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MIDDLE JURASSIC - LOWER CRETACEOUS DEVELOPMENT OF THE PRUSKÉ UNIT IN THE WESTERN PART OF THE PIENINY KLIPPEN BELT

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Abstract: Two new lithostratigraphic units were distinguished within the Pruské Unit of the Pieniny Klippen Belt: 1. Samášky Formation representing crinoidal flysch of Bajocian - Bathonian age; 2. Horné Srnie Limestone Member - a massive pink organodetritic limestone of Berriasian - Lower Valanginian age. New radiolarian species *Orbiculiforma catenaria* Ožvoldová, n.sp. was described from the Czajakowa Formation of the Samášky locality.

Key words: Jurassic, Western Carpathians, Pieniny Klippen Belt, Pruské Unit, stratigraphy, microfacies, radiolarians, sedimentology.

Introduction

The Pruské Unit was first mentioned by Andrusov (1945) as the Pruské development of the Pieniny Unit. Its type locality occurs in the Podhradská Dolina Valley at Pruské village. The presence of grey marls with crinoidal limestone intercalations and the two horizons of nodular limestones is significant. It indicates the transitional character of this unit between the Czorsztyn Unit, containing mostly a shallow shelf facies, to the Pieniny Unit, containing mostly a deep pelagic facies. Later Birkenmajer (1953) described the similar Niedzica Unit from the Polish part of the Pieniny Klippen Belt. The occurrences of the Pruské Unit in the Váh Valley were mapped and described also by Began (1969).

A new profile of the Pruské Unit was found at the Samášky local part near the village Horné Srnie. It represents a roadcut outcrop within the area of the local cement factory quarries. It is very suitable for detailed investigation, for it was not very affected by the tectonic processes.

Description of the lithostratigraphic units based on the Samášky profile

The profile represents a roadcut along the road connecting the main transport road with an abandoned quarry at Samášky (Fig. 1). The whole profile is about 400 m long, with layers generally dipping about 30° SSW. It is almost complete, only some interruptions occur, caused by faults, debris and soil cover. Several lithostratigraphic units were recognized (Fig. 2). The detailed description of them is given in the next subchapters.

Harcygrund Shale Formation

The formation is poorly outcropped, only in local excavations at the road. It represents grey spotted marlstones with the local sandy crinoidal limestone turbiditic intercalations of up to 5 cm in thickness. The observable thickness of the whole formation is about 50 m. Frequent shells of *Bositra buchi* (Römer) represent the only macrofauna. The formation is very poor also micro-

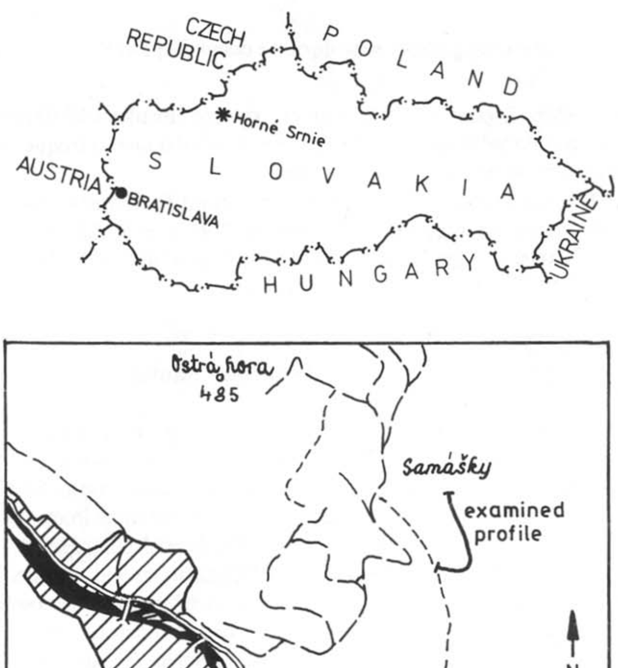


Fig. 1. Location of the Horné Srnie-Samášky locality.

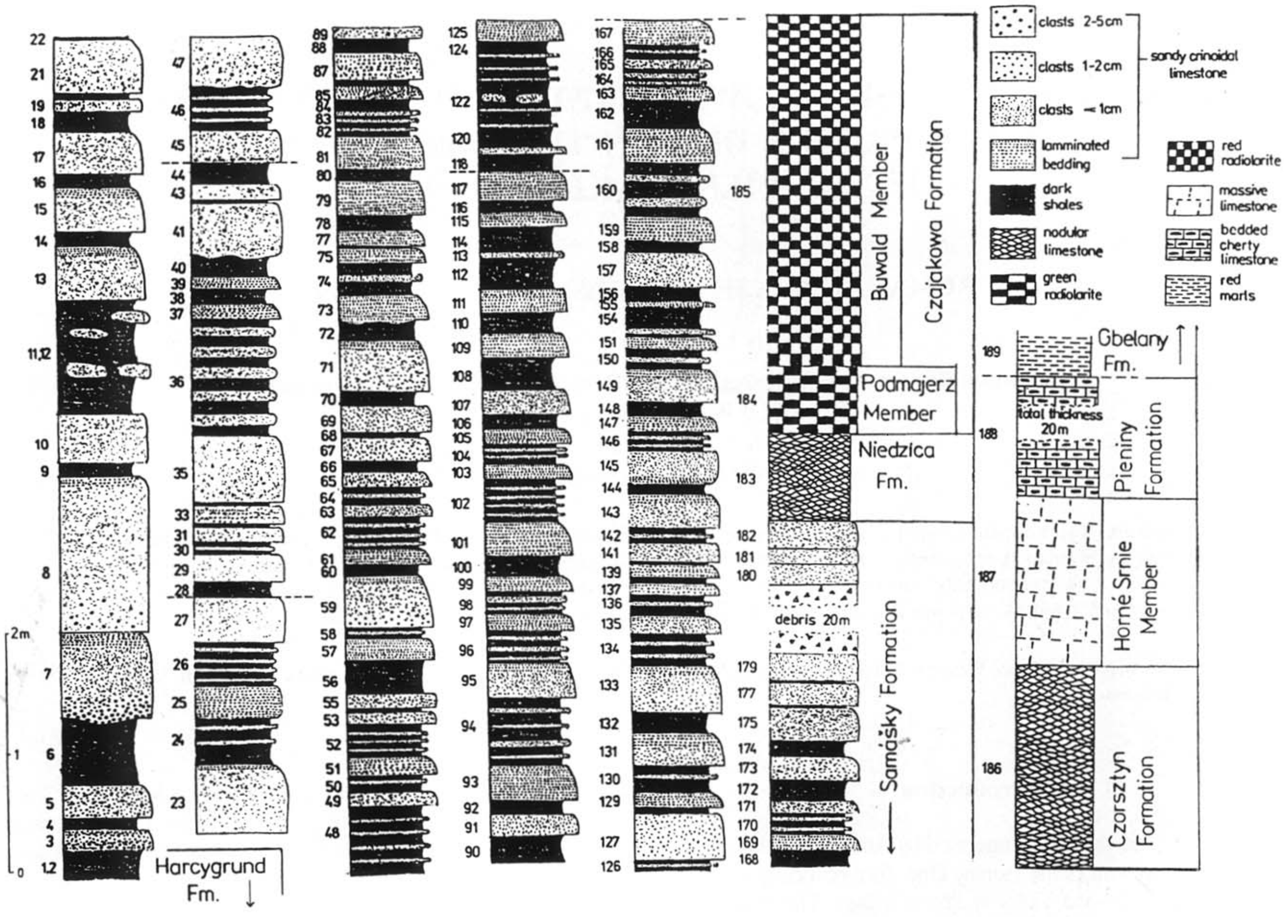


Fig. 2. Lithostratigraphic scheme of the examined profile.

scopically. It contains only frequent sponge spicules with some lenticulinid foraminifers. The silt admixture of quartz is frequent also. The sediment is finely laminated.

The age determination of the Harcygrund Formation, based only on the analogy with Birkenmajer (1977), is Middle Bajocian. However, this formation was not documented in the Niedzica (Pruské) Unit (Birkenmajer, l.c.).

