endanulus belong to this form.

Cuneipollis cuneolis nov. gen. et sp.

Plate IV. figs. 1—9

Holotypus: preparation No. 73/1, coordinates 15.4—110.0, photo No. 842/31—37. Plate IV, figs. 1—4.
Derivatio nominis: named after its deep cuneuses.
Locus typicus: borehole Sümeg Sp. 2.
Stratum typicum: 115.8—117.0 m, light grey clayey limestone, Upper Campanian.

Diagnosis: In E-plane the exterior contour of a Normapolles pollen of medium size is triangular with rounded apexes, convex sidelines and trifolium-like interior contour, three germinal apertures. It is elongated in a beak-like manner at the germinal region, with evolved ektanulus and asymmetrically opening brevicolpat germinal aperture. There is no oculus present. The wall is thick. The ratio of the sexine:nexine is 1:2. The sculpture of the surface is maculate on both sides. At the endogerminal parts there is a vestibulum, a stub-like endanulus as well as an apparent cuneus.

Dimensions: Holotype and range of variation: maximum diameter 30 μm (28—34 μm), wall thickness 2.5 μm (1.6—3.0 μm), anulus index 0.58 (0.46—0.58), pore channel index 0.26 (0.24—0.26), cuneus index 0.46 (0.36—0.46), sexine curvature index 0.33 (0.33—0.62), grain curvature index 0.60 (0.59—0.60).

Differential diagnosis: The specimens assigned to the *Cuneipollis cuneolis* nov. gen. et sp. are nearest in form, dimensions and construction to the form *Hofkeripollenites triangularis* n. fsp. described by KEDVES et HERNGREEN 1980 from the Gulpen Formation, the Netherlands, Maastrichtian Stage (p. 516, Pl. VIII, figs. 4—5). As it is unambiguous on the basis of the description of the species that the type specimen has no endanulus, whereas the *Cuneipollis cuneolis* nov. gen.

et sp. has a stub-like endanulus, on the basis of this feature we have to treat these two taxa as separate species.

Remark: On the basis of the rich and varied material referred to the genus Cuneipollis of the Upper Campanian and Lower Maastrichtian formations of the Transdanubian Central Range it is not excluded that with the accumulation of further specimens of *Hofkeripollenites triangulus* KEDVES et HERNGREEN this species will be assigned to the genus of Cuneipollis as a morpho-species with weekly evolved endanulus.

Occurrence: boreholes Sümeg Sp. 2, 115.8—117.0 m, 351.55—351.90 m, Devecser Dv. 3, 820.0 m—830.0 m, Dv. 2, 820.0 m, Magyarpolány Mp. 38, 418.0 m; from the upper phase of the Lower Campanian till the upper phase of the Lower Maastrichtian. Its acme can be placed at the Upper Campanian.

Coronatipollis nov. gen.

Genus typus: *Coronatipollis proprius* nov. gen. et sp.
Derivatio nominis: named after its form.

Genus diagnosis: In E-plane the exterior contour of the polyanulate pollen grains is triangular with slightly rounded apexes. The interior countour is similar to three horseshoes with intensive bends on the ends. They have three germinal apertures, their size is medium to large, the width of the wall is variable, extending from 1 μm to 5 μm. The width ratio of the interior and the exterior wall can be fairly variable between the individual species. The surface at both sides is of maculate sculpture. The size and distribution of the maculae are different at the different species. At some cases they are clustered on the distal side, in the region of the pores into thin but definitely contoured oculus, in some other instances, we find only a germ of an oculus while, in most cases, there are no oculi at all. The ektanulus is polyanulate, considerably well developed, elongated in a beak-form manner. The exogerminalia is brevicolpat, opened asymmetrically. The structure of the exogerminalia is composed of a vestibulum, a wide endoporus and, in some species, a weak endanulus.

Differential diagnosis: The Coronatipollis nov. gen. is seemingly nearest, on the basis of its exterior and interior contour, to Cuneipollis nov. gen. and Hofkeripollenites KEDVES et HERNGREEN 1980. The lack of the cuneus separates it from both while the broken exterior side-contour and the considerably well developed ektanulus separate it from Hofkeripollenites KEDVES et HERNGREEN 1980 and Longanulipollis GÓCZÁN 1967.

Remark: The majority of the species assigned to Coronatipollis nov. gen. are frequently occurring in the formations of the stages Upper Campanian and Lower Maastrichtian.

Coronatipollis proprius nov. gen. et sp.
Plate IV, figs. 10—12

Holotypus: peparation No. 41591/2, coordinates: 14.2—103.1, photo No. 859/9—14, Plate IV, figs. 10—12.

Derivatio nominis: after the latin word "proprius", on the basis of its permanent, characteristic contour.
Locus typicus: borehole Csabrendek Cn. 931.
Stratum typicum: 289.5—292.5 m grey claymarl, Upper Campanian.

Diagnosis: In E-plane the exterior contour is triangular with slightly rounded apexes, and with broken convex sidelines. The interior contour is reminiscent of three horseshoe-shape forms set beside each other at their corners. This shape is delineated by the very convex arch of the nexine which is bent inwards at the pore region and the interrupting wide aperture of the endoporus together. The wall is c. 2 μm thick and bipartite. The exterior part of the wall is thinner than the interior one. The exterior part of the wall is centrifugally thickened at the pore region, forming a beak-like elongated ektanulus. The exogerminalia is asymmetrically opening brevicolpat. At the endogerminal region there are the vestibulum, the centripetally slightly thickened endanulus as well as a c. 4 μm wide and 3 μm deep endoporus, connected inwards to an endogerminal aperture which is wider than 10 μm, formed of the covering lamella of the nexine, which is thinner than 0.5 μm. The ornamentation of the surface is maculate at both sides. The size of the maculae can exceed at the pore region of the distal side 1 μm and; reminiscent of a germ of an oculus, slightly concentrated forming, however, no real oculus. At the extragerminal region and the central field they are smaller and more sparsely dispersed.

Dimensions: Holotype: maximum diameter c. 36. μm, wall thickness c. 2 μm, anulus index 0.35, pore channel index 0.27, nexine curvature index 0.72, grain curvature index 0.40.

Differential diagnosis: The *Coronatipollis proprius* nov. gen. et sp. is most similar to the species *Coronatipollis corpulentus* nov. sp. On the basis of its major dimensions, thinner wall, smaller ektanuli, however, it can be fairly well separated from the more bulky *C. corpulentus* nov. sp.

Remark: The species is of rare occurrence but typical species of its genus.

Coronatipollis corpulentus nov. sp.
Plate IV, figs. 13—15

Holotypus: preparation No. 25470, coordinates 3.5—120.4, Photo No. 681/16, Plate IV, figs. 13—15.
Derivatio nominis: named after its bulky, corpulent form.
Locus typicus: borehole Devecser Dv. 3.
Stratum typicum: 830.0 m, grey calcareous marl, Upper Campanian.

Diagnosis: Its exterior contour is very convex, slightly broken in the E-plane, its form is rounded triangular. The line of the interior contour is determined by the three, intensively bent, horseshoe form line of its nexine, interrupted in the pore region by the apertures of the endopores. The wall is apparently very thick compared to the size of the specimen. At the extragerminal parts it can reach or even surpass 4 μm. The ratio of the sexine to the nexine is 1:2.5—1:3. At the pore region there is a strong, beak-form ektanulus with slightly asymmetrical opening brevicolpat germ aperture. At the endopores region there is a wide, narrow vestibulum, a 2—3 μm wide and deep endopores and no endanulus. The surface is ornamented by, fine, roughly equigranular maculae, no larger than 1 μm from both sides.There is no oculus observable.

Dimensions: maximum diameter c. 36. μm, wall thickness c. 4. μm, anulus index 0.40, pore channel index 0.33, nexine curvature index 0.70, grain curvature index 0.44.

Differential diagnosis: The *Coronatipollis corpulentus* nov. sp. can be fairly well separated, on the basis of its bulky construction, relatively great ektanulus (compared to its size), thick wall and fine maculate ornamentation from *Coronatipollis proprius* nov. sp., which is larger, has thinner wall, smaller ektanulus and coarser maculae on its surface, as well as *Coronatipollis coronatus* (GÓCZÁN 1964) nov. comb., which is similar to *C. corpulentus* in construction but has much smaller dimensions.

Remark: The species is of rare occurrence but characteristic member of the Upper Campanian sporomorph associations.

Longanulipollis GÓCZÁN 1967 emend

Remark: On the basis of the rich sporomorph material found since the description of the genus, the authors suggest the following emendation in respect of the diagnosis of the genus Longanulipollis GÓCZÁN 1967:

1. The part of the original description cited here, "Aussenkontur im E △ " (p. 472) should be modified accordingly: its exterior contour in the E-plane is concave, straight, or only slightly convex, its side is unbroken or slightly broken rounded triangular.

2. The pore channel index value published as 0.4 should be modified as 0.3.

3. The anulus index value published as 0.6 should be modified as >0.5.

Longanulipollis polanyensis nov. sp.
Plate II, figs 4—9

Holotypus: preparation No. 47480, coordinates 22.8—108.5, photo No. 135/18—21, Plate II, figs. 4—9.
Derivatio nominis: named after the site of its first occurrence.
Locus typicus: borehole Magyarpolány Mp. 38.
Stratum typicum: 418.0 m, Upper Campanian.

Diagnosis: The exterior contour in the E-plane is triangular with rounded apexes and with straight or slightly broken sides. The interior contour is circular, slightly impressed along the pore region. The wall is wider than 1 μm, the nexine is thicker than the sexine. The exogerminals comprise a strong, elongated, beak-form ektanulus and a considerably asymmetrically opening short colpus. On the endogerminal region there is a narrow vestibulum starting from the end of the anuli. The 2—3 μm wide and deep endoporus is formed of the inclining, slightly thickened end of the nexine dissected to small lamellae, closed by a widely opening endolamella which is thinner than 0.5 μm. The surface is ornamented on both sides by maculae, smaller than 1 μm. At the central parts they are often uniting into each other, forming short rugae. The pore region is open on both sides, there is no oculus present.

Dimensions: Holotype and paratype: maximum diameter 38 μm (35 μm), wall thickness 2.5 μm (3.0 μm), anulus index 0.52 (0.68), pore channel index 0.32 (0.37), nexine curvature index 0.5 (0.42), grain curvature index 0.35 (0.35—0.37).

Differential diagnosis: The *Longanulipollis polyanyensis* nov. sp. is similar in form and construction to *Longanulipollis monstruosis* nov. sp. Its thinner wall, finer ornamental elements and the lack of oculus, however, can adequately separate it from *L. monstruosis* nov. sp.

Remark: The species is relatively rare, known so far from the Upper Campanian layers of the Magyarpolány boreholes.

Longanulipollis monstruosis nov. sp.

Plate II, figs. 10—12

Holotypus: preparation No. 47480, coordinates 20.1—105.8, photo No. 136/24—27, Plate II, figs 10—12.
Derivatio nominis: named after its size and construction.
Locus typicus: borehole Magyarpolány Mp. 38.
Stratum typicum: 418.0 m, Upper Campanian.

Diagnosis: The exterior contour in the E-plane is straight, slightly concave or slightly broken, triangular with cut angles. The interior contour is circular, slightly flattened in the region of the pores. The wall is thicker than 3 μm. The sexine is thinner than the nexine. The ratio of their width is approx. 1:2. The surface is ornamented on both sides by maculae, which are around 1 μm at the central as well as the exogerminal parts triangular with straight or slightly broken sides. At the pore region of the distal side they form irregular clusters reminding to an oculus. The exogerminalia is composed of a huge, strong, centrifugally thickened polyanulat ektanulus and a slightly asymmetrically opening colpus. Around the endogerminal parts there is a narrow vestibulum and a 2—3 μm wide and deep endopores. Along the pores the including ends of the nexine which are slightly thickened and dissected to lamellae form the endopores closed by widely opening covering lamella of c. 0.5 μm width.

Dimensions: Holotype: maximum diameter 38 μm, wall thickness 4.0 μm, anulus index 0.55, pore channel index: 0.34, nexine curvature index 0.45, grain curvature index 0.40.

Differential diagnosis: The *Longanulipollis monstruosis* nov. sp. is similar to *Longanulipollis polanyensis* nov. sp. , differring mainly in the thickness of the wall, the oculus-like clusters of maculae at the germinal region of the distal side and the higher values of grain curvature index.

Remark: Its appearance is corresponding to those of *Longanulipollis polanyensis* nov. sp. It is rarely occurring species of the Upper Campanian.

Longanulipollis fornicatus nov. sp.
Plate III, figs. 1—3

Holotypus: preparation No. 47483., coordinates 11.9—114.2, photo No. 139/18—23, Plate III, figs. 1—3.

Derivatio nominis: fornicatus (latin) = arched. Named after its uniformly, but moderately convex exterior contour.

Locus typicus: borehole Magyarpolány Mp.-38.

Stratum typicum: 430.0 m, Upper Campanian.

Diagnosis: The exterior contour in the E–plane is triangular with slightly convex and slightly broken sidelines and with rounded apexes. The interior contour is circular, slightly impressed by the endopores. The surface of the wall, which is thicker than 2 μm is ornamented on both sides by smaller maculae, less than 1 μm large. The nexine is forming a beak–like elongated ektanulus at the pore region. The exterior aperture is brevicolpat, opening asymmetrically. In the endogerminal region we find a wide but narrow vestibulum — which is 2—3 μm wide — and a deep endoporus. The interior surface of the nexine is covered by a covering lamella which is thinner than 0.5 μm, forming an interior aperture with wider opening than that of the endopores.

Dimensions: Holotype: maximum diameter 35 μm, wall thickness 4 μm, anulus index 0.66, pore channel index 0.31, nexine curvature index 0.36, grain curvature index 0.60.

Differential diagnosis: The most similar species to the *Longanulipollis fornicatus* nov. sp. are the *Longanulipollis polanyensis* nov. sp. and the *Longanulipollis monstruosis* nov. sp. It can be, however, well distinguished on the basis of its stockier form, smaller pore channel index and the curve index of the nexine.

Remark: Due to its slightly convex sidelines and stockier shape the *Longanulipollis fornicatus* nov. sp. is a transition towards the Intercalaripollis nov. gen. (pore channel index below 0.3). Most frequently it occurs in the Upper Campanian and Lower Maastrichtian.

Intercalaripollis nov. gen.

Genus typus: *Intercalaripollis arcuatus* nov. gen. et sp.

Derivatio nominis: intercalaris (latin) = to be intercalated. Named after its transitional construction intermediate between several genera.

Genus diagnosis: In E–plane the exterior contour in triangular with unbroken or slightly broken, uniformly convex sideline, and with rounded apexes. The interior contour is a slightly flattened circle on the pore region. Its wall is thicker than 2 μm. The thickness of the sexine agrees with that of the nexine, or somewhat thinner than that. Its surface is ornamented by small maculae on both sides. The ornamental elements are more delicate on one side than or the other. At the distal side, in the pore region they can form oculus–like clusters forming, however, no real oculus. The ektanulus is developed, centrifugally elongated. The exterior aperture is brevicolpat. In the endogerminal region, generally we find a narrow medium-wide vestibulum. Endanulus might occur but weakly developed. The diameter and depth of the endopore is 2—3 μm, which can be associated with a much wider aperture of a very thin covering lamella sticking tightly to the interior surface of the nexine.

Dimensions: medium to large grains, pore channel index<0.3, anulus index<0.4.

Differential diagnosis: The Intercalaripollis nov. gen. can be differentiated on the basis of its uniformly arched exterior contour, shorter anuli and the pore channel index (under 0.3) from the species belonging to Longanulipollis GÓCZÁN 1967, which have similar contours as well as from Felderipollenites KEDVES et HERNGREEN 1980. From the taxon Coronatipollis nov. gen., which is also similar to Intercalaripollis, it can be differentiated on the basis of its less intensively arched exterior and interior contour.

Remark: The Intercalaripollis is a collective genus for those medium or large Normapolles PF. 1953 with convex side and thick ectanulus that cannot be assigned, on the basis of the ratio of wall thickness, pore channel index and exterior—interior contours either to Longanulipollis GÓCZÁN 1967 or Extratriporopollenites PF. 1953a, Felderipollenites KEDVES et HERNGREEN 1980 as well as Coronatipollis nov. gen. Their occurrence and frequency can be dated to the Campanian and early Maastrichtian.

Intercalaripollis arcuatus nov. gen. et sp.

Plate III, figs. 4—6

Holotypus: preparation No. 47480, coordinates 16.6—100.9, photo No. 137/27—29, Plate III, figs. 4—6.

Derivatio nominis: arcuatus (latin) = arched. Named after its exterior contour, slightly arched in the E-plane.

Locus typicus: borehole Magyarpolány Mp. 38.

Stratum typicum: 418.0 m, Upper Campanian.

Diagnosis: In E-plane the exterior contour is triangular, with uniformly arched, slightly convex sidelines and with slightly rounded apexes. The interior contour is circular, slightly impressed at the germinal parts. The wall is thick, the exterior part of the wall is somewhat thinner than the interior one. Its surface is ornamented at both sides by maculae. The size of the maculae at the different sides is fairly different. On one side, they are under 1 μm in the central field, while on the other side they are around 2 μm. At the endogerminal parts as well as by the sides they are often uniting forming, however, no real oculus. At the exogerminal region there is a strong ektanulus and apparently asymmetrically opening brevicolpat aperture. At the endogerminale the nexine forms a slight endanulus. The vestibulum is wide but shallow. The endanulus, split into thin lamellae, forms a 2—3 μm deep endoporus, connected by, from the interior side, a more than 5 μm wide aperture formed by the covering lamella.

Dimensions: Holotype: maximum diameter 34 μm, wall thickness 4.0

μm, anulus index 0.38, pore channel index 0.27, nexine curvature index 0.59, grain curvature index 0.4.

Differential diagnosis: The *Intercalaripollis arcuatus* nov. sp., with its exterior contour, thick wall and dimensions is nearest to, among the taxa known so far and described here, to *Coronatipollis corpulentus* nov. sp., differring from it on the basis of its more weakly arched circular interior contour, endanulus and special sculpture, i.e., and on the different maculate ornamentation on the two sides.

Remark: Rarely occurring but characteristic member of the Upper Campanian sporomorph assemblage.

Genus: Magnoporopollis W. KR. 1967
Genus typus: *Magnoporopollis praemagnoporatus* W. KR. 1967

Magnoporopollenites krutzschii KEDVES et HERNGREEN 1980
Plate III, figs. 7—11

Remark: M. KEDVES et G. F. W. HERNGREEN (1980) described it from the Netherlands, from Maastrichtian layers. On the basis of their description and figure (p. 572, Pl. XI, figs. 7—8) it seems that the specimen found in borehole Magyarpolány Mp. 42 at 372.7 m from Upper Campanian formation can be assigned to this taxon, in spite of the small difference that in case of the latter, the nexine shows a slight endanulus-like widening at the pore region.

Genus: Trudopollis (PF. 1953) W. KR. 1967
Genus typus: *Trudopollis pertrudens* (PF. 1953a) PF. 1953b

Trudopollis triangulus KEDVES et HERNGREEN 1980
Plate III, figs. 12—15

Remark: This species was also described from the Maastrichtian formations of the Netherlands (p. 510, Pl. VII, figs. 17—20). At 327.7 m of the borehole Magyarpolány Mp. 38, a pollen grain was found which can be assigned, in spite of its slightly thicknes wall and the slight endanulus-like thickening, to this taxon according to its form and the construction of the exine.

Trudopollis cf. *lativerrucatus* KEDVES et HERNGREEN 1980
Plate V, figs. 7—9

Remark: The borehole Magyarpolány Mp. 42 transsected at the depth interval of 372.7 m from grey limy marl a representative of the genus Trudopollis W. KR. 1967, most reminiscent of the species described by M. KEDVES et G. F. W. HERNGREEN from the Maastrichtian layers of the Dutch Gulpen Formation (1980,

p. 508, Plate VII, figs 11—12). The state of preservation of our specimen does not allow the observation of the characteristic feature, the 2 μm large flat verrucae, therefore we cannot determine the species unambiguously.

Trudopollis cf. *hojrupensis* KEDVES 1979
Plate V, figs. 13—16

Remark: One of the representatives of the genus Trudopollis, encountered relatively sparsely at the rich Upper Campanian sporomorph association taken from 418.0 m of the borehole Magyarpolány Mp. 38, shows the greatest similarity to those specimens that were described from the Maastrichtian layers of the Dutch Gulpen Formation by M. KEDVES and G. F. W. HERNGREEN 1980 under the name of *Trudopollis hojrupensis* KEDVES 1979a (p. 506, Pl. V, figs 1—6). On the basis of the photos published on the Dutch specimens it seems that the pollen grains of Magyarpolány seem to have essentially thicker walls and their sexine:nexine ratio is nearer to the found in the Maastrichtian layers to the holotype of Danian age with thinner walls (KEDVES 1979, p. 171, Pl. I, figs. 15—16.)

Genus: Semioculopollis GÓCZÁN, W. KR. et PACLT. 1967
Genus typus: *Semioculopollis minutus* W. KR. et PACLT. 1967

Semioculopollis coronatiformis nov. sp.
Plate V, figs. 1—6

Holotypus: preparation No. 29969/1, coordinates 16.0—106.8, photo No. 531.32—36, Plate V, figs. 1—3.

Derivatio nominis: named after its construction similar to Coronatipollis nov. gen.

Locus typicus: borehole Magyarpolány Mp. 37. 145.0—146.0 m.

Stratum typicum: 145.0—146.0 m, Lower Maastrichtian.

Diagnosis: The E-contour is triangular with very convex and considerably broken sidelines and with slightly rounded apexes. The interior contour reminds us to three horseshoe-shaped forms placed beside each other. This form is the consequence of the strong flattening of the nexine at the endogerminal parts and its interruption by the endopores. The surface is covered by, maculae of 1 μm or even smaller size on both sides. The wall is thick most frequently over 2 μm. Generally the exterior wall is thinner than the interior one. The ektexine is forming a wide beak-like centrifugally bent ektanulus in the germinal region, on the edge of which there is a narrow, brevicolpat aperture, opening with a considerable asymmetry. At the distal side, around the germinal region, on the whole area of the ektanulus a flat but well confined oculus is formed. In the endogerminal region — generally, along the whole width of the ektanulus — there is a wide but shallow vestibulum. Consequently the nexine is attached to the sexine closely only at a short phase. A weak endanulus or germs of an endanulus can occur. The endoporus is 2—3 μm wide and deep.

Dimensions: medium large grains. Holotype: maximum diameter 3 µm, wall thickness 3.0 µm, anulus index 0.52, pore channel index 0.31, nexine curvature index 0.66, grain curvature index 0.39.

Differential diagnosis: The *Semioculopollis coronatiformis* nov. sp. is nearest in its form and construction to *Coronatipollis corpulentus* nov. sp. It is different from the latter in its oculus of characteristic outlines found at one side, considered by the authors as a differential feature on the genus level, and its higher anulus index values.

Remark: The species *Semioculopollis coronatiformis* is one of the frequent and typical forms of the Upper Campanian sporomorph associations. Due to its similar form and construction, it can be separated from the specimens of the species of the genus Coronatipollis in case of adequately preserved pieces only.

Semioculopollis daniensis KEDVES 1979

Plate V, figs. 10—12

Remark: Our specimen found in the Upper Campanian sample taken at 372.7 m of the borehole Magyarpolány Mp. 42. The wall is thick. The exterior and interior layers together comprise 5 µm or more, measured at the middle of the sideline. The sculpture of the surface is different at the two sides. At the proximal side, the surface is ornamented by very fine, c. 1 µm large maculea. At the distal side the dimension of the maculae is larger, uniting around the germinal region into oculus-like clusters. At the same side, over the thick triangular nexine, there are verrucae of different size (3—5 µm) situated, often uniting around their basis forming wreath-like ornaments. In the central field surrounded by the triangle there are 2—10 µm large verrucae of irregular flattened globular shape. The sexine is of fairly uniform thickness along the lateral sides. At the germinal region it forms a thick, dense, centrifugally thickenes club-form ektanulus. The exterior germ aperture is fissurelike, placed asymmetrically. The nexine is thicker than 2 µm, tightly sticking to the sexine along its whole length forming at the pore region a centrifugally thickened club-like andanulus. The vestibulum is short and narrow, but agrees fairly well with *Semioculopollis daniensis* KEDVES 1979, from the Lower Danian argillaceous formations of Denmark (p. 169, Pl. I, figs. 9—10). In the Hungarian Upper Campanian, Lower Maastrichtian layers it is a rare but consequently occurring species.

Genus: Hungaropollis GÓCZÁN 1964
Genus typus: *Hungaropollis krutzschii* GÓCZÁN 1964

Hungaropollis rectilineus nov. sp.

Plate VI. figs. 1—5

Holotypus: preparation No. 47483, coordinates 7.3—107.2, photo No. 139/5—10, Plate VI. figs. 1—5.

Derivatio nominis: rectilineus (latin) = straight. Named after the straight lines of its exterior contour.

Locus typicus: borehole Magyarpolány Mp. 38.

Stratum typicum: grey clay marl transsected at 430.0 m, Upper Campanian.

Diagnosis: Its exterior contour in the E-plane is triangular. The sidelines can range from straight to slightly concave or slightly convex. The apexes are slightly rounded or cut in a straight line. The interior contour is a definitely rounded triangle with straight sides, the rounded angles of which fall into the medial line of the exterior it can be missing as well. The endopore is 2—3 µm wide and 5—6 µm deep, and has a characteristic structure of the genus Hungaropollis.

Dimensions: large grains (40—45 µm). Holotype: maximum diameter 42 µm, wall thickness 5—6 µm, anulus index 0.52, pore channel index 0.29, nexine curvature index 0.38,

Differential diagnosis: The *Hungaropollis rectilineus* nov. sp. is most similar, to *Hungaropollis krutzschii* GÓCZÁN 1964. But on the basis of its straight or slightly concave lateral side and the coarse verrucae of the distal side, it can be fairly well separated.

Remark: The species had appeared by the end of the Lower Campanian, and its acme can be placed at the end of the Upper Campanian. The species is fairly frequent.

Hungaropollis nodosus nov. sp.
Plate VI, figs. 6—9

Holotypus: preaparation No. 184/2, coordinates 9.9—109.5, photo No. 135/5—8, Plate VI, figs. 6—9.

Derivatio nominis: nodosus (latin) = with knots. Named after the knot at the central region of the distal side.

Locus typicus: borehole Magyarpolány Mp. 42.

Stratum typicum: grey clayey-calcareous marl transsected at 372.7 m, Upper Campanian.

Diagnosis: Its exterior sidelines in the E-plane can range from straight to broken slightly convex, triangular. The apexes can be cut or rounded.The interior contour is convex, rounded triangular, placed with angles set perpendicular to the sides of the exterior contour. The wall is thick, 3—5 µm, comprising two groups of layers. The interior wall is thicker than the exterior one. Both sides of the surface are ornamented with fine maculae, approx. 1 µm. These small flat elements can be present at the germinal region of the distal side in the form of an oculus like thickening. There is, however, no real oculus observable. At the same side, in the central field, generally there is a single 6—10 µm wide, roughly circular, flat knot. The sexine forms in the pore region a well developed, characteristic ektanulus, inclining outwards in an "ear", in which the exterior aperture is reminding to a narrow, compressed funnel. At the endogerminal parts there is no vestibulum and no endanulus, but the ends of the nexine are widened along the pores. The endopores is composite, generally deeper than its width.

Dimensions: medium and large grains. Holotype: maximum diameter 36 µm wall thickness 4—6 µm, pore channel index 0.27, nexine curvature index 0.5.

Differential diagnosis: The *Hungaropollis nodosus* nov. sp. with its characteristic "eared" ektanulus and single large knot in the central region can be fairly well separated from all of the known species of Hungaropollis.

Remark: A characteristic and frequent species of the Upper Campanian sporomorph association.

Hungaropollis hollossyi nov. sp.

Plate VI, figs. 10—12

Holotypus: preparation No. 30828/1. coordinates 16.4—112.0, photo No. 798/29—35, Plate VI, figs. 10—12

Derivatio nominis: in honour of TIBOR HOLLOSSY, former professor of the author F. GÓCZÁN.

Locus typicus: borehole Magyarpolány Mp. 37.

Stratum typicum: grey clayey calcareous marl transsected at 217.0—217.5, Upper Campanian.

Diagnosis: In E-plane the exterior contour is triangular with medium convex and definitely broken sidelines, and with very rounded apexes. The interior contour is triangular with straight or concave sidelines and with definitely rounded apexes. The wall is 5—6 µm thick, comparising two groups of layers. The exterior wall is thinner than the interior one. The surface is ornamented at both sides with 1—3 µm wide maculae at both sides. They can unit into each other at the pore region in an oculus-like manner, forming, however, no regular oculus. At the distal side over the triangular nexine some flat, irregularly dispersed verruceae might occur. At the germinal parts the sexine is centrifugally thickened, forming a club-like ektanulus. The brevicolpat aperture is asymmetrical. The thick nexine is considerably curved, sticking tigthly to the sexine along its whole length. At the germinal region it is slightly thickened and polylamellated, forming an endopores characteristic of the genus. It may have a short and narrow vestibulum as well.

Dimensions: large grains. Holotype: maximum diameter 46 µm, anulus index 0.5, pore channel index 0.26, nexine curvature index 0.41—0.46, grain curvature index >0.5.

Differential diagnosis: The *Hungaropollis hollossyi* nov. sp. is sharply different, on the basis of its definitely broken, curved side triangular exterior contour, the distribution of the ornamental elements of the exine both from *Hungaropollis krutzschii* GÓCZÁN 1964 as well as *Hungaropollis rectilineus* nov. sp.

Remark: The species is a frequent and characteristic constituent of the Senonian i.e. Upper Campanian formations of the Transdanubian Central Range.

Genus: Krutzschipollis GÓCZÁN 1967
Genus typus: *Krutzschipollis spatiosus* GÓCZÁN 1967

Krutzschipollis crassis (GÓCZÁN 1964) GÓCZÁN 1967
Plate VII, figs. 1—3

Remark: In the Upper Campanian clayey calcareous marl sample taken from 418.0 m of the borehole Magyarpolány Mp. 38 there are pollen grains in the sporomorph association which can be identified with this form species. It seems that at the proximal side of the Magyarpolány specimens the dimensions of the maculae is smaller than that of the Sümeg specimens. The species is one of the most frequent represantives of the substage Upper Campanian.

Krutzschipollis rotundus nov. sp.
Plate VII, figs. 4—6

Holotypus: preparation No. 474831, coordinates 9.9—117.5, photo No. 138/28—30, Plate VII, figs. 4—6.

Derivatio nominis: named after its circular form.

Locus typicus: borehole Magyarpolány Mp. 38

Stratum typicum: grey clayey-calcareous marl transsected at 430.0 m, Upper Campanian.

Diagnosis: Its exterior contour in the E-plane shows a circular form broken at the germinal region. The interior contour is also circular, slightly impressed along the endopores. The wall is double, the two layers are 5—6 μm together. They are, roughly, of equal width. At the germinal region the sexine is elongated in a beak-like manner, forming a centrifugally inclined ektanulus. The exogerminal aperture is a narrow fissure, asymmetrically situated. The surface covered, densely, from both sides with maculae. On the proximal side these maculae are finer than on the distal one where they can form a flat, sausage-like cluster consisting of 2—3 μm large knots running from pore to pore, forming, however, no real oculus. At the extragerminal part the maculae are finer. The nexine is 2—3 μm thick, sticking tightly along its whole length to the sexine. At the endogerminal region it is getting, from the outside inwards, suddenly very narrow. It forms endanulus. The vestibulum is short and narrow. The endopore is 3—4 μm wide and 2—3 μm deep.

Dimensions: medium and large grains. Holotype: maximum diameter 40 μm, anulus index 0.69, pore channel index 0.27, nexine curvature index 0.28, grain curvature index 0.77.

Differential diagnosis: The species *Krutzschipollis rotundus* nov. sp. can be adequately differentiated on the basis of its characteristic circular exterior and interior contour from *Krutzschipollis crassis* (GÓCZÁN 1964) GÓCZÁN 1967. The species is rarely occurring.

Krutzschipollis elegans nov. sp.
Plate VII, figs. 7—9

Holotypus: preparation No. 20477, coordinates 6.8—117.5, photo No. 699/17—22, Plate VII, figs. 7—9.

Derivatio nominis: named after its habit.
Locus typicus: borehole Pápa P. 2.
Stratum typicum: clayey limestone transsected at 495.1—499.0 m, Upper Campanian.

Diagnosis: In E-plane its exterior contour is triangular with convex and broken sidelines and with slightly rounded apexes. Its interior contour is that of an almost regular circle. Its wall is 5—6 μm thick, composed of two layers. The exterior and the interior layers are almost equally thick or, the exterior one is somewhat thinner. The sexine is definitely alongated at the germinal parts, forming a beak-like ektanulus on the edge of which there is an asymmetrically opening brevicolpat exterior aperture. The nexine is uniformly curved, sticking tigthly to the sexine almost along its whole length. At the endogerminal parts there is a very slight impression visible. There are no endanulus or interloculum observable. The surface is ornaménted by, on both sides, maculae of the size 1—3 μm. At the central parts the maculae are larger than at the margins. At the distal side they form a 10 μm wide pattern clustered in a veinlike form running from pore to pore. There is no oculus visible.

Dimensions: large grains of Krutzschipollis can be assigned to this taxon. Holotype: maximum diameter 45 μm, wall thickness 6 μm, anulus index, 0.70, pore channel index 0.33, nexine curvature index 0.30, grain curvature index 0.55.

Differential diagnosis: The *Krutzschipollis elegans* nov. sp. can be separated on the basis of its broken convex triangular form, elongated anuli and characteristic maculate sculpture from *Krutzschipollis spatiosus* GÓCZÁN 1967 which is of similar construction, but much coarser maculate ornamentation and less evolved anulus. Its occurrence falls to the Upper Campanian. It is a relatively rare species.

Genus: Suemegipollis GÓCZÁN 1964
Genus typus: *Suemegipollis triangularis* GÓCZÁN 1964

Suemegipollis triangularis GÓCZÁN 1964
Plate VII, figs. 13—18

Remark: One of the most characteristic morphospecies of the Senonian, Upper Campanian formations of the Transdanubian Central Range. The Magyarpolány specimens agree well with the representatives of this fairly variable species. The width of the endopores and the length of the nexine sticking to the sexine depends mostly on the maturity of the pollen grains.

Suemegipollis germanicus W. KR. 1973
Plate VII, figs. 10—12

Remark: Among the Mediterranean Senonian Normapolles taxa the formaspecies *Suemegipollis germanicus* W. KR. 1973 is represented both in the Boreal and in the Atlantic Senonian Regions.

W. KRUTZSCH (1973) described this species from the Maastrichtian sediments of Northern Germany (p. 96—97, Pl. III, Bild 42—44). He mentioned the occurrence of the species from Southern France, Bohemia and Hungary as well. According to him, the species can be found since the Santonian till the Maastrichtian substages, but it is of rare occurrence. From the Senonian sequence of Magyarpolány the authors were first to find it now, from Upper Campanian layers.

Genus: Triporopollenites PF. et TH. 1953
Genus typus: *Triporopollenites coryloides* PF. 1953a

Triporopollenites robustus PF. 1953a subfsp. *robustus*
Plate VIII, figs. 1—4

Remark: The specimen found in the Upper Campanian of Magyarpolány are considered to belong to this subspecies based mainly on the specimen delineated by M. KEDVES (1979) from the Fish Clay Formation of Lower Danian age from Denmark (p. 175, Pl. IV, figs. 7—8). So far, only one specimen has been found.

Genus: Plicapollis PF. 1953b
Genus typus: *Plicapollis serta* PF. 1953b

Plicapollis hungaricus nov. sp.
Plate VIII, figs. 5—8

Holotypus: preparation No. 47480, coordinates 9.0—101.7, photo No. 138/12—18, Plate VIII, figs. 5—8.
Derivatio nominis: named after its country of occurrence.
Locus typicus: borehole Magyarpolány Mp. 38.
Stratum typicum: grey clayey–calcareous marl transsected at 418.0 m, Upper Campanian.

Diagnosis: In E-plane the exterior contour is triangular with uniformly, slightly convex sidelines and with rounded apexes. The interior contour is circular, interrupted by the aperture of the endopores only. The wall is relatively thick, consisting of two layers. The exterior layer is c. three times thicker than the interior one. The sexine is centrifugally thickened, forming, at the pore region, an ektanulus, with a narrow brevicolpat germ aperture opening asymmetrically at its edges. The nexine is thin, less than 1 μm with regular plicae, a relatively wide and deep endopores (c. 3 x 3 μm) and a wide vestibulum. The surface of the exine is densely ornamented by, on both sides, maculae which are hardly smaller than 1 μm.

Dimensions: Holotype: maximum diameter 25 μm, wallthickness 2—3 μm, ratio of the sexine:nexine c. 4:1, anulus index 0.3, pore channel index 0.20, nexine curvature index 0.33, grain curvature index 0.65.

Differential diganosis: *Plicapollis hungaricus* nov. sp. can be adequately separated on the basis of its characteristic construction, exterior and interior contour, ratio of the sexine:nexine, endopore, vestibulum and maculate surface from all of the morphospecies of Plicapollis described so far.

Remark: The acme of Plicapollis PF. 1953b is known to take place during the Eocene. It is represented by a few species and specimens in the Senonian. It is equally rare in the Senonian of the Transdanubian Central Range as well.

Genus: Subtriporopollenites PF. et TH. 1953
Genus typus: *Subtriporopollenites anulatus* PF. et TH. 1953

Subtriporopollenites cf. *anulatus* PF. et TH. 1953 subspecies *anulatus*
Plate VIII, figs. 9—11

Remark: This Subtriporopollenites pollen grain from Magyarpolány can be considered as representatives of this very variable subspecies, in spite of their much larger endopores, at least till more specimens can be found.

Genus: Vacuopollis PF. 1953b
Genus typus: *Vacuopollis percentus* PF. 1953b

Vacuopollis cf. *percentus* PF. 1953b
Plate VIII, figs. 12—13

Remark: The specimen found in the Lower Campanian at Magyarpolány can be assigned to this formaspecies only with the value of cf., differring from the holotype of the species (PF. 1953b, s. 104, Taf. 20, Figs. 24—26) in its much thicker wall and unbroken lines.

Trudopollis minimus GÓCZÁN 1964
Plate VIII, figs. 14—15

Remark: There was one specimen found in the borehole Magyarpolány Mp. 38, transsected at 418.0 m from Upper Campanian layers that can be assigned to the morphospecies described from the Lower Maastrichtian formations of the borehole Bakonypölöske, Bp. 1 (GÓCZÁN 1964, p. 255, Pl. IX. Fig. 2a—c).

Genus: Pseudopapillopollis GÓCZÁN 1967
Genus typus: *Pseudopapillopollis praesubhercynicus* (GÓCZÁN 1964) GÓCZÁN 1967

Pseudopapillopollis simplex nov. sp.
Plate VIII, figs. 16—19

Holotypus: preparation No. 47480, coordinates 18.4—107.9, photo No. 137/22, Plate VIII, figs. 16—19.

Derivatio nominis: named after its simple construction.
Locus typicus: borehole Magyarpolány Mp. 38.
Stratum typicum: grey clayey-calcareous marl transsected at 418.0 m, Upper Campanian.

Diagnosis: A pollen grain bearing the characteristic features of the genus Pseudopapillopollis, with weakly developed polpapillae, thin wall, circular exterior contour, wide and deep vestibulum and endopores.

Dimensions: Holotype: maximum diameter 18 μm, wall thickness 1—1.5 μm, diameter of the polpapillae c. 4 μm, ratio of the sexine:nexine c. 1:1.

