SBORNÍK GEOLOGICKÝCH VĚD
JOURNAL OF GEOLOGICAL SCIENCES

paleontologie

palaeontology

31

Publikace Ústředního ústavu geologického,
nositele Řádu republiky a Řádu práce

Vědecký redaktor

RNDr. IVO CHLUPÁČ, CSc.

Diskuse o pracích se konala
na poradním sboru vědeckého redaktora dne 15. února 1989

ISBN 80-7075-010-3

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VYDAL ÚSTŘEDNÍ ÚSTAV GEOLOGICKÝ
PRAHA 1990

OBSAH

Sbor. geol. věd	Paleontologie, 31	Pages 9—65	3 figs.	— tab.	12 pls.	Praha 1990 ISSN 0036-5297

Calcareous nannoplankton in flysch sediments of the Bílé Karpaty Unit (the West Carpathians)

Vápnitý nanoplankton ve flyšových sedimentech bělokarpatské jednotky (Západní Karpaty)

Lilian Švábenická[1]

Received July 25, 1988

1 : 50 000
25-34, 41, 43, 44
34-24
35-11, 12, 13, 14, 21

Calcareous nannoplankton
Taxonomy
Biostratigraphy
Upper Cretaceous
Paleocene
Lower Eocene
Magura Formation
Flysch Carpathians

Švábenická, L. (1990): Calcareous nannoplankton in flysch sediments of the Bílé Karpaty Unit (the West Carpathians). — Sbor. geol. Věd, Paleont., 31, *9—65*. Praha.

Abstract: Flysch sediments of the outer development of the Bílé Karpaty Unit (Javorina and Svodnice Formations — sensu Stráník et al. 1986) contain calcareous nannofossils which can be used for determination of the relative age of the rocks within stage to zone precision. In the Javorina Formation (Campanian—Maastrichtian) seven nannoplankton zones were delimited; they are partially identical with CC Zones (Sissingh 1977). In the Paleogene classical Martini's (1971) zonation could be used in the range of NP1—2 through NP11 Zones (lower Paleocene through lower part of the lower Eocene). The work gives definitions of determined nannoplankton zones in the Cretaceous and a systematic overview of the Cretaceous and Paleogene species of calcareous nannoplankton (including illustrations) in the Bílé Karpaty Unit.

[1] *Ústřední ústav geologický, Malostranské nám. 19, 118 21 Praha 1*

Introduction

The basic study of geological structure of the Bílé Karpaty Unit (Flysch Carpathians) was published by Matějka and Roth with a microbiostratigraphic passage by Hanzlíková in 1956. On the basis of facial changes two lithostratigraphic units were defined from the bottom to the top: 1. lower section of the Paleogene represented namely by variegated beds; 2. upper section of the Paleogene formed by flysch beds with noncalcareous claystones and flysch beds with calcareous claystones.

In the following years the paleontologic research in this area was reduced only to single papers. Hanzlíková (1980) made a revision of sediments of the Bílé Karpaty Unit in the basement of the Vienna Basin. She called attention to a possible flysch development already in the Senonian. Foraminiferal assemblages showed no calcareous specimens and the biostratigraphic determination had to be based on the associations of sandy benthic forms only. From the borehole Hluk V-3 situated in the western part of the Bílé Karpaty Unit microfauna was described by Hanzlíková (1984a) and nannoplankton from identical samples by Švábenická (1985). Both methods established sediments of the lower, middle and upper Eocene, foraminifers indicated even the lower Oligocene. Hanzlíková proposed to define the deep red-brown noncalcareous claystones with *Uvigerinammina jankoi* Majzon as a new lithostratigraphic member — the Gbely Member. Hanzlíková (1984b) also devised an orientational microbiostratigraphic correlation for the study of geotraverses in the Púchov area. The concept of the Bílé Karpaty Unit structure in Stráník et al. (1986) is based on the classical division of Matějka and Roth (1956). However, Stráník et al. proposed several changes in the upper part of the Paleogene.

In this paper, the biostratigraphy of the Bílé Karpaty Unit (Javorina and Svodnice Formations) was studied using two micropaleontologic methods; the classical one, based on foraminifers, and a new one, based on calcareous nannoplankton. Both methods complemented each other and provided interesting comparison and mutual checking.

The nannoplankton corpuscles were determined in all calcareous sediments of the flysch and variegated development. The nannofossil assemblages usually showed greater species diversity and contained markers permitting to determine the age of the sediments within stages to zones precision.

This article deals with calcareous nannoplankton including its taxonomic review in the flysch sediments of the outer development of the Bílé Karpaty Unit (sensu Stráník et al. 1986). The presence of turbidites is typical of flysch sediments and determination of their relative age has been rather problematic. Individual intervals of flysch rhythms show a poor fossil record. We presume that in turbidite all material is redeposited. In the pelagic interval T_e (sensu Bouma 1962) the fossils are considered an autochthonous component. This paper discusses the problem whether calcareous nannofossils in flysch sediments are an autochthonous component or merely a redeposited material and whether the nannoplankton zonation can be used for determining the relative age of the flysch sediments in the Outer Carpathians.

The sediments exhibited prevailingly or only agglutinated foraminifers and calcareous nannofossils. The species composition of agglutinated foraminifers usually indicated a broader stratigraphical range — the upper Senonian—Paleocene. Unfortunately, these assemblages lacked species (e.g. representatives of the species *Rzehakina* are very rare), which would help to determine the age of the sediments more precisely. Calcareous nannoplankton permitted to state more closely the relative age. However, we do not know yet the degree of autochthonism of nannofossils in the flysch sediments. Samples were taken predominantly from the thin T_{et-p} layers (Weidmann 1967) — from calcareous pelagites which probably were not yet products of pure quiescent sedimentation. In this rhythm phase the finest corpuscles of turbidite were probably deposited exhibiting also tiny particles of redeposited nannofossils. Simultaneously, sedimentation of autochthonous material occurred. For comparison of the assemblage contents samples from turbidite phases of flysch rhythms were taken in selected localities. They contain nannofossil taphocenoses of species similar to those of the T_{et-p} pelagites. In my opinion, the sedimentation of the material on the continental shelf and its resedimentation in the deep-sea environment took place within a relatively short time-span, maximally in the framework of one nannoplankton zone. The taphocenoses exhibited clearly redeposited nannofossils from earlier stages or formations and the stratigraphically "youngest" corpuscles which documented the sedimentation age of even turbidites on the continental shelf and thus could be considered an isochronous component of the sediment (turbidite).

The sediments were chip-sampled during mapping tours from brook beds, road cuts, abandoned quarries, etc.

Calcareous nannoplankton from sediments of the outer development of the Bílé Karpaty Unit

The Javorina Formation

Stráník et al. (1986) defined a new lithostratigraphic member — the Javorina Formation — in the Vlára development of the Bílé Karpaty Unit. It is a complex of small to medium-scale rhythmic flysch sediments with green-grey to grey claystones, usually noncalcareous and variably psammitic. They contain poor, badly preserved and stratigraphically inconclusive, usually agglutinated foraminifers and calcareous nannofossils.

The sediments of the Javorina Formation show features of "classical turbidites" which are typical of the lower part of the alluvial fan abutting on the basin plain.

Stráník et al. (1986) ranges the whole complex of the Javorina Formation with the lower Paleocene. The authors explain the presence of solely Cretaceous assemblages of calcareous nannofossils in these sediments by mass redeposition into younger stages probably without development of autochthonous nannoflora.

This opinion was not confirmed by the results of nannoplankton and microfauna research in the Javorina Formation. The sediments contained relatively rich assemblages of calcareous nannofossils of Campanian—Maastrichtian age (Zones CC18—CC26 sensu Sissingh 1977) without any Paleogene indications and agglutinated foraminifers of a broader stratigraphic range the Upper Cretaceous—Paleocene. Provided that all the material of the Javorina Formation Cretaceous was redeposited into the Paleogene we should answer several questions: Why the nannofossil assemblage contains solely corpuscles unequivocally determining a relatively narrow stratigraphic range of e.g. the Campanian?; why these "redeposited" associations do not contain also younger particles of the Maastrichtian? The Maastrichtian was established in the sediments of the Bílé Karpaty Unit in many localities of the variegated and flysch development. The Campanian and Maastrichtian species are commonly found as redeposited material in the Paleocene and lower Eocene assemblages of the Svodnice Formation.

Corpuscles of the calcareous nannoplankton deposited relatively slowly in quiescent environment. For a long time they were floating in a suspension with fine dust, clay and autochthonous withered organic material and together they sank to the bottom. The nannoplankton corpuscles are small (2—30 μm) and exhibit usually flat, disc-shaped outline. Calcareous nannoplankton remains longer in suspension compared with foraminiferal tests.

Redeposited nannofossils were partially protected from acidity and other adverse effects of the environment by clay minerals. Autochthonous withered coccospheres were coated with gelatine substance which for a certain period preserved the corpuscles from impairment even in great depths within CCD. Schlanger et al. (1973) studied diagenetic processes resulting from $CaCO_3$ dissolution and its secondary recrystallization. They discovered that the coccolith bodies do not dissolve entirely below the carbonate level of compensation. The authors explain this nannofossil resistance by the presence of protein mucous membrane of the primary living organism which covers calcite elements and preserves them against agresivity of the environment. Another protection of the nannofossil corpuscles in the water column below the CCD level against the adverse effects of the environment is the rain of fecal pellets containing calcareous corpuscles of nannofossils in the form of undigested remnants (Honjo 1976). These pellets are produced by zooplankton which feeds on fytoplankton. The protective role of the pellets in acid environment was verified also by laboratory methods.

When simultaneously studying foraminifers and nannoplankton in the flysch sediments we came across a conspicuous feature; the same sample exhibited a relatively rich assemblage of calcareous nannofossils while microfauna contained only agglutinated foraminifers devoid of calcareous elements. This phenomenon is typical of the sediments of the Javorina Formation. The presence of nannofossils in deep-water sediments testifies rather of corpuscle redeposition than of the material autochthony. Schlanger et al. (1973) found stratigraphic intervals completely devoid of withered calcareous foraminiferal assemblages but exhibiting nannofossils in the northern Pacific Ocean. They presume that the calcite originally contained in the foraminiferal tests dissolved and recrystallized either as micrite or deposited on skeletal remains of coccoliths, or formed an interspace mass of the sediment.

The Svodnice Formation

The flysch sediments with calcareous claystones similar to the Vsetín type of the Zlín Formation and marls of the Lacko type of Paleocene—lower Eocene age are stratigraphically the highest member of the Bílé Karpaty Unit. This complex of sediments was named the Svodnice Formation by Pesl (1968).

Compared with the Javorina Formation the sediments of the Svodnice Formation show a different development of microfauna and calcareous nannoplankton. Beside associations of agglutinated foraminifers the microfauna contained frequently also calcareous plankton and benthos. This calcareous component of foraminifers corroborated a similar relative age of the sediments as did calcareous nannofossils.

Calcareous nannoplankton indicates the age of the Svodnice Formation ranging between the Paleocene—lower Eocene. Nannofossil assemblages contain index species of standard nannoplankton zones sensu Martini (1971).

According to the nannoplankton research we may presume in the Svodnice Formation almost continuous sedimentation without significant interruption from the lower Paleocene to the lower Eocene. Rich redepositions from the Upper Cretaceous (predominantly the Campanian and Maastrichtian as well as earlier stages) are typical of these Paleogene nannofossil assemblages. It is interesting that the associations of the upper Paleocene very rarely exhibit nannofossils redeposited from the lower Paleocene, and also the lower Eocene shows abundant redepositions from the Upper Cretaceous while the species redeposited in the Paleocene almost do not occur in these taphocenoses.

In the Svodnice Formation the dependence of the nannoflora and microfauna assemblage composition on individual flysch rhythms was detailedly studied. For example in the abandoned stone quarry Modrá Voda the sediments exhibited nannofossil assemblages with a higher species diversity of upper Paleocene age (NP7 — horizon with frequent *Scapholithus fossilis*). Calcareous nannoplankton of the Paleocene may be considered an isochronous component of the sediment. The microfauna is predominantly agglutinated, with species of a broader stratigraphic range. The rare finding of *Globigerina triloculinoides* Plummer confirms this stratigraphical range. It was interesting to observe how the fossil record changed in dependence on the character of the turbidite interval. In the hemipelagite deposit T_{et} only calcareous nannoplankton was found. The washing residue contained worked up fragments of brick-red claystones which could be explained as redeposited material from the variegated strata of the Cretaceous accounting also for the presence of redeposited nannofossil corpuscles of Campanian—Maastrichtian age. The calcareous claystone — pelagite deposit T_{et-p} contained poor assemblage of nannofossils in which only species with "massive" corpuscle construction were preserved since they were more resistant against dissolving and other adverse effects of the paleoenvironment. Conversely, the microfauna was richer in this sample. Agglutinated foraminifers with rare *Rzehakina complanata* (Grzyb.) and *Matanzia varians* (Glaessner) predominated. Tiny specimens of *Globigerina triloculinoides* Plummer (P1—P4 Biochrone; the lower part of the P4 Zone can be correlated with the NP7 Zone sensu Bolli et al. 1985) formed a significant component in the sample.

Summary

Detailed research into the dependence of species composition on nannofossil taphocenoses and foraminifers on the genesis of individual flysch rhythm intervals revealed that the calcareous nannofossils and microfauna complemented each other. Calcareous nannofossils were absent only in the noncalcareous pelagites T_{ep} (sensu Weidmann 1967) which originated in deep-water environment below the carbonate

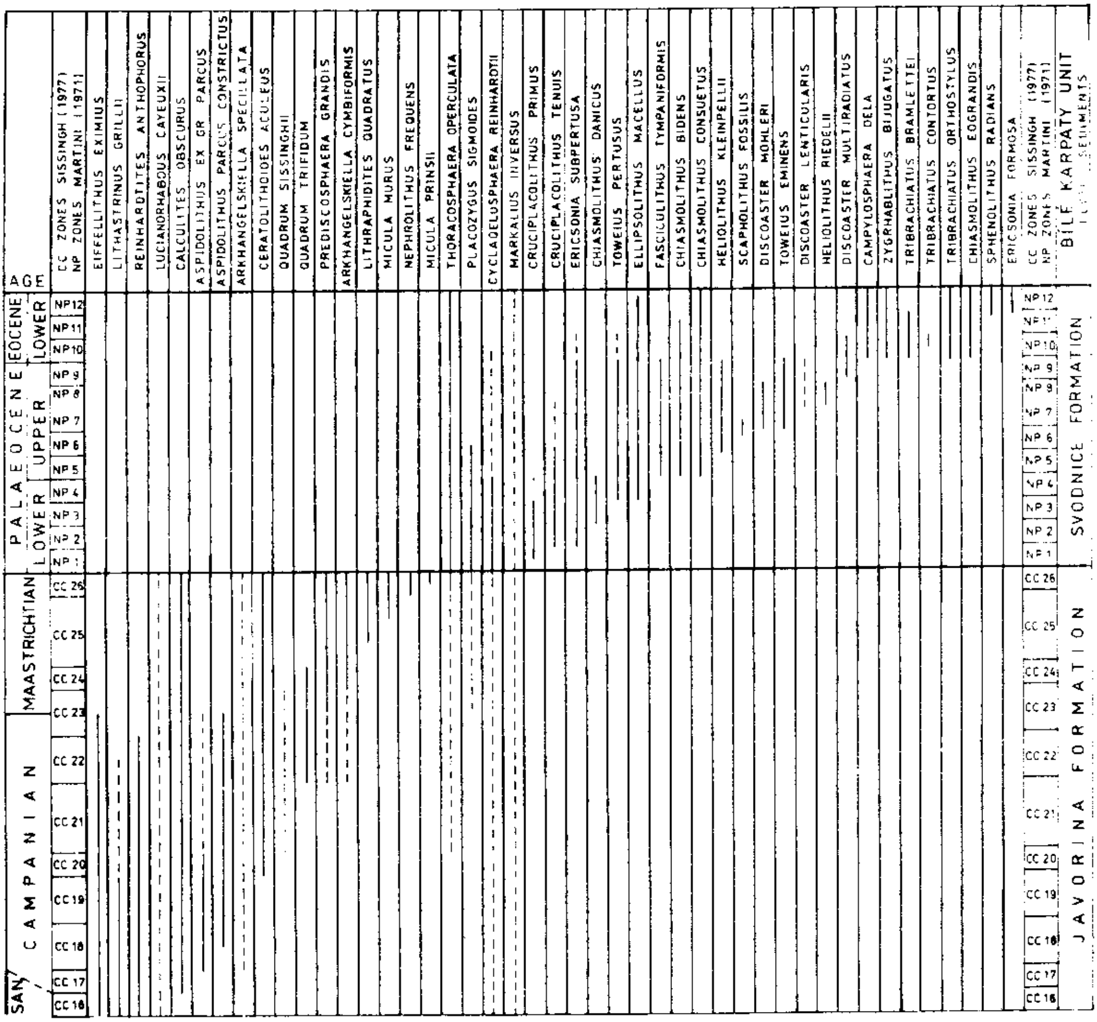
compensation level during the period of quiescent sedimentation. These sediments exhibit relatively rich assemblages of agglutinated foraminifers with a higher species diversity and a broader stratigraphic range, and very rarely plankton.

Calcareous nannofossils are found in a) calcareous as well as in weakly calcareous turbidite sediments of flysch sedimentation in the T_d intervals, where redeposited material should be rightly presumed, b) calcareous claystones of the quiescent phase of the T_e flysch rhythm sedimentation in which a long-term deposition of pelagic material is assumed. The species composition of nannofossil taphocenosis showed that in these pelagites redeposited particles as well as autochthonous and/or isochronous material accumulated. It has been documented that the stratigraphically youngest components of calcareous nannofossil taphocenosis deposited already in the finest phase of the turbidite rhythm — in clayey calcareous siltstone T_d and that it was in isochronous component of genetically complicated flysch sedimentation.

Nannoplankton zones of the flysch sediments of the Bílé Karpaty Unit

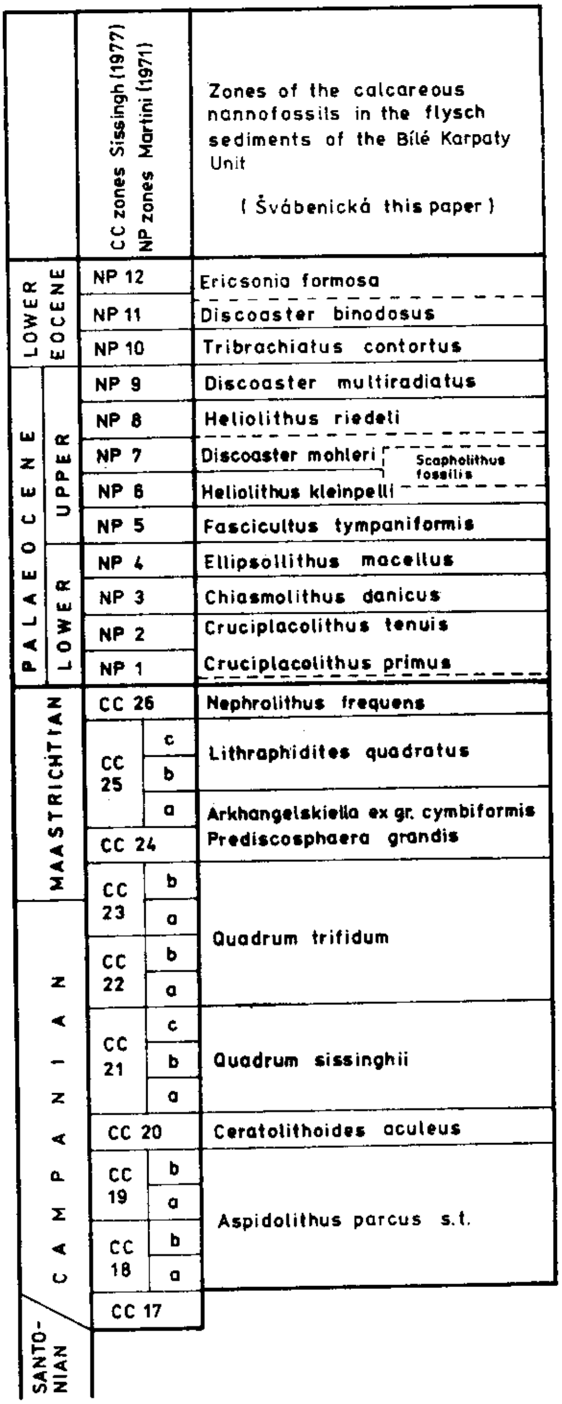
The sediments of the Bílé Karpaty Unit are relatively rich in associations of calcareous nannofossils with index species according to which samples can be ranged with nannoplankton zones permitting to determine more closely the relative age of the rocks (see text-fig. 1).

In the Upper Cretaceous (Campanian—Maastrichtian) there developed taphocenoses of calcareous nannoplankton with a higher species diversity. "Running species" which start in the Lower Cretaceous or in the lower part of the Upper Cretaceous and die out at the Cretaceous/Tertiary boundary, predominate. It has been found out during sample studies that some stratigraphically important nannofossils did not occur in associations and thus it was not possible to use standard CC Zones (sensu Sissingh 1977). In the Bílé Karpaty Unit and Javorina Formation seven nannoplankton zones (see text-fig. 2) were delimited within the range of the Campanian—Maastrichtian. The lower biozone boundaries are defined by the first occurrence of a nominal species. Sissingh (1977) gives nine CC zones in the identical stratigraphic interval. The development of calcareous nannofossil assemblages and their phyllogenic link-up excludes the possibility of the absence of certain zones due to a longer discontinuation of the sedimentation. Some species are absent probably due to specific paleoecologic and paleogeographic conditions in the sedimentary basin.



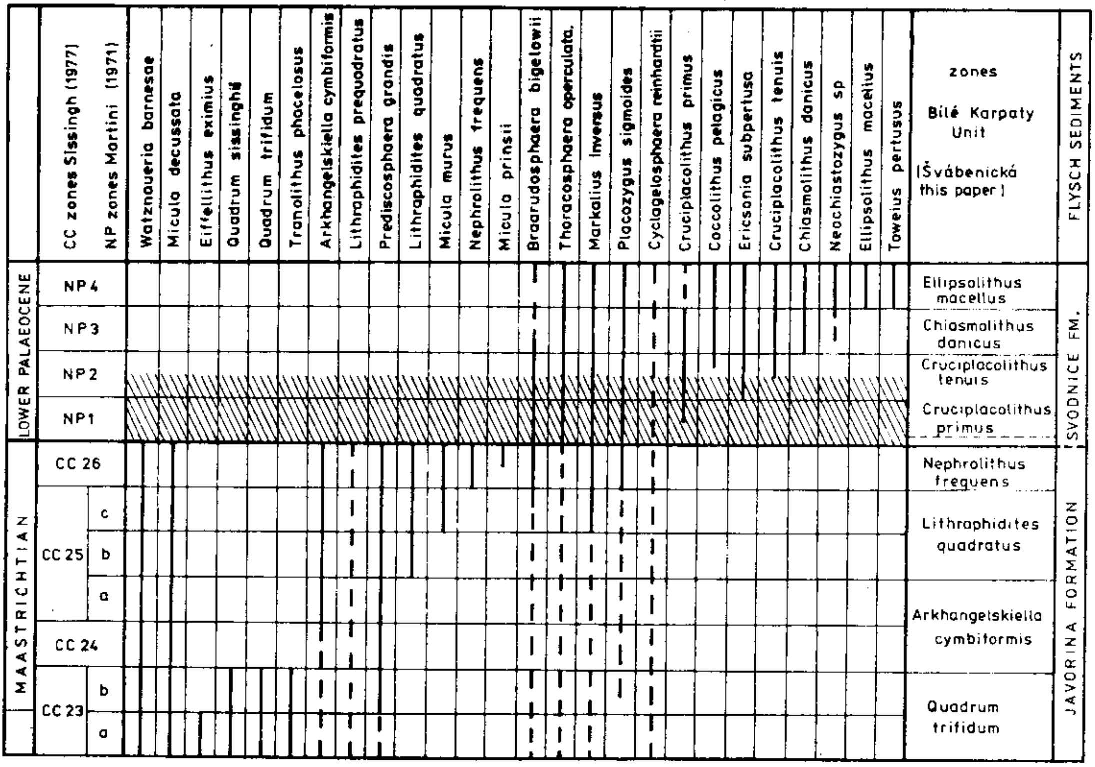
1. Distribution of stratigraphically important calcareous nannofossil species in the sediments of the Bílé Karpaty Unit

In the Paleogene of the Svodnice Formation a gradual qualitative and quantitative evolution of calcareous nannofossil assemblages from the lower Paleocene to the lower Eocene within the Zones NP1—NP2 through NP11 (sensu Martini 1971), took place. Nannofossil associations precisely identical with the NP1 Zone, with mass occurrence of *Markalius inversus* and *Thoracosphaera* sp. (sensu Gašparíková



		CC zones Sissingh (1977) NP zones Martini (1971)		Zones of the calcareous nannofossils in the flysch sediments of the Bílé Karpaty Unit (Švábenická this paper)
LOWER	EOCENE	NP 12		Ericsonia formosa
		NP 11		Discoaster binodosus
		NP 10		Tribrachiatus contortus
PALAEOCENE	UPPER	NP 9		Discoaster multiradiatus
		NP 8		Heliolithus riedeli
		NP 7		Discoaster mohleri Scapholithus fossilis
		NP 6		Heliolithus kleinpelli
		NP 5		Fasciculitus tympaniformis
	LOWER	NP 4		Ellipsolithus macellus
		NP 3		Chiasmolithus danicus
		NP 2		Cruciplacolithus tenuis
		NP 1		Cruciplacolithus primus
MAASTRICHTIAN		CC 26		Nephrolithus frequens
		CC 25	c	Lithraphidites quadratus
			b	
			a	Arkhangelskiella ex gr. cymbiformis Prediscosphaera grandis
		CC 24		
		CC 23	b	Quadrum trifidum
CAMPANIAN			a	
		CC 22	b	
			a	
		CC 21	c	Quadrum sissinghii
			b	
			a	
		CC 20		Ceratolithoides aculeus
		CC 19	b	Aspidolithus parcus s.t.
			a	
		CC 18	b	
			a	
		CC 17		
SANTONIAN				

2. Calcareous nannofossil zones in the flysch sediments of the Bílé Kapaty Unit



3. Distribution of calcareous nannofossils on the Cretaceous-Tertiary boundary in the sediments of the Bílé Karpaty Unit

in Salaj et al. 1978) have not been found yet in the sediments of the Bílé Karpaty Unit.

According to the micropaleontologic data from the sediments of the outer development of the Bílé Karpaty Unit we may expect flysch sedimentation without significant interruption at the Cretaceous/Tertiary boundary. *Lithraphidites quadratus* of the CC25b Zone and *Nephrolithus frequens* of the CC26 Zone (sensu Sissingh 1977) were documented from the upper Maastrichtian and already in the lower Paleocene the Zones NP1—NP2 and NP3 with *Cruciplacolithus primus* (large and small form), *C. tenuis,* abundant occurrence of *Thoracosphaera operculata, Markalius inversus, Ericsonia subpertusa,* etc. — see text-fig. 3 — were found.

In the Bílé Karpaty Unit the species *Braarudosphaera bigelowii, Markalius inversus, Thoracosphaera operculata, Placozygus sigmoides* and *Cyclagelosphaera reinhardtii* (text-fig. 2) pass from the Cretaceous into the Tertiary.

Nannoplankton zones of the Cretaceous in the Javorina Formation

Aspidolithus parcus Biozone

In the Bílé Karpaty Unit the Aspidolithus parcus Zone can be presented as the zone of a partial extent of the taxon from the first occurrence of *Aspidolithus* ex gr.*parcus* (Stradner) Noel to the first occurrence of *Ceratolithoides aculeus* (Stradner) Prins and Sissingh.

Discussion: Sissingh (1977) introduced two zones in the lower Campanian: CC18 Aspidolithus parcus and CC19 Calculites ovalis. The boundary between these two zones is defined by the last occurrence of *Marthasterites furcatus*. Roth (1978) and Doeven (1983) define only the Zone Broinsonia parca in the lower Campanian, from the first occurrence of *Broinsonia parca* (synonym of *Aspidolithus parcus*) up to the first occurrence of *Ceratolithoides aculeus*. According to Perch-Nielsen (*in* Bolli et al. 1985) the interval in which *Aspidolithus parcus* occurs together with *Marthasterites furcatus* is short and frequently even absent.

In the sediments of the Bílé Karpaty Unit only single specimens of *Marthasterites furcatus* were found, mostly as an element redeposited into the Paleogene. For this reason the last occurrence of *Marthasterites furcatus* cannot be used for the boundary of the CC18/CC19 Zones and thus for delimiting the CC19 Zone Calculites ovalis.

In the Czechoslovak Carpathians, Broinsonia parca Biozone was delimited by Gašpariková (*in* Andrusov - Samuel 1983) and correlated with the foraminiferal zone of *Globotruncana arca* (lower Campanian) in the Čorštýn Unit of the Klippen Belt, in the Manín "series" and Myjavská pahorkatina hills.

Ceratolithoides aculeus Biozone

Definition: The interval from the first occurrence of *Ceratolithoides aculeus* (Stradner) Prins and Sissingh to the first occurrence of *Quadrum sissinghii* Perch-Nielsen.

Authors: Čepek - Hay (1969), emend. Martini (1976), nom. corr. Perch-Nielsen.

Age: Upper part of the lower Campanian.

Remark: In the Bílé Karpaty Unit this biozone is widespread in the flysch development of the Javorina Formation and in variegated beds. From this zone comes the first occurrence of *Placozygus sigmoides* which passes from the Cretaceous to the Tertiary in the sediments of the Bílé Karpaty Unit.

In the Czechoslovak Carpathians the Tetralithus aculeus Zone (synonym of *Ceratolithoides aculeus*) is described from the Čorštýn Unit of the Klippen Belt and from the Myjavská pahorkatina hills and correlated with the foraminiferal zone of *Globotruncana rugosa.* Its basement is formed by the Broinsonia parca Zone and overlying strata by the Lithraphidites quadratus Zone (Gašparíková *in* Andrusov - Samuel 1983).

Quadrum sissinghii Biozone

Definition: The interval from the first occurrence of *Quadrum sissinghii* Perch-Nielsen [synonym of *Quadrum nitidum* (Martini) Prins and Perch-Nielsen] to the first occurrence of *Quadrum trifidum* (Stradner) Prins and Perch-Nielsen.

Authors: Sissingh (1977), nom. corr. Perch-Nielsen (*in* Bolli et al. 1985).

Age: Lower part of the upper Campanian.

Remark: Sissingh used the stratigraphic range of *Ceratolithoides arcuatus* Prins and Sissingh for dividing the Quadrum sissinghii Zone into three subzones. However, in the sediments of the Bílé Karpaty Unit this species was not found.

Up to the present, this biozone has not been reported from the Czechoslovak Carpathians.

Quadrum trifidum Biozone

In the Bílé Karpaty Unit this zone is comprehended as the zone of a complete range of the taxon with stratigraphic age from the upper part of the upper Campanian through the lower part of the lower Maastrichtian.

Discussion: Sissingh (1977) determined two zones in the interval of the upper part of the upper Campanian through the lower part of the lower Maastrichtian: CC22 Quadrum trifidum and CC23 Tranolithus phacelosus. He defined the boundary of these zones by the last accurrence of *Reinhardtites anthophorus.* The upper part of the CC23 Zone is delimited by the last occurrence of *Tranolithus phacelosus.* Since *Reinhardtites anthophorus* occurs irregularly in the Campanian nannofossil assemblages of the sediments of the Bílé Karpaty Unit, its last occurrence is not suitable for delimiting the boundary of the CC22/CC23 Zones.

According to Perch-Nielsen (*in* Bolli et al. 1935) the last occurrence of the species *Quadrum sissinghii* and *Quadrum trifidum* is identical with the last occurrence of stratigraphically common marker *Tranolithus phacelosus* (sensu Sissingh 1977). Both representatives of the genus *Quadrum* form a conspicuous horizon in the sediments of the Bílé Karpaty Unit. Therefore it is advantageous to use besides *Tranolithus phacelosus* also the last occurrence of *Quadrum sissinghii* and *Quadrum trifidum* for stratigraphic division of these sediments.

The Tetralithus trifidus Zone is reported by Gašpariková (1984) from the lower Maastrichtian of the Czechoslovak Carpathians and it is correlated with the foraminiferal zone of *Globotruncana falsostuarti.*

Arkhangelskiella cymbiformis Biozone

In the Bílé Karpaty Unit the Arkhangelskiella cymbiformis Biozone represents an interval zone from the last occurrence of *Quadrum sissinghii* Perch-Nielsen and *Quadrum trifidum* (Stradner) Prins and Perch-Nielsen to the first occurrence of *Lithraphidites quadratus* Bramlette and Martini.

Disucussion: The CC24 Reinhardtites levis Biozone (sensu Sissingh 1977) defined as the interval from the last occurrence of *Tranolithus phacelosus* to the last occurrence of *Reinhardtites levis* cannot be used in the sediments of the Bílé Karpaty Unit. According to Perch-Nielsen (*in* Bolli et al. 1985) the last occurrence of *Tranolithus phacelosus* is roughly identical with the last occurrence of *Quadrum sissinghii* and *Q. trifidum.* A typical *Reinhardtites levis* was not determined under light microscope.

Perch-Nielsen (1972) emend. Sissingh (1977) defined the CC25 Arkhangelskiella cymbiformis Zone as the interval from the last occurrence of *Reinhardtites levis* to the first occurrence of *Nephrolithus frequens.* The CC24 and CC25 Zones are unfit for zoning of the lower Maastrichtian sediments of the Bílé Karpaty Unit.

Remark: The assemblages of the Arkhangelskiella cymbiformis Zone of the Bílé Karpaty Unit sediments rarely exhibit *Prediscosphaera grandis* Perch-Nielsen and very rarely *Lithraphidites praequadratus* Roth. In this zone *Microrhabdulus decoratus* is relatively abundant and the species *Eiffellithus eximius, Tranolithus phacelosus, Quadrum sissinghii* and *Q. trifidum* are already absent.

This zone has not been reported yet from the Czechoslovak Carpathians.

Lithraphidites quadratus Biozone

In the Bílé Karpaty Unit the Lithraphidites quadratus Zone can be defined as the zone of a partial taxon range from the first occurrence of *Lithraphidites quadratus* Bramlette and Martini to the first occurrence of *Nephrolithus frequens* Górka. In the upper part of the Lithraphidites quadratus Zone the Subzone Micula murus can be delimited from the first occurrence of *Micula murus* (Martini) Bukry to the first occurrence of *Nephrolithus frequens* Górka.

Discussion: In the upper Maastrichtian Sissingh (1997) defines the interval from the first occurrence of *Lithraphidites quadratus* to the first occurrence of *Micula murus* as the Subzone b of the interval Zone CC25 Arkhangelskiella cymbiformis. The onset of the taxon *Lithraphidites quadratus* is conspicuous in the Bílé Karpaty Unit. *Micula murus* is rare in the sediments, however also this species can be employed for a detailed stratigraphic division in the upper Maastrichtian.

In the Czechoslovak Carpathians the Lithraphidites quadratus Biozone was described by Gašpariková from the Klippen Belt of the Čorštýn Unit and from the Manín "series" and correlated with the foraminiferal zone of *Racemiguembelina varians* s.l. (Gašpariková 1984).

Nephrolithus frequens Biozone

Definition: The interval from the first to the last occurrence of *Nephrolithus frequens* Górka, i.g. up to the disappearance of majority of calcareous nannofossil species at the Cretaceous/Tertiary boundary.

Authors: Čepek and Hay (1969).

Age: Upper Maastrichtian.

Remark: This species was determined both in the variegated and flysch sediments of the Bílé Karpaty Unit. A high species diversity is typical of the calcareous nannofossil taphocenoses of this interval. The nominal species of the zone, *Nephrolithus frequens,* occurs in relatively small number in the assemblages. *Micula prinsii* which was reported only from the upper part of the CC26 Zone by Perch-Nielsen (*in* Bolli et al. 1985) was sporadically found. Nannofossil associations of this zone exhibit species which pass from the Cretaceous to the Tertiary (sensu Perch-Nielsen *in* Bolli et al., 1985) and were also established in the Paleocene of the Bílé Karpaty Unit in the Svodnice Formation: *Placozygus sigmoides, Markalius inversus, Cyclagelosphaera reinhardtii, Braarudosphaera bigelowii* and *Thoracosphaera operculata* (text-figs. 2, 3).

In the Czechoslovak Carpathians the Nephrolithus frequens Zone is reported from the Manín "series" in the Žilina area where it represents the upper Maastrichtian and corresponds with the foraminiferal zone of *Abathomphalus mayaroensis.* From its overlying strata the first Paleogene Zone NP1 Markalius inversus was described (Gašpariková *in* Andrusov - Samuel 1983).

Paleogene nannoplankton zones of the Svodnice Formation

Cruciplacolithus primus Biozone

In the Bílé Karpaty Unit the presence of *Cruciplacolithus primus* Perch-Nielsen (small form) is characteristic of this interval even before the onset of *Cruciplacolithus tenuis* (Stradner) Hay and Mohler.

Discussion: Calcareous nannofossil assemblage precisely corresponding to the description of the NP1 Markalius inversus Zone (Hay - - Mohler *in* Hay 1967) was not determined in the sediments of the Bílé Karpaty Unit. The studied material showed no *Biantholithus sparsus* Bramlette and Martini. None of the samples contained mass representation of *Markalius inversus* and *Thoracosphaera operculata* as described by Gašpariková (*in* Salaj et al. 1978) from the Paleogene of the Klippen Belt.

Remark: In the Svodnice Formation, assemblage of calcareous nannofossils with *Cruciplacolithus primus* was determined solely in flysch sediments with prevalence of sandstone — the so called Vlára type. Both small and big forms of *Cruciplacolithus primus* still without the typical *Cruciplacolithus tenuis* in association with *Markalius inversus, Thoracosphaera operculata, Placozygus sigmoides* and *Ericsonia subpertusa* were determined in these strata.

The zone with this assemblage has not been described so far from the Czechoslovak Carpathians.

For dating of the superlying Paleogene sediments of the Bílé Karpaty Unit in the interval of the NP2 Cruciplacolithus tenuis Zone through the NP11 Discoaster binodosus Zone, Martini's zonation (1971) can be used in its full extent.

Systematic part

Systematic classification of calcareous nannofossils and their stratigraphic distribution are took over from Perch-Nielsen (*in* Bolli et al. 1985).

Calcareous nannoplankton of the Cretaceous

Class *Coccolithophyceae* Rothmaler 1951

Family *Ahmuellerellaceae* Reinhardt (1965)

Genus *Ahmuellerella* Reinhardt 1964

Ahmuellerella octoradiata (Górka) Reinhardt

Pl. II, fig. 3—5

1957 *Discolithus octoradiatus* sp. n.; Górka, p. 259, pl. 4, fig. 10.
1963 *Zygolithus octoradiatus* (Górka) comb. nov.; Stradner, p. 180, pl. 5, fig. 2.
1966 *Ahmuellerella octoradiata* (Górka) comb. nov.; Reinhardt, p. 24, pl. 22, figs. 3, 4.
1969 *Vagalapilla octoradiata* (Górka) comb. nov.; Bukry, p. 58, pl. 33, figs. 5—7.

Distribution: Upper Cenomanian to Maastrichtian, CC9—CC26.

Genus *Vagalapilla* Bukry 1969

Vagalapilla matalosa (Stover) Thierstein

Pl. I, figs. 1—4

1966 *Coccolithus matalosus* sp. n.; Stover, p. 139, pl. 2, figs. 1, 2; pl. 8, fig. 10.
1971 *Staurolithite matalosus* (Stover) Čepek - Hay; Manivit, p. 84, pl. 24, figs. 6—10.
1981 *Vagalapilla matalosa* (Stover) Thierstein; Smith (cum synonymy), p. 75, tab. 14, figs. 1—13.
1982 *Vekshinella matalosa* (Stover) comb. nov.; Hanzlíková, Krhovský, Švábenická, p. 145, pl. 6, figs. 15, 16.

Distribution: Albian to lower Maastrichtian.

Genus *Vekshinella* Loeblich - Tappan 1963

Vekshinella crux (Deflandre - Fert) Shafik - Stradner

Pl. II, figs. 1, 2.

1954 *Discolithus crux* sp. n.; Deflandre - Fert, p. 143, pl. 14, fig. 4; text-fig. 55.
1971 *Vekshinella crux* (Deflandre - Fert) comb. nov.; Shafik - Stradner, pl. 39, figs. 1—4.

Distribution: Albian to Maastrichtian.

Family *Arkhangelskiellaceae* Bukry 1969

Genus *Arkhangelskiella* Vekshina 1959

Arkhangelskiella cymbiformis Vekshina

Pl. III, figs. 22, 23; pl. IV, figs. 13—15

1959 *Arkhangelskiella cymbiformis* sp. n.; Vekshina, p. 66 (partim), pl. 1, fig. 1; pl. 2, fig. 3 (non fig. 4).

1969 *Arkhangelskiella cymbiformis* Vekshina; Bukry, p. 21, pl. 1, figs. 1—3.

non 1981 *Arkhangelskiella cymbiformis* Vekshina; Smith, p. 28, pl. 1, figs. 16—34.

Remark: Under light microscope it shows strikingly large and morphologically conspicuous placoliths. In the central field in each quadrant *A. cymbiformis* exhibits five or less perforations situated along sutures. Sutures are parallel with the ellipse axes.

Distribution: Campanian to Maastrichtian, CC21a—CC25a rare, CC25b—CC26 frequent.

Arkhangelskiella specillata Vekshina

Pl. II, fig. 21; pl. III, figs. 20, 21

1959 *Arkhangelskiella specillata* sp. n.; Vekshina, p. 67, pl. 2, fig. 5.

1983 *Arkhangelskiella specillata* Vekshina; Doeven, p. 48, pl. 2, fig. 4.

Remark: Suture in the central field is parallel with the longer axis of elliptic disc, shorter suture is declined by 10° clockwise from the shorter ellipse axis. Disc margin is narrower than in *A. cymbiformis.* Doeven (1983) describes the following morphological differences from *A. cymbiformis:* 1) narrower disc margin, 2) oblique sutures in the central field, 3) greater number of perforations along suture margins.

Distribution: Upper part of the lower Campanian to Maastrichtian.

Genus *Aspidolithus* Noël 1969

Aspidolithus parcus constrictus (Hattner, Wind-Wise) Perch-Nielsen

Pl. IV, figs. 6, 7, 9, 10

1964 *Arkhangelskiella parca* Stradner; Bramlette-Martini, p. 298, pl. 1, figs. 1, 2.

1966 *Arkhangelskiella cymbiformis* Vekshina; Stover, p. 137 (partim), pl. 1, fig. 17 (non fig. 18).

1969 *Broinsonia parca* (Stradner) comb. nov.; Bukry, p. 23 (partim), pl. 3, figs. 3, 4 (non figs. 5—10).

1969 *Aspidolithus parcus* (Stradner) com. nov.; Noël, p. 196, pl. 1, figs. 3, 4.

1980 *Broinsonia parca constricta* ssp. n.; Hattner-Wind-Wise, p. 59, pl. 6, figs. 7—10; pl. 7, figs. 1—9.

1984a *Aspidolithus parcus constrictus* (Hattner-Wind-Wise) comb. nov.; Perch-Nielsen, p. 43.

Remark: *A. parcus constrictus* exhibits a characteristic structure of corpuscle — large, broadly oval placolith with conspicuously small central field which is very expressive in the crossed nicols. In the sediments of the Bílé Karpaty Unit it is abundant in the Campanian and rare in the lower Maastrichtian.

Distribution: Lower Campanian up to the Campanian/Maastrichtian boundary, CC18b—CC23a.

Aspidolithus parcus parcus (Stradner) Noël

Pl. IV, fig. 11; pl. V, figs. 1, 2

1963 *Arkhangelskiella parca* sp. n.; Stradner, p. 10, pl. 1, fig. 3.
1968 *Arkhangelskiella magnacava* sp. n.; Gartner, p. 38, pl. 18, fig. 25; pl. 22, fig. 9.
1969 *Broinsonia parca* (Stradner) comb. nov.; Bukry, p. 23 (partim), pl. 3, figs., 5, 6, 7 (non figs. 3, 4, 8—10).
1985 *Aspidolithus parcus parcus* (Stradner) Noël; Perch-Nielsen (*in* Bolli et al. 1985), p. 354, pl. 16, fig. 8; pl. 17.

Remark: *A. parcus parcus* corpuscles have a larger central field with more perforations than *A. p. constrictus*. In the lower Campanian sediments of the Bílé Karpaty Unit we may observe transgressive forms between *A. p. parcus* and *A. p. constrictus.*

Distribution: Lower Campanian, CC18a—CC19a.

Genus *Broinsonia* Bukry 1969

Broinsonia ex gr. enormis (Shumenko) Manivit

Pl. I, figs. 5. 9, 10

1968 *Arkhangelskiella enormis* sp. n.; Shumenko, p. 33 (partim), pl. 1, figs. 2, 3 (non fig. 1).
1969 *Broinsonia bevieri* sp. n.; Bukry, p. 21, pl. 1, figs. 8—10.
1971 *Broinsonia enormis* (Shumenko) comb. nov.; Manivit, p. 105, pl. 1, figs. 18—20.

Remark: In the sediments of the Bílé Karpaty Unit it sporadically occurs in the lower Campanian. Corpuscles of the genus *Broinsonia* are smaller than representatives of the genera *Aspidolithus* or *Arkhangelskiella.*

Distribution: Turonian to lower Campanian (Perch-Nielsen 1979).

Genus *Gartnerago* Bukry 1969

Gartnerago obliquum (Stradner) Reinhardt

Pl. IV, figs. 1—4

1963 *Arkhangelskiella obliqua* sp. n.; Stradner, p. 176, pl. 1, fig. 2.
1966 *Discolithus segmentatus* sp. n.; Stover, p. 143, pl. 3, figs. 3—6; pl. 8, fig. 19.
1980 *Gartnerago obliquum* (Stradner) Reinhardt; Hattner - Wise (cum synonymy), p. 63, pl. 18, figs. 2—9; pl. 19, fig. 1; pl. 40, fig. 1, 4.

Distribution: Lower Turonian to Maastrichtian.

Genus *Kamptnerius* Deflandre 1959

Kamptnerius magnificus Deflandre

Pl. II, fig. 22; pl. V, figs. 14—16

1959 *Kamptnerius magnificus* sp. n.; Deflandre, p. 135, pl. 1, figs. 1—4.
1981 *Kamptnerius magnificus* Deflandre; Smith (cum synonymy), p. 49, pl. 8, figs. 1—11.

Remark: In the sediments of the Bílé Karpaty Unit it occurs rarely and poorly preserved (frequently with broken off flag-like margin which is typical of this genus).

Distribution: Turonian to Maastrichtian.

Family *Biscutaceae* Black 1971

Genus *Biscutum* Black in Black - Barnes 1959

Biscutum constans (Górka) Black

Pl. III, figs. 4—6

1957 *Discolithus constans* sp. n.; Górka, p. 279, pl. 4, fig. 7.
1976 *Biscutum constans* (Górka) Black; Hill (cum synonymy), p. 123, pl. 1, figs. 32—37; pl. 13, figs. 2—4.

Distribution: Albian to Maastrichtian (Cretaceous/Tertiary boundary, ? Paleocene).

Family *Braarudosphaeraceae* Deflandre 1947

Genus *Braarudosphaera* Deflandre 1947

Braarudosphaera bigelowii (Gran - Braarud) Deflandre

Pl. V, figs. 10—13; pl. VII, figs. 11, 12

1935 *Pontosphaera bigelowi* sp. n.; Gran - Braarud, p. 388, pl. 67.
1947 *Braarudosphaera bigelowi* (Gran - Braarud) comb. nov.; Deflandre, p. 439, figs. 1—5.

Remark: In the Bílé Karpaty Unit it is rare. A relatively more frequent occurrence can be observed in the upper Maastrichtian in rich assemblages with *Nephrolithus frequens* and in the lower Paleocene in associations poor in species and quantity, with *Placozygus sigmoides, Markalius inversus* and *Cruciplacolithus primus*.

Distribution: Cenomanian to Recent.

Family *Calyptrosphaeraceae* Bourdeaux-Hay 1969

Genus *Lucianorhabdus* Deflandre 1959

Lucianorhabdus cayeuxii Deflandre

Pl. VII, fig. 13—15

1959 *Lucianorhabdus cayeuxii* sp. n.; Deflandre, p. 142, pl. 4, figs. 11—25.
1983 *Lucianorhabdus cayeuxii* Deflandre; Doeven, pl. 4, fig. 7.

Remark: In the sediments of the Bílé Karpaty Unit it occurs rarely compared to the Senonian of the central Europe boreal region. In literature a theory was presented that the genera *Calculites* and *Lucianorhabdus* could be only one genus because the oval corpuscles of the genus *Calculites* are in fact basal parts of lengthened holococcoliths of the genus *Lucianorhabdus* (e.g. *in* Wind-Wise 1977, Perch-Nielsen 1979). However, the investigation of the sediments of the Bílé Karpaty Unit did not corroborate this opinion. In the Campanian and Maastrichtian samples, *Calculites obscurus* is abundant but representatives of the genus *Lucianorhabdus* are very rare.

Distribution: Upper Santonian to Maastrichtian, CC16—CC26.

Genus *Calculites* Prins-Sissingh in Sissingh 1977

Calculites obscurus (Deflandre) Prins-Sissingh

Pl. II, figs. 18, 19

1959 *Tetralithus obscurus* sp. n.; Deflandre, p. 138, pl. 3, figs. 26—29.
1977 *Calculites obscurus* (Deflandre) comb. nov.; Prins-Sissingh (in Sissingh 1977), p. 60.
1979 *Phanulithus obscurus* (Deflandre) Wind-Wise; Perch-Nielsen, p. 249, fig. 18.

Distribution: Santonian/Campanian boundary up to the Maastrichtian, CC17—CC24 (occasionally up to CC25c).

Calculites ovalis (Stradner) Prins-Sissingh

1963 *Tetralithus ovalis* sp. n.; Stradner, p. 12, pl. 6, fig. 7.
1977 *Calculites ovalis* (Stradner) comb. nov.; Prins-Sissingh (*in* Sissingh 1977), p. 60.

1977 *Phanulithus ovalis* (Stradner) comb. nov.; Wind - Wise (*in* Wise - - Wind 1977), p. 304, pl. 34, fig. 1.

Remark: In the Bílé Karpaty Unit we can observe rare occurrence of this species in the lower Campanian, however, more frequent are transitional forms between *Calculites ovalis* and *C. obscurus. Calculites ovalis* occurs in association with *Aspidolithus parcus parcus;* this species has not been found yet in association with *Ceratolithoides aculeus.*

Distribution: Upper Coniacian to lower Campanian, CC14—CC19. Sediments of the boreal development of the Bohemian Cretaceous Basin exhibit *Calculites ovalis* already in the Turonian.

Family *Chiastozygaceae* Road, Hay - Barnard 1973

Genus *Chiastozygus* Gartner 1968

Chiastozygus litterarius (Górka) Manivit

Pl. IV, fig. 5; pl. VI, figs. 2—5

1957 *Discolithus litterarius* sp. n.; **Górka**, p. 251, pl. 3, fig. 3.
1971 *Chiastozygus litterarius* (Górka) comb. nov.; **Manivit**, p. 92 (partim), pl. 4, figs. 1—3 (non figs. 4, 5).

Distribution: Lower Aptian to Maastrichtian.

Family *Eiffellithaceae* Reinhardt 1965

Genus *Eiffellithus* Reinhardt 1965

Eiffellithus eximius (Stover) Perch-Nielsen

Pl. I, figs. 16, 17, 21, 22

1966 *Clinorhabdus eximius* sp. n.; Stover, p. 138, pl. 2, figs. 15, 16; pl. 8, fig. 15.
1968 *Eiffellithus eximius* (Stover) comb. nov.; Perch-Nielsen, p. 30, pl. 3, figs. 8—10; text-fig. 5d.

Remark: In the Bílé Karpaty Unit it commonly occurs in the Campanian. In the upper part of the Campanian a quantitative decrease was observed, in the Maastrichtian this genus is rare (redeposition from the Campanian?).

Distribution: Upper Turonian to the Campanian/Maastrichtian boundary, CC12—CC23a.

Eiffellithus trabeculatus (Górka) Reinhardt - Górka

Pl. II, figs. 16, 17

1957 *Discolithus trabeculatus* sp. n.; Górka, p. 277, pl. 3, fig. 9.

1967 *Eiffellithus trabeculatus* (Górka) comb. nov.; Reinhardt - Górka, p. 25, pl. 31, figs. 19, 23; pl. 32, fig. 1.

Distribution: Turonian to Maastrichtian.

Eiffellithus turriseiffeli (Deflandre) Reinhardt

Pl. I, figs. 18—20; pl. XII, fig. 2

1954 *Zygolithus turriseiffeli* sp. n.; Deflandre (*in* Deflandre - Fert), p. 149, pl. 13, figs. 15, 16.

1965 *Eiffellithus turriseiffeli* (Deflandre) comb. nov.; Reinhardt, p. 32, 35.

Distribution: Upper Cenomanian to upper Maastrichtian, CC9—CC26.

Family *Ellipsagelosphaeraceae* Noël 1965

Genus *Cyclagelosphaera* Noël 1965

Pl. III, figs. 7—9

Remark: Under light microscope *C. reinhardtii* is poorly distinguishable from *C. margerelii*. According to Perch-Nielsen (*in* Bolli et al. 1985) *C. reinhardtii* has a relatively short stratigraphic range from the upper Senonian to Paleocene and coincides with the distribution of *C. margerelii*. In the Bílé Karpaty Unit specimens of the genus *Cyclagelosphaera* occur sporadically in the Upper Cretaceous sediments and very rarely in the Paleogene. It cannot be determined precisely whether in the Paleogene it is a redeposited or autochthonous element because it always occurs with redeposited elements from the Upper Cretaceous.

Distribution: Jurassic to Paleogene.

Genus *Ellipsagelosphaera* Noël 1965

Ellipsagelosphaera britannica (Stradner) Perch-Nielsen

Pl. III, fig. 15

1963 *Coccolithus britannicus* sp. n.; Stradner, p. 10, pl. 1, fig. 7.

1968 *Ellipsagelosphaera britannica* (Stradner) comb. nov.; Perch-Nielsen, p. 71.

Distribution: Upper Liassic to Campanian.

Genus *Manivitella* Thierstein 1971

Manivitella pemmatoidea (Deflandre) Thierstein

Pl. V, figs. 17—19

1965 *Cricolithus pemmatoideus* sp. n.; Deflandre (*in* Manivit 1965), p. 192, pl. 2, fig. 8.
1971 *Manivitella pemmatoidea* (Deflandre ex Manivit) comb. nov.; Thierstein, p. 480, pl. 5, figs. 1—3.
1984 *Manivitella pemmatoidea* (Deflandre) **Thierstein; Stradner-Steinmetz**, p. 597, pl. 28, figs. 1—6.

Remark: Corpuscles form a broadly oval placolith with en empty great central field. Under polarized light this species can be well determined even from fragments according to saw-toothed inner element cycle.

Distribution: Berriasian to Maastrichtian.

Genus *Markalius* Bramlette-Martini 1964

Markalius inversus (Deflandre) Bramlette-Martini

Pl. V, figs. 6, 7; pl. VIII, figs. 4, 5; pl. X, figs. 7, 8

1954 *Cyclococcolithus leptoporus* **Murray-Blackman** var. *inversus* v. n.; Deflandre (*in* Deflandre-Fert 1954), p. 150 (partim), pl. 9, figs. 4, 5 (non figs. 6, 7).
1964 *Markalius inversus* (Deflandre) comb. nov.; Bramlette-Martini, p. 302, pl. 2, figs. 4—9; pl. 7, fig. 2.

Distribution: Albian to lower Paleocene (Danian).

Genus *Watznaueria* Reinhardt 1964

Watznaueria barnesae (Black) Perch-Nielsen

Pl. III, figs. 12—14

1959 *Tremalithus barnesae* sp. n.; Black (*in* Black-Barnes 1959), p. 325, pl. 9, figs. 1, 2.
1968 *Watznaueria barnesae* (Black) comb. nov.; Perch-Nielsen, p. 69, pl. 22, figs. 1—7; pl. 23, figs. 1, 4, 5, 16.

Remark: *Watznaueria barnesae* is the main component of the Campanian and Maastrichtian nannofossil assemblages in the Bílé Karpaty Unit. In the Maastrichtian a quantitative decrease of this species and an increase of *Micula decussata* can be observed. A similar phenomenon was described by Doeven (1983). Structure of the corpuscle is solid and massive. That is why *W. barnesae* is found even in sediments with unfavourable genesis for preservation of calcareous nannofossils. In poorly preserved material it is found in association with *Micula decussata,* representatives of the genus *Eiffellithus, Prediscosphaera* and *Reinhardtites.*

Distribution: Middle Jurassic to Maastrichtian.

Family *Microrhabdulaceae* Deflandre 1963

Genus *Lithraphidites* Deflandre 1963

Lithraphidites carniolensis Deflandre

Pl. IV, fig. 5; pl. XII, fig. 1

1963 *Lithraphidites carniolensis* sp. n.; Deflandre, p. 3486, figs. 1—8.

Distribution: Berriasian to Maastrichtian, CC1—CC26.

Lithraphidites praequadratus Roth

1978 *Lithraphidites praequadratus* sp. n.; Roth, p. 749, pl. 3, figs. 1—4.
1983 *Lithraphidites praequadratus* Roth; Hattner - Wise, p. 64, pl. 21, figs. 5—8; pl. 41, figs. 10—12.

Remark: In the Bílé Karpaty Unit it is very rare. In poorly preserved (fretted) material it is difficult to decide which specimen belongs to *L. carniolensis* and which to *L. praequadratus*.

Distribution: Campanian to Maastrichtian, CC17—CC26.

Lithraphidites quadratus Bramlette - Martini

Pl. III, figs. 1—3

1964 *Lithraphidites quadratus* sp. n.; Bramlette - Martini, p. 310, pl. 6, figs. 16, 17; pl. 7, fig. 8.
1983 *Lithraphidites quadratus* Bramlette - Martini; Doeven, pl. 3, figs. 8, 9; pl. 6, figs. 5, 6.

Remark: This morphologically significant holococcolith forms a conspicuous component of the upper Maastrichtian calcareous nannoplankton assemblages in the Bílé Karpaty Unit.

Distribution: Upper Maastrichtian, CC25b—CC26.

Genus *Microrhabdulus* Deflandre 1959

Microrhabdulus belgicus Hay - Towe

Pl. VII, figs. 9, 10

1963 *Microrhabdulus belgicus* sp. n.; Hay - Towe, p. 95, pl. 1.

Distribution: Upper Cenomanian to upper Maastrichtian, upper part of CC10—CC24, rarely CC26.

Microrhabdulus decoratus Deflandre

Pl. VII, figs. 7, 8

1959 *Microrhabdulus decoratus* sp. n.; Deflandre, p. 140, pl. 4, figs. 1—5.

Remark: In the Bílé Karpaty Unit it is remarkably frequent in the Maastrichtian in association with representatives of the genera *Arkhangelskiella* and *Lithraphidites quadratus.*

Distribution: Upper Cenomanian to lower Maastrichtian, sporadically upper Maastrichtian; CC10—CC23—CC26.

Family *Nannoconaceae* Deflandre 1963

Genus *Nannoconus* Kamptner 1931

Nannoconus elongatus Brönnimann

Pl. V, figs. 8, 9

1955 *Nannoconus elongatus* sp. n.; Brönnimann, p. 38, pl. 1, figs. 10—14; text-fig. 2v—y.

Remark: In the Bílé Karpaty Unit the representatives of the genus *Nannoconus* were found only as single specimens in the Campanian and as a redeposited element in the Paleocene.

Distribution: Barremian to lower Campanian.

Nannoconus farinacciae Bukry

Pl. V, fig. 3

1969 *Nannoconus farinacciae* sp. n.; Bukry, p. 67, pl. 40, figs. 9—12.

Remark: In the Bílé Karpaty Unit *N. farinacciae* was found only as a redeposited element in the Paleogene of the Svodnice Formation.

Distribution: Santonian.

Family *Podorhabdaceae* Noël 1965

Genus *Cretarhabdus* Bramlette-Martini 1964

Cretarhabdus conicus Bramlette-Martini

Pl. VI, figs. 15—18

1964 *Cretarhabdus conicus* sp. n.; Bramlette-Martini, p. 299, pl. 3, figs. 5—8.
1981 *Cretarhabdus conicus* Bramlette-Martini; Smith, p. 35 (cum synonymy), pl. 2, figs. 37—48; pl. 3, figs. 1—19.

Distribution: Berriasian to Maastrichtian.

Genus *Cribrosphaerella* Deflandre in Piveteau 1952

Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre

Pl. I, figs. 6—8; pl. VI, fig. 19

1912 *Cribrosphaera ehrenbergi* sp. n.; Arkhangelsky, p. 412, pl. 6, figs. 19, 20.
1981 *Cribrosphaerella ehrenbergii* [Arkhangelsky] Deflandre; Smith, p. 39, pl. 4, figs. 18—42.

Remark: In the Bílé Karpaty Unit this species has a broad variation range from almost circular forms to oval shape and includes also corpuscles which are smaller and exhibit parallel wider sides of the oval. Smaller forms with parallel sides were found especially in the Maastrichtian.

Distribution: Albian to Maastrichtian.

Genus *Nephrolithus* Górka 1957

Nephrolithus frequens Górka

1957 *Nephrolithus frequens* sp. n.; Górka, p. 282, pl. 5, fig. 7.
1966 *Nephrolithus gorkae* sp. n.; Åberg, p. 65, pl. 1, figs., 1—5; pl. 3, figs. 1—5; text-fig. 1.
1983 *Nephrolithus frequens* Górka; Doeven, pl. 3, figs. 10, 11.

Remark: In the Bílé Karpaty Unit it is found only as single specimens.

Distribution: Upper Maastrichtian, CC26.

Genus *Stradneria* Reinhardt 1964

Stradneria crenulata [Bramlette-Martini] Noël

Pl. VI, figs. 12—14

1964 *Cretarhabdus crenulatus* sp. n.; Bramlette - Martini, p. 300, pl. 2, figs. 21—24.
1985 *Stradneria crenulata* [Bramlette - Martini] Noël; Perch-Nielsen [*in* Bolli et al. 1985], p. 385, pl. 8, figs. 88, 89; pl. 51, fig. 25.

Distribution: Berriasian to Maastrichtian, CC2—CC26.

Family *Polycyclolithaceae* Forchheimer 1972

Genus *Eprolithus* Stover 1966

Eprolithus floralis [Stradner] Stover

Pl. III, figs. 16, 17

1962 *Lithastrinus floralis sp. n.;* Stradner, p. 370, pls. 6—11.
1966 *Eprolithus floralis* [Stradner] comb. nov.; Stover, p. 149, pl. 7, figs. 4—7; 9; pl. 9, fig. 21.

Remark: Cylindrical coccolith with a relatively large central field is composed of nine radially arranged elements. It occurs only in flysch beds of the Javorina Formation in association with *Lucianorhabdus* ex gr. *cayeuxii* and with representatives of the genus *Aspidolithus*. There is no unanimity in the opinion on the last occurrence of *E. floralis*. Perch-Nielsen (*in* Bolli et al. 1985) reports this species solely till the Santonian CC15, Stover (1966) and Hill (1976) till the Campanian.

Distribution: Albian to Santonian (Campanian?).

Genus *Lithastrinus* Stradner 1962

Lithastrinus grilli **Stradner**

Pl. III, figs. 18, 19; pl. VI, figs. 20, 21

1962 *Lithastrinus grilli* sp. n.; Stradner, p. 369, pl. 2, figs. 1—5.
non 1980 *Lithastrinus grilli* Stradner; Doeven, pl. 4, figs. 10, 11.

Remark: *Lithastrinus grilli* has a narrow central field and six long radial rays running from the wall in two cycles. Number of rays is the species sign. Some authors range with this species also specimens with up to seven rays (e.g. Doeven 1983). But such specimens belong to *Lithastrinus septenarius* Forchheimer with a different stratigraphic range upper Coniacian to upper Santonian. In the Bílé Karpaty Unit the genus *Lithastrinus* with seven rays has not been found yet. *L. grilli* with six rays occurs very rarely in the Campanian of the Bílé Karpaty Unit.

Distribution: Lower Santonian to upper Campanian, CC15—CC22b.

Genus *Micula* Vekshina 1959

Micula concava (Stradner) Verbeek

Pl. II, figs. 6, 7

1960 *Nannotetraster concavus* sp. n.; Stradner (*in* Martini - Stradner 1960), p. 269, text-fig. 18.
1980 *Micula decussata* Vekshina; Hattner - Wise, p. 65 (partim), pl. 26, figs. 6, 9 (non figs. 7, 8).

Distribution: Lower Santonian to upper Maastrichtian, CC15—CC26.

Micula decussata Vekshina

Pl. II, figs. 8—12, 22

1959 *Micula decussata* sp. n.; Vekshina, p. 71, pl. 1, fig. 6; pl. 2, fig. 11.
1963 *Micula stauraphora* (Gardet) comb. nov.; Stradner, p. 14, pl. 4, fig. 12.
1972 *Micula cubiformis* sp. n.; Forchheimer, p. 54, pl. 25, figs. 1, 3—5.

1977 *Quadrum gartneri* Prins - Perch-Nielsen; Manivit et al., p. 177, pl. 1, figs. 9, 10.

Distribution: Upper Coniacian to upper Maastrichtian, CC14—CC26.

Micula murus (Martini) Bukry

1961 *Tetralithus murus* sp. n.; Martini, p. 4, pl. 1, fig. 6; pl. 4, fig. 42.

Remark: In the Bílé Karpaty Unit it occurs in small number in the upper part of the Lithraphidites quadratus Zone of the upper Maastrichtian.

Distribution: Upper Maastrichtian, CC25c—CC26.

Micula prinsii Perch-Nielsen

1979 *Micula prinsii* sp. n.; Perch-Nielsen, p. 266, pl. 1, fig. 11, 14—16.

Remark: In the Bílé Karpaty Unit it occurs very rarely in the uppermost part of the Maastrichtian always in association with *Micula murus, Nephrolithus frequens* and *Lithraphidites quadratus.*

Distribution: Upper part of the upper Maastrichtian, CC26.

Genus *Quadrum* Prins - Perch-Nielsen in Manivit et al. 1977

Quadrum gartneri Prins - Perch-Nielsen

Pl. II, figs. 13—15

1968 *Tetralithus gothicus* Deflandre; Gartner, p. 42, pl. 24, fig. 4.

1977 *Quadrum gartneri* sp. n.; Prins - Perch-Nielsen (*in* Manivit et al. 1977), p. 177, pl. 1, figs. 9, 10.

Remark: In the Bílé Karpaty Unit it occurs sporadically especially in flysch sediments of the Javorina Formation. Further investigation will show whether this nannofossil is redeposited into the Campanian and Maastrichtian or whether it is still an autochthonous element in the lower Campanian.

Distribution: Turonian up to the Santonian/Campanian boundary, CC11—CC16.

Quadrum sissinghii Perch-Nielsen

1977 *Quadrum nitidum* (Martini) comb. nov.; Prins - Perch-Nielsen (*in* Manivit et al. 1977), p. 178.

1985 *Quadrum sissinghii* Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), p. 390, pl. 58, fig. 19.

Remark: In the Bílé Karpaty Unit it occurs in a short time range and forms an important stratigraphic horizon in the upper Campanian.

Distribution: Upper Campanian to lower Maastrichtian, CC21a—CC23b.

Quadrum trifidum (Stradner) Prins - Perch-Nielsen

1961 *Tetralithus gothicus trifidus* ssp. n.; Stradner (*in* Stradner - Papp), p. 124, text-fig. 23.

1977 *Quadrum trifidum* (Stradner) comb. nov.; Prins - Perch-Nielsen (*in* Manivit et al. 1977), p. 178.

Remark: In the Bílé Karpaty Unit it was found only in few samples but always in greater amount. It forms an important stratigraphic horizon on the Campanian/Maastrichtian boundary.

Distribution: Upper Campanian to lower Maastrichtian, CC22a—CC23b.

Family *Prediscosphaeraceae* Rood, Hay - Barnard 1971

Genus *Prediscosphaera* Vekshina 1959

Prediscosphaera cretacea (Arkhangelsky) Gartner

Pl. VI, figs. 6—9

1912 *Coccolithospora cretacea* sp. n.; Arkhangelsky, p. 140, pl. 6, figs. 12, 13.

1968 *Prediscosphaera cretacea* (Arkhangelsky) comb. nov.; Gartner, p. 19, pl. 2, figs. 10—14; pl. 3, fig. 8; pl. 4, figs. 19—24; pl. 6, figs. 14, 15; pl. 9, figs. 1—4; pl. 12, fig. 1; pl. 14, figs. 20—22; pl. 18, fig. 8; pl. 22, figs. 1—3; pl. 23, figs. 4—6; pl. 25, figs. 12—14; pl. 26, fig. 2.

Remark: In the Bílé Karpaty Unit it is a common component of Cretaceous nannofossil assemblages. A wider variability of this species was observed during study. Specimens differed in detailed structure of corpuscles which became evident especially on the electron microscope photographs. However, these small morphological variations are significant for study under light microscope and they are of no consequence for stratigraphic evaluation of the samples. In the assemblages there were often found also massive stems of corpuscles with characteristic crown on the distal end (see pl. VI, fig. 22).

Distribution: Albian to Maastrichtian; according to Perch-Nielsen (*in* Bolli et al. 1985) lower Campanian to upper Maastrichtian, CC18b—CC26.

Prediscosphaera grandis Perch-Nielsen

1979 *Prediscosphaera grandis* sp. n.; Perch-Nielsen, p. 267, pl. 2, fig. 8.

1984 *Prediscosphaera grandis* **Perch-Nielsen; Stradner - Steinmetz**, p. 597, pl. 36, fig. 1.

Remark: In the Bílé Karpaty Unit it occurred already in associations with representatives of the genera *Aspidolithus* and *Quadrum*. This species was never abundant in assemblages but always conspicuous due to its size.

Distribution: Maastrichtian CC23b, in the studied material rarely Campanian to Maastrichtian.

Prediscosphaera spinosa (Bramlette - Martini) Gartner

Pl. VI, figs. 10, 11

1964 *Deflandrius spinosus* sp. n.; Bramlette - Martini, p. 301, pl. 2, figs. 17—20.

1968 *Prediscosphaera spinosa* (Bramlette - Martini) comb. nov.; Gartner, p. 20, pl. 2, figs. 15, 16; pl. 3, figs. 9, 10; pl. 5, figs. 7—9; pl. 11, fig. 17.

Distribution: Lower Cenomanian to upper Maastrichtian, CC9b—CC26.

Family *Rhagodiscaceae* Hay 1977

Genus *Rhagodiscus* Reinhardt 1967

Rhagodiscus angustus (Stradner) Reinhardt

Pl. VI, fig. 1

1963 *Rhabdolithus angustus* sp. n.; Stradner, p. 178, pl. 5, fig. 6.

1980 *Rhagodiscus angustus* (Stradner) Reinhardt; Hattner - Wise, p. 66, pl. 29, fig. 9; pl. 30, fig. 1.

Distribution: Aptian/Albian boundary up to the upper Maastrichtian, CC7b—CC26.

Family *Stephanolithiaceae* Black 1968

Genus *Corollithion* Stradner 1961

Corollithion exiguum Stradner

1961 *Corollithion exiguum* sp. n.; Stradner, p. 83, figs. 58—61.

1981 *Corollithion exiguum* Stradner; Smith, p. 33, pl. 2, figs. 13—21.

Remark: Nannofossils with gentle bar-like structure of corpuscles are rare in the Bílé Karpaty Unit (only in pure pelagites).

Distribution: Upper Cenomanian to upper Maastrichtian.

Genus *Rotelapillus* Noël 1973

Rotelapillus crenulatus (Stover) Perch-Nielsen

Pl. VII, figs. 5, 6

1966 *Stephanolithion crenulatum* sp. n.; Stover, p. 160, pl. 7, figs. 25—27; pl. 9, figs. 25—27.
1984 *Rotelapillus crenulatus* (Stover) comb. nov.; Perch-Nielsen, p. 43.
1985 *Rotelapillus crenulatus* (Stover) Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), p. 402, pl. 74; pl. 75, figs. 5, 6.

Remark: In my opinion the species *R. crenulatus* and *R. laffittei* cannot be distinguished from each other under light microscope. According to Perch-Nielsen (*in* Bollli et al. 1985) the genus *R. crenulatus* is characteristic in having eight thorns distributed along the ring periphery. Another morphologic difference between the two species is in the shape of the corpuscle cross-section which can be distinguished only under light microscope.

Distribution: Hauterivian to Maastrichtian.

Family *Thoracosphaeraceae* Schiller 1930

Genus *Thoracosphaera* Kamptner 1927

Remark: In the sediments of the Bílé Karpaty Unit the representatives of the genus *Thoracosphaera* are found in the Upper Cretaceous of the Javorina Formation and in the lower Paleogene of the Svodnice Formation. *Thoracosphaera* sp. belongs among five taxons passing from the Cretaceous to the Tertiary in the Bílé Karpaty Unit.

Family *Zygodiscaceae* Hay-Mohler 1967

Genus *Glaukolithus* Reinhardt 1964

Glaukolithus compactus (Bukry) Perch-Nielsen

Pl. I, fig. 11

1969 *Zygodiscus compactus* sp. n.; Bukry, p. 59, pl. 34, figs. 1, 2.
1985 *Glaukolithus compactus* (Bukry) Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), p. 407, pl. 82, figs. 1—3.

