OSTRACODS OF THE MÓJCZA LIMESTONE

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Olempska, E. 1994. Ostracods of the Mójcza Limestone. — *In:* J. Dzik, E. Olempska, and A. Pisera 1994. Ordovician carbonate platform ecosystem of the Holy Cross Mountains, Poland. *Palaeontologia Polonica* **53**, 129–212.

82 ostracod species, belonging to 51 genera, included in three orders (Beyrichiocopa, Platycopa and Podocopa) from the Ordovician Mójcza Limestone at its type locality at Mójcza (Holy Cross Mountains) are described, 6 genera and 39 species being new. Only a few species are shared by the Holy Cross Mts and Baltoscandian ostracod faunas. Most of genera from Mójcza are known from Baltoscandia, some occur also in Ibero-Armorica, the British Isles and Bohemia. Phosphatized ostracod valves occur in Mójcza in carbonate sediments probably deposited in a stable environment with very slow sedimentation rate. Diversity of the assemblages is generally high and rather stable in time especially in the Middle Ordovician. It is somewhat lower in the basal part of the sequence, gradually increases during the Llanvirn and Landeilo, then strongly decreases in the early Caradoc while increasing again in the middle Caradoc. Biometrical population studies of morphologic evolution demonstrated that larger elements of shell ornamentation (such as crests or spines) were subject to evolutionary changes while the microornamentation remained unchanged; microornamentation is stable also in the ontogeny. The *Mojczella* lineage is the best example of smooth acceleration in ontogenetic expression of the junction of crest C1 and C3, which originally were separated throughout the ontogeny. Probably environmentally controlled variation in size of carapaces in time has been shown for several species. The pore canals in walls of the Ordovician ostracods and special morphological features, which are believed to have functioned for buoyancy control, are described. Morphology of the tubulous velar structure is described.

Key words: Ostracoda, biostratigraphy, evolution, palaeoecology, variation, shell structures, Ordovician, Holy Cross Mts, Poland.

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INTRODUCTION

The following monograph presents the results of a study of the latest Early, Middle and early Late Ordovician Ostracoda from the Holy Cross Mountains of Poland. The faunas come from the eight meter thick stratigraphically condensed Mójcza Limestone exposure in a quarry on Skała hill at Mójcza, near Kielce. This area is a part of the Małopolska Massif (see DZIK and PISERA 1994, Pl. 1, Text-figs 1–3).

The highly condensed Ordovician strata exposed there range in age from the conodont *Amorphognathus variabilis* Zone, Arenig-Llanvirn boundary beds (early Kundan Stage), to the *Amorphognathus ordovicicus* Zone, early Ashgill (DZIK 1990; DZIK 1994). According to DZIK (1989, 1994) there is a sedimentary break about 1.5 m above the base of the section, corresponding to the late Kundan and early Lasnamagian Stages, i.e. the conodont *Eoplacognathus suecicus* Zone and *E. foliaceus* subzone of the *Pygodus serra* Zone. This gap was probably a result of submarine erosion (DZIK and PISERA 1994).

In the basal part of the section, calcareous sandstone of the *A. variabilis* Zone is exposed, followed by biosparite passing upward into argillaceous biomicrites with shaley intercalations.

The conodonts from the Mójcza limestones were studied also by SPASOV and TELLER (1963), BEDNARCZYK (1966, 1971) and BERGSTRÖM (1971). Recently, the existing information on the Ordovician of the Małopolska Massif was summarized by DZIK (1983, 1989, 1994), DZIK and PISERA (1994), and the DZIK (1994) stratigraphical classification is followed here.

In contrast with Baltoscandia (Estonia, Latvia, Lithuania, St. Petersburg area, Sweden, Norway), Ibero-Armorica and the British Isles where ostracod faunas are sufficiently well documented (cf. VANNIER, SIVETER and SCHALLREUTR 1989), in Poland they are very poorly known. Recently, SZTEJN (1985) began research on Ordovician ostracods of NE Poland (the SW margin of the East European Platform). The following is the first descriptive study of the Ordovician ostracods of the Holy Cross Mountains.

The work was carried out at the Institute of Paleobiology of the Polish Academy of Sciences, Warsaw (abbreviated ZPAL), where the material is housed (coll. n. O.XXV).

Acknowledgements. — I am deeply grateful to Dr. Jean M. BERDAN (National Museum of Natural History, Washington) who carefully read the manuscript and made many very helpful comments concerning both the merits and language. I am grateful to Dr. Lembit SARV (Institute of Geology, Estonian Academy of Sciences, Tallinn) and Dr. Ludmila MELNIKOVA (Institute of Paleontology, Academy of Sciences, Moscow) who allowed me to study the museum collections of Ordovician ostracods. Through the kindness of Dr. Valdar JAANUSSON (Swedish Museum of Natural History, Stockholm) I have had the opportunity to study comparative material from Sweden. The Stefan Batory Foundation is gratefully acknowledged for partial support of this research.

SEM photographs were taken at the Electron Microscopy Laboratory of the Nencki Institute of Experimental Biology, Warsaw.

Figures were drawn by Mrs. D. SŁAWIK (Institute of Paleobiology, Polish Academy of Sciences, Warsaw).

MATERIALS AND METHODS

Samples (0.5–2 kg) were taken for the study at close intervals, each being about 10 cm in thickness. Of these, ostracods were studied from 69 samples. They were extracted from limestones with dilute acetic acid. Specimens are preserved as phosphatic coatings of originally calcitic valves. A free space corresponding to the dissolved calcite wall of the valve can be seen between the outer and inner phosphate layers (Text-fig. 12a). The pore canals within the valves have also been cast in phosphate.

The collection yielded a total of about 8000 specimens. Ostracod shells are most commonly preserved as separate valves. In the Lower Ordovician (*A. variabilis* Zone) part of the section, ostracods are rather rare. Many specimens are fragmented. The assemblages of ostracods from the upper part of the Llasnämagian and Uhaku Stages are the richest and best preserved of all those considered in the monograph. The microborings bearing valves occur in this part of the section in organodetrital limestones (see OLEMPSKA 1986). These assemblages are rich in juvenile specimens as well as species with small adult shell size. Large adult specimens (over 2 mm) are rare and preserved as shell fragments.

Phosphatic linings of ostracod shells occur throughout the lower 2/3 of the section up to the base of the Ashgill. In the uppermost part of the sequence, in argillaceous biomicrites of the Zalesie Formation, ostracod shells were not covered by a phosphatic coat and it was not possible to extract them from the rock. The samples from this part of the section are not included in this study. The state of preservation of the ostracods was highly variable. Some of the specimens were very well preserved with easily identifiable details of microornamentation, while others, represented especially by metacopids, were preserved mostly as moulds. Because of the state of preservation, the structure of hinges and other details of internal morphology were not studied.

Heteromorphs have not been identified in all species expected to display sexual dimorphism.

STRATIGRAPHICAL DISTRIBUTION OF THE OSTRACODS

The stratigraphy of the Mójcza Limestone is based mainly on conodonts (DZIK 1978, 1990, 1994) which enables relatively precise dating of the ostracod assemblages. Text-fig. 1 and Tabs 1–3 summarize the biostratigraphy of Arenig to Ashgill ostracod faunas from the Mójcza Limestone.