Differential diagnosis: The species *Pseudopapillopollis simplex* nov. sp. differs from the type of the genus in its weaker polpapillae, wider and deeper vestibulum and endopores. So far, one specimen was found as yet. The sporomorph assemblages of other lithostratigraphical units of the Senonian formations of the Transdanubian Central Range will be presented in the next study of ours.

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Plate I

1—2. *Devecserisporites campanicus* Á. SIEGL-FARKAS (1986)
Borehole Magyarpolány Mp. 42. 394.0 m, Upper Campanian

3—4. *Gleicheniidites senonicus* (ROSS 1949) BOLCH 1968 forma *minor*
Borehole Magyarpolány Mp, 426.3—426.6 m, Upper Campanian

5. *Polypodiaceoisporites* cf. *stockmarrii* KEDVES 1980
Borehole Magyarpolány Mp. 42. 426.3—426.6 m, Upper Campanian

6—7. *Trilites* cf. *asolidus* W. KR. 1959b
Borehole Magyarpolány Mp. 42. 403.7—403.9 m, Upper Campanian

8. *Plicifera delicata* (BOLCH 1953) BOLCH 1968
Borehole Magyarpolány Mp. 38. 432.4—432.5 m, Upper Campanian

9—10. *Vadaszisporites urkuticus* (DEÁK 1965) DEÁK et COMBAZ 1967
Borehole Magyarpolány Mp. 38, 432.4—432.5 m, Upper Campanian

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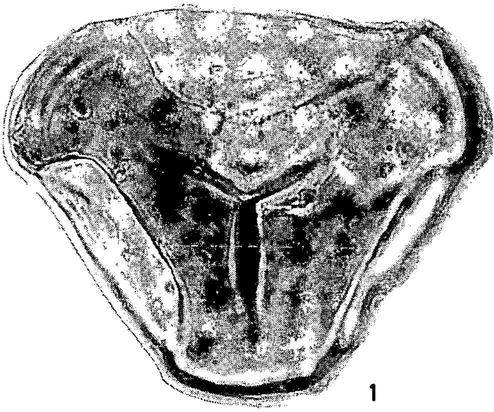
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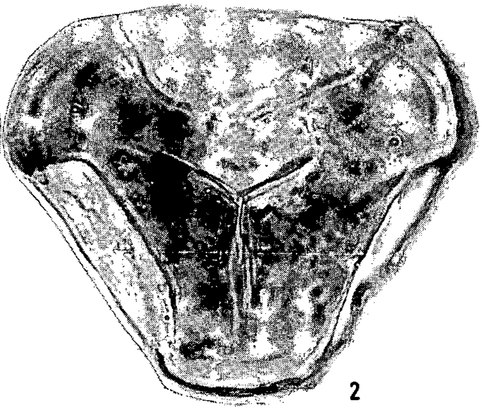
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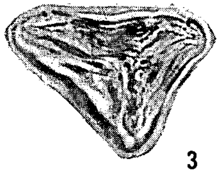
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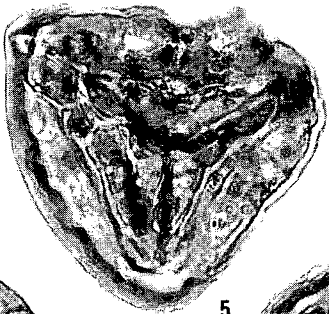
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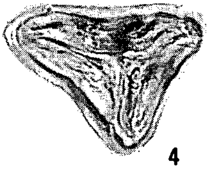
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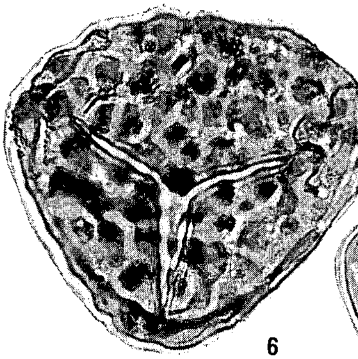
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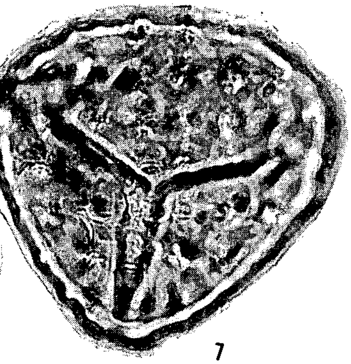
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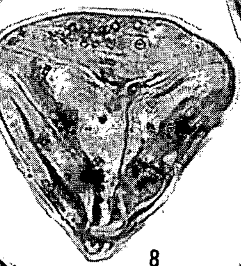
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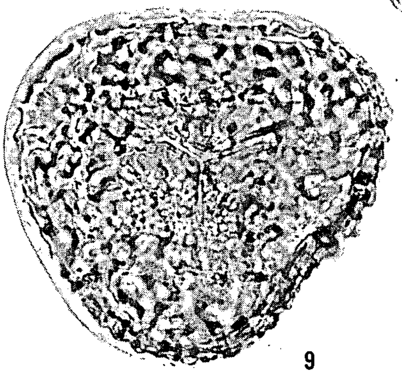
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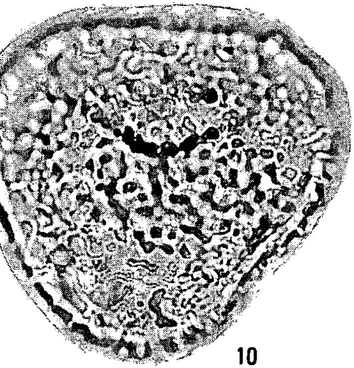
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Plate II

1—3. *Longanulipollis longianulus* (GÓCZÁN 1964) GÓCZÁN 1967
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

4—6 *Longanulipollis polanyensis* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

7—9. *Longanulipollis polanyensis* nov. sp. Paratype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

10—12. *Longanulipollis monstruosis* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, UpperCampanian

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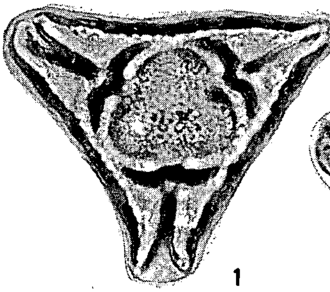
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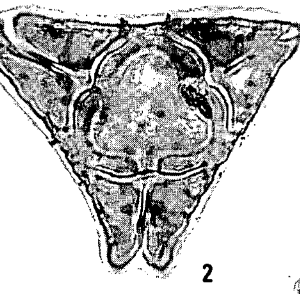
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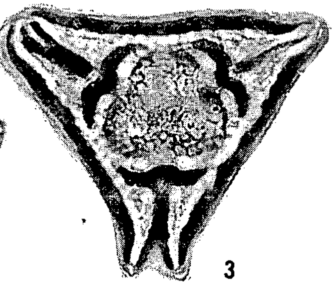
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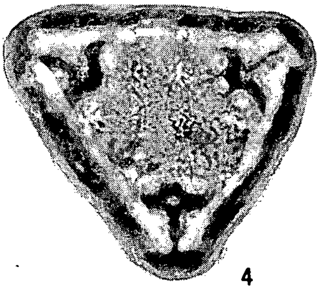
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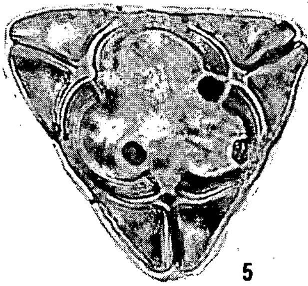
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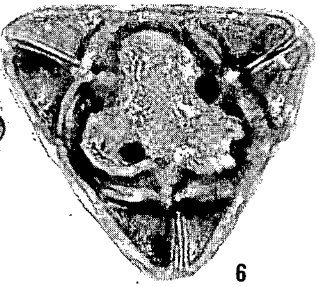
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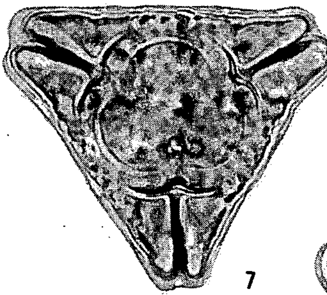
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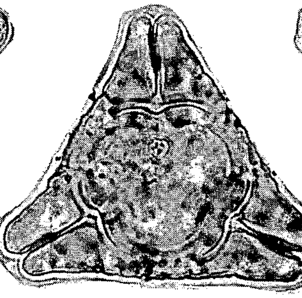
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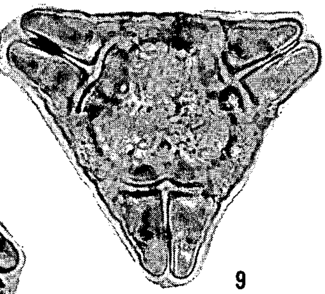
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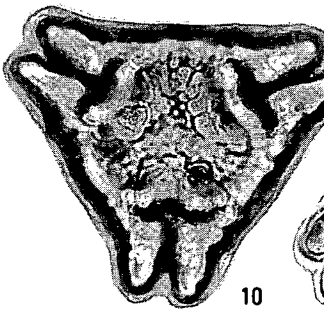
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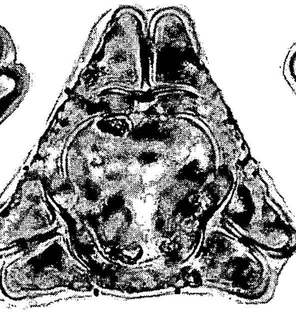
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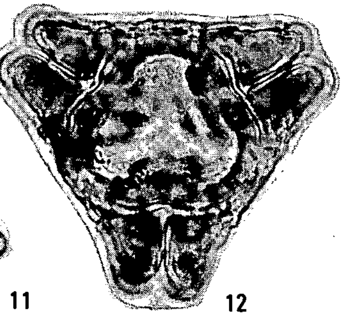
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Plate III

1—3. *Longanulipollis fornicatus* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 430.0 m, Upper Campanian

4—6. *Intercalaripollis arcuatus* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

7—11. *Magnoporopollis krutzschii* KEDVES et HERNGREEN 1980
Borehole Magyarpolány Mp. 42, 372.7m, Upper Campanian

12—15. *Trudopollis triangulus* KEDVES et HERNGREEN 1980
Borehole Magyarpolány Mp. 38, 372.7 m, Upper Campanian

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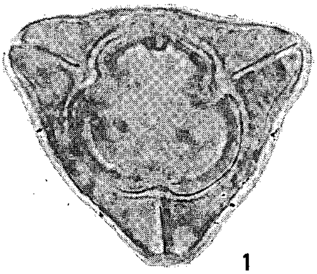
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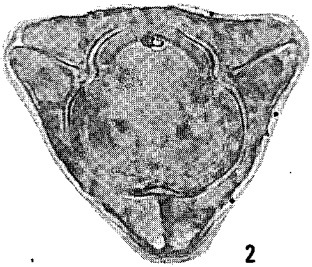
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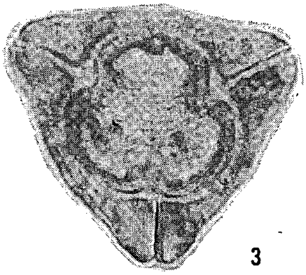
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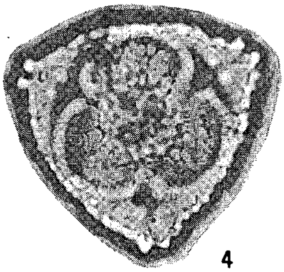
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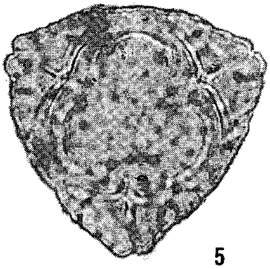
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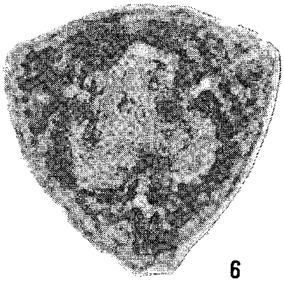
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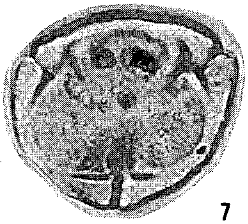
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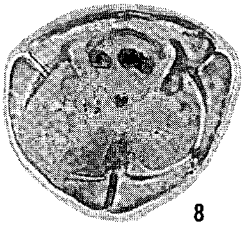
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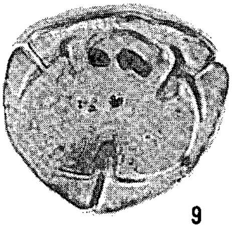
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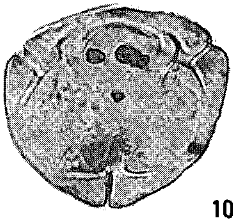
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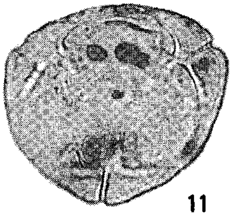
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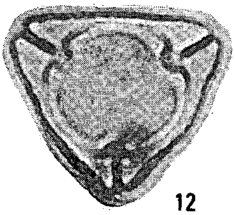
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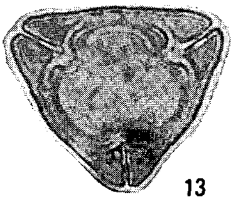
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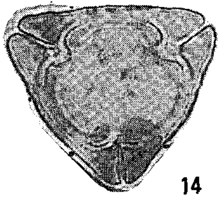
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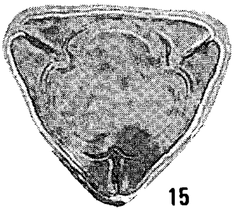
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Plate IV

1—4. *Cuneipollis cuneolis* nov. gen et sp. Genotype
Borehole Sümeg Sp. 2, 115.8—117.0 m, Upper Campanian

5—7. *Cuneipollis cuneolis* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

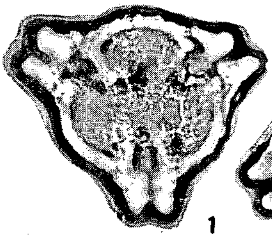
8—9. *Cuneipollis cuneolis* nov. sp. Paratype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

10—12. *Coronatipollis proprius* nov. gen et sp. Genotype
Borehole Csabrendek Cn. 931, 289.5—292.5 m, Upper Campanian

13—15. *Coronatipollis corpulentus* n. sp. Holotype
Borehole Devecser Dv. 3, 830.0 m, Upper Campanian

16—18. *Coronatipollis* cf. *coronatus* (GÓCZÁN 1964) nov. comb.
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

1—18.: 1000X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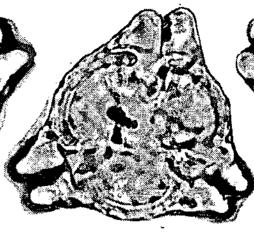
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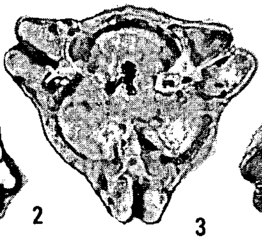
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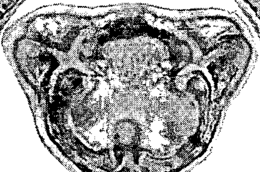
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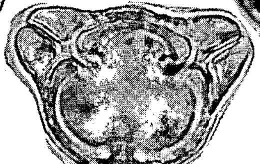
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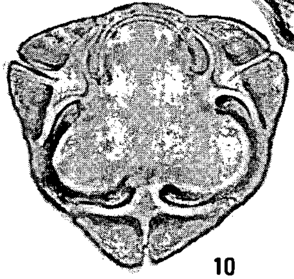
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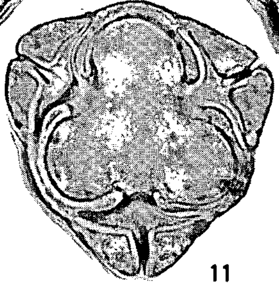
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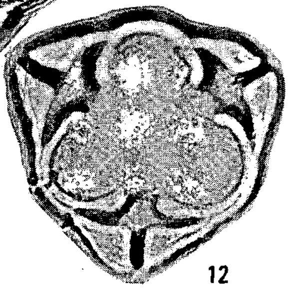
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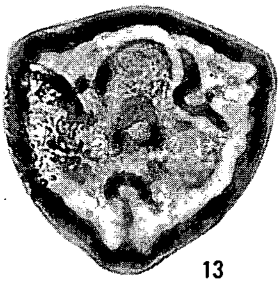
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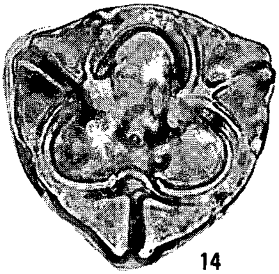
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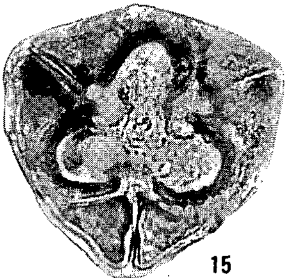
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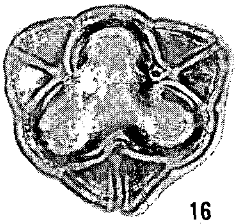
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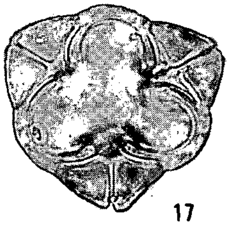
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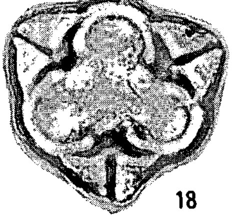
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Plate V

1—3. *Semioculopollis coronatiformis* nov. sp. Holotype
Borehole Magyarpolány Mp. 37, 145.0—146.0 m, Lower Maastrichtian

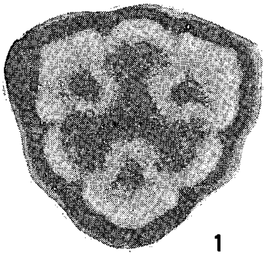
4—6. *Semioculopollis coronatiformis* nov. sp. Paratype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

7—9. *Trudopollis* cf. *lativerrucatus* KEDVES et HERNGREEN 1980
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian

10—12. *Semioculopollis daniensis* KEDVES 1979
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian

13—16. *Trudopollis* cf. *hojrupensis* KEDVES 1979
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

1—16.: 1000X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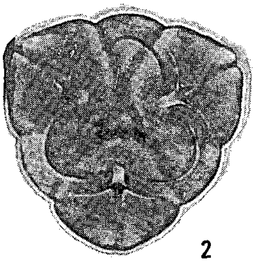
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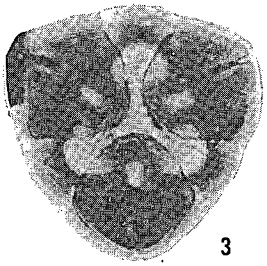
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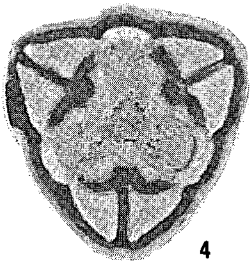
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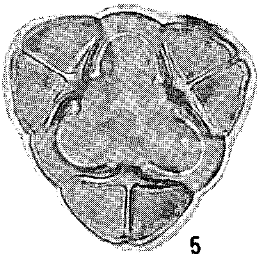
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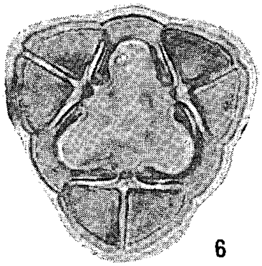
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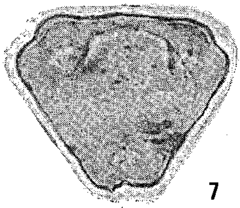
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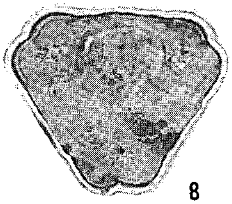
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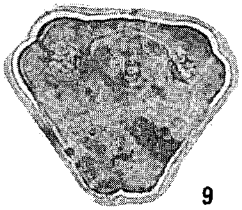
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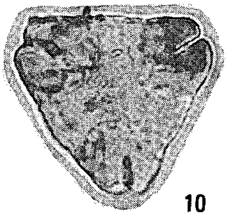
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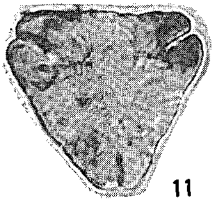
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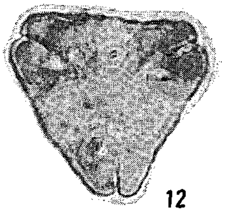
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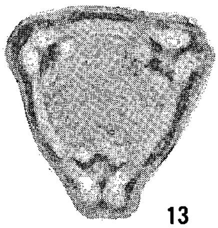
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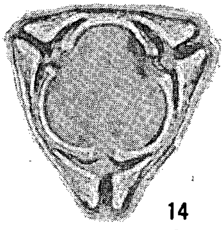
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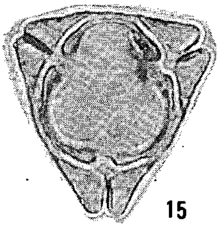
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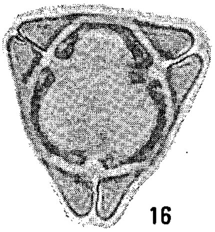
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Plate VI

1—5. *Hungaropollis rectilineus* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 430.0 m, Upper Campanian

6—9. *Hungaropollis nodosus* nov. sp. Holotype
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian

10—12. *Hungaropollis hollossyi* nov. sp. Holotype
Borehole Magyarpolány Mp. 37, 217.0—217.5 m, Upper Campanian

1—12.: 1000X


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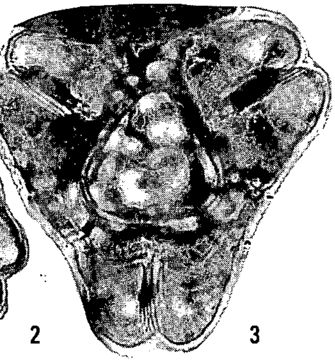
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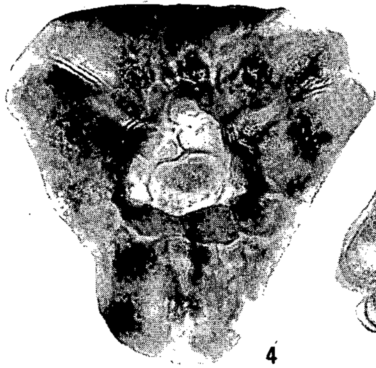
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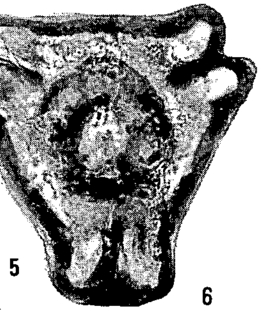
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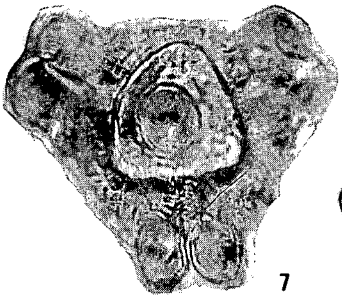
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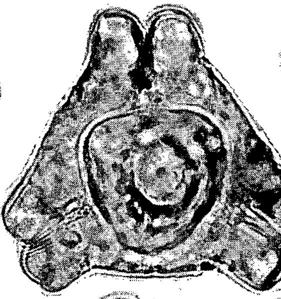
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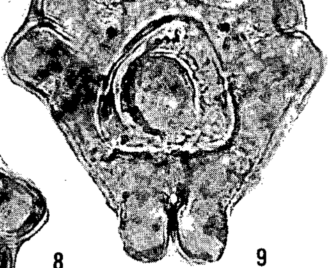
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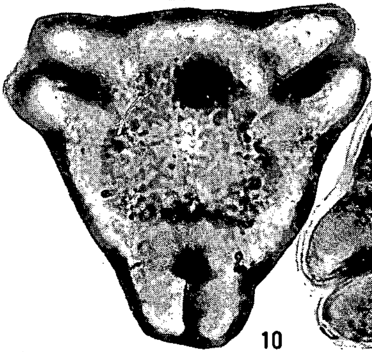
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Plate VII

1—3. *Krutzschipollis crassis* (GÓCZÁN 1964) GÓCZÁN 1967
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

4—6. *Krutzschipollis rotundus* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 430.0 m, Upper Campanian

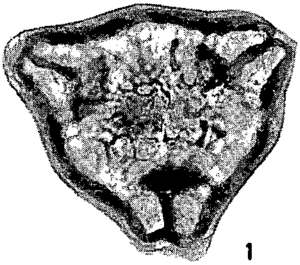
7—9. *Krutzschipollis elegans* nov. sp. Holotype
Borehole Pápa 2, 495.1—499.0 Upper Campanian

10—12. *Suemegipollis germanicus* W. KR. 1973
Borehole Magyarpolány Mp. 42, 429.6 m, Upper Campanian

13—15. *Suemegipollis triangularis* GÓCZÁN 1964
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian

16—18. *Suemegipollis triangularis* GÓCZÁN 1964
Borehole Magyarpolány Mp. 38, 430.0 m, Upper Campanian

1—18.: 1000X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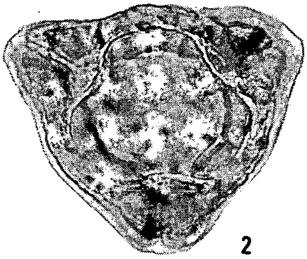
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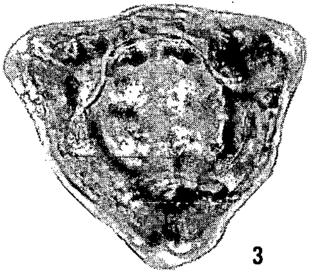
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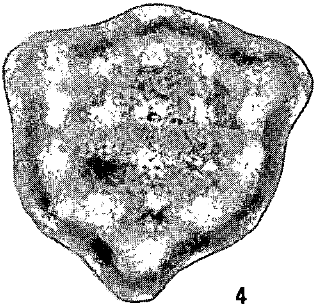
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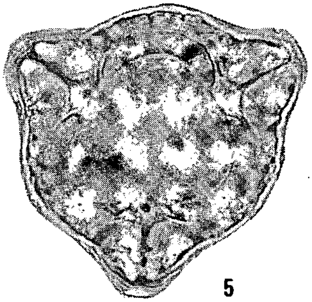
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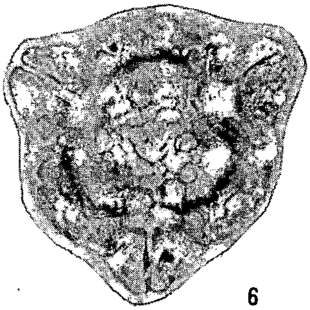
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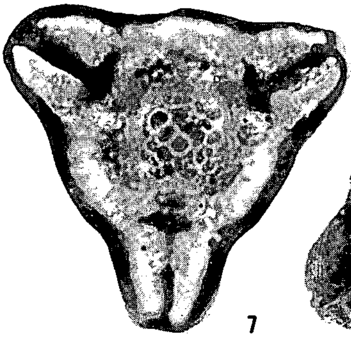
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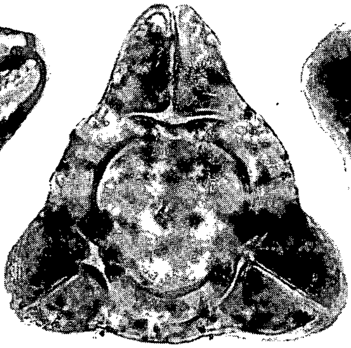
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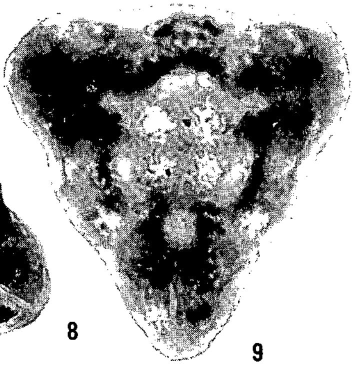
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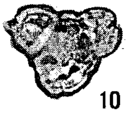
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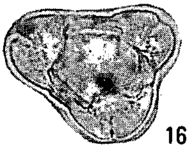
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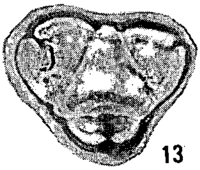
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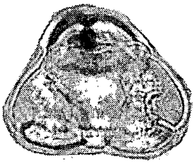
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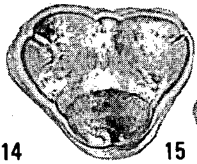
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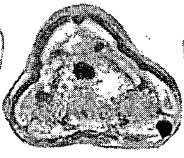
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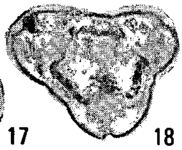
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Plate VIII

1—4. *Triporopollenites robustus* PF. 1953a subfsp. *robustus*
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian
5—8. *Plicapollis hungaricus* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian
9—11. *Subtriporopollenites* cf. *anulatus* PF. et TH 1953
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian
12—13. *Vacuopollis* cf. *percentus* PF. 1953b
Borehole Magyarpolány Mp. 38, 430.0 m, Upper Campanian
14—15. *Trudopollis minimus* GÓCZÁN 1964
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian
16—19. *Pseudopapillopollis simplex* nov. sp. Holotype
Borehole Magyarpolány Mp. 38, 418.0 m, Upper Campanian
20—21. *Dinogymnium denticulatum* (ALBERTI) 1959 EVITT et al. 1967
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian
22—23. *Dinogymnium cretaceum* (DEFLANDRE) 1935 EVITT et al. 1967
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian
24. A part of the organic pallium of a Rotaloid Foraminifera specimen
Borehole Magyarpolány Mp. 42, 372.7 m, Upper Campanian
25—26. *Cymatiosphaera* sp.
Borehole Magyarpolány Mp. 42, 405.7 m, Upper Campanian

1—26.: 1000X


1


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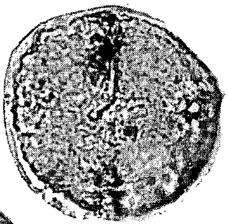
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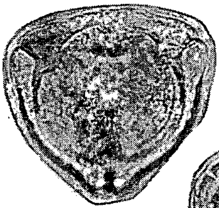
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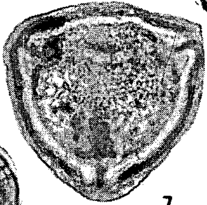
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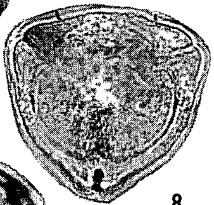
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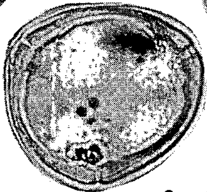
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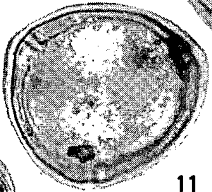
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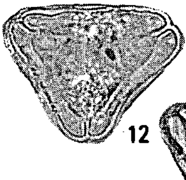
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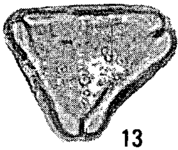
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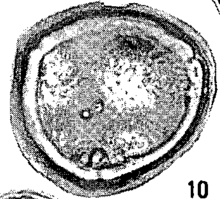
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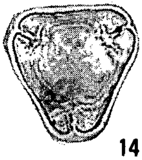
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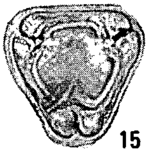
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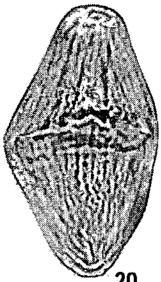
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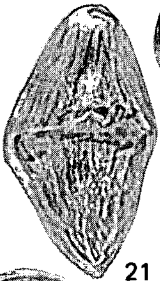
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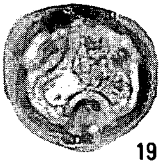
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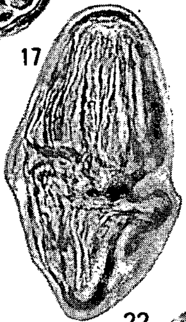
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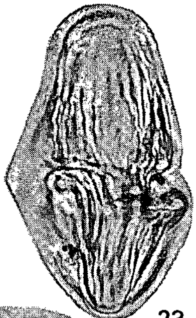
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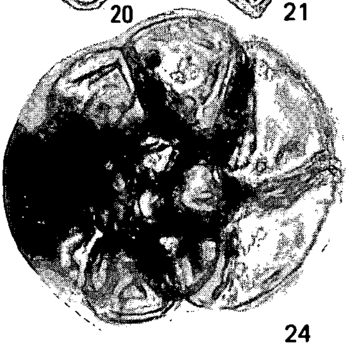
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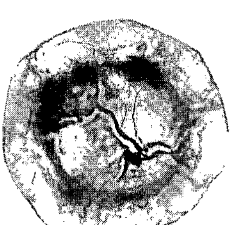
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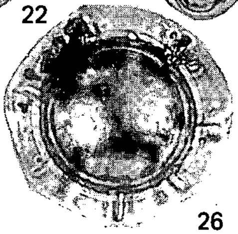
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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II. RÉSZ (1989)

THE MICRITINAS. A HYPOTHETICAL ROCK-FORMING MICROFOSSIL GROUP IN THE UPPER JURASSIC—LOWER CRETACEOUS FORMATIONS OF THE MECSEK AND VILLÁNY BELT

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Allochemical components and most of the micritic matrix of the Szársomlyó Limestone Formation and similar lithofacies are considered as remnants of living organisms; the author proposes palaeontological investigation of the constituents of the microfacies. A temporary system is established to help investigations recognizing major types of the remnants called Micritina. The system contains 22 form species, 18 form genera, 12 form subfamilies, 4 form families and 1 form superfamily. Complete descriptions are published in Acta Geologica Hungarica (NAGY I. 1989). The Micritinas are considered as one of the most widespread fossils in earth history, with significant role in the Hungarian Mesozoic, too.

Introduction

From 1969 to 1971 I participated in the ornamental stone exploration programme of the Hungarian Geological Institute in the Villány Mts. Having studied the microfacies of the 300-m-thick Upper Jurassic Szársomlyó Limestone Formation in hundreds of thin sections, I have described ooidic—pseudo-ooidic texture complying with the then actual usage. Returning to these formations in 1984, I prepared a short description of one of the outcrops, published in the Excursion guide for a field trip organized in Hungary by the Moscow International Geological Congress. In this paper I used the categories "pellet" and "intraclast", too. At that time, I have recognized that organic remnants bear a much greater role in this microfacies than ever considered.

In 1986 I was contracted for the microfacies and micropalaeontological investigations of the Upper Jurassic formations drilled by borehole Bóly 1, set in the northern foreland of the Villány Mts. During the examinations I had to recognize that I could not interpret these rocks of complicated texture as inorganic lithofacies. By this way of thinking I have recognized, that here not only the living organisms play important role besides inorganic components, but nearly all components are remnants of living organisms, and the abiogenic elements play a secondary part only: these are curious components only, except for the sparite.

This working hypothesis helped me in further investigations, until I became that almost all pellets, pseudo-ooids, ooids, and intraclasts are peculiar remnants of former living organisms. Since most remnants are made of micrite, it seemed a practical suggestion to establish the name based on this character: Micritina (also the rock matrix is mostly of the same origin).

The present study is intended to give impulse to a study of modern views of this kind of formation. This aim is served by the description of some selected, characteristic taxa.

System of the Micritina

The taxonomical descriptions have been published in Acta Geologica Hungarica (NAGY I. 1989); here a short description is provided only (Fig. 1).

Micritinidae form family

Remnants of relatively homogeneous constitution.

Micritina form genus. The simplest forms belong to this group; their basic character is the micritic composition. The form type species, *M. Vulgaris* is a nearly isometric form, with rounded corners.

Globomicritina form genus. Sphaerical forms; form type species is *G. pulla* (=black-stained by filth). Special form is *G. erodens* (=corrosive), which secreted its test by dissolving probably biogenic carbonate laminae.

Oomicritina form genus. Concentric spherical forms, ooids. The light-coloured walls rarely bear small rounded or oval embayment, possibly infillings or former chambers (*O. concentricellata*).

Pellmicritina form genus. Pellet-like, tiny, oval forms. Type species: *P. solida* (=compact).

Correptomicritina form genus. Fossil-filling, pseudomorph-forming Micritinas. Frequent forms are those, which moved in Radiolaria tests (correptus=crawling into sg). The name of the type form species—*C. falsa*—indicates the bogus (=falsa) character. There is the special *C. grandiglòbulosa* species: the test of a globular Foraminifera was dissolved and substitued by micrite by the organisms producing the Micritinas.

Crusmicritina form genus. The encrusting Micritinas belong to this group (crusta=crust). The *C. includens* (=including) completely surrounds the encrusted remnant, *C. considers* (=settling) covers its surface only, while *C. solvens* (=solving) possibly dissolves the enclosed remnant.

Cinmicritina form genus. Micritinas embracing (=cingens) larger fragments of fossils are concerned here. The name of the type form species *C. circumveniens* (=surrounding) indicates the one and the same character.

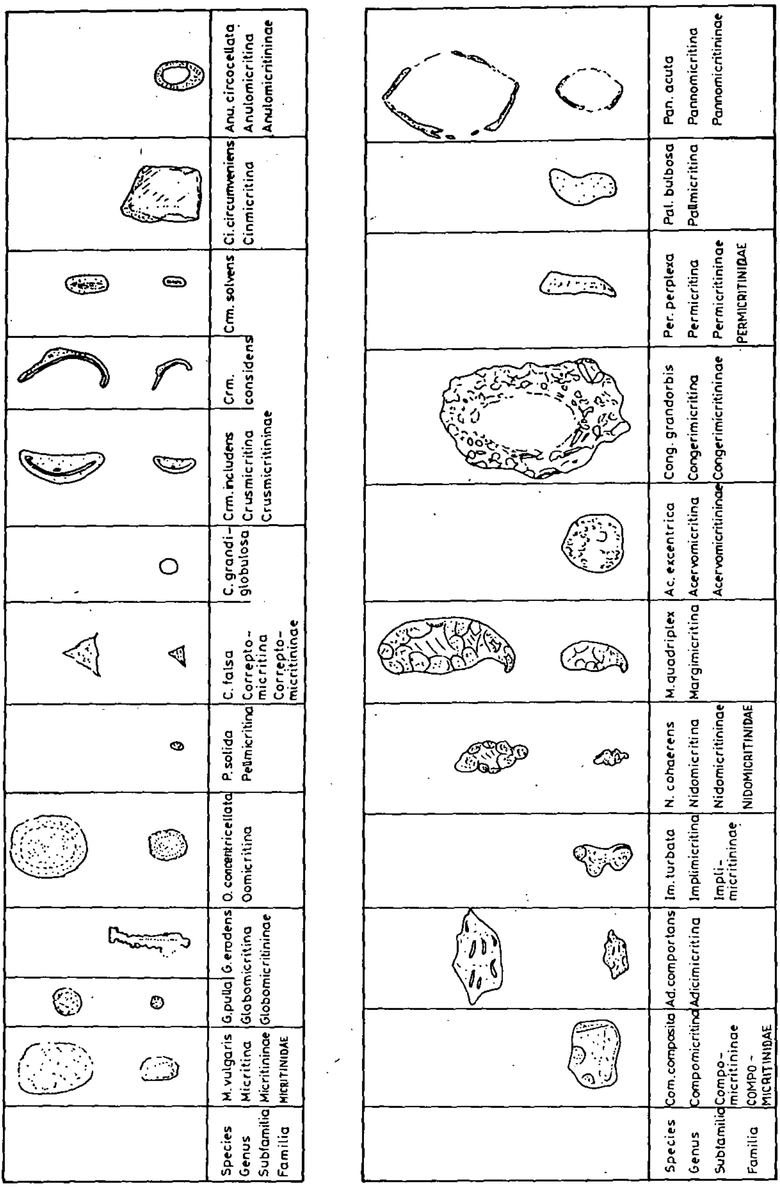

Fig. 1. Systematic review of the Micritinoidea superfamily

Anulomicritina form genus. Micritinas with annular (=anulatus) cross-section (*A. circocellata*).

