JADWIGA KARCZEWSKA and MARIA ZIEMBIŃSKA-TWORZYDŁO

# NEW UPPER CRETACEOUS CHAROPHYTA FROM THE NEMEGT BASIN, GOBI DESERT

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Upper Cretaceous gyrogonites of Charophyta, including thirty four species belonging to sixteen genera, are described from the continental deposits of the Nemegt Formation from the Nemegt Basin, Gobi Desert, in Mongolia. It is demonstrated that the studied charophyte assemblages are autochtonous. The lack of transport is indicated by an excellent preservation of the gyrogonite ornamentation and by great differentiation of their size. Eighteen species are new. Most common are the representatives of the genera *Mongolichara* and *Mesochara*, which are typical of this region. The generic composition of the Upper Cretaceous charophyte assemblages of Mongolia and China is similar. Among others the genera: *Euaclistochara*, *Maedlerisphaera*, *Obtusochara*, *Latochara* and *Harrisichara* are common for China and Mongolia, but *Atopochara* found in the Upper Cretaceous of Mongolia has not so far been recorded from China.

Key words: Mesozoic Algae, Charophyta, Cretaceous, oogonia.

*Jadwiga Karczewska. Polska Akademia Nauk, Zakład Paleobiologii, 02-089 Warszawa, al. Żwirki i Wigury 93, Poland*; *Maria Ziembińska-Tworzydło. Uniwersytet Warszawski, Zakład Paleontologii, 02-089 Warszawa, al. Żwirki i Wigury 93, Poland.*

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*Streszczenie.* — W pracy niniejszej opracowano oogonia górnokredowych Charophyta z formacji Nemegt, z Basenu Nemegt w Mongolii, które zaliczone zostały do 34 gatunków, 16 rodzajów. Wykazano, że opisywany zespół Charophyta znajduje się na złożu pierwotnym, o braku transportu świadczy bardzo dobry stan zachowania ornamentacji oogoniów oraz duże zróżnicowanie ich wielkości. W zespole tym jest osiemnaście gatunków nowych. Najliczniejsze i najbardziej zróżnicowane gatunkowo są rodzaje *Mongolichara* i *Mesochara*, które są typowe dla Basenu Nemegetańskiego. Okazało się, że na obszarze Mongolii skład rodzajowy zespołów górnokredowych Charophyta jest zbliżony do analogicznych zespołów w Chinach. Między innymi można wymienić rodzaje: *Euaclistochara*, *Maedlerisphaera*, *Obtusochara*, *Latochara* i *Harrisichara* wspólne dla Mongolii i Chin. Poza tym w Mongolii znaleziono *Clavatoraceae* z rodzaju *Atopochara*, które dotychczas nie były opisywane z obszaru Chin.

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## INTRODUCTION

The gyrogonites of Charophyta described in the present paper were recovered, together with ostracodes from the rocks of the Nemegt Formation in the Nemegt Basin (the localities Nemegt and Altan Ula IV), in 1970 and 1971 by members of the Polish-Mongolian Palaeontological expeditions to the Gobi Desert (KIELAN-JAWOROWSKA and BARSBOLD 1972).

The deposits of the Nemegt Formation are poorly cemented, variegated sandstones, varying in colour from yellowish to grey-brown, more seldom red or orange, containing intercalations of olive coloured mudstones and clays. The charophytes and ostracodes have been found exclusively in the latter rocks. The Nemegt Formation is believed to be of ?Upper Campanian, and ?Lower Maastrichtian age (GRADZIŃSKI *et al.* 1977) as estimated from stages of evolution of the vertebrate and invertebrate assemblages present.

Samples for micropalaeontological investigations were collected in two localities, from the successive mudstone and claystone intercalations of the Nemegt Formation sandstones exposed in steep walls of the sayrs. The localities Nemegt and Altan Ula are 60 km apart; the localization is shown in figs 1–4. In most samples the gyrogonites of Charophyta occurred together with ostracodes (SZCZECHURA 1979). Not all the samples were yielding in the same degree, some were barren, but generally the material obtained was very abundant in gyrogonites. The richest was the sample Nemegt no. 100 (figs. 3 and 4); this was also the largest sample (ca. 20 kg) derived from the deposits most abounding in charophyte gyrogonites and ostracode carapaces. The remaining samples were 1 kg each.

The clays and mudstones, which have been deposited in stagnant or slowly flowing water within an alluvial plain (GRADZIŃSKI *et al.* 1977), contain autochtonous charophyte oogonia. The lack of transport is indicated by the excellent preservation of the gyrogonite ornamentation and by strong differentiation of their size, as both, large (ca. 750 μm) and small (ca. 250 μm) specimens are present. The assemblage of the smallest oogonia will be the subject of a separate paper.

The charophytes from the same localities were described by us earlier (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970) but the material then at our disposal was much poorer than the present one both in specimens and taxa. The presently described numerous and perfectly preserved gyrogonites extend the knowledge on the Upper Cretaceous Charophyta of the Gobi Desert.

The gyrogonites of Charophyta from Mongolia were also described by KYANSEP-ROMASCHKINA (1975). That paper concerns not only the Charophyta from the Upper Cretaceous of the Nemegt Basin but also those from the Upper Jurassic of the Mongolian Altai and western Mongolia, Lower Cretaceous of north-eastern Mongolia and lower part of the Upper Cretaceous (Albian-Cenomanian) of the eastern Gobi.

Thirty four species are recorded in the present paper; their occurrence in the particular samples is presented in table 1. In our paper from 1970, thirteen species were recorded; of these the representatives of *Alistochara* cf. *bransoni* PECK, *Maedleriella monilifera* (PECK and RECKER) GRAMBAST and *Sphaerochara verticillata* (PECK) PECK, occurring as single specimens, have not been found in the present material. Of the seven species described by KYANSEP-ROMASCHKINA (1975) from the Upper Cretaceous of the Nemegt Basin, four are also recorded in the present material. These are *Mongolichara gobica* (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970) KYANSEP-ROMASCHKINA, 1975 (*M. deplanata* KYANSEP-ROMASCHKINA, 1975); *Mongolichara costulata* KYANSEP-ROMASCHKINA, 1975; *Mesochara stankevitchi* KYANSEP-ROMASCHKINA, 1975 and *Atopochara ulanensis* KYANSEP-ROMASCHKINA, 1975. The concept of the species *Mesochara texensis* KYANSEP-ROMASCHKINA, 1975 and *Mesochara oviformis* KYANSEP-ROMASCHKINA, 1975 is very wide; in our opinion each of these includes more than one species. The species *Mongolichara bugintsavica* KYANSEP-ROMASCHKINA, 1975 belongs to the genus *Lamprothamnium* (see KARCZEWSKA and KYANSEP-ROMASCHKINA 1979).

According to KYANSEP-ROMASCHKINA (1975) the species recorded by her are derived from deposits of two "svitas", the barungoyotskaya svita and the nemegetinskaya svita; the assemblages of Charophyta from both svitas are the same. According to GRADZIŃSKI *et al.* (1977) the concept of the svita of the Soviet authors is not the same as that of formation, as applied by GRADZIŃSKI and JERZYKIEWICZ (1972) in Mongolia. This disagreement is especially distinct when the vertical ranges of the Nemegt Formation and the nemegetinskaya svita, or

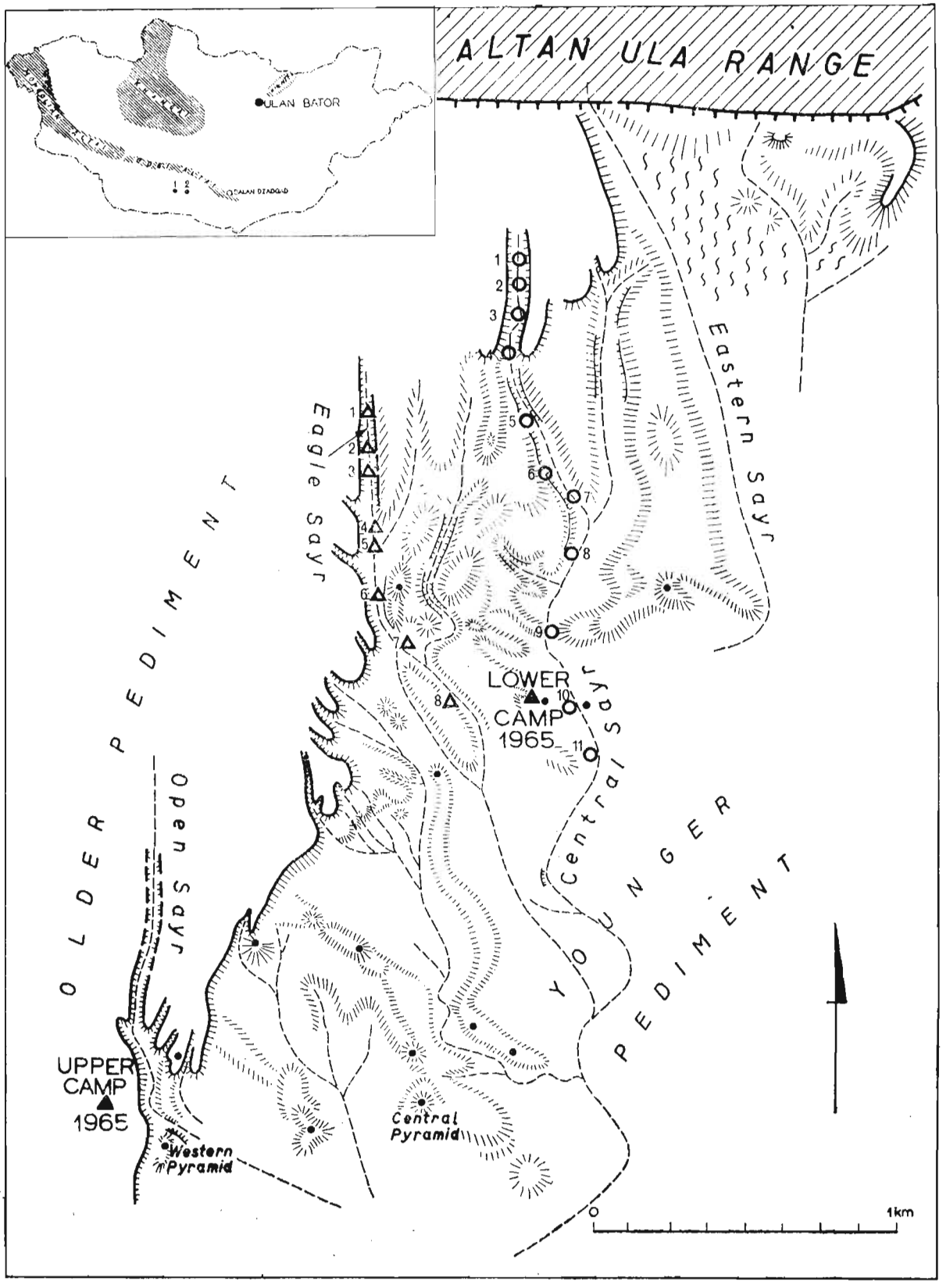


Fig. 1

Map of locality Altan Ula IV. The circles denote micropaleontological samples collected in Central Sayr; the triangles — the samples collected in Eagle Sayr (after GRADZIŃSKI *et al.* 1969, emended). The points at the map of Mongolia indicate: 1 — locality Altan Ula IV, 2 — locality Nemegt.

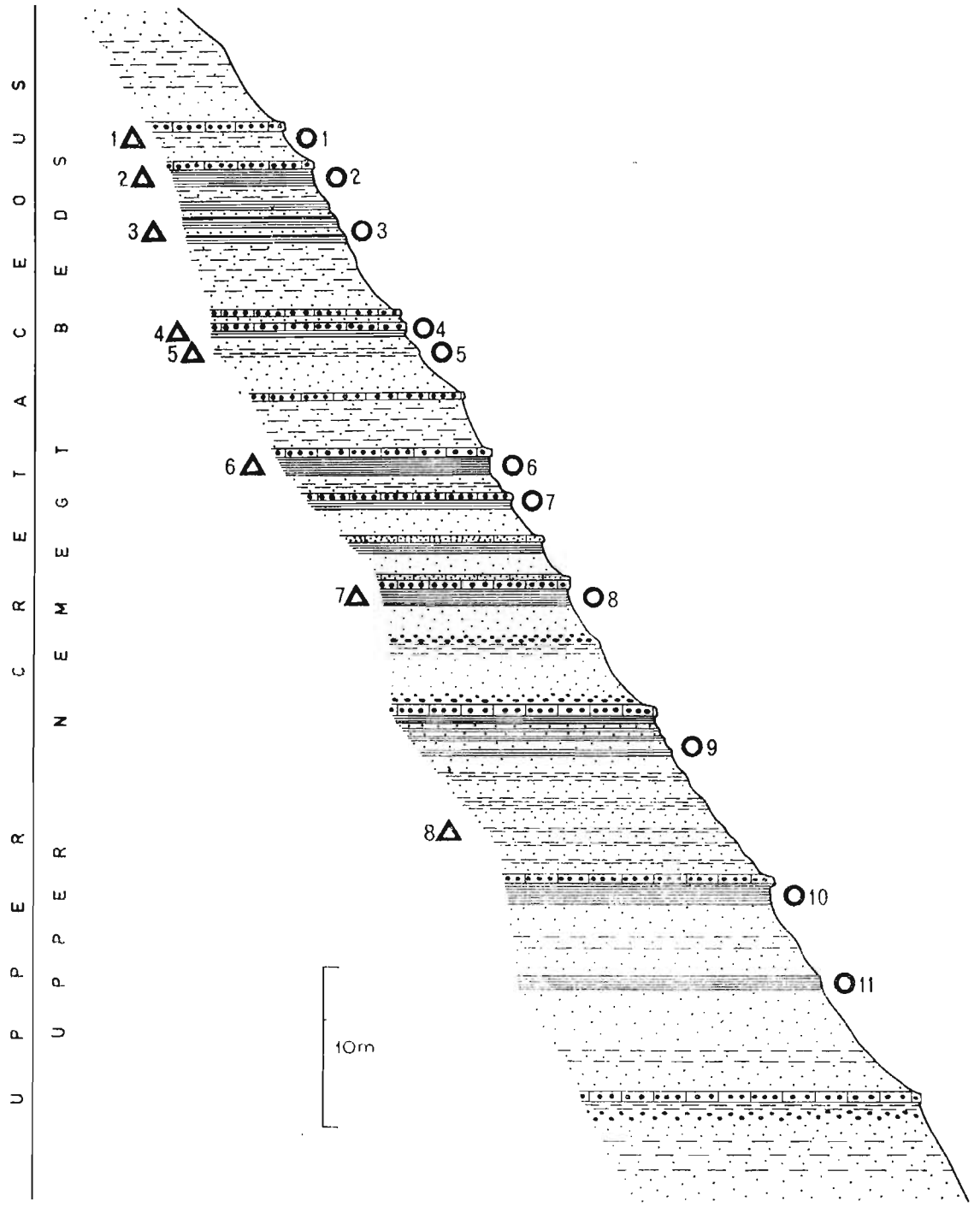


Fig. 2
Geological profile of Upper Cretaceous (Nemegt Formation) sediments at locality Altan Ula IV. The circles and triangles denote the micropaleontological samples. For location of the samples see Fig. 1 (after GRADZIŃSKI *et al.* 1969, emended).

the Barun Goyot Formation and the barungoyotskaya svita are compared. According to GRADZIŃSKI *et al.* 1977 the upper part of the barungoyotskaya svita *sensu* SOCHAVA (1975) is the equivalent of the Nemegt Formation. In this upper part of the barungoyotskaya svita (*sensu* SOCHAVA 1975) in the Bugeen Tsav and Altan Ula I localities, KYANSEP-ROMASCHKINA (1975) has found gyrogonites of Charophyta identical with those occurring in the deposits of the nemegetinskaya svita and with those described in the present paper from the Nemegt Formation.

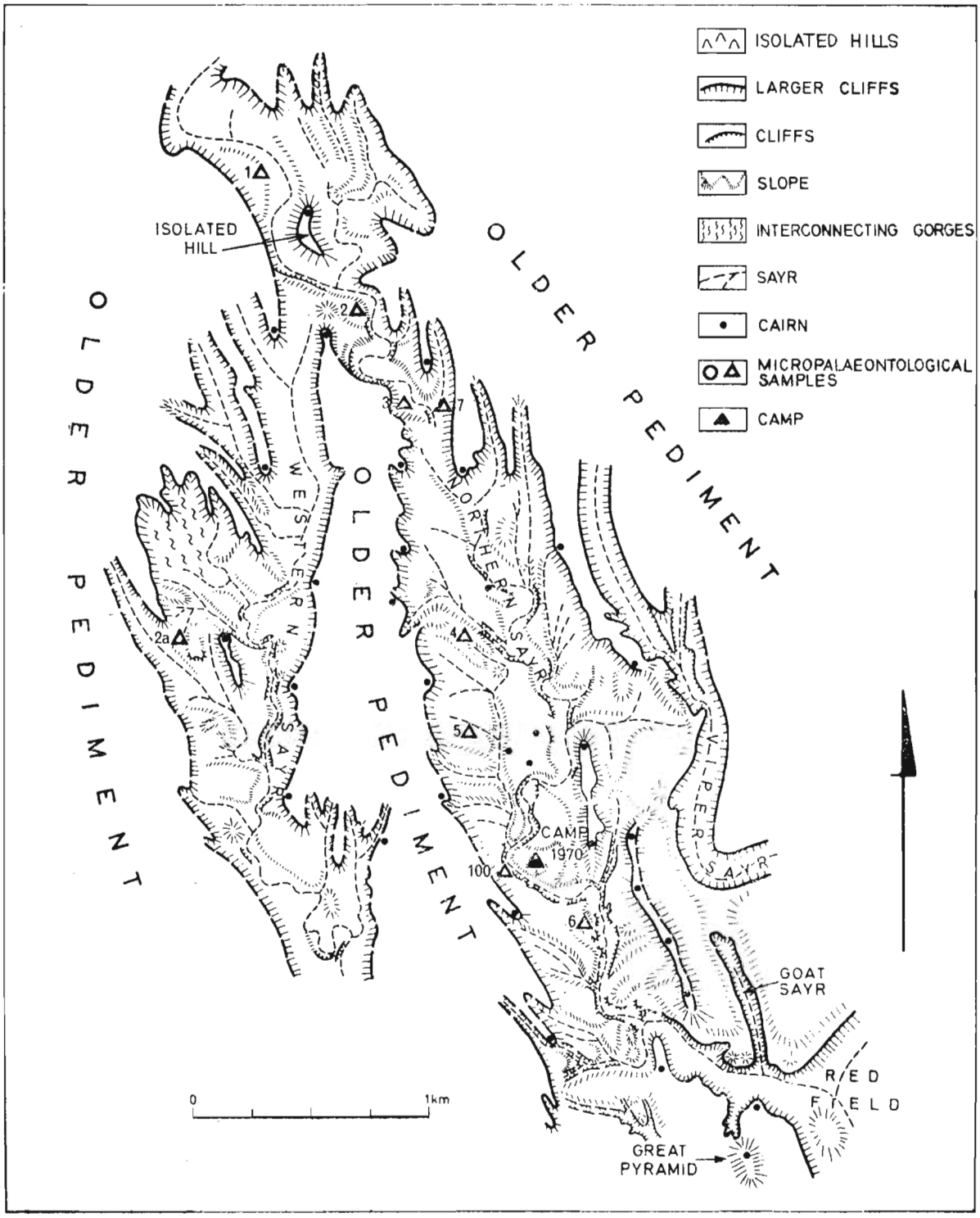


Fig. 3
Map of the northern part of locality Nemegt. Micropaleontological samples indicated by triangles (after GRADZIŃSKI and JERZYKIEWICZ 1972, emended).

This seems to confirm the suggestion of GRADZIŃSKI *et al.* (1977) that the Nemegt Formation is present also in the localities Bugeen Tsav and Altan Ula I. Thus, the Upper Cretaceous deposits from Bugeen Tsav, Ulan Bulak, Altan Ula I, Altan Ula IV and Nemegt are time equivalents.

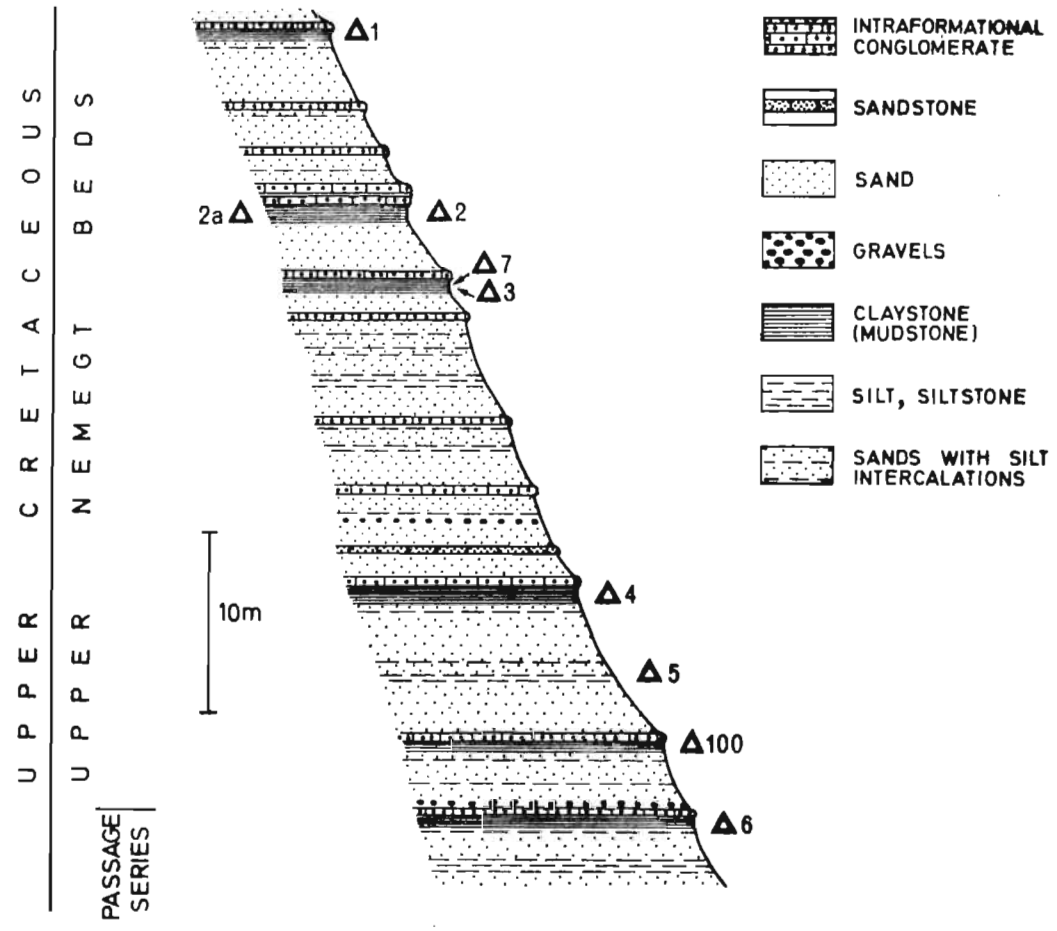


Fig. 4

Geological profile of Upper Cretaceous Nemegt Formation sediments at northern part of Nemegt locality. The triangles denote the micropaleontological samples. For location of the samples see Fig. 3 (after GRADZIŃSKI and JERZYKIEWICZ 1972, emended). The sediments denoted as the passage series represent the lowermost beds of the Nemegt Formation, intermediate in some respects between the Barun Goyot and Nemegt formations.

In November 1978, J. KARCZEWSKA met N. P. KYANSEP-ROMASCHKINA in Leningrad, and discussed the problems concerning the generic status of the species described by KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970), which were recombined by KYANSEP-ROMASCHKINA (1975). Some conclusions of the discussion are presented below:

— *Tectochara gobica* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO 1970, *recte Mongolichara gobica* (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO) KYANSEP-ROMASCHKINA, 1975, is conspecific with *Mongolichara deplanata* KYANSEP-ROMASCHKINA, 1975. *M. deplanata* is the junior synonym of *M. gobica*.

— *Mongolichara aurea* (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970) KYANSEP-ROMASCHKINA, 1975, formerly *Tectochara aurea* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970, should be included in *Mongolichara*.

— The remaining species described by KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970) included in *Mongolichara* by KYANSEP-ROMASCHKINA (1975) cannot be assigned to this genus. These are: *Saportanella nana* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970 and *Lamprothamnium altanulaensis* (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970) comb.n. For details on the genus *Mongolichara* see KARCZEWSKA and KYANSEP-ROMASCHKINA (1979).

— *Mesochara voluta* (PECK) GRAMBAST, described by us in 1970, is a species distinct from

*M. stankevitchii* KYANSEP-ROMASCHKINA, 1975 and cannot be considered the synonym of the latter.

The occurrence in the present material of the gyrogonites of Charophyta from the group Clavatoraceae, represented by the species *Atopochara ulanensis* KYANSEP-ROMASCHKINA, 1975 is noteworthy. The genus *Atopochara* was described from the Lower Cretaceous deposits of North America (PECK 1938); it was later recorded from Upper Cretaceous deposits from USA, Europe, North Africa, Syria, Peru (PECK 1957, GRAMBAST 1961, 1968). According to GRAMBAST (1967, 1968, 1969 and 1974) in *Atopochara* it is possible to trace the successive evolutionary stages, which make possible to precisely date the Cretaceous deposits.