Distribution: Barremian to Maastrichtian.

Glaukolithus diplogrammus (Deflandre) Reinhardt

Pl. I, fig. 13

1954 *Zygolithus diplogrammus* sp. n.; Deflandre (*in* Deflandre - Fert), p. 148, pl. 10, fig. 7; text-fig. 57.

1968 *Glaukolithus diplogrammus* (Deflandre) Reinhardt; Perch-Nielsen, p. 32, pl. 4, figs. 1—10.

Distribution: Valanginian to Maastrichtian.

Genus *Placozygus* Hoffmann 1970

Placozygus fibuliformis (Reinhardt) Hoffmann

Pl. I, figs. 14, 15

1964 *Glaukolithus (?) fibuliformis* sp. n.; Reinhardt, p. 758, pl. 1, fig. 4.
1964 *Zygodiscus spiralis* sp. n.; Bramlette - Martini, p. 303, pl. 4, figs. 6—8.
1981 *Zygodiscus fibuliformis* (Reinhardt) Bukry; Smith (cum synonymy), p. 82, pl. 16, figs. 16—24.
1985 *Placozygus fibuliformis* (Reinhardt) Hoffmann; Perch-Nielsen (*in* Bolli et al. 1985), p. 407, pl. 82, figs. 12—15.

Distribution: Albian to Maastrichtian.

Placozygus sigmoides (Bramlette - Sullivan) Romein

1961 *Zygodiscus sigmoides* sp. n.; Bramlette - Sullivan, p. 149, pl. 4, fig. 11.
1979 *Placozygus sigmoides* (Bramlette - Sullivan) comb. nov.; Romein, p. 46, pl. 2, figs. 4, 5.

Remark: In the sediments of the Bílé Karpaty Unit it occurs in small amount in the upper Campanian, passes the Cretaceous/Tertiary boundary and is relatively abundant in poor assemblages of the lower Paleocene flysch sediments of the Svodnice Formation.

Distribution: Maastrichtian to Paleocene.

Genus *Reinhardtites* Perch-Nielsen 1968

Reinhardtites anthophorus (Deflandre) Perch-Nielsen

Pl. V, figs. 4, 5; pl. VII, figs. 1, 2

1959 *Rhabdolithus anthrophorus* sp. n.; Deflandre, p. 137, pl. 1, figs. 21—22.
1968 *Reinhardtites anthophorus* (Deflandre) comb. nov.; Perch-Nielsen, p. 38 (partim), pl. 5, figs. 1, 5, 6 (non text-figs. 13, 14; pl. 5, figs. 2—4, 7, 8).
1983 *Reinhardtites anthophorus* (Deflandre) Perch-Nielsen emend. Prins - Sissingh; Doeven, p. 49, pl. 2, figs. 5, 6.

Remark: *R. anthophorus* occurs irregularly in nannofossil assemblages of the Bílé Karpaty Unit and therefore its last occurrence cannot be used for boundary of the Zones CC22/CC23.

Distribution: Santonian to Campanian, CC15—CC22b.

Genus *Tranolithus* Stover 1966

Tranolithus exiguus Stover

Pl. I, fig. 12; pl. XII, fig. 4

1966 *Tranolithus exiguus* sp. n.; Stover, p. 146, pl. 4, figs. 19—21; pl. 9, figs. 3, 4.
1969 *Zygodiscus deflanderi* sp. n.; **Bukry**, p. 59 (partim), pl. 34, figs. 3, 5 (non fig. 4).
1981 *Tranolithus solillum* (Noël) comb. nov.; Crux, p. 638, pl. 2, figs. 7, 8, 10—12.
1985 *Tranolithus exiguus* Stover; Perch-Nielsen (*in* Bolli et al. 1985), p. 408, pl. 83, figs. 6—8.

Distribution: Albian to lower Maastrichtian.

Tranolithus gabalus Stover

1966 *Tranolithus gabalus* sp. n.; Stover, p. 146, pl. 4, fig. 22; pl. 9, fig. 5.
1976 *Tranolithus gabalus* Stover; Hill, p. 156, pl. 11, figs. 36—41; pl. 15, fig. 13.

Distribution: Hauterivian to Campanian.

Tranolithus phacelosus Stover

Pl. VII, figs. 3, 4

1966 *Tranolithus phacelosus* sp. n.; Stover, p. 146, pl. 4, figs. 23—25; pl. 9, fig. 7.

Remark: An elliptic coccolith with a simple wall, in the central part showing four partially overlapping deltoid plates. The plates are a conspicuous identification sign in well preserved specimens under polarized light. In poorly preserved specimens these plates are usually fretted and form only denticulate projections in the central aperture of the corpuscle. These specimens can be easily confused with *T. exiguus*.

Distribution: Lower/upper Albian boundary to lower Maastrichtian, CC8—CC23b.

Genus *Zeugrhabdotus* Reinhardt 1965

Zeugrhabdotus embergeri (Noël) Perch-Nielsen

Pl. IV, figs. 8, 12

1959 *Discolithus embergeri* sp. n.; Noël, p. 164, pl. 1, figs. 1, 7, 8.
1963 *Parhabdolithus embergeri* (Noël) comb. nov.; Stradner, p. 8.
1985 *Zeugrhabdotus embergeri* (Noël) Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), p. 408, pl. 5, figs. 6, 7; pl. 84, figs. 4, 6, 9, 10, 14, 15,

Distribution: Kimeridgian to Maastrichtian.

Zeugrhabdotus theta (Black) Black

Pl. XII, fig. 6

1959 *Discolithus theta* sp. n.; Black (*in* Black - Barnes 1959), p. 327, pl. 12, fig. 1.
1969 *Zygodiscus theta* (Black) comb. nov.; Bukry, p. 62, pl. 36, figs. 7, 8.
1985 *Zeugrhabdotus theta* (Black) Black; Perch-Nielsen (*in* Bolli et al. 1985), p. 409, pl. 84, fig. 5.

Distribution: Albian to Maastrichtian.

Incertae sedis

Ceratolithoides aculeus (Stradner) Prins - Sissingh

Pl. III, figs. 10, 11

1961 *Zygrhablithus aculeus* sp. n.; Stradner, p. 81, figs. 53—57.
1976 *Tetralithus aculeus* (Stradner) Gartner; Thierstein, p. 350, pl. 5, figs. 22, 23.
1977 *Ceratolithoides aculeus* (Stradner) comb. nov.; Prins - Sissingh (*in* Sissingh 1977), p. 60.

Distribution: Lower Campanian to upper Maastrichtian, CC20—CC26.

Calcareous nannoplankton of the Paleogene

Class *Coccolithophyceae* Rothmaler 1951

Family *Coccolithaceae* Poche 1913

Genus *Campylosphaera* Kamptner 1963

Campylosphaera dela (Bramlette - Sullivan) Hay - Mohler

Pl. X, figs. 1, 2

1961 *Coccolithites delus* sp. n.; Bramlette - Sullivan, p. 151, pl. 7, figs. 1, 2.
1967 *Campylosphaera dela* (Bramlette - Sullivan) comb. nov.; Hay - Mohler, p. 1531, pl. 198, fig. 15.
1976 *Cruciplacolithus delus* (Bramlette - Sullivan) Perch-Nielsen; Bystrická, p. 280, pl. 3, fig. 2.

Remark: This morphologically conspicuous large placolith with semielliptic to almost rectangular ring and with central cross in the direction of ellipse axes is frequent in the lower Eocene of the Svodnice Formation in the Bílé Karpaty Unit.

Distribution: Lower to middle Eocene, NP10—NP16.

Genus *Chiasmolithus* Hay, Mohler-Wade 1966

Chiasmolithus bidens (Bramlette-Sullivan) Hay-Mohler

Pl. IX, figs. 5, 6, 11; pl. XII, fig. 3

1961 *Coccolithus bidens* sp. n.; Bramlette-Sullivan, p. 139, pl. 1, fig. 1.
1967 *Chiasmolithus bidens* (Bramlette-Sullivan) comb. nov.; Hay-Mohler, p. 1526, pl. 196, figs. 14, 15, 17; pl. 197, figs. 4, 9, 14.
1974 *Chiasmolithus bidens* (Bramlette-Sullivan) Hay-Mohler; Sherwood, p. 15, pl. 1, figs. 8—10; pl. 2, figs. 4, 5.

Remark: *Ch. bidens* has a small central field bridged with an X-shaped structure. In the Bílé Karpaty Unit it is frequent in the upper Paleocene of the Svodnice Formation and rare in the lower Eocene.

Distribution: Upper Paleocene to lower part of the lower Eocene, NP5—NP11.

Chiasmolithus consuetus (Bramlette-Sullivan) Hay-Mohler

Pl. IX, figs. 9, 10

1961 *Coccolithus consuetus* sp. n.; Bramlette-Sullivan, p. 139, pl. 1, fig. 2.
1967 *Chiasmolithus consuetus* (Bramlette-Sullivan) comb. nov.; Hay-Mohler, p. 1526, pl. 196, figs. 23—25; pl. 198, fig. 16.
1974 *Chiasmolithus consuetus* (Bramlette-Sullivan) Hay-Mohler; Sherwood, p. 15, pl. 1, figs. 11, 12; pl. 2, fig. 6.

Distribution: Upper Paleocene to lower Eocene, NP5—NP19.

Chiasmolithus danicus (Brotzen) Hay-Mohler

1959 *Cribrosphaerella danica* sp. n.; Brotzen, p. 25 (partim), text-fig. 9. (non 3—6).
1967 *Chiasmolithus danicus* (Brotzen) comb. nov.; Hay-Mohler, p. 1526, pl. 196, figs. 16, 21, 22; pl. 198, figs. 8, 12, 13.

Distribution: Upper part of the lower Paleocene to lower part of the upper Paleocene, NP3—NP6.

Chiasmolithus eograndis Perch-Nielsen

Pl. X, figs. 9, 10

1971d *Chiasmolithus eograndis* sp. n.; Perch-Nielsen, p. 53, pl. 2, figs. 5—8.

1983 *Chiasmolithus eograndis* Perch-Nielsen; Aubry, pl. 3, figs. 30, 31, 34.

Distribution: Lower Eocene, NP10—NP13.

Chiasmolithus grandis (Bramlette-Riedel) Radomski

Pl. X, figs. 15, 16

1954 *Coccolithus grandis* sp. n.; Bramlette - Riedel, p. 391, pl. 38, fig. 1.
1968 *Chiasmolithus gradis* (Bramlette - Riedel) comb. nov.; Radomski, p. 560, pl. 44, figs. 3, 4.

Remark: In the Bílé Karpaty Unit it occurs very rarely in the lower Eocene of the Svodnice Formation in association with *Ericsonia formosa.*

Distribution: Lower to middle Eocene, NP11—NP17.

Chiasmolithus solitus (Bramlette-Sullivan) Locker

Pl. IX, fig. 7

1961 *Coccolithus solitus* sp. n.; Bramlette - Sullivan, p. 140, pl. 2, fig. 4.
1968 *Chiasmolithus solitus* (Bramlette - Sullivan) comb. nov.; Locker, p. 221, pl. 1, figs. 5, 6.

Remark: In the Bílé Karpaty Unit it occurs rarely in the lower Eocene together with representatives of the genus *Tribrachiatus.*

Distribution: Lower to middle Eocene, NP10—NP16.

Genus *Cruciplacolithus* Hay - Mohler in Hay et al. 1967

Cruciplacolithus primus Perch-Nielsen

Pl. VIII, figs. 2, 3

1977 *Cruciplacolithus primus* sp. n.; Perch-Nielsen, p. 731, pl. 12, figs. 1—7.

Remark: In the sediments of the Bílé Karpaty Unit *Cruciplacolithus primus* — small form (sensu Perch-Nielsen *in* Bolli et al. 1985) is found in association with the species *Markalius inversus, Ericsonia subpertusa, Placozygus sigmoides, Braarudosphaera bigelowii* before the first occurrence of *C. tenuis.*

Distribution: Lower Paleocene, NP1—NP2 (small form), NP2—NP4, rarely up to NP8 (big form).

Cruciplacolithus tenuis (Stradner) Hay-Mohler

Pl. X, figs. 17—19

1961 *Heliorthus tenuis* sp. n.; Stradner, p. 84, figs. 64, 65.
1967 *Cruciplacolithus tenuis* (Stradner) comb. nov.; Hay - Mohler (*in* Hay et al. 1977), p. 446.

1967 *Cruciplacolithus tenuis* (Stradner) Hay - Mohler; Hay - Mohler, p. 1527, pl. 196, figs. 29—31; pl. 198, fig. 1, 17.

Distribution: Paleocene, NP3—NP9.

Genus *Coccolithus* Schwartz 1894

Coccolithus pelagicus (Wallich) Schiller

1877 *Coccosphaera pelagica* sp. n.; Wallich, p. 348, figs. 1, 2, 5, 11, 12.
1930 *Coccolithus pelagicus* (Wallich) comb. nov.; Schiller, p. 249, figs. 123, 124.

Distribution: Tertiary.

Genus *Ericsonia* Black 1894

Ericsonia formosa (Kamptner) Haq

Pl. X, figs. 3, 4

1963 *Cyclococcolithus formosus* sp. n.; Kamptner, p. 163, pl. 2, fig. 8; text-fig. 20.
1971 *Ericsonia formosa* (Kamptner) comb. nov.; Haq, p. 17, pl. 4, figs. 7, 8.

Remark: In the Bílé Karpaty Unit it occurs rarely already in the upper part of the NP11 Zone still without *Discoaster lodoensis*.

Distribution: Lower Eocene to lower Oligocene, NP12—NP21.

Ericsonia robusta (Bramlette - Sullivan) Perch-Nielsen

Pl. IX, figs. 17—19

1961 *Cyclolithus? robustus* sp. n.; Bramlette - Sullivan, p. 141, pl. 2, fig. 7.
1985 *Erisconia robusta* (Bramlette - Sullivan) Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), pl. 23, fig. 45.

Remark: Conspicuous rounded placolith with a characteristic large open central field. In the Bílé Karpaty Unit it occurs sporadically in the upper Paleocene and lower Eocene.

Distribution: Upper Paleocene, rarely lower Eocene.

Ericsonia subpertusa Hay - Mohler

Pl. VIII, fig. 1; pl. IX, figs. 13—16

1967 *Ericsonia subpertusa* sp. n.; Hay - Mohler, p. 1531, pl. 198, figs. 11, 15, 18; pl. 199, figs. 1—3.

Remark: In the Bílé Karpaty Unit it occurs already in the lower Paleocene together with *Cruciplacolithus primus, Placozygus sigmoides* and *Markalius inversus*.

Distribution: Lower to upper Paleocene.

Family *Calciosoleniaceae* Kamptner 1927

Genus *Scapholithus* Deflandre in Deflandre-Fert 1954

Scapholithus fossilis Deflandre

Pl. IX, fig. 12

1954 *Scapholithus fossilis* sp. n.; Deflandre (*in* Deflandre - Fert), p. 51 pl. 8, figs. 12, 16, 17.

Remark: In the Bílé Karpaty Unit it occurs in the upper Paleocene in a short time interval (upper part of the NP6 Zone to the lower part of the NP7 Zone). It forms a marker horizon which could be used for a more detailed stratigraphy of the Svodnice Formation.

Distribution: Lower Cretaceous (Hauterivian) to Recent.

Family *Calyptrosphaeraceae* Bordeaux-Hay 1969

Genus *Zygrhablithus* Deflandre 1959

Zygrhablithus bijugatus (Deflandre) Deflandre

Pl. X, figs. 13, 14

1954 *Zygolithus bijugatus* sp. n.; Deflandre (*in* Deflandre - Fert 1954), p. 148, pl. 11, figs. 20, 21.

1961 *Zygrhablithus bijugatus* (Deflandre) Deflandre; Bramlette - Sullivan, p. 151, pl. 6, figs. 16—18.

Remark: In the Bílé Karpaty Unit this morphologically conspicuous holococcolith occurs together with *Tribrachiatus bramlettei* already at the base of the lower Eocene in the NP10 Zone, and has been found even in the NP9 Zone is association with *Discoaster multiradiatus,* still without representatives of the genus *Tribrachiatus, Transversopontis* and *Campylosphaera.*

Distribution: Lower Eocene to upper Oligocene, NP11—NP25.

Family *Discoasteraceae* Tan 1927

Genus *Discoaster* Tan 1927

Discoaster binodosus Martini

1958 *Discoaster binodosus* sp. n.; Martini, p. 362, pl. 4, fig. 18.

1968 *Discoaster binodosus* Martini; Bystrická, p. 208, pl. 63, figs. 6—8.

Remark: In the Bílé Karpaty Unit it occurs rarely in the lower Eocene in association with representatives of the genus *Tribrachiatus.*

Distribution: Upper part of the upper Paleocene (Paleocene/ /Eocene boundary) to the middle Eocene, NP9—NP15.

Discoaster deflandrei Bramlette - Riedel

Pl. XI, fig. 2

1954 *Discoaster deflandrei* sp. n.; Bramlette - Riedel, p. 394, pl. 38, 39; te;t-fig. 1—3.
1969 *Discoaster deflandrei* Bramlette - Riedel; Bystrická, p. 83, pl. 13, figs. 1—4.

Distribution: It occurs rarely in the Eocene in the NP11 to NP20 Zones; it is frequent in Oligocene and Miocene.

Discoaster delicatus Bramlette - Sullivan

Pl. XI, fig. 1

1961 *Discoaster delicatus* sp. n.; Bramlette - Sullivan, p. 159, pl. 11, fig. 3.

Distribution: Upper part of the upper Paleocene, NP8—NP9.

Discoaster lenticularis Bramlette - Sullivan

Pl. XI, fig. 3

1961 *Discoaster lenticularis* sp. n.; Bramlette - Sullivan, p. 160, pl. 12, figs. 1, 2.
1971 *Discoaster lenticularis* Bramlette - Sullivan; Haq, p. 39, pl. 14, fig. 5.

Remark: In the Bílé Karpaty Unit it occurs already in association with *Discoaster mohleri* still before the appearance of *D. multiradiatus.*

Distribution: Upper part of the upper Paleocene to the base of the Eocene, NP9—NP10.

Discoaster mohleri Bukry - Percival

Pl. XI, fig. 5

1959 *Discoaster gemmeus* sp. n.; Stradner, p. 479, text-fig. 40.
1967 *Discoaster gemmeus* Stradner; Hay - Mohler, p. 1538, pl. 204, figs. 19, 20; pl. 206, figs. 3, 5, 6, 8.
1971 *Discoaster mohleri* sp. n.; Bukry - Percival, p. 128, pl. 3, figs. 3—5.

Distribution: Upper part of the upper Paleocene, NP7—NP8, rarely NP9.

Discoaster multiradiatus Bramlette - Riedel

Pl. XI, figs. 9, 10; pl. XII, figs. 5, 7

1954 *Discoaster multiradiatus* sp. n.; Bramlette - Riedel, p. 396, pl. 38, fig. 10.

1965 *Discoaster multiradiatus* Bramlette - Riedel; Sullivan, p. 43, pl. 10, figs. 13, 15.

Distribution: Paleocene/Eocene boundary to the lower Eocene, NP9—NP11.

Family *Fasciculithaceae* Hay - Mohler 1967

Genus *Fasciculithus* Bramlette - Sullivan 1961

Fasciculithus involutus Bramlette - Sullivan

Pl. VIII, figs. 8, 9, 13

1961 *Fasciculithus involutus* sp. n.; Bramlette - Sullivan, p. 164, pl. 14, figs. 1—5.

Remark: In the sediments of the Bílé Karpaty Unit the corpuscles of *F. involutus* occur in the upper Paleocene — they are not fixed only to the NP9 Zone associations; they frequently occur already with *Discoaster mohleri.*

Distribution: Upper part of the upper Paleocene, solely the NP9 Zone (sensu Perch-Nielsen *in* Bolli et al. 1985).

Fasciculithus tympaniformis Hay - Mohler

1967 *Fasciculithus tympaniformis* sp. n.; Hay - Mohler *in* Hay et al., p. 447, pl. 8, figs. 1—5.

1975 *Fasciculithus tympaniformis* Hay - Mohler; Proto Decima et al., p. 49, pl. 5, figs. 8, 13.

Distribution: Upper Paleocene, NP5—NP9.

Family *Heliolithaceae* Hay - Mohler 1967

Genus *Heliolithus* Bramlette - Sullivan 1961

Heliolithus kleinpellii Sullivan

Pl. IX, fig. 20

1964 *Heliolithus kleinpellii* sp. n.; Sullivan, p. 193, pl. 12, fig. 5.

1975 *Heliolithus kleinpellii* Sullivan; Proto Decima et al.; p. 49, pl. 5, figs. 17, 18.

Distribution: Upper Paleocene, NP6—NP9.

Heliolithus riedelii Bramlette - Sullivan

1961 *Heliolithus riedeli* sp. n.; Bramlette - Sullivan, p. 164, pl. 14, figs. 9—11.

1971 *Heliolithus riedeli* Bramlette - Sullivan; Martini, pl. 1, figs. 15, 16.

Remark: In the sediments of the Bílé Karpaty Unit it is very rare.
Distribution: Upper part of the upper Paleocene, NP8.

Family *Pontosphaeraceae* Lemmermann 1908

Genus *Transversopontis* Hay, Mohler - Wade 1966

Transversopontis pulcher (Deflandre) Perch-Nielsen

Pl. X, fig. 6

1954 *Discolithus pulcher* sp. n.; Deflandre (*in* Deflandre - Fert 1954), p. 142, pl. 12, figs. 17, 18.
1985 *Transversopontis pulcher* (Deflandre) Perch-Nielsen; Perch-Nielsen (*in* Bolli et al. 1985), pl. 51, fig. 12.

Remark: *Transversopontis pulcher* occurs sporadically in the lower Eocene of the Svodnice Formation in association with *Campylosphaera dela, Zygrhablithus bijugatus, Chiasmolithus eograndis* and *Discoaster multiradiatus.*

Distribution: Upper Paleocene to lower Eocene.

Transversopontis pulcheroides (Sullivan) Perch-Nielsen

Pl. X, fig. 5

1964 *Discolithus pulcheroides* sp. n.; Sullivan, p. 1983, pl. 4, fig. 7.
1971d *Transversopontis pulcheroides* (Sullivan) comb. nov.; Perch-Nielsen, p. 40, pl. 33, figs. 3, 7.

Distribution: Upper Paleocene to lower Eocene.

Family *Prinsiaceae* Hay - Mohler 1967

Genus *Toweius* Hay - Mohler 1967

Toweius eminens (Bramlette - Sullivan) Perch-Nielsen

Pl. VIII, figs. 16—21

1961 *Coccolithus eminens* sp. n.; Bramlette - Sullivan, p. 139, pl. 1, fig. 3.
1971b *Toweius eminens* (Bramlette - Sullivan) comb. nov.; Perch-Nielsen, p. 360.
1976 *Toweius eminens* (Bramlette - Sullivan) Perch-Nielsen; Wind - - Wise, p. 296, pl. 5, figs. 1—3.

Remark: Elliptic to almost round placolith. A small central field shows four large perforations conspicuous under light microscope. In the sediments of the Bílé Karpaty Unit this species occurs already in the NP6 Zone still without representatives of the genus *Discoaster*.

Distribution: Upper Paleocene to Paleocene/Eocene boundary, NP7—NP10.

Toweius pertusus (Sullivan) Romein

Pl. VIII, figs. 10—12

1965 *Coccolithus pertusus* sp. n.; Sullivan, p. 32, pl. 3, figs. 5, 6.
1971b *Toweius craticulus* Hay - Mohler; Perch-Nielsen, p. 360, pl. 13, figs. 7—10; pl. 14, figs. 1, 2.
1979 *Toweius pertusus* (Sullivan) comb. nov.; Romein, p. 131, pl. 4, figs. 8—11.

Remark: Small, elliptic to almost round placolith. Central field takes up to one half of the corpuscle diameter and is filled with a grille with 8 to 20 perforations. In the Bílé Karpaty Unit it occurs already in the upper part of the lower Paleocene, in the Zone NP4. Bystrická (*in* Andrusov - Samuel 1983) also reported this species already from the NP4 Zone. Gašpariková (*in* Salaj et al. 1978) even delimited the Subzone Toweius craticulus (synonym of *T. pertusus*) in the upper part of the NP4 Zone.

Distribution: Upper Paleocene, rarely lower Eocene, NP6—NP9 (rarely up to NP12) sensu Perch-Nielsen (*in* Bolli et al. 1985), in the studied material the upper part of the lower Paleocene.

Toweius tovae Perch-Nielsen

1971b *Toweius tovae* sp. n.; Perch-Nielsen, p. 359, pl. 13, figs. 1, 2, 5; pl. 14, figs. 8, 9.

Remark: An elliptic to round placolith with 6 pores in the central field. Perch-Nielsen (*in* Bolli et al. 1985) reported a very short stratigraphic range of this species — solely the NP9 Zone (on the boundary of the CP8a/b Subzones sensu Okada - Bukry 1980). In the sediments of the Bílé Karpaty Unit it was found always with other species of the genus *Toweius* in association with *Heliolithus kleinpellii, Discoaster mohleri,* etc. already in the NP7—NP8 Zones, i.e. stratigraphically lower than reported Perch-Nielsen.

Distribution: Upper part of the upper Paleocene, NP9 (sensu Perch-Nielsen *in* Bolli et al. 1985).

Family *Sphenolithaceae* Deflandre 1952

Genus *Sphenolithus* Deflandre in Grassé 1952

Sphenolithus anarrhopus Bukry - Bramlette

1969 *Sphenolithus anarrhopus* sp. n.; Bukry - Bramlette, p. 140, pl. 3, figs. 5—8.
1975 *Sphenolithus anarrhopus* Bukry - Bramlette; Proto Decima et al., p. 51, pl. 6, fig. 10.

Distribution: Upper Paleocene to lower part of the lower Eocene, NP6—NP10 (? up to NP11).

Sphenolithus primus Perch-Nielsen

Pl. VIII, figs. 6, 7

1971b *Sphenolithus primus* sp. n.; Perch-Nielsen, p. 357, pl. 11, fig. 4; pl. 12, figs. 4, 5, 7—12; pl. 14, figs. 22—24.

Distribution: Upper part of the lower Eocene up to lower part of the lower Eocene, NP4—NP11.

Sphenolithus radians Deflandre

Pl. X, figs. 11, 12

1954 *Sphenolithus radians* sp. n.; Deflandre (*in* Deflandre - Fert 1954), pl. 12, figs. 36—38; text-fig. 109—112.
1973 *Sphenolithus radians* Deflandre; Locker, p. 772, pl. 11, figs. 3, 4.

Remark: In the sediments of the Bílé Karpaty Unit it occurs rarely in the NP11 Zone.

Distribution: Lower to upper Eocene, NP11—NP19.

Family *Zygodiscaceae* Hay - Mohler 1967

Genus *Neochiastozygus* Perch-Nielsen 1971a

Neochiastozygus concinnus (Martini) Perch-Nielsen

Pl. VIII, figs. 14, 15

1961 *Zygolithus concinnus* sp. n.; Martini, p. 18, pl. 3, fig. 35; pl. 5, fig. 54.
1971c *Neochiastozygus concinnus* (Martini) comb. nov.; Perch-Nielsen, p. 59, pl. 4, fig. 6; pl. 7, figs. 4—6.

Distribution: Upper Paleocene, NP5—NP8.

Neochiastozygus distentus (Bramlette - Sullivan) Perch-Nielsen

1961 *Zygolithus distentus* sp. n.; Bramlette - Sullivan, p. 150, pl. 6, figs. 4—7.
1971c *Neochiastozygus distentus* (Bramlette - Sullivan) comb. nov.; Perch-Nielsen, p. 61, pl. 4, figs. 1—4; pl. 7, figs. 1—3.

Distribution: Upper part of the upper Paleocene to lower part of the lower Eocene, NP8—NP11.

Genus *Zygodiscus* Bramlette-Sullivan 1961

Zygodiscus adamas Bramlette-Sullivan

1961 *Zygodiscus adamas* sp. n.; Bramlette-Sullivan, p. 148, pl. 4, figs. 9, 10.

Distribution: Upper part of the upper Paleocene to lower part of the lower Eocene, NP8—NP11.

Zygodiscus herlyni Sullivan

1964 *Zygodiscus herlyni* sp. n.; Sullivan, p. 186, pl. 6, figs. 1—3.

Distribution: Upper Paleocene, NP7—NP9.

Zygodiscus plectopons Bramlette-Sullivan

1961 *Zygodiscus plectopons* sp. n.; Bramlette-Sullivan, p. 148, pl. 4, fig. 12.
1975 *Zygodiscus plectopons* Bramlette-Sullivan; Proto Decima et al., p. 51, pl. 6, fig. 22.

Distribution: Paleocene to lower Eocene.

Incertae sedis

Genus *Ellipsolithus* Sullivan 1964

Ellipsolithus distichus (Bramlette-Sullivan) Sullivan

Pl. IX, figs. 1—4

1961 *Coccolithus distichus* sp. n.; Bramlette-Sullivan, p. 152, pl. 7, fig. 8.
1964 *Ellipsolithus distichus* (Bramlette-Sullivan) comb. nov.; Sullivan, p. 184, pl. 5, figs. 4—6.
1973 *Ellipsolithus distichus* (Bramlette-Sullivan) Sullivan; Locker, p. 760, pl. 7, fig. 17.

Distribution: Upper Paleocene to lower Eocene.

Ellipsolithus macellus (Bramlette-Sullivan) Sullivan

Pl. IX, fig. 8

1961 *Coccolithus macellus* sp. n.; Bramlette-Sullivan, p. 152, pl. 7, figs. 11—13.
1964 *Ellipsolithus macellus* (Bramlette-Sullivan) comb. nov.; Sullivan, p. 184, pl. 5, fig. 3.
1975 *Ellipsolithus macellus* (Bramlette-Sullivan) Sullivan; Proto Decima et al.; p. 51, pl. 6, fig. 15.

Distribution: Upper part of the lower Paleocene to lower Eocene, NP4—NP12.

Genus *Tribrachiatus* Shamrai 1963

Tribrachiatus bramlettei (Brönnimann - Stradner) Proto Decima

1930 *Marthasterites bramlettei* sp. n.; Brönnimann - Stradner, p. 336, figs. 17—20, 23, 24.
1975 *Tribrachiatus bramlettei* (Brönnimann - Stradner) comb. nov.; Proto Decima et al., p. 49, pl. 4, figs. 17, 18.

Distribution: Lower part of the lower Eocene, NP10—NP11.

Tribrachiatus contortus (Stradner) Bukry

Pl. XI, fig. 7

1958 *Discoaster contortus* sp. n.; Stradner, p. 187, figs. 35, 36.
1959 *Marthasterites contortus* (Stradner) comb. nov.; Deflandre, p. 139.
1972 *Tribrachiatus contortus* (Stradner) comb. nov.; Bukry, p. 1081.

Remark: In the Bílé Karpaty Unit this morphologically conspicuous species is well preserved in the lower Eocene, in the NP10 Zone in association with *Discoaster multiradiatus, Tribrachiatus bramlettei, Transversopontis pulcher,* etc.

Distribution: Lower Eocene, upper part of the NP10 Zone.

Tribrachiatus orthostylus Shamrai

Pl. XI, figs. 6, 8; pl. XII, fig. 6

1954 *Discoaster tribrachiatus* sp. n.; Bramlette - Riedel, p. 379, pl. 38, fig. 11.
1963 *Tribrachiatus orthostylus* sp. n.; Shamrai, p.38, pl. 2, figs. 13, 14.
1976 *Marthasterites tribrachiatus* (Bramlette - Riedel) Deflandre; Bystrická, p. 295, pl. 6, figs. 1, 2.

Distribution: Lower Eocene, NP10—NP12 (rarely to NP15).

K tisku doporučil J. Krhovský
Přeložila T. Hlavatá

Literatura

Aberg, M. (1966): Electron microscopic studies on Nephrolithus (Coccolithophoridae). — Stockholm Contr. Geol., 13, 63—67. Stockholm.

Andrusov, D. - Samuel, O. (1983): Stratigrafický slovník Západných Karpát. — Geol. úst. D. Štúra. Bratislava.

Arkhangelsky, A. D. (1912): Upper Cretaceous deposits of east European Russia. — Mater. Geol. Ross., 25, *1—631.*

Aubry, M. P. (1983): Biostratigrafie du paléogène épicontinental de l'Europe du nord-ouest. Étude fondée sur les nannofossiles calcaires. — Dos. Lab. Géol. Fac. Sci. Lyon, 89, *1—317.* Lyon.

Black, M. - Barnes, B. (1959): The structure of coccoliths from the English Chalk. — Geol. Mag., 96, *321—328.* Cambridge.

Bolli, H. M. - Saunders, J. B. - Perch-Nielsen, K. (1985): Plankton stratigraphy. — Cambridge Univ. Press. Cambridge.

Bouma, A. H. (1962): Sedimentology of some flysch deposits: A graphic approach to facies interpretation. — Elsevier Publ. Co. Amsterdam.

Bramlette, M. N. - Martini, E. (1964): The great change in calcareous nannoplankton fossil between the Maastrichtian and Danian. — Micropaleontology, 10, *291—322.* New York.

Bramlette, M. N. - Riedel, W. R. (1954): Stratigraphic value of discoasters and some other microfossils related to Recent coccolithophores. — J. Paleont., 28, *385—403.* Tulsa.

Bramlette, M. N. - Sullivan, F. R. (1961): Coccolithophorids and related nannoplankton of the Early Tertiary in California. — Micropaleontology, 7, *129—174.* New York.

Bramlette, M. N. - Wilcoxon, J. A. (1967): Middle Tertiary calcareous nannoplankton of the Cipero Section, Trinidad, W. I. — Tulane Stud. Geol. Paleont., 5, *93—131.* New Orleans.

Brönnimann, P. (1955): Microfossils incertae sedis from the Upper Jurassic and Lower Cretaceous of Cuba. — Micropaleontology, 1, *28—51.* New York.

Brönnimann, P. - Stradner, H. (1960): Die Foraminiferen- und Discoasteridenzonen von Kuba und ihre interkontinentale Korrelation. — Erdöl Erdgas Z., 76, *364—369.* Wien.

Brotzen, F. (1959): On Tylocidaris species (Echinoidea) and the stratigraphy of the Danian of Sweden. — Årsbok (Sver. geol. Unders.), 54, *1—81.* Stockholm.

Bukry, D. (1969): Upper Cretaceous coccoliths from Texas and Europe. — Univ. Kan. Paleont. Contr. Protista, 51, *1—79.* Lawrence.

— (1973): Phytoplankton stratigraphy, DSDP Leg 20, Western Pacific Ocean. — Initial Rep. Deep Sea drill. Proj., 20, *307—317.* Washington.

Bukry, D. - Bramlette, M. N. (1969): Some new and stratigraphically useful calcareous nannofossils of the Cenozoic. — Tulane Stud. Geol. Paleont., 7, *131—142.* New Orleans.

Bukry, D. - Percival, S. F. (1971): New Tertiary calcareous nannofossils. — Tulane Stud. Geol. Paleont., 8, *123—146.* New Orleans.

Bybell, L. M. (1975): Middle Eocene calcareous nannofossils at Little Stave Creek, Alabama. — Tulane Stud. Geol. Paleont., 11, *177—247.* New Orleans.

Bystrická, H. (1968): Les discoastéridés du Paléogène des Karpates Occidentales. — Acta geol. geogr. Univ. Comen., Geol., 17, *175—243.* Bratislava.

— (1969): Discoasterides — Nannoplankton der bunten Schichten des mittleren Eozäns. — Acta geol. geogr. Univ. Comen., Geol., 18, *19—92.* Bratislava.

— (1976): Calcareous nannoplankton of the Marthasterites tribrachiatus zone from the Lower Eocene sediments of Slovakia. — Geol. Sbor. Slov. Akad. Vied, 27, *273—297.* Bratislava.

Čepek, P. - Hay, W. W. (1969): Calcareous nannoplankton and biostratigraphic subdivision of the Upper Cretaceous. — Trans. Gulf Coast Assoc. geol. Soc., 19, *323—336.*

Crux, J. A. (1981): New calcareous nannofossils taxa from the Cretaceous of South East England. — Neu. Jb. Geol. Paläont., Mh., 10, *633—640*. Stuttgart.

Deflandre, G. (1947): Braarudosphaera nov. gen. type d'une famille nouvelle de Coccolithophoridés actuels à éléments composites. — C. R. hebd. Séanc. Acad., Sci. Sér. D, 225, *439—441*. Paris.

— (1959): Sur les nannofossiles calcaires et leur systématique. — Rev. Micropaléont., 2, *127—152*. Paris.

— (1963): Sur les Microhabdulidés, famille nouvelle de nannofossiles calcaires. — C. R. hebd. Séanc. Acad. Sci., Sér. D, 256, *3484—3486*. Paris.

Deflandre, G. - Fert, C. (1954): Observations sur les Coccolithophoridés actuels et fossiles en microscopie ordinaire et électronique. — Ann. Paléont., 40, *115—176*. Paris.

Dères, F - Achéritéguy, J. (1972): Contribution à l'étude des Nannoconidés dans le Crétacé inferieur du Basin d'Aquitanie. — Mém. Bur. Rech. géol. min., 77, *155—163*. Orléans.

Doeven, P. H. (1983): Cretaceous nannofossil stratigraphy and paleoecology of the Canadian Atlantic Margin. — Bull. Geol. Surv. Can., 356, *1—70*. Ottawa.

Ehrenberger, C. C. (1836): Bemerkungen über feste mikroskopische anorganische Formen in den erdigen und derben Mineralien. — Ber. Dtsch. Akad. Wiss., Jg. 1836, *1—85*.

Forchheimer, S. (1972): Scanning electron microscope studies of Cretaceous coccoliths from the Köpingsberg borehole no. 1, SE Sweden. — Sver. geol. Unders., Ser. C, 65, *5—140*. Stockholm.

Gartner, S. (1968): Coccoliths and related calcareous nannofossils from Upper Cretaceous deposits of Texas and Arkansas. — Univ. Kan. Paleont. Contr., Protista, 48, *1—56*. Lawrence.

— (1971): Calcareous nannofossils from the Joides blake plateau cores, and revision of Paleogene nannofossil zonation. — Tulane Stud. Geol. Paleont., 8, *101—146*. New Orleans.

Gašpariková, V. (1977): Correlation of nannoplankton assocations with Upper Cretaceous foraminiferal biozones of the West Carpathians. — Západ. Karpaty, Sér. Paleont., 2—3, *151—173*. Bratislava.

— (1984): Cretaceous nannoplankton zones of the West Carpathians — nanoplanktónové zóny kriedy Západných Karpát. — Západ. Karpaty, Sér. Paleont., 9, *73—86*. Bratislava.

Górka, H. (1957): Les coccolithophoridés du Maestrichtien supérieur de Pologne. — Acta palaeont. pol., 2, *235—284*. Warszawa.

Gran, H. H. - Braarud, T. (1935): A quantitative study of the phytoplankton in the Bay of Fundy and the Gulf of Marine. — J. Biol. Board Canada, 1, *279—467*.

Hanzlíková, E. (1956): B. Mikrobiostratigrafický výzkum popisovaného území a jeho okolí. *In:* A. Matějka - Z. Roth: Geologie magurského flyše v severním povodí Váhu mezi Bytčou a Trenčínem. — Rozpr. Ústř. Úst. geol., 22, *207—220* Praha.

— (1980): Revize mikrobiostratigrafie magurského flyše v úseku Jih a v podloží neogénu v moravské části vídeňské pánve. — MS Ústř. úst. geol., *1—228*. Praha.

— (1984a): Biostratigrafie vrtu Hluk V3. — MS Ústř. úst. geol., *1—15*. Praha.

— (1984b): Hlavní výsledky výzkumu geotraversů v bělokarpatské jednotce. Mikropaleontologická biostratigrafie vybraných profilů v oblasti púchovské. — MS Ústř. úst. geol., *1—46*. Praha.

Hanzlíková, E. - Krhovský, J. - Švábenická, L. (1982): Calcareous nannoplankton from the type locality of the Frýdek Formation (Lower Maastrichtian). — Sbor. geol. Věd, Paleont., 25, *127—155.* Praha.

Haq, B. U. (1971): Paleogene calcareous nannoflora Parts I—IV. — Stockholm Contr. Geol., 25, *1—158.* Stockholm.

Hattner, J. G. - Wind, F. S. - Wise, S. W. Jr. (1980): The Santonian—Campanian boundary: comparison of nearshore — offshore calcareous nannofossil assemblages.. — Cah. Micropaleont., 3, *9—26.* Paris.

Hattner, J. G. - Wise, S. W. Jr. (1980): Upper Cretaceous calcareous nannofossil biostratigraphy of South Carolina. — South Carolina Geology, 24, *41—115.* Florida.

Hay, W. W. - Mohler, H. (1967): Calcareous nannoplankton from early Tertiary rocks at Pont Labau, France, and Paleocene—Eocene correlations. — J. Paleont., 41, *1505—1541.* Tulsa.

Hay, W. W. - Mohler, H. - Roth, P. H. et al. (1967): Calcareous nannoplankton zonation of the Cenozoic of the Gulf Coast and Caribbean—Antillean area, and transoceanic correlations. — Trans. Gulf Coast Assoc. Geol. Soc., 17, *428—480.*

Hay, W. W. - Mohler, H. - Wade, M. E. (1966): Calcareous nannofossils from Nal'chik (Northwest Caucasus). — Eclogae geol. Helv., 59, *379—399.* Basel.

Hay, W. W. - Towe, K. M. (1963): Microrhabdulus belgicus, a new species of nannofossil. — Micropaleontology, 9, *95—96.* New York.

Hill, M. E. (1976): Lower Cretaceous calcareous nannofossils from Texas and Oklahoma. — Paleontographica, Abt. B, 156, *103—197.* Stuttgart.

Hoffmann, N. (1970): Placozygus n. gen. (Coccolithineen) aus der Oberkreide des nördlichen Mitteleuropas. — Geologie, 19, *1004—1009.* Berlin.

Honjo, S. (1976): Coccoliths: production, transportion and sedimentation. — Mar. Micropaleont., 1, *65—79.* Amsterdam.

Locker, S. (1968): Biostratigraphie des Alttertiärs von Norddeutschland mit Coccolithophoriden. — Mber. Dtsch. Akad. Wiss. Berlin, 10, *220—229.* Berlin.

— (1973): Coccolithineen aus dem Paläogen Mitteleuropas. — Paläobotanik, 3, *735—836.* Berlin.

Manivit, H. (1965): Nannofossiles calcaires de l'Albo-Aptien. — Rev. Micropaléont., 8, *189—201.* Paris.

— (1971): Nannofossiles calcaires du Crétacé français (Aptien—Maestrichtien). Essai de biozonation appuyée sur stratotypes. — Thèse Doctorate d'État, Fac. Sci. d'Orsay et Luis Jean a Gap, *1—187.* Paris.

— (1984): Paleogene and Upper Cretaceous calcareous nannofossils from DSDP Leg 74. — Initial Rep. Deep Sea drill. Proj. 74, *475—499.* Washington.

Manivit, H. - Perch-Nielsen, K. - Prins, B. - Verbeek, J. W. (1977): Mid-Cretaceous calcareaus nannofossil biostratigraphy. — Kon. Nederl. Akad. Wet., B 80, *169—181.* Amsterdam.

Martini, E. (1958): Discoasteriden und verwandte Formen im NW-deutschen Eozän (Coccolithophorida), 1. Taxonomische Untersuchungen. — Senckenberg. lethaea, 39, *353—388.* Frankfurt.

— (1961): Nannoplankton aus dem Tertiär und der obersten Kreide von SW-Frankreich. — Senckenberg, lethaea, 42, *1—32.* Frankfurt.

— (1971): Standard Tertiary and Quaternary calcareous nannoplankton zonation. — Proc. II. Plankt. Conf., Roma 1970, 2, *739—785.* Roma.

Martini, E. - Stradner, H. (1960): Nannotetraster, eine stratigraphisch bedeutsame neue Discoasteridengattung. — Erdöl Erdgas Z., 76, *266—270.* Wien.

Matějka, A. - Roth, Z. (1956): Geologie magurského flyše v severním povodí Váhu mezi Bytčou a Trenčínem. — Rozpr. Ústř. Úst. geol., 22, *7—332.* Praha.

Noël, D. (1959): Étude de coccolithes du Jurassique et du Crétacé inferieur. — Publ. Serv. Carte géol. Algérie, 2, 20, *155—196.* Alger.

— (1965): Sur les Coccolithes du Jurassique Européen et d'Afrique du Nord. — Edition du CNRS Paris, *1—209.* Paris.

— (1969): Arkhangelskiella (coccolithes crétacés) et formes affines du Bassin de Paris. — Rev. Micropaléont., 11, *191—204.* Paris.

— (1970): Coccolithes Crétacés, La Craie Campanienne du Basin de Paris. — Edition du CNRS Paris, *1—129.* Paris.

Okada, H. - Bukry, D. (1980): Supplementary modification and introduction of code numbers to the low-latitude coccolith biostratigraphic zonation. — Mar. Micropaleont., 5, *321—325.* Amsterdam.

Perch-Nielsen, K. (1968): Der Freibau und die Klassifikation der Coccolithen aus dem Maastrichtien von Dänemark. — K. dan. Vidensk. Selsk. Biol. Skr., 16, *1—96.* Kopenhagen.

— (1971a): Durchsicht tertiärer Coccolithen. — Proceedings II. Planktonic Conference, Roma 1970, 2, *939—980.* Roma.

— (1971b): Einige neue Coccolithen aus dem Paläozän der Bucht von Biskaya. — Bull. Geol. Soc. Den., 21, *347—361.* Kopenhagen.

— (1971c): Neue Coccolithen aus dem Paläozän von Dänemark, der Bucht von Biskaya und dem Eozän der Labrador-See. — Bull. Geol. Soc. Den., 21, *51—66.* Kopenhagen.

— (1971d): Elektronenmikroskopische Untersuchungen an Coccolithen und verwandten Formen aus dem Eozän von Dänemark. — K. dan. Vidensk. Selsk. Biol. Skr 18, *1—76.* Kopenhagen.

— (1977): Albian to Pleistocene calcareous nannofossils from the western South Atlantic. — Initial Rep. Deep Sea drill. Proj., 39, *699—823.* Washington.

— (1979): Calcareous nannofossils from the Cretaceous between the North Sea and the Mediterranean. — Aspekte der Kreide Europas, IUGS Ser. A, 6, *223—272.* Stuttgart.

— (1981): New Maastrichtian and Paleocene calcareous nannofossils from Africa, Denmark, the USA and the Atlantic, and some Paleocene lineages. — Eclogae geol. Helv., 74, *831—863.* Basel.

— (1984): Validation of new combinations. — INA Newsletter, 6, *42—46.* Utrecht.

Pesl, V. (1968): Litofacie paleogénu v magurské jednotce vnějších flyšových Karpat. — Zbor. geol. Vied, Západ. Karpaty, 9, *71—118.* Bratislava.

Prins, B. (1971): Speculations on relations, evolution and stratigraphic distribution of discoasters. — Proc. II. Plankt. Conf., Roma 1970, 2, *1017—1037.* Roma.

Proto Decima, F. - Roth, P. H. - Todesco, L. (1975): Nannoplancton calcareo del Paleocene e dell'Eocene della Sezione di Possagno. — Schweiz. paläont. Abh., 97, *35—55.* Basel.

Radomski, A. (1968): Calcareous nannoplankton zones in Palaeogene of the western Polish Carpathians. — Rocz. Pol. Tow. geol., 38, *545—605.* Kraków.

Reinhardt, P. (1964): Einige Kalkflagellaten-Gattungen (Coccolithophoriden, Coccolithineen) aus dem Mesozoikum Deutschlands. — Mber. Dtsch. Akad. Wiss. Berlin, 6, *749—759.* Berlin.

— (1965): Neue Familien für fossile Kalkflagellaten (Coccolithophoriden, Coccolithineen). — Mber. Dtsch. Akad. Wiss. Berlin, 7, *29—40.* Berlin.

— (1966): Zur Taxonomie und Biostratigraphie des fossilen Nannoplanktons aus dem Malm, der Kreide und dem Alttertiär Mitteleuropas. — Freiberg. Forsch.-H., R. C, 196, *5—109.* Freiberg.

— (1971): Synopsis der Gattungen und Arten der mesozoischen Coccolithen und anderer kalkiger Nannofossilien, III. — Freiberg. Forsch.-H., R. C, 267, *19—41.* Freiberg.

Reinhardt, P. - Górka, H. (1967): Revision of some Upper Cretaceous coccoliths from Poland and Germany. — Neu. Jb. Geol. Paläont., Abh., 129, *240—256.* Stuttgart.

Romein, A. J. T. (1979): Lineages in early Paleogene calcareous nannoplankton. — Utrecht micropaleont. Bull., 22, *1—231.* Utrecht.

Roth, P. H. (1978): Cretaceous nannoplankton biostratigraphy and oceanography of the Northwestern Atlantic Ocean. — Initial Rep. Deep Sea drill. Proj., 44, *731—759.* Washington.

Roth, P. H. - Thierstein, H. (1972): Calcareous nannoplankton: Leg 14 of the DSDP. — Initial Rep. Deep Sea drill. Proj., 14, *421—485.* Washington.

Salaj, J. - Kysela, J. - Gašpariková, V. - Began, A. (1978): Dán a mont manínskej série západne od Žiliny a otázka laramského vrásnenia. — Geol. Práce, Spr. 70, *57—81.* Bratislava.

Schiller, J. (1930): Coccolithineae. — *In:* L. Rabenhorst: Kryptogamen-Flora von Deutschland, Österreich und Schweiz, 10, *89—267,* Akad. Verlag. Berlin.

Schlanger, S. O. - Douglas, R. G. et al. (1973): Fossil preservation and diagenesis of pelagic carbonates from the Magellan Rise, central North Pacific Ocean. — Initial Rep. Deep Sea drill. Proj., 18, *208—253.* Washington.

Seyve, Ch. (1984): Le passage Crétacé—Tertiaire à Pont Labau (Pyrénées-Atlantiques, France). — Bull. Cent. Rech. Explor., 8, *385—423.* Pau.

Shamrai, I. A. (1963): Certain forms of Upper Cretaceous and Paleogene coccoliths and discoasters from the southern Russian Platform. — Izv. vys. učeb. Zaved., Geol. Razv., 6, *27—40.* Moskva.

Shafik, S. - Stradner, H. (1971): Nannofossils from the Eastern Desert, Egypt with reference to Maastrichtian nannofossils from the USSR. — Jb. Geol. Bundesanst., Sonderband 17, *60—104.* Wien.

Sherwood, R. W. (1974): Calcareous nannofossils systematics, paleoecology and biostratigraphy of the Middle Eocene Weches Formation of Texas. — Tulane Stud. Geol. Paleont., 11, *1—79.* New Orleans.

Sissingh, W. (1977): Biostratigraphy of Cretaceous nannoplankton, with Appendix by Prins B. et Sissingh W. — Geol. en Mijnb., 56, *37—65.* Haag.

Smith, Ch. C. (1981): Calcareous nannoplankton and stratigraphy of Late Turonian, Coniacian and early Santonian age of the Eagle Ford and Austin Groups of Texas. — Geol. Surv. profess. Pap., 1075, *1—98.* Washington.

Stover, L. E. (1966): Cretaceous coccoliths and associated nannofossils from France and the Netherlands. — Micropaleontology, 12, *133—167.* New York.

Stradner, H. (1958): Die fossilen Discoasteriden Österreichs, I. — Erdöl Erdgas Z., 74, *178—188.* Wien.

— (1959): Die fossilen Discoasteriden Österreichs, II. — Erdöl Erdgas Z., 75, *472—488.* Wien.

— (1961): Vorkommen von Nannofossilien im Mesozoikum und Alttertiär. — Erdöl Erdgas Z., 77, *77—88.* Wien.

— (1962): Über neue und wenig bekannte Nannofossilien aus Kreide und Alttertiär. — Verh. Geol. Bundesanst., 2, *363—377.* Wien.

Stráník, Z. - Menčík, E. - Krejčí, O. (1986): Přínos studia geotraversů pro geologii bělokarpatské jednotky a řešení jejího vztahu k vnějším jednotkám magurského příkrovu a k bradlovému pásmu. — MS Ústř. úst. geol., *1—57.* Praha.

Sullivan, F. R. (1964): Lower Tertiary nannoplankton from the California Coast Ranges I. Paleocene. — Univ. Calif. Publ. geol. Sci., 44, *163—227.* Los Angeles.

— (1965): Lower Tertiary nannoplankton from the California Coast Ranges II. Eocene. — Univ Calif. Publ. geol. Sci., 53, *1—74.* Los Angeles.

Šumenko, S. I. (1968): Nekotorye momenty ontogeneza, izmenčivosti i sistematiki iskopaemych kokkolitoforid na osnove élektronno-mikroskopičeskich issledovanij. — Paleont. Ž., 4, *32—37*. Moskva.

Švábenická, L. (1985): Mikrobiostratigrafie vrtů Hluk V2, Hluk V3 a Hluk V4. — MS Ústř. úst. geol., *1—38*. Praha.

— (1986): Vápnitý nanoplankton v sedimentech lokalit Modrá Voda - Komňa a Bzová (bělokarpatská jednotka). — Zpr. geol. Výzk. v Roce 1984, *211—212*. Praha.

— (1987): Vápnitý nanoplankton ve flyšových sedimentech bělokarpatské jednotky. — MS Ústř. úst. geol., *1—152*. Praha.

— (1988): Svrchní senon v sedimentech flyšového vývoje bělokarpatské jednotky. — Zpr. geol. Výzk. v Roce 1985, *194*. Praha.

— (v tisku): Results of microbiostratigraphic study of the Bělokarpatská Unit. — Knihovnička ZPN Miscelanea Micropalaeontologica II. Hodonín.

Thierstein, H. R. (1976): Mesozoic calcareous nannoplankton biostratigraphy of marine sediments. — Mar. Micropaleont., 1, *325—362*. Amsterdam.

Vekšina, V. N. (1959): Kokkolitoforidy maastrichtskich otloženij zapadnosibirskoj nizmennosti. — Trudy CNIIGGIMS, 2, *56—77*. Leningrad.

Wallich, G. C. (1977): Observations on the coccosphere. — Ann. Mag. natur. Hist., 4, *322—339*. London.

Weidmann, M. (1967): Petite contribution à la connaissaince du flysch. — Bull. Lab. Géol. Minéral. Géophys. Mus. géol. Univ., 1966, *1—6*. Lausanne.

Wise, W. - Wind, F. H. (1976): Mesozoic and Cenozoic calcareous nannofossils recovered by DSDP Leg 36 drilling on the Falkland Plateau, SW Atlantic sector of the Southern Ocean. — Initial Rep. Deep Sea drill. Proj., 36, *269—313*. Washington.

Explanation of plates

Abbreviations used: trans. light = transmitted light; x-nic. = crossed nicols.

Pl. I

1—4. *Vagalapilla matalosa* (Stover) Thierstein; 1, 2 — Javořina 31D, 1 — trans. light, 2 — x-nic.; 3, 4 — Janegov Mlyn 1162/3, x-nic.

5, 9, 10. *Broinsonia ex gr. enormis* (Shumenko) Manivit; 5 — Svinárský brook 40, x-nic.; 9, 10 — Javořina 31A, 9 — trans. light, 10 — x-nic.

6—8, 24. *Cribrosphaerella ehrenbergii* (Arkhangelsky) Deflandre; 6—8 — Svinárský brook 40, 6 — trans. light, 7, 8 — x-nic.; 24 — Zemianske Podhradie 9A, trans. light.

11. *Glaukolithus compactus* (Bukry) Perch-Nielsen; Janegov Mlyn J149/9, x-nic.

12. *Tranolithus exiguus* Stover; Javořina 31D, x-nic.

13. *Glaukolithus diplogrammus* (Deflandre) Reinhardt; Vyškovec 51A, x-nic.

14, 15. *Placozygus fibuliformis* (Reinhardt) Hoffmann; Vyškovec 51A, x-nic.

16, 17, 21, 22. *Eiffellithus eximius* (Stover) Perch-Nielsen; 16, 17 — Svinárský brook 40, 16 — trans. light, 17 — x-nic.; 21, 22 — Javořina 31D, 21 — trans. light, 22 — x-nic.

18—20, 23. *Eiffellithus turriseiffeli* (Deflandre) Reinhardt; 18, 19 — Javořina 31D, 18 — trans. light, 19 — x-nic.; 20, 23 — Kostolník 5, x-nic.

×2500

Pl. II

1, 2. *Vekshinella crux* (Deflandre et Fert) Shafik et Stradner; Kostolník 5, 1 — trans. light, 2 — x-nic.

3—5. *Ahmuellrella octoradiata* (Górka) Reinhardt; 3, 4 — Javořina 31A, 3 — trans. light, 4 — x-nic.; 5 — Svinárský brook, x-nic.

6, 7. *Micula* cf. *concava* (Stradner) Verbeek; Vápenky 209, 6 — trans. light, 7 — x-nic.

8—12. *Micula decussata* Vekshina; 8, 9 — Uhlisko brook 11C, 8 — trans. light, 9 — x-nic.; 10 — Vápenky 209, x-nic.; 11, 12 — Javořina 31A, x-nic.

13—15. *Quadrum gartneri* Prins et Perch-Nielsen; Svinárský brook 40, 13 — trans. light, 14, 15 — x-nic.

16, 17. — *Eiffellithus trabeculatus* (Górka) Reinhardt et Górka; Janegov Mlyn J162/3, 16 — trans. light, 17 — x-nic.

18, 19. *Calculites obscurus* (Deflandre) Prins et Sissingh; Javořina 31A; 18 — trans. light, 19 — x-nic.

20. *Aspidolithus* ex gr. *parcus* (Stradner) Noël; Javořina 31D, x-nic.

21. *Arkhangelskiella specillata* Vekshina; Janegov Mlyn J149/2, x-nic.

22. *Micula decussata* Vekshina, *Kamptnerius magnificus* Deflandre; Javořina 31D, trans. light. ×2500

Pl. III

1—3. *Lithraphidites quadratus* Bramlette et Martini; Vyškovec 51A, 1, 2 — trans. light, 3 — x-nic.

4—6. *Biscutum constans* (Górka) Black; 4, 5 — Uhlisko brook 11C, 4 — trans. light 5 — x-nic.; 6 — Vyškovec 51A, x-nic.

7—9. *Cyclagelosphaera reinhardtii* (Perch-Nielsen) Romein; 7, 8 — Uhlisko brook 11A, 7 — trans. light, 8 — x-nic.; 9 — Filipovo valley 4A, x-nic.

10, 11. *Ceratolithoides aculeus* (Stradner) **Prins et Sissingh**; Javořina — Velička 31A, 10 — trans. light, 11 — x-nic.

12—14 *Watznaueria barnesae* (Black) Perch-Nielsen; Svinárský brook 40, 12 — trans. light, 13, 14 — x-nic.

15. *Ellipsagelosphaera britannica* (Stradner) Perch-Nielsen; Janegov Mlyn J162/3, x-nic.

16, 17. *Eprolithus floralis* (Stradner) Stover; Javořina 31A, 16 — trans. light, 17 — x-nic.

18, 19. *Lithastrinus grillii* Stradner; Janegov Mlyn J162/2, 18 — trans. light, 19 — x-nic.

20, 21. *Arkhangelskiella specillata* Vekshina; Javořina 31A, 20 — trans. light, 21 — x-nic.

22, 23. *Arkhangelskiella cymbiformis* Vekshina; Uhlisko brook 11C, 22 — trans. light, 23 — x-nic.

Figs. 1—21 ×2500
Figs. 22, 23 ×2000

Pl. IV

1—4. *Gartnerago obliquum* (Stradner) Reinhardt; 1, 2 — Svinárský brook 45B, 1 — trans. light, 2 — x-nic.; 3, 4 — Vyškovec 51A, 3 — trans. light, 4 — x-nic.

5. *Chiastozygus litterarius* (Górka) Manivit; *Lithraphidites carniolensis* Deflandre; Žítková 12A, x-nic.

6, 7, 9, 10. *Aspidolithus parcus constrictus* (Hattner) Perch-Nielsen; 6, 7 —

Janegov Mlyn J151, 6 — trans. light, 7 — x-nic.; 9 — Javořina 31A, x-nic.; 10 — Svinárský brook 45B, x-nic.

11. *Aspidolithus parcus parcus* (Stradner) Noël; Svinárský brook 45B, x-nic.

8, 12. *Zeugrhabdotus embergeri* (Noël) Perch-Nielsen; 8 — Žítková 12A, x-nic.; 12 — Janegov Mlyn J149/9, x-nic.

13—15. *Arkhangelskiella cymbiformis* Vekshina; 13, 14 — Vyškovec 51A, 13 — trans. light; 14 — x-nic.; 15 — Zemianske Podhradie 9A, x-nic. ×2000

Pl. V

1, 2. *Aspidolithus parcus parcus* (Stradner) Noël; Javořina 31A, 1 — trans. light, 2 — x-nic.

3. *Nannoconus* cf. *farinacciae* Bukry; Svinárský brook 45B, trans. light.

4, 5. *Reinhardtites* cf. *anthophorus* (Deflandre) Perch-Nielsen; 4 — Janegov Mlyn J149/9, x-nic.; 5 — Javořina 31A, x-nic.

6, 7. *Markalius inversus* (Deflandre) Bramlette et Martini; Zemianske Podhradie, 6 — trans. light, 7 — x-nic.

8, 9. *Nannoconus elongatus* Brönnimann; Javořina 31A, 8 — trans. light, 9 — x-nic.

10—13. *Braarudosphaera bigelowii* (Gran et Braarud) Deflandre; 10, 11 — Žítková 12A, 10 — trans. light, 11 — x-nic.; 12, 13 — Vyškovec 51A, 12 — trans. light, 13 — x-nic.

14—16. *Kamptnerius magnificus* Deflandre; 14, 15 — Vápenky 209, 14 — trans. light, 15 — x-nic.; 16 — Javořina 31D, trans. light.

17—19. *Manivitella pemmatoidea* (Deflandre) Thierstein; 17 — Svinárský brook 45B, x-nic.; 18, 19 — Javořina 31A, 18 — trans. light, 19 — x-nic. ×2500

Pl. VI

1. *Rhagodiscus angustus* (Stradner) Reinhardt; Vyškovec 51A, x-nic.

2—5. *Chiastozygus litterarius* (Górka) Manivit; 2, 3 — Svinárský brook 45B, 2 — trans. light, 3 — x-nic.; 4, 5 — Žítková 12A, 4 — trans. light, 5 — x-nic.

6—9. *Prediscosphaera cretacea* (Arkhangelsky) Gartner; 6, 7 — Uhlisko brook 11C, 6 — trans. light, 7 — x-nic.; 8, 9 — Vyškovec 51A, 8 — trans. light, 9 — x-nic.

10, 11. *Prediscosphaera spinosa* (Bramlette et Martini) Gartner; 10 — Javořina 31D, x-nic.; 11 — Vyškovec 51A, x-nic.

12—14. *Stradneria crenulata* (Bramlette et Martini) Noël; 12 — Svinárský brook 45B, x-nic.; 13, 14 — Žítková 12A, x-nic.

15—18. *Cretarhabdus conicus* Bramlette et Martini; 15, 16 — Zemianske Podhradie 9A, 15 — trans. light, 16 — x-nic.; 17, 18 — Javořina 31A, 17 — trans. light, 18 — x-nic.

19. *Cribrosphaerella ehrenbergii* (Arkhangelsky) Deflandre; Uhlisko brook 11C, trans. light.

20, 21. *Lithastrinus grillii* Stradner; Svinárský brook 40, 20 — trans. light, 21 — x-nic.

22. *Prediscosphaera* sp.; Janegov Mlyn J162/3, trans. light. ×2500

Pl. VII

1, 2. *Reinhardtites anthophorus* (Deflandre) Perch-Nielsen; Javořina 31D, 1 — trans. light, 2 — x-nic.

3, 4. *Tranolithus phacelosus* Stover; Myjava brook, 7, 3 — trans. light, 4 — x-nic.

5, 6. *Rotelapillus crenulatus* (Stover) Perch-Nielsen; Svinársky brook 40, 5 — trans. light, 6 — x-nic.

7, 8. *Microrhabdulus decoratus* Deflandre; Kostolník 5, 7 — trans. light, 8 — x-nic.

9, 10. *Microrhabdulus belgicus* Hay et Towe; Janegov Mlyn J162/3, 9 — trans. light, 10 — x-nic.

11, 12. *Braarudosphaera* sp.; Kostolník 5, 11 — trans. light, 12 — x-nic.

13—15. *Lucianorhabdus cayeuxii* Deflandre; 13, 14 — Javořina 31D, 13 — trans. light, 14 — x-nic.; 15 — Janegov Mlyn J162/2, trans. light. ×2000

Pl. VIII

1. *Ericsonia subpertusa* Hay et Mohler; sv. Štěpán quarry 7h, x-nic.

2, 3. *Cruciplacolithus primus* Perch-Nielsen; Studený hill 17A, 2 — trans. light, 3 — x-nic.

4, 5. *Markalius inversus* (Deflandre) Bramlette et Martini; Klanečnice brook 4A, 4 — trans. light, 5 — x-nic.

6, 7. *Sphenolithus primus* Perch-Nielsen; Modrá Voda quarry 5A, 6 — trans. light, 7 — x-nic.

8, 9, 13. *Fasciculithus involutus* Bramlette et Sullivan; 8, 9 — Bílý hill 11, 8 — trans. light, 9 — x-nic.; 13 — Čerešenková hill 59, x-nic.

10—12. *Toweius pertusus* (Sullivan) Romein; Modrá Voda quarry 5A, 10 — trans. light, 11, 12 — x-nic.

14, 15. *Neochiastizygus concinnus* (Martini) Perch-Nielsen; Čerešenková hill 59, 14 — trans. light, 15 — x-nic.

16—21. *Toweius eminens* (Bramlette et Sullivan) Perch-Nielsen; 16, 17 — Čakanov 8B/85, 16 — trans. light, 17 — x-nic.; 18, 19 — Velká n. Veličkou 9, 18 — trans. light, 19 — x-nic.; 20, 21 — Podbranč 1A, 20 — trans. light, 21 — x-nic. ×2500

Pl. IX

1—4. *Ellipsolithus distichus* (Bramlette et Sullivan) Sullivan; 1, 2 — Bílý hill 11, 1 — trans. light, 2 — x-nic.; 3, 4 — Velká n. Veličkou 9, 3 — trans. light, 4 — x-nic.

5, 6, 11. *Chiasmolithus bidens* (Bramlette et Sullivan) Hay et Mohler; 5, 6 — Modrá Voda quarry 5A, 5 — trans. light, 6 — x-nic.; 11 — Bzová 6A, trans. light.

7. *Chiasmolithus solitus* (Bramlette et Sullivan) Locker; Louka 1, trans. light.

8. *Ellipsolithus macellus* (Bramlette et Sullivan) Sullivan; Čerešenková hill 59, x-nic.

9, 10. *Chiasmolithus sp.* cf. *Ch. consuetus* (Bramlette et Sullivan) Hay et Mohler; Bzová 6A, 9 — trans. light, 10 — x-nic.

12. *Scapholithus fossilis* Deflandre; Modrá Voda quarry 5A, x-nic.

13—16. *Ericsonia subpertusa* Hay et Mohler; 13, 14 — Studený hill 17A, 13 — trans. light, 14 — x-nic.; 15, 16 — Klanečnice brook 4A, 15 — trans. light, 16 — x-nic.

17—19. *Ericsonia robusta* (Bramlette et Sullivan) Perch-Nielsen; Javorník 12C, 17 — trans. light, 18, 19 — x-nic.

20. *Heliolithus kleinpellii* Sullivan; Čerešenková hill 59, x-nic. ×2500

Pl. X

1, 2. *Campylosphaera dela* (Bramlette et Sullivan) Hay et Mohler; Velká n. Veličkou 11, 1 — trans. light, 2 — x-nic.

3, 4. *Ericsonia formosa* (Kamptner) Haq; Velká n. Veličkou 11, trans. light.

5. *Transversopontis pulcheroides* (Sullivan) Perch-Nielsen; Javorník 12D, x-nic.

6. *Transversopontis pulcher* (Deflandre) Perch-Nielsen; Šance-Nová Hora J31, x-nic.

7, 8. *Markalius inversus* (Deflandre) Bramlette et Martini; sv. Štěpán quarry 7j, 7 — trans. light, 8 — x-nic.

9, 10. *Chiasmolithus eograndis* Perch-Nielsen; Velká n. Veličkou 11, 9 — trans. light, 10 — x-nic.

11, 12. *Sphenolithus radians* Deflandre; Velká n. Veličkou 10, x-nic.

13, 14. *Zygrhablithus bijugatus* (Deflandre) Deflandre; Bílý hill 10E, 13 — trans. light, 14 — x-nic.

15, 16. *Chiasmolithus grandis* (Bramlette et Riedel) Radomski; Bílý hill 10E, 15 — trans. light, 16 — x-nic.

17—19. *Cruciplacolithus sp.* cf. *C. tenuis* (Stradner) Hay et Mohler; Modrá Voda quarry 5A, 17 — trans. light, 18, 19 — x-nic.

×2500

Pl. XI

1. *Discoaster delicatus — multiradiatus*; Modrá Voda quarry 5B.
2. *Discoaster deflandrei* Bramlette et Riedel; Javorník 20.
3. *Discoaster lenticularis* Bramlette et Sullivan; Podbranč 1A.
4. *Discoaster sp.* cf. *D. gemmifer* Stradner; Šance-Nová Hora J31.
5. *Discoaster mohleri* Bukry et Percival; Podbranč 1A.

6, 8. *Tribrachiatus orthostylus* Shamrai; 6 — Bílý hill 10D; 8 — Javorník 13 E.

7. *Tribrachiatus contortus* (Stradner) Bukry; Bílý hill 10E.

9, 10. *Discoaster multiradiatus* Bramlette et Riedel; 9 — Bílý hill 11, 10 — Šance-Nová Hora J31.

×2500

Pl. XII

1. *Lithraphidites carniolensis* Deflandre; Svinárský brook 40, ×6000.
2. *Eiffellithus turriseiffeli* (Deflandre) Reinhardt; Podbranč 15, ×10500.
3. *Chiasmolithus bidens* (Bramlette et Sullivan) Hay et Mohler; Klanečnice brook 5, ×6000.
4. *Tranolithus exiguus* Stover; Svinárský brook 40, ×10400.

5, 7. *Discoaster multiradiatus* Bramlette et Riedel; 5 — Bílý hill 11, ×7000; 7 — Javorník 12B, ×8000.

6. *Zeugrhabdotus theta* (Black) Black; Svinárský brook 40, ×9400.

8. *Tribrachiatus orthostylus* Shamrai; Javorník 13E, ×5200.

Light micrographs by author, SEM photographs by F. Odehnal.

Vápnitý nanoplankton ve flyšových sedimentech bělokarpatské jednotky (Západní Karpaty)

(Résumé anglického textu)

Lilian Švábenická

Předloženo 29. ledna 1988

Flyšové sedimenty vnějšího vývoje bělokarpatské jednotky (javorinské a svodnické souvrství sensu Stráník et al. 1986) obsahují společenstva vápnitých nanofosilií s druhy, pomocí kterých můžeme stanovit relativní stáří hornin s přesností na stupně až zóny. Vzorky byly odebrány převážně z vrstviček T_d a T_{et-p} flyšových rytmů.

V javorinském souvrství se vyskytuje nanoplankton stáří spodní kampan až svrchní maastricht bez paleogenních indicií. Bylo zjištěno 62 druhů nanofosilií. Vzhledem k odchylnému biofaciálnímu vývoji nemohla být použita v celém rozsahu zonace Sissingha (1977). Pro oblast bělokarpatské jednotky bylo vymezeno 7 nanoplanktonových zón, které se částečně kryjí s CC zónami (sensu Sissingh 1977): Aspidolithus parcus, Ceratolithoides aculeus, Quadrum sissinghii, Quadrum trifidum, Arkhangelskiella cymbiformis, Lithraphidites quadratus a Nephrolithus frequens. Souběžně studovaná mikrofauna obsahovala pouze aglutinované foraminifery bez vápnitých forem širšího stratigrafického rozsahu svrchní křída—paleocén.

Ve svodnickém souvrství byl zjištěn odlišný vývoj mikrofaun a vápnitého nanoplanktonu ve srovnání s javorinským souvrstvím. Mikrofauny obsahovaly vedle aglutinovaných foraminifer i vápnitý plankton a bentos a doložily obdobné relativní stáří jako vápnité nanofosilie. Nanoplankton (zjištěno 47 druhů) udává stáří svodnického souvrství spodní paleocén až spodní eocén ?NP1—NP2 až NP11 (sensu Martini 1971). Pro flyšové sedimenty svodnického souvrství jsou charakteristické hojné redepozice ze svrchní křídy. Přeplavený paleogenní materiál se v paleocénu a spodním eocénu vyskytoval ojediněle.