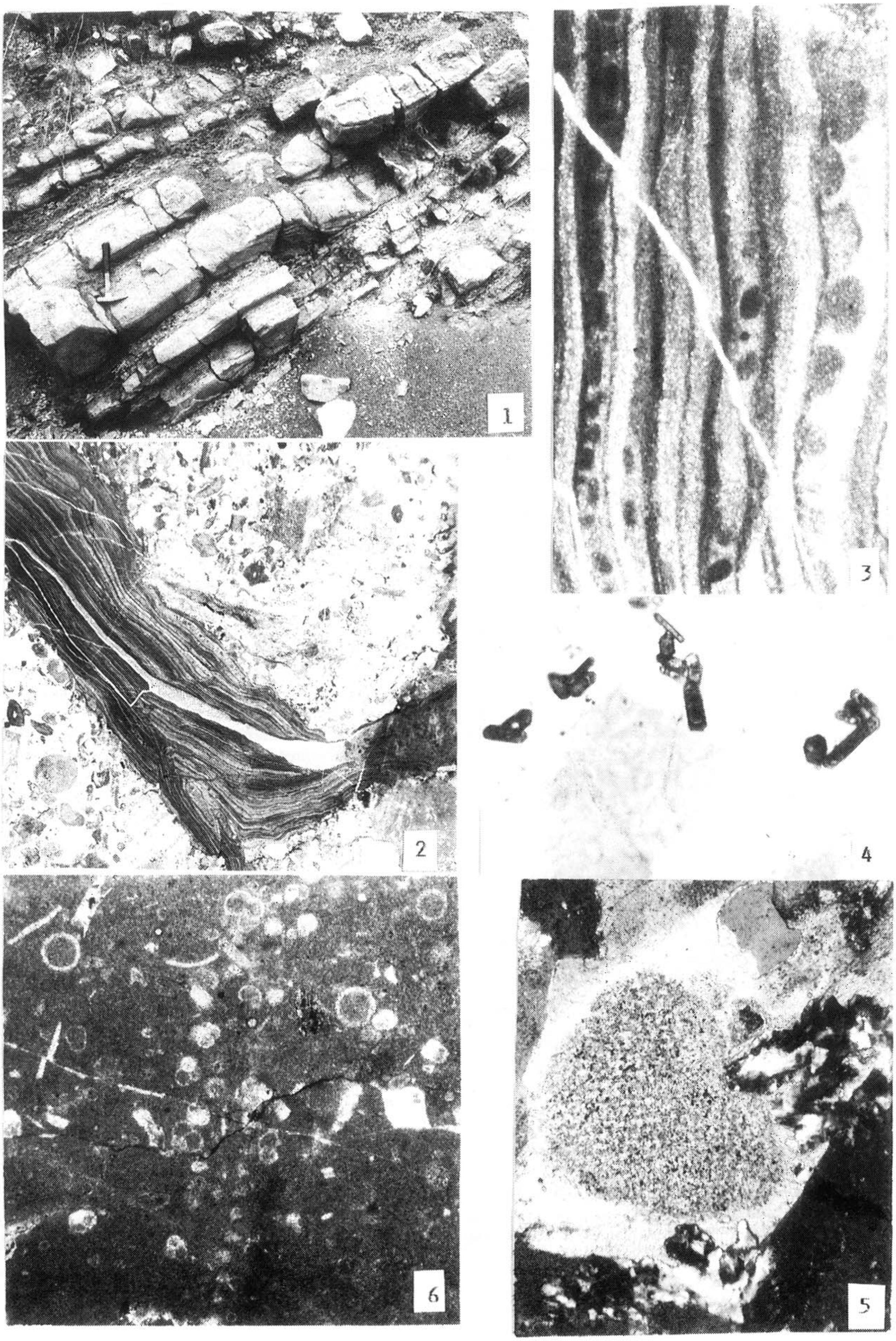
Samášky Formation (new name)

A regular alternation of crinoidal turbiditic layers and marlstones to claystones signals the beginning of a new formation (Pl. I: Fig. 1). It is about 35 to 40 m thick and was never described in detail in the literature. The first mention of this formation came from Andrusov (1945) from the type locality of the Pruské Unit. He described crinoidal limestones with marly intercalations and regarded it as the lateral equivalent of "Aalenian flysch" (now Szlachtowa Formation) but with a predominance of crinoidal detritus. Began (1969) mentioned that the predominance of shales (in the type locality) changes westward and crinoidal limestones become predominant. Westernmost, at the occurrences near the Horná Súča village, it represents only irregularly bedded crinoidal limestones.

In the described profile, the crinoidal flysch begins with relatively thick turbiditic layers with thick sandy shale intercalations. A slump structure occurs, formed in the second turbiditic layer (No. 5). Several thickening-upward cycles can be distinguished then (beds No. 28 - 35, 36 - 41, 42 - 47, 48 - 59) indicating prograding of the turbiditic fan. The turbiditic layers become thinner upwards and more regularly alternated with shales. In the shale layers, thin sandy intercalations are frequent, especially in the middle part of the flysch sequence. Many of the turbiditic layers contain A and B Bouma intervals; a C interval is absent. That indicates a relatively high proximality indice, though in calciturbidites the coarser fraction could be moved to more distal areas than in the siliciclastic ones. The basal parts of the beds are often formed by matrix-supported fine-grained conglomerates with indistinctly graded bedding. The main portion of the bed is usually formed by coarse-grained structureless sandy crinoidal limestone. The upper parts of the layers are often parallely laminated especially in the upper part of the profile. Diagenetic silicification is very frequent in these parts. The SiO_2 comes from sponge spicules, which are abundant mainly in the marly

PLATE I: Fig. 1 - The view of the calciturbiditic sequence of the Samášky Formation. The head of hammer is on the layer No. 79. Photo: P. Reichwalder (other photos by L. Osvald). **Fig. 2** - Small neptunian dyke originated probably by a slump movement, 4.5x magn. **Fig. 3** - Detail of the neptunian dyke (Fig. 2) showing faecal pellets of limnivores arranged in parallel lamminae, 27x magn. **Fig. 4** - Zonary zircons enclosed in quartz grain clast, 170x magn. **Fig. 5** - Syntaxial overgrowth around crinoidal particle disturbed by the later silicification, 86x magn. **Fig. 6** - *Globuligerina* sp. together with calcified radiolarians in Horné Srnie Limestone Member (Valanginian), 45x magn.