The Clavatoraceae are rare in the present material; also KYANSEP-ROMASCHKINA has found in the Nemegt Formation only few specimens, on which her new species *Atopochara ulanensis* is based. According to GRAMBAST (1974) one stage of the evolutionary lineage of *Atopochara* is *Atopochara restricta* GRAMBAST which is indicative of the Albian. This species is a direct ancestor of the Cenomanian *Atopochara multivolvis* PECK. Neither the diagnosis nor the description of *A. restricta* was given; basing on the drawing and discussion in GRAM-

Table I

Distribution of Upper Cretaceous Charophyta in the Nemegt Basin

| Species \ Locality and samples numbers | ALTAN ULA IV | | | | | | | | | NEMEGT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Central Sayr | | | | | Eagle Sayr | | | | 2a | 3 | 7 | 100 |
| | 1 | 2 | 5 | 6 | 11 | 1 | 4 | 5 | 7 | | | | |
| *Amblyochara agathae* sp. n. | + | + | + | + | + | − | + | + | − | − | − | + | + |
| *Amblyochara nemegetensis* sp. n. | − | − | − | − | − | − | − | − | − | + | − | − | + |
| *Atopochara ulanensis* KYANSEP-ROM. | − | − | − | − | − | − | − | − | − | − | + | − | + |
| *Euaclistochara mundula* (PECK) Z. WANG, HUANG and S. WANG | + | − | − | − | − | − | + | + | − | − | − | − | + |
| *Gobichara caerulea* sp. n. | − | − | + | − | − | − | − | + | − | + | − | − | + |
| *Gobichara viridis* sp. n. | − | − | − | − | − | − | − | + | − | + | − | − | + |
| *Harrisichara cretacea* KARCZ. and ZIEMB. | + | − | − | − | − | − | + | + | − | + | + | − | + |
| *Harrisichara cepaeformis* sp. n. | − | − | − | − | − | − | + | + | − | + | − | − | + |
| *Lamprothamnium altanulaensis* (KARCZ. and ZIEMB.) comb. n. | + | + | + | − | − | − | − | + | + | + | + | + | + |
| *Latochara* sp. | − | − | − | − | − | − | − | − | − | − | − | − | + |
| *Maedlerisphaera pseudoulmensis* KARCZ. and ZIEMB. | − | + | + | + | − | − | + | + | − | + | + | + | + |
| *Mesochara mongolica* KARCZ. and ZIEMB. | − | − | + | − | − | − | + | + | − | + | − | − | + |
| *Mesochara stankevitchii* KYANSEP-ROM. | − | − | − | + | − | − | − | + | − | + | − | − | + |
| *Mesochara voluta* (PECK) GRAMBAST | + | + | + | + | + | − | + | + | − | − | − | + | + |
| *Mesochara gradzinskii* sp. n. | − | − | + | − | − | − | + | + | − | − | − | − | + |
| *Mesochara inflata* sp. n. | + | − | − | + | + | − | + | + | − | + | + | − | + |
| *Mesochara luculenta* sp. n. | + | − | − | + | + | − | + | + | − | − | − | − | + |
| *Mesochara obventicia* sp. n. | − | − | − | − | − | − | − | + | − | − | − | − | + |
| *Mesochara orientalis* sp. n. | − | − | − | − | − | − | − | − | − | + | − | − | + |
| *Mesochara* sp. | − | − | − | − | − | − | − | − | − | − | − | − | + |
| *Microchara* cf. *cristata* GRAMBAST | − | − | − | − | − | − | + | + | − | + | + | − | + |
| *Mongolichara gobica* (KARCZ. and ZIEMB.) KYANSEP-ROM. | + | + | + | + | − | ? | + | + | − | + | + | + | + |
| *Mongolichara aurea* (KARCZ. and ZIEMB.) KYANSEP-ROM. | + | − | − | − | − | − | + | + | − | + | + | − | + |
| *Mongolichara costulata* KYANSEP-ROM. | + | − | − | − | − | − | − | + | − | + | + | + | + |
| *Mongolichara fulgida* sp. n. | + | + | + | − | − | + | + | + | − | + | + | + | + |
| *Mongolichara grovesioides* sp. n. | + | − | − | − | − | − | + | + | − | + | + | + | + |
| ?*Mongolichara immatura* sp. n. | + | − | + | − | − | + | + | + | − | + | + | + | + |
| *Mongolichara turnaui* sp. n. | + | − | + | − | − | − | + | + | − | + | − | − | + |
| *Obtusochara* cf. *lanpingensis* Z. WANG, HUANG and S. WANG | − | − | − | − | − | − | − | − | − | − | − | − | + |
| *Peckichara praecursoria* sp. n. | − | − | − | − | − | − | ? | + | − | − | ? | − | + |
| *Saportanella nana* KARCZ. and ZIEMB. | + | + | + | + | + | − | + | + | − | + | + | + | + |
| *Saportanella romaschkinae* sp. n. | + | − | + | + | + | − | ? | − | − | + | + | − | + |
| *Sphaerochara jacobii* sp. n. | + | − | + | − | + | − | + | + | − | − | − | − | + |
| *Stephanochara castelii* sp. n. | − | − | − | − | − | − | − | + | − | − | − | − | + |

BAST (1974) one may suppose that *A. restricta* is identical with *A. ulanensis* KYANSEP-ROMASCHKINA, 1975.

The occurrence of *Atopochara* in the Upper Cretaceous deposits of Mongolia is quite peculiar, as it is missing from the Upper Cretaceous deposits from China, which yielded the assemblages described by Z. WANG 1978; Z. WANG *et al.* (1976); S. WANG *et al.* (1978). The composition of genera of the Upper Cretaceous charophyte assemblages from Mongolia and China is similar — the differences occur at a specific level. It is interesting that we have recorded in Mongolia the genus *Euaclistochara*, represented in our material by *E. mundula* (PECK) Z. WANG, HUANG and S. WANG, 1976. This genus has been erected by the Chinese authors to include gyrogonites in which the apical part has an apical pore. This is a conservative feature typical of the Triassic and Jurassic genera. In North America and China *E. mundula* occurs in the Albian and Aptian deposits. A few other species from our material have equivalents (the same or similar species) in the Chinese assemblages. In several cases it was difficult to establish the true relations between the Mongolian and the Chinese species because of poor illustrations in Chinese papers.

Two genera of Charophyta dominate in the present material; they are represented by the highest number of both specimens and species. These are: *Mesochara* and *Mongolichara* — the genus erected by KYANSEP-ROMASCHKINA (1975), not recorded so far, from the outside of Mongolia (KARCZEWSKA and KYANSEP-ROMASCHKINA 1979). According to these authors *Mongolichara* is an ancestor, or stays close to *Peckichara* GRAMBAST, 1957, which is represented by numerous species and widely distributed in the Lower Tertiary deposits.

The conventional taxonomy of fossil oogonia of Charophyta used in the present paper is generally accepted as an artificial one. In our opinion the application of natural taxonomy to the description of fossil gyrogonites of the Charophyta is not possible, since the taxonomy of the recent Charophyta has been based mostly on the vegetative parts.

The specimens described in the present paper are housed in the Institute of Palaeobiology, Polish Academy of Sciences, Warsaw, abbreviated as ZPAL.

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The SEM micrographs have been produced in the Laboratory of Electron Microscopy at the Nencki Institute of the Experimental Biology, Polish Academy of Sciences. The transmitted-light micrographs have been made by Mr. M. DZIEWIŃSKI in the Institute of Palaeobiology, Polish Academy of Sciences.

## SYSTEMATIC PART

The terminology and abbreviations determining the shape and dimensions of the gyrogonites are the same as in KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970 and 1972):

LPA — length of the polar axis of the gyrogonite
LED — largest equatorial diameter of the gyrogonite

ISI — isopolarity index $\frac{LPA}{LED} \times 100$

AND — distance from the apical poles to the LED as calculated along the polar axis

ANI — anisopolarity index $\frac{AND}{LPA} \times 100$

EA — equatorial axis

Numb. conv. — number of convolutions in the lateral view

Width conv. at EA — width of the spirals at the equatorial axis

The shape terminology:

| | ISI |
|---|---|
| prolate spheroidal | 100–114 |
| subprolate | 114–133 |
| prolate | 133–200 |
| | ANI |
| subovoidal | 29–43 |
| ellipsoidal | 43–57 |
| subobovoidal | 57–71 |

## Genus *Amblyochara* GRAMBAST, 1962

*Type species*: *Amblyochara begudiana* GRAMBAST, 1962, France, Upper Cretaceous.

### *Amblyochara agathae* sp. n.

(pl. 22: 1, 4, 5, 8)

*Holotype*: ZPAL MgChar-III/47; pl. 22:8.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *agathae* — Lat. *Agatha* from the name Agata of the daughter of the second author.

**Diagnosis.** — Gyrogonite middle-sized, prolate spheroidal to subprolate and ellipsoidal, with broadly rounded summits and bases. Cellular spirals concave or flat, delimited by low and blunt intercellular ridges. Cellular spirals continue onto the summit without changing their width and shape, but in the apical centre distinctly thinner. Basal plug wider than thick.

**Material.** — About 500 well preserved specimens.

Measured gyrogonites of *Amblyochara agathae* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Number conv, | Width conv. in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 332 | 567 | 500 | 113 | 268 | 47 | 7 | 85 | – |
| 337 | 584 | 510 | 114 | 309 | 52 | 9 | 78 | – |
| 334 | 617 | 518 | 119 | 302 | 49 | 8 | 86 | – |
| 336 | 618 | 510 | 121 | 340 | 55 | 7 | 90 | – |
| 47 | 620 | 540 | 114 | 320 | 51 | 8 | 80 | – |
| 333 | 620 | 544 | 114 | 316 | 51 | 8 | 86 | – |
| 331 | 637 | 561 | 113 | 316 | 50 | 8 | 85 | – |
| 226 | 639 | 571 | 111 | 300 | 47 | 7 | 90 | 84 |
| 227 | 645 | 572 | 112 | 330 | 51 | 8 | 120 | 81 |
| 335 | 656 | 566 | 116 | 323 | 49 | 7 | 93 | – |
| Range: | 567–656 | 500–572 | 111–121 | 268–340 | 47–52 | 7–9 | 78–120 | 81–84 |

**Description.** — Gyrogonites middle-sized, prolate spheroidal to subprolate (ISI 106–120) and ellipsoidal (ANI 38–52), with broadly rounded summits and bases; length from 522 to 724 μm, width from 479 to 640 μm. Seven to nine convolutions visible in lateral view. Cel-

lular spirals wide (80–107 μm), on most specimens concave and shallow, delimited by low and narrow intercellular ridges. Cellular spirals continue onto somewhat flattened summit without changing their width and shape to meet in centre along an irregular line or in a point slightly raised above the general surface. In the basal part cellular spirals as wide as at the equator or somewhat widened around the basal pore; tips ending truncately or roundedly, in most specimens surrounding a distinctly pentagonal outer opening of the basal pore. Equatorial angle 10 to 15°.

In longitudinal section, cellular spirals thick, with two calcification zones; the inner layer dark, thin, the outer light-coloured and three times thicker; laminate texture invisible. In the apical part cellular spirals distinctly thinner than at the equator. Basal pore with outer opening in the bottom of a pentagonal depression, pore cone-shaped, basal plug wider than thick. Oospore membrane represented by black line along interior wall of spirals (pl. 1: 5).

**Remarks.** — *Amblyochara agathae* sp. n. is most similar to *Amblyochara peruviana* GRAMBAST 1967 described from the Upper Cretaceous deposits of Peru, but it differs in being much smaller. From *A. latifasciata* (PECK) GRAMBAST, 1962, described by PECK (1957) from the Albian deposits of North America it differs in having smaller size and shorter canal of the basal pore (seen in longitudinal section); also, in *A. agathae*, the specimens with concave cellular spirals predominate.

**Occurrence.** — Upper Cretaceous (Nemegt Formation); Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## *Amblyochara nemegetensis* sp. n.

(pl. 39:2–5, 8)

*Holotype*: ZPAL MgChar-III/139; pl. 39:4.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *nemegetensis* — occurring in the Nemegt Basin.

**Diagnosis.** — Gyrogonites middle-sized, subprolate and ellipsoidal with broadly rounded and flat summits and slightly protruding bases. Cellular spirals continue onto the summit without changing their shape and size; in the apical centre these are slightly thinner than at the equator.

**Material.** — About 600 well preserved specimens.

Measured gyrogonites of *Amblyochara nemegetensis* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Number conv. | Width conv. in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 232 | 606 | 468 | 129 | 240 | 40 | 8 | 72 | 45 |
| 339 | 617 | 493 | 125 | 312 | 50 | 8 | 81 | – |
| 341 | 629 | 476 | 132 | 297 | 47 | 9 | 85 | – |
| 139 | 650 | 500 | 130 | 320 | 49 | 10 | 80 | – |
| 338 | 680 | 537 | 127 | 320 | 47 | 8 | 96 | – |
| 340 | 680 | 566 | 120 | 323 | 47 | 8 | 95 | – |
| 342 | 705 | 510 | 139 | 290 | 41 | 9 | 88 | – |
| 343 | 710 | 561 | 127 | 340 | 48 | 9 | 93 | – |
| 233 | 720 | 540 | 133 | 300 | 41 | 8 | 84 | 60 |
| 344 | 748 | 612 | 122 | 374 | 50 | 8 | 102 | – |
| Range: | 606–748 | 468–612 | 120–139 | 240–374 | 41–50 | 8–10 | 72–120 | 45–60 |

**Description.** — Gyrogonites middle-sized, subprolate (ISI 120–139) and ellipsoidal (ANI 40-50), with broadly rounded and flat summits and slightly protruding bases; length from 606 to 748 μm, width from 468 to 612 μm. Eight to ten convolutions visible in lateral view. Cellular spirals wide (72–102 μm), more or less concave, delimited by low and sharp intercellular ridges. Cellular spirals continue onto summit without changing their size and shape and meet in the apical centre along a short irregular line. In the basal part cellular spirals slightly widened; outer opening of the basal pore distinctly pentagonal. Equatorial angle about 10°.

In longitudinal section, cellular spirals are of an average thickness (about 45-60 μm), in the apical part they have the same thickness as at the equator. Fructificational wall preserved imperfectly and only locally.

**Remarks.** — *Amblyochara nemegetensis* sp. n. is most similar to *Amblyochara agathae* sp. n. from which it differs in having more elongate shape, more protruding bases and cellular spirals which are not narrower in the apical part. *Amblyochara nemegetensis* is also similar to *Amblyochara subeiensis* HUANG and XU, 1978 from which it differs in having more elongated shape and somewhat smaller dimensions.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin Gobi Desert

## Genus *Atopochara* PECK, 1938

*Type species*: *Atopochara* Peck, 1938, North America, Lower Cretaceous.

### *Atopochara ulanensis* KYANSEP-ROMASCHKINA, 1975
(pl. 25:1a–c; pl. 31:1a–c, 2a–c, 3)

1975. *Atopochara ulanensis* KYANSEP-ROM.: KYANSEP-ROMASCHKINA; 190–191, pl. 2a–b; pl. 3:1, 2.

**Material.** — Four specimens.

Measured specimens of *Atopochara ulanensis* KYANSEP-ROMASCHKINA

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI |
|---|---|---|---|---|---|
| 53 | 1000 | 850 | 117 | 450 | 45 |
| 105 | 1000 | 820 | 122 | 440 | 44 |
| 39 | 1050 | 900 | 116 | 500 | 48 |
| 68 | 1050 | 1050 | 100 | 500 | 44 |
| Range: | 1000–1050 | 820–1050 | 100–122 | 440–500 | 44–48 |

**Description.** — See KYANSEP-ROMASCHKINA (1975). Representatives of the species discussed undoubtedly fall within the range of variability of *A. ulanensis* KYANSEP-ROM.

**Remarks.** — *Atopochara ulanensis* from our material is represented only by four variably preserved specimens. One, very well preserved specimen (pl. 31: 2a–c) makes the precise specific assignment possible. In the remaining gyrogonites the utricle is destroyed in various degree. One specimen completly devoid of sculpture (pl. 31: 3) is almost identical with that illustrated by KYANSEP-ROMASCHKINA (1975, pl. 3: 2) as the gyrogonite of this species.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt, Nemegt Basin, Gobi Desert (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, present paper). Upper Cretaceous (Nemegt Formation): Ulan Bulak (KYANSEP-ROMASCHKINA 1975)

## *Euaclistochara* Z. WANG, HUANG and S. WANG, 1976

*Type species*: *Euaclistochara lufengensis* Z. WANG, HUANG and S. WANG, 1976, China, Upper Jurassic.

**Remarks.** — The genus *Euaclistochara* has been erected by the Chinese authors to include gyrogonites in which the morphology of the apical part was such as in *Euaclistochara* mundula and in related species. *E. mundula* was described by PECK in 1941 as *Aclistochara mundula*; later, it was included, also by PECK (1957), to *Stellatochara* HORN af RANTZIEN because of the apical part morphology of these gyrogonites. Z. WANG (1978) remarked that there are essential differences in the morphology of the apical part between the gyrogonites of *Stellatochara* and "*Aclistochara mundula*". In the opinion of Z. WANG (1978) the latter species should be included in a new genus, but this was not done in his paper. Instead, he included "*A. mundula*" in *Porochara*, with a question mark, referring to GRAMBAST 1961, who, according to Z. WANG, used this new combination. However, GRAMBAST (1961) did not formally transfer *Stellatochara mundula* (PECK) PECK to another genus. Z. WANG *et al.* (1976) erected the genus *Euaclistochara*; spheroidal and ovoid gyrogonites with truncated apex, rounded bases, concave cellular spirals and sharp intercellular ridges were included. Most important diagnostically is, according to Z. WANG *et al.*, the morphology of the apical part, which is different than in *Stellatochara* and *Porochara*. In "*Aclistochara mundula*", the cellular spirals turn strongly at the apex and bend down abruptly into the apical pore forming a deep and wide canal. Z. WANG (1978) suggested that a new genus should be erected to include gyrogonites in which the apical part was similar to that of "*Aclistochara mundula*", and as such genus was already created by Z. WANG *et al.* (1976), we suppose that the paper of 1978 had been written earlier than that published in 1976.

The difference between the apical part of gyrogonites *Stellatochara* and those of "*Aclistochara mundula*" was noticed already in 1954 by HORN af RANTZIEN, who considered the lack of raised tips of the cellular spirals at the apex in the latter species and lack of the typical beak around the apical pore to be important features.

In our opinion, the difficulties in the generic assignment of "*Aclistochara mundula*" are due to the lack of precision in descriptions of the gyrogonite apical part. We think that Z.WANG *et al.* (1976) were right to erect a new genus including the forms possessing the apical part like that in "*Aclistochara mundula*". However, the diagnosis of this genus is not very plain and only discussion and description make it clear that the genus *Euaclistochara* is important.

The morphology of the apical part in the three close genera is as follows:

In *Stellatochara* the cellular spirals rise abruptly at the apex changing the course to a higher angle, without changing the width and shape; they form a distinct beak. In longitudinal section, a cylindrical canal surrounded by straight cellular spirals, as wide as at the equator is visible.

In *Porochara* the gyrogonites possess a flat apex with the pentagonal apical pore situated at the same level as the endings of the surrounding spirals. The cellular spirals neither rise nor bend down at the apex.

In *Euaclistochara* the cellular spirals reach the margin of the apical part without changing their shape or dimensions. In the apical part, close to the margin, these become narrower but do not rise, making a turn along the margin and bend down abruptly to form the cylindrical apical canal. In longitudinal section, in the apical part, the cellular spirals surrounding the canal taper strongly to 1/3 of the equatorial width.

### *Euaclistochara mundula* (PECK, 1941) Z. WANG, HUANG and S. WANG, 1976

(pl. 38:1–6)

1941. *Aclistochara mundula* PECK; PECK: 291, pl. 42:7–11.

1957. *Stellatochara mundula* (PECK) PECK; PECK: 29–30, pl. 3:25–35.

1976. *Euaclistochara mundula* (PECK) Z. WANG *et al.*; Z. WANG, HUANG and S. WANG: 71.
1978. *Porochara*? *mundula* (PECK) GRAMBAST; Z. WANG: p. 71, pl. 2:17–26.

**Material.** — About 450 well preserved specimens.

**Description.** — Gyrogonites small, subprolate to prolate (ISI 125—145) and subovoidal, ellipsoidal to subovoidal (ANI 42—59) with flat summits and broadly rounded bases; length

Measured gyrogonites of *Euaclistochara mundula* (PECK) Z. WANG *et al.*

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 394 | 340 | 282 | 121 | 144 | 43 | 9 | 34 | – |
| 395 | 350 | 268 | 130 | 148 | 42 | 9 | 46 | – |
| 396 | 374 | 289 | 129 | 183 | 49 | 8 | 36 | – |
| 46 | 410 | 320 | 128 | 200 | 49 | 10 | 45 | – |
| 170 | 441 | 358 | 123 | 197 | 45 | 9 | 49 | – |
| 398 | 459 | 351 | 131 | 272 | 59 | 10 | 52 | – |
| 400 | 462 | 377 | 124 | 212 | 46 | 9 | 59 | – |
| 169 | 464 | 327 | 142 | 235 | 51 | 9 | 49 | – |
| 397 | 479 | 362 | 133 | 246 | 53 | 10 | 59 | – |
| 399 | 502 | 358 | 145 | 221 | 44 | 10 | 54 | – |
| Range: | 340–502 | 268–362 | 121–145 | 144–272 | 42–59 | 8–10 | 34–59 | – |

from 340 to 502 μm, width from 279 to 377 μm. Eight to ten convolutions visible in lateral view. Cellular spirals concave, separated by sharp and narrow intercellular ridges. At the equator the spirals are 34 to 60 μm wide. Cellular spirals reach the periphery of the apical part without changing their shape and width. In the apical periphery they taper distinctly and turn, then bend down sharply into the summits opening. Cellular spirals, as a rule, continue onto the base without changing their shape and size, in some specimens slightly widened around the basal pore. Outer opening of the basal pore small, situated at the same level as the surrounding spirals. Equatorial angle about 10°.

In longitudinal section, two calcification zones are visible; the inner one darker, very thin, fine-crystalline, the outer light-coloured, thicker and slightly laminated. In the apical periphery, cellular spirals narrow and bend sharply downward, forming distinct cylindrical canal. Basal plug thin and flat. Fructificational wall preserved imperfectly and only locally.

**Remarks.** — The specimens of *E. mundula* (PECK) Z. WANG *et al.* from Mongolia do not differ in any important respect from those described from America (PECK, 1941, 1957) and China (Z. WANG *et al.* 1978).

**Occurrence.** — Aptian and Albian: North America, China. Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Gobichara* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1972

*Type species*: *Gobichara deserta* KARCZ. and ZIEMB., 1972, Mongolia, Lower Tertiary.

### *Gobichara caerulea* sp. n.
(pl. 22: 2, 3, 6, 7)

*Holotype*: ZPAL MgChar-III/29; pl. 22:7.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *caeruleus* = blue.

**Diagnosis.** — Gyrogonites middle-sized, prolate and subovoidal to ellipsoidal, with rounded to slightly protruding summits and conically protruding bases. In the apical periphery cellular spirals slightly narrower and somewhat thinner than at the equator; apical junction

Measured gyrogonites of *Gobichara caerulea* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 235 | 600 | 420 | 143 | 240 | 40 | 7 | 83 | 50 |
| 364 | 629 | 425 | 147 | 289 | 46 | 9 | 85 | – |
| 363 | 634 | 428 | 149 | 290 | 46 | 9 | 85 | – |
| 367 | 648 | 450 | 144 | 326 | 50 | 8 | 86 | – |
| 29 | 680 | 450 | 151 | 340 | 50 | 9 | 90 | – |
| 368 | 680 | 442 | 154 | 318 | 47 | 10 | 73 | – |
| 362 | 680 | 474 | 144 | 306 | 45 | 8 | 93 | – |
| 365 | 680 | 510 | 133 | 300 | 44 | 8 | 92 | – |
| 366 | 680 | 486 | 139 | 297 | 44 | 8 | 102 | – |
| 361 | 686 | 493 | 140 | 318 | 46 | 8 | 85 | – |
| Range: | 600–686 | 420–510 | 133–154 | 240–326 | 40–50 | 7–10 | 73–102 | 50 |

in form of a very short line. In the basal part cellular spirals as wide as at the equator. Basal pore with pentagonal outer opening, surrounded by the prolonged basal tips of cellular spirals.

**Material.** — Eighteen well preserved specimens.

**Description.** — Gyrogonites middle-sized, prolate (ISI 133—154) and subovoidal to ellipsoidal (ANI 40—50), with rounded to slightly protruding summits and conically protruding bases; length from 600 to 686 μm, width from 420 to 510 μm. Seven to ten convolutions visible in lateral view. Cellular spirals wide (73–102 μm), concave, delimited by distinct and narrow intercellular ridges. In the apical periphery cellular spirals slightly narrower, or as thick as at the equator, uniting in a point or along a short, slightly zigzagged line. Basal pore with outer opening distinctly pentagonal, surrounded by the prolonged basal tips of cellular spirals. Equatorial angle about 15°.

In longitudinal section, cellular spirals of an average thickness (about 50 μm); in the apical part they are as thick or somewhat thinner, than at the equator. Basal part cone-shaped, basal plug thin. Oospore membrane represented by black line along interior walls of spirals.

**Remarks.** — *Gobichara caerulea* sp. n. is most similar to *Gobichara nigra* KARCZ. and ZIEMB., 1972 but is larger, has less protruding base and lacks the secondary ridges.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## *Gobichara viridis* sp. n.

(pl. 26:4, 7, 9, 11)

*Holotype*: ZPAL MgChar-III/85; pl. 26:7.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *viridis* = green.