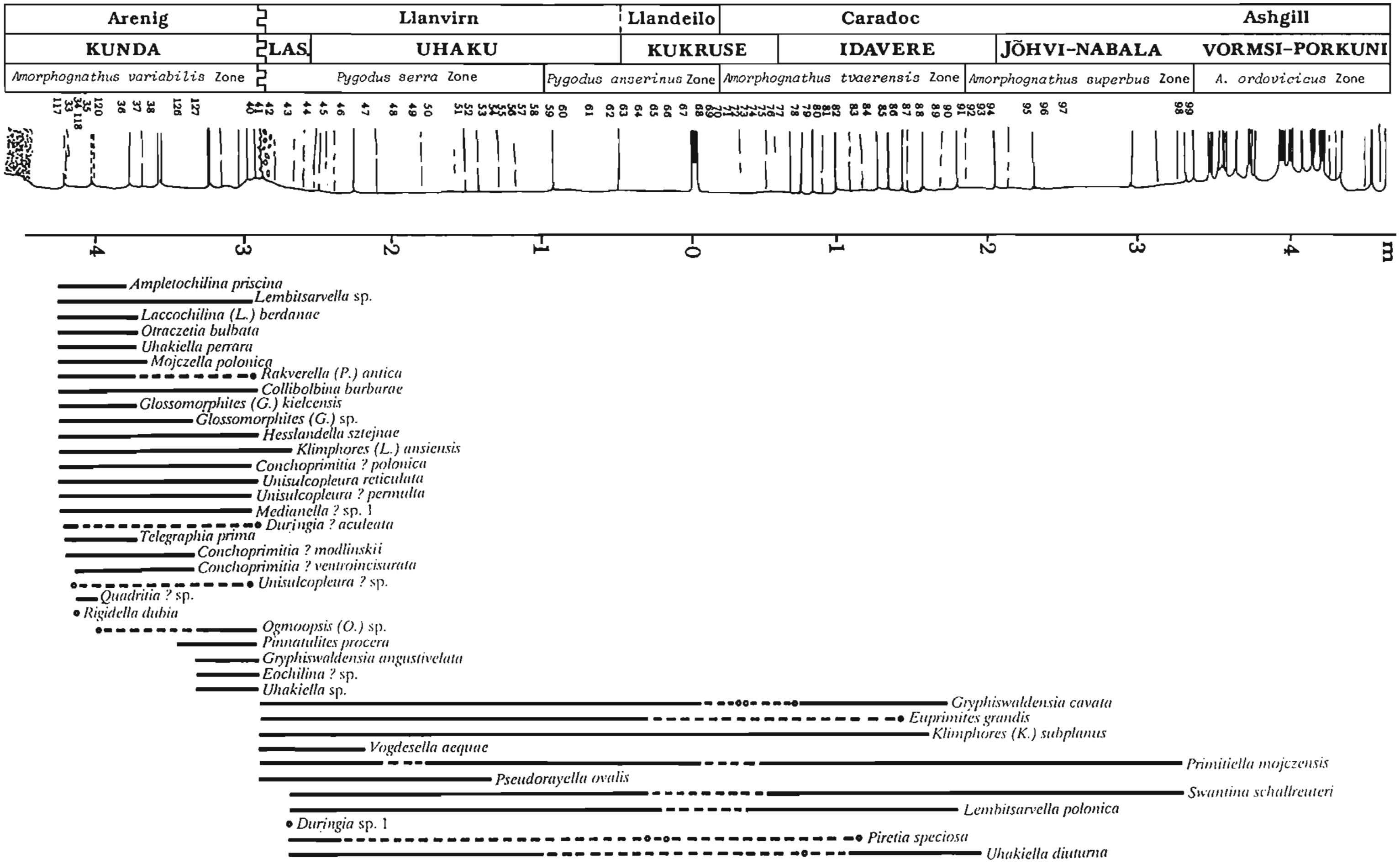

Fig. 1.
Vertical distribution of ostracod species in the Mójcza section.

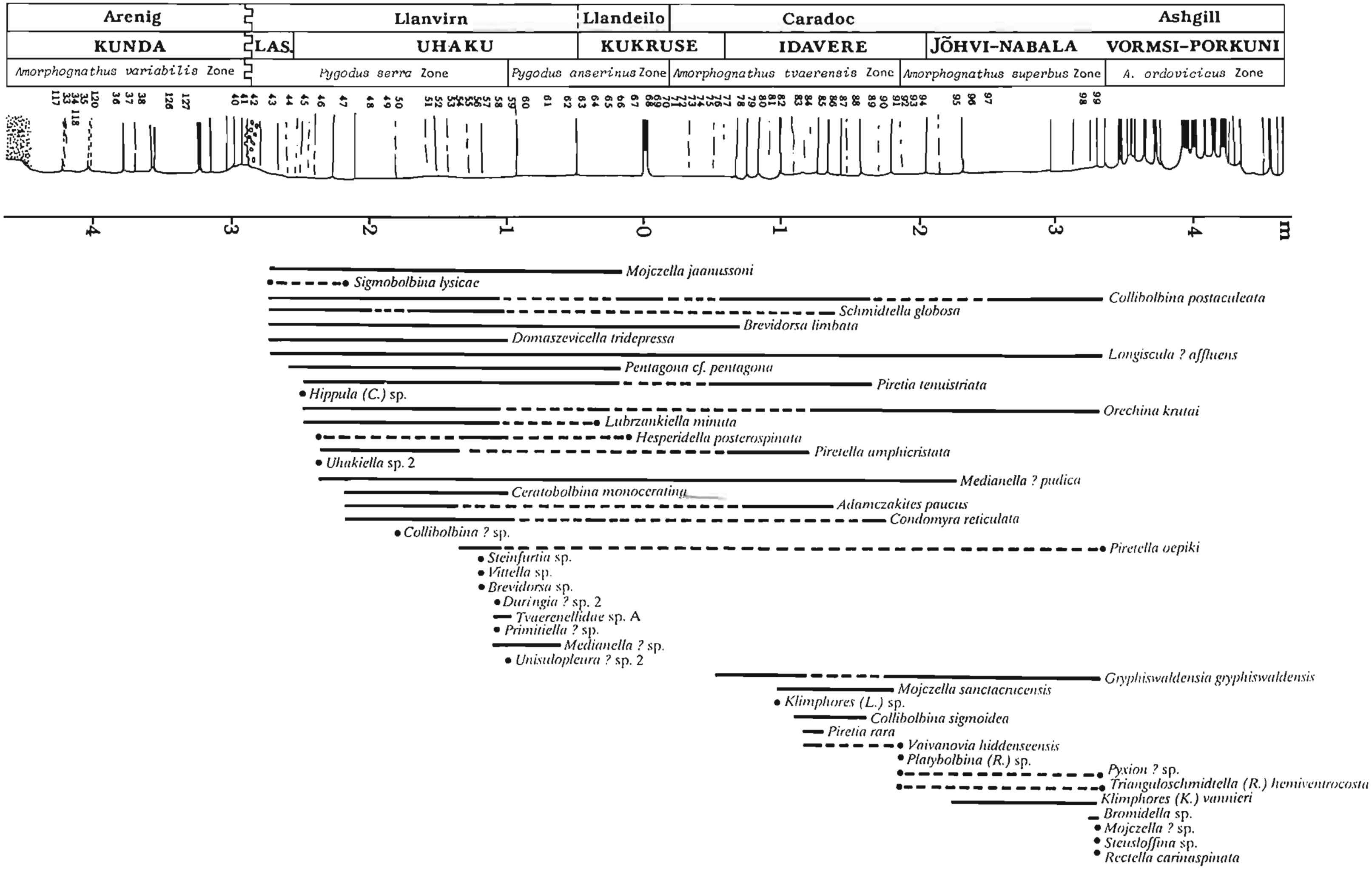

Fig. 1.
(continued)

Many of the ostracods in the Mójcza Limestone show extended stratigraphic ranges which reflect their fairly slow evolution, especially in the Middle Ordovician. Neverthless, some of them do have restricted ranges and can be used as marker species.

EARLY ORDOVICIAN OSTRACODS

The studied interval ranged from 4.3 to 2.85 m below the bentonite layer. It is represented by sandy biomicrites of the conodont *Amorphognathus variabilis* Zone. The ostracod assemblage comprises 28 species (Text-fig. 1, Tab. 1). A majority of them are new taxa. In the basal part of the section 4.3 m to 3.6 m below the bentonite (samples MA-117 to MA-38) the ostracod assemblage is rich and diverse (24 species). Unfortunately, most of the palaeocope species are broken into fragments. The *Mojczella* lineage appears in the Mójcza section close to its base (*M. polonica*) and continues throughout much of the section (see OLEMPSKA 1989).

The species most widely represented in the lowest part of the *A. variabilis* Zone are *Lembitsarvella* sp., *Laccochilina (L.) berdanae* sp. n., *Mojczella polonica* OLEMPSKA, *Otraczetia bulbata* gen. et sp. n., *Hesslandella sztejnae* sp. n., *Rakverella (P.) antica* sp. n., *Collibolbina barbarae* sp. n., *Glossomorphites (G.) kielcensis* sp. n., *Unisulcopleura reticulata* sp. n., *U.*? *permulta* sp. n., *Conchoprimitia*? *modlinskii* sp. n., *C.*? *polonica* sp. n., *C.*? *ventroincisurata* HESSLAND, and *Klimphores (Laterophores) ansiensis* GAILITE. Numerous specimens of *Medianella*, identified however only to the generic level, are also present. Of this assemblage, only *C.*? *ventroincisurata* and *K. (L.) ansiensis* have been recorded in the Lower Ordovician of Baltoscandia. *C.*? *ventroincisurata* has been found in the Lower Ordovician deposits of Siljan District in Sweden (HESSLAND 1949), it is limited to the lower part of the "G" layer (lower part of the Kundan Stage, its Hunderumian and Valastean Substages). *K. (L.) ansiensis* in Latvia was found in the sediments of the Kundan Stage (GAILITE 1971). In the samples representing the upper part of the *A. variabilis* Zone (samples MA-126 to MA-41), *Pinnatulites procera* (KUMMEROW) appears and is an important marker for this level in Mójcza. *P. procera* was described (HESSLAND 1949) from the upper part of the "G" layer in Siljan District of Sweden (Kundan Stage – Valastean Substage). In northern Estonia, *P. procera* has been found in the B IIIβ and B IIIγ substages (SARV 1959), in the same substages in Latvia (GAILITE and ULST 1972; MÄNNIL 1966) and Lithuania (SIDARAVIČIENE 1976, 1992). In addition to the *P. procera* in these samples, *Gryphiswaldensia angustivelata* sp. n., *Eochilina*? sp. and *Uhakiella* sp. make their appearance. About 1.5 m above the base of the limestone section there is a sedimentary break corresponding to the late Kundan and Early Lasnamägian Stages. At the discontinuity surface species of *Conchoprimitia, Glossomorphites, Rakverella, Ogmoopsis, Pinnatulites* and *Laccochilina* disappear.