Studium druhové skladby společenstev vápnitého nanoplanktonu a mikrofauny ukázalo závislost výskytu obou skupin v jednotlivých intervalech flyšových rytmů T_d a T_e. Vápnité nanofosilie se nevyskytují pouze v nevápnitých jílovcích T_{ep}, které vznikly v období klidové sedimentace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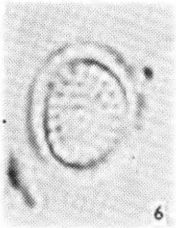
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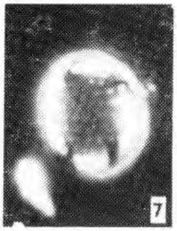
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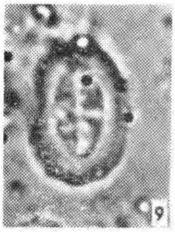
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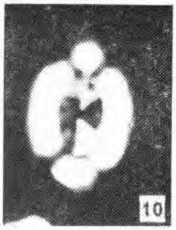
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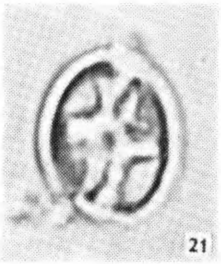
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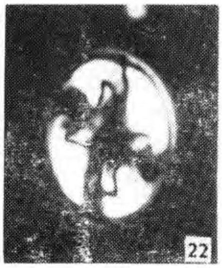
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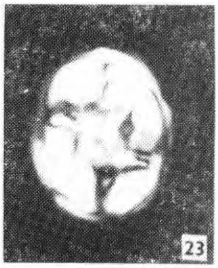
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Pl. II


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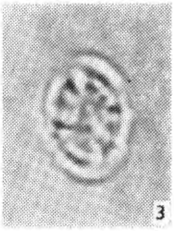
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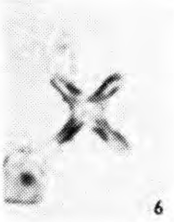
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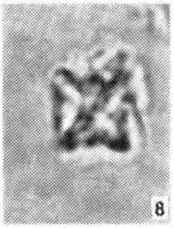
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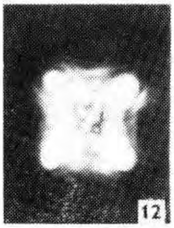
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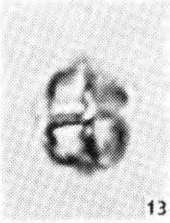
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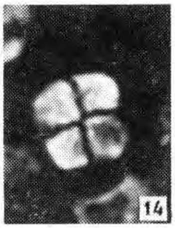
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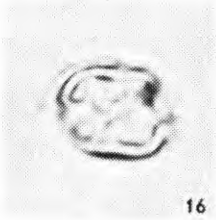
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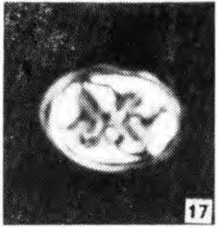
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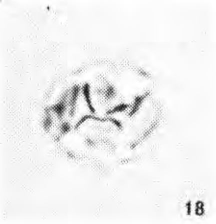
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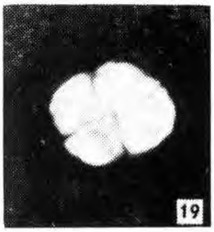
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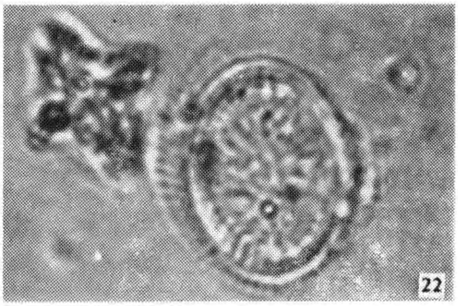
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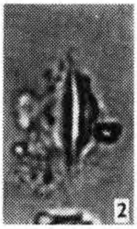
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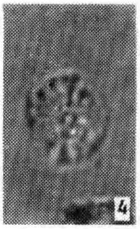
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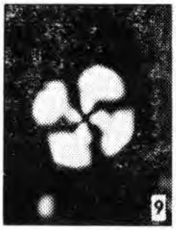
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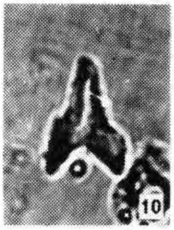
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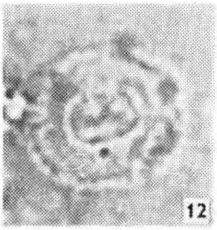
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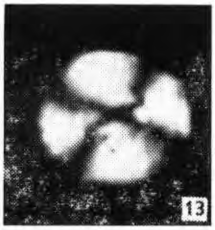
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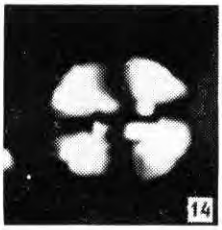
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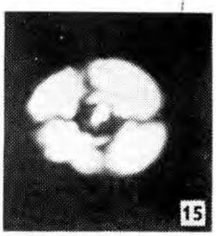
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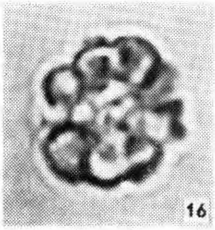
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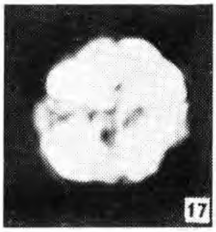
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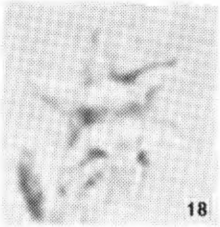
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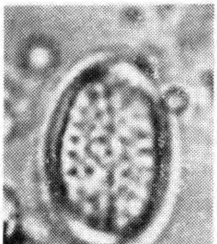
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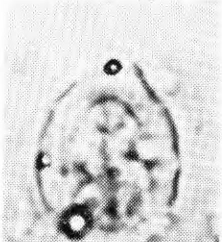
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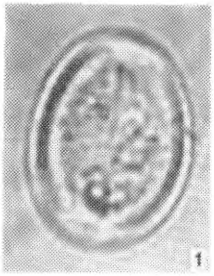
Pl. IV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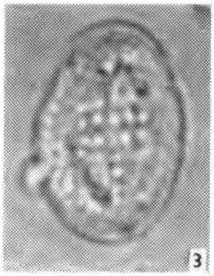
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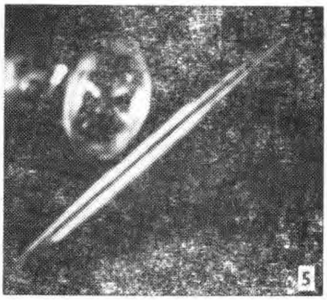
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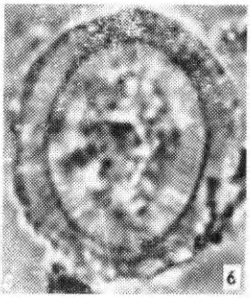
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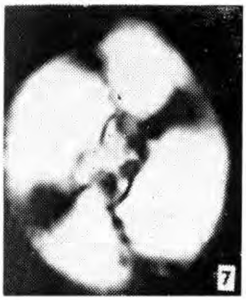
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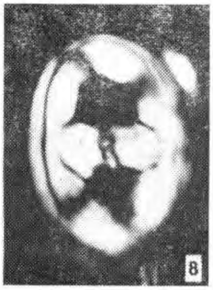
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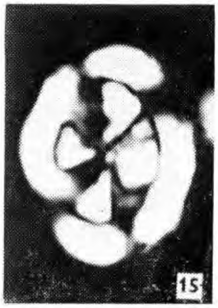
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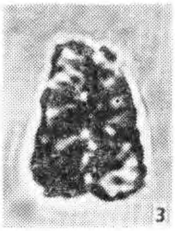
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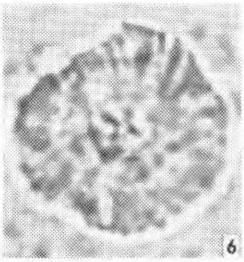
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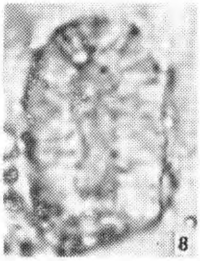
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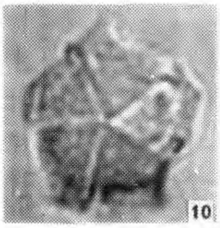
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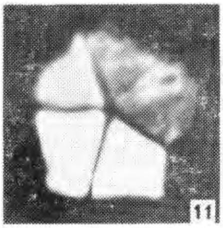
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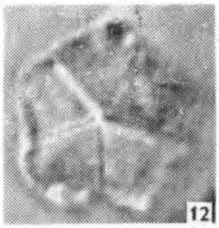
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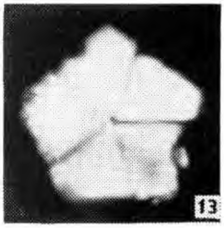
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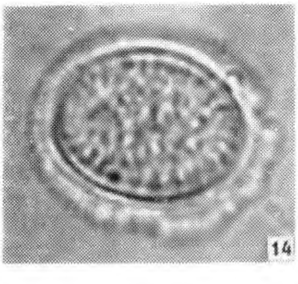
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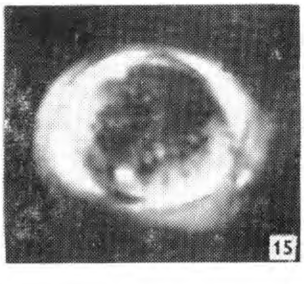
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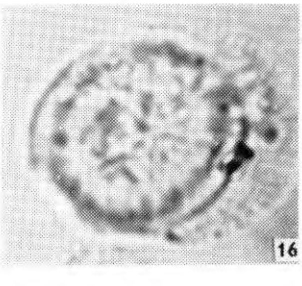
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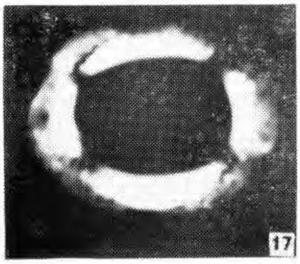
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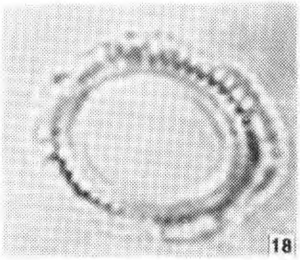
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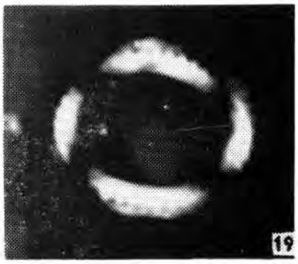
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Pl. VI


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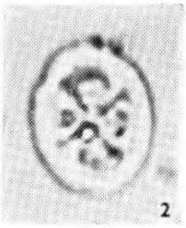
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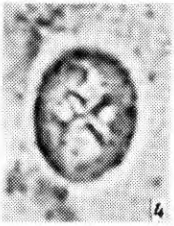
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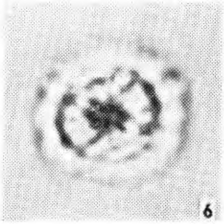
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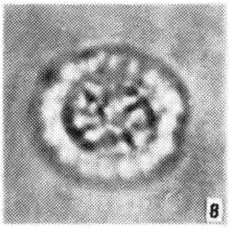
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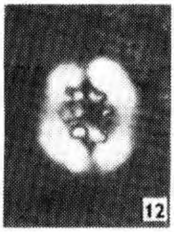
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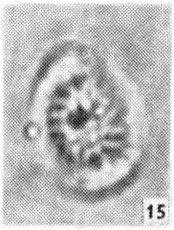
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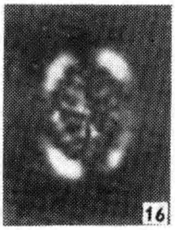
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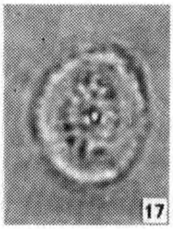
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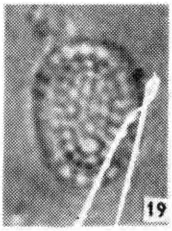
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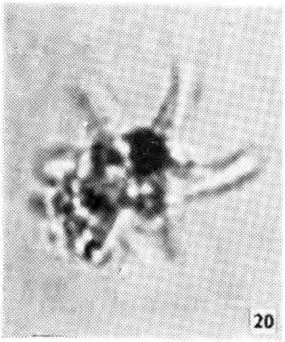
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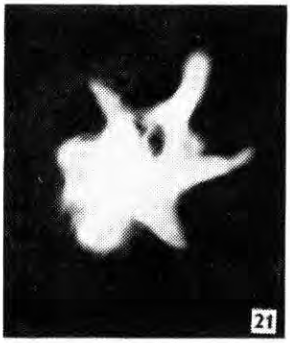
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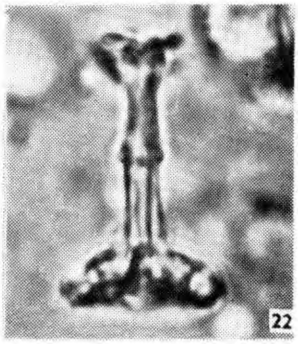
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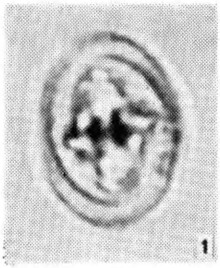
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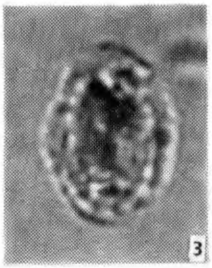
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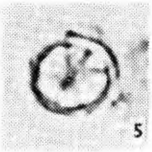
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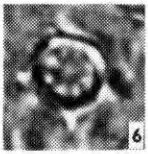
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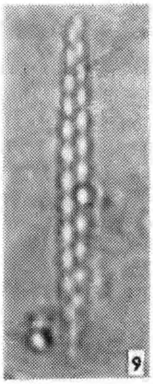
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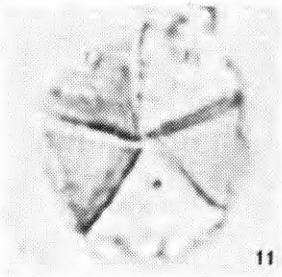
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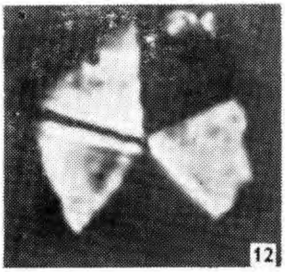
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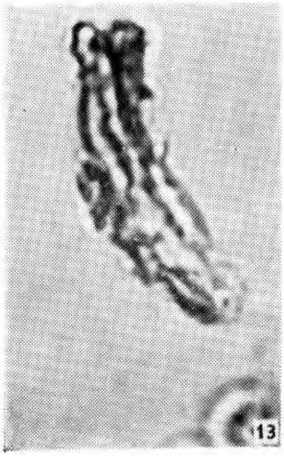
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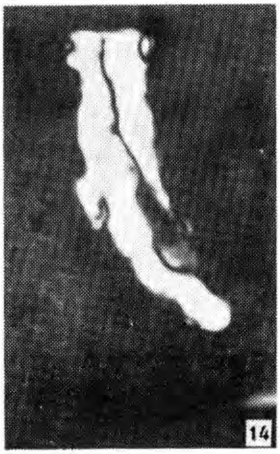
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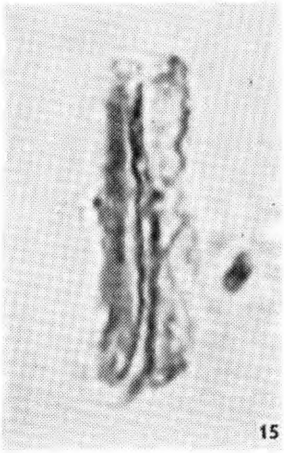
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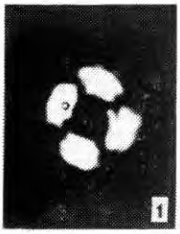
Pl. VIII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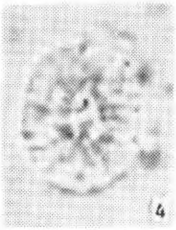
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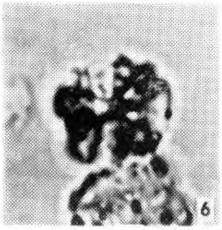
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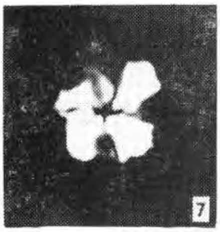
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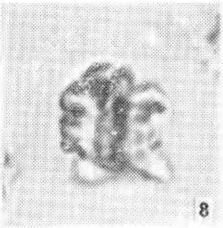
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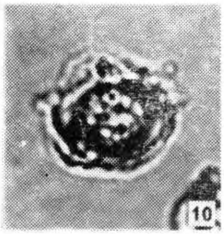
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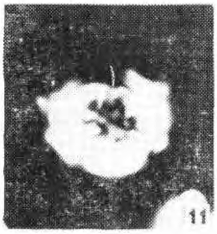
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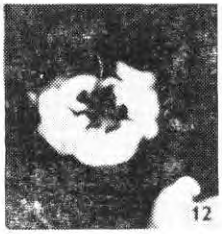
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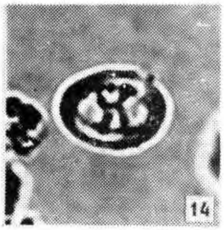
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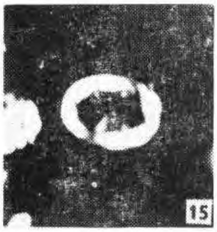
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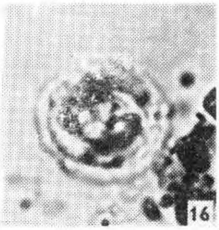
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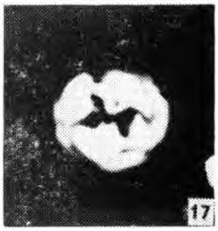
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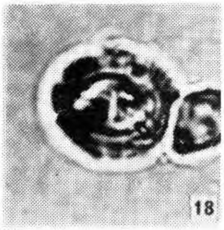
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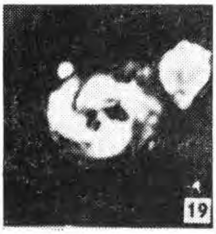
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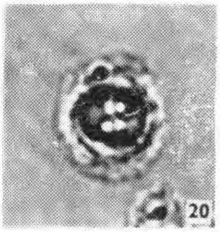
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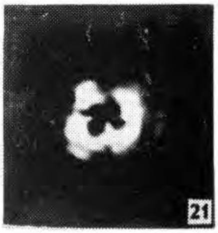
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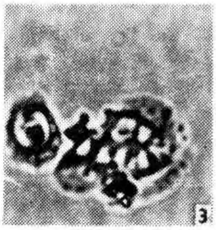
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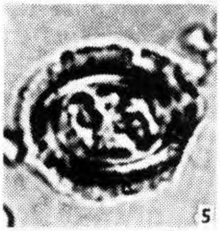
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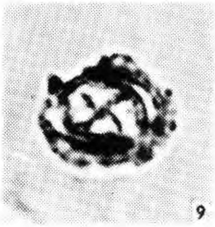
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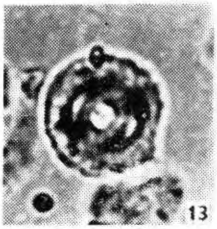
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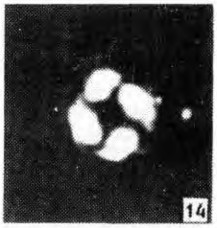
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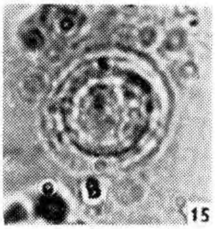
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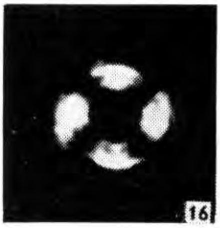
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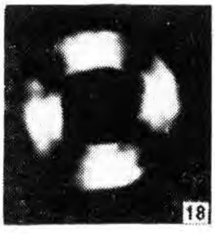
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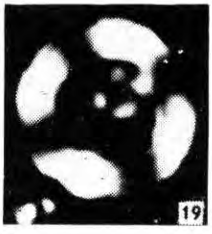
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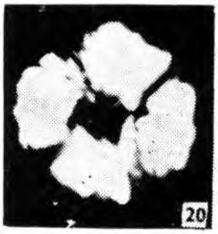
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Pl. X


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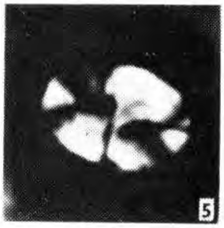
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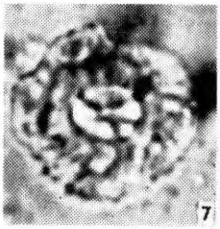
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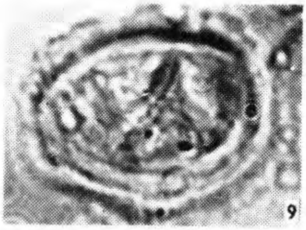
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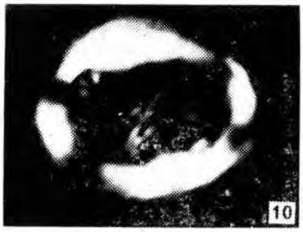
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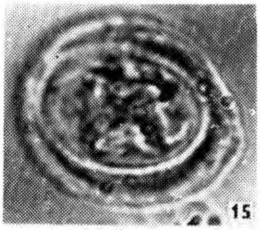
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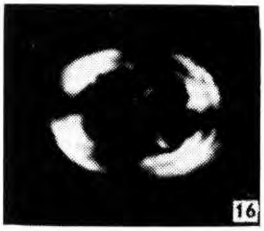
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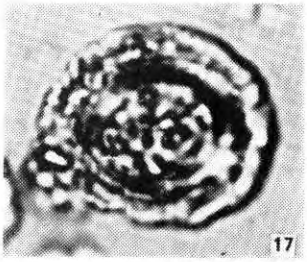
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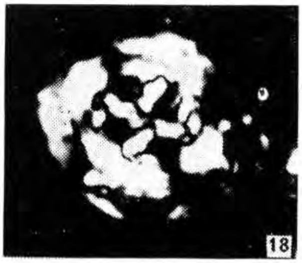
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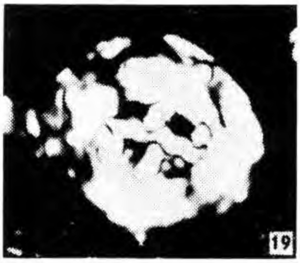
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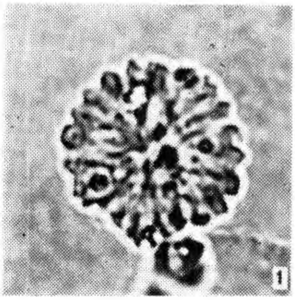
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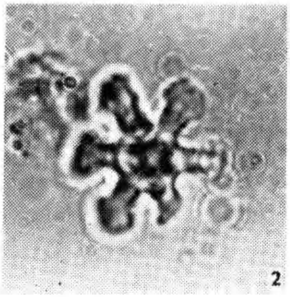
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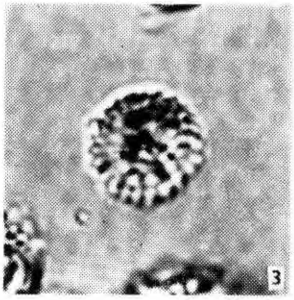
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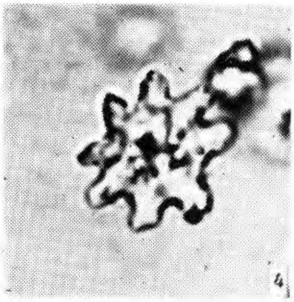
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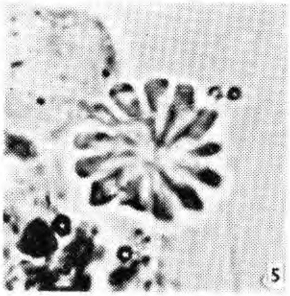
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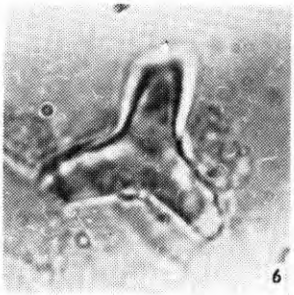
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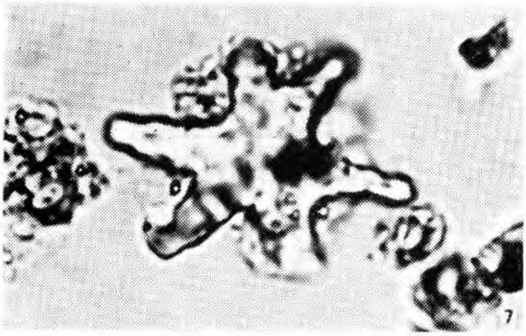
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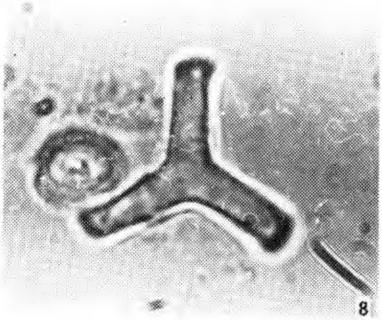
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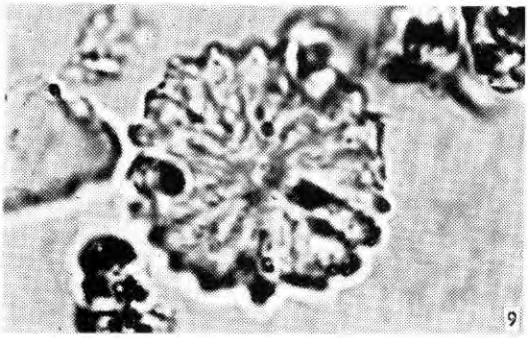
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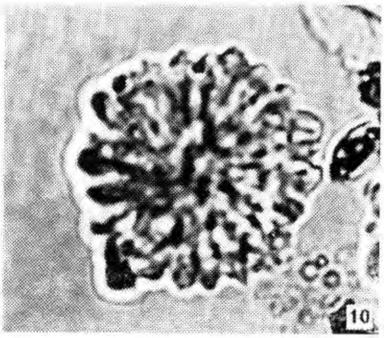
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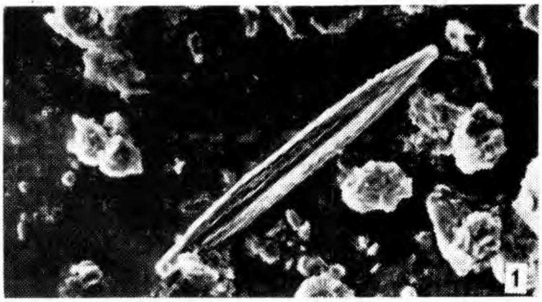
Pl. XII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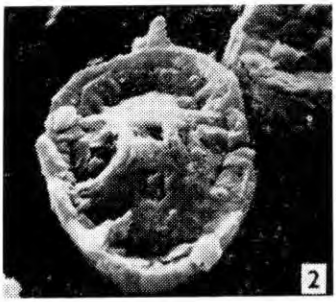
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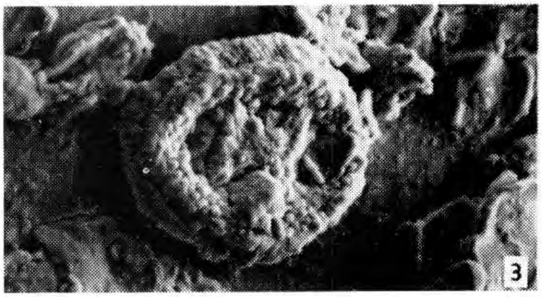
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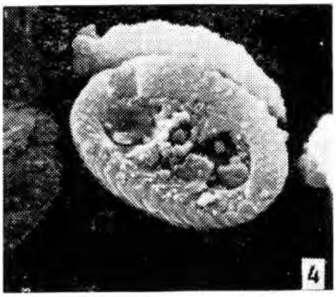
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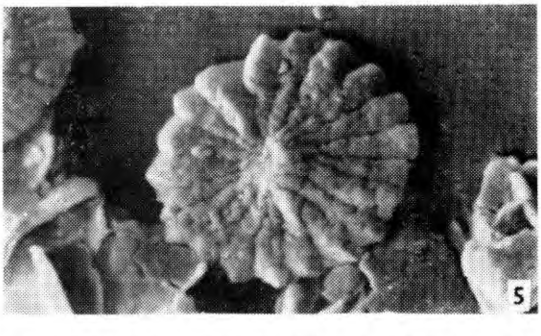
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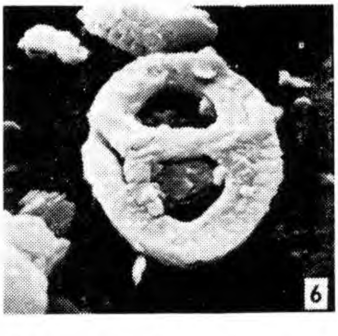
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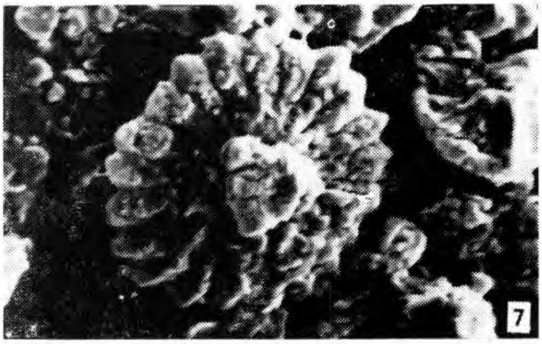
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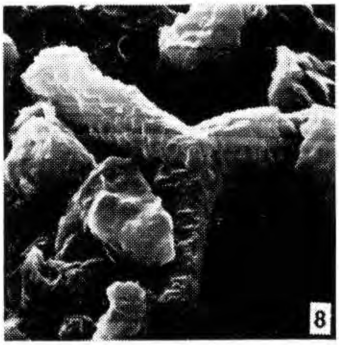
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v hlubokovodním prostředí pod karbonátovou kompenzační hladinou CCD. V těchto sedimentech jsou naopak relativně bohatá společenstva aglutinovaných foraminier s vyšší druhovou diverzitou a širším stratigrafickým rozsahem, velmi vzácně se vyskytuje plankton.

Vápnité nanofosilie nacházíme: 1. ve vápnitých i velmi slabě vápnitých sedimentech turbiditní fáze flyšového rytmu T_d, kde můžeme právem předpokládat vliv suspenze redeponovaného materiálu, 2. ve vápnitých jílovcích klidové fáze flyšového rytmu T_e nad hladinou CCD, kde došlo k dlouhotrvající depozici pelagického materiálu.

Известковый нанопланктон во флишевых осадочных породах белокарпатской единицы (Западные Карпаты)

Флишевые осадочные породы внешнего развития белокарпатской единицы (яворинская и сводницкая свиты) в смысле Страника и др. (Stránik et al. 1986) содержат известковые мельчайшие ископаемые организмы, по которым можно определить относительный возраст горных пород с точностью от ярусов до зон.

В яворинской свите (кампанского до маастрихтского возраста) выделено 7 нанопланктонных зон, соответствующих частично стандартным нанопланктонным зонам в смысле Сиссинга (Sissingh 1977). В палеогене применено в полном обьеме классическое разделение на зоны в смысле Мартини (Martini 1971) в диапазоне от NP 1—2 до NP 11 (т.е. от нижнего палеогена до нижней части нижнего эоцена).

В представленной работе приводятся определения установленных нанопланктонных зон меловой системы и систематический обзор (в т.ч. также изображения) меловых и палеогеновых видов известкового нанопланктона, встречаемых в белокарпатской единице.

Přeložil A. Kříž

Sbor. geol. věd	Paleontologie, 31	Pages 67—104	18 figs.	— tab.	12 pls.	Praha 1990 ISSN 0036-5297

Middle Cambrian inarticulate brachiopods from Central Bohemia

Středokambričtí inartikulátní ramenonožci ze středních Čech

Michal Mergl[1] - Petra Šlehoferová[2]

Received September 12, 1988

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12-14, 32, 34, 43

Inarticulate brachiopods
Taxonomy
Cambrian
Bohemia

Mergl, M. - Šlehoferová, P. (1990): Middle Cambrian inarticulate brachiopods from Central Bohemia. — Sbor. geol. Věd, Paleont., 31, *67—104*. Praha.

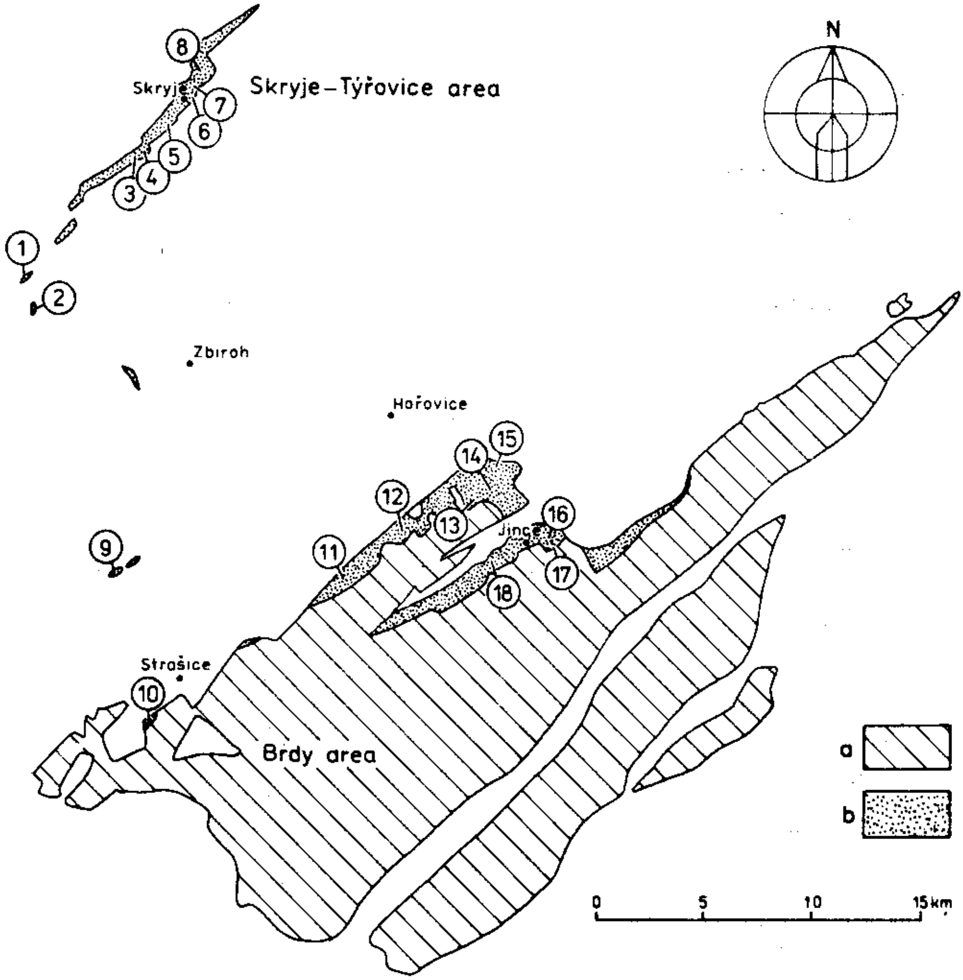
Abstract: Middle Cambrian inarticulate brachiopods comprise 14 species, which belong to 9 genera; *Lindinella* and *Luhotreta* are erected as new genera, Distribution of species is controlled by lithology and stratigraphic levels: sandy, shallow environment was inhabited by several lingulacean associations, whereas deeper parts of the basin were occupied by *Acrothele* and *Botsfordia* associations.

[1] *Pedagogická fakulta, třída 1. máje 51, 306 19 Plzeň*
[2] *Nad pískovnou 56, 140 00 Praha 4*

Introduction

The sediments of the Příbram-Jince Basin range from the Lower to the Upper Cambrian; of them, the Jince Formation is the sole unit yielding a rich marine fauna. The Jince Formations includes the nearly complete Middle Cambrian sequence in the Brdy area (Havlíček, 1971; Fatka, 1986), whereas in the smaller Skryje-Týřovice area this formation consists of the Eccaparadoxides pusillus Zone only. In addition, there are minor differences in the faunal content of the both areas (for main localities see fig. 1).

Inarticulate brachiopods are an uncommon but significant group of marine biotas in sediments of both areas. Rarity of brachiopods prevented complex study of them until the unpublished paper of Šlehoferová (1980). Barrande (1879) and Pompeckj (1896) described and figured several species which were with minor changes accepted



1. Distribution of Lower and Middle Cambrian rocks in Central Bohemia
a — Lower Cambrian, b — Middle Cambrian (Jince Formation).
Localities: 1 — Lohovice, 2 — Biskoupky, 3 — Skryje, Buchava quarry, 4 — Skryje, Čihátko, 5 — Skryje, Dlouhá hora, 6 — Skryje, "Pod třešní", 7 — Skryje, Luh, 8 — Skryje, "Pod hruškou", 9 — Medový Újezd, 10 — Strašice, Kamenná Hill, "V Andělkách" Forest, 11 — Kvaň, Čihadlo, 12 — Beranec Hill, 13 — Rejkovice, western part of the village, 14 — Rejkovice, Hejdův dvůr, 15 — Rejkovice, Zelený mlýn, 16 — Jince, Vinice slope, 17 — Jince, southern part of Vinice slope, 18 — Jince, Vystrkov Hill

by Walcott (1912). Further, several species were described but not illustrated by Želízko (1911), and Koliha (1921); minute lingulaceans mentioned by Šuf (1926, 1927) have been neither described nor figured.

The present paper is based on material deposited at the National Museum, Prague (NM-L), at the Geological Survey, Prague (MM, MŠ, GS-YA), at the Academy of Sciences, Prague (PEŠ), and at the District Museum of Rokycany (OMR, VH). We are greatly indebted to O. Fatka, V. Havlíček, J. Kraft, R. J. Prokop, and M. Šnajdr for loan of the material; to V. Kordule and F. Knížek for gifts of some nice brachiopod specimens. We are indebted to F. Stojaspal (Geologische Bundesanstalt, Vienna, Austria) for loan of Pompeckj's type specimen of *Acrothele quadrilineata.*

Preservation of brachiopods

The best brachiopod material comes from fine sandstones with carbonatic cement and from carbonatic nodules, which occur in some layers of the shale sequence. Brachiopods are not deformed and their original shell substance has not been disturbed. Nice internal and external moulds can be obtained by removing the phosphatic shell substance by hydrochloric acid. Inarticulate brachiopods in coarse sandstones display less favourable preservation. They have kept main features, but fine details of their internal an external morphology (muscle scars, pallial markings) cannot be examinated. Brachiopods from silty and clayey shales are preserved as composite moulds; many external features are usually impressed onto imprint of interior, and the valves are often strongly deformed.

Brachiopod associations

Brachiopod associations in the Brdy area

In the Brdy area, the fluviatile to lacustrine conglomerates and sandstones of the Chumava-Baština Formation were replaced by a deposition of clastic sediments of the Jince Formation in shallow marine environment. Coarse- to fine-grained sandstones near the base of the Jince Formation bear a low-diversity *Westonia ? fatkai* association.

Westonia ? fatkai association is dominated by *W. ? fatkai* and by rare *Botsfordia* sp. Their valves are always detached, usually broken, and form clusters in carbonate-rich intercalations. Brachiopods are accompanied by common, simple, vertical trace fossils of *Scolithos* type.

Lithology, taphonomy, trace fossils and low-diversity of association indicate intertidal to shallow subtidal rough-water environment (**Fatka-Kordule-Mergl-Šarič**, in press). This association was replaced by the more diversified *Botsfordia* association in the following sequence.

Botsfordia association is composed of *Botsfordia snajdri* (about 30 % of total brachiopod fauna), *Lingulella sufi* (about 50 %), and *Luhotreta pompeckji* (about 20 %); fragments of large lingulids are rare. Brachiopods with conjoint valves are rare, detached valves are often broken. Minute size of all brachiopods and their prevalence over trilobites are characteristic features of the *Botsfordia* association.

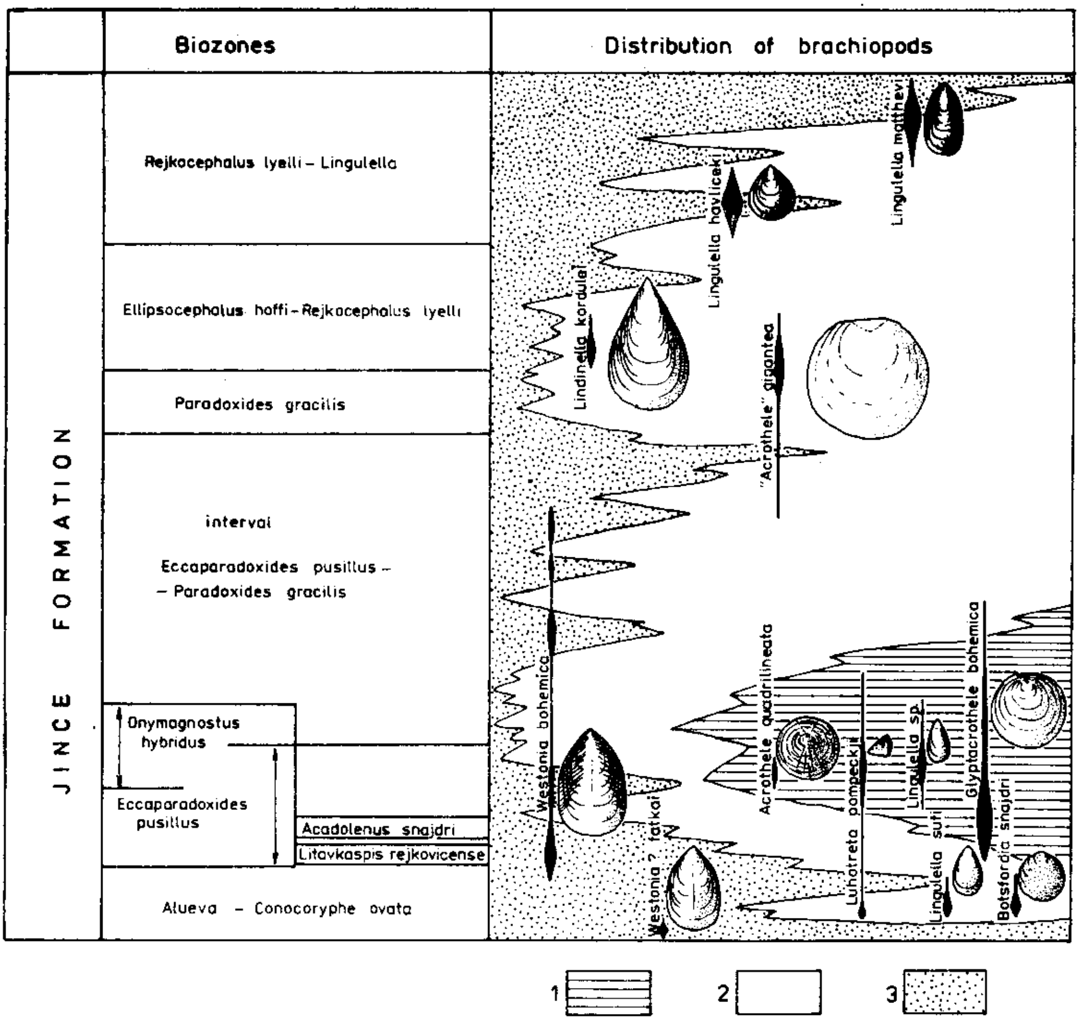
This association, recently discovered by O. Fatka, is accompanied by trilobites *Alueva, Conocoryphe, Ellipsocephalus, Kingaspis,* and *Rejkocephalus*; mitrate echinoderms (*Ceratocystis*) and ostracods are very rare. Low diversity of assemblage, its taphonomy, lithology, and presence of *Diplocraterion* ichnofossil indicate a rough-water, shallow subtidal environment (Fatka - Kordule - Mergl - Šarič, in press). The overlying sequence of silty to clayey shales of Eccaparadoxides pusillus Zone, Onymagnostus hybridus Zone, and the interval between Eccaparadoxides pusillus to Paradoxides gracilis Zones contain a distinct *Acrothele* association.

Acrothele association is composed of *Acrothele quadrilineata* (less than 1 % of total brachiopod fauna), *Glyptacrothele bohemica* (about 30 to 80 %), *Luhotreta pompeckji* (10 to 60 %), and tiny lingulids (1 to 20 %). With an exception of *A. quadrilinata,* the percentual presences of species change in each sample from the other ones. Valves usually are not disturbed, rather common are finds of closed shells. Minute size of brachiopod shells, and their paucity in comparison with trilobites and echinoderms characterize this association.

Acrothele association is accompanied by highly diversified trilobite assemblage with *Eccaparadoxides, Hydrocephalus, Conocoryphe, Ptychoparia,* and *Jincella.* The lower part of the Eccaparadoxides pusillus Zone bears *Acadolenus, Ellipsocephalus, Litavkaspis, Skreiaspis, Rejkocephalus* a. o.; Onymagnostus hybridus Zone contains rich miomerid trilobites with *Dawsonia, Doryagnostus, Hypagnostus, Onymagnostus, Peronopsis, Phalagnostus* and *Phalacroma.* Echinoderms, articulate brachiopods (*Brahimorthis, Oligomys*), hyolithids, gastropods and ostracods (*Konicekion*) are rare. *Acrothele* association together with accompanying groups represent the richest benthic assemblage in the Brdy area; its occurrence is connected with the maximum deepening of the basin (Fatka, 1986). Westwards from the Jince area the amount of sandy intercalations increases (Havlíček, 1971); sandstone intercalations, occasionally with carbonatic cement contain large-lingulid *Westonia* association.

Westonia bohemica forms a low-diversity association with no other brachiopod species. Valves of this large lingulid are moderately thick, with well-developed divaricate pattern, which indicate infaunal, burrowing mode of life in a coarse sandy substrate (Savazzi, 1986). Abundance of valves varies: whereas they are rare near Jince, at the westernmost part of the basin their valves crowded bedding planes of sandstones.

Westonia association is accompanied by trilobites and echinoderms (*Stromatocystites*) near Jince, but the westernmost occurrence of *Westo-*



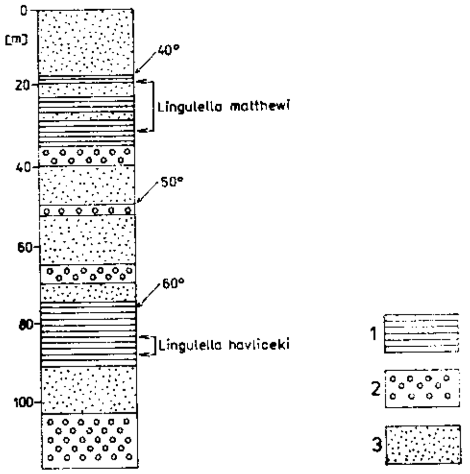
2. Stratigraphy and brachiopod distribution of the Jince Formation in the Brdy area (according to O. Fatka, 1986)
1 — clayey shales, *2* — silty shales to siltstones, *3* — sandstones

nia bohemica (Strašice, Kamenná Hill, "V Andělkách" Forest) is devoid of other macrofossils (Havlíček, 1960). Silty shales of Paradoxides gracilis Zone contain only *"Acrothele" gigantea* of brachiopods, although poorly diversified trilobites (*Conocephalina, Conocoryphe, Hydrocephalus, Paradoxides, Ptychoparia, Peronopsis* a. o.) and echinoderms (*Akadocrinus, Etoctenocystis, Lichenoides, Stromatosystites*) are common; hyolithids and ostracods are less frequent. The large lingulid *Lindinella* association appears at the lower part of Ellipsocephalus hoffi—Rejkocephalus lyelli Zone, and is accompanied by trilobites *Ellipsocephalus* and *Rejkocephalus,* common minute hyolithids, and large crustaceans.

Lindinella association consists of *Lindinella kordulei* (about 90 % of total brachiopod fauna), *"Acrothele" gigantea* is less common. Shells of both species are large, usually unbroken, mostly with detached valves, although specimens with conjoint valves have also been found. Specimens of *Lindinella* with closed valves oriented obliquely to perpendicularly to the bedding planes are scarce but indicate an infaunal mode of life in the fine sandy substrate. In comparison with other preserved benthic biotas, brachiopods are uncommon (less than 5 % of all fossils).

The top of the Jince Formation bears two medium-sized lingulid associations. The lower part of Rejkocephalus lyelli — Lingulella Zone bears the *Lingulella havliceki* association.

Lingulella havliceki forms a low-diversity brachiopod association with dominance of the type species. Detached and often crushed valves of this medium-sized lingulid occur very frequently in some sandstone layers. Fragments of trilobite carapaces (*Ellipsocephalus, Rejkocephalus*) and ostracods (*Konicekion*) are rare.



3. Section of borehole Mý-XII with marked levels of *Lingulella havliceki* and *L. matthewi* associations (according to M. Šnajdr, 1957)
1 — silty shales, *2* — coarse sandstones, conglomerates, *3* — fine sandstones

The younger *Lingulella matthewi* association is known from Medový Újezd only, where it occurs about 40 metres above the earlier *Lingulella havliceki* association (fig. 3).

Lingulella matthewi forms a low-diversity brachiopod assemblage with high dominance of the type species; *Lindinella kordulei* is very rare. Specimens of *Lingulella* have always detached valves, but these are only rarely broken. Inarticulate brachiopods are accompanied by very frequent vertical trace fossils but other shelly fossils are exceptional (fragments of trilobite *Rejkocephalus*).

Both low-diversity *Lingulella* assemblages, increasing amount of vertical trace fossils, and a higher supply of terrigenous material indicate shallowing of the basin and deteriorating of the marine environment up to a nearly intertidal, maybe brackish one (Havlíček - Šnajdr, 1951; Fatka, 1986). This topmost part of the Jince Formation is overlain by conglomerates, greywackes and sandy shales of the Ohrazenice Formation which are devoid of the fossils.

Facies development and faunal distribution reflect a stratigraphically symmetric development of the Jince Formation in the Brdy area (Fatka, 1986). Large to moderate-sized lingulid associations occuppying sandy and silty bottoms appear mainly near the base and in the upper part of the formation. A relatively deep-water *Acrothele* association with highly diversified trilobite and echinoderm faunas occurs during the maximum deepening of the basin. This model of brachiopod distribution well corresponds with the presumed facies and depth zonation of trilobites and echinoderms suggested by Fatka (1986).

Brachiopod associations in the Skryje-Týřovice area

Marine sediments in the Skryje-Týřovice area are equivalent of the lower part of the Jince Formation (Havlíček, 1971) comprising mainly Eccaparadoxides pusillus Zone. The two oldest stratigraphical units, the Mileč Conglomerates and Sandstones, and the Týřovice Conglomerates and Greywackes yield the articulate brachiopod *Pompeckium* association.

The *Pompeckium* association consists of orthacean *Pompeckium kuthani, Jamesella perpasta* and *J. subquadrata*; inarticulate brachiopods are very scarce and occur in the Týřovice Greywackes only. They are represented by *Lindinella* sp., and minute undeterminable acrotretaceans. Valves of articulate brachiopods often cover bedding planes, and are always disarticulated and often broken; the relatively thin valves of *Lindinella* are crushed, too.

Accompanying fauna consists of the polymerid trilobites *Conocephalina, Ellipsocephalus, Perneraspis, Ptychoparia* and undeterminable paradoxids. *Helcionella* and other molluscs with conical shells are rare. These articulate brachiopods dominated the *Pompeckium* association occupied bottom in the proximity of beaches in intertidal to shallow subtidal environments (Kukal, 1971). The stratigraphic range of this association corresponds to the brachiopod Pompeckium kuthani Zone of Havlíček (1971). The younger Bohemiella romingeri Zone (Havlíček, 1971) comprises Skryje Shales and Vosník Conglomerates.

Whereas the latter are devoid of fossils, the greenish clayey shales, in places with sandy intercalations, bear a rich faunal assemblage which includes also the brachiopod *Bohemiella-Acrothele* association.

Bohemiella romingeri is dominant in this association; *Acrothele quadrilineata* is rare, *Glyptacrothele bohemica, Luhotreta pompeckji* and tiny lingulids are rather common in some layers. The valves of orthacean *Bohemiella* are usually complete, often crowded in the bedding planes, and its closed shells form monospecific clusters in some places. Inarticulate brachiopods display the same mode of preservation as in the *Acrothele* association in the Brdy area. The common occurrence of *Bohemiella* and the relative paucity of inarticulate brachiopods in comparison with trilobites characterize this brachiopod association.

The *Bohemiella-Acrothele* association occurs in an assemblage with richly diversified polymerid trilobites (*Agraulos, Conocoryphe, Ctenocephalus, Eccaparadoxides, Ellipsocephalus, Hydrocephalus, Jincella, Sao, Skreiaspis*), miomerid trilobites (*Condylopyge, Peronopsis, Phalagnostus, Phalacroma, Pleuroctenium, Skryjagnostus*), hyolithids (*Buchavalites, Maxilites, Oboedalites, Parentilites, Slapylites*), echinoderms (*Ceratocystis, Lichenoides, Trochocystites*) and molluscs (*Cambretina, Costipelagiella, Helcionella*). This benthic assemblage inhabited a deep-water environment influenced by a deposition of fluxoturbidites on a steep paleoslope of a deep trough (Kukal, 1971). Its taxonomic composition and mode of preservation is close to the contemporaneous *Acrothele* association in the Brdy area.

Systematic part

Lingulacea Menke, 1828

Obolidae King, 1846

Lingulellinae Schuchert, 1893

Lindinella gen. n.

Type species: *Lindinella kordulei* sp. n.

Diagnosis: Large obolid with tear-drop shaped outline, acutely pointed ventral beak, and moderate thick valves. Ventral pseudointerarea long, anteriorly undercut, divided by a deep, narrowly triangular pedicle groove into large propareas with distinct flexure lines. Dorsal pseudointerarea anteriorly undercut, with a wide, gently concave median depression. Visceral area weakly defined, narrowly triangular in outline, with poorly impressed muscle scars. External ornamentation consists of coarse elevated concentric lines. On flanks, there are lines dichotomously or laterally branched, but in median sector, the lines are unbranched, with regular course parallel with growth lines.

Remarks: *Lindinella* internally recalls *Lingulella* and *Westonia* but the former has ornamentation of coarse elevated concentric lines, which is never developed in *Lingulella,* which has ornamentation of fine growth lines. *Westonia* has growth lines obliquely crossed by transverse terrace lines (Savazzi, 1986); this pattern is never developed at *Lindinella.*

Species assigned: *L. kordulei* sp. n.; Jince Formation, Brdy area. *L.* sp.; Jince Formation, Skryje-Týřovice area.

Lindinella kordulei sp. n.

Pl. I, figs. 1—5, pl. II, figs. 1, 2; text-figs. 4, 5

1975 *Lingulella* sp. n.; Šnajdr, p. 158.

Holotype: Pedicle valve figured on pl. I as figs. 1, 4, deposited in the Geological Survey, Prague (GS-YA 1290).

Type horizon: Jince Formation, Ellipsocephalus hoffi—Rejkocephalus lyelli Zone.

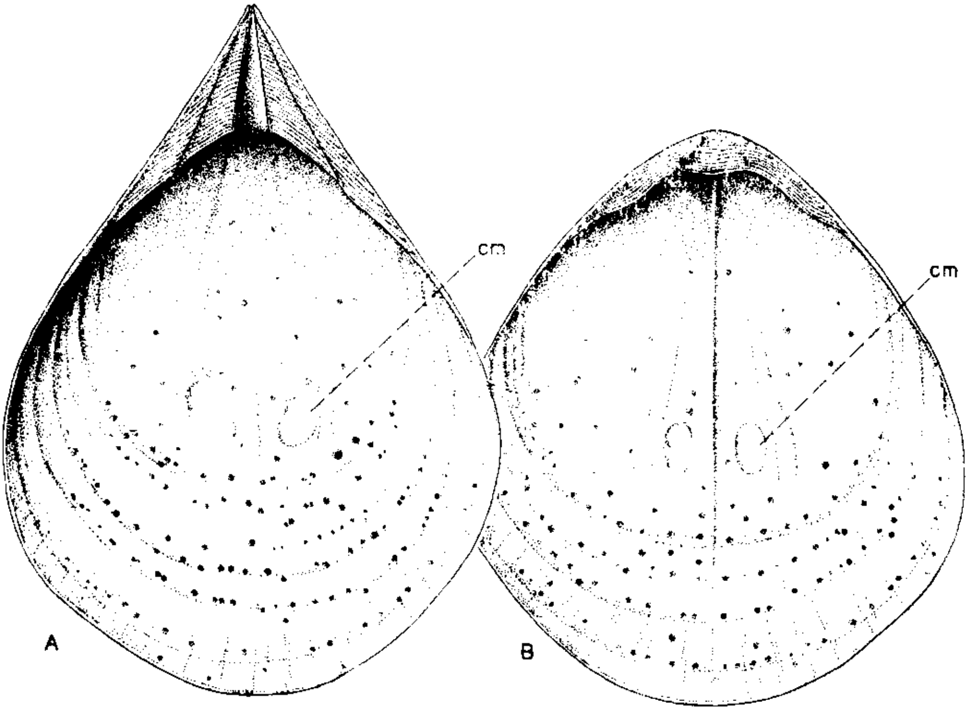
Type locality: Rejkovice, railway cutting near Zelený mlýn.

Name: After V. Kordule.

Material: 16 pedicle and 8 brachial valves.

Description: Shell large, biconvex, 13 mm wide in largest specimens. Pedicle valve widest at interior third, 115—145 % as long as wide, teardrop-shaped in outline. Ventral beak pointed, beak angle 60—65°. Anterior and lateral margins evenly rounded, posterolateral margins straight to weakly arched. The valve is gently convex in lateral and transverse profiles. Pedicle groove deep, long, U-shaped in transverse profile, strongly tapering posteriorly, with its bottom at the same level as valve floor. Large catacline ventral pseudointerarea anterolaterally passes into narrow strip bordering posterolateral margins of the valve, and attains nearly mid-length of the valve. Each proparea is divided by a strong flexure line into shorter inner, and much longer outer parts. The surface of pseudointerarea bears coarse growth lines weakly curved near pedicle groove. The bottom of pedicle groove is devoid of striation. Anterior margin of propareas undercut. Valve floor bears oval, poorly impressed central muscle scars and a narrow, weakly defined triangular visceral field. Visceral field occupies 40 % of valve length and is more distinct posteriorly than anteriorly.

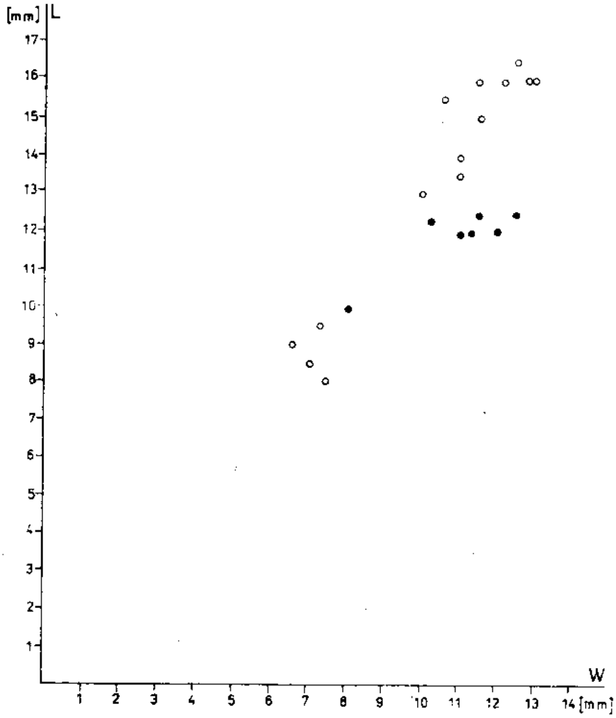
Brachial valve shorter than pedicle valve, subpentagonal in outline, 115—120 % as long as wide. Anterior and lateral margins evenly rounded, posterolateral margin gently curved. Beak rounded. The valve is more convex posteriorly than anteriorly in lateral profile, and is weakly convex, with shallow depression in transverse profile. Dorsal pseudointerarea long, weakly raised above valve floor, anteriorly undercut. Pseudointerarea medianly divided into two narrowly triangular propareas by wide, weakly concave median depression, which anteriorly extends into short tongue. Surface of pseudointerarea bears coarse growth lines. Central muscle scars minute, circular, weakly impressed at the centre of the valve. Fine and low median ridge extends just before median depression and reaches nearly anterior margin of the valve. Vascula media poorly impressed, running parallel posteriorly but gently divergent anteriorly. Fine terminal vascular canals are impressed along peripheries of both valves. Inner surface of both valves bear fine pitting irregularly arranged of following course of growth lines.



4. *Lindinella kordulei* sp. n.
A — interior of pedicle valve; B — interior of brachial valve; cm — central muscle scars

Ornamentation: Surface of shell covered by prominent elevated concentric lines, branching and rather irregular on flanks but unbranched and more regular in midsectors of the valves. The size of lines is uniform on entire shell surface. Growth lamellae several in number, externally indistinct but internally marked by a thickening of the valve wall.

Occurrence: Brdy area; Ellipsocephalus hoffi—Rejkocephalus lyelli Zone: Jince (Vystrkov Hill), Rejkovice (railway cutting near Zelený mlýn); Rejkocephalus lyelli—Lingulella Zone: Medový Újezd (quarry).



5. Relationship between length versus width in *Lindinella kordulei* sp. n. L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

Lindinella sp.

Pl. III, figs. 5—8

Material: one fragment of pedicle valve, 2 brachial valves.

Description: Shell large, 12 mm wide at adults, subequally biconvex. Pedicle valve poorly known. Posterior part of pedicle valve strongly convex in transverse profile. Ventral pseudointerarea forms narrow, high shelf bordering posterolateral margin of the valve, and is covered by coarse growth lines. Pedicle groove long and deep.

Brachial valve roundelly triangular to subpentagonal in outline, moderately convex in both profiles, with evenly rounded front margin. Beak rounded, with posterolateral margins subtending 90°. Dorsal pseudointerarea gently raised above valve floor, anteriorly undercut, with median depression weakly defined from propareas. Surface of pseudointerarea covered by coarse growth lines. Valve floor bears fine, long median ridge, extending over midlength of the valve. Feebly impressed central muscle scars laterally bounded by faint ridges and located at the centre of the valve.

Ornamentation: Surface of valves densely covered by coarse concentric lines of equal size, with the same pattern as in *Lindinella kordulei.*

Comparison: *Lindinella* sp. differs from *L. kordulei* by shorter dorsal pseudointerarea and more rounded outline.

Occurrence: Skryje-Týřovice area; Týřovice Greywackes, Pompeckium kuthani Zone: Lohovice.

Westonia Walcott, 1901

Westonia bohemica (Koliha, 1921)

Pl. II, figs. 3—6, pl. III, figs. 1—4; text-figs. 6, 7

1911 *Lingulella* nov. sp.; Želízko, p. 5.
1921 *Lingulella bohemica* n. sp.; Koliha, p. 30.
1980 *Westonia bohemica* (Koliha, 1921); Šlehoferová, p. 27, pl. 2, figs. 6—9.

Lectotype: Specimen with both valves, selected from the original Koliha's material, figured herein on pl. II, fig. 3, deposited in the National Museum, Prague (NM-L 18202).

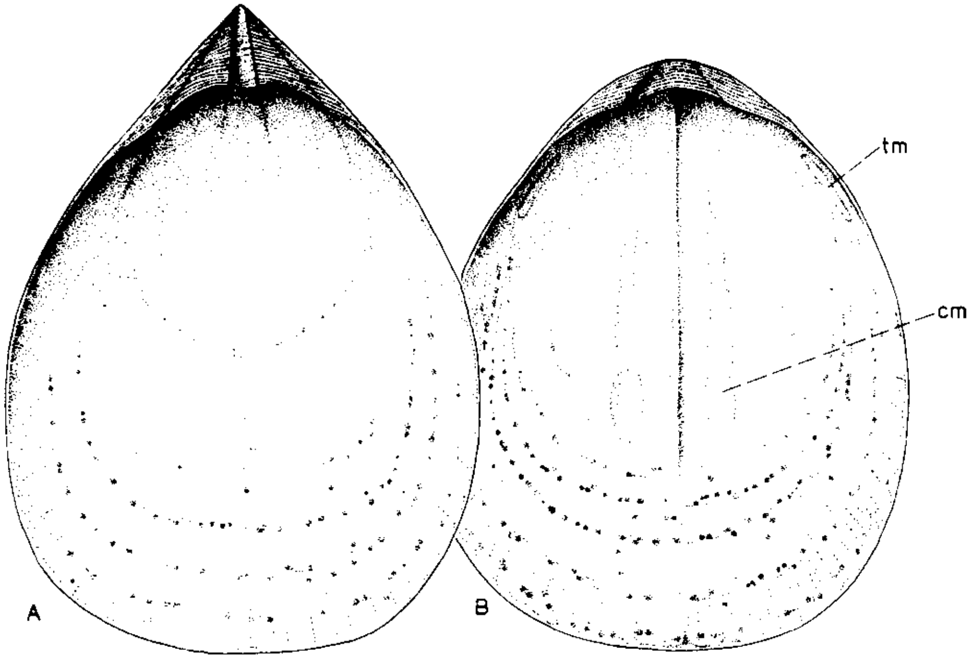
Type horizon: Jince Formation, interval between Eccaparadoxides pusillus and Paradoxides gracilis Zones.

Type locality: Jince, Vystrkov Hill.

Material: 22 pedicle and 14 brachial valves.

Description: Shell large, equally biconvex, thick-walled, 12 mm wide in the largest specimen. Pedicle valve subpentagonal to widely teardrop-shaped in outline, 115—150 % as long as wide, widest anteriorly to midlength. In transverse profile, beak region is strongly convex but convexity decreases anteriorly. In lateral profile, the valve is evenly and weakly convex. Lateral margins gently arched, anterior margin evenly rounded with less curved middle part. Beak pointed, postelolateral margins subtend 80—85°. Shallow, gently widening sulcus is developed near anterior margin. Ventral pseudointerarea orthocline, short, anteriorly undercut, 65—70 % as wide as valve. Pedicle groove deep, U-shaped in transverse profile, moderately widening anteriorly. The bottom of pedicle groove gently raised above valve floor with anterior part undercut. Propareas narrowly triangular, bordering posterolateral margins of the valve. Each proparea is divided by flexure line into inner and shorter, and outer, narrower and longer parts. Anterior edges of propareas subtend 110—120°. Surface of propareas is covered by coarse densely crowded growth lines, distinct also on the flanks of pedicle groove. Visceral area poorly defined, occupying posterior half of the valve.

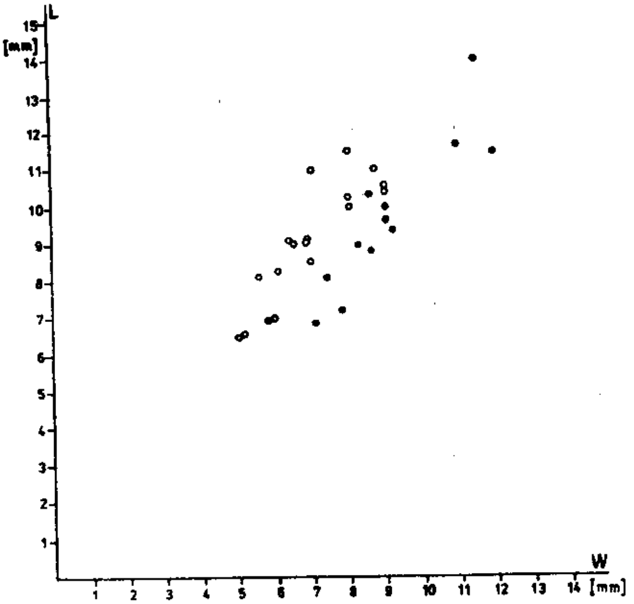
Brachial valve of subpentagonal outline, 115—130 % as long as wide, widest anteriorly to midlength. The valve is convex as or slightly more than the pedicle one, with median sector nearly flat, passing anteriorly into shallow sulcus. Beak rounded, lateral margins gently arched, front margin rounded with less curved middle part. Dorsal pseudointerarea short, anteriorly undercut, gently raised above valve floor. Median depression shallow, wide, laterally bounded by the deflection of the growth lines. Anterior edge of median depression concave anteriorly. Surface of pseudointerarea bears coarse growth lines. Visceral field poorly defined. Large, oval, paired central muscle scars poorly impressed anteromedianly, and very close to each another. Transmedian muscle scars are narrowly elliptical, poorly impressed laterally in front of pseudointerarea. Fine median ridge originating at the beak extends over midlength of the valve. Vascular system poorly impressed, with paired, gently widening vascula media, which are located laterally to the median ridge. Vascula terminalia radially arranged along peripheries of both valves. Inner surfaces



6. *Westonia bohemica* (Koliha, 1921)
A — interior of pedicle valve; B — interior of brachial valve; cm — central muscle scars; tm — transmedian muscle scars

of both valves bear minute circular pits, which are commonly arranged in concentric bands.

Ornamentation consists of coarse elevated growth lines of uniform size, which cover in regular intervals the entire surface of the shell. Oblique terrace lines of the same size as the growth lines are developed in lateral sectors of the valves. Terrace lines form regular network-like pattern (pl. II, figs. 5, 6). Median sector of the valves is devoid of terrace lines; this sector is about 30 % as wide as the valve in posterior part, but expands anteriorly and attains 60 % of the valve width near front margin.



7 Relationship between length versus width in *Westonia bohemica* (Koliha, 1921)
L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

Comparison: *W. bohemica* may be distinguished by the shape of its terrace lines; there is never a developed zig-zag pattern common in some species (*W. aurora* (Hall), *W. ella* (Hall - Whitfield), and terrace lines do not cover the entire posterior part of the valve as in *W.? elongata* Walcott, *W. iphis* Walcott or *W. finlandensis* Walcott.

Occurrence: Brdy area; Eccaparadoxides pusillus Zone and interval between Eccaparadoxides pusillus and Paradoxides gracilis Zones: Strašice (Kamenná Hill, “V Andělkách” Forest), Beranec Hill, Jince (Vystrkov Hill), Rejkovice (Hejdův dvůr).