**Diagnosis.** — Gyrogonites small to middle-sized, subprolate to prolate and subovoidal to ellipsoidal, with rounded summits and protruding bases. Cellular spirals concave, wide, continue onto the summit without changing their shape and size. In the basal part, cellular

spirals as wide as at the equator. Outer opening of the basal pore pentagonal. Basal plug thin.

**Material.** — Twenty well preserved specimens.

**Description.** — Gyrogonites small to middle-sized, subprolate to prolate (ISI 125–142) and subovoidal to ellipsoidal (ANI 41–48), with rounded summits and protruding bases; length from 442 to 527 μm, width from 340 to 394 μm. Eight to ten convolutions visible in lateral view. Cellular spirals concave, wide (44–66 μm), continue onto the summit without changing their shape and size; in the apical centre these join each other along a short, irregular line. In the basal part cellular spirals as wide as at the equator, tips ending truncately, surrounding the outer opening of the basal pore. Equatorial angle about 15°.

In longitudinal section, in the apical part cellular spirals the same thickness as at the equator. Basal plug thin, closing a short canal of the basal pore.

**Remarks.** — Gyrogonites of *Gobichara viridis* sp. n. are most similar to those of *Gobichara nigra* KARCZ. and ZIEMB., especially to the specimen without secondary ridges (see KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1972, pl. 14: 3, 4), from which they differ in being somewhat larger.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt, and Altan Ula IV, Nemegt Basin, Gobi Desert.

Measured gyrogonites of *Gobichara viridis* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 369 | 442 | 340 | 130 | 204 | 46 | 9 | 44 | |
| 370 | 476 | 360 | 133 | 197 | 41 | 8 | 64 | |
| 371 | 493 | 374 | 132 | 221 | 45 | 8 | 64 | |
| 372 | 493 | 394 | 125 | 238 | 48 | 10 | 58 | |
| 373 | 510 | 362 | 141 | 240 | 47 | 10 | 58 | |
| 220 | 510 | 360 | 142 | 218 | 43 | 8 | 60 | 32–40 |
| 85 | 525 | 367 | 142 | 230 | 44 | 9 | 66 | |
| 374 | 527 | 384 | 137 | 224 | 43 | 8 | 61 | |
| Range: | 442–527 | 340–394 | 125–142 | 197–240 | 41–48 | 8–10 | 44–66 | |

## Genus *Harrisichara* GRAMBAST, 1957

*Type species*: *Harrisichara vasiformis* (REID and GROVES, 1921) GRAMBAST, 1957, England, Eocene.

### *Harrisichara cretacea* KARCZ. and ZIEMB., 1970
(pl. 36: 1, 3, 4, 6)

1970. *Harrisichara cretacea* KARCZ. and ZIEMB.; KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO: 128–129, pl. 32: 4; fig. 3.

**Material.** — About 40 well preserved specimens.

**Description.** — See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970). It may be added herein that the gyrogonites of this species from the present material display greater variability in comparison with those described by us earlier (1970), which is due to the richness of the present material. The variability concerns the gyrogonite length and width and the isopolarity index (ISI). The specimens described possess distinctly elongated basal part which is an important feature of the genus *Harrisichara*. This feature is visible especially well in longitudinal section. Secondary ridges are high and wide with a very characteristic structure (pl. 36: 3b), intercellular ridges are very low with distinctly developed sutures.

Measured gyrogonites of *Harrisichara cretacea* KARCZ. and ZIEMB.

| ZPAL MgChar- | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| I/55 | 342 | 310 | 110 | 185 | 54 | 7 | 52 | |
| III/345 | 497 | 374 | 132 | 255 | 51 | 7 | 64 | |
| III/346 | 510 | 350 | 146 | 238 | 47 | 8 | 68 | |
| III/347 | 510 | 377 | 135 | 234 | 45 | 8 | 68 | |
| III/348 | 510 | 382 | 134 | 258 | 50 | 7 | 61 | |
| III/349 | 527 | 401 | 131 | 246 | 47 | 8 | 68 | |
| III/350 | 538 | 396 | 135 | 261 | 48 | 10 | 69 | |
| III/351 | 538 | 382 | 134 | 258 | 50 | 7 | 61 | |
| I/105 | 550 | 450 | 122 | 210 | 38 | 8 | 77 | |
| III/238 | 556 | 399 | 140 | 240 | 43 | 9 | 60 | 45 |
| Range: | 342–556 | 310–450 | 110–146 | 185–261 | 38–54 | 7–10 | 52–77 | 45 |

In longitudinal section, two calcification zones are visible; the inner one darker, thin, the outer light-coloured, thicker. Cellular spirals with secondary ridges higher than the intercellular ones. In the apical part cellular spirals are of the same thickness, or slightly thinner than at the equator. Basal plug thin, flat, deeply inserted, closing a funnel-like canal of the basal pore. Oospore membrane represented by black line along the interior walls of the spirals.

**Remarks.** — See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970).

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Harrisichara cepaeformis* sp. n.
(pl. 25:5–7)

*Holotype*: ZPAL MgChar-III/74; pl. 25:6.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *cepaeformis* — Lat. *cepa* = onion, *forma* = shape, of the shape of an onion.

**Diagnosis.** — Gyrogonites small to middle-sized, subprolate and ellipsoidal, with broadly rounded summits and prolonged and protruding bases. Cellular spirals narrowing in the apical periphery. Apical junction in the form of a short irregular line.

**Material.** — Ten well preserved specimens.

**Description.** — Gyrogonites small to middle-sized, subprolate (ISI 112—127) and ellipsoidal (ANI 40—49), with broadly rounded summits and bases protruding in the form of a cone-shaped projection. Length from 438 to 510 μm, width from 355 to 452 μm. Six to nine convolutions visible in lateral view. Cellular spirals wide (56–71 μm), concave, with secondary ridges developed along the centres of the cellular furrows. Intercellular ridges more conspicuous than the secondary ones, which are low. Cellular spirals slightly narrowing in the apical periphery, forming an apical plate. Apical junction in the form of a short irregular line. Basal opening pentagonal. Outer opening of the basal pore situated at the same level as the surrounding spirals. Equatorial angle about 20°.

**Remarks.** — *Harrisichara cepaeformis* sp. n. is most similar to *H. cretacea* KARCZ, and ZIEMB., from which it differs in having more rounded summits and more prolonged bases.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

Measured gyrogonites of *Harrisichara cepaeformis* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm |
|---|---|---|---|---|---|---|---|
| 352 | 438 | 357 | 122 | 217 | 49 | 6 | 59 |
| 74 | 440 | 355 | 124 | 200 | 45 | 8 | 56 |
| 353 | 467 | 402 | 116 | 224 | 48 | 9 | 58 |
| 354 | 479 | 377 | 127 | 224 | 47 | 7 | 64 |
| 355 | 493 | 387 | 127 | 229 | 46 | 8 | 68 |
| 356 | 493 | 425 | 116 | 238 | 48 | 9 | 71 |
| 357 | 496 | 408 | 121 | 241 | 48 | 8 | 71 |
| 358 | 510 | 414 | 123 | 251 | 49 | 7 | 71 |
| 359 | 510 | 433 | 118 | 238 | 47 | 9 | 68 |
| 360 | 510 | 452 | 112 | 204 | 40 | 9 | 68 |
| Range: | 438–510 | 355–452 | 112–127 | 200–251 | 40–49 | 6–9 | 56–71 |

## Genus *Lamprothamnium* GROVES, 1916

*Type species*: *Lamprothamnium papulosum* (WALLROTH) J. GROVES, 1916 emend. R. D. WOOD, 1965, Sweden, Recent.

### *Lamprothamnium altanulaensis* (KARCZ. and ZIEMB., 1970) comb. n.

(pl. 32:1–8)

1970. *Tectochara altanulaensis* (KARCZ. and ZIEMB.); KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 139–141, pl. 32: 5, 6; pl. 34:2; fig. 11.

**Emended diagnosis.** — Gyrogonites small, subprolate to prolate, subovoidal to ellipsoidal, with slightly rounded or slightly protruding summits and somewhat protruding bases; cellular spirals in the apical centre approximately as wide as at the equator but very thin (1/4 of the equatorial thickness), forming peripheral depression. Basal pore situated in the bottom of a distinct, pentagonal depression. Basal plug very thin.

**Material.** — About 150 well preserved specimens.

**Description.** — Gyrogonites small, subprolate to prolate (ISI 116—149) and subovoidal to ellipsoidal (ANI 40—56) with slightly protruding summits and somewhat protruding and subtruncate bases; length from 355 to 552 μm, width from 302 to 397 μm. Five to nine convolutions visible in lateral view. Cellular spirals flat, concave or rarely convex, relatively wide, separated by narrow but distinct intercellular furrows. In the apical part cellular spirals approximately as wide as at the equator, but very thin, forming peripheral depression; towards summit they extend and rise meeting each other at one point or along a very short irregular line. In the basal part, cellular spirals of the same width as at the equator, surrounding a pentagonal basal pore, slightly depressed. Equatorial angle about 15°.

In longitudinal section, cellular spirals of an average thickness (40–50 μm). In the apical part slight calcification of cellular spirals, which are about four times thinner than at the equator, is visible. Basal plug thin and flat, closing a funnel-like canal of the basal pore. Oospore well visible in some specimens filling the gyrogonite inside (pl. 11: 4); in many specimens the oospore membrane represented by black line along interior walls of spirals (pl. 11: 5, 6).

**Remarks.** — Owing to the richness of the present material it was possible to make detailed observations on the morphology of the gyrogonites *L. altanulaensis*, in longitudinal section. It appears that the apical part is very characteristic; the cellular spirals in this area, thin out strongly to form a peripheral groove and rise in the centre, which is typical of the genus *Lamprothamnium*. Thus, *L. altanulaensis* may be included in this genus without doubt. *Lamprotham-*

Measured gyrogonites of *Lamprothamnium altanulaensis* (KARCZ. and ZIEMB.) comb. n.

| ZPAL MgChar- | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at. EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| I/76 | 355 | 302 | 120 | 145 | 48 | 7 | 55 | |
| I/33 | 390 | 335 | 116 | 220 | 56 | 6 | 65 | |
| I/32 | 400 | 320 | 125 | 162 | 40 | 5 | 80 | |
| I/35 | 430 | 295 | 149 | 205 | 47 | 7 | 65 | |
| III/182 | 456 | 337 | 138 | 196 | 43 | 7 | 72 | 37 |
| III/401 | 467 | 397 | 118 | 193 | 41 | 6 | 73 | |
| III/402 | 470 | 380 | 124 | 195 | 41 | 6 | 81 | |
| III/181 | 511 | 390 | 131 | 207 | 40 | 7 | 63 | 51 |
| III/403 | 540 | 394 | 138 | 238 | 44 | 9 | 59 | |
| III/404 | 552 | 390 | 142 | 255 | 46 | 8 | 71 | |
| Range: | 355–552 | 302–397 | 116–149 | 145–255 | 40–56 | 5–9 | 55–81 | |

*nium* is the recent genus. Its fossil representatives were found first by CASTEL and GRAMBAST (1969) in the Eocene deposits of France. *L. altanulaensis* is the oldest species of this genus recorded until now.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Latochara* MÄDLER, 1955

*Type species*: *Latochara latitruncata* (PECK) MÄDLER, 1955, North America, Upper Jurassic.

### *Latochara* sp.
(pl. 34:5a–b)

**Material.** — One well preserved specimen.

**Description.** — Gyrogonite barrel-shaped, with truncate summit and broadly rounded base; length 420 μm, width 340 μm, isopolarity index 123. Eight convolutions visible in lateral view. Cellular spirals flat, delimited by indistinctly marked intercellular sutures. In the summit area calcification of cellular spirals reduced; there, the spirals become shallowly concave and remain concave as they turn upward to form a truncate pyramidal-shaped projection in the centre. Outer opening of the basal pore pentagonal. Equatorial angle about 15°.

**Remarks.** — *Latochara* sp. is most similar to *Latochara curtula* Z. WANG (1978) from which it differs in size and in structure of apical projection.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt, Nemegt Basin, Gobi Desert.

## Genus *Maedlerisphaera* HORN af RANTZIEN, 1959

*Type species*: *Maedlerisphaera ulmensis* (STRAUB, 1952) HORN af RANTZIEN, 1959, Germany, Oligocene.

### *Maedlerisphaera pseudoulmensis* KARCZ. and ZIEMB., 1970
(pl. 37:1–7)

**Emended diagnosis.** — Gyrogonites small to middle-sized, subprolate to prolate and ellipsoidal with protruding summits and rounded or slightly protruding bases. In the apical periphery cellular spirals distinctly narrowing and constricted, forming a deep peripheral groove; in the apical centre cellular spirals increase in width. Apical nodules sometimes prominent. Basal plug wider than thick.

**Material.** — About 150 well preserved specimens.

**Description.** — Gyrogonites small to middle-sized, subprolate to prolate (ISI 119–150) and ellipsoidal (ANI 45–52), with protruding summits and rounded or slightly protruding bases; length from 400 to 535 μm, width from 300 to 420 μm. Eight to ten convolutions visible in lateral view. Cellular spirals concave or flat, from 50 to 56 μm wide, delimited by very low and narrow intercellular ridges, with sutures poorly marked. In the apical periphery cellular spirals narrow rapidly to about 1/3 of their normal width, then turn abruptly towards the centre, expanding rapidly and then uniting along a short irregular line. In the basal part cellular spirals slightly narrowing with tips somewhat widened around the basal pore, ending roundedly. Equatorial angle about 15°.

Measured gyrogonites of *Medlerisphaera pseudoulmensis* KARCZ. and ZIEMB.

| ZPAL MgChar- | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| I/155 | 400 | 300 | 133 | 200 | 50 | 9 | 42 | |
| I/157 | 417 | 350 | 119 | 217 | 52 | 8 | 47 | |
| I/154 | 417 | 320 | 150 | 212 | 51 | 8 | 42 | |
| III/197 | 480 | 406 | 118 | 234 | 48 | 8 | 60 | 56 |
| III/196 | 490 | 397 | 130 | 234 | 49 | 8 | 53 | 54 |
| III/195 | 510 | 420 | 121 | 258 | 51 | 8 | 60 | 50 |
| III/383 | 510 | 352 | 145 | 234 | 45 | 10 | 59 | |
| III/382 | 527 | 393 | 134 | 261 | 49 | 8 | 75 | |
| III/384 | 533 | 409 | 130 | 263 | 49 | 9 | 68 | |
| III/385 | 535 | 401 | 133 | 248 | 47 | 9 | 65 | |
| Range: | 400–535 | 300–420 | 119–150 | 200–263 | 45–52 | 8–10 | 42–75 | 50–56 |

In longitudinal section, cellular spirals of an average thickness (50–56 μm), with poorly marked lamination. In the apical periphery cellular spirals rapidly thinning and in the apical centre regaining their equatorial thickness. In the basal part cellular spirals as thick as at the equator. Basal plug wider than thick.

Fructificational wall locally visible as a dark zone.

**Remarks.** — The present material contained numerous and well preserved specimens of *Maedlerisphaera pseudoulmensis*, thus, it was possible to make through an observation on the morphology of the gyrogonites apical part. These morphological features can not be considered to be falling within the variability range of the genus *Sphaerochara* HORN af RANZIEN. Therefore, we sustain our opinion expressed in 1970 that the genus *Maedlerisphaera* should not be included in *Sphaerochara* (See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970: 131).

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Mesochara* GRAMBAST, 1962

*Type species*: *Mesochara symmetrica* (PECK, 1957) GRAMBAST, 1962; North America, Aptian.

### *Mesochara mongolica* KARCZ. and ZIEMB., 1970

(pl. 28:2–4, 6, 7)

1970. *Mesochara mongolica* KARCZ. and ZIEMB.; J. KARCZEWSKA and M. ZIEMBIŃSKA-TWORZYDŁO, 132, pl. 30: 1; pl. 34: 1; fig. 5.

**Material.** — About 170 well preserved specimens.

**Description.** — See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970).

**Remarks.** — The specimens from the present material undoubtedly fall within the range of variability of *Mesochara mongolica* KARCZ. and ZIEMB. (1970). In comparison with the gyrogonites referred to *M. obventicia* sp. n. they are larger and have more protruding summits and bases and somewhat shorter canal of the basal pore.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

### *Mesochara stankevitchii* KYANSEP-ROMASCHKINA, 1975
(pl. 29:1–3, 6, 7)

1975. *Mesochara stankevitchii* KYANSEP-ROM.; N. P. KYANSEP-ROMASCHKINA, 195–196, pl. 4:1, 2.

**Material.** — About thirty well preserved specimens.

**Description.** — Gyrogonites small, subprolate to prolate (ISI 130—143) and subovoidal to ellipsoidal (ANI 40—48), with protruding summits and bases; length from 340 to 415 μm. Seven to ten convolutions visible in lateral view. Cellular spirals concave, narrow, with distinct intercellular ridges; secondary ridges absent. Cellular spirals continue onto the summit without changing their size and shape; in the apical centre these are slightly widened to join each other in a point or along a short, irregular line. At the equator the spirals are 25 to 61 μm wide.

Measured gyronogonites of *Mesochara stankevitchii* KYANSEP-ROM.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv, at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 276 | 340 | 258 | 131 | 163 | 46 | 9 | 40 | – |
| 277 | 340 | 238 | 143 | 136 | 40 | 9 | 25 | – |
| 281 | 364 | 255 | 143 | 161 | 44 | 9 | 35 | – |
| 201 | 364 | 264 | 138 | 150 | 41 | 8 | 42 | 24–44 |
| 206 | 374 | 280 | 133 | 180 | 48 | 8 | 41 | 25–44 |
| 282 | 384 | 275 | 140 | 183 | 48 | 9 | 37 | – |
| 283 | 387 | 284 | 136 | 170 | 44 | 10 | 30 | – |
| 278 | 408 | 314 | 130 | 170 | 42 | 8 | 21 | – |
| 279 | 408 | 299 | 137 | 178 | 43 | 7 | 61 | – |
| 280 | 415 | 302 | 137 | 170 | 41 | 9 | 42 | – |
| Range: | 340–415 | 238–314 | 130–143 | 136–183 | 40–48 | 7–10 | 25–61 | 24–44 |

Basal poles prolonged and protruding into a cone-shaped projection. Outer opening of the basal pore pentagonal, situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 20°.

In longitudinal section, cellular spirals of an average thickness, narrow, of the same thickness or somewhat thinner in the apical part than at the equator. Basal plug thin, deeply inserted, closing cylindrical canal of the basal pore. Basal canal long and narrow; the outer part of the basal pore enclosed by appendages protruding downwards from the gyrogonites. Fructificational wall visible locally as a dark zone.

**Remarks.** — *Mesochara stankevitchii*, was erected by KYANSEP-ROMASCHKINA (1975) to include specimens similar to gyrogonites of *Mesochara voluta* (PECK, 1937) GRAMBAST, 1965 differing from those described by PECK in having strongly elongated basal part. PECK (1957), when describing the North American Mesozoic gyrogonites of *Mesochara voluta*, included in this species, beside the typical forms, also those possessing an elongated basal part. In the same time this author remarked that "it is possible that more than one species is represented" (p. 39).

In the present material one can observe that the gyrogonites of *M. stankevitchii* differ from those of *M. voluta* in having elongated not only the basal but also the apical part, strongly crowded spirals visible in lateral view and also in displaying very characteristic structure of the cellular spirals in longitudinal section. Therefore, our investigations resulted in a better recognition of the morphology of gyrogonites *M. stankevitchii* enabling the separation of this species from those related. After having examined the material from the Mongolian Upper Cretaceous deposits described by KYANSEP-ROMASCHKINA (1975) we have together with the latter author reached the conclusion that the inclusion of gyrogonites *M. voluta* described by KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970) to *M. stankevitchii* was unjustified.

**Occurrence.** — Upper Cretaceous (Campanian — Maastrichtian): Bugeen Tsav and Altan Ula I, (KYANSEP-ROMASCHKINA, 1975). Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

### *Mesochara voluta* (PECK, 1937) GRAMBAST, 1965
(pl. 26:2, 5)

1937. *Chara voluta* PECK; R. E. PECK, 85, pl. 14:16–19.
1941. *Chara voluta* PECK; R. E. PECK, 289, pl. 42:12–14.
1957. *Praechara voluta* (PECK) PECK; R. E. PECK, 39, pl. 7: 22–24, 26; *non* pl. 7: 25, 27.
1965. *Mesochara voluta* (PECK) GRAMBAST; L. GRAMBAST, 581
1967. *Mesochara voluta* (PECK) SCHAIKIN; J. M. SCHAIKIN, 46.
1970. *Mesochara voluta* (PECK) KARCZ. and ZIEMB.; J. KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 133, pl. 30:2, 3; fig. 6.
1975. *Mesochara voluta* (PECK) SCHAIKIN; N. P. KYANSEP-ROMASCHKINA, 197, pl. 4: 4–6.

**Material.** — About forty well preserved specimens.

**Description.** — Gyrogonites small, prolate spheroidal to subprolate (ISI 106–125) and ellipsoidal (ANI 44–51), with broadly rounded summits and slightly protruding bases; length from 340 to 411 μm, width from 285 to 350 μm. Seven to nine convolutions visible in lateral view. Cellular spirals concave, from 42 to 60 μm wide, delimited by sharp intercellular ridges. Cellular spirals continue onto summit without changing their size and shape, to join each other along a short irregular line. The outer opening of the basal pore situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 5°.

In longitudinal section, cellular spirals about 40 μm thick, fine-crystalline; in the apical part cellular spirals of the same thickness as at the equator. Basal plug thin, flat, deeply inserted, closing a funnel-like canal of the basal pore. Basal canal short and wide.

Measured gyrogonites of *Mesochara voluta* (PECK) GRAMBAST

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 284 | 340 | 285 | 119 | 149 | 44 | 8 | 56 | – |
| 286 | 357 | 299 | 119 | 170 | 48 | 8 | 42 | – |
| 285 | 362 | 340 | 106 | 187 | 51 | 8 | 54 | – |
| 289 | 374 | 319 | 120 | 183 | 49 | 9 | 51 | – |
| 292 | 380 | 318 | 120 | 183 | 48 | 7 | 51 | – |
| 290 | 380 | 300 | 125 | 187 | 49 | 7 | 49 | – |
| 203 | 394 | 341 | 115 | 164 | 44 | 7 | 56 | 41–60 |
| 287 | 398 | 350 | 112 | 195 | 50 | 7 | 54 | – |
| 288 | 400 | 340 | 118 | 180 | 45 | 8 | 60 | – |
| 291 | 411 | 331 | 123 | 204 | 50 | 8 | 46 | – |
| Range: | 340–411 | 285–350 | 106–125 | 149–204 | 44–51 | 7–9 | 42–60 | 41–60 |

**Remarks.** — The gyrogonites of the genus *Mesochara* are most differentiated and several species may be distinguished. KYANSEP-ROMASCHKINA (1975) included *M. voluta* described by KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970) to the species *M. stankevitchii* KYANSEP-ROMASCHKINA, which is disscussed earlier in this text, in remarks on *M. stankevitchii* (p. 118).

**Occurrence.** — Upper Jurassic, Lower Cretaceous (Aptian and Albian): North America. Upper Cretaceous: USSR, Moldavia-Krym; Central Asia-Western Erdeni Ula. Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Mesochara gradzinskii* sp. n.
(pl. 27:3-6)

*Holotype*: ZPAL MgChar-III/108; pl. 27:3.
*Type horizon*: Upper Cretaceous; Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *gradzinskii* — in honour of Professor RYSZARD GRADZIŃSKI who encouraged our research on Charophyta.

**Diagnosis.** — Gyrogonites very small, prolate spheroidal and ellipsoidal with broadly rounded summits and bases; length from 267 to 357 μm, width from 270 to 316 μm. Cellular spirals strongly concave, wide and of acute equatorial angle, delimited by sharp and protruding intercellular ridges. Cellular spirals continue onto the summit without changing their size and shape; apical junction short or punctiform.

**Material.** — About fifty well preserved specimens.

**Description.** — Gyrogonites very small, prolate spheroidal (ISI 98—114) and ellipsoidal (ANI 38—58), with broadly rounded summits and bases; length from 267 to 357 μm, width from 270 to 316 μm. Five to seven convolutions visible in lateral view. Cellular spirals strongly concave, 51 to 73 μm wide, delimited by sharp and protruding intercellular ridges. Cellular spirals continue onto the summit without changing their size and shape; apical junction short, in some specimens almost punctiform. Outer opening of the basal pore pentagonal, comparatively small, situated at the same level as the ends of surrounding spirals. Equatorial angle very acute, less than 5°.

Measured gyrogonites of *Mesochara gradzinskii* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 215 | 267 | 270 | 98 | 156 | 58 | 6 | 53 | 35–44 |
| 325 | 278 | 272 | 103 | 105 | 38 | 6 | 51 | – |
| 326 | 282 | 278 | 101 | 119 | 42 | 7 | 51 | – |
| 214 | 300 | 295 | 102 | 141 | 47 | 5 | 60 | 21–48 |
| 108 | 310 | 300 | 103 | 140 | 45 | 8 | 60 | – |
| 320 | 311 | 297 | 106 | 144 | 46 | 6 | 64 | – |
| 321 | 314 | 289 | 109 | 156 | 50 | 6 | 57 | – |
| 322 | 316 | 306 | 103 | 149 | 47 | 7 | 54 | – |
| 323 | 348 | 316 | 110 | 146 | 42 | 8 | 54 | – |
| 324 | 357 | 314 | 114 | 163 | 46 | 6 | 73 | – |
| Range: | 267–357 | 270–316 | 98–114 | 105–163 | 38–58 | 5–6 | 51–73 | 21–48 |

In longitudinal section, cellular spirals strongly calcified; in the apical part their thickness is about two times smaller than at the equator. Basal plug not preserved. Fructificational wall preserved imperfectly and only locally.