A number of genera such as *Klimphores, Collibolbina, Mojczella,* and *Lembitsarvella* continue their evolution in the Middle Ordovician sediments, and new species appear there which are undoubtedly related to those in the Lower Ordovician. *K. (L.) ansiensis* is the only species that ranges into overlying *Pygodus serra* Zone.

MIDDLE ORDOVICIAN OSTRACODS

The *Pygodus serra* Zone deposits are represented by organodetrital limestones (samples MA-42 to MA-58). Just above the discontinuity surface, numerous new taxa of ostracods appear (Text-fig. 1, Tabs 1, 2). This assemblage consists predominantly of the palaeocope species *Lembitsarvella polonica* sp. n., *Swantina schallreuteri* sp. n., *Gryphiswaldensia cavata* sp. n., *Euprimites grandis* sp. n., *Uhakiella diuturna* sp. n., *Piretia speciosa* sp. n. and *Collibolbina postaculeata* sp. n. All these species are long-ranging and of limited value for age definition. The *Mojczella* lineage is represented here by *M. jaanussoni* OLEMPSKA, appearing in this part of the section and passing higher up (see OLEMPSKA 1989). At the base of the *P. serra* Zone, *Primitiella mojczensis* sp. n. makes its appearance and occurs in great numbers. *Sigmobolbina lysicae* sp. n., *Vogdesella aequae* sp. n. and *Pseudorayella ovalis* NECKAJA are resticted to the lower part of the *Pygodus serra* Zone and are thus important markers for this part of the section. *Domaszevicella tridepressa* sp. n. disappears close to the uppermost sample of the *Pygodus serra* Zone.

In the overlying deposits (samples MA-45 to MA-46), *Piretia tenuistriata* sp. n., *Orechina krutai* sp. n. and *Lubrzankiella minuta* sp. n., *Hesperidella posterospinata* sp. n., *Piretia amphicristata* sp. n., *Medianella*? *pudica* sp. n., and ostracods identifiable only to generic level (*Uhakiella, Hippula*) make their appearance.

In the middle part of the *P. serra* Zone, *Condomyra reticulata* SCHALLREUTER makes its appearance, known until now only from Upper Ordovician Öjlemyrflint erratic boulders (SCHALLREUTER 1968b, 1986). Its range in the Mójcza Limestone corresponds to a part of the Uhakuan, Kukrusean, and Idaverean Stages. Another important species appearing in the same part of the sequence (sample MA-47) is *Ceratobolbina monoceratina* (JAANUSSON), restricted to the Uhakuan and Kukrusean Stages in Baltoscandia (JAANUSSON 1957; SARV 1959). In Mójcza only tecnomorphic valves of this species have been found. In the upper part of the *Pygodus serra* Zone, *Piretella oepiki* THORSLUND makes its appearance. In Mójcza it is a long ranging species (up to the *Amorphognathus superbus* Zone), in Baltoscandia *P. oepiki* is restricted (THORSLUND 1940) to the upper *Chasmops* series (late Caradoc). Taxonomically, the upper part of the *P. serra* and the lower one of *Pygodus anserinus* Zones are fairly similar in composition.

No significant faunal change was connected with the bentonite deposition. Above the bentonite layer (samples MA-67 to MA-83) in the upper part of the *Pygodus anserinus* and the lower part of *Amorphognathus tvaerensis* Zones, the ostracod assemblage is less rich and diverse compared to that of the *P. serra* and the lower part of *P. anserinus* Zones.

The assemblage of the *A. tvaerensis* Zone consists predominantly of a metacope *Medianella*? *pudica* sp. n. and *Longiscula*? *affluens* sp. n. Palaeocopes disappear in this Zone or are very rare. In the middle part of the *A. tvaerensis* Zone (sample MA-76), *Gryphiswaldensia gryphiswaldensis* SCHALLREUTER makes its appearance. According to SCHALLREUTER (1975a) this species is common in Backsteinkalk erratic boulders (lower Upper Viruan). In the upper part of the *A. tvaerensis* Zone, 1.1 m above the bentonite layer (samples MA-83 to MA-85) palaeocopes *Lembitsarvella polonica* sp. n., *Gryphiswaldensia cavata* sp. n., *Uhakiella diuturna* sp. n., *Swantina schallreuteri* sp. n., and *Collibolbina postaculeata* sp. n. reappear abruptly. The upper boundary of the *A. tvaerensis* Zone is not crossed by *G. cavata, L. polonica*, and *U. diuturna*, the last two named species reappear higher.

The most significant ostracod in the *A. tvaerensis* Zone is *Mojczella sanctacrucensis* OLEMPSKA, the end-member of the *Mojczella* evolutionary lineage. In the upper part of the *A. tvaerensis* Zone, *Vaivanovia hiddenseensis* SCHALLREUTER makes its appearance, described by SCHALLREUTER (1966) from Backsteinkalk erratic boulders (lower Upper Viruan). Taxonomically, the upper part of the *A. tvaerensis* Zone and lower part of the *Amorphognathus superbus* Zone (samples MA-84 to MA-93) are fairly similar in composition to the strata below in the section.

LATE ORDOVICIAN OSTRACODS

A significant change in the composition of ostracode species took place in the upper part of the *A. superbus* Zone (sample MA-99, Text-fig. 1, Tab. 3). A number of species make their appearance: *Trianguloschmidtella (Rempesgrinella) hemiventrocosta* (KNÜPFER), *Rectella carinaspinata* SCHALLREUTER, *Klimphores (K.) vannieri* sp. n., *Bromidella* sp., *Steusloffina* sp. *R. carinaspinata* was described by SCHALLREUTER (1972) from Öjlemyrflint erratic boulders (Upper Ordovician).

Sediments which represent the *Amorphognathus ordovicicus* Zone (samples MA-100 to MA-116) contain a rich fauna of ostracods, but it was not possible to extract them from the rock.

AFFINITIES OF THE MÓJCZA OSTRACODS

The comparison between the ostracod assemblages of three major Ordovician palaeogeographic domains of Europe: Baltoscandia, Ibero-Armorica and the British Isles, and that of the Holy Cross Mountains Ordovician ostracod assemblages, shows that they are different with regard to specific

	Holy Cross Mts Baltoscandia	Holy Cross Mts - British Isles	Holy Cross Mts - Ibero-Armorica
Palaeocopa	*Platybolbina* /R./	*Platybolbina* /R./	
	Ampletochilina		
	Swantina		
	Piretella		
	Hesperidella		
	Laccochilina /L./		
	Duringia	*Duringia*	
	Gryphiswaldensia		
	Steinfurtia		
	Hithis		
	Bromidella		
	Uhakiella	*Uhakiella*	
	Euprimites	*Euprimites*	*Euprimites*
	Piretia		
	Quadritia	*Quadritia*	*Quadritia*
	Rigidella		
	Rakverella /P./		
	Ogmoopsis /O./		
	Sigmobolbina		
	Pentagona		
	Ceratobolbina		
	Hippula /C./		
	Hesslandella		
	Glossomorphites		
	Vittella	*Vittella*	*Vittella*
	Collibolbina		
Binodicopa	*Klimphores* /K./	*Klimphores* /K./	*Klimphores* /K./
	Klimphores /L./	*Klimphores* /L./	*Klimphores* /L./
	Vaivanovia		
	Vogdesella	*Vogdesella*	*Vogdesella*
	Orechina		
	Pyxion		
others	*Brevidorsa*		*Brevidorsa*
	Conchoprimitia		*Conchoprimitia*
	Primitiella		*Primitiella*
	Unisulcopleura		
	Pinnatulites		
	Rectella		
	Longiscula		
	Trianguloschmidtella /R.		
	Medianella		*Medianella*
	Condomyra		