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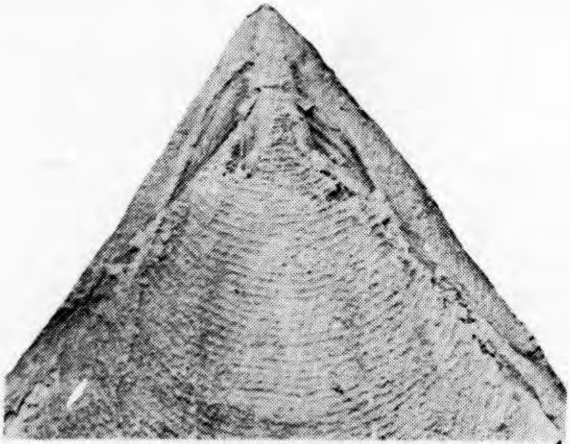
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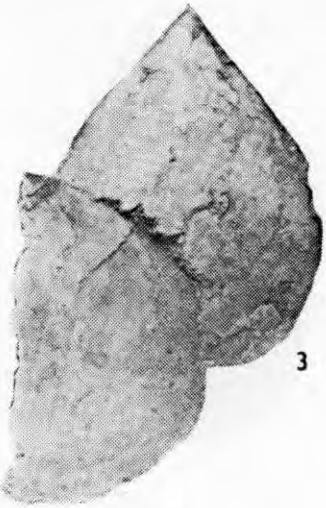
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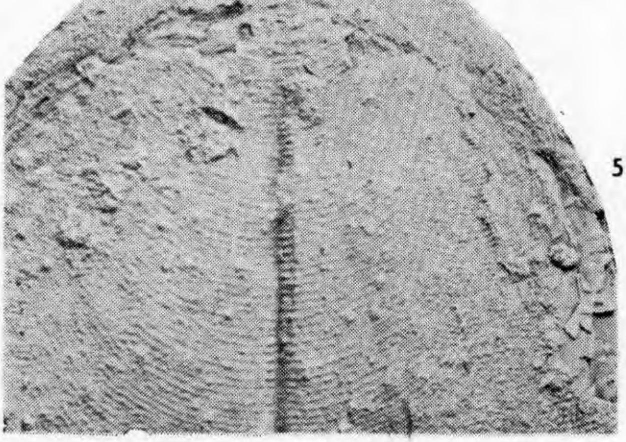
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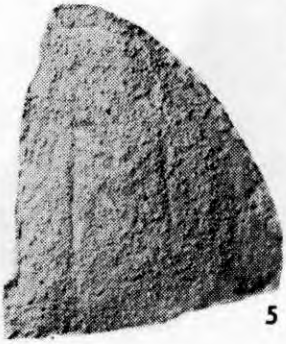
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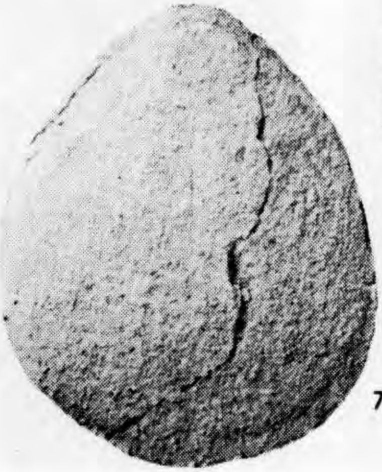
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Pl. IV


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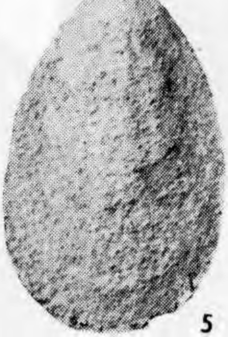
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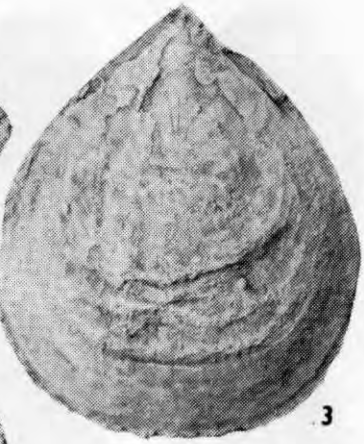
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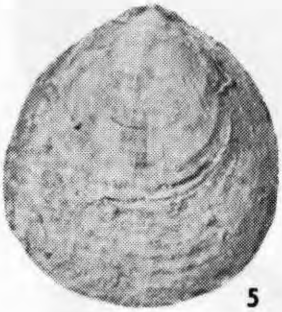
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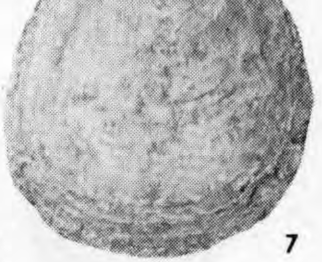
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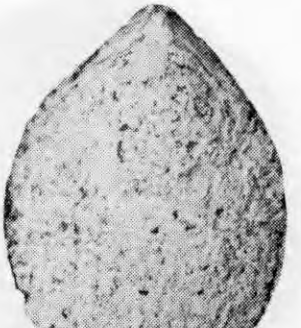
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Pl. VI


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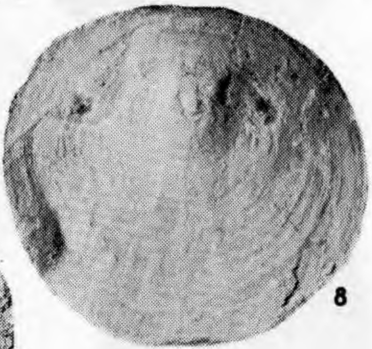
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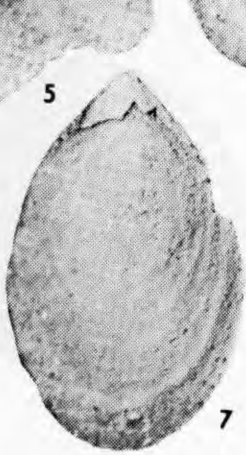
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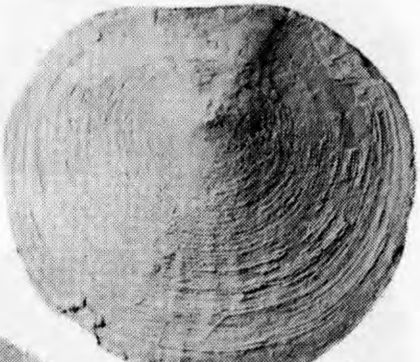

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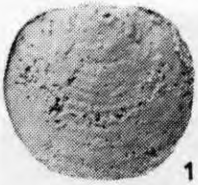
Pl. VIII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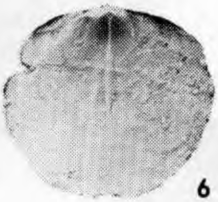
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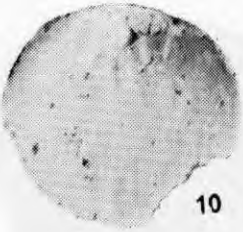
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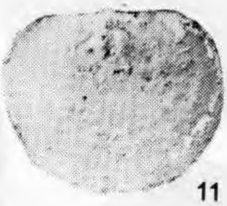
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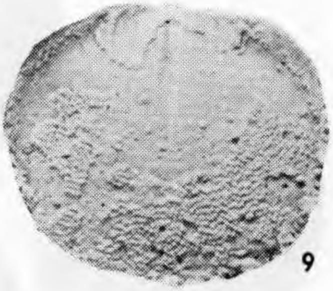
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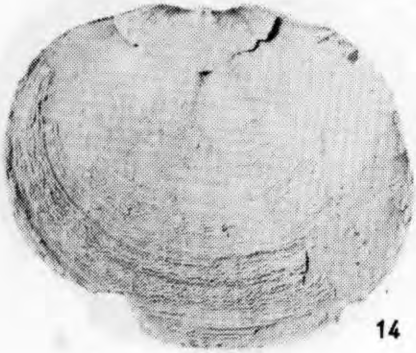
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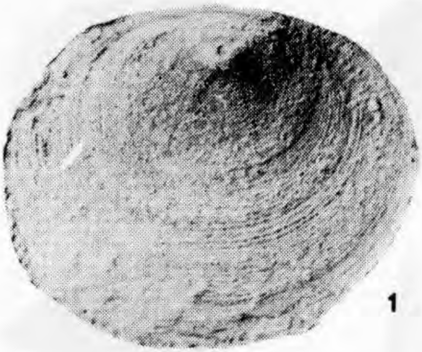

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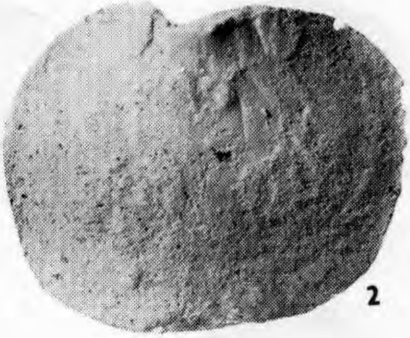

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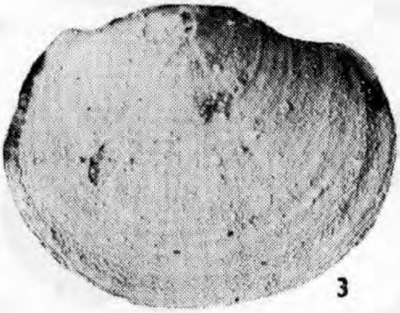

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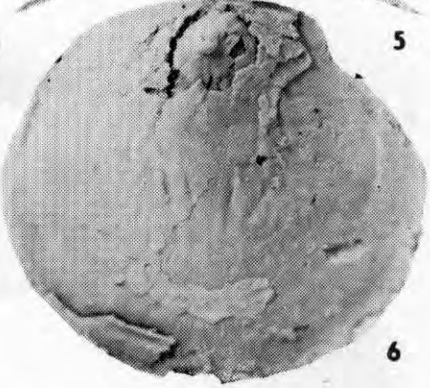

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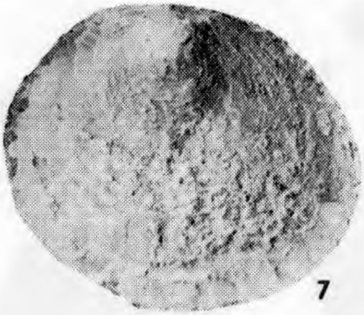

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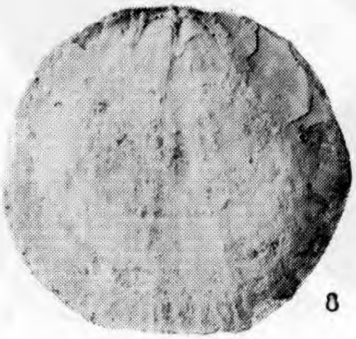

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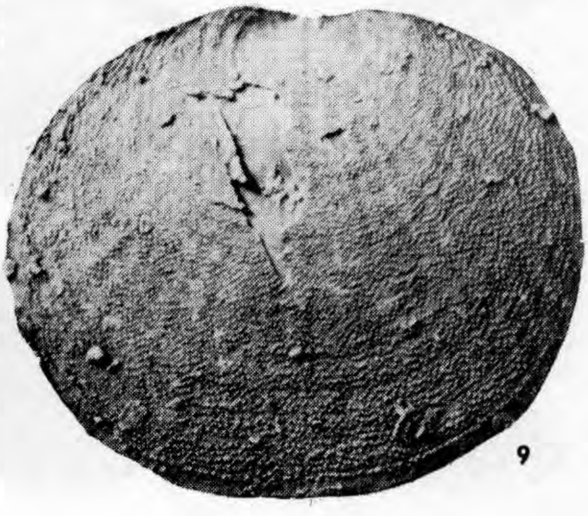

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Pl. X


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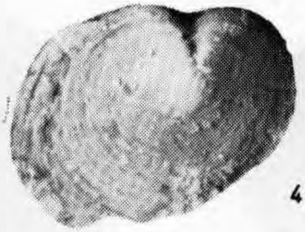
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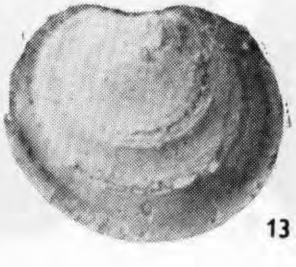
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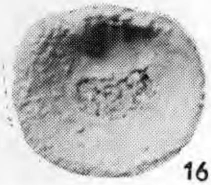
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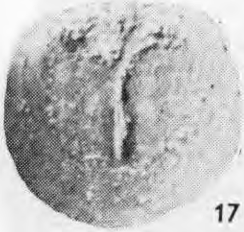
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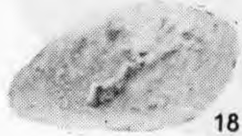
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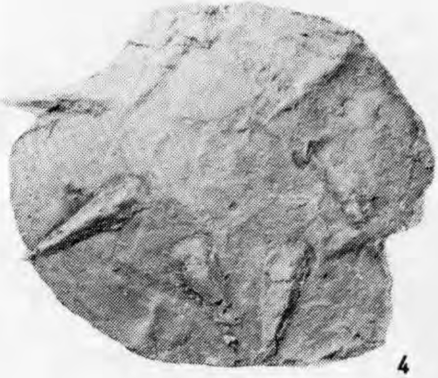

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Westonia ? fatkai sp. n.

Pl. VI, figs. 9—13; text-fig. 8

Holotype: Brachial valve figured on pl. VI, figs. 9, 13, deposited in the District Museum at Rokycany (OMR 20464).

Type horizon: Jince Formation, the layer below horizon with *Alueva — Conocoryphe ovata.*

Type locality: Jince, southern part of Vinice slope.

Name: After Dr. O. Fatka.

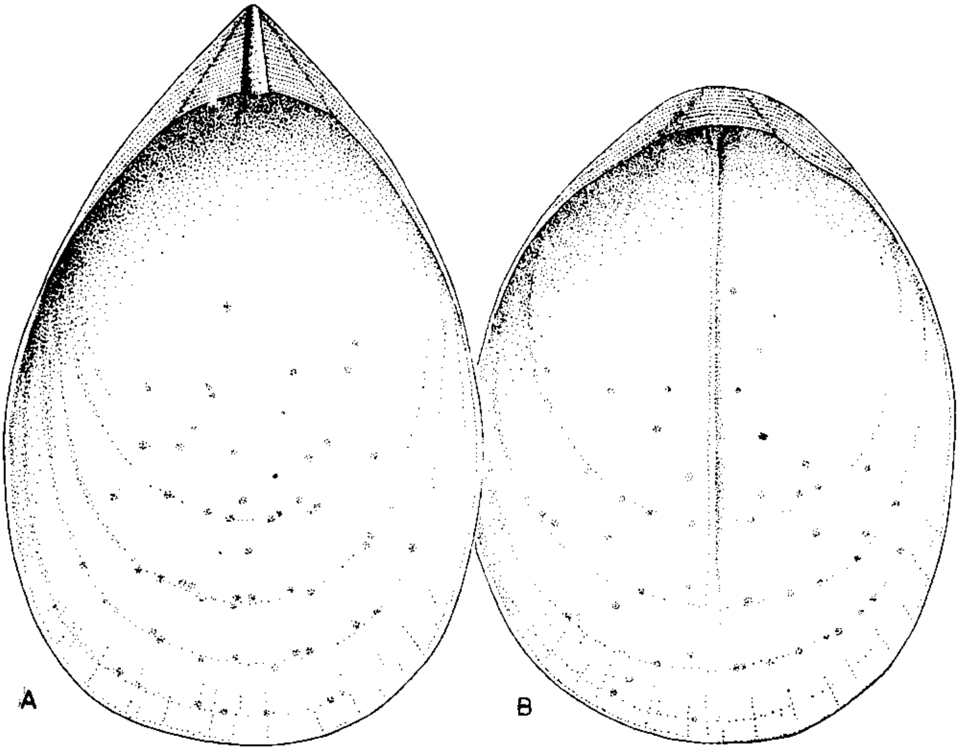
Material: 4 pedicle and 6 brachial valves, many fragments.

Description: Shell large, equally biconvex, thick-walled, 10 mm wide at adults. Pedicle valve oval in outline, with pointed beak, 130—140 % as long as wide, widest at midlength. Anterior margin semicircular, lateral margins gently curved; posterolateral margins subtend 80°. The valve is strongly convex in transverse profile, and evenly and gently convex in lateral profile. Ventral pseudointerarea large, gently raised above valve floor, anteriorly undercut. Pedicle groove U-shaped in transverse profile, deep, about twice as long as wide, weakly widening anteriorly. Propareas narrowly triangular, with distinct flexure lines and densely crowded coarse growth lines. Anterior edges of propareas subtend 90°—100°. Imprints of visceral field and muscle scars not preserved. Gently diverging, wide paired trunks of vascula lateralia feebly impressed in posterolateral sectors of valve.

Brachial valve oval to subpentagonal in outline, 115—120 % as long as wide, widest at midlength. The valve is moderately convex in transverse profile and gently convex in lateral profile, with deep, narrow sulcus originating near umbo. Posterior margin rounded. Dorsal pseudointerarea is wide, anteriorly undercut shelf, weakly elevated above valve floor. Median depression weakly bounded, slightly concave, with front edge concave anteriorly; propareas widely triangular. Surface of pseudointerarea covered by coarse growth lines. Median ridge originates at umbo and extends over midlength of the valve. Ridge low, coarse, and anteriorly gradually passes into flat elevation. Inner surfaces of both valves bear fine radial striating; minute, circular pits are uncommon.

Ornamentation consists of coarse, elevated growth lines, arranged in regular interval on the entire shell surface; growth lines very fine, of uniform size. Oblique terrace lines not developed.

Comparison: The size, shape, and interiors of both valves of *W. ? fatkai* resemble those of *W. bohemica,* but the former lacks oblique terrace lines; nevertheless, we consider *W. bohemica* to be a descendant of *W. ? fatkai.* In the diagnosis of *Westonia* (Walcott, 1901; Rowell, 1965), the network-like or zig-zag patterns of ornamentation, formed by oblique terrace lines have been considered as a main generic



8. *Westonia ? fatkai* sp. n.
A — interior of pedicle valve; B — interior of brachial valve

feature of *Westonia.* Terrace lines are an ecologic adaptation of lingulids for burrowing life style in sandy substrate (Savazzi, 1986). Thus, appearance of terrace lines is only an evolutionary convergence inside inarticulate brachiopods and need not reflect the taxonomic affinity.

Occurrence: Type locality only.

Lingulella Salter, 1866

Lingulella matthewi Koliha, 1921

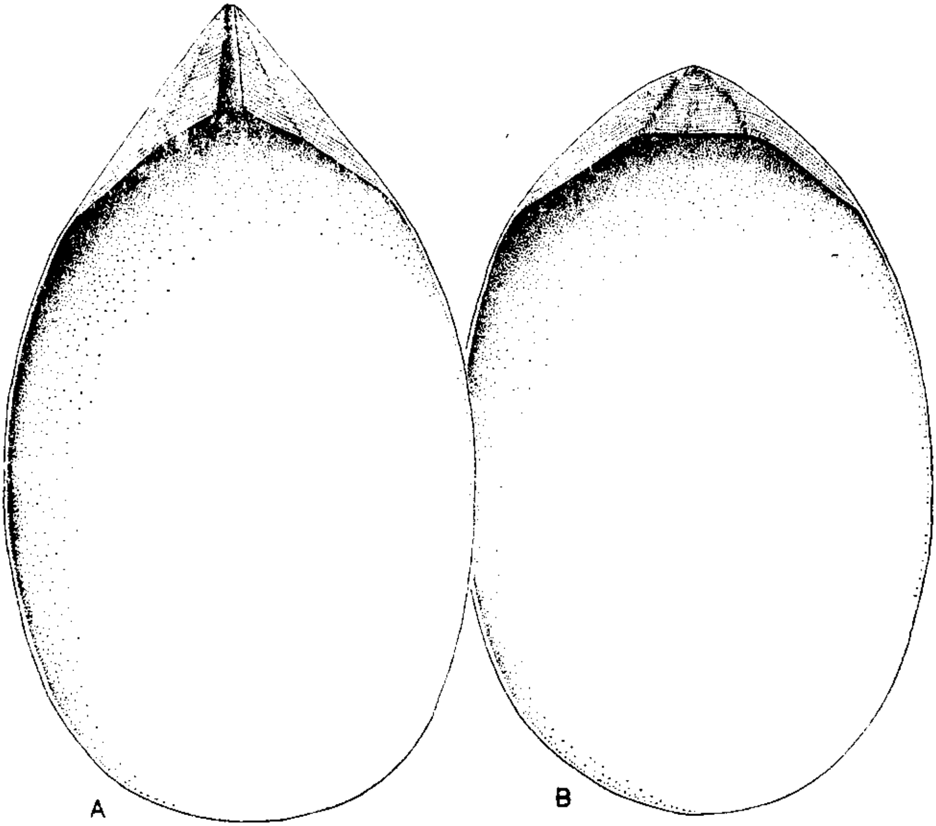
Pl. IV, figs. 1—10; text-figs. 9, 10

1921 *Lingulella Matthewi* n. sp.; Koliha, p. 30
1980 *Lingulella matthewi* Koliha, 1921; Šlehoferová, p. 18, pl. 1, figs. 1—6.

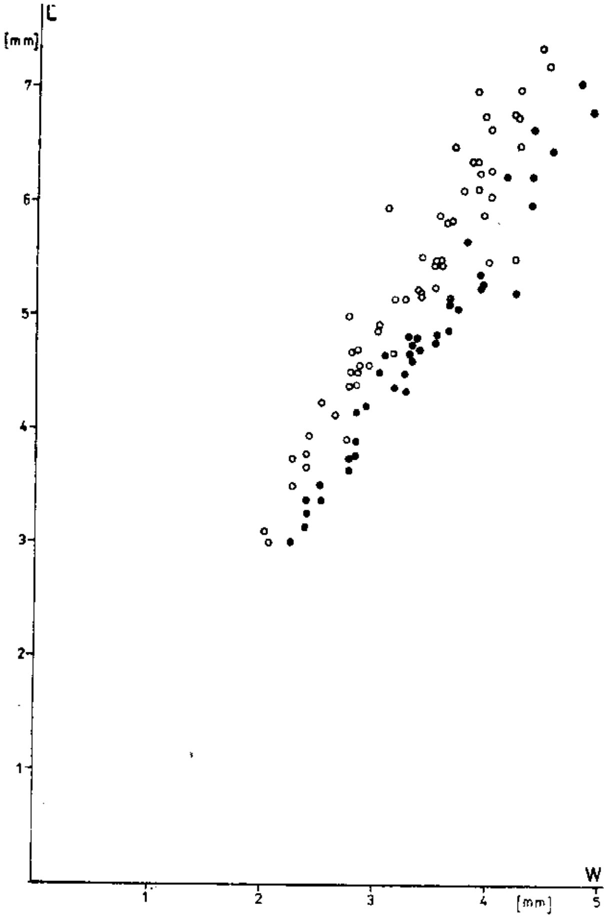
Lectotype: Pedicle valve selected from the original Koliha's material, figured herein on pl. IV, fig. 9, deposited in the National Museum, Prague (NM-L 26034).
Type horizon: Jince Formation, Rejkocephalus lyelli—Lingulella Zone (upper part).
Type locality: Medový Újezd, quarry.
Material: 65 pedicle and 50 brachial valves.

Description: Shell of medium size, biconvex, 6—7 mm long in adults, thin-walled. Pedicle valve elliptical, 140—185 % as long as wide, widest at midlength, nearly parallel-sided. Anterior margin evenly rounded, sides gently curved. Beak pointed, posterolateral margins subtend 80—85°. The valve is gently and evenly convex in lateral profile, and moderately convex in transverse profile. Ventral pseudointerarea long, slightly elevated above valve floor, 15—20 % as long as the valve. Pedicle groove narrow, gently widening anteriorly, 25 % as wide as long, its anterior width is about double as posterior width. Propareas large, widely triangular. Flexure lines coarse, straight, dividing propareas into two uneven parts. Surface of pseudointerarea covered by coarse growth lines.

Brachial valve oval, 125—150 % as long as wide, widest at midlength. Anterior and lateral margins evenly rounded, beak angle 90—100°. Dorsal



9. *Lingulella matthewi* Koliha, 1921
A — interior of pedicle valve; B — interior of brachial valve



10. Relationship between length versus width in *Lingulella matthewi* Kolíha, 1921 L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

pseudointerarea large, anteriorly probably undercut, gently raised above valve floor. Median depression widely triangular, defined by deflection of growth lines, and extends forward into short tongue. The surface of pseudointerarea covered by coarse growth lines. Neither muscle scars nor pallial markings are preserved.

Ornamentation: The surface of both valves is covered by fine, regularly spaced growth lines of uniform size. A pair of flat, indistinct, anteriorly widening radial plications are preserved in any specimens.

Comparison: *L. sufi* is close to *L. matthewi*, but the former is distinct in nearly smooth valve surface, smaller width/length ratio of the pedicle valve, and by absence of radial plications.

Occurrence: Brdy area; Rejkocephalus lyelli—Lingulella Zone (upper part); Medový Újezd (quarry; borehole Mý-XII, depth 10.00—32.00 m).

Lingulella havliceki sp. n.

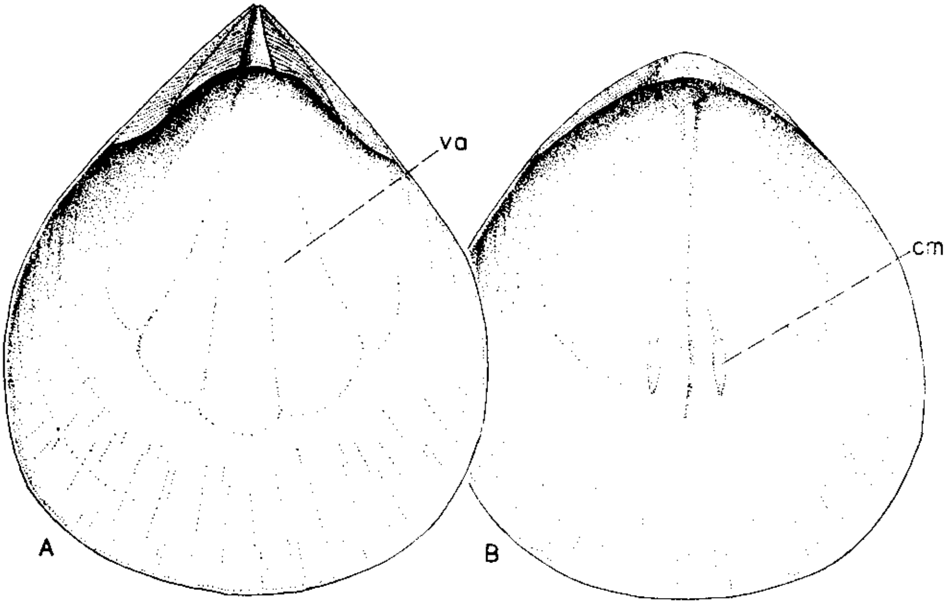
Pl. V, figs. 1—10; text-fig. 11, 12

Holotype: Pedicle valve figured herein on pl. V, fig. 1, deposited in the National Museum, Prague (NM-L 26031a).
Type horizon: Jince Formation, Rejkocephalus lyelli—Lingulella Zone (lower part).
Type locality: Jince, the top of Vystrkov Hill.
Name: After Dr. V. Havlíček.
Material: 15 pedicle and 15 brachial valves.

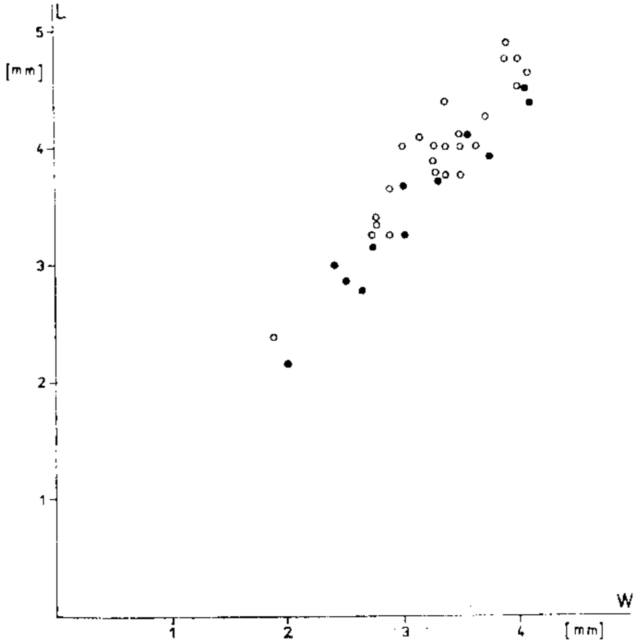
Description: Shell of minute size, biconvex, 4.5—6 mm long in adults, thin-walled. Pedicle valve broadly subpentagonal in outline, 105—130 % as long as wide, widest at anterior third. Anterior half semicircular in outline, posterolateral margins nearly straight. The valve is evenly and moderately convex in beak region in transverse profile, the convexity decreases anteriorly; the valve is slightly convex in lateral profile. Beak pointed, with posterolateral margins subtending 82—85°. Ventral pseudointerarea catacline, anteriorly undercut, 70 % as wide as valve. Pseudointerarea divided by a long, deep, moderately widening pedicle groove about twice as long as wide. Anterior of pedicle groove rests on the shelf elevated and undercut above valve floor. Propareas long, large, each is divided by a weak flexure line into two parts. Surface of propareas covered by slightly inclined fine growth lines. Visceral area very large, occupying 70 % of the valve length and 50—60 % of valve width, divided by fine radially arranged ridges into several (five to seven) narrowly triangular lobes. Muscle scars poorly impressed, with two pairs of them located in the umbonal region. Terminal vascular canals densely crowded along periphery of the valve.

Brachial valve oval to subpentagonal in outline, 105—120 % as long as wide, with evenly rounded anterior and lateral margins. Posterior margin rounded, with tumid beak, posterolateral margins subtend 100—120°. The valves is as deep as or slightly deeper as the pedicle valve, and it is moderately convex in both profiles. Dorsal pseudointerarea short, slightly elevated above valve floor, anteriorly undercut. Widely triangular median depression poorly defined, with anteriorly concave front edge. Surface of pseudointerarea is densely covered by fine growth lines. Interior of brachial valve bears large, flabellate visceral area, which is divided by low, incipient median ridge. A pair of central muscle scars rather small, narrowly elliptical, poorly impressed at the centre of the valve. Vascula media gently divergent; the arrangement of terminal vascular canals is the same as in pedicle valve.

Ornamentation consists of low, prominent growth lines of uneven size. Radial striation of the inner shell layers well-preserved in partly exfoliated specimens.



11. *Lingulella havliceki* sp. n.
A — interior of pedicle valve; va — visceral area; B — interior of brachial valve; cm — central muscle scars



12. Relationship between length and width in *Lingulella havliceki* sp. n.
L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

Comparison: The broadly subpentagonal shell and the shape of ventral pseudointerarea distinguish *L. havliceki* from other Bohemian lingulids of Cambrian age. *L. hayesi* (Walcott), and *L. oweni* (Walcott), although similar in size and shape, differ by deeper impression of muscles and by different shape of dorsal pseudointerareas.

Occurrence: Brdy area; Rejkocephalus lyelli—Lingulella Zone (lower part); Jince (Vinice slope, the top of Vystrkov Hill), Čihadlo near Kváň, Medový Újezd (borehole Mý-XII, depth 84.30—88.50 m).

Lingulella sufi sp. n.

Pl. VI, figs. 5—7; text-figs. 13, 14

Holotype: Pedicle valve figured on pl. VI, fig. 5, deposited in the Geological Survey, Prague (MM 259).

Type horizon: Jince Formation, horizon with *Alueva — Conocoryphe ovata.*

Type locality: Jince, southern part of Vinice slope.

Name: After the late Professor J. Šuf.

Material: 20 pedicle and 18 brachial valves.

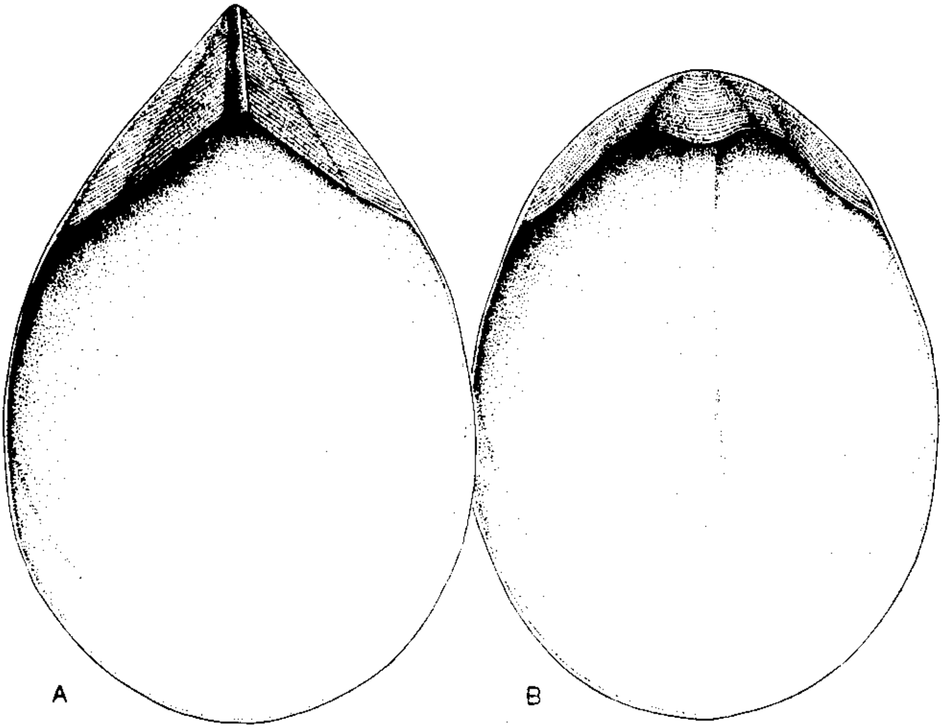
Description: Shell minute, equally biconvex, 3.7 mm long in the largest specimens, rather thick-walled. Pedicle valve elliptical in outline, widest at midlength, 140—180 % as long as wide. Anterior margin evenly rounded, lateral and posterolateral margins gently curved. The valve is moderately and evenly convex in transverse profile and gently convex in lateral profile. Beak pointed, posterolateral margins subtend 80—85°. Ventral pseudointerarea large, 70 % as wide as the valve, anteriorly undercut, weakly raised above valve floor. Pseudointerarea is medianly divided by a narrow, deep pedicle groove into two large propareas. Pedicle groove U-shaped in transverse profile, 30 % as wide as long anteriorly, slightly tapering posteriorly. Flexure lines subtend 60°, and divide propareas into inner, shorter parts, which are steeply inclined toward pedicle groove, and longer and less inclined outer parts. Surface of pseudointerarea is covered by fine growth lines. Interior of pedicle valve is devoid of muscle scars, large rhomboidal visceral field is feebly impressed.

Brachial valve elliptical in outline, widest at midlength 135—155 % as long as wide, with rounded beak. The valve is as deep as or slightly deeper than the pedicle valve. Dorsal pseudointerarea short, anteriorly inclined, weakly raised above valve floor. Pseudointerarea is medianly divided by weakly concave, poorly defined and widely triangular median depression, which extends forward as a short tongue. Surface of pseudointerarea covered by fine growth lines. Very fine, wide, flat median ridge extends from median depression and extends over midlength of the valve. Visceral area large, poorly defined, subrectangular in outline. Other features not preserved.

Ornamentation: Surface of the shell covered by very fine growth lines and devoid of radial ornamentation. Growth lamellae poorly defined externally, but internally they are marked by the thickening of the wall.

Comparison: See *L. matthewi* (p. 0000).

Occurrence: Type locality only.



13. *Lingulella sufi* **sp. n.**
A — interior of pedicle valve; B — interior of brachial valve

Lingulella sp.

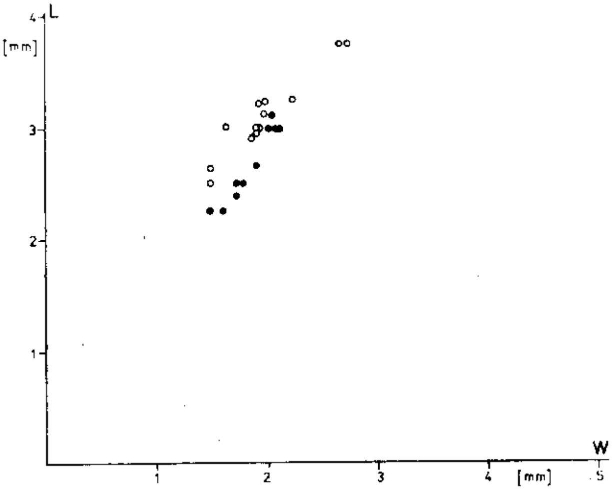
Pl. VI, figs. 1—4

1896 *Lingulella* (?) sp.; Pompeckj, p. 509, pl. 14, figs. 16a—b.
1912 *Lingulella* cf. *ferruginea* Salter; Walcott, p. 500, pl. 30, fig. 4.
1980 *Lingulella jahni* sp. n.; Šlehoferová (MS), p. 22, pl. 2, figs. 1—5.

Material: Several dozens of specimens.

Remarks: Minute lingulids are very difficult for taxonomic study, because the amount of diagnostic features is limited. Many tiny lingulids of Cambrian to Ordovician age have been assigned to the genus *Lingulella* (Biernat-Tomczykova, 1968; Rowell-Krause, 1975; Rowell, 1977; Laurie, 1986). However, lingulids preserved in shales are strongly deformed and are not suitable for description and comparison. Therefore, we consider to be better assigned minute Bohemian lingulids from the shales in generic level only.

Occurrence: Skryje-Týřovice area, Bohemiella romingeri Zone: Skryje (Luh, Dlouhá hora, Hradiště, "Pod hruškou"). Brdy area; Onymagnostus hybridus Zone: Jince (Vinice slope).



14. Relationship between length versus width in *Lingulella sufi* sp. n. L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

Acrotretacea Schuchert, 1893

Acrothelidae Walcott-Schuchert, 1903

Acrothelinae Walcott-Schuchert, 1903

Acrothele Linnarsson, 1876

Acrothele quadrilineata Pompeckj, 1896

1896 *Acrothele quadrilineata* nov. spec.; Pompeckj, p. 511, pl. 14, fig. 6.
1912 *Acrothele quadrilineata* Pompeckj; Walcott, p. 655, pl. 62, fig. 5.
1980 *Acrothele quadrilinata* Pompeckj; Šlehoferová, p. 45, pl. 6, figs. 1—9.

Holotype (by monotypy): Pedicle valve figured by Pompeckj (1896) on pl. XIV, fig. 6, refigured herein on pl. VI, fig. 8, deposited in the Geologische Bundesanstalt, Wien.

Type horizon: Jince Formation, Bohemiella romingeri Zone.
Type locality: Skryje, Buchava quarry.
Material: 8 pedicle and 2 brachial valves.

Description: Shell large for the genus, 8 mm wide in adults, thin-walled. Pedicle valve is a very low, eccentric cone, with beak situated in posterior third of the valve. Pedicle valve nearly circular in outline, with evenly rounded anterior and lateral margins, and less curved to nearly straight posterior margin. In lateral profile, commissure straight with ventrally deflected posterior part. Pseudointerarea procline, widely triangular, about 40 % as wide as valve, well-defined by the deflection of the growth lines. Pedicle opening minute, circular in outline, located immediately posteriorly from the beak. Interior of pedicle valve with narrow, anteriorly converging vascula lateralia; muscle scars not preserved.

Brachial valve has the same outline as pedicle valve with marginal beak. The valve is flat in tranverse and lateral profiles, with ventrally deflected umbonal region. Protegulum of brachial valve minute, circular, with a pair of divergent, low, elliptical protegular nodes. Interior of brachial valve unknown.

Ornamentation: Surface of shell covered by coarse, elevated growth lines increasing in size anteriorly. Growth lines may be weakly undulating; growth lamellae not developed. Additional ornamentation of fine granules is less distinct on the growth lines than on the bottom of interspaces. Wide, flat rays radiate from the umbo of pedicle valve, increase in a size anteriorly and reach front margin; additional rays originate by implantation between older ones. There ar 4 to 6 rays in front margins of large valves. All rays of the pedicle valve are confined to the median sector; rays of the same shape in the brachial valve are located on flanks, median sector is devoid of radial ornamentation.

Comparison: *A. quadrilineata* is close to *A. coriacea* Linnarsson the latter differs by more posteriorly located ventral beak, more transverse shell and by narrower ventral pseudointerarea. Specimens assigned by Termier - Termier (1974) to *A. coriacea* from the Montagne Noire, France, are poorly preserved but they probably lack radial rays.

Occurrence: Brdy area: Onymagnostus hybridus Zone: Jince (Vinice slope). Skryje-Týřovice area; Bohemiella romingeri Zone: Skryje (Buchava, "Pod třešní").

Glyptacrothele Termier - Termier, 1974

Remarks: *Glyptacrothele* Termier - Termier is characterized by lamello-granulose ornamentation and slightly elliptical outer pedicle opening (Termier - Termier, 1974). Apart from *G. courtessolei* Termier - Termier, the species *Acrothele granulata* Linnarsson has been assigned to this genus by Termier - Termier (1974). However, *A. granulata* is the type species of *Redlichella* Walcott (Walcott, 1912; Rowell, 1965) and has deeply impressed cardinal muscle scars, whereas cardinal scars of *Glyptacrothele* seem to be weakly impressed. The additional investigation on better preserved material of *Glyptacrothele* is necessary to determine whether *Glyptacrothele* is a valid genus or a younger subjective synonym of *Redlichella.*

Glyptacrothele bohemica (Barrande, 1879)

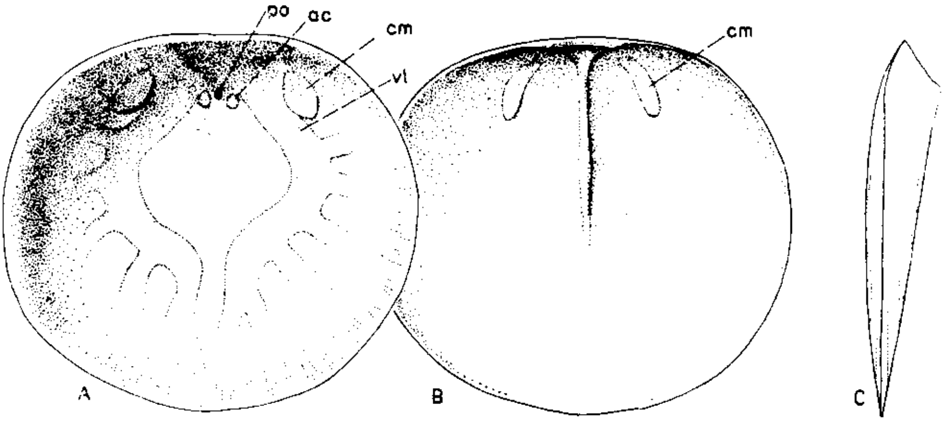
Pl. VIII, figs. 10—16, pl. IX, figs. 1—9; text-fig. 15

1879 *Obolus ? bohemicus* Barrande; Barrande, pl. 102, fig. 7:1—3.
1896 *Acrothele bohemica* Barr.; Pompeckj, p. 509, pl. 14, figs. 7—15.
1912 *Acrothele bohemica* (Barrande); Walcott, p. 639, pl. 56, fig. 1.
1921 *Acrothele bohemica,* Barr. sp.; Koliha, p. 30.
1980 *Acrothele bohemica* (Barrande, 1879); Šlehoferová, p. 40, pl. 4, figs. 1—7, pl. 5, figs. 1—8.

Lectotype: Selected here, pedicle valve figured by Barrande (1879) on pl. 102, fig. 7:1, re-figured herein on pl. IX, fig. 7, deposited in the National Museum, Prague (NM-L 26028).
Type horizon: Jince Formation, Bohemiella romingeri Zone.
Type locality: Mlečice.
Material: 40 pedicle and brachial valves, many fragments.

Description: Shell of medium size, 6—7 mm wide in adults, thin-walled (less than 0.2 mm in adults). Pedicle valve is a low, assymmetric cone, subcircular in outline, 70—90 % as long as wide, and less than 20 % as high as wide. Apex situated at posterior sixth of the valve, surface of the valve weakly sloping anteriorly and laterally from the apex. Anterior and lateral margins evenly rounded, posterior margin slightly less curved. Commissure straight in anterior and lateral positions, posterior part is deflected ventrally. Ventral pseudointerarea widely triangular, short, moderately to steeply procline, in lateral profile straight to gently concave, about 25 % as wide as the valve. Borders of pseudointerarea marked by deflections of valve surface and growth lines. Pedicle opening elliptical, minute, located immediately posteriorly from the apex. Interior of pedicle valve with a pair of large, weakly impressed cardinal muscle scars, located laterally from the apex, and further with smaller paired muscle scars, laterally bounding inner pedicle opening. Vascular canals gently impressed, running parallel with valve margins; each main canal branches anterolaterally into several secondary canals, which terminate by fine canals along valve periphery.

Brachial valve has the same outline as pedicle valve. Beak marginal, with raised protegulum, which bears a pair of spinose, elliptical protegular nodes. The valve is weakly and evenly convex in transverse profile, and flat in lateral profile, except for ventrally deflected dorsal beak. Dorsal pseudointerarea is a tiny, very short plate bordering posterior margin of valve, and is supported by a strong, low median ridge reaching 30 % of the valve length. Cardinal muscle scars large, feebly impressed, narrowly elliptical, located in posterolateral parts of valve floor. Other muscle scars and pallial markings not preserved.



15. *Glyptacrothele bohemica* (Barrande, 1879)
A — interior of pedicle valve; ac — anterocentral muscle scars, cm — cardinal muscle scars, po — inner pedicle opening, vl — vascula lateralia; B — interior of brachial valve; cm — cardinal muscle scars; C — lateral profile of complete shell

Ornamentation consists of minute granules, irregularly spaced or forming discontinuous, undulating concentric lines. The size of granules increases anteriorly. Growth lines indistinct in median sector, but coarse in flanks. The surface of central pseudointerarea bears finer granules than the adjacent shell surface, but growth lines are better developed there. Growth lamellae poorly developed, marked by an absence of granulose ornamentation. The dominance of granulose or concentric ornamentation varies. Overally, the specimens from the Skryje-Týřovice area have better developed granules, whereas specimens from the Brdy area have more distinct growth lines; nevertheless, these differences may be explained by an intraspecific variability. Radial ornamentation weak and usually more distinct on the brachial valve; rays originate at umbo and increase in size anteriorly; there are 26—30 rays in adults.

Comparison: *G. bohemica* is close to *Redlichella granulata* (Linnarsson), but the latter differs by stronger muscle impressions and by absence of radial rays. *G. courtessolei* Termier - Termier has a more centrally located ventral beak and coarser growth lines in comparison with *G. bohemica.*

Occurrence: Brdy area; Eccaparadoxides pusillus Zone, Onymagnostus hybridus Zone, and interval between Eccaparadoxides pusillus and Paradoxides gracilis Zones: Jince (Vinice slope), Rejkovice (W part of the village). Skryje-Týřovice area; Bohemiella romingeri Zone: Skryje (Luh, Čihátko, Dlouhá hora, Hradiště, Buchava), Mlečice, Biskoupky.

Botsfordiidae Schindewolf, 1955

Botsfordiinae Schindewolf, 1955

Botsfordia Matthew, 1892

Botsfordia snajdri sp. n.

Pl. VIII, figs. 1—9; text-figs. 16, 17

Holotype: Brachial valve, figured on pl. VIII, figs. 3, 4, 9, deposited in the Geological Survey, Prague (MM 258).

Type horizon: Jince Formation, horizon with *Alueva — Conocoryphe ovata.*

Type locality: Jince, southern part of Vinice slope.

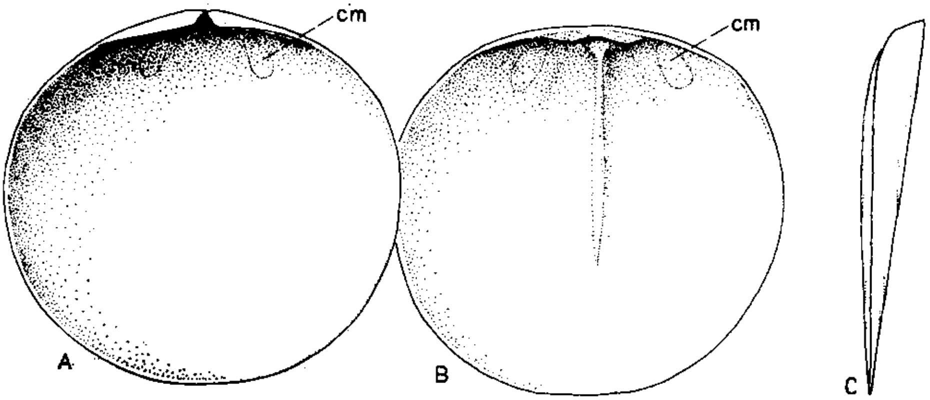
Name: After the late Dr. M. Šnajdr.

Material: 5 pedicle and 12 brachial valves.

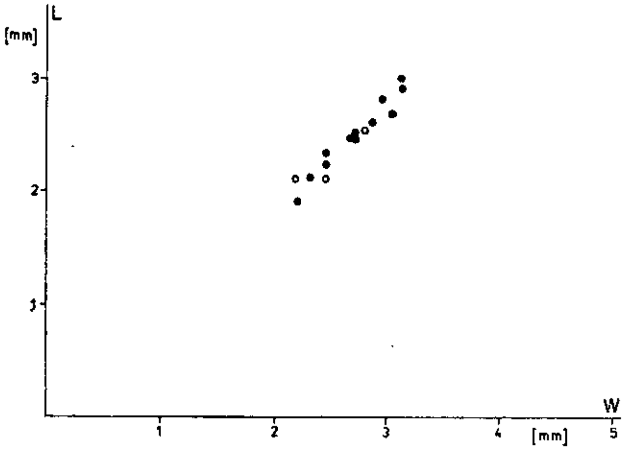
Description: Shell minute, 3 mm wide in adults, thin-walled. Pedicle valve subcircular in outline, 88—92 % as long as wide, with anterior and lateral margins evenly rounded. Posterior margin nearly straight, deflected ventrally in median part. Ventral beak marginal, forming the top of the valve; surface evenly sloping anteriorly and laterally from the beak. Ventral pseudointerarea steeply apsacline, very low, divided by a minute, deep, narrowly triangular delthyrium into two tiny propareas. A pair of deeply impressed, minute, oval muscle scars located between apex and lateral margins.

Brachial valve circular in outline, 83—90 % as long as wide, with posterior margin deflected ventrally. In anterior view, the valve is nearly flat, but in lateral profile, the valve is gently convex posteriorly and becomes nearly flat in anterior half. Dorsal pseudointerarea short, high, with inclined propareas which laterally pass into valve floor without distinct boundaries. Median plate strongly elevated, well defined, anteriorly supported by a fine median buttress, which expands forward as a low, narrow median ridge. Median ridge extends anteriorly over midlength. Posterolaterally located cardinal muscle scars large, elongate, deeply impressed. Pallial markings not preserved.

Ornamentation consists of minute, densely and irregularly spaced granules of uniform size. Growth lines and radial ornamentation not developed.



16. *Botsfordia snajdri* sp. n.
A — interior of pedicle valve; B — interior of brachial valve; C — lateral profile of complete shell; cm — cardinal muscle scars



17. Relationship between length versus width in *Botsfordia snajdri* sp. n. L — length, W — width, *empty circles* — pedicle valve, *full circles* — brachial valve

Comparison: *B. snajdri* is most similar to *B. epigona* Mergl from the early Middle Cambrian of Morocco (Mergl, 1988), but the latter differs by much shorter and anteriorly deflected ventral pseudointerarea. *B. caelata* (Hall) (Walcott, 1912; Pelman, 1977) differs by more rounded posterior margin, less distinct median ridge, and better developed growth lines. *B. poletaevae* Aksarina (Aksarina - Pelman, 1978) differs from *B. snajdri* by more distinct growth lines and by longer median ridge in brachial valve interior.

Occurrence: Type locality only.

Acrotretidae Schuchert, 1893

Acrotretinae Schuchert, 1893

Luhotreta gen. n.

Type species: *Luhotreta pompeckji* (Šlehoferová)

Diagnosis: Large acrotretid with a moderately high, widely conical pedicle valve. Ventral pseudointerarea catacline to steeply procline, intertrough deeply cut. Brachial valve weakly convex, with an orthocline pseudointerarea divided by a widely triangular median plate. Median plate supported anteriorly by a strong median buttress, median ridge absent. Cardinal muscle scars large, laterally spaced. Coarse, scarse lamellae and fine growth lines cover shell surface.

Remarks: *Luhotreta* is close to *Vandalotreta* Mergl (Mergl, 1988); the latter differs by an absence of growth lamellae, and by a pair of large central muscle scars centrally located in brachial valve interior. *Hadrotreta* Rowell (Rowell, 1966) differs from *Luhotreta* by a weakly sulcate brachial valve and by presence of a coarse median ridge in brachial valve interior.

Species assigned: *L. pompeckji* (Šlehoferová); Jince Formation, Brdy and Skryje-Týřovice areas.

Luhotreta pompeckji (MS Šlehoferová, 1980), emend.

Pl. X, figs. 1—16; text-fig. 18

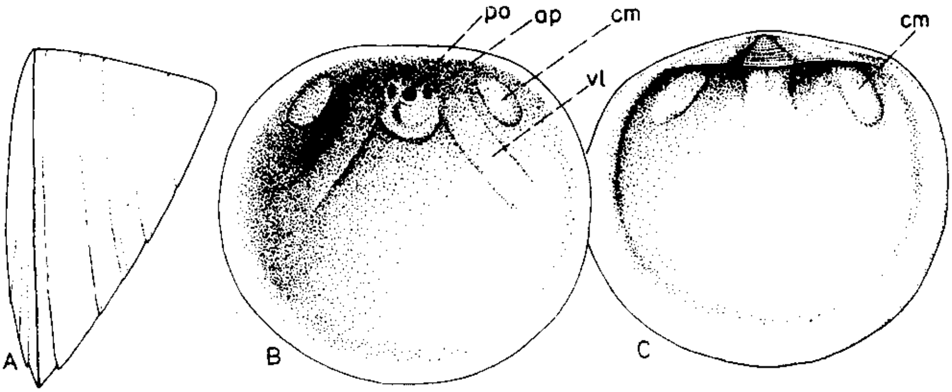
1896 *Acrotreta* nov. spec.; Pompeckj, p. 512, pl. 14, fig. 17.
1980 *Acrotreta pompeckji* sp. nov.; Šlehoferová, p. 34, pl. 3, figs. 1—13.

Holotype: Brachial valve figured on pl. X, fig. 11, deposited in the Academy of Sciences, Prague (PEŠ 42).
Type horizon: Jince Formation, Bohemiella romingeri Zone.
Type locality: Skryje, Hradiště hill.
Material: 15 pedicle and 8 brachial valves.

Description: Shell large for *Acrotretinae,* thin-walled, 2.5 mm wide in large specimens. Pedicle valve conical, nearly circular in outline, about 60—70 % as high as wide. Apical angle 80—90° in posterior view, and 60—80° in lateral view. Ventral pseudointerarea catacline to steeply procline, defined by the flattening of the valve; intertrough narrow and deep. Outer pedicle opening minute, circular, located immediately posteriorly from the apex. Interior of valve with minute, but well-developed apical process, and slightly elliptical inner pedicle opening, which extends into short pedicle tube internally. Apical pits minute, situated laterally to the pedicle tube. Cardinal muscle scars large, deeply impressed, located posterolaterally. Vascula lateralia deeply impressed in umbonal area, shallowing and diverging anteriorly.

Brachial valve nearly circular, weakly convex in transverse profile, and weakly convex apically but flat anteriorly in lateral profile. Dorsal pseudointerarea short, orthocline, with weakly concave, widely triangular median plate. Propareas narrowly triangular, as wide as median plate. Median buttress strong, nearly as wide as the median plate, and not extending anteriorly as median ridge. Cardinal muscle scars large, poorly impressed, located posterolaterally. Except for posterior margin, the periphery of the brachial valve interior forms narrow, flat brim.

Ornamentation consists of fine, regularly spaced growth lines slightly finer on the surface of ventral pseudointerarea. Growth lamellae scarce, several in number, very strong and overlapping near periphery of large shells.



18. *Luhotreta pompeckji* (Šlehoferová, 1980)
A — lateral profile of complete shell; B — interior of pedicle valve; ap — apical pits, cm — cardinal muscle scars, po — inner pedicle opening, vl — vascula lateralia; C — interior of brachial valve; cm — cardinal muscle scars

Occurrence: Brdy area; horizon with *Alueva — Conocoryphe ovata* to Onymagnostus hybridus Zone: Jince (southern part of Vinice slope, Vinice slope). Skryje-Týřovice area; Bohemiella romingeri Zone: Skryje (Luh, Dlouhá hora, Hradiště, Buchava a. o.), Biskoupky.

Hadrotreta Rowell, 1966

Hadrotreta sp.

Pl. X, figs. 17, 18

Remarks: A single, gently convex brachial valve with a minute, distinct median ridge is available only. Overall shape of the valve with shallow sulcus and presence of median ridge recall *Hadrotreta* Rowell, but generic assignment without knowledge of dorsal pseudointerarea and pedicle valve is only tentative,

Occurrence: Skryje-Týřovice area; Bohemiella romingeri Zone: Skryje (Buchava).

Superfamily, family and genus unknown

"Acrothele" gigantea Želízko, 1911

Pl. XI, figs. 1—6

1896 *Acrothele* nov. spec.; Pompeckj, p. 566.
1911 *Acrothele gigantea* Žel.; Želízko, p. 4.
1989 *Acrothele* (?) *gigantea* Želízko, 1911; Šlehoferová, p. 48, pl. 7, figs. 1—4.

Lectotype: Selected here, pedicle (?) valve figured herein on pl. XI, figs. 1, 2, deposited in the National Museum, Prague (NM-L 26032).
Type horizon: Jince Formation, Ellipsocephalus hoffi—Rejkocephalus lyelli Zone.
Type locality: Jince, Koníček Hill.
Material: 13 pedicle and 2 brachial valves.

Description: Shell large, planoconvex, thin-walled, maximally 30 mm long. Pedicle (?) valve subcircular in outline, with flattened posterior margin, 100—120 % as long as wide. Beak gently pointed, located nearly at posterior margin. Posterior part of the valve steeply sloping toward posterior margin. Ventral pseudointerarea poorly defined, widely triangular. A pair of minute, triangular impressions are developed anterolaterally from the beak. Several fine, radially arranged ridges are situated at the centre of the valve; they may correspond to vascular canals.

Opposite valve (? brachial) flat, with fine ridge near marginal beak, and paired, poorly divergent ridges at the centre of the valve. Shell devoid of the ornamentation except for coarse 4—5 in number, concentric lamellae.

Remarks: All available specimens are poorly preserved; valves are strongly flattened, wrinkled, and original shell substance is dissolved. Large-size and probably only fine ornamentation, and ? absence of pedicle opening distinguish *"Acrothele" gigantea* from other acrothelid genera (*Acrothele* Linnarsson, *Eothele* Rowell, *Glyptacrothele* Termier - Termier, *Redlichella* Walcott, *Spinulothele* Rowell), but recall the Lower Ordovician genus *Oxlosia* Ulrich - Cooper, 1936. In addition, it is not excluded, that *"A." gigantea* may be rejected from the brachiopods.

Dimensions (in mm):	length	width
pedicle valve NM-L 26032	27.0	25.0
pedicle valve GS-YA 1305	24.0	24.0
pedicle valve GS-YA 1324	25.0	25.0
brachial valve MM 284	25.5	25.5

Occurrence: Brdy area; interval between Eccaparadoxides pusillus and Paradoxides gracilis Zones to Ellipsocephalus hoffi—Rejkocephalus lyelli Zone: Jince (Vystrkov Hill, Vinice slope, Koníček Hill, Ovčín), Rejkovice (railway cutting near Zelený mlýn).

K tisku doporučil V. Havlíček.

Přeložil M. Mergl

References

Aksarina, N. A. - Pelman, J. L. (1978): Kembrijskie brachiopody i dvuchstvorčatye molljuski Sibiri. — Izdat. Nauka. Moskva.

Barrande, J. (1879): Système silurien du centre de la Bohême, V. — Prag, Paris.

Biernat, G. - Tomczykova, E. (1968): On the Upper Cambrian Lingulella Salter (Brachiopoda) from the Holy Cross Mountains, Poland. — Acta paleont. pol., 13, 2, *159—185*. Warszawa.

Fatka, O. (1986): Biostratigrafie jineckého souvrství. — MS Geofond. Praha.

Fatka, O. - Kordule, V. - Mergl, M. - Šarič, R. (in press): Early Middle Cambrian fauna in Jince area (Central Bohemia). — Věst. Ústř. Úst. geol. Praha.

Havlíček, V. (1960): Jinecké vrstvy a jejich nadloží na Strašicku. — Zpr. geol. Výzk. v Roce 1958, *55—58*. Praha.

— (1971): Stratigraphy of the Cambrian of Central Bohemia. — Sbor. geol. Věd, Geol., 20, *7—52*. Praha.

Koliha, J. (1921): Ramenonožci z řádu Atremat v českém středním kambriu. — Čas. Mus. Král. čes., 95, *29—31*. Praha.

Kukal, Z. (1971): Sedimentology of Cambrian deposits of the Barrandian area (Central Bohemia). — Sbor. geol. Věd, Geol., 20, *53—100*. Praha.

Laurie, J. R. (1986): Phosphatic fauna of the Early Cambrian Todd River Dolomite, Amadeus Basin, central Australia. — Alcheringa, 10, *431—454*. Sydney.

Mergl, M. (1988): Inarticulate brachiopods of early Middle Cambrian age from the High Atlas, Morocco. — Věst. Ústř. Úst. geol., 63, 5, *291—295*. Praha.

Pelman, J. L. (1977): Ranne- i srednekembrijskie bezzamkovye brachiopody Sibirskoj platformy. — Trudy Inst. Geol. Geofiz., 316, *1—167*. Novosibirsk.

Pompeckj, J. F. (1896): Die Fauna des Cambrium von Tejřovic und Skrej in Böhmen. — Jb. K.-Kön. geol. Staatsanst., 45, *495—614*. Wien.

Rowell, A. J. (1965): Inarticulata. *In:* Treatise on invertebrate paleontology, part H, Brachiopoda (edit. Moore, R. C.). — Univ. Kansas Press.

— (1966): Revision of some Cambrian and Ordovician inarticulate brachiopods. — Palaeont. Contr., 7, *1—88*. Lawrence.

— (1977): Early Cambrian brachiopods from the southwestern Great Basin of California and Nevada. — J. Paleont., 51, 1, *68—85*. Menasha.

Rowell, A. J. - Krause, F. F. (1975): Distribution and systematics of the inarticulate brachiopods of the Ordovician carbonate mud mound of Meikjlejohn Peak, Nevada. — Palaeont. Contr., 61, *1—74*. Lawrence.

Savazzi, E. (1986): Burrowing sculptures and life habits in Paleozoic lingulacean brachiopods. — Paleobiology, 12, 1, *46—64*. Chicago.

Šlehoferová, P. (1980): Inartikulátní ramenonožci středního kambria Čech. — MS přírodověd. fak. Univ. Karl. Praha.

Šnajdr, M. (1975): Additional notes on the stratigraphy of the Jince Formation. — Věst. Ústř. Úst. geol., 50, *157—161*. Praha.

Šuf, J. (1926): Předběžná zpráva o faunistických obzorech jineckých vrstev středního kambria na Vystrkově u Jince. — Věst. St. geol. Úst., Čs. Republ., 2, *129—135*. Praha.

— (1927): Předběžná zpráva o faunistických obzorech jineckých vrstev středního kambria u Rejkovic. — Věst. St. geol. Úst. Čs. Republ., 3, *120—124*. Praha.

Termier, G. - Termier, H. (1974): Les brachiopodes cambriens de la Montagne Noire (Sud de la France). — Géol. méditerr., 1, *35—52*. Marseille.

Ulrich, E. O. - Cooper, G. A. (1938): Ozarkian and Canadian Brachiopoda. — Bull. Geol. Soc. Amer., 13, *1—323*. Baltimore.

Walcott, C. D. (1901): Cambrian Brachiopoda: Obolella, subgenus Glyptias; Bicia; Obolus, subgenus Westonia; with descriptions on new species. — Proc. US nat. Mus., 23, *669—695*. Washington.

— (1912): Cambrian Brachiopoda. — Monogr. US geol. Surv., 51, *1—872*. Washington.

Želízko, J. V. (1911): Nové příspěvky ke studiu jineckého kambria. — Rozpr. Čes. Akad. Věd Slovesn. Umění, Tř. II, 20, 10, *1—7*. Praha.

Explanation of plates

All photos by M. Mergl

Pl. I

Lindinella kordulei sp. n.; Ellipsocephalus hoffi—Rejkocephalus lyelli Zone; locality: Rejkovice (Zelený mlýn) (1—5).
1, 4 — holotype, composite mould and latex cast of exterior of pedicle valve, ×3.8, ×10.0, GS-YA 1290; 2 — composite mould of pedicle valve, ×3.8, GS-YA 1285; 3 — composite mould of brachial valve, ×3.8, GS-YA 1290; 5 — latex cast of exterior of brachial valve, ×10.0, GS-YA 1292.

Pl. II

Lindinella kordulei sp. n.; Ellipsocephalus hoffi—Rejkocephalus lyelli Zone; locality: Rejkovice (Zelený mlýn) (1, 2).
1 — internal mould of ventral pseudointerarea, ×10.0, GS-YA 1283; 2 — internal mould of dorsal pseudointerarea, ×10.0, MM 251.
Westonia bohemica (Koliha, 1921); interval between Eccaparadoxides pusillus and Paradoxides Zones; locality: Jince (Vystrkov Hill) (3—6).
3 — lectotype, internal an external moulds of complete shell, ×5.0, NM-L 18202; 4—6 — internal mould of brachial valve, latex cast and external mould of exterior, ×5.0, ×10.0, ×16.0, NM-L 26030.

Pl. III

Westonia bohemica (Koliha, 1921); Eccaparadoxides pusillus Zone; localities: Strašice (Kamenná Hill, "V Andělkách" Forest) (1—3), Rejkovice (Hejdův dvůr) (4).
1 — internal mould of pedicle valve, ×5.2, VH 3406; 2, 3 — internal moulds of bra-

chial valves, ×5.2, ×5.2, VH 3406, VH 3406; 4 — internal mould of brachial valve, ×4.5, VH 5416.

Lindinella sp.; Pompeckium kuthani Zone; locality: Lohovice (5—8).

5, 6 — internal mould and latex cast of exterior of incomplete brachial valve, ×5.0, PEŠ 40; 7, 8 — internal mould and latex cast of exterior of brachial valve, ×5.0, PEŠ 41.

Pl. IV

Lingulella matthewi Koliha, 1921; Rejkocephalus lyelli—Lingulella Zone; locality: Medový Újezd (quarry) (1—10).

1, 4, 6—8 — composite moulds of brachial valves, all ×9.0, OMR 4542, VH 5418b, VH 5417c, VH 5420a, MŠ 1223d; 2, 3, 5 — composite moulds of pedicle valves, all ×9.0, OMR 5863, VH 5418a, VH 5417d; 9 — lectotype, composite mould of pedicle valve, ×12.0, NM-L 26034; 10 — composite mould of pedicle valve, ×12.0, NM-L 26035.

Pl. V

Lingulella havliceki sp. n.; Rejkocephalus lyelli—Lingulella Zone; localities: Jince (Vystrkov Hill) (1—10).

1 — holotype, internal mould of pedicle valve, ×12.0, NM-L 26031a; 2 — internal mould of ventral pseudointerarea, ×12.0, NM-L 26031c; 3, 4, 10 — internal moulds of pedicle valves, ×12.0, NM-L 26031b, d, MM 288b; 5, 7, 9 — internal moulds of brachial valves, ×12.0, NM-L 26031e, f, MM 288a; 6, 8 — exterior of pedicle and brachial valves, ×12.0, NM-L 26031g, h.

Pl. VI

Lingulella sp.; Bohemiella romingeri Zone; localities: Skryje (Dlouhá hora) (1,2), Skryje ("Pod hruškou") (3), Skryje (old brickyard) (4).

1, 2 — internal mould and latex cast of exterior of brachial valve, ×12.0, PEŠ 05; 3 — composite mould of pedicle valve, ×12.0, OMR 8081; 4 — internal mould of pedicle valve, ×12.0, PEŠ 45.

Lingulella sufi sp. n.; horizon with *Alueva — Conocoryphe ovata*; locality: Jince (southern part of Vinice slope) (5—7).

5 — holotype, interior of pedicle valve, ×12.0, MM 259; 6 — interior of brachial valve, ×12.0, MM 253; 7 — internal mould of pedicle valve with partly preserved shell, ×12.0, MM 261.

Acrothele quadrilineata Pompeckj, 1896; Bohemiella romingeri Zone; Skryje (Buchava) (8).

8 — holotype, composite mould of pedicle valve, ×6.5, without number.

Westonia ? fatkai sp. n.; layers below horizon with *Alueva — Conocoryphe ovata*; locality: Jince (southern part of Vinice slope) (9—13).

9, 13 — latex cast and external mould of brachial valve, ×5.0, ×10.0, OMR 20464; 10 — internal mould of dorsal pseudointerarea, ×10.0, MM 399; 11 — internal mould of ventral pseudointearea, ×10.0, MM 398; 12 — holotype, internal mould of pedicle valve, ×5.0, OMR 20465.

Pl. VII

Acrothele quadrilineata Pompeckj, 1896; Bohemiella romingeri Zone (1, 2, 4—8), and Onymagnostus hybridus Zone (3); localities: Skryje ("Pod třešní") (1, 2, 4—8), Jince (Vinice slope) (3).

1, 2 — composite moulds of pedicle valves, ×7.0, PEŠ 35, PEŠ 44; 3 — latex cast of pedicle valve exterior, ×9.0, VH 5415; 4 — external mould with partly preserved shell of pedicle valve, ×7.0, PEŠ 33; 5, 6 — latex cast of pedicle valve exterior and external mould of brachial valve of the same specimen, ×7.0, PEŠ 38, 7, 8 — latex casts of brachial and pedicle valves of the same specimen, ×7.0, PEŠ 39.

Pl. VIII

Botsfordia snajdri sp. n.; horizon with *Alueva — Conocoryphe ovata*; locality: Jince (southern part of Vinice slope) (1—9).
1 — internal mould of pedicle valve, ×9.0, MM 253; 2 — internal mould of brachial valve, ×9.0, MM 257; 3, 4, 9 — holotype, internal mould with partly preserved shell, its external mould, and detail of ornamentation, ×9.0, ×9.0, ×15.0, MM 258; 5 — interior of pedicle valve, ×9.0, MM 292; 6 — interiors of brachial valves, all ×9.0, MM 256, MM 255, MM 254.
Glyptacrothele bohemica (Barrande, 1879); Eccaparadoxides pusillus Zone (11—14), Bohemiella romingeri Zone (10, 15, 16); localities: Rejkovice (W part of the village) (11—13), Jince (Vinice slope) (14), Skryje (Čihátko) (15, 16), Skryje (Hradiště) (10).
10, 11 — internal moulds of minute pedicle valves, ×11.0, PEŠ 24, MM 291; 12, 13 — internal moulds of minute brachial valves, ×11.0, MM 289, MM 290; 14 — internal mould of brachial valve with partly preserved shell, ×8.0, VH 5419; 15, 16 — latex cast of exterior and internal mould of incomplete brachial valve, ×11.0, PEŠ 27.

Pl. IX

Glyptacrothele bohemica (Barrande, 1879); Eccaparadoxides pusillus Zone (1), Bohemiella romingeri Zone (2—9); localities: Jince (Vinice slope) (1), Biskoupky (2—6,9), Mlečice (7, 8).
1 — composite mould of pedicle valve, ×7.5, MM 266; 2 — incomplete internal mould of pedicle valve showing scars and pallial markings, ×10.0, MM 264; 3 — latex cast of pedicle valve exterior, ×10.0, MM 263; 4—6 — internal mould of pedicle valve, lateral, posterior, and ventral views, all ×8.0, VH 5421; 7 — lectotype, internal mould of pedicle valve, ×9.5, NM-L 26028a; 8 — internal mould of brachial valve, specimen figured by Barrande (1879), ×9.5, NM-L 26028b; 9 — exterior of brachial valve showing protegulum and ornamentation, ×15.0, MM 265.

Pl. X

Luhotreta pompeckji (Šlehoferová, 1980); Bohemiella romingeri Zone (1—3, 7—13), Onymagnostus hybridus Zone (4—6), horizon with *Alueva — Conocoryphe ovata* (14—16); localities: Skryje (Dlouhá hora) (1—3), Skryje (Hradiště) (11), Skryje (Buchava) (12), Skryje (Luh) (13), Biskoupky (7—10), Jince (Vinice slope) (4—6) Jince (southern part of Vinice slope) (14—16).
1—3 — pedicle valve exterior, ventral, anterior, and lateral views, ×17.0, MM 278; 4—6 — internal mould of pedicle valve, ventral, posterior, and lateral views, ×17.0, MM 278; 7—9 — internal mould of pedicle valve, ventral, posterior, and lateral views, ×17.0, MM 275; 10 — internal mould of large pedicle valve, ×14.0, PEŠ 43; 11 — holotype, interior of incomplete brachial valve, ×17, PEŠ 42; 12 — internal mould of brachial valve with partly preserved shell, ×17.0, VH 5424; 13 — composite mould of pedicle valve, ×17.0, MM 272; 14, 15 — internal mould of pedicle valve, anterior and ventral views, ×14.0, MM 286; 16 — interior of brachial valve, ×14.0, MM 270.
Hadrotreta sp.; Bohemiella romingeri Zone; locality: Skryje (Buchava) (17,18).
17, 18 — interior of brachial valve, ventral and oblique views, ×17.0, VH 5423.

Pl. XI

"Acrothele" gigantea Želízko, 1912; Paradoxides gracilis Zone (3, 6), Ellipsocephalus hoffi—Rejkocephalus lyelli Zone (1, 2, 4, 5); localities: Jince (Koníček Hill) (1, 2), Jince (Vinice slope) (3), Rejkovice (Zelený mlýn) (4, 5), Ovčín (6).
1, 2 — lectotype, internal and external moulds of pedicle valve, ×2.5, NM-L 26032; 3, 4, 6 — deformed composite moulds of pedicle valves, all ×2.5, GS-YA 1324, GS-YA 1305, PEŠ 36; 5 — composite mould of brachial valve, ×2.5, MM 284.

Pl. XII

1 — slab with valves of *Lingulella matthewi* Koliha, 1921; Rejkocephalus lyelli—Lingulella Zone (upper part); Medový Újezd (quarry), ×3.0, OMR 15533.
2, 3 — slabs with valves of *Lingulella havliceki* sp. n.; Rejkocephalus lyelli—Lingulella Zone (lower part); Medový Újezd (borehole Mý-XII), (2), Jince (Vystrkov Hill) (3), all ×3.0, MŠ 990, NM-L 26031.

Středokambričtí inartikulátní ramenonožci ze středních Čech

(Résumé anglického textu)

Michal Mergl - Petra Šlehoferová

Předloženo 12. září 1988

Inartikulátní ramenonožci jsou důležitou, avšak nehojnou složkou bentických marinních společenstev českého středního kambria. Celkem zde bylo zjištěno 14 druhů, z toho jsou dva rody (*Lindinella, Luhotreta*) popsány jako nové.

Rozšíření brachiopodových faun je v těsné závislosti na litologickém vývoji a stratigrafické úrovni. V brdské oblasti byla písčitá dna osídlena několika lingulovými asociacemi: asociací s *Westonia ? fatkai, Westonia bohemica, Lingulella havliceki* a *Lingulella matthewi.* V těchto asociacích je nebrachiopodová fauna nehojná. Bahnitá dna ve větších hloubkách byla osídlena asociacemi s *Acrothele* a *Botsfordia,* ve vyšší části jineckého souvrství s nehojným lingulidním druhem *Lindinella kordulei.* Tyto asociace jsou doprovázeny hojnými a druhově rozmanitými faunami trilobitů, ostnokožců a dalších skupin (hyolitů, gastropodů, ostrakodů aj.). Podobně jako trilobiti a ostnokožci (Fatka, 1986) i sled brachiopodových asociací v brdském kambriu dokládá symetrický vývoj pánve: lingulová společenstva jsou vázána na spodní a svrchní část jineckého souvrství, zatímco ve střední části souvrství jsou potlačena. V souvislosti s prohloubením pánve ve střední části souvrství (Fatka, 1986) se místo nich objevují asociace s *Acrothele* a *Botsfordia.*

Ve skryjsko-týřovické oblasti je s výjimkou hrubozrnných klastik ve spodní části jineckého souvrství zastoupena pouze asociace s *Acrothele,* která je i zde doprovázena hojnou a druhově početnou faunou trilobitů, ostnokožců, hyolitů i dalších skupin.