**Remarks.** — *Mesochara gradzinskii* sp. n. differs from other known species of *Mesochara* in being smaller and displaing a very acute equatorial angle of the spirals and low isopolarity index.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Mesochara inflata* sp. n.
(pl. 27:1, 2; pl. 7:1, 5)

*Holotype*: ZPAL MgChar-III/55; pl. 27: 1.
*Type horizon*: Upper Cretaceous, Nemegt Formation,
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *inflatus* = inflated.

**Diagnosis.** — Gyrogonites small, prolate spheroidal to subprolate and ellipsoidal with rounded summits and broadly truncated bases; length from 374 to 441 μm. Cellular spirals concave, delimited by low and blunt intercellular ridges. Cellular spirals continue onto the summit without changing their shape and size; apical junction predominantly punctiform. Equatorial angle about 15°.

**Material.** — About fifty well preserved specimens.

**Description.** — Gyrogonites small, prolate spheroidal to subprolate (ISI 109—124) and ellipsoidal (ANI 43—47), with rounded summits and broadly truncated bases; length from 374 to 441 μm, width from 335 to 362 μm. Six to nine convolutions visible in lateral view. Cellular spirals concave, from 50 to 60 μm wide, delimited by low and blunt intercellular ridges. Cellular spirals continue onto the summit without changing their size and shape. In the apical centre spiral ends slightly pointed, forming a punctiform apical junction, or meeting each other along a short irregular line. Outer opening of the basal pore distinctly pentagonal, situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 15°.

Measured gyrogonites of *Mesochara inflata* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 293 | 374 | 340 | 110 | 161 | 43 | 8 | 51 | – |
| 213 | 377 | 345 | 109 | 167 | 44 | 8 | 60 | 46 |
| 209 | 385 | 335 | 115 | 180 | 47 | 6 | 60 | 39–53 |
| 55 | 390 | 320 | 121 | 185 | 47 | 9 | 50 | – |
| 294 | 399 | 357 | 109 | 176 | 44 | 8 | 57 | – |
| 295 | 400 | 362 | 111 | 187 | 47 | 8 | 51 | – |
| 296 | 401 | 362 | 111 | 183 | 45 | 7 | 57 | – |
| 297 | 408 | 340 | 120 | 183 | 45 | 8 | 59 | – |
| 298 | 416 | 340 | 123 | 184 | 44 | 9 | 54 | – |
| 212 | 441 | 356 | 124 | 204 | 46 | 7 | 60 | 41–60 |
| Range: | 374–441 | 335–362 | 109–124 | 161–204 | 43–47 | 6–9 | 50–60 | 39–60 |

In longitudinal section, cellular spirals fine-crystalline, of an average thickness (about 59 μm), in the apical part somewhat thinner than at the equator. Basal canal long and funnel-like; outer part of the basal pore enclosed by appendages protruding downwards from the gyrogonite.

**Remarks.** — *Mesochara inflata* sp. n. is most similar to *Mesochara voluta* (PECK) GRAMBAST from which it differs in being larger and having more pointed apical part, more elongated

and truncate basal part, higher equatorial angle and thinning apical part of cellular spirals visible in longitudinal section.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

### *Mesochara luculenta* sp. n.

(pl. 29;4, 5; pl. 30:8, 12)

*Holotype*: ZPAL MgChar-III/33; pl. 29: 5.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *luculentus* = glistening.

**Diagnosis.** — Gyrogonites small, subprolate to prolate and ellipsoidal, with protruding summits and rounded bases; length from 360 to 454 μm, width from 295 to 350 μm. Cellular spirals wide and concave, delimited by low and blunt intercellular ridges. Cellular spirals reach the apex at a relatively high angle, forming slightly extended apical junction. Equatorial angle about 15°.

**Material.** — About forty well preserved specimens.

**Description.** — Gyrogonites small, subprolate to prolate (ISI 120—138) and ellipsoidal (ANI 43—50), with protruding summits and rounded bases; length from 360 to 454 μm, width from 295 to 350 μm. Seven to nine convolutions visible in lateral view. Cellular spirals wide (42–64 μm), delimited by low and blunt intercellular ridges. Cellular spirals reach the apex at a relatively high angle, forming slightly extended apical junction. The outer opening of

Measured gyrogonites of *Mesochara luculenta* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 33 | 360 | 295 | 122 | 170 | 47 | 8 | 45 | – |
| 299 | 369 | 302 | 122 | 185 | 50 | 8 | 47 | – |
| 300 | 391 | 309 | 126 | 170 | 43 | 8 | 47 | – |
| 199 | 396 | 330 | 120 | 171 | 44 | 8 | 60 | 46–60 |
| 301 | 405 | 331 | 122 | 175 | 43 | 8 | 59 | – |
| 305 | 419 | 340 | 123 | 209 | 50 | 8 | 56 | – |
| 304 | 430 | 328 | 131 | 209 | 48 | 7 | 57 | – |
| 303 | 440 | 320 | 138 | 207 | 47 | 7 | 64 | – |
| 302 | 442 | 350 | 126 | 208 | 47 | 7 | 51 | – |
| 307 | 454 | 340 | 133 | 221 | 49 | 9 | 51 | – |
| Range: | 360–454 | 295–350 | 120–138 | 170–221 | 43–50 | 7–9 | 45–64 | 46–60 |

the basal pore pentagonal, situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 15°.

In longitudinal section, cellular spirals thick in the apical part gradually thinning down to 1/3 of their thickness at the equator. Basal canal funnel-like, long and narrow. Basal plug not preserved. Fructification wall visible locally as a dark zone.

**Remarks.** — *M. luculenta* sp. n. is most similar to those of *M. stankevitchii* KYANSEP-ROMASCHKINA from which it differs in displaying lower isopolarity index and having more rounded bases, wider cellular spirals and lower equatorial angle. From *Mesochara inflata*

sp. n. it differs in having less elongated bases, thicker cellular spirals and somewhat lower isopolarity index.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Mesochara obventicia* sp. n.
(pl. 30:5–7, 10)

*Holotype*: ZPAL MgChar-III/51; pl. 30:10.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *obventicius* = incidental.

**Diagnosis.** — Gyrogonites small, subprolate to prolate and ellipsoidal, with slightly protruding summits and bases; length from 340 to 403 μm, width from 272 to 324 μm. Cellular spirals concave, delimited by distinct and protruding intercellular ridges. Cellular spirals continue onto the summit at a large angle; in the apical part spirals slightly narrower; apical junction punctiform. Equatorial angle about 20°.

**Material.** — About twenty well preserved specimens.

**Description.** — Gyrogonites small, subprolate to prolate (ISI 124—144), and subovoidal to ellipsoidal (ANI 40—51), with slightly protruding summits and bases; length from 340 to 403 μm, width from 272 to 324 μm. Seven to ten convolutions visible in lateral view. Cellular spirals concave, delimited by distinct and protruding intercellular ridges. Cellular spirals continue onto summit at a large angle, narrowing slightly in the apical periphery, extending and rising to meet each other at one point or along a very short irregular line. At the equator cellular spirals from 34 to 60 μm wide. Basal part, as a rule, slightly prolonged, but truncate in the basal centre. Outer opening of the basal pore pentagonal, situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 20°.

In longitudinal section, cellular spirals fine-crystalline, thick and of the same thickness in the apical part as at the equator. Basal plug thin, deeply inserted, closing funnel-like canal of the basal pore. Basal canal wide; the outer part of the basal pore enclosed by thick appendages protruding downwards from the gyrogonite.

Measured gyrogonites of *Mesochara obventicia* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 312 | 340 | 275 | 124 | 148 | 43 | 9 | 34 | |
| 315 | 352 | 277 | 127 | 147 | 42 | 8 | 44 | |
| 316 | 374 | 285 | 132 | 175 | 47 | 10 | 35 | |
| 314 | 375 | 275 | 136 | 148 | 40 | 9 | 39 | |
| 51 | 375 | 280 | 134 | 150 | 40 | 8 | 35 | |
| 319 | 379 | 284 | 134 | 197 | 51 | 10 | 39 | |
| 317 | 380 | 277 | 138 | 194 | 51 | 9 | 39 | |
| 318 | 386 | 289 | 133 | 170 | 44 | 9 | 35 | |
| 313 | 391 | 272 | 144 | 170 | 43 | 9 | 34 | |
| 210 | 403 | 324 | 124 | 173 | 43 | 7 | 60 | 32–48 |
| Range: | 340–403 | 272–324 | 124–144 | 147–197 | 40–51 | 7–10 | 34–60 | 32–48 |

**Remarks.** — *M. obventicia* sp. n. is most similar to *M. mongolica*, from which it differs in being smaller and having less elongated apex, more rounded bases and larger basal canal encircled by very thick spiral endings.

**Occurrence.** — Upper Cretaceous (Nemegt Formation): Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Mesochara orientalis* sp. n.
(pl. 25:2–4; pl. 26:1)

*Holotype*: ZPAL MgChar-III/83; pl. 25:3.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *orientalis* = eastern.

**Diagnosis.** — Gyrogonites middle-sized, prolate and ellipsoidal, with protruding summits and prolonged but subtruncate bases. Cellular spirals concave, with secondary ridges of almost the same height as the intercellular ridges. Cellular spirals continue onto summit at a large angle, narrowing slightly in the apical periphery; apical junction punctiform. Basal plug thin.

**Material.** — Ten well preserved specimens.

**Description.** — Gyrogonites middle-sized, prolate (ISI 150—210) and ellipsoidal (ANI 41—49) with protruding summits and prolonged but subtruncate bases; length from 457 to 620 μm, width from 223 to 352 μm. Eight to eleven convolutions visible in lateral view. Cellular

Measured gyrogonites of *Mesochara orientalis* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 309 | 457 | 300 | 153 | 210 | 41 | 10 | 51 | |
| 308 | 465 | 312 | 150 | 224 | 48 | 11 | 54 | |
| 223 | 492 | 320 | 154 | 233 | 47 | 9 | 60 | 46 |
| 310 | 493 | 223 | 210 | 240 | 49 | 8 | 51 | |
| 311 | 527 | 353 | 150 | 231 | 44 | 10 | 61 | |
| 83 | 620 | 400 | 154 | 300 | 48 | 9 | 65 | |
| Range: | 457–620 | 223–352 | 150–210 | 210–300 | 41–49 | 8–11 | 51–65 | 46 |

spirals concave, with well developed and distinctly ornamented secondary ridges. Intercellular ridges somewhat lower than the secondary ones. Cellular spirals continue onto summit at a large angle narrowing slightly in the apical periphery, extending and rising to meet each other at one point or along a very short irregular line. Poorly developed tubercles are visible below the apical junction. Cellular spirals at the equator from 51 to 65 μm wide. Basal part elongated but truncate in the basal centre. Outer opening of the basal pore small, situated at the same level as the protruding ends of surrounding spirals. Equatorial angle about 10°.

In longitudinal section, cellular spirals are of an average thickness ca. 46 μm composed of two calcification zones; the inner one thinner, darker and fine-crystalline, the outer thicker, light-coloured and crystalline in texture. In the apical part cellular spirals are thinner than at the equator. Basal plug thin, flat, deeply inserted, closing a funnel-like canal of the basal pore. Basal canal wide; the outer opening of the basal pore enclosed by thick appendages that protrude downwards from the gyrogonite. Oospore membrane represented by black line along the interior walls of the spirals.

**Remarks.** — *Mesochara orientalis* sp. n. is most similar to *Mesochara terebrata* KARCZ. and ZIEMB., 1972 from which it differs in having larger dimensions, smaller protrusion of the summit, and more elongated cellular spirals in the basal part.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt, Nemegt Basin, Gobi Desert.

*Mesochara* sp.
(pl. 30:1, 2; pl. 31:4, 5)

**Material.** — Five well preserved specimens.

**Description.** — Gyrogonites middle-sized, prolate (ISI 140—151) and ellipsoidal (ANI 47—50), with protruding summits and bases; length from 510 to 560 μm, width from 352 to 400 μm. Eight to ten convolutions visible in lateral view. Cellular spirals concave, with secondary ridges. Cellular spirals continue onto the summit without changing their shape and size; in the apical centre they join each other in one point. At the equator cellular spirals from 56 to 68 μm wide. Basal part slightly prolonged. Outer opening of the basal pore situated at the same level as the ends of surrounding spirals. Equatorial angle about 20°.

In longitudinal section, cellular spirals thick (50 μm) and composed of two calcification zones; the inner one thin, darker, the outer four times thicker. Secondary ridges higher than the

Measured gyrogonites of *Mesochara* sp.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 329 | 510 | 365 | 140 | 238 | 47 | 10 | 66 | |
| 155 | 532 | 352 | 151 | 266 | 50 | 10 | 60 | |
| 328 | 533 | 382 | 140 | 263 | 49 | 10 | 61 | |
| 330 | 535 | 357 | 150 | 255 | 50 | 8 | 64 | |
| 221 | 560 | 400 | 140 | 270 | 49 | 10 | 68 | 50 |
| Range: | 510–560 | 352–400 | 140–151 | 238–270 | 47–50 | 8–10 | 56–68 | 50 |

intercellular ones, especially strongly developed in the apical part. Basal plug thinner than wide. Oospore membrane represented by black line along interior wall of spirals.

**Remarks.** — *Mesochara* sp. described herein is most similar to *Mesochara* sp. described by KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1972) from the Palaeocene deposits of Mongolia, from which it differs in having somewhat larger dimensions and smaller protrusion of the summit.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt, Nemegt Basin, Gobi Desert.

Genus *Microchara* GRAMBAST, 1959

*Type species*: *Microchara hystrix* GRAMBAST, 1959, France, Eocene.

*Microchara* cf. *cristata* GRAMBAST, 1971
(pl. 30:3, 4, 9, 11)

**Material.** — About forty well preserved specimens.

**Description.** — Gyrogonites small, prolate spheroidal to subprolate (ISI 103—130) and ellipsoidal (ANI 40—54), with rounded summits and slightly protruding bases; length from 397 to 510 μm, width from 340 to 433 μm. Seven to ten convolutions visible in lateral view.

Cellular spirals wide (54–69 μm), concave, with secondary ridges well developed, often ornamented by small and indistinctly delimited protuberances. Secondary ridges more conspicuous than the intercellular ones. Intercellular ridges low and sharp, with invisible sutures. Cellular spirals continue onto the summit without changing their width; secondary ridges disappearing at the apical periphery. The apical centre is occupied by more or less distinctly developed cellular tubercles, situated on each of the tips close to the apical junction. Basal pole slightly protruding but truncate in the basal centre; intercellular ridges markedly higher, ending more or less roundedly towards the basal pore. Outer opening of the basal pore pentagonal, situated somewhat lower than the protruding ends of surrounding spirals. Equatorial angle about 10°.

In longitudinal section, cellular spirals wide, with secondary ridges higher than the intercellular ones; in the apical part they are of the same thickness or somewhat thicker than at the equator. In the apical periphery cellular spirals without secondary ridges raising in the apical centre to form distinct apical nodules. Basal plug not preserved.

**Remarks.** — Gyrogonites of *Microchara* cf. *cristata* from Mongolia differ from those described by GRAMBAST (1971) from the Upper Cretaceous of southern France in being smaller and displaying somewhat lower isopolarity index, therefore they can be only tentatively included in this species.

Measured gyrogonites of *Microchara* cf. *cristata* GRAMBAST, 1971

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 422 | 397 | 340 | 116 | 209 | 53 | 8 | 61 | |
| 423 | 400 | 387 | 103 | 183 | 45 | 7 | 59 | |
| 424 | 442 | 374 | 118 | 232 | 53 | 8 | 61 | |
| 194 | 458 | 410 | 112 | 185 | 40 | 8 | 60 | 51 |
| 165 | 457 | 385 | 118 | 216 | 47 | 9 | 64 | |
| 166 | 467 | 408 | 114 | 230 | 49 | 9 | 63 | |
| 425 | 467 | 357 | 130 | 224 | 48 | 9 | 54 | |
| 426 | 486 | 385 | 126 | 231 | 48 | 9 | 64 | |
| 427 | 489 | 413 | 117 | 265 | 54 | 10 | 64 | |
| 428 | 510 | 433 | 117 | 246 | 48 | 8 | 69 | |
| Range: | 397–510 | 340–433 | 103–130 | 183–265 | 40–54 | 7–10 | 54–69 | 51 |

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Mongolichara* (KYANSEP-ROMASCHKINA, 1975) emend. KARCZEWSKA and KYANSEP-ROMASCHKINA, 1979

*Type species*: *Mongolichara gobica* (KARCZ. and ZIEMB., 1970) KARCZEWSKA and KYANSEP-ROM., 1979, Mongolia, Upper Cretaceous.

### *Mongolichara gobica* (KARCZ. and ZIEMB., 1970) KARCZEWSKA and KYANSEP-ROMASCHKINA, 1979

(pl. 35:4–6)

1970. *Tectochara gobica* KARCZ. and ZIEMB.; KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 137–139, pl. 33: 1, 2; pl. 34: 5, fig. 10.

1975. *Mongolichara deplanata* KYANSEP-ROM.; KYANSEP-ROMASCHKINA, 201, pl. 5: 2.

1979. *Mongolichara gobica* (KARCZ. and ZIEMB.) KARCZEWSKA and KYANSEP-ROM; KARCZEWSKA and KYANSEP-ROMASCHKINA, 424, pl. 3: 1–4.

**Material.** — About 700 well preserved specimens.

**Description.** — See KARCZEWSKA and KYANSEP-ROMASCHKINA (1979).

**Additional description.** — In longitudinal section, two calcification zones are visible; the inner one darker, thin, composed of crystals of uniform size, closely set, perpendicular to the oospore membrane. The outer zone light-coloured, three to four times thicker than the inner one, with well developed lamination. Secondary ridges wide, higher than the intercellular ones. Basal plug thick, pyramidal, with inner surface flat and outer one concave. Canal of the

Measured gyrogonites of *Mongolichara gobica* (KARCZ. and ZIEMB.) KARCZEWSKA and KYANSEP-ROMASCHKINA

| ZPAL MgChar- | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| I/62 | 427 | 375 | 144 | 205 | 48 | 7 | 57 | – |
| I/63 | 455 | 370 | 123 | 205 | 45 | 8 | 50 | – |
| III/190 | 578 | 501 | 115 | 278 | 48 | 7 | 87 | 80 |
| III/241 | 586 | 535 | 109 | 306 | 52 | 7 | 93 | – |
| III/242 | 612 | 544 | 112 | 311 | 50 | 7 | 107 | – |
| III/243 | 630 | 598 | 106 | 340 | 54 | 6 | 102 | – |
| III/244 | 637 | 612 | 103 | 295 | 46 | 7 | 90 | – |
| III/245 | 663 | 569 | 118 | 272 | 41 | 9 | 85 | – |
| III/189 | 675 | 600 | 112 | 276 | 41 | 7 | 98 | 99 |
| III/246 | 697 | 649 | 104 | 323 | 46 | 7 | 104 | – |
| Range: | 427–697 | 375–649 | 103–123 | 205–340 | 41–54 | 6–9 | 50–107 | 80–99 |

basal pore short and wide. Two calcification zones also distinctly developed. Fructificational wall visible in sectioned specimens as a brownish, distinctly delimited zone.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, present paper). Upper Cretaceous (Campanian — Maastrichtian) Bugeen Tsav, Altan Ula, Ulan Bulak (KYANSEP-ROMASCHKINA, 1975).

### *Mongolichara aurea* (KARCZ. and ZIEMB.) KARCZ. and KYANSEP-ROM., 1979
(pl. 15:2, 5)

1970. *Tectochara aurea* KARCZ. and ZIEMB.; J. KARCZEWSKA and M. ZIEMBIŃSKA-TWORZYDŁO, 141–142, pl. 30: 4; fig. 12.
1979. *Mongolichara aurea* (KARCZ. and ZIEMB.) comb. n.; J. KARCZEWSKA and N. P. KYANSEP-ROMASCHKINA, pl. 4:2a–c.

**Material.** — About fifty well preserved specimens.

**Description.** — See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970).

**Additional description.** — In longitudinal section, two calcification zones are visible; inner zone darker, very thin, the outer one light-coloured, five times thicker. In the apical part cellular spirals three times thinner than at the equator. Basal plug thinner than wide, the inner part slightly convex, the outer one concave. Fructification wall preserved imperfectly and only locally.

**Remarks.** — See KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970). *Mongolichara aurea* is most similar to *Mongolichara costulata* KYANSEP-ROMASCHKINA (1975) from which it differs in being much smaller.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

*Mongolichara costulata* KYANSEP-ROMASCHKINA, 1975
(pl. 23:1, 2, 4–6)

1975. *Mongolichara costulata* KYANSEP-ROM.; N. P. KYANSEP-ROMASCHKI NA, 202, pl. 5: 3; pl. 6: 1, 4.

**Material.** — About 450 well preserved specimens.

**Description.** — Because KYANSEP-ROMASCHKINA has not described longitudinal section of the gyrogonites, this description is given in the present paper.

In longitudinal section, cellular spirals of gyrogonites thick and wide (80–87 μm), with poorly marked lamination.

Secondary ridges low, of almost the same height as the intercellular ones. Cellular spirals in the apical periphery narrowing abruptly, two or three times narrower in the apical centre than at the equator, forming a distinct apical depression. Oospore membrane represented by black zone occurring along the inner walls of the cellular spirals.

**Occurrence.** — Upper Cretaceous (Campanian — Maastrichtian), Bugeen Tsav, Altan Ula and Ulan Bulak (KYANSEP-ROMASCHKINA, 1975). Upper Cretaceous (Nemegt Formation) Nemegt and Altan Ula IV (KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, present paper), Nemegt Basin, Gobi Desert.

*Mongolichara fulgida* sp. n.
(pl. 24:2, 5–7)

*Holotype*: ZPAL MgChar-III/150; pl. 24:2.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *fulgidus* = lustrous.

**Diagnosis.** — Gyrogonites middle-sized, subprolate and subovoidal to ellipsoidal with, broadly rounded and somewhat flattened summits and rounded bases. Cellular spirals thick and flat to convex. In the apical part cellular spirals narrower and depressed forming a distinct peripheral groove; in the apical centre these are slightly thicker meeting each other along a very short irregular line. Basal plug thick. Outer opening of the basal pore distinctly pentagonal, situated in the bottom of a low crater-like depression.

**Material.** — About 150 well preserved specimens.

**Description.** — Gyrogonites middle-sized, subprolate (ISI 112—125) and subovoidal to ellipsoidal (ANI 36—48), with broadly rounded and somewhat flattened summits and rounded bases; length from 642 to 751 μm, width from 534 to 637 μm. Seven to nine convolutions visible in lateral view. Cellular spirals flat to convex, from 79 to 102 μm wide, delimited by distinct,

Measured gyrogonites of *Mongolichara fulgida* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 255 | 642 | 558 | 112 | 292 | 45 | 8 | 93 | – |
| 150 | 650 | 540 | 120 | 309 | 47 | 8 | 90 | – |
| 224 | 654 | 534 | 123 | 315 | 48 | 7 | 102 | 99 |
| 256 | 680 | 544 | 125 | 309 | 45 | 8 | 95 | – |
| 257 | 680 | 561 | 121 | 320 | 47 | 8 | 81 | – |
| 258 | 680 | 586 | 117 | 323 | 47 | 8 | 93 | – |
| 259 | 680 | 595 | 114 | 299 | 43 | 8 | 98 | – |
| 260 | 700 | 567 | 124 | 306 | 44 | 8 | 85 | – |
| 261 | 705 | 589 | 118 | 251 | 36 | 9 | 79 | – |
| 262 | 751 | 637 | 118 | 284 | 38 | 9 | 90 | – |
| Range: | 642–751 | 534–637 | 112–125 | 251–323 | 36–48 | 7–9 | 79–102 | 99 |

slightly depressed intercellular sutures. In the apical part cellular spirals much narrower forming a peripheral groove; in the apical centre these are somewhat thicker, uniting along a very short irregular line. In the basal pole cellular spirals as wide as at the equator, with their tips slightly widened around the basal pore. Outer opening of the basal pore pentagonal, situated in the bottom of a low crateriform depression. Equatorial angle about 10°.

In longitudinal section, cellular spirals thick (about 100 μm) composed of two calcification zones; the inner one somewhat darker, fibrous in texture. The outer zone three times thicker and fine-crystalline, with more or less distinctly marked lamination. In the apical part a very strong thinning of the spirals down to half of their thickness at the equator is visible. In the basal part ends of cellular spirals as thick as at equator, surrounding a short funnel-like canal of the basal pore. Basal plug well developed, also composed of two calcification zones, thick, pyramidal, with the inner surface convex and the outer concave. Oospore membrane represented by black line along interior walls of spirals.

**Remarks.** — *Mongolichara fulgida* sp. n. is most similar to *M. costulata* KYANSEP-ROMASCHKINA (1975), the distinguishing characters of the species are convex cellular spirals, more acute equatorial angle and different thickness of the calcification zones in longitudinal section.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## *Mongolichara grovesioides* sp. n.

(pl. 33: 4, 5, 7, 8)

*Holotype*: ZPAL Mg Char-III/48; pl. 33: 7.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *grovesioides* = displaying some similarity to *Grovesichara*.

**Diagnosis.** — Gyrogonites middle-sized, prolate spheroidal to subprolate and ellipsoidal with rounded summits and subtruncated bases. Cellular spirals convex with tendention to ornamentation. In the apical part cellular spirals slightly narrower and depressed forming a distinct peripheral groove and uniting in the apical centre along a short irregular line. Outer opening of the basal pore at the same level as the widened ends of surrounding spirals.

**Material.** — About 120 well preserved specimens.

Measured gyrogonites of *Mongolichara grovesioides* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 237 | 528 | 433 | 122 | 264 | 50 | 7 | 73 | 58 |
| 263 | 586 | 540 | 108 | 277 | 46 | 7 | 80 | – |
| 264 | 629 | 574 | 110 | 306 | 49 | 9 | 90 | – |
| 265 | 646 | 547 | 118 | 306 | 47 | 7 | 98 | – |
| 48 | 650 | 546 | 119 | 320 | 49 | 8 | 95 | – |
| 266 | 680 | 557 | 120 | 340 | 50 | 8 | 107 | – |
| 267 | 680 | 640 | 196 | 317 | 46 | 8 | 93 | – |
| 268 | 697 | 590 | 118 | 323 | 47 | 9 | 90 | – |
| 269 | 703 | 593 | 120 | 340 | 47 | 8 | 95 | – |
| Range: | 528–703 | 433–640 | 106–120 | 264–340 | 46–50 | 7–9 | 73–107 | 58 |

**Description.** — Gyrogonites middle-sized, prolate spheroidal to subprolate (ISI 106—120) and ellipsoidal (ANI 46—50), with broadly rounded summits and subtruncated bases; length from 528 to 703 μm, width from 433 to 640 μm. Seven to nine convolutions visible in lateral view. Cellular spirals flat to convex, from 73 to 107 μm wide, delimited by well developed intercellular sutures. A few gyrogonites possess regularly spaced low tubercles on the surface of the cellular spirals. In the apical part cellular spirals slightly narrower forming a low apical depression, and uniting along a short irregular line. At the basal pole cellular spirals as wide as at the equator. Outer opening of the basal pore at the same level as the widened ends of surrounding spirals. Equatorial angle less than 10°.

In longitudinal section cellular spirals thick, composed of two calcification zones; the inner one somewhat darker, not well preserved; the outer zone three times thicker, with more or less distinctly marked lamination. In the apical part cellular spirals twice thinner than at the equator. Basal plug unknown. Oospore membrane preserved imperfectly and only locally.

**Remarks.** — *Mongolichara grovesioides* sp. n. is most similar to *M. fulgida* sp. n. from which it differs in having subtruncated shape of the basal part, lacking the crateriform basal depression and displaying a tendention to surface ornamentation.

**Occurrence.** — Upper Cretaceous, (Nemegt Formation); Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

### ?*Mongolichara immatura* sp. n.

(pl. 34:6, 8–10)

*Holotype*: ZPAL MgChar-III/161: pl. 34:10.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *immaturus* = immature.

**Diagnosis.** — Gyrogonites small to middle-sized, subprolate to prolate and ellipsoidal with broadly rounded summits and subtruncate bases. Cellular spirals flat to convex. In the apical part cellular spirals narrower and thinning gradually to form an indistinct peripheral groove; in the apical centre cellular spirals sometimes slightly thicker, uniting along a short irregular line. Outer opening of the basal pore distinctly pentagonal, situated in the bottom of a crateriform depression.

**Material.** — About 100 well preserved specimens.

**Description.** — Gyrogonites small to middle-sized, subprolate to prolate (ISI 122—145) and predominantly ellipsoidal (ANI 42—53), with broadly rounded summits and subtruncate bases; length from 459 to 561 μm, width from 354 to 445 μm. Six to nine convolutions visible in lateral view. Cellular spirals smooth and flat to convex, from 47 to 76 μm wide, delimited by more or less depressed intercellular sutures. In the apical part cellular spirals narrowing gradually to form a low peripheral groove, meeting each other along a short irregular line. At the basal pole cellular spirals slightly widened and somewhat extended around the basal pore. Outer opening of the basal pore distinctly pentagonal, situated in the bottom of a crateriform depression. Equatorial angle about 10°.

In longitudinal section, cellular spirals of an average thickness (42–60 μm), composed of two indistinctly marked calcification zones; the inner one somewhat darker, fibrous in texture. The outer zone three times thicker, with more or less distinctly marked lamination. In the apical part cellular spirals thinning gradually, but only in the apical periphery slightly depressed or forming poorly marked peripheral groove. At the basal pole cellular spirals somewhat thinner than at the equator, surrounding short canal of the basal pore. Basal plug not well preserved, wider than thick, deeply inserted.

**Remarks.** — ?*Mongolichara immatura* sp. n. is most similar to *M. fulgida* from which it differs in having smaller dimensions and more elongated shape. Moreover, in ?*M. immatura*

Measured gyrogonites of? *Mongolichara immatura* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 270 | 459 | 354 | 130 | 229 | 50 | 9 | 47 | – |
| 161 | 460 | 374 | 123 | 220 | 48 | 8 | 66 | – |
| 229 | 480 | 390 | 123 | 225 | 47 | 7 | 66 | 42 |
| 230 | 495 | 370 | 134 | 225 | 44 | 6 | 72 | 60 |
| 271 | 510 | 365 | 140 | 255 | 50 | 8 | 74 | – |
| 273 | 510 | 404 | 127 | 212 | 42 | 8 | 59 | – |
| 228 | 522 | 414 | 126 | 280 | 53 | 8 | 66 | 50 |
| 274 | 540 | 374 | 145 | 246 | 45 | 9 | 76 | – |
| 272 | 547 | 445 | 122 | 272 | 50 | 8 | 71 | – |
| 275 | 561 | 394 | 142 | 250 | 44 | 7 | 64 | – |
| Range: | 459–561 | 354–445 | 122–145 | 212–280 | 42–53 | 6–9 | 47–76 | 42–60 |

the cellular spirals are not so distinctly depressed in the apical part as it is the case in all other recorded species of *Mongolichara*. Only in some specimens an indistinct peripheral depression may be observed. For these reasons this species is only tentatively included in *Mongolichara*.

**Occurrence.** — Upper Cretaceous (Nemegt Formation); Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## *Mongolichara turnaui* sp. n.

(pl. 33:1–3, 6, 9)

*Holotype*: ZPAL MgChar-III/130; pl. 33:2.

*Type horizon*: Upper Cretaceous, Nemegt Formation

*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.

*Derivation of the name*: *turnaui* — in honour of Dr E. TURNAU (Institute of Geological Sciences, Polish Academy of Sciences, Cracow).

**Diagnosis.** — Gyrogonites middle-sized, subprolate to prolate and subovoidal to ellipsoidal with broadly rounded summits and protruding bases. Cellular spirals concave with secondary ridges somewhat higher than the intercellular ones. In the apical periphery cellular spirals narrow distinctly, forming a well delimited depression; in the apical centre they thicken slightly meeting each other along a very short irregular line. Basal plug thick. Outer opening of the basal pore situated in the bottom of a low, crater-like depression.

**Material.** — About 130 well preserved specimens.

**Description.** — Gyrogonites middle-sized, subprolate to prolate (ISI 120—139) and subovoidal to ellipsoidal (ANI 40—52), with broadly rounded summits and protruding bases; length from 612 to 748 μm, with from 472 μm to 612 μm. Seven to nine convolutions visible in lateral view. Cellular spirals concave, from 78 to 110 μm wide, delimited by low and thin intercellular ridges; secondary ridges well developed, wider and thicker than the intercellular ones. In the apical periphery cellular spirals narrower and depressed, somewhat thicker toward the summit, meeting each other in the apical centre along a very short irregular line. Basal part, as a rule, slightly prolonged but truncate in the basal centre. Outer opening of the basal pore pentagonal, situated in the bottom of a low crater-like depression formed by thickened ends of the surrounding spirals. Equatorial angle about 15°.

In longitudinal section, cellular spirals thick, composed of two calcification zones; the inner one somewhat darker, coarse-crystalline, the crystals closely packed, perpendicular to the oospore membrane. The outer zone fine-crystalline with poorly marked lamination. In the api-

Measured gyrogonites of *Mongolichara turnaui* sp. n.

| ZPAL MgChar-III | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 247 | 612 | 472 | 130 | 306 | 50 | 8 | 88 | – |
| 248 | 663 | 544 | 120 | 316 | 47 | 7 | 98 | – |
| 249 | 680 | 510 | 133 | 270 | 40 | 8 | 88 | – |
| 250 | 680 | 533 | 127 | 289 | 42 | 10 | 78 | – |
| 251 | 688 | 544 | 126 | 362 | 52 | 8 | 95 | – |
| 252 | 705 | 510 | 139 | 290 | 41 | 9 | 88 | – |
| 225 | 708 | 555 | 128 | 348 | 49 | 8 | 83 | 83 |
| 253 | 709 | 574 | 123 | 340 | 48 | 7 | 110 | – |
| 130 | 720 | 540 | 133 | 330 | 46 | 8 | 90 | – |
| 254 | 748 | 612 | 122 | 374 | 50 | 8 | 102 | – |
| Range: | 612–748 | 470–612 | 120–139 | 270–374 | 40–52 | 7–10 | 78–110 | 83 |

cal part cellular spirals twice thinner than at the equator and formed only by the inner calcification zone. In the basal part the ends of cellular spirals slightly thinner, surrounding short and cylindrical canal of the basal pore. Basal plug also composed of the calcification zones, thick, pyramidal, with the inner surface flat and the outer concave. Fructificational wall visible in the specimens sectioned as a brownish, distinctly delimited zone.

**Remarks.** — *Mongolichara turnaui* sp. n. is most similar to *Mongolichara costulata* KYANSEP-ROMASCHKINA (1975) from which it differs in having more elongated shape, more protruding bases and somewhat larger dimensions.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Obtusochara* MÄDLER, 1952

*Type species*: *Obtusochara prima* MÄDLER, 1952, Germany, Kimmerdgian.

### *Obtusochara* cf. *lanpingensis* Z. WANG, HUANG and S. WANG, 1976

(pl. 23:3a–c)

**Material.** — One well preserved specimen.

**Description.** — Gyrogonite middle-sized (length — 566 μm, width 360 μm), prolate (ISI 157) and subovoidal (ANI 38), with flattened summit and somewhat protruding base. Eight convolutions visible in lateral view. Cellular spirals flat, wide (72 μm), intercellular ridges lacking, intercellular sutures distinctly visible. In the apical periphery cellular spirals somewhat narrowing meeting each other along a very short irregular line. In the basal part cellular spirals slightly narrowing; outer opening of the basal pore at the same level as the protruding ends of surrounding spirals. Basal plug unknown. Equatorial angle about 25°.

**Remarks.** — *Obtusochara* cf. *lanpingensis* falls within the range of size variability of *Obtusochara lanpingensis* S. WANG *et al.*, but it has cellular spirals narrowing slightly in the apical periphery, and more protruding basal part.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt, Nemegt Basin, Gobi Desert.

## Genus *Peckichara* GRAMBAST, 1957

*Type species*: *Peckichara varians* GRAMBAST, 1957, France, Eocene.

### *Peckichara praecursoria* sp. n.

(pl. 34:1–4, 7)

*Holotype*: ZPAL MgChar-III/42; pl. 34:1.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: Lat. *praecursorius* = preceding.

**Diagnosis.** — Gyrogonites middle-sized, prolate spheroidal to subprolate and ellipsoidal with subtruncate summits and rounded bases. Cellular spirals thick with secondary ridges well developed. In the apical periphery, cellular spirals slightly narrower and thinner than at the equator, forming an interrupted peripheral groove. In the apical centre, cellular spirals with distinctly developed apical nodules. Basal pore situated in the bottom of a distinct pentagonal depression.

**Material.** — About thirty well preserved specimens.

**Description.** — Gyrogonites middle-sized, prolate spheroidal to subprolate (ISI 104–123) and ellipsoidal (ANI 44–51), with rounded and subtruncated summits and broadly truncated bases; length from 619 to 680 μm, width from 552 to 629 μm. Six to eight convolutions visible in lateral view. Cellular spirals concave or flat, from 96 to 113 μm, wide, with secondary

Measured gyrogonites of *Peckichara praecursoria* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 192 | 619 | 593 | 104 | 270 | 44 | 6 | 96 | 112 |
| 379 | 642 | 569 | 113 | 332 | 51 | 6 | 110 | |
| 380 | 646 | 600 | 107 | 300 | 46 | 6 | 112 | |
| 42 | 656 | 520 | 123 | 320 | 49 | 8 | 105 | |
| 381 | 680 | 595 | 114 | 300 | 44 | 7 | 113 | |
| 375 | 680 | 629 | 108 | 337 | 50 | 7 | 105 | |
| 376 | 680 | 552 | 123 | 306 | 45 | 7 | 102 | |
| 377 | 680 | 583 | 116 | 330 | 48 | 7 | 98 | |
| 378 | 680 | 560 | 121 | 297 | 49 | 6 | 102 | |
| Range: | 619–680 | 552–629 | 104–123 | 270–337 | 44–51 | 6–8 | 96–113 | 112 |

ridges well developed. Intercellular ridges low and narrow, with sutures poorly marked. In the apical periphery cellular spirals slightly narrower and thinner forming an interrupted peripheral groove. In the apical centre extended and the thickened spiral ends form more or less distinctly developed nodules. In the basal pole cellular spirals as wide as at the equator, with the tips slightly widened around the basal pore and ending roundedly. Basal depression distinct, regularly pentagonal and crateriform. Equatorial angle about 20°.

In longitudinal section, cellular spirals thick (about 110 μm) with poorly marked two calcification zones; the inner one darker, thinner and fibrous in texture. The outer zone lighter in colour, finely laminated, three times thicker than the inner one. Secondary ridges wide and higher than the intercellular ridges. In the apical part two calcification zones also developed, but the outer one thinner than at the equator. Canal of the basal pore cylindrical, wider than

high. Basal plug not preserved. Oospore membrane represented by black line along the interior walls of spirals.

**Remarks.** — *Peckichara praecursoria* sp. n. is most similar to *Peckichara dangyangensis* Z. WANG, 1978, from which it differs in being larger, of more elongated shape and in having well developed secondary ridges.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Saportanella* GRAMBAST, 1962

*Type species*: *Saportanella maslovi* GRAMBAST, 1962, France, Upper Cretaceous.

### *Saportanella nana* KARCZ. and ZIEMB., 1970
(pl. 26:3, 6, 8, 10)

1970. *Saportanella nana* KARCZ. and ZIEMB.; J. KARCZEWSKA and M. ZIEMBIŃSKA-TWORZYDŁO, 135, pl. 31: only 1–3; fig. 8.

**Material.** — About 1500 well preserved specimens.

Measured gyrogonites of *Saportanella nana* KARCZ. and ZIEMB.

| ZPAL MgChar-III | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 405 | 275 | 272 | 101 | 130 | 47 | 7 | 39 | |
| 409 | 277 | 277 | 100 | 132 | 48 | 10 | 30 | |
| 408 | 306 | 285 | 107 | 132 | 43 | 7 | 39 | |
| 406 | 313 | 273 | 115 | 146 | 46 | 8 | 40 | |
| 407 | 314 | 314 | 100 | 147 | 46 | 8 | 41 | |
| 411 | 363 | 306 | 119 | 156 | 44 | 9 | 42 | |
| 410 | 369 | 340 | 109 | 199 | 54 | 9 | 42 | |
| 413 | 408 | 370 | 110 | 217 | 53 | 9 | 39 | |
| 412 | 431 | 387 | 112 | 195 | 59 | 8 | 59 | |
| 171 | 442 | 376 | 117 | 204 | 46 | 8 | 49 | 70 |
| Range: | 275–442 | 272–387 | 100–119 | 130–217 | 43–54 | 7–10 | 39–59 | 70 |

**Description.** — Gyrogonites very small, predominantly prolate spheroidal (ISI 100—119) and ellipsoidal (ANI 43—54), with broadly rounded to truncate summits and rounded bases; length from 275 to 442 μm, width from 272 to 387 μm. Seven to ten convolutions visible in lateral view. Cellular spirals slightly convex, separated by shallow intercellular furrows; cellular spirals in the apical periphery gradually narrowing and thinning, ending acutely or subacutely. In the apical centre the spirals absent, replaced by five opercular cells, placed in continuation of the surrounding spirals, forming a well developed rosette. Apical junction of cellular spirals forms an irregular line. Cellular spirals narrow gradually towards the basal region, in some specimens they are slightly widened around the basal pore; outer opening of the basal pore slightly lowered beneath the surfaces of the surrounding spirals. Equatorial angle about 10°.

In longitudinal section, cellular spirals very thick, much thicker than wide; the opercular cells are thinner than the equatorial part of the cellular spirals. Apical centres slightly depressed below the apical periphery. Basal plug unknown. Oospore preserved as a dark substance inside the gyrogonites.

**Remarks.** — We have excluded from the species *S. nana* all forms with concave cellular spirals. After an examination in longitudinal sections of the gyrogonites belonging to *Saportanella*, it appeared that there are significant differences between the forms with flat or convex cellular spirals and those with concave spirals to allow their inclusion in one species. The specimens in which the cellular spirals are concave have also flattened apical part. These are included in the new species *S. romaschkinae* together with the gyrogonites described earlier as *S. nana* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO (1970, pl. 31: only 4a–c).

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan IV, Nemegt Basin, Gobi Desert.

*Saportanella romaschkinae* sp. n.
(pl. 39:1, 6, 7, 9, 10)

*Holotype*: ZPAL MgChar-III/100; pl. 39:10.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: in honour of the Russian Charologist N. P. KYANSEP-ROMASCHKINA.

1970. *Saportanella nana* KARCZ. and ZIEMB. J. KARCZEWSKA and M. ZIEMBIŃSKA-TWORZYDŁO, 135, pl. 31: only 4a–c.

**Diagnosis.** — Gyrogonites small, prolate spheroidal to subprolate and ellipsoidal, with truncate summits and rounded bases. Apical centre slightly depressed below the apical periphery, opercular cells thinner than the equatorial cellular spirals. Cellular spirals strongly concave, delimited by sharp and more or less protruding intercellular ridges. Outer opening of the basal pore situated at the same level as the surfaces of surrounding spirals.

**Material.** — About 1000 well preserved specimens.

**Description.** — Gyrogonites small, prolate spheroidal to subprolate (ISI 100—117) and ellipsoidal (ANI 43—52), with truncate summits and rounded bases; length from 340 to 425 μm, width from 306 to 419 μm. Seven to nine convolutions visible in lateral view. Cellular spirals concave, delimited by sharp and more or less protruding intercellular ridges. In some specimens ornamentation in form of secondary ridges, generally identical in height and width with intercellular ridges. Intercellular sutures poorly visible on intercellular ridges. In the apical periphery cellular spirals gradually narrowing, then slightly widened around the apical rosette, ending truncately. Apical centres slightly depressed below the apical periphery, composed of five opercular cells of slightly irregular shape and variable size. Cellular spirals as a rule, continue onto the base without changing their size and shape, in some specimens slightly widened around the basal pore. Basal opening distinctly pentagonal. Outer opening of the basal pore small, situated at the same level as the surface of surrounding spirals. Equatorial angle less than 5°.

Measured gyrogonites of *Saportanella romaschkinae* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 414 | 340 | 302 | 111 | 176 | 52 | 8 | 51 | |
| 416 | 357 | 324 | 110 | 154 | 43 | 7 | 45 | |
| 417 | 358 | 319 | 112 | 137 | 48 | 7 | 39 | |
| 418 | 365 | 360 | 101 | 170 | 46 | 8 | 59 | |
| 100 | 385 | 385 | 100 | 190 | 49 | 8 | 50 | |
| 415 | 416 | 416 | 100 | 207 | 49 | 8 | 54 | |
| 420 | 419 | 419 | 100 | 197 | 47 | 9 | 51 | |
| 172 | 420 | 396 | 106 | 180 | 43 | 7 | 48 | 40–60 |
| 421 | 420 | 404 | 104 | 187 | 44 | 8 | 56 | |
| 419 | 425 | 362 | 117 | 204 | 48 | 9 | 56 | |
| Range: | 340–425 | 306–419 | 100–117 | 137–207 | 43–52 | 7–9 | 39–59 | 40–60 |

In longitudinal section, cellular spirals thick, more or less concave; the opercular cells thinner than the equatorial part of cellular spirals. Apical centre slightly depressed below the apical periphery. Canal of the basal pore approximately cylindrical, basal plug not preserved.

**Remarks.** — *S. romaschkinae* sp. n. is most similar to *S. nana* KARCZ. and ZIEMB. but it has concave cellular spirals, more flattened apical part and different structure of the cellular spirals in longitudinal section.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Sphaerochara* MÄDLER, 1952 emend. HORN AF RANTZIEN and GRAMBAST, 1962

*Type species*: *Sphaerochara hirmeri* (RASKY, 1945) MÄDLER, 1952, Hungary, Upper Oligocene.

### *Sphaerochara jacobii* sp. n.
(pl. 35:1–3, 7)

*Holotype*: ZPAL MgChar-III/140; pl. 35: 3.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin. Gobi Desert.
*Derivation of the name*: *jacobii* — Lat. *Jacob* = James from the name of the son the second author.

**Diagnosis.** — Gyrogonites very small, prolate spheroidal to subprolate and ellipsoidal, with broadly rounded and subtruncate summits and bases. Cellular spirals deeply concave, delimited by sharp intercellular ridges. Near the apex cellular spirals more or less constricted. Basal plug thick, closing a low and wide canal of the basal pore.

**Material.** — Thirty well preserved specimens.

**Description.** — Gyrogonites very small, prolate spheroidal to subprolate (ISI 103–128) and ellipsoidal (ANI 43–52) with broadly rounded and subtruncate summits and bases; length from 295 to 357 μm, width from 253 to 306 μm. Nine to eleven convolutions visible

Measured gyrogonites of *Sphaerochara jacobii* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 433 | 295 | 258 | 114 | 144 | 49 | 9 | 34 | |
| 140 | 300 | 253 | 118 | 130 | 43 | 10 | 40 | |
| 431 | 311 | 289 | 108 | 161 | 52 | 11 | 35 | |
| 434 | 312 | 272 | 111 | 148 | 49 | 11 | 34 | |
| 429 | 317 | 306 | 103 | 153 | 48 | 8 | 49 | |
| 185 | 328 | 289 | 113 | 147 | 45 | 9 | 40 | 32 |
| 435 | 340 | 272 | 126 | 166 | 49 | 9 | 37 | |
| 430 | 340 | 267 | 128 | 170 | 50 | 11 | 34 | |
| 432 | 357 | 283 | 125 | 187 | 52 | – | – | |
| Range: | 295-357 | 253–306 | 103–128 | 130–187 | 43–52 | 8–11 | 34–49 | 32 |

in lateral view. Cellular spirals deeply concave, without secondary ridges, 34 to 49 μm wide. Intercellular ridges sharp, sutures invisible. In the apical periphery cellular spirals somewhat narrower than at the equator, of varying width (30–40 μm). Apical junction forming a short

irregular line, occasionally punctiform. Basal part more or less broadly rounded but at the centre subtruncate; cellular spirals with slightly widened tips around the basal pore. Outer opening of the basal pore at the same level as the surfaces of surrounding spirals. Equatorial angle less than 5°.

In longitudinal section, cellular spirals approximately as thick as at the equator but somewhat narrower. Basal plug slightly wider than thick closing a low and wide canal of the basal pore.

**Remarks.** — *Sphaerochara jacobii* sp. n. is most similar to *Sphaerochara granulifera* (HEER) MÄDLER, 1955 described from the Upper Tertiary by HEER (1954) and MÄDLER, recorded also from the Upper Cretaceous deposits of China by WANG SHUI (1965), but it is much smaller.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

## Genus *Stephanochara* GRAMBAST 1959

*Type species*: *Stephanochara compta* GRAMBAST, 1959, Great Britain, Oligocene.

### *Stephanochara castelii* sp. n.
(pl. 24:1, 3, 4, 8)

*Holotype*: ZPAL MgChar-III/133; pl. 24:1.
*Type horizon*: Upper Cretaceous, Nemegt Formation.
*Type locality*: Nemegt, Nemegt Basin, Gobi Desert.
*Derivation of the name*: *castelii* — in honour of the French charologist Dr M. FEIST-CASTEL.

**Diagnosis.** — Gyrogonites middle-sized to large, subprolate to prolate, ellipsoidal with rounded summits and slighty protruding bases. Cellular spirals thick, concave, with tendention to ornamentation. In the apical periphery cellular spirals distinctly thinner, forming a peripheral depression; widened in the apical centre they meet each other along an irregular line. Outer opening of the basal pore situated in the bottom of a distinctly crater-like depression formed by thickened ends of surrounding spirals.

**Material.** — Eighteen well preserved specimens.

Measured gyrogonites of *Stephanochara castelii* sp. n.

| ZPAL MgChar-III/ | LPA in μm | LED in μm | ISI | AND in μm | ANI | Numb. conv. | Width conv. at EA in μm | Thick. conv. in μm |
|---|---|---|---|---|---|---|---|---|
| 231 | 674 | 470 | 144 | 300 | 44 | 8 | 85 | 92 |
| 389 | 680 | 556 | 122 | 336 | 49 | 8 | 95 | |
| 386 | 688 | 476 | 144 | 321 | 47 | 9 | 68 | |
| 387 | 710 | 564 | 126 | 340 | 48 | 9 | 85 | |
| 133 | 710 | 500 | 141 | 330 | 47 | 7 | 90 | |
| 388 | 714 | 544 | 131 | 340 | 47 | 7 | 108 | |
| 391 | 714 | 544 | 131 | 357 | 50 | 9 | 81 | |
| 393 | 748 | 547 | 134 | 348 | 47 | 8 | 93 | |
| 390 | 754 | 550 | 137 | 362 | 48 | 7 | 90 | |
| 392 | 826 | 476 | 173 | 377 | 46 | 8 | 88 | |
| Range: | 674–826 | 470–564 | 122–173 | 300–377 | 44–50 | 7–9 | 68–108 | 92 |

**Description.** — Gyrogonites middle-sized to large; subprolate to prolate (ISI 122—173) and ellipsoidal (ANI 44—50), with rounded summits and slighty protruding bases; length from 674 to 826 μm, width from 470 to 564 μm. Seven to nine convolutions visible in lateral view.