PLATE I



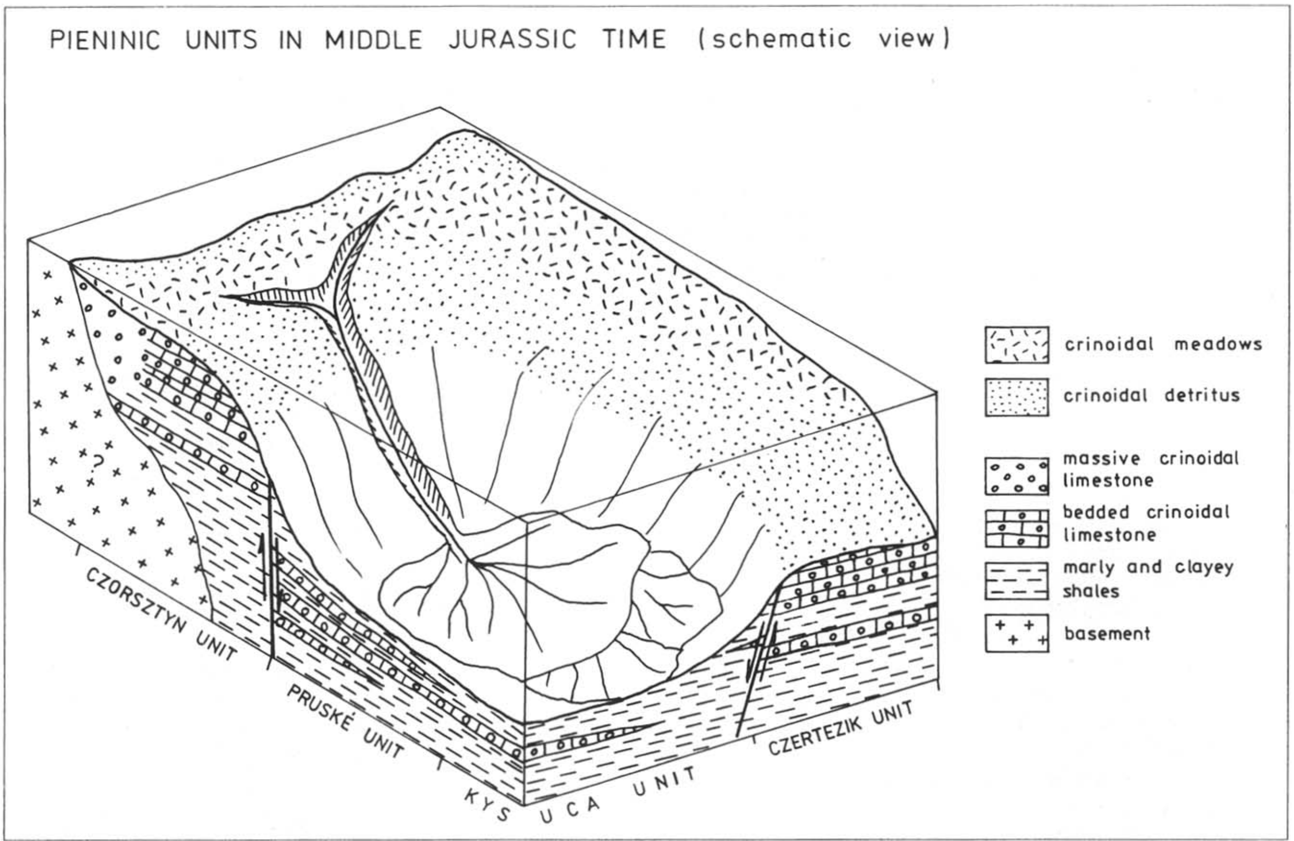


Fig. 3. Schematic view of the Pieninic units in Middle Jurassic.

intercalations. A small-scale (3 cm) neptunian dyke occurs in layer No. 5 (Pl. I: Fig. 2). It probably originated from a slight slumping of the bed and filling the newly formed small fracture with lime mud before the next turbiditic layer sedimented. The mud is perfectly parallely laminated also by the activity of limnivores, as suggested by faecal pellets arranged along some laminae (Pl. I: Fig. 3).

The crinoidal limestones are of white to light-grey colouration, yellowish if weathered. They represent sandy crinoidal biosparites, sometimes with unperfectly washed-out lime mud. Rare twinning lamelles are visible in the crinoidal particles and in the sparite, which indicates weak affection by the pressure. From crinoidal particles, cirrals and brachials are relatively frequent, which coincide well with the Z_2 crinoids accumulation Zone of Gluchowski (1987). The zonation is developed due to the transport sorting of crinoidal detritus. The bivalve shells, thick-shelled ostracodes, echinoid spines, punctate brachiopods, bryozoans, nodosariid and lenticulinid foraminifers and sponge spicules are the main organic remnants besides the crinoidal detritus. Frequent silicification of the crinoid particles is observable. It represents post-cementational silicification for it cuts the syntaxial overgrowths (Pl. I: Fig. 5). From the non-skeletal elements a sandy admixture of quartz, also rarely feldspars is abundant. The quartz grains reach up to 3 cm size. In some of them, numerous little zonary zircon grains are present. From the larger-size clasts also the intraclasts of marlstones, spongolites and sandstones are present; they were derived from the sea bottom by turbidity current being moved. The abundant dolomitic clasts are present also.

The marly layers are of a grey to yellowish colouration (if weathered), with a rich silty admixture. They contain abundant sponge spicules, rare crinoidal particles and lenticulinid foraminifers. Sometimes, fibrous-calcite veinlets of 1 cm size occur: they probably originated by dessication and contraction by water being released from clay minerals.

The proposed age of the formation is Bajocian to Bathonian.

Niedzica Limestone

It represents a 75 cm thick layer of red nodular limestone with small nodules of up to 5 cm. They are often formed by indeterminable casts of ammonoids, strongly affected by dissolution.

Microscopically it represents biomicrite - wackestone with abundant "fibres" (cross-sections of thin *Bositra* shells), gastropods, juvenile ammonoids, ostracodes, *Globochaete alpina* Lombard and foraminifers, especially *Lenticulina* sp. and nodosariid foraminifers. *Globuligerina* sp. is also present, but not in mass. This fact allows the determination of the stratigraphical range of the limestone as Bathonian. The overlaying green Podmajerz Radiolarite Member begins in Upper Bathonian - Early Callovian.

Czajakowa Radiolarite Formation

It consists of two members: Podmajerz (green radiolarites) and Buwald (red radiolarites) Members. The Kamionka Radiolarite Member described by Birkenmajer (1977) is absent.

Podmajerz Member is a 60 cm thick layer of 5 to 15 cm thick green radiolarite beds. Locally, thin manganoxide coatings are found. Two clayey intercalations with poor microfauna were found within the radiolarites. Radiolarians are concentrated in laminae. They are usually spherical of bad preservation, filled with chalcedony or sometimes with a pyritised centre. Outer parts of tests are often calcified. In the more marly parts, the radiolarians are flattened. In spite of the apparent bad preservation, a relatively rich fauna of radiolarians was separated by dissolution in hydrofluoric acid (Tab. 1; Pl. II - partially IV).

The radiolarian assemblage from the lowermost part of the green radiolarites (sample HS-1a) with *Guexella nudata* (Kocher), *Stylocapsa oblongula* Kocher, *Tricolocapsa conexa* Matsuoka etc. can be ranked to the *Tricolocapsa conexa* Zone (Matsuoka & Yao 1986). According to the new results of Matsuoka (1992), this zone is ranging from Upper Bajocian to Lower Callovian and corresponding approximately with upper A0 Zone (U.A. 1) and A1 Zone (U.A. 2 - 4) of Baumgartner's zonation (Baumgartner 1984). The presence of the species *G. nudata* and *T. conexa* and the absence of *S. tecta* Matsuoka indicates the middle part of this zone (Matsuoka 1992). Thus, the association could probably represent Late Bathonian.

According to Baumgartners' zonation (Baumgartner 1984) the presence of *Mirifusus fragilis* Baumgartner, *Mirifusus dianae* (Karrer), *Stylocapsa oblongula* Kocher and *Tritrabs ewingi* (Pessagno) indicates the stratigraphical range of U.A. 4 - 5 which corresponds with Late Bathonian - Callovian.

The species *Hsuum brevicostatum* (Ožvoldová) is very abundant in this association.

The sample HS-15, taken laterally in the lowermost part of the green radiolarites, besides the common species with the previous sample also contained ?*Dictyomitrella kamoensis* Mizutani & Kido and frequent *Stichocapsa robusta* Matsuoka.

In the uppermost part of the green radiolarite member (sample HS-6a), *Hsuum brevicostatum* (Ožvoldová) still occurs frequently, also *Guexella nudata* (Kocher), *Stylocapsa oblongula* Kocher and *Tricolocapsa conexa* Matsuoka. The species *Podobursa triacantha* (Fischli) appears, too. According to our results from the other localities this species appears in the associations which represent U.A. 5. In Baumgartner (1984) the species *Stylocapsa oblongula* has its last occurrence in U.A. 5. The upper boundary of U.A. 5 is of Callovian age.

From this data, it can be estimated that the associations from Podmajerz Member represent the stratigraphical interval - Late Bathonian - Callovian.

Buwald Member is about 4 m thick. It is represented by bedded red radiolarite, with beds of up to 15 cm thick. The marginal parts of the beds are sometimes of greenish colouration. In the upper part, several thin intercalations of red shales occur. The greenish parts contain a higher portion of calcite, almost twice if compared with the Podmajerz Member. The clay mineral composition is the same in both members. On the basis of the thermical and optical analysis (J. Turan - Geol. Inst.,Faculty of Sci., Com. Univ.), they are represented mainly by smectites of the montmorillonite type.

In the thin section, a very well preserved radiolarian fauna together with dispersed broken radiolarian spines is observable. Radiolarians are filled mainly by chalcedony; they are commonly selectively calcified near the calcitic veinlets. In the marly parts they are flattened, so as in the shaly intercalations.

The red radiolarite member begins with a 20 cm thick layer of red radiolarite with Mn coatings which contains very poor radiolarian assemblage. Above, an approximately 15 cm thick layer of greenish-gray fine radiolarite (sample HS-9b) occurs, containing rich microfauna (Pl. IV). In the rich association the first occurrence of *Acaeniotyle diaphorogona* Foreman, *Tetratrabs bulbosa* Baumgartner and *Tritrabs exotica* (Pessagno) and the absence of *Emiluvia orea* Baumgartner and other species which occur higher (U.A. 7 - 8) indicates the appearence U.A. 5 in the continuous section. The lower boundary of the occurrence U.A. 5 (lower A2 Zone, Baumgartner 1984) is placed approximately to the Middle Callovian (O'Dogherty et al. 1989).