Беззамковые брахиоподы среднего кембрия из средней Чехии

Монографическая обработка беззамковых брахиоподов из среднего кембрия содержит 14 видов, относящихся к 9 родам; определены новые роды Lindinella и Luhotreta Распространение отдельных видов обусловлено литологическим составом и стратигра фическим уровнем: мелководные районы с песчаным дном обитало несколько лингулидных сообществ, тогда как более глубокие части бассейна с болотистым дном обитали сообщества с Acrothele и Botsfordia.

Přeložil A. Kříž

Sbor. geol. věd	Paleontologie, 31	Pages 105—205	32 figs.	3 tabs.	24 pls.	Praha 1990 ISSN 0036-5297

Sedimentology, benthic communities, and brachiopods in the Suchomasty (Dalejan) and Acanthopyge (Eifelian) Limestones of the Koněprusy area (Czechoslovakia)

Sedimentologie, bentická společenstva a ramenonožci suchomastských a akantopygových vápenců (dalej-eifel) koněpruské oblasti

Vladimír Havlíček[1] - Zdeněk Kukal[1]

Received March 30, 1989

Articulate brachiopods
Benthic communities
Sedimentology
Carbonate platform
Lower—Middle Devonian
Czechoslovakia

1 : 50 000
12-41

Havlíček, V. - Kukal, Z. (1990): Sedimentology, benthic communities, and brachiopods in the Suchomasty (Dalejan) and Acanthopyge (Eifelian) Limestones of the Koněprusy area (Czechoslovakia). — Sbor. geol. Věd, Paleont., 31, *105—205*. Praha.

Abstract: Sedimentary structures and composition indicate that the two units Suchomasty and Acanthopyge Limestones deposited in shallow-water environment of the carbonate platform in the Koněprusy area. In the first unit (Suchomasty Limestone) water agitation and depth varied from place to place, but the depth did not exceed several tens of metres. Extremely shallow-water environment of deposition of the Acanthopyge Limestone corresponds also to carbonate platform with sedimentation of bahamites in flat depressions. Brachiopod communities of the Suchomasty and Acanthopyge Limestones clearly differ from the perireefal communities of the Koněprusy Limestone (Pragian) because they contain mainly smooth and weakly plicate spire-bearing brachiopods. In the Koněprusy Limestone, on the other hand, strongly costate and costellate shells prevail. Benthic fauna of the Suchomasty Limestone was assigned to the *Karbous-Orbitoproetus* and *Orbitoproetus-Scabriscutellum* Communities, the shelly fauna of the Acanthopyge Limestone is attributed to the *Karbous-Acanthopyge* Community. In the Suchomasty and Acanthopyge Limestones, 55 genera of articulate brachiopods were recognized; out of them, *Mamutinetes (Chonetacea), Lysigypa (Cypidulacea), Trigonatrypa, Cerberatrypa, Radimatrypa (Atrypacea)*, and *Rochtex (Gyrtiacea)* are erected as new genera. Further, 30 species were described as new; the *Bojothyrididae* is a new family of the *Spiriferacea*.

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[1] *Ústřední ústav geologický, Malostranské nám. 19, 118 21 Praha 1*

Introduction

Sedimentological and biostratigraphical concepts of the Koněprusy area (Barrandian, Central Bohemia) have changed several times during the last fourty years. Present concept of stratigraphy (see fig. 2) is based mainly on Chlupáč's studies (1955, 1957, 1959). The pink Vinařice and reefal Koněprusy Limestones are of Pragian age; the reddish Suchomasty Limestone has been assigned to the Dalejan; only the Acanthopyge Limestone is of Middle Devonian (Eifelian) age.

The lithostratigraphic units in the Koněprusy area differ in their structures, textures, petrological and chemical composition and also in their depositional environments. For this reason, also the benthic faunas are different in each lithostratigraphic unit. Brachiopods represent a significant component of the benthic fauna; in the last three decades, several papers were devoted to the brachiopods of the Koněprusy Limestone whereas those of the Suchomasty and Acanthopyge Limestones remained for a long time beyond main interest of palaeontologists. For this reason, the present paper deals with benthic communities and brachiopods of the Suchomasty and Acanthopyge Limestones. As the benthic communities are closely related to the sediment composition and depositional environment the chapter about sedimentology of the two units is also added.

Abbreviations: L — length; W — width; T — thickness; bv — brachial valve; pv — pedicle valve; sh — shell; ia — interarea; su — sulcus.

Abbreviations used in brachiopod collections: letter L preceding the catalogue number: collection of the National Museum, Prague. Letters VH preceding the catalogue number: collection of Vladimír Havlíček (it is being prepared for deposition in the Museum at Rokycany, Czechoslovakia).

Sedimentology of the Suchomasty and Acanthopyge Limestones

(Z. Kukal)

Structures, textures, petrological, mineralogical and chemical composition of the limestones were studied on the basis of about 300 thin sections and several dozens of metres of split and polished drill cores. Fresh samples from the two units were obtained from numerous outcrops and quarries in the Koněprusy area and also from many boreholes. Geological investigation of this area was accompanied by a complex drilling programme in several stages. Several hundreds of metres of cores penetrated the Suchomasty and Acanthopyge Limestones and halved and polished cores offered a good opportunity to study sedimentary structures. Depositional environment of limestones was reconstructed from sedimentological data based on modern investigation of standard microfacies, facies belts and comparison with recent carbonate depositional environments.

The Suchomasty Limestone

The Suchomasty Limestone consists of limestones which are generally red with various shades of reddish-brown, pink, purple and sometimes also greenish, greyish, whitish and bluish. Due to the presence of a stromatactis structure this limestone is often mottled and variegated. For their colour effects and remarkable structures these limentones are industrially used for decoration purposes. Several types of "marbles" have been quarried in this area and used and even exported abroad under various denominations, e.g. Rouge Antique, Rouge Nationale, Cardinal, Pink Marble, Blue Stone, etc.

Structures

The Suchomasty Limestone consists of very heterogeneous limestones from the point of view of sedimentary structures. Colours and also their grain sizes are strongly variable. Rapid alternation of coarser bioclasts and finer biomicritic portions is typical feature of these limestones. Accumulations of coarse bioclasts form lenses and streaks which pass quickly into micritic layers. Stromatactis structures are very common. They were described in detail by Kukal (1972). They are mostly elongated, often bound to veins and fractures which are parallel or subparallel to the bedding. Some stromatactis structures have internal sediment within their secondary sparite. Some coarser bioclastic lenses display traces of current bedding.

Nodular structure is partly developed in reddish-brown micritic portions, but not in mature form. Various sutures and seams coated with clayey insoluble residue are very common. They pass sometimes into stylolites with small amplitude. Large sutures pass into a minor network of microsutures which are also coated with clay and iron compounds. Many sparitic veins and veinlets are developed being often connected with stromatactis. All these features speak in favour of intensive pressure solution.

Primary sedimentary structures indicate rapidly changing current activity, i.e. high-energy stages alternating with low-energy sedimentation.

Bottom currents might have been temporarily very intensive. Secondary structures indicate large-scale pressure solution. Numerous dissolution seams which are oriented paralelly to the bedding indicate that this could have been caused by deeper burial. This is, however, not in accordance with the present geological situation. Internal sedimentation also indicates fossil karstification which occurred prior to the deposition of the overlying Acanthopyge Limestone. Well known deep and branching fissures in the underlying reefal Koněprusy Limestone indicate karstification of the surface of the carbonate platform before the deposition of the Suchomasty Limestone. These fissures, described in detail by Chlupáč (1955, 1957) are developed as clastic dikes filled from above by the material of the Suchomasty Limestone. Dike-filling limestones display the same structures and textures as the bulk of the overlying rocks.

Limestone textures

The Suchomasty Limestone displays only small variability of textures. Bioclastic limestones of varying grain size and variable micrite admixture strongly predominate. All the 150 microscopically investigated samples were classified according to Folk (1962). Percentages of the individual types are as follows:

Sparse biomicrite	42 %
Packed biomicrite and poorly washed biosparite	28 %
Sorted and rounded biosparite	17.5 %
Fossiliferous micrite	12.5 %

(rounded biosparite is very rare and thus is added to the class of sorted biosparite).

Dunham's (1962) classification was also applied. Most of the limestones are mud-supported which means that wackestones and even mudstones prevail. Minor amount of grain-supported packstones follows. Grainstones are very rare. Coarser types such as floatstones (matrix--supported) and rudstones (particle-supported) are present in variable quantities.

Among allochems bioclasts strongly prevail. Smaller amount of intraclasts (lime mud fragments of small size) also occurs. Neither ooids nor pellets and lumps were found. Coated grains are absent. Micritization of bioclasts is almost missing. Bioclasts are represented mostly by crinoid stems (some of them attain even centimetre size across). Some brachiopods, pelecypods, trilobites, bryozoans, ostracodes and unidentified bioclast fragments also occur. Whole-skeletal fossils are also present, mostly brachiopods and trilobites. Fragmentation of bioclasts is common, but rounding of fragments is negligible. Mixing of fragments by burrowing (bioturbation) was observed but was never too distinct.

Standard microfacies and facies belts (after Wilson 1975)

The limestones belong generally to SMF 8 (Wilson's description: bioclastic wackestone or bioclastic micrite, almost invariably sediment-containing fragments of diverse organisms jumbled and homogenized through burrowing). Compared to Wilson's (1975) description, micritization is almost missing in the Suchomasty Limestone and bioturbation is not too pronounced. Description of Wilson's Facies Belt No 4 fits well to the investigated limestones: open marine platform facies (shallow undathem), which is characterized by an environment in straits, open lagoons, and behind the outer platform edge water depth was generally shallow, a few tens of metres at most. Salinity varied from essentially normal marine to somewhat variable. Circulation is moderate. Several samples, however, belong to SMF 4 (of the same Facies Belt): coarse lithoclastic rudstone or floatstone (with some bioclasts).

Mineralogy and chemistry

Mineralogical composition of the limestones is very simple. Out of carbonate minerals only calcite was found. In the insoluble residue, apart from quartz, potassium feldspar, kaolinite and illite also haematite was found. Dolomite was not identified neither in thin section nor by X-ray investigation. Chemical analyses, however, show that some minor amounts of dolomite might be present (see 0.90 % MgO, table 1). Authigenic silica is almost absent. Microscopically slight silicification of some bioclasts was observed but this is rather an exception. From the chemical analyses it follows that higher amounts of silica correspond to higher amounts of alumina and are thus bound to clay minerals.

Chemical analyses are tabulated in table 1.

The amount of insoluble residue is variable, indicating changing admixture of clay minerals. Some higher amounts of iron oxide were found (up to 1.24 %). The iron oxide percentage can be positively correlated with the alumina and silica contents. This means that all impurities can be associated with the secondary pressure-solution effects and leaching of carbonate. Some iron, as described by Kukal (1964), is primary

Table 1

Chemical analyses of the Suchomasty Limestone from the Koněprusy area (mass %)

Borehole	Depth (m)	Ignition loss	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	MnO	P	Na_2O	K_2O
V-101	25.0—26.0	42.14	1.45	0.79	0.48	0.06	53.97	0.52	0.02	tr.	0.15	0.23
	37.4—37.7	40.62	3.09	1.63	1.24	0.24	51.67	0.73	0.07	tr.	0.16	0.44
	41.2—42.2	40.94	2.23	1.26	0.81	0.13	53.04	0.83	0.01	tr.	0.16	0.34
V-102	18.3—19.0	42.80	0.51	0.27	0.32	0.04	54.64	0.62	0.01	tr.	0.15	0.08
	21.0—21.8	42.50	0.79	0.27	0.41	0.04	54.36	0.62	0.01	tr.	0.18	0.13
	28.0—28.8	42.82	0.78	0.25	0.45	0.08	54.50	0.94	0.01	tr.	0.15	0.09
	42.1—42.8	42.31	0.74	0.36	0.50	0.09	54.78	0.31	0.01	tr.	0.15	0.12
	44.3—44.9	43.02	0.31	0.21	0.19	0.04	55.51	0.31	0.01	tr.	0.15	0.06
	47.0—48.0	42.66	0.14	0.19	0.16	0.08	55.80	0.42	0.01	tr.	0.16	0.10
V-103	7.0—7.70	42.93	0.22	0.27	0.53	0.08	54.84	0.42	0.01	tr.	0.16	0.10
V-104	7.2—7.6	41.92	1.22	0.82	0.82	0.11	53.97	0.42	0.01	tr.	0.21	0.17
V-105	44.0—45.0	43.33	0.80	0.51	0.29	0.04	53.54	0.29	0.01	tr.	0.18	0.13

Analysed by B. Měřilová et al. in the Laboratories of the Geological Survey, Prague.

Table 1 (*continued*)

Locality	Type of limestone	Insol. res.	CaO	MgO	Fe_2O_3	Al_2O_3	CO_2	H_2O^-	$CaCO_3$	$MgCO_3$
Císařský quarry	red bioclastic	1.40	54.15	0.82	0.13	0.07	43.40	0.10	96.95	1.72
Císařský quarry	red biomicritic	1.48	53.64	0.94	0.33	0.25	43.11	0.18	95.73	1.96
Husák quarry	red biomicritic	2.00	54.03	0.46	0.30	0.17	42.89	1.18	96.42	0.96
Husák quarry	red bioclastic nodular	7.41	50.51	0.63	0.30	0.40	40.31	0.38	90.14	1.31
Husák quarry	pink biomicritic (pink marble)	2.19	52.46	0.74	0.15	0.11	44.16	0.15	95.81	1.55
Červený quarry	deep red biomicritic (Cardinal marble)	4.32	51.83	0.69	0.85	0.39	41.42	0.38	92.50	1.44
Červený quarry	deep red biomicritic nodular	7.86	49.14	0.90	1.15	0.87	39.55	0.44	87.70	1.89
Červený quarry	whitish bioclastic (snow marble)	1.20	54.10	0.88	0.06	0.07	43.41	0.22	96.55	1.84
Červený quarry	variegated biomicritic (blue stone)	5.84	51.45	0.55	0.22	0.29	40.97	0.27	91.82	1.15

Analysed by I. Švasta et al. in the Laboratories of the Geological Survey, Prague.

and in form of haematite particles trapped in the open porous network of crinoids. Secondary redistribution and concentration of iron was affected by intensive pressure solution.

Environmental reconstruction

Judging from the primary structures and textures, from the mineralogy, standard microfacies and facies belt reconstruction it could be stated that the bulk of the Suchomasty Limestone unit deposited in very shallow water, temporary agitated, temporary quiet. Bioclasts are poorly washed and not rounded, and they sedimented in depressions on the carbonate platform the surface of which was formed by the underlying Koněprusy Limestone. The water agitation and depth varied from place to place, but the depth generally did not exceed several tens of metres. The limited water agitation could be explained by conditions far from the high-energy margin of carbonate platform.

Total absence of ooids, and even cortoids and coated grains tried to explain Kukal (1964), but the final evidence is still missing. Absence of ooids is connected with the lack of pellets and lumps in the whole sequence of the Barrandian Palaeozoic limestones. Could it have been caused by slightly lower salinity on the carbonate platform, near their outer parts? The proper reason, however, is not yet known.

Rocks of the Suchomasty Limestone unit belong to the carbonate red beds which are comparatively abundant among the Barrandian Palaeozoic limestones. The members of these red beds are either of bioclastic or of micritic nature. According to Kukal (1964) red components consist both of haematite and iron oxihydrates and come mostly from the lateritically wheathered source areas.

The Acanthopyge Limestone

The Acanthopyge Limestone was sampled in quarries and natural outcrops in the Koněprusy area and also in numerous boreholes which were drilled during the investigation of industrial high-percentage limestones. The Acanthopyge Limestone unit is far more homogeneous than the underlying Suchomasty Limestone. Its colour is mostly whitish and greyish.

Structures

Several boreholes displayed vertical alternation of coarse-grained bioclastic and fine-grained, prevalently micritic limestones. Nodular structure is not developed, some sutures and stylolites were found but they are not so markedly developed as in the underlying limestones. Stromatactis is present, but the open spaces are usually of minor size, passing into bird's-eye structure. Some parts of the sequence are densely fissured, fissures being of variable thickness and different generations. In general, the Acanthopyge Limestone lacks abundant traces of intensive pressure-solution. Some whole-skeleton fossils are present in streaks and scattered within the micrite matrix.

Limestone textures

120 thin sections display only smaller variability of textures. Two of them can be defined, bioclastic and biomicritic (together with micritic). These types are intimately associated. Bioclastic limestones are sometimes very coarse-grained with crinoid stems of cm size. Some other allochems are also present, namely intraclasts made of micrite mud, which might be also of cm-size and sometimes give the rock breccia-like appearance.

The calculation of bioclasts in all the sections gave the following averages:

crinoids	51 %
brachiopods	14 %
trilobites	6 %
bryozoans	12 %
corals	9 %
ostracodes	2 %
sponges	2 %
others (algae ?)	4 %

Two associations can be recognized; the first one represented by coarser bioclastic limestone with crinoid-brachiopod-trilobite association and the second one represented by biomicrite with ostracode-sponge association. There exists also the third type of limestone which possesses increased amounts of bryozoans and corals but this type is comparatively rare.

The Acanthopyge Limestone is also characterized by the presence of lumps which have usually 0.2—1.5 mm across. Sometimes internal structure can be recognized having an appearance of several smaller lumps welded together. The outer outlines of lumps are sometimes sharp, sometimes hazy. Occasionally whole lumps are recrystallized into microsparite and only darker rim divides them from the matrix. These lumps strongly resemble grapestones described by Beales (1958) from Bahamas and later by many other authors. Secondary textures are also very common in the finer varieties of the limestones. Their matrix is generally recrystallized into clotty (grumeleux) texture. The clasts have generally hazy boundaries and their size is between the limits of 0.05—0.1 mm. Similar clasts might signify, as it is well known, presence of faecal pellets, algae or simply differential recrystallization of micrite into microsparite (Flügel 1982). In this case, the origin by recrystallization is favoured.

Standard microfacies and facies belts

The bulk of the Acanthopyge Limestone belongs to the SMF 8, the same as in the case of the Suchomasty Limestone. There is, however, also another microfacies present — SMF 17 which is rather unique among the Palaeozoic Barrandian limestones. According to Wilson (1975) this SMF is characterized as mixed facies of isolated peloids, agglutinated peloids, some coated particles and lumps which are in part small intraclasts. Typical representatives of this microfacies are bahamites with their grapestones (Beales 1958) deposited in extremely shallow water with only moderate circulation.

The two microfacies (SMF 8 8 and 17) indicate shallow-water environments and their association means rapid change of high-energy and low-energy environments.

Mineralogy and chemistry

Two samples of the Acanthopyge Limestone from Zlatý kůň hill contain small amounts of aragonite, as recognized by X-ray method (Kukal 1966). These samples are characterized by grapestone texture, they contain neither open-space structures nor secondary sparite. This means that aragonite is primary and represents a relic of primary aragonite deposited in bahamites. It is well known that relics of primary aragonite can be preserved even in Lower Palaeozoic and Proterozoic limestones provided they contained micrite and possibly also higher amounts of organic matter.

Dolomite was not found in the Acanthopyge Limestone, neither microscopically nor roentgenographically, even though the percentages of MgO (see table 2) might indicate that some traces were present. Authigenic silica is present as impregnations of fossils and also in sponge spicules. Samples of insoluble residue (obtained by solution in 5 % HCl) contain great amount of quartz of silt size, only few grains of quartz of sand

Table 2

Chemical analyses of the Acanthopyge Limestone from the Koněprusy area (mass %)

Borehole	Depth	Ignition loss	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	MnO	P	Na_2O	K_2O
V-101	13.3—14.0	42.85	0.09	0.20	0.20	0.06	55.50	0.42	0.01	tr.	0.15	tr.
V-102	11.7—12.0	42.58	0.31	0.33	0.18	0.04	55.80	0.42	0.01	tr.	0.15	tr.
		Ignition loss	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	P_2O_5	SO_3	Na_2O	K_2O
V-105	6.0—7.0	43.38	1.23	0.48	0.21	0.09	53.21	0.67				
V-106	5.0—6.0	43.60	0.46	0.32	0.12	0.04	53.89	0.80				
	11.0—12.0	43.45	0.55	0.40	0.25	0.04	53.50	0.96				
V-109	7.0—8.0	43.64	0.29	0.28	0.13	0.03	54.34	0.58				
	9.0—10.0	43.56	0.26	0.20	0.11	0.07	54.61	0.58	0.03	0.05	0.17	0.03

Analysed by B. Měřilová et al. in the Laboratories of the Geological Survey, Prague.

Locality	Limestone type	Insol. res.	SiO_2	CaO	MgO	Fe_2O_3	Al_2O_3	S	CO_2	$CaCO_3$	$MgCO_3$
Zadní kobyla	white bioclastic	0.13		55.41	0.21	0.07	0.04		43.74	98.92	0.44
Zadní kobyla	white bioclastic		0.13	55.25	0.51	0.19	0.05	0.02	43.92	98.60	1.08
Zadní kobyla	grey, clotty with sponge spicules		0.66	54.47	0.69	0.34	0.19	0.04	43.52	97.22	1.46

Analysed by J. Švasta et al. in the Laboratories of the Geological Survey, Prague.

size, some potassium feldspars, some heavy minerals (zircon and tourmaline), also volcanic glass and siliceous sponge spicules.

Chemical analyses of the Acanthopyge Limestones, tabulated in table 2, show that these limestones are rich in calcium carbonate and poor in impurities. Silica amount is generally deep below 1 %, the amount of iron is negligible (as compared to the Suchomasty Limestone). The amount of clay admixture, characterized by alumina content, is also small.

Environmental reconstruction

There are two main limestone types in this limestone unit but both can deposit in the same facies belt. It could be suggested that the depositional environment was shallow up to extremely shallow and that the sedimentation occurred on the carbonate platform. Bioclastic limestones deposited closer to its margin while "bahamites" in shallow depression of its central part, near the water level. Prior to deposition of the Acanthopyge Limestones karstification of the surface of the underlying Suchomasty Limestones occurred, and karst fissures were later filled with the material of the Acanthopyge Limestones and have now an appearance of clastic veins.

Brachiopod assemblages in the Koněprusy area

(V. Havlíček)

All the brachiopods collected from the bioclastic limestones in the Koněprusy area were assigned by Barrande (1847, 1848, 1879) to his substage Ff_1 and supposed to be of nearly the same age. Even later on, after subdividing the Koněprusy carbonate complex into several lithostratigraphic units, it was not easy to separate the Pragian suit of brachiopods from that of the Dalejan-Eifelian age; an especially intricate problem arose when examining the old collections containing free shells without any piece of adhering rock that could help us to recognize the lithostratigraphic unit that had yielded the specimens under examination. During past three decades, the present author gathered an enormous material of shelly fauna that included most (but not all!) of the species described and illustrated by Barrande (l.c.) from the Koněprusy area. This new collection allowed us to distinguish the brachiopod associations of various ages.

In spite of the fact that the Suchomasty and Koněprusy Limestones are of the Lower Devonian age, the generic representation is quite different

Table 3

Survey of articulate brachiopods in the Koněprusy area

	K	S	A
Ptychopleurella	r		
Fascizetina	c		
Arcualla	c		
Costisorthis	c		
Peleicostella	r		
Biernatium	r		
Dicoelosia	r		
Muriferella	r		
Cycladigera	c		
Schizophoria	r		
Leptaena	c		
Lepidoleptaena	c		
Taleoleptaena	r		
Cymostrophia	c		
Papillostrophia	r		
Tubulistrophia	c		
Gladiostrophia	c		
Pholidostrophia	c		
Crinistrophia	r		
Gorgostrophia	c		
Tastaria	r		
Rhytistrophia	c		
Velostrophia	r		
Bojodouvillina	c		
Planodouvillina	r		
Quasistrophonella	c		
Iridistrophia	c		
Aesopomum	c		
Boicinetes	r		
Parachonetes	c		
Caplinoplia	c		
Squamatina	c		
Sieberella	c		
Gashaomiaoia	r		
Procerulina	c		
Stenorhynchia	c		
Zlichorhynchus	r		
Praegnantenia	r		
Phoenicitoechia	r		
Eucharitina	c		
Uncinulus	c		
Nasonirhynchia	r		
Aikarhyncha	r		
Kotysex	r		
Rackirhynchia	r		
Eoglossinotoechia	c		
Glossinotoechia	c		
Latonotoechia	c		
Sicorhyncha	c		
Cherubicornea	c		
Onugorhynchia	c		
Voskopitoechia	c		
Dictynonella	r		
Rugosatrypa	c		
Kyrtatrypa	c		
Lixatrypa	r		
Oglu	c		
Araneatrypa	r		
Atrypunculus	r		
Lissatrypa	r		
Rhynchospirina	c		
Meristella	c		
Nucleospira	c		
Havlicekia	c		
Plicocyrtina	r		
Howellella	c		
Hysterolites	c		
Xerospirifer	c		
Araspirifer	r		
Najadospirifer	c		
Cryptonella	c		
Paulinella	r		
Dalejina	r	r	
Protoleptostrophia	r	r	
Myriospirifer	c	r	
Cyrtina	c	c	
Quadrithyris	c	r	
Areostrophia	c	r	
Leptochonetes	c	r	
Gypidulina	c	r	
Iberirhynchia	r	r	
Taimyrrhynx	c	r	
Tetratomia	r	r	
Hergetatrypa	r	c	
Athyris	c	c	
Leptaenopyxis	c	r	
Astutorhyncha	r	c	
Merista	c	c	r
Clorinda	c	c	r
Carinatina	c	r	r
Plectospira	c	c	r
Quasimartinia	r	r	r
Leptathyris	c	c	c
Cortezorthis		r	
Holynetes		r	
Mamutinetes		r	
Markitoechia		c	
Monadotoechia		r	
Corvinopugnax		c	
Isopoma		r	
Septalaria		c	
Plicogypa		c	
Pseudosieberella		c	
Lysigypa		r	
Fossatrypa		c	
Alaskospira		r	
Metaplasia		r	
Pinguispirifer		c	
Undispirifer		r	
Quadrithyrina		c	

Table 3 (*continued*)

	K	S	A
Kaplicona		r	
Quasidavidsonia		c	c
Amissopecten		c	c
Trigonatrypa		c	c
Karbous		c	c
Rhynchatrypa		c	c
Cerberatrypa		r	c
Radimatrypa		r	r
Ambocoelia		r	r
Amoenospirifer		c	r
Bojothyris		r	c
Eoreticularia		c	c
Cnaulodermis		c	c
Rochtex		r	r
Obesaria			c
Kaplex			r
Kransia			r

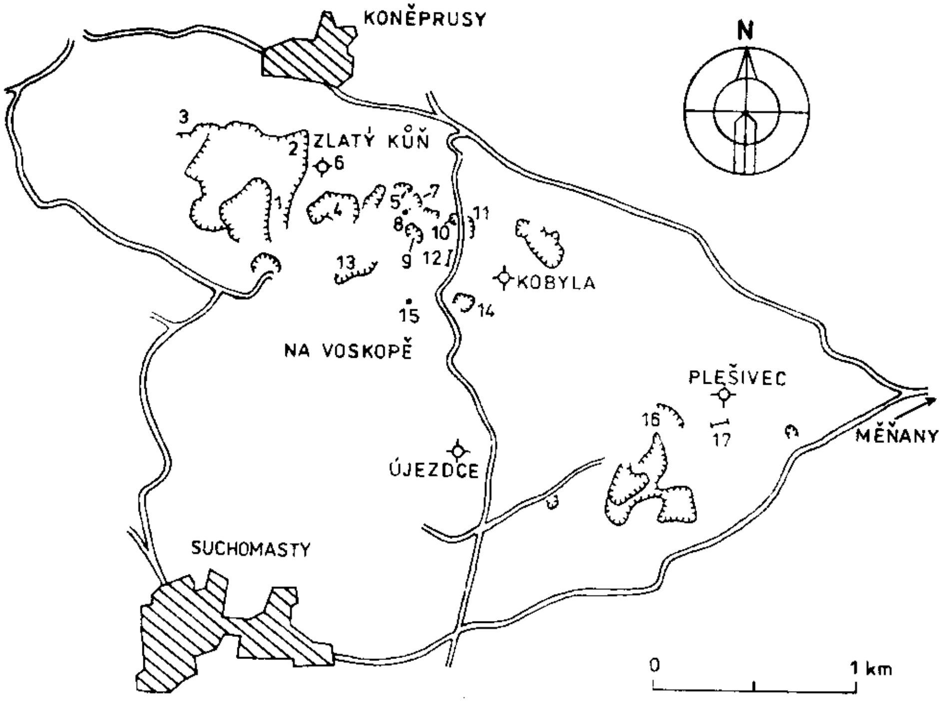
K — perireefal assemblage in the Koněprusy Limestone; S — *Karbous-Orbitoproetus* Community in the Suchomasty Limestone; A — *Karbous-Acanthopyge* Community in the Acanthopyge Limestone; c — common; r — rare

in the two units as shown in table 3. The brachiopod genera are either of Pragian or Dalejan age; only a lesser part of them occurs in both the units. The differences in brachiopod associations are best explained on environmental terms which played a more important role than the moderately different ages of the relevant lithostratigraphic units.

The Koněprusy Limestone (Pragian)

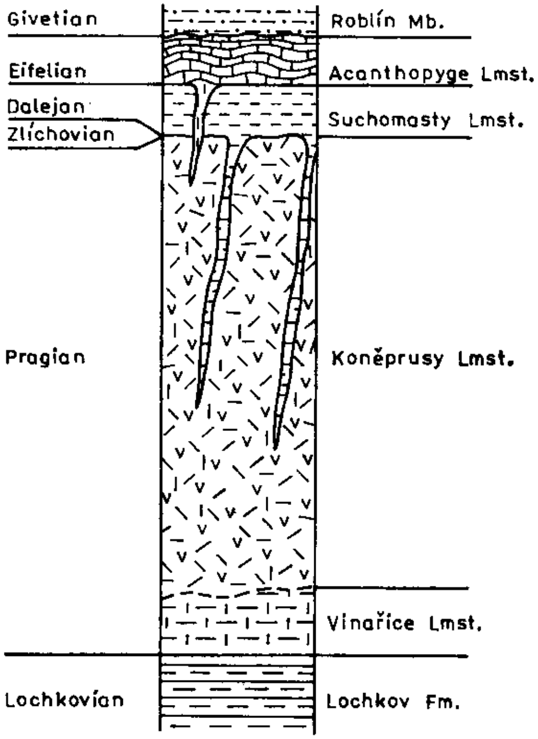
The Pragian reef complex, mostly consisting of massive, white to light-grey biolithic and bioclastic Koněprusy Limestone, gradually developed from the underlying shallow-water, bioclastic Vinařice Limestone (also of Pragian age) which is pink in colour and bears nearly the same shelly fauna as the former unit. The Koněprusy Limestone developed on a submarine elevation that may have functioned periodically as a slightly rising zone as it is evident from the break in sedimentation and erosion in the Zlíchovian time, and from the appearance of numerous vertical fissures in several generations, filled up with younger sediments (e.g. with the Suchomasty and Acanthopyge Limestones). These neptunian (sedimentary) dykes were several centimetres to several metres broad, over 100 m deep, and trending predominantly E—W (Chlupáč 1955, 1957, 1983, 1987).

In the Pragian reef complex, Chlupáč (1955, 1983, 1987) discovered the wave-resisting reef core built up predominantly of calcareous algae, stromatoporoids, and corals; remarkable are the wave-resisting crinoids with massive crowns, robust stems, and richly branched holdfast root-systems (*Pernerocrinus* and allied genera; Prokop 1987). Some benthic organisms, including *Pernerocrinus,* have been found in their



1. Review of localities in the Koněprusy area; all localities described in a greater detail by I. Chlupáč (1955, 1957)
1 — Zlatý kůň, Císařský quarry, eastern wall; sequence of the Koněprusy Limestone (in southern part richly fossiliferous); several neptunian dikes filled by the Suchomasty and Acanthopyge Limestones; below the upper edge of the wall, the Koněprusy Limestone is conformably overlain by the Suchomasty Limestone with ripple marks in its lowermost layer. *2* — Zlatý kůň, Císařský quarry, northern part near the fault ("Mramorová stěna"); sequence of the uppermost Koněprusy Limestone and richly fossiliferous Suchomasty and Acanthopyge Limestones; neptunian dikes up to 8 m thick, filled by the Suchomasty Limestone (*Karbous-Orbitoproetus* Community). *3* — Zlatý kůň, Císařský quarry, upper edge of the northern wall ("Nad tunelem"); Suchomasty Limestone confined to a neptunian dike up to 12 m thick (mostly *Karbous-Orbitoproetus* Community). *4* — Zlatý kůň, Houba quarry; sequence of the Koněprusy Limestone, in southern part of the quarry richly fossiliferous (perireefal communities); in upper part of the northern wall conformably (but sharply) overlain by the Suchomasty Limestone. *5* — Zlatý kůň, Herget quarry; sequence of the Suchomasty Limestone; type locality of the *Karbous-Orbitoproetus* Community. *6* — Zlatý kůň, top of the hill; Acanthopyge Limestone with numerous *Amplexus florescens*. *7* — Zlatý kůň, eastern part; locality "Malé lůmky", Acanthopyge Limestone. *8* — Zlatý kůň, between the Herget and Husák quarries (locality "U transformátoru"); upper part of the Suchomasty Limestone. *9* — Between Zlatý kůň and Kobyla, Husák quarry; Suchomasty Limestone resting on the massive Koněprusy Limestone with stromatolites. *10* — Between Zlatý kůň and Kobyla, small quarry at the western side of the road; Acanthopyge Limestone with abundant trilobites (e.g. *Phacops (Chotecops) hoseri*), *Amplexus florescens* and smooth brachiopods. *11* — Between Zlatý kůň and Kobyla, small quarry at the eastern side of the road, including adjacent fields with many loose fossiliferous boulders; Acanthopyge Limestone, type locality of the *Karbous-Acanthopyge* Community. *12* — Between Kobyla and "Na Voskopě" hill, west of the road; Suchomasty Limestone, transition between the *Karbous-Orbitoproetus* and *Orbitoproetus-Scabriscutellum* Communities. *13* — "Na Voskopě" hill, new quarry; Koněprusy Limestone (perireefal communi-

original growth positions. The trilobites (mostly scutelluids) and other benthic faunas occur in small lens-like accumulations that represent fillings of primary depressions and cavities in the wave-resisting buildup and its proximity (Chlupáč 1955, 1983). Of brachiopods, the biplanar shells of *Tubulistrophia* often form coquinas in these habitats (Císařský quarry). Other shells in this part of the reef complex are often abraded due to turbulent water (*Rhynchospirina, Aesopomum, Gypidulina*).



2. Lower and Middle Devonian on Zlatý kůň, Koněprusy area

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ties). *14* — Kobyla, Červený quarry; Suchomasty Limestone yielding a complete sequence of conodont (*Polygnathus laticostatus* - *P. serotinus* - *P. costatus patulus* *P. c. partitus*) and tentaculite zones (*Nowakia elegans* - *N. cancellata* - *N. richteri* - *N. holynensis*); *Orbitoproetus-Scabriscutellum Community*; bottom of the quarry formed by the Koněprusy Limestone, *15* — Between Kobyla and "Na Voskopě" hill; small quarries; neptunian dikes filled by the Suchomasty Limestone; abundant trilobites, poor brachiopod association (*Orbitoproetus-Scabriscutellum* Community). *16* — Plešivec, exposures and new quarry on the western slope; Koněprusy Limestone gradually developing from the underlying Vinařice Limestone; perireefal communities. *17* — Plešivec, southern slope; neptunian dikes filled by the Suchomasty Limestone, penetrating deep into the Koněprusy Limestone

The bulk of shelly fauna occurs beyond the reef core and is confined to massive, biodetrital limestones, surrounding and occasionally penetrating into the reef body. According to Chlupáč (1955, 1987), the sediment is formed mostly of unsorted crinoidal detritus, in places with pebbles and boulders of limestones coming from the reef core. The trilobites, which are a subordinate component of the Koněprusy Limestone, were assigned by Chlupáč (1983) to his reef scutelluid-proetid assemblage in about Benthic Assemblage 3 life position in Boucot's (1975) classification. The most diversified brachiopod assemblages occur in the lower-middle part of the Koněprusy Limestone (quarries Císařský and Houba, hills Na Voskopě and Plešivec) and contain more than 80 genera. The brachiopods can be classified into several ecological types; the cemented shells are not common (large craniids, *Taleoleptaena*). Peculiar are the irregular shells lacking attachment scars on their beaks; for this reason, they are believed to have lived firmly adpressed (but not cemented) to the substratum. During growth of the animal, their thick-walled pedicle valves followed precisely all the unevenesses on the sea floor, including various obstacles such as crinoidal columnals, fragments of corals and other organisms (Havlíček 1967). Some of these brachiopods have a well-developed pedicle (e.g. *Leptaena goldfussiana*, *"Leptaena" praepostera*), some lost the pedicle in adult growth stages to have reposed semiburied, but unattached, in the sediment (*Aesopomum*, some shells of *Areostrophia*). The irregular and asymmetrical shells were probably confined to rough-water environment.

The majority of shelly fauna should be assigned to the ecological type of pedunculate brachiopods (*Dalmanellacea, Enteletacea, Rhynchonellacea, Athyridacea, Retziacea, Cyrtiacea* a. o.). Beside the pedicle, some forms developed additional devices for a better stabilization on the sea floor such as large interareas (e.g. *Cyrtina, Plicocyrtina, Havlicekia*), wide hinge margins (e.g. *Hysterolites, Xerospirifer, Fascizetina*), or strikingly transversal shells with long, slender lateral extensions (*Thliborhynchia amalthea*). Pedunculate, nearly globose rhynchonellids should be assigned to the ecological subtype of reclining brachiopods (e.g. *Kransia, Uncinulus, Taymirrhynx*).

Frequent are free-lying stropheodontids and orthotetaceids with rather large, plano-convex to weakly concavo-convex (rarely resupinate) shells with low body cavities; some shells are thin-walled, very low and fragile, thus indicating a quiet-water environment in sheltered habitats as are the local depressions protected against wave and current activity (e.g. *Rhytistrophia sowerbyi, Tastaria lenis*).

Deeply concavo-convex shells have been attributed to the quasi-infaunal ecological type. According to Rudwick (1970), the quasi-infaunal elements were stabilized against overturning in that the calcareous detritus settled onto their upper, concave brachial valve, whereas the valve edges projected above the sea bottom (e.g. *Cymostrophia stephani, C. golem, Gorgostrophia gorgo, Gladiostrophia verneuili*). Moreover, some quasi-infaunal elements were also attached to the substratum by means of the pedicle (*Lepidoleptaena*) or minute cardinal spines directed postero-laterally (*Parachonetes, Boicinetes*).

A different type of free-lying brachiopods are the atrypids whose pedicle atrophied during life of the animal, whereas large marginal spines (*Oglu semiorbis*) or horizontally disposed trails developed (*Kyrtatrypa balda*). Some trail-bearing atrypids retained their pedicle till late adult stages (*Carinatina comata, Rugosatrypa verneuilliana*).

In perireefal assemblages, the brachiopods are usually preserved as articulated specimens not damaged by transport, and retaining all details of surficial characters including spines and trails. Disarticulated specimens are rather common only on the "Na Voskopě" hill. The brachiopods are often accompanied by bryozans (usually complete, neither crushed nor deformed zoaria), less commonly by trilobites, gastropods, and other organisms (list of fossils: Chlupáč 1955, 1987). Frequent (often dominant) component of the perireefal benthic assemblages are the large, mostly disarticulated crinoids *Eucalyptocrinites, Beyrichocrinus, Icthyocrinus, Hexacrinites, Perunocrinus, Spyridiocrinus*, and the polypeltids (Prokop 1987), associated with coprophagous platyceratids (*Praenatica, Orthonychia*). Common are also rostroconchids (*Conocardium*) and algae (*Parachaetetes* a. o.).

The Pragian benthic faunas clearly differ from those of the Suchomasty and Acanthopyge Limestones in being more diversified and involving mostly costate and costellate brachiopods, whereas the smooth shells prevail in the Dalejan—Eifelian sequences in the Koněprusy area. The Pragian perireefal benthic assemblages are not uniform over the whole Koněprusy area as they occupy various habitats ranging from the quiet to turbulent-water environments. On the whole, most of the brachiopod assemblages may be assigned to subtidal, well aerated Benthic Assemblage 3 life zone in the terminology of Boucot (1975). Chlupáč (1983) supposed the same life position for his scutelluid-proetid trilobite assemblages occupying nearly the same habitats.

The Suchomasty Limestone (Dalejan)

After the marine regression from the Koněprusy area in the Zlíchovian, the marine sedimentation reappeared in the Dalejan. This changeover in the sedimentary-tectonic regime was accompanied by an erosion of the underlying Koněprusy Limestone and by appearance of numerous neptunian (sedimentary) dikes. The biomicrites and biosparites of Dalejan age are mostly red, pink, less commonly grey in colour; locally, a coarse crinoidal detritus with abundant shelly fauna predominates in the Suchomasty Limestone (e.g. Herget quarry). Almost everywhere the trilobites are richly diversified, whereas other sessile and vagile elements are less frequent (gastropods, cystoids, rugose and auloporid corals, cephalopods). The mostly disarticulated crinoids, unlike those of the Koněprusy Limestone, are represented by genera with small, thick-walled crowns (*Pisocrinus, Parapisocrinus, Tiaracrinus, Heracrinus*; Prokop 1987). A list of fossils collected from various localities in the Suchomasty Limestone was compiled by Chlupáč (1957, 1983).

Due to various environments in the Koněprusy area, the benthic fauna may be classified into two communities, namely the *Karbous-Orbitoproetus* Community with numerous brachiopods, and the *Orbitoproetus-Scabriscutellum* Community with strongly reduced shelly fauna.

Karbous-Orbitoproetus Community

Type locality: Koněprusy, Herget quarry (locality 5), sequence of the Suchomasty Limestone.

The most diversified sessile and vagile benthic fauna has been found in pink, massive, bioclastic (crinoidal) limestones in the Herget quarry where almost all the brachiopods are preserved as articulated specimens accompanied by numerous proetids (*Orbitoproetus orbitatus, Myoproetus myops, Eremiproetus dufresnoyi, Tropidocoryphe latens*) and much less frequent other trilobites (e.g. *Scabriscutellum oblongum*).

The brachiopod assemblage found in the Herget quarry is more uniform than that of the underlying Koněprusy Limestone, because it mostly contains the smooth and weakly plicate pedunculate forms. By contrast, the Koněprusy Limestone has yielded diverse ecological types of brachiopods including the irregular orthotetaceids, free-lying stropheodontids and many quasi-infaunal elements which all are absent in the Suchomasty Limestone. Moreover, among the Pragian brachiopods are frequent the costate and costellate shells which are rare in the Suchomasty Limestone. In the Herget quarry, the strongly ribbed forms such as *Amoenospirifer oenone, Plycogypa lukesi* and *Pseudosieberella labrusca* are subordinate components of the community. In the *Karbous-Orbitoproetus* Community, the smooth brachiopods prevail (*Merista, Clorinda, Lysigypa, Pinguispirifer, Trigonatypa, Karbous, Eoreticularia, Cingulodermis* a. o.). Interesting are the originally costate and plicate stocks which became smooth or weakly plicate in the Suchomasty Limestone. For example, *Quasidavidsonia tenuissima* is the earliest member of the carinatinid stock which has lost completely its radial pattern.

Another example of brachiopods tending to lose their radial ornament is *Plectospira*; in the Herget quarry, it comprises a complete sequence of forms ranging from the coarsely costate shells (*P. dione, P. grochonia*) to very weakly plicate shells; in extreme cases, some specimens retained a weak plication only in umbonal regions, whereas the rest of their shells became almost smooth. Owing to its strongly reduced plication, *P. leniplicata* is an unusual brachiopod among the *Retziacea.*

The transition from the costate to weakly plicate (rarely almost smooth) forms has also been found in *Amoenospirifer. A. oenone* is distinguished by strong, angular ribs, whereas both *A. amoenoides* and *A. foedus* bear rounded ribs often tending to disappear on the flanks.

Owing to prevalence of smooth spire-bearing brachiopods not affected by wave and current activity, we suppose a quiet, very shallow environment for the *Karbous-Orbitoproetus* Community in about Benthic Assemblage 2 life zone.

Survey of brachiopods of the *Karbous-Orbitoproetus* Community:

Cortezorthis sp.	A
Leptaenopyxis irena (H.)	B
Protoleptostrophia sp.	A
Areostrophia ares sp. n.	B
Leptochonetes papyrus H. & R.	B
Mamutinetes perlatipleura sp. n.	A
Plicogypa lukesi sp. n.	C
Pseudosieberella labrusca sp. n.	C
Lysigypa morosoides sp. n.	C
Gypidulina ariadna sp. n.	B
Gypidula sp.	A
Clorinda exarmata sp. n.	C
Clorinda robustisella sp. n.	C
Clorinda baccalaria sp. n.	C
Clorinda acrimona sp. n.	C
Corvinopugnax corvinus (Barr.)	C
Astutorhyncha proserpina (Barr.)	C
Markitoechia omissa H.	A (D)
Markitoechia clavula sp. n.	B
Septalaria palumbina (Barr.)	C
Amissopecten velox (Barr.)	B
Amissopecten obsolescens (Barr.)	B
Tetratomia coalescens sp. n.	B
Trigonatrypa protobaucis sp. n.	B
Radimatrypa zelaria sp. n.	B
Karbous aperinus H.	C
Karbous truncatus H.	C
Rhynchatrypa thetis (Barr.)	C
Cerberatrypa dissidens (Barr.)	B
Fossatrypa granulifera (Barr.)	C
Carinatina arimaspus (Eichw.)	B
Hergetatrypa minuta (Siehl)	C
Plectospira dione sp. n.	C
Plectospira grochonia sp. n.	B
Plectospira leniplicata sp. n.	C
Leptathyris deino sp. n.	C
Merista passer (Barr.)	C
Merista repellens sp. n.	C
Rochtex lissopleura sp. n.	B

Myriospirifer insidiosus (Barr.)	A
Pinguispirifer fessus sp. n.	C
Amoenospirifer oenone sp. n.	C
Amoenospirifer foedus sp. n.	C
Quadrithyris sobrina sp. n.	A
Quadrithyris orba (Barr.)	C
Quadrithyrina ivanovae H.	C
Eoreticularia indifferens (Barr.)	B
Eoreticularia fraterna (Barr.)	C
Undispirifer transiens (Barr.)	(A) D
Bojothyris nikiforovae H.	B
Alaskospira accedens (Barr.)	B
Quasimartinia lubrica sp. n.	B
Cingulodermis columbina (H.)	C
Metaplasia nekvasilovae sp. n.	B
Ambocoelia mesodevonica H.	A
Cyrtina platypleura sp. n.	C
Cyrtina aff. *morana* H.	B

A — very rare (1 or 2 specimens found up to now); B — rare (less than 10 specimens); C — frequent; D — mostly old collections.

On the periphery of the *Karbous-Orbitoproetus* Community, the composition of shelly fauna moderately differs from that of the Herget quarry. On the northern wall of the Císařský quarry (locality 3), it acquires several elements absent from the type locality — e.g. *Isopoma alecto* (Barr.), *Kaplicona fragilis* (Barr.), *Quasidavidsonia tenuissima* (Barr.), *Athyris odolens* sp. n., and *Pinguispirifer infirmus* (Barr.). Moreover, many specimens are disarticulated and often accompanied by crushed trilobites, thus indicating a rough-water environment.

A similar community has been discovered south of the Herget quarry (locality 8); besides the shelly fauna recognized in the Herget quarry, it has yielded many shells of *Athyris odolens* sp. n. and richly diversified gastropods, hyolithids, and goniatites (Chlupáč - Vaněk 1957).

Orbitoproetus-Scabriscutellum Community

Type locality: Koněprusy, Císařský quarry (locality 1), sequence of the Suchomasty Limestone.

The *Orbitoproetus-Scabriscutellum* Community, including a complete list of trilobite species, was described by Chlupáč (1983) under the name *Orbitoproetus-Scabriscutellum* Assemblage. It is confined to red or grey biosparites and biomicrites with variable amount of crinoidal detritus, locally passing into nodular muddy limestone. Richly diversified trilobites are represented by proetids and phacopids, while scutelluids, harpids, cheirurids, lichids, otarionids, and odontopleurids are a subordinate component of the community. Rather frequent are crinoids, cystoids, gastropods, small bivalves, rugose and auloporid corals, all accompanied by planktic and nectic forms (conodonts, nautiloids, goniatites, tentaculites) (Chlupáč 1955, 1957, 1983). According to Chlupáč (1983), the fragmentary state of trilobites, local accumulations of fossils, and abrupt changes in the grain-size indicate deposition under high-energy, shallow water environment of Benthic Asemblage 3 in Boucot's classification.

By contrast to the *Karbous-Orbitoproetus* Community, the brachiopods are not common in the *Orbitoproetus-Scabriscutellum* Community; in quarries Císařský (eastern wall), Houba and Červený, the Suchomasty Limestone has yielded mainly small brachiopods which are absent from the *Karbous-Orbitoproetus* Community, e.g. *Dalejina* sp., *Dalejodiscus subcomitans* (Havl.), and *Holynetes* cf. *holynensis* H. & R., accompanied by *Bojothyris nikiforovae* Havl. and *Leptaenopyxis irena* (Havl.). Several brachiopods collected in the past century in the Koněprusy area should also be assigned to the *Orbitoproetus-Scabriscutellum* Community (e.g. *Monadotoechia monas* (Barr.), *Quadrithyris orba* Havl., *Eoreticularia indifferens* (Barr.), *Amoenospirifer amoenoides* Havl.).

The Acanthopyge Limestone (Eifelian)

Chlupáč (1959, 1983, 1987) assigned to the Acanthopyge Limestone a sequence of light grey biosparites of various grain sizes alternating with layers of coarse bioclastic limestone bearing transported and reworked tabulates and stromatoporoids; biomicrites with fragile clusters of rugose corals (*Amplexus*) show no trace of redeposition. As the Acanthopyge Limestone deposited on a submarine elevation, its total thickness is very small (15—20 m), although it corresponds in age to the substantial part of the Eifelian. The very slow rate of subsidence is reflected in a shallow-water character of sediments not uncommonly showing a higher salinity (Kukal 1964; bahamites).

The carbonate sedimentation continued uninterrupted from the Dalejan to the Eifelian; for this reason, the benthic assemblages of the uppermost Lower Devonian and Eifelian are closely related to each other. The generation of neptunian (sedimentary) dikes of lower Eifelian age is less significant than that of the Dalejan age; an oblique dike penetrating deep into the Suchomasty Limestone and filled with the Acanthopyge Limestone containing many fossils (e.g. *Acanthopyge haueri*, *Amissopecten velox*) was discovered by Chlupáč (1959, 1983) in the Herget quarry. The vagile and sessile faunas are high-diversified in the Acanthopyge Limestone; list of fossils was compiled by Chlupáč (1959, 1983).

Karbous-Acanthopyge Community

Type locality: **Koněprusy, small quarry between Zlatý kůň and Kobyla (locality 11), sequence of the Acanthopyge Limestone.**

This community was proposed by Chlupáč (1983) under the name *Acanthopyge-Phaetonellus* Assemblage; the most abundant trilobites are proetids of the genera *Phaetonellus, Orbitoproetus, Tropidocoryphe, Eremiproetus, Proetopeltis, Koneprusites,* and *Ignoproetus,* usually accompanied by *Acanthopyge haueri, Phacops (Chotecops) hoseri, Leonaspis pigra, Aulacopleura bohemica, Cheirurus affinis affinis,* and *Thysanopeltis speciosa.* The brachiopods are abundant, but less diversified than in the underlying Suchomasty Limestone. Interesting is the difference between the trilobite and brachiopod associations: the Eifelian-age trilobites are clearly distinct from those of the Dalejan age, whereas almost all brachiopod genera and many brachiopod species cross the Lower/Middle Devonian boundary to survive till the Eifelian. Over two thirds of the Eifelian brachiopod species are common to the Suchomasty and Acanthopyge Limestones.

The smooth, spire-bearing brachiopods are dominant elements among the sessile benthic faunas in the Acanthopyge Limestone. They are never accompanied by strongly costate forms; few species with weak radial ribbing do occur there (*Amissopecten velox, A. obsolescens*).

Survey of brachiopods of the *Karbous-Acanthopyge* Community:

Clorinda strix (Barr.)	C
Errhynx sp.	D
Kransia aff. *parallelepipeda* (Br.)	A
Amissopecten velox (Barr.)	C
Amissopecten obsolescens (Barr.)	C
Trigonatrypa baucis (Barr.)	C
Trigonatrypa securis (Barr.)	B
Karbous hassiacus (Siehl)	C
Karbous truncatus H.	B
Rhynchatrypa thetis (Barr.)	C
Cerberatrypa dissidens (Barr.)	D
Cerberatrypa cerberus sp. n.	C
Radimatrypa zelaria sp. n.	B
Carinatina sp.	A
Quasidavidsonia mediocarinata (H.)	C
Plectospira varioplicata Siehl	A
Leptathyris deino sp. n.	C
Merista repellens sp. n.	B
Rochtex lissopleura sp. n.	B
Amoenospirifer oenone sp. n.	A
Amoenospirifer amoenoides H.	A
Eoreticularia fraterna (Barr.)	C
Bojothyris nikiforovae H.	C
Quasimartinia lubrica sp. n.	A
Obesaria obesa (Barr.)	C
Cingulodermis columbina (H.)	C
Ambocoelia mesodevonica H.	B
Kaplex bohemicus (Barr.)	B

A — very rare (1 or 2 specimens in the collection); B — rare (less than 10 specimens); C — frequent; D — old collections.

Due to prevalence of smooth, pedunculate, spire-bearing brachiopods, the *Karbous-Acanthopyge* Community closely recalls the Silurian *Dubaria* Community which is also distinguished by predominance of smooth, spire-bearing, never disarticulated shells overcrowding the banks of bioclastic limestone; for this reason, we may suppose a similar environment for both. The *Karbous-Acanthopyge* Community is assigned here to the shallowest, well aerated, subtidal Benthic Assemblage 2 (localy 3); the layers yielding abundant brachiopods were deposited under a quiet-water regime, whereas several layers of bioclastic, often brecciated limestone with reworked corals and stromatoporoids originated in a rough-water environment. After examining the trilobites, Chlupáč (1983) came to the same conclusion and suggested B.A. 2—3 life zone for his *Acanthopyge-Phaetonellus* Assemblage.

The very shallow, warm-water environment with a higher salinity may also be documented by the presence of bahamites in some parts of the Eifelian sequence (Kukal 1964). Several growths of fragile corals (*Amplexus florescens*), that were never damaged during transport, indicate the Eifelian biostromes in the Koněprusy area (Chlupáč 1983).

Karbous-Orbitoproetus and Karbous-Acanthopyge Communities in the Rhenish-Bohemian Region

The *Karbous-Orbitoproetus* and *Karbous-Acanthopyge* Communities occur only in the Koněprusy area in the Prague Basin (Barrandian area). A few elements of these communities (e.g. brachiopods, trilobites) were discovered at Horní Benešov (Nízký Jeseník Mts., Moravia) in calcareous shales and limestone nodules, in association with several brachiopods indicating a somewhat deeper environment (Havlíček - Pek 1986).

In the Rhenish-Bohemian Region, the most similar benthic fauna occurs near Greifenstein (Rheinisches Schiefergebirge, F.R.G.) in the Greifenstein Limestone (Eifelian) which strongly recalls the Suchomasty Limestone not only by its lithological character and colour but also by the richly diversified vagile and sessile benthos with brachiopods consisting mostly of smooth and weakly plicate forms. According to Siehl (1962), the following species are common to the Greifenstein Limestone and the Suchomasty-Acanthopyge limestone complex: *Kaplicona fragilis, Prodavidsona tenuissima, Monadotoechia monas, Septalaria palumbina, Hergetatrypa minuta, Fossatrypa granulifera, Rhynchatrypa thetis, Merista passer, Plectospira varioplicata, Pinguispirifer infirmus, Amoenospirifer* *thetidis, Quadrithyris orba, Quadrithyrina ivanovae, Eoreticularia fraterna, E.* aff. *indifferens, Ambocoelia mesodevonica,* and *Cingulodermis columbina.* Further, *Leptathyris gryphis* is very close to the Bohemian *L. deino.* The genus *Trigonatrypa* most probably occurs in both the areas. Of trilobites, *Orbitoproetus orbitatus* and *Leonaspis pigra* were found both at Greifenstein and in the Koněprusy area. Moreover, many trilobites are represented in the Greifenstein Limestone by forms closely related to those of the Suchomasty-Acanthopyge limestone complex, namely those of the genera *Acanthopyge, Thysanopeltis, Eremiproetus, Phaetonellus,* and *Tropidocoryphe.* Judging from the close faunistic relations, we may suppose nearly the same, very shallow-water environment both at Greifenstein and in the Koněprusy area. According to Siehl (1962), the Greifenstein Limestone deposited on a submarine, flat-topped elevation built of crinoidal detritus, with prevalence of thick-shelled brachiopods. Small, smooth brachiopods and abundant trilobites prevail in the biomicrite layers. Although many species are common to the Suchomasty and Greinfenstein Limestone, the latter unit is somewhat younger and corresponds to the Pinacites jugleri Zone of Eifelian age. The coincidence in faunas is best explained on environmental terms.

Survey of articulate brachiopods

(V. Havlíček)

Dalmanellacea Schuchert, 1913

Dalmanellidae Schuchert, 1913

Prokopia Havlíček, 1953

Prokopia sp.

Occurrence: Suchomasty Limestone, locality 15 (rare).

Cortezorthis Johnson & Talent, 1967

Cortezorthis sp.

1977 *Cortezorthis* sp.; Havlíček, p. 199, pl. 56, figs. 10, 11.

Occurrence: Suchomasty Limestone, localities 5, 8.

Rhipidomellidae Schuchert, 1913

Dalejina Havlíček, 1953

Dalejina sp.

Pl. III, fig. 1

Remarks: All valves were collected from a red-brown micrite with shelly fauna and trilobites crushed into fragments 1—5 mm large, accompanied by columnals of crinoids.

Occurrence: Suchomasty Limestone, locality 4.

Plectambonitacea Jones, 1928

Sowerbyellidae Öpik, 1930

Dalejodiscus Havlíček, 1961

Dalejodiscus subcomitans (Havlíček, 1956)

1967 *Dalejodiscus subcomitans* (Havlíček, 1956); Havlíček, p. 65, pl. 8, figs. 8, 9, 11—16; text-figs. 33, 34.

Occurrence: Suchomasty Limestone, locality 15.

Strophomenacea King, 1846

Leptaenidae Hall & Clarke, 1894

Leptaenopyxis Havlíček, 1963

Leptaenopyxis irena (Havlíček, 1967)

Pl. III, figs. 2—6

1967 *Glossoleptaena? irena* sp. n.; Havlíček, p. 117, pl. 20, figs. 15—17.

Exterior (based on recently gathered material): Shell small for the genus, 16—22 mm wide at the hinge line, with a low body cavity; disc of pedicle valve trapezoidal in outline, gently convex umbonally but flat or even slightly concave anteriorly, separated by a low, transverse ridge (less commonly by a conspicuous edge) from the high trail that is directed dorsally. Trails, located at the antero-lateral sides of the disc, are highly raised in ventral direction; their tops recurve again dorsally, thus recalling the shape of shell of *L. bouei* (Barr.). Cardinal angles acute; ventral interarea low, flat, apsacline; pseudodeltidium in all specimens examined ill-preserved. Pedicle foramen sealed in adult specimens.

Disc of brachial valve flat to gently concave posteriorly but slightly convex anteriorly and laterally, separated by a deep furrow from the trail that is bent dorsally in the median sector of the valve. Antero-lateral sides of the brachial valve reflected ventrally to produce small to large (depending on age of the specimen) tongue-shaped extensions that are interpreted as antero-lateral trails directed ventrally. Dorsal interarea anacline, somewhat smaller than the ventral one; chilidial plates not examined. Protegular stage preserved as an elongate, highly raised node.

Ribs low, rounded, narrower than interspaces, numbering 10—13 per 2 mm; concentric rugae weak to obscure umbonally, but narrow, rather high anteriorly, numbering over 10 (maximum 20) in the median sector; in antero-lateral portions of the ventral disc, the rugae are more frequent than in the median sector, because 2 or 3 new ones set off from the transverse ridge bounding the disc. Concentric ornament is often irregular as some rugae are more slender than the others, or one rather strong ruga may split locally into two slender ones.

Interior: Shell pseudopunctate; papillae in a chaotic arrangement in umbonal regions of both valves, but anteriorly and laterally forming concentric rows located on tops of ridges corresponding to the concentric furrows of the outer valve surface. Ventral muscle field circular, surrounded by ridges, not extending beyond a third of the length of the disc. Diductor scars about as large as the triangular adductor scar that is located on a low platform.

Brachiophores not examined; dorsal muscle field elongate-oval, occupying about 2/3 of the length of the disc. Adductor impressions underlain by low pads of secondary shell material, separated from each other by a triangular field bearing a slender median ridge. Visceral cavity bounded anteriorly by a high diaphragm.

Remarks: By its shape of the shell, presence of strong rugae, peculiar arrangement of trails, and presence of a high diaphragm in the brachial valve, *L. irena* recalls the Lower Devonian (Pragian) species *L. bouei* (Barr.); it lacks, however, a shallow median depression that is well-developed in the brachial valve of *L. bouei*. In spite of its much smaller size, there is no reason to exclude the species *"irena"* out of *Leptaenopyxis*.

Occurrence: Suchomasty Limestone, localities 2, 3, 5, 8. Further Gornyi Altai Mts., topmost Lower Devonian (the shells figured by Gracianova, 1967, under the name *Rugoleptaena hornyi* Havl. are not distinguishable from the Bohemian *L. irena* in the size, shape, and ornamentation).

Stropheodontacea Caster, 1939

Leptostrophiidae Caster, 1939

Protoleptostrophia Caster, 1939

Pl. III, fig. 16

Remarks: Our material includes only one pedicle valve that is 17.6 mm wide; its surface is finely striated with 11—12 rounded capillae per 2 mm; intergrooves are angular. The valve was damaged and subsequently repaired during life of the animal. Anterior part of the valve bears shallow, moderately irregular dimples; we are not sure if this is a growth anomaly or a post-mortem deformatin of the valve.

Occurrence: Suchomasty Limestone, locality 5.

Orthotetacea Waagen, 1884

Schuchertellidae Williams, 1953

Areostrophia Havlíček, 1965

Areostrophia ares sp. n.

Pl. III, figs. 7, 8

Holotype: brachial valve figured on pl. III as fig. 7; VH 2545a.

Type horizon and locality: Suchomasty Limestone, locality 3.

Material: 1 shell, 4 brachial valves, 3 pedicle valves, and several incomplete specimens.

Exterior: Shell 8.5—12.5 mm wide, planoconvex to ventri-biconvex with a low body cavity. Pedicle valve gently to moderately convex in lateral profile; sides curved, anterior margin nearly straight; cardinal angles narrowly rounded; ventral interarea apsacline, nearly flat, pseudodeltidium large, convex.

Brachial valve flat or slightly convex in lateral profile, medianly with a shallow sulcus originating near the beak and reaching the front margin. Dorsal interarea and chilidial plates absent.

Costellae slender, subangular, 6—7 per 2 mm antero-medianly, separated by flat interspaces; concentric fila not observed (due to imperfect state of preservation?).

Interior: Shell impunctate; dental plates missing. Interior of brachial valve not examined.

Comparison: By its overall shape and ornamentation, *A. ares* recalls *Eoschuchertella popovi* Gracianova (Gornyi Altai, Eifelian; Gracianova 1974), but it lacks the dorsal interarea and chilidial plates which are a significant feature of the latter species. For this reason, the new Bohemian species is retained within the genus *Areostrophia* which — unlike *Eoschuchertella* — is distinguished by the absence of both the dorsal interarea and chilidial plates.

A. ares differs from the earlier *A. distorta* (Barr.) (Koněprusy and Zlíchov Limestones) in having smaller size and finer ornamentation; further, the brachial valve of the new species is planar to slightly convex, that of *A. distorta* always convex.

Occurrence: Suchomasty Limestone, localities 3, 5.

Chonetacea Bronn, 1862

Chonetidae Bronn, 1862

Holynetes Havlíček & Racheboeuf, 1979

Holynetes cf. *holynensis* Havlíček & Racheboeuf, 1979

Pl. IV, figs. 5—8

Remarks: The specimens available are closely similar to *H. holynensis* (Choteč Limestone, Pinacites jugleri Horizon) except for being somewhat smaller and having finer ribbing. Pedicle valves collected from the Suchomasty Limestone are 4.6—5.5 mm wide and bear over 5 costellae per 1 mm. Cardinal spines not examined due to poor preservation.

Occurrence: Suchomasty Limestone, localities 3, 14 (only 1 brachial and 3 pedicle valves available).

Leptochonetes Havlíček & Racheboeuf, 1979

Leptochonetes papyrus Havlíček & Racheboeuf, 1979

Pl. IV, figs. 11—13

1979 *Leptochonetes papyrus n. sp.;* Havlíček - Racheboeuf, p. 95, pl. 8, figs. 9—11.

Occurrence: Suchomasty Limestone, localities 3, 5.

Mamutinetes g.n.

Type species: *Mamutinetes latipleura* sp. n.

Diagnosis: Shell similar to that of *Chonetes* Fischer, gently concavo-convex, with rectangular cardinal angles; hinge spines orthomorph-oblique, 3 at each side of the posterior margin. Radial pattern characterized by broad and very low ribs moderately expanding forward, rarely bifurcating and gradually disappearing towards beaks of both valves.

Ventral muscle field obscure; ventral mid-septum short (about 1/6 of the maximum valve length); postero-lateral sides of the field bounded by short ridges containing about a right angle.

Cardinal process short, U-shaped, probably with bilobate posterior face; alveolus deep, elongate-oval; breviseptum low, extending to about 4/5 of the valve length; accessory septa even weaker, all bearing fine papillae on their tops. Anderidia not clearly individualized. Inner cristae long, occupying slightly less than half-width of the valve, with lateral portions straight, highly elevated, running parallel with the hinge line. Dorsal muscle field obscure. Coarse papillae confined to the peripheral part of the brachial valve, where they are arranged in radial rows.

Comparison: *Chonetes* Fischer, based on *Terebratula sarcinulata* Schlotheim (re-examined by Racheboeuf 1978), differs from *Mamutinetes* in having well-developed costellae and capillae over the whole surface of both valves, whereas the new genus bears broad ribs of inconspicuous relief gradually disappearing towards the beaks. For this reason, the umbonal regions of both valves are nearly smooth in *Mamutinetes*. Another distinguishing feature is the size of the mid-septum in the pedicle valve; the mid-septum occupies about 2/3 of the maximum length of the pedicle valve in *Chonetes*, that of *Mamutinetes* is only 1/6 as long as the valve. Brachial valve interior is nearly the same in both the genera except for the alveolus which is deeply excavated in the new genus but very shallow in *Chonetes*. Further, the inner cristae are short and curved in *Chonetes*, those of *Mamutinetes* are strikingly long with straight and strong lateral portions running parallel with the hinge line.

Mamutinetes latipleura sp. n.

Pl. IV, figs. 1—4

Holotype: pedicle valve figured on pl. IV as fig. 4; VH 2347.

Type horizon and locality: Choteč Limestone, Praha - Hlubočepy, locality "U mamutího jezírka".

Material: 6 pedicle valves, 2 brachial valves, and several incomplete specimens.

Exterior: Shell low, gently concavo-convex, 10—12 mm wide. Pedicle valve moderately convex in transverse and lateral profiles, about 64 % as long as maximum width, widest at hinge line; cardinal angles rectangular. Beak gently elevated; ventral interarea low, apsacline, deltidial plates not observed (due to weak preservation). Three pairs of orthomorph-oblique spines, containing acute to almost right angles with the posterior margin. Brachial valve gently concave; dorsal interarea very low, anacline to catacline, notothyrium not examined.

Ribs very low, of inconspicuous relief, in umbonal regions obscure, forwardly increasing in size to become rather broad, in anterior part of the shell counting 5 per 2 mm, mostly simple, exceptionally bifurcating, somewhat broader than interspaces.

Interior: Medium septum low, slender, occupying about 17 % of the pedicle-valve length; ventral muscle field bordered postero-laterally by short, weak ridges; anterior and lateral margins of the field obscure. Coarse papillae not developed in the pedicle valve.

Cardinal process short, in ventral view U-shaped, posteriorly directed; its lobes ill-preserved in all specimens available. Alveolus deep, elongate; breviseptum weak, slightly increasing in size toward front margin, reaching its maximum height in its anterior part, extending forward beyond 4/5 of the valve length. Accessory septa even weaker than the breviseptum, not extending beyond 2/5 of the valve length, and containing about 25°. Anderidia indistinct. Inner cristae curved near the cardinal process but straight laterally to run parallel with the hinge line, fairly long, occupying about 45 % of the maximum width of the brachial valve. Dental sockets elongate, shallow. Fine papillae located on tops of the breviseptum and accessory septa; the coarsest papillae, arranged in radial rows, occur beyond the visceral field; muscle scars obscure in the brachial valve.

Occurrence: Type locality only.

Mamutinetes perlatipleura sp. n.

Pl. IV, fig. 9; pl. XXIII, fig. 1

1979 *"Chonetes"* sp. 1; Havlíček - Racheboeuf, p. 111, pl. 6, fig. 9.

Holotype: Pedicle valve figured on pl. IV as 9; VH 2304a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 2 pedicle valves and few incomplete specimens.

Exterior: By its size, shape, and ornamentation similar to *M. latipleura* but having a somewhat greater convexity in ventral umbonal region and clearly broader costae which count 3 per 2 mm near front margin. Interior not investigated.

Occurrence: Type locality only.

Gypidulacea Schuchert & LeVene, 1929

Gypidulidae Schuchert & LeVene, 1929

Plicogypa Ržonsnickaja, 1975

Plicogypa lukesi sp. n.

Pl. V, figs. 3—6; text-fig. 3

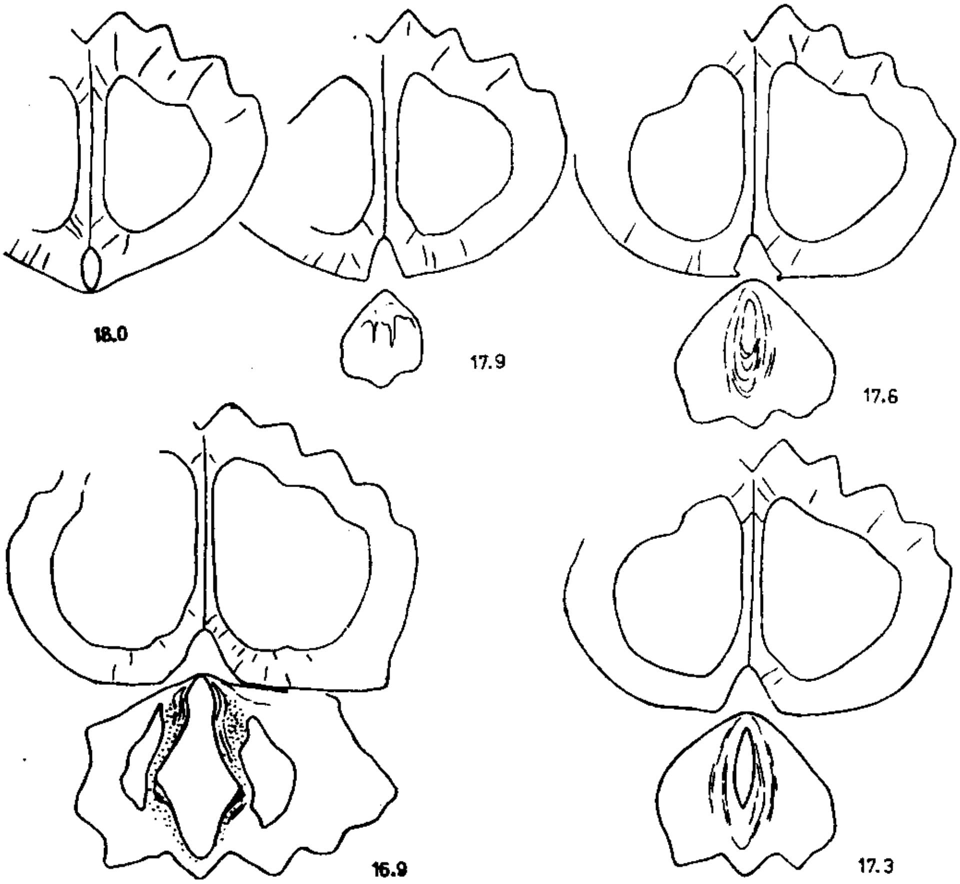
Holotype: Shell figured on pl. V as fig. 6; VH 4813d.
Type horizon and locality: Suchomasty Limestone, locality 5.
Name: After Pavel Lukeš who revised tentaculites of the Suchomasty Limestone.
Material: 24 shells and several valves.