Cellular spirals predominantly concave, from 68 to 108 μm wide, with secondary ridges low and narrow, with distinctly marked intercellular sutures. In some specimens cellular tubercles forming interrupted secondary ridges. Cellular spirals continue onto the summit without changing their width, depressed in the apical periphery to form a distinct peripheral groove. In the apical centre the ends of cellular spirals are extended and thickened, uniting along an irregular line. Basal pole subtruncate. Cellular spirals as wide as at the equator, their tips distinctly thickened and slightly widened around the basal pore, ending subtruncately. Outer opening of the basal pore situated in the bottom of a distinctly crater-like depression. Equatorial angle about 10°.

In longitudinal section, cellular spirals thick (about 90 μm) with more or less distinctly marked lamination. In the apical part cellular spirals as wide as at the equator or slightly narrower. In the apical periphery cellular spirals two times thinner than at the equator; in the apical centre they are somewhat thicker. Basal plug unknown. Fructification wall locally and imperfectly preserved.

**Remarks.** — *Stephanochara castelii* sp. n. is most similar to *Stephanochara ungeri* FEIST-CASTEL, 1977, from which it differs in being somewhat smaller and having a lower number of convolutions, also in the presence of secondary ridges.

**Occurrence.** — Upper Cretaceous (Nemegt Formation), Nemegt and Altan Ula IV, Nemegt Basin, Gobi Desert.

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# EXPLANATION OF THE PLATES 22–39

All figures are scanning electron micrographs except for longitudinal sections.
All figured specimens are from the Upper Cretaceous, Nemegt Formation; Nemegt Basin, Gobi Desert, Mongolia.

## PLATE 22

### *Amblyochara agathae* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/49), × 110; apical view
4. Gyrogonite (ZPAL MgChar-III/45), *a* — basal view, × 75; *b* — outer opening of the basal pore, × 450.
5. Gyrogonite (ZPAL MgChar-III/226), × 75; longitudinal section.
8. Gyrogonite, holotype (ZPAL MgChar-III/47), × 75; lateral view.

### *Gobichara caerulea* sp. n.
Nemegt locality

2. Gyrogonite (ZPAL MgChar-III/235), × 75; longitudinal section.
3. Gyrogonite (ZPAL MgChar-III/76), × 150; basal view.
6. Gyrogonite (ZPAL MgChar-III/75), × 150; apical view.
7. Gyrogonite, holotype (ZPAL MgChar-III/29), × 75; lateral view.

## PLATE 23

### *Mongolichara costulata* KYANSEP-ROMASCHKINA, 1975
Nemegt locality

1. Gyrogonite (ZPal MgChar-III/4), *a* — basal view, × 110; *b* — outer opening of the basal pore with the basal plug, × 340.
2. Gyrogonite (ZPAL MgChar-III/67), × 60; lateral view.
4. Gyrogonite (ZPAL MgChar-III/187), × 75; longitudinal section.
5. Gyrogonite (ZPAL MgChar-III/64), × 110; apical view.
6. Gyrogonite (ZPAL MgChar-III/1), × 90; apical view.

*Obtusochara* cf. *lanpingensis* Z. WANG, HUANG and S. WANG, 1976
Nemegt locality

3. Gyrogonite (ZPAL MgChar-III/94), × 110; *a* — lateral view, *b* — apical view, *c* — basal view.

PLATE 24

*Stephanochara castelii* sp. n.
Nemegt locality

1. Gyrogonite, holotype (ZPAL MgChar-III/133), × 75; lateral view.
3. Gyrogonite (ZPAL MgChar-III/127), × 110; basal view.
4. Gyrogonite (ZPAL MgChar-III/231), × 75; longitudinal section.
8. Gyrogonite (ZPAL MgChar-III/126), × 110; apical view.

*Mongolichara fulgida* sp. n.
Nemegt locality

2. Gyrogonite, holotype (ZPAL MgChar-III/150), × 75; lateral view.
5. Gyrogonite (ZPAL MgChar-III/224), × 75; longitudinal section.
6. Gyrogonite (ZPAL MgChar-III/152), × 110; apical view.
7. Gyrogonite (ZPAL MgChar-III/151), × 110, basal view.

PLATE 25

*Atopochara ulanensis* KYANSEP-ROMASCHKINA, 1975
Nemegt locality

1. Utricle (ZPAL MgChar-III/53), *a* — apical view, × 75; *b* — basal view, × 75; *c* — lateral view, × 60.

*Mesochara orientalis* sp. n.
Nemegt locality

2. Gyrogonite (ZPAL MgChar-III/84), × 90; basal view.
3. Gyrogonite, holotype (ZPAL MgChar-III/83), × 60; lateral view.
4. Gyrogonite (ZPAL MgChar-III/223), × 150; longitudinal section.

*Harrisichara cepaeformis* sp. n.
5, 6 — Nemegt locality
7 — Altan Ula IV locality

5. Gyrogonite (ZPAL MgChar-III/153), × 150; apical view.
6. Gyrogonite, holotype (ZPAL MgChar-III/74), × 220; lateral view.
7. Gyrogonite (ZPAL MgChar-III/154), × 150, basal view.

PLATE 26

*Mesochara orientalis* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/128), × 150; apical view.

*Mesochara voluta* (PECK, 1937) GRAMBAST, 1965
Nemegt locality

2. Gyrogonite (ZPAL MgChar-III/24), × 160; lateral view.
5. Gyrogonite (ZPAL MgChar-III/203), × 150; longitudinal section.

*Saportanella nana* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970
Nemegt locality

3. Gyrogonite (ZPAL MgChar-III/23), × 160; lateral view.
6. Gyrogonite (ZPAL MgChar-III/171), × 75; longitudinal section.
8. Gyrogonite (ZPAL MgChar-III/18), × 150; basal view.
10. Gyrogonite (ZPAL MgChar-III/19), × 150; apical view.

*Gobichara viridis* sp. n.
Nemegt locality

4. Gyrogonite (ZPAL MgChar-III/220), × 75; longitudinal section.
7. Gyrogonite, holotype (ZPAL MgChar-III/85), × 90; lateral view.
9. Gyrogonite (ZPAL MgChar-III/149), × 110; basal view.
11. Gyrogonite (ZPAL MgChar-III/148), × 150; apical view.

PLATE 27

*Mesochara inflata* sp. n.
Nemegt locality

1. Gyrogonite, holotype (ZPAL MgChar-III/55), × 150; lateral view.
2. Gyrogonite (ZPAL MgChar-III/212), × 150; *a* — longitudinal section, *b* — fragment of gyrogonite showing lime-spirals structure.

*Mesochara gradzinskii* sp. n.
Altan Ula IV locality

3. Gyrogonite, holotype (ZPAL MgChar-III/108), × 250; lateral view.
4. Gyrogonite (ZPAL MgChar-III/131), × 250; apical view.
5. Gyrogonite (ZPAL MgChar-III/215), × 200; longitudinal section.
6. Gyrogonite (ZPAL MgChar-III/132), × 250; basal view.

PLATE 28

*Mesochara inflata* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/25), × 250; basal view.
5. Gyrogonite (ZPAL MgChar-III/26), × 250; apical view.

*Mesochara mongolica* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970
Nemegt locality

2. Gyrogonite (ZPAL MgChar-III/216), × 100; longitudinal section showing the basal pore.
3. Gyrogonite (ZPAL MgChar-III/217), × 200; longitudinal section.
4. Gyrogonite (ZPAL MgChar-III/114), × 200; lateral view.
6. Gyrogonite (ZPAL MgChar-III/115), × 200; basal view.
7. Gyrogonite (ZPAL MgChar-III/113), × 200; apical view.

PLATE 29

*Mesochara stankevitschii* KYANSEP-ROMASCHKINA, 1975
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/12), × 200; lateral view.
2. Gyrogonite (ZPAL MgChar-III/201), × 200; longitudinal section with *a* — lime-spirals structure in focus, *b* — basal pore in median focal plane.
3. Gyrogonite (ZPAL MgChar-III/206), × 200; longitudinal section showing the basal plug.
6. Gyrogonite (ZPAL MgChar-III/141), × 300; apical part.
7. Gyrogonite (ZPAL MgChar-III/116), × 200; basal part.

*Mesochara luculenta* sp. n.
Nemegt locality

4. Gyrogonite (ZPAL MgChar-III/199), × 100; longitudinal section.
5. Gyrogonite, holotype (ZPAL MgChar-III/33), × 200; lateral view.

PLATE 30

*Mesochara* sp.
Nemegt locality

1. Gyrogonite ZPAL MgChar-III/157, × 110; apical view.
2. Gyrogonite ZPAL MgChar-III/158, × 110; basal view.

*Microchara* cf. *cristata* GRAMBAST, 1971
Nemegt locality

3. Gyrogonite (ZPAL MgChar-III/166), × 110; lateral view.
4. Gyrogonite (ZPAL MgChar-III/168); × 110; apical view.
9. Gyrogonite (ZPAL MgChar-III/165), × 110; basal view.
11. Gyrogonite (ZPAL MgChar-III/194), × 75; longitudinal section.

*Mesochara obventicia* sp. n.
Nemegt locality

5. Gyrogonite (ZPAL MgChar-III/50), × 150; apical view.
6. Gyrogonite (ZPAL MgChar-III/56), × 150; basal view.
7. Gyrogonite (ZPAL MgChar-III/210), × 150; longitudinal section.
10. Gyrogonite, holotype (ZPAL MgChar-III/51), × 150; lateral view.

*Mesochara luculenta* sp. n.
Nemegt locality

8. Gyrogonite (ZPAL MgChar-III/52), × 150; basal view.
12. Gyrogonite (ZPAL MgChar-III/54), × 150; apical view.

PLATE 31

*Atopochara ulanensis* KYANSEP-ROMASCHKINA, 1975
Nemegt locality

1. Utricle (ZPAL MgChar-III/39), × 75; *a* — lateral view, *b* — basal view, *c* — apical view.
2. Utricle well preserved (ZPAL MgChar-III/68), × 50; *a* — lateral view, *b* — basal view, *c* — apical view.
3. Specimen without utricle (ZPAL MgChar-III/105), × 60; lateral view.

*Mesochara* sp.
Nemegt locality

4. Gyrogonite (ZPAL MgChar-III/221), × 75; longitudinal section.
5 Gyrogonite (ZPAL MgChar-III/155), × 110; lateral view.

PLATE 32

*Lamprothamnium altanulaensis* (KARCZ. and ZIEMB., 1970) comb. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/6), *a* — lateral view, × 110; *b* — basal part, × 450.
2. Gyrogonite (ZPAL MgChar-III/60), × 110; lateral view.
3. Gyrogonite (ZPAL MgChar-III/3), × 150; apical view.

4. Gyrogonite (ZPAL MgChar-III/180), × 75; longitudinal section with preserved oosporangial membrane.
5. Gyrogonite (ZPAL MgChar-III/236), × 75; longitudinal section with basal plug well visible.
6. Gyrogonite (ZPAL MgChar-III/182), × 75; longitudinal section showing the apical structure.
7. Gyrogonite (ZPAL MgChar-III/15), × 150; basal view.
8. Gyrogonite (ZPAL MgChar-III/65), × 150; apical view.

PLATE 33

*Mongolichara turnaui* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/17), × 110; apical view.
2. Gyrogonite, holotype (ZPAL MgChar-III/130), × 75; lateral view.
3. Gyrogonite (ZPAL MgChar-III/14), × 200; apical part.
6. Gyrogonite (ZPAL MgChar-III/225), × 75; longitudinal section.
9. Gyrogonite (ZPAL MgChar-III/10), × 200; basal part.

*Mongolichara grovesioides* sp. n.
Nemegt locality

4. Gyrogonite (ZPAL MgChar-III/81), × 80; apical view.
5. Gyrogonite (ZPAL MgChar-III/82), × 80; basal view.
7. Gyrogonite, holotype (ZPAL MgChar-III/48), × 75; lateral view.
8. Gyrogonite (ZPAL MgChar-III/237), × 75; longitudinal section.

PLATE 34

*Peckichara praecursoria* sp. n.
Nemegt locality

1. Gyrogonite, holotype (ZPAL MgChar-III/42), × 100; lateral view.
2. Gyrogonite (ZPAL MgChar-III/13), × 110; apical view.
3. Gyrogonite (ZPAL MgChar-III/28), × 200; fragment of the apex. showing apical nodules.
4. Gyrogonite (ZPAL MgChar-III/192), × 75; longitudinal section.
7. Gyrogonite (ZPAL MgChar-III/40), × 70; basal view.

*Latochara* sp.
Nemegt locality

5. Gyrogonite (ZPAL MgChar-III/86), *a* — apical view, × 150; *b* — lateral view, × 110.

?*Mongolichara immatura* sp. n.
Nemegt locality

6. Gyrogonite (ZPAL MgChar-III/228), × 75; longitudinal section.
8. Gyrogonite (ZPAL MgChar-III/160), × 110; apical view.
9. Gyrogonite (ZPAL MgChar-III/159), × 110; basal view.
10. Gyrogonite, holotype (ZPAL MgChar-III/161), × 110; lateral view.

PLATE 35

*Sphaerochara jacobii* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/162), × 225; apical view.
2. Gyrogonite (ZPAL MgChar-III/185), × 150; longitudinal section.
3. Gyrogonite, holotype (ZPAL MgChar-III/140), × 225; lateral view.
7. Gyrogonite (ZPAL MgChar-III/163), × 225; basal view.

*Mongolichara gobica* (KARCZ. and ZIEMB., 1970), KYANSEP-Romaschkina, 1975
Nemegt locality

4. Gyrogonite (ZPAL MgChar-III/142), × 75; lateral view.
5. Gyrogonite (ZPAL MgChar-III/144), × 110; basal view.
6. Gyrogonite (ZPAL MgChar-III/189), × 75; longitudinal section.

PLATE 36

*Harrisichara cretacea* KARCZEWSKA and ZIEMBIŃSKA-TWORZYDŁO, 1970
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/78), × 200; apical view.
3. Gyrogonite (ZPAL MgChar-III/66), *a* — lateral view, × 120; *b* — fragment of gyrogonite surface showing the secondary ridges structure, × 1000.
4. Gyrogonite (ZPAL MgChar-III/77), × 200; basal view.
6. Gyrogonite (ZPAL MgChar-III/238), × 100; longitudinal section.

*Mongolichara aurea* (KARCZ. and ZIEMB., 1970) KYANSEP-ROMASCHKINA, 1975
Altan Ula IV locality

2. Gyrogonite (ZPAL MgChar-III/240), × 100; lateral view.
5. Gyrogonite (ZPAL MgChar-I/52), × 100; longitudinal section.

PLATE 37

*Maedlerisphaera pseudoulmensis* KARCZ. and ZIEMB., 1970
1–6 Nemegt locality, 7 Altan Ula IV locality

1. Gyrogonite (ZPAL MgChar-III/2), × 200; apical view.
2. Gyrogonite (ZPAL MgChar-III/147), × 200; basal view.
3. Gyrogonite (ZPAL MgChar-III/196), × 100; longitudinal section.
4. Gyrogonite (ZPAL MgChar-III/197), × 100; longitudinal section.
5. Gyrogonite (ZPAL MgChar-III/195), × 100; longitudinal section.
6. Gyrogonite (ZPAL MgChar-III/124), × 150; lateral view.
7. Gyrogonite (ZPAL MgChar-III/121), × 200; apical part showing the peripheral groove.

PLATE 38

*Euaclistochara mundula* (PECK, 1941) Z. WANG, HUANG and S. WANG, 1976
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/44), × 200; apical view.
2. Gyrogonite (ZPAL MgChar-III/169), *a* — longitudinal section, × 100; *b* — longitudinal section showing the apical structure, × 200.
3. Gyrogonite (ZPAL MgChar-III/170), × 100; longitudinal section.
4. Gyrogonite (ZPAL MgChar-III/88), × 400; apical view.
5. Gyrogonite (ZPAL MgChar-III/73), × 250; basal view.
6. Gyrogonite (ZPAL MgChar-III/46); × 200; lateral view.

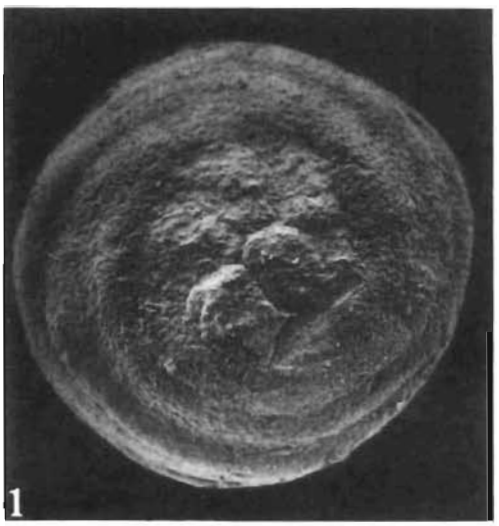
PLATE 39

*Saportanella romaschkinae* sp. n.
Nemegt locality

1. Gyrogonite (ZPAL MgChar-III/135), × 150; apical view.
6. Gyrogonite (ZPAL MgChar-III/172), × 75; longitudinal section.
7. Gyrogonite (ZPAL MgChar-III/173), × 75; longitudinal section.
9. Gyrogonite (ZPAL MgChar-III/20), × 150; basal view.
10. Gyrogonite, holotype (ZPAL MgChar-III/100), × 150; lateral view.