Compomicritinidae form family

Forms composed of the tests of other Micritinas and other fossils (compositus=compound).

Compomicritina form genus. Expresses the basic character together with the type species *C. composita.*

Adicimicritina form genus. Micritinas formed by ingestion of other fossils (adicio=ingestion). Type species: *A. comportans* (comportans=collector).

Implimicritina form genus. Very complex Micritinas (in composition and form). Type species *I. turbata* (=turbid).

Nidomicritinidae form family

Nestle-like (=nidus) forms made of the tests of other Micritinas.

Nidomicritina form genus. Nests made of mostly globular Globomicritinas. The components of the type species (*N. cohaerens)* are only weakly adhered to each other (=cohaerens).

Margimicritina form genus. The nest-forming elements are surrounded by micritic margin (=marginatus). The type species is formed of four minor, framed nests, gradually growing in size, and all of them are surrounded by another micritic margin (*M. quadruplex*).

Acervomicritina form genus. Forms made of similar Micritinas forming heap-like nests (acervus=homogeneous heap) (*A. excentrica*).

Congerimicritina form genus. Forms made of different Micritinas (congeries=inhomogeneous heap), forming heap-like nests. The single species was found in a single specimen. It is the *C. grandorbis* (=great ring), and is the largest known Micritina. Its section is an oval ring, made of extremely large amount of Micritina tests of different sizes and shapes. There are no traces in the inner part of the ring of a former animal living there, but the ring contains several sparitic fields, which may have served as habitats for several animals. (It is possible that this remnant was a colony.)

Permicritinidae form family

Uncertain forms with indefinite outlines; their name (perplexus=enigmatic) expresses it well.

Permicritina form genus. Elongated forms with miciritic edges; there are Micritinas in their internal parts, similar ones as outside (*P. perlexa*).

Pallmicritina form genus. Forms with micritic margins, with indefinite internal part; the enclosed Micritinas are solved to obscure (pallidus=dim, obscure). The type species (*P. bulbosa*) was named after its potato-like (=bulbus) shape.

Pannomicritina form genus. Forms made of Micritinas, surrounded by uneven, dissected "ribbon" (pannosus=ragged). The type species *(P. acuta)* is tapering at one end (=acutus).

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The Micritina species were described from the formations of the Szársomlyó Limestone Formation, from the following localities and stratigraphic units:

— Nagyharsány, Szobros quarry, Oxfordian,
— Borehole Bóly 1, Lower Tithonian,
— Borehole Doboz 1, ?Valanginian—Hauterivian.

Size of the Micritinas

Holotype sizes of some Micritinas are only given here (in μm, rounded; for elongate forms, the larger dimensions are mentioned): *Pellmicritina solida* 20, *Globomicritina pulla* 250, *Oomicritina concentricellata* 650, *Micritina vulgaris* 650, *Crusmicritina includens* 350, *Compomicritina composita* 1,200, *Nidomicritina cohaerens* 600, *Margimicritina quadruplex* 1,200, *Congerimicritina grandorbis* 8,000.

Chambers of Micritinas

In the Micritina tests there are frequently observed tiny, light, rounded or elongated patches with definite or indefinite outlines, made of large calcite crystals, which can be interpreted as chambers. Part or all of them served the protection of the protoplasm. Inside the nest-like and heap-like tests there are sparitic fields of polygonal or other form, preserving the habitats of the animals. The organisms producing the Micritinas did not live in their tests all times, these were not grown into their houses. The test did not serve as an outer solid skeleton, but as a retreat only. Mostly it served as a holdfast. That is the reason, why these rests lack typical chamber systems.

Working hypothesis for Micritina studies

1. The Micritina-producing organisms may have been beings, which became suitable for secretion of fine-grained (microgranulated) calcareous material (micrite).

2. The biomicrite-secreting potential allowed the building of a solid test, suitable for fossilization.

3. This character was a successful step in evolution, because it provided protection against predators in most of the life span of the organism. The protection may have been enjoyed by the sessile forms, too, because these ones avoided the eddy-making or suctioning effects of the predators, and resisted current drifting.

4. Part of the Micritina-producing organisms had a peculiar character: we must suppose that they were able to leave their tests, and spent part of their life-span unfastened. One of the types of this is, when the living organism moved out to the surface of the test to expand the test with further chambers. Another type is, when it leaves the test for a considerable distance, compared to its body size. The reason may be food acquisition or collecting materials suitable for building of the test.

5. A special function of the house, if it served as resistance against currents, had a role of a counterweight and made possible fastening. This way of life may have been the most characteristic one of the organisms which produced the Micritina.

6. The method of house building is a tradition, it is a specific element, important for systematization, and classification.

7. Environmental dependence of the Micritina forms is evident for the pseudomorphs only (*Correptomicritina fálsa*), the dependence is weaker for Cinmicritinas and for e.g. the Crusmicritinas. Their form varies from the almost perfect sphere to a completely irregular outline, but not many identifiable varieties exist, because the spectrum of the regular forms is narrow. They may have been built up by metazoans, protozoans, algae, bacteria, or inorganic processes.

8. To build a Micritina form calcareous material is needed, which can originate from the following sources:

— Sea water; the organism secretes $CaCO_3$ from it (together with $MgCO_3$: it may be an explanation for the higher Mg-content of the Micritina rocks than of the Calpionella limestone),

— calcareous skeletons of foreign animals, collected, embedded, encrusted, solved, corroded, and then secreted in the form of biomicrite,

— other Micritinas,

— biomicrite produced from Micritinas.

During diagenesis some Micritina specimens may lose their individuality, and assemble to form biomicrite. This can be called micritine after its origin.

9. The Micritinas act as grains in lithofacies:

— due to submarine resedimentation a wide spectrum of Micritina-containing mixed materials may be formed, the Micritinas and the micrinite may occur in alien facies, too,

— massive redeposition of different sized Micritinas may show graded bedding; Globomicritinas and Pellmicritinas, which once lived together, may be separated in bands.

10. The Micritinas are the most widespread fossils in the history of the Earth in space and time. Most of their occurrences are characterized by an extremely rich growth of the individuals: covering, embedding, encrusting everything, forming their own basement. Most of them are shallow marine, but may be abundant in shallow bathyal regions, and some types may have been formed at even greater depths. Their stratigraphic value cannot be estimated as yet; possibly the separation of several hundred species may help in biostratigraphic analysis. Their distribution is shown in a profile (Fig. 1).

Observations on the organic origin of the Micritinas and contradictions concerning inorganic derivation

1. The original rock of the lithoclasts of the Szársomlyó Limestone Formation is not known by me. These components do not show the slightest resemblance to the true intraclasts in the resedimented limestones of Mecsek Mountains, which are similar in age but deeper in facies.

2. The irregular, Micritina configurations of characteristic outline are consequent, these never bear sharp corners of long, straight sides. There are no truncated or eroded fossils or other components.

3. If Micritinas were extraclasts, they would have been formed in the wave zone. In this environment the fragile fossils would have been reworked (e.g. the substrate-bearing Globochaete of the slender Lombardias). These fossils are alien in the surf zone, like the similarly important Radiolarias and Cadosinas.

4. The spheroidal components 15 μm in diameter (tiny Globomicritinas) could not have been rolled, therefore could not been worn, and also could not have been increased. The large size spheres, like ooids of true ooliths, and pisolites are missing in this facies. (The relatively large spheres here originally were radiolarians or Foraminifera tests turned to Micritinas.)

5. The allochemical components could not have been formed in the wave-agitated zone, because then the nests and heap-nests would have been disaggregated.

6. It is a biogenic character, that the material of intraclasts is the same as of the encrustations.

7. The biomicrites formed from Micritinas (=micritinite) are never completely uniform, because some former Micritina individuals or their details stand out from it.

8. Formation of the remnant, observed as a form solved to a sawtooth-like outline, observed in *Crusmicritina solvens* cannot be imagined abiogenically. The same is valid for the calcareous laminae indented by Globomicritina erodens, which are too consequent to be interpreted as lusus naturae.

9. The large calcite crystals of echinoderms are turned to micrite by *Cinmicritina circumveniens* from the outside towards the inside. In an inorganic situation the process could hardly have happened, because micrite is more soluble than the echinoderm fragments, which frequently form residues in intrastratal clays.

10. We cannot imagine the encrustation of the fragile, only some-micrometre-thick Globochaete substrate to have happened in an inorganic way, because it would have crushed or buried instead of a slow carbonate precipitation. The biogenic variety seems better: the organism producing *Crusmicritina includens* coated rapidly it with biomicrite and without injure (Fig. 2).

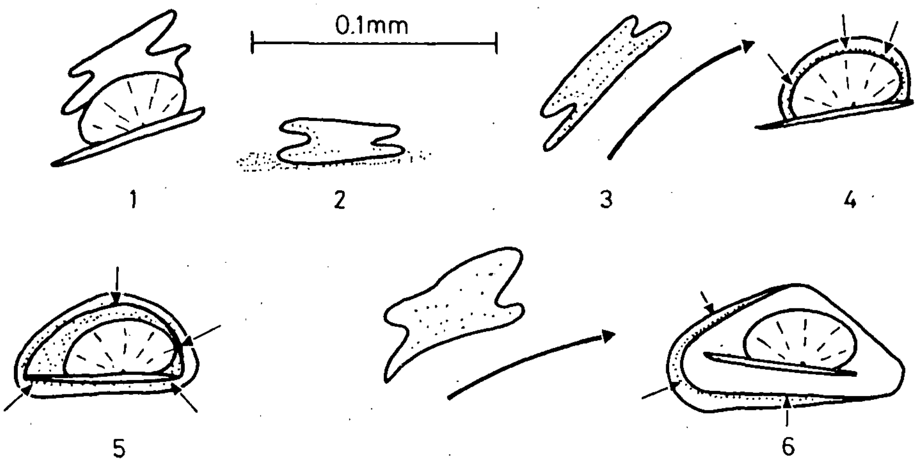

Fig. 2. A presumable sequence of the development of *Crusmicritina includens*
Settles on a small substrated Globochaete oospore *(1)*. Secreting from seawater and/or collecting from the bottom *(2—3)* begins to encrust the Globochaete with biomicrite *(4)*. Completely covers *(5)*, or, if the formation is too big, built it further in parts *(6)*

11. On the holotype of *Crusmicritina considens* the hump with the tiny chamberlet indicates a pre–existent living creature.

12. The presence of frequently recognizable chambers testifies to an animal being.

13. The large specimens of the Implimicritina with complicated buildup and shape cannot have been formed by rolling, or any other inorganic way.

14. The spheres forming the Nidomicritina nest could not have been gathered without the help of living organisms, especially in a field of different grain size. It is a zoogenic character.

15. The cover of the four units of *Margimicritina quadruplex* and their common cover show great similarity, it is a zoogenic character like the gathering together.

16. The selective gathering of the elements of *Congerimicritina grandorbis* can be imagined by the work of animal organisms only.

17. Inorganic processes could not have formed such a varicolored, complex formation–assemblage.

More features of the Micritina

1. The superfamily Micritinoidea is a fossilium category; these fossils can be characterized as living beings can be hypothetical only. The remnants, here called as Micritina, are material remains of the life functions of living beings. A certain part of these may be considered as "house" or "nest" or "den", most of them supposedly were balance weights, which the living organism holded on to avoid drifting or becoming a prey (defended itself by inhaesio against abriptatio and praedatio).

2. Most of the Micritina remains are not steinkerns, their houses—nests—hold-on-bases are pigmented, microgranulated calcite secreted by living organisms, like the test of *Cadosina fusca* WANNER.

3. Possibly the shape of Micritinas are not influenced by inherited biological factors. The beings hardly bear the shapes of their buildings in their genes, only the simplest spherical or spherical surface shape, but they bear the constraint of secretion (=secretio) and transformation (=commutatio). We can imagine, that most of the Micritinas are formed, when the living beings transform some kind of detritus. For example, the tiny, elongated, oval Pellmicritinas may have been transformed from powder-like calcitic shell fragments. The house-building can be combined with sedimentational or other exogenic factors, like inorganic, bacterial or algal lime secretion. It is probable, that most of the large-size *Micritina vulgaris* specimens were originally fossil (e.g. Echinodermata) fragments, or multielemental Compomicritinas; these were transformed or homogeneized into *M. vulgaris*.

4. Possibly part of the metazoans make their nests by picking out (=collectio) and agglutinating (=conglutinatio) of their components. From among those of smaller size many specimens can be transformed into *M. vulgaris*, after, e.g. the inhabitant of Nidomicritina dies or leaves its nest and the *M. vulgaris*-producing organisms with the capacity of commutatio move it.

5. The Micritina-producing organisms may have catched the falling or streaming food, while holding on their houses (=domuncula), nests (=nidus) or sticking to their adhesion (=inhaesio) base.

6. Other organisms, like the Correptomicritina-forming ones move into the houses of other beings, like Radiolaria or Foraminifera, frequently into the cell-pores of calcareous algae, and are fossilized as pseudomorphs. I believe to recognize on published photographic plates of Permian Mizzias, Jurassic Clypeinas, Cretaceous Acicularias, Eocene Gryphoporellas, etc. A special phenomenon was recognized in thin section of Barremian—Aptian limestones from the Mecsek Mts: there are Foraminifera tests in some Radiolaria. The dragging (=pertractio) into the Radiolaria is attributed to animal organisms.

7. The *Globomicritina erodens* may have been formed by intruting into calcareous laminae. The frequent linear arrangement of the individuals may be due to the habit of beginning the solving in former pores of the fragments.

8. In the Crusmicritina biofacies formed by encrusting and overgrowing forms near 100% of the grains are encrusted. the *Crusmicritina considens* overgrows not only shell fragments, but other Micritinas, too. In this microfacies there are rare uncrusted large shells, indicating the absence of Cinmicritinas. The living being producing *Crusmicritina solvens* dissolves the encrusted calcitic shell fragments; if the dissolution ends without any trace, then the form is mostly indeterminable.

9. Some of the Pellmicritina-like tiny forms may be undigestable material thrown out by the protoplasm of protozoans. The larger ones may have been Metazoa groups.

10. The Micritina remains are unconditionally in some kind of unity with each other. From among them the most general is the most important, i.e. these were produced by living beings, for which evolution is valid. I.e. their remnants are specific, this provocates palaeontological analysis, concomitant of which is the application of binominal nomenclature.

Micrite—biomicrite—micritinite

Micrites are called here biomicrite when produced mostly by living organisms.

Micritinite is a special kind of biomicrite: it is a fossil appearance of calcite secreted by the Micritina-producing organisms.

The micritinite as litho-matrix is produced from Micritina remains mostly by elidative (elido=squash) homogenization caused by diagenesis.

The Micritina-producing living being, which produces micritine:

— secretes it directly from sea water (=secretio),

— transforms it from large calcite crystals (=commutatio),

— excretes as digestion remains (=excretio),

— builds into itself from other Micritina remains or existing micritinite (raptatio=drag in).

The Micritina-producing organisms transform into biomicrite only the larger calcite crystal grains or remains, but do not solve the micritic ones, like the Micritinas and the biomicrite-shelled Foraminifera. (Presumably, the latter did not secrete the biomicrite for their houses, but they collected it from micritinite, unless their houses were made of larger calcite crystals, which then were transformed into biomicrite by the Micritina-producing organisms.)

Infilling of the Micritina chambers is sparitic or rarely chemomicritic. The supposedly sticky biomicrite could not move as sand, therefore it could not fill immediately e.g. the chambers or the shell of a fossil. The regular white tiny spots in the micritine field may be the traces of former chambers.

Differentation of chemomicrite and micritinite is problematic with simple methods. By a coarse approach:

— chemomicrites are more gray, have more isometric grains, which are more angular and larger,

— micritinites are more brownish, the grains are hooked or arcuated and smaller.

Some faciological questions of the Szársomlyó Limestone Formation

Allochemical components of the Formation are almost exclusively of Micritina origin, and occur in rockforming amount (Fig. 3).

In this microfacies only the sparitic material is chemogenic, the other components are biogenic, partly as shell fragments of fossils, and as Micritina remains, and as biomicritic matrix or micritinite derived from the disintegration of Micritinas.

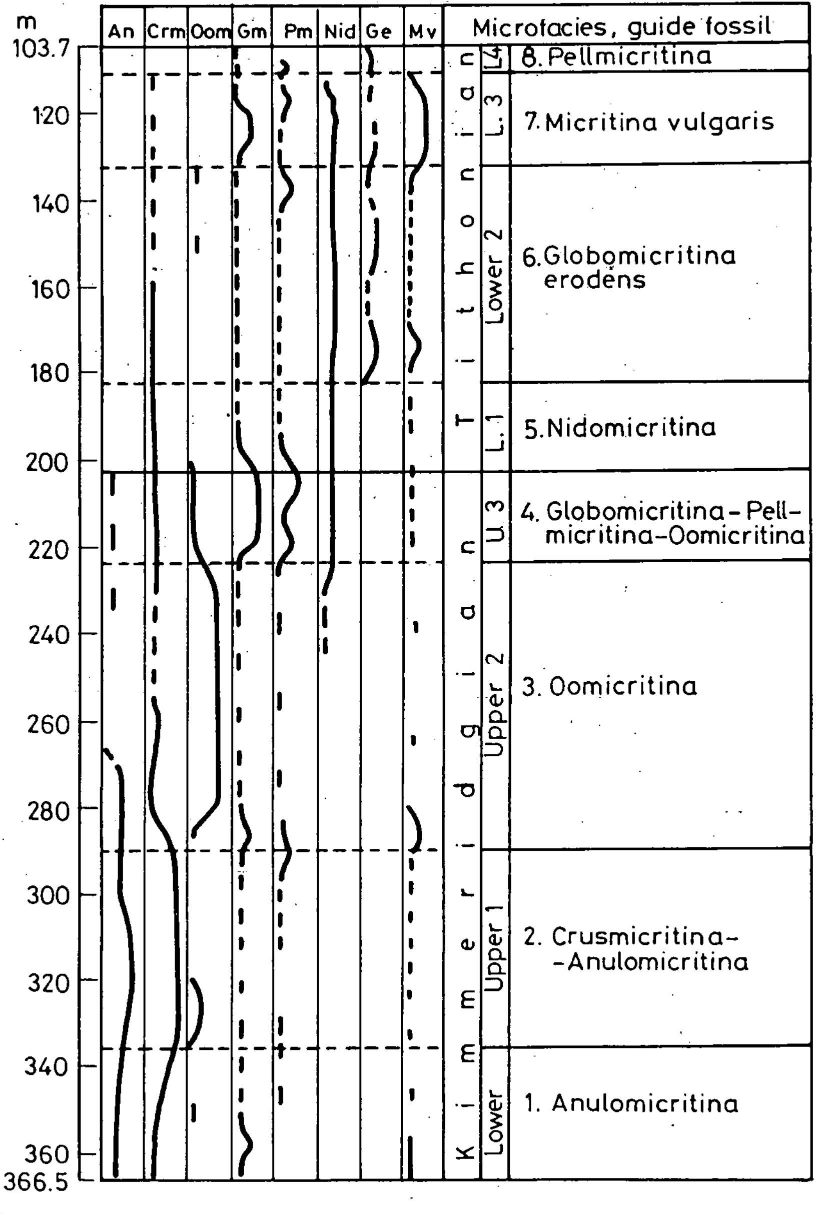

Fig. 3. Distribution of Micritinas in the stratigraphic column of boreholes Villány 9 and 9a

Where Correptomicritina-producing organisms lived, there these lent micritic infill to the Radiolaria. These are the characteristic dark radiolarites, which are significant in the Oxfordian section of the formation.

This litho- and biofacies is free from fine grains, gracile shells and houses, i.e. from all what can be drifted by the weakly-flowing water. But the heavier or sessile Foraminifera or Micritina-agglutinating organisms, remain; and from the light ones only those, which are encrusted by Micritinas.

The organic matter content of the initially sticky biomicrite may decay, then the micrite is mobilized washed out from the sediment or is separated by reworking. Reaching farther than the grains (i.e. the Micritinas) may contribute to the formation of limestones in the deep bathyal region.

The formations of the Szársomlyó Limestone Formation were formed in an environment where only weak currents acted with no wave activity. Here the extremely light elements (e.g. the protoplasm of Protozoa) may have been carried away, but the large-size bioclasts and the Micritinas remain. The largest depth of deposition may have been in the shallow bathyal region. It is characteristic for the lower part of the sequence, whereas for the upper part a shallow marine environment can be assumed to have existed.

Distribution of Micritinas

Reviewing publications the Micritinas may be the most common, frequently rock-forming remains in Earth history, widespread in space and time. Considering that thousands of publications touch upon them and photographic illustrations are very frequent, only some figures of a single paper are cited here: it is the study of BARATTOLO F. and PUGLIESE A. (1987).

Plate 26, fig. 1: Aalenian. Dominated by Pellmicritina and Compomicritina, characteristic Oomicritinas, some of them are enclosed by Compomicritinas. There are some *Micritina vulgaris* as well. The Micritinas float in white sparite far from each other. The sparite cannot be of micritic origin, since the Micritinas are completely intact, recrystallization did not damage them. It is more probable that the space among the Micritinas originally was filled by the organic material derived from the mass of Micritina-producing organisms, which leaved as fluid after deterioration, and its place was gradually filled by sparite.

Plate 26, fig. 2: Aalenian. Dominated by Pellmicritina, there is a few *Micritina vulgaris*. In the field ranging from the lower right corner to the middle of the picture the Micritinas were compacted to micritic matrix (=micritinite), where the outlines of some individuals can be recognized.

Plate 27, fig. 1: Aalenian. Beside dominating Pellmicritina, Oomicritina, *Crusmicritina includens* and *Micritina vulgaris* are seen. Sparitisation seems to be post-micritic, because the Micritinas are frequently damaged.

Plate 27, fig. 2: Bathonian. Dominated by Oomicritina, Compomicritina, one or two Globomicritinas and Pellmicritinas. The Oomicritina near the lower right corner bear well visible tiny rounded chamberlets arranged in a circular pattern.

Plate 30, fig. 2: Bathonian. Dominated by Compomicritinas, some of them contain Oomicritina. In the middle of the picture, somewhat below there is a tiny *Compomicritina composita*, and a *Crusmicritina considens* settled on its upper end.

Plate 31: Middle—Upper Liassic. Palaeodasycladuses are overgrown by *Crusmicritina considens*, but the Solenoporas are not. The formation may be partly or completely reworked, the two floral elements were not deposited in the same sedimentary basin.

The role Micritinas in the Mesozoic formations of Hungary

Szársomlyó Limestone Formation

The Micritinas are rock-forming fossils of the Formation. These are known from the following localities and ages:

— Villány Mts, outcrops: Oxfordian—Lower Tithonian.
— Borehole Villány 9, 9a: Kimmeridgian—Lower Tithonian.
— Borehole Magyarbóly 1: Oxfordian.
— Borehole Bóly 1: Lower and Middle Tithonian.
— Borehole Békés 2: Upper Tithonian—Lower Berriasian.
— Borehole Doboz 1: ?Valanginian—Hauterivian.
— Borehole Sátoraljaújhely 8: Oxfordian—Lower Berriasian.
— Boreholes Nagybaracska 27 and 28: Lower and Upper Tithonian (after G. CSÁSZÁR et al. 1983).

Other Mesozoic formations

Micritinas are usually rare.

Southern Transdanubia

— Villány Mts, Triassic outcrops: Anisian—Ladinian.

— Mecsek Mts, Oxfordian—Upper Tithonian: secondary in importance, worked froom topographic highs; except in the northern and southern belts of tectonic scales, where the Oxfordian dark radiolarites are considered autochtonous.

— Mecsek Mts, ?Barremian—Aptian: characteristic Micritinas, significant deposition.

Transdanubian Central Range

Micritinas are frequent, but in small amount.

— Pilis Mts, Velka Skala: Liassic, Oxfordian—Lower Tithonian.

— Gerecse Mts: Oxfordian—Upper Tithonian.

— Vértes foreland, boreholes Tatabánya: Oxfordian—Albian; Pusztavám and Oroszlány: Aptian—Albian; Kocs and Környe: Albian.

— Bakony Mts, boreholes: Borzavár: Oxfordian—Upper Tithonian; Olaszfalu: Oxfordian—Middle Tithonian; Csehbánya 27: Upper Oxfordian—Lower Kimmeridgian.

Northern Hungary

— Bükk Mts: from pebbles of an Upper Cretaceous conglomerate: boreholes Dédestapolcsány, Nekézseny, Nagyvisnyó: Oxfordian—Tithonian.

— Borehole Sátoraljaújhely 8: Anisian.

— Sárospatak: limestone xenoliths from Miocene rhyolite tuff: Cordevolian—Upper Triassic, ?Liassic.

Great Hungarian Plain

— Borehole Békés 2: ?Upper Triassic.

The localities listed are shown in Fig. 4. Micritina spectra of some samples from the localities listed under point 2 are shown in Table 1.

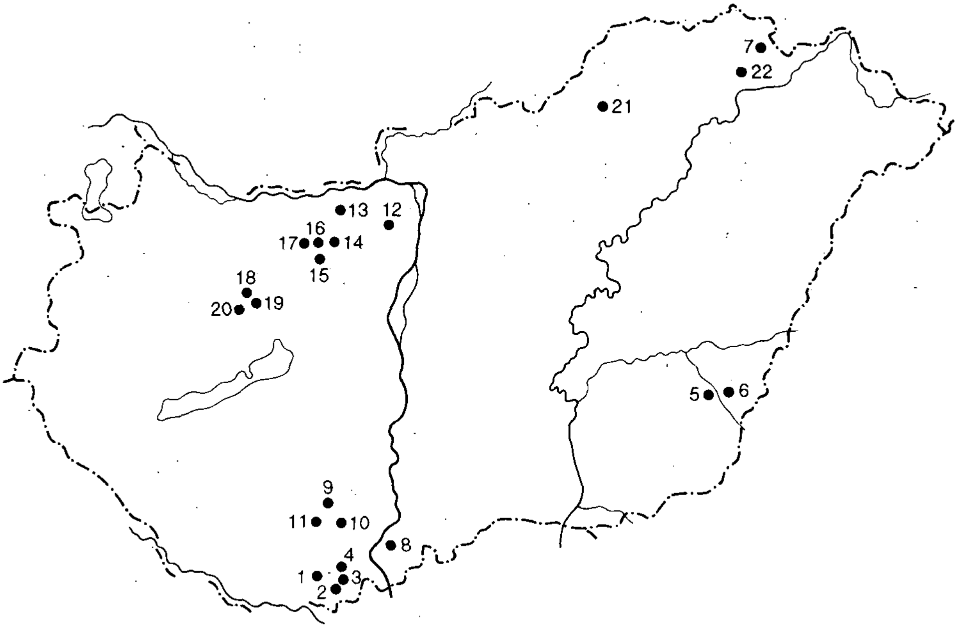

Fig. 4. Sketch map showing Micritina localities

1. Villány Mts, *2.* boreholes Villány 9 and 9a, *3.* borehole Magyarbóly 1, *4.* borehole Bóly 1, *5.* borehole Békés 2, *6.* borehole Doboz 1, *7.* borehole Sátoraljaújhely 8, *8.* boreholes Nagybaracska 27 and 28, *9.* Mecsek Mts, northern Upthrust belt, *10.* Mecsek Mts, southern Upthrust belt, *11.* Mecsek Mts, perisynclinal area, *12.* Pilis Mts, Velka Skala, *13.* Gerecse Mts, *14.* Tatabánya, *15.* Oroszlány and Pusztavám, *16.* Környe, *17.* Kocs, *18.* Borzavár and Zirc, *19.* Olaszfalu, *20.* Csehbánya, *21.* Dédestapolcsány, Nekézseny and Nagyvisnyó, *22.* Sárospatak

Description of the new form-taxa

Micritina multicamerata n. forma sp.

Code: Mmc, Reg. No. MP-71.

Holotypus: Sample No. Szv. F-1, Plate III, Fig. 4.

Table 1

A few examples of the distribution of Micritinas in Hungary

Micritina taxa / Locality (Age)	*Micritina vulgaris*	*Globomicritina pulla*	*Pellmicritina solida*	*Oomicritina concentricellata*	*Correptomicritina falsa*	*Globomicritina erodens*	*Crusmicritina includens*	*Crusmicritina considens*	*Crusmicritina solvens*	*Anellomicritina* sp.	*Compomicritina composita*	*Micritina* sp. 1	*Micritina* sp. 2	*Cinmicritina* sp.
Zengővárkony (Oxfordian)	+	+	+		+									
Ófalu (Oxfordian)		+	+		+		+		+					
Magyaregregy (Tithonian)		+	+			+		+			+			
Kisújbánya (Tithonian)		+	+	+	+					+				
Pécsvárad (?Barremian)	+		+		+	+								
Pécsvárad (?Aptian)	+											+	+	
Jánosi-puszta (?Aptian)	+				+							+		
Mázaszászvár (?Aptian)	+						+		+			+	+	+
Nagyharsány (Barremian)	+		+			+								
Nagyharsány (Aptian)	+		+											+
Pilis Mountain (Liassic)	+						+							
Pusztavám (Aptian)	+											+		
Oroszlány (Aptian)	+					+			+			+	+	+
Kocs (Albian)	+	+										+		
Környe (Albian)	+											+	+	
Tatabánya (Tithonian)	+	+	+				+	+	+	+				
Tatabánya (Aptian)	+	+					+					+		

Derivatio nominis: Indicating the many (=multus) chambers.
Locus typicus: Mázaszászvár (Baranya County, Hungary).
Stratum typicum: ?Aptian (from Miocene gravel).

Description: Isometric form of small to medium size, of micritic material, where the tiny, rounded chamberlets are densely located.

Size: Holotype 500 μm.

Micritina quadratopulverulenta n. forma sp.

Code: Mqp. Reg. No. MP–72.
Holotypus: Sample No. Szv. F–8, Plate V, Fig. 1.
Derivatio nominis: indicating, that it contains rectangular (=quadratus), dust–grain–like (=pulverulentus—dusty) grains.
Locus typicus: Mázaszászvár (Baranya County, Hungary).
Stratum typicum: ?Aptian (from Miocene gravel).

Description: Nearly isometric form, small to medium in size, of micrite material, with light, rectangular grains, which are densely located.

Size: Holotype 300 μm.

Micritina triangula n. forma sp.

Code: Mta, Reg. No. MP-73.
Holotypus: Sample No. Szv. F-7, Plate V, Fig. 2.
Derivatio nominis: indicating the triangular shape.
Locus typicus: Mázaszászvár (Baranya County, Hungary).
Stratum typicum: ?Aptian (from Miocene gravel).

Description: triangular form, small to medium in size, of micritic material, slightly elongated along one side. Few, very small spots, which may be traces of chambers.

Size: Holotype 450 μm.

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Plate I

1. Micritina microbiofacies with many small Pellmicritinas
   Borehole Villány 9a, 122.0 m, Lower Tithonian
2. Correptomicritinas (1) filling Radiolaria, tiny Globomicritinas (2) and Compomicritina (3) enclosing other Micritinas
   Ófalu, Meszes valley, Oxfordian
3. Nidomicritina (1), *Micritina vulgaris* (2), Radiolaria-infilling Correptomicritina (3) encrusted by Crusmicritina (4)
   Borehole Villány 9a, 167.1 m, Lower Tithonian
4. Anellomicritina (1) and Crusmicritina (2)
   Borehole Villány 9a, 122.0 m, Lower Tithonian

1., 3—4.: 24X

2.: 60X

Photo: Mrs Dr. L. PELLÉRDY

1

2

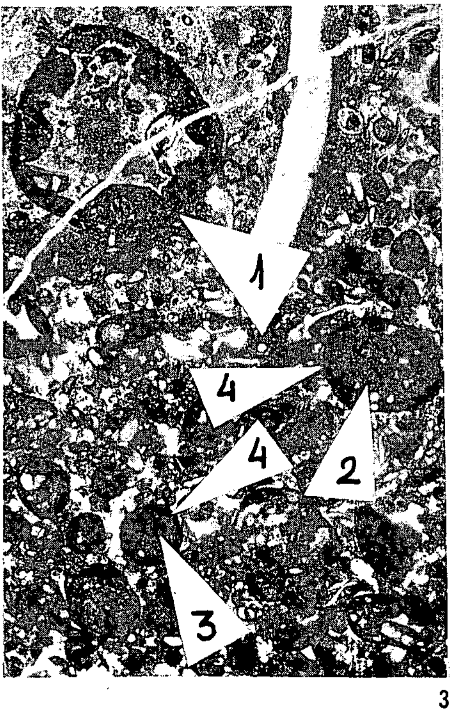

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Plate II

1. Cinmicritina as solving tiny calcareous lamina (1), Crusmicritinas (2) and Nidomicritina (3)
Borehole Villány 9a, 167.1 m, Lower Tithonian

2. Cinmicritina solves calcareous skeletal element
Borehole Villány 9a, 11.0, Lower Tithonian

3. Oomicritinas. The large Oomicritina (1) surrounds a *Crusmicritina solvens* (2) just dissolving a Lombardia skeletal element
Borehole Villány 9a, 257.0 m, Upper Kimmeridgian

4. *Implimicritina turbata*
Borehole Villány 9a, 111.0 m, Lower Tithonian

1., *4.*: 24X

2—3.: 60X

Photo: Mrs Dr. L. PELLÉRDY

1

2

3

4

Plate III

1. A Crusmicritina (1) encrusting a shell fragment initially was surrounded by Oomicritina (2), then by Nidomicritina (3), finally all were covered by Oomicritina (4)
Borehole Villány 9a, 207.0 m, Upper Kimmeridgian

2. Oomicritina surrounds a former Radiolaria or Foraminifera test filled by sparitising Micritinas, and already has dissolved the wall of the test
Borehole Villány 9a, 257.0 m, Upper Kimmeridgian

3. Nidomicritina formed by Globomicritinas and Oomicritinas
Borehole Villány 9a, 152.0 m, Lower Tithonian

4. *Micritina multicamerata* n. sp. Holotype
Mázaszászvár, ?Aptian (from Miocene gravel formations)

1—3.: 60X
4.: 24X
Photo: Mrs Dr. L. PELLÉRDY

1

2

3

4

Plate IV

1. Calcite-fragment-solving Cinmicritina
Mázaszászvár, Aptian (from Miocene gravel formations)

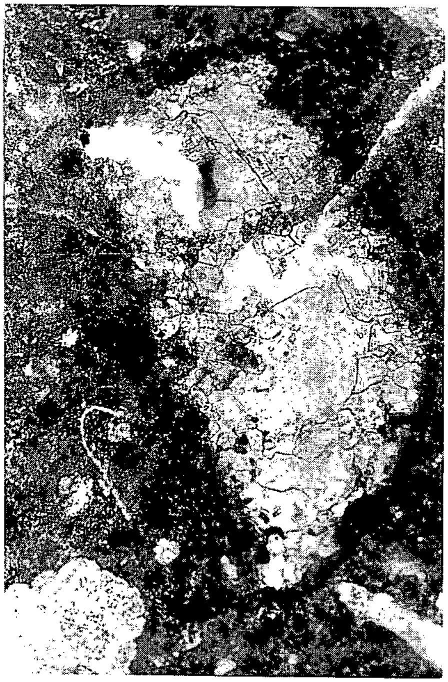
2—3. Foraminifera tests dragged into Radiolaria
Borehole Pécsvárad 11, 68.0 m, ?Barremian

4. Crusmicritna enclosing substrated Globochaete
Mázaszászvár, Upper Tithonian

1.: 60X

2—4.: 150X

Photo: Mrs Dr. L. PELLÉRDY



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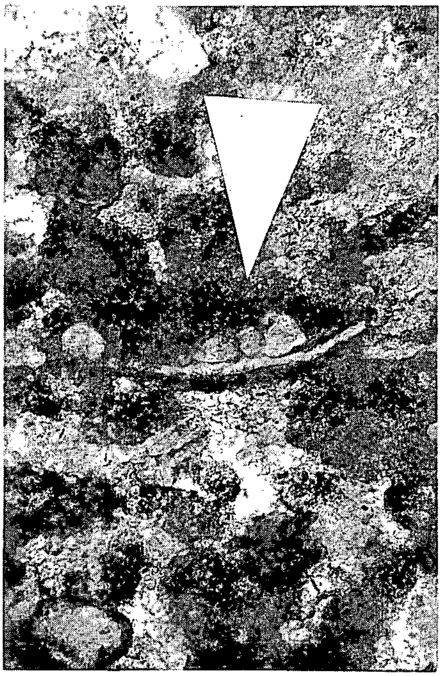

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Plate V

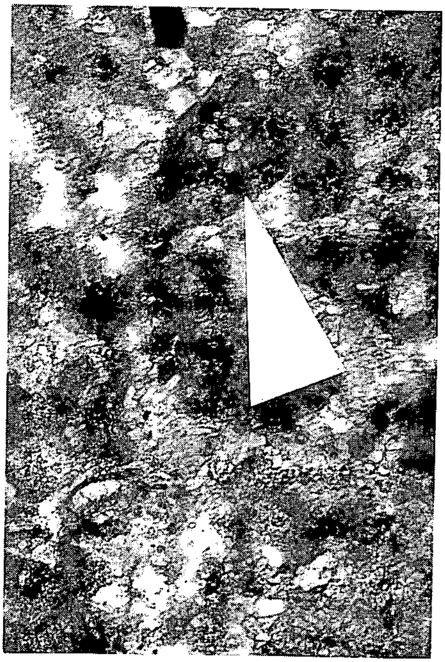
1. *Micritina quadratopulverulenta* n. sp. Holotype
   Mázaszászvár, ?Aptian (from Miocene gravel formations)
2. *Micritina triangula* n. sp. Holotype
   Mázaszászvár, ?Aptian (from Miocene gravel formations)
3. *Globomicritina erodens* as solving tiny calcareous lamina
   Borehole Bóly 1, 1216.0 m, Middle Tithonian
4. *Crusmicritina solvens* (1) showing saw-derted soution of a tiny calcareous lamina and enclosed by Compomicritina (2)
   Borehole Bóly 1, 1283.0 m, Lower Tithonian

1—2.: 48X

3.: 65X

4.: 165X

Photo: Mrs Dr. L. PELLÉRDY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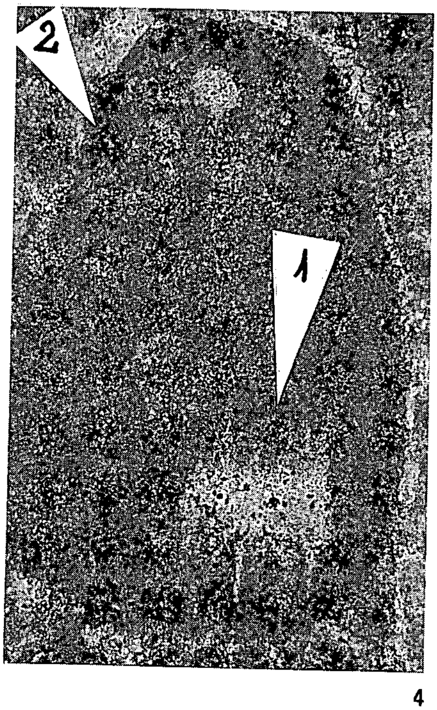

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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II. RÉSZ (1989)

PALAEOBATHYMETRIC STUDY OF PALAEOGENE PROFILES UPON FORAMINIFERA

by
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UDC: 551.781:563.12:551.22

Keywords: Palaeogene, bathymetry, Foraminifera, Transdanubia (Hungary)

Bathymetric curves of Palaeogene profiles in Transdanubia were constructed upon the percentage distribution of plankton and benthos Foraminifera following the method of R. G. WRIGHT (1977) and L. J. VAN MARLE et al. (1987). The results were completed with bathymetric data gained through considering benthos Foraminifera.