Fig. 2.
Ordovician (Arenig-Ashgill) genera common between Holy Cross Mountains and Baltoscandia, British Isles and Ibero-Armorica. Data from the three latter regions after VANNIER *et al.* (1989).

content, but have many genera and subgenera in common. Recently, the existing information on the Ordovician ostracods in these palaeogeographic regions was summarized by VANNIER *et al.* (1989). Over 250 ostracod genera have thus far been recognized in Ordovician ostracod faunas of Baltoscandia, the British Isles, Armorica (see VANNIER *et al.*, 1989), and Bohemia (SCHALLREUTER and KRŮTA 1988). They represent four orders (Beyrichiocopa, Platycopa, Leperditicopa, Podocopa) and are subdivided into over 50 families. Ordovician ostracods of Europe, and especially those of the Baltic region, show substantial differentiation at all taxonomic levels. Palaeocopes and binodicopes represent 85% of all genera. A palaeocopid domination increases from the Ibero-Armorican Massif through the British Isles and reaches its maximum in the Baltic region (VANNIER *et al.* 1989). According to these authors, the most extensive generic similarities are between Baltoscandia and the British Isles in the Late Ordovician.

The ostracod generic links most clearly occur between the Holy Cross Mountains and Baltoscandia. These regions have 42 genera in common (Text-fig. 2). Palaeocopes and binodicopes represent the dominant components in these regions.

The Early Ordovician palaeocope fauna of the Holy Cross Mountains and Baltoscandia posesses 9 genera in common (53%); 5 palaeocope genera, one binodicope (*Klimphores*), one eridostracan

(*Conchoprimitia*) and two metacope genera (*Pinnatulites, Medianella*). Differences in the character of ostracod assemblages between Baltoscandia and the Mójcza section of the Małopolska Massif, are mainly expressed by the absence in the Holy Cross Mountains of a number of genera very characteristic of Baltoscandia. In the Early Ordovician, such characteristic genera as *Aulacopsis, Tallinella, Tallinellina, Piretopsis, Protallinella* and many others do not occur in the Mójcza Limestone.

The Kundan ostracod assemblages in Baltoscandia along with *Pinnatulites* are dominated by species of *Conchoprimitia*. A few species of *Conchoprimitia* are found in Mójcza, represented mostly by new species. The Early Ordovician ostracods from other regions are poorly documented, the lack of information being related to lithological factors, e.g. coarse-grained deposits in Ibero-Armorica (see VANNIER *et al.* 1989).

In the Middle Ordovician, the Holy Cross Mountains and Baltic ostracod faunas show strong similarities at the generic level. These regions have 27 ostracode genera in common in the Middle Ordovician; 15 palaeocope genera, 6 binodicope genera, one leiocopes, two platycope genera and 3 metacope genera. Many palaeocope genera important in Baltoscandia such as *Steusloffia, Tetrada, Tetradella, Oepikella, Chilobolbina, Laccochilina, Tallinella, Polyceratella*, and others are absent in the Holy Cross Mountains Middle Ordovician deposits. Generic affinities exist in the Early and Middle Ordovician with Sweden or Estonia as well as north-eastern Poland, which belongs to the East European Platform. Ordovician ostracods in NE Poland are of the Baltic type, being particularly close to those of Lithuania and Latvia (SZTEJN 1985). There are no species in common with the Holy Cross Mountains there. Two palaeocope genera (*Euprimites, Vittella*), two binodicope (*Klimphores, Vogdesella*), one platycopid (*Primitiella*), and one metacopid (*Medianella*) are also common to the Holy Cross Mountains and Ibero-Armorica in the Middle Ordovician. Generic affinities between the Holy Cross Mountains and the British Isles are not numerous, four genera being in common in the Middle Ordovician (*Duringia, Vittella, Klimphores*, and *Vogdesella*). The Ashgillian ostracod fauna is only partly documented in the Mójcza section. There are some differences between the Holy Cross Mountains and Baltoscandian ostracod faunas in the Ashgill. Binodicopes and metacopes are relatively much more important components in the Holy Cross Mountains and palaeocopes are relatively less important than in Baltoscandia. These two regions have 11 ostracode genera in common in the Ashgill; 5 palaeocopes (*Platybolbina, Swantina, Piretella, Gryphiswaldensia, Bromidella*), two binodicopes (*Klimphores, Orechina*) and four podocope genera (*Rectella, Trianguloschmidtella, Steusloffina* and *Medianella*). The Ashgill is characterizes by very low generic affinities between the Holy Cross Mountains and Ibero-Armorica and the British Isles. The Holy Cross Mountains and Bohemia have only one genus (*Orechina*) in common in the Late Ordovician (see SCHALLREUTER and KRŮTA 1988).

SCHALLREUTER and SIVETER (1985) analyzed the composition of Ordovician and Silurian ostracod faunas in Europe (southern Britain and Baltoscandia) and North America, on both sides of the Iapetus Ocean. They found many genera common to both of these regions, contrary to the current view about the complete isolation of Ordovician ostracods in both of these areas. The suspected width of the Iapetus Ocean during the Ordovician was about 2000–3000 km (WILIAMS 1980; MCKERROW, and COKS 1976). SCHALLREUTER and SIVETER (1985) suggest the possibility of a smaller width of the Iapetus Ocean with a smaller depth or presence of "islands", which eased animal migration.

Ordovician ostracods of the Holy Cross Mountains show weak connections with the ostracode faunas of the North American Midcontinent (Laurentia). Only the Middle Ordovician genera *Vittella* and *Klimphores* present in Mójcza are also found in the Llandeilo of South Wales (SCHALLREUTER and SIVETER 1985). Many other genera are missing in Mójcza including *Pseudulrichia, Tallinnellina, Cryptophyllus*, and others present either in Baltoscandia or in North America (cf. SCHALLREUTER and SIVETER 1985). In the Late Ordovician ostracod faunal connections between the Baltoscandia and North America are substantially stronger. Unfortunately, in the Mójcza Limestone, Late Ordovician ostracods are very poorly preserved and difficult to identify. Rare links exist at the generic level between the Holy Cross Mountains, N-E Asia, and Kazakhstan (KANYGIN 1971; MELNIKOVA 1986).

ENVIRONMENTAL CONDITIONS

The highly condensed Ordovician in the Mójcza section consists predominantly of carbonates, except for sandy deposits in the lower part of the section and marly sediments at the top. In this area the sediments were formed in the sublittoral, shallow neritic environment (DZIK 1976; SZULCZEWSKI 1977; MODLIŃSKI 1982). For interpretation of relative depth, water energy, intensity of bioturbation, rate of sedimentation etc., the fossil ostracod assemblage may yield useful information.

Ostracods are preserved in the Mójcza section almost exclusively as separate valves instead of closed carapaces, which is suggestive of the low rate of accumulation (POKORNÝ 1965; OERTLI 1971; ADAMCZAK 1981; GUERNET and LETHIERS 1989). In thin sections perpendicular to the bedding plane, concave-up orientation of the valves, which could have suggested shell resedimentation after a period of turbulence, has not been found. Convex-up orientation of the valves suggesting current effects (GUERNET and LETHIERS 1989) was also not found. A decisive majority of the valves is found in the "normal" position (partly convex-up, partly concave-up) with a certain amount of the shells in a vertical orientation to the bedding plane. Vertical orientation of ostracod shells suggests intersedimentary animal activity and sediment mixing (ADAMCZAK 1981). While studying ostracod shell orientation in the sediments of the Silurian of Gotland, ADAMCZAK (1981) observed that the relation of vertically oriented ostracod valves compared with other valve positions (convex-up, concave-up) provides a measure for the intensity of bioturbation. The bioturbation index proposed by ADAMCZAK (1981) could not be objectively calculated in individual thin sections of limestones from Mójcza due to the excess amount of ostracod fragments difficult to orient. The samples do not show any apparent reworking. The absence of mixed conodont (DZIK 1990, 1994) and ostracod faunas as well as the small number of vertically oriented ostracod valves suggest that the depth of bioturbation was very low, probably not exceeding a few centimeters.

In the sediments at the end of the Llandeilo the amount of ferruginous ooids in the sediment increases, but the genesis and the environment of ferruginous ooids is still debated (cf. DZIK and PISERA 1994). In this part of the section, ostracod shells serially inserted into one another are often found. This "saucer stack" effect is often observed (GUERNET and LETHIERS 1989) when a large quantity of shells of one species, usually with a smooth shell surface, are present on the bottom and are slightly but systematically moved by water. This type of environmental energy is present near the banks of lakes and lagoons (GUERNET and LETHIERS 1989). Bioerosion is also documented in ostracod valves (OLEMPSKA 1986).