*Amblyochara nemegetensis* sp. n.
Nemegt locality

2. Gyrogonite (ZPAL MgChar-III/13), × 110; basal view.
3. Gyrogonite (ZPAL MgChar-III/137), × 250; basal view.
4. Gyrogonite, holotype (ZPAL MgChar-III/139), × 110; lateral view.
5. Gyrogonite (ZPAL MgChar-III/233), × 75; longitudinal section.
8. Gyrogonite (ZPAL MgChar-III/138), × 110; apical view.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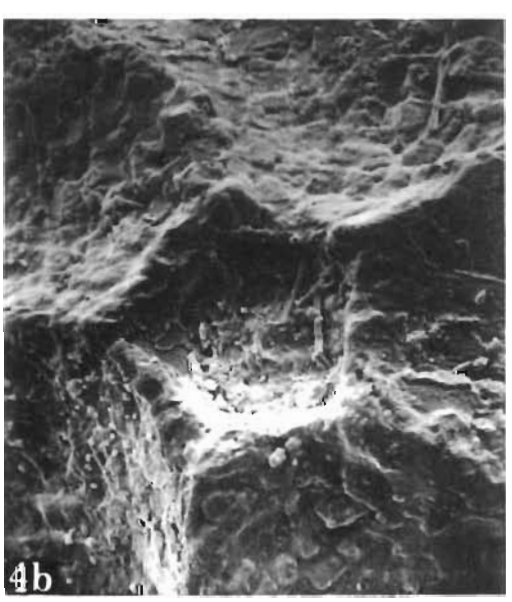
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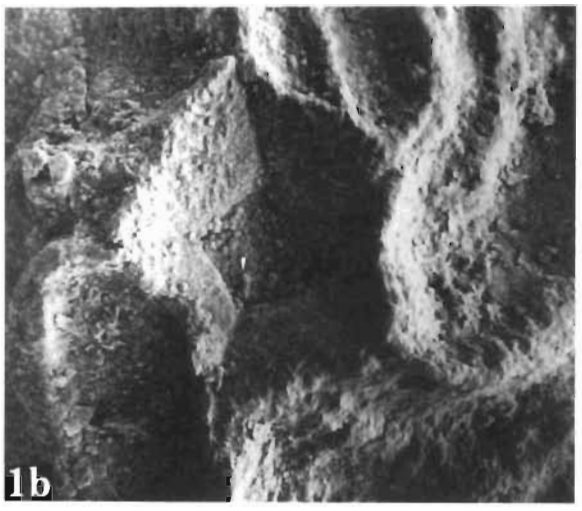
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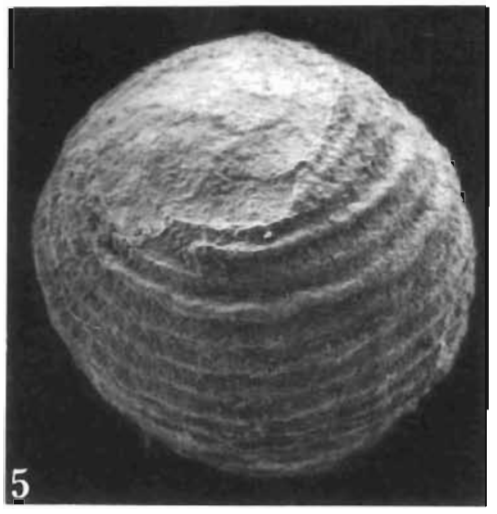
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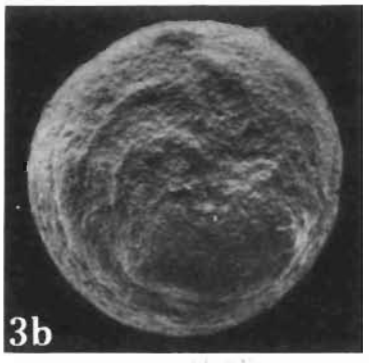
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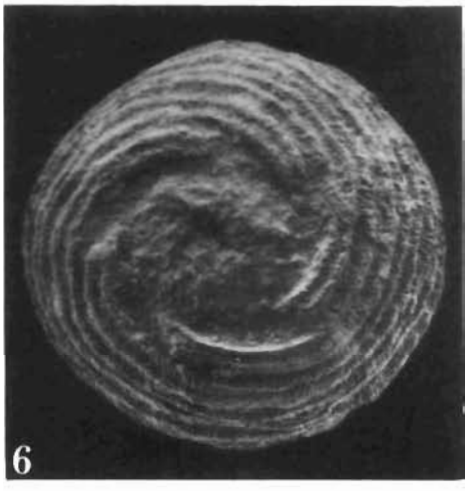
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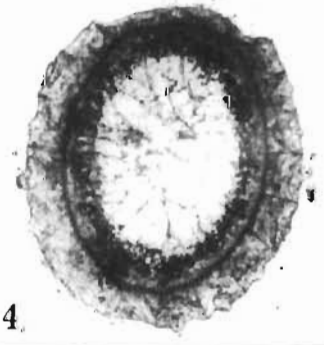
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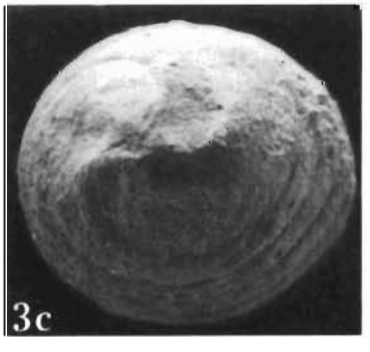
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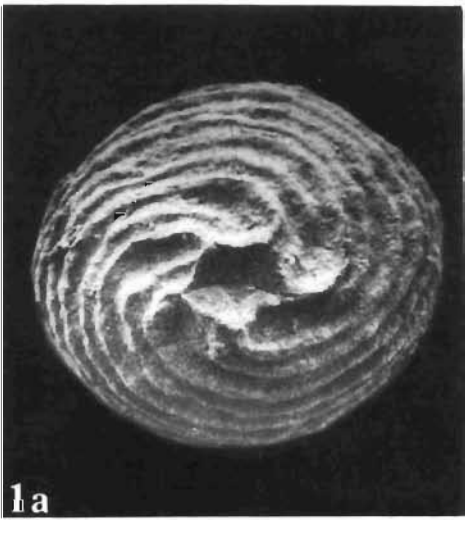
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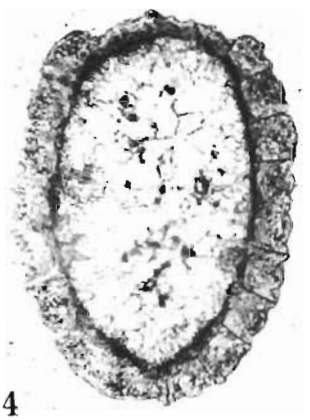
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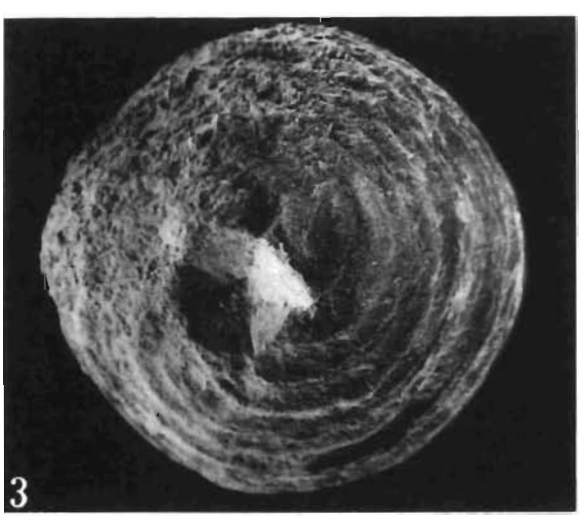
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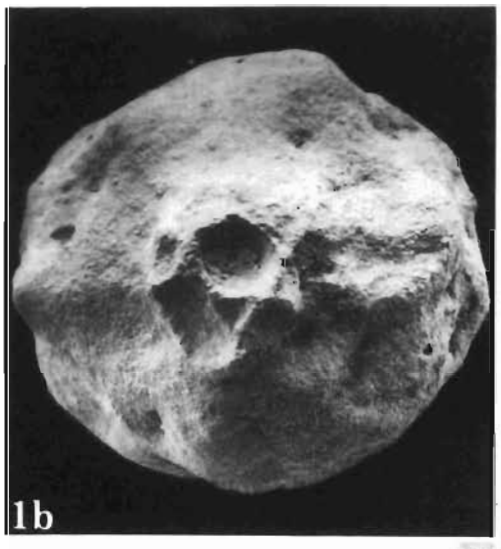
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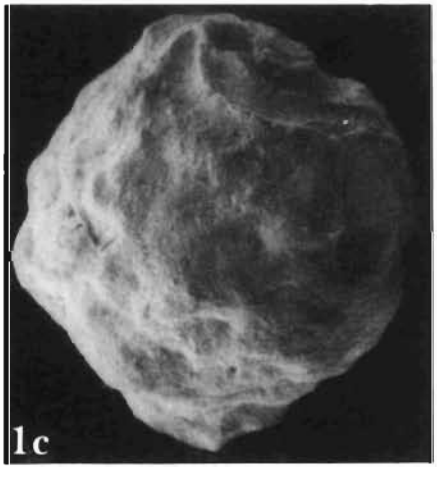
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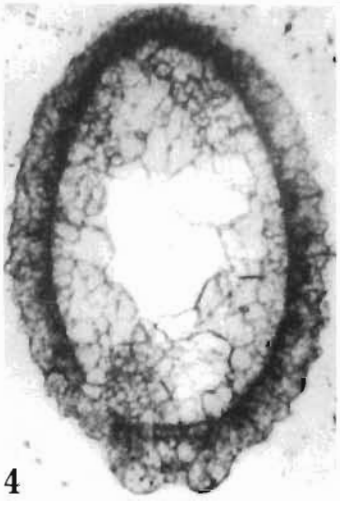
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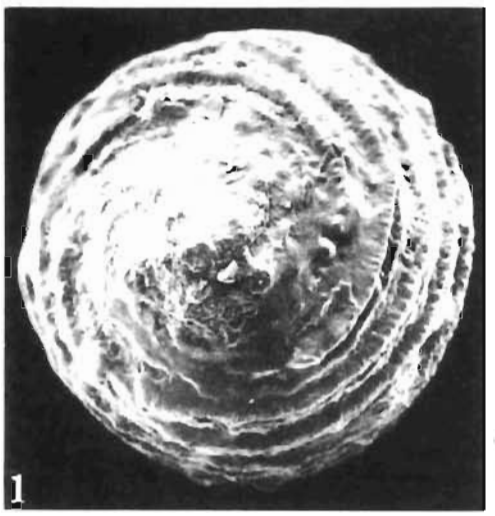
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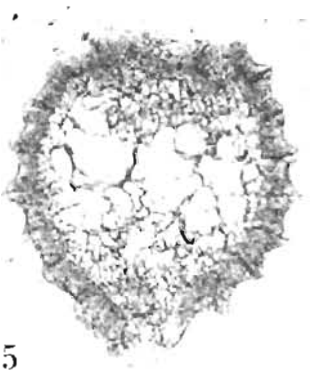
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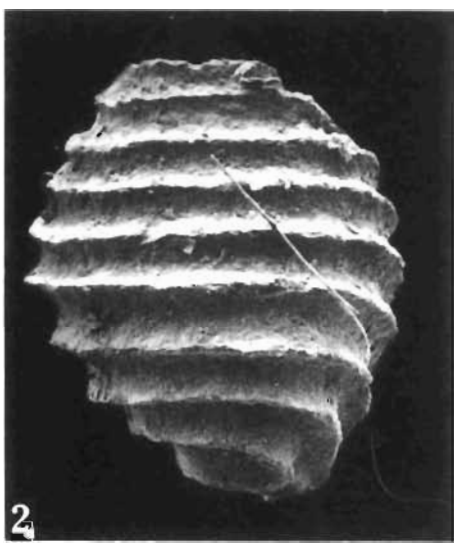
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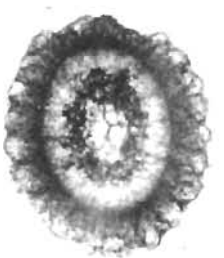
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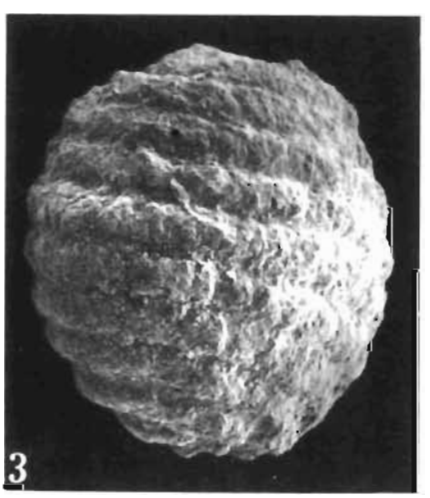
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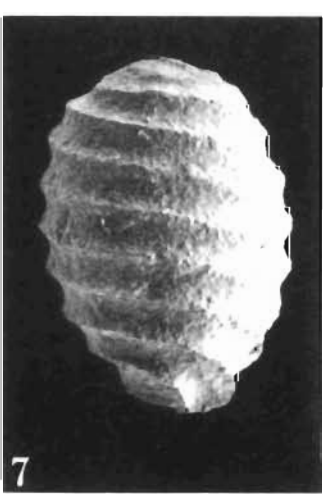
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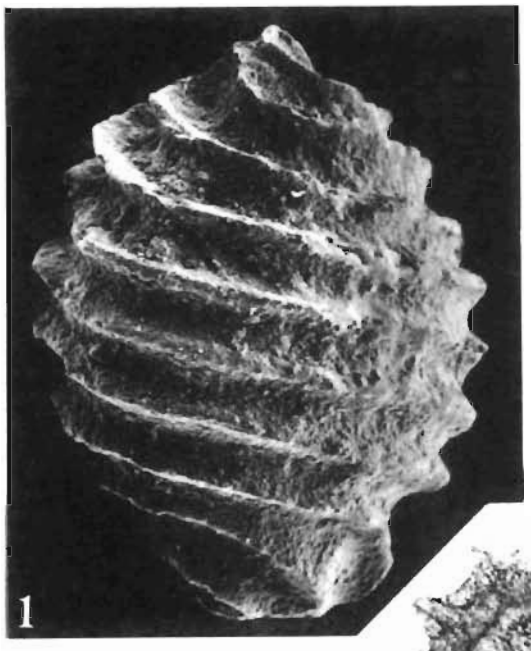
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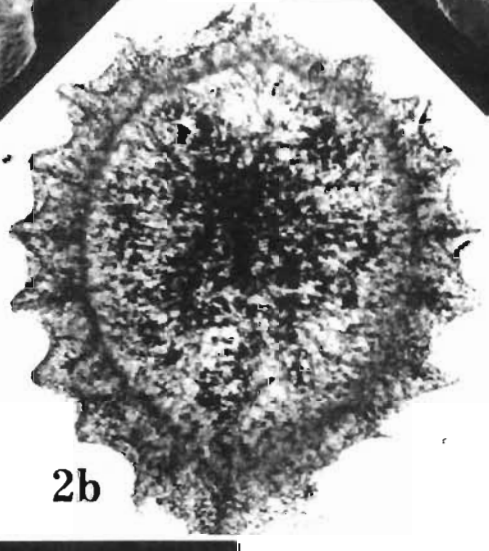
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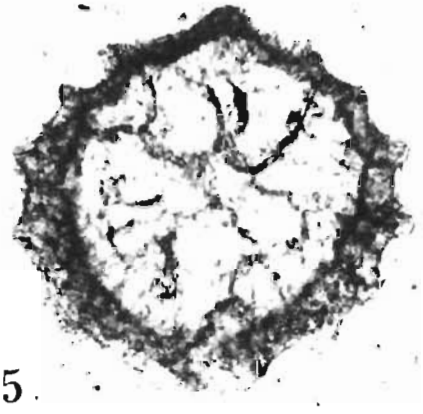
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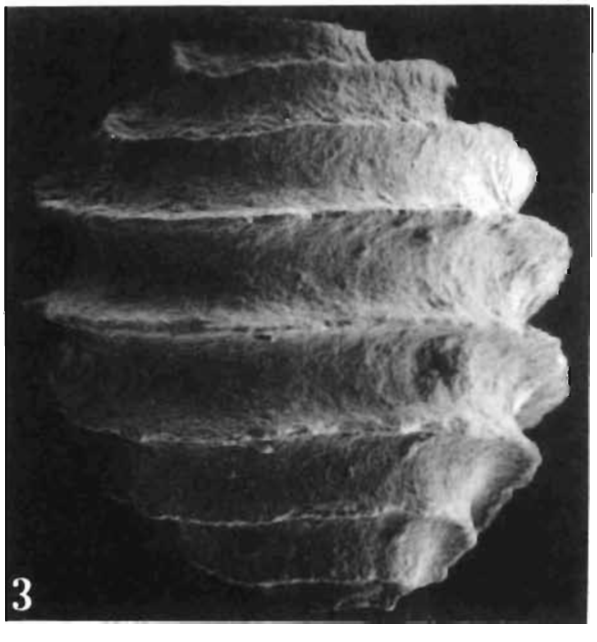
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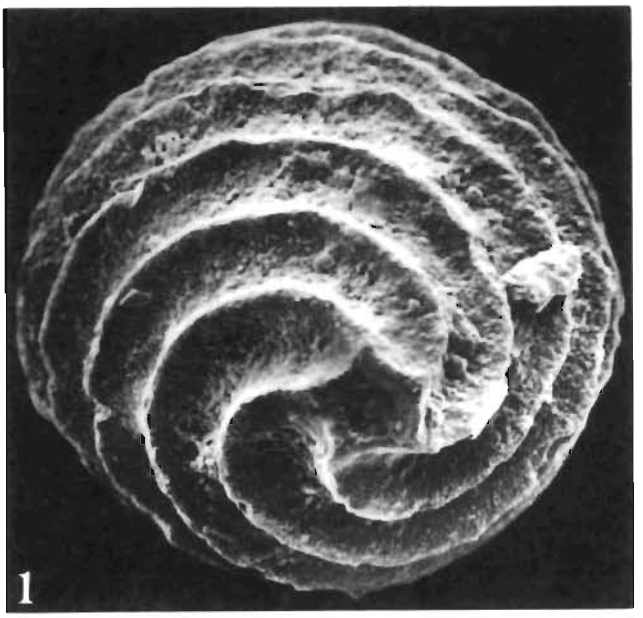
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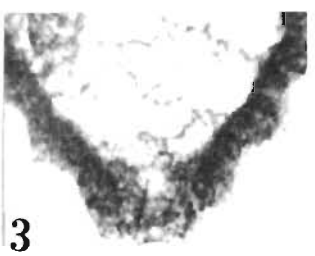
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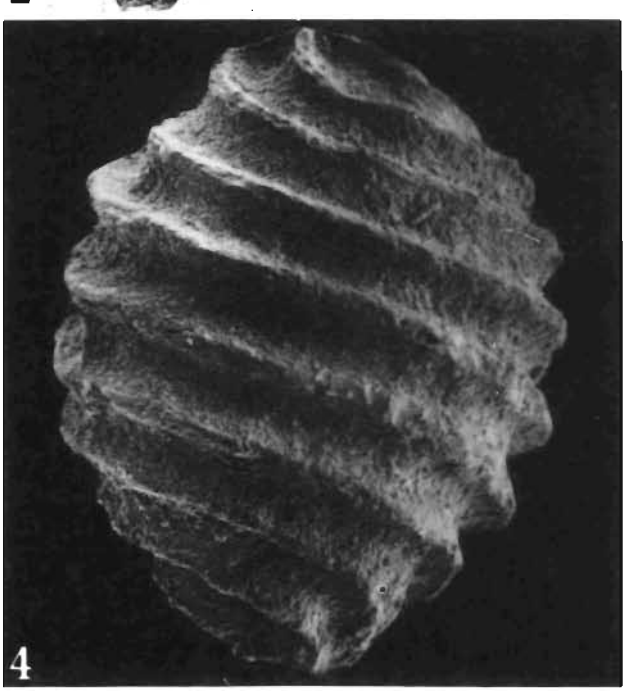
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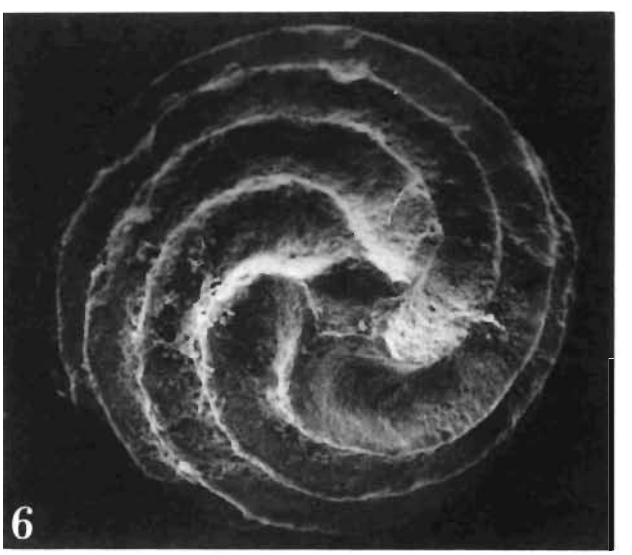
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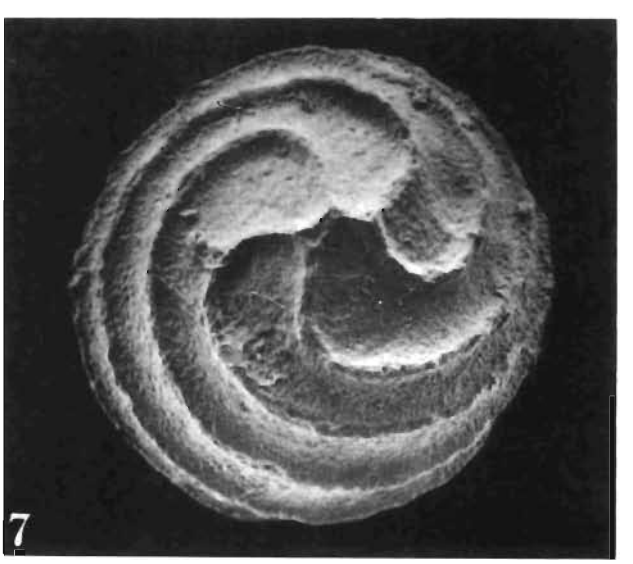
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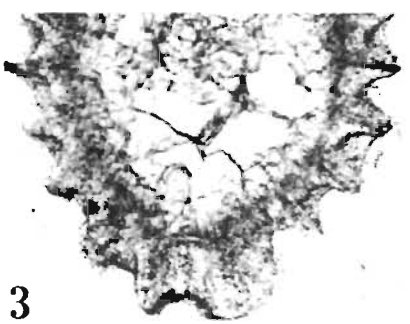
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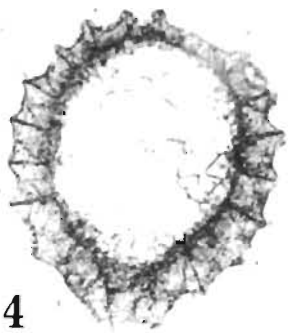
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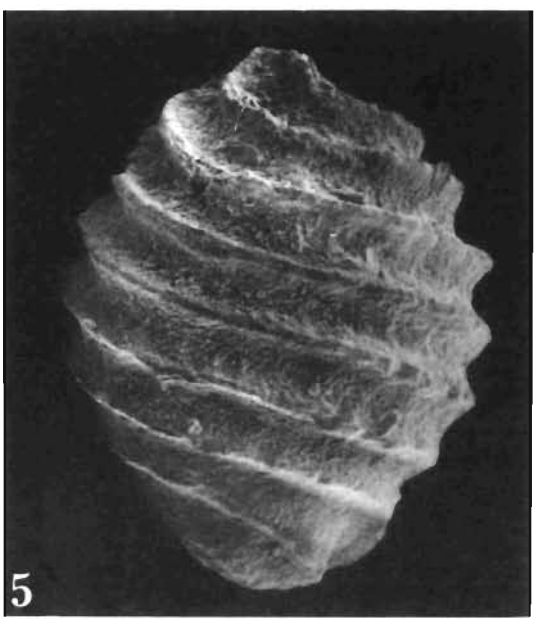
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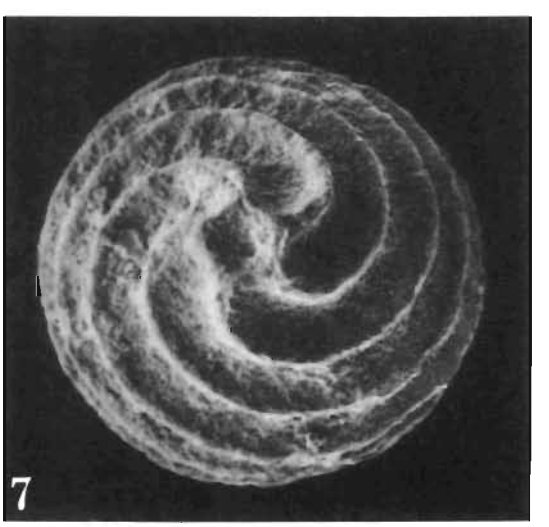
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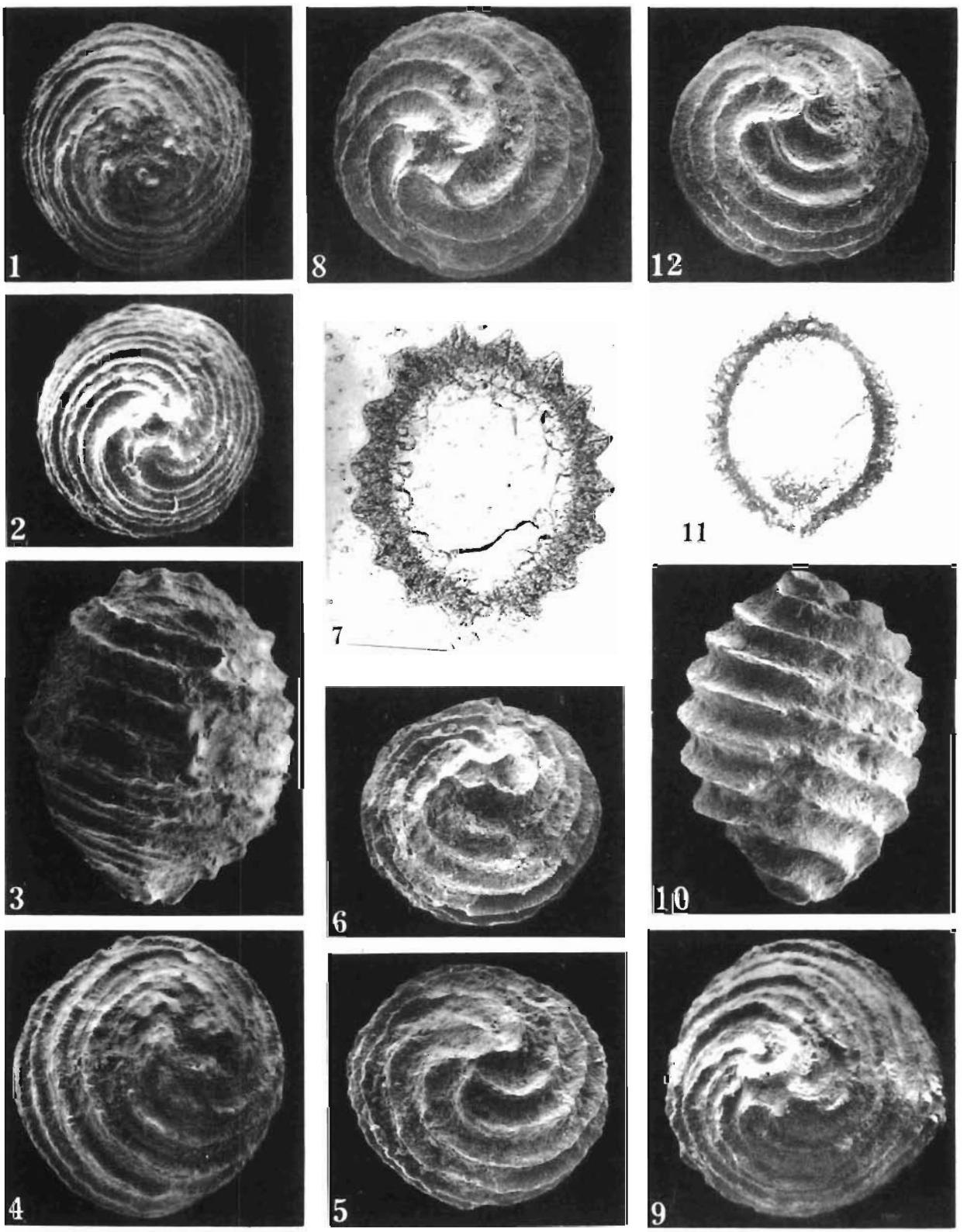
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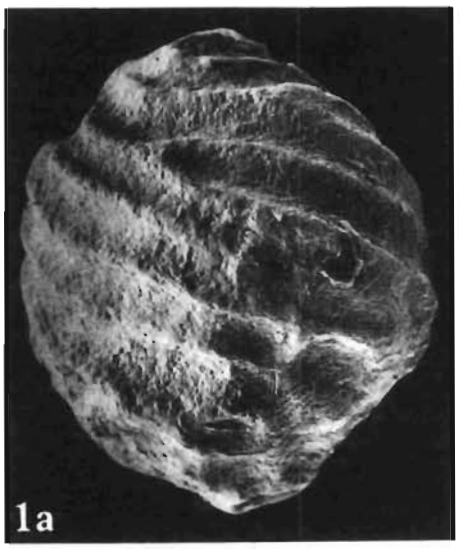
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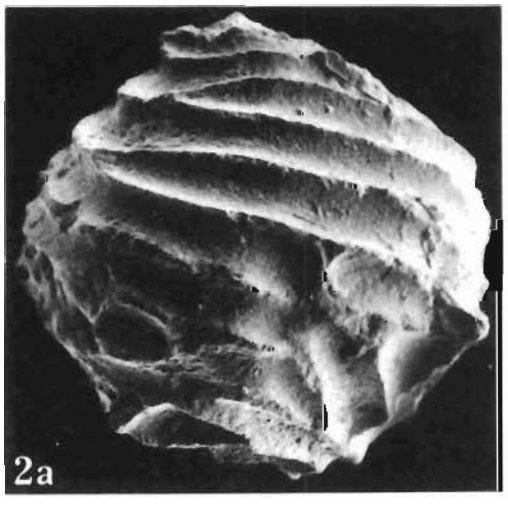
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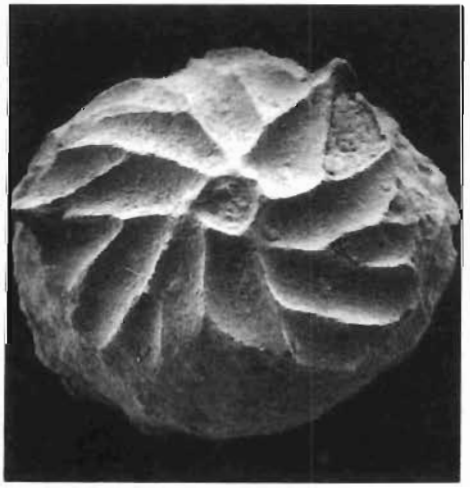