Exterior: By its general aspect recalling a strongly costate *Sieberella,* 10.0—23.6 mm wide in specimens available, in young specimens 54—60 % as high as maximum width, in late adults 57—73 % as high as wide. Pedicle valve much higher than the brachial valve, 77—95 % as long as its maximum width, with a strong, incurved beak. Ventral fold very low to almost indistinct, flat-topped; flanks of pedicle valve steeply sloping towards lateral commissures.

Brachial valve transversely elliptical, 71—77 % as long as wide (extreme: 82.6 % in the largest specimen available), widest near the hinge line; in longitudinal (median) section more curved umbonally than anteriorly; dorsal beak hardly raised above valve surface; sulcus, appearing anterior to the beak, is shallow, well-developed, less commonly obscure; tongue always present, trapezoidal.

Ribs subangular to angular, usually simple, broader than deep angular interspaces, devoid of fine grooves on their tops; interesting is the largest shell available which on top of each costa bears a very fine ridge that disappears near the front margin to be substituted by a short (less than 1 mm) groove, a feature recalling the *Ivdelinia*-type pattern. As these incipient short grooves have been observed only in one gerontic shell, they are not regarded as a feature indicating a close relation to *Ivdelinia* Chodalevič. Sulcus bears always a median costa starting at the beak, and a pair of lateral ribs that originate as secondaries on inner sides of the sulcus-bounding costae in a short distance from the beak. In the late adult shell (pl. V, fig. 6b), the mid-rib bifurcates about at mid-length of the valve. Ventral fold of young and adult shells bears 4 ribs, all starting at the beak, whereas the gerontic shell has 6 ribs in anterior part of the fold because of bifurcation of some costae. Flanks occupied by 3—5 ribs. Growth lines present.

Interior: See text-fig. 3; shell thick-walled, inner prismatic layer covering both the inner surface of valves and the sides of the mid-sep-



3. *Plicogypa lukesi* sp. n.; transverse serial sections, ×7

tum and spondylium. Median septum extends to about a quarter of the pedicle-valve length. Vascula media faintly impressed, broadly divergent, originating at front of the median septum.

Dorsal plates lyre-shaped in cross section; septal plates converge to the valve floor but never fuse into a cruralium; their bases extend anteriorly beyond a third of the valve length, slightly diverge forward to bound laterally a very narrow field about 1.2—1.5 mm wide, 5 mm from the apex.

Comparison: *P. pseudoacutolobata* (Ržonsnickaja) (Salairka Beds, Middle Devonian, Kuzneck Basin; Ržonsnickaja 1960, 1975; Upper Emsian, southern Tian-Shan, and Kireevsk Beds, Lower Devonian, Gornyi Altai; Malygina - Sapeľnikov 1973) is closely similar to *P. lukesi*; it differs from the latter in having an elongate pedicle valve, rounded ribs, and 4—5 ribs in the sulcus, whereas the pedicle valve of the new species is always wider than long, the ribs are subangular to angular, and 3 costae occupy the bottom of the sulcus in the Bohemian species.

Occurrence: Suchomasty Limestone, locality 5.

Pseudosieberella Godefroid, 1972

Pseudosieberella labrusca sp. n.

Pl. V, figs. 1, 2; text-figs. 4—6

Holotype: Shell figured on pl. V as fig. 1; VH 4816a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 35 shells.

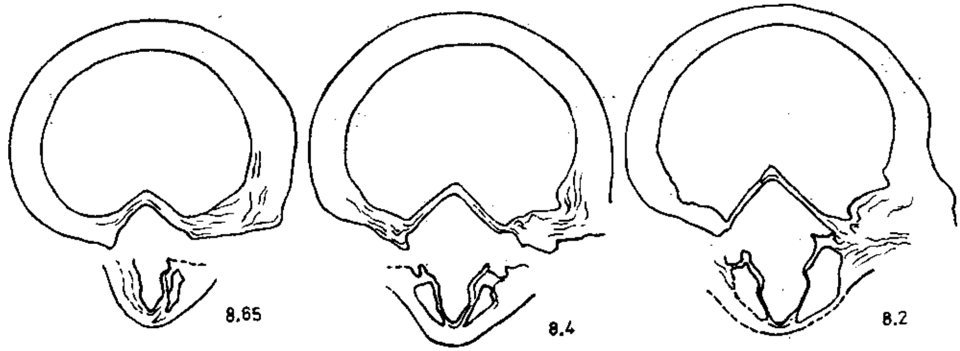
Exterior: Shell 7.6—15.2 mm wide, and 55—65 % (exceptionally 78 %) as high as maximum width, by general aspect recalling a small *Sieberella*, ventri-biconvex, with a strong ventral beak extending considerably beyond the hinge line. Pedicle valve 77—90 % as long as its maximum width (extremes: 68.3 and 92.7 %), strongly and almost evenly convex in lateral profile, with a flat-topped fold in its anterior part. Ventral palintrope low, incurved, not bounded by edges. Delthyrium almost completely filled by the beak of the opposite valve.

Brachial valve transversely elliptical, usually 72—82 % as long as wide (extremes: 68.1 and 83.4 %), with a smooth, slightly elevated beak. In longitudinal (median) section, brachial valve strongly and evenly convex; sulcus, developed in anterior part of the valve, occupies about half-width of the shell (extremes: 44 and 57 % of the maximum width).

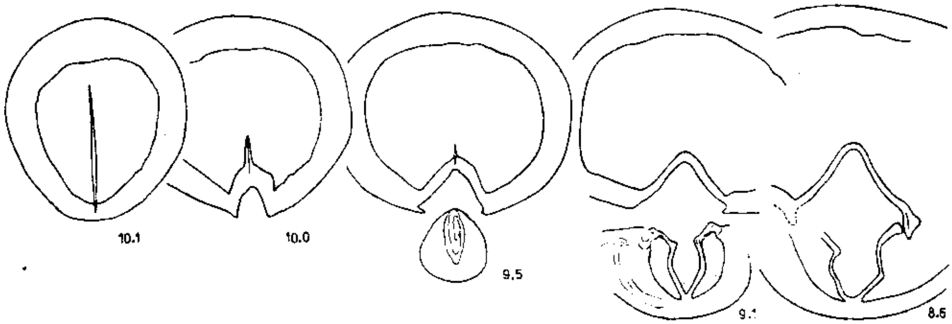
Ribs subangular, broader than angular interspaces, mostly simple, exceptionally bifurcating and never bearing grooves on their tops, thus differing from the *Ivdelinia*-type costae. Fold with 3 or 4 ribs, exceptionally bearing 2 (in one specimen) or 5 ribs (also in one specimen). Flanks occupied by 3—4 costae. Bottom of sulcus usually bears 2 ribs, less commonly 3 or 4 ribs. One sole shell has 1 rib in the sulcus.

Interior: See text-figs. 4—6.

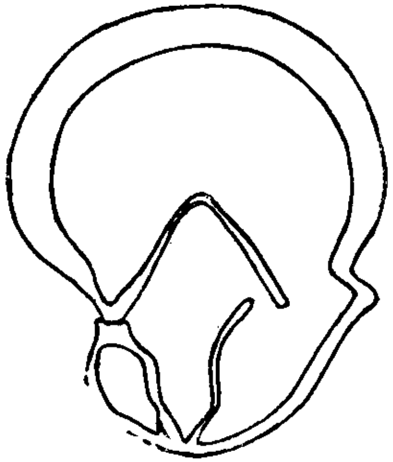
Comparison: By its general aspect, *P. labrusca* recalls *P. montana* (Spriestersbach) (Ohle Beds, lower part of the Middle Devonian, Bergisches Land; and Ahrdorf Beds, upper Couvinian, the Eifel; Godefroid 1972). The ribs in *P. montana,* however, originate much later than those of the Bohemian species, as they appear at or even anterior to mid-length of both valves; the fold of *P. montana* bears 2—3 ribs. and the sulcus is occupied by 1—2 ribs, whereas the ribs in *P. labrusca* are more numerous (3—4 on the fold, 2—3 in the sulcus).



4. *Pseudosieberella labrusca* sp. n.; transverse serial sections, ×6



5. *Pseudosieberella labrusca* sp. n.; transverse serial sections, ×5



6. *Pseudosieberella labrusca* sp. n.; transverse section, ×12

P. corrugata Godefroid (Upper Couvinian, Belgium; Godefroid 1972) differs from the Bohemian species in having much larger shell with an elongate pedicle valve; further, it bears 2—3 ribs on the fold, and 1—2 ribs in the sulcus, whereas *P. labrusca* has usually 3—4 costae on the fold and 2—3 in the sulcus. By contrast to the Couvinian species, *P. labrusca* is always wider than long.

Occurrence: Suchomasty Limestone, localities 5, 8.

Lysigypa g. n.

Type species: *Lysigypa morosoides* sp. n.

Diagnosis: Shell smooth, non-costate, devoid of the fold and sulcus; anterior commissure rectimarginate or very slightly curved either in ventral or, less commonly, in dorsal direction. Ventral beak robust, palintrope not defined by any edges. Pedicle valve with a thick inner prismatic layer; spondylium rather large, of lamellar calcite, free except for its posterior part that is supported by a very short median septum, partly embedded in the prismatic layer. Dorsal plates lyre-shaped in cross-section; they converge to the valve floor to form a cruralium sedens; bases of septal plates touch each other both umbonally and anteriorly, but — in contrast to *Sieberella* — never fuse into a median septum. Brachial valve much less convex and less thick-walled that the pedicle valve.

Comparison: *Lysigypa* is a probable descendant of *Gashaomiaoia* Rong, Su & Li differing from the latter in having a thick prismatic layer in its pedicle valve, and parallel bases of septal plates that touch each other along their whole length; on the other hand, both the valves of *Gashaomiaoia* are of lamellar calcite; further, the bases of septal plates gently diverge forward in the latter genus.

Remarks to synonymy of *Gashaomiaoia:* Smooth surface of both valves, absence of a fold and sulcus, lamellar structure of the shell, short median septum supporting spondylium, and subparallel bases of the septal plates are features common to *Gashaomiaoia* Rong, Su & Li, 1985 and *Lysidium* Havlíček, 1985; it is then apparent that the two taxa cannot be treated as separate genera. The paper dealing with *Gashaomiaoia* appeared in September, 1985, whereas the diagnosis of *Lysidium* was published in October in the same year. For this reason, the name of *Lysidium* is to be considered as a junior synonym of *Gashaomiaoia.*

Lysigypa morosoides sp. n.

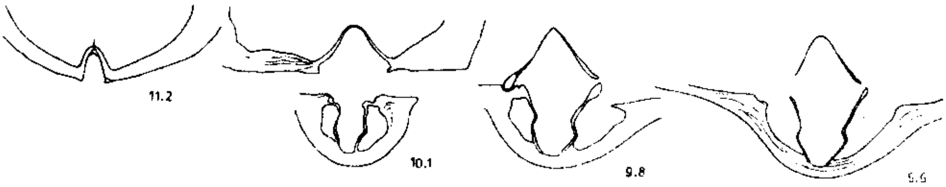
Pl. VI, fig. 2; pl. VII, fig. 7; text-figs. 7, 8

Holotype: Shell figured on pl. VI as fig. 2; VH 4817b.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 22 specimens.

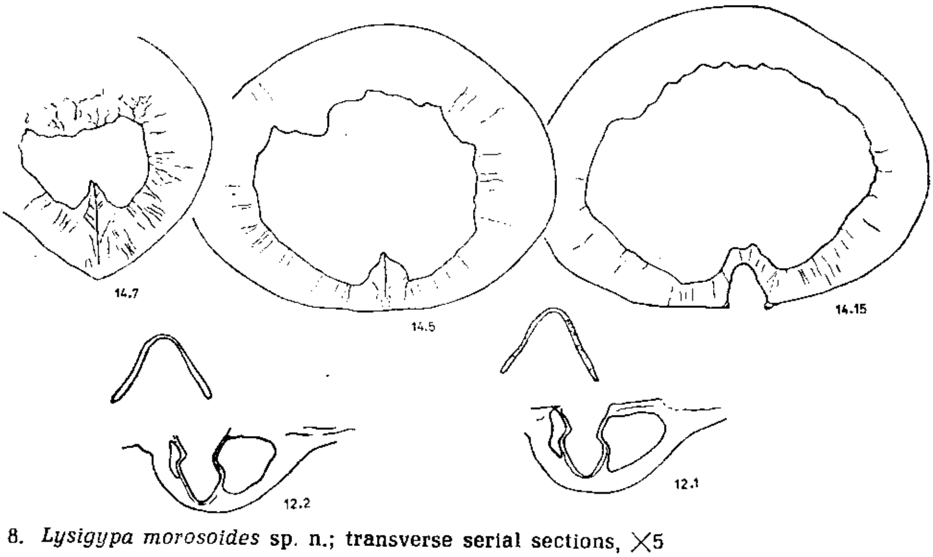
Exterior: Shell ventri-biconvex, nearly globose, 14.0—18.6 mm wide in adults, and 60—63 % as high as maximum width in young specimens, 63—67 % in adults, and 68—71 % in gerontic specimens. Shell smooth, devoid of both the fold and sulcus; anterior commissure either slightly curved ventrally, rectimarginate, or faintly curved dorsally. Pedicle valve slightly shorter than its maximum width (90—100 % as long as wide), with a robust, strongly incurved beak that considerably extends beyond the hinge line. Ventral palintrope not bounded by edges; delthyrium filled by the beak of the opposite valve. In lateral profile, pedicle valve strongly and evenly convex.

Brachial valve elliptical to subcircular in outline, 80—84 % as long as maximum width, with gently raised and moderately incurved beak. Surface smooth; exceptionally, weak growth lines and weak, densely crowded pits present.

Interior: See text-figs. 7, 8 and diagnosis of the genus. Vascula media and lateralia developed as two pairs of straight, narrow, divergent canals gently inserted in the shell; genital markings faintly impressed.



7. *Lysigypa morosoides* sp. n.; transverse serial sections, ×5



8. *Lysigypa morosoides* sp. n.; transverse serial sections, ×5

Comparison: *L. morosa* (Havl.) (Dvorce-Prokop Limestone) is distinguished by extremely thick-walled pedicle valve with considerable secondary-shell accumulations on its inner side, lateral to the spondylium; for this reason, the pallial markings are deeply excavated in the shell of *L. morosa,* whereas those of *L. morosoides* form shallow, straight canals, impressed in a less thick wall of the pedicle valve.

Occurrence: Suchomasty Limestone, locality 5.

Gypidulina Ržonsnickaja, 1956

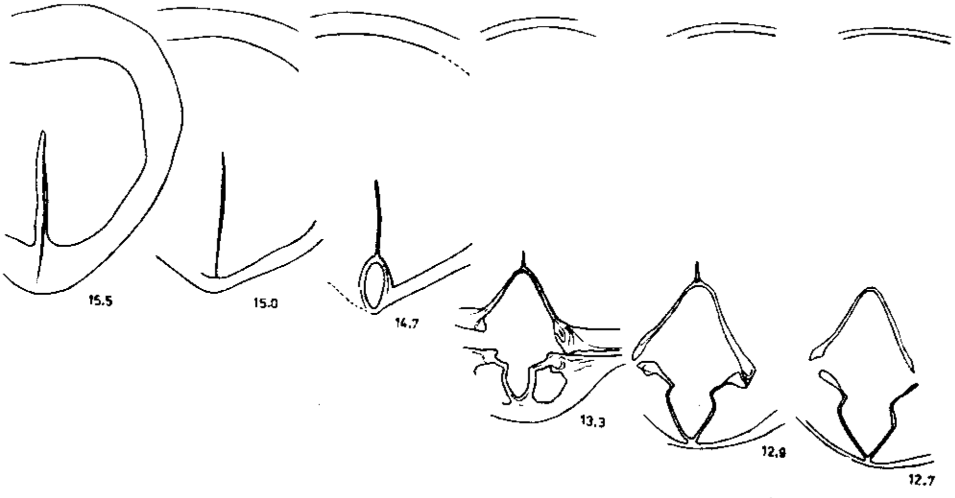
Gypidulina ariadna sp. n.

Pl. VI, fig. 5; text-fig. 9

Holotype: Shell figured on pl. VI as fig. 5; VH 4814a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 6 shells and 1 pedicle valve.

Exterior: Shell 13.0—20.7 mm wide, with pedicle valve much higher than the gently convex brachial valve; pvL/W — 89.6—94.5 %; bvL/W — 71,3—84.4 %; shT/W — 76.2—84.4 %. Pedicle valve strongly and evenly convex in lateral profile, with a strongly inflated beak. Ventral fold low, rather narrow (about 50 % or even less of the maximum width), originating posterior to the mid-length of valve, bounded laterally by weak plications which may be reduced into weak, rounded edges in some specimens. Top of the fold flat or even slightly concave.

Brachial valve transversely elliptical; beak gently raised; sulcus confined to the anterior part of the valve, where it is narrow and rather deep, bordered by rounded edges; tongue prominent, trapezoidal.



9. *Gypidulina ariadna* sp. n.; transverse serial sections, ×12

Ribs weak to indistinct; a short, low plication usually occupies the bottom of the sulcus; fold bears 2 or 3 very weak plications, the flanks are either devoid of ribbing or the lateral commissures are slightly undulated.

Interior: It is closely similar to that of *G. optata* (Barr.) (see text-fig. 9).

Comparison: *G. optata* (Barr.) is much larger than the new species (it is 31—54.5 mm wide in adults) and has a broader fold and sulcus. Internally, the septal plates and brachial plates are of about the same size in *G. optata* (see Havlíček 1985b, text-figs. 3, 4), whereas the septal plates in *G. ariadna* are clearly larger than both the brachial plates and bases of the brachial apparatus.

Occurrence: Suchomasty Limestone, locality 5.

Gypidula Hall, 1867

Gypidula sp.

Pl. VI, fig. 6

Material: One shell (its brachial valve damaged by flattening).

Remarks: Shell rather large (26.1 mm wide) with a low fold appearing in front of the beak; dorsal sulcus rather deep in anterior part of the valve. Ribs rounded, originating in front of both beaks, unequal in size; the strongest are the ribs bounding laterally the fold and sulcus; bottom of sulcus occupied by two low ribs; one rib is located in a median depression between the strong costae on the top of the fold. Lateral ribs obscure. Fine granules observed only at anterior margin of the pedicle valve. Interior not investigated.

Occurrence: Suchomasty Limestone, locality 5.

Clorindidae Ržonsnickaja, 1956

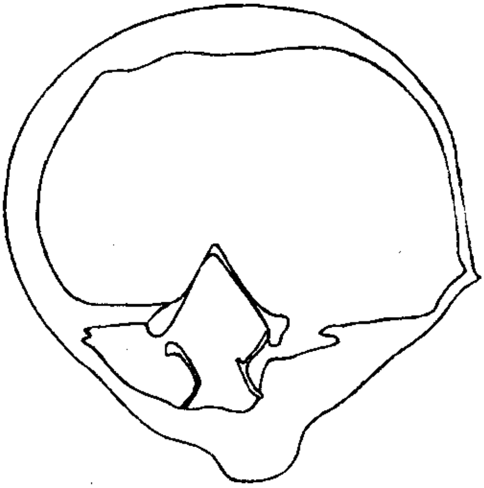
Clorinda Barrande, 1879

Clorinda exarmata sp. n.

Pl. VII, figs. 1, 2; text-fig. 10

Holotype: Shell figured on pl. VII as fig. 2; VH 4818b.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 27 shells.

Exterior: Shell closely similar to that of *C. armata* Barr. with the following features: shW — 6.5—12.4 mm; pvL/W — 83.0—101.0 %; bvL/W — 81.4—91.2 %; shT/W — 66.0—72.5 %. Pedicle valve more convex umbonally than anteriorly or almost evenly convex in lateral profile, with a small, strongly incurved beak moderately extending beyond the hinge line; delthyrium not exposed for examination as it is covered with the beak of the opposite valve. Sulcus appears at or anterior to mid-length of the valve as a very shallow to almost indistinct depression, hardly discernible from the flanks, with a flat or very slightly convex bottom; tongue high, arcuate.



10. *Clorinda exarmata* sp. n.; transverse section, ×7

Brachial valve moderately wider than long, with a moderately raised beak; fold well-developed in anterior part of the valve where it occupies more than half-width of the valve (exceptionally up to 70 % of the maximum width). Fold highly elevated, rounded in cross-section, bounded laterally by rounded depressions. In side view, its top is moderately convex umbonally, nearly flat in the mid-length, and gently curved dorsally near the front margin.

Interior: The same as in *C. armata.*

Comparison: Brachial valve of *C. armata* Barr. is transversely elliptical, that of *C. exarmata* subcircular (81.4—91.2 % as long as wide); further, the top of the fold in *C. armata* is straight in lateral profile, that of the new species is straight in its mid-length but clearly raised dorsally in its anterior part.

C. exarmata may be derived from *C. maiderensis* Drot (Pragian, Morocco; Drot 1969); the latter species is somewhat larger (12.0—17.3 mm wide in specimens figured by Drot 1969) and has obscure fold and low tongue, whereas *C. exarmata* is distinguished by a short, but highly raised fold and highly arcuate tongue.

Occurrence: Suchomasty Limestone, localities 5, 8.

Clorinda robustisella sp. n.

Pl. VI, figs. 3, 4; text-fig. 11

?1879 *Pentamerus linguiferus* Sow.; Barrande (partim), pl. 24, case III, figs. 6, 8.

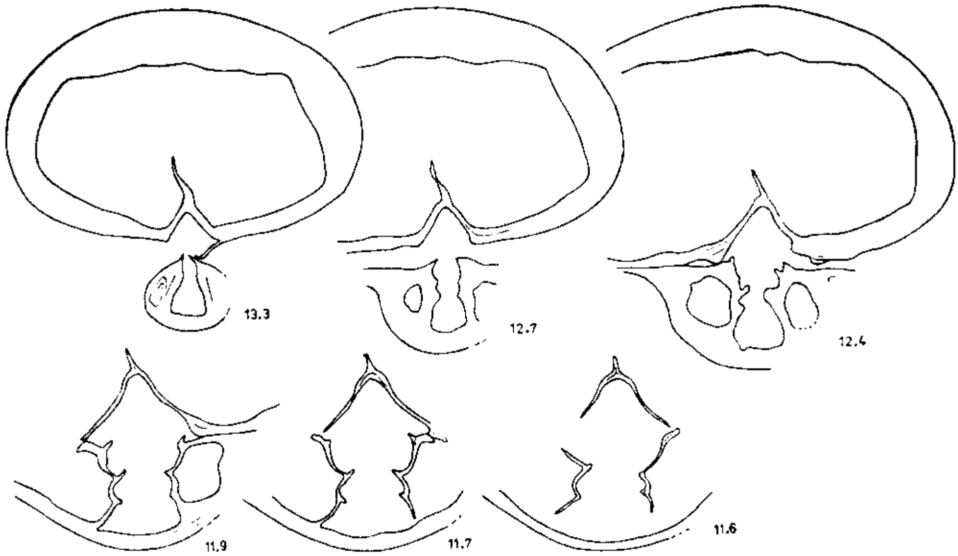
Holotype: Shell figured on pl. VI as fig. 3; VH 4819a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 31 shells.

Exterior: Shell smooth, ventri-biconvex, with the following features: shW — 12.5—17.8 mm; pvL/W — 72.2—84.1 %; bvL/W — 60.4—71.9 %; shT/W — 56.0—97.9 % (this broad range of variation depends on age and size of the specimens investigated, and the size of the fold).

Pedicle valve strongly convex in lateral profile, with a shallow sulcus starting at the beak; bottom of sulcus gently concave posteriorly but nearly flat in anterior part of the valve. Ventral beak overhangs the dorsal beak, delthyrium not exposed for examination.

Brachial valve transversely elliptical, widest at or posterior to its mid-length, with a rounded, highly raised and rather narrow fold extending along the full length of the valve. In contrast to *C. armata* and *C. exarmata*, the fold of *C. robustisella* is clearly developed even in umbonal region as a ridge rounded in cross-section. In side view, top of the fold is moderately convex umbonally but flat anteriorly. Tongue very high, arcuate.

Interior: See text-fig. 11.



11. *Clorinda robustisella* sp. n.; transverse serial sections, ×5

Comparison: *C. baccalaria* sp. n. clearly differs from the coeval *C. robustisella* in bearing a strong plication in its weak sulcus.

Remarks: Gortani (1915) erected *Pentamerus linguifer bohemicus* as a new subspecies based on the Silurian and Devonian specimens described by Barrande (1879) under the name *Pentamerus linguiferus* Sow. Gortani designated no shell as the type specimen; in order to avoid any mistake in concept of *P. linguifer bohemicus*, we are selecting the shell figured by Barrande on pl. 22 as fig. 4 as the lectotype. This shell comes from the Motol Formation and is closely related to *Antirhynchonella ancillans* (Barr.). The Devonian shells figured by Barrande (1879) on pl. 24, case III, as figs. 6 and 8, are externally similar to *C. robustisella*, but they are not available for the study (are they lost?); for this reason, none of them could be used as the lectotype.

Occurrence: Suchomasty Limestone, localities 5, 8.

Clorinda baccalaria sp. n.

Pl. VI, fig. 1; pl. VII, figs. 4, 6

Holotype: Shell figured on pl. VI as fig. 1; VH 4821c.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 14 shells and 3 pedicle valves.

Exterior: Shell rather large, 16.0—18.7 mm wide, ventri-biconvex; pvL/W — 78.4—94.6 %; bvL/W — 69.8—87.1 %; shT/W — 68.1—74.3 %. Pedicle valve sligthly wider than long, strongly and evenly convex in lateral profile, with a strongly incurved beak. Sulcus very shallow to indistinct, originating in front of the beak, anteriorly extending into a prominent, rounded tongue. Bottom of sulcus occupied by a broad plication that is better developed on the tongue than in the posterior part of the valve.

Brachial valve transversely elliptical, widest at or posterior to its midlength; fold rather narrow posteriorly, extending from the beak, moderately expanding forward, rounded in cross section; in anterior part of the valve, it occupies 2/3—3/4 of the maximum width of the shell.

Interior: See pl. VII, fig. 6.

Comparison: *C. baccalaria* is distinguishable from *C. armata* Barr. (Zlíchov Limestone) in its larger size, presence of very shallow sulcus bearing a mid-plication, and presence of a highly elevated fold originating near the beak. Unlike the new species, *C. armata* lacks the ventral sulcus and its rounded fold is discernible only in the anterior part of the brachial valve. Further, the delthyrium is open in *C. armata* but covered by the dorsal beak in *C. baccalaria*.

Occurrence: Suchomasty Limestone, locality 5.

Clorinda acrimona sp. n.

Pl. VII, figs. 3, 5

Holotype: Shell figured on pl. VII as fig. 5; VH 4820b.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 22 shells.

Exterior: Shell medium to large in size, ventri-biconvex; shW — 11.2—17.7 mm; pvL/W — 78.3—84.8 %; bvL/W — 52.5—68.9 %; shT/W — 67.5—86.5 %. Pedicle valve strongly convex in lateral profile, with a strong, incurved beak; delthyrium blocked up by the beak of the opposite valve; sulcus originates at the beak, gradually broadens forward, and extends into a high, triangular tongue directed dorsally. Sulcus V-shaped in cross-section, deepest at about its mid-length, rather shallow at the tongue; its longitudinal axis accentuated by an angular groove.

Brachial valve transversely elliptical; strong fold originates just at the beak as a narrow, highly raised ridge and reaches its maximum size at the front margin of the valve, where it occupies 3/5—2/3 of the maximum width of the shell; fold separated by rounded depressions from the gently convex flanks. In cross section, the fold is roundedly angular to angular.

Interior: The same as in *C. armata* Barr.

Comparison: *C. acrimona* differs from *C. baccalaria* in having a roundedly angular to angular fold and a rather deep, V-shaped sulcus; instead of a broad plication present in the sulcus of *C. baccalaria, C. acrimona* has an angular groove in the longitudinal axis of its sulcus.

C. garretti Perry (Delorme Fm., late Lochkovian to earliest Pragian, the Yukon, Canada; Perry 1984) is closely similar to *C. acrimona* in that it has a high, angular fold in the brachial valve. It is easily distinguishable from the Bohemian species by its shallow, smoothly concave sulcus, whereas the sulcus of *C. acrimona* is deep, V-shaped in cross-section, with a groove in the longitudinal axis.

Occurrence: Suchomasty Limestone, localities 5, 3.

Clorinda strix (Barrande, 1879)

Pl. VIII, figs. 1, 2; text-fig. 12

1879 *Pentamerus strix* Barr.; Barrande, pl. I, figs. 11, 12.

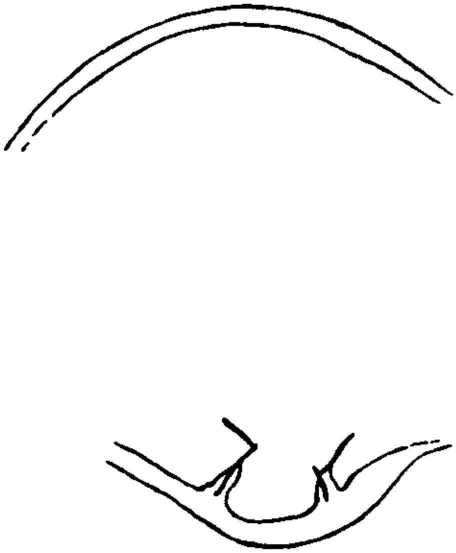
Lectotype (SD herein): Shell figured by Barrande on pl. I as fig. 12 (not available).
Type horizon and locality: Acanthopyge Limestone, Koněprusy.
Material: 18 shells and several valves.

Exterior: Size and shape of the shell similar to those of *C. ex-*

armata except for lacking a ventral sulcus; dorsal fold low, short, tongue very low, arcuate. Pedicle valve 86.6—107.0 % as long as wide.

Interior: See text-fig. 12.

Occurrence: Acanthopyge Limestone, localities 6, 11, 10.



12. *Clorinda strix* (Barrande); transverse section, ×12

Rhynchonellacea Schuchert, 1896

Pugnacidae Ržonsnickaja, 1956

Corvinopugnax Havlíček, 1961

Corvinopugnax corvinus (Barrande, 1847)

Pl. VIII, fig. 3

1961 *Corvinopugnax corvinus* (Barrande, 1847); Havlíček, p. 37, pl. 13, figs. 2, 3; text-figs. 5, 6.

Occurrence: Suchomasty Limestone, locality 5.

Isopoma Torley, 1934

Isopoma alecto (Barrande, 1847)

1961 *Isopoma alecto* (Barrande, 1847); Havlíček, p. 40, pl. 6, fig. 5; text-fig. 7.

Occurrence: Suchomasty Limestone, locality 3.

Errhynx Havlíček, 1982

Errhynx sp.

Pl. XIII, fig. 2

1982 *Errhynx* sp.; Havlíček, pl. 1, figs. 13, 14.

Occurrence: Acanthopyge Limestone, Koněprusy (old collection; a single shell available).

Trigonirhynchiidae McLaren, 1965

Iberirhynchia Drot & Westbroek, 1966

Iberirhynchia nargis (Havlíček, 1961)

Pl. VIII, fig. 4

1961 *Nymphorhynchia nargis* sp. n.; Havlíček, p. 92, pl. 10, fig. 2.

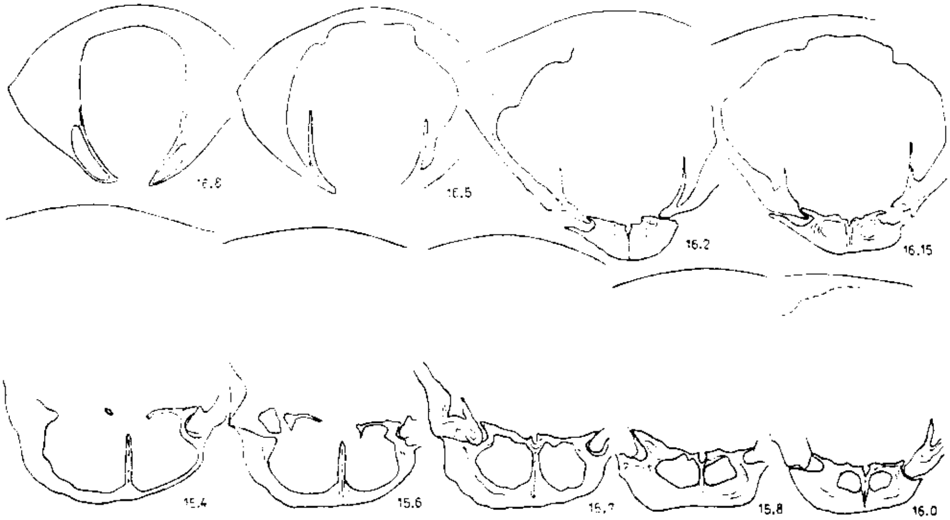
Occurrence: Suchomasty Limestone, Zlatý kůň (a single shell found by M. Šnajdr).

Astutorhyncha Havlíček, 1961

Type species: *Terebratula proserpina* Barrande, 1847.

Diagnosis (emended): Shell transverse, medium to large in size (17—30 mm wide), in early growth stages lenticular in lateral profile with a gently curved anterior commissure, in adults high, nearly cuboidal but never truncated anteriorly. Pedicle valve planar in posterior view; in sagittal profile, its maximum curvature occurs in anterior part where the shallow sulcus passes into a high tongue. Ventral beak moderately incurved, bounded laterally by sharp and long edges separating the low postero-lateral walls from the rest of the valve. Deltidial plates probably absent. Dorsal fold low, flat-topped, in side view moderately convex so that its highest part occurs posterior to its anterior margin. Ribs rounded, broader than interspaces, never bifurcating, in umbonal region weak to indistinct but strong anteriorly. Sulcus occupied by 5—6 (rarely by 4 or 7) ribs, flanks bear 3—5 (exceptionally even more) costae; parietal ribs absent or weak; anterior commissure serrate and uniplicate.

Both valves thick-shelled; teeth minute, medianly inclined; dental plates very short (less than a tenth of the valve length), lateral cavities mostly filled by secondary shell material; ventral muscle field elongate-oval, deeply impressed.



13. *Astutorhyncha proserpina* (Barrande); transverse serial sections, ×5

Septalium minute, resting on a strong median septum, U-shaped in cross-section, never bridged over by a connective band; cardinal process absent; dorsal muscle field small, elongate, gently impressed.

Comparison: *Eoparaphorhynchus* Sartenaer (Upper Devonian) differs from *Astutorhyncha* in having angular ribs and lacking prominent edges bounding postero-laterally the ventral beak; further, its septalium is deeper and its dental plates converge towards the valve floor.

Astutorhyncha proserpina (Barrande, 1847)

Pl. VIII, figs. 7, 8; text-fig. 13

1961 *Astutorhyncha proserpina* (Barrande, 1847); Havlíček, p. 107, pl. 12, figs. 3—7; text-figs. 40, 41.

Occurrence: Suchomasty Limestone, localities 5, 8.

Uncinulidae Ržonsnickaja, 1956

Markitoechia Havlíček, 1959

Markitoechia omissa Havlíček, 1961

Pl. X, fig. 4

1961 *Markitoechia omissa* n. sp.; Havlíček, p. 150, pl. 25, figs. 8—10; text-fig. 59.

Occurrence: Suchomasty Limestone, mostly old collections; a single shell found at locality 5.

Markitoechia clavula sp. n.

Pl. IX, fig. 2

Holotype: Shell figured on pl. IX as fig. 2; VH 3317b.
Type horizon and locality: Suchomasty Limestone, locality 8.
Material: 46 shells.

Exterior: Shell small, 5.3—5.9 mm wide, and 76—91 % as high as maximum width, anteriorly and laterally truncated. Pedicle valve elongate, 103—112 % as long as wide, with fairly long and nearly straight postero-lateral sides containing about a right angle (88—95°); ventral beak incurved, terminating with a small, sharp apex directed postero-dorsaly. Deltidial plates present.

Sulcus confined to the anterior part of valve where it is formed as a moderately deep depression rounded in cross-section. Rarely, floor of the sulcus is flat or even slightly convex. Tongue high, rectangular.

Brachial valve pentagonal in outline, with a short fold originating at about 2/3 of the valve length; top of the fold convex, bearing low, rounded ribs.

Posterior part of both valves smooth; sulcus occupied by 3 (exceptionally 2 or 4) rounded ribs much broader than the interspaces; ribs on the fold short, rounded, whereas those on the tongue and truncated walls are flat, medianly grooved and crossed by fine growth lines in a zig-zag arrangement; marginal spines present.

Interior: The same as in *M. marki* (Havl.).

Comparison: The earlier (Zlíchovian) species *M. marki* (Havl.) is moderately larger and has more ribs in the sulcus and on the fold; it is 6.0—8.0 mm wide with a pentagonal brachial valve, usually slightly wider than long or slightly elongate (pvL/W — 98—104 %), exceptionally moderately elongate (pvL/W — 105—112 %; about 5 % of specimens in the population). By contrast to *M. clavula,* the sulcus of *M. marki* is very short and shallow with a flat or gently convex floor, rarely with a slightly concave floor usually bearing 6—7 costellae (exceptionally 5 costellae).

Occurrence: Suchomasty Limestone, localities 5 (rare), 8 (frequent), 17 (one shell).

Kransia Westbroek, 1967

Kransia aff. *parallelepipeda* (Bronn, 1837)

Pl. IX, fig. 1

1972 *Kransia* aff. *parallelepipeda* (Bronn, 1837); Mohanti, p. 161, pl. 3, fig. 6; pl. 4, figs. 1, 2; text-figs. 17, 18.

Occurrence: Acanthopyge Limestone, locality 7 (one shell only). Northeastern Spain, Cantabrian Mts., Member B of the Portilla Fm. (Middle Devonian) (Mohanti, 1972).

Taimyrrhynx Havlíček, 1982

Taimyrrhynx rufus sp. n.

Pl. VIII, fig. 5

Holotype: Shell figured on pl. 8 as fig. 5; VH 3329b.
Type horizon and locality: Suchomasty Limestone, locality 9.
Material: One shell, one pedicle valve, and several incomplete valves.

Exterior: Size and overall shape of shell nearly the same as in *T. knjaspensis* (Chodalevič); dimensions of the holotype: shW: 17.3 mm; pvL: 14.0 mm; shT: 14.1 mm; suW: 9.5 mm.

Sulcus shallow, bounded laterally by gently elevated flanks; bottom of sulcus nearly flat. Fold short, with a slightly convex top and low, steep sides. Tongue high, trapezoidal; its margin slightly curved. Anterior commissure straight to gently undulate.

Ribs fine, rounded-angular, well discernible even in umbonal regions of both valves, of uniform size over most of the shell surface, increasing in number by bifurcation; sulcus bears 15—19 ribs, parietal ribs 4—5; on anterior and lateral vertical walls, all the ribs flattened and medianly grooved as in other uncinulids; marginal spines present.

Interior not known adequately.

Comparison: *T. rufus* is closely similar to the coeval *T. knjaspensis* (Chodalevič) (Eifelian, east slope of the Ural Mts., Sverdlovsk region; Chodalevič 1951); the latter species, however, has a rectangular tongue with parallel sides, and ribs arranged in poor bundles in posterior part of the shell where the costellae are clearly stronger than anteriorly. By contrast, the fascicostellate character of the ornamentation has not been found in the Bohemian species. Further, the anterior commissure is serrate in *T. knjaspensis* but nearly straight in *T. rufus*.

Occurrence: Suchomasty Limestone, locality 9.

Septalariidae Havlíček, 1960

Septalaria Leidhold, 1928

Septalaria palumbina (Barrande, 1879)

Pl. IX, fig. 3

1961 *Septalaria palumbina* (Barrande, 1879); Havlíček, p. 182, pl. 27, figs. 1—5; text-fig. 82.

Occurrence: Suchomasty Limestone, localities 3, 5, 8.

Amissopecten Havlíček, 1960

Amissopecten velox (Barrande, 1847)

Pl. IX, figs. 7, 8

1961 *Amissopecten velox* (Barrande, 1847); Havlíček, p. 185, pl. 22, figs. 3—6; text-figs. 83, 84.

Occurrence: Suchomasty Limestone, locality 5. Acanthopyge Limestone, localities 6, 7, 11.

Amissopecten obsolescens (Barrande, 1879)

Pl. IX, fig. 6; pl. X, fig. 1

1961 *Amissopecten obsolescens* (Barrande, 1879); Havlíček, p. 187, pl. 27, fig. 12.

1986 *Amissopecten obsolescens* (Barrande, 1879); Havlíček - Pek, p. 19, pl. 2, figs. 9—12; text-figs. 1, 2.

Remarks: *"Atrypa" assula* (Barrande, 1879, pl. 93, fig. I-3; pl. 146, fig. I-1) may represent young shells of *A. obsolescens*; to stabilize the nomenclature, the shell figured by Barrande (1879) on pl. 146 as fig. I-1 is selected herein as the lectotype of the invalid species *Atrypa assula.*

Occurrence: Suchomasty Limestone, locality 5. Acanthopyge Limestone, locality 2 (bank with *Acanthopyge haueri, Amplexus florescens* and *Quasidavidsonia mediocarinata*). Moravia, Horní Benešov in the Nízký Jeseník Mts., Chabičov Member (= upper part of the Stínava-Chabičov Formation, Eifelian).

Monadotoechia Havlíček, 1960

Monadotoechia monas (Barrande, 1847)

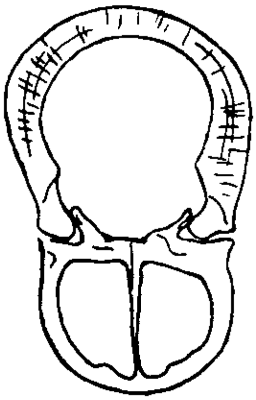
Pl. IX, figs. 4, 5; text-figs. 14, 15

1961 *Monadotoechia monas* (Barrande, 1847); Havlíček, p. 193, pl. 26, figs. 11, 12.

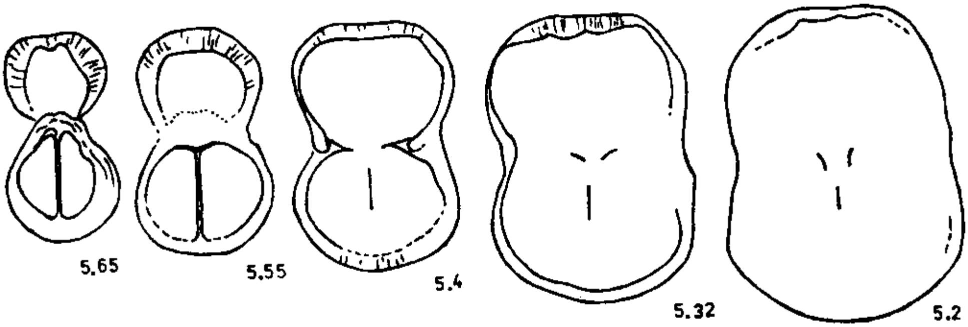
1961 *Monadotoechia monadina* n. sp.; Havlíček, p. 194, pl. 26, figs. 9, 10; text-fig. 87.

Remarks: The "monas" type ribbing consists of 4 equally strong costae on the fold, whereas the "monadina" type ribbing is formed by two anteriorly bifurcating costae. The recently collected material has shown existence of gradual transition between the two types of ribbing; for this reason, *Monadotoechia monas* and *M. monadina* are supposed to be conspecific.

Occurrence: Suchomasty Limestone, localities 15, 17.



14. *Monadotoechia monas* (Barrande); transverse section, ×12



15. *Monadotoechia monas* (Barrande); transverse serial sections, ×9

Wellerellidae Licharev in Ržonsnickaja, 1956

Remarks: Havlíček (1961) considered *Tetratomia* to be the earliest genus of the *Wellerellidae*, a family that was rather common in the Carboniferous and Permian and survived till the Mesozoic. Inner morphology of *Tetratomia*, however, needs further investigation.

Tetratomia H. Schmidt, 1941

Tetratomia coalescens sp. n.

Pl. VIII, fig. 6

Holotype: Shell figured on pl. VIII as fig. 6; VH 4157.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 10 shells and several incomplete specimens.

Exterior: Shell 3.6—4.6 mm wide, nearly globose, 63.9—75.5 % as high as maximum width, by overall shape and size closely similar to

T. amanshauseri (Dahmer) (uppermost Lower Devonian, Rhineland). Pedicle valve pentagonal in outline, 100—102 % as long as wide; ventral beak small, incurved, its apex directed postero-dorsally; shoulder angle 92—100°; sulcus shallow, originating at a quarter to a third of the valve length, anteriorly extending into a short, trapezoidal tongue. Brachial valve moderately convex with a low fold appearing at about the mid-length.

Ribs angular, separated by angular interspaces, counting 11—13, all extending from the posterior margin; bifurcation not established. Interesting are the submedian ribs of the first and second pairs which often coalesce in anterior part of the pedicle valve into strong costae bounding the sulcus; for this reason, the sulcus bears only a slender mid-rib. In case that the submedian ribs do not coalesce into stronger ones, the floor of the sulcus is occupied by three slender ribs. Fold bears 2 or 4 angular ribs.

Interior: Not investigated.

Comparison: *T. amanshauseri* (Dahmer) differs from the new species in having only one rib in the sulcus, two ribs on the fold, and never developing coalescing costae in the anterior part of the pedicle valve. By contrast, the coalescing ribs are a significant feature of that part of population of *T. coalescens* that bears a single rib in its sulcus.

Occurrence: Suchomasty Limestone, locality 5.

Atrypacea Gill, 1871

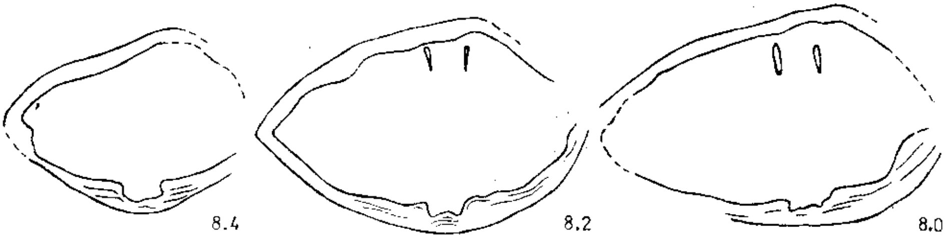
Lissatrypidae Twenhofel, 1914

Trigonatrypa g. n.

Type species: *Meristella holynensis* Havlíček, 1956.

Diagnosis: Shell smooth, triangular to pentagonal in outline, widest in 2/3 or 3/4 of its length; anterior commissure rectimarginate to uniplicate; postero-lateral commissures located either on sharp edges or on nearly vertical walls. Ventral beak short, gently to moderately incurved, palintrope small, apsacline to orthocline; deltidial plates minute, less commonly missing (in *T. holynensis*). Ventral sulcus absent or formed as a very broad, shallow depression; dorsal fold absent.

Pedicle valve thin-walled and devoid of dental plates in the earlier (Zlíchovian—Dalejan) species becoming rather thick-walled in the Eifelian species that have short, moderately diverging dental plates. Ventral muscle field triangular, gently impressed, in the Eifelian species underlain anteriorly by a low pad of secondary shell material. Hinge plates disjunct, massive, underlain by pads of secondary shell material, separated from dental sockets by moderately elevated rigdes; inner margins of hinge plates raised in the form of short ridges serving as crural bases. Crura slender, ventrally to postero-ventrally curved, touching almost the inner surface of the pedicle valve. Spiral cones and jugal processes not discovered. Dorsal muscle field elongate, weakly impressed, bisected by a myophragm.



16. *Trigonatrypa holynensis* (Havlíček); transverse serial sections, ×10

Trigonatrypa is confined to both the quiet, deeper-water environment of nodular, muddy limestone inhabited by trilobites of the *Phacops-Struveaspis* Assemblage in about B.A. 4—5 life zone, and the very shallow-water environment of bioclastic limestone in the Koněprusy area (*Karbous-Orbitoproetus* and *Karbous-Acanthopyge* Communities).

Comparison: *Trigonatrypa* may have been derived from *Glassia* Davidson (recently revised by Copper 1986); it differs from the latter in having triangular (less commonly pentagonal) shells widest in 2/3 or 3/4 of their length, always lacking a dorsal fold or sulcus, and having a very broad, shallow ventral sulcus. Unlike the new genus, *Glassia* is rounded to elliptical in outline, its shell is rectimarginate and often bisulcate. Unfortunately, the spiral cones have not been discovered in many Bohemian species; for this reason, attribution of *Trigonatrypa* to the *Glassiinae* is not sure.

Trigonatrypa baucis (Barrande, 1847)

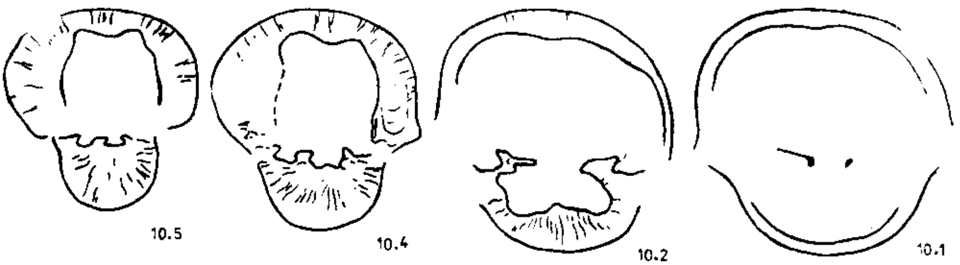
Pl. X, fig. 2; pl. XII, fig. 5; text-figs., 17, 18.

1847 *Terebratula Baucis* Barr.; Barrande, p. 389, pl. 16, fig. 7.
1879 *Merista? Baucis* Barr.; Barrande, pl. 17, case IV, figs. 1—11.

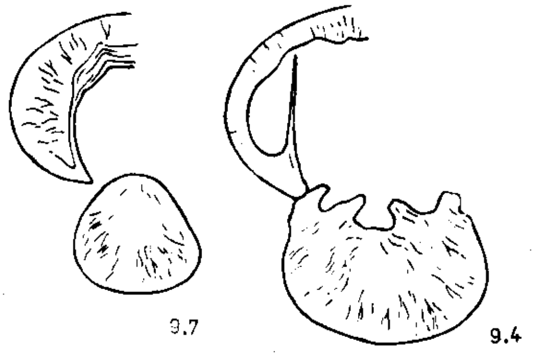
Lectotype (SD herein): Shell figured by Barrande in 1847 on pl. 16 as figs. 7a—7c; refigured by Barrande in 1879, pl. 17, case IV, fig. 10; L 23982.
Type horizon and locality: Acanthopyge Limestone, Koněprusy.
Material: More than 50 shells (partly old collections).

Exterior: Shell subequally biconvex, variable in size and shape, 11.0—17.5 mm wide in adult specimens, 41—51 % as high as wide in young shells (smaller than 7.5 mm) becoming 52—59 % as high as the maximum width in late adults. Pedicle valve triangular in outline, usually elongate (103—107 % as long as wide), less commonly wider than long (89—100 % as long as wide). Postero-lateral margins long, straight, containing an acute angle varying from 69° to 82°. Widest part of pedicle valve at about the anterior third of its length; in ventral view, anterior margin gently arcuate to straight. Ventral beak short, gently incurved, terminating with a sharp apex directed postero-dorsally. Deltidial plates present, pedicle foramen not examined due to an imperfect state of preservation. Ventral sulcus ill-defined; if present, it forms a very shallow depression with a flat to slightly concave bottom. Longitudinal axis of ventral sulcus accentuated by a narrow groove originating posterior to mid-length of valve, and not expanding forward. Anterior commissure bent in dorsal direction.

Brachial valve evenly convex in lateral profile, devoid of a fold. In posterior view, the postero-lateral portions of both valves deflected towards the commissure to form low, very steep to vertical walls. Surface smooth, no growth lines observed; exceptionally, both valves bear weak radial plications near anterior margins (e.g. the shell figured by Barrande in 1847 pl. 16, fig. 7d; and refigured by him in 1879, pl. 17, case IV, fig. 11d, has 6—7 weak, rounded plications).



17. *Trigonatrypa baucis* (Barrande); transverse serial sections, ×7



18. *Trigonatrypa baucis* (Barrande); transverse serial sections, ×12

Interior: Shell walls rather thick, consisting of a fibrous, outer layer, and a prismatic, inner layer. Dental plates short, divergent. Ventral muscle field small, triangular, anteriorly underlain by a low pad of secondary material.

Cardinal process absent; hinge plates solid, disjunct; dorsal muscle field elongate, surrounded by ridges, bisected by a myophragm, about 1/6—1/7 as broad as the maximum width of the valve, and occupying about 1/3 of the valve length.

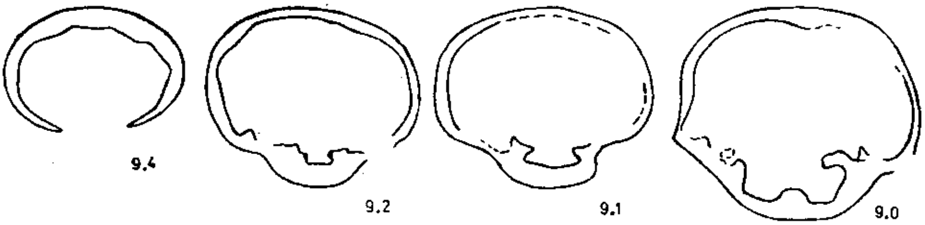
Occurrence: Acanthopyge Limestone, localities 2, 6, 7, 10, 11.

Trigonatrypa protobaucis sp. n.

Pl. X, fig. 3; text-fig. 19

Holotype: Shell figured on pl. X as fig. 3; VH 3322b.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 16 shells.

Exterior and interior: Externally not distinguishable from *T. baucis* but thin-walled, lacking dental plates, and with a hardly impressed ventral muscle field.



19. *Trigonatrypa protobaucis* sp. n.; transverse serial sections, ×7

Comparison: *T. baucis* differs from the new species in being thick-walled and in having short, moderately diverging dental plates.

T. holynensis (Třebotov Limestone; *Phacops-Struveaspis* Assemblage) differs from the new species in having the maximum width of its shell at about 3/4 of its length; further, lateral commissures are located on sharp edges, and the anterior commissure is nearly rectimarginate in *T. holynensis* but uniplicate in *T. protobaucis*. Moreover, ventral beak of *T. holynensis* is so incurved that it rests on the beak of the opposite valve, while that of *T. protobaucis* is apsacline to orthocline, not touching the dorsal beak.

Occurrence: Suchomasty Limestone, localities 2, 3, 5, 8, 12.

Trigonatrypa securis (Barrande, 1847)

Pl. X, fig. 5; pl. XI, fig. 1

1847 *Terebratula Securis* Barr.; Barrande, p. 388, pl. 16, fig. 1.

1879 *Merista Securis* Barr.; Barrande, pl. 17, case III, figs. 1—10; pl. 142, case V, fig. 1.

Holotype: Shell figured by Barrande in 1847; refigured by Barrande in 1879 on pl. 17, case III, as fig. 9; L 25316.

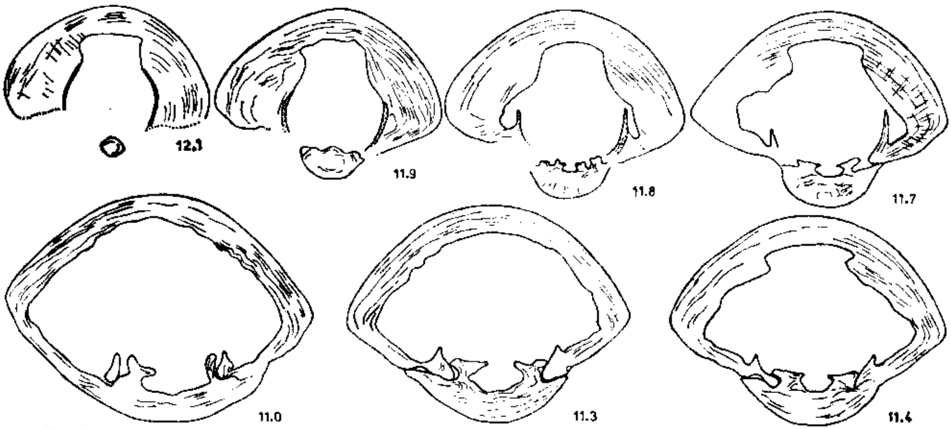
Type horizon and locality: Acanthopyge Limestone, Koněprusy.

Material: one shell from the Suchomasty Limestone, and 10 specimens from the Acanthopyge Limestone (old collections).

Exterior: Shell pentagonal in outline, subequally biconvex, 89—100 % as long as maximum width, exceptionally conspicuously elongate, widest at about 2/3—3/4 of the pedicle-valve length; 11.5—18.0 mm wide in adult specimens, and 42—47 % as high as maximum width. Anterior margin of shell usually straight or even slightly emarginate. In lateral profile, both valves moderately and evenly convex; adult pedicle valves bear a median flattening that often changes into a very shallow, not clearly differenciated, sulcus. Median depression in the brachial valve of the same kind as that in the pedicle valve; anterior commissure rectimarginate; both anterior and lateral commissures located on acute edges. Ventral beak short, straight, directed posteriorly; minute palintrope orthocline, bounded by obscure edges; delthyrium ill-preserved. Surface smooth.

Interior: Ventral muscle field underlain anteriorly by a low pad of secondary material. Interior of brachial valve not examined.

Occurrence: Suchomasty Limestone, locality 12. Acanthopyge Limestone, old collections (probably locality 10).



20. *Karbous aperinus* Havlíček; transverse serial sections, ×5

Karbous Havlíček, 1985

Remarks: *Karbous,* based on *K. aperinus* Havl., is closely similar to *Peratos* Copper; the latter genus has medially directed spiralia, a feature indicating attribution to the *Glassiinae.* By contrast, *K. hassiacus* (Siehl) has dorsally directed spiral cones (Siehl, 1962); the same type of spiralia was mentioned by Havlíček (1985a) in *K. vaneki* (Zlíchov Fm., Bohemia). A closely similar species *"Cryptatrypa" lenticula* Perry (Delorme Fm., Zlíchovian; the Yukon) is distinguished by laterally directed spiral cones (Perry 1984, pl. 40, fig. 19).

Karbous aperinus Havlíček, 1985

Pl. XI, figs. 3—6; text-fig. 20

1985a *Karbous aperinus* sp. n.; Havlíček, p. 236, pl. 1, fig. 3; pl. 2, figs. 1, 2; text-figs. 2, 3.

Occurrence: Suchomasty Limestone, localities 3, 5.

Karbous truncatus Havlíček, 1985

Pl. XIII, figs. 1, 2

1985a *Karbous truncatus* sp. n.; Havlíček, p. 237, pl. 2, figs. 3, 4.

Occurrence: Suchomasty Limestone, localities 3, 5. Acanthopyge Limestone, locality 11.

Karbous hassiacus (Siehl, 1962)

Pl. XI, fig. 7

1962 *?Cryptatrypa hassiaca* n. sp.; Siehl, p. 198, pl. 27, figs. 5, 6; pl. 37, figs. 4, 6.

Occurrence: Acanthopyge Limestone, localities 2, 7, 10, 11. Rhineland, Greifenstein Limestone (upper Eifelian) (Siehl 1962).

Rhynchatrypa Siehl, 1962

Type species: *Terebratula thetis* Barrande, 1847.

Remarks: By its inner and outer morphology, the Silurian genus *Dubaria* Termier is so close to the Devonian *Rhynchatrypa* to leave no doubt that it is an ancestor of the latter genus. *Dubaria* has minute, narrowly triangular, coalescing deltidial plates rarely exposed for examination because of its incurved ventral beak; on the other hand, the deltidial plates of *Rhynchatrypa* are rather large, low and rather wide, medianly fusing into one piece with a clearly discernible suture, surrounding the pedicle foramen (see pl. XII, fig. 6). By contrast to *Dubaria,* the ventral beak of *Rhynchatrypa* is nearly straight. Further, the hinge line of *Dubaria* remains curved till late adult growth stages, whereas that of *Rhynchatrypa* undergoes significant changes throughout ontogeny. It is curved in young specimens whereas it becomes straight in late adult shells; this modification is accompanied by appearance of small dorso-ventrally flattened ears (see pl. XII, fig. 4a, 4c) that have never been found in the Silurian *Dubaria.*

We are not sure if these differences between *Dubaria* and *Rhynchatrypa* are sufficient enough to warrant erection of two separate genera (or subgenera?); unfortunately, the lack of the Lochkovian, Pragian, and lower Zlíchovian septatrypids devoid of a dorsal mid-septum prohibits us to get to know the evolution of the *Dubaria* - *Rhynchatrypa* stock more precisely during the Lower Devonian.

Rhynchatrypa thetis (Barrande, 1847)

Pl. XII, figs. 1—4, 6

1847 *Terebratula Thetis* Barr.; Barrande, p. 394, pl. 14, figs. 5a—5f.

1879 *Atrypa Thetis* Barr.; Barrande, pl. 86, case IV, figs. 4, 5, 7—10; pl. 133, case I, figs. 6—8.

1962 *Rhynchatrypa thetis* (Barrande, 1847); Siehl, p. 200, pl. 28, figs. 1, 2; pl. 37, fig. 11; pl. 38, figs. 1, 2; text-figs. 23—26.

1986 *Rhynchatrypa jesenia* sp. n.; Havlíček - Pek, p. 20, pl. 2, figs. 1—8; text-fig. 3.

Lectotype (SD herein): Shell figured by Barrande in 1847, pl. 14, as figs. 5d—5e (non figs. 5a—c); refigured by Barrande in 1879 on pl. 86 as fig. IV-10; L 25898.

Type horizon and locality: Acanthopyge Limestone, Koněprusy.

Material: 60 shells from the Suchomasty and Acanthopyge Limestones; further numerous specimens in old collections.

Exterior: See Barrande, 1847 and Siehl, 1962.

Interior: See Siehl, 1962 (transverse sections).

Remarks: Size and outline of shell and size of the fold are rather variable; the different forms do not represent separate species because of gradual transitions among them. Also *R. jesenia,* erected by Havlíček and Pek (1986) (Chabičov Member, Eifelian; Moravia) should be considered a form of *R. thetis,* differring from the latter only in somewhat smaller size and less elevated fold.

The old collections include several large, strikingly transverse shells (pvL/W — 72—76 %) that have a narrow, highly elevated fold (pl. XII, fig. 4). It is probable that these specimens are to be treated as a separate species; their age, however, is not sure (Acanthopyge Limestone?).

Occurrence: Chýnice Limestone (upper part of the Zlíchovian); Bubovice, Čeřinka quarry. Suchomasty Limestone, localities 5, 12. Acanthopyge Limestone, localities 2, 6, 10, 11, Moravia; Horní Benešov in the Nízký Jeseník Mts., Chabičov Member (Eifelian) (Havlíček - Pek 1986). Rhineland, Greifenstein Limestone (upper Eifelian) (Siehl 1962). Gornyi Altai, Iakushinsk Beds, upper part of the Lower Devonian (Gracianova 1967).

Radimatrypa g. n.

Type species: *Radimatrypa zelaria* sp. n.

Diagnosis: Externally similar to *Septatrypa* Kozlowski but thick-walled, with a short median septum and small, open septalium in the brachial valve; dorsal median septum continuous with a strong ridge. Dental plates missing.

Comparison: Unlike the new genus, *Septatrypa* Kozlowski is thin-walled, has thin, moderately diverging dental plates, and its dorsal median septum is not continuous with a strong median ridge.

Radimatrypa zelaria sp. n.

Pl. XIII, figs. 3, 4; text-fig. 21

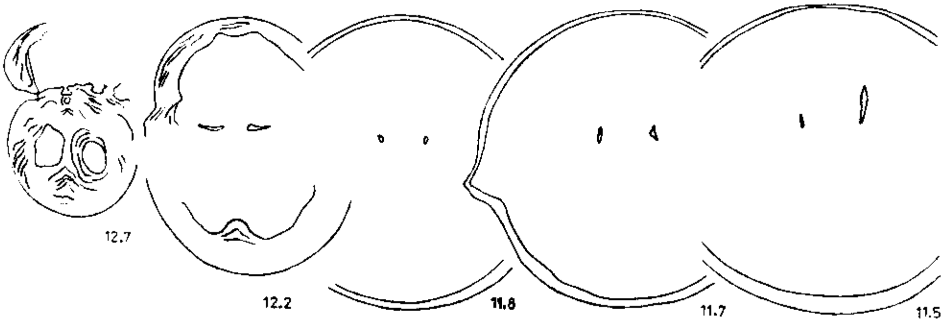
1879 *Atrypa Zelia* Barr.; Barrande (partim), pl. 90, case II, figs. 1—5.
1879 *Atrypa Thetis* Barr.; Barrande (partim), pl. 86, case IV, fig. 11.
1879 *Atrypa assula* Barr.; Barrande (partim), pl. 146, case I, fig. 2.

Holotype: Shell figured by Barrande in 1879 on pl. 90, case II, as fig. 2; refigured herein on pl. 13 as fig. 4; L 25939.
Type horizon and locality: Acanthopyge Limestone, Koněprusy.
Material: 14 shells.

Exterior: Shell lenticular in early growth stages, about 35 % as high as wide, with a very weak sulcus in the pedicle valve and slightly curved anterior margin. Shell of adult specimens pentagonal in outline, 17.0—22.5 mm wide (the largest shell 26.7 mm wide), and 48.0—58.3 % as high as maximum width. Hinge line always curved, ventral interarea very small, bordered by rounded edges; in adults, delthyrium not exposed for examination as the ventral beak nearly touches the beak of the opposite valve.

Pedicle valve 75—90 % as long as wide, evenly convex in posterior part; ventral sulcus appears at about the mid-length and extends into a trapezoidal tongue directed antero-dorsally to dorsally. At about two thirds of the valve length, the sulcus occupies 3/4 or 4/5 of the maximum width of the shell. Bottom of sulcus gently concave to almost flat, in some specimens with a weak median groove. Shoulder angle about 120°.

Brachial valve strongly and evenly convex in its posterior part; anterior to mid-length, a low fold appears; its top is flat or slightly concave, sometimes bearing a median, very shallow groove. Surface smooth; no growth lines observed.



21. *Radimatrypa zelaria* sp. n.; transverse serial sections, ×5

Interior: See text-fig. 21.

Comparison: Barrande (1879) assigned to his *Atrypa zelia* shells of various ages; Plodowski (1971) selected as the lectotype a Wenlockian shell which clearly differs from the Dalejan-Eifelian specimens in having well-developed dental plates and lacking a thick layer of fibrous material in umbonal regions of both valves and on sides of the dorsal median septum.

Occurrence: Suchomasty Limestone, localities 3, 5. Acanthopyge Limestone, old collections.

Cerberatrypa g. n.

Type species: *Cerberatrypa cerberus* sp. n.

Diagnosis: Shell smooth, cordate to pentagonal in outline, equally biconvex, with curved hinge line in all growth stages; ventral sulcus narrow and rather deep; brachial valve either evenly convex or medianly sulcate; dorsal fold always absent, anterior commissure rectimarginate to uniplicate. Ventral beak nearly straight; palintrope small, apsacline to orthocline, coalescing deltidial plates present.

Dental plates short, lateral umbonal cavities free of secondary accumulations. Hinge plates disjunct, horizontally disposed or moderately incurved dorso-medianly. Median septum or ridge absent. Spiralia not discovered.

Comparison: *Cerberatrypa* may be considered as a terminal link of the *Dubaria* stock sharing with *Dubaria* s.s. the smooth shell, presence of short dental plates, absence of a median septum and septalium, and presence of disjunct hinge plates, but it differs from the latter in having a heart-shaped to pentagonal shape of the shell devoid of a prominent, dorsally directed tongue, and in lacking any sign of a dorsal fold.

The co-eval *Rhynchatrypa* Siehl differs from *Cerberatrypa* in having a *Dubaria*-shaped shell with a prominent tongue in adult specimens, and in developing a straight hinge line during ontogeny.

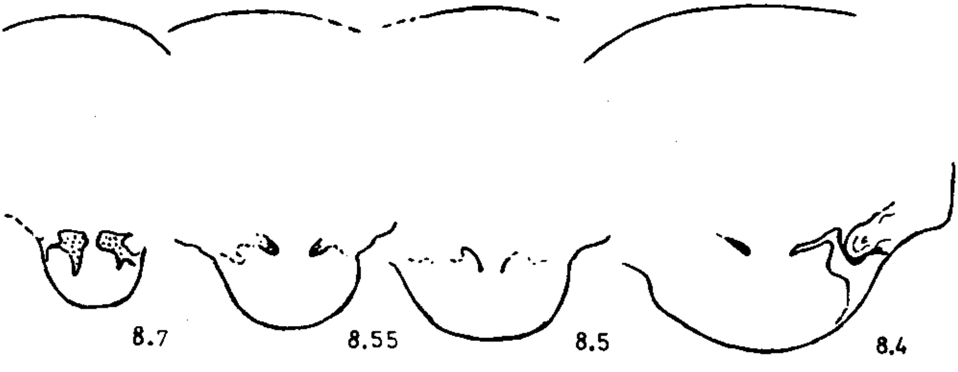
Cerberatrypa cerberus sp. n.

Pl. X, fig. 6; text-fig. 22

Holotype: Shell figured on pl. X as fig. 6; VH 4165f.
Type horizon and locality: Acanthopyge Limestone, locality 11.
Material: 9 shells.

Exterior: Shell heart-shaped in outline, 8.0—12.0 mm wide, equally biconvex, 49.3—56.4 % as high as maximum width; widest part between the mid-length and two thirds of the shell length. Pedicle valve 87.0—89.0 % as long as wide; postero-lateral sides rather long, straight or slightly curved toward mid-line; shoulder angle 103—113°. Anterior margin straight in young shells becoming emarginate in late adults. Anterior commissure rectimarginate to gently curved dorsally.

Pedicle valve moderately and evenly convex in lateral profile; ventral beak small, gently incurved, terminating with a sharp apex directed posteriorly to postero-dorsally; palintrope low, apsacline, concave, bordered by obtuse to rounded edges; deltidial plates present, but ill-preserved in all specimens examined. Brachial valve more convex umbonally than anteriorly. Both the pedicle and brachial valves bear a rounded



22. *Cerberatrypa cerberus* sp. n.; transverse serial sections, ×12

sulcus that originates near the beak and gradually expands forwards to become moderately broad and moderately deep in anterior part of the shell. Surface smooth, no growth lines observed.

Interior: See text-fig. 22.

Comparison: *C. cerberus* has a cordate, bisulcate shell, whereas *C. dissidens* bears a narrow, rather deep sulcus only in its pedicle valve; its brachial valve is evenly convex, without any sign of a fold or sulcus. Further, the shell of *C. cerberus* is more transverse than that of *C. dissidens*; its pvL/W ranges from 87.0 to 89.0 % whereas *C. dissidens* is always over 90 % as long as wide.

Occurrence: Acanthopyge Limestone, locality 11 (topmost part of the formation).

Cerberatrypa dissidens (Barrande, 1879)

Pl. X, fig. 7; text-fig. 23

1879 *Atrypa dissidens* Barr. Var. de *canaliculata* Barr.; Barrande, pl. 146, case I, fig. 2 (non fig. 1).

Lectotype (SD herein): Shell figured by Barrande in 1879 on pl. 146, case I, fig. 2; L 24954.

Type horizon and locality: Acanthopyge Limestone, Koněprusy.

Material: 46 shells.

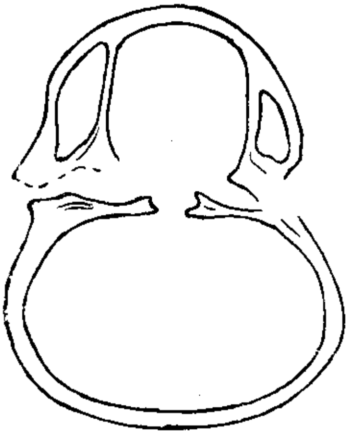
Exterior: Shell equally biconvex, heart-shaped to subpentagonal in outline, with a straight or gently emarginate anterior margin, usually 7—10 mm wide (extremes: 4.6 and 11.8 mm wide), and 51.1—69.3 % as high as maximum width. Pedicle valve slightly wider than long, exceptionally elongate, 90.6—100.0 % as long as wide (extreme: 108.1 %); in lateral profile evenly convex with a moderately curved beak extending into a posteriorly to postero-dorsally directed apex. Ventral interarea small, gently concave, apsacline, bounded by obtuse edges; deltidial plates broadly triangular, pedicle foramen not found (due to a poor preservation). Postero-lateral sides of pedicle valve rather long, straight, enclosing 91°—98°. Ventral sulcus originates just in front of the beak as a narrow groove that broadens forward to give rise to a moderately deep sulcus with a rounded bottom; tongue absent.

Brachial valve more convex umbonally than anteriorly, with a strongly swollen beak. Fold absent; a few specimens bear a weak median flattening that never changes into a true sulcus. Surface smooth.

Interior: See text-fig. 23.

Remarks: The specimens collected from the Suchomasty Limestone differ from the Acanthopyge-limestone population in having much shallower ventral sulcus. We are not sure if the weak sulcus is a constant feature in specimens from the Suchomasty Limestone, because our collection contains only 3 shells. For this reason we retain all the heart-shaped shells lacking a dorsal sulcus within the species rank of *C. dissidens*.

Occurrence: Suchomasty Limestone, locality 5. Acanthopyge Limestone, Konèprusy (old collections).



23. *Cerberatrypa dissidens* (Barrande); transverse section, ×12

Punctatrypidae Ržonsnickaja, 1960

Fossatrypa Mizens & Ržonsnickaja, 1979

Fossatrypa granulifera (Barrande, 1847)

Pl. XII, figs. 8, 10

1987 *Fossatrypa granulifera* (Barrande, 1847); Havlíček, p. 89, pl. 13, figs. 1—5.