Depth intervals were used in evaluation instead of absolute depth; these data can be supplemented by results from studying other groups of the fauna.

Percentage distribution of plankton—benthos Foraminifera clearly and objectively displays water depth change trends, rates and directions. The bathymetric curve can yield important data for the reconstruction of the subsidence histories of Palaeogene basins.

Introduction

Early investigations of recent sediments have shown that variability of benthos taxa due to life conditions may be a tool of water depth estimations. Unfortunately, application of this method is severely hindered by the extremely large amount of new taxa, produced by diagnostic uncertainties i.e. imprecise determination. Some authors consider (e.g. F. VAN MORKHOVEN et al. 1986) that about 25,000 species may be invalid out of 30,000 ones described.

In our study we tried a method, which provided reliable data based on objective methods, for the subsidence history of Palaeogene basins.

The method applied excludes the mistakes of taxonomic determinations (WRIGHT 1977, VAN MARLE et al. 1987), and deepening and shallowing trends may be objectively described.

The method was applied for sediments containing pelagic plankton foraminifers. Earlier boreholes of the Hungarian Geological Institute, have provided the material, enabling us to make an ecological reinterpretation (Fig. 1).

Our study is part of the project ”Reconstruction of the subsidence histories of Hungarian Palaeogene basins, based on palaeoecological and bathymetric analysis

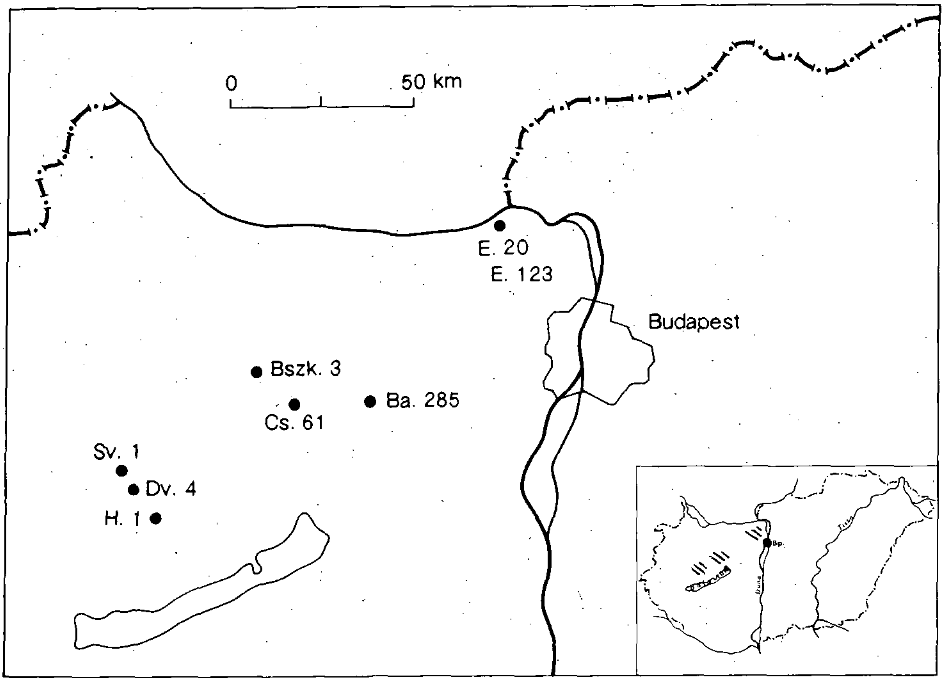

Fig. 1. Location of boreholes

of their molluscan, foraminiferal and ostracoda faunas" (Department of Geology, Roland Eötvös University, Budapest, No. 1202/3370113). The Eocene profiles were investigated by K. HORVÁTH-KOLLÁNYI, while the Oligocene ones by Á. NAGY-GELLAI.

Previous studies

Water depth estimations are usually based on modern analogies, but their application yields less and less precise results for older ages.

Different Foraminifera associations live under different environmental conditions. This fact can be used for water depth estimations; however, imprecise determination of taxa put severe constraints on the possible application of this method. To improve this, F. VAN MORKHOVEN et al. (1986) compiled an atlas of Cenozoic cosmopolitan benthos Foraminifera.

There are published observations on morphological changes with depth of foraminiferal genera and species (E. BOLTOVSKY—R. WRIGHT 1976, A. PUJOS—LAMY 1984, VAN MORKHOVEN et al. 1986).

W. A. BERGGREN (1984) has observed changes in the deep marine benthos foraminiferal associations during Middle Eocene to Early Oligocene time due to gradual cooling of the climate. The end of the Early Oligocene is dominated by

Uvigerinida, Upper Eocene by Planulinida, Lower Oligocene by Siphonina and Sphaeroidina.

Further data for water depth estimation is provided by the analysis of the ratio of plankton and benthos foraminifers occurring together in the sediment (F. B. PHLEGER 1960, T. GRIMSDALE—F. VAN MORKHOVEN 1955, W. MURRAY 1973, R. G. WRIGHT 1977, VAN MARLE et al. 1987, L. M. BYBELL—T. G. GIBSON 1985).

In Hungary GY. LELKES (1970) studied the Middle Oligocene Kiscell Clay Formation from Szépvölgyi road localities and interpreted the foraminiferal fauna after PHLEGER (1960). He concluded that inner and outer shelf environments alternated during the deposition of the Kiscell Clay Formation.

K. SZTRÁKOS (1979) subdivided the northeastern Hungarian Oligocene sediments into infralittoral, circalittoral and epibathyal zones and gave depth intervals, too.

M. HORVÁTH (1980) described foraminiferal assemblages in the Hungarian Upper Oligocene and Lower Miocene and provided data on palaeoenvironment and depth of deposition.

Methods

We have applied the water depth estimation methods of WRIGHT (1977) and VAN MARLE et al. (1987), complemented by data from the benthos foraminifers and other methods.

WRIGHT's (1977) model for bathymetric estimations is based on the percentage distribution of plankton foraminifers. He investigated 688 recent samples from known depths of open-marine sediments of normal salinity from all over the world. Percentage distribution of plankton foraminifers was plotted as a function of depth. The approximately exponential function is described by the following equation:

$$D = e^{(0.42\,P + 3.48)},$$

where D = depth in metres and P = plankton percentage.

The same method was applied by VAN MARLE et al. (1987) for recent sediments of the Eastern Indonesian islands. Thirty-six samples from 40—2119 m depth interval of the Australia—Irian Jaya continental margin were examined. The uppermost 1 cm of the sediment was sampled, then the samples were conserved is 60% ethanol and kept in cold-storage plant. After drying and washing through a 63 micrometre sieve the samples were dried out again and the plankton/benthos ratio was calculated from the 125 micrometre sieve aresidue. About 300—400 specimens were counted from each sample.

The ratios were plotted as a function of depth: the curve is similar to that of WRIGHT's but not coincident with it (Fig. 2):

$$D = e^{(0.061\,P + 1.25)},$$

The difference in the parameters may be explained by the fact that the WRIGHT

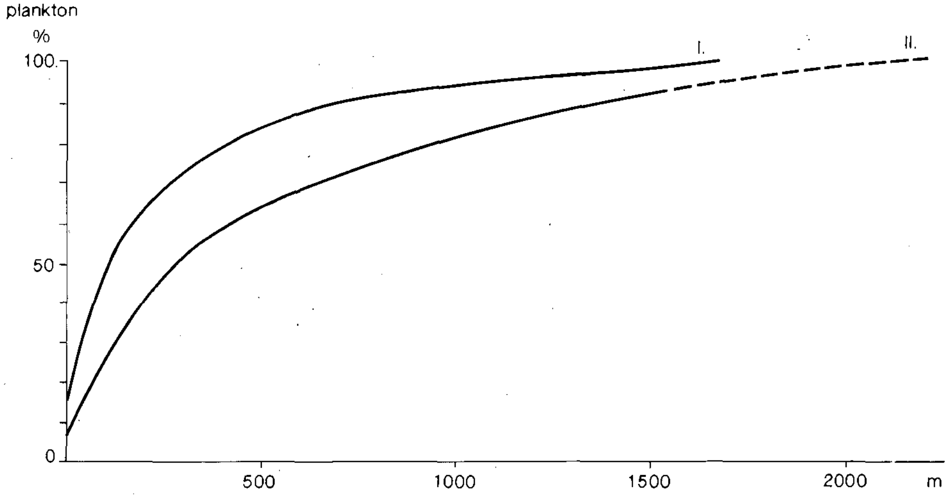

Fig. 2. Bathymetric curve based on the percentage of plankton Foraminifera
I. Curve of VAN MARLE. *II.* curve of WRIGHT

model is based on open marine environment,while the VAN MARLE model was developed at the continental margin.

The two methods mentioned above were used by us on pelagic sediments containing plankton foraminifers.

Five hundred specimens were counted in the washed sieve residue, and the percentage of the plankton foraminifers were calculated. Then the water depth was calculated by the equations of WRIGHT (1977) and VAN MARLE et al. (1987). This method is very time-consuming, therefore the percentage of the plankton foraminifers was estimated in densely sampled sections. As the WRIGHT and VAN MARLE curves indicate slightly different depths, this interpolating estimation probably did not yield significant errors.

Investigation of Eocene profiles

Pelagic Eocene profiles were selected by their plankton foraminiferal contents. Each figures display the stratigraphic column of the borehole, the age, the BOLLI (1972) zones, and the WRIGHT and VAN MARLE water depths.

The two water depth curves are similar but not identical. The difference is due to different depositional environments: WRIGHT sampled an open marine environment, while VAN MARLE sampled the continental margin. Applicability of the WRIGHT model is constrained by the fact that a very wide environment was sampled resulting in a very variable material obtained. Environmental conditions strongly influence the distribution of plakton—benthos species, e.g.: decrease of salinity due to freshwater inflow, turbidity, slope transport, calcium carbonate dissolution, etc.

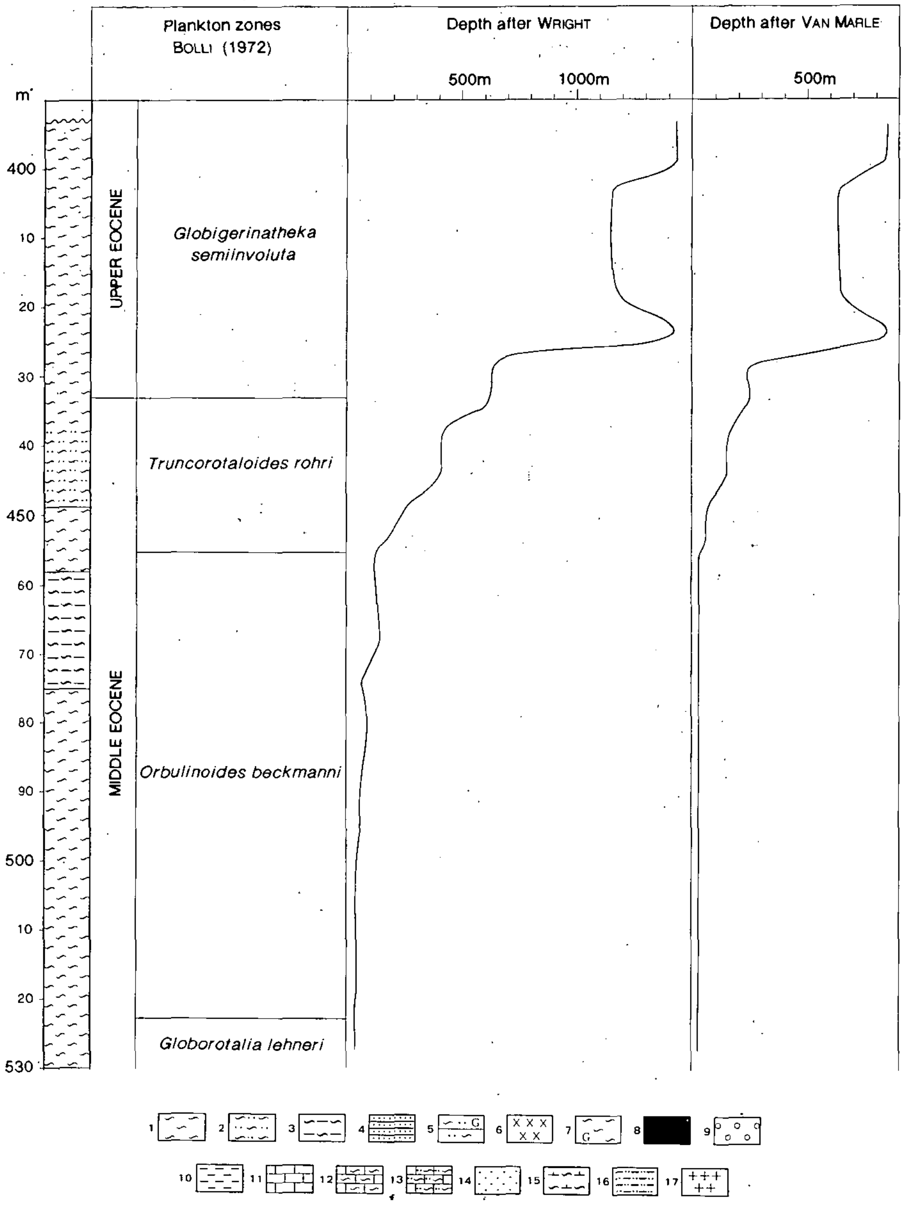

Fig. 3. Bathymetric curve plotted upon borehole Bakonyszentkirály 3
1. Marl, *2.* marl with siltstone, *3.* clay–marl, *4.* hard sandstone, *5.* marly sandstone, considerably glauconitic, *6.* tuff, *7.* glauconitic marl, *8.* coal, *9.* pebble and conglomerate, *10.* clay, *11.* limestone, *12.* marly limestone, *13.* sandy calcareous marl, *14.* sand, siltstone, *15.* calcareous marl, *16.* clayey fine sandstone, *17.* andesite

Samples of VAN MARLE are from a more narrow area, from the Banda Arc; these are less scattered, — comparing to WRIGHT's data — due to less varied environmental factors.

Precision of both methods is lowered by calcium carbonate dissolution at greater depths, yielding less plankton foraminifers embedded in sediments.

If the percentage of plankton is less than 5% or more than 95%, these models cannot be applied above 40 m depth, and below 1600 m depth, respectively, due to the inadmissible errors.

According to WRIGHT (1977), the vertical circulation increases the relative amount of plankton foraminifers, causing oxygen depletoion in the lower water strata , which decreases the number of benthos foraminifers. This phenomenon of ascent or descent may have a role in the difference between the two models, as this phenomenon is missing from the WRIGHT model, so the amount of plankton is less than compared to the VAN MARLE model. In the VAN MARLE model strong ascension and descent was observed in the strict investigated area due to monsoon effect, increasing the amount of plankton (Fig. 2).

Since the investigated region in the Bakony Mts is somewhat different from the model areas, we use water depth intervals instead of absolute depth values, and complete them with other data resulting from the interpretation of benthos foraminifers.

Applying the methods outlined above, we have detected a gradual, rarely sudden increase of depth in the Bakonyszentkirály 3 borehole section (Fig. 3). Between 528.0 and 455.0 m there is slow increase of depth, reaching 60—80 m from 455.0 to 425.0 m it is rapidly increasing to 200—400 m. The greatest depth (800—1000 m) was verified by the samples from 425.0—390.0 m.

The column of borehole Balinka 285 does not show any significant depth of sea. An 50 to 70-m-deep environment is suddenly followed by a 100-m-deep one at 535.0 m. The greatest depth (150—200 m) was reached from 490.0 m upwards (Fig. 4).

In borehole Csetény 61 (Fig. 5) the one-time sea depth was checked up about 50—100 m between 455.0 and 390.0 m, then 500—600 m up to 310.0 m; then suddenly increased to 800—1000 m between 310.0 and 280.0 m. A slight decrease in depth is verified to have existed 280.0—270.0 m (500—600 m).

Benthos foraminifers also provide supplementary data. The species *Bulimina jacksonensis* CUSHMAN (occurring between 420.0 and 415.0 m) lived in 30—600 m depth. Plankton foraminifes help to constrain this interval to 50—100 m depth.

The species *Uvigerina havanensis* CUSHMAN et BERMUDEZ (living from 600 to 1000 m) and *Nuttalides truempyi* (NUTTALL) (living below 600 m) was found between 303.0 and 280.0 m, indicating 800—1000 m depth together with a large number of plankton Foraminifera VAN MORKHOVEN et al. 1986).

The Devecser 4 borehole section (Fig. 6). contains the richest plankton foraminiferal fauna. The lowest part of the column (98.0—95.0 m) may have deposited in 200—300 m. From 95.0 m there is a slow, gradual subsdience up to 62.0 m. Here the sea gradually reached the depth of 600—800 m. The section between 61.0 and 46.0 m may have deposited in a 800 to 1000-m-deep sea.

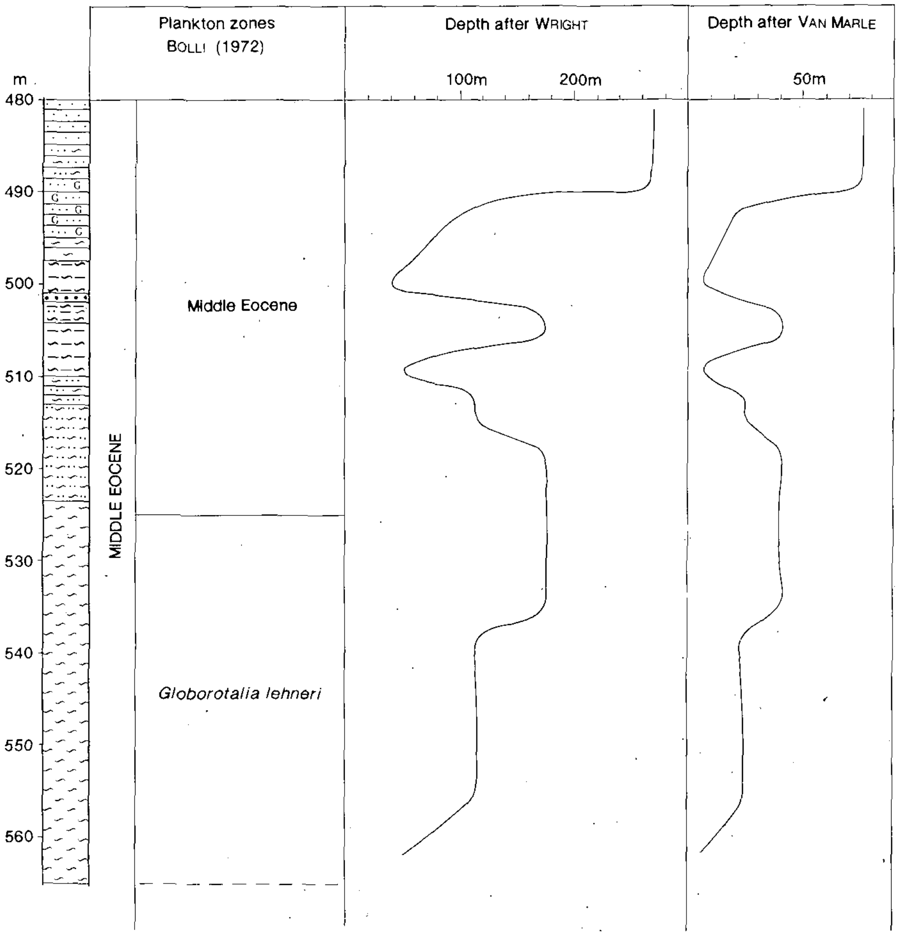

Fig. 4. Bathymetric curve plotted upon borehole Balinka 285
For explanations, see Fig. 3

In the lower part of the Halimba 1 borehole section (Fig. 7), between 80.0 and 40.0 m, plankton foraminifers indicate slow increase of depth (20 to 100 m). From 40.0 m upwards to the uppermost section of the borehole a relatively rapid, but even increase of depth is experienced by plankton foraminifers. Here from 100.0 m, a sea depth ranging from 800 to 1000 m is attested to.

The most detailed investigations were carried out on the cores of borehole Somlóvásárhely 1(Fig. 8). The c. 170-m-thick Eocene profile contains plankton foraminifers throughout, so the figure clearly shows water depth changes. The lowermost part of the profile shows the most shallow and most nearshore features, while upwards the deep and open marine character, is getting stronger. The greatest depth was monitored between 640.0 and 590.0 m; c. greatest 800—1000 m. Then the depth is decreasing again.

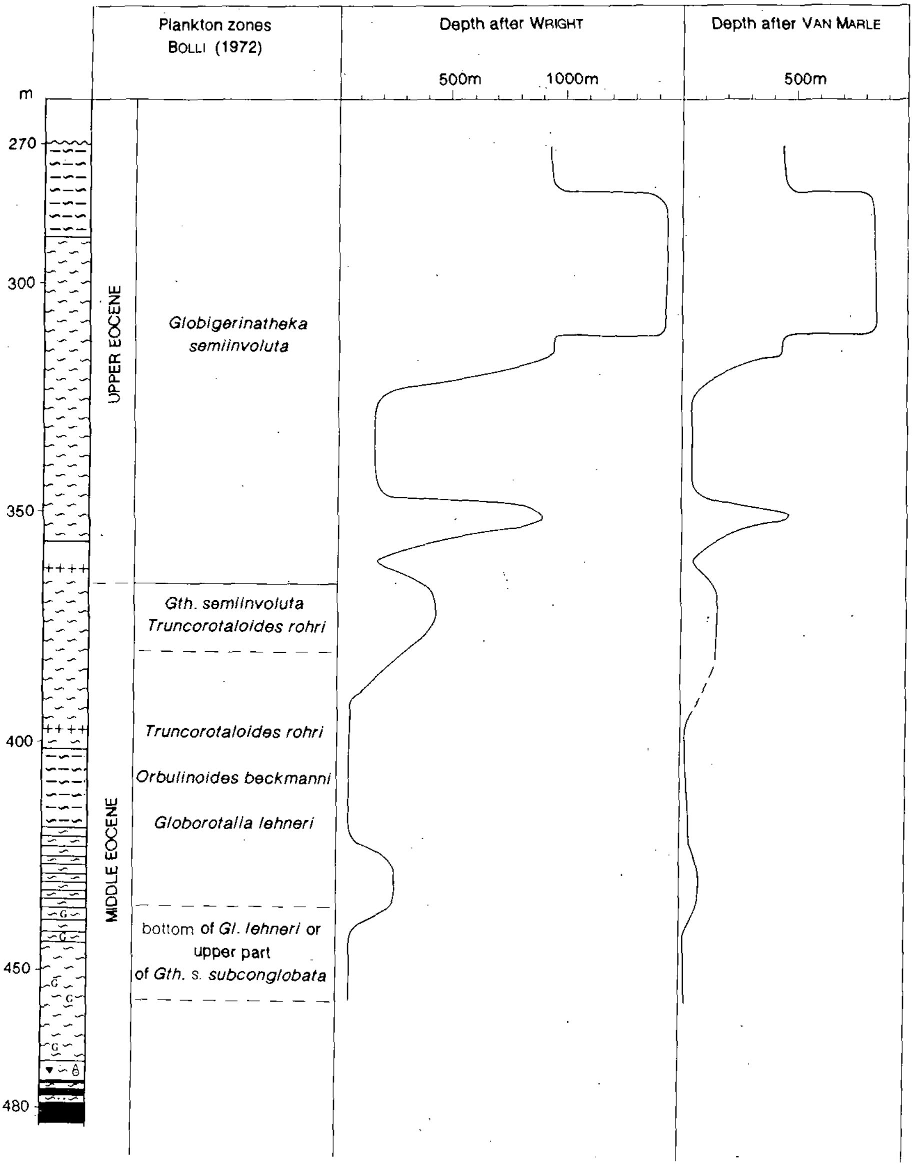

Fig. 5. Bathymetric curve plotted upon borehole Csetény 61
For explanations, see Fig. 3

GIBSON's "tau" foraminifer-environmental index (BYBELL—GIBSON 1985) (Fig. 9) was calculated for the samples of borehole Somlóvásárhely 1. The horizontal axis shows the "tau" values (tau = percentage of plankton foraminifers multiplied by the number of species in the samples), and the vertical one indicates the location of the sample in the borehole. Both axes are drawn on a logarithmic scale.

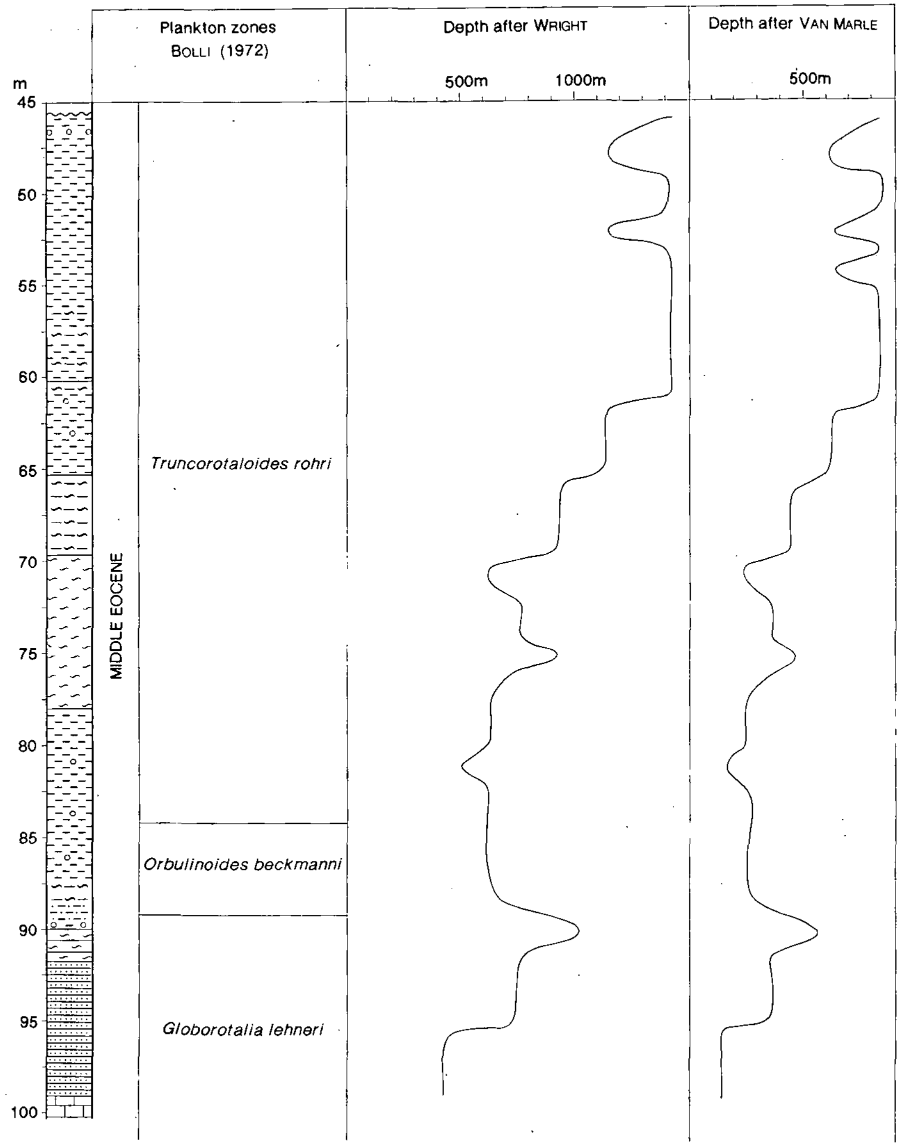

Fig. 6. Bathymetric curve plotted upon borehole Devecser 4
For explanations, see Fig. 3

The largest "tau" values are reached in the intervals of 635.0—647.0 m and 591.0—602.0 m (tau = 15—23). The lowest values are in the lower part of the profile (tau = 1—2). The figure clearly indicates a gradual increase of depth: the basin reached its greatest depth between 590.0 and 640.0 m of the section.

Change of the "tau" values within a profile shows the change in relative water level (increase or decrease of depth), but does not give absolute water depth data.

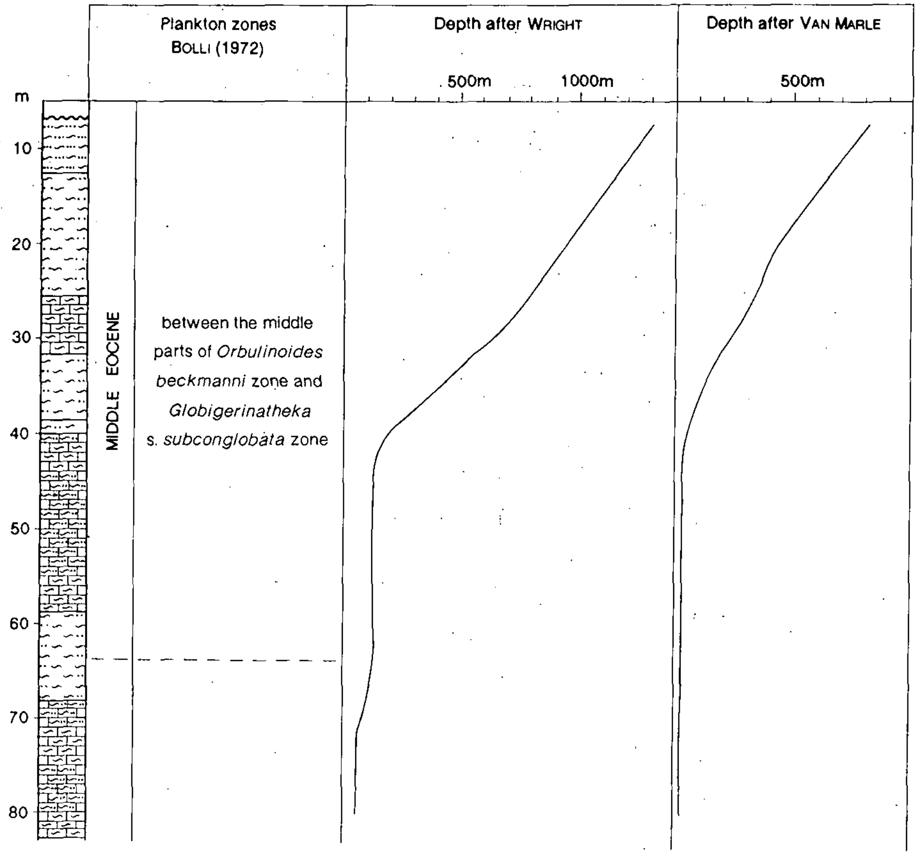

Fig. 7. Bathymetric curve plotted upon borehole Halimba 1
For explanations, see Fig. 3

Investigation of Oligocene profiles

The investigated Oligocene profile do not contain as rich a plankton foraminiferal fauna as the Eocene ones do. Therefore supplementary data by benthos foraminifers were mostly considered for the construction of the water depth curve. Two boreholes were investigated: Esztergom 123 and Esztergom 20. The samples of borehole Esztergom 123 are from the 29.2—626.0 m interval, investigated in great details in 1987.

We determined that part of the cored section where deepest-water deposits have been found (500.0—464.0 m). These samples are richest in plankton foraminifers and, in turn, their benthos foraminifers are the richest in species. Six samples were selected and analysed. After decantation, we have got the number of plankton and benthos forms in the residue, than calculating the pertinent water depth upon the WRIGHT and VAN MARLE models. Within such a short distance (only 36 metres between the smallest and largest values) such great change is surprising,

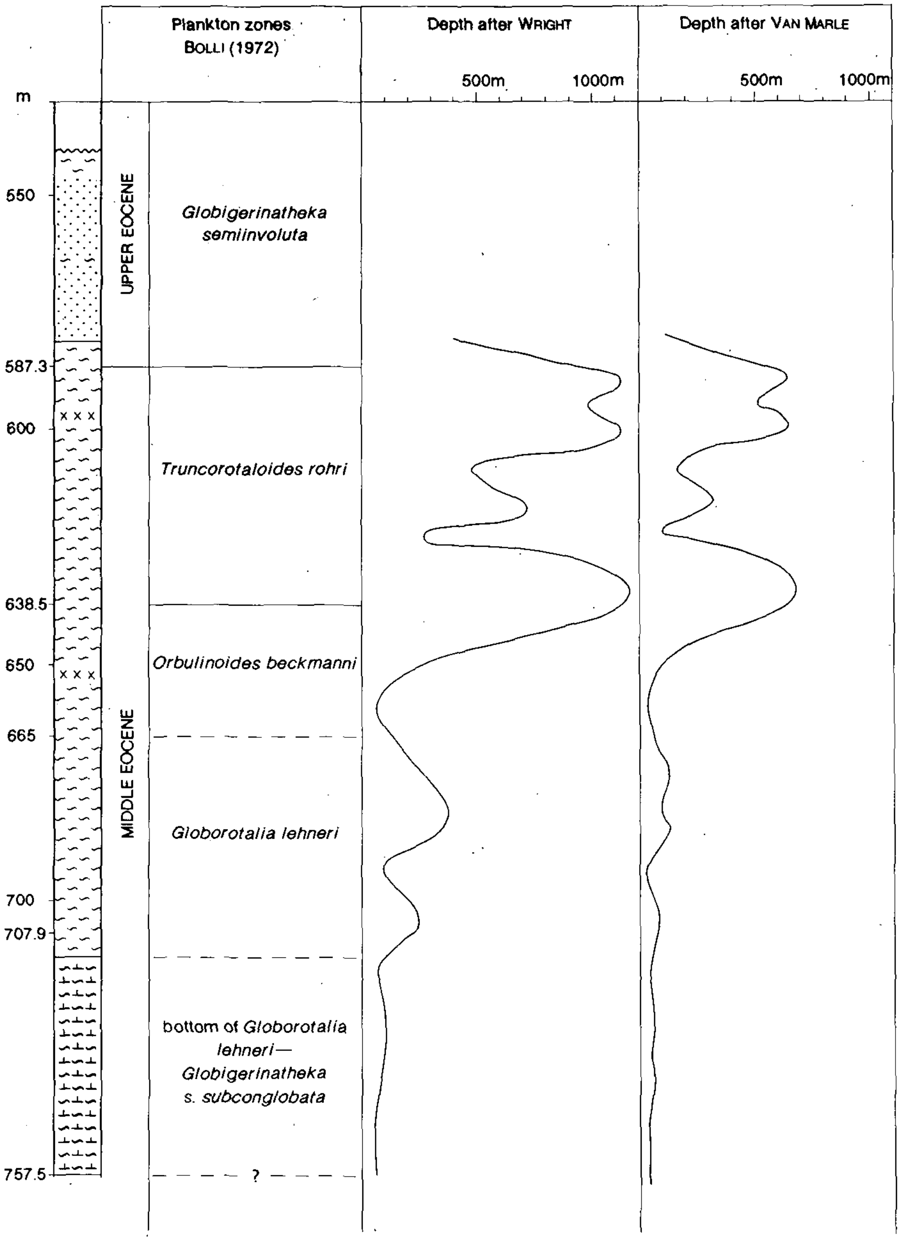

Fig. 8. Bathymetric curve plotted upon borehole Somlóvásárhely 1
For explanations, see Fig. 3

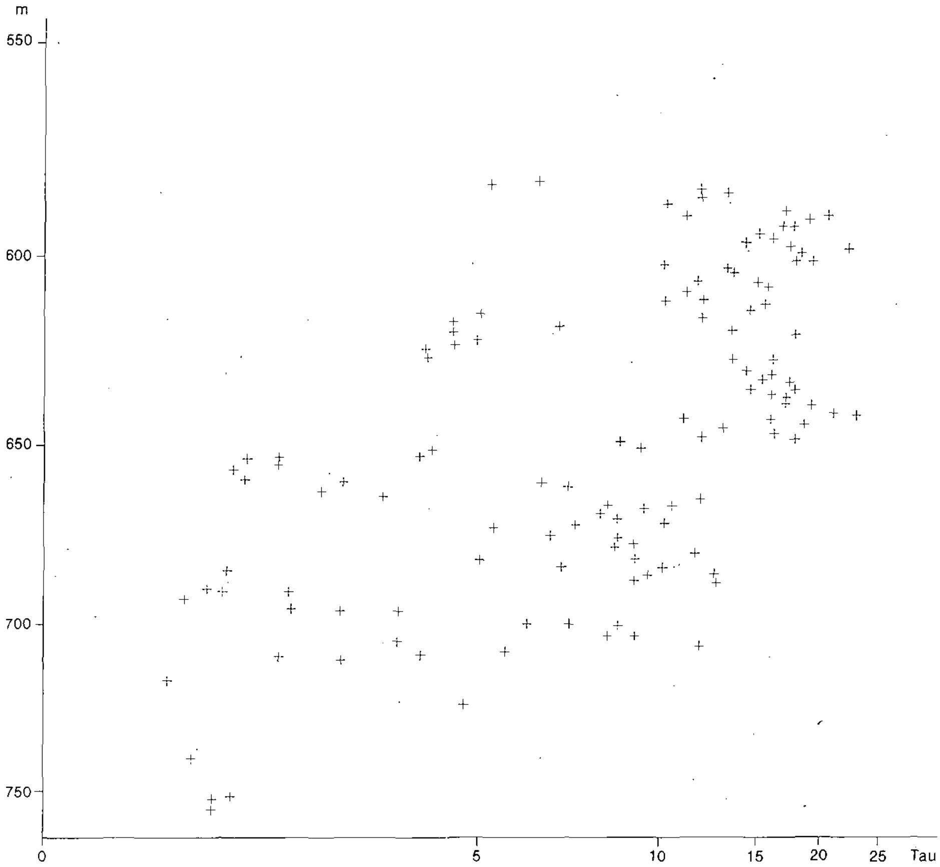

Fig. 9. "Tau" Foraminifera-environmental index (borehole Somlóvásárhely 1)
Tau = percentage of plankton multiplied by number of species in the sample

because it implies great difference in water depth. Probably, here an environmental impect and not a difference in water depth can be involved. The change in environmental effects is supported by a change of the sediment any material. Therefore the two side values in the curves were connected, and this was figured in the borehole log. The depths calculated from the VAN MARLE model are very shallow. The depths calculated from the WRIGHT model are more acceptable (Fig. 10). Since the VAN MARLE model cannot be applied in this case, other models were also used.

After PHLEGER (1960), we have calculated:

— the ratio of plankton—benthos specimens,
— the percentage of agglutinated species compared to that of benthos species,
— the total number of species and
— the number of genera.