In the sediments of the Llanvirn, Llandeilo, and Caradoc in Mójcza, many species display ornamentation such as reticulation and costation for strenghtening the carapace. According to BENSON (1975, 1981), LIEBAU (1977), PEYPOUQUET (1979), and BECKER and BLESS (1990) shallow water species in an environment with a favourable chamical gradient for the precipitation of calcite are capable of secreting massive shells with redundant structural elements. More primitive types of ornament were maintained in the quiet waters of the marine deep sublittoral and bathyal zones. Reticulation with equal-sized fossae and high broadened muri present in the species of *Klimphores* common in the Mójcza sediments, according to LIEBAU (1977) is an adaptation to protect the pore clusters or to strengthen the shell in turbulent shallow waters. The area of the Mójcza Limestone formation did not represent, however, the marginally shallow littoral sedimentation zone. Periods of weaker and stronger bottom water turbulence with small displacement of a part of the sediments could have been an important feature of the Mójcza limestone sedimentation. It is also possible that it took place close to the zone of "upwelling" currents, which support the rich development of animal life. In zones of such current activity, substantial quantities of phosphates, so characteristic of Mójcza limestones, are present. According to DZIK and PISERA (1994) the deposition of Mójcza limestones took place in an extremely stable environment with very slow sedimentation rate and with a homogenization of the sediment by very shallow bioturbation. The absence of entire macrofossils was caused by their destruction during prolonged period of exposure on the sea bottom and such exposure was also necessary for the origin of phosphatic envelopes (DZIK and PISERA 1994).

FAUNAL DYNAMICS OF THE MÓJCZA OSTRACODS

Ostracod faunal dynamics, that is, changes in the composition of ostracod assemblages in time and space with respect to environmental conditions, as reflected in lithology, were analyzed (according to JAANUSSON's 1976 methodology) in the entire Mójcza section begining with the Kundan up to the Upper Ordovician (sample MA-99). This analysis was biased by the varying state of preservation of the specimens some of which, those without phosphate coating, were lost during chemical preparation.

The number of specimens in a sample was counted and their relative frequency calculated. A quantitative composition of each ostracod sample yielding at least 10 specimens its present in the diagram of relative abundance (Text-fig. 3). Only species that form 10% or more of the total number of ostracods in at least one sample are shown, the remaining are grouped as "others". Each separate valve was counted as one specimen. Fragmented valves were not counted. No lower size limit was applied. Because only one sequence has been investigated to date, it is difficult to analyze the distribution of assemblages and species of ostracods in relation to lithofacies. It is not always clear which changes were the results of local environmental events, and which depended on interregional factors.

Clear lithologic changes in the Mójcza section are found on the boundary between the Kundan and Lasnamägian stages, where sandy biosparenites are replaced by organodetrital limestones. Another significant lithologic change is found at the top of the sequence where argillaceous biomicrites appear.

The lower part of the *Amorphognathus variabilis* Zone is charactrized by the domination of *Unisulcopleura*? *permulta* sp. n., whose relative frequency varies between 8% and 32% in all samples from this part of the sequence. *Conchoprimitia*? *polonica* sp. n. whose relative frequency in this part of the profile varies between 12 and 25% with the exception of sample MA-33, where it achieves 54% of total content, is subdominant. The remaining 25 species which appear in the lowest part of the section do not exceed a few percent of each sample content and six of them, *Mojczella polonica, Collibolbina barbarae, Hesslandella sztejnae, Klimphores (L.) ansiensis, Unisulcopleura reticulata* and *Medianella*? sp. appear with a frequency below 15%. *Pinnatulites procera* appears rather abruptly in large numbers in sample MA-126. At the beginning it constitues 27–48% of the total content and in sample Ma-40 it achieves about 70% of the contents of the assemblage. As in other areas of the Baltic region, this species disappears completely with the upper Kundan boundary. In Baltoscandia one of the most pronounced changes in the Ordovician carbonate sequences took place at the boundary between the Kundan and Aserian Stages. Many genera disappear in the ostracode fauna at this level (MÄNNIL 1966; JAANUSSON 1960, 1976).

The most significant change in the ostracod fauna in the Mójcza section took place at the discontinuity surface. *Glossomorphites, Pinnatulites, Rakverella, Conchoprimitia*, and *Laccochilina* characteristic for all of Baltoscandia in the Kundan Stage, disappear completely. In the Mójcza section these genera do not appear again in the upper parts of the section, while some genera such as *Conchoprimitia, Laccochilina, Rakverella*, and others in the other Baltic areas continue their evolution and are represented by a number of species characteristic of the Middle Ordovician.

The discontinuity surface is associated with a significant turnover in the ostracod faunas, and numerous new taxa appear. The gap at Mójcza corresponds to the basal Viru discontinuity surface in the Baltic area, and terminal Llanvirn regression in Wales and China (cf. DZIK and PISERA 1994). In the lower part of the *Pygodus serra* Zone the assemblage is dominated by the following three species (with the maximum abundance given in brackets): *Primitiella mojczensis* (73% in sample MA-42), *Klimphores (K.) subplanus* (25% in sample MA-45), and *Vogdesella aequae* (14% in sample MA-43). The upper part of the *Pygodus serra* Zone is dominated by *Longiscula*? *affluens* (44% in sample MA-56) and *Gryphiswaldensia cavata* (27% in sample MA-51). Specimens of *Klimphores (K.) subplanus* are also comparatively numerous (19–21% in samples MA-52, MA-54). Numerous palaeocope species occurring there are present in small numbers. The assemblage from the lower part of the *Pygodus anserinus* Zone is similar to those in the upper part of the *P. serra* Zone but are poorer in genera and species.

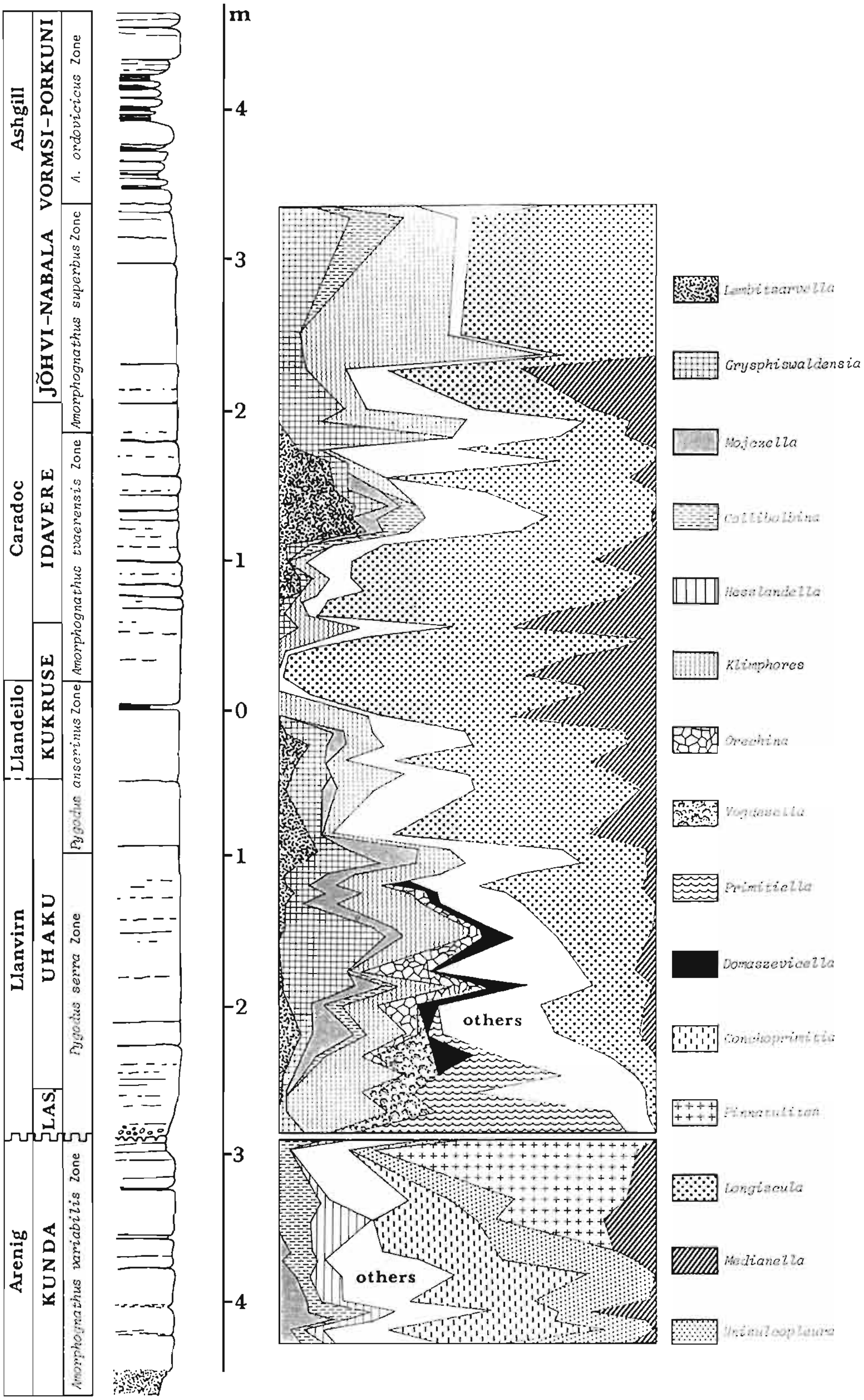

Fig. 3.