Occurrence: Suchamosty Limestone, localities 3, 5, 8. Rhineland, Greifenstein Limestone (Eifelian) (Siehl 1962).

Carinatinidae Ržonsnickaja, 1960

Carinatina Nalivkin, 1930

Carinatina arimaspus (Eichwald, 1840)

Pl. XVII, fig. 9; pl. XXIII, fig. 4

1975 *Carinatina arimaspus* (**Eichwald**, **1840**); **Ržonsnickaja**, **p. 139**, **pl. 31**, **figs. 1—3, 12; text-fig. 45.**

1987 *Carinatina arimaspus* (**Eichwald**, **1840**); **Havlíček**, p. 93, pl. 11, figs. 7—9.

Occurrence: Suchomasty Limestone, locality 5. Ural Mts., Central Asia, Salair Mts.; upper Zlíchovian to lower Eifelian (Ržonsnickaja 1975).

Carinatina sp.

1987 *Carinatina* sp.; Havlíček, p. 94, pl. 14, fig. 1.

Occurrence: Acanthopyge Limestone, locality 7.

Hergetatrypa Havlíček, 1987

Hergetatrypa minuta (Siehl, 1962)
Pl. XVII, figs. 1—3

1962 *Carinatina minuta* n. sp.; Siehl, p. 188, pl. 24, figs. 2, 3; pl. 38, figs. 5—7.
1987 *Hergetatrypa minuta* (Siehl, 1962); Havlíček, p. 98, pl. 14, figs. 4—6.

Occurrence: Suchomasty Limestone, localities 3, 5. Rhineland, Greifenstein Limestone (Eifelian) (Siehl 1962).

Davidsoniatrypidae Havlíček, 1987

Kaplicona Havlíček, 1987

Kaplicona fragilis (Barrande, 1879)
Pl. IV, fig. 10

1967 *Biconostrophia fragilis* (Barrande, 1879); Havlíček, p. 211, pl. 48, figs. 11, 12.

Occurrence: Suchomasty Limestone, locality 3.

Davidsoniidae King, 1850

Quasidavidsonia Havlíček, 1987

Quasidavidsonia mediocarinata (Havlíček, 1967)
Pl. III, figs. 11—15

1967 *Prodavidsonia mediocarinata* sp. n.; Havlíček, p. 215, pl. 49, figs. 10—14.

Occurrence: Acanthopyge Limestone, localities 2, 7, 10, 11.

Quasidavidsonia tenuissima (Barrande, 1879)
Pl. III, figs. 9, 10

1967 *Prodavidsonia tenuissima* (Barrande, 1879); Havlíček, p. 214, pl. 49, figs. 15—20.

Occurrence: Suchomasty Limestone, localities 3, 5.

Retziacea Waagen, 1883

Retziidae Waagen, 1883

Plectospira Cooper, 1942

Remarks: In Czechoslovakia, *Plectospira* is widely distributed; the lineage of strongly costate species begins with *P. membranifera* (Barr.) in the Pragian (Koněprusy Limestone; see Barrande 1879, pl. 34, figs. 7—9; non fig. 6 = *Spirigerina* sp.), continues with *P. oronia* nom. n. in the Zlíchovian, and terminates with *P. ferita* (Buch) in the Givetian (Čelechovice Beds, Moravia). The shells collected from the Suchomasty Limestone (Dalejan) differ from the main lineage in that the ribbing tends to be weak or even obscure, most probably due to a very shallow-water environment. *P. dione* still has rounded ribs but always less strong than those of the main plectospirid stock. Even much weaker ribbing was found in *P. leniplicata* whose costae tend to disappear forward.

Plectospira dione sp. n.

Pl. XV, figs. 2, 3; text-fig. 24

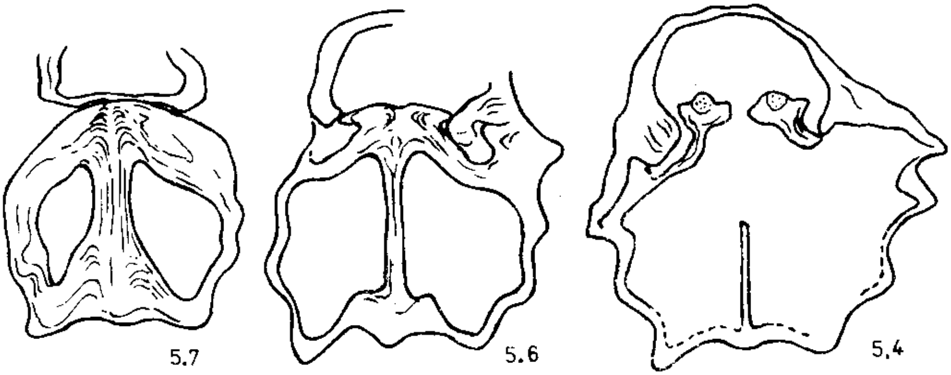
Holotype: Shell figured on pl. XV as fig. 3; VH 2625d.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 20 shells.

Exterior: Shell subequally biconvex, elongate; the youngest specimen available 3.2 mm wide and 5.0 mm long, with a narrow and straight beak. Adult specimens 7.0—9.0 mm wide, and 57.6—74.3 % as high as maximum width. Pedicle valve 108—122 % as long as wide, drop-shaped in outline, in lateral profile gently convex, usually more curved anteriorly than in the mid-length. Beak narrow, straight; delthyrium covered by a triangular plate; pedicle foramen not examined due to a less favourable preservation. Ventral sulcus as broad as intercostal interspaces.

Brachial valve moderately and almost evenly convex in lateral profile; mid-rib in brachial valve more slender than the other ribs, usually slightly expanding forward to reach the front margin of the valve as a narrow ridge; in some specimens, however, it passes into a very low but rather broad plication just at front of the valve.

Pedicle valve bears 2 pairs of strong, rounded ribs increasing in size toward front margin. The third pair, if present, is very weak. Each flank of brachial valve bears 2 ribs. The ribs are straight umbonally but clearly deflected antero-laterally near front margin of the shell.

Interior: See text-fig. 24.



24. *Plectospira dione* sp. n.; transverse serial sections, ×12

Comparison: By contrast to *P. dione,* the Eifelian species *P. varioplicata* Siehl (Greinfenstein Limestone, Rhineland; Siehl 1962) has 3 pairs of ribs on its brachial valve; further, the dorsal umbonal cavity is much more reduced by secondary shell material in *P. varioplicata* than in the Bohemian species; for this reason, the median septum is thin and high in *P. dione,* whereas that of *P. varioplicata* (at least its posterior part) is greatly obscured by the secondary deposits (see Siehl 1962, pl. 35, fig. 2).

Occurrence: Suchomasty Limestone, localities 5, 8.

Plectospira varioplicata Siehl, 1962

Pl. XVII, fig. 7

Occurrence: Acanthopyge Limestone, small quarry north of the locality 10 (only one shell available). Rhineland, Greifenstein Limestone (Eifelian) (Siehl 1962).

Plectospira grochonia sp. n.

Pl. XV, fig. 1; pl. XVI, fig. 1

Holotype: Shell figured on pl. XV, as fig. 1; VH 2528a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 6 shells.

Exterior: Externally recalling *P. varioplicata* but smaller, subcircular in outline, with a short ventral beak gently extending beyond the hinge line. Ribs strong, rounded, 4 (exceptionally 6) in the pedicle valve, and 5 in the brachial valve. Height of ribs increases more rapidly at anterior margin than in the middle part of the shell. For this reason, anterior margin of each rib is recurved ventrally in the pedicle valve, and correspondingly dorsally in the brachial valve, thus simulating the rib-pattern of *P. oronia* and *P. ferita* (Buch).

Interior: Not investigated.

Comparison: *P. grochonia* may be derived from the earlier *P. oronia* (Zlíchov Limestone, Bohemia); it shares with the latter the typical shape of the ribs, but it differs in having rounded costae even just at the anterior commissure, whereas the commissure of *P. oronia* is deeply indented owing to very high, in cross-section subangular ribs in proximity of the front margin of the shell. Further, the ventral beak of *P. grochonia* is shorter than that of *P. oronia*.

Occurrence: Suchomasty Limestone, locality 5.

Plectospira oronia nom. n.

1956 *Plectospira sexplicata* sp. n.; Havlíček, p. 617, pl. 4, figs. 18—22.

Exterior and interior: See Havlíček 1956.

Remarks: Name of *P. sexplicata* Havlíček is pre occupied by *P. sexplicata* (White & Whitfield, 1862); for this reason, a new name *P. oronia* is suggested here for the Bohemian species.

Occurrence: Zlíchov Limestone, Praha - Hlubočepy.

Plectospira leniplicata sp. n.

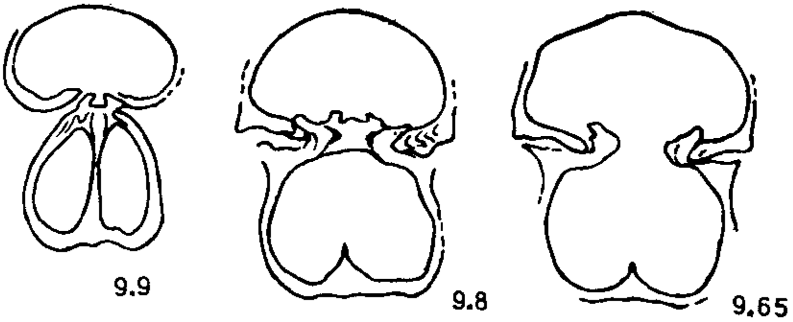
Pl. XIV, figs. 1—4; text-fig. 25

Holotype: Shell figured on pl. XIV as fig. 1; VH 2624a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 61 shells.

Exterior: Shell subquadrate in outline, dorsi-biconvex, 10.0—13.0 mm wide in adults and 48.2—58.0 % as high as maximum width. Pedicle valve gently convex in lateral profile, 92—111 % as long as its maximum width, with a narrow, straight beak terminating with a sharp apex directed posteriorly. Delthyrium covered by a flat to slightly concave plate, pedicle foramen not seen (probably small). Ventral sulcus about as broad as the intercostal interspaces, very shallow, less commonly obscure.

Brachial valve more curved umbonally than anteriorly, subcircular in outline. Ribbing variable; in pedicle valve, 2 (rarely 3) pairs of plications originate near the posterior margin as low, rounded ridges separated by very shallow interspaces. The plications often reach the front of the shell, less commonly they are weak umbonally and disappear before reaching front of the valve. In the brachial valve, 5 rounded ribs start at the posterior margin; the mid-rib is the most slender of them. All ribs often become obscure before reaching the mid-length of the brachial valve, less commonly they keep the shape of low, rounded ridges even in the anterior part of the valve except for the mid-rib which in all specimens available tends to disappear forward. An exceptional shell is devoid of ribbing in its brachial valve, but it has hardly discernible 4 plications in its pedicle valve (see pl. 14, fig. 4).

Interior: See text-fig. 25 (shell thin-walled).



25. *Plectospira leniplicata* sp. n.; transverse serial sections, ×12

Comparison: In *P. leniplicata,* the ribs tend to be weak or even obscure in the anterior part of the shell, whereas those of *P. varioplicata* are formed as rounded ridges over the whole surface of both valves. The median rib is well-developed even in the anterior part of the brachial valve in *P. varioplicata,* whereas it is obscure (sometimes missing altogether) near the anterior margin of *P. leniplicata.* A few specimens of *P. leniplicata* bear low, rounded ribs even in the anterior part of the shell except for the mid-rib which is anteriorly always obscure or even indistinct; on the other hand, the dorsal mid-rib in *P. varioplicata* is always formed as a rounded ridge both umbonally and anteriorly. Further, *P. varioplicata* is more elongate than *P. leniplicata.*

Occurrence: Suchomasty Limestone, locality 5.

Athyridacea M'Coy, 1844

Athyrididae M'Coy, 1844

Leptathyris Siehl, 1962

Leptathyris deino sp. n.

Pl. XIV, figs. 5, 6; text-fig. 26

Confer: 1962 *Leptathyris* n. sp. A; Siehl, p. 214, pl. 36, fig. 3; pl. 39, fig. 4.

Holotype: Shell figured on pl. XIV as fig. 6; VH 2640.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 36 shells.

Exterior: Shell equally biconvex, 9.5—15.3 mm wide in adult specimens, subcircular to heart-shaped in outline, 52—60 % as high as maximum width, exceptionally even thicker. Pedicle valve usually slightly wider than long, rarely slightly elongate, 91.0—104.5 % as long as its maximum width. In lateral profile, pedicle valve evenly convex, with a moderately curved short beak terminating with a sharp apex directed postero-dorsally. Palintrope small, apsacline, in specimens from the Acanthopyge Limestone bounded by obtuse edges, in specimens from the Suchomasty Limestone not clearly defined. Delthyrium partly restricted by small deltidial plates. Pedicle valve usually depressed near the anterior margin, rarely bearing a shallow sulcus; anterior commissure rectimarginate; shoulder angle 95—100°.

Brachial valve more convex umbonally than anteriorly devoid of a fold, exceptionally bearing a median flattening as does the pedicle valve. Surface smooth, no growth lines observed.

Interior: See text-fig. 26.

Comparison: *L. gryphis* Siehl (Greifenstein Limestone, Eifelian, Rhineland) is closely related to the Bohemian species; it is distinguished by the common presence of a shallow sulcus in each valve, whereas *L. deino* bears rarely a sulcus in its pedicle valve, and its brachial valve is unsulcate (exceptionally displaying a median flattening). Further, the ventral beak of *L. deino* is longer than that of *L. gryphis.*

L. sp. A (Greifenstein Limestone, Rhineland; Siehl 1962) is very close to *L. deino* except for having a weakly uniplicate anterior commissure.

Occurrence: Suchomasty Limestone, locality 5. Acanthopyge Limestone, localities 7, 10, 11.

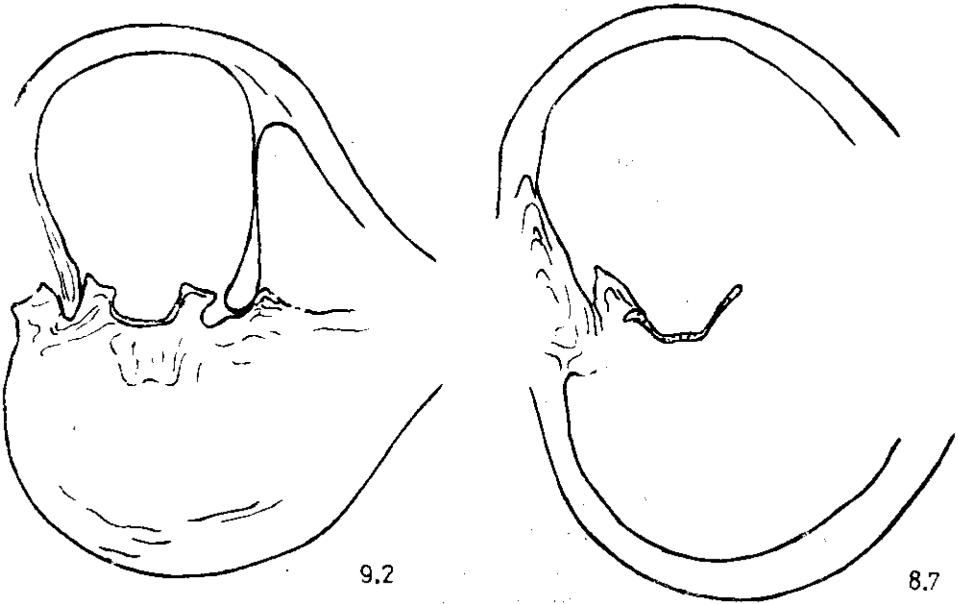
Athyris M'Coy, 1844

Athyris odolens sp. n.

Pl. XIII, figs. 5, 6; text-fig. 27

Holotype: Shell figured on pl. XIII as fig. 5; VH 4161b.
Type horizon and locality: Suchomasty Limestone, licality 8.
Material: 18 shells.

Exterior: Shell transversely elliptical, 14.0—21.6 mm wide, equally biconvex, 51.0—60.0 % as high as maximum width. Pedicle valve evenly convex in lateral profile, 84—97 % as long as wide, with a shallow

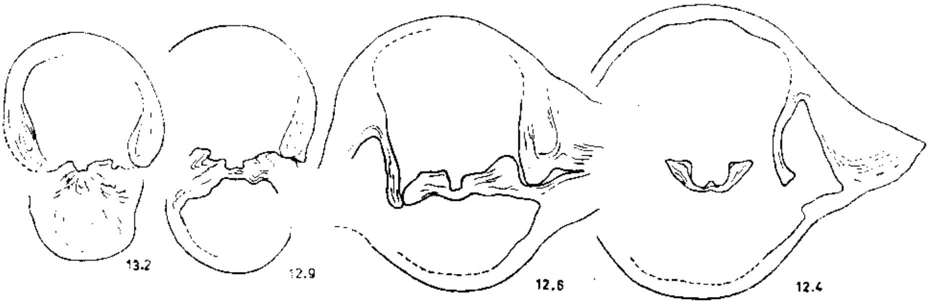


26. *Leptathyris deino* sp. n.; transverse sections, ×12

groove that widens anteriorly to form a subangular sulcus occupying over 2/5 of the maximum width of the shell (but less than half-width); anterior commissure uniplicate; ventral beak short, incurved, deltidial plates and pedicle foramen not exposed.

Brachial valve 72.5—90.1 % as long as wide, widest at about its mid-length; sides evenly rounded, hinge margin gently arcuate; dorsal beak small, moderately swollen; fold absent or formed as a weak elevation hardly distinguishable from the convex flanks; median groove in brachial valve, if at all present, very shallow.

Ribs absent; concentric lamellae coarse, usually 2 per 3 mm.



27. ***Athyris odolens* sp. n.; transverse serial sections, ×5**

Interior: See text-fig. 27. Ventral muscle field weakly impressed, bisected by a myophragm.

Comparison: *A. ceres* (Barr.) (Koněprusy Limestone, Pragian) differs from *A. odolens* in having finer concentric lamellae counting 8—9 per 3 mm, deeper subangular sulcus originating near the beak, higher tongue, and a subcarinate brachial valve, whereas the brachial valve of *A. odolens* is evenly curved in its median sector.

Occurrence: Suchomasty Limestone, localities 3, 8.

Meristellacea Waagen, 1883

Meristellidae Waagen, 1883

Merista Suess, 1851

Merista repellens sp. n.

Pl. XV, figs. 4—6; text-fig. 28

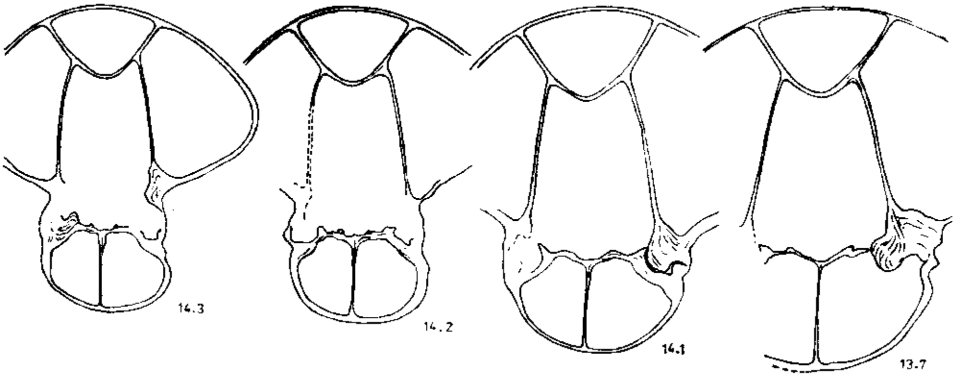
1879 *Merista passer* Barr.; Barrande (partim), pl. 14, case I, figs. 14, 16.

Holotype: Shell figured on pl. XV as fig. 5; VH 4828c.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 80 shells.

Exterior: Young shells (smaller than 13.0 mm) subquadrate in outline, moderately wider than long, widest at about mid-length, lenticular both in transverse and longitudinal profiles, lacking fold and sulcus, with a rectimarginate to gently arcuate anterior commissure; thickness equals to half-width (or even less) of the shell.

Adult specimens subequally biconvex to dorsi-biconvex (depending on size of the fold), 18.0—25.6 mm wide, usually slightly wider than long, 56—60 % as high as maximum width; in a few gerontic specimens, shT/W: 70.0—76.0 %. Pedicle valve evenly convex in longitudinal profile, less commonly more convex posteriorly than anteriorly, subquadrate to subpentagonal in outline, usually 95—101 % as long as its widest part; postero-lateral margins long, nearly straight, enclosing an obtuse angle (95—108°). Ventral beak short, incurved, with apex directed dorsally. Palintrope not clearly separated from the rest of the valve surface. Sulcus confined to anterior part of the pedicle valve, usually shallow, not clearly differentiated, extending into a low to high (depending on age of the specimen), rounded, rarely trapezoidal tongue. Most of delthyrium covered by the beak of the opposite valve.

Dorsal beak moderately swollen; fold occupies anterior part of the valve; in side view, its top is flat or gently raised dorsally just at front of the valve. Surface smooth, devoid of growth lines.



28. *Merista repellens* sp. n.; transverse serial sections, ×5

Interior: See text-fig. 28.

Comparison: Two *Merista* species are abundant in the Suchomasty Limestone, namely *M. passer* and *M. repellens*; the former is derived from a small, elongate, not yet described species of the Pragian age, the latter one is a probable descendant of *M. herculea,* an index species in the Pragian. Young shells of *M. passer* and *M. repellens* are easy to distinguish; *M. repellens* includes subquadrate shells lenticular both in lateral and transverse profiles, wider than long, whereas the shells of young *M. passer* are elongate-elliptical, in posterior view clearly more convex than those of *M. repellens.*

When examining adult specimens, we can easily separate in most cases the elongate *"passer"* forms from the transverse *"repellens"* forms. The length/width ratio, however, proved to be not quite reliable, because several late adult shells of *M. passer* are slightly wider than long, and vice versa, several shells of *M. repellens* are slightly elongate. As auxilliary features for distinguishing the two species may serve the shape of the dorsal beak which in *M. passer* is usually more inflated than in *M. repellens,* and the form of the tongue, which in *M. passer* is trapezoidal, that of *M. repellens* rounded. Unfortunately, some shells remained undetermined, because the shapes of their tongues and dorsal beaks did not fully correspond to those of the "typical forms" of the species under discussion.

In many aspects, *M. herculea* (Barr.) is closely similar to *M. repellens,* but it is much larger (35—47 mm wide in adult specimens), and the postero-lateral sides of its pedicle valve are commonly curved (not straight as in *M. repellens*).

M. turgens Siehl (Greifenstein Limestone, Rhineland; Siehl 1962) recalls the new species; its shell, however, has shorter and less incurved beak, is moderately larger (21.0—34.5 mm), and more transverse (pvL/W: 70—86 %) than that of *M. repellens*. Further, the shoulder angle of *M. turgens* is usually 103—130 °, that of *M. repellens* 95—108 °.

Occurrence: Suchomasty Limestone, localities 3, 5, 8. Acanthopyge Limestone, locality 6.

Merista passer (Barrande, 1847)

Pl. XVI, figs. 2—5

1847 *Terebratula Passer* Barr.; Barrande, p. 381, pl. 16, fig. 2.
1879 *Merista passer* Barr.; Barrande, pl. 14, case I, figs. 8—11, 13.
1962 *Merista passer* (Barrande); Siehl, pl. 29, figs. 6—8.

Holotype (by monotypy): Shell figured by Barrande in 1847; refigured by Barrande in 1879 (pl. 14, case I, fig. 10) and herein on pl. XVI as fig. 4; L 25287.

Type horizon and locality: Suchomasty Limestone, Koněprusy.

Material: about 100 shells.

Exterior: Young shells elongate-oval, without fold and sulcus, rather strongly convex in posterior view, 65—75 % as high as maximum width, with a gently arcuate anterior commissure. Adult shells 12.0—17.2 mm wide, usually elongate, less commonly slightly wider than long, and 60.5—80.3 % as high as maximum width.

Pedicle valve 95—120 % as long as wide, almost evenly convex in lateral profile, with a strong, incurved beak. Postero-lateral sides usually enclose an acute angle, rarely a right angle (70—90°). Ventral sulcus well-defined in late adult specimens as a shallow and broad depression with a flat bottom, less commonly the sulcus is missing even in late adult shells (e.g. in the holotype). Tongue trapezoidal, low to high, dorsally directed.

Beak of brachial valve inflated; fold short, just at its front deflected dorsally. Surface either smooth or a few step-like growth imbrications present.

Interior: See Siehl, 1962, pl. 29, figs. 6—8 (transverse sections).

Occurrence: Suchomasty Limestone, localities 3, 5, 8, 12.

Cyrtiacea Frederiks, 1919

Cyrtiidae Frederiks, 1919

Cyrtiinae Frederiks, 1919

Rochtex g. n.

Type species: *Rochtex lissopleura* sp. n.

Diagnosis: Shell cyrtiid in appearance with hemipyramidal pedicle valve much higher than the nearly planar brachial valve; ventral interarea flat to slightly concave below the apex, catacline to slightly procline; pseudodeltidium convex, unperforated, covering the whole delthyrium to leave no place for passage of the pedicle. Dorsal interarea low, orthocline to apsacline. Ventral sulcus shallow, smooth, exceptionally bearing one (maximum two) very weak plications. Dorsal fold low, rounded, sometimes with a flattened top. Flanks costate; costae rounded, usually 3—4 pairs, mostly simple, rarely one of them may bifurcate. Surface devoid of both the radial and concentric striations; if the shell is partly exfoliated, the radially disposed fibres appear.

Dental plates short, slightly diverging anteriorly, intrasinal. Crural plates fine, never resting on the valve floor; cardinal process not found.

Comparison: By its overall shape of shell, *Rochtex* is closely similar to the Silurian genus *Plicocyrtia* Boucot, but it differs from the latter in lacking the radial capillae on shell surface and in having free crural plates and a pseudodeltidium not pierced by the pedicle foramen at least in adult specimens. In spite of the absence of radial striation, we may assign *Rochtex* to the cyrtiid stock as indicated by such significant features as are the cyrtiid shape of shell, very high and nearly flat ventral interarea, high pseudodeltidium, and divergent dental plates.

Rochtex is probably derived from *Callispirifer* Perry (upper part the Delorme Fm., Yukon, Canada; Perry 1984) differing from the latter in loss of microornament and presence of a large pseudodeltidium that covers the whole deltidium. By contrast, *Callispirifer* has growth lines which become forwardly imbricate. Further, pseudodeltidium of *Callispirifer* is usually small, apical; rarely, in some small shells, it occupies a rather large proportion of the delthyrium to leave only a small pedicle opening. Further, the ribs of *Callispirifer* are much stronger than the low plications of *Rochtex*.

Rochtex lissopleura sp. n.

Pl. XX, figs. 1, 2, 5

Holotype: Shell figured on pl. XX as fig. 5; VH 4783.
Type horizon and locality: Suchomasty Limestone, locality 2.
Material: 11 shells and several fragments.

Exterior and interior: See diagnosis of the genus. Dimensions: shW: 15.8—27.2 mm; bvL/W: 52.2—64.5 %; shT/W: 57.0—67.4 %; SuW/shW: 31.6—35.3 %.

Occurrence: Suchomasty Limestone, localities 2, 5, 12. Acanthopyge Limestone, locality 7 (only 2 shells).

Eospiriferinae Schuchert & LeVene, 1929

Myriospirifer Havlíček, 1978

Myriospirifer insidiosus (Barrande, 1879)

1980 *Myriospirifer insidiosus* (Barrande, 1879); Havlíček, p. 39, pl. 10, figs. 1—4; pl. 11, fig. 1.

Occurrence: Suchomasty Limestone, locality 5.

Pinguispiriferinae Havlíček, 1971

Pinguispirifer Havlíček, 1957

Pinguispirifer fessus sp. n.

Pl. XX, figs. 3, 4, 6, 9; text-fig. 29

1971 *Pinguispirifer infirmus* (Barr.); Havlíček, pl. 5, fig. 3.

Holotype: Shell figured on pl. XX as fig. 6; VH 2195a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: about 50 shells.

Interior: Shell 20—24 mm wide in adults, about 67 % as high as maximum width (extremes: 62 and 78 %); early growth stages lenticular in side view, less high than half-width of the shell. Pedicle valve somewhat higher than the brachial valve, about 76.3 % as long as wide (extremes: 69 and 86 %; one exceptional valve: 66 % as long as wide), widest at mid-length; ventral interarea deeply concave, occupying more than 2/3 of the shell-width, separated by edges from the rest of the valve; lower part of the interarea catacline to slightly procline, delthyrium restricted by narrow deltidial plates; ventral beak small, terminating with a sharp apex directed posteriorly. Sulcus shallow, occupying about half-width of the shell, anteriorly extending into a short, arcuate tongue. Flanks of pedicle valve evenly convex, smooth.

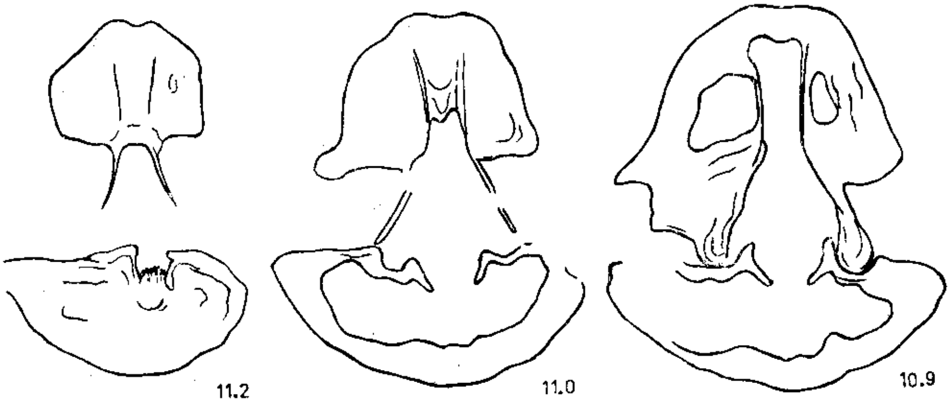
Brachial valve about 73.0 % as long as wide (extremes: 68 and 77 %); cardinal angles obtuse; fold low, rounded, separated by shallow grooves from the gently convex flanks; ribs either absent or a pair of very weak undulations developed in about 4 % of the Herget-quarry population. Dorsal interarea anacline.

Microornamentation usually worn away; if present, it is confined to the uppermost layer of the shell and consists of fine radial capillae (about 8 per 1 mm); spines absent.

Interior: Pedicle valve thick-shelled umbonally; very short dental plates obscured by the secondary shell material in the same way as in *P.*

infirmus. Ventral muscle field minute, elongate, deeply inserted in the shell.

Crural plates do not rest on the valve floor; diductor attachment radially striated. Dorsal muscle field bounded postero-laterally by strong ridges; its anterior margin obscure.



29. *Pinguispirifer fessus* sp. n.; transverse serial sections, ×8

Comparison: *P. fessus* is easily distinguishable from *P. infirmus* by lack of radial ribs on both valves, exceptionally bearing a pair of very weak undulations on its brachial valve. By contrast, *P. infirmus* has 2 to 4 pairs of low radial ribs, the outer pair of which tends to be obscure. Further, the fold is flat-topped in *P. infirmus* and its tongue is trapezoidal, whereas *P. fessus* has a low, rounded fold and an acruate tongue.

Occurrence: Suchomasty Limestone, localities 5, 8, 12.

Pinguispirifer infirmus (Barrande, 1879)

Pl. XIX, fig. 6

1959 *Pinguispirifer infirmus* (Barrande, 1879); Havlíček, p. 81, pl. 17, figs. 5—7, 10, 11; text-figs. 32—36.

1962 *Pinguispirifer infirmus* (Barrande, 1879); Boucot, text-figs. 1, 2.

Exterior and interior: See Havlíček 1959. Dimensions: shW: 20.0—28.0 mm in adults; shT/shW: about 57 % (extremes: 52 and 67 %); pvL/W: about 70.0 % (extremes: 66 and 77 %); bvL/W: about 67.5 % (extremes: 61 and 73 %); suW/shW: about 50.1 % (extremes: 43 and 57 %); width of interarea: 65—75 % of maximum width.

Sulcus and fold smooth, flanks bear 2—4 pairs of low, rounded ribs; the outer pair tends to be obscure. Top of the fold flattened, tongue trapezoidal.

Occurrence: Suchomasty Limestone, locality 3.

Amoenospirifer Havlíček, 1957

Amoenospirifer amoenoides Havlíček, 1959

Pl. XVIII, fig. 4

1959 *Amoenospirifer amoenoides* n. sp.; Havlíček, p. 110, pl. 21, figs. 1, 2.

Exterior: See Havlíček 1959. Dimensions: shW: 17.0—20.0 mm (7 specimens measured); shT/shW: 70.6—81.0 %; pvL/W: 85.9—93.5 %; bvL/W: 63.4—76.4 %; suW/shW: 42.5—53.9 %; shT/bvL: 105.0—111.3 %. Pedicle valve strongly convex in lateral profile; cardinal angles rounded to obtuse; due to low, deeply concave interarea, distance between the ventral and dorsal beaks is less than 1 mm; bottom of a broad sulcus concave umbonally but nearly flat anteriorly; tongue rectangular to trapezoidal. Ribs usually in three pairs, rounded; the ribs bounding the sulcus rather strong, whereas the lateral costae are weak; the ribs of the third pair tend to be obscure. Microornamentation as in *A. thetidis.*

Interior: Not investigated.

Occurrence: Suchomasty Limestone, localities 4, 8 (rare). Acanthopyge Limestone, locality 7 (two shells available; both somewhat more transverse than the earlier population of the Suchomasty Limestone; the almost complete specimen VH-2478a is 82.2 % as long as wide, and 66.6 % as high as its maximum width).

Amoenospirifer oenone sp. n.

Pl. XVIII, figs. 6—8; pl. XXII, fig. 7

1879 *Spirifer Thetidis* Barr.; Barrande (partim), pl. 6, figs. 1, 5.

Holotype: Shell figured on pl. XVIII as fig. 8; VH 2389d.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 37 shells and several valves.

Exterior: Shell subcircular in early growth stages becoming much wider than long in late aduts. The youngest shell available is 7.5 mm wide, 6.9 mm long, 4.7 mm thick, and bears only 3 pairs of ribs on its pedicle valve. Adult specimens are 18.5—25.0 mm wide with the following features: pvL/W: about 72 % (extremes: 71 and 75 %); bvL/W: about 65 % (extremes: 62 and 70 %); shT/W: about 62 % (extremes: 59 and

64 %); shT/bvL: about 94 % (extremes: 91 and 101 %). Young specimens, smaller than 12 mm, are less transverse with brachial valves 70—74 % as long as wide; owing to strong ventral beak the pvL/W ranges from 87 to 92 % in young pedicle valves.

Pedicle valve strongly and evenly convex in side view, with a strong beak considerably surpassing the hinge line. Ventral interarea deeply concave, steeply apsacline to catacline, as wide as or slightly shorter than the maximum width of shell, bounded laterally by prominent edges, medianly with an open delthyrium. Ventral sulcus deep and concave umbonally but shallow anteriorly where its bottom is nearly flat; sulcus about 41 % as wide as the shell; tongue subrectangular.

Brachial valve moderately convex with its greatest curvature in umbonal region; cardinal angles rounded in young specimens but rectangular to acute in adults. Dorsal interarea orthocline to apsacline.

Ribs strong (stronger than in other species of *Amoenospirifer*), posteriorly narrow and angular, separated by deep angular interspaces; toward front margin, the ribs become roundedly angular to rounded; young specimens (smaller than 12 mm) bear 3—4 pairs of ribs, the late adult ones have 5—6 pairs of simple, never bifurcating ribs.

Fine ornamentation consists of concentric fila crossed by even finer radial capillae; some growth lines may extend into short concentric lamellae.

Interior: Umbonal regions of both valves thick-shalled; delthyrial cavity deep, minute, less wide than 10 % of the maximum width and less long than 25 % of the pedicle-valve length. Dental plates missing; vascula media more divergent than the ribs of the first pair. Genital markings (pitting) clearly developed laterally to the muscle field. Anterior parts of crural plates free; dorsal muscle field bounded posterolaterally by low ridges.

Comparison: The Herget quarry has yielded two easily discernible species of *Amoenospirifer,* namely *A. foedus* and *A. oenone*; the former species is distinguished by obtuse cardinal angles and weak plications tending to obscurity, whereas *A. oenone* bears strong, rounded to rounded-angular ribs and its cardinal angles are rectangular to acute in late adult specimens.

A. amoenoides differs from the new species in having a more convex and less wide shell, a clearly broader sulcus, less numerous ribs, and obtuse to rounded cardinal angles; unlike *A. oenone, A. amoenoides* is confined to the *Orbitoproetus-Scabriscutellum* Community.

A. thetidis has never been found in the Herget quarry; all specimens available come from old collections probably made in organodetrital limestones filling the neptunian dikes. *A. thetidis* differs from *A. oenone* in having less high shells with shT/shW ratio ranging from 42 to 53.2 %, somewhat weaker radial pattern in which one or two ribs may bifurcate; further, the cardinal angles remain rounded through ontogeny in *A. thetidis.*

Occurrence: Suchomasty Limestone, localities 3 (mostly disarticulated), 5 (common, never disarticulated). Acanthopyge Limestone, locality 7 (one shell only).

Amoenospirifer thetidis (Barrande, 1848)

Pl. XVII, figs. 4, 5

1959 *Amoenospirifer thetidis* (Barrande, 1848); Havlíček, p. 106, pl. 21, figs 3, 4, 6, 7; text-fig. 49.

Exterior: See Havlíček 1959. Dimensions: shW: 20.0—25.0 mm (exceptionally 32.0 mm) in adult specimens; pvL/W: 53.0—57.1 %; bvL/W: 50.8—53.6 %; shT/W: 42.0—53.2 %; suW/shW: 36.1—55.7 %. Cardinal angles obtuse to rounded; in lateral profile, ventral umbonal region more curved than the anterior part of the valve; ventral sulcus narrow umbonally but rapidly expanding toward front margin; consequently, the ribs bounding the sulcus are usually curved antero-laterally (not straight as in *A. oenone*). Flanks bear 4—5 (rarely 6) pairs of rounded ribs; in some specimens, the ribs of the first or second pair may bifurcate either on one or both sides of the valve, or a low rib may intercalate between the costae of the first and second pairs.

Interior: See Havlíček 1959.

Occurrence: Suchomasty Limestone, old collections.

Amoenospirifer foedus sp. n.

Pl. XVIII, figs. 1—3

Holotype: Shell figured on pl. XVIII as fig. 3; VH 2392a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 12 shells.

Exterior: By its size and shape closely similar to *A. thetidis* but differing from the latter in having very weak plications that in some specimens tend to obscurity; cardinal angles obtuse to rectangular. Dimensions of the holotype: shW: 28.9 mm; pvL: 15.7 mm; shT: 14.8 mm; suW: 12.2 mm.

Interior not investigated.

Occurrence: Suchomasty Limestone, locality 5.

Spiriferacea King, 1846

Delthyrididae Waagen, 1883

Quadrithyris Havlíček, 1957

Quadrithyris sobrina sp. n.

Pl. XIX, fig. 4

Holotype: Shell figured on pl. XIX as fig. 4; VH 2417.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 2 shells and several incomplete specimens.

Exterior: Closely similar to *Q. robusta* except for having a very shallow sulcus and a thick-shelled umbonal part of the pedicle valve. Dimensions of the holotype: shW: 22.0 mm; pvL: 17.1 mm; bvL: 16.4 mm; shT: 13.6 mm.

Interior: High median septum and dental plates in pedicle valve. Brachial valve interior not investigated.

Comparison: Widest part of *Q. robusta* occurs in the posterior quarter to third of the brachial-valve length, that of *Q. sobrina* is located about at mid-length of the brachial valve. Further, the sulcus of *Q. robusta* is moderately deep and clearly separated from the flanks by rounded-angular edges, whereas the sulcus of *Q. sobrina* is very shallow to obscure.

Occurrence: Suchomasty Limestone, locality 5.

Quadrithyris orba Havlíček, 1959

Pl. XIX, fig. 1

1959 *Delthyris (Quadrithyris) orba* n. sp.; Havlíček, p. 130 and 243, pl. 22, figs. 11—13; text-fig. 60.

Exterior: shW: 10—15 mm; pvL/W: about 70 %; bvL/W: 64—72 %; shT/W: 75—90 %; suW/shW: 50—62 %. Ventral beak strong, incurved, its apex directed postero-dorsally. Sulcus shallow, rounded, rarely tending to be angular. High ventral interarea bounded by inconspicuous edges, about 53—60 % as wide as the maximum width of the shell, gently concave; its lower part procline, rarely almost catacline.

Brachial valve strongly convex in lateral view; dorsal fold rounded, originating near the posterior margin, highly raised above the gently convex flanks. Dorsal interarea short, orthocline to gently apsacline. Concentric fila fine (6—8 per 1 mm), separated by even finer concentric grooves. Fine radial ridges, located on tops of the fila, rarely preserved in specimens from the Suchomasty Limestone but clearly discernible in specimens from the Zlíchov Limestone.

Interior: Dental plates thin, high, always shorter than the high median septum that extends beyond three quarters of the valve length. Dental plates almost parallel to each other and define a deep, very narrow delthyrial cavity.

Cardinal process is a fine transverse plate filling the apical part of the notothyrium; hinge plates large, triangular in outline, highly raised above valve floor, anteriorly extending into sharp points; dorsal muscle field obscure (inner morphology exposed in free valves coming from the Zlíchov Limestone).

Occurrence: Zlíchov Limestone, Hlubočepy (U kapličky quarry). Suchomasty Limestone, localities 3, 5.

Quadrithyrina Havlíček, 1959

Quadrithyrina ivanovae Havlíček, 1959

Pl. XIX, fig. 2

1959 *Quadrithyrina ivanovae* n. sp.; Havlíček, p. 137 and 245, pl. 24, figs. 3, 4, 6; text-fig. 62.

Exterior: shW: 15—19 mm (the largest valve 21.0 mm); bvL/W: about 68 % (extremes: 62 and 74 %); shT/W: about 72 % (extremes: 68 and 79 %); shT/bvL: about 104 % (extremes: 97 and 114 %). Ventral beak strong, highly raised, terminating with a postero-dorsally directed apex. Sulcus weak in umbonal region but moderately deep and fairly broad (about half-width of the valve) anteriorly. Ventral interarea high, concave, steeply apsacline to catacline; delthyrium open.

Widest part of brachial valve about in its mid-length; hinge line short, lateral margins rounded. Dorsal beak moderately elevated above valve surface, posteriorly extending beyond the hinge line. Fold low, rounded; dorsal interarea short, low, apsacline. Ribbing absent. Microornament of low concentric fila (5—6 per 1 mm) never extending into concentric lamellae; spines and papillae not observed (due to less favourable preservation?).

Interior: Dental plates absent; median septum strong (1.0—1.5 mm thick in umbonal region), occupying slightly more than a third of the vale length. Muscle field elongate, slightly longer than the median septum, 1/6—1/8 as wide as the maximum width of the valve. Vascula media divergent, excavated in shell in places corresponding to the sulcus-bounding edges of the outer valve surface. Late adult pedicle valves bear genital markings in the form of elongate pits tending to coalesce into radial canals.

Umbonal region of brachial valve so thickened that the posterior portions of the hinge plates are supported by secondary shell material (text-fig. 62 in Havlíček 1959); dorsal muscle field elongate-oval, confined to the trough corresponding to the fold of the outer valve surface, and anteriorly extending to about mid-length of the valve; it is bounded laterally by ridges. Myophragm does not reach the front margin of the muscle field. Vascula genitalia as in the pedicle valve.

Occurrence: Suchomasty Limestone, localities 3, 5, 8.

Reticulariidae Waagen, 1883

Eoreticularia Nalivkin, 1939

Eoreticularia indifferens (Barrande, 1848)

Pl. XVII, fig. 6

1959 *Eoreticularia indifferens* (Barrande, 1848); Havlíček, p. 158, pl. 26, figs. 1—3, 6; text-figs. 76—78.

Exterior: shW: 24—28 mm (the largest shell 33.1 mm); bvL/W: 61—79 %; shT/W: about 50 % (extremes: 42 and 59 %). Pedicle valve transversely elliptical, moderately and evenly convex both in transverse and lateral profiles. Ventral beak strong, incurved, terminating with a sharp apex directed postero-dorsally. Ventral interarea small, apsacline, usually less wide than half-width of the valve, defined by inconspicuous, subangular edges; distance between the ventral and dorsal beak ranges from 1.8 to 2.8 mm. Sulcus hardly perceptible in umbonal region; in anterior part of the valve, it is shallow, gently concave, separated from flanks by weak, rounded edges.

Brachial valve low, rather variable in outline, widest at about its mid-length; hinge line short, gradually passing into the evenly rounded sides; in dorsal view, anterior margin nearly straight or slightly curved towards hinge line. Dorsal beak small, gently elevated, hardly extending beyond the hinge line. Fold either absent or forming a very short and low elevation just at the front margin of the valve, gradually passing into the flanks. Dorsal interarea almost indistinct. Ribs absent. Concentric rugellae better developed near front margin than in umbonal region, never extending into concentric lamellae. Fine granules preserved exceptionally; they are densely crowded in oblique rows, 12—13 per 1 mm, 10 mm from the hinge.

Interior: Dental plates less long than a third of the valve length, slightly divergent, on their inner sides sometimes bearing short extensions recalling subdelthyrial plates (see text-fig. 78b in Havlíček 1959).

Hinge plates minute, not resting on the valve floor, less commonly underlain by a secondary shell material that forms a short median ridge.

Occurrence: Suchomasty Limestone, mostly old collections; rare at localities 3 and 5.

Eoreticularia fraterna (Barrande, 1879)

Pl. XIX, fig. 5; pl. XXIV, fig. 2; text-fig. 30

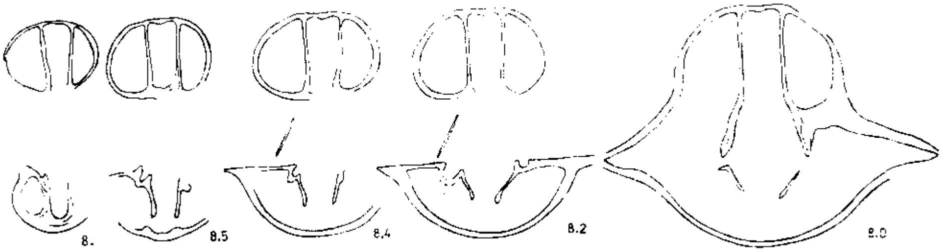
1959 *Eoreticularia fraterna* (Barrande, 1879); Havlíček, p. 162, pl. 26, figs. 4, 5, 7, 8; text-figs. 79—84.

1971 *Eoreticularia fraterna* (Barr.); Havlíček, pl. 1, fig. 1.

Exterior: shW: 10.0—18.0 mm; pvL/W: 68.7—88.3 %; bvL/W: 64.3—81.4 %; shT/W: 53.1—64.0 % (exceptionally 70.6 %). Shell ventri-biconvex, with pedicle valve longer than the brachial valve, less commonly pedicle valve as long as the brachial valve in specimens with procline interarea and small ventral beak. In lateral profile, pedicle valve almost evenly convex; sulcus shallow, occupying about half-width of the valve, gradually passing into the moderately convex flanks, usually bearing a median groove. Tongue low, arcuate. Ventral interarea low, bounded by obtuse edges, very steep, incurved below the apex, about 50 % as broad as the maximum width of the valve.

Brachial valve evenly convex in transverse profile, usually without a fold; rarely, a weak elevation occurs just at front margin of the valve. Hinge line short, sides of valve evenly rounded; anterior margin gently curved or straight, less commonly gently emarginate; widest part of brachial valve about at its mid-length. Dorsal interarea strongly reduced. Ribs absent.

Microornamentation consists of fine granules arranged in regular concentric rows, or the granules fuse to form fine concentric rugellae of subequal size; the rugellae never change into concentric lamellae.



30. *Eoreticularia fraterna* (Barrande); transverse serial sections, ×5

Interior: See text-fig. 30.

Occurrence: Suchomasty Limestone, localities 3, 5, 8, 12. Acanthopyge Limestone, localitiies 6, 7, 10, 11. Chabičov Member (Eifelian), Horní Benešov in the Nízký Jeseník Mts. (Havlíček - Pek 1986).

Undispirifer Havlíček, 1957

Undispirifer transiens (Barrande, 1879)

1959 *Undispirifer transiens* (Barrande, 1879); Havlíček, p. 169, pl. 17, figs. 8, 9; text-figs. 87—89.

Occurrence: Suchomasty Limestone, mostly old collections.

Bojothyrididae fam. n.

Diagnosis: Shell brachythyrid, non-costate, with a shallow sulcus and an obscure fold; delthyrium restricted by slender deltidial plates. Microornamentation of fine concentric rugellae.

Thin dental plates converge to the high median septum to join it a small distance under its upper edge, thus forming a spondylium-like structure. Crural plates do not touch the floor of the valve.

Comparison: The *Bojothyrididae* are distinguished by their peculiar pedicle valve interior. *Bojothyris* is closely similar to *Eoreticularia* (*Reticulariidae*) by its overall shape of shell, but it strikingly differs from the latter in having a high median septum and a spondylium-like structure in its pedicle valve.

Bojothyris Havlíček, 1959

Bojothyris nikiforovae Havlíček, 1959

Pl. XX, figs. 7, 8; pl. XXIV, fig. 1; text-fig. 31

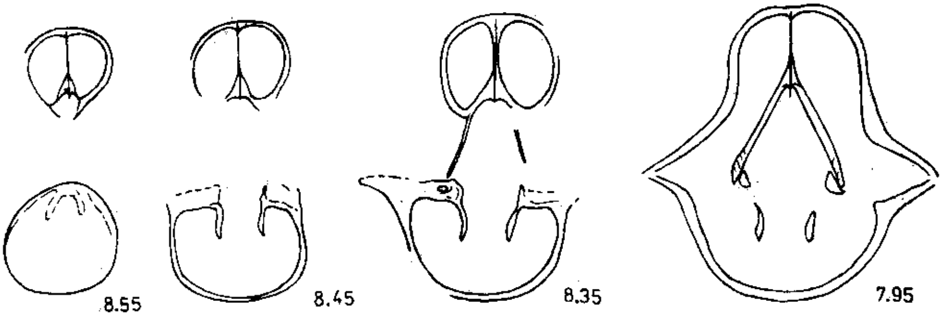
1959 *Bojothyris nikiforovae* n. sp.; Havlíček, p. 147, and 248, pl. 24, figs. 1, 2; text-fig. 68.

1971 *Bojothyris nikiforovae* Havl.; Havlíček, pl. 3, fig. 2.

Exterior (based on population of the Acanthopyge Limestone): Shell brachythyrid, ventri-convex, non-costate, with the following features: shW: 13.0—16.7 mm; pvL/W: 67.0—71.0 % (extreme: 79.3 %); bvL/W: 67.0—71.7 %; shT/W: 58.1—67.0 %. In side view, pedicle valve more convex umbonally than anteriorly; ventral beak small, incurved, with an apex directed postero-dorsally. Ventral interarea high, below the beak concave, steeply apsacline to procline, separated by weak edges from the flanks; delthyrium open. Sulcus shallow, concave, in some specimens bearing a subangular groove on its bottom, bounded laterally by weak, rounded edges. Tongue high, arcuate.

Brachial valve evenly convex in lateral profile; its median sector more convex than the flanks. Widest part of brachial valve between its posterior third and mid-length. Sides evenly rounded, anterior margin gently curved to almost straight. Fold either absent or hardly perceptible near front margin. Dorsal interarea small, nearly orthocline.

Concentric rugellae fine, usually with anterior faces steeper than the posterior ones, never extending into concentric lamellae. Rugellae equal to subequal in size, some of them more accentuated than the others. Radial capillae absent, the subsurface layer exceptionally exhibits continuous to discontinuous striations [VH-2474].



31. *Bojothyris nikiforovae* Havlíček; transverse serial sections, ×8

Interior: See text-fig. 31.

Remarks: By contrast to the population of the Acanthopyge Limestone, the size and shape of the specimens from the Suchomasty Limestone are strikingly variable; besides the rather large shells with steep ventral interareas, the Suchomasty Limestone has yielded also the shells 9.5—13.0 mm wide (young specimens?) with pedicle valves 70.0—96.0 % as long as wide owing to less steep inclination of their ventral interareas.

By its general aspect and presence of a median septum, *Spirifer imperficiens* Barr. is closely similar to *B. nikiforovae*. It differs from the latter, however, in having fine radial capillae, a feature not found in *B. nikiforovae*. As Barrande's collection contains only one shell of *Spirifer imperficiens* (probably coming from the Acanthopyge Limestone), we are not able to atribute it to a relevant genus; in any case, it is not conspecific with *Eoreticularia fraterna* as assumed by Havlíček (1959).

Occurrence: Suchomasty Limestone, localities 3, 5, 15. Acanthopyge Limestone, localities 10, 11. Havlíček (1959) assumed that the Vinařice Limestone is the type horizon of *B. nikiforovae*; this statement is incorrect as the holotype most probably comes from the Suchomasty Limestone deposited in a neptunian (sedimentary) dike penetrating deep into the Pragian sequence.

Xenomartiniidae Havlíček, 1971

Alaskospira Kirk & Amsden, 1952

Alaskospira accedens (Barrande, 1879)

Pl. XXII, figs. 3, 4

1879 *Spirifer accedens* Barr.; Barrande, pl. 4, fig. 6.
1959 *"Spirifer" accedens* Barrande, 1879; Havlíček, p. 198.
1971 *Proreticularia obses* sp. n.; Havlíček, p. 25, pl. 7, figs. 1, 2, 6, 10, 11, 15.

Exterior: shW: 8.6—11.0 mm (8 specimens measured); pvL/W: 78.3—87.2 %; bvL/W: 72.1—81.3 %; shT/W: 56.7—67.6 %. Pedicle valve almost evenly convex in side view with a very shallow to almost indistinct sulcus; anterior commissure slightly bent in dorsal direction; ventral interarea low, steep, incurved.

Brachial valve more convex in posterior part than anteriorly, widest near the posterior margin; cardinal angles narrowly rounded. Fold absent, flanks either smooth or bearing extremely weak plications (2—3 pairs) discernible only at valve margins. Fine ornamentation consists of concentric fila (about 10—12 per 1 mm anteriorly); short radial striae located on the fila are hardly discernible owing to the imperfect state of preservation.

Interior: Dental plates and median septum absent. Crural plates underlain by secondary shell accumulations.

Remarks: This species involves both the non-costate forms and the forms with weak plications along their anterior margins. The presence or absence of radial plications cannot warrant erection of two separate species because of gradual transitions between the two forms. Some shells bear so extremely weak plications that we are not able to assign them either to the smooth *"obses"* form or to the plicate *"accedens"* form.

Occurrence: Suchomasty Limestone, locality 5.

Quasimartinia Havlíček, 1959

Type species: *Quasimartinia rectimarginata* Havlíček, 1959.
Junior synonym: *Candispirifer* Havlíček, 1971.

Diagnosis (emended): Shell smooth, small to medium in size with a wide hinge line; cardinal angles rounded. Pedicle valve highly elevated, ventral beak strong, incurved; ventral interarea low, defined by obtuse angles; delthyrium open; deltidial plates slender, never fusing into a deltidium. Ventral sulcus absent or narrow, usually weak. Brachial valve moderately convex, subrectangular in outline, usually without a fold and sulcus, less commonly medianly flattened to slightly depressed (e.g. in *Q. rectimarginata*), or bearing a weak, very short fold; anterior commissure rectimarginate to weakly uniplicate. Dorsal interarea low, anacline to orthocline. Shell surface devoid of both the microspines and radial capillae.

Dental plates absent, ventral muscle field gently impressed. Cardinal process knob-like, bisected by a median groove into two lobes; crural plates do not touch the inner surface of the valve; dental sockets floored by concave subsocket plates.

Remarks: Inner and outer morphology of *Quasimartinia* and *Candispirifer* are essentially the same except for slight variations of the anterior commissure. Havlíček (1959) assigned to *Quasimartinia* the smooth, rectimarginate shells devoid of dental plates; later on, he erected *Candispirifer* as a new genus to embrace the smooth, weakly uniplicate shells, also lacking the dental plates. After a reinvestigation of the type species of the two genera, the form of the anterior commissure turned to be not reliable enough to distinguish the two xenomartiniid genera. *Candispirifer candidus* (= type species of *Candispirifer*) has its anterior commissure more commonly weakly uniplicate than rectimarginate, while most shells of *Quasimartinia rectimarginata* (= type species of *Quasimartinia*) are rectimarginate, whereas the uniplicate specimens are rare (about 1 % of the Švarcenberský-quarry population). It is then evident that the anterior commissure alone is not a good distinguishing character among the xenomartiniids.

Quasimartinia lubrica sp. n.

Pl. XXII, figs. 5, 6

Holotype: Shell figured on pl. XXII as fig. 5; VH 4786a.
Type horizon and locality: Suchomasty Limestone, locality 5.
Material: 3 shells and several incomplete specimens.

Exterior: Similar to *Q. candida* (Havl.), lacking a fold in young specimens (smaller than 8.0 mm) but having a weak, very short fold near anterior margin in adult specimens. Ventral sulcus shallow to almost indistinct, tongue short, arcuate; flanks smooth. Ventral interarea nearly catacline, deeply concave, not clearly separated from the rest of the valve; delthyrium open. Microornamentation absent.

Dimensions of 3 shells: shW: 7.2; 10.5; 13.6 mm; pvL: 7.45; —; 12.2 mm; bvL: 6.4; 8.6; 11.0 mm; shT: 5.1; 7.5; 9.0 mm.

Interior: Median septum and dental plates absent; interior of brachial valve not investigated.

Comparison: *Q. candida* (Havl.) (Koněprusy Limestone) differs from the new species in lacking the fold in all growth stages; further, its sulcus is formed as a shallow groove clearly narrower than the medial depression in the pedicle valve of *Q. lubrica.*

Occurrence: Suchomasty Limestone, locality 5. Acanthopyge Limestone, locality 2 (one shell only).

Obesaria Havlíček, 1957

Obesaria obesa (Barrande, 1848)

Pl. XIX, fig. 3; pl. XXIII, fig. 2

1959 *Obesaria obesa* (Barrande, 1848); Havlíček, p. 166, pl. 25, figs. 5—8; text-figs. 85, 86.

Occurrence: Acanthopyge Limestone, localities 2, 6, 10.

Martiniidae Waagen, 1883

Cingulodermis Havlíček, 1971

Cingulodermis columbina (Havlíček, 1959)

Pl. XXI, figs. 5—8

1959 *Martiniopsis columbina columbina* n. susp.; Havlíček, p. 190, pl. 28, figs. 3—5; text-fig. 97.

1959 *Martiniopsis columbina asellata* n. subsp.; Havlíček, p. 192, pl. 28, figs. 1, 2.

Exterior: Shell 9—12 mm wide, ventri-biconvex, with pedicle valve twice to four times as high as the brachial valve (depending on size of the fold). The largest shell available is 15.0 mm wide; shT/W: about 69.9 % (extremes: 59 and 78 %); bvL/shT: about 89.2 % (extremes: 79 and 106 %). Ventral interarea steeply apsacline to catacline; delthyrium restricted by deltidial plates. Sulcus shallow, about 54—61 % as wide as the pedicle valve, separated by rounded edges from the flanks.

Brachial valve gently convex, subrectangular, 60—75 % as long as wide; hinge line wide, cardinal angles obtuse to narrowly rounded. Dorsal interarea very low, orthocline to apsacline. Size of fold variable; fold usually appears between the posterior third and mid-length of the brachial valve, rarely originates just anterior to the beak; in several specimens, the weak fold originates in about two thirds of the valve length. Depending on size of the fold, anterior commissure is uniplicate to rectimarginate even in late adult growth stages. Different shape of the fold was used by Havlíček (1959) for erecting two subspecies, namely *C. c. columbina* with well-developed fold, and *C. c. asellata* lacking the fold. Recent extensive collection, however, has shown that the size and shape of the fold, owing to intraspecific variability, are not constant features even within the same population. Many transitional forms, existing between the *columbella* and *asellata* "subspecies", give evidence against subdivision of *C. columbina* into separate subspecies.

Growth imbrications weaker than in *C. cingulata* Havl. Radial capillae fine (about 8 per 1 mm), rarely preserved on the uppermost layer of the shell.

Interior: The same as in *C. cingulata* Havl. (see text-fig. 97 in Havlíček, 1959). Dorsal muscle field elongate, weakly impressed, about a third as long as the valve, medianly with a ridge-like myophragm.

Occurrence: Suchomasty Limestone, localities 3, 5, 8. Acanthopyge Limestone, localities 2, 6, 7, 10, 11.

Ambocoeliidae George, 1931

Remarks: Attribution of this family to the *Spiriferacea* is questionable.

Metaplasia Hall & Clarke, 1894

Metaplasia nekvasilovae sp. n.

Pl. XXII, fig. 2

Holotype: Shell figured on pl. XXII as fig. 2; VH 4794c.
Type horizon and locality: Suchomasty Limestone, locality 5.
Name: After Dr. Olga Nekvasilová of the Czechoslovak Academy of Sciences.
Material: 11 shells and several incomplete specimens.

Exterior: Shell small, ventri-biconvex, with pedicle valve much higher than the gently convex brachial valve; shW: 4.5—5.4 mm; pvL/W: 91—112 % (in a young shell 4.5 mm wide: 89 %); shT/W: 72.2—84.0 % (in young shell 4.5 mm wide: 66 %); suW/shW: 38—42 % (extreme: 52 %).

Pedicle valve strongly and evenly convex with a strong, incurved beak; hinge line wide, cardinal angles obtuse. Sulcus narrow, rounded to rounded-angular, separated by rounded ribs from the flanks; tongue short, arcuate. Ventral interarea nearly catacline, concave, bordered by obtuse edges; delthyrium partly restricted by minute deltidial plates.

Brachial valve moderately wider than long, maximum width near the hinge line at about a quarter, less commonly a third of the valve length. Fold rounded, narrow; lateral ribs (only one pair) always less strong than the fold. Microornamentation not preserved.

Interior: Dental plates missing.

Comparison: By its small size and general aspect *M. minuta* Boucot (Onondaga Stage, Maine; Boucot 1959) is closely similar to the new species, but it differs from the latter in having strongly apsacline and gently incurved ventral interarea, whereas that of *M. nekvasilovae* is deeply concave and its lower part makes about a right angle with the lateral commissure (catacline condition).

Occurrence: Suchomasty Limestone, locality 5.

Ambocoelia Hall, 1860

Ambocoelia mesodevonica Havlíček, 1959

Pl. XXII, fig. 1

1959 *Ambocoelia mesodevonica* n. sp.; Havlíček, p. 173, pl. 27, figs. 9, 10.

Occurrence: Suchomasty Limestone, locality 5 (rare); Acanthopyge Limestone, locality 7.

Suessiacea Waagen, 1883

Cyrtinidae Frederiks, 1912

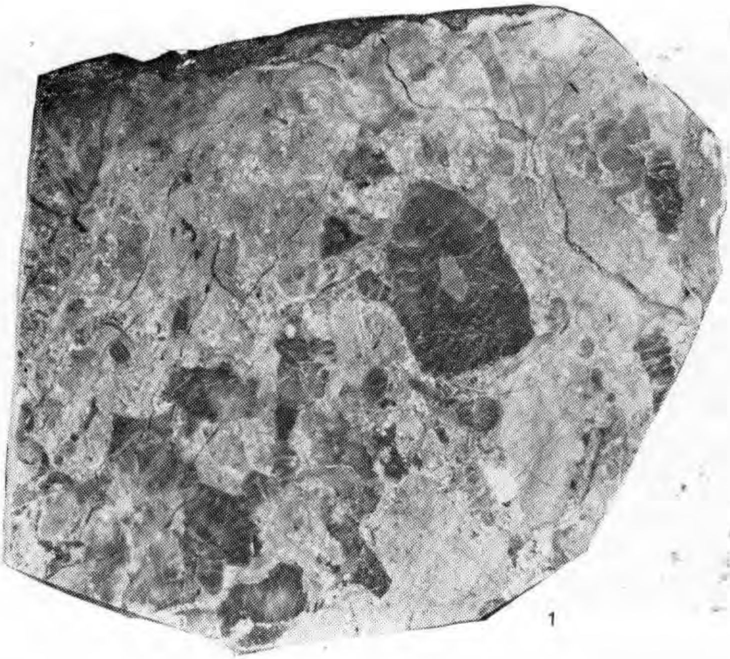
Cyrtina platypleura sp. n.

Pl. XXI, figs. 3, 4; text-fig. 32

Holotype: Shell figured on pl. XXI as fig. 3; VH 3320a.
Type horizon and locality: Suchomasty Limestone, locality 8.
Material: 18 shells.

Exterior: Shell 7.0—10.5 mm wide (the youngest specimen 4.0 mm wide), with hemipyramidal pedicle valve much higher than the moderately convex brachial valve. Pedicle valve triangular in lateral profile, with an erect beak, in side view flat to gently convex between the beak and front margin. Ventral interarea highly triangular, steeply procline to catacline, flat or sligthly concave below the apex. Deltidium convex, below the apex pierced by an elliptical pedicle foramen. Sulcus shallow, subangular; flanks of pedicle valve bear 2 (rarely 3) pairs of low, rounded costae as broad as the interspaces.