These data indicate the depth of the upper continental slope (100—1000 m). As it is a very large interval, it was precised by water depth data offered by some

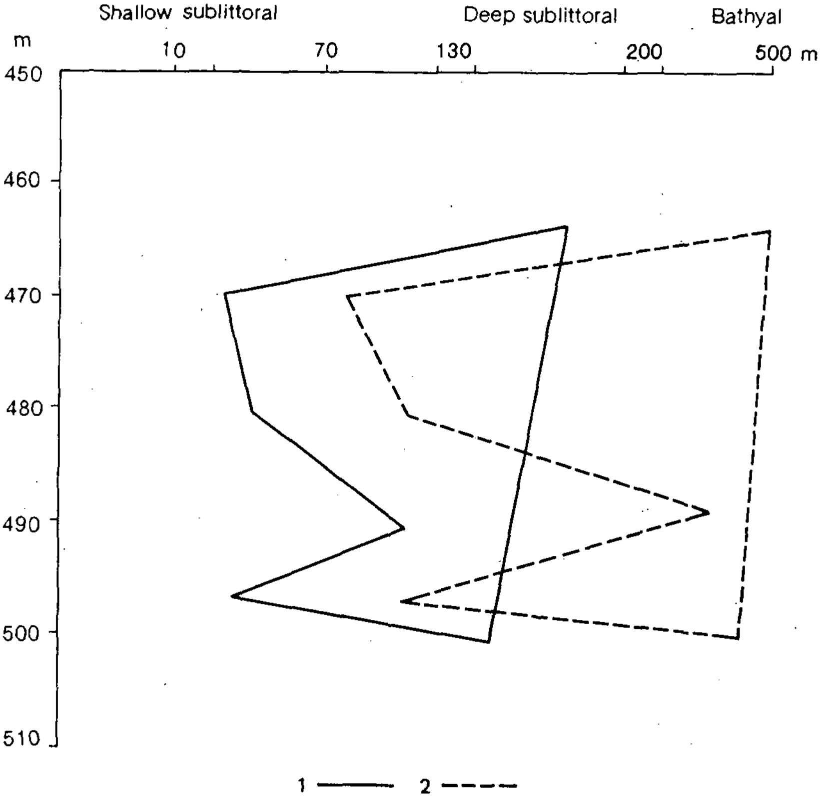

Fig. 10. Depth distribution curves
1. Curve of VAN MARLE, *2.* curve of WRIGHT

genera and species. The study of A. PUJOS-LAMY (1984) contains some forms common with our fauna, which indicate epibathyal environment deeper than 250 m. These species are *Tritaxia szabói* (HANTKEN), *Vulvulina* div. sp., *Uvigerina* div. sp., *Sigmoilina* div. sp., Cassidulinidiae. In our samples there are large amounts of *Uvigerina hantkeni* CUSHMAN—EDWARDS and *Tritaxia szabói* (HANTKEN), and smaller amounts of Sigmoilina, Vulvulina, and Globocassidulina. VAN MORKHOVEN et al. (1986) write that *Planulina costata* HANTKEN, *Cibicidoides mexicanus* (NUTTALL), *Heterolepa dutemplei* (D'ORBIGNY) occur. All of them indicate major depths. The species *Planulina costata* is an upper to middle bathyal species (100—2000 m), and the *Cibicidoides mexicanus* (NUTTALL) is a middle neritic to upper bathyal one (30—600 m).

During our last year's Foraminifera investigations we have plotted the water depth curve of borehole Esztergom 123, considering the data of the new methods (Fig. 11). Some cored sections do not contain plankton foraminifers therefore mostly benthos foraminifers were taken into account. The interpretation was helped by the works of K. SZTRÁKOS (1979), H. REISER (1987) and M. HORVÁTH (1980).

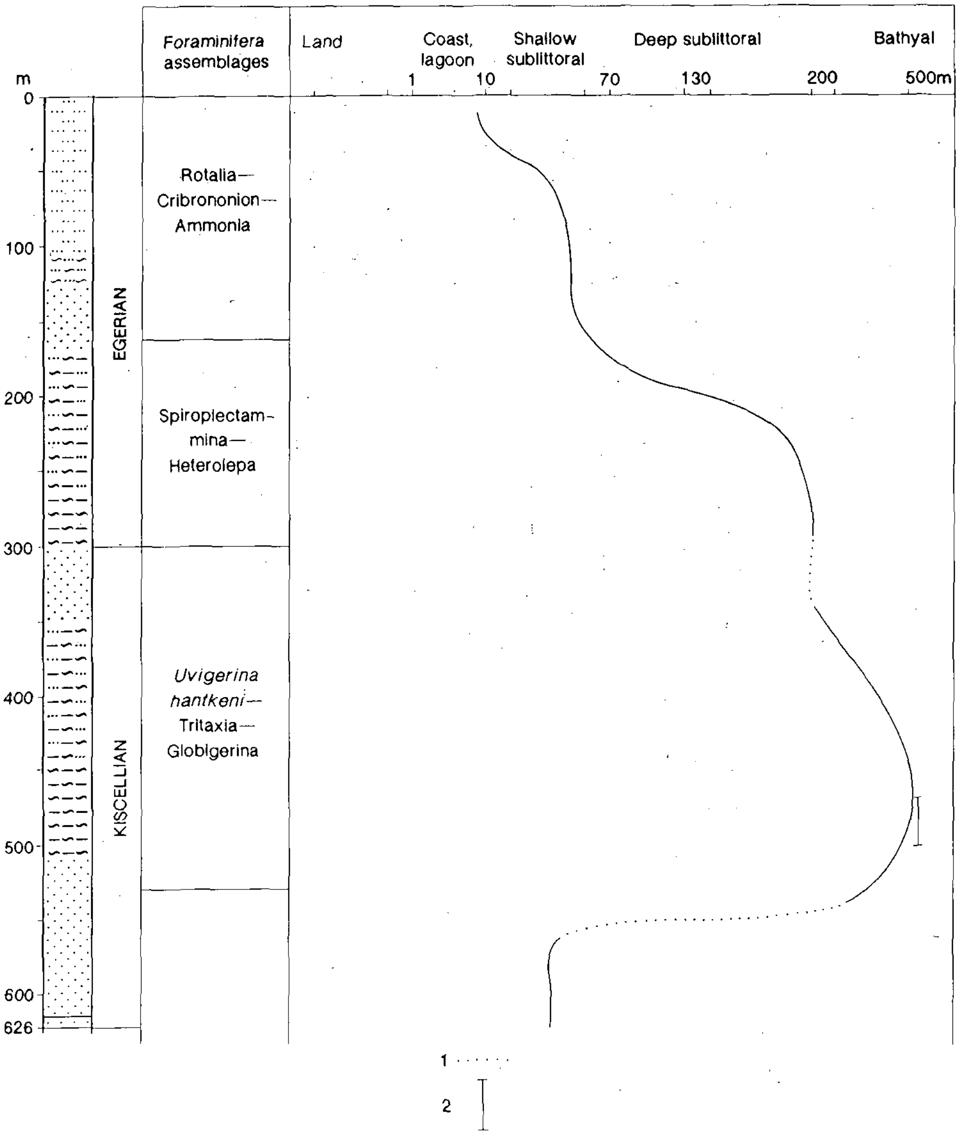

Fig. 11. Bathymetric curve plotted upon foraminifers from borehole Esztergom 123
1. Fossil-free. *2.* plankton—benthos percentage curve after the WRIGHT model (464,0—500.0 m). For further explanations. see Fig. 3

The deepest part of the Esztergom 123 borehole section corresponds to a water depth of 500 m, if we accept the values calculated from the WRIGHT model. The application of PHLEGER's method, however, has resulted in the recording of a water depth of 100—1000 m. Comparing these with the data of A. PUJOS-LAMY (1984), the Tritaxia—Uvigerina—Globigerina assemblage should indicate depths below 250 m.

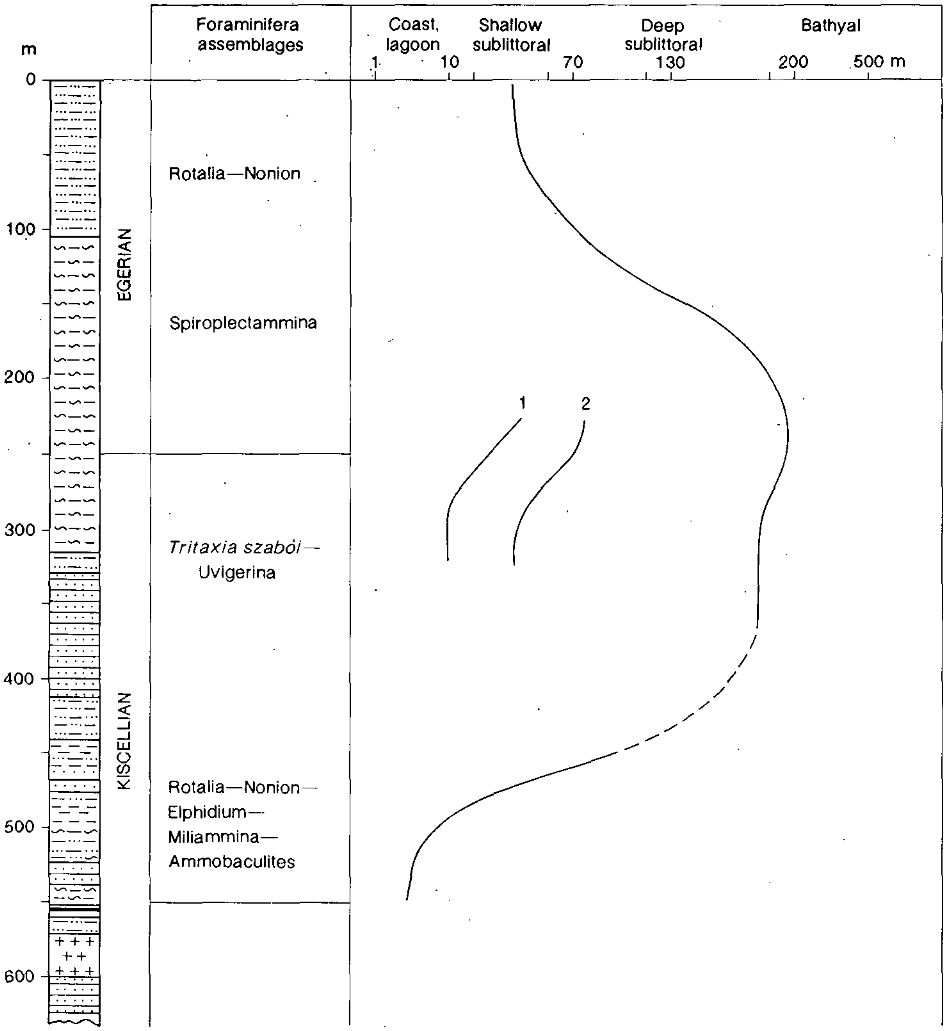

Fig. 12. Bathymetric curve plotted upon foraminifers from borehole Esztergom 20
1. Plankton—benthos percentage curve after the VAN MARLE model, *2.* after the WRIGHT model. For further explanations, see Fig. 3.

Taking it all in all, the depositional depth for the Kiscell Clay must have been 250—500 m. This value is higher than those given by former authors (GY. LELKES 1970, K. SZTRÁKOS 1979, M. HORVÁTH 1980). This greater depth is corroborated by the application of the method of modern analogies. Of course, these attempts to estimate the depth of water may involve several errors. More investigations are needed to prove its applicability, and the depth should be interpreted together with results by other fossil groups investigated.

The Esztergom 20 borehole section (a key borehole in the Dorog Basin), was studied in 1960. Here we tried to determine the deepest-water interval upon foraminifers: it lies between 220.0 and 320.0 m.

The sequence is poor in plankton foraminifers. In this section, the maximum value is 25%. It indicates minor depths only. Therefore the water depth curve was plotted as based on benthos foraminiferal assemblages, indicating the values calculated upon the plankton. Here we can clearly see that in the plankton/benthos ratio calculations the water-depth indicating role of the benthos foraminifers is extremely important. It is especially important when the plankton percentage is very low. In the environment represented by the deepest part of the borehole section the Miliammina—Ammobaculites association had flourished in seashore lagoons. The deepening of the sea is indicated by the Rotalia—Nonion—Elphidium association. Latest observation have showed that Rotalias live in 10—30 m, and Elphidiums in 100 m depth, respectively. The section between 460.0 and 344.0 m does not contain any foraminifers. The *Tritaxia szabói*—Uvigerina association indicate 200 m depth, in a deep sublittoral or deeper environment. The calculation of plankton/benthos ratio was made mostly for this section. The greatest water depth indicated by this borehole was about 220 m. Regarding the *Spiroplectammina carinata* association, the pertaining water depth may have been about 100—150—200 m, while the Rotalia—Nonion association indicates a depth less than 100 m. The benthos fauna from this borehole indicates 200—250 m. The low plankton percentage shows smaller depth, which may be attributed to several causes (Fig. 12).

Comparing the water depth curves plotted upon the two Esztergom boreholes we can observe a sudden deepening from the middle of the Kiscellian Stage. Following this steady depth a more gradual, and slower shallowing took place as long as till the end of the Egerian.

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DELINEATION OF HANTKEN'S FORAMINIFERAL SPECIES FROM THE ORIGINAL COLLECTION

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UDC: 551.781:563.12

Keywords: palaeogene, Foraminifera, collection

The author presents the SEM photographs of 35 species which have remained from HANTKEN's original collection.

We are currently paying off an old debt when gathering together inventorizing the material being left from the collection of HANTKEN, on the occassion of the XXIst Micropalaeontological Colloquium. This work is a survey of the material preceding, hopefully, an up-to-date revision of the Hantkenian species.

M. HANTKEN's work published in 1875, describing and delineating the Foraminifera fauna of the *Clavulina szabói* beds has been ranged among the pioneering studies in the Hungarian as well as international micropalaeontological literature. As early as the year of publication, it was printed in German, too. HANTKEN had previously published foraminiferal species from the Kiscell Clay Formation (M. HANTKEN 1868) as well as from the Eocene beds of the Esztergom Coal Measures (M. HANTKEN 1871). His most renowned work, displays the lithographic print of 93 species described by him (M. HANTKEN 1875).

The *Clavulina szabói* beds were described by HANTKEN under the name of the lower and upper divisions. The lower part comprises the Upper Eocene Buda Marl Formation, while the upper division includes the Lower Oligocene Kiscell Clay Formation. The allocation of the individual localities for the Foraminifera species presented here agree with the original names.

L. MAJZON, a distinguished palaeontologist of our century, in his commemoration paper on HANTKEN's activity (L. MAJZON 1962) publishes the copies of the original lithographic tables of the foraminiferal fauna collected from the *Clavulina szabói* beds, with some modifications concerning the nomenclature. He did not mention, however, the fossils preserved from HANTKEN's collection, which are mainly foraminifers.

The bulk of the collection, unfortunately deficiently preserved, is in the possession of the Palaeontological Department of the Roland Eötvös University, rendered available for us by. M. MONOSTORI. A minor part was obtained from M.

HORVÁTH of the Department of Geology. Some 5 pieces belong to the collection of the Hungarian Geological Survey.

HANTKEN stored the microfaunal samples in fixed glass tubes on a cardboard 22 x 9 cm large covered by black paper coating. The glass tubes are fixed at the top and the bottom by a thin wire. One sheet of cardboard generally contains 8—12 such tubes. The names of the fossils are written, together with that of the locality, beside the tubes. Fairly often, the species names and the figures are marked with the same numbers (Fig. 1). Apart from the dominant small and large foraminifers, the collection contains ostracods, corals and calcareous algae as well. Apart from the material of Hungarian localities, we find comparative material from Italy, France and the Vienna Basin.

The present-state collection contains 111 fossils fixed on cardboard in glass tubes as well as 46 foraminifers stored in Franke cells. This amount would probably constitute only a fragment — maybe, half — of the original material. We suppose this on the basis of the serial numbers found on the cardboard sheets. Even more painful as it is, some of the glass tubes are missing and not all of the disposable ones contain the forams any more. The foraminiferal species of the HANTKEN's collection were SEM microphotographed whenever we had at least 2—3 specimens in a vial, in the SEM. Most of the specimens are of fairly bad state of preservation. We can present 35 species of the original HANTKEN's collection according to his own system. Our presentation here has been offered to the participants of the Colloquium and it can be considered as a beginning of an up-to-date revision of the material.

Genus and species index of the taxa presented

Bolivina elongata	Plate XIII, figs. 5—6
Bolivina reticulata	Plate XIII, figs. 3—4
Cassidulina globosa	Plate XIII, figs. 1—2
Clavulina cylindrica	Plate III, figs. 1—5
Clavulina szabói	Plate IV, figs. 1—7
Cristellaria granosa	Plate VII, figs. 1—3
Cristellaria porvaensis	Plate VII, fig. 4
Cristellaria schwageri	Plate VII, figs. 5—6
Dentalina contorta	Plate V, figs. 1—2
Dentalina hörnesi	Plate V, figs. 5—7
Dentalina semilaevis	Plate V, figs. 3—4
Dimorphina elegans	Plate XII, figs. 2—5
Frondicularia tenuissima	Plate VI, figs. 1—2
Gaudryina reussi	Plate II, figs. 1—2
Gaudryina textillaroides	*Plate II, figs. 3—5*
Haplophragmium acutidorsatum	Plate I, figs. 1—3
Marginulina subbullata	Plate VI, figs. 5—6
Nummulites budensis	Plate XVIII, fig. 5
Plecanium elegans	Plate I, figs. 4—5

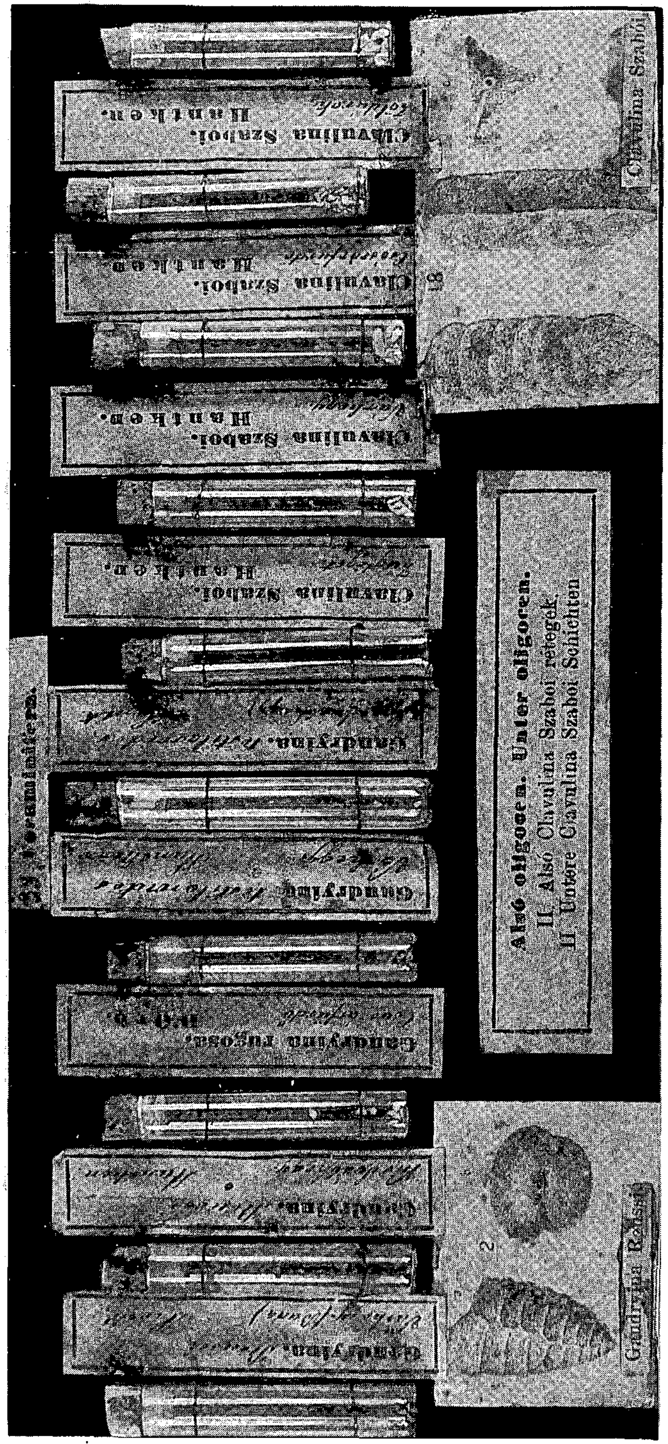

Fig. 1. A copy of the original cardboards from HANTKEN's collection (1875). Photo: I. LAKY

Pleurostomella acuta	Plate VI, figs. 3—4
Polymorphina acuta	Plate X, figs. 1—2
Rhynchospira abnormis	Plate XV, fig. 1
Robulina arcuatostriata	Plate VIII, figs. 1—3
Robulina budensis	Plate VIII, figs. 4—5
Robulina granulata	Plate IX, figs. 4—5
Robulina kubinyii	Plate IX, figs. 1—3
Textilaria subflabelliformis	Plate XIV, fig. 1
Truncatulina conica	Plate XV, figs. 2—4
Truncatulina costata	Plate XVI, figs. 1—6
Truncatulina granosa	Plate XVII, figs. 1—5, Plate XVIII, figs. 1—4
Uvigerina farinosa	Plate X, figs. 3—5
Uvigerina multistriata	Plate XI, figs. 1—4
Virgulina hungarica	Plate XII, fig. 1
Verneuilina tokodensis	Plate IV, fig. 8
Vulvulina pectinata	Plate XIV, figs. 2—5

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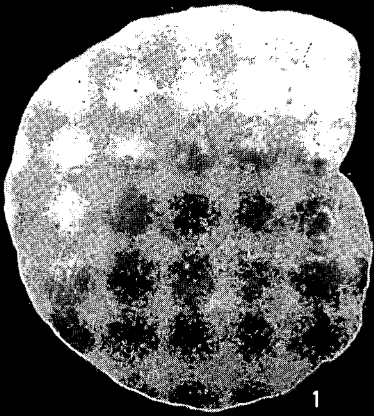
Plate I

1—3. *Haplophragmium acutidorsatum* HANTKEN 1868
Budapest, Újlak, Kiscell Clay Formation
1. Total view, SEM 20X
2. Slightly tilted, SEM 20X
3. Total view (another specimen), SEM 26X

4—5. *Plecanium elegans* HANTKEN 1868
Budapest, top of the Kis Svábhegy hill, Buda Marl Formation
4. Total view, SEM 60X
5. View from above, with the aperture, SEM 60X

Photo: MRS TAKÁCS and I. LAKY



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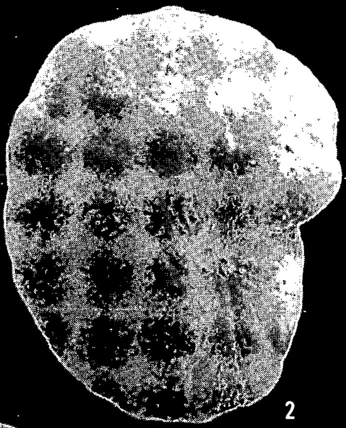

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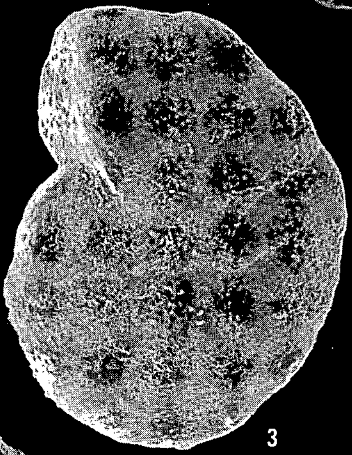

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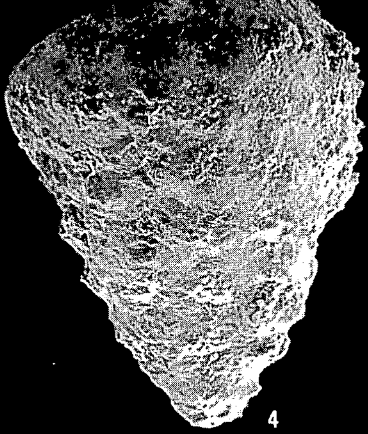

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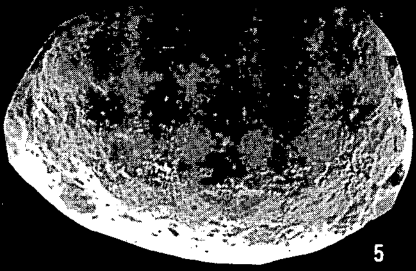

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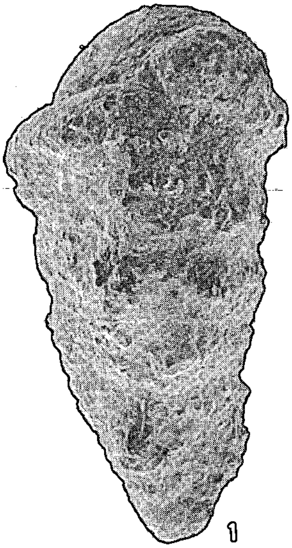
Plate II

1—2. *Gaudryina reussi* HANTKEN 1868
Budapest, Kis Svábhegy hill, Buda Marl Formation
1. Total view, SEM 30X
2. View from above, with the aperture, SEM 32X

3—5. *Gaudryina textillaroides* HANTKEN 1875
Budapest, Várhegy hill
3. Total view, slightly tilted, SEM 24X
4. Total view, SEM 30X
5. View from above, with the aperture, SEM 480X

Photo: MRS TAKÁCS and I. LAKY



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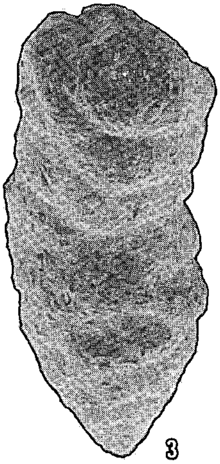

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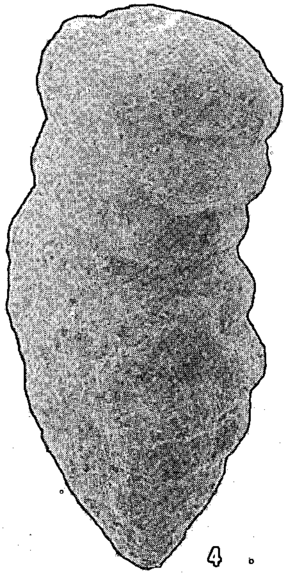

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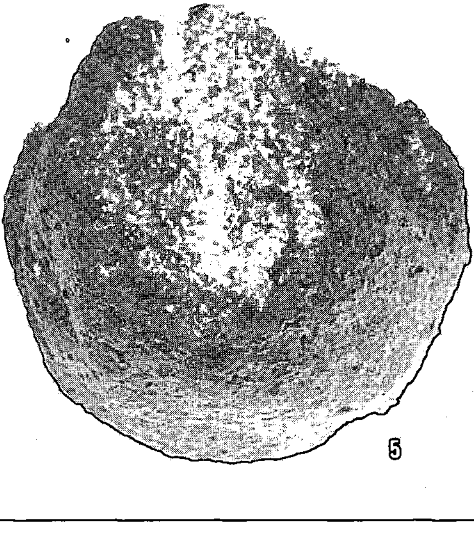

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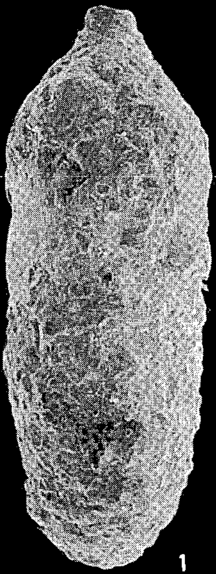
Plate III

1—5. *Clavulina cylindrica* HANTKEN 1875
Budakeszi
1. Total view, SEM 40X
2. Detail of the neck parts, SEM 130X
3. View from above, with the aperture, SEM 300X
4. Total view (another specimen), SEM 20X
5. Detail of the neck parts, SEM 400X

Photo: MRS TAKÁCS and I. LAKY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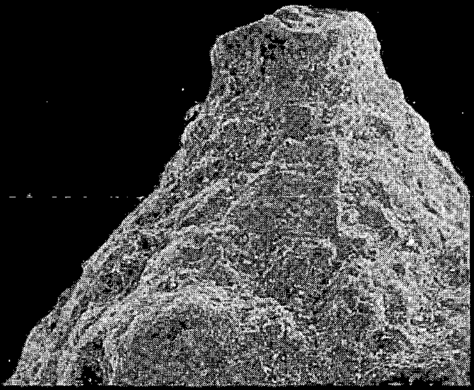
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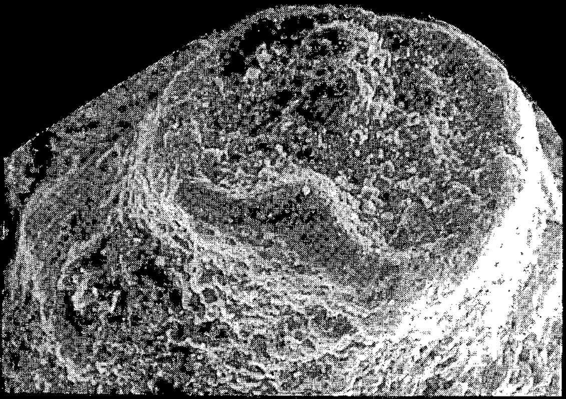
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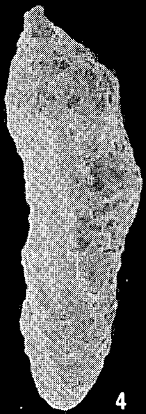
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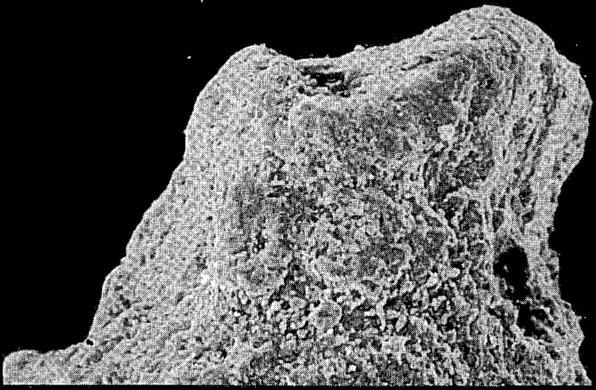
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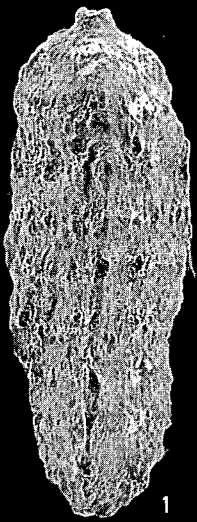
Plate IV

1—7. *Clavulina szabói* HANTKEN 1868
Budapest, Császárfürdő
1. Total view, SEM 32X
2. Aperture, SEM 130X
3. View from above, with the aperture, SEM 40X
4. Total view (another specimen), SEM 36X
5. Slightly tilted, SEM 36X
6. Total view from both sides (other specimen), SEM 36X
7. Third view, SEM 40X

8. *Verneuilina tokodensis* HANTKEN 1871
Dorog, Esztergom
Total view, SEM 100X

Photo: MRS TAKÁCS and I. LAKY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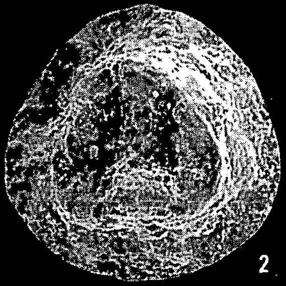
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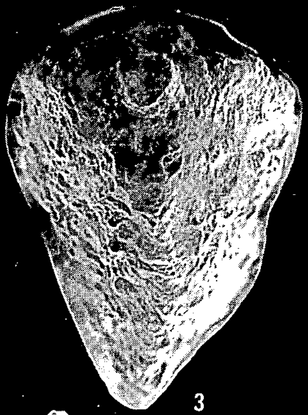
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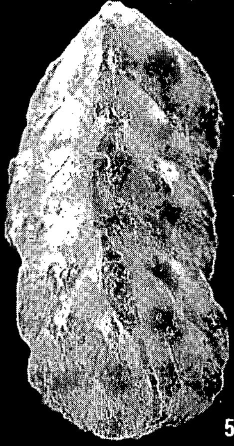
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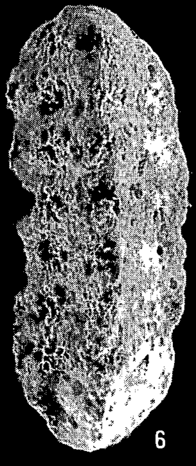
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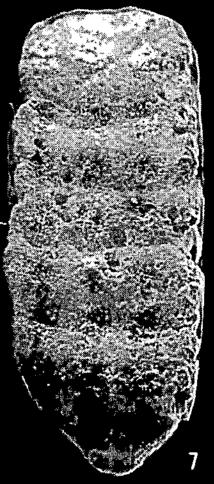
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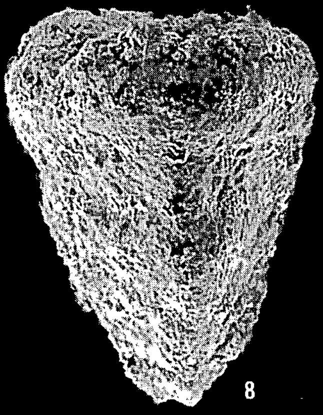
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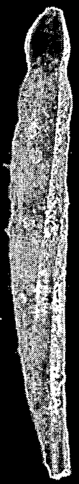
Plate V

1—2. *Dentalina contorta* HANTKEN 1868
Budapest, Újlak, Kiscell Clay Formation
1. Total view, SEM 20X
2. View from above, with the aperture, SEM 160X

3—4. *Dentalina semilaevis* HANTKEN 1875
Kiscell Clay Formation
3. Total view, SEM 40X
4. View from above, with the aperture, SEM 160X

5—7. *Dentalina hörnesi* HANTKEN 1868
Budapest, bottom of the Kis Svábhegy hill, Buda Marl Formation
5. Total view (broken specimen) SEM 26X
6. Slightly tilted, SEM 36X
7. Section of the chamber wall with ribs, SEM 100X

Photo: MRS TAKÁCS and I. LAKY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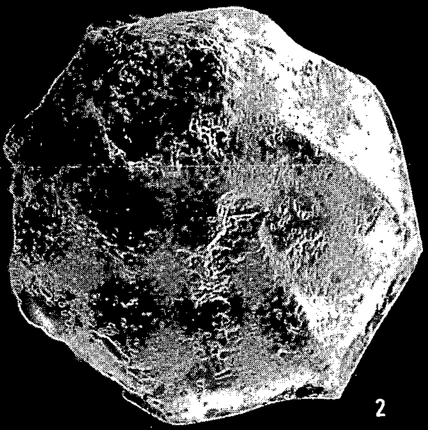
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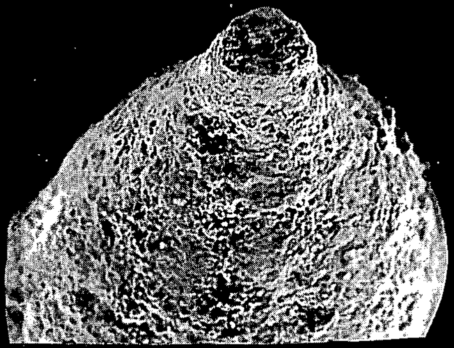
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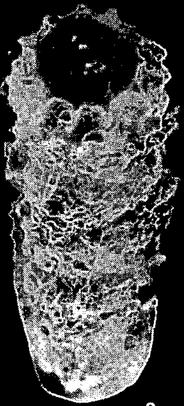
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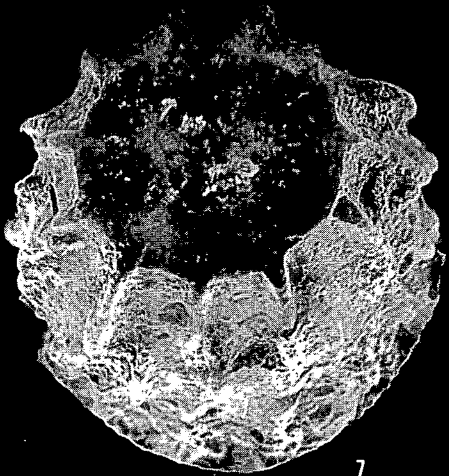
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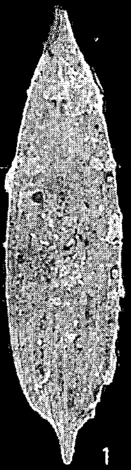
Plate VI

1—2. *Frondicularia tenuissima* HANTKEN 1875
Kiscell Clay Formation
1. Total view, SEM 60X
2. Aperture region with rugulate-foveolate sculpture, SEM 1800X

3—4. *Pleurostomella acuta* HANTKEN 1875
Budapest, bottom of the Kis Svábhegy hill, Buda Marl Formation
3. Total view, SEM 70X
4. View from above, with the aperture, SEM 100X

5—6. *Marginulina subbullata* HANTKEN 1875
Budapest, Kis Svábhegy hill, Buda Marl Formation
5. Total view, SEM 60X
6. View from above with the aperture, SEM 200X

Photo: MRS TAKÁCS and I. LAKY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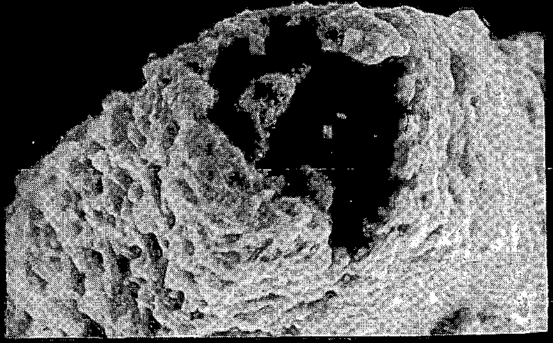
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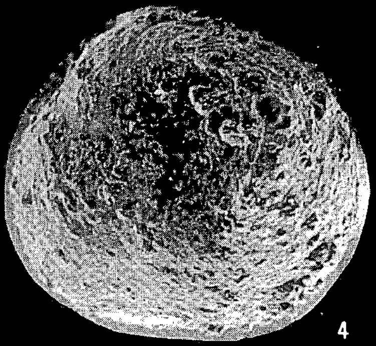
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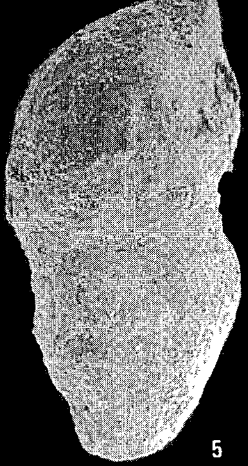
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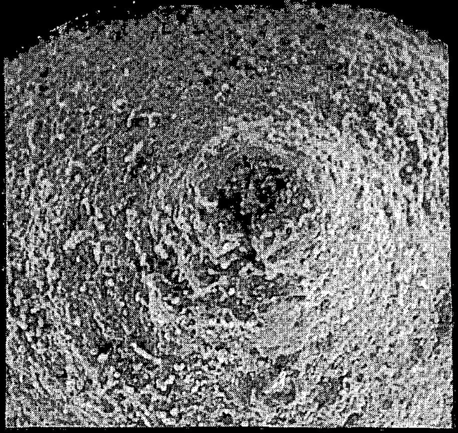
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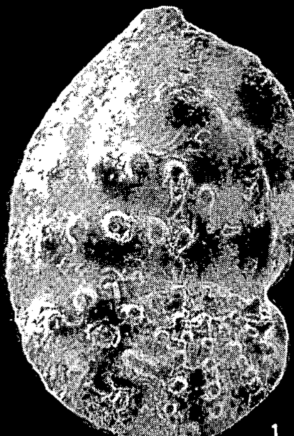
Plate VII

1—3. *Cristellaria granosa* HANTKEN 1871
Tokod, Esztergom
1. Total view with gemmate ornamentation arranged in rows, SEM 72X
2. Slightly tilted, SEM 72X
3. Aperture, SEM 300X

4. *Cristellaria porvaensis H*ANTKEN 1875
Porva
Total view, SEM 54X

5—6. *Cristellaria schwageri* HANTKEN 1875
Budapest, top of the Kis Svábhegy hill, Buda Marl Formation
5. Total view, SEM 26X
6. Slightly tilted, with the aperture, SEM 40X