In the upper part of this member, a poor association in the sample HS-12b also contained the species *Foremanella diamphidia* (Foreman) and *Tritrabs casmaliaensis* (Pessagno) indicating U.A. 8 (upper B Zone, Baumgartner 1984).

The best representation of U.A. 8 was found in the HS-13b sample with *Emiluvia orea* Baumgartner, *Emiluvia premyogii* Baumgartner and *Tritrabs exotica* (Pessagno) together with a new species *Orbiculiforma catenaria* n.sp. (the description is given in the paleontological part).

From the upper more calcareous parts (1 m beneath the top, HS-3 sample), a very poor association with *Neotripocyclia echiodes* (Foreman) was extracted. This species already indicates Kimmeridgian age.

According to O'Dogherty et al.(1989), A2 Zone approximately begins in the Middle Callovian and B Zone ends in the Upper Oxfordian. Thus the age determination of gained microfauna of the Buwald Member in the examined locality is Middle Callovian to Upper Oxfordian (?Kimmeridgian).

The boundary between Podmajerz and Buwald Members can be placed into the stratigraphical range U.A. 5 (Middle - Late Callovian) in this locality.

The uppermost part just beneath the Czorsztyn Limestone apparently seems to belong to the radiolarite formation. In fact,

PLATE II: Fig. 1 - *Emiluvia* sp.- 0897, 130x magn., HS-1a. **Fig. 2** - *Acanthocircus suboblongus* (Yao) - 0886, 210x magn., HS-1a. **Fig. 3** - *Sethocapsa trachyostraca* Foreman - 0881, 280x magn., HS-1a. **Fig. 4** - *Eoxitus hungaricus* Kozur - 1162, 300x magn., HS-1a. **Fig. 5** - *Praeconocaryomma hexacubica* Baumgartner - 0899, 235x magn., HS-1a. **Fig. 6** - *Stichocapsa decora* Rüst- 1144, 280x magn., HS-1a. **Fig. 7** - *Guexella nudata* (Kocher) - 1184, 400x magn. **Fig. 8** - *Obesacapsula* sp. B - 1173, 300x magn., HS-1a. **Fig. 9** - *Angulobracchia sicula* Kito & Dewever - 0883, 150x magn., HS-1a. **Fig. 10** - *Stylocapsa oblongula* Kocher - 0939, 550x magn., HS-1a. **Fig. 11** - *Stylocapsa* cf. *catenarum* Matsuoka - 1158, 700x magn., HS-1a; **Fig. 12** - *Eucyrtidiellum pustulatum* Baumgartner - 0906, 550x magn., HS-1a. **Fig. 13** - *Eucyrtidiellum disparile* Nagai & Mizutani - 1142, 500x magn., HS-1a. **Fig. 14** - *Napora* sp. - 9354, 250x magn., HS-1a. **Fig. 15** - *Eucyrtidiellum unumaensis* (Yao) - 0901, 430x magn., HS-1a.

PLATE III: Fig. 1 - *Stichocapsa convexa* Yao - 9348, 320x magn., HS-15. **Fig. 2** - *Sethocapsa* sp. - 9336, 300x magn., HS-15. **Fig. 3** - ?*Dictyomitrella kamoensis* Mizutani & Kido - 9346, 300x magn., HS-15. **Fig. 4** - *Pseudodictyomitrella* sp. - 0900, 400x magn., HS-1a. **Fig. 5** - *Stichocapsa robusta* Matsuoka - 9318, 300x magn., HS-15. **Fig. 6** - *Protunuma* sp. - 0944, 400x magn., HS-6a. **Fig. 7** - *Archaeodictyomitra* sp. - 0890, 400x magn., HS-1a; **Fig. 8** - *Hsuum brevicostatum* (Ožvoldová) - 0884, 290x magn., HS-1a. **Fig. 9** - *Obesacapsula* sp.A - 0895, 300x magn., HS-1a. **Fig. 10** - *Zhamoidellum mikamense* Aita - 9300, 300x magn., HS-15. **Fig. 11** - *Tritrabs* sp. - 9335, 110x magn., HS-15. **Fig. 12** - *Mirifusus fragilis* Baumgartner - 1174, 160x magn., HS-1a. **Fig. 13** - *Tricolocapsa conexa* Matsuoka - 9329, 380x magn., HS-15. **Fig. 14** - *Praezhamoidellum yaoi* Kozur - 0905, 270x magn., HS-1a. **Fig. 15** - *Obesacapsula morroensis* Pessagno - 1150, 140x magn., HS-1a.