Log of percent frequency for ostracod genera in the Mójcza section (see text for full explanation).

The most profound ostracod faunal change takes place in the upper part of the *Pygodus anserinus* Zone and the lower part of the *Amorphognathus tvaerensis* Zone (the part of sequence just above the bentonite layer). The ostracod assemblage is characterized by a drastic decrease in the diversity of species. Palaeocope and binodicope species became rare and the metacope *Longiscula*? *affluens* dominates, occasionally with a frequency of up to 78% (sample MA-74), together with the metacope *Medianella*? *pudica* (33% in sample MA-71). The faunal change is also expressed here in conodont species diversity (DZIK 1994). This faunal change is not connected with any significant change in the sedimentation regime. This was probably a result of the basal Caradoc transgression, and suggests a warming of the climate (cf. DZIK and PISERA 1994). The assemblage of the upper part of the *Amorphognathus tvaerensis* Zone is characterized by an increase in the relative frequency of palaeocope species, *Lembitsarvella polonica* (up to 23% in sample MA-84), *Gryphiswaldensia cavata* (up to 9% in sample MA-86), *Mojczella sanctacrucensis* (9% in sample MA-87), *Collibolbina sigmoidea* (up to 12% in sample MA-84). This part of the sequence is marked by a decrease in the frequency of metacope species, but they are still dominant forms (*Longiscula*? *affluens* up to 52% in sample MA-90). New species also appear but are in insignificant quantities.

Ostracod assemblage of the *Amorphognathus superbus* Zone are dominated by the following three species: *Longiscula*? *affluens* (up to 52% in sample MA-97), *Klimphores (K.) vannieri* (up to 63% in sample MA-96) and *Gryphiswaldensia gryphiswaldensis* (up to 44% in sample MA-91). At sample MA-99, the next change in the ostracod fauna takes place. *Trianguloschmidtella (Rempesgrinella) hemiventrocosta*, *Steusloffina* sp., *Bromidella* sp., *Rectella carinaspinata* make their appearance. They constitue a very small percentage of the assemblage. *Longiscula*? *affluens* is still the dominant species in this sample (30% of the total content). *Klimphores (K.) vannieri* (24% of the total content) and *Orechina krutai* (14%) are also important components of the assemblage.

The result of the investigations indicate clearly that in the Mójcza Limestone there are major changes in the ostracod fauna primarily at three stratigraphic levels: (1) the discontinuity surface, Kundan-Lasnamägian boundary, (2) upper Kukrusean interval, (3) early Ashgill interval. These levels are also associated with major changes in the fauna of conodonts (see DZIK 1990; DZIK and PISERA 1994).

With reference to the ecological model of BRETSKY and LORENTZ (1970), VANNIER *et al.* (1989) recognized two main types of Ordovician ostracod faunas: binodicope-rich faunas typically associated with a clastic and unstable environment, such as Ibero-Armorica, and more diversified, palaeocope-rich faunas typically associated with more stable conditions and carbonate sedimentation, such as in Baltoscandia. The Middle Ordovician ostracod fauna from Mójcza belongs to the second type, characterized by a palaeocope-binodicope ratio bigger than 1. This type of paleobiological model of VANNIER *et al.* (1989) refers to stable environmental conditions, high diversity, low frequency, high evolution rates and low persistence of stable community structure and high spatial heterogeneity. Assemblages that can be classified as belonging to this type are recognizable in Mójcza only in Lasnamägian, Uhakuan and early Kukrusean time. In the late Kukrusean and early Idaverean Stages, the composition of the assemblage changes, but without change in carbonate sedimentation. Metacopes play the diminant role here.

Often, the relative frequency of palaeocopes is higher in extremely shallow water environments than in beds deposited at some depth (KAESLER and PETERSON 1977; JAANUSSON 1979). In Recent benthic assemblages, as long as other conditions are constant, species frequency does not vary much beneath 150–250 m of sea depth. Large differences in species frequency within the shelf region do not appear to be depth dependent, but are primarily controlled by factors such as substrate and variety of niches (JAANUSSON 1979). JAANUSSON and BERGSTRÖM (1980) suggested that temperature, rather than depth, could have been one of the more important factors controlling the distribution of confacies belts in the Ordovician. According to JAANUSSON (1984) the changes in Ordovician benthic associations along environmental gradients (e.g. graptolitic shale to coarse grained sediments) were more substrate-dependent than depth-related, although of course depth remains one of the parameters.

Differences in ostracode diversity and composition of ostracode fauna in Mójcza probably were thus not controlled as much by facies defferences as by climatic changes (see also DZIK and PISERA 1994).

BIOGEOGRAPHIC POSITION OF THE MÓJCZA OSTRACODS

The Małopolska Massif, according to data available to date, was the Ordovician area closest geographically and faunistically to the East European Platform (Baltoscandia). These two areas were separated by a belt of deep-sea, possibly oceanic sediments. There was no continuation between the carbonate platforms of these areas (MODLIŃSKI 1982; DADLEZ 1987; DZIK 1983, 1990; DZIK and PISERA 1994). The problem of distance from the Holy Cross Mountains to the East European Platform in the Ordovician has been the subject of many works. Except for paleomagnetic data, often saddled with a large margin of error, the most significant in this debate are faunistic studies, especially of the benthic faunas. Ostracods described here, except for trilobites and brachiopods are one of the most important groups.

Palaeomagnetic investigations published by LEWANDOWSKI (1987) indicate 60° paleolatitude of the southern hemisphere for the Lower Ordovician Bukówka sandstone from Mójcza. LEWANDOWSKI (1987) suggests a 35–40° paleolatitude gap between East European Platform and the Małopolska Massif, and a 4000 (±2000) kilometers wide ocean between the Platform and the southern part of the Holy Cross Mountains in the Late Cambrian – Early Ordovician time. In his opinion the Holy Cross Mountains area travelled with an averaged velocity of approximately 4 cm/year from a polar province in the Middle/Late Cambrian times, through subpolar latitudes in the Early Ordovician to the equatorial zone at the end of the Silurian. The new paleomagnetic data (LEWANDOWSKI 1993) suggest the translation of the southern region of the Holy Cross Mountains during the Variscan orogeny, on the distance ca. 1000 km, from the recent position of the Crimean Penninsula along the present day East European Platform border.

Studies of Middle Ordovician trilobites, brachiopods and conodonts demonstrate that faunistic differences between the carbonate platform of the Małopolska Massif and the East European Platform were not big enough to support the concept of separation of these regions by a wide ocean or attribution to different climatic zones. DZIK and PISERA (1994) suggest the presence of about a 350 kilometer wide deep zone separating the Małopolska Massif and East European Platform during the Ordovician.

The comparison between the Baltic and Mójcza Ordovician ostracod assemblages shows that they are different in regard to specific content, but yield many common genera. Therefore I suggest that the part of the Törnquist Sea separating the Holy Cross Mountains from Baltica could not be as wide as suggested by LEWANDOWSKI (1987). However, it was probably wider then 100–200 kilometers.

CHRONOMORPHOCLINES IN THE MÓJCZA OSTRACODS

Quantitative research on intra- and inter-population variability of ostracod species in the Mójcza Limestone has resulted in recognition of several small but significant shifts in the morphology of the carapace over time. It was possible to do this in the case of species with long continuous ranges and in the case of related species, possibly representing a punctuated record of continuous lineages. The study has been focused on changes in the ostracod shell size and ornamentation. A tendency among many species to increase shell size with time and among certain species to "strengthen the shell" by the development of shell surface crests was observed.