Photo: MRS TAKÁCS and I. LAKY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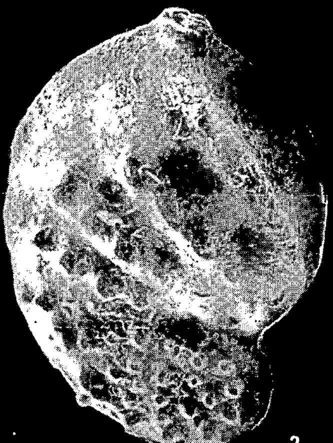
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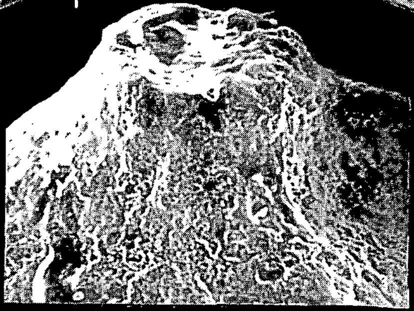
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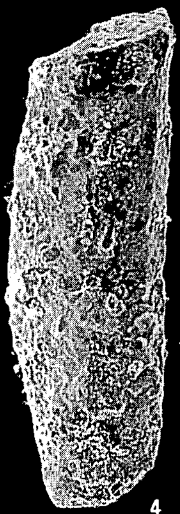
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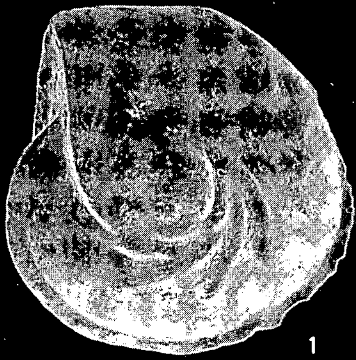
Plate VIII

1—3. *Robulina arcuatostriata* HANTKEN 1868
Budapest, Újlak, Kiscell Clay Formation
1. Total view, SEM 30X
2. Slightly tilted, SEM 30X
3. Detail of the central rib, SEM 72X

4—5. *Robulina budensis* HANTKEN 1875
Budapest, Újlak, Kiscell Clay Formation
4. Total view, SEM 30X
5. Lateral view, tilted, SEM 30X

Photo: MRS TAKÁCS and I. LAKY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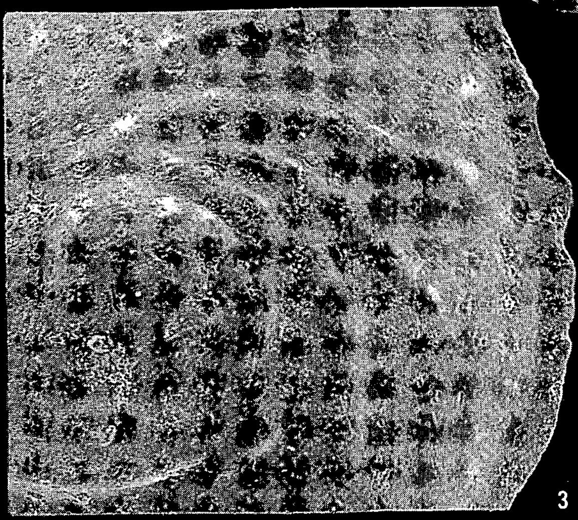
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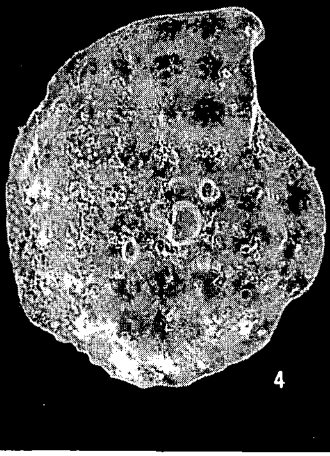
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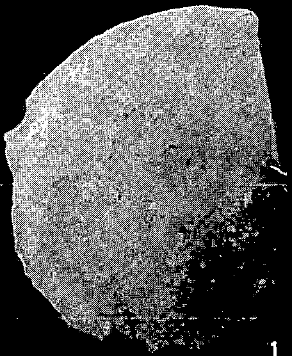
Plate IX

1—3. *Robulina kubinyii* HANTKEN 1868
Budapest, Újlak, Kiscell Clay Formation
1. Total view, SEM 20X
2. Total view (another specimen), SEM 20X
3. Aperture, SEM 1500X

4—5. *Robulina granulata* HANTKEN 1875
Porva
4. Total view, SEM 20X
5. Verrucate detail of the surface, SEM 600X

Photo: MRS TAKÁCS and I. LAKY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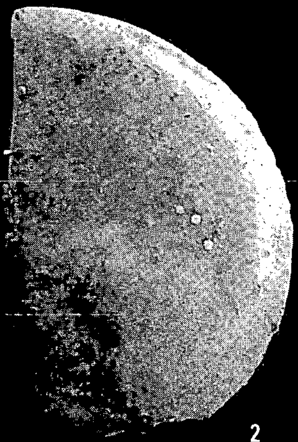
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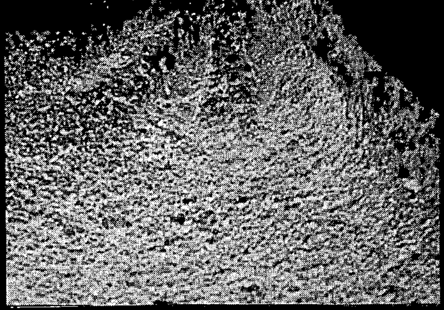
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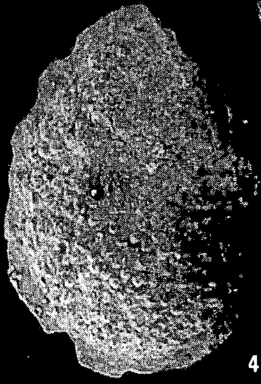
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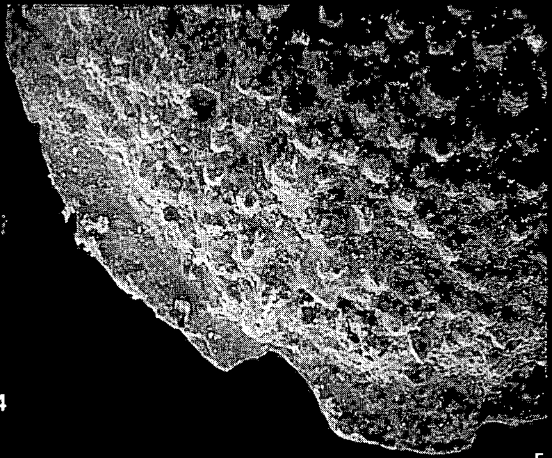
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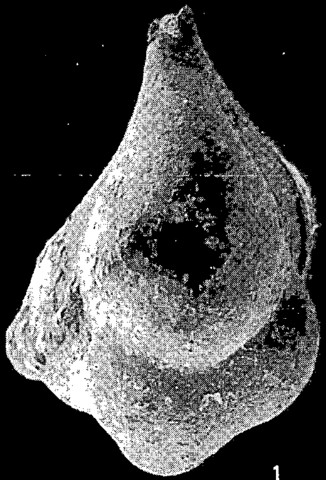
Plate X

1—2. *Polymorphina acuta* HANTKEN 1875
Kiscell Clay Formation
1. Total view, SEM 60X
2. View from above, with the aperture, SEM 400X

3—5. *Uvigerina farinosa* HANTKEN 1875
Budapest, Újlak, Kiscell Clay Formation
3. Total view with verrucate ornamentation, SEM 130X
4. Detail of the surface, SEM 540X
5. View from above, with the aperture, SEM 220X

Photo: MRS TAKÁCS and I. LAKY



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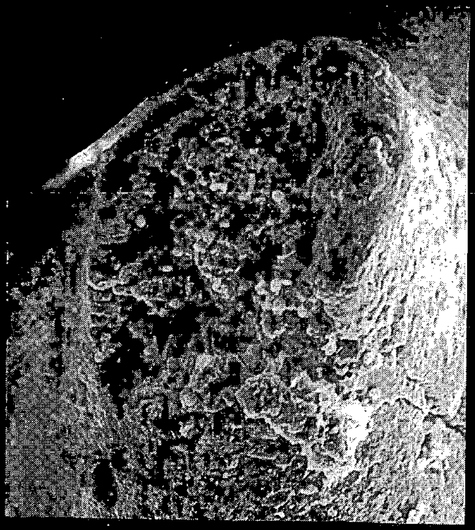

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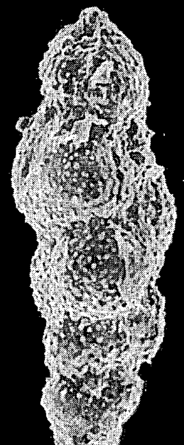

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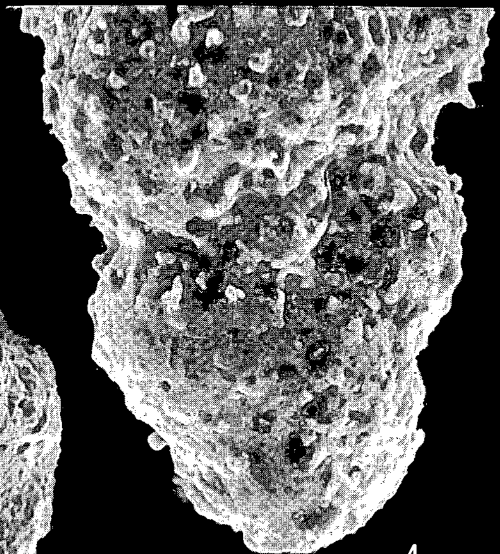

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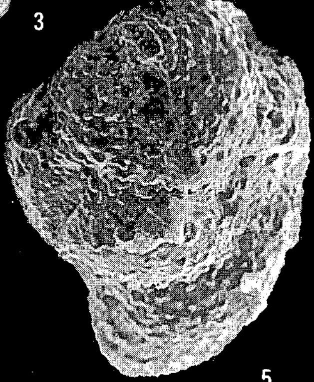

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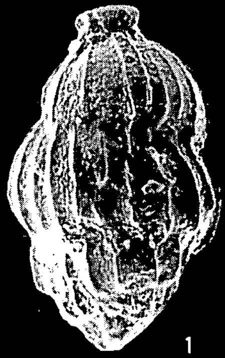
Plate XI

1—4. *Uvigerina multistriata* HANTKEN 1871
    Szt. Miklós, Komárom county
    1. Total view, SEM 100X
    2. Aperture, SEM 600X
    3. Detail with the ribs, SEM, 1000X
    4. Slightly tilted, with the aperture, SEM 150X

Photo: MRS TAKÁCS and I. LAKY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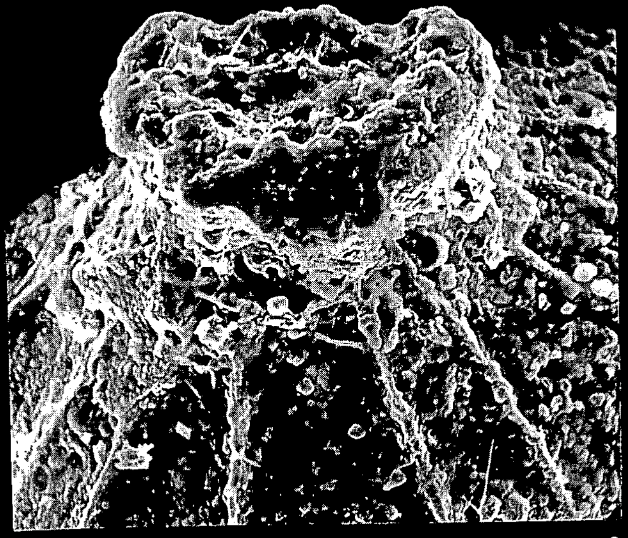
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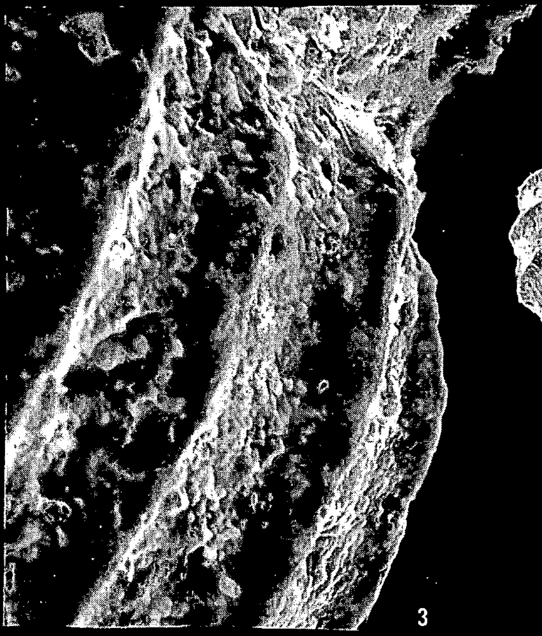
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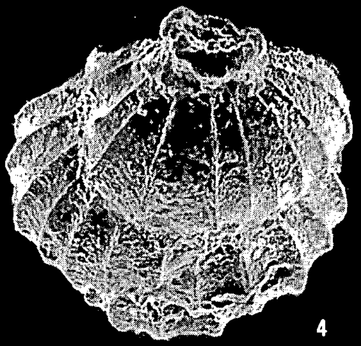
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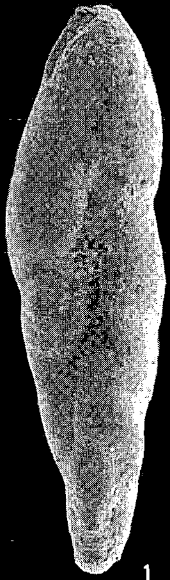
Plate XII

1. *Virgulina hungarica* HANTKEN 1871
   Dorog
   Total view, SEM 100X

2—5. *Dimorphina elegans* HANTKEN 1875
   Budapest, Újlak, Kiscell Clay Formation
   2. Total view, with the foveolate surface, SEM 100X
   3. View from above, with the aperture, SEM 200X
   4. The neck and the last chamber, SEM 300X
   5. Detail of the surface, SEM 3000X

Photo: MRS TAKÁCS and I. LAKY



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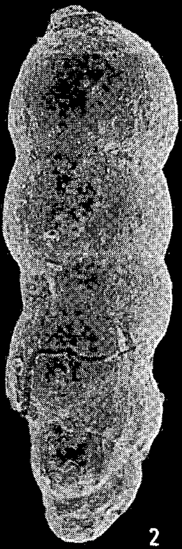

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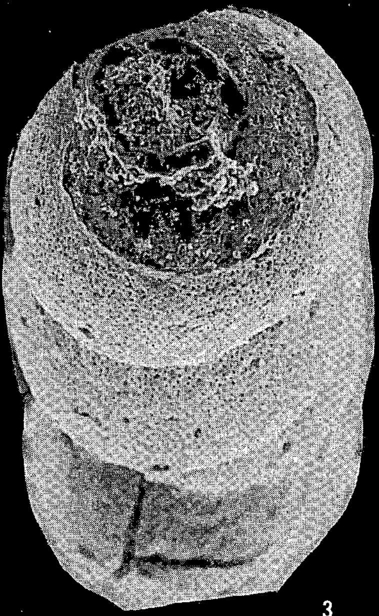

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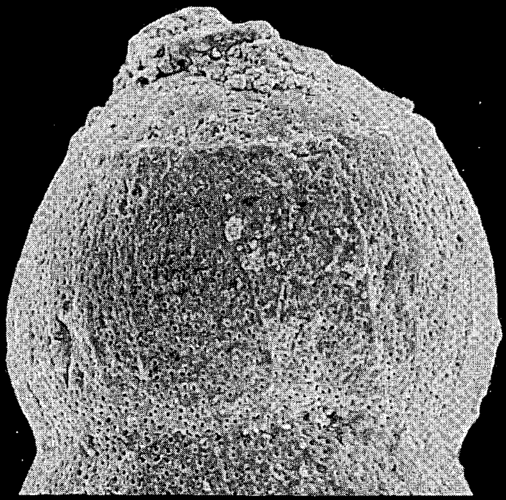

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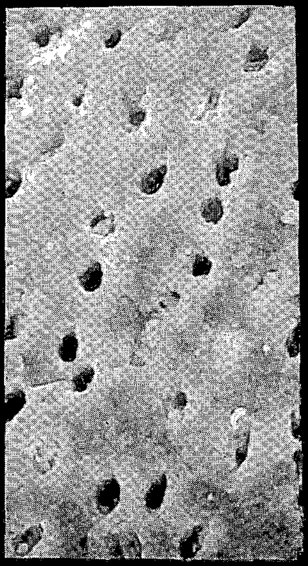

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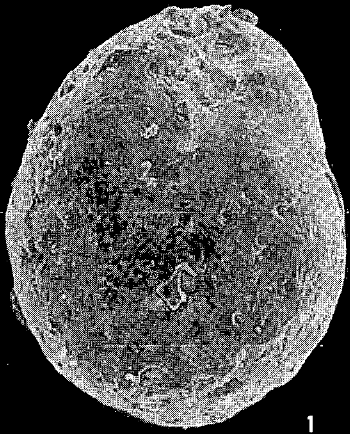
Plate XIII

1—2. *Cassidulina globosa* HANTKEN 1875
Budapest, Újlak, Kiscell Clay Formation
1. Total view, SEM 150X
2. View from above, with the aperture, SEM 150X

3—4. *Bolivina reticulata* HANTKEN 1875
Kiscell Clay Formation
3. Total view, SEM 60X
4. Environs of the aperture with foveolate surface, SEM 600X

5—6. *Bolivina elongata* HANTKEN 1875
5. Total view, with verrucate surface, SEM 86X
6. Aperture, SEM 260X

Photo: MRS TAKÁCS and I. LAKY



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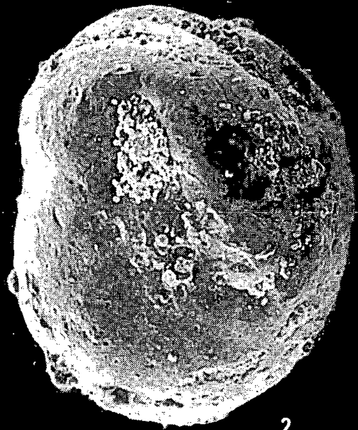

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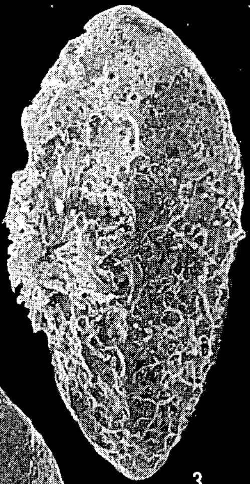

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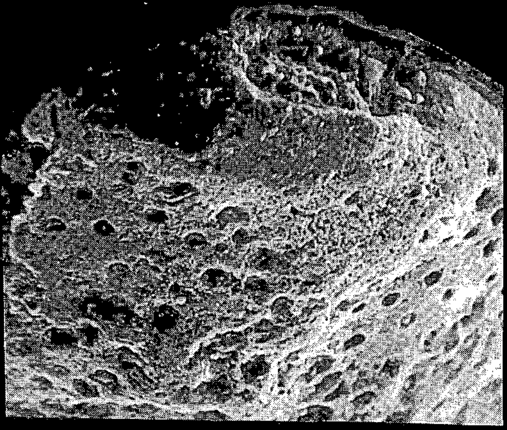

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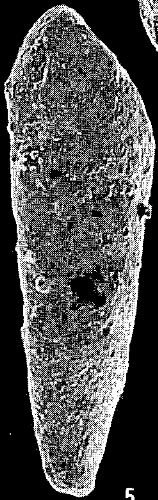

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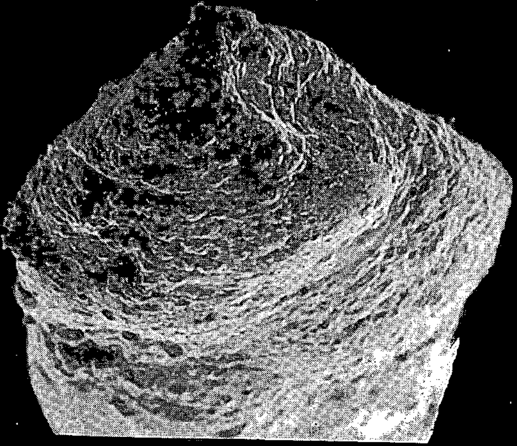

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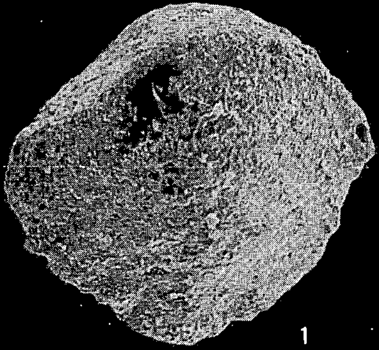
Plate XIV

1. *Textilaria subflabelliformis* HANTKEN 1868
   Budapest, top of the Kis Svábhegy hill, Buda Marl Formation
   Total view, SEM 60X

2—3. *Vulvulina pectinata* HANTKEN 1875
   Budapest, Újlak, Kiscell Clay Formation
   2. Total view, SEM 60X
   3. Slightly tilted, with the aperture, SEM 72X

4—5. *Vulvulina pectinata* HANTKEN 1875
   Budapest, Kis Svábhegy hill, Buda Marl Formation
   4. Total view, SEM 86X
   5. Lateral view, SEM 86X

Photo: MRS TAKÁCS and I. LAKY



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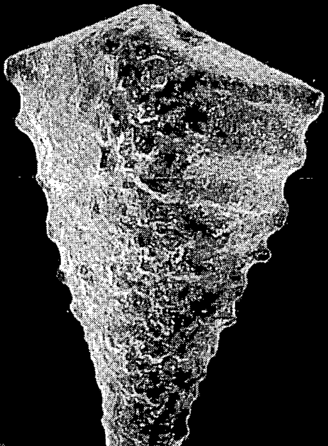

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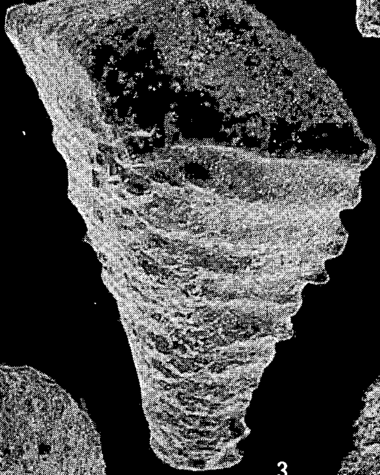

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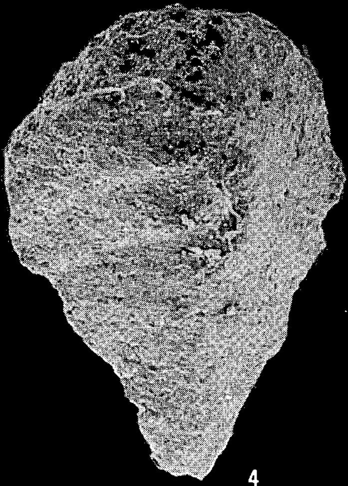

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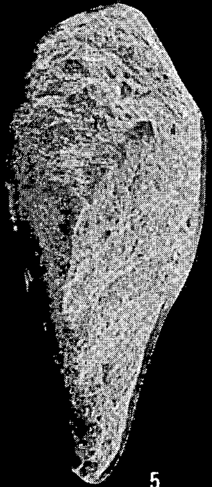

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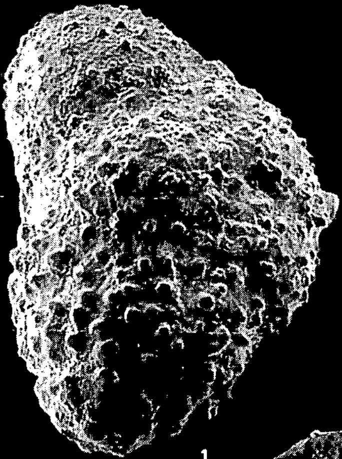
Plate XV

1. *Rhynchospira abnormis* HANTKEN 1875
   Budapest, bottom of the Kis Svábhegy hill, Buda Marl Formation
   Total view, with conate sculpture, SEM 30X

2—4. *Truncatulina conica* HANTKEN 1871
   Dorog
   2. Total view, coil side, SEM 100X
   3. Total view, umbilical side, SEM 100X
   4. Foveolate detail of the surface, SEM 1500X

Photo: MRS TAKÁCS and I. LAKY



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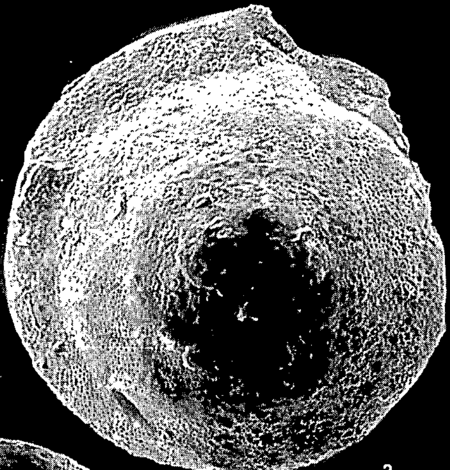

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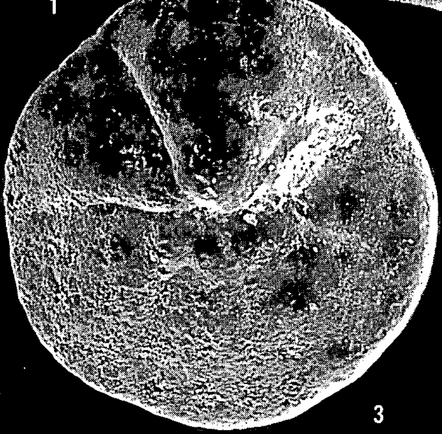

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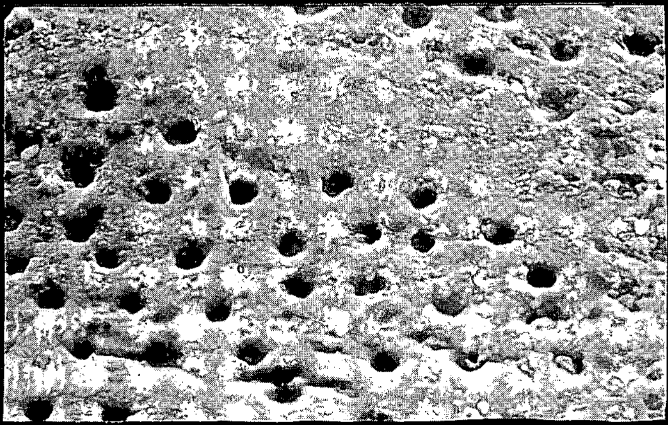

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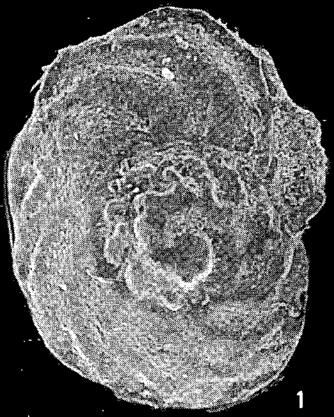
Plate XVI

1—6. *Truncatulina costata* HANTKEN 1875
Budapest, Újlak, Kiscell Clay Formation
1. Total view, coil side, SEM 60X
2. Total view, umbilical side, SEM 60X
3. Aperture, SEM 480X
4. Slightly tilted, with the aperture, SEM 60X
5. Detail of the surface with ribs and the foveoles, SEM 300X
6. A negative reticulate detail of the surface with the foveoles and the microconids, SEM 10,000X

Photo: MRS TAKÁCS and I. LAKY



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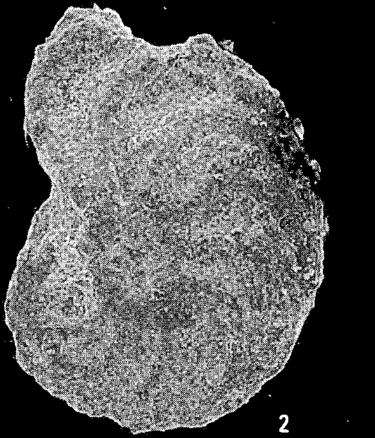

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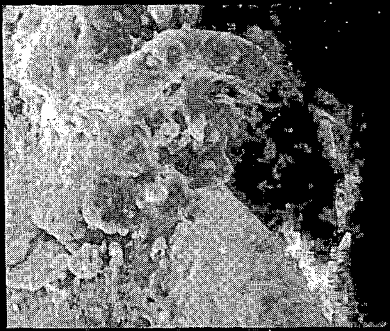

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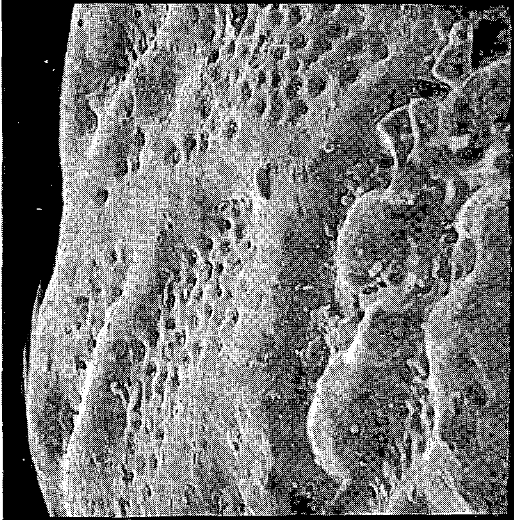

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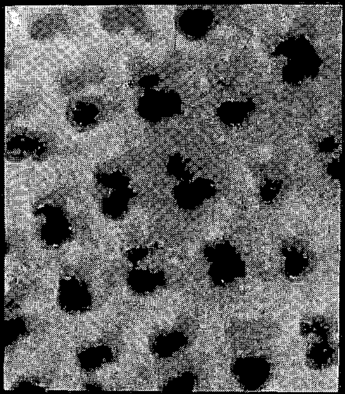

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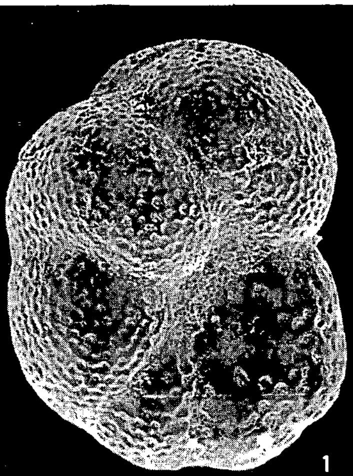
Plate XVII

1—5. *Truncatulina granosa* HANTKEN 1875
    Budapest, bottom of the Kis Svábhegy hill, Buda Marl Formation
    1. Total view, coil side, SEM 60X
    2. Total view, umbilical side, SEM 60X
    3. Coil side, slightly tilted, SEM 60X
    4. Umbilical side, slightly tilted, SEM 60X
    5. Detail of the surface with perforate foveoles, SEM 200X

Photo: MRS TAKÁCS and I. LAKY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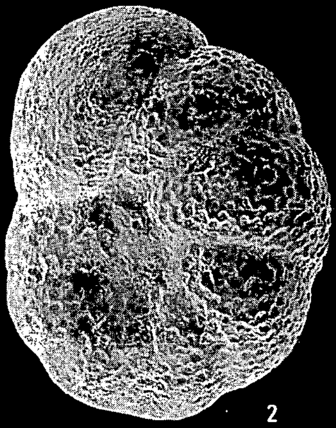
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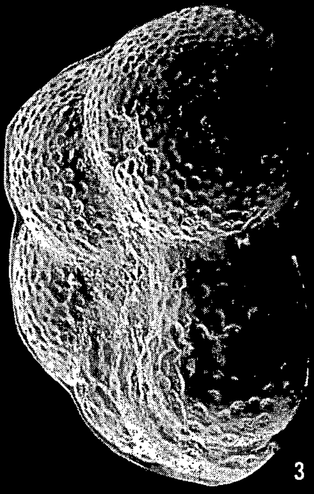
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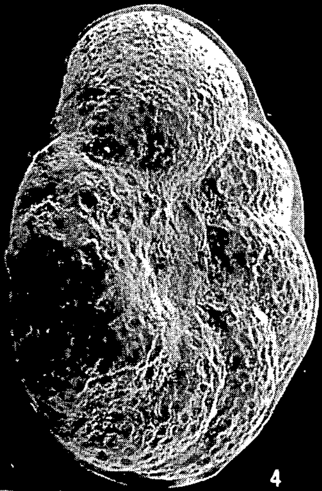
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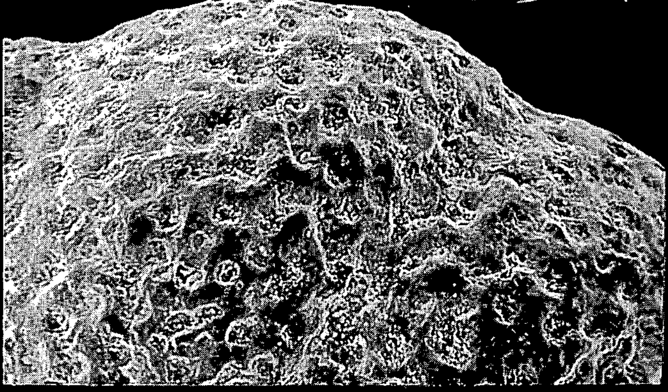
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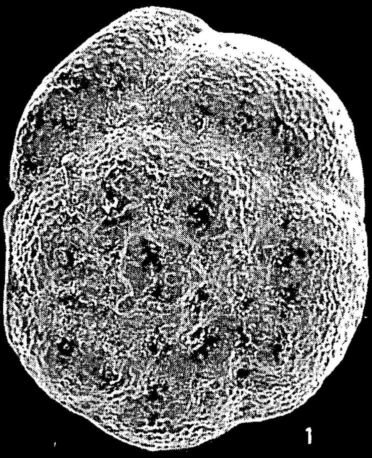
Plate XVIII

1—4. *Truncatulina granosa* Hantken 1875
Budapest, bottom of the Kis Svábhegy hill, Buda Marl Formation
1. Total view, coil side, SEM 60X
2. Total view, coil side, slightly tilted SEM 60X
3. Total view, umbilical side, SEM 60X
4. Environs of the aperture with perforate foveolate surface, lateral view, SEM 150X

5. *Nummulites budensis* Hantken 1875
Budapest, Kis Svábhegy hill, Buda Marl Formation
Total view, SEM 40X

Photo: Mrs Takács and I. Laky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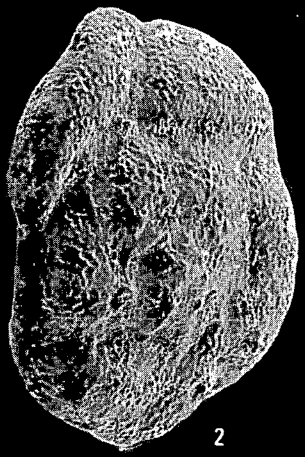
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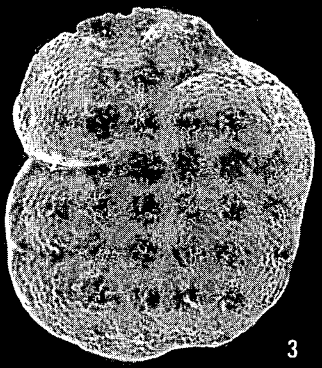
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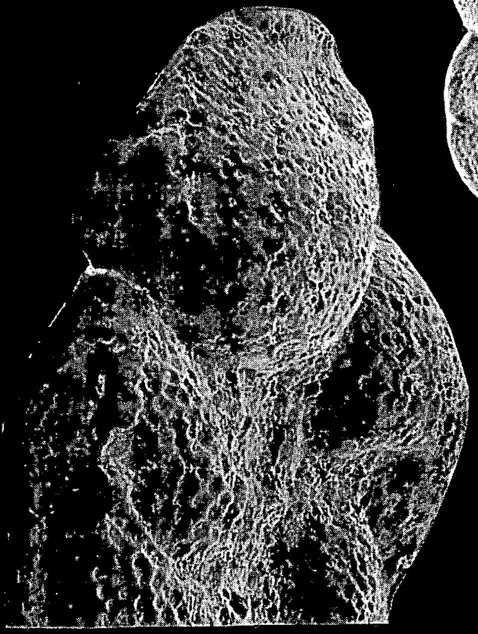
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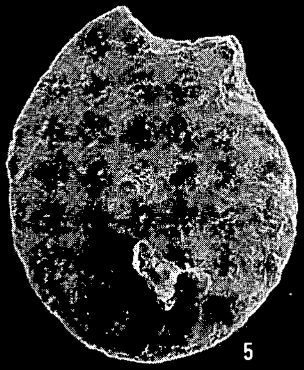
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FORAMINIFERA FAUNA OF THE POLÁNY MARL FORMATION, RENDEK MEMBER AT MAGYARPOLÁNY

by
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Keywords: biostratigraphy, microfacies, Foraminifera, Upper Cretaceous, Senonian, Campanian, Polány Marl Formation, Rendek Member, Magyarpolány (Transdanubian Central Range, Hungary)

The argillaceous limestone and calcareous marl samples from the Magyarpolány outcrop belong to the Rendek Member of the Polány Marl Formation. The Rendek Member forms a transition between the shallow marine Ugod Limestone Formation and the pelagic Polány Marl Formation. This carbonate member contains plankton and benthos Foraminifera, Inoceramus prisms, Echinodermata spines and fragments, indicating shallow, but open marine environment of normal salinity. Plankton foraminifers, as *Globotruncanita elevata* (BROTZEN), *Globotruncana ventricosa* WHITE, *Globotruncanita stuarti* (DE LAPPARENT), *Globotruncanella* cf. *havanensis* (VOORWIJK) indicate deposits belonging to end of the *Globotruncana ventricosa* Interval zone, and possibly to the initial part of the *Globotruncanita calcarata* Total range zone. The member is not younger than early Upper Campanian.

History of investigations

More than hundred years ago M. HANTKEN (1884) mentioned the species *Rosalina canaliculata* REUSS (now Dicarinella) from the Inoceramus marl at Magyarpolány, and ranged the sequence into the Upper Cretaceous. He has recognized the stratigraphic significance of this species and applied it for correlation with the Scaglia near Padova (outcrops at Colli Euganea). Later S. JASKÓ (1935), K. BARNABÁS (1937), and L. MAJZON (1956, 1961, 1966) published data on the Foraminifera fauna. MAJZON (1961) registered more than hundred taxa, determined at the species level, and discussed synonyms and taxonomy. Biostratigraphic subdivision of the Hungarian Senonian formations—among others of the Polány Marl—was made by M. SIDÓ (1963).

J. HAAS (1979) as well as HAAS and E. JOCHA-EDELÉNYI (in HAAS et al. 1984) erected the Rendek Member for the lower part of the Polány Marl Formation, made of argillaceous limestone and calcareous marl, and published the results of a complex investigation.

F. GÓCZÁN (1988) organized the investigation of the outcrop in front of the village church at Magyarpolány, to present the Rendek Member for the participants of the International Micropalaeontological Colloquium in Budapest.

Results

The following Foraminifera fauna has been determined from washing residue:

Plankton

Globotruncana arca (CUSHMAN), *Globotruncana bulloides* VOGLER, *Globotruncana lapparenti* BROTZEN, *Globotruncana linneiana* (D'ORBIGNY), *Globotruncana ventricosa* WHITE, *Globotruncana* cf. *ventricosa* WHITE, *Globotruncanita elevata* (BROTZEN), *Globotruncanita stuartiformis* (DALBIEZ), *Globotruncanita* aff. *stuarti* (DE LAPPARENT), *Rosita fornicata* (PLUMMER)—*Rosita contusa* (CUSHMAN) transitional form, *Rosita fornicata* (PLUMMER), *Hedbergella holmdelensis* OLSSON, *Heterohelix striata* (EHRENBERG).