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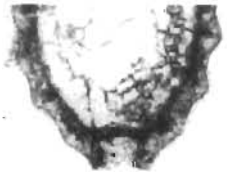
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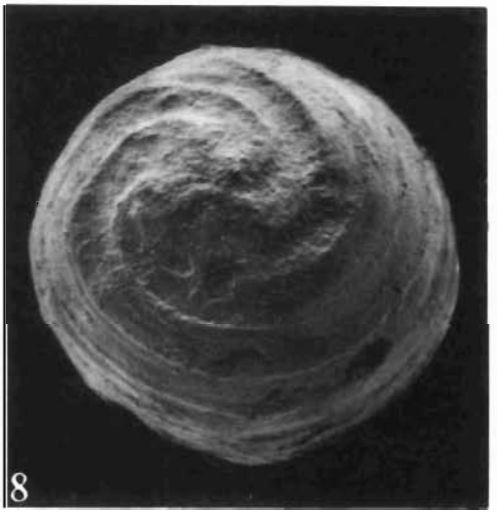
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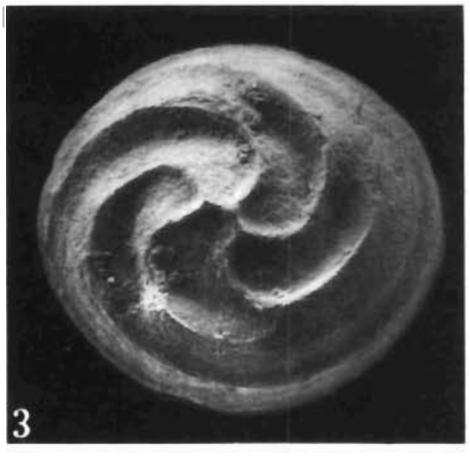
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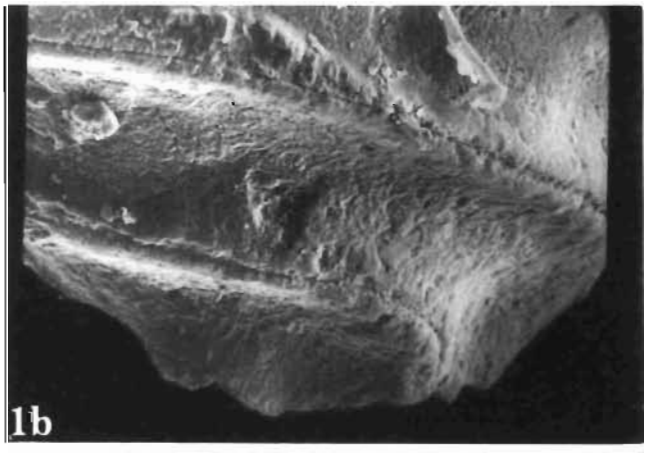
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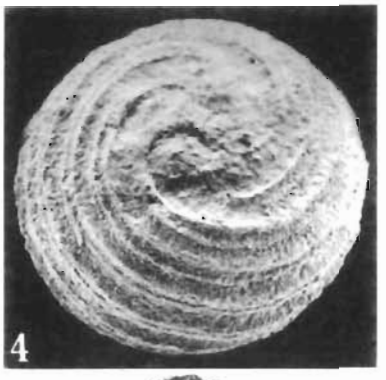
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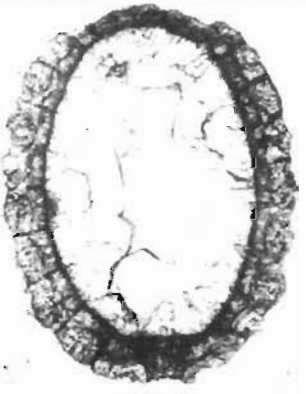
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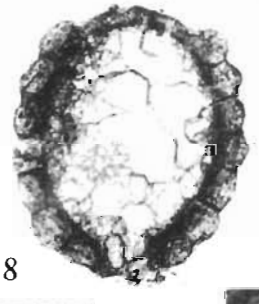
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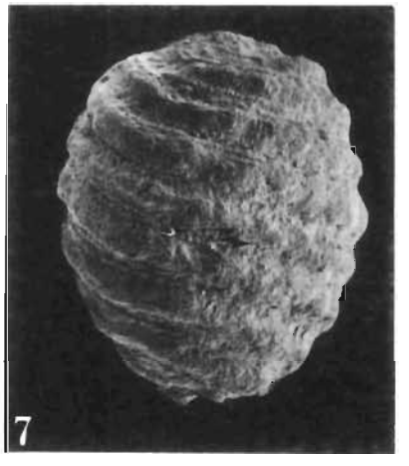
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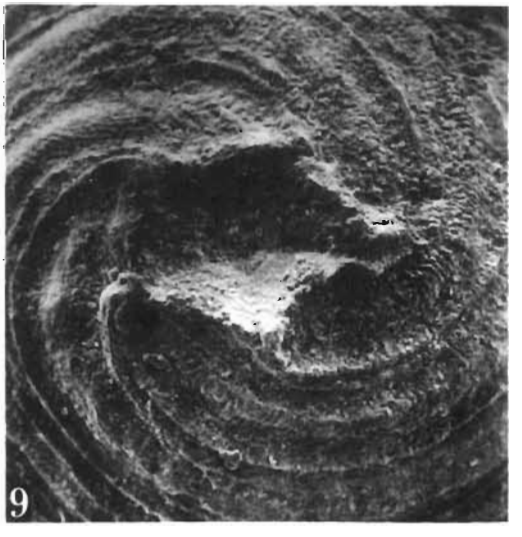
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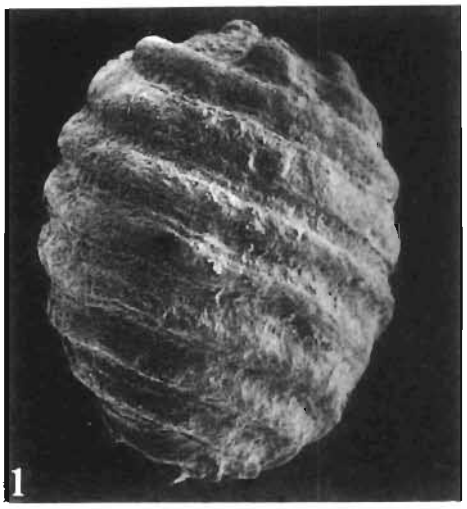
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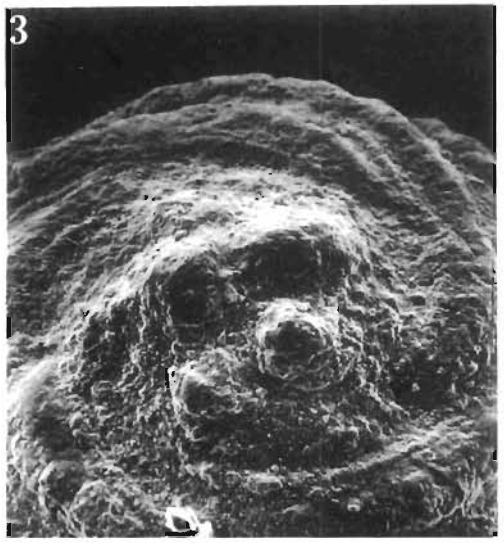
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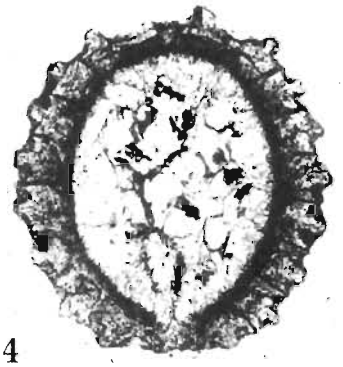
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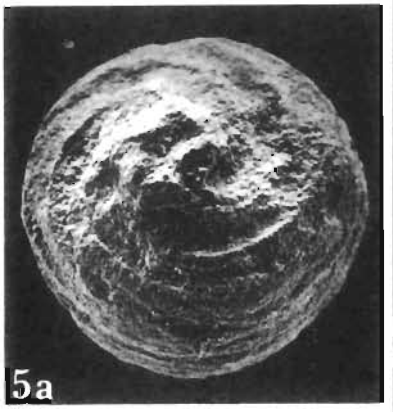
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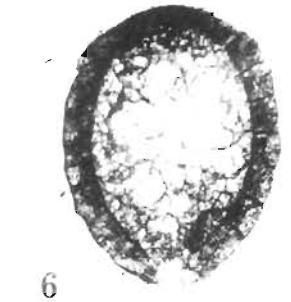
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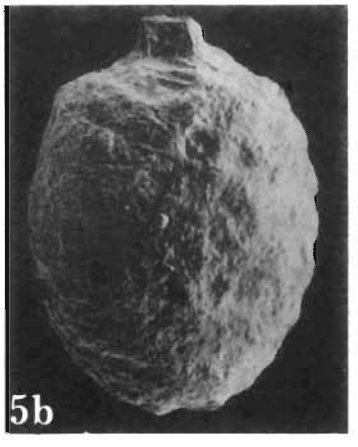
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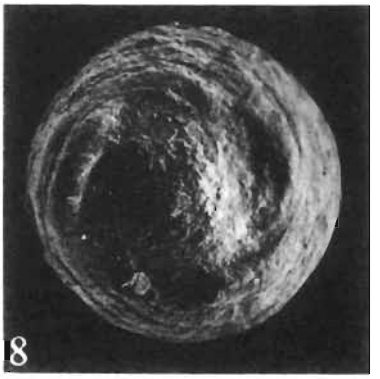
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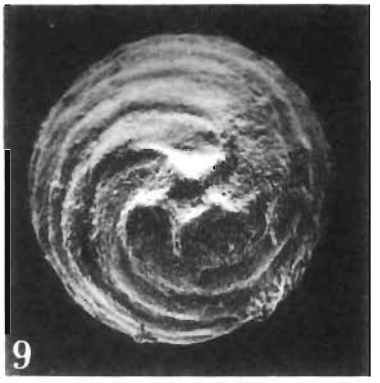
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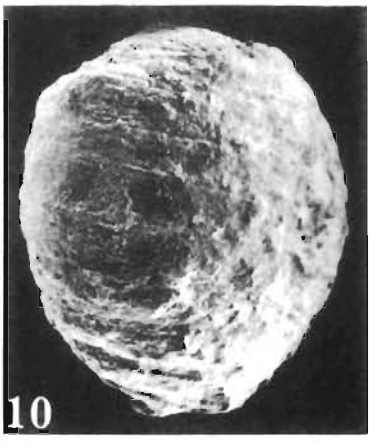
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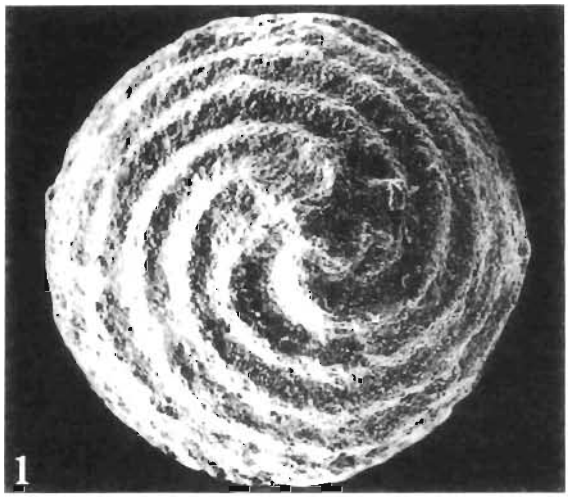
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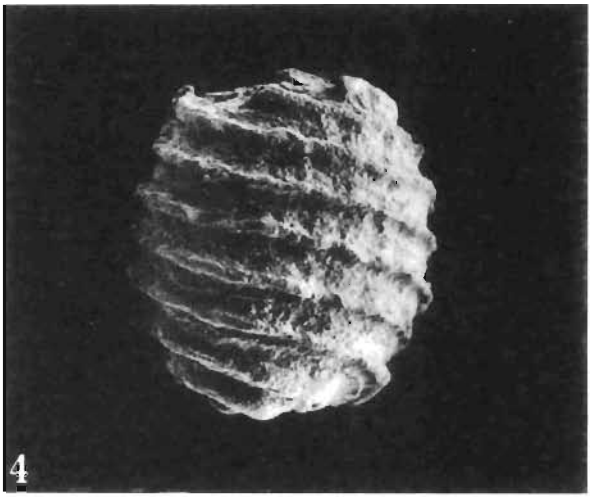
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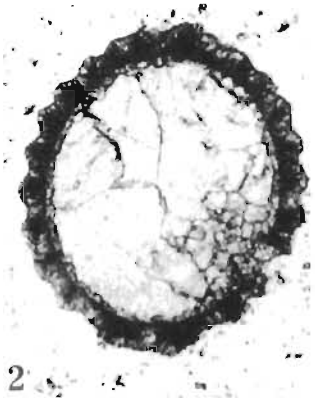
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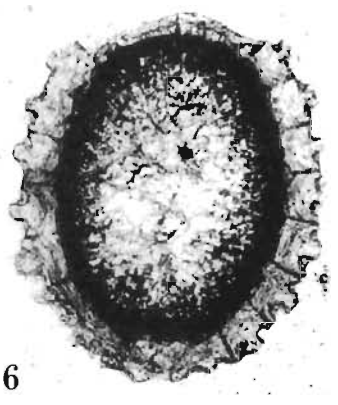
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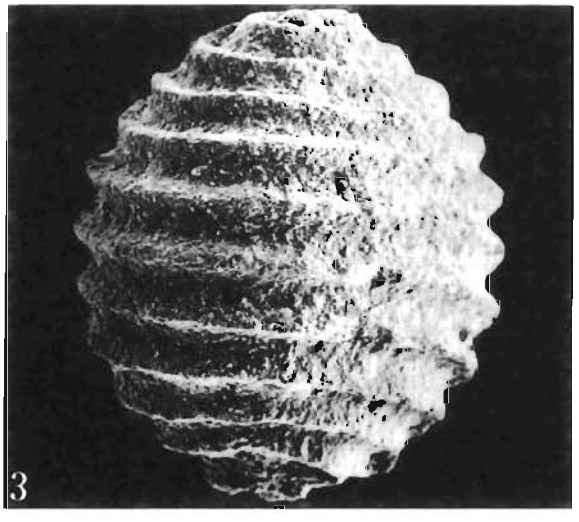
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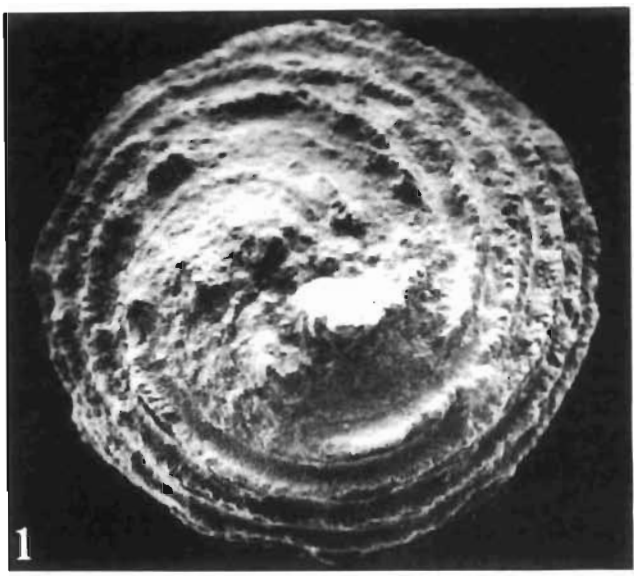
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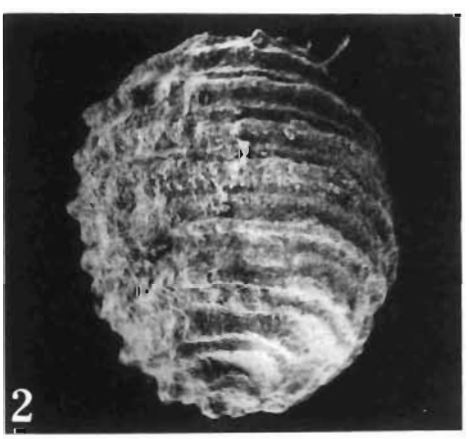
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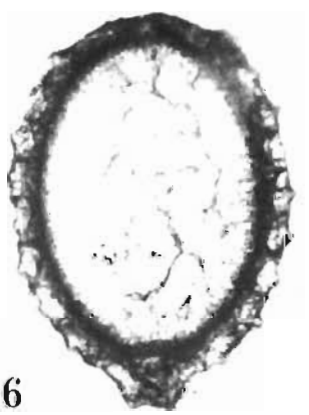
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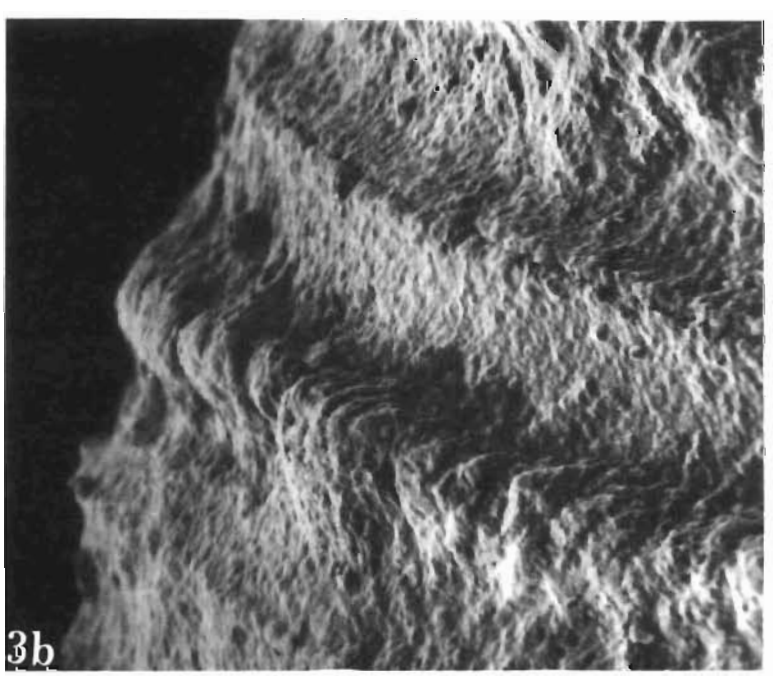
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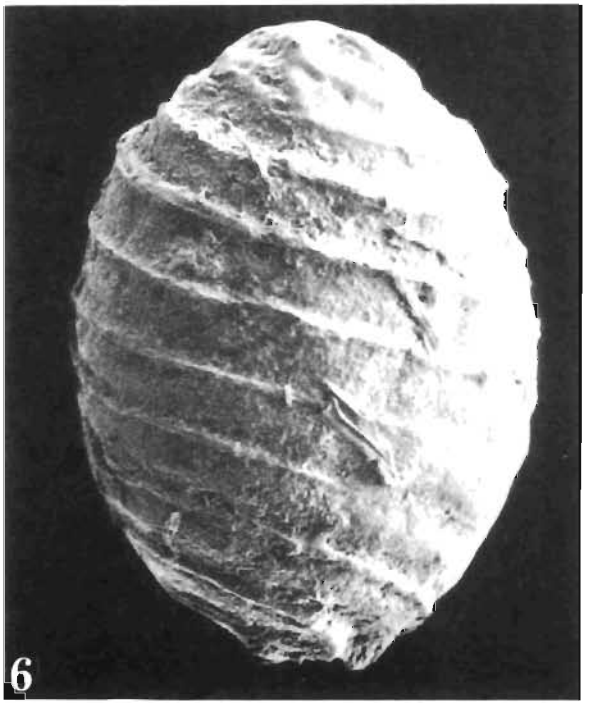
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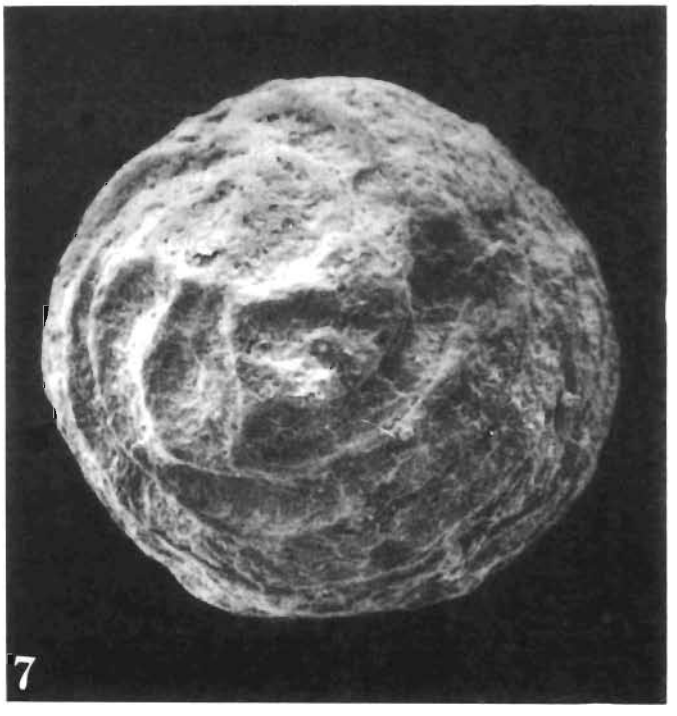
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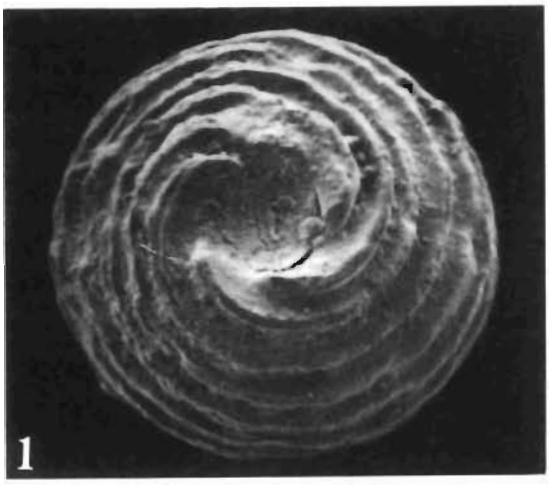
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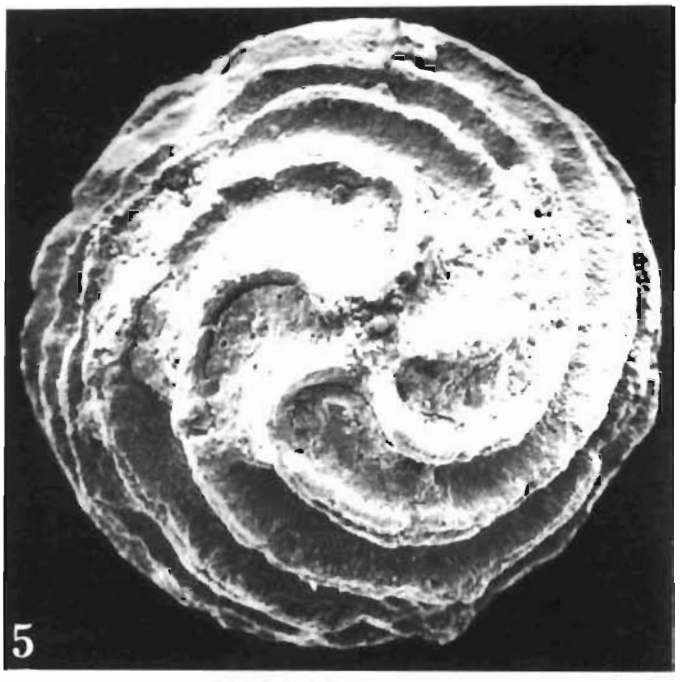
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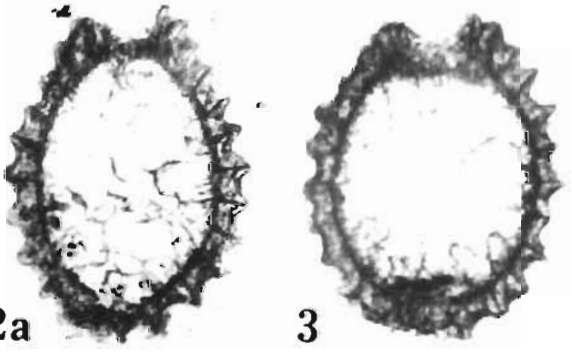
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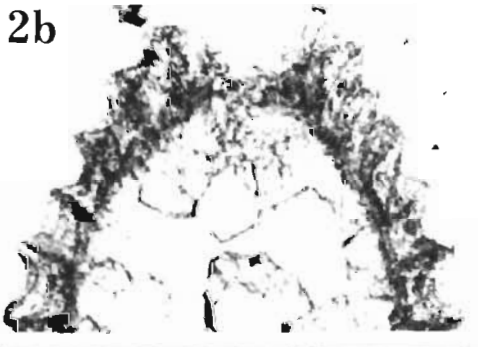
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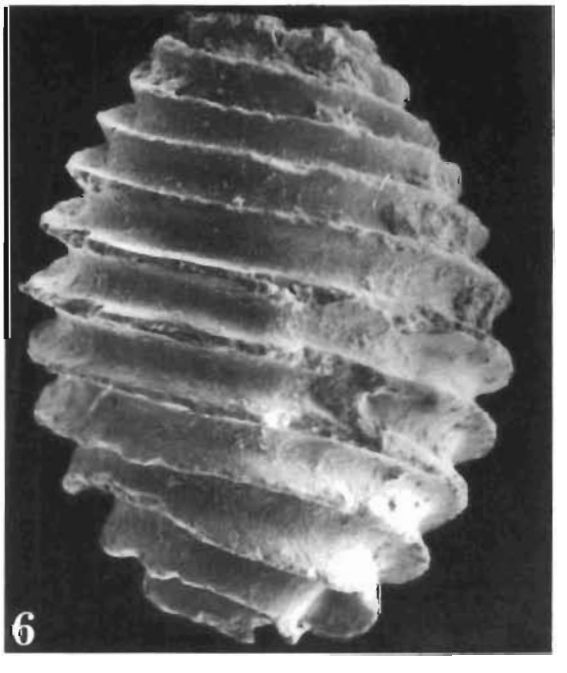
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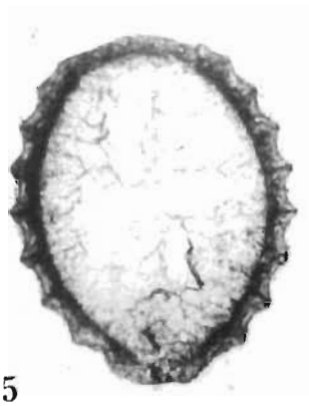
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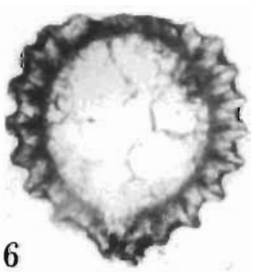
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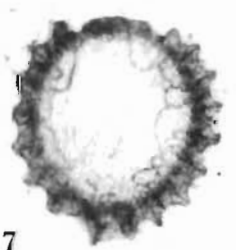
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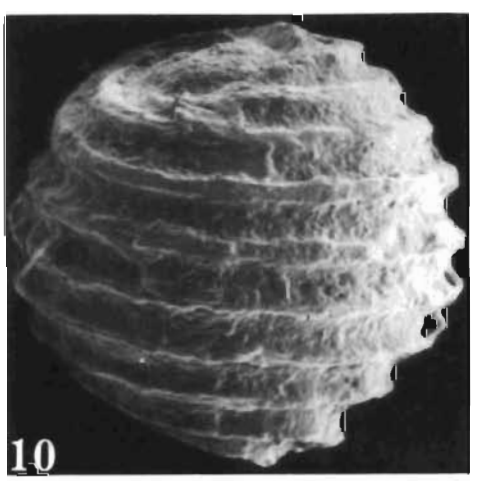
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