The microornamentation shows almost no variation in both ontogeny and phylogeny. No modifications of the lateral outline of the shell have been observed.

VARIATION IN SIZE OF CARAPACE

An analysis was carried out of the variation of 11 ostracod species which are present in the Mójcza section in larger quantities of specimens and for relatively long period of time. Length and height of valves of all moult stages in each population were measured and then shell size distribution in each

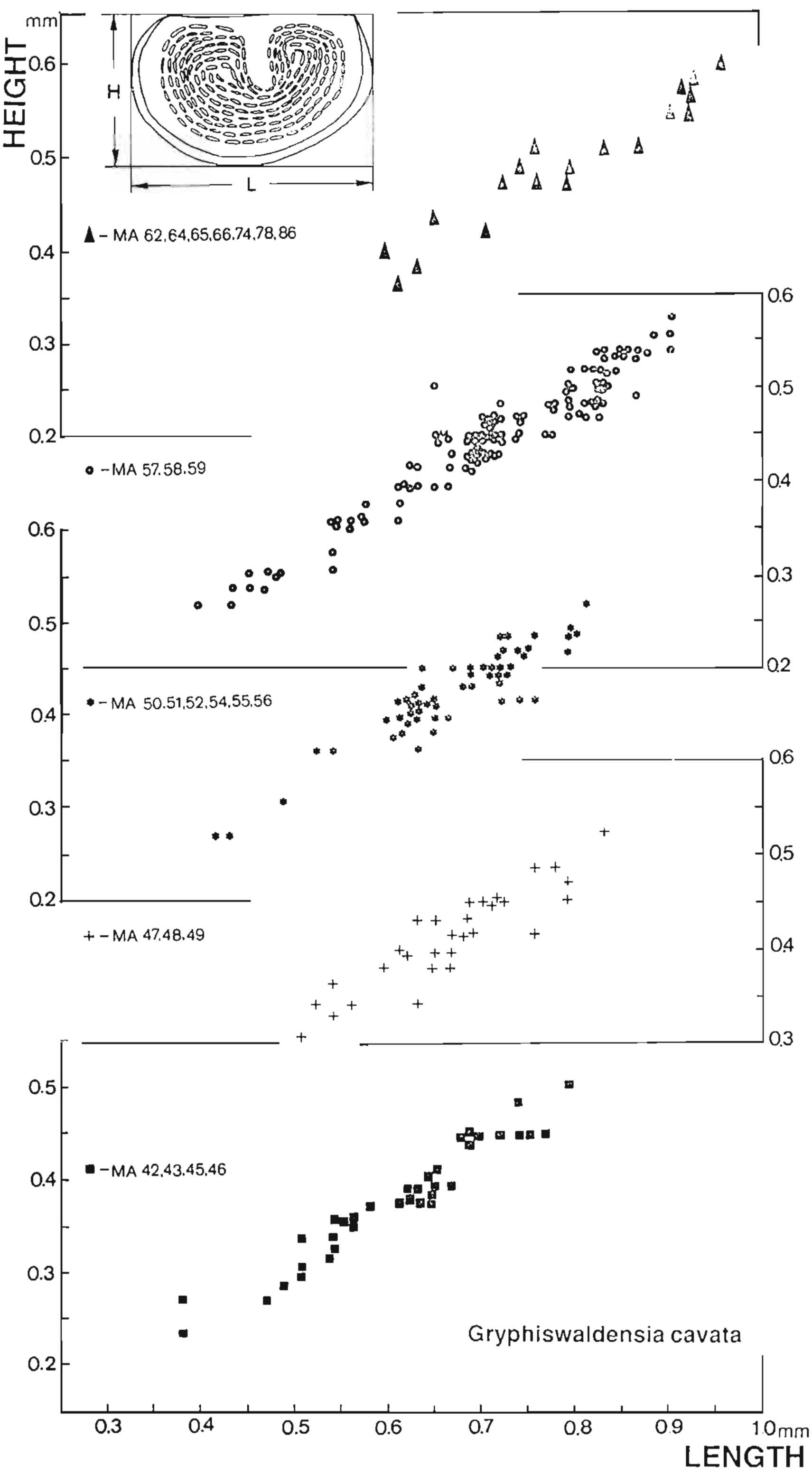

Fig. 4.

Size dispersion of *Gryphiswaldensia cavata* sp. n. Samples MA-42, 43, 45, 46 – lower part of the *Pygodus serra* Zone; samples MA-47, 48, 49 – middle part of the *Pygodus serra* Zone; samples MA-50, 51, 52, 54, 55, 56; samples MA-57, 58, 59 – upper part of the *Pygodus serra* to the lower part of the *Pygodus anserinus* Zone; samples MA-62, 64, 65, 66, 74, 78, 86 – middle part of the *Pygodus anserinus* Zone to the middle part of the *Amorphognathus tvaerensis* Zone.

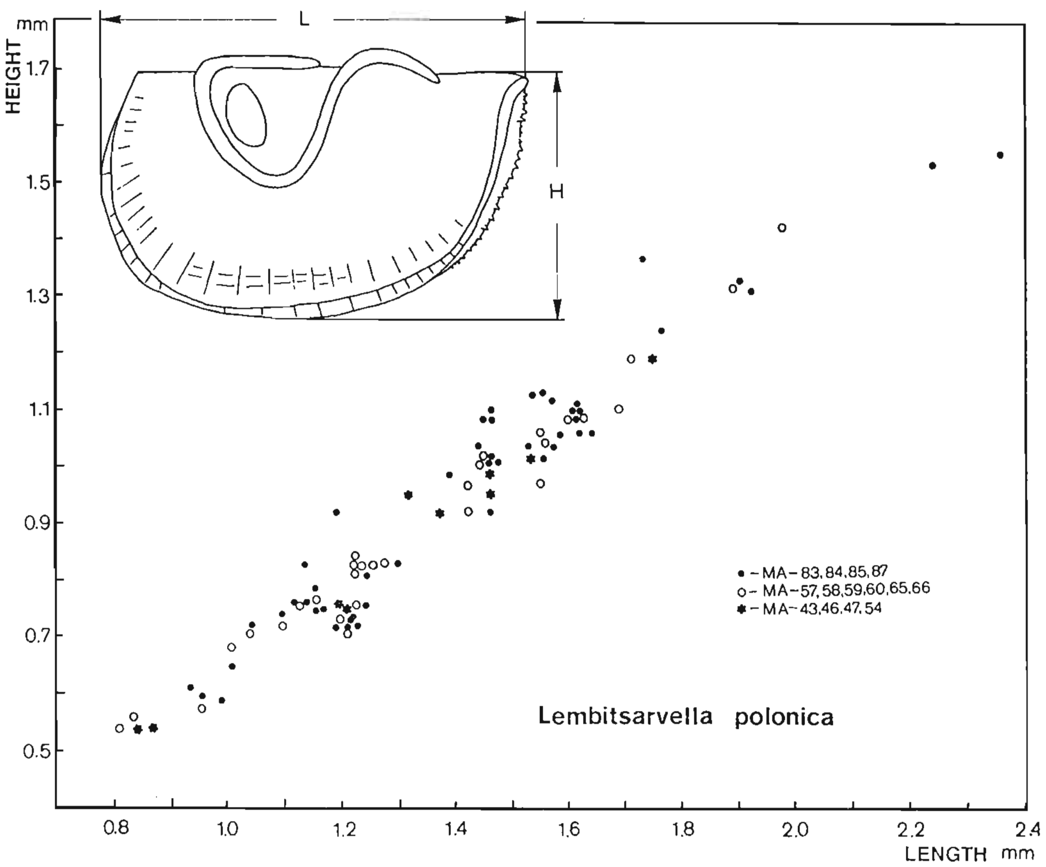

Fig. 5.
Size dispersion of *Lembitsarvella polonica* gen. et sp. n. Samples MA-43, 46, 47, 54 – lower and middle part of the *Pygodus serra* Zone; samples MA-57, 58, 59, 60, 65, 66 – upper part of the *Pygodus serra* Zone, lower and middle part of the *Pygodus anserinus* Zone; samples MA-83, 84, 85, 87 – middle part of the *Amorphognathus tvaerensis* Zone.

moult stage was compared. Usually a small but significant increase of the size of carapaces in time was observed.

