GEOLOGICA CARPATHICA, 49, 2, BRATISLAVA, APRIL 1998
99–108

AN UPPER TRIASSIC LIMESTONE PEBBLE WITH "*SPIRIGERA*" *DESLONGCHAMPSI* SUESS FROM THE SOUTHERN PART OF THE WESTERN CARPATHIANS, SOUTHERN SLOVAKIA

MILAN SÝKORA[1], MILOŠ SIBLÍK[2] and JÁN SOTÁK[3]

[1] Department of Geology and Paleontology, Faculty of Sciences, Comenius University, Mlynská dolina, 842 15 Bratislava, Slovak Republic
[2] Geological Institute, Academy of Sciences of the Czech Republic, Rozvojová 135, 165 00 Prague, Czech Republic
[3] Geological Institute, Slovak Academy of Sciences Bratislava; Branch: Severná 5, 974 01 Banská Bystrica, Slovak Republic

(Manuscript received October 3, 1997; accepted in revised form December 11, 1997)

Abstract: The brachiopod "*Spirigera*" *deslongchampsi* Suess has so far been known only in the Northern Calcareous Alps. It is the first find of this fossil in the Western Carpathians. The brachiopod belongs to the family Spirigerellidae Grunt 1965 (sensu Dagys 1974) and it is most probably a new genus. It is a very rarely occurring fossil (only a very few speciments were found altogether) so its generic identification for the time being remains doubtful. According to macro and mainly micro fossils the pebble material is of the Early Rhaetian age. We assume that it derives from a transitional type between Hallstatt limestones and Zlambach Beds facies.

Key words: Western Carpathians, Late Triassic, microfacies, microfossils, "Alpine" brachiopods.

Introduction

A limestone pebble with "*Spirigera*" *deslongchampsi* has been found in conglomerates of Egerian age on the northern margin of the Rimavská kotlina Depression. It is the first find of this species on the Western Carpathians territory and the first occurrence outside the Northern Calcareous Alps. The locality is situated 2 km SW from Chvalová village in the Banská Valley, see Fig. 1. The first petrographical analysis of these conglomerates was carried out by Marková 1959. The conglomerates are formed by pebbles of Mesozoic rocks (Triassic and Jurassic) of the Silica Nappe and partly of rocks of the Meliata Formation as reported by Mišík & Sýkora 1981. They identified Lower Triassic limestones with *Meandrospira iulia* Premoli-Silva, limestones of Wetterstein facies, "Tisovec" Limestone with *Clypeina besici* Radoicic, Hallstatt Limestone and limestone pebble with the brachiopods. Results of the brachiopod study are given in the present contribution. All these rocks mentioned belong to Silica Nappe succession. Metamorphic limestone and radiolarites of the Meliata Formation were rarely found.

Description of investigated pebble

The pebble studied is well rounded with (a) axis of 15 cm. The limestone is fine-grained and of rusty-brown to yellowish colour and nondescriptly spotted. The limestone is biomicrite — wackestone to packstone (Pl. II: Fig. 9). The biodetritus is mainly formed by calcified silicisponge spicules. Ossicles of echinoderms — crinoids, echinoid spines, ossicles of ophiuria, planctonic crinoids of the genus *Osteocrinus*, holoturian sclerites — *Theelia* sp. are present. Fragments of punctate brachiopods, foraminifers and ostracods occur relatively often. Sporadically zoospores — *Globochaete alpina* Lombard, *G. tatrica* Radwanski and *G. gregaria* Schäfer & Senowbari-Daryan are found. Fragments of dasycladacean thalli (Pl. II: Fig. 3), Halicoryne (Pl. II: Fig. 4), *Thaumatoporella parvovesiculifera* (Raineri) as well as fragments of juvenile ammonite shells, minutegastropods and lamellibranch fragments are rare. Fragments of bryozoan zooecia of the order Cyclostomata are scattered, mainly belonging to a form of genus *Stomatopora*. *Aeolisaccus tintinniformis* Mišík, *A.* cf. *amplimuralis* Pantic, *A.* cf. *inconstans* Radoicic, *Didemnoides moreti* (Durand Delga) (Pl. II: Fig. 5) are rare. The organic detritus is prevailingly fragmentary and mainly of the size of fine-grained sand. Besides organic remains, a terrigenous admixture (clay and clastic quartz of silt size) is present. It contains several shells of „*Spirigera*" only but one specimen is relatively well preserved. We emphasize that this facies has not been found in the outcrops of the Silica Nappe yet.

Description of the brachiopod specimen

Order: **Athyridida** Boucot, Johnson & Staton 1964
Superfamily: **Athyridacea** Davidson 1881
Family: **Spirigerellidae** Grunt 1965

"*Spirigera*" d'Orbigny 1847

"*Spirigera*" *deslongchampsi* Suess 1855
(Pl. I: Figs. 1–2, Text. Fig. 2)

1855 *Spirigera Deslongchampsi* Suess — Suess, p. 26, Pl.1, Fig. 3.
1890 *Spirigera Deslongchampsi* Suess — Bittner, p. 243, Pl. 15, Figs. 3–5.
1988 "*Spirigera*" *deslongchampsi* Suess — Siblík, p. 83, Pl. 6, Fig. 5 (with note on using the name "*Spirigera*").

Holotype: It is deposited in the collection of the Geologische Bundesanstalt in Vienna under No. 1855/5/2 (Pl. I:

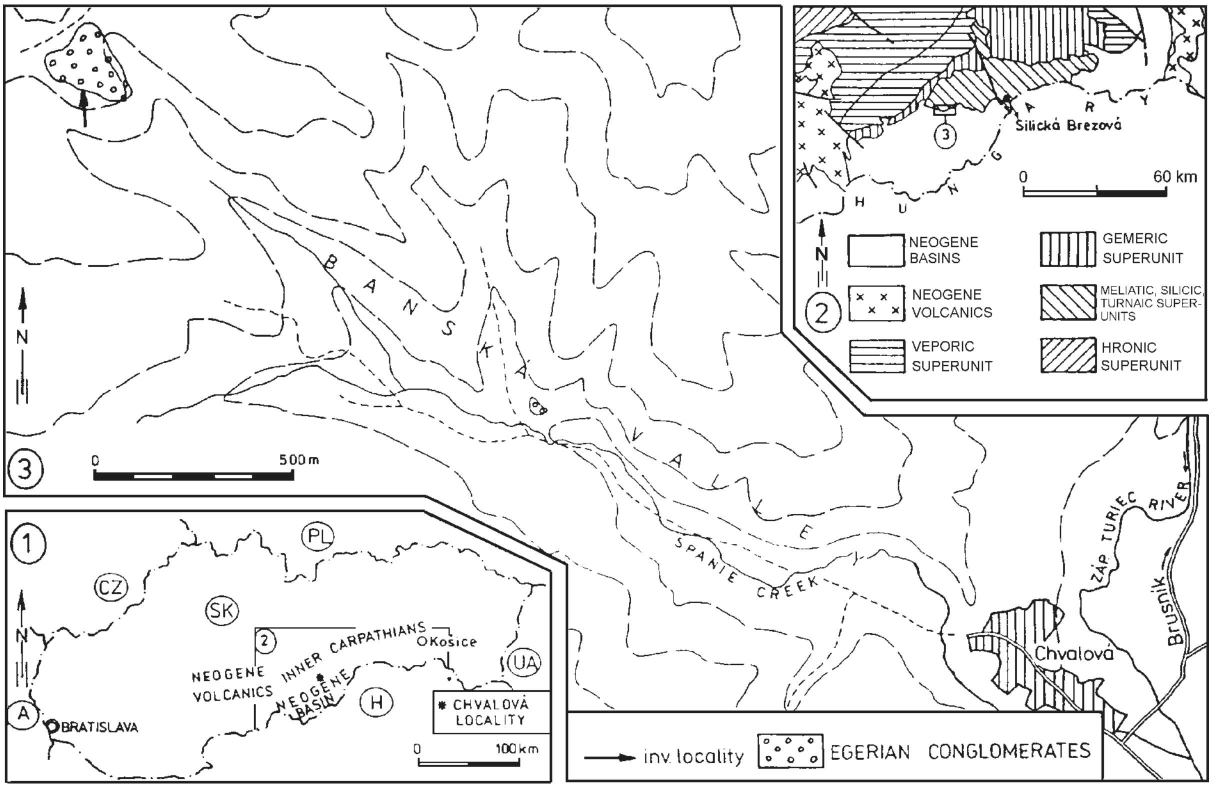


Fig. 1. Location of finding place of the examined pebble.

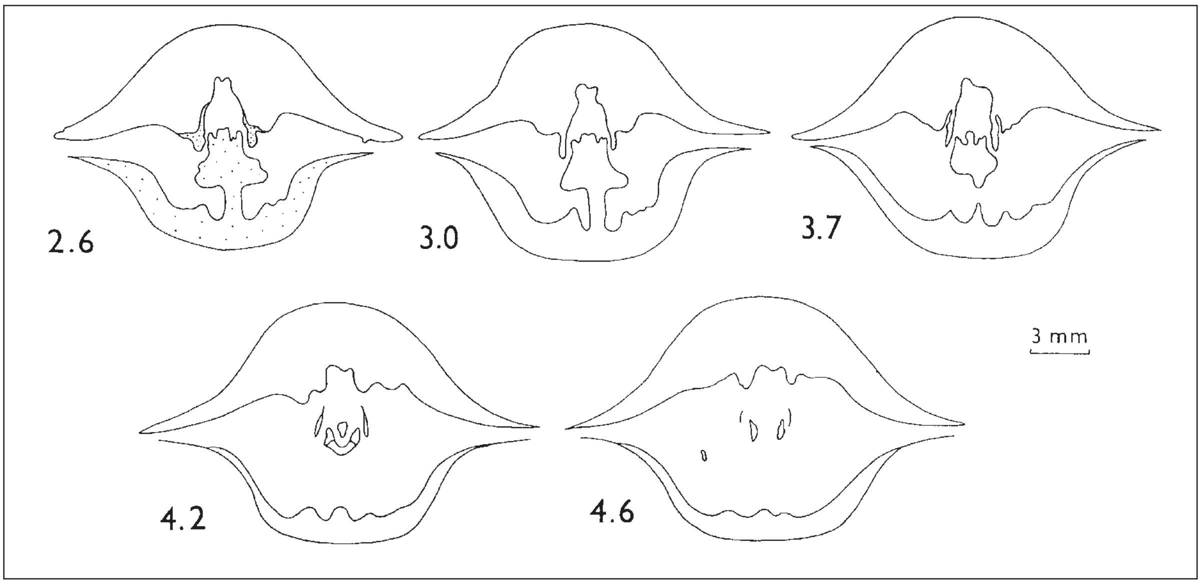


Fig. 2. *"Spirigera" deslongchampsi* Suess. Five transverse sections through posterior part of shell. Chvalová. Magnified.

Fig. 2). It measures ca. 23.0 × 31.0 × 14.8 mm and derives from the Norian "Hallstätterkalk" of the Steinbergkogel near Hallstatt — the Hallstatt Zone, Juvavic Superunit, Upper Austria.

Material: One damaged specimen without posterior part of pedicle valve, measuring ca. 24.0 × ca. 34.0 × 16.2 mm (Pl. I: Fig. 1) and one incomplete pedicle valve, deposited in the collection of Slovak National Museum under No. SNM Z 21978.

Diagnosis and remarks: Equibiconvex smooth shells of subpentagonal outline. Shallow sulcations developed both in pedicle valve and on corresponding fold of brachial valve, perceptible as a flattening near umbones. Low uniplication relatively broad, rising steeply from commissural plane, and straightly limited on dorsal side. Due to the bad preservation of the only available specimen, no more than several sections through the interior structure could be gained. They showed quite different characters of the cardinalia (Fig. 2) in comparison with those known in other large, smooth athyridid genera as *Oxycolpella* Dagys, *Majkopella* Moisseiev or *Ochotathy-*

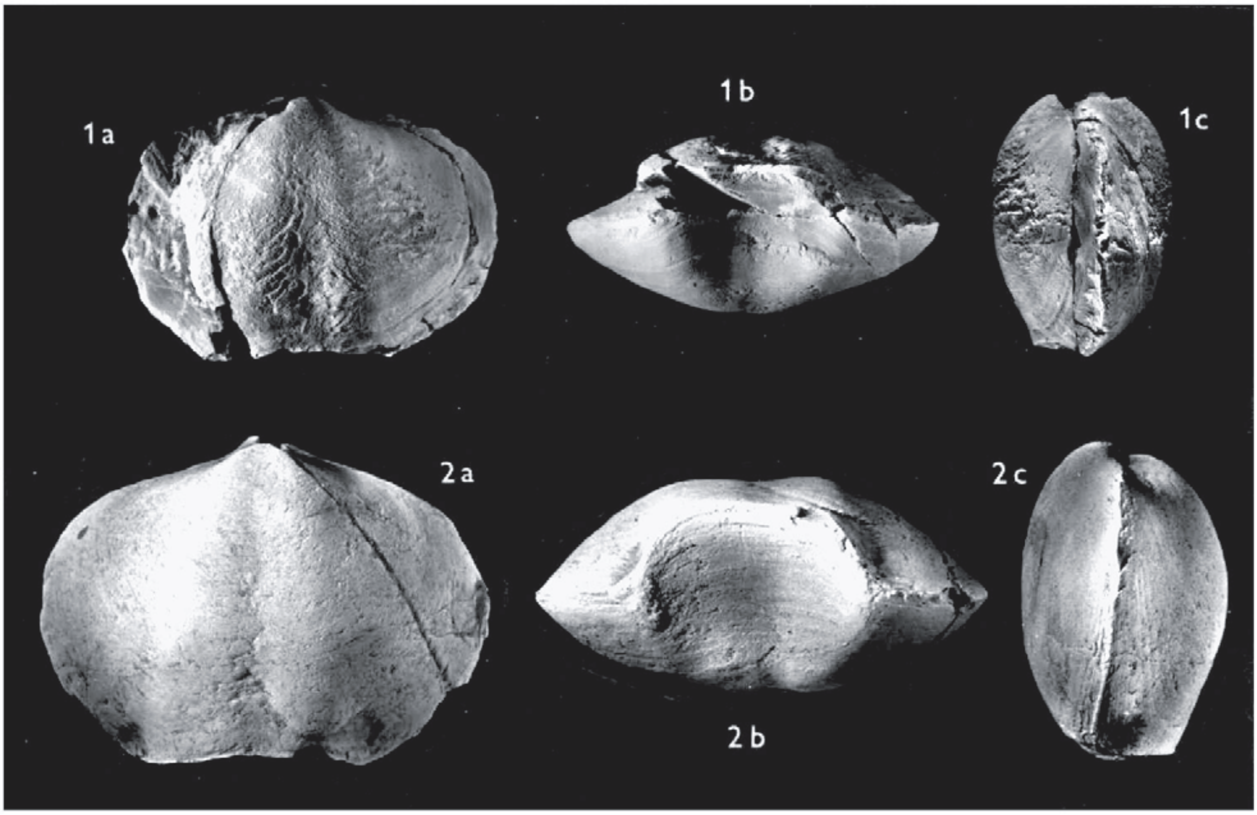


Plate I: Fig. 1 — *"Spirigera" deslongchampsi* Suess, Chvalová, ×1.5. Slovak National Museum No. SNM Z 21978. **Fig. 2** — *"Spirigera" deslongchampsi* Suess. Steinbergkogel near Hallstatt. Holotype. Geologische Bundesanstalt No. 1855/5/2, ×2.

ris Dagys. In this respect, former Dagys' presumption of the possible appurtenance of "*deslongchampsi*" to *Oxycolpella* (Dagys 1965, p. 132) seems incorrect. Our material is characterized by absence of the pedicle collar, by a tripartite, very strong cardinal process and by poorly developed dental lamellae. In these characters it differs substantially from *Oxycolpella.* Howerer the appurtenance to *Spirigerellidae* Grunt 1965 (sensu Dagys 1974) seems legitimate. The generic identification of "*Spirigera*" (= "*Athyris*") *deslongchampsi* regrettably remains doubtful (most probably new genus) until further, more favourably preserved finds. For the time being, the original generic name for "*deslongchampsi*" is used even if invalid.

The species has been only very rarely reported from the Northern Calcareous Alps. Our specimens agree well to the original material that we had at our disposal for comparison. Apart from the holotype (the only specimen known to Suess 1855) the collection of the Geologische Bundesanstalt in Vienna exhibits three specimens figured by Bittner (1890) on Pl. 15 (Fig. 3 with the dimensions 22.2 × 30.5 × 14.2 mm; and young specimens on Fig. 4: 10.1 × 9.9 × 4.8 mm and on Fig. 5: 10.3 × 12.2 ×5.2 mm). They all derive from Steinbergkogel near Hallstatt. New collecting done at this locality by L. Krystyn yielded a well-preserved pedicle valve (measuring 20.5 × 29.0 mm) that we had at our disposal, too.

Occurrence: Chvalová, Southern Slovakia. According to Bittner (1890) the most specimens came from Steinbergkogel near Hallstatt (marly Hallstatt Limestone of Late Norian age, and light-coloured crinoid limestone of Vandaites sturzenbaumi Subzone = Early Rhaetian sensu Wiedmann & Krystyn in Wiedmann et al. 1979, p. 145). Siriuskogel near Ischl; other occurrences mentioned by Bittner (1890) are uncertain (Nassköhr near Neuberg, Teltschen near Bad Aussee and Barmsteine near Hallein).

Microfossils and their stratigraphic evaluation

The stratigraphic position of the analysed limestone pebble was established by determination of macro and micro fauna. "*Spirigera*" *deslongchampsi* has rarely been reported from Hallstatt Limestone of Late Norian age and from light coloured crinoid limestones of Early Rhaetian age, see part Description of brachiopod specimen. A part of pebble (about 25 dkg) was dissolved in 10% acetic acid. In insoluble residue, the following statigraphically important microfossils were found: conodonts, sclerites of holothurians, spines of ophiuroids, pedicellarian valves of echinoids and siliceous spicules of sponges.

Determinated forms:

a/ Conodonts — *Misikella hernsteini* (Mostler), (Pl. IV: Fig. 1); *M. posthernsteini* Kozur & Mock (Pl. IV: Fig. 2, 3); *Oncodella paucidentata* (Mostler), (Pl. IV: Fig. 4). *M. hernsteini* is predominant. The first determination of the conodonts in our sample was already made by Mock (1980, p. 133), and it was confirmed by our present study.

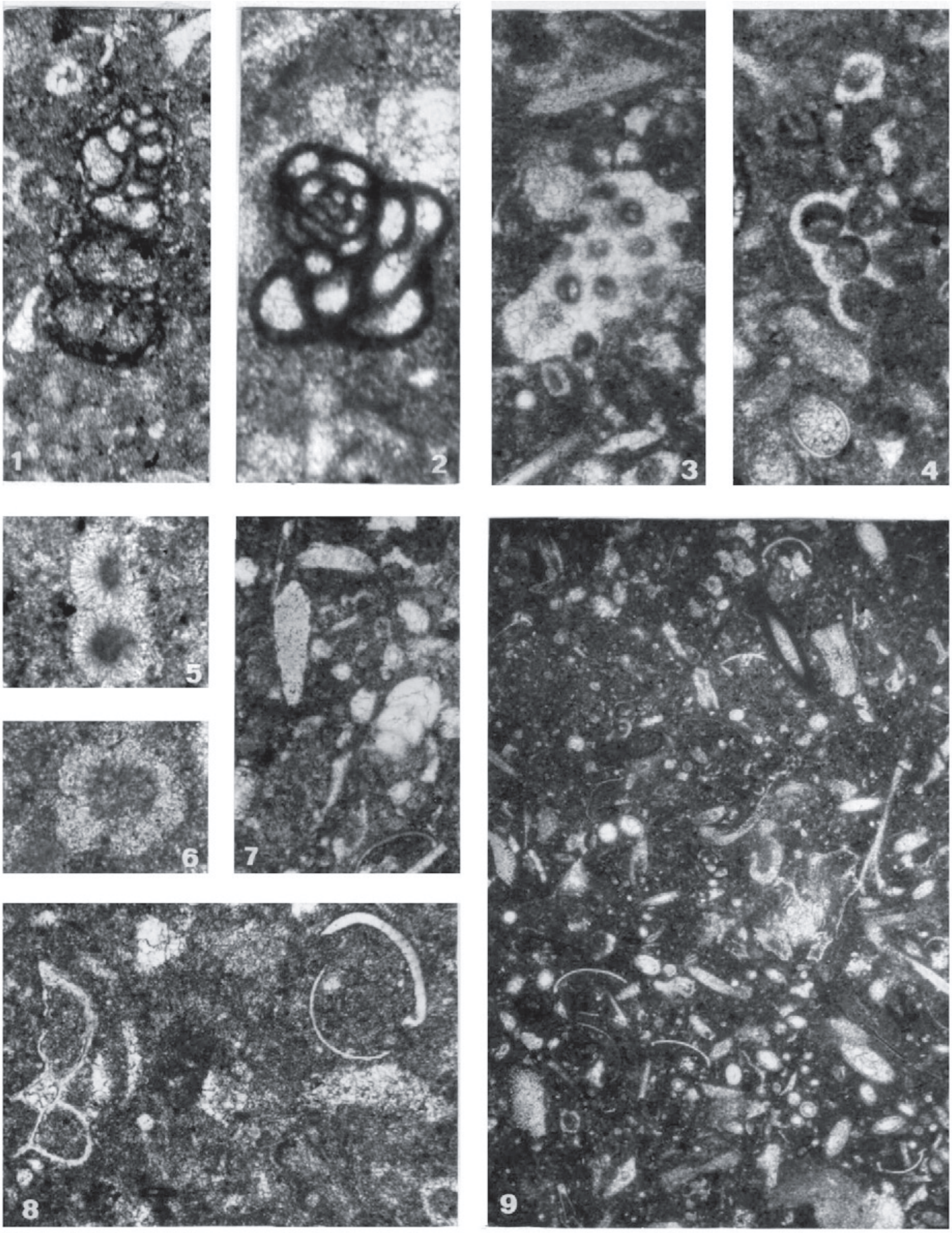


Plate II: Fig. 1 — *Tetrataxis nanus* Kristan-Tollmann, thin sec. 11211, ×86. **Fig. 2** — *Meandrospiranella?* aff. *planispira* Oravecz-Scheffer, thin sec. 20834, ×133. **Fig. 3** — Fragment of dasycladacean alga, thin sec. 20834, ×56. **Fig. 4** — Fragment of Halicorynean thalli, thin sec. 20833, ×56. **Fig. 5** — *Muranella parvissima* (Dragastan), thin sec. 11211, ×190. **Fig. 6** — *Didemnoides moreti* (Durand Delga), thin sec. 11211, ×190. **Fig. 7** — *Osteocrinus* sp., thin sec.11211, ×50. **Fig. 8** — Bryozoan fragment and valves of ostracods, thin sec. 11211, ×100. **Fig. 9** — Fossils assemblage in the analysed limestone, thin. sec. 11211, ×27.

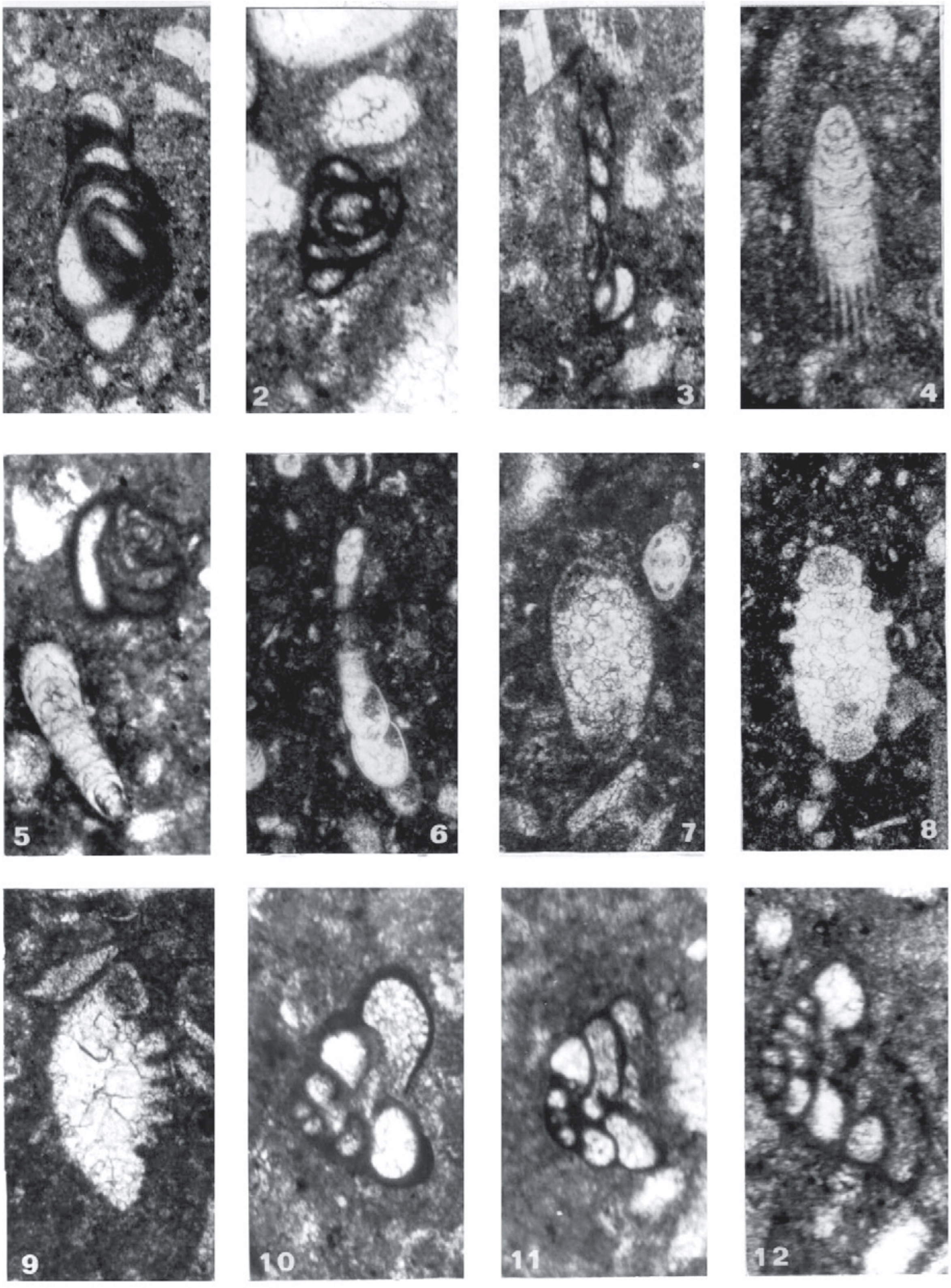


Plate III: Fig. 1 — *Agathamminoides spiroloculiformis* (Oravecz-Scheffer), thin sec. 11211, ×86. **Fig. 2** — *Agathammina incostans* (Michalík, Jendrejaková & Borza), thin sec. 11292, ×129. **Fig. 3** — *Planiinvoluta carinata* Leischner, thin sec. 20833, ×86. **Fig. 4** — *Austrocolomia canaliculata* Oberhauser, thin sec. 20834, ×127. **Fig. 5** — *Frondicularia woodwardi* Howchin and *Quinqueloculina* sp., thin sec. 20834, ×86. **Fig. 6** — *Rectoglandulina* aff. *polyarthra* Kristan-Tollmann, thin sec. 20833, ×45. **Fig. 7** — *Aulotortus communis* (Kristan), thin sec. 20834, ×86. **Fig. 8** — *Involutina* cf. *turgida* Kristan, thin sec. 11211, ×45. **Fig. 9** — *Trocholina granosa* (Frenzen), thin sec.11211, ×110. **Figs. 10, 11** — *Tetrataxis inflata* Kristan, thin sec. 20833 ×117, 20834, ×86. **Fig. 12** — *Tetrataxis nanus* Kristan-Tollmann, thin sec. 11296, ×119.

b/ Sclerites of holothurians — *Theelia stellifera* Zankl (Pl. VI: Fig. 1); *Theelia simoni* Kozur & Mock (Pl. VI: Fig. 2); *Theelia corbula* Zankl (Pl. VI: Fig. 3); *Theelia variabilis* Zankl (Pl. VI: Fig. 4); *Theelia sp.* (Pl. VI: Fig. 5); *Punctatites sp.* (Pl. VI: Fig. 6).

c/ Ophiuroid spines — "Loch" types sensu Mostler (l972, Pl. 3) — (Pl. V: Figs. 7, 8). These forms were reported by Mostler l.c. from Late Norian and Rhaetian age. The other types (Pl. V: Figs. 6, 9, 10) are similar to those found and figured by Mostler (1971) from the Upper Triassic limestones.

d/ Pedicellarian valves — tridentate (Pl. IV: Figs. 5, 6); ophicephalous (Pl. IV: Figs. 7, 8), similar types of valves were described by Mostler (1972, Pl. 1, 2) from limestones of Norian age.

e/ Sponge spicules — tetraxons, orthodichotriaene forms (Pl. IV: Fig. 10; Pl. V: Fig. 1); tetraxons ?triaene form with reduction of rhabds (Pl. V: Fig. 3); desmas, rhabdoclone types (Pl. IV: Fig. 11; Pl. V: Fig. 2); diactinal monoaxon, amphitilote type (Pl. V: Fig. 5) and criccostyl (Pl. V: Fig. 4). Forms of the sponge spicules on Pl. IV: Figs. 10, 11; Pl. V: Figs. 1, 2, 3, 4 are similar to those figured by Mostler (1976) from limestones of Sevatian age.

In the thin sections we identified stratigraphically important foraminifers. Their association is characterized by prevailing ophthalmidia and sessile forms. These groups of forams are represented by the following species: *Ophthalmidium lucidum* (Trifonova), *Oph. triadicum* (Kristan), *Oph. fusiformis* Trifonova, *Paleonubecularia? floriformis* Ciarapica & Zaninetti, *Agathammina incostans* (Michalík, Jendrejáková & Borza) (Pl. III: Fig. 2), *A. austroalpina* Kristan-Tollmann & Tollmann, *Agathamminoides spiroloculiformis* (Oravecz-Scheffer) (Pl. III: Fig. 1), *Planiinvoluta multitabulata* (Kristan-Tollmann), *P. carinata* Leischner (Pl. III: Fig. 3), and *P. regularis* Salaj, Borza & Samuel.

In the associations also Milioporidae represented by the species *Galeanella? tollmanni* (Kristan) are found sporadically. Nodosarian foraminifers like *Austrocolomia canaliculata* Oberhauser (Pl. III: Fig. 4), *Dentalina hoi* Trifonova, *Pseudonodosaria* sp., *Frondicularia xiphoidea* Kristan-Tollmann, *F. woodwardi* Howchin (Pl. III: Fig. 5) and *Rectoglandulina* aff. *polyarthra* Kristan-Tollmann (Pl. III: Fig. 6) are among the common species.

Involutinid and glomospiroid foraminifers occur less frequently and have subtle growth. They are represented by *Aulotortus communis* (Kristan) (Pl. III: Fig. 7) *A. tumidus* (Kristan-Tollmann), *Gandinella falsofriedli* (Salaj, Borza & Samuel), *Coronipora austriaca* (Kristan), *Involutina* cf. *turgida* Kristan (Pl. III: Fig. 8) and *Trocholina granosa* (Frentzen) (Pl. III: Fig. 9). From further groups the species *Trochammina januensis* Brönnimann & Page, *Tetrataxis inflata* Kristan (Pl. III: Figs. 10, 11), *T. nanus* Kristan-Tollmann (Pl. III: Fig. 12), *Meandrospiranella?* aff. *planispira* Oravecz-Scheffer (Pl. II: Fig. 2), *Turrispirillina minima* Pantic, *Oberhauserella ovata* Fuchs and *Earlandia amplimuralis* (Pantic) were indentified. The described assemblage of foraminifers with numerous forms of ophthalmidia, nodosaria (mainly *Austrocolomia canaliculata*), points to the Norian age s.l. (i.e. including the Early Rhaetian). From the point of view of the indistinct occurrence of involutid forams which does not correspond to their explosive extension in the Norian s.s., the age of the limestone studied would rather correspod to the Early Rhaetian. This range is also supported by the sporadic presence of the Early Rhaetian index species *Gandinella falsofriedli*, Early Rhaetian Angulodiscus friedli Zone according to Salaj et al. (1983) and the appearance of Early Rhaetian *Milioporidae* (species *Galeanella? tollmanni*). In the associations of foraminifers the first involutinas (*Involutina* cf. *turgida*) already appear. They are mentioned by Salaj et al. l.c. from the Rhaetian Triassina hantkeni Zone. According to all the mentioned microfossils the pebble is of Early Rhaetian age. According to conodonts it belongs to Misikella hersteini–Misikella posthernsteini Subzone sensu Kozur & Mock (1991).

Comparison of the analysed limestone with Upper Triassic sediments of the Silica Nappe near Silická Brezová village

The microfacies of the limestone with "*Spirigera*" was compared with the microfacies of Upper Triassic limestones and marls near Silická Brezová village (situated approximately 26 km E of Chvalová village, see Fig. l) at two localities:

A. New section SW of old quarries — red and pink Hallstatt Limestone in its uppermost part probably corresponds according to unpublished stratigraphic data to the Early Rhaetian.

B. Malý Mlynský vrch Hill — locality situated l km east of Silická Brezová village where the Zlambach Beds of Late Norian to Rhaetian age occur (their age according to Mock 1973, l980 and Kozur & Mock 1974a,b).

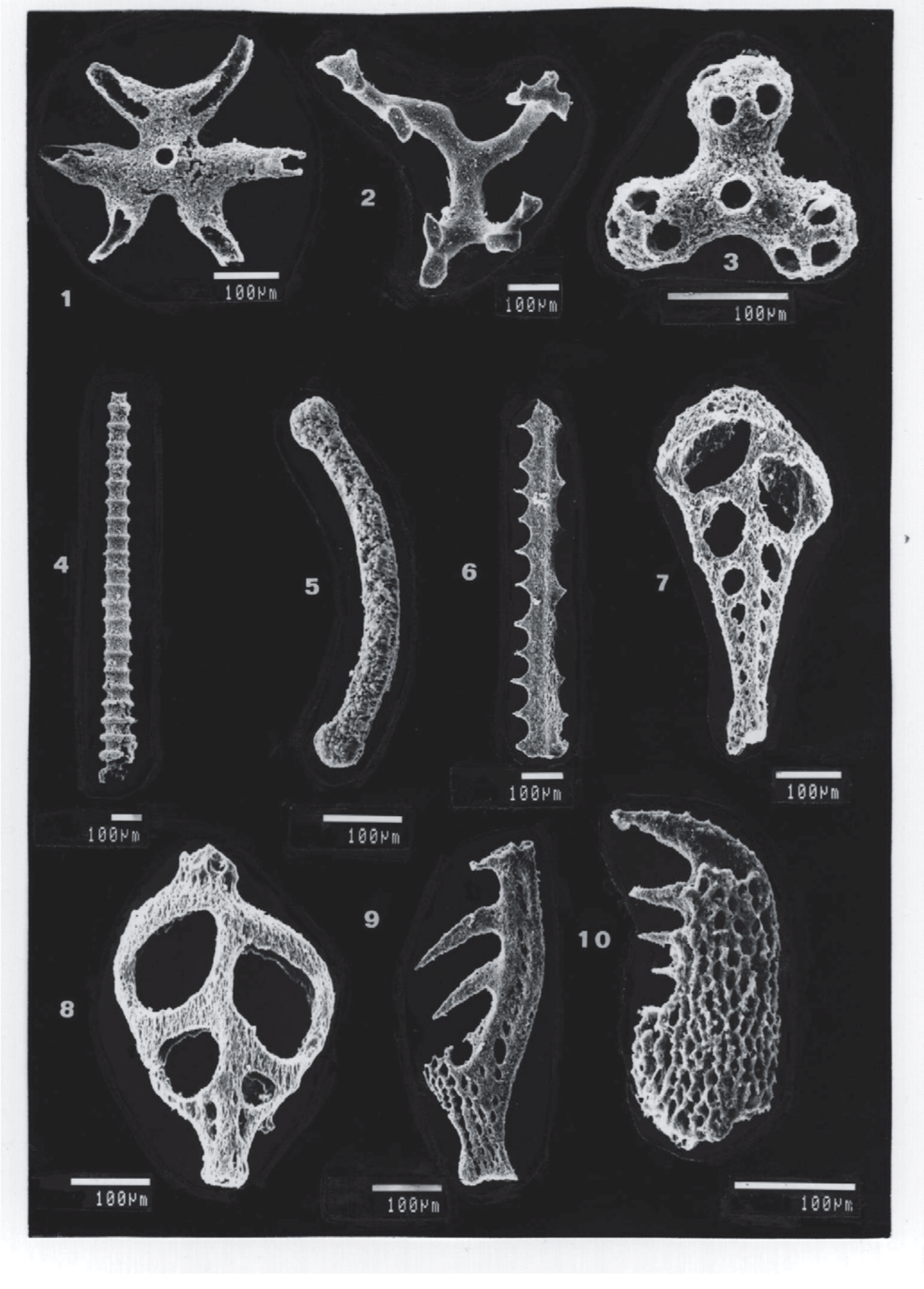
In another place — Bohúňovo village — the sedimentation of Zlambach Beds facies continued into the Early Jurassic (Mello l997), as in the Northern Calcareous Alps (see e.g. Zankl 1971).

The red Hallstatt Limestone (loc. A) is represented by wackestones to packstones. They contain a relatively abundant association of fossil remains: mainly shells of bivalves, juvenile ammonites, ostracods, sponge spicules, ossicles of echinoderms, foraminifers in various proportions. Allochems are not sorted. Terrigenous admixture is very low, about 2 grains of quartz per thin section (compare also Mišík & Borza l976).

→

Plate IV: Fig. 1 — *Misikella hernsteini* (Mostler), neg. 1454, × 370. **Fig. 2** — *Misikella posthernsteini* Kozur & Mock, neg.1421, × 450. **Fig. 3** — *Misikella posthernsteini* Kozur & Mock, neg.1419, ×450. **Fig. 4** — *Oncodella paucidentata* (Mostler), neg, 1456, × 220. **Fig. 5** — Tridentate pedicellarian valve of a sea urchin without a tip part, neg. 1448, ×150. **Fig. 6** — Tridentate pedicellarian valve of a sea urchin without a tip part, neg. 1428, ×190. **Fig. 7** — Ophiocephalous pedicellarian valve of a sea urchin, neg. 1443, × 150. **Fig. 8** — Dentated tip of the ophiocephalous pedicellarian valve, neg. 1444, ×230. **Fig. 9** — Agglutinate foraminifera, neg. × 150. **Fig. 10** — Sponge spicule, tetraxon - orthodichotriaene, neg. 1457, ×80. **Fig. 11** — Sponge spicule, desma - rhabdoclone, neg. 1463, ×150.


1
100μm
2
10μm
3
10μm
4
100μm
5
100μm
6
100μm
7
100μm
8
100μm
9
100μm
10
100μm
11
100μm


1
100µm
2
100µm
3
100µm
4
100µm
5
100µm
6
100µm
7
100µm
8
100µm
9
100µm
10
100µm

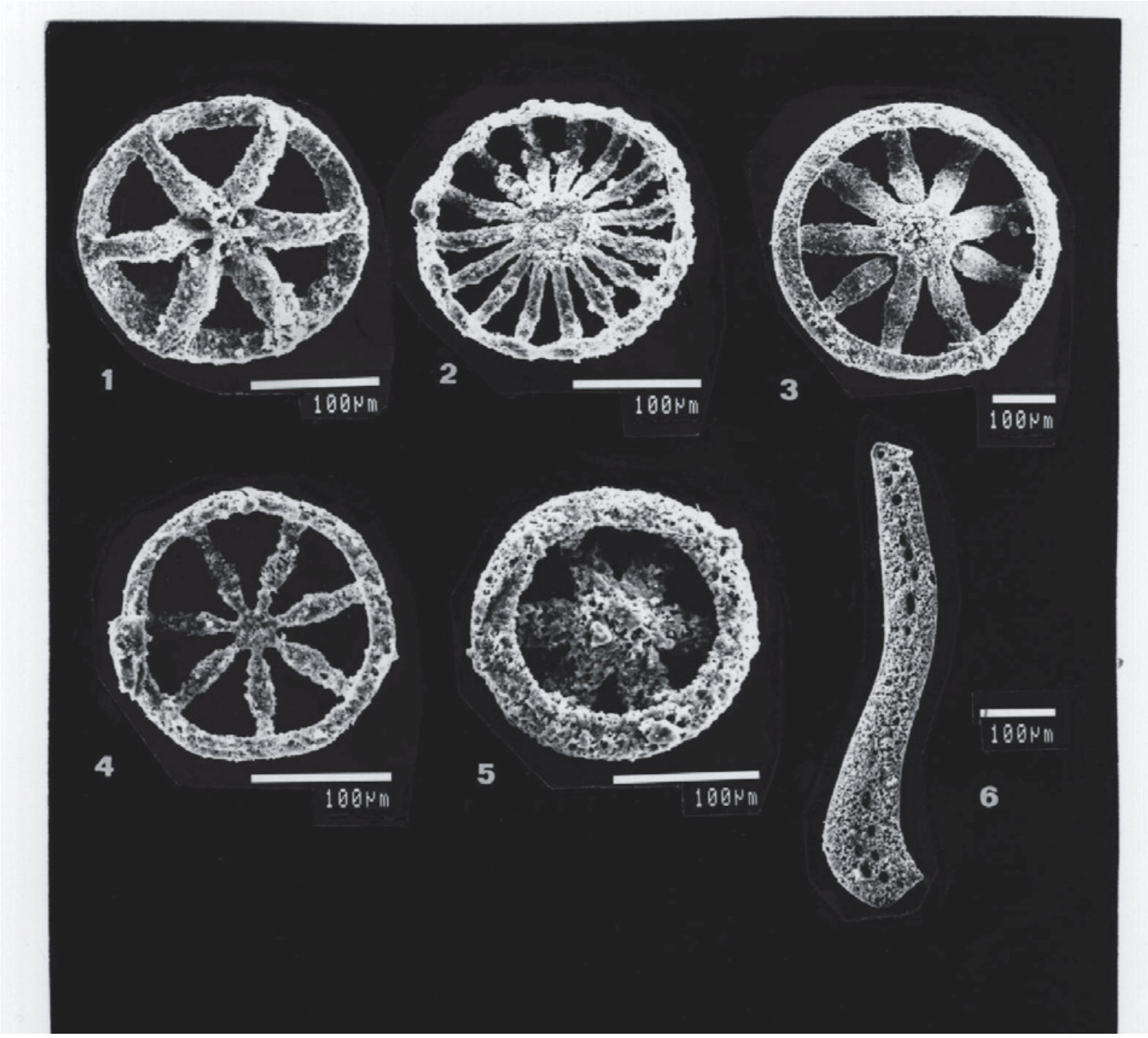


Plate VI: Fig. 1 — *Theelia stellifera* Zankl, neg. 1436, ×300. **Fig. 2** — *Theelia simoni* Kozur & Mock, neg. 1426 ×300. **Fig. 3** — *Theelia corbula* Zankl, neg. 1449, ×150. **Fig. 4** — *Theelia variabilis* Zankl, neg. 1455, ×330. **Fig. 5** — *Theelia* sp., neg. 1438, ×350. **Fig. 6** — *Punctatites* sp., neg. 1434, ×180.

Grey to grey-brownish rocks of the Zlambach Beds (loc. B) are wackestones, they contain small fragmentary skeletal remains (silt to very fine sand size mainly). Thus the identification of allochems is often difficult. Fragments of bivalve shells, echinoderm ossicles, foraminifers and ostracods were distinguished. Peloids, small intraclasts and epigenetic pyrite are present, too.

←

Plate V: Fig. l — Sponge spicule, tetraxon - orthodichotriaene with reduction of rhabds, neg. 1425, ×190. **Fig. 2** — Sponge spicule, desma - rhabdoclone, neg. 1418, ×150. **Fig. 3** — Sponge spicule, tetraxon - ?triaene with reduction of rhabds, neg. 1452, ×350. **Fig. 4** — Sponge spicule, criccostyl neg. 1431, ×90. **Fig. 5** — Sponge spicule, diactinal monoaxon - aphitylote, neg. 1433, ×230. **Fig. 6** — Thorny spine of ophiuroid, neg. 1427, ×120. **Fig. 7** —"Loch" spine of ophiuroid, neg. 1422, ×190. **Fig. 8** — "Loch" spine of ophiuroid, neg. 1447, ×200. **Fig. 9** — Hooked spine of ophiuroid, neg. 1440, ×350. **Fig. 10** — Hooked spine of ophiuroid, neg. 1462, ×350.

The rock also contains terrigenous admixture — clay and silt mainly (quartz: silt to 0.3 mm), it is often bioturbated and spotted. In the upper parts of the formation, beds of hybrid calcareous sandstones with a quartz content of 40–50 % sporadically appear. They differ from the Zlambach Beds of the Northern Calcareous Alps mainly in the smaller content and reduced diversity of their fossils, and in the absence of corals (compare Zankl l971; Pistotnik 1972; Matzner 1986).

According to the association of fossil remains, the studied limestone with "*Spirigera*" is similar to Hallstatt Limestone near Silická Brezová.

It differs from it in the content of terrigenous component (admixture), colour and indistinct spottedness. It differs from rocks of the Zlambach Beds near Silická Brezová in the assemblage, preservation and size of organic remains, also in colour and the smaller content of terrigenous component (compare description of the pebble studied). We suppose that the analysed limestone pebble represents a facies type, transitional between the the facies of Hallstatt Limestone and Zlambach Beds.

Although papers, describing the lithology and microfacies of the Hallstatt Limestone (containing „Spirigeras") in detail are not familiar for us (localities Steinbergkogel near Hallstatt, Siriuskogel near Ischl, Nassköhr near Neuberg, see Suess 1855; Bittner 1890), we suppose that the Upper Triassic limestones in some localities of the Juvavic Superunit (Northern Cacareous Alps) and Silicic Superunit (Western Carpathians) sedimented under similar biofacial conditions.

Acknowledgements: The brachiopod study was financially supported by the Grant No. A 3013606 of the Grant Agency of the Academy of Sciences of the Czech Republic. For making available their own collections or museum material grateful thanks is owing to Prof. L. Krystyn — Paleontological Institute of the Vienna University and Dr. F. Stojaspal from Geological Survey, Vienna. We are indebted also to Dr. K. Zágoršek — Department of Geology and Paleontology, Comenius University, Bratislava for kind determination of the bryozoan remains.

References

Bittner A., 1890: Brachiopoden der alpinen Trias. *Abh. k. k. Geol. Reichsanst.,*14, 1–320, Pls. 1–41.

Dagys A. S., 1965: Triassic brachiopods of Siberia. *Izdat. Nauka*, 1–186, Pls. 1–26 (in Russian).

Dagys A. S., 1974: Triassic brachiopods, *Trans. Inst. Geol. Geoph. Novosibirsk*, 214, 1–322, Pls. 1–49 (in Russian).

Kozur H. & Mock R., 1974a: Holothurien — Sklerite aus der Trias der Slowakei und ihre stratigraphische Bedeutung. *Geol. Zborník, Geol. Carpathica,* XXV, l, 113–145.

Kozur H. & Mock R., 1974b: Misikella posthernsteini n.sp., die jungste Conodontenart der tethyalen Trias. *Čas. mineral. geol.*, 19, 3, 245–250.

Kozur H. & Mock R., 1991: New Middle Carnian and Rhaetian Conodonts from Hungary and the Alps. Stratigraphic Importance and Tectonic Implications for the Buda Mountains and Adjacent Areas. *Geol.B.*- A., 134, H.2, 271–297.

Marková M., 1959: Occurrence of the Jurassic rocks pebble in the SW Margin of the Slovak Karst. *Geol. Práce,* Zoš. 55, 267–278 (in Slovak).

Matzner Ch., 1986: Die Zlambach-Schichten (Rhät) in den Nördlichen Kalkalpen: Eine Plattform-Hang-Becken-Entwicklung mit allochthoner Karbonatsedimentation, *Facies,* 14, 1–104.

Marschall W., 1941: Die Foraminiferen der Triasablagerungen von Eberstein bei Klagenfurt. *Paleont. Z.*, 22, 181–212.

Mello J., 1997: Explanations to the geological map of the Slovak Karst, 1:50,000, 255, *Dionýz Štúr Publishers*, (in Slovak, English Summary)

Mišík M. & Borza K., 1976: Obere Trias bei Silická Brezová (Westkarpaten). *Acta geol. geogr. Univ. Comenianae, Geol.* 30, 5–49.

Mišík M. & Sýkora M., 1981: Jura der Silica - Einheit, rekonstruiert aus Geröllen und Oberkretazische Süsswasserkalke des Gemerikums. *Geol. Zborník, Geol. Carpathica*, 31, 3, 239–261.

Mock R., 1973: Über einen Fund von Zlambach-Schichten (Nor) im Slowakischen Karst. *Geol. práce*, *Zpr.* 60, 221–224.

Mock R., 1980: Triassic of the West Carpathians. Second European Conodont. Symposium (ECOS II). *Guide book Abstracts. Abh. Geol. B.-A.,* 35, 129–144.

Mostler H., 1971: Ophiurenskelettelemente (äussere Skelettanhänge) aus der alpinen Trias. *Geol. Paläont. Mitt.* Innsbruck, 1, 9, 1–35.

Mostler H., 1972: Die stratigraphische Bedeutung von Crinoiden, Echiniden und Ophiuren-Skelettelementen in triassischen Karbonatgesteinen. *Mitt, Ges. Geol. Bergbaustud.*, 21, 711–728.

Mostler H., 1976: Poriferenspiculae der alpinen Trias. *Geol. Paläont. Mitt.,* Innsbruck, 6/5, 1–42.

Pistotnik U., 1972: Zur Mikrofazies und Paläogeographie der Zlambachschichten (O.Nor–?U.Lias) im Raume Bad Goisern — Bad Aussee (Nördlichen Kalkalpen). *Mitt. Ges. Geol. Bergbaustud.*, 21, 279–288.

Salaj J., Borza K. & Samuel O., 1983: Triassic foraminifers of the West Carpathians. *D. Štúr Institute of Geology*,1–213, Pl. I–CLVII.

Siblík M., 1988: Brachiopoda triadica. *Catalogus Fossilium* Austriae, V c2 (a) Wien, 1–131, Pls.1–6.

Suess E., 1855: Über die Brachiopoden der Hallstätter Schichten. *Denkschr. Akad. Wiss*. Wien, 9, 23–32, Pls.1–2.

Wiedmann J., Fabricius F., Krystyn L., Reitner J. & Urlichs, M., 1979: Über Umfang und Stellung des Rhaet . *Newsl. Stratigr.*, 8, 133–152.

Zankl H., 1971: Upper Triassic Carbonate Facies in the Northern Limestone Alps. *Guide Book,* VIII Internat. Sed.Congr. Heidelberg, 147–185, Fig. 20, Tab. I.