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STRATIGRAPHY AND MACROFAUNA OF THE ZÁMOSTIE LIMESTONES (UPPER PELSONIAN—LOWER ILLYRIAN) OF THE CHOČ NAPPE AT THE SOUTHERN SLOPES OF THE NÍZKE TATRY MTS. (WEST CARPATHIANS)

(Figs. 10, Pl. 1)

Contribution to Project Nr. 198

A b s t r a c t: The article analyses a part of the bed sequence of Anisian limestones, understood traditionally as the basis of the Reifling Limestone. In fact, this part of the sequence represents the sequence of the Zámostie Limestone independent lithostratigraphically and environmentally, with a characteristic shallow-water fauna, particular lithological composition, structures, position in the bed sequence. The systematic part of the work is connected with treatment of the ammonite fauna of R a k ú s (1985) by descriptions of four bivalve taxa, one scaphopod, nine gastropods and four brachiopod species.

Р е з ю м е: В статье анализируется часть последовательности пластов аниских известняков по традиции понимания как фундамент райфлингского известняка. На самом деле эта часть последовательности представляет собой по литостратиграфии и среде самостоятельную толщу замостских известняков с характерной мелководной фауной, особым литологическим составом, текстурами, местом в последовательности пластов. Систематическая часть работы исходит из обработки аммонитовой фауны Р а к у с а (R a k ú s, 1985) описаниями четырех таксонов двустворок, девяти гастропод, одного таксона скафоподов и четырех видов брахиоподов.

Introduction

D. Š t ú r (1868) stated that the slopes of the terrace above the Hron valley near Nemecká and Predajná are formed by dark "Muschelkalk-Dolomit". In its overlier he distinguished grey cherty limestones, which he parallelized with the Reifling Limestone of the Alps (he found the brachiopod *"Terebratula" angusta* in them). North of Predajná in the uppermost part of the "Muschelkalk" he found thin-platy black limestones resembling the Wengen beds, covered with the complex of Reingraben shales 20—30 feet thick. The Triassic sequence was terminated by the complex of the "Main Dolomite".

Š f a s t n ý (1928) considered dark splintery dolomites, covered with dark-grey limestones of Gutenstein type as the basis of this sequence ("Nízke Tatry series" according to him), passing into black cherty limestones with "Terebratula" fauna. The higher Reifling Limestones with light-coloured cherts should be covered with the "Hrádok beds" with sporadical intercalations of black

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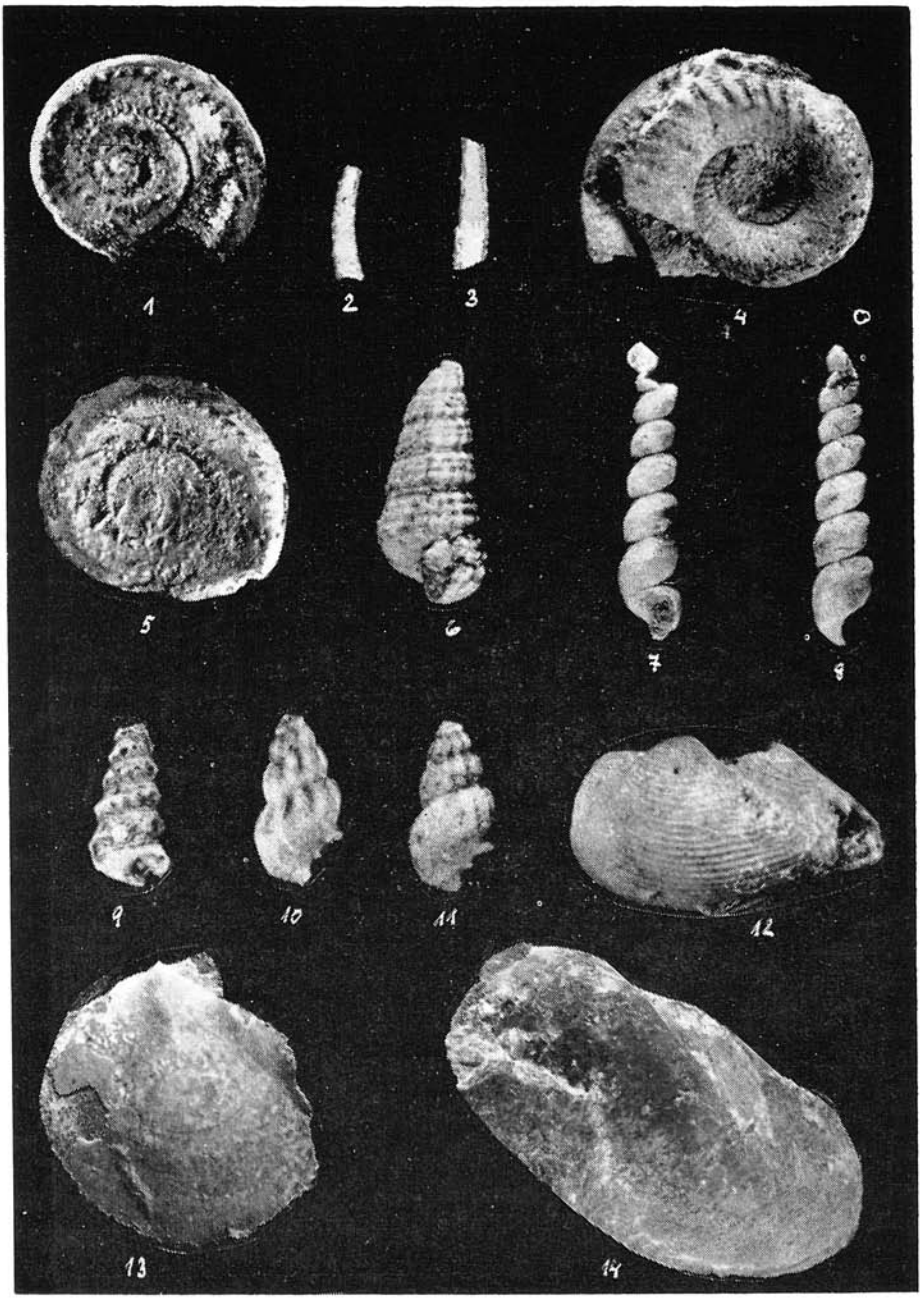
Plate I



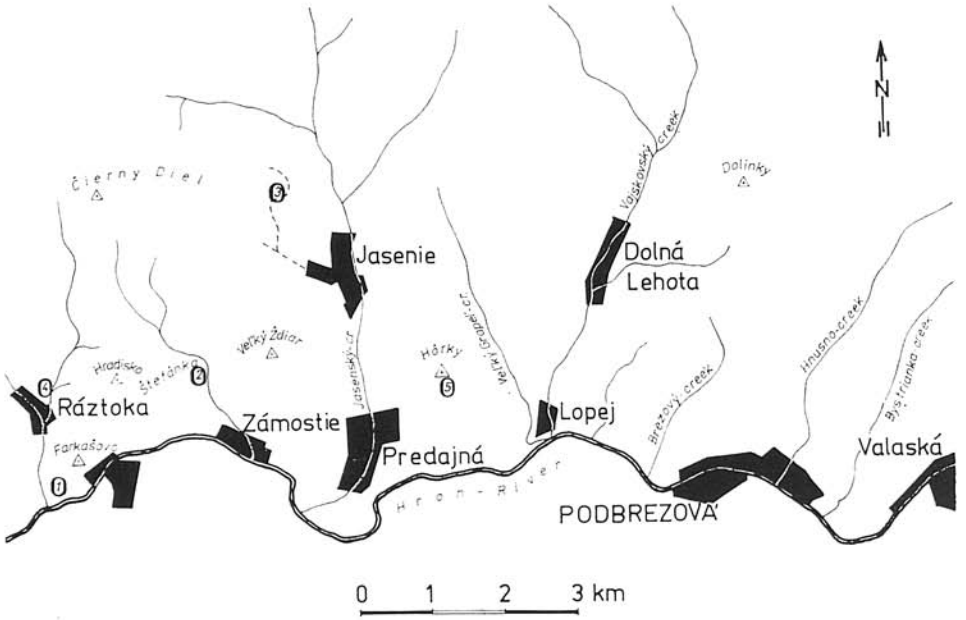


Fig. 1. Sketch-map of localities of the Zámostie Member at the southern slope of the Nízke Tatry Mts. in the area of Predajná, Jasenie and Nemecká.

Legend: 1 — stratotype of the Farkašovo Formation; 2 — stratotype of the Zámostie Formation (hypostratotype of the Jasenie Member), locality Zámostie—Štefánka; 3 — stratotype of the Jasenie Member, locality Jasenie—Čierny Diel; 4 — stratotype locality of the Ráztoka Member, Ráztoka—Pod Hradiskom; 5 — locality Predajná—Hôrky.

Plate I

Figs. 1, 4—5. *Straparolus (Euomphalus)* cf. *granulatus* (ASSMANN), magnif. 4.2×, 3.4×, 3×.
Figs. 2—3. *Dentalium (Antalis)* sp., magn. 5×.
Fig. 6. *Promathilda* ? sp., magn. 3.6×.
Figs. 7—8 *Polygyrina gracilior* (SCHAUROTH), magn. 3×.
Fig. 9. *Promathilda* cf. *contraria* (BÖHM), magn. 5×.
Figs. 10—11. *Zygopleura* ? sp., magn. 7.6×.
Fig. 12. *Phenodesmia* cf. *beneckei* TORNQUIST, magn. 4×.
Fig. 13. *Entolium discites* (SCHLOTHEIM), magn. 1.8×.
Fig. 14. *Hoernesia* cf. *socialis* (SCHLOTHEIM), magn. 1.5×.
The specimens in Figs. 1—12. are from the locality Hôrky (Jasenie Member) specimens in Figs. 13—14 from the locality Štefánka (Ráztoka Member).

Photo: C. Michalíková.

compact limestones at the base. The overlier of this sequence should have been formed by the higher tectonic unit.

The position and sequence of the Reifling Limestone near Nemecká and Predajná were dealt with by A n d r u s o v—M a t ě j k a (1931) and S p e n g l e r (1932). In the year 1937 D. A n d r u s o v and 1939 Z. R o t h described a fauna with *"Rhynchonella" trinodosi* at the base of the Reifling Limestones from Predajná. The geological conditions in the Choč nappe at the slopes of the

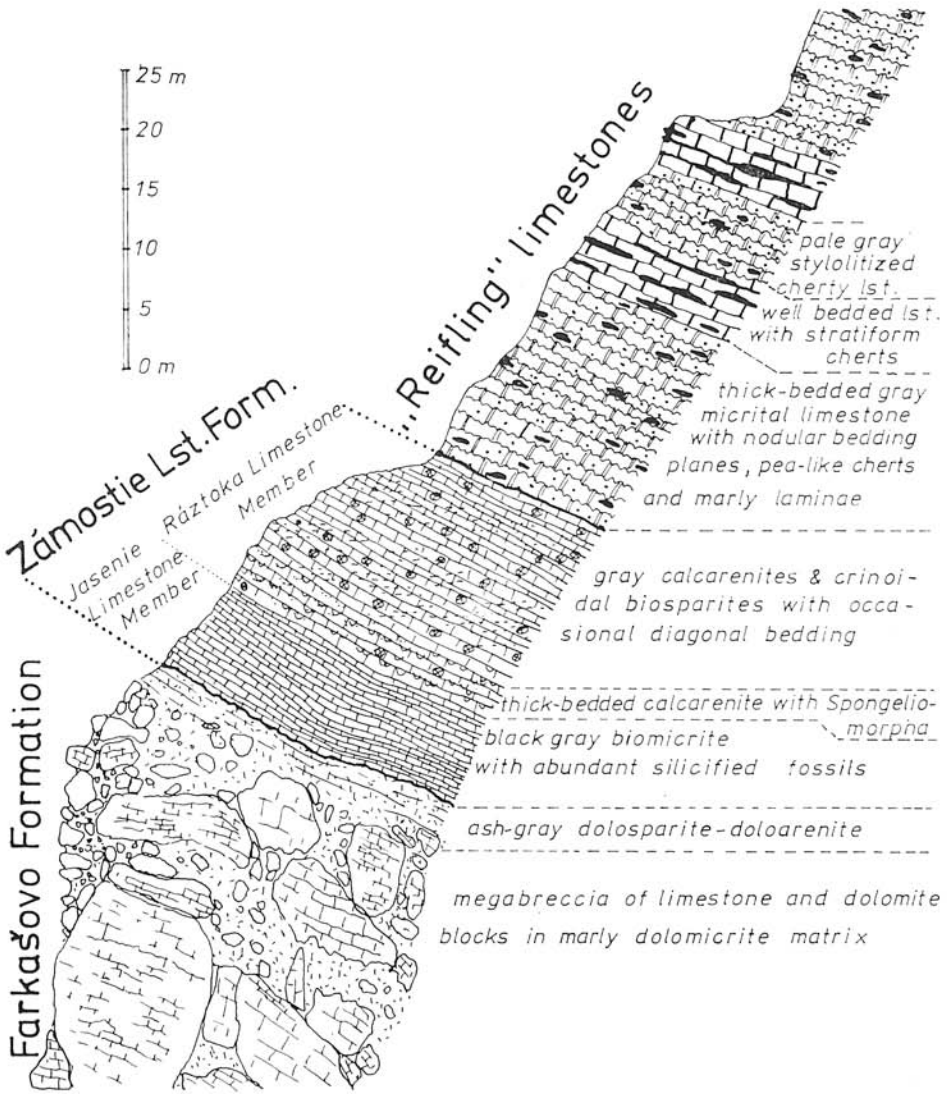


Fig. 2. Schematic lithostratigraphical division of the Middle Triassic carbonate complexes underlying the Reifling Limestone, in the Choč nappe, the southern slope of the Nízke Tatry Mts.

Nízke Tatry Mts. were characterized by Biely (1964) and Bystrický—Biely (1966). They ascribed a Ladinian age to the Reifling Limestones, parallelizing the shaly sequences in their overlier with the Lunz beds.

Borza (1970) was dealing with more detailed stratigraphy of the lower part of the "Reifling Limestones". He distinguished the sequence of dark-grey limestones with sporadical cherts (= "limestones with Terebratula fauna" of Šťastný l.c.) in the overlier of light-grey fine-grained dolomites. In these

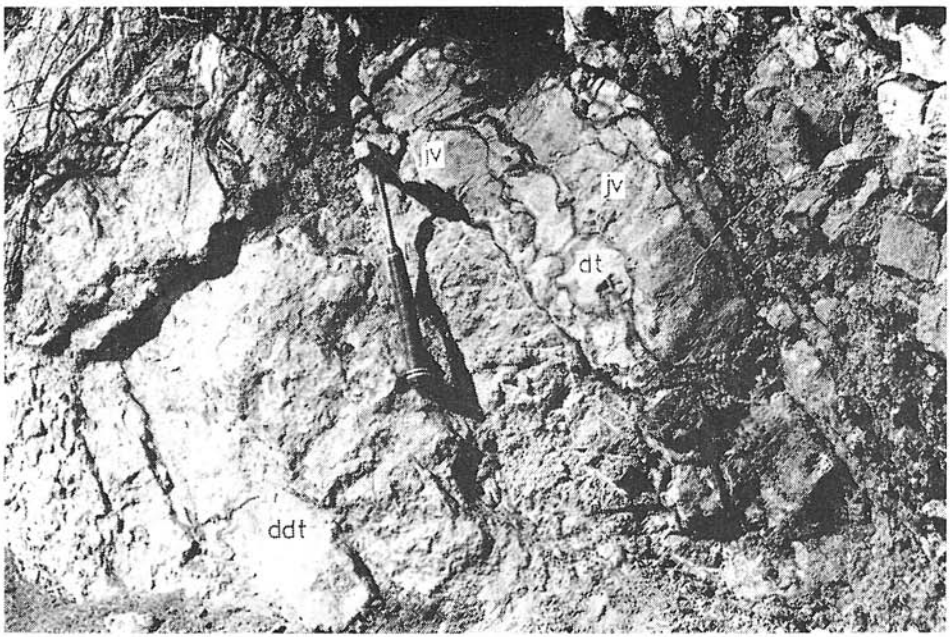


Fig. 3. Contact of basal layers of the Jasenie Member with the upper part of the Farkašovo Formation (detrital dolomites, ddt.).
Explanations: jv — limestone of the Jasenie Member; dt — dolomite intercalation. Locality Jasenie—Čierny Diel, photo by J. Michalík.

limestones, which he characterized microfacially in detail, he found a rich association of foraminifers *(Pilammina densa).* The overlier of the limestones is formed by indistinctly nodular light-grey cherty Reifling Limestones. Głazek—Trammer—Zawidzka (1973) criticized the choice of Borza's locality, at which allegedly no other fauna besides foraminifers was found and which allegedly is lying in the zone of tectonic weakening and polemized with supposed assignment of the limestones with *Glomospira densa* to the Hydaspian.

Recently, Michalík (1979 a,b); Bystrický—Michalík—Mock (1980); Jendrejáková—Michalík—Papšová (1981); Papšová—Pevný (1982) and Papšová—Jendrejáková (1984) have been dealing with geological and stratigraphical conditions of this sequence in the area of Jasenie,

Predajná and Nemecká. In these works the fundamental features of litho-and biostratigraphical division of the complex of Middle Triassic limestones (Alpine Muschelkalk Group of some Austrian and German authors) were presented, to which we refer in the next chapter.

Formal lithostratigraphy

1. Farkašovo Megabrecia Formation, new term

Name: According to mount Farkašovo above the monument of SNP (Slovak National Uprising) near Nemecká (Michalík, 1979 a).

Stratotype: Abandoned quarries and adjacent outcrops in the southern slope of Farkašovo-hill near Nemecká (Fig. 1).

History: D. Štúr (1868) considered the "Muschelkalk-Dolomit" in the area of Nemecká and Predajná as a sequence in subhorizontal position. Later authors (Maheľ et col. 1964, 1966), however, observed frequent rauhwackes and tectonites. Michalík (1979 a) proved that the whole complex consists of large, mutually discontinuous blocks of limestones and dolomites, cemented by marly dolomicrite.

Dominant lithology: The blocks are of size from several cm to 4—5 m and of irregular shape. They consist mostly of grey massive to thick-banked calcareous or weakly marly dolomite. The blocks of variously dolomitized grey limestones of "Gutenstein type" with laminae of biodetritus, marl or bitumen and infaunal burrows are less frequent. The cement between blocks is composed of yellowish marly dolomite with remnants of laminar structure.

Boundaries: The lower boundary with the shaly Lower Triassic sequence is not exposed. Towards the overlier the size of blocks decreases and the breccia is passing into grey detrital dolomites.

Fossils: The find of diploporid alga *Andrusoporella pauciforata* (in Bystrický—Biely, 1964) comes from isolated dolomite blocks. The megabreccia matrix itself does not contain autochthonous organic remnants.

Age: On the basis of superposition probably Pelsonian (?).

Genesis: The origin of the megabreccia may be interpreted as the collapse product of sequence overlying large evaporite bodies after their leaching out, or as the product of submarine sliding of intertidal carbonates into forming shallow basin after sudden sinking of water level. We are tending to the second interpretation.

Distribution: Mount Farkašovo, small quarries south of Ráztoka and north of Zámostie, quarry at the southern slope of the hill near Predajná, Lopej.

Equivalents: Laterally replacing with Gutenstein beds. Similar phenomena have been observed in the Upper Serla Fm. and Dont Fm. in the Southern Alps (compare Pisa et al., 1980; Farabegoli—Guasti, 1980).

2. Zámostie Limestone Formation, new term

Name: According to the Zámostie village. The limestones of this type were characterized first by Šťastný (1928) in abandoned quarry above the village. The outcrop is inaccessible nowadays.

Stratotype: The section at the right slope of the valley above Zámostie at the foot-hill of Štefánka hill (Fig. 1).

History: The sequence was considered at the lower fossiliferous part of Reifling Limestone for a long time, in the last time it was called informatelly as

the "black sequence" (Bystrický et al., 1980; Jendrejáková et al., 1981 etc.).

Division: The lower part is designated as the Jasenie Member, the upper part as the Ráztoka Member. Both the parts are partially equivalent laterally, replacing each another in the middle part of the sequence (Fig. 2).

2 a. Jasenie Limestone Member, new term

Name: According to the village Jasenie near Predajná.

Stratotype: Cut of forest path in the southeastern slope of mount Čierny diel northwest above Jasenie (Fig. 1).

Hypostratotypes: Foot of Štefánka hill on the right side of the valley above Zámostie, southern slope of Hôrky hill above the abandoned quarry between Predajná and Lopej.

Dominant lithology: Borza (1970) characterized the typical rock of the Jasenie Member as thin-banked dark-grey limestones with sporadical black chert concretions. The thin layers to beds (15—20 cm) are separated by thin intercalations of marl (Figs. 2—10). The bedding planes are irregularly knotted, unevennesses being formed by unequal compaction of sediment during diagenesis. Microscopically it consists of biomicrite with intraclasts of pelitomorphic dolomicrites and biomicrites (up to 2 mm) and with quartz silt (up to 0.1 mm). The rock was affected by partial diagenetic and epigenetic dolomitization and by selective silicification. The latter process affected mainly brachiopod shells, less moluscs, foraminifers, whereas ostracodes, echinoderm stems and conodonts are unaffected by silicification. Sponge spicules and radiolarians are sometimes partly calcified.

Boundaries: The boundary of the basal bank and underlying detrital dolomite is sharp, distinctly erosive (Fig. 3). Close above the base several intercalations of detrital dolomite in the limestone sequence have been observed. The upper boundary with the Ráztoka Member is gradual, being characterized by thickening of limestone layers, prevalence of organodetrital material and gradually decreasing portion of organic matter and iron monosulphide, causing the dark colour of underlying sediment.

Fossils: Brachiopods and mollusscs described in detail in the taxonomic part of the work are the most abundant, echinoderm remnants (holoturians, crinoids, ophiurids and echinoids), fish teeths and scales, foraminifers (*Pilammina densa, Meandrospira dinarica, M.* aff. *insolita, Glomospirella* aff. *irregularis* etc., cf. Jendrejáková et al., 1981), conodonts (*Gondolella bulgarica, G. bifurcata, G. hambulogi, G. excelsa, Nicoraella kockeli* etc., cf. Papšová—Pevný, 1983; Jendrejáková—Papšová, 1984), sponge spicules, ostracodes, bipartite globochaets and sporadical radiolarians.

Age: According to ammonites the *Balatonites balatonicus* Zone (Upper Pelsonian, cf. Rakús, 1985). This assingment of age also agrees with the association of conodonts, belonging to the *Kockeli* Zone (Papšová—Pevný, 1982).

Genesis: The rich association of herbivorous gastropods, scaphopods and other benthic fauna indicates an environment within the reach of the photic zone. Preservation and deposition of fossils excludes the possibility of a long transport. The character of sediment also indicates an absence of distinct currents and a normal (perhaps sometimes insignifically raised) salinity. In

spite of that the level of the anaerobic zone was obviously lying not deep below the bottom surface, it permitted life of a relatively diverse burrowing infauna. The water environment was obviously well aerated. From all this facts the conclusion results that the sediments formed in depths of several tens of metres in the protected area of bottom, with clean and aerated sea water. The basin had a relatively flat bottom and an equable, permanent supply of fine terrigenous material.

Distribution: Nízke Tatry Mts.: area of Zámostie (Štefánka), Predajná (Hôrka), Jasenie (foothill of Čierny diel, saddle below Črchľa), Veľká Fatra Mts. (Malinô Brdo), Strážovské vrchy Mts. (Markovica—Húštik), Malé Karpaty Mts. (Suchá dolina, Hurtovec etc.).

Equivalents: The lower part of some sequences ranged to the Reifling Limestone in some Alpine sections (cf. Gessner, 1966; Bechstädt—Mostler, 1976)? Some lithostratigraphic units of the Southern Alps underlying the basinal Buchenstein (Livinallongo) Formation also appear to resemble the described sequence: e.g. Bivera Fm., but mainly the Prezzo Lst. Fm.). Gaetani, 1969, 1970; Epting, et al., 1976; Farabegoli—Guasti, 1980; Marinelli, 1980; Wood, 1981 etc.).

2b. Ráztoka Limestone Member, new term

Name: According to the village Ráztoka 1 km NW of Nemecká.

Stratotype: Right slope of the valley, west below Hradisko-hill 1 km NNE above Ráztoka, small natural rock outcrops.

Hypostratotype: Right slope of the valley above Zámostie between Mt. Veľký Ždiar and Hradisko-hill at the foothill of Štefánka, beds No. 1—2 (Fig. 1.).

History: The sequence was described under the name "ash-grey organodetrital limestones" (Jendrejáková et al., 1981).

Dominant lithology: Dark-grey to light-ash-grey biosparite to biomicrite limestones. Lamination is frequent, formed by streaks of finer and coarser detritus, revealing cross- and ripple mark (?) — bedding and flow structures, intercalations of dolomites and marks of early diagenetic dolomitization of sediment. The remnants of organisms are mostly distinctly redeposited, sometimes worked up by transport, bivalve shells being more completely preserved only.

Boundaries: The distinct upper boundary is given by sudden vanishing of organodetrital admixture and increasing share of marly intercalations between nodular bedding planes of the overlying light-grey cherty Reifling Limestones. The lower boundary with the Jasenie Member is less distinct, mutual lateral replacement and wedging out of both lithotypes are frequent.

Fossils: *Hoernesia socialis, Entolium discites, Schafhaeutlia* sp. (cf. Jendrejáková et al., 1981). Redeposited foraminifers are represented by *Pilammina densa, Paleomiliolina judicariensis, Turitella mesatriassica, Ophthalmidium plesiospirus, O. tricki* etc., better preserved are *Pseudonodosaria obconica, Dentalia* cf. *subplana, Jaculella dentaliniformis.* Holothurian sclerites are very abundant *(Priscopedatus triassicus, Tetravirga perforata . . .),* as well as the uniaxial sponge spicules, remnants of crinoids, ostracodes and echinoids. Ramiform

Fig. 4. Basal part of the Ráztoka Member with fossil burrows of *Spongeliomorpha* type burrows at locality Zámostie—Štefánka.

Photo by J. Michalík.

conodonts of the species *Gondolella excelsa, G. cornuta, G. hambulogi, G. constricta* and other are dominating (cf. Papšová in Jendrejáková et al., 1981). The upper parts of the limestone layers in the lower part of the Štefánka section contain galleries of tubular crustacean burrows of *Spongeliomorpha paradoxica* — type (Fig. 4) filled up with sparite calcite indicating the environment of detrital barrier ridges with medium high to high energy (cf. Baud, 1976). More completely preserved macrofaunal remnant are missing in these bioturbated layers, the microfauna is fragmentary preserved or completely missing.

Thickness: 10—30 metres.

Age: Upper Pelsonian to Illyrian.

Genesis: The concentrations of organic shells (mainly benthic ostracodes), variable thickness of the sequence and composition of organic associations testify a relatively shallow neritic environment within the reach of currents and wave activity. Current bedding and granulometry of sediments indicate an environment with an active current regime. The negligible portion of terrigenous material and great amount of remnants of marine organisms, redeposited from older and synchronous sediments, are astonishing. This testifies to the assumption that the environment was under the influence of pelagic currents (perphaps forming of ascending currents, which together with deepening of the basin caused a change of the type of sedimentation — formation of the overlying type of cherty Reifling Limestone without remnants of macrofauna). The Ráztoka Member limestones probably formed at the margin of the neritic carbonate platform in the zone of barrier ridges, formed by wave activity.

Distribution: The Choč nappe of the Nízke Tatry, Veľká Fatra, Strážovské vrchy Mts.

Equivalents: The characteristic features of the Ráztoka Limestone Member resemble the descriptions of some members of the „Reiflinger Bankkalk" of Bechstädt and Mostler (1976), which also contain tubular cavities filled up with sparite. However, the term of these authors probably includes several facial — lithostratigraphic units.

Systematic part

Applied methods

The Jasenie Limestone Member contains a rich association of remnants of benthic macrofauna. The matter of their shells is silicified. This preservation causes their striking weathering out from the rock surface: the chemical difference in composition of shells and surrounding rock was used in chemical separation of these fossils by acetic acid. The treatment of chemical preparation enabled us to obtain great amount of brachiopod, gastropod, bivalve and scaphopod shells, but also a rich group of microfaunistic remnants. The majority of individuals does not attain dimensions greater than 4—12 mm. The gastropods were the most abundant molusc remnants: *Straparolus (Euomphalus)* cf. *granulatus* (ASSMANN), *Rhaphistomella* sp., *Dicosmos* sp., *Cryptonerita* sp., *Polygyrina gracilior* (SCHAUROTH), *Zygopleura?* sp., *Promathilda* cf. *contraria* (BÖHM), *P.* cf. *subnodosa* (MÜNSTER) and *P.* sp. *Scaphopod Dentalium*

(Antalis) sp. and bivalves *Phenodesmia* cf. *beneckei* TORNQUIST and *Schafhaeutlia* sp. belong. to the less frequent fossils.

The Ráztoka Limestone Member is essentially poorer in remnants of fauna. Remnant of bivalves *Hoernesia* cf. *socialis* (SCHLOTHEIM) and *Entolium discites* (SCHLOTHEIM) could be obtained from them only. Their shells have original, calcite composition and were separated from rock in classical mechanical way.

Class *Bivalvia* LINNÉ, 1758
Palaeotaxodonta — Nuculoida — Nuculanacea
Malletiidae H. ADAMS et A. ADAMS, 1858
Genus: *Phenodesmia* BITTNER, 1894
Type species: *P. klipsteiniana* BITTNER, 1894 (St. Cassian).

Phaenodesmia cf. *beneckei* TORNQUIST, 1900
Pl. I, Fig. 12

1900 *Phaenodesmia Beneckei* n. sp. — TORNQUIST, pp. 141—142, Pl. 4. Fig. 6

Material: 23 damaged two-valved shells.
Dimensions: Hight = 5 mm, length = ?7 mm (in illustration).
Description: One better preserved left valve has a partly weathered posterior keel-shaped projection, which belongs to diagnostic marks of the species. The anterior margin of the valve is rounded, the protruding beak is moderately shifted anteriorly and the area below it is most convex. A depression, bordering the diagonal boundary, runs from the beak area across the posterior part of the valve. A narrow depressed field is still behind it. The sculpture consists of distinct regular dense concentric lines. Our specimens differ from typical specimens of the species in less elongated outline; the sculpture on the corroded diagonal edge is indistinct.
Stratigraphic and geographic range: Anisian; Southern Alps.
Occurrence in the West Carpathians: Predajná-Hôrky, Jasenie Member.

Pteriomorpha — Pterioida — Pteriacea
Bakevellidae KING, 1850
Hoernesia LAUBE, 1866
Type species: *Mytulites socialis* SCHLOTHEIM. Middle Triassic, Germany.

Hoernesia cf. *socialis* (SCHLOTHEIM, 1822)
Pl. I, Fig. 14

1822 *Mytulites socialis* sp. n. — SCHLOTHEIM, p. 112, Pl. 37, Fig. 1 (non vidi, fide Diener)
1923 *Hoernesia socialis* SCHLOTHEIM — DIENER, p. 99—100, (cum syn.)
1931 *Hoernesia socialis* SCHLOTH. — KUTASSY, p. 323

Material: One core of the left valve partly covered with rock.
Remarks: The dimensions cannot be mentioned because of incomplete spe-

cimen. The valve is characteristically height, oblique, its beak being considerably inclined above the hinge line. Towards the posterior margin a blunt edge is running from it, behind which the depressed posterior wing is found. The surface of core is smooth, the pattern of sculpture unknown.

Stratigraphic and geographic range: Scythian to Ladinian; Germany, Southern Alps, Sardinia, Sicily, Hungary and Spain.

Occurrence in the West Carpathians: Štefánka—Zámostie, Ráztoka Member.

Pteriomorphia — Pterioida — Pectinacea
Entoliidae KOROBKOV, 1960
Entolium MEEK, 1865
Type species: *Pecten demissus* PHILLIPS, 1829 (as illustrated in Quenstedt, 1856—1858). Jurassic? Europe.

Entolium discites (SCHLOTHEIM, 1820)
Pl. I., Fig. 13

1820 *Pleuronectites discites* sp. n. — SCHLOTHEIM, p. 218
1972 *Entolium discites* (SCHLOTHEIM) — ALLASINAZ, p. 284—287, Pl. 35, Figs. 8—9 (cum syn.)

Material: Incomplete right and left valve.

Dimensions: Height of the left valve 23.5 mm, length 23.5 mm, apical angle 110°.

Remarks: The central part of the valve is moderately convex, the lower margin being widely rounded. Pointed central beak and moderate depression along both lateral margins. The incomplete auricles seem to be approximately of equal size. The surface is smooth, with only several traces after growth lines, visible under the magnyfing glass only.

Stratigraphic and geographic range: Allasinaz mentions the Scythian to Ladinian (l.c.), Farsan (1972) Scythian to Norian distribution.

Distribution: Germany, Spain, Upper Silesia, Southern Alps, Hungary, Rumania, North Africa, Afghanistan, Salt Range, China, Indochina, Eastern Siberia, Argentina.

Occurrence in the West Carpathians: Štefánka—Zámostie, Ráztoka Member.

Heterodonta — Veneroida — Lucinacea
Fimbriidae NICOL, 1950
Schafhaeutlia COSSMANN, 1897
Type species: *Gonodon ovatum* SCHAFHAEUTL, 1863. Jurassic; Southern Apennines.

Schafhaeutlia sp.

Material: Three small cores of complete shells, six incomplete shells.

Dimensions: Height 4 mm, length 4 mm.

Remarks: Besides total morphology, outline and sculpture there are no criteria in these corroded and recrystalization-damaged specimens, which would make nearer determination than generic possible.

Occurrence: Predajná—Hôrky, Jasenie Member.

Scaphopoda

Dentaliidae GRAY, 1834

Dentalium (Antalis) H. ADAMS et A. ADAMS, 1854

Type species: *Dentalium antalis* LINNAEUS, 1758. Pliocene—Recent; Europe—North America.

Dentalium (Antalis) sp. *(D.* aff. *laeve?)*
Pl. I., Figs. 2—3

Material: Five mostly incomplete shells.

Remarks: The minute shell is narrow, tubular, at both ends open, moderately arch-like bent. Its surface is smooth. In general view the specimens resemble the Upper Anisian species *D. laeve* mentioned by Langenhan (1903) (Pl. 9., Fig. 7) from Germany.

Occurrence in the West Carpathians: Predajná—Hôrky, Zámostie—Štefánka; Jasenie Member.

Gastropoda

Archaeogastropoda — Macluritina — Euomphalacea

Eumphalidae de KONINCK, 1881

Straparolus de MONTFORT, 1810

Type species: *Euomphalus pentagulatus* SOWERBY, 1814. Lower Carboniferous; England.

Straparolus (Euomphalus) cf. *granulatus* (ASSMANN, 1924)
Pl. I., Figs. 1, 3, 5.

1924 *Euomphalus granulatus* n. sp. — ASSMANN, pp. 12—13, Pl. I., Figs. 25—28
1926 *Euomphalus granulatus* ASSMANN — DIENER, p. 48 (cum syn.)
1940 *Euomphalus granulatus* ASSMANN — KUTASSY, p. 271 (cum syn.)

Material: Thirteen incomplete specimens, one fragment.

Remarks: Specimens with disk-shaped shell of diameter 11.5 mm, 10 mm and 7 mm mostly resemble the Assmann's illustration. They differ in coiling of the whorls in one plane similarly as *E. exiguus* PHIL. They also resemble the species *Kokenella barberoi* TICHY, in the general shape and sculpture character, however, without even any indication of the characteristic selenizone.

Stratigraphic and geographic range: Anisian; Upper Silesia.

Occurrence in the West Carpathians: Predajná—Hôrky, Jasenie Member.

Archaeogastropoda — Pleurotomariina — Pleurotomariacea
Eotomariidae WENZ, 1938
Rhaphistomella KITTL, 1981
Type species: *Pleurotomaria radians* WISSMANN in MÜNSTER, 1841 Carnian; South Tyrol.

Rhaphistomella sp.

Material: Four incomplete minute cores.
Remarks: The shell is low, bluntly conical, whorls angular, separated by a deep narrow suture. The lower side of the body whorl is highly convex, the umbilicus distinct. Dense growth lines and a ring from minute granules are parallel with the suture on the whorls upper sides. Several relatively strong oblique rays have preserved around the umbilicus at one section. The specimens resemble considerably the species *Rhaphistomella radians* (WISSMANN, 1841) from the St. Cassian beds. The preservation, however, does not permit any more reliable correlations.
Occurrence in the West Carpathians: Jasenie—Čierny diel; Jasenie Member.

Archaeogastropoda — Neritopsina — Neritacea
Neritopsidae GRAY, 1847
Discosmos CANAVARI, 1890
Type species: *Dicosmos pulcher* CANAVARI, 1890. Middle Triassic—Ladinian; Southern Alps.

Dicosmos sp.

Material: One considerably damaged shell, one fragment.
Remarks: Because of insufficient preservation no more precise determination than generic is possible.
Occurrence in the West Carpathians: Predajná—Hôrky; Jasenie Member.

Neritidae RAFINESQUE, 1815
Cryptonerita KITTL, 1894
Type species: *Cryptonerita elliptica* KITTL, 1894. Ladinian; Southern Alps.

Cryptonerita sp.

Material: Thirteen incomplete minute cores, two fragments.
Remarks: Turbiniform shaped disc is composed of 4 whorls, the body whorl being the largest. The base is convex, a funnel-shaped umbilicus being situated in the middle at the mouth margin. The mouth itself has not preserved. The surface is smooth, without traces after sculpture.
Occurrence: Jasenie—Čierny diel; Jasenie Member.

Caenogastropoda — Loxonematacea
Loxonematidae KOKEN, 1889
Polygyrina KOKEN, 1892
Type species: *Turritella lommeli,* MÜNSTER, 1941. Middle Triassic — —Ladinian; South Tyrol, Alps.

Polygyrina gracilior (SCHAUROTH, 1855)
Pl. I., Figs. 7—8.

1855 *Turbonilla gracilior* sp. n. — SCHAUROTH, p. 520, Pl. 2. Fig. 11 (non vidi, fide Diener)
1926 *Polygyrina gracilior* SCHAUROTH — DIENER, p. 173 (cum syn.)

Material: 286 mostly incomplete specimens and many fragments.
Remarks: The slender high disc formed by 8-and more rounded whorls, the last of which is the largest. Our specimens are identical with Arthaber's (1906; Pl. 34, Fig. 7) illustration.
Stratigraphic and geographic range: Scythian to Anisian: Northern and Southern Alps, Bakony, Germany, Poland.
Occurrence in the West Carpathians: It is the most numerous gastropod in the Jasenie Member at the localities Predajná—Hôrky, Zámostie—Štefánka and Jasenie—Čierny diel.

Zygopleuridae WENZ, 1938
Zygopleura KOKEN, 1892
Type species: *Cerithium meyeri* KLIPPSTEIN, 1834. Middle Triassic—Ladinian; Italy.

Zygopleura ? sp.
Pl. I., Figs. 10—11

Material: 20 specimens with missing or damaged protoconch.
Remarks: Small conical spires with about 3 mm height resemble in general shape forms of the genus *Kitliconcha.* They consist of 4—5 increasing whorls whith oval mouth. The sculpture of the outer surface is formed only by relatively strong ribs, which on the contrary to *Kitliconcha* are also found on the body whorl. The specimens cannot be ranged to any of the known species of the genus *Zygopleura.*
Occurrence: Predajná—Hôrka, Zámostie—Štefánka and Jasenie—Čierny diel; Jasenie Member.

Caenogastropoda — Cerithiacea
Mathildidae COSSMANN, 1912
Promathilda ANDREAE, 1887
Type species: *Cerithium bisertum* MÜNSTER, 1841. Triassic; Eastern Alps.

Promathilda cf. *contraria* (BÖHM, 1895)
Pl. I., Fig. 9.

1895 *Tretospira contraria* sp. nov. — BÖHM, pp. 300—301, Pl. 14, Figs. 8—8a
1899 *Promathilda contraria* (BÖHM) — KITTL, p. 189

Material: Eight incomplete specimens with considerably corroded surface.

Remarks: The tower-like spire is formed by medially convex whorls, separated deep sutures. The base seems to be flat, the mouth being not preserved. A ring composed of minute granules runs, admist each the whorl two parallel linear longitudinal ridges are visible (when magnified). They are most similar to the specimen cited in the synonymics: in the Böhm's figure, however, there are only two whorl so that consistent identification in not possible.

Stratigraphic and geographic range: Ladinian; Southern Alps.

Occurrence in the West Carpathians: Predajná—Hôrka, and Jasenie—Čierny diel; Jasenie Member.

Promathilda cf. *subnodosa* (MÜNSTER, 1841)

1841 *Turritella subnodosa* sp. n. MÜNSTER, p. 120, Pl. 13, Fig. 26
1894 *Promathilda subnodosa* MÜNSTER sp. — KITTL, pp. 224—225, Pl. 9., Figs. 36—45
1923 *Promathilda subnodosa* (MÜNSTER) — DIENER, p. 219 (cum syn.)

Material: Fifteen incomplete specimens.

Remarks: The small tower-like spira resembles in shape the preceeding species *P.* cf. *contraria:* on each the whorl are, however, two spiral longitudinal ridges with minute knots. The lower of them is less distinct. Our specimen mostly resembles Kittl's specimen (1894, Pl. 9, Fig. 43), however, the preservation is imperfect.

Stratigraphic and geographic range: Cordevolian; Southern Alps.

Occurrence in the West Carpathians: Predajná—Hôrky; Jasenie Member.

Promathilda ?sp.
Pl. I., Fig. 6

Material: Five incomplete specimens with considerably abraded surficial sculpture.

Remarks: Tower-like disk of height 4.5 mm. composed of 9—10 flat whorls, separated by shallower sutures. The base of the body whorl seems to be flat, the mouth has not preserved. The sculpture on each the whorl is formed by three spiral rings, formed by minute knots, the less distinct fourth is covered with suture. The base is sculptureless. The specimens resemble the species *P. decussata* MÜNSTER, which, however, has less inflated whorls and in details quite a different sculpture.

Occurrence: Predajná—Hôrky, Zámostie—Štefánka and Jasenie —Čierny diel; Jasenie Member.

Brachiopoda DUMERIL, 1806

Articulata — Rhynchonellida — Rhynchonellacea
Praecyclothyrididae MAKRIDIN, 1964
Holcorhynchonellinae DAGYS, 1974
Piarorhynchella DAGYS, 1974
Type species: *Piarorhynchella mangyshlakensis* DAGYS, 1974. Olenekian; Mangyshlak Peninsula.

Piarorhynchella trinodosi (BITTNER, 1890)
(Figs. 5, 7—8)

1890 *Rhynchonella trinodosi* n. sp. — BITTNER, p. 13, pl. 32. Figs. 17—28
1969 *Piarorhynchia trinodosi* (BITTNER) — GAETANI, pp. 499—506, Pl. 33, Figs: 8—9; Pl. 34, Figs. 1—7, text-f. 6—7 (cum syn.)
1974 *Piarorhynchella trinodosi* (BITTNER) — DAGYS, p. 112

Material: 989 silicified shells, 68 ventral valves, 52 dorsal valves.

Remarks: Small subpentagonal cynocephaliid shells with uniplicate (in the posterior part rectilinear) commissure. Maximum width in the anterior third of shell length. The ventral sulcus forms 1/3—1/4 of valve length, plica trapezoidal. The ventral beak is less curved than the dorsal beak. The dorsal fold reaches 1/3—1/2 length of dorsal valve. All specimens have 2/1 medial ribs and 3/2 lateral ribs.

The delthyrial cavity is distinct, delthydial plates small, well developed, lateral cavities reach the beak, without callose deposits. The teeth are oval, bent laterodorsally. Muscle impressions are raised at the margin, the impressions of individual muscle groups being only unclearly separated. Cardinal plates straight, inner teeth socket ridge only slightly thickened. The median septum is low, reaching 1/3 of valve length and divides the field of adductor muscle scars. The cruralium (septalium) is distinct, flabelliform; crural bases high, rod-like. The crura are radulifer, slender, pointed, diverging ventrolaterally.

Pallial channels only rudimentarily preserved: forming two pallial sinuses diverging anterolaterally from the anterior edge of the muscle scars field on the ventral valve only.

Bittner (op. cit.) distinguished within the species *P. trinodosi* a series of morphological varieties. Gaetani (op. cit.) ranged some of them to ontogenetic stages *(minutula, toblachensis)*, other to ecoforms: whilst the specimen from assemblages with abundant benthos have 2/1 medial ribs (var. typica), rare dwarfed forms scattered in the sediment have even 2—3 medial ribs (var. minor).

Stratigraphic and geographic range: Anisian, Middle Triassic; Southern Alps, Northern Limestone Alps, Carpathians, Bakony Mts., Balkans.

Occurrence in the West Carpathians: Slovak Karst (Brzotín, Zakázané, Nízke Tatry Mts. (Liptovský Ján, Horná Lehota, Jasenie—Čierny diel, Predajná—Hôrky, Zámostie—Štefánka) Galmus (Slovinská skala), Malé Kar-

paty Mts. (Hurtovec, Plavecké Podhradie)-cf. Siblík, 1971. A typical fossil of the Jasenie Limestone Member.

Spiriferida — Spiriferidina — Reticulariacea
Martiniidae WAAGEN, 1833
Mentzeliinae DAGYS, 1974
Mentzelia QUENSTEDT, 1871
Type species: *Spirifer Mentzeli* DUNKER, 1851 — Middle Triassic; Germany.

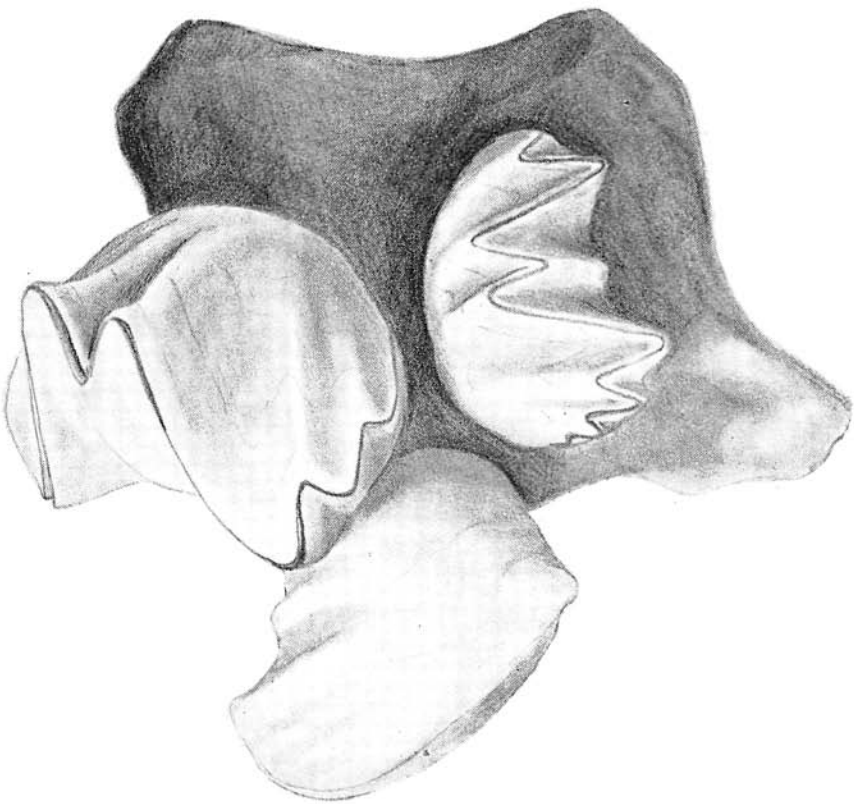


Fig. 5. Association of three specimens of *Piarorhynchella trinodosi* (BITTN.) from the Jasenie Member of the locality Predajná—Hôrky.

Drawing: J. Michalík.

Mentzelia sp.

Material: One incomplete specimen, one fragment. Shell of oval outline, hinge margin shorter than width of valve. Area high, delthyrium uncovered.
Occurrence: Predajná—Hôrky; Jasenie Member.

Terebratulida — Terebratellina — Zeilleriacea
Zeilleriidae ALLAN, 1940
Aulacothyris DOUVILLÉ, 1879
Type species: *Terebratula resupinata* SOWERBY, 1816 — Liassic; England.

Aulacothyris sp. (cf. *angusta*?)

Material: Two considerably fragmentary specimens.
Remarks: Relatively small shells with flat dorsal valve and highly convex ventral valve. Beak slender, sharp, with mesothyrid foramen. Hing plates bent ventrally, septalium circular, deep, median septum long. Dental lamellae short, distinct.
Occurrence: Predajná—Hôrky; Jasenie Member.

Terebratulida — Terebratulidina — Dielasmatacea
Dielasmatidae SCHUCHERT, 1913
Dielasmatinae SCHUCHERT, 1913
Coenothyris DOUVILLÉ, 1879
Type species: *Terebratulites vulgaris* SCHLOTHEIM, 1820. Middle Triassic: German Muschelkalk, Germany.

Coenothyris vulgaris (SCHLOTH., 1820)

Material: One incomplete core, three fragments of shell.
Remarks: Moderately biconvex medium large shell, with indistinct wide ventral beak. The commissure is almost rectimarginate with indication of uniplicate sinus. Foramen permesothyrid.
Occurrence: Zámostie—Štefánka; Ráztoka Member.
Stratigraphic and geographic range: Middle Triassic of the germanotype region, Alps, Carpathians, Dinarides, Balkans, Caucasus, Himalaya.

Remarks to stratigraphy of fossiliferous sequences

The described species of bivalves, gastropodes and scaphopodes do not permit more precise dating of sequences, from which they come, all of too wide stratigraphic range. Some hope is the occurrence of *P. trinodosi,* which traditionally was considered as a Lower Illyrian form in the West Carpathians (Bystrický—Biely 1966; Siblík, 1971 etc.). However, as Gaetani

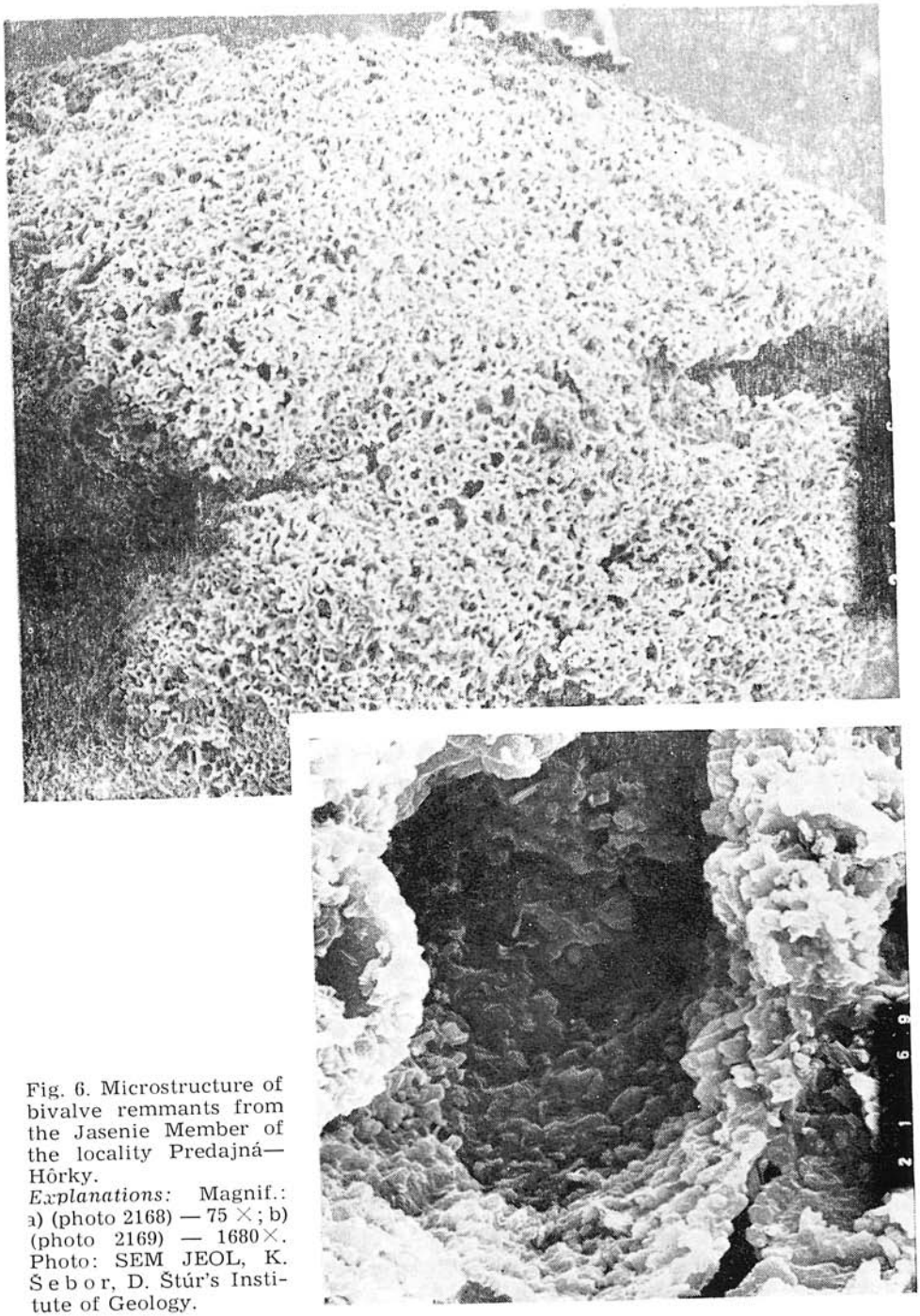


Fig. 6. Microstructure of bivalve remmants from the Jasenie Member of the locality Predajná—Hôrky.
Explanations: Magnif.: a) (photo 2168) — 75 ×; b) (photo 2169) — 1680×. Photo: SEM JEOL, K. Šebor, D. Štúr's Institute of Geology.

(1969, 1970) mentions, although *P. trinodosi* is associated with typical *"trinodosus"* fauna in the Southern Alps, its vertical range is greater: in Giudicaria and Dosso Alto in Val Trompia it begins at the level with *Judicarites*, but already in northern Grigne it is present in the whole Calcare di Prezzo sequence.

Papšová (in Jendrejáková et al., 1981) considered on the basis of the occurrence of conodonts *Gondolella bulgarica* (BUDUROV et STEFANOV) and *Nicoraella kockeli* (TATGE) the Jasenie Member as Upper Pelsonian. According to the association of conodont and foraminifers (Papšová — Pevný, 1982; Jendrejáková — Papšová, 1982) also the Ráztoka Member is of similar or close age. Rakús (1985) confirmed competence of the Jasenie Member to the Pelsonian *Balatonicus* Zone on the basis of ammonites *Balatonites* ex gr. *balatonicus* (MOJS.) and *Norites psilodiscus* ARTH. The fauna found in the Ráztoka Member (locality Dubové—Zámostie: cf. Rakús, op. cit.) belongs to the Lower Illyrian *Trinodosi* Zone.

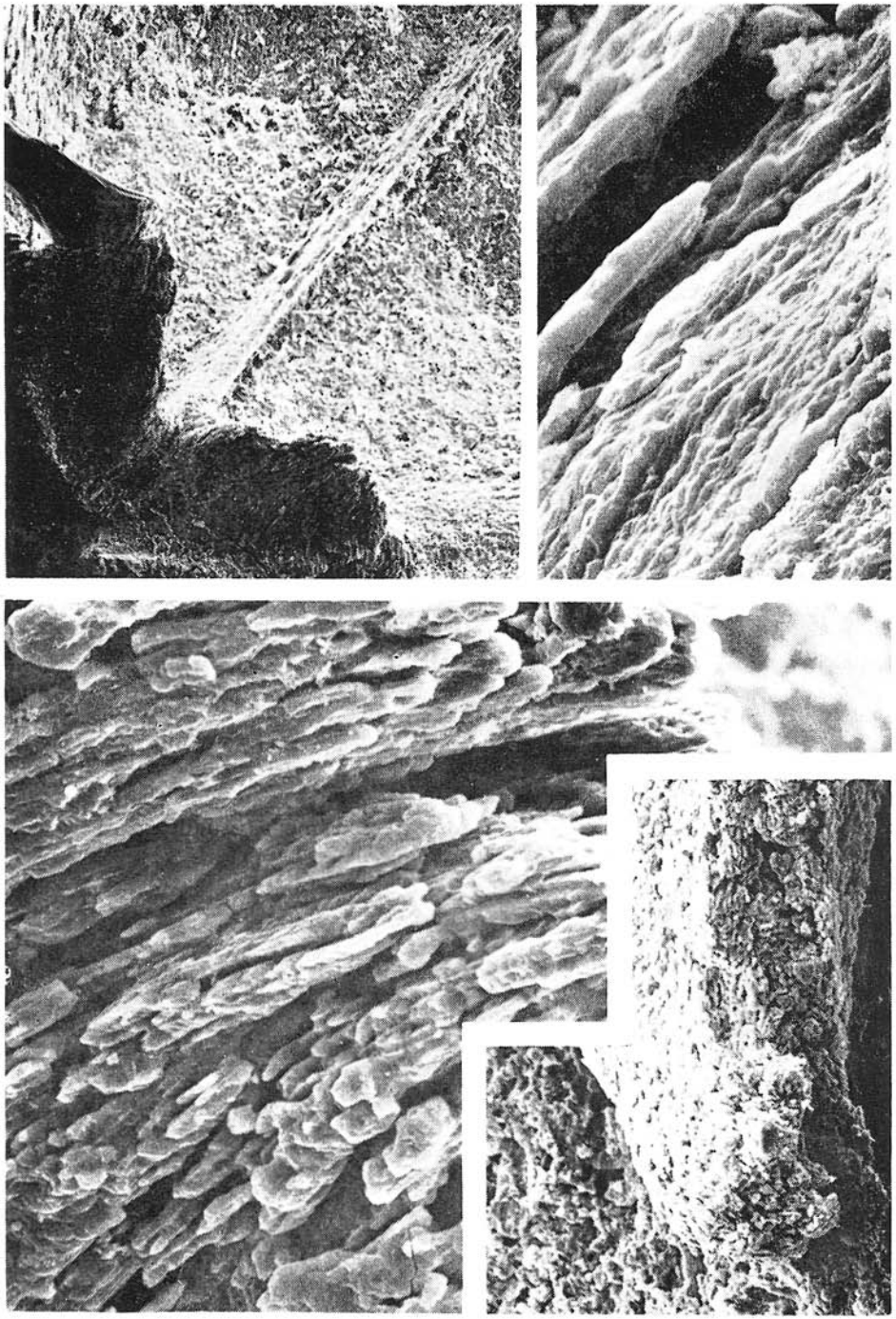
Taking this knowledge into consideration, it is obvious that the above described rich molluscs ad brachiopods associations from the Jasenie Member are of Upper Pelsonian age; the Pelsonian—Illyrian associations of fossils of the Ráztoka Member are less frequent, containing a greater portion of nektonic organisms.

Remarks to the environment and fossilization of fauna

Preservation of fossils

There is a distinct difference in preservation of bivalve and brachiopod shells. Whilst the original calcite matter of brachiopod shells is practically completely replaced by quartzine (Figs. 7—8), the sponge-like habit of gastropod and mainly bivalve shells (Fig. 6) is caused by selective silicification with numerous "islands" of carbonate matter. Tracing the microstructure of brachiopod shells, it can be confirmed that replacement of calcite fibres by quartz matter was taking place gradually: the pattern of the shell mosaic (Fig. 7), course and outlines of fibres of the secondary layer (Fig. 8) have remained roughly preserved so that in macroscopic view they give a true picture of original morphological elements of the inner and outer structure of the valves. A different situation is in the originally aragonite shells of molluscs (Fig. 6). Recrystallization of aragonite to calcite preceeding silicification, wiped off the traces of original structures. It seems that so altered shell was resisting silicification for a longer time. The advancing process of silicification which proceed along the rims of newly formed calcite grains preserved the remnants of the calcite grain cores for a long time: many of them dissolved already in the epigenetic (?) stage. This process resulted in the origin of irregular spongy structures, which preserve the original morphologic details of shells in rough features only.

Fig. 7. Microstructure of the outer surface of *Piarorhynchella trinodosi* from the Jasenie Member of the locality Predajná—Hôrky.
Explanations: Magnif.: a (2166) — 86×; b (2170) — 858×. Photo: K. Šebor, SEM JEOL, D. Štúr's Institute of Geology.



Composition and distribution of faunistic associations

Fossiliferous dark limestones at the base of the sequence of Middle Triassic Reifling- type Limestones have been known from West Carpathians already for a long time. Abundant brachiopods, gastropods, bivalves, echinoid spines and skeletal remnants of crinoids are cited from them in form of "Faunenlisten" (Biely — Bystrický, 1964; Bystrický, 1969 etc.). Minimum attention, however, is devoted to the data about qualitative—quantitative composition of the represented associations and their spatial changes. It is shown that knowledge about the occurrences of the Zámostie Member is not sufficient for definition of lateral variability of benthic associations in that time. The facts obtained by faunal analysis from a limited number of our localities, however, prove that with tracing of these regularities it would be possible to obtain an amount of valuable informations not only about the paleobiogeographic features of dwelling by benthic associations but also about morphology of the sedimentary area of Middle Triassic sequences in the present-day Choč nappe.

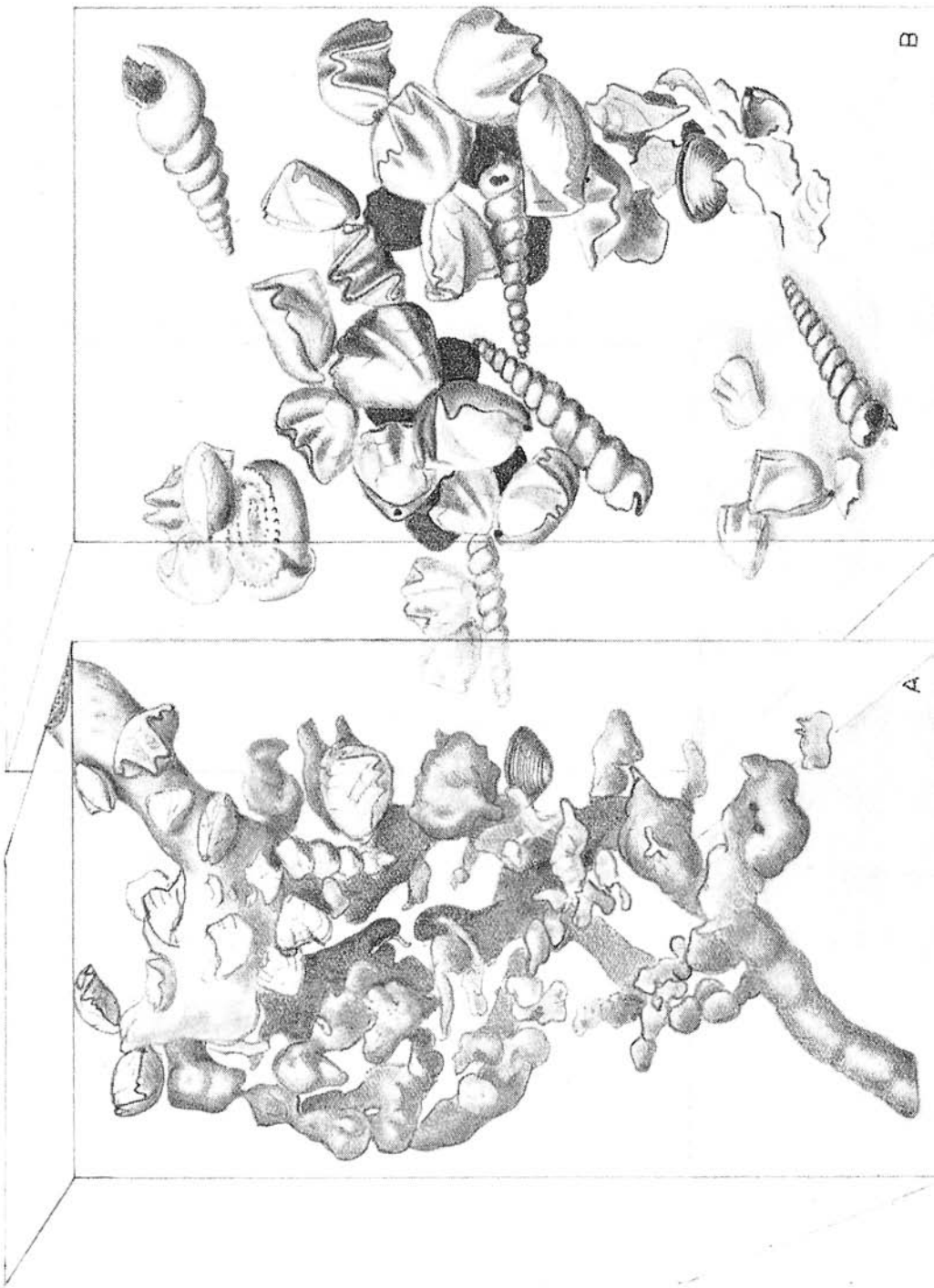
Already the comparison of three localities not very far away from one another near Predajná (Predajná—Hôrky, Zámostie—Štefánka and Jasenie—Čierny diel, cf. Fig. 4) leads to the conclusion that composition of the associations and the type of occurrence of fossils are very variable. At the locality Hôrky the fossil remnants are found in fine-grained sediment in form of densely accumulated clusters. The individual shells are often in primary orientation — they are attached to each other, to larger fragments of organic skeletons or bodies forms resembling sponges(?) (Fig. 9). This association is characterized by the greatest degree of diversity from all localities (64 % *P. trinodosi*, 17 % *Polyg. gracilior*, 35 % *Phenodesmia* sp., 2 % *Straparolus*, 2 % *Zygopleura* etc.). Its composition points to a normal marine environment near the photic zone: filtrators and detritus eaters are prevalent.

P. trinodosi is found in a similar fine-grained sediment also at the locality Jasenie—Čierny diel. It forms groups of 4—15 specimens, usually scattered near the upper surface of 4—10 cm thick limestone layers here (Fig. 10). This species, however, is part of an almost monotypic association at the mentioned

Fig. 8. Microstructure of the inner surface of *P. trinodosi*, Jasenie Member of the locality Predajná—Hôrky.
Explanations: Magnif.: a (2172) — 75×; b (2173) — 625×; c (2174) — 1680×; d (2175) — 126×. Photo: K. Šebor, SEM JEOL D. Štúr's Institute of Geology.

Fig. 9. Spatial arrangement of macrofossil associations from the localities Hôrky (a) and Štefánka (b).

Original J. Michalík.


B
A

locality (more than 95 % of preserved faunistic remnants). The bivalves, scaphopods, polychaetes and many other forms *(Aulacothyris, Mentzelia)* are completely missing in this association. Moreover, the gastropods are not found in common associations with *P. trinodosis*, but in a particular, own horizon ("gastropod bank") at the locality. Thus the association is composed almost exlusively of filtrators (detritophagous gastropods can be an allochthonous component). This fact testifies to extremness of the environment (partly isolated, possibly lagoonar depression of the bottom?). The presence of ammonites, however, testifies to (at least intermittent) connection with an open sea.

The Zámostie—Štefánka locality is characterized by a particular, different

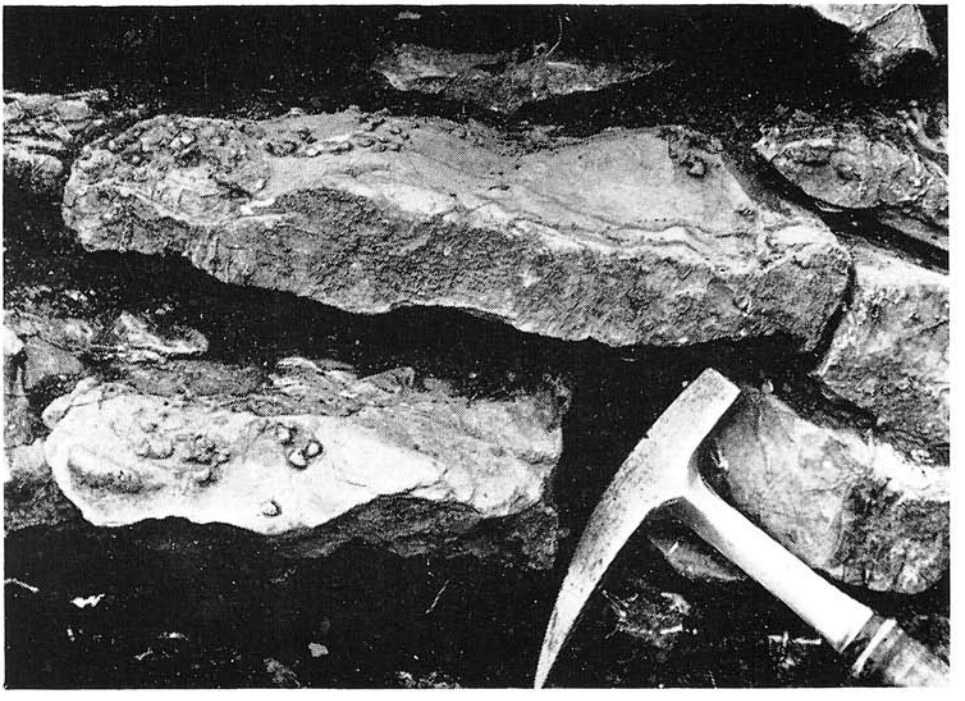
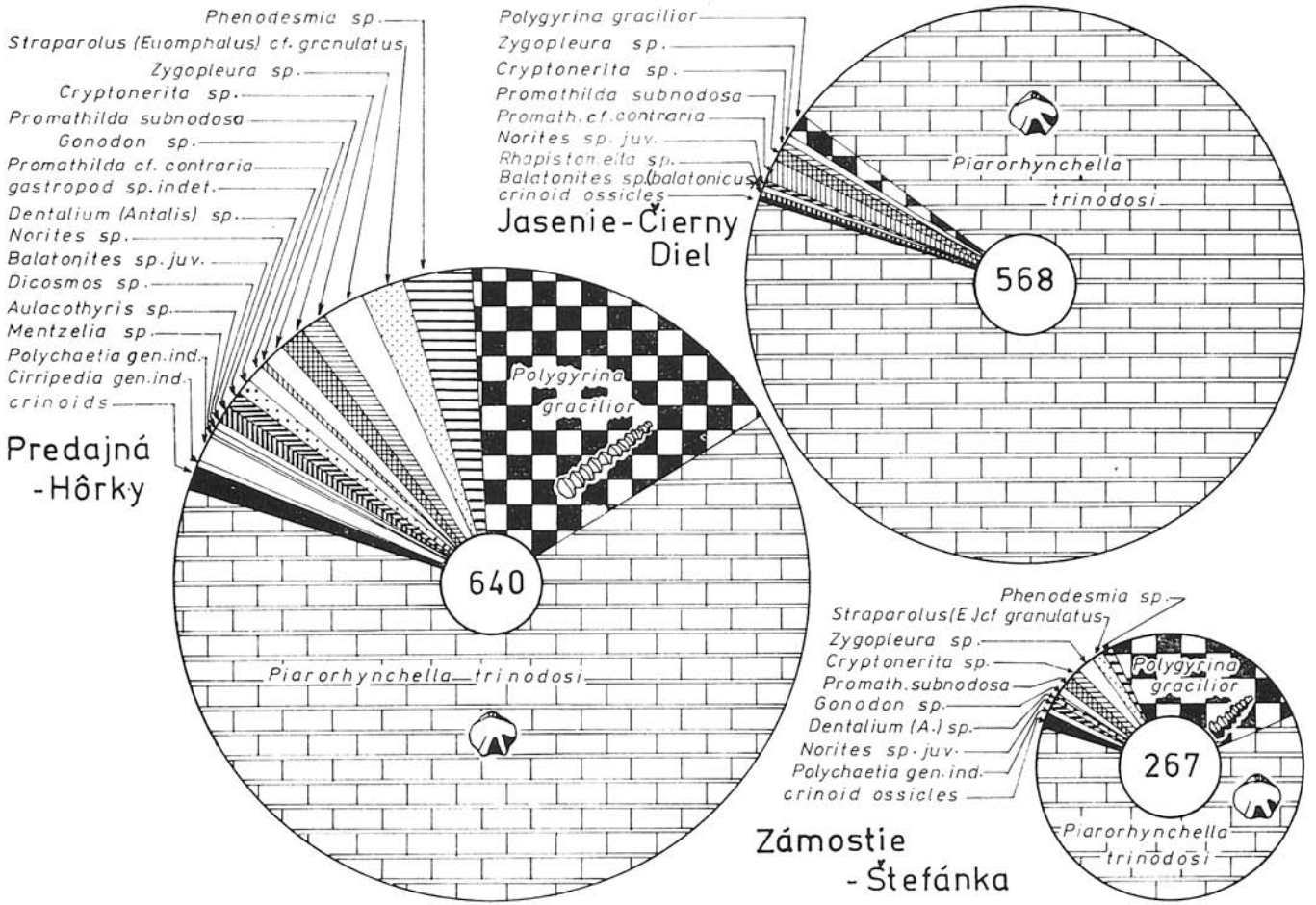


Fig. 10. Occurrence of shells of *P. trinodosi* at the locality Jasenie—Čierny Diel. Jasenie Member cut of the forest path.

Photo: by J. Michalík.

Fig. 11. Quantitative composition of the macrofossil associations from the localities of the Jasenie Member, Hôrky, Čierny Diel and Štefánka.
Explanations: The datum in the middle of the graphs indicates the number of fossils obtained from the locality, the sector of circle designates the percentage share of specimens of the component species in composition of the obtained fossil collection. Original J. Michalík.


Phenodesmia sp.
Straparolus (Euomphalus) cf. granulatus
Zygopleura sp.
Cryptonerita sp.
Promathilda subnodosa
Gonodon sp.
Promathilda cf. contraria
gastropod sp. indet.
Dentalium (Antalis) sp.
Norites sp.
Balatonites sp. juv.
Dicosmos sp.
Aulacothyris sp.
Mentzelia sp.
Polychaetia gen. ind.
Cirripedia gen. ind.
crinoids
Predajná
-Hôrky
640
Polygyrina gracilior
Piarorhynchella trinodosi
Polygyrina gracilior
Zygopleura sp.
Cryptonerita sp.
Promathilda subnodosa
Promath. cf. contraria
Norites sp. juv.
Rhaphistomella sp.
Balatonites sp. (balatonicus)
crinoid ossicles
Jasenie-Čierny
Diel
568
Piarorhynchella
trinodosi
Phenodesmia sp.
Straparolus (E.) cf. granulatus
Zygopleura sp.
Cryptonerita sp.
Promath. subnodosa
Gonodon sp.
Dentalium (A.) sp.
Norites sp. juv.
Polychaetia gen. ind.
crinoid ossicles
Polygyrina gracilior
267
Piarorhynchella trinodosi
Zámostie
-Štefánka

type of occurrence. The fossils of the association nearly similar to that of the Hôrky locality (61.5 % *P. trinodosi*, 26.5 % *Polyg. gracilior;* 2.25 % *Zygopleura;* 2 % crinoids etc.), are found in more or less detritic sediment. Fragmentary preservation of shells and higher share of disarticulated brachiopod valves, is common, brachiopod "clusters" in original life orientation are completely missing in horizons with coarser detritus. Individuals in fine detrital sediment sometimes occur in small (3—7 individuals) groups associated around larger fragments of shells. More distinct representation of detritophage gastropods indicates sediment originally containing also a higher portion of organic detritus. However, the amount of autochthonous epibenthos indicates that the sediment was stabilized in spite of distinct influences of currents (perhaps by algal growths?).

Conclusion

Investigated carbonate sequence in the underlier of pelagic cherty limestones can be divided into the Farkašovo Megabreccia Fm., originated by submarine sliding and laterally replacing with the Gutenstein Formation and into the shallow neritic Zámostie Formation. The Zámostie Formation consists of the Jasenie Member — a group of black fine-grained limestones with abundant neritic silicified fauna and Ráztoka Member - detrital limestones with marks of sedimentation influenced by currents on the slope of a platform with carbonate sedimentation.

The fauna of the Jasenie Member at the localities Hôrky and Štefánka belongs the *Piarorhynchella—Polygyrina* association, consisting of three brachiopod taxa, two ammonites, two bivalves, one scaphopod, polychaetes, balanids (?), crinoids and further macroorganisms, indicating a shalow-water environment (within the reach of the photic zone ?). The association of the second locality has been influenced by moderated flow. The third locality, characterized by an almost monoassociation of *Piarorhynchella,* indicates a local depression with extreme conditions for life of the benthos, however, in contact with the open sea.

The fauna of the Ráztoka Member is found more sporadically: it consists of ammonites, bivalves and sporadical brachiopods. The structure of associations could not be studied because of lacking material.

The overlying sequence of cherty limestones implies a period of sudden deepening of the environment combined with a change of temperature (cool upwelling current).

Translated by J. Pevný

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