PLATE II

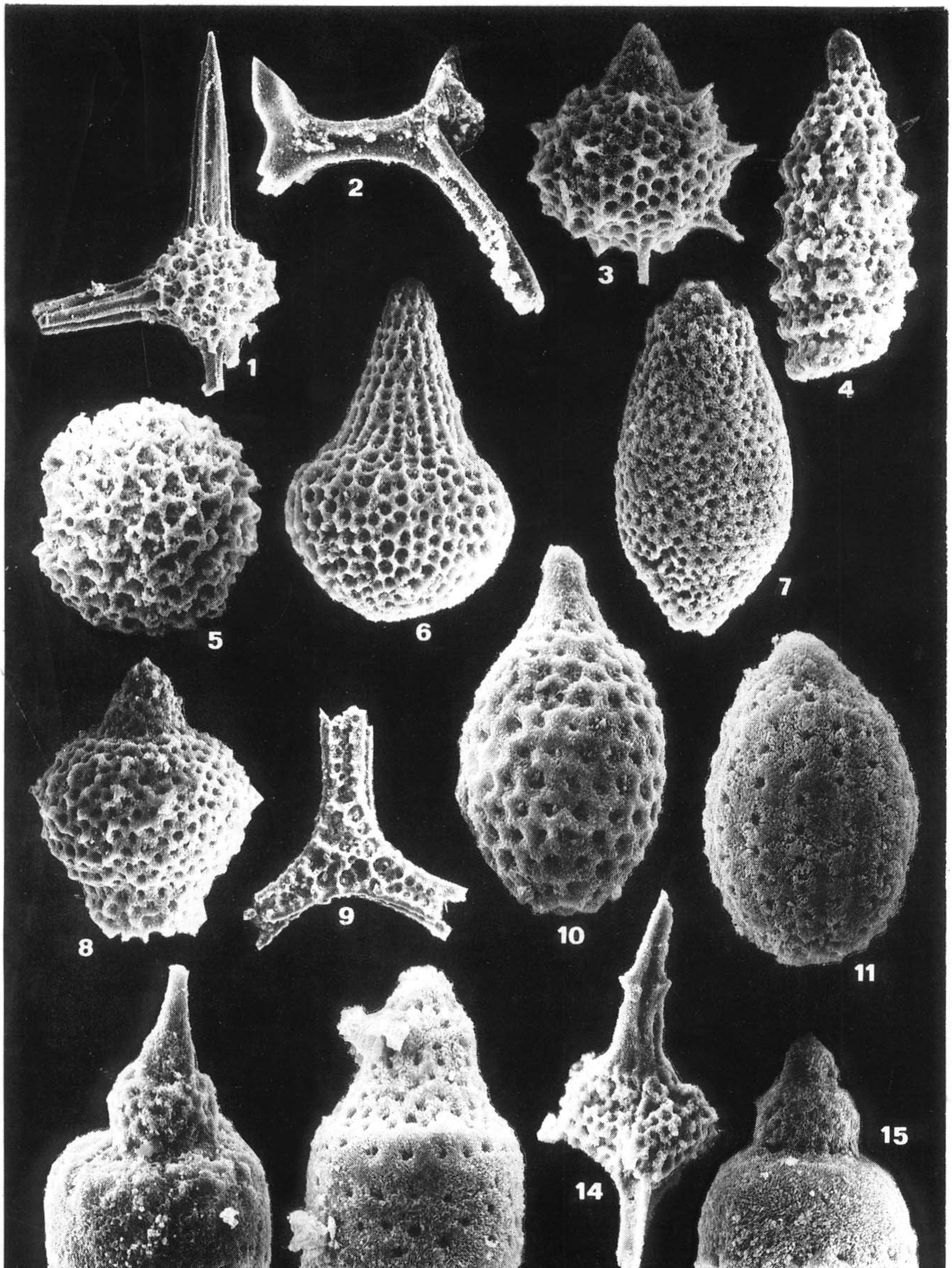


PLATE III

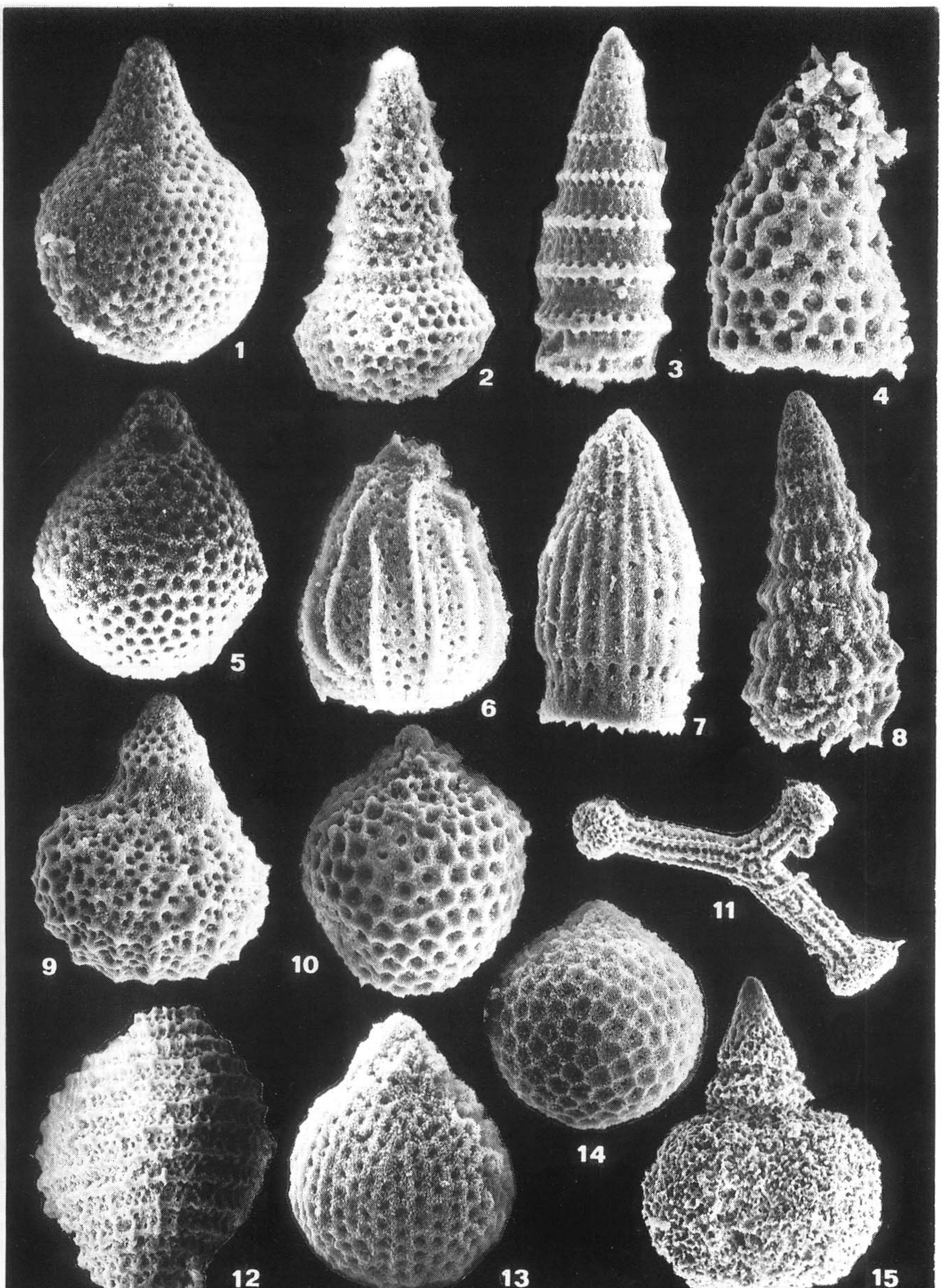


Table 1: Distribution of the radiolarian fauna extracted from the Czajakowa Radiolarite Formation.

	HS 1a	HS 15	HS 6a	HS 9b	HS 12b	HS 13b	HS 3
Acaeniotyle diaphorogona Foreman				◆		◆	
Acanthocircus suboblongus (Yao)	◆	◆	◆			◆	
Acanthocircus variabilis (Squinabol)			◆				
?*Angulobracchia cava* Ožvoldová						◆	
Angulobracchia sicula Kito & De Wever	◆	◆	◆				
Archaeospongoprunum imlayi Pessagno	◆			◆		◆	◆
Cinguloturris carpatica Dumitrica	◆	◆				◆	
?*Dictyomitrella kamoensis* Mizutani & Kido		◆					
Emiluvia ordinaria Ožvoldová						◆	
Emiluvia orea Baumgartner						◆	
Emiluvia pessagnoi Foreman						◆	
Emiluvia premyogii Baumgartner						◆	
Emiluvia salensis Pessagno				◆	◆	◆	◆
Emiluvia sedecimporata (Rüst)				◆		◆	
Emiluvia sp.	◆						
Eoxitus hungaricus Kozur	◆						
Eucyrtidiellum disparile Nagai & Mizutani	◆	◆					
Eucyrtidiellum pustulatum Baumgartner	◆	◆					
Foremanella diamphidia (Foreman)					◆		
Guexella nudata (Kocher)	◆	◆	◆				
Higumastra coronaria Ožvoldová						◆	
Higumastra aff. *inflata* Baumgartner					◆		
Homoeoparonaella argolidensis Baumgartner	◆			◆			
Homoeoparonaella cf. *elegans* Pessagno						◆	
Homoeoparonaella sp.				◆			
Hsuum maxwelli Pessagno	◆	◆					
Mirifusus fragilis Baumgartner	◆	◆					
Mirifusus mediodilatatus (Rüst)	◆						
Monosera unumaensis (Yao)	◆		◆				
Napora deweveri Baumgartner				◆			
Napora sp.	◆						
Obesacapsula morroensis Pessagno	◆						
Obesacapsula sp. A	◆						
Obesacapsula sp. B	◆						
Obesacapsula sp. C			◆				
Orbiculiforma catenaria n. sp.						◆	
Paronaella cf. *bandyi* Pessagno						◆	
Paronaella mulleri Pessagno					◆	◆	
Paronaella pristidentata Baumgartner						◆	
Parvicingula decora (Pessagno & Whalen)			◆				
Parvicingula dhimenaensis Baumgartner	◆	◆	◆				
Parvicingula hsui Pessagno						◆	
Perispyridium ordinarium (Pessagno)						◆	
Podobursa spinosa (Ožvoldová)						◆	◆
Podobursa triacantha (Fischli)			◆		◆	◆	
?*Praeconocaryomma hexacubica* Baumgartner	◆						
Praezhamoidellum yaoi Kozur	◆						
Protunuma sp.			◆				
Pseudocrucella cf. *procera* Ožvoldová						◆	
Pseudodictyomitrella sp.	◆						
Sethocapsa trachyostraca Foreman	◆						
Sethocapsa sp.		◆					
Spongocapsula cf. *perampla* (Rüst)						◆	
Staurosphaera antiqua Rüst				◆		◆	◆
Stichocapsa convexa Yao		◆					
Stichocapsa decora Rüst	◆						
Stichocapsa robusta Matsuoka		◆					
Stylocapsa cf. *catenarum* Matsuoka	◆						
Stylocapsa oblongula Kocher	◆		◆				
Tetraditryma pseudoplena Baumgartner	◆		◆		◆		◆
Tetratrabs bulbosa Baumgartner				◆	◆		
Tetratrabs cf. *bulbosa* Baumgartner						◆	
Tetratrabs zealis (Ožvoldová)	◆			◆			
Triactoma blakei (Pessagno)						◆	
Triactoma jonesi (Pessagno)	◆	◆		◆		◆	◆
Neotripocyclia echioides (Foreman)							◆
Tricolocapsa conexa Matsuoka	◆	◆	◆				
Tricolocapsa undulata (Heitzer)		◆					
Tripocyclia trigonum Rüst		◆	◆	◆			
Tritrabs casmaliaensis (Pessagno)					◆		
Tritrabs aff. *casmaliaensis* (Pessagno)						◆	
Tritrabs exotica (Pessagno)				◆		◆	
Tritrabs ewingi (Pessagno)	◆			◆			
Tritrabs hayi (Pessagno)					◆		
Tritrabs rhododactylus Baumgartner				◆		◆	
Tritrabs sp.		◆					
Zhamoidellum mikamense Aita	◆	◆	◆				
Gen. et sp. indet.					◆		

it is completely silicified *Saccocoma* limestone. The *Saccocoma* particles are largely corroded and concentrated in the laminae. The bad preserved flattened radiolarians filled by chalcedony are present also. No determinable radiolarian fauna was separated from this part. According to the mass occurrence of *Saccocoma* sp., we can presume, that this part already belongs to Kimmeridgian. It cannot be considered as a separate member for it is macroscopically indistinguishable from the real radiolarite in the field.