(1) *Gryphiswaldensia cavata* sp. n. Measurements were done for 256 specimens from 23 samples (Text-fig. 4). The species is present beginning with the discontinuity surface (*Pygodus serra* Zone) to the uppermost *A. tvaerensis* Zone. Between adult specimens from the *P. serra* Zone (average length 0.75 mm) and *A. tvaerensis* Zone, an increase in average length of about 0.2 mm and height of 0.1 mm takes place. The youngest moult stages are subject to minimal changes. The average shell length of the smallest specimens of *G. cavata* both in the populations derived from sediments of the *P. serra* Zone and derived from the lower part of the *P. anserinus* Zone is about 0.4 mm. In the sediments of the upper part of *P. anserinus* and *A. tvaerensis* Zones the smallest specimens found have a shell length of approximately 0.6 mm. However, because of the small quantity of specimens in these Zones, it is difficult to determine unequivocally which moult stages are and which are not represented.

(2) *Lembitsarvella polonica* sp. n. Measurements of 78 specimens from 14 samples, beginning from the *P. serra* to *A. tvaerensis* Zones, were done (Text-fig. 5). In the upper part of the section, only single specimens were present. They were not considered in biometric studies. The increase in average length of shells of the pre-adult specimens between the populations of this species in the *P. serra* and *A. tvaerensis* Zones is approximately 0.6 mm. The corresponding average height increase is approximately 0.25 mm. In this species accurate measurements of female and adult tecnomorphic valves were not possible because of the significant degree of damage to shells greater than 2–3 mm. *Lembitsarvella* sp., occurring in the lowest part of the sequence (*A. variabilis* Zone) and clearly being very closely

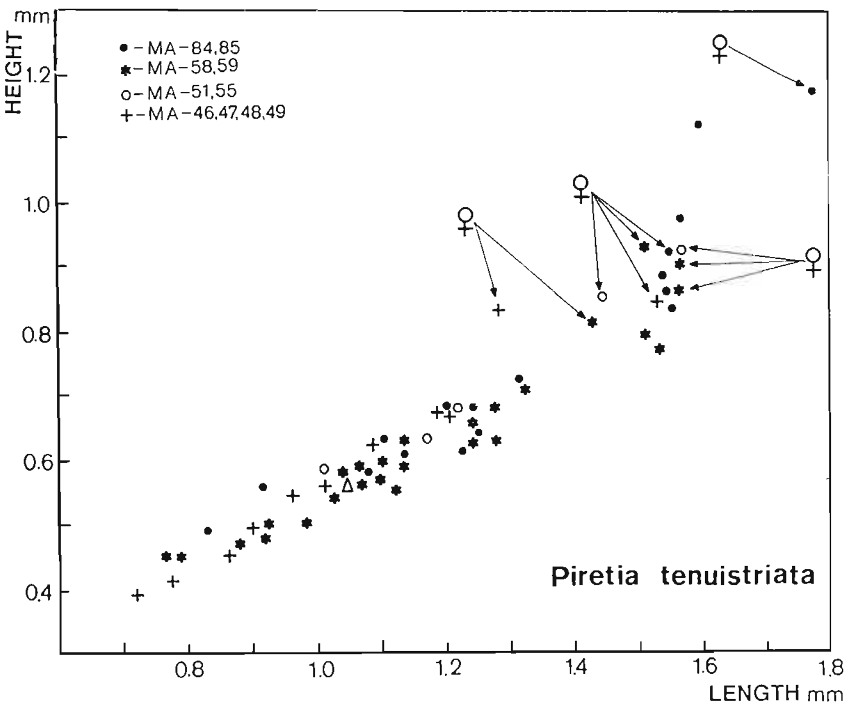

Fig. 6.
Size dispersion of *Piretia tenuistriata* sp. n. Samples MA-46, 47, 48, 49 – lower and middle part of the *Pygodus serra* Zone; samples MA-51, 55 – upper part of the *Pygodus serra* Zone; samples MA-58, 59 – boundary between *Pygodus serra* and *Pygodus anserinus* Zones; samples MA-84, 85 – middle part of the *Amorphognathus tvaerensis* Zone.

related with *L. polonica*, could not be included in the biometric studies because of a significant amount of shell damage and small quantity of specimens.

(3) *Piretia tenuistriata* sp. n. 53 specimens from 10 samples from the *P. serra* to *A. tvaerensis* Zones were measured (Text-fig. 6). It is one of the longest-ranging species in the Mójcza sequence. The difference in average shell length of the female valves in the *P. serra* Zone (average length 1.5 mm) and the *A. tvaerensis* Zone is 0.2 mm. There is, however, rather significant variability in female shell size within each population, e.g. in sample MA-84 shell length differences among heteromorphs are 0.2 mm.

(4) *Uhakiella diuturna* sp. n. 45 specimens from 13 samples were measured (Text-fig. 7). Here too, a certain tendency of shell size increase over time can be observed. However, the small quantity of female valves in the sequence does not allow an unequivocal evaluation of the changes occurring.

(5) *Mojczella* lineage. Length and height measurements of shells of three species of *Mojczella* were performed in 5 samples in the Lower Ordovician (*M. polonica*) and in 27 samples in the Middle Ordovician (*M. jaanussoni* and *M. sanctacrucensis*). Altogether 300 specimens in various moult stages were measured (Text-fig. 8). Between adult specimens of *M. polonica* (average length 1.4 mm) from the *A. variabilis* Zone and adult specimens of *M. jaanussoni* (average length 1.8 mm) from the *Pygodus serra* Zone there is a specimen length increase of approximately 0.5 mm and an average height increase of approximately 0.3 mm. Specimens of *M. sanctacrucensis* from the *A. tvaerensis* Zone show further increase in shell size. Specimens of moult stage A-1 are larger than specimens of the same moult stage in an earlier population. Among the *M. sanctacrucensis*, unfortunately no female specimens were found, which would have allowed precise determination of adult size of this species. An increase in shell size was observed in all moult stages of sequentially appearing populations.

(6) *Ampletochilina priscina* sp. n. – *Swantina schallreuteri* sp. n. lineage. 102 specimens of *S. schallreuteri* from 17 samples from the *P. serra* Zone to the *A. superbus* Zone were measured (Text-fig. 9). Adult specimens of this species appear in samples in the entire just mentioned part of the section.

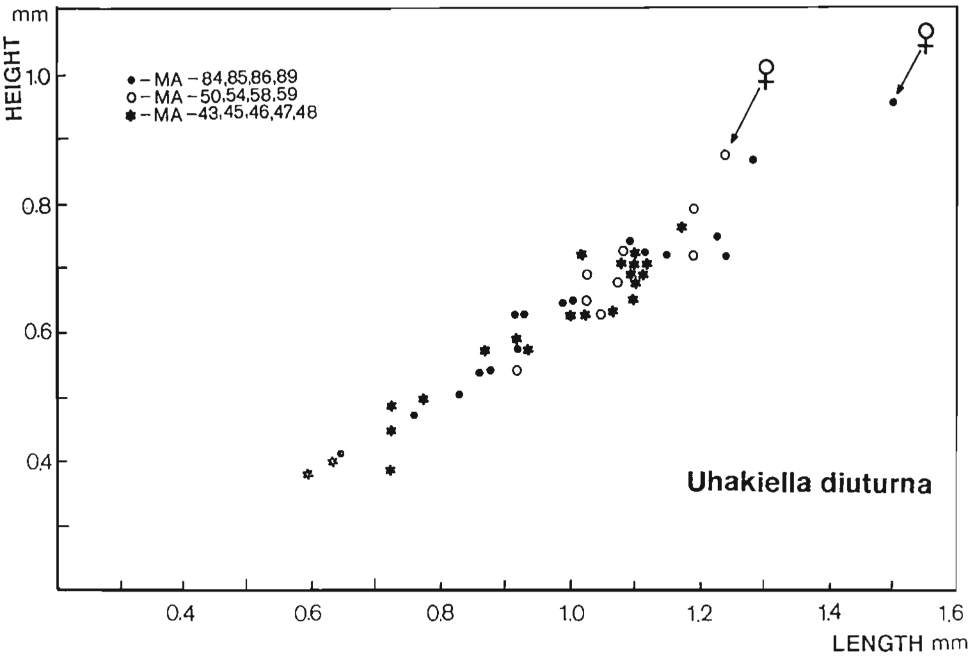

Fig. 7.
Size dispersion of *Uhakiella diuturna* sp. n. Samples MA-43, 45, 46, 47, 48 – lower part of the *Pygodus serra* Zone; samples MA-50, 54, 58, 59 – upper part of the *Pygodus serra* and lower part of the *Pygodus anserinus* Zone; samples MA-84, 85, 86, 89 – middle and upper part of the *Amorphognathus tvaerensis* Zone.

Between adult specimens of *S. schallreuteri* of the lower part of the *P. serra* Zone (average length 1.1 mm) and the lower part of the *A. superbus* Zone there is a length increