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TRIASSIC CARBONATES FROM NORTH OF RARĂU SYNCLINE (EAST CARPATHIANS): MICROFACIES AND PALEOGEOGRAPHICAL IMPLICATIONS

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Abstract. In the North of the Tătarca stream, the Triassic deposits crop out on the inner flank of Rarău Syncline. Structurally, the Triassic deposits belong to the Bucovinian Nappe of the Median Dacides (Săndulescu, 1984). These deposits appear like a continuous bând, approximately constant in thickness, between Tătarca and Deremoxa streams, widening afterwards in the North vvhere it makes up the Găina and Ştirbu Mts.

The Triassic sedimentation starts with conglomerates and quartz sandstones (Seisian) followed by massive dolomites (Hydaspian) and white limestones (Pelsonian - Ladinian). The microfacies of white limestones are made up of pelmicrites, pelsparites and pelintramicrites. The bioclastic content consists especially of dasycladalean algae: *Physoporella - Oligoporella* group, *Julpiaella subtilis* (Pia) Bucur & Enos, *Diplopora annulatissima* Pia, *Diplopora annulata* Schafhăutl. Numerous specimens of *Tubiphyîes* nodules are also present besides few foraminifers: *Meandrospira dinarica* Kochansky - Devide & Pantic, *Earlandia amplimuralis* Pantic, *Earlandia gracilis* Elliott.

Keywords: Microfacies - Paleogeography - Rarău Syncline, Triassic

INTRODUCTION

The Triassic deposits in the Rarău Syncline belong to the system of the Median Dacides Nappes, the most developed of which is the Bucovinian Nappe. The entire syncline, oriented NV-SE, is made up actually of the sedimentary deposits of this nappe.

The area we have studied is situated in north of the Rarău Syncline, on its inner flank. This area lies between the Lucina brook, northwards, and the Tătarca brook, southwards. The entire sedimentary of the area is sectioned by several brooks which are right tributaries of the Moldova river. They are: Tătarca, Deremoxa, Lucava, Lucina (fig.1).

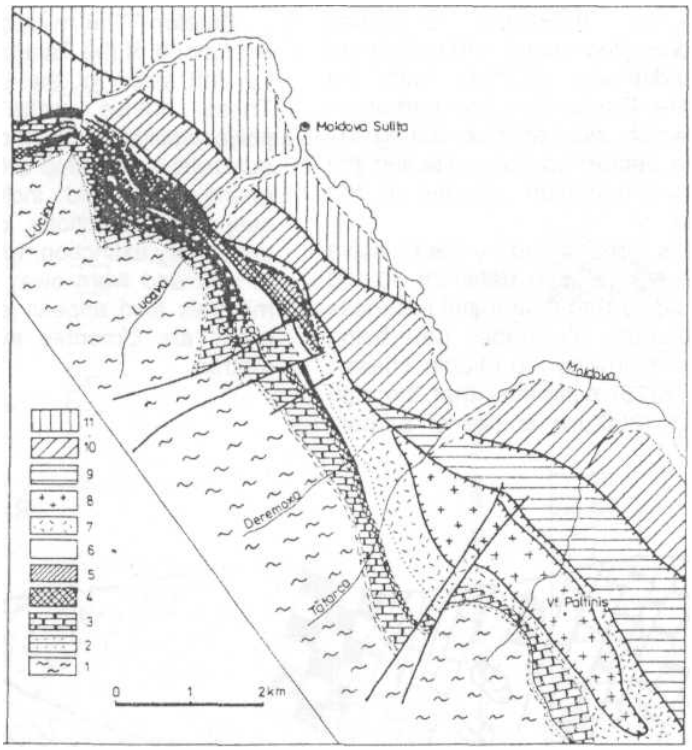

Fig. 1 Geological map of the north part of Rarău Syncline (according to Dimian 1970, Krâutner et al. 1975). Buconinian Nappe: 1 - crystalline basement; 2 - conglomerates and sandstones (Seisian); 3 - dolomites (Lower Anisian); 4 - algal limestones (Middle Anisian - Ladinian); 5 - limestones and Tătarca breccia (Dogger); 6 - jaspers (Callovian - Oxfordian); 7 - wildflysch (Hauterivian - Albian). Transilvanian Nappes: 8 - serpentines. Flysch: 9 - Ceahlău Nappe; 10 - Teleajen Nappe; 11 - Audia Nappe.

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Between the Tătarca and Deremoxa brooks the Triassic sedimentary appears as a continuous bând of an approximately constant thickness, which form to the north the entire Găina and Ştirbu Mountains.

The lithological column of the Bucovinian Triassic in the investigated area begins with the detritic Seisian, followed by the dolomitic Hydaspian, and end with the algal calcareous Pelsonian-Ladinian. In the Rarău Syncline the Upper Triassic deposits are absent. They are cropping out only in the central part of the Hăghimaş Syncline, situated to the south of the elevation of the crystalline basement of the Bistriţa Mountains.

The microfacies analysis has been focused mainly on the carbonate deposits, but we have considered also necessary to investigate the microscopical aspects offered by the underlying detritic level.

LITHOLOGY AND STRATIGRAPHY

As we have pointed out, the Triassic deposits develop only on the Seisian-Ladinian interval. The Campiiian, made up of plate limestones and dolomites is missing in this sector, although Mutihac (1968, 1969) notifies them.

The **Seisian** is represented by a detritic level of approximately 5-10 m thickness consisting predominantly of microconglomerates and isolated of quartzitic coarse sandstones. Starting with the Campiiian, in the entire Rarău Syncline carbonate sedimentation begin which will continue during the Middie Triassic. In the sector we have studied the conditions of such sedimentation appear at the beginning of the Anisian.

The Early Anisian is represented by the massive dolomites with a thickness ranging between 50-150 m; Mutihac(1968) considers that their inițial thickness was much more important, the upper part being removed by the erosion following the Middie Triassic exondation. Krâutner (1929) estimates that the high value of the thickness (200 m) is not of primary origin, but it is due to some subsequent processes of folding and spalling which involved both the Bucovinian sedimentary and the crystalline basement. North of the Tătarca Valley to the Lucava Valley the bând of dolomites becomes broader and broader as a result of some tectonic doubling, and then, between the brooks Lucava and Lucina it becomes narrow again because of the laminations (Mutihac, 1968, 1969, 1970; Dimian 1970).

Starting with **Middie** and **Late Anisian** and continuing during the whole **Ladinian** in the north of the Rarău Syncline appear conditions favourable to some algal limestone sedimentation. These limestones outcrop in the stream system forming on the Lucava brook a short sector of gorge. Of all the outcrops, only that from the left slope of Tătarca brook offered a rich micropaleontological content mainly in algal fragments

The limestones from the Tătarca brook are white, some of them with reddish and grey or orange portions. They are disposed immediately under the Tătarca breccia (Dogger) (fig. 2). The limestones from the Lucava brook are grey, sometimes black with fine white joints of calcite.

MICROFACIES

Seisian. The microconglomerates outcrop in the right slope of the Tătarca brook (sample 245) and on the left slope of the Lucava brook (sample 224). These detritic rocks have diverse lithoclasts: polycrystalline quartz, sericitic-quartzitic and quartzitic-feldspathic schists. Very frequently, quartz grains with fluid inclusions occur, oriented on subparallel directions, quartz crystals often with an undulatory extinction, with variable sizes from arenite to siltit and worn away edges. Grains of carbonate minerals also appear, especially dolomite. All these clasts are cimented by brown coloured carbonate matrix.

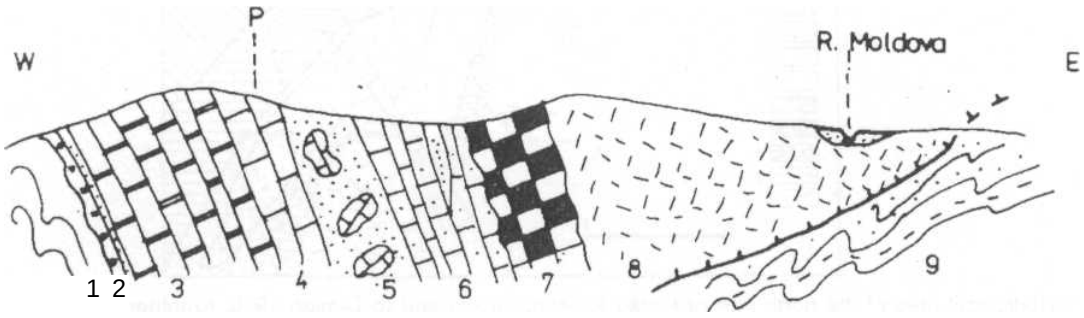

Fig. 2 Geological sketch of the inner flank of Rarău Syncline (Tătarca brook area). Buconinian Nappe: 1 - crystalline basement; 2 - conglomerates and sandstones (Seisian); 3 - dolomites (Lower Anisian); 4 - algal limestones (Middie Anisian - Ladinian); 5 - Tătarca breccia and 6 - limestones and calcareous sandstones (Dogger); 7 - jaspers (Callovian - Oxfordian); 8 - wildflysch (Hauterivian - Albian). Flysch: 9 - Ceahlău Nappe. P - sampled section.

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Early Anisian. I have remarked the predominance of two microfacies types: dolosparites with the non-planar anhedral fabric and dolomicrites. Compared with the dolomites investigated on other profiles, which contain rare bioclasts especially of foraminifers *(Earlandia),* in the area to the north of the Tătarca brook the deposits under discussion are totally devoid of microfauna.

Middle Anisian - **Ladinian.** In the outcrop from the right slope of the Lucava brook, the limestones contain a dolomitic level (20-25 m thickness) to the upwards of stratigraphic succession (fig. 3). This level is formed by grey-black dolomites (samples 234, 236, 237) and orange dolomites (sample 235) disposed in centimeter thick strata. These deposits are dolosparites (samples 234, 237) and dolomicrosparites (samples 235, 236) with calcite veins.

The study of the thin sections through the limestones samples on the both slopes of the Lucava brook (fig. 4, 5) have proved the preponderant existence of the **micrites** (samples 225-223, 238, 239, 716-720). They contain a ranges of the anhedral crystals of twinned calcite and more rarely of euhedral dolomite crystals. Some of them are crossed by fine calcite joints; totally isolated (samples 228) occur large joints filled with anhedral crystals of carbonate minerals and completely isolated of detritic quartz. The sizes of some crystals from the joints decrease from the center of the joint to its edges, at the contact with the mioritic matrix. The bioclastic content of these limestones is represented by rare foraminifers, crinoids plates and ostracods with thin shells. The interior of the shells is geopetally filled with gray 'cristal silf pointing to vadose overprint.

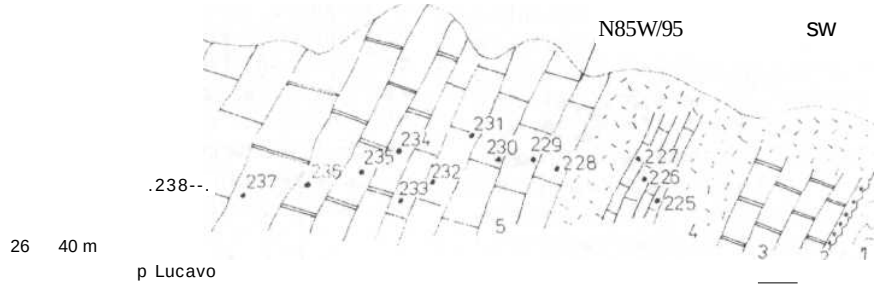

Fig. 3 Geological sketch of the carbonate rocks situated on the right slope of Lucava brook. 1 - crystalline basement; 2 - conglomerates (Seisian); 3 - grey and black dolomites, 5 - grey limestones (Anisian); 4 - deluvial deposits.

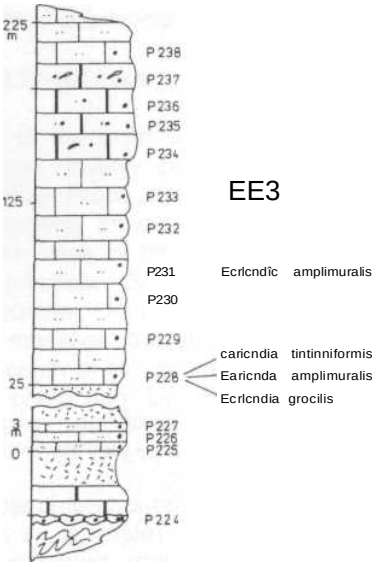

Fig. 4 Biostratigraphical column of the carbonate Triassicdeposits from the right slope of Lucava brook. 1 - conglomerates; 2 - massive dolomites; 3 - deluvial deposits; 4 - micrites; 5 - dolopelsparites; 6 - dolomicrosparites.

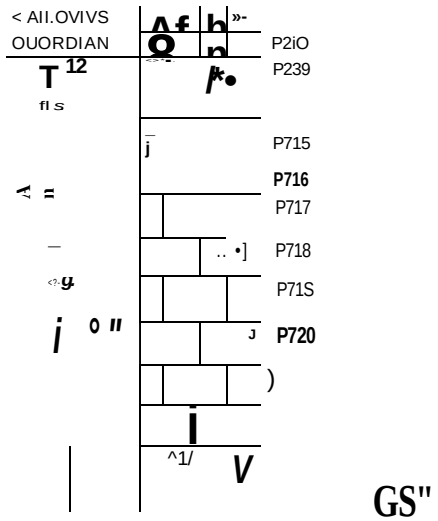

Fig 5 Lithological column of the Middle Triassic deposits of the left slope of Lucava brook. 1 - Massive dolomites; 2 - micrites; 3 - pelmicrosparites; 4 - jaspers.

The foraminifers are represented by: *Earlandia amplimuralis* Pantic, *Earlandia gracilis* Pantic, *Earlandia tintinniformis* Misik (Plate 1).

The **pelmicrosparites** appear isolated (samples 239, 715), characterized by a "phantom-like" structure created by the existence of some aggregates with a circular or ovoid shape made up of coarse dolomite. The dolomite is sourrounded by a finer-grained matrix. The sediment was probably an oolithic or peloidal wackstone. It would seem likely that the original grains had been dissolved and were replaced by dolomite. The foraminifers are represented by few species: *Pilammina densa* Pantic, *Meandrospira dinarica* Kochansky-Devide, *Earlandia* sp.(Plate 1). Totally isolated occur the dasycladalean alga *(Physoporella* sp.j

The Triassic limestones in the Tătarca profile are different from those in the Lucava brook. They contain few microfacies types which, according to their frequency, are: biopelmicrites, biopelsparites, pelmicrites and pelintramicrites (fig 6).

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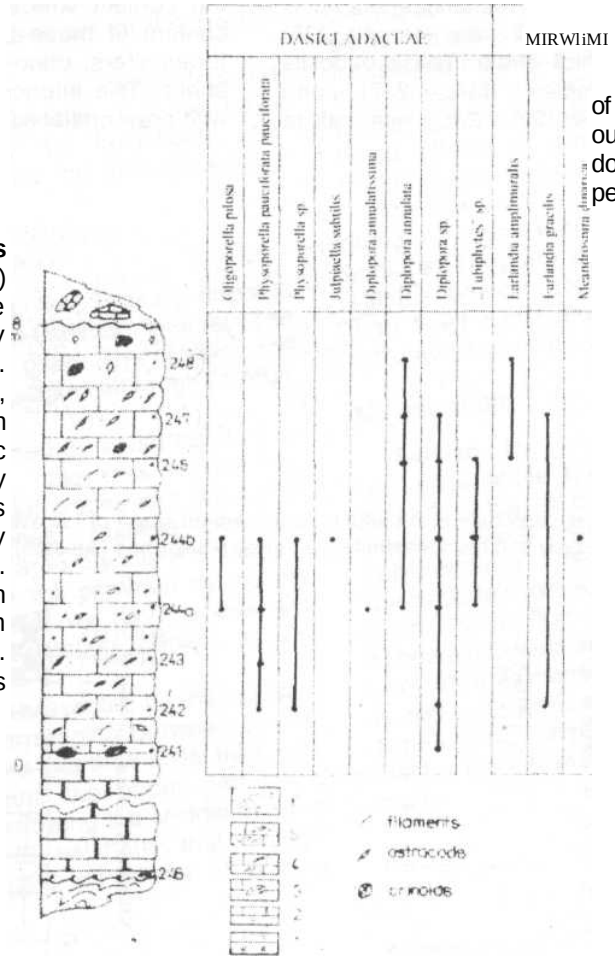

Fig. 6 Biostratigraphical column of the Triassic carbonate deposits in the Tătarca brook outcrop.
1 - conglomerates; 2 - dolomites; 3 - calcareous breccia; 4 - pelmicrites; 5 - pelsparites; 6 - pelintramicrites.

The **biopelmicrites** (samples 242-244b, 247) predominate and are characterized by micropaleontological richness. The pelmicritic matrix, contains dolomite clasts with micritic envelopes and sparitic cement constituted especially by subhedral calcite crystals and more rarely by euhedrale dolomite crystals. They are rocks abounding in algal fragments, some of them intensely recrystallized. Additonal fossil components are: rare filaments,

crinoids, ostracods, fragments of juvenile ammonites. The foraminifers are relatively rare and poorely preserved, most of them belonging to *Earlandia gracilis* Elliott, and, rare, to other taxa: *Meandrospira dinarica* Kochansky-Devide & Pantic, *Meandrospira* sp., *Nodosinella* sp. Isolated also appear some taxa of *Globochaete alpina* Lombard.

The sample 244b corresponds to an algal biolithite which has offered the richest association of

dasycladales ever described from Triassic depositsin the Rarău Syncline. The assemblage contains the following taxa: *Physoporella pauciforata pauciforata* (Gumbel) Bystricky, *Physoporella* sp., *Oligoporella pilosa* Pia, *Julpiaella subtilis* (Pia) Bucur & Enos, *Diplopora annulata* Schafhăutl, *Diplopora* sp. (Piates 2,3 4).

The biopelsparites corresponding to 244a sample belong to the same algal level mentioned above. If in the biopelmicrites the algae appear in association with the foraminifers and other bioclasts, in biopelsparites appear only algae. The dasycladal association are represented by fragments of: *Physoporella pauciforata pauciforata* (Gumbel) Bystricky, *Physoporella* sp., *Oligoporella pilosa* Pia, *Diplopora annulatissima* Pia, ?*Diplopora annulata* Schafhăutl, *Diplopora* sp. In addition numerous samples of nodules of the *Tubiphytes* type appear.

The pelmicrites (sample 246) and the **pelintramicrites** (sample 248) partially correspond to the grey limestones with orange hues outcropping on the right slope of the Tătarca brook. The pelmicrites crossed by fine joints of sparry calcite, present rare intraclastes of diagenetic sparry dolomite. The bioclasts are rare: *Earlandia amplimuralis* Pantic, *Earlandia* gracilis Elliott and *Meandrospira* sp. In addition appear fevv taxa: *Diplopora annulata* Schafhăutl, *Diplopora sp., Tubiphytes.*

In the **pelintramicrites,** where the carbonate intraclasts predominate, the bioclasts are much more diversified consisting of frequent crinoide piates, echinoid spines, fragments of brachiopods, rare dasicladalean algae *(Diplopora annulata* Schafhăutl) and foraminifers *(Earlandia amplimuralis* Pantic).

Age of algal limestones

The age of the algal limestones has been very much disputed. Initially considered Upper Triassic (Atanasiu 1958; Preda and Pelin 1963), they have been subsequently attributed to Ladinian by Băncilă (1941) on the base of two dasicladacean species - *Diplopora annulata* Schafhăutl and *Gyroporella perforata* Gumbel, found in the grey limestones underlying massive dolomites from the Coniac Mountains (south of Hăghimaş Syncline). The same age was upheld too by: Stănbiu (1966, 1967), Patrulius (1966, 1967), Patrulius et al.(1971), Grasu (1971, 1972-1973), Grasu & Turculeţ (1978), Mutihac (1966), Turculeţ (1971), Săndulescu (1974, 1981). Mutihac (1968, 1969) and Dimian (1970) consider the extension of the above mentioned deposits in the interval Ladinian - ?Carnian. Săndulescu (1975) attributed them to the interval Anisian - Ladinian, while Grasu et al. (1995) places these limestones in Pelsonian - Illyrian.

The algal and foraminiferal association identified by us contains the typical Anisian species *(Meandrospira dinarica* Kochansky-Devide & Pantic *Pilammina densa* Pantic, *Physoporella - Oligoporella* group, *Julpiaella subtilis* (Pia) Bucur & Enos together with other species with a larger stratigraphic range, including a part of Anisian and Ladinian *(Diplopora annulatissima* Pia, *Earlandia gracilis* Elliott). *Diplopora annulata* Schafhăutl defines the Ladinian.

Taking into consideration the stratigraphic repartition of the main species we determined in the algal limestones, we assume the Pelsonian-Ladinian age for the white dasiclad - bearing limestones

PALEOGEOGRAPHIC IMPLICATIONS

Microfacies data indicate the existence of a carbonate platform. Relatively low diversity, high abundance of algae and the association with euryhaline organisms indicate a low energy, shallow restricted lagoonal environment. The carbonate Triassic platform developed also in Hăghimaş Syncline. The limestones comparable in biofacies and age with the carbonates of Rarău Syncline occur in the middle and south part, respectively on the inner flank of the Hăghimaş Syncline.

CONCLUSION

The complete stratigraphic alpin Triassic succession in Bucovinian facies contains: a detritic level (Seisian), bedded limestones and dolomites (Campilian), massive dolomites (Lower Anisian), dasiclad - bearing white limestones (Middle Anisian - Ladinian). In the studied area the Campilian is absent, proving an exondation process followed by strong erosion in the north of Rarău Syncline that determined the complet removal of the carbonate deposits underlying the detritic level.

The microscopical analysis of carbonate Triassic deposits showed the presence of few microfacies types; the most important components of these carbonate rocks are dasicladalean algae and foraminifers. This bioclastic debris was found in the white limestones of the Tătarca brook outcrop. The same limestones that outcrop on the Lucava brook contain few recristaliiyed algae and rare foraminifers. The age of these limestones is Middle Anisian based on the calcareous algal association.

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PLATES

PLATE I

Triassic Foraminifera

1,2 - Conglomerates with metamorphic quartz, quartz - sericitic schists clasts and carbonate grains in carbonate matrix. 1 - sample 245a Tătarca; 2 - sample 224, Lucava, Seisian, N+, x 24.
3 - Micrite with calcit twined and coarse dolomite crystals infilling the joints. Sample 717a, Lucava Pass, Upper Anisian - Ladinian,x24.
4 - Dolomite with non - planar anhedral fabric. Sample 250a, Deremoxa, Lower Anisian, x24.
5 - *Pilammina densa* Pantic in an algal biopelsparite. Sample 239a, Lucava Pass, x 24.
6,8 - *Meandrospira dinarica* Kochansky-Devide & Pantic in an algal biopelsparite. 6 - sample 239c, Lucava Pass; 8 - sample 224b, Tătarca, Middle Anisian, x 70.
7 - Pelintramicrite with crinoid plates and few foraminifers *(Earlandia amplimuralis* Pantic). Sample 248a, Tătarca, Middle Anisian - Ladinian, x70.

PLATE II

Dasicladalean algae in Middle - Upper Anisian limestones from Tătarca exposuro.

1,6 - *Physoporella pauciforata pauciforata* (Gumbel) Bystricky. 1 - sampie 244bo, longitudinal section; 6 - sample 244ac, oblique-longitudinal section; 1,6 x24.
4 - *Oligoporella pilosa* Pia. Sample 244ad, transversal section, x24.
2,3,5 - *Oligoporella* sp. 2 -sample 244af, transversal section, x70; 3 - sample 244an; 5 - sample 244be; 3,5 x24.

PLATE III

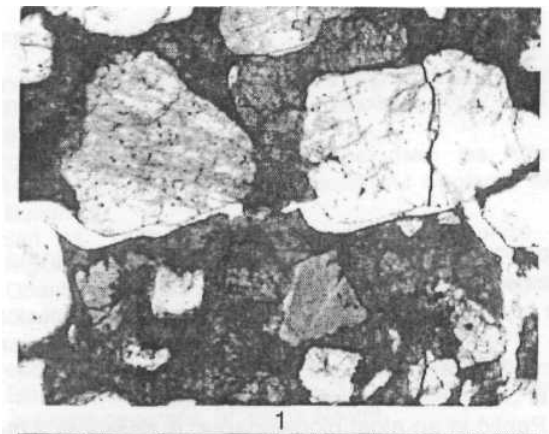
Dasicladalean algae in Middle Anisian - Ladinian limestones from Tătarca outcrop.

1,2 - ?*Physoporella* sp. 1 - sample 244am; 2 - sample 244ao, x24.
3 - 8 - *Oligoporella pilosa* Pia. 3 - sample 244bu; 4 - sample 244bi and 5 - sample 244bc, transversal section; 6 - sample 244ah; 7 - sample 244bu; 8 - sample 244ab; x 24.

PLATE IV

Dasicladalean algae in Middle Anisian - Ladinian limestones from Tătarca outcrop.

1 - *Julpiaella subtilis* (Pia) Bucur & Enos. Sample 244br, x24.
2 - *Physoporella* sp. Sample 244br, x24.
3,5 - *Diplopora annulatissima* Pia. 3 - sample 244aa; 5 - sample 244aj; 3,5 x24.
6 - *Diplopora* sp. Sample 244bd, x24.
4, 7 - *?Diplopora annulata* Schafhăutl. 4 - sample 244bm; 7 - sample 244ba; 4,7 x24.
8 - *Oligoporella* sp. (?*Oligoporella prealpina* Pia) Sample 244br, x24.



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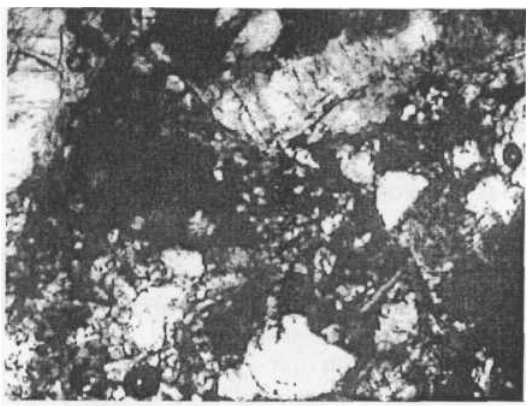

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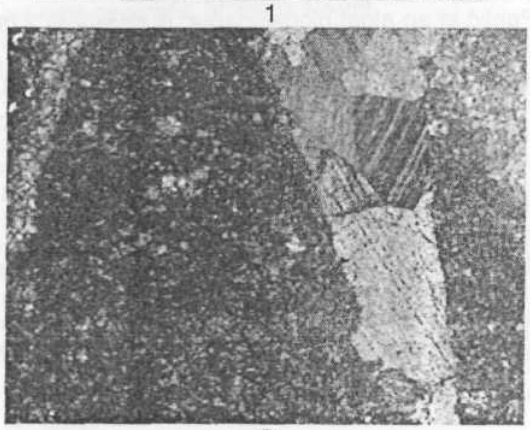

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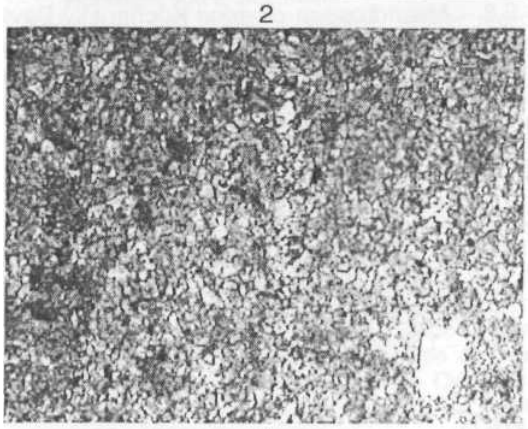

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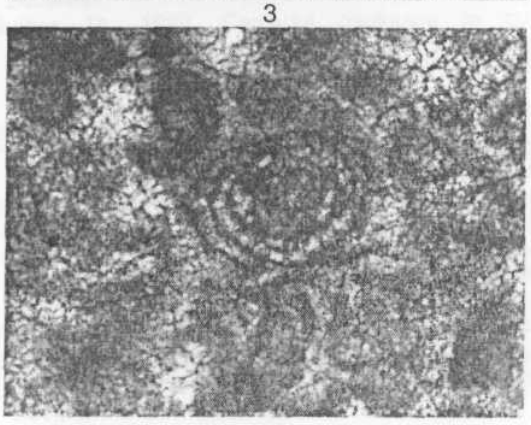

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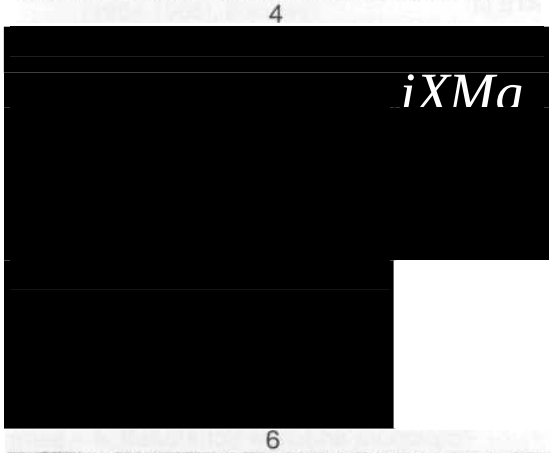

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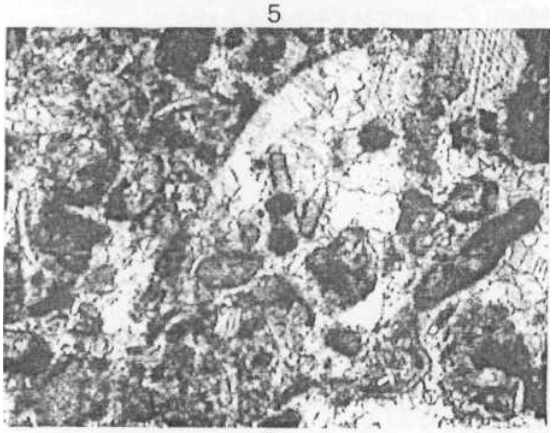

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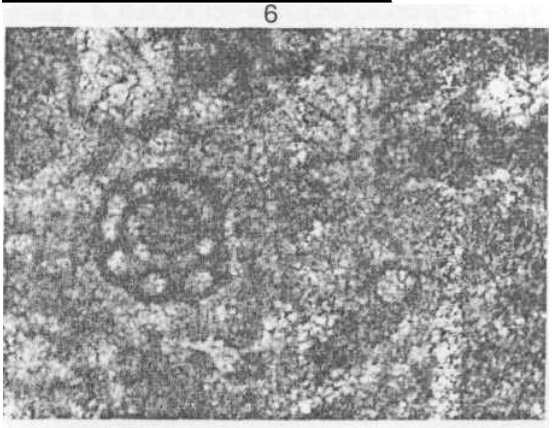

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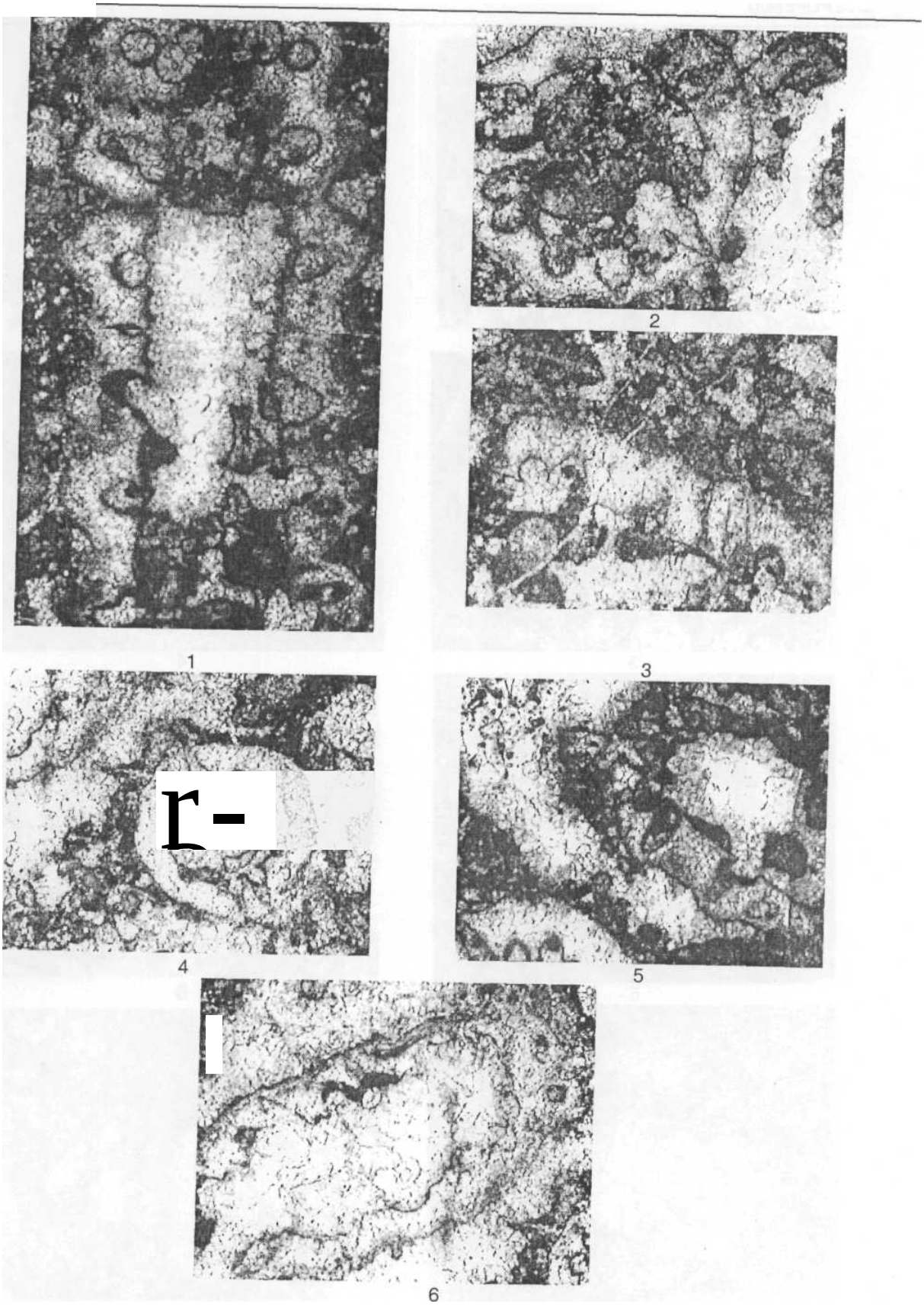

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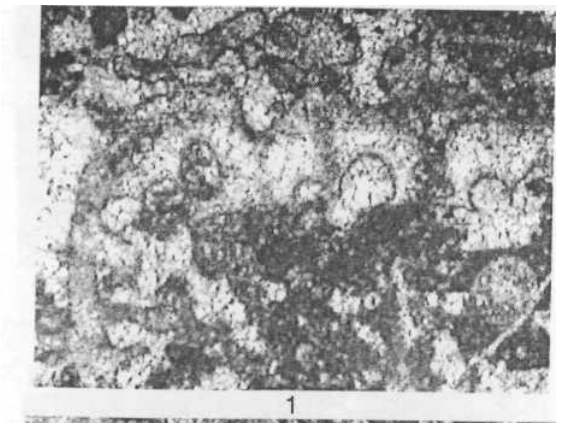

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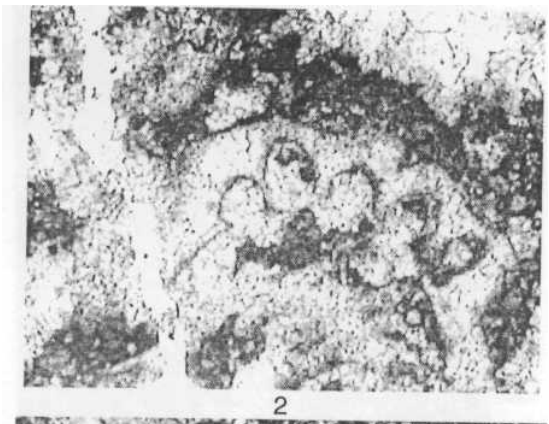

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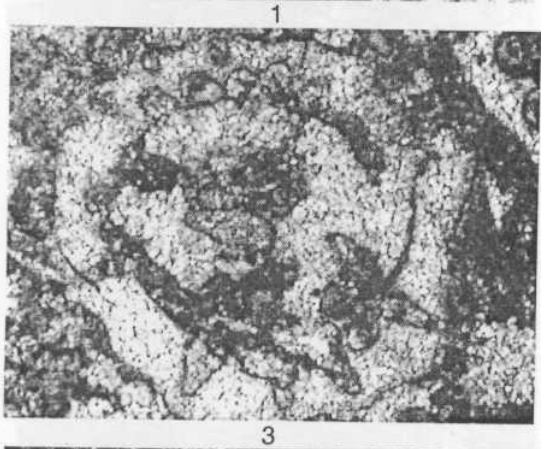

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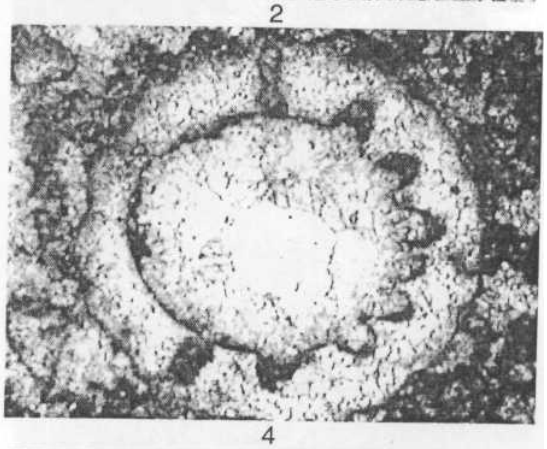

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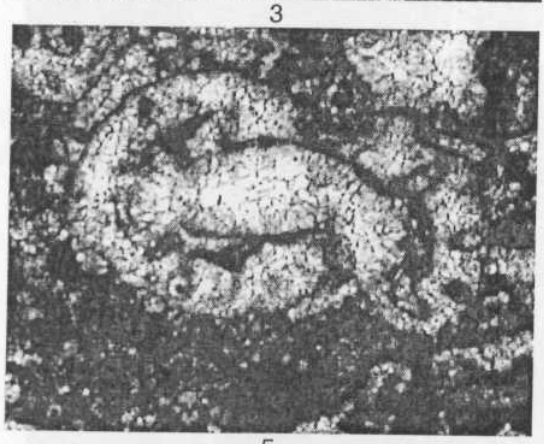

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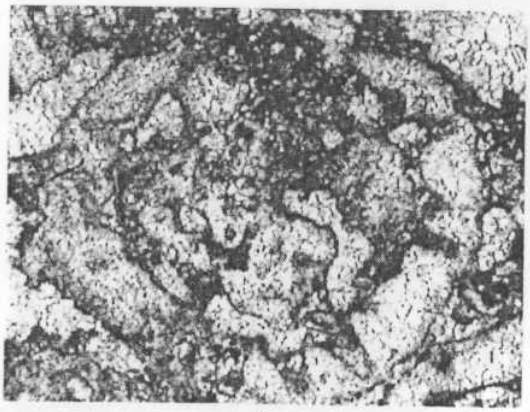