It is clear, that the beginning of the radiolarite sedimentation in the Pruské Unit in this locality is earlier than that one in the equivalent Niedzica Unit in the Polish territory (Birkenmajer 1977; Widz 1991; Widz 1992). However the results of Polish authors demonstrate the diachronous character of this sedimentation (ibidem). Callovian age of the Podmajerz Member and the beginning of the Buwald Member in the range of Middle to Late Callovian support this fact.

Czorsztyn Limestone

The formation is 170 cm thick. It represents upper red nodular limestone ranging from Kimmeridgian to Berriasian.

In the lower part, it represents *Saccocoma* packstone, with aptychus fragments (Lamellaptychus, Laevaptychus), ostracodes and rare particles of other crinoids. The *Saccocoma* particles are often corroded and affected by pressure-solution. The nodules are of larger size (up to 10 cm) than those in the Niedzica Limestone. From the weathered marly parts, the free *Saccocoma* particles together with holothurian sclerites *Theelia* sp. were separated also.

The upper part represents a wackestone with frequent *Calpionella alpina* Lorenz, less *Crassicollaria intermedia* (Durand Delga) (indicating Late Tithonian age), frequent calcified radiolarians, aptychus fragments and ostracodes. Rarely echinoid spines, gastropods fragments, planispiral foraminifers, juvenile ammonoids, some particles of crinoids and ophiurians can be found also. The stratigraphical range of this formation is Kimmeridgian to Late Tithonian.

Horné Srnie Limestone Member (new name)

It represents a massive 140 cm thick layer of pink micritic limestone. Skeletal debris and cross sections of ammonoids are visible macroscopically. In thin sections, frequent calcified radiolarians, less crinoidal fragments, bivalve shells, aptychi, bryozoan fragments (Trepostomata) and foraminifers e.g. *Lenticulina* sp. are present. Foraminifers *Globuligerina* sp. are relatively frequent in the limestone, which is atypical for this stratigraphical level (Pl. I: Fig. 6). Calpionellids *Calpionellopsis oblonga* (Cadisch), *Calpionellopsis simplex* (Colom), *Remaniella dadayi* (Knauer), *Tintinopsella longa* (Colom), *Tintinopsella carpathica* (Murgeanu & Filipescu) and rare *Calpionella alpina* Lorenz can be observed in thin sections also. This association indicates Berriasian to Early Valanginian age sensu Borza (1984). It ranks most probably to the Lysa Limestone Formation sensu Birkenmajer (1977) according to its stratigraphical position. No one from the members mentioned by Birkenmajer (l.c.) has the features characteristic for this member. According to the description, it is most similar to the Harbatova Limestone Member, which differs by the thin bedding.

Pieniny Limestone Formation

The 20 m thick formation of bedded white micritic limestone with black to brownish chert layers, to chert nodules in the upper part, represents the uppermost part of the described profile. It is disturbed by several small faults cutting the layers diagonally. The limestone is pure micrite with rare microfauna. At the base some calcified radiolarians, ostracodes, thin bivalve shells, rare crinoidal particles and foraminifers *Lenticulina* sp. are present. A rich radiolarian assemblage was extracted from the continuous chert layer about 2 m above the base (Pl. VI): *Acanthocircus dicranacanthos* (Squinabol), *A. trizonalis* (Rüst), *A. variabilis* Squinabol, *Acaeniotyle umbilicata* Foreman, *Alievium helenae* Schaaf, *Alievium* sp., ?*Angulobracchia* cf. *crassa* (Ožvoldová), *Cecrops septemporatus* (Parona), *Mesosaturnalis aculeatus* (Rüst), *M. hueyi* (Pessagno), *Mirifusus dianae* (Karrer) s.l., *Pantanellium lanceola* (Parona), *Parvicingula hsui* Pessagno, *Podobursa* aff. *triacantha* Foreman, *Praeconocaryomma prisca* Pessagno, *Pseudocrucella procera* Ožvoldová, *Thanarla conica* (Aliev), *T. pulchra* (Squinabol), *Neotripocyclia echiodes* (Foreman), *Tritrabs worzeli* (Pessagno).

The assemblage indicates a stratigraphical range from the Late Valanginian to Hauterivian (U.A. 14, Baumgartner 1984, 1987; Schaaf 1984). According to the occurrence of *Mirifusus dianae* Karrer s.l. and the absence of *Sethocapsa uterculus* (Parona), the lower part of this interval is supposed.

No calpionellids were found in the limestone; the only age proof is provided by *Colomisphaera* cf. *vogleri* (Borza) indicating the Hauterivian age. The upper part is almost sterile. It is formed

PLATE IV: Fig. 1 - *Parvicingula decora* (Pessagno & Whalen) - 0921, 300x magn., HS-6a; **Fig. 2** - *Parvicingula dhimenaensis* Baumgartner - 0924, 310x magn., HS-6a. **Fig. 3** - *Podobursa triacantha* (Fischli) - 1151, 160x magn., HS-6a; **Fig. 4** - *Globuligerina* sp. - 1156, 400x magn., HS-6a. **Fig. 5** - *Obesacapsula* sp.C - 0923, 320x magn., HS-6a. **Fig. 6** - *Napora deweveri* Baumgartner - 1170, 175x magn., HS-9b. **Fig. 7** - *Acanthocircus variabilis* (Squinabol) - 1157, 195x magn., HS-6a. **Fig. 8** - *Acaeniotyle diaphorogona* Foreman - 9572, 210x magn., HS-9b. **Fig. 9** - *Angulobracchia sicula* Kito & Dewever - 0911, 195x magn., HS-6a. **Fig. 10** - *Archaeospongoprunum imlayi* Pessagno - 1161, 195x magn., HS-9b. **Fig. 11** - *Tritrabs exotica* (Pessagno) - 1163, 130x magn., HS-9b. **Fig. 12** - *Tetratrabs bulbosa* Baumgartner - 1169, 90x magn., HS-9b. **Fig. 13** - *Homoeoparonella* sp. B - 1165, 140x magn., HS-9b. **Fig. 14** - *Emiluvia sedecimporata* (Rüst) - 1178, 170x magn., HS-9b. **Fig. 15** - *Tritrabs ewingi* (Pessagno) - 1172, 110x magn., HS-9b. **Fig. 16** - *Tritrabs rhododactylus* Baumgartner - 1182, 140x magn., HS-9b;

PLATE V: Fig. 1 - *Orbiculiforma catenaria* n.sp. - holotype 9569, 210x magn., HS-13b. **Fig. 2** - *Orbiculiforma catenaria* n.sp. - side view of Fig. 1, 9580, 170x magn., HS-13b. **Fig. 3** - *Tetratrabs* cf. *bulbosa* Baumgartner - side view of Fig. 5, 9541, 140x magn., HS-13b. **Fig. 4** - *Paronaella* cf. *bandyi* Pessagno - 9577, 145x magn., HS-13b. **Fig. 5** - *Tetratrabs* cf. *bulbosa* Baumgartner - 9537, 130x magn., HS-13b; **Fig. 6** - *Emiluvia orea* Baumgartner - 9280, 130x magn., HS-13b. **Fig. 7** - *Paronaella mulleri* Pessagno - 9545, 160x magn., HS-13b. **Fig. 8** - *Emiluvia pessagnoi* Foreman - 9582, 125x magn., HS-13b. **Fig. 9** - *Podobursa spinosa* Ožvoldová - 9590, 125x magn., HS-13b. **Fig. 10** - *Higumastra coronaria* Ožvoldová - 9271, 110x magn., HS-13b. **Fig. 11** - *Homoeoparonaella* sp. A - 9583, 115x magn., HS-13b. **Fig. 12** - *Emiluvia ordinaria* Ožvoldová - 9564, 145x magn., HS-13b. **Fig. 13** - *Paronaella pristidentata* Baumgartner - 9279, 160x magn., HS-13b. **Fig. 14** - *Pseudocrucella* cf. *procera* Ožvoldová - 9581, 160x magn., HS-13b. **Fig. 15** - *Parvicingula* aff. *hsui* Pessagno - 9584, 225x magn., HS-13b.