Brachial valve 66—79 % as long as its maximum width, widest between its posterior quarter and mid-length; cardinal angles narrowly rounded; anterior and lateral margins evenly arcuate; fold narrow and low, by its size recalling a median costa that originates just in front of the beak. Flanks of brachial valve gently convex, bearing 2 (less commonly 1) pairs of low ribs. Concentric lamellae rarely preserved due to exfoliation



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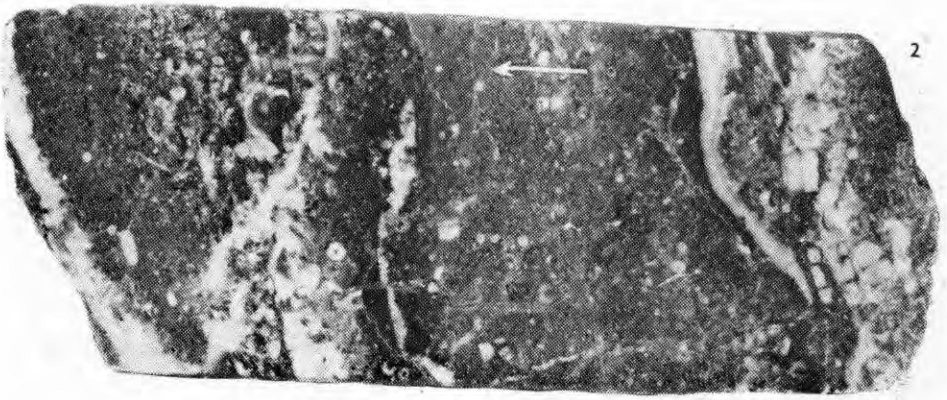
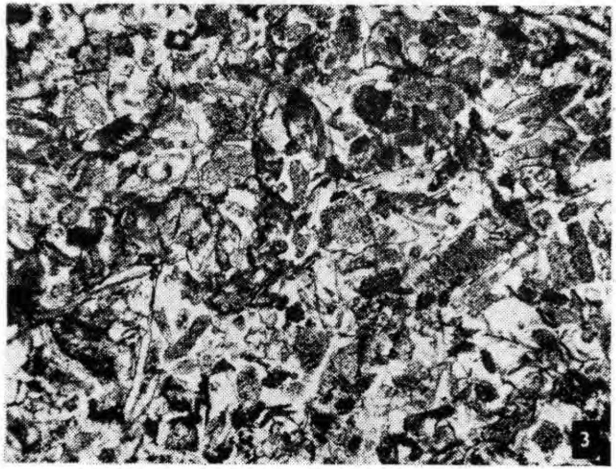


2

Pl. II


1


2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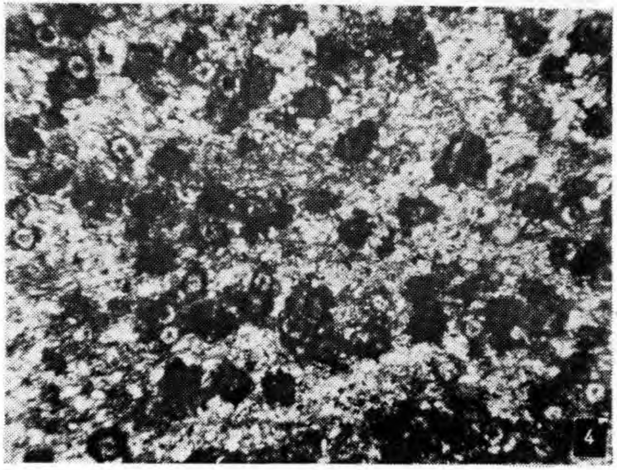
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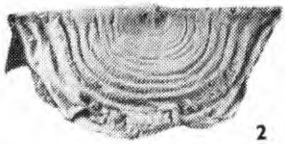
Pl. III


1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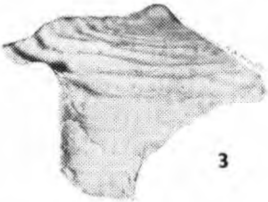
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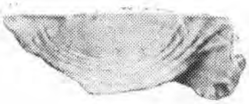
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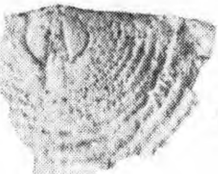
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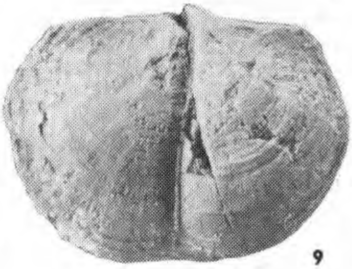
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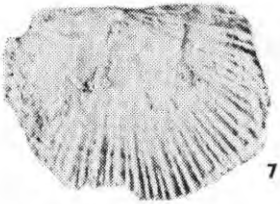
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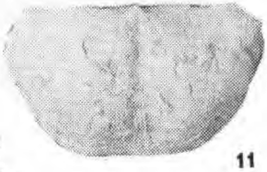
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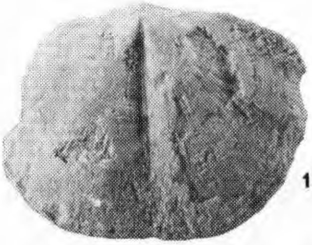
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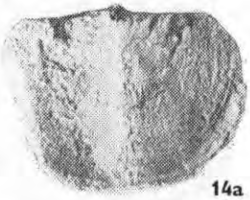
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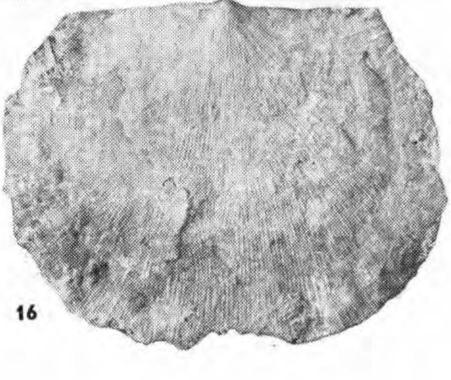
14b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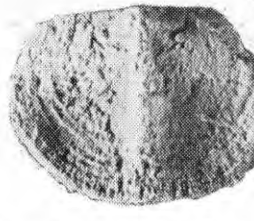
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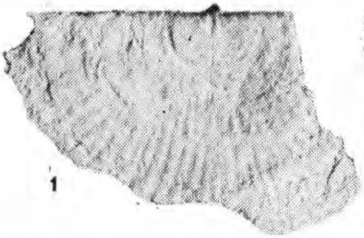
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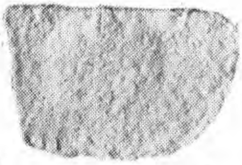
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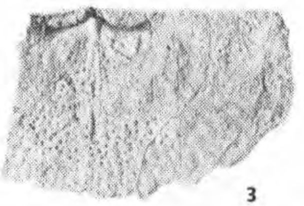
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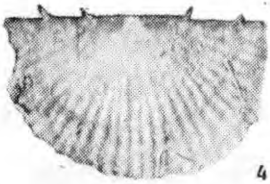
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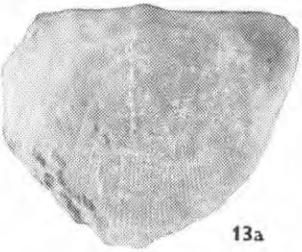
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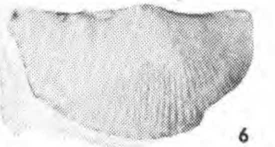
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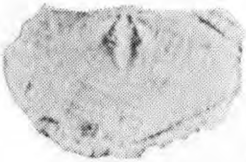
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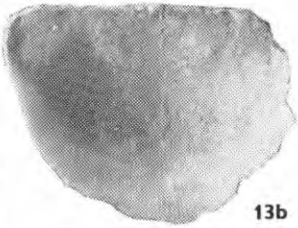
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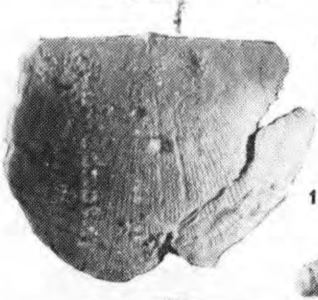
10


9


13c


8a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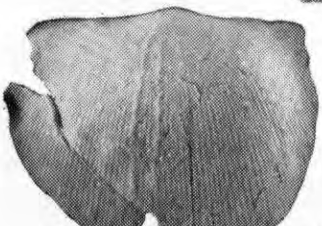
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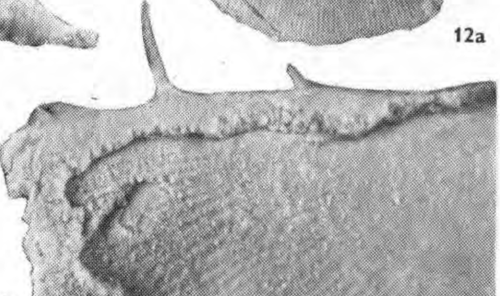
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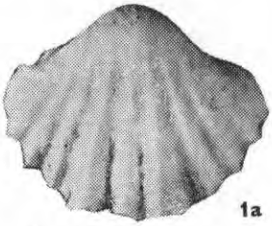

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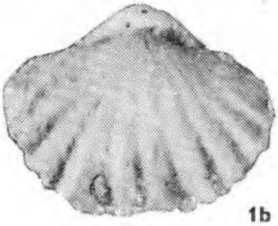

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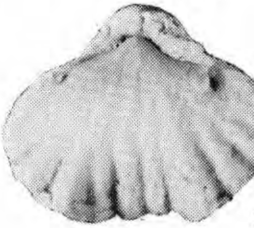

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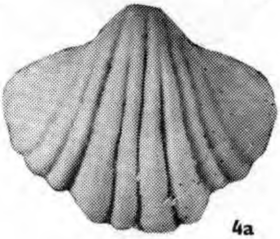

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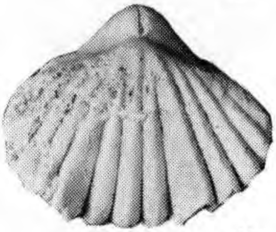

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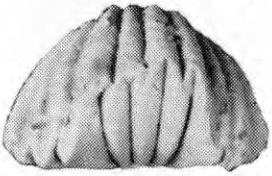
5a

5b



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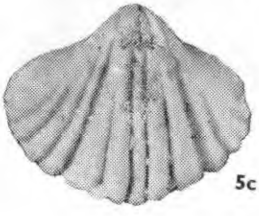

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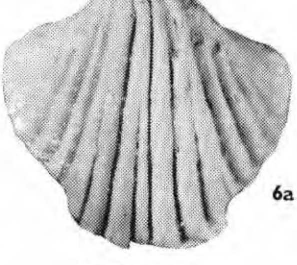

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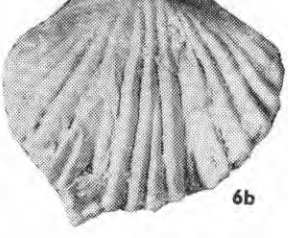

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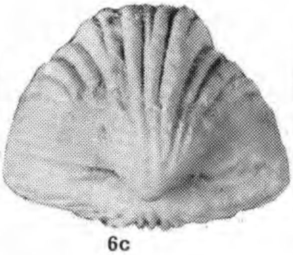

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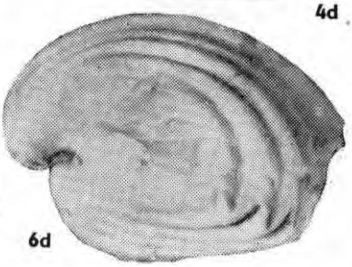

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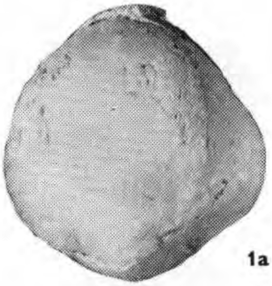
Pl. VI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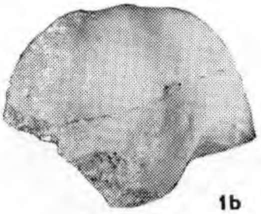
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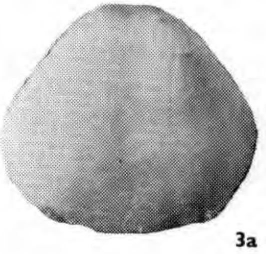
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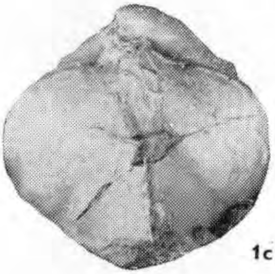
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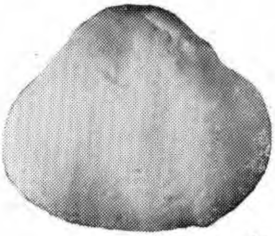
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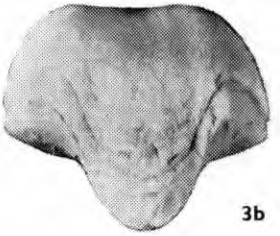
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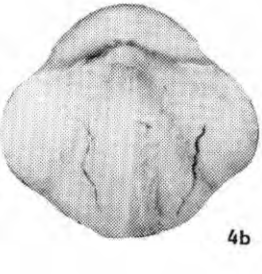
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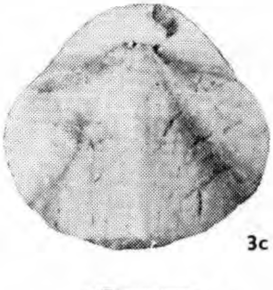
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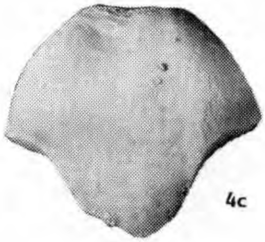
4c


2c


5b


6

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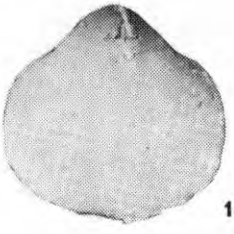
Pl. VII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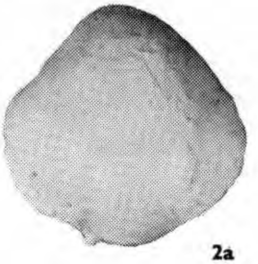
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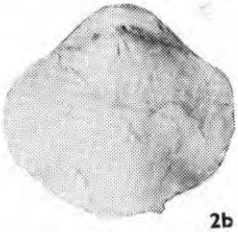
1c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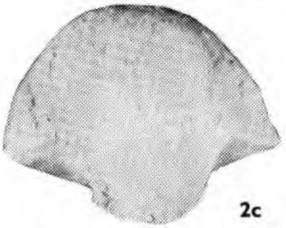
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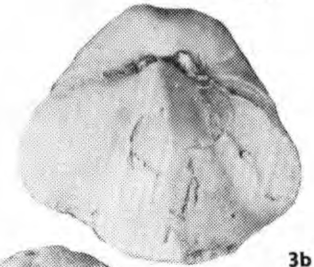
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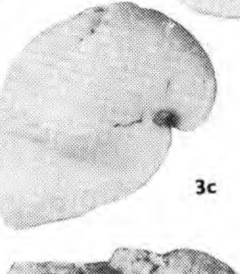

3c


4b


5a


6


5b


7

Pl. VIII

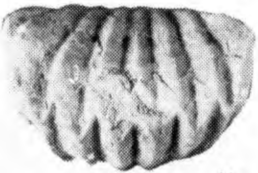

1a


3a


4a


1b


3b


4b


1c


3c


7a


7b

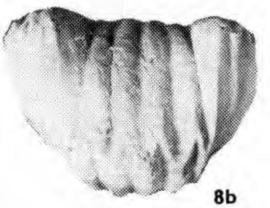

2


6a


8a


5a

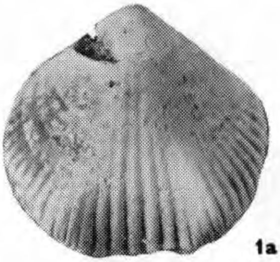

6b


8b


5b

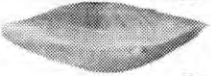

6c


8c


1a


3a


6a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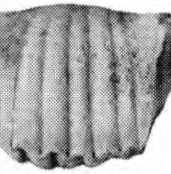
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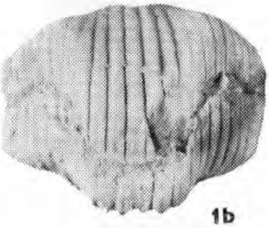
1b


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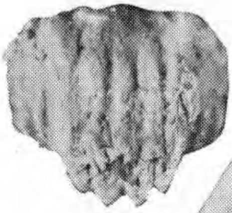
7a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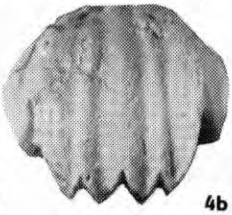
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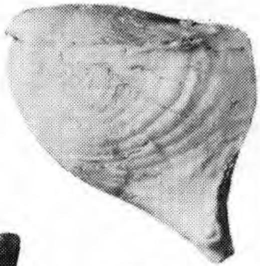
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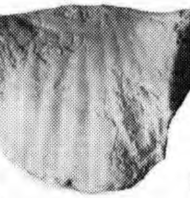
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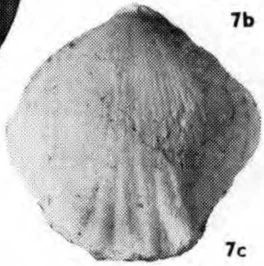
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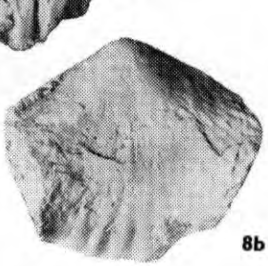
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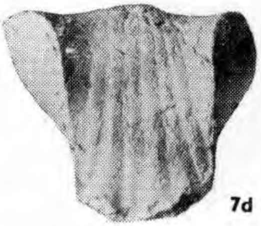
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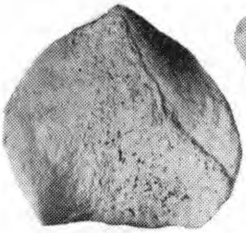
Pl. X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3a


3b


2a


2b


3c


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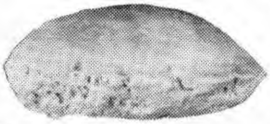
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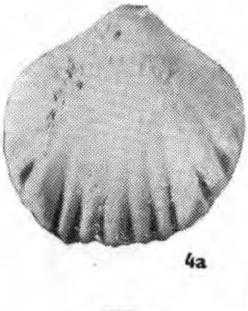
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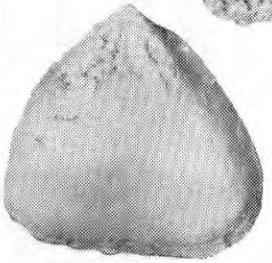
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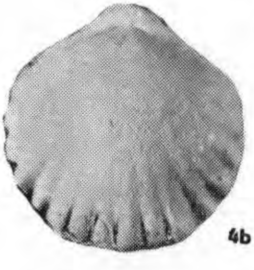
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6'c

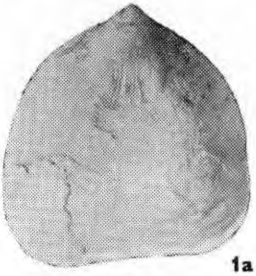

6b


7b


4c


7a


7c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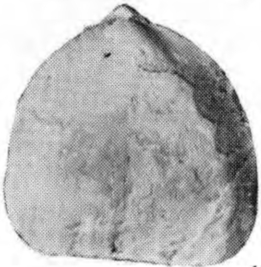
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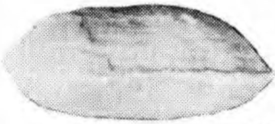
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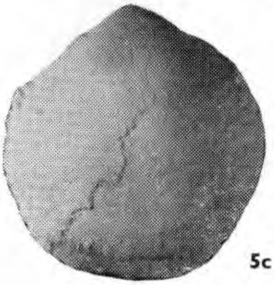
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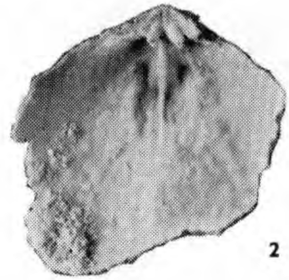
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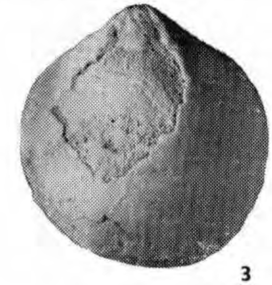
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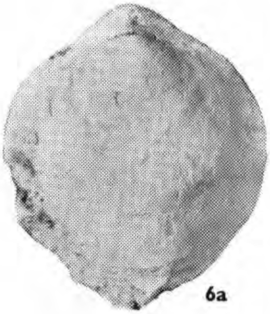
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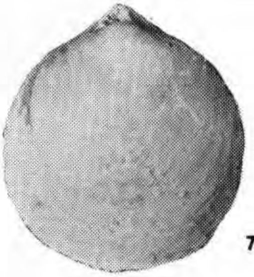
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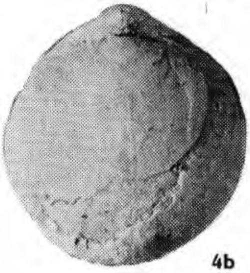
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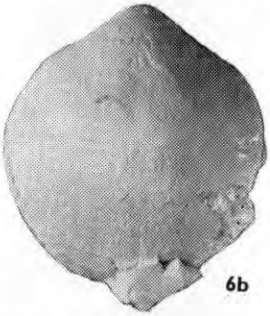
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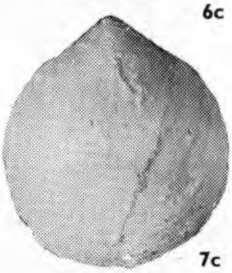
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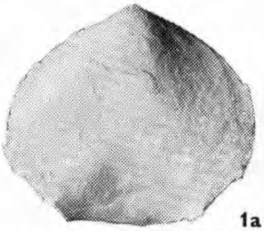
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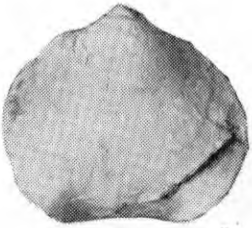
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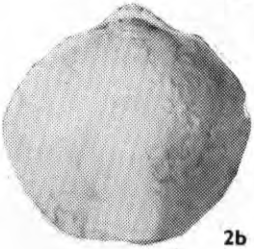
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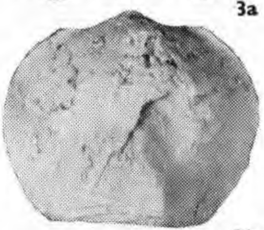
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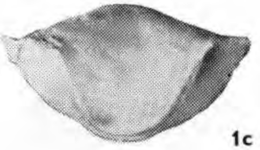
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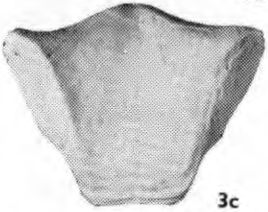
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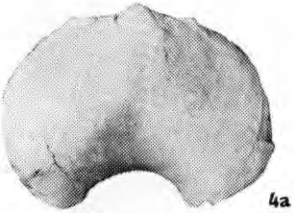
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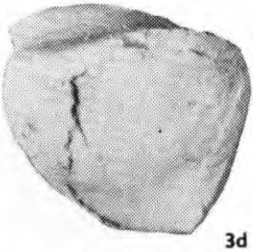
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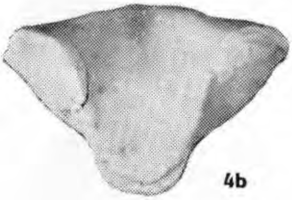
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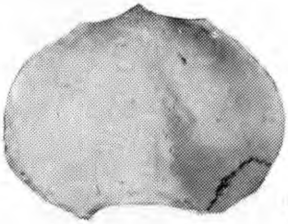
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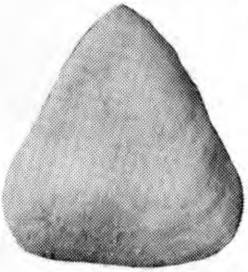
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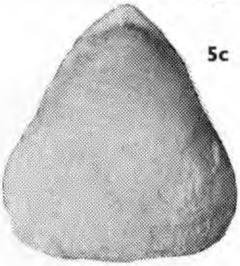
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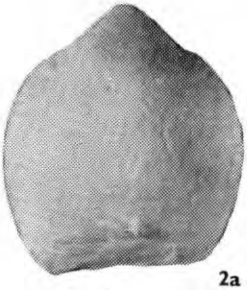
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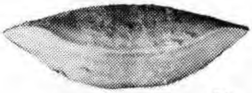
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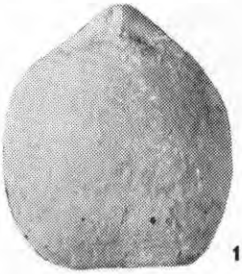
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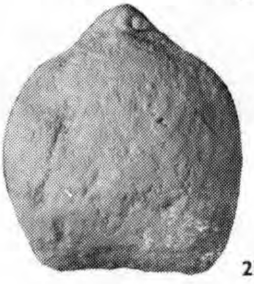
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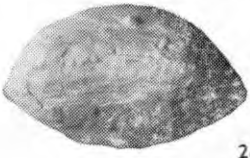
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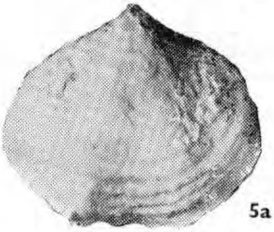
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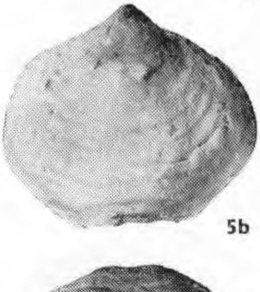
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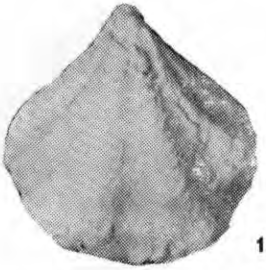
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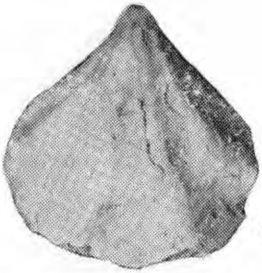
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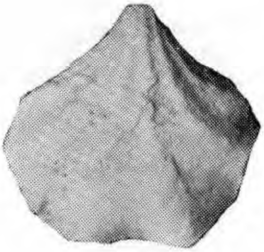
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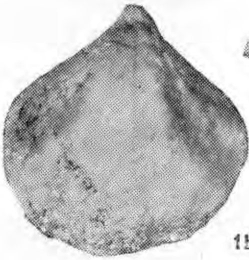
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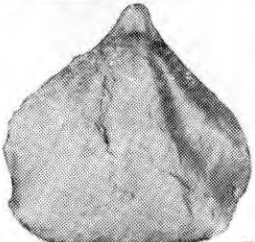
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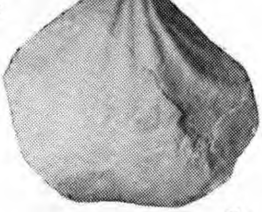
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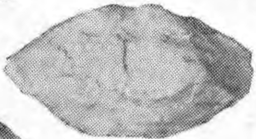
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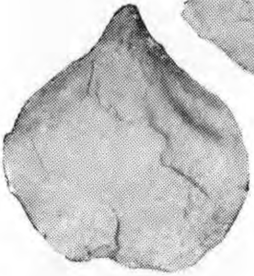
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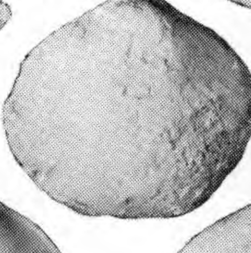
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5b


5a


5d


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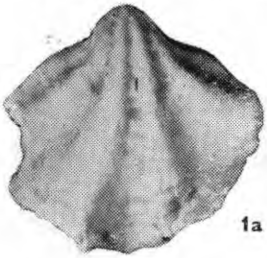
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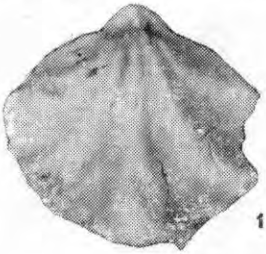
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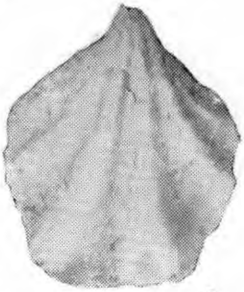
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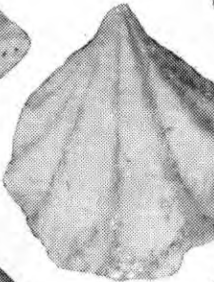
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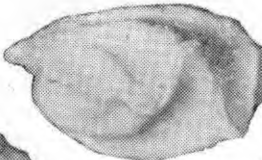
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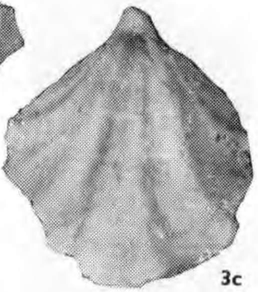
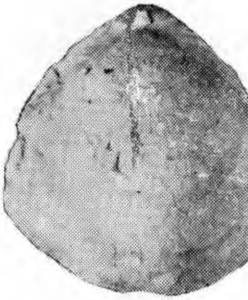

3c


3d


4a


4b


4c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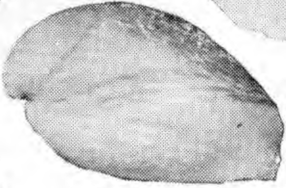
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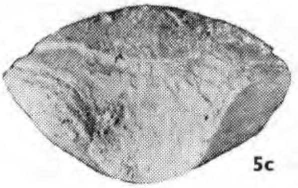
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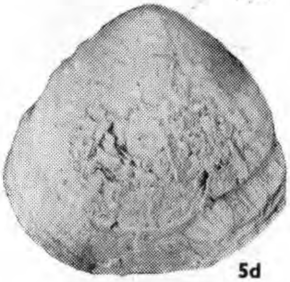
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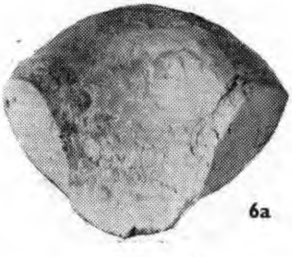
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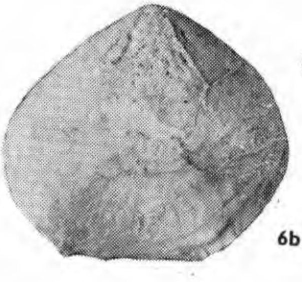
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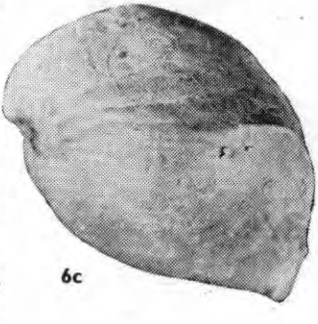
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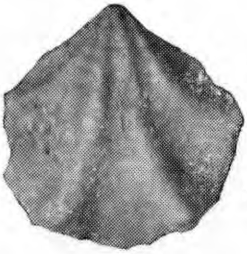
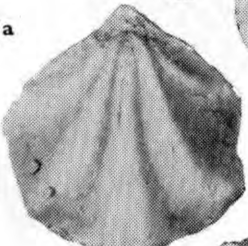
Pl. XVI


1a


2a


2b

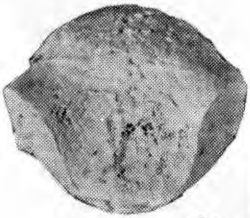

2c


1c


1b


1d


3c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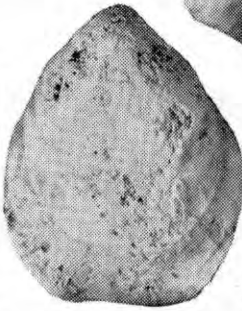
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4c


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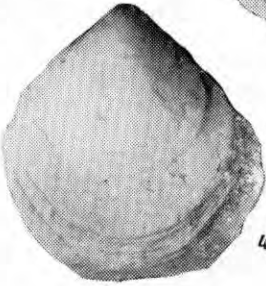
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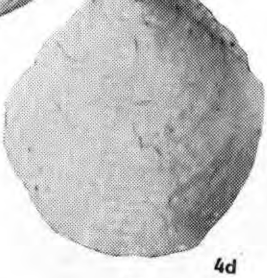
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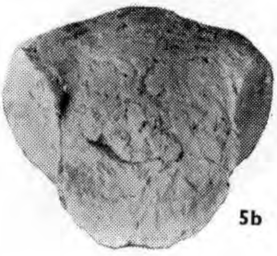
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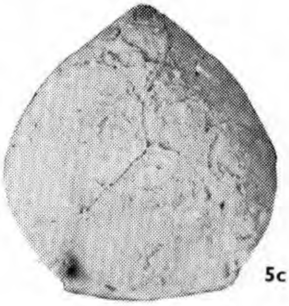
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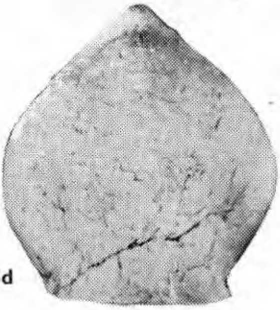
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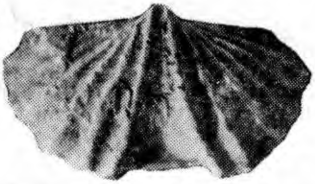

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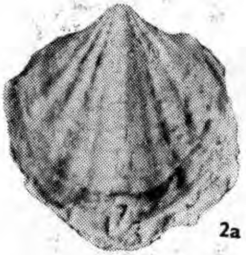

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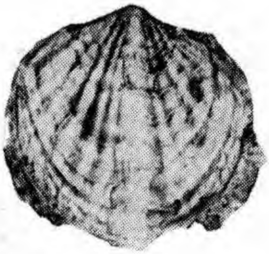

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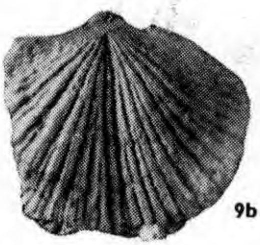

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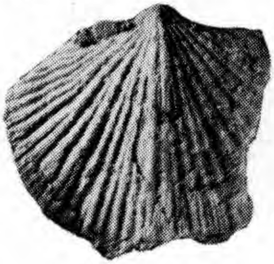

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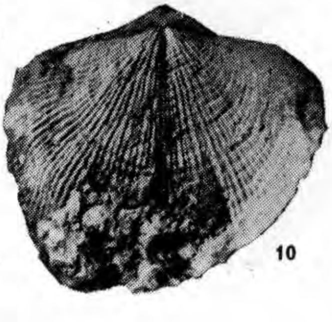

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Pl. XVIII


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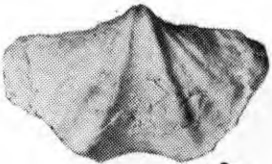
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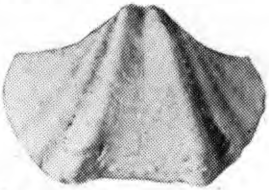
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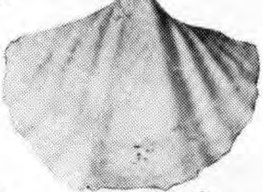
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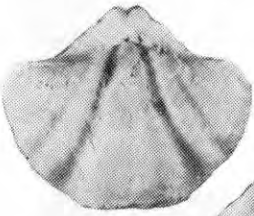
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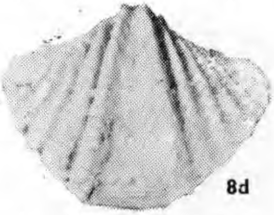
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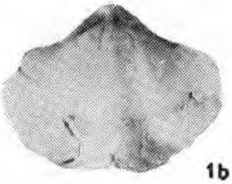
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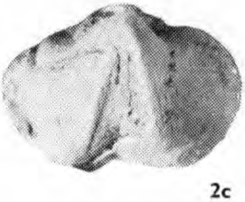
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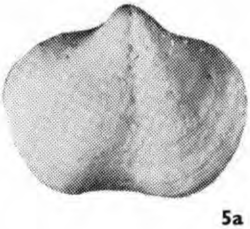
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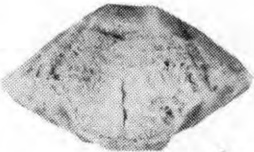
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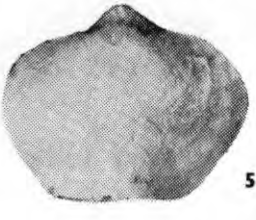
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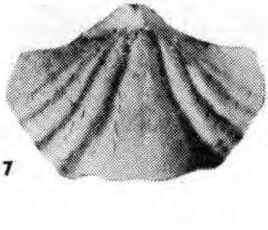

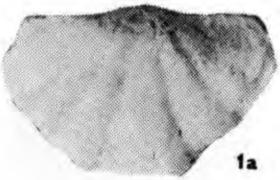
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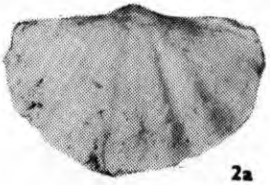
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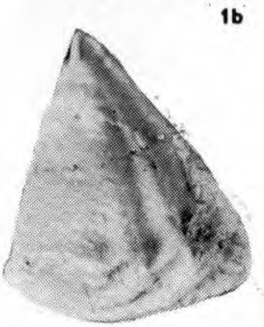
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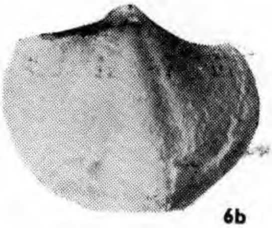
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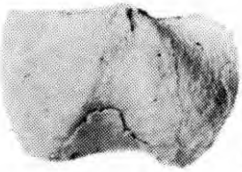
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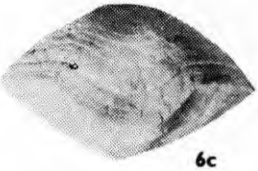
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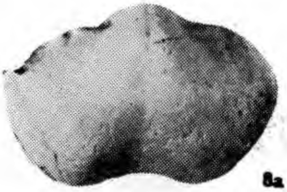
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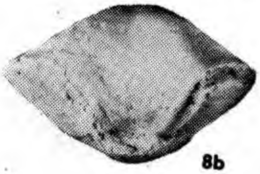
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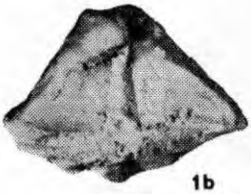
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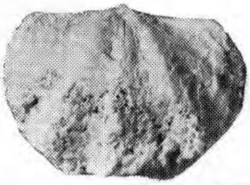
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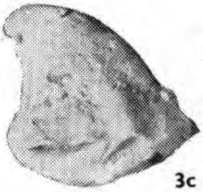
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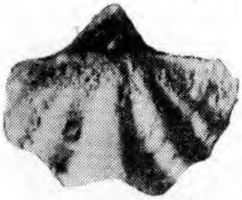
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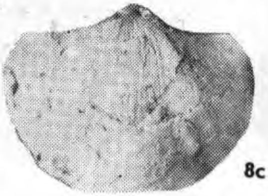
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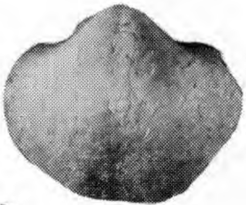
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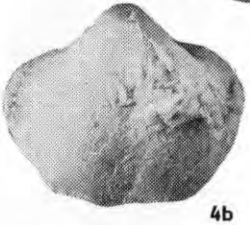
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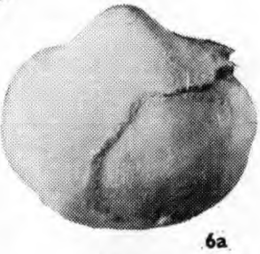
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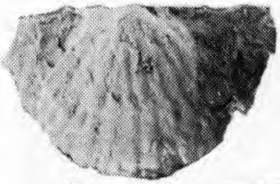
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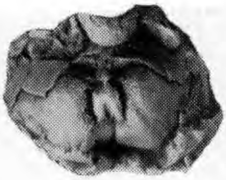
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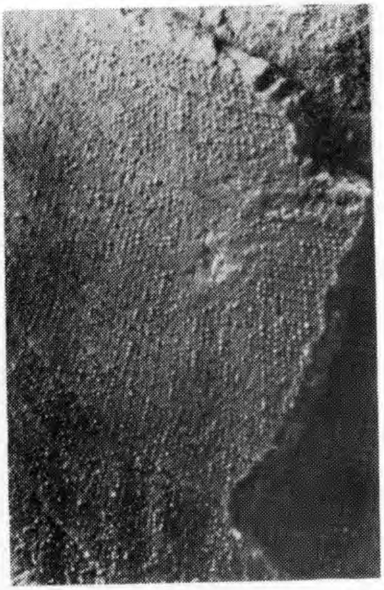
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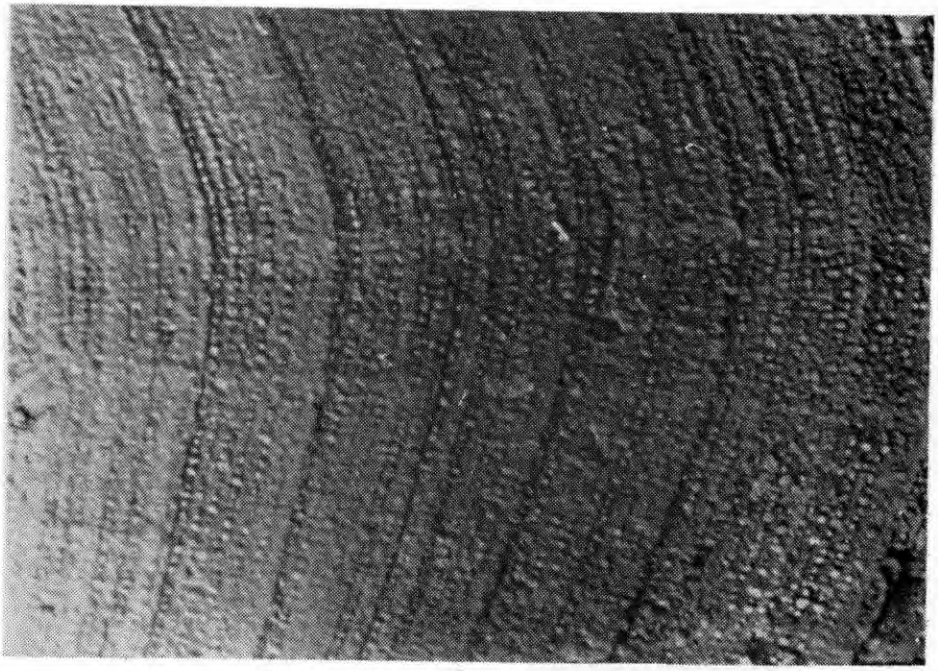

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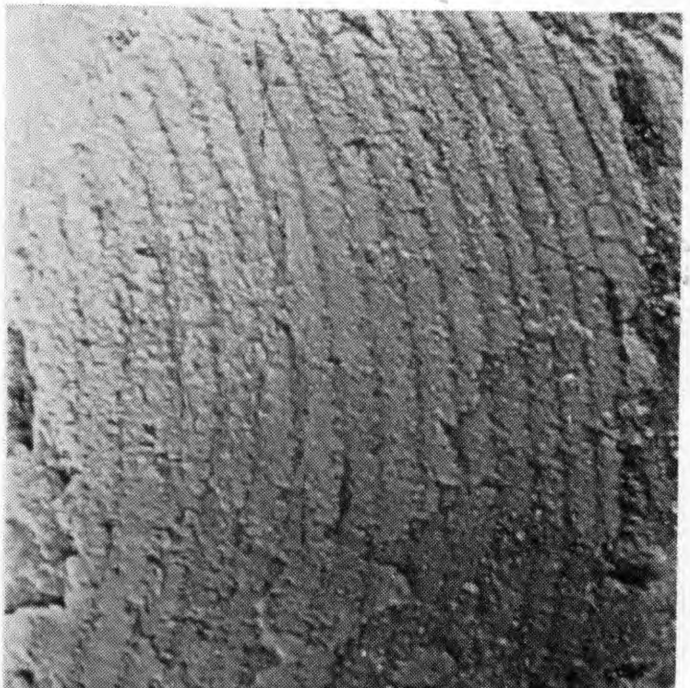
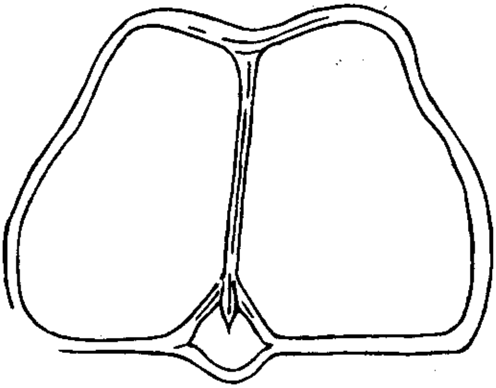


1

of all shells examined. Partly decorticated shells exhibit finely and densely endopunctate shell substance.

Interior: Median septum, spondylium, and tichorhinum in pedicle valve (text-fig. 32); interior of brachial valve not examined.



32. *Cyrtina platypleura* sp. n.; pedicle valve, oblique section; ×10

Comparison: Owing to its low costae counting 2 or 3 pairs on the pedicle valve *C. platypleura* recalls *C. kazi* Havl. (Dvorce-Prokop and Zlíchov Limestones); the latter species is even smaller (4.0—6.5 mm wide) and has a slightly convex brachial valve, whereas that of the new species is always moderately vaulted in lateral profile. Moreover, *C. kazi* bears coarse and fairly long spines on its surface, thus differring from all Bohemian species of *Cyrtina* (including *C. platypleura*).

Occurrence: Suchomasty Limestone, localities 5, 8.

Cyrtina aff. *morana* Havlíček, 1956

Pl. XXI, figs. 1, 2

Remarks: By the size and shape of the shell, and by the presence of strong ribs, this species is closely similar to *C. morana* (Zlíchov Limestone) except for having less ribs on the flanks (3 pairs on the brachial valve).

Occurrence: Suchomasty Limestone, locality 5.

Stringocephalacea King, 1850

Stringocephalidae King, 1850

Bornhardtininae Cloud, 1942

Kaplex Ficner & Havlíček, 1975

Kaplex bohemicus (Barrande, 1879)

1986 *Kaplex bohemicus* (Barrande, 1879); Mergl, p. 230, pl. 2, figs. 1—3.

Occurrence: Acanthopyge Limestone, locality 2 (very rare; collected by J. Bouška); Choteč Limestone (Eifelian), Holyně (collected by J. Bouška).

K tisku doporučil M. Siblík

Přeložili autoři

References

Barrande, J. (1847): Über die Brachiopoden der silurischen Schichten von Böhmen. — Naturwiss. Abh. (Haidingers), 1, *357—475*. Wien.

— (1848): Über die Brachiopoden der silurischen Schichten von Böhmen. — Naturwiss. Abh. (Haidingers), 2, *155—256*. Wien.

— (1879): Système silurien du centre de la Bohême, V. — Prag, Paris.

Beales, F. W. (1958): Ancient sediments of Bahama type. — Bull. Amer. Assoc. Petrol. Geol., 45, *1845—1880*. Tulsa.

Boucot, A. J. (1959): Early Devonian Ambocoeliinae (Brachiopoda). — J. Paleont., 33, *16—24*. Tulsa.

— (1962): Observations regarding some Silurian and Devonian spiriferoid genera. — Senckenberg. lethaea, 43, *411—432*. Frankfurt a. M.

— (1975): Evolution and extinction rate controls. — Elsevier. Amsterdam.

Chlupáč, I. (1955): Stratigraphical study of the oldest Devonian beds of the Barrandian. — Sbor. Ústř. Úst. geol., Odd. geol., 21, *91—224*. Praha.

— (1957): Facial development and biostratigraphy of the Lower Devonian of Central Bohemia. — Sbor. Ústř. Úst. geol., Odd. geol., 23, *369—485*. Praha.

— (1959): Facial development and biostratigraphy of Daleje Shales and Hlubočepy Limestones (Eifelian) in the Devonian of Central Bohemia. — Sbor. Ústř. Úst. geol., Odd. geol., 24, *446—511*. Praha.

— (1983): Trilobite assemblages in the Devonian of the Barrandian area and their relations to palaeoenvironments. — Geologica et Palaeont., 17, *45—73*. Marburg.

Chlupáč, I. (1987): Devon. *In:* Chlupáč, I. - Brunnerová, Z. - Havlíček, V. - Kovanda, J. - Kříž, J. - Šalanský, K. - Štych, J. - Zelenka, P.: Vysvětlivky k základní geologické mapě ČSSR 1:25 000, 12-413 Králův Dvůr. — Ústř. úst. geol. Praha.

Chlupáč, I. - Vaněk, J. (1957): Nové nálezy fauny ve vyšších vrstvách koněpruského devonu. — Čas. Miner. Geol., 2, *349—351*. Praha.

Chodalevič, A. N. (1951): Nižnedevonskie i éjfeľskie brachiopody Ivdeľskogo i Serovskogo rajonov Sverdlovskoj oblasti. — Trudy Sverdlovsk. gor. Inst., 18 Moskva.

Copper, P. (1986): Evolution of the earliest smooth spire-bearing strypoids (Brachiopoda: Lissatrypidae, Ordovician-Silurian). — Palaeontology, 29, *827—866*. London.

Drot, J. (1969): Clorindinae (Pentamerida) du Maroc présaharien. — Not. Mém. Serv. géol. Maroc, 29, 213, *33—43*. Rabat.

Dunham, R. J. (1962): Classification of carbonate rocks according to depositional texture. — Amer. Assoc. Petrol. Geol., Bull., Mem. 1, *108—121*. Tulsa.

Flügel, E. (1982): Microfacies analysis of limestones. — Springer; Berlin, Heidelberg, New York.

Folk, R. L. (1962): Spectral subdivision of limestone types. — Amer. Assoc. Petrol. Geol. Bull., Mem. 1, *62—84*. Tulsa.

Godefroid, J. (1972): Pseudosieberella (Pentameridae), nouveau genre Couvinien, et genres apparantés. — Bulletin (Inst, roy. Sci. natur. Belg.), Sér. Sci. Terre, 48, *5*. Bruxelles.

Gortani, M. (1915): Fossili Eodevonici della base del Capolago (Seekopfssockel). — Palaeontographia italica, 21, *117—187*. Pisa.

Gracianova, R. T. (1967): Brachiopody i stratigrafija nižnego devona Gornogo Altaja. — Izdat. Nauka. Moskva.

— (1974): „Šuchertelly" rannego i srednego devona na juge Zapadnoj Sibiri: sistematičeskaja prinadležnosť, élementy ékologii, stratigrafičeskoe značenie. — *In:* Sreda i žizn' v geologičeskom prošlom, *77—87*. Izdat. Nauka, Sibirskoe otdelenie. Novosibirsk.

Havlíček, V. (1956): Ramenonožci vápenců branických a hlubočepských z nejbližšího pražského okolí. — Sbor. Ústř. Úst. geol., Odd. paleont., 22, *535—665*. Praha.

Havlíček, V. (1959): Spiriferidae v českém siluru a devonu. — Rozpr. Ústř. Úst. geol., 25. Praha.

— (1961): Rhynchonelloidea des böhmischen älteren Paläozoikums (Brachiopoda). — Rozpr. Ústř. Úst. geol., 27. Praha.

— (1967): Brachiopoda of the suborder Strophomenida in Czechoslovakia. — Rozpr. Ústř. Úst. geol., 33. Praha.

— (1971): Non-costate and weakly costate Spiriferidina (Brachiopoda) in the Silurian and Lower Devonian of Bohemia. — Sbor. geol. Věd, Paleont., 14, *7—34*. Praha.

— (1977): Brachiopods of the order Orthida in Czechoslovakia. — Rozpr. Ústř. Úst. geol., 44. Praha.

— (1980): New Eospiriferinae (Brachiopoda) in Bohemia. — Sbor. geol. Věd, Paleont., 23, *7—48*. Praha.

— (1982): New Pugnacidae and Plectorhyncheilidae (Brachiopoda) in the Silurian and Devonian rocks of Bohemia. — Věst. Ústř. Úst. geol., 57, *111—114*. Praha.

— (1985a): Karbous g. n. (Lissatrypidae, Brachiopoda; Devonian) in Bohemia. — Věst. Ústř. Úst. geol., 60, *235—240*. Praha.

— (1985b): Gypidula and allied genera (Pentameracea; Silurian, Lower Devonian) in Bohemia. — Věst. Ústř. Úst. geol., 60, *295—301*. Praha.

— (1987): Lower Devonian and Eifelian Atrypacea (Brachiopoda) in central Bohemia. — Sbor. geol. Věd, Paleont. 28, *61—115*. Praha.

Havlíček, V. - Pek, I. (1986): Middle Devonian brachiopods from Horní Benešov in the Nízký Jeseník Mts. (Moravia). — Čas. Mineral. Geol., 31, *17—26*. Praha.

Havlíček, V. - Racheboeuf, P. (1979): Chonetacea (Brachiopodes) du Silurien et du Dévonien de Bohême (Tchécoslovaquie). — Ann. Paléont., Sér. Invertébr., 65, *69—138*. Paris.

Kukal, Z. (1964): Litologie barrandienských karbonátových souvrství (Lithology of the Barrandian carbonate sequences). — Sbor. geol. Věd, Geol., 6, *123—165*. Praha.

— (1972): Open-space structures in the Devonian limestones of the Barrandian (Central Bohemia). — Čas. Mineral. Geol., 16, *345—362*. Praha.

Malygina, A. A. - Sapeľnikov, V. P. (1973): Silurijskie, rannedevonskie i éjfeľskie Pentamerida Južnogo Altaja. — Trudy Geol. Geochim. Akad. Nauk SSSR, Uraľskij nauč. centr, 104. Moskva.

Mergl, M. (1986): Rare Devonian terebratulids (Brachiopoda) from the Prague Basin (Bohemia). — Věst. Ústř. Úst. geol., 61, *229—232*. Praha.

Mohanti, M. (1972): The Portilla Formation (Middle Devonian) of the Alba Syncline, Cantabrian Mountains, Prov. Leon, northwestern Spain: Carbonate facies and rhynchonellid palaeontology. — Leidse geol. Meded., 48, *135—205*. Leiden.

Perry, D. G. (1984): Brachiopoda and biostratigraphy of the Silurian-Devonian Delorme Formation in the district of Mackenzie, the Yukon. — Life Sciences Contributions, 138. Royal Ontario Museum, Toronto.

Plodowski, G. (1971): Glattschalige Atrypacea aus den Zentralkarnischen Alpen und aus Böhmen. — Senckenberg. lethaea, 52, *285—313*. Frankfurt a. M.

Prokop, R. (1987): The stratigraphical distribution of Devonian crinoids in the Barrandian area (Czechoslovakia). — Newslett. Stratigr., 17, *101—107*. Berlin, Stuttgart.

Racheboeuf, P. R. (1978): Révision de Chonetes sarcinulatus (Schlotheim, 1820) (Brachiopoda, Chonetacea) du Dévonien inférieur du Harz, Allemagne. — N. Jb. Geol. Paläont., Abh., 156, *338—352*. Stuttgart.

Rong Jia-yu - Su Yang-zheng - Li Wen-guo (1985): Brachiopods of the Xibiehe Formation (Upper Silurian) in Darhan Mumingan Joint Banner, Inner Mongolia. — Silurian and Devonian rocks and faunas of the Bateaobao area in Darhan Mumingan Joint Banner, Inner Mongolia. Edit. Li Wen-guo, Rong Jia-yu and Dong De-yuan; People's publishing House of Inner Mongolia.

Rudwick, M. J. S. (1970): Living and fossil brachiopods. — Hutchinson Univ. Libr. London.

Ržonsnickaja, M. A. (1960): Nadsemejstvo Pentameracea. — *In:* Novye vidy drevnich rastenij i bespozvonočnych SSSR, časť 1, *298—308*. Moskva.

— (1975): Biostratigrafija devona okrain Kuzneckogo bassejna. — Trudy Vsesojuz. nauč.-issled. geol. Inst. VSEGEI, 244. Leningrad.

Sartenaer, P. (1961): Late Upper Devonian Famennian rhynchonelloid brachiopods. — Bulletin (Inst. roy. Sci. natur. Belg.), Sér. Sci. Terre., 37, 24. Bruxelles.

Schmidt, H. (1941): Die mitteldevonischen Rhynchonelliden der Eifel. — Abh. Senckenberg. naturforsch. Gesell., 459, *1—79*. Frankfurt a. M.

Siehl, A. (1962): Der Greifensteiner Kalk (Eiflium, Rheinisches Schiefergebirge) und seine Brachiopodenfauna. — Palaeontographica, Abt. A, 119, *173—221*. Stuttgart.

Wilson, J. (1975): Carbonate facies in geologic history. — Springer, New York.

Explanation of plates

(Pls. III—XXIII: all specimens coated with ammonium chloride; photographed in ÚÚG by B. Matoulková, V. Skala, and H. Vršťalová)

Pl. I

1. Coarse unsorted bioclastic limestone (floatstone) with some larger unrounded bioclasts floating in finer matrix. The Suchomasty Limestone. Natural size.
2. Polished core of the Suchomasty Limestone. Biomicritic limestone with larger bioclasts (mostly crinoid particles floating in micrite matrix. Bioclasts arranged in streaks and lenses. Stromatactis are parallel to the bedding. About natural size.

Both photographs by H. Vršťalová

Pl. II

1. Fine-grained bioclastic crinoidal limestone cut by stylolite seam. The Suchomasty Limestone, Zlatý kůň, ×13.
2. Stromatactis with blade calcite crystals and some bioclasts in the internal sediments. The Suchomasty Limestone, Zlatý kůň. ×21.7.
3. Bioclastic layers of the Acanthopyge Limestone. Fine-grained hash of bioclasts with sparitic cement. Zlatý kůň. ×60.
4. Fine-grained layer of the Acanthopyge Limestone. Consists of microsparite with clots of micrite. Also some microspheres are present. Zlatý kůň. ×61.

All photographs by S. Bártlová

Pl. III

Dalejina sp.; Suchomasty Limestone
1. Brachial valve; VH 5875a, ×5.5.

Leptaenopyxis irena (Havlíček); Suchomasty Limestone
2. Brachial valve; VH 382, ×2.1.
3. Brachial valve, oblique view showing a trail; VH 2629b, ×2.8.
4. Internal mould of pedicle valve; VH 383, ×2.8.
5. Pedicle valve; L 6663, ×2.5.
6. Pedicle valve, oblique view; VH 2637b, ×2.2.

Areostrophia ares sp. n.; Suchomasty Limestone
7. Brachial valve; VH 2545a, ×4.0.
8. Pedicle valve; VH 2544, ×4.3.

Quasidavidsonia tenuissima (Barrande); Suchomasty Limestone
9. Dorsal view; VH 495b, ×2.3.
10. Dorsal and ventral views; 495a, ×2.0.

Quasidavidsonia mediocarinata (Havlíček); Acanthopyge Limestone
11. Brachial valve; VH 3327, ×2.1.
12. Brachial valve interior; VH 5247, ×2.3.
13. External mould of pedicle valve; VH 442c, ×3.0.
14. Ventral and dorsal views; VH 442a, ×3.0.
15. Ventral view; VH 442b, ×2.8.

Protoleptostrophia sp.; Suchomasty Limestone
16. Pedicle valve; VH 3890, ×2.7.

Pl. IV

Mamutinetes latipleura sp. n.; Choteč Limestone
1. External mould of brachial valve; VH 2634g, ×5.0.
2. Internal mould of pedicle valve; VH 2634c, ×6.0.

3. Internal mould of brachial valve; VH 2634d, ×4.5.
4. Pedicle valve; VH 2347, ×4.6.

Holynetes cf. ***holynensis*** **Havlíček & Racheboeuf**; Suchomasty Limestone

5. Pedicle valve; VH 2635, ×6.0.
6. Pedicle valve; VH 2636b, ×6.0.
7. Brachial valve; VH 2636c, ×14.0.
8. Pedicle valve, ventral and posterior views; L 14568, ×6.0.

Mamutinetes perlatipleura sp. n.; Suchomasty Limestone

9. Pedicle valve; VH 2304a, ×3.5.

Kaplicona fragilis (Barrande); Suchomasty Limestone

10. Pedicle valve; L 6780, ×3.5.

Leptochonetes papyrus Havlíček & Racheboeuf; Suchomasty Limestone

11. Dorsal and ventral views; VH 2305, ×3.5.
12. Shell with marginal spines; VH 2308, ×3.5 and ×10.0
13. Ventral, dorsal, and posterior views; VH 2306, ×3.5.

Pl. V

Pseudosieberella labrusca sp. n.; Suchomasty Limestone

1. Ventral, dorsal, and anterior views; VH 4816a, ×2.5.
2. Ventral, dorsal, and anterior views; VH 4816b, ×2.4.

Plicogypa lukesi sp. n.; Suchomasty Limestone

3. Pedicle valve; VH 4813a, ×2.4.
4. Ventral, dorsal, anterior, and lateral views; VH 4813c, ×1.7.
5. Dorsal, anterior, and ventral views; VH 4813b, ×1.8.
6. Ventral, dorsal, posterior, and lateral views; VH 4813d, ×1.6 and ×1.8.

Pl. VI

Clorinda baccalaria sp. n.; Suchomasty Limestone

1. Ventral, anterior, and dorsal views; VH 4821c, ×2.0.

Lysigypa morosoides sp. n.; Suchomasty Limestone

2. Ventral, dorsal, and anterior views; VH 4817b, ×2.1.

Clorinda robustisella sp. n.; Suchomasty Limestone

3. Ventral, anterior, and dorsal views; VH 4819a, ×2.5.
4. Ventral, dorsal, and anterior views; VH 4819b, ×2.6.

Gypidulina ariadna sp. n.; Suchomasty Limestone

5. Ventral and anterior views; VH 4814a, ×2.0.

Gypidula sp.; Suchomasty Limestone

6. Pedicle valve; VH 4815, ×1.0.

Pl. VII

Clorinda exarmata sp. n.; Suchomasty Limestone

1. Ventral, dorsal and anterior views; VH 4818a, ×3.4.
2. Ventral, dorsal, and anterior views; VH 4818b, ×2.8.

Clorinda acrimona sp. n.; Suchomasty Limestone

3. Anterior, dorsal, and lateral views; VH 4820a, ×2.1.
5. Anterior and dorsal views; VH 4820b, ×2.0.

Clorinda baccalaria sp. n.; Suchomasty Limestone

4. Pedicle valve, anterior and ventral views; VH 4821e, ×2.2 and ×1.6.
6. Transverse section; ×6.7, VH 4827.

Lysigypa morosoides sp. n.; Suchomasty Limestone

7. Internal mould of pedicle valve; VH 4817f, ×2.7.

Pl. VIII

Clorinda strix (Barrande); Acanthopyge Limestone

1. Ventral, dorsal, and anterior views; VH 3319a, ×3.8.
2. Ventral view; VH 5876c, ×3.3.

Corvinopugnax corvinus (Barrande); Suchomasty Limestone

3. Ventral, dorsal, and anterior views; VH 2538f, ×2.4.

Iberirhynchyia nargis (Havlíček); Suchomasty Limestone

4. Ventral and anterior views; VH 249, ×1.5.

Taimyrrhynx rufus sp. n.; Suchomasty Limestone

5. Ventral and anterior views; VH 3329b, ×2.1 and ×2.3.

Tetratomia coalescens sp. n.; Suchomasty Limestone

6. Dorsal, ventral, and anterior views; VH 4157, ×8.1.

Astutorhyncha proserpina (Barrande); Suchomasty Limestone

7. Young shell, ventral and anterior views; VH 2552a, ×1.9.
8. Late adult shell, ventral, anterior, and dorsal views; VH 2551a, ×1.4.

Pl. IX

Kransia aff. *parallelepipeda* (Bronn); Acanthopyge Limestone

1. Ventral and anterior views; VH 3314, ×4.0.

Markitoechia clavula sp. n.; Suchomasty Limestone

2. Anterior, ventral, and dorsal views; VH 3317b, ×5.5.

Septalaria palumbina (Barrande); Suchomasty Limestone

3. Ventral and anterior views; VH 5883, ×2.9.

Monadotoechia monas (Barrande); Suchomasty Limestone

4. Ventral and anterior views; VH 246, ×5.4.
5. Ventral and anterior views; VH 204, ×5.4.

Amissopecten obsolescens (Barrande); Acanthopyge Limestone (= *Atrypa assula* Barrande, 1879, pl. 93, case I, fig. 3)

6. Ventral and anterior views; L 24368, ×3.2.

Amissopecten velox (Barrande); Acanthopyge (fig. 7) and Suchomasty (fig. 8) Limestones

7. Ventral, lateral, dorsal, and anterior views; VH 2554c, ×1.4.
8. Anterior and ventral views; VH 2524e, ×1.5.

Pl. X

Amissopecten obsolescens (Barrande); Acanthopyge Limestone

1. Ventral and anterior views; VH 5854a, ×2.1.

Trigonatrypa baucis (Barrande); Acanthopyge Limestone

2. Ventral and dorsal views; pedicle valve exfoliated to show muscle field; VH 3325c, ×2.8.

Trigonatrypa protobaucis sp. n.; Suchomasty Limestone

3. Dorsal, anterior, ventral, and lateral views; VH 3322b, ×2.5.

Markitoecha omissa Havlíček; Suchomasty Limestone

4. Ventral, dorsal, and anterior views; VH 205, ×4.0.

Trigonatrypa securis (Barrande); Acanthopyge Limestone

5. Ventral and anterior views; pedicle valve exfoliated to show muscle field; L 25317, ×2.5.

Cerberatrypa cerberus sp. n.; Suchomasty Limestone

6. Dorsal, ventral, and anterior views; VH 4165f, ×2.8.

Cerberatrypa dissidens (Barrande); Acanthopyge Limestone

7. Dorsal, anterior, and ventral views; VH 3323a, ×4.5.

Pl. XI

Trigonatrypa securis (Barrande); Acanthopyge Limestone
1. Ventral, dorsal, and anterior views; L 25315, ×2.5.

Trigonatrypa holynensis (Havlíček); Třebotov Limestone
2. Interior of brachial valve; VH 5877a, ×4.7.

Karbous aperinus Havlíček; Suchomasty Limestone
3. Pedicle valve partly exfoliated to show its muscle field; L 22917, ×3.5.
4. Lateral and dorsal views; VH 5878, ×3.2.
5. Lateral, anterior, and ventral views; VH 4949a, ×3.4.
6. Dorsal, ventral, and lateral views; VH 4949b, ×3.0.

Karbous hassiacus (Siehl); Acanthopyge Limestone
7. Dorsal, anterior, ventral, and lateral views; VH 2638, ×3.1.

Pl. XII

Rhynchatrypa thetis (Barrande); Acanthopyge (figs. 1, 3, 4), Suchomasty (fig. 2) and Chýnice (fig. 6) Limestones
1. Ventral, dorsal, and anterior views; VH 2648b, ×2.2.
2. Ventral, dorsal, anterior, and lateral views; VH 2647b, ×2.5.
3. Ventral, dorsal, anterior, and lateral views; VH 2649, ×2.1.
4. Ventral, anterior, and dorsal views; VH 4155d, ×1.9.
6. Posterior part of a shell showing disjunct deltidial plates; VH 3326b, ×3.7.

Trigonatrypa baucis (Barrande); Acanthopyge Limestone
5. Anterior, ventral, and dorsal views; VH 3325b, ×3.2.

Pl. XIII

Karbous truncatus Havlíček; Suchomasty Limestone
1. Ventral, dorsal, anterior, and lateral views; VH 4948a, ×3.9.
2. Ventral, dorsal, and anterior views; VH 4948b, ×3.9.

Radimatrypa zelaria sp. n.; Acanthopyge Limestone
3. Young shell (= *Atrypa assula,* Barrande 1879, pl. 146, case VII, fig. 2), ventral and anterior views; L 24964, ×2.5.
4. Ventral, dorsal, and lateral views; L 25939, ×2.0.

Athyris odolens sp. n.; Suchomasty Limestone
5. Ventral, dorsal, and anterior views; VH 4161b, ×1.7.
6. Dorsal, anterior, and ventral views; VH 4161a, ×2.0.

Pl. XIV

Plectospira leniplicata sp. n.; Suchomasty Limestone
1. Ventral, dorsal, and anterior views; VH 2624a, ×2.8.
2. Ventral, lateral, anterior, and dorsal views; VH 2624b, ×2.8.
3. Ventral, dorsal, and anterior views; VH 2624c, ×3.0.
4. Ventral, anterior, and dorsal views (ribs obscure!); VH 2624d, ×3.0.

Leptathyris deino sp. n.; Acanthopyge (fig. 5) and Suchomasty (fig. 6) Limestones
5. Ventral, lateral, anterior, and dorsal views; VH 2641, ×2.8.
6. Anterior, dorsal, and ventral views; VH 2640, ×2.3.

Pl. XV

Plectospira grochonia sp. n.; Suchomasty Limestone
1. Ventral and dorsal views; VH 2528a, ×4.5.

Plectospira dione sp. n.; Suchomasty Limestone

2. Pedicle valve; VH 2625c, ×3.8.
3. Ventral, lateral, dorsal, and anterior views; VH 2625d, ×3.7.

Merista repellens sp. n.; Suchomasty Limestone

4. Anterior, ventral, and dorsal views; VH 4828b, ×2.1.
5. Dorsal, lateral, anterior, and ventral views; VH 4828c, ×2.8.
6. Anterior, ventral, and lateral views; VH 4828d, ×1.5.

Pl. XVI

Plectospira grochonia sp. n.; Suchomasty Limestone

1. Ventral, lateral, dorsal, and anterior views; VH 2528b, ×4.5.

Merista passer (Barrande); Suchomasty Limestone

2. Anterior, dorsal, and ventral views; VH 4829a, ×3.2.
3. Anterior, ventral, and dorsal views; VH 4829b, ×2.6.
4. Lateral, ventral, anterior, and dorsal views (holotype); L 25287, ×2.3.
5. Lateral, anterior, ventral, and dorsal views; VH 4829c, ×2.1.

Pl. XVII

Hergetatrypa minuta (Siehl); Suchomasty Limestone

1. Ventral and posterior views; VH 3389c, ×3.4.
2. Ventral and posterior views; VH 3389a, ×4.7.
3. Ventral view; VH 3389d, ×3.0.

Amoenospirifer thetidis (Barrande); Suchomasty Limestone

4. Ventral and posterior views; L 25222, ×1.5.
5. Dorsal, lateral, and anterior views; L 25224, ×1.5.

Eoreticularia indifferens (Barrande); Suchomasty Limestone

6. Dorsal, anterior, and ventral views; VH 2440, ×1.5.

Plectospira varioplicata Siehl; Acanthopyge Limestone

7. Incomplete shell, dorsal view; VH 3324, ×3.1.

Fossatrypa granulifera (Barrande); Suchomasty Limestone

8\. Shell with subcarinate pedicle valve and sulcate brachial valve, anterior view; L 21573, ×2.1.

10\. Dorsal view; VH 3386b, ×2.1.

Carinatina arimaspus (Eichwald); Suchomasty Limestone

9\. Posterior, dorsal, and ventral views; VH 4097b, ×2.2.

Pl. XVIII

Amoenospirifer foedus sp. n.; Suchomasty Limestone

1. Ventral, anterior, and dorsal views; VH 2395b, ×1.4.
2. Ventral, dorsal, and anterior views; VH 2395a, ×1.5.
3. Ventral and anterior views; VH 2392a, ×1.1.

Amoenospirifer amoenoides Havlíček; Suchomasty Limestone

4. Ventral, dorsal, and anterior views; VH 2484c, ×2.1.

Amoenospirifer cf. *thetidis* (Barrande); Suchomasty Limestone

5. Ventral and anterior views; VH 172, ×1.6.

Amoenospirifer oenone sp. n.; Suchomasty Limestone

6. Ventral, anterior, and dorsal views; VH 2389c, ×1.6.
7. Ventral and anterior views; VH 2416d, ×1.9.
8. Anterior, dorsal, lateral and ventral views; VH 2389d, ×1.5.

Pl. XIX

Quadrithyris orba Havlíček; Suchomasty Limestone
1. Ventral, dorsal, and anterior views; VH 5880, ×2.6.
Quadrithyrina ivanovae Havlíček; Suchomasty Limestone
2. Dorsal, anterior, and ventral views; VH 170, ×2.1.
Obesaria obesa (Barrande); Acanthopyge Limestone
3. Ventral, dorsal, and anterior views; VH 182, ×1.8.
Quadrithyris sobrina sp. n.; Suchomasty Limestone
4. Dorsal, anterior, and ventral views; VH 2417, ×1.5.
Eoreticularia fraterna (Barrande); Acanthopyga Limestone
5. Ventral, anterior, and dorsal views; VH 5881, ×2.3.
Pinguispirifer infirmus (Barrande); Suchomasty Limestone
6. Anterior and ventral views; VH 5882, ×1.4.
Amoenospirifer cf. *thetidis* (Barrande); Suchomasty Limestone
7. Dorsal view; VH 172, ×1.6.

Pl. XX

Rochtex lissopleura sp. n.; Acanthopyge (fig. 2) and Suchomasty (figs. 1, 5) Limestones
1. Dorsal, anterior, and lateral views; VH 4784b, ×1.8.
2. Dorsal and posterior views; VH 4782a, ×2.1.
5. Anterior and lateral views; VH 4783, ×2.1 and ×3.2.
Pinguispirifer fessus sp. n.; Suchomasty Limestone
3. Internal mould of brachial valve; VH 2397a, ×1.8.
4. Internal mould of pedicle valve; VH 2433b, ×1.3.
6. Ventral, dorsal, anterior, and lateral views; VH 2195a, ×1.7.
9. Ornamentation; VH 2433a, ×2.4.
Bojothyris nikiforovae Havlíček; Acanthopyge Limestone
7. Pedicle valve umbonally exfoliated to show median septum; VH 5879a, ×2.2.
8. Ventral, anterior, and dorsal views; VH 2476e, ×1.9.

Pl. XXI

Cyrtina cf. *morana* Havlíček; Suchomasty Limestone
1. Anterior, posterior, lateral, and dorsal views; VH 3321a, ×3.6.
2. Posterior and dorsal views; VH 3321b, ×2.0.
Cyrtina platypleura sp. n.; Suchomasty Limestone
3. Dorsal, posterior, lateral, and anterior views; VH 3320a, ×3.7.
4. Dorsal, lateral, and anterior views; VH 3320c, ×3.6.
Cingulodermis columbina (Havlíček); Suchomasty (figs. 5, 8) and Acanthopyge (figs. 6, 7) Limestones
5. Dorsal and anterior views; VH 4799, ×2.9.
6. Dorsal, and anterior views; VH 4809, ×2.7.
7. Anterior part of the fold with fine radial striation; ×4.5.
8. Ventral, anterior, and dorsal views; VH 189, ×2.4.

Pl. XXII

Ambocoelia mesodevonica Havlíček; Suchomasty Limestone
1. Ventral, anterior, and dorsal views; VH 716, ×5.2.
Metaplasia nekvasilovae sp. n.; Suchomasty Limestone
2. Ventral, anterior, and dorsal views; VH 4794c, ×6.0.
Alaskospira accedens (Barrande); Suchomasty Limestone

3. Ventral, dorsal, and anterior views; VH 4796b, ×3.2.
4. Anterior, ventral, and dorsal views; VH 4792c, ×3.0.

Quasimartinia lubrica sp. n.; Suchomasty (fig. 5) and Acanthopyge (fig. 6) Limestones

5. Dorsal, ventral, and anterior views; VH 4786a, ×2.4.
6. Ventral, anterior, and dorsal views; VH 4785, ×2.5.

Amoenospirifer oenone sp. n.; Suchomasty Limestone

7. Internal mould of pedicle valve; VH 2190a, ×1.3.

Pl. XXIII

Mamutinetes perlatipleura sp. n.; Suchomasty Limestone

1. Pedicle valve; VH 2304b, ×3.5.

Errhynx sp.; Acanthopyge Limestone

2. Dorsal, anterior, and ventral views; VH 3910, ×4.1.

"Spirifer" extraneus Barrande (according to Havlíček 1959 conspecific with *Obesaria obesa* (Barrande); Acanthopyge Limestone (orig. Barrande 1879, pl. 76, fig. V)

3. Pedicle valve showing muscle field (×1.0) and microornamentation (×12.0).

Carinatina arimaspus (Eichwald); Suchomasty Limestone

4. Pedicle valve; VH 4097a, ×2.2.

Pl. XXIV

Bojothyris nikiforovae Havlíček; Suchomasty Limestone

1. Microornamentation; VH 643, ×30.0.

Eoreticularia fraterna (Barrande); Suchomasty Limestone

2. Microornamentation; VH 638, ×20.0

Both photographs by Jiří Kříž

Sedimentologie, bentická společenstva a ramenonožci suchomastských a akantopygových vápenců (dalej-eifel) koněpruské oblasti

(Résumé anglického textu)

Vladimír Havlíček - Zdeněk Kukal

Předloženo 30. března 1989

Sedimentární textury a složení suchomastských a akantopygových vápenců dokazují, že sedimenty obou jednotek jsou produktem mělkovodního prostředí na karbonátové platformě. V suchomastských vápencích jsou přítomny znaky jak vysokoenergetického, tak i nízkoenergetického prostředí, přičemž hloubka vody nepřesahovala několik desítek metrů. Během sedimentace akantopygových vápenců převládalo mimořádně mělkovodní prostředí, ve kterém na karbonátové platformě dokonce docházelo k ukládání tzv. bahamitů. Společenstva ramenonožců suchomastských a akantopygových vápenců se značně liší od společenstev útesových koněpruských vápenců (prag), protože jsou tvořena převážně hladkými a chabě žebrovanými ramenonožci obvykle se spirálně stočeným ramenním aparátem. Naproti tomu v koněpruských vápencích převládají silně i slabě žebrované schránky. Bentická fauna suchomastských vápenců je přiřazena ke společenstvům *Karbous-Orbitoproetus* a *Orbitoproetus-Scabriscutellum.* Fauna akantopygových vápenců náleží společenstvu *Karbous-Acanthopyge.* V suchomastských a akantopygových vápencích bylo zjištěno 55 rodů artikulárních ramenonožců; z nich jsou považovánv za nové *Mamutinetes (Chonetacea), Lysigypa (Gypidulacea), Trigonatrypa, Cerberatrypa, Radimatrypa (Atrypacea)* a *Rochtex (Suessiacea).* Kromě toho bylo popsáno 30 nových druhů a jedna nová čeleď (*Bojothyridae*).

Седиментология, бентические сообщества и плеченогие сухомастских (далейский ярус) и акантопиговых (эйфель) известняков в окрестностях с. Конепрусы (Чехословакия)

Осадочные текстуры и состав сухомастских и акантопиговых известняков доказывают, что осадочные породы обоих подразделений являются продуктом мелководной среды на карбонатной платформе. В сухомастских известняках наблюдаются признаки как высокоэнергетической, так и низкоэнергетической среды, причем глубина воды не превышала нескольких десятков метров. В течение отложения акантопиговых известняков преобладала чрезвычайно мелководная среда, в которой на карбонатной платформе отлагались даже т. наз. багамиты. Сообщества плеченогих сухомастских и акантопиговых известняков значительно отличаются от сообществ рифовых конепрусских известняков (пражский ярус), так как они состоят из преимущественно гладких или слабогребенчатых створок плеченогих со спирально свернутым брахидиумом, а наоборот, в конепрусских известняках преобладают сильно- и тонкогребенчатые раковины. Бентическая фауна сухомастских известняков относится к сообществам Karbous — Orbitoproetus и Orbitoproetus — Scabriscutellum, а фауна акантопиговых известняков — к сообществу Karbous — Acanthopyge. В сухомастских и акантопиговых известняках было определено 55 родов замковых плеченогих, из которых новыми считаются следующие: Mamutinetes (Chonetecea), Lysigypa (Gypidulacea), Trigonatrypa, Cerberatrypa, Radimatrypa (Atrypacea) и Rochtex (Suessiacea). Кроме того описано 30 новых видов и одно новое семейство (Bojothyridae)

Přeložil A. Kříž

SBORNÍK GEOLOGICKÝCH VĚD
JOURNAL OF GEOLOGICAL SCIENCES

paleontologie

palaeontology

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Vydal Ústřední ústav geologický
Praha 1990

Vědecký redaktor: RNDr. Ivo Chlupáč, CSc.
Obálku navrhl Miloslav Cihelka
Odpovědná redaktorka: Vlasta Čechová
Překlady: Taťjana Hlavatá, Antonín Kříž
Technická redakce: M. Brzobohatá, M. Sokolová

Vydání I. — 205 stran (53 obr.), 48 křídových příloh
Vytiskla Grafia, Zlín — 60046-90
17,22 AA — 17,44 VA

Náklad 650 výtisků — 03/11 — 9450 — 60-424-90

Cena brož. výtisku Kčs 31,—
509/827
ISBN 80-7075-010-3