Benthos

Ataxophragmium crassum (D'ORBIGNY), *Ataxophragmium variabile* (D'ORBIGNY), *Arenobulimina preslii* (REUSS), *Arenobulimina murchisoniana* (REUSS), *Astacolus* sp., *Cibicides stephensoni* CUSHMAN, *Cibicides constrictus* (HAGENOW), *Dorothia pupa* (REUSS), *Dentalina concinna* (REUSS), *Dentalina communis* (D'ORBIGNY), *Eggerella trochoides* REUSS, *Frondicularia* sp., *Gavellinella clementiana* (D'ORBIGNY), *Gavellinella* sp., *Globorotalites conicus* (CARSEY), *Globorotalites* sp., *Globulina lacrima* (REUSS), *Globulina prisca* (REUSS), *Haplophragmoides rugosus* CUSHMAN et WHITE, *Marssonella oxycona* (REUSS), *Nodosaria* sp., *Praebulimina carseyae* (PLUMMER), *Reusella szajnochae* (GRZYBOWSKI), *Spiroplectammina laevis* (ROEMER) var. *cretosa* CUSHMAN, *Stensioeina excolata* CUSHMAN, *Tritaxia pyramidata* (REUSS), *Tritaxia tricarinata* (REUSS), *Tritaxia plummerae* CUSHMAN, *Textularia agglutinans* D'ORBIGNY, *Textularia subconica* FRANKE, *Bulimina ovulum* REUSS, *Lenticulina muensteri* ROEMER, *Lenticulina rotulata* (LAMARCK).

Plankton foraminifers found in thin sections, one or two in each, are grouped by their species ranges after CARON (1985).

Forms ranging through the Campanian Stage: *Globotruncana arca* (CUSHMAN), *Globotruncana bulloides* VOGLER, *Globotruncana lapparenti* BROTZEN, *Heterohelix globulosa* (EHRENBERG), *Archaeoglobigerina* cf. *blowi* PESSAGNO, *Archaeoglobigerina* sp., *Rosita fornicata* (PLUMMER), *Globigerinelloides* cf. *prairiehillensis* PESSAGNO, *Globigerinelloides* sp., *Globotruncana* cf. *linneiana* (D'ORBIGNY).

Forms appearing in the *Globotruncana ventricosa* Interval zone: *Globotruncana* cf. *ventricosa* WHITE, *Pseudotextularia* cf. *elegans* (RZEHAK).

Forms disappearing in the *Globotruncanita calcarata* Total range zone: *Globotruncanita* cf. *elevata* (BROTZEN).

Forms appearing in the *Globotruncanita calcarata* Total range zone: *Globotruncana* cf. *falsostuarti* SIGAL, *Globotruncanella* cf *havanensis* (VOORWIJK), *Globotruncanita stuarti* (DE LAPPARENT).

Forms disappearing in Middle Campanian Substage (after POSTUMA 1974): *Globotruncana* aff. *carinata* DALBIEZ, *Globotruncana* cf. *angusticarinata* GANDOLFI.

Benthos forms found very rarely in thin sections: *Dorothia* cf. *pupa* (REUSS), *Reusella szajnochae* (GRZYBOWSKI), *Eponides* sp., *Bolivina* sp.

Biostratigraphic interpretation

Three Foraminifera Taxon zones can be defined in the Campanian Stage after the plankton foraminifer stratigraphy of CARON (1985):

— *Globotruncanita calcarata* Total range zone,
— *Globotruncana ventricosa* Interval zone,
— *Globotruncanita elevata* Partial range zone.

The plankton foraminifers determined from washing residues indicate that the investigated samples should be ranged into the *Globotruncana ventricosa* Interval zone of the Campanian Stage, as indicated by the common occurrence of *Globotruncana ventricosa* WHITE and *Globotruncanita elevata* (BROTZEN). We have investigated a few samples only, therefore we cannot disregard the oral communication of F. GÓCZÁN, that the *Globotruncanita calcarata* Upper Campanian zonal index form is extremely rare in Magyarpolány, especially in the lower part of the *Globtruncanita calcarata* Total range zone. Therefore we cannot exclude with high certainty a younger Upper Campanian age for our samples.

Plankton foraminifers observed in thin sections: *Globotruncanita stuarti* (DE LAPPARENT), *Globotruncanella* cf. *havanensis* (VOORWIJK), and *Globotruncanita* cf. *elevata* (BROTZEN) indicate the *Globotruncanita calcarata* Total range zone of the Upper Campanian stage.

Nannoplankton studies of L. FÉLEGYHÁZY (in GÓCZÁN et al. 1988) ranged the samples into the Sissingh CC 21 zone, as "lower—middle part of Upper Campanian". The CC 21 *Quadrum sissinghii* nannoplankton zone can be correlated with the upper part of the *Globotruncana ventricosa* Interval zone and with the lower part of the *Globotruncanita calcarata* Total range zone.

Microfacies and environment

The examined rock is foraminifer biomicrite, biomicrosparite. The texture is wackestone. The matrix is micrite, or recrystallized microsparite. The ratio of components is 15%, the intact biogenic components do not exceed 10%. There are some Mollusca fragments, some Echinodermata spines and fragments, and a few Ostracoda valves beside Inoceramus prisms. Characteristic foraminifers are plankton and benthos forms, with a ratio of 5:1. The occurrence of plankton forms indicate open marine environment of normal salinity. There are 1—2 Calcisphaerulas in each thin section, also indicating open marine environment. According to the energy index of PLUMLEY (in FLÜGEL 1978) which is III, poorly agitated water is verifiable for the depositional basin.

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Plate I

1—3. *Globotruncana bulloides* VOGLER
  1. spiral view
  2. umbilical view
  3. lateral view

4—5. *Globotruncana arca* (CUSHMAN)
  4. spiral view
  5. lateral view

6—7. *Globotruncanita* aff. *stuarti* (DE LAPPARENT)
  6. spiral view
  7. lateral view

1—7.: SEM 80X


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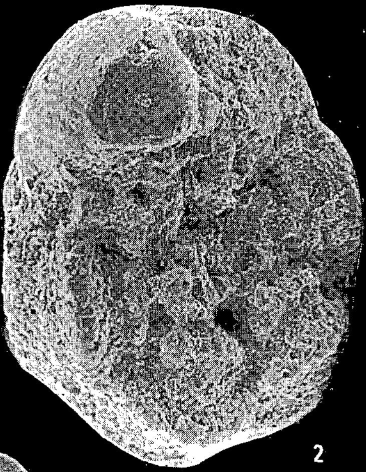
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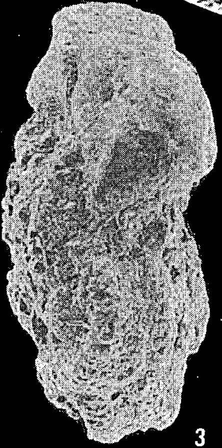
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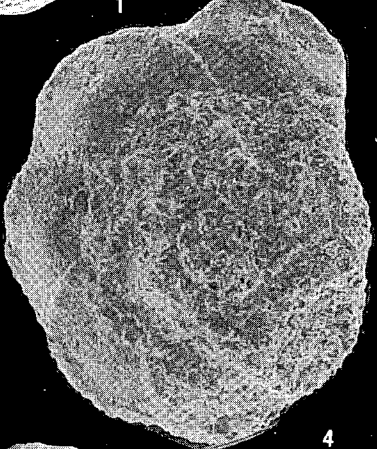
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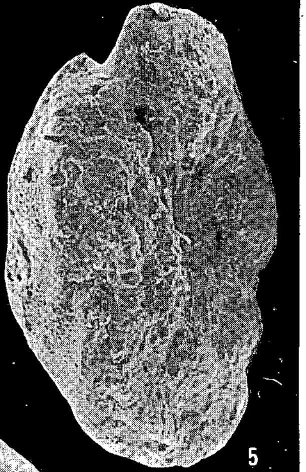
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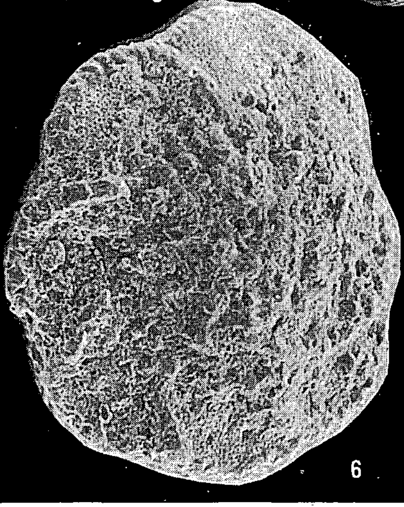
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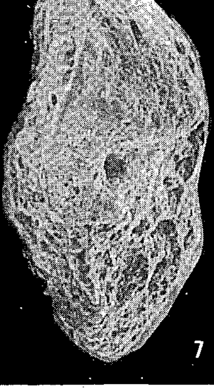
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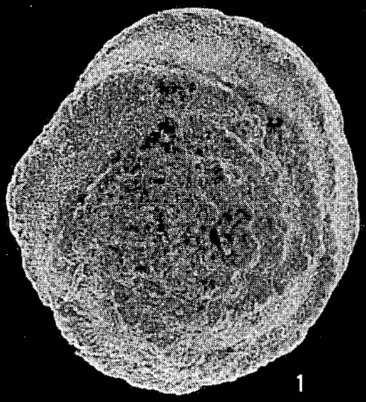
Plate II

1—2. *Rosita fornicata* (PLUMMER)
  1. spiral view
  2. lateral view

3—4. *Rosita fornicata* (PLUMMER)—*Rosita contusa* (CUSHMAN) transitional forms
  3. spiral view
  4. lateral view

5—6. *Globotruncanita stuartiformis* (DALBIEZ)
  5. spiral view
  6. lateral view

1—2.: SEM 100X
3—4.: SEM 80X
5—6.: SEM 90X



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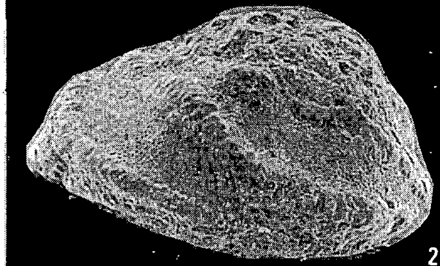

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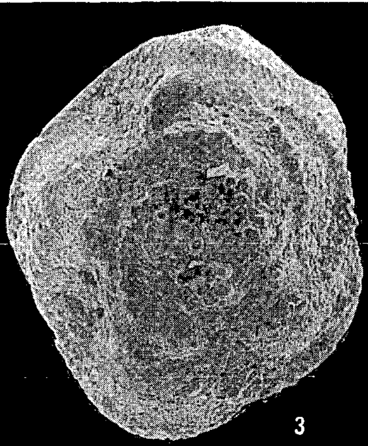

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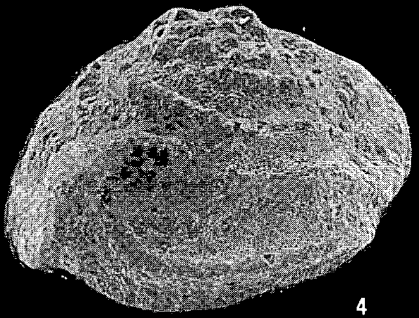

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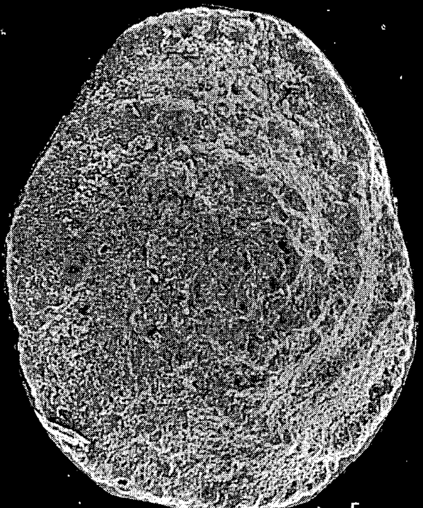

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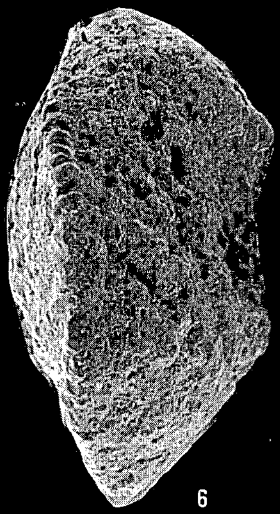

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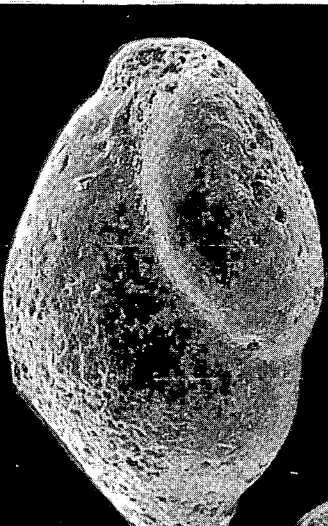
Plate III

1—2. *Praebulimina carseyae* (PLUMMER)
lateral views, with aperture in Fig. 1

3—4. *Gavelinella* sp.
  3. spiral view
  4. lateral view

5—6. *Globorotalites conicus* (CARSEY)
  5. lateral view
  6. spiral view

1—2.: SEM 90X
3—4.: SEM 65X
5—6.: SEM 75X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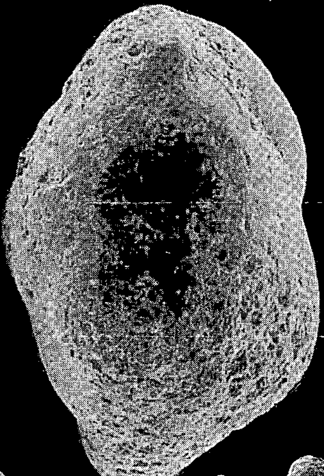
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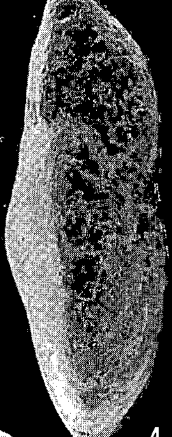
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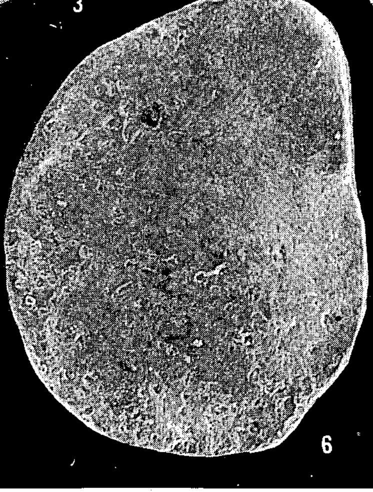
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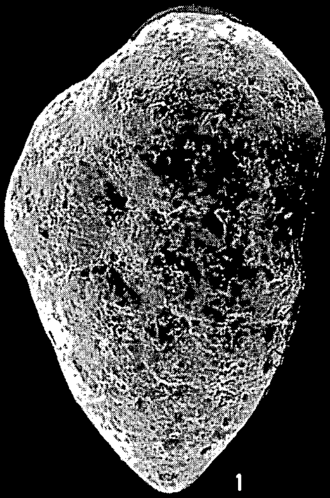
Plate IV

1, 4. *Dorothia pupa* (REUSS)
  1. lateral view
  2. apertural view

2. *Ataxophragmium variabile* (D'ORBIGNY)
lateral view

3. *Ataxophragmium crassum* (D'ORBIGNY)
lateral view

1—4.: SEM 60X



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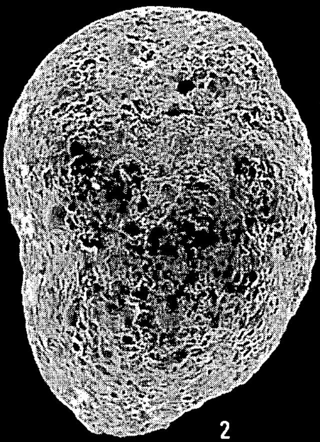

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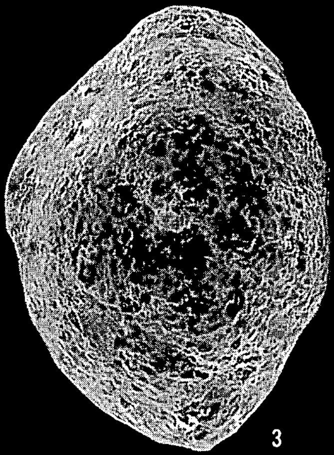

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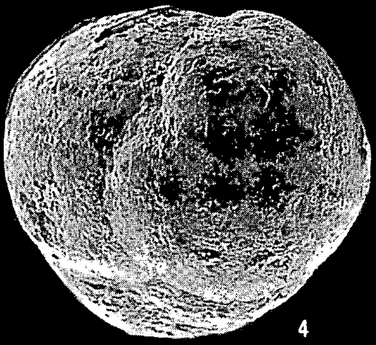

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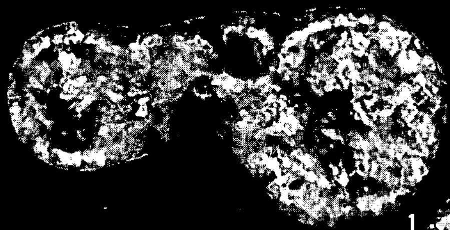
Plate V

1. *Hedbergella* sp.
2. *Globotruncana lapparenti* BROTZEN
3. *Globotruncana arca* (CUSHMAN)
4. *Archaeglobigerina* sp.
5. *Globotruncanita stuarti* (DE LAPPARENT)
6. *Dorothia* cf. *pupa* (REUSS)
7. *Globotruncana bulloides* VOGLER
8. *Rosita fornicata* (PLUMMER)

1., 4.: 275X
2.: 150X
3., 8.: 140X
5.: 80X
6.: 60X
7.: 160X



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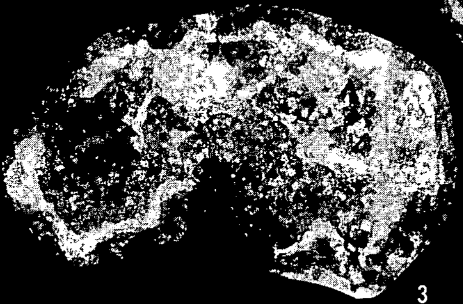

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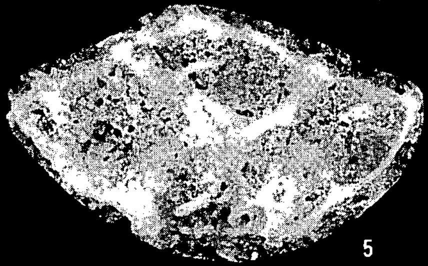

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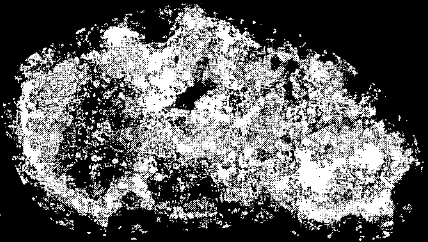

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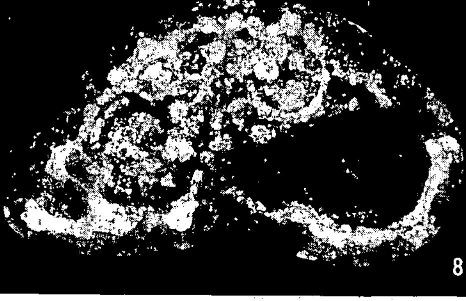

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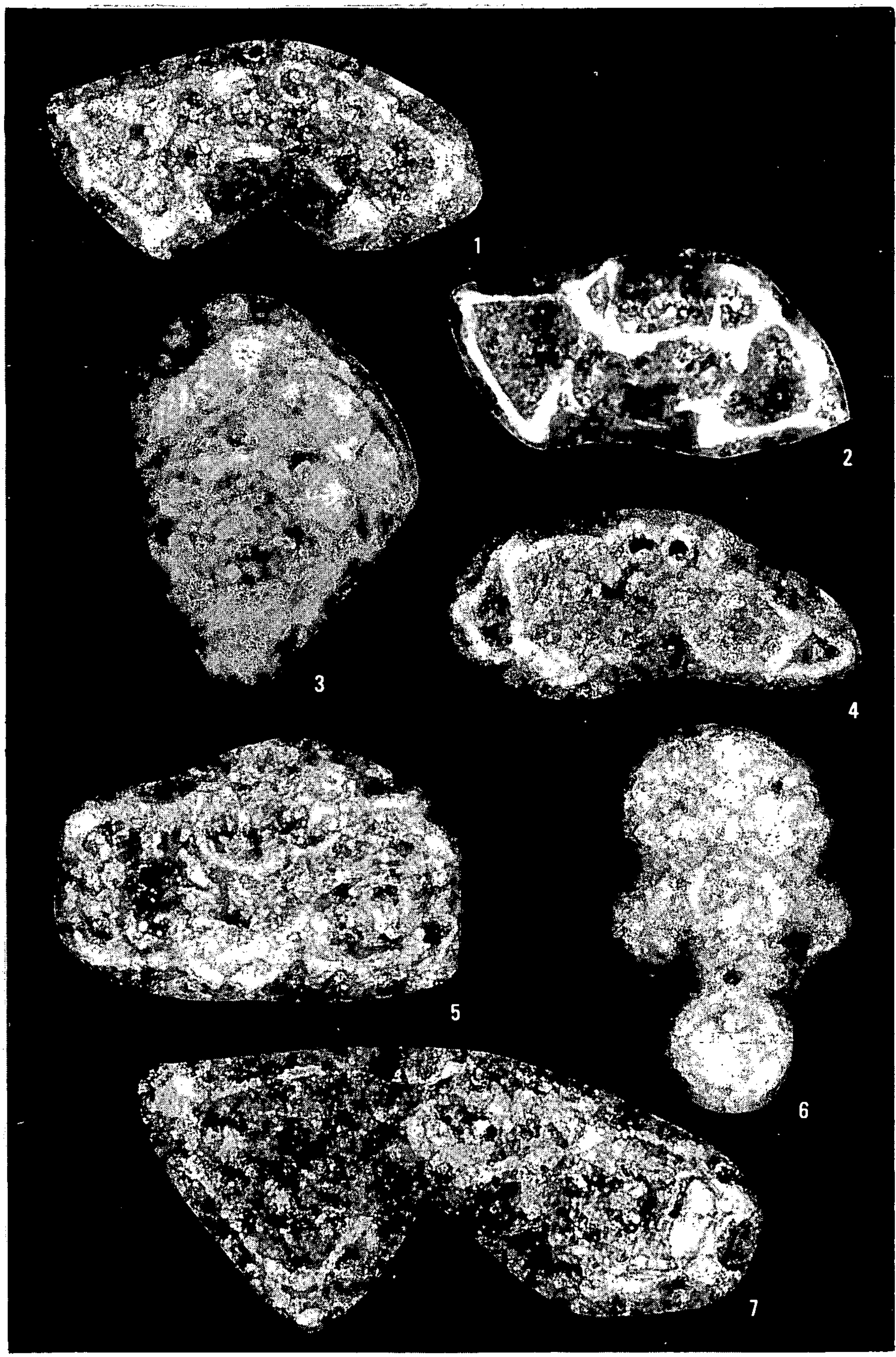
Plate VI

1. *Globotruncana* cf. *angusticarinata* GANDOLFI
2. *Globotruncanita* cf. *elevata* (BROTZEN)
3. *Reusella szajnochae* (GRZYBOWSKI)
4. *Globotruncanella* cf. *havanensis* (VOORWIJK)
5. *Globotruncana* cf. *linneiana* (D'ORBIGNY)
6. *Globigerinelloides* sp.
7. *Globotruncana* cf. *ventricosa* WHITE

1., 4.: 140X
2.: 90X
3., 6., 7.: 160X
5.: 180X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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II. RÉSZ (1989)

TRIASSIC RADIOLARIANS FROM DALLAPUSZTA (MOUNT DARNÓ, N HUNGARY)

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UDC: 563.14(439.13)

Keywords: stratigraphy, Radiolaria, new taxa, Triassic, Mt. Darnó (N Hungary)

The age of the red radiolarite located at the flanks of Mount Darnó could be refined on the basis of the Radiolaria fauna. Within the sequence, a change in the fauna could be observed. There were separated from assemblage two subspecies of the species *Sarla kretaensis* KOZUR and KRAHL.

The radiolarite outcrop of Dallapuszta is located between Recsk and Sirok by the road No. 24, at the southern flanks of the Mt. Darnó (Fig. 1). The stratified, red radiolarite can be observed in a length of 10 metres within the outcrop (Fig. 2). The thickness of the beds is varying between 10—40 cm. The outcrop was systematically sampled along its whole length. 24 samples were prepared from the material, using 5% HF acid. With the exception of two samples only, all of the samples yielded radiolarians. The distribution of the radiolarians within the rock is uneven. Typically they are accumulated in thin stripes, lenses. During the solution we could observe that a part of the radiolarians were already injured. A frequent type of injury is the lack or break-off of spines and arms. These facts seem to indicate that the radiolarians were partly washed together by bottom currents.

Radiolarians of the concerned section had formerly been studied by P. DE WEVER and H. KOZUR. H. KOZUR has mentioned from the section the presence of the species *Sarla kretaensis* as well as conodonts indicating Late Longobardian age (H. KOZUR—J. KRAHL 1984). P. DE WEVER examined 13 samples from the section, comprising only 3 "positive" ones. In his article (P. DE WEVER 1984), a list of the radiolarian fauna recovered is published, including 12 species of 10 genera. The author, however was able to find merely 9 species of 12 genera. Comparing the two faunal lists we find only 4 genera and 2 species in common. Especially remarkable is the great difference encountered in the representatives of the subfamily of Oertlisponginae. P. DE WEVER published 7 species of genera assigned to this taxon, while the investigations of the author resulted in finding only some badly preserved specimens of the species *Spongoserrula rarauna* DUMITRICA (Table 1).

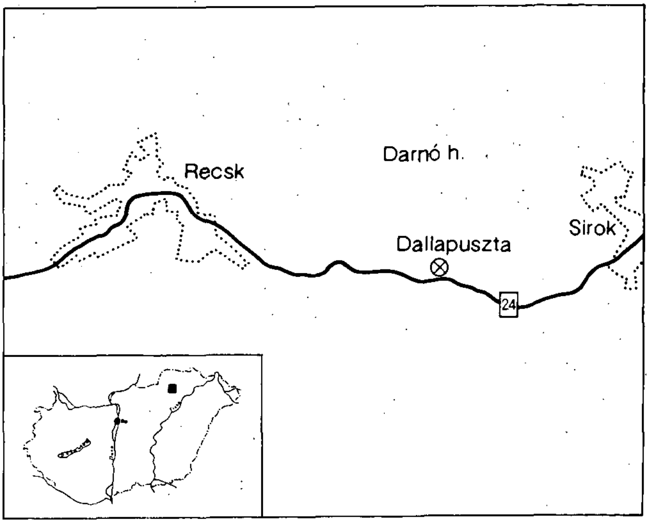

Fig. 1. Location of the Dallapuszta outcrop

Fig. 2. Recsk, Dallapuszta radiolarite outcrop
* = layer 14

Table 1

Radiolarian fauna of the Dallapuszta radiolarite section

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Astrocentrus sp.												+														+		
Canoptum sp.				+		+						+			+		+				+		+					+
Capnuchosphaera sp.				+				+		+		+		+				+		+							+	
Cenosphaera sp.	+					+				+		+		+	+	+	+	+		+	+	+	+	+	+	+	+	+
Nakasekoellus polita (HINDE)												+		+	+			+				+						
Plafkerium cochleata (NAKASEKO et NISHIMURA)	+	+		+		+		+		+		+		+														
Poulpus sp.						+		+																				
Pseudostylosphaera coccostyla (RÜST)	+			+		+																						
Pseudostylosphaera helicanta (NAKASEKO et NISHIMURA)	+	+		+		+		+		+		+		+	+	+	+				+	+		+	+	+	+	
Sarla kretaensis kretaensis KOZUR et KRAHL										+		+		+	+	+	+	+		+	+	+			+		+	
Sarla kretaensis robusta DOSZTÁLY	+	+		+		+		+				+		+	+	+		+		+	+	+	+	+	+		+	
Spongoserrula rarauna DUMITRICA	+			+										+				+										
Spongostylus tortilis KOZUR et MOSTLER		+										+						+										
Triassocampe sp.	+	+		+		+		+		+		+		+	+	+	+	+		+	+	+	+	+	+	+	+	+
Triassocampe deweveri (NAKASEKO et NISHIMURA)		+		+		+				+					+													
Triassocampe sulovense KOZUR et MOCK										+																		

On the whole we can mention that the radiolarian fauna is dominated by massive, robust species. In the sequence a considerable change within the fauna could be observed.

At the lower parts of the section, representatives of the species *Plafkerium cochleata* are fairly frequent (Plate I, figs. 1, 2, 3). After layer 14, however, none of this species were found. On the other hand, in bed 10 variants of *Sarla kretaensis* are present, as identifiable with the holotype (Plate I, figs 3, 4). These are getting more and more frequent towards the upper part section. It should be noted, however, that a short-armed subspecies of *Sarla kretaensis* appears as deeply as in layer 1, and is dominating the lower part of the sequence (Plate I, figs. 1, 2). Forms intermediate between the two types are encountered starting from layer 4 upwards through the whole sequence.

The age of the formation

The age of the formation, on the basis of the radiolarians, is Upper Ladinian. The faunal change observed within the section offered the possibility of a more precise dating. Accordingly, the lower part of the sequence can be dated to the Middle Longobardian, on the basis of the presence of the species *Plafkerium cochleata*, while the upper part can be put, by the presence of subspecies *Sarla kretaensis kretaensis* to the Upper Longobardian. This conclusion seems to be supported by the Conodonta studies of H. KOZUR (H. KOZUR—J. KRAHL 1984) as well. There were certain taxa spotted in the sequence which are frequently met in the Karnian stage like *Spongostylus tortilis* (Plate I, fig. 5) and *Capnuchosphaera* sp. (Plate II, fig. 4.). In spite of the fact that these species are characteristic of the Karnian and Norian stages they are known to appear as early as in late Ladinian time.

Palaeontological description

Phylum: Protozoa
Classis: Reticularia
Subclassis: Radiolaria
Ordo: Polycystina
Subordo: Spumellaria
Familia: Capnuchosphaeridae DE WEVER emend KOZUR et MOSTLER 1979
Genus: Sarla PESSAGNO 1979
Genus typus: *Sarla prietoensis* PESSAGNO 1979

Sarla kretaensis kretaensis KOZUR et KRAHL 1984
(Plate I, figs. 3—4)

1984. *Sarla kretaensis* n. sp. KOZUR et KRAHL p. 401—403, pl. 1., figs. 3—4.
1984. *Sepsagon longispinosus* (KOZUR et MOSTLER): DE WEVER p. 305, pl. 1, fig. 6; pl. 3, fig. 7.
1988. *Sarla kretaensis* KOZUR et KRAHL: CORDEY et al. p. 34; pl. 2, fig. 9—11.

Description: The form of the cortical test is nearly globular, slightly ovaloid. The interior layer consists of small polygonal pores. The secondary exterior test has bigger pores. At the joints of the bars connecting the pores there are noduses situated. On the cortical test there are three long primary spines, lying in the same plane. One of the spines is straight, the other two are twisted. The straight one is slightly thickened at the medial parts. All of the spines are built up of three ribs, dissected by deep depressions implying the presence of six ribs.

The ratio of the length of the arms compared to the diameter of the test is more than 2. The ratio of the length of the arms compared to their width is generally surpassing 4.

Distribution: Crete (Greece), British Columbia (Canada), Dallapuszta (Mt. Darnó, N Hungary).

Sarla kretaensis robusta n. ssp.
(Plate I, figs. 1—2)

1988 *Sarla kretaensis* KOZUR et KRAHL 1988. CORDEY et al. p. 34., pl. 2, fig. 7.

Derivatio nominis: named after its bulky, robust construction.
Holotype: Triassic Collection of the Hungarian Geological Survey, inv. T6343 (Plate I. fig. 1).
Locus typicus: Dallapuszta (Recsk), layer 1.
Stratum typicum: Middle Triassic, Longobardian Stage.

Description: The cortical test agrees with that of the type species. The three primary spines are placed in one plane. The spines are thick and bulky. One of the spines is straight while the others are twisted. The diameter of the spines is of uniform thickness till the very end of the spines. It can be differentiated from the species *Eptingium manfredi robustum* KOZUR et MOSTLER by the exterior layer and the existence of the noduses.

Distribution: British Columbia (Canada), Dallapuszta (Mt. Darnó, N Hungary).

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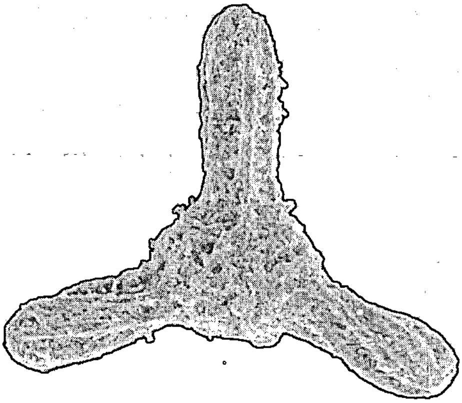
DE WEVER P. 1984: Triassic radiolarians from the Darnó area (Hungary). — Acta Geol. Hung. 27 (3—4): 295—306.

KOZUR H.—KRAHL J. 1984: Erster Nachweiss triassischer Radiolaria in der Phyllit-Gruppe auf der Insel Kreta. — N. Jb. Geol. Paläont. 77: 400—404. Stuttgart.

Plate I

1. *Sarla kretaensis robusta* n. ssp. Holotype
   Dallapuszta, layer 1, 160X
2. *Sarla kretaensis robusta* n. ssp. Paratype
   Dallapuszta, layer 2, 160X
3. *Sarla kretaensis kretaensis* KOZUR et KRAHL
   Dallapuszta, layer 14, 120X
4. *Sarla kretaensis kretaensis* KOZUR et KRAHL
   Dallapuszta, layer 12, 110X
5. *Spongostylus tortilis* KOZUR et MOSTLER
   Dallapuszta, layer 2, 150X

Photo: MRS TAKÁCS



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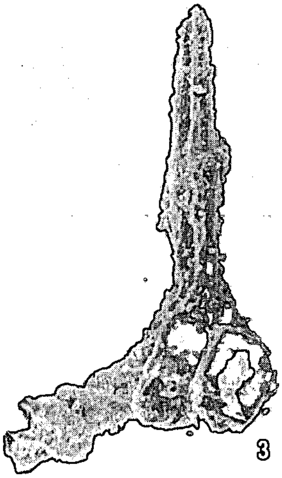

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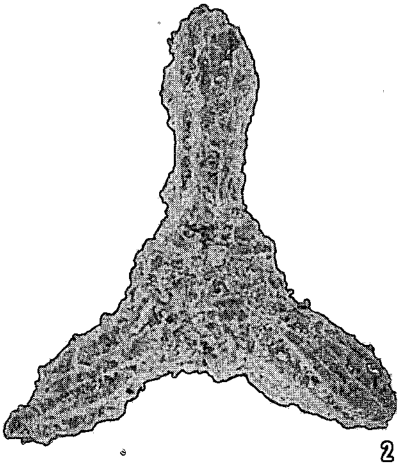

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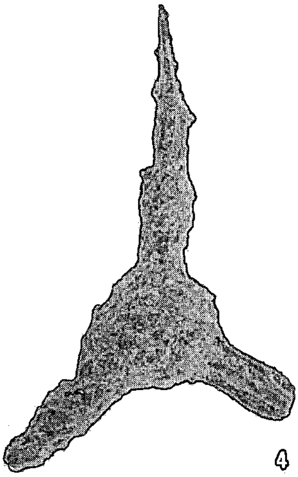

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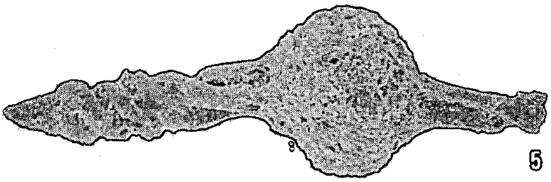

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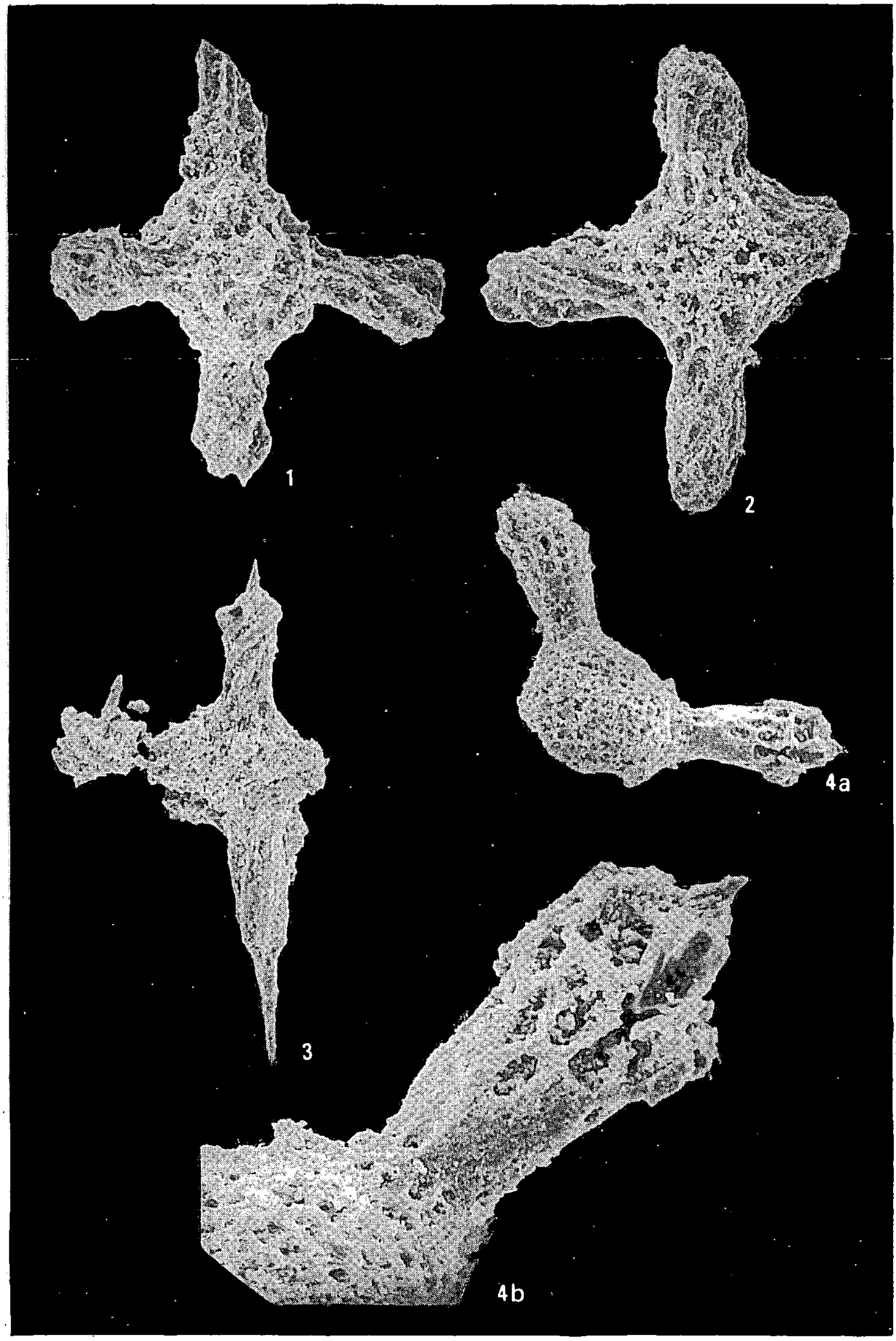
Plate II

1. *Plafkerium cochleata* (NAKASEKO et NISHIMURA)
   Dallapuszta, layer 6, 180X
2. *Plafkerium cochleata* (NAKASEKO et NISHIMURA)
   Dallapuszta, layer 8, 160X
3. *Plafkerium cochleata* (NAKASEKO et NISHIMURA)
   Dallapuszta, layer 10, 100X
4. *Capnuchosphaera* sp.
   Dallapuszta, layer 10, *a.* 220X, *b.* 600X

Photo: MRS TAKÁCS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M. ÁLL. FÖLDTANI INTÉZET ÉVI JELENTÉSE AZ 1988. ÉVRŐL, II RÉSZ (1989)

AN EVALUATION OF SPOROMORPHS AND OSTRACODS OF THE FEHÉRPART EXPOSURE AT TIHANY, LAKE BALATON

by
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UDC: 565.33(439.117/.118)

Keywords: biostratigraphy, paleoecology, sporomorphs, ostracods, Pontian, Upper Pannonian, Tihany (Hungary)

The Pontian (Upper Pannonian) section of Tihany-Fehérpart is probably one of the most characteristic exposures of the Tihany Formation. By their investigation, the authors have succeeded in complementing the list of ostracods and sporomorphs of this locality, published by B. ZALÁNYI (1959) and E. NAGY (in F. BARTHA 1959).