PLATE IV

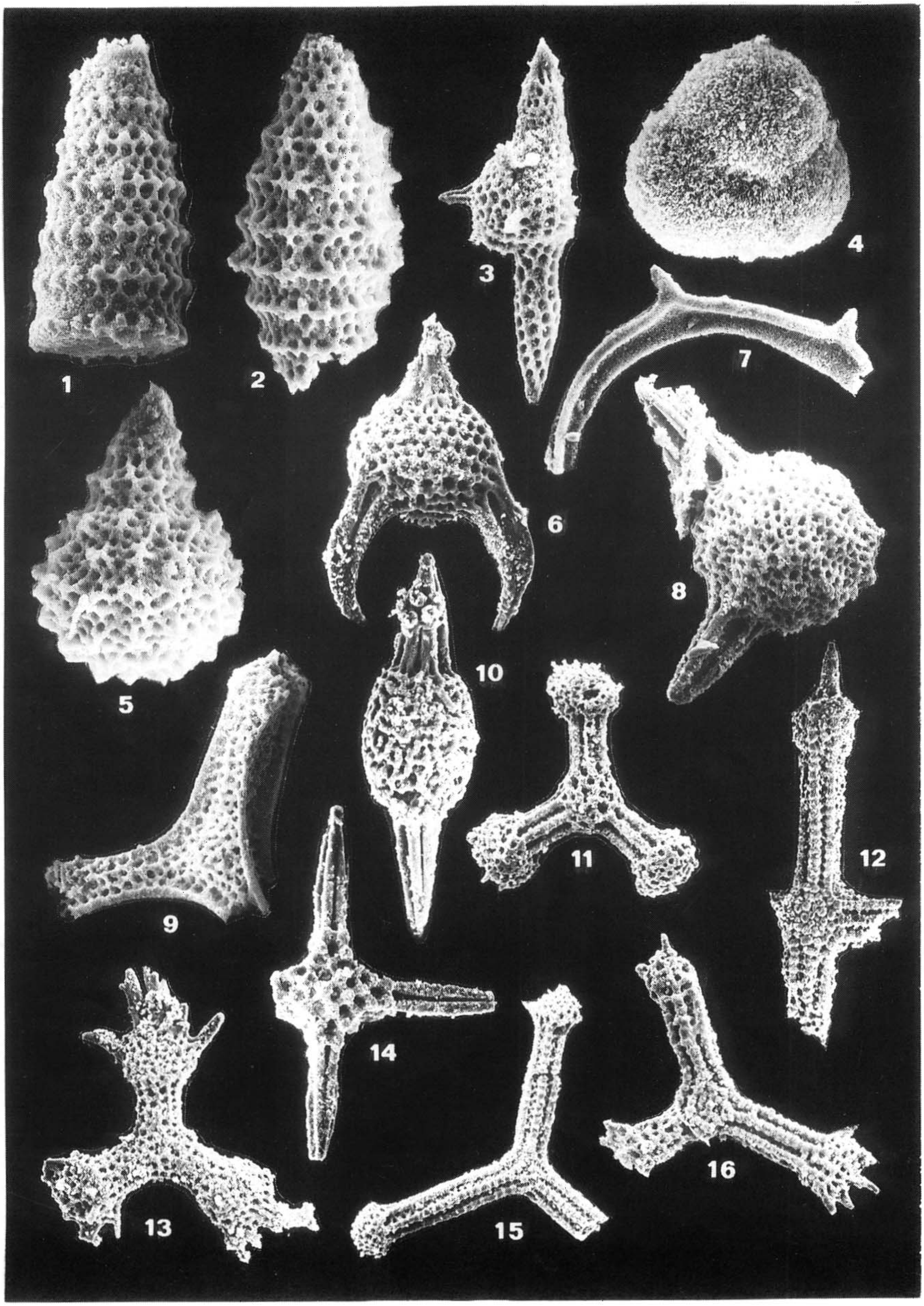


PLATE V.