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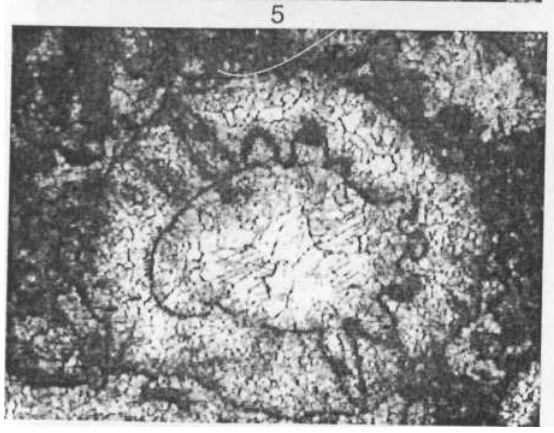

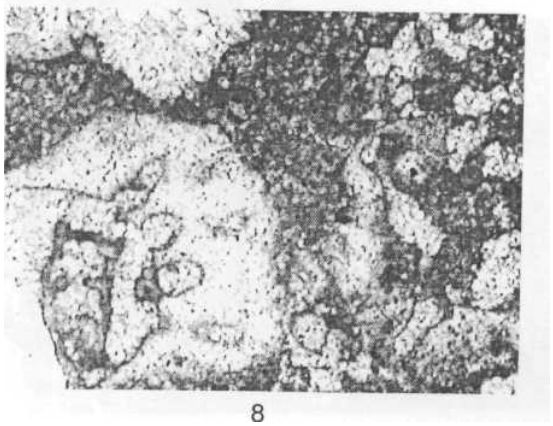

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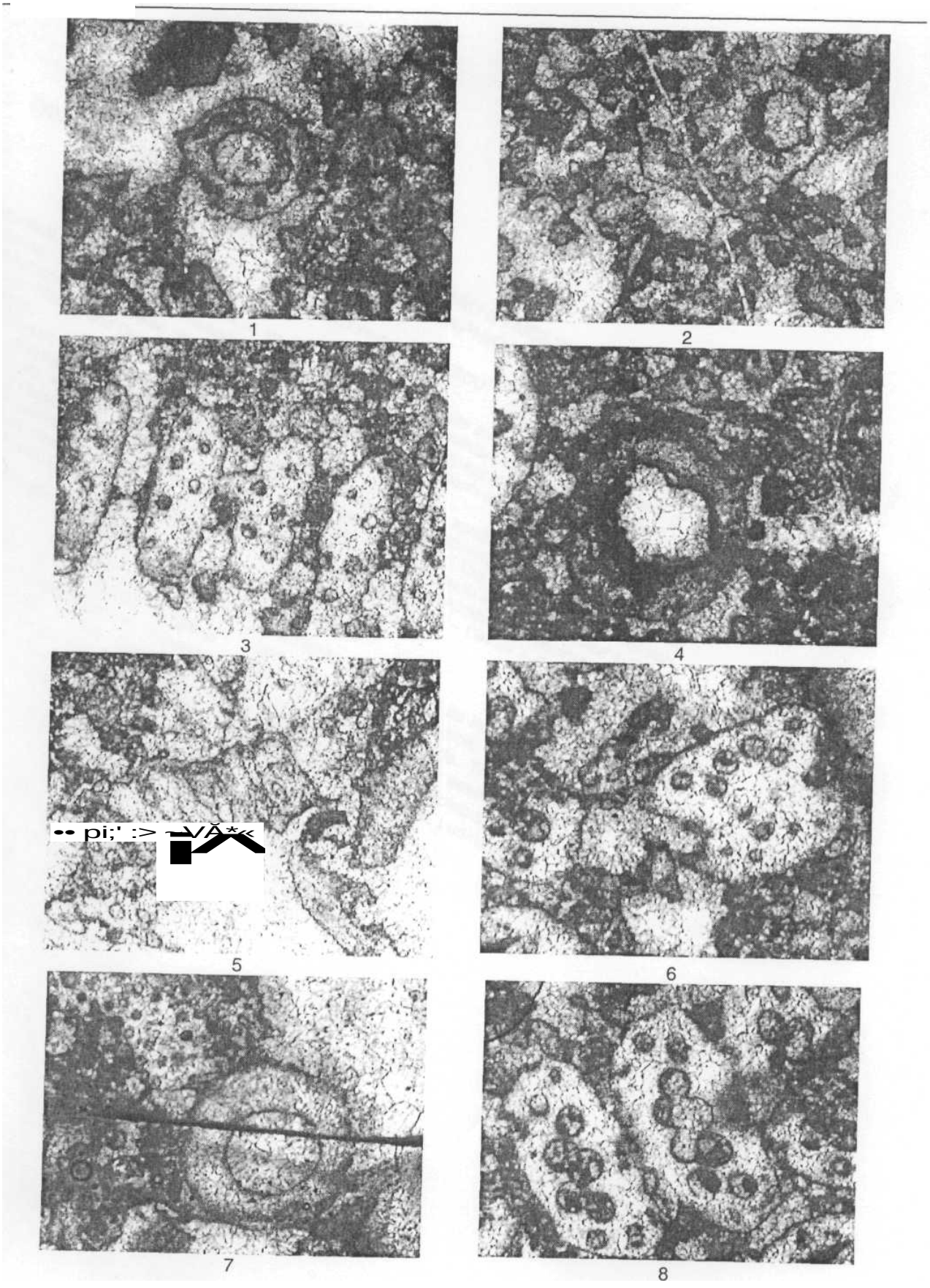

PLATE IV