The sporomorph association is fairly poor, representing the middle part of the Upper Pannonian. The Ostracoda fauna is rich and preserved in good state. The species encountered here are known from the Pontian layers of the Eastern and Central Paratethys.

The quantitative evaluation of the freshwater—oligohaline and mesohaline Ostracoda enables us to draw some conclusions regarding the salinity variation of the water in the contemporaneous depositional basin.

History of study

The exposure of Tihany-Fehérpart was possible one of the first Hungarian localities identified as Pannonian. P. PARTSCH was able to introduce the genus Congeria in 1835 when studying the fossils collected from this locality.

The molluscan fauna of the Fehérpart section was investigated later by GY. HALAVÁTS (1902—1909), I. LÖRENTHEY (1905—1909), I. Vitális (1908—1909) and F. BARTHA (1959—1971).

The first investigation of the local sporomorphs was performed by E. NAGY (in F. BARTHA 1959).

Within the 11 samples examined, she could establish the presence of a scarce sporomorph material comprising Pineaceae, on the basis of which she supposed a relatively great distance of the shores from the place of fossilization. Her results are complemented and corroborated by our data as well.

The first Ostracoda studies can be attached to the name of B. ZALÁNYI (1959). He described several new Ostracoda species from this site and drew certain conclusions concerning the ecological conditions of the biotope upon the percent distribution of freshwater and brackish water species.

KRSTIČ (1972) published a short faunal list from the section, assigning it to the Upper Pontian.

A brief lithological description and the lithostratigraphic position of the sequence

The Fehérpart exposure is situated near the shore of Lake Balaton, 1600 m to the NE of the Tihany port (Fig. 1). It is a steep wall 30 m high comprising an alternating sequence of fine-grained sand, clay and silt. The megascopical description of the sequence was published by P. MÜLLER—M. SZÓNOKY (1988b).

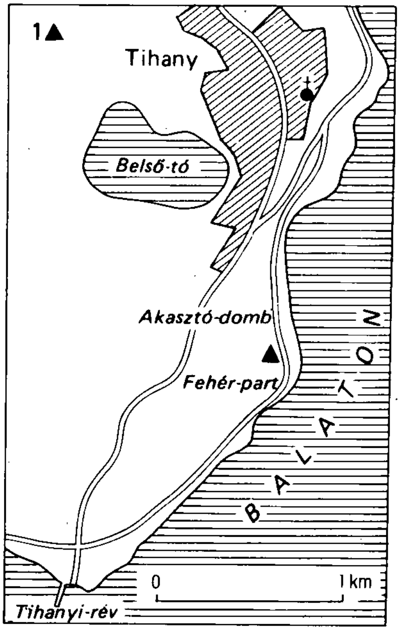


Fig. 1. Location map of the Tihany-Fehérpart section (after P. MÜLLER—M. SZÓNOKY 1988b)
1. Place of the locality

A few lowermost-lying beds are covered by debris up to the height of c. 8 m. The layers are almost horizontal and well distinguishable in the section. The section shows a two fold division visible from afar. The lower part extending roughly up to a height of 15 m contains no stripes of swamp deposits, while higher up dark huminitic layers are alternating with sandy and silty beds.

Besides cross-bedded layers there are well-stratified and unstratified ones, too. At some places, ripple marks, lumachelle beds and lenticular intercalations can also be observed. At the upper part of the section, some variegated clay, terrestrial molluscs and small vertebrate remains indicate the occasional withdrawal of water (Fig. 2).

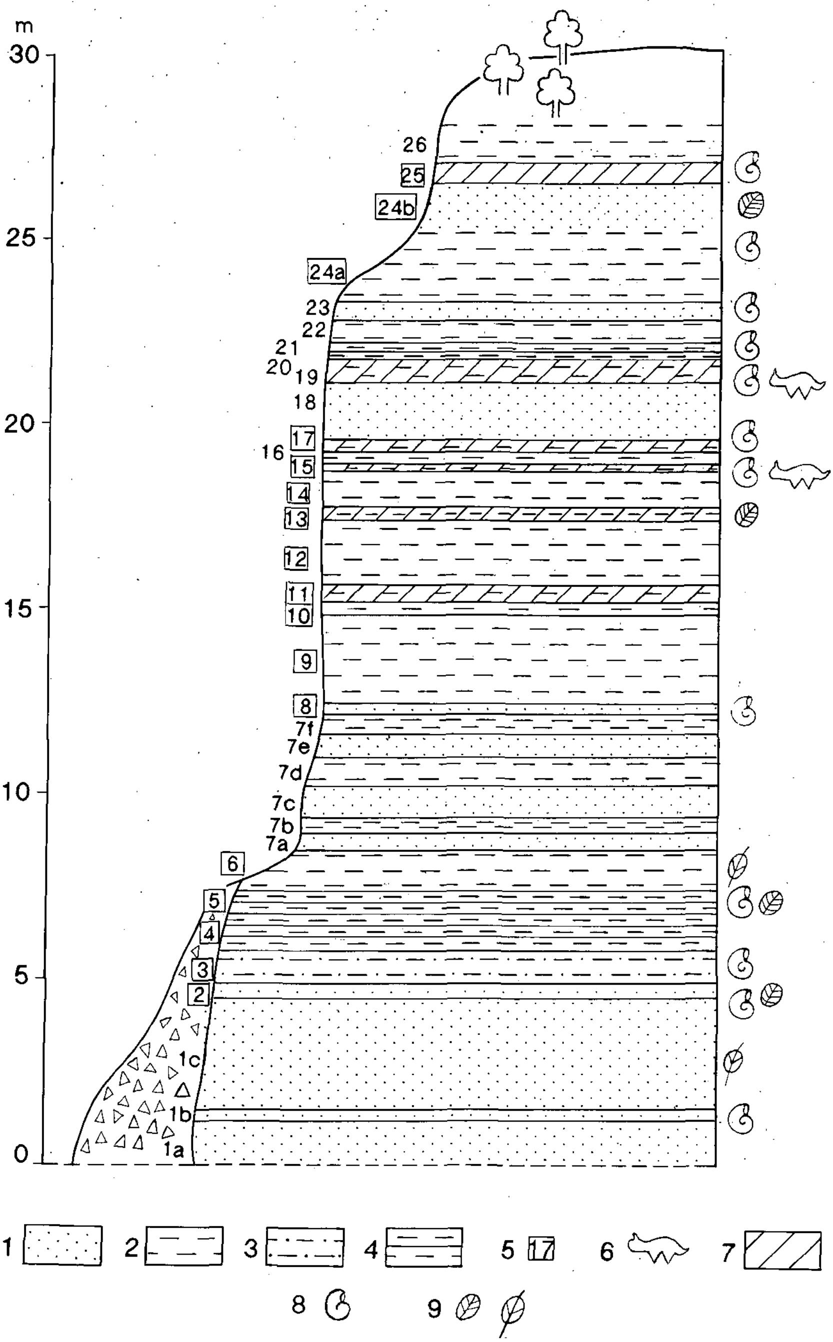


Fig. 2. Geological section of the Tihany–Fehérpart exposure (after MÜLLER—SZÓNOKY 1988b) *1.* Sand, *2.* fine silt, *3.* coarse silt, *4.* argillaceous fine silt, *5.* layers examined, *6.* vertebrate remains, *7.* layers with humus, *8.* molluscs, *9.* flora

F. BARTHA (1971) proposed the Tihany-Fehérpart section as neostratotype for the middle part of the Upper Pannonian. Acting partly on the basis of this proposal, Á. JÁMBOR named the Tihany Member by this section. Later this member gained a higher "rank" as Tihany Formation (J. FÜLÖP et al. 1983). Then this section was proposed to stand for the facies stratotype for the Tihany Formation by P. MÜLLER—M. SZÓNOKY (1988a).

In the Tihany-Fehérpart section, no underlying or overlying beds are observable. These are known, however, from boreholes in the environs of the Balaton. Accordingly, the Tihany Formation is passing from the underlying Somló Formation into the overlying Torony Formation with continuous sedimentation (Á. JÁMBOR 1980).

Biostratigraphical and ecological evaluation of the sporomorph association and the Ostracoda fauna

Palynological investigations were performed on the beds marked 2—24b from the Tihany-Fehérpart section (Fig. 2).

Samples taken from the layers 9—24b were sterile in respect of sporomorphs, except for samples 24b, 24a and 12 where, there were some pollen grains of bladderless Coniferae.

The sporomorph associations of layers 2—6 were poor, comprising in dominant quantity the pollen of Pineaceae (*Pinuspollenites labdacus, Abietinaepollenites microalatus*).

Samples marked as 2—3 contained, in a poor sporomorph association; 1—2 pieces of pine pollens, *Pinuspollenites labdacus* as well as a *Sparganiumpollenites polygonalis* testyfying to freshwater environment.

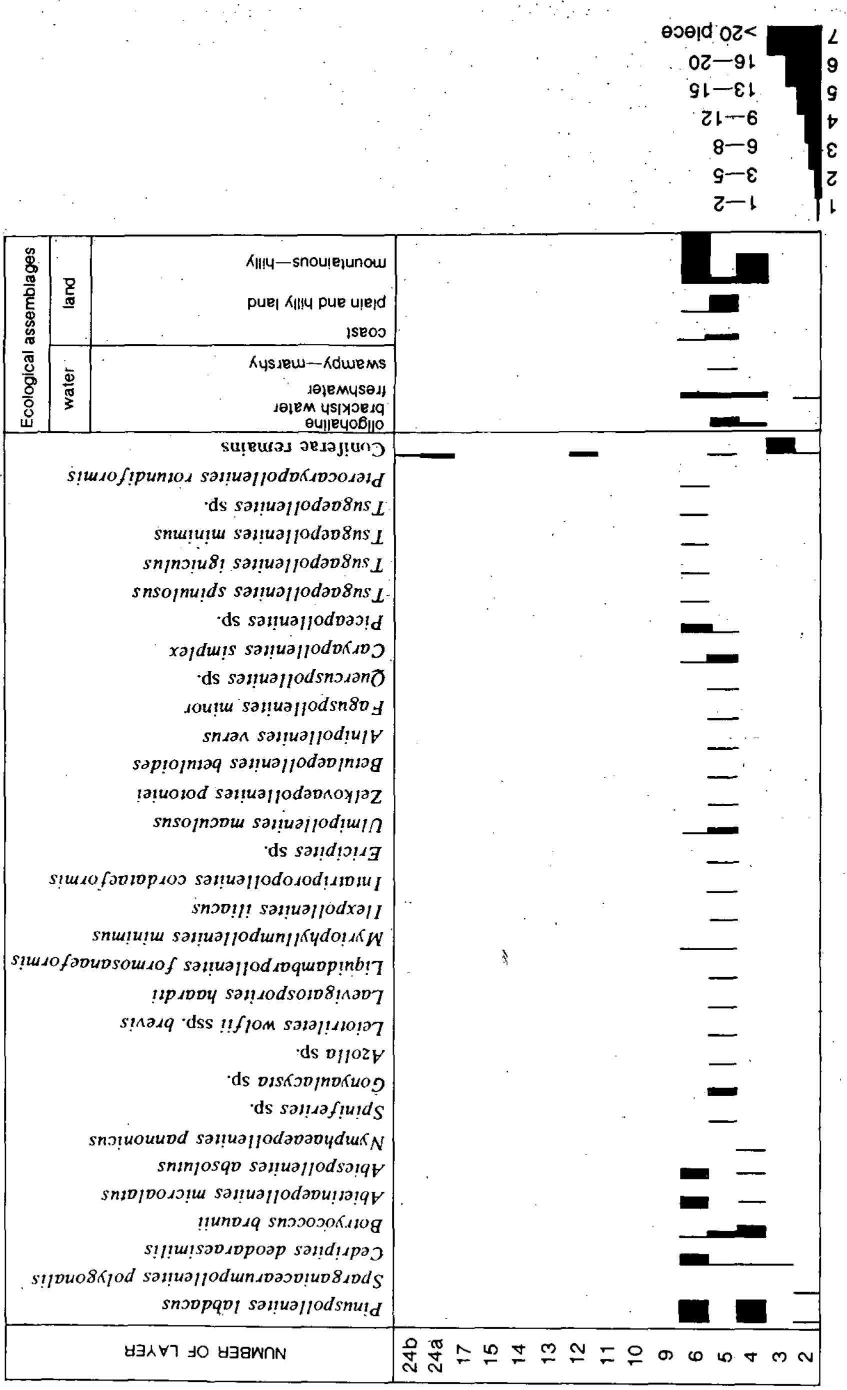
In sample 4, the pollen of Pineaceae are dominating, like *Pinuspollenites labdacus, Cedripites deodaraesimilis* (Plate I.). There was a single pollen of the freshwater plant *Nymphaeaepollenites pannonicus* found here as well, known since to appear from the middle Lower Pannonian. The association is coloured by the remains of the algae Botryococcus as well.

In sample 5, the leading role of pine tree pollens is already overtaken by the pollen grains of deciduous trees, denoting a more near-shore environment: *Intatriporopollenites cordataeformis, Quercopollenites* sp., *Betulaepollenites betuloides* (Plate II). This sample included also the brackish planktonic organisms: the representatives of Gonyaulacysta and Spiniferites genus (Plate I). The pollen grains of freshwater and freshwater shore plants (*Myriophyllumpollenites minimus, Caryapollenites simplex, Alnipollenites verus*) were also included, but in a smaller occurence (Plate II).

In sample 6, again the pine tree pollens are dominating. Apart from the *Pinuspollenites labdacus*, the climatic requirement of which is warm-temperate there are present species which had required warm and humid climate like *Tsugaepollenites igniculus, Tsugaepollenites spinulosus*, occurring also in the Lower and Upper Pannonian (Plate II). The pollen of Myriophyllum and *Caryapollenites simplex* already indicate freshwater environment (Plate II).

Table 1

Sporomorph assemblages of the Tihany–Fehérpart section and their ecological evaluation



On the basis of the above evidence we can say that the poor sporomorph association encountered, together with pollen grains of freshwater plants and brackish planktonic organisms occurring together, are indicative of middle horizon of the Upper Pannonian (Table 1). Among the prevailing pine tree pollen those of warm to temperate climatic requirements as well as of warm-humid climatic reguirements are equally found.

The dominance of the pine tree pollens (70:30) indicate a relatively far-lying shore. The sedimentation of the layer represented by sample 5 took place relatively nearer to the shore, as reflected by the dominance of the pollen of deciduous trees. A similar change in the environment was observed by M. FARAGÓ-MIHÁLTZ (1982) when examining the borehole Rákoskeresztúr 26 section of the same age.

For the study of the Ostracoda fauna, 500-500 g of each sample collected were treated by decantation. All ostraccods were carefully selected from the residue. Apart from the complete specimens of good state of preservation, juvenile and poorly preserved specimens were also determined at the level of genus or subgenus, whenever possible.

In the rich and well-preserved Ostracoda fauna yielded by the Tihany-Fehérpart section, among others, species described from the Pontian layers of the Eastern and the Central Paratethys have also been identified. Table 2 shows members of the faunal assemblage that were described also from the Pontian layers of the neighbouring countries or Georgia.

It is apparent from the Table 2 that the species *Candona (Bakunella) dorsoarcuata* (ZALÁNYI), *Candona (Pontoniella) acuminata* (ZALÁNYI) and *Leptocythere? (Maeotocythere) bosqueti* (LIVENTAL) have a wide geographic distribution. These species are still living in the Caspean sea. From the Pontian fauna of the Eastern Paratethys known to us, the Hungarocypris species are completely missing, as well as Amplocypris and Cyprideis species frequently met in the contemporary faunas of the Central Paratethys are represented only by 1—2 specimens in the Pontian formations of the Eastern Paratethys.

The most frequent species found at Tihany-Fehérpart is the species *Candona (Caspiolla) zalanyii* KRSTIČ. N. KRSTIČ (1972) gave this common name to this taxon, which was published by B. ZALÁNYI (1959) from the Fehérpart under the name of *Candona extensa* n. sp. (ZALÁNYI published a juvenile specimen) and the species *Camptocypria hungarica* n. sp. This species from the Serbian Pontian layers was published by N. KRSTIČ (1972).

The other frequent member of the fauna is *Cyprideis seminulum* (REUSS) was published by K. KOLLMANN (1960) as an element characteristic of zone G of the Pannonia in the Vienna Basin.

The Fehérpart section can be divided into two parts on the basis of the Ostracoda fauna. During the formation of the lower part (layers 2—9), we can suppose a mesohaline seawater. The following species (among others are seemingly confined to this succession: *Candona (Bakunella) dorsoarcuata* (ZALÁNYI), *Candona (Pontionella) acuminata* ZALÁNYI, *Hungarocypris pannonica* ZALÁNYI, *Amplocypris dorsobrevis* SOKAČ.

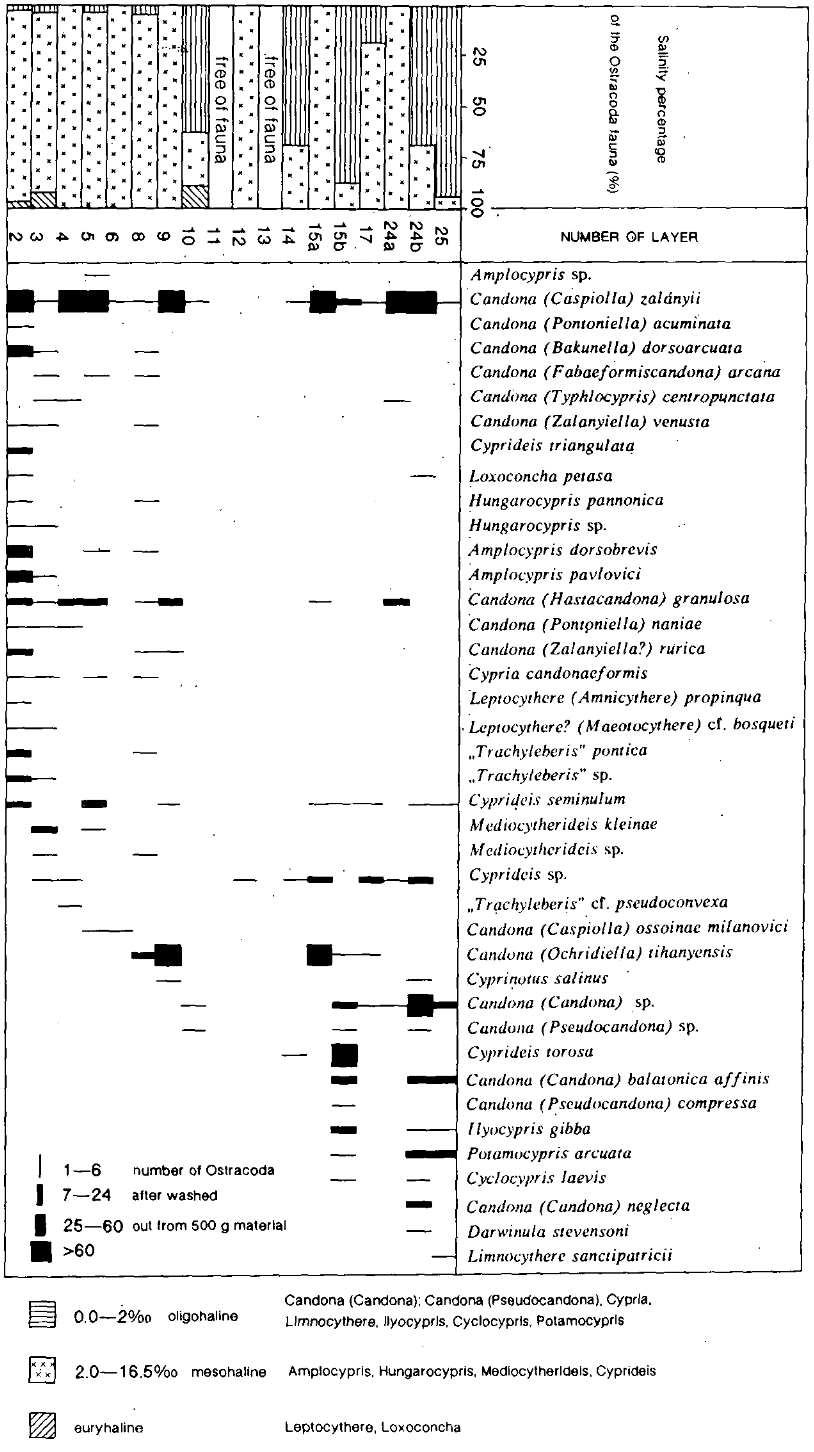
Table 2

The geographic distribution of some cosmopolitan Ostracoda species of Tihany–Fehérpart during Pontian time

Geographic distribution during Pontian time / Cosmopolitan elements of the Ostracoda fauna of the Tihany–Fehérpart section	Central Paratethys				Eastern Paratethys
	Pannonian Basin		Dacian Basin		
	Yugoslavia				
	Slavonia A. SOKAČ 1972	Serbia N. KRSTIČ 1968, 1972, 1973, 1975	NW Bulgaria M. STANCHEVA 1965	Romania Dacian Basin E. HANGANU 1974, 1982	Georgia S. VEKUA 1975
Candona (Bakunella) dorsoarcuata (ZALÁNYI)	+	+	+	+	+
Candona (Pontoniella) acuminata (ZALÁNYI)	+	+	+	+	+
Candona (Zalanyiella) venusta (ZALÁNYI)	+	+	+	+	
Candona (Caspiolla) ossoinae milanovici KRSTIČ		+		+	
Hungarocypris pannonica (ZALÁNYI)	+	+			
Amplocypris dorsobrevis SOKAČ	+	+		+	
Cyprideis seminulum REUSS		+			
Cyprideis triangulata KRSTIČ	+	+			
Mediocytherideis kleinae MARKOVA		+			+
"Trachyleberis" pontica LIVENTAL			?	?	+
Leptocythere? (Maeotocythere) bosqueti (LIVENTAL)	+	+	+		+
Loxoconcha petesa LIVENTAL	+			+	

Table 3

Ostracoda fauna of the Tihany-Fehérpart section and evaluation of the assemblage according to salinity requirements



From about the middle point of the sequence, in layer 10 freshwater—oligohaline ostracods appear but by a few specimens only, like Candona (Candona) and Candona (Pseudocandona).

Layers 10—14 are sterile or contain a very poor fauna. Starting from layer 15, the Ostracoda fauna is again rich in species and in number of specimens. From this layer upwards, bed groups of freshwater—oligohaline and mesohalie origin are alternating. This oscillation in the salt content can be properly followed by the quantitative evaluation of the ostracods requiring waters of different salintiy Table 3.

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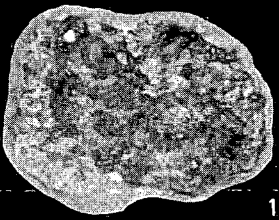
Plate I

1. *Botryococcus braunii* KÜTZIG 1849
2. *Spiniferites validus* SÜTŐ-SZENTAI M. 1982
3. *Pinuspollenites labdacus* (R. POT. 1931) R. POT. 1958
4. *Tsugaepollenites igniculus* (R. POT. 1931) R. POT. —VENITZ 1934
5. *Cedripites deodaraesimilis* (NAGY 1969) NAGY 1985
6. *Leiotriletes wolfii* W. KR. 1962 ssp. *brevis* W. KR. 1962

1.: Sample 4
2., 6.: Sample 5
3., *4.*, *5.*: Sample 6

1—6.: 1000X



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4

5

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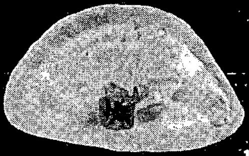
Plate II

1. *Nymphaeaepollenites pannonicus* (NAGY 1969) NAGY 1985
2. *Liquidambarpollenites formosanaeformis* NAGY 1969
3. *Myriophyllumpollenites minimus* NAGY 1985
4. *Ilexpollenites iliacus* (R. POT. 1931) R. POT. 1960
5. *Intatriporopollenites cordataeformis* (WOLF 1934) MAI 1961
6. *Ulmipollenites maculosus* NAGY 1969
7. *Betulaepollenites betuloides* (PFLUG 1953) NAGY 1969
8. *Zelkovaepollenites potoniei* NAGY 1969
9. *Alnipollenites verus* R. POT 1934
10. *Faguspollenites minor* NAGY 1969
11. *Quercopollenites* sp.
12. *Pterocaryapollenites rotundus* NAGY 1969
13. *Caryapollenites simplex* (R. POT. 1931) RAATZ 1937

1., 13.: Sample 6
2—12.: Sample 5
1—13.: 1000X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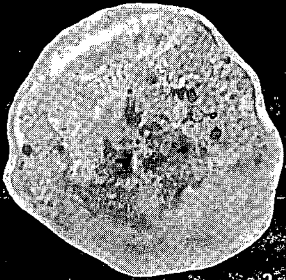
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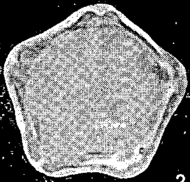
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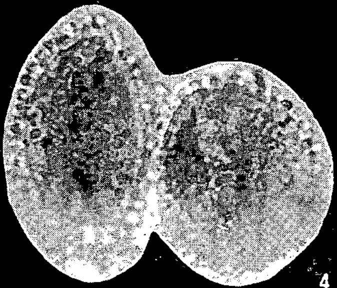
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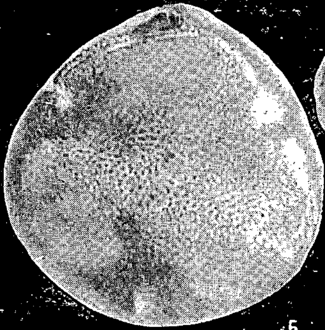
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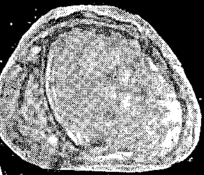
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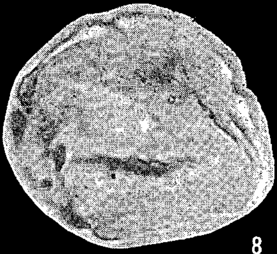
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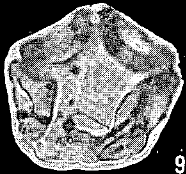
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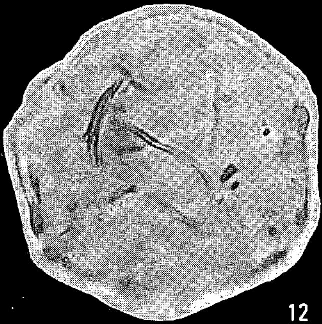
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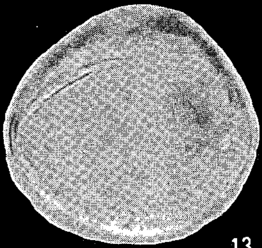
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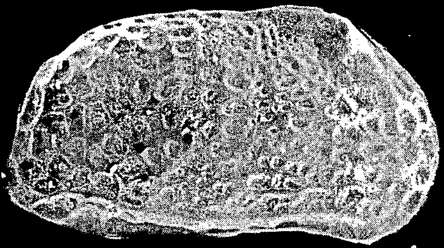
Plate III

1—2. *Hemicytheria* sp.
Tihany-Fehérpart, layer 2
1. Right side valve in exterior lateral view
2. Left side valve in exterior lateral view
3. Right side valve in interior lateral view

4—5. *Leptocythere? (Maetocythere)* cf. *bosqueti* LIVENTAL
Tihany-Fehérpart, Layer 3
4. Left side valve in exterior lateral view
5. Right side valve in exterior lateral view

6—7. *Mediocytherideis kleinae* MARKOVA
6. Right side valve in exterior lateral view
7. Left side valve in exterior lateral view

1—3.: 60X
4—5.: 130X
6.: 100X
7.: 120X



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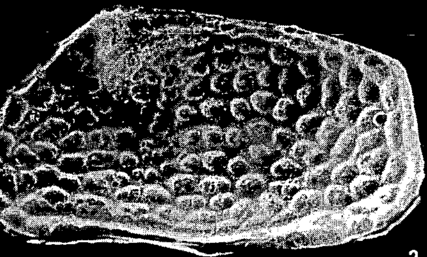

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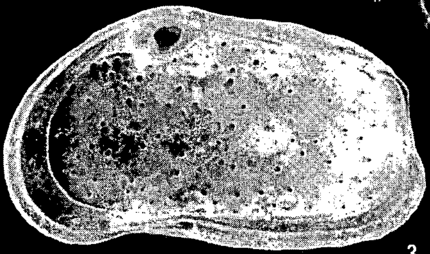

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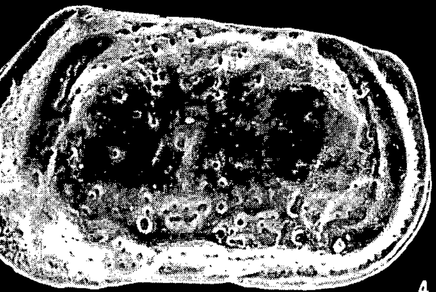

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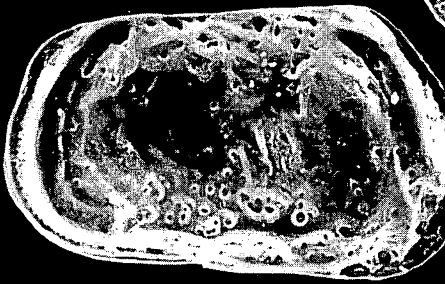

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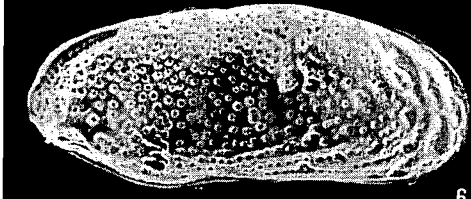

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Plate IV

1—4. *Cyprideis seminulum* (REUSS)
Tihany-Fehérpart, layer 24b
1., 3. Left side valve in exterior lateral view
2., 4. Right side valve in exterior lateral view

5—7. *Candona (Caspiolla) zalanyii* KRSTIČ
Tihany-Fehérpart, layer 24a
5. Left side valve in exterior lateral view
6. Right side valve in exterior lateral view
7. Left side valve of a juvenile specimen in exterior lateral view

8—9. *Hungarocypris pannonica* ZALÁNYI
Tihany-Fehérpart, layer 3
8. Right side valve in exterior lateral view
9. Right side valve in interior lateral view

1—7.: 50X
8—9.: 12.8X


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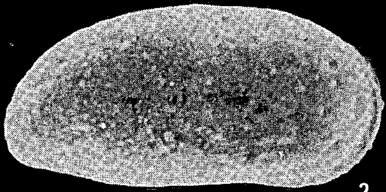
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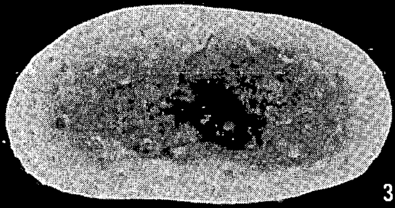
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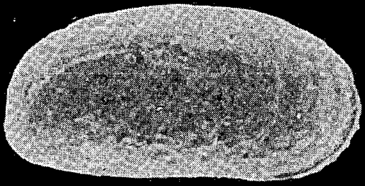
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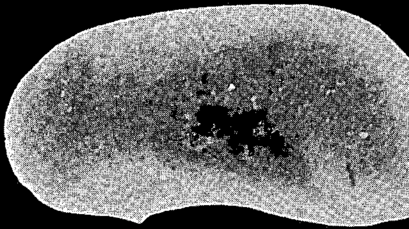
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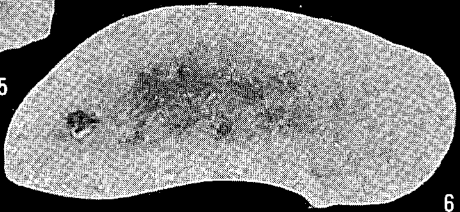
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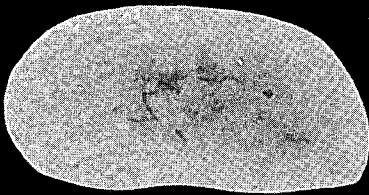
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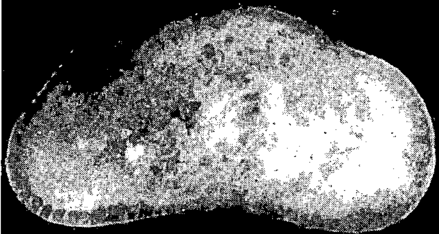
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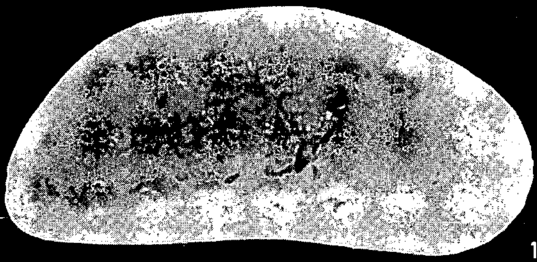
Plate V

1—3. *Amplocypris dorsobrevis* SOKAČ
Tihany-Fehérpart, layer 2
1. Right side valve in exterior lateral view
2. Left side valve in exterior laterial view
3. Right side valve in interior view

4—5. *Amplocypris pavlovici* KRSTIČ
Tihany-Fehérpart, layer 2
4. Left side valve in exterior laterial view
5. Right side valve in exterior laterial view

1—5.: 50X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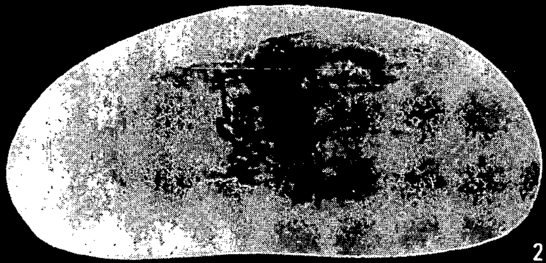
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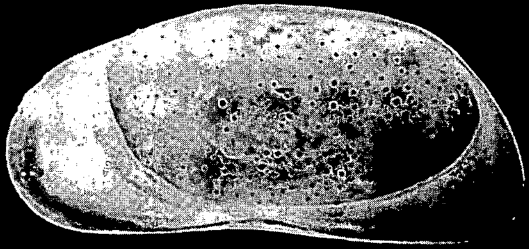
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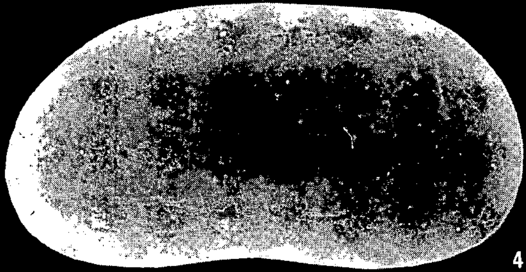
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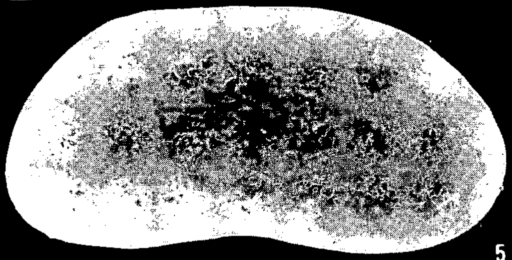
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Plate VI

1—2. *Candona (Candona) balatonica affinis* ZALÁNYI
Tihany-Fehérpart, layer 25
1. Right side valve in exterior laterial view
2. Left side valve in exterior laterial view

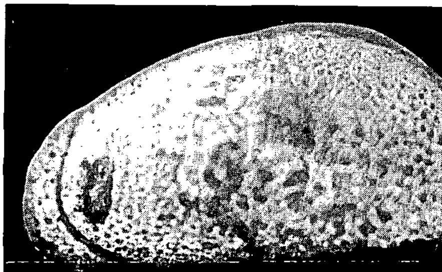
3—4. *Candona (Hastacandona) granulosa* ZALÁNYI
Tihany-Fehérpart, layer 24a
3. Right side valve in exterior laterial view
4. Left side valve in exterior laterial view

5. *Potamocypris arcuata* (G. O. SARS)
Tihany-Fehérpart, layer 24b
Left side valve in exterior laterial view

6. *Darwinula stevensoni* BRADY et ROB.
Tihany-Fehérpart, layer 24b
Left side valve in exterior laterial view

7—8. *Candona (Ochridiella) tihanyensis* ZALÁNYI
Tihany-Fehérpart, layer 15
7. Right side valve in exterior laterial view
8. Left side valve in exterior laterial view

1—4.: 63X
5.: 120X
6.: 80X
7—8.: 50X



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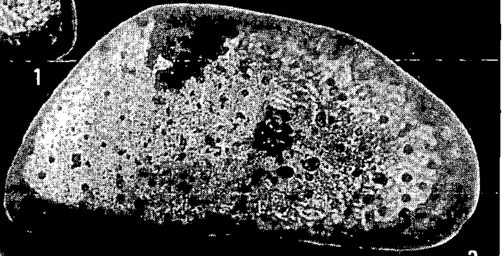

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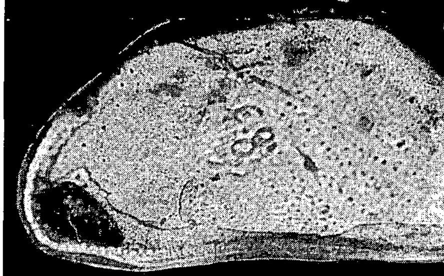

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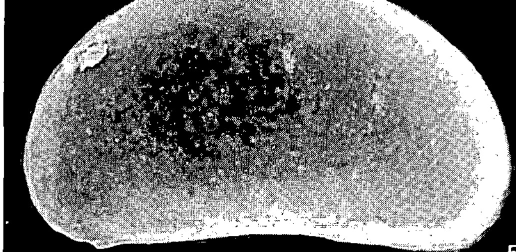

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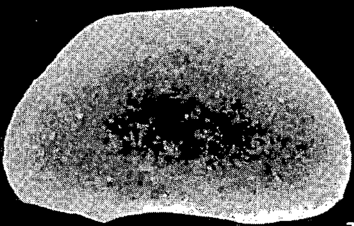

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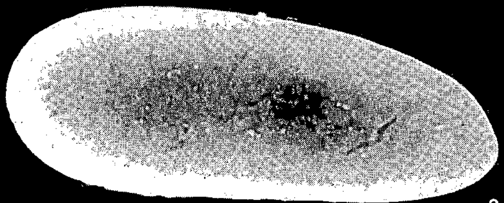

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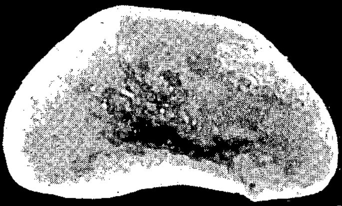

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