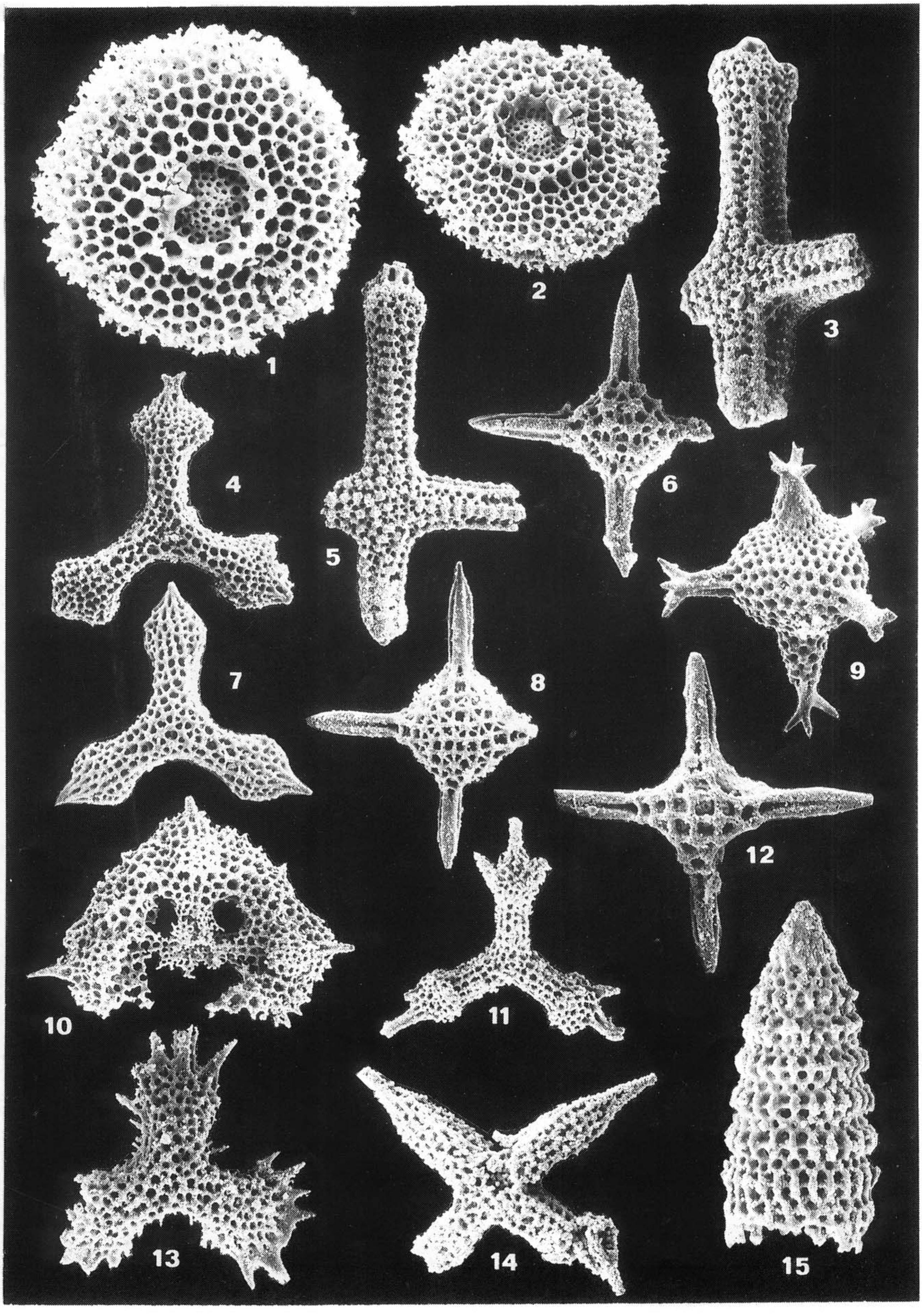
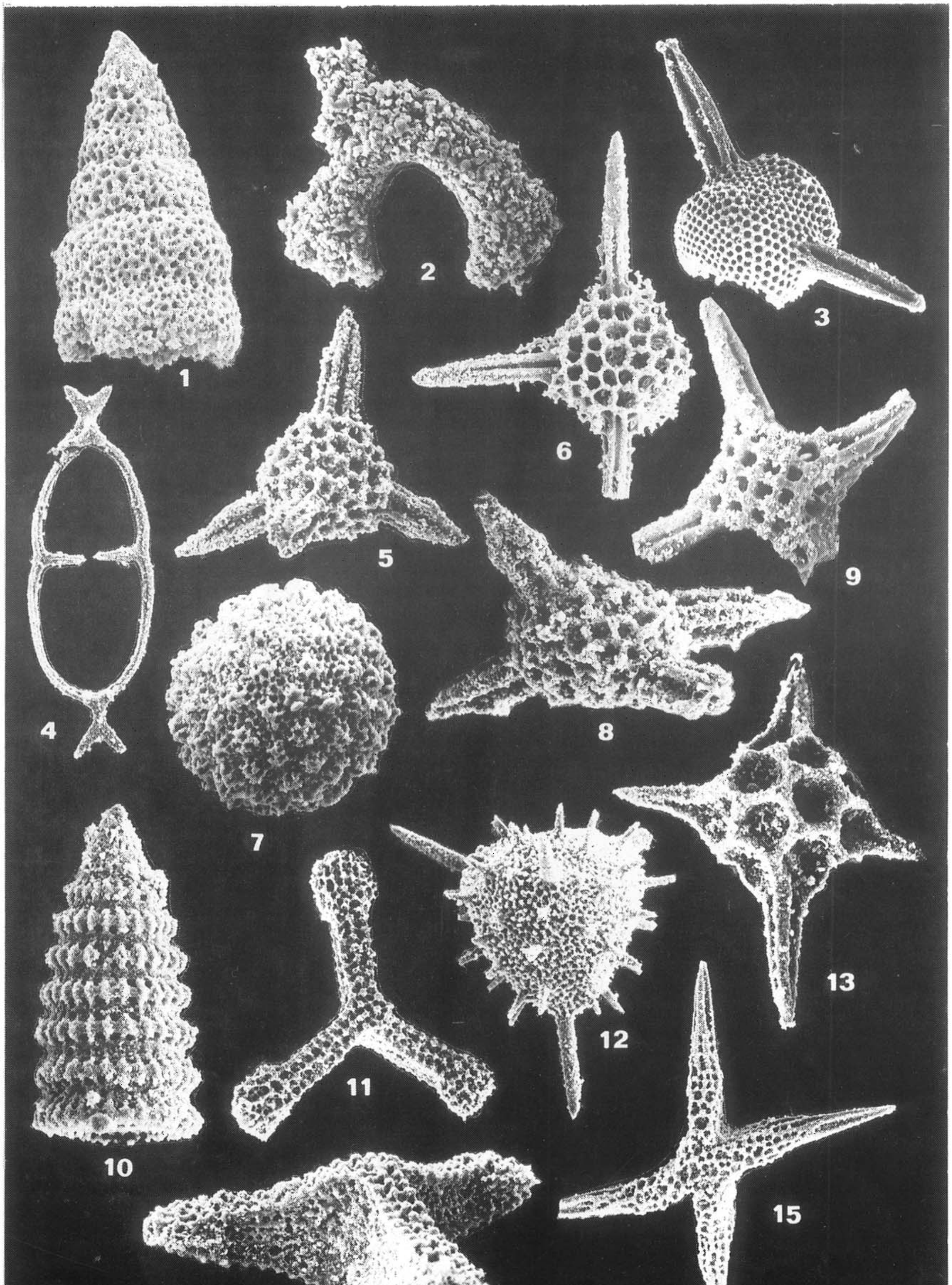


PLATE VI



by nanofossils *Nannoconus* sp. *Hedbergella* foraminifers are not present yet in this part, thus it can be ranked to Middle Hauterivian.

Gbelany Formation

This formation is in tectonic contact with the described sequence and represents its relatively soft envelope. It is formed by red marlstones, former known as the Púchov Marls. It contains numerous, but not diversified fauna of foraminifers *Globotruncana arca* (Cushman), *Heterohelix globulosa* (Ehrenberg), *Heterohelix ultimatumida* (White) and *Dorothia oxycona* (Reuss)(determined by J. Salaj - D. Štúr Geol. Inst.). The fauna indicates Early Campanian age.

Paleontological part

Genus: *Orbiculiforma* Pessagno, 1973
Typical species: *O. quadrata* Pessagno, 1973
Orbiculiforma catenaria Ožvoldová, n. sp.
Pl. V: Figs. 1, 2

Holotype: No. 9569, 9580 (Pl. V: Figs. 1, 2), deposited in the Slovak National Museum in Bratislava (SNM - Z-21170).

Type locality: Horné Srnie - Samášky, Biele Karpaty Mts.

Stratotype: radiolarites - Oxfordian

Denomination: lat. catenarius = chain; according to the chain of pores around the central cavity.

Description: Test is circular in outline. Central cavity form 1/4 of the test diameter. Meshwork of the test consists of large tetragonal to polygonal pore frames of unequal size. The margin of the central cavity is conspicuously raised. It is formed by a chain of large pores of oval to oblong shape. The central cavity is finely porous. Its centre is slightly raised.

Dimensions:	Holotype	Min.	Max.
Width of the test	0.270	0.230	0.310
Width of central cavity	0.065	0.050	0.080

Conclusions

The described profile confirmed the transitional character of the Pruské Unit already in Bajocian-Bathonian time. The Samášky Formation is a transitional link between the Smolegowa and Krupianka Limestone Formations sedimented on the elevated shelf area of the Czorsztyn Unit and Flaki Limestone Formation from deeper-water Kysuca and Pieniny Units representing the distal parts of the crinoidal turbidites (Fig. 3). A relatively uniform pre-Bajocian sedimentary area was differentiated due to the tectonic tilting probably caused by an advanced opening of Penninic ocean. The Czorsztyn and Pruské Units were divided by the tectonic escarpment, which together with an eustatic sea-level drop in Late Aalenian, provided the main control of facial development in the Pieninic units.

On the base of micropaleontological study in the examined locality, the radiolarite sedimentation begins earlier than in the Niedzica Unit in Poland. However, it is in accordance with its diachronic character expressed by the Polish authors (Birkenmajer 1977; Widz 1991, 1992).

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PLATE VI: Fig. 1 - *Spongocapsula* cf. *perampla* (Rüst) - 9561, 195x magn., HS-13b. **Fig. 2** - *Foremanella diamphidia* (Foreman) - 1195, 235x magn., HS-12b. **Fig. 3** - *Neotripocyclia echiodes* (Foreman) - 0205, 145x magn., HS-3. **Fig. 4** - *Acanthocircus dicranacanthos* (Squinabol) - 2775, 90x magn., HS-19c. **Fig. 5** - Gen. et sp. indet. - 1188, 160x magn., HS-12b. **Fig. 6** - *Staurosphaera antiqua* Rüst 9266, 115x magn., HS-13. **Fig. 7** - *Praeconocaryomma prisca* Pessagno - 2755, 195x magn., HS-19c. **Fig. 8** - Gen. et sp. indet. - lateral view of Fig. 5, 1189, 220x magn., HS-12b. **Fig. 9** - *Emiluvia sedecimporata* (Rüst) - 9552, 170x magn., HS-13b. **Fig. 10** - *Parvicingula hsui* Pessagno - 2784, 235x magn., HS-19c. **Fig. 11** - ?*Angulobracchia* cf. *crassa* (Ožvoldová) - 2777, 125x magn., HS-19c. **Fig. 12** - *Alievium* sp. - 2758, 140x magn., HS-19c. **Fig. 13** - *Cecrops septemporatus* (Parona) - 2767, 225x magn., HS-19c. **Fig. 14** - ?*Angulobracchia* cf. *crassa* (Ožvoldová) - lateral view of Fig. 11, 2779, 160x magn., HS-19c. **Fig. 15** - *Pseudocrucella procera* Ožvoldová - 2757, 115x magn., HS-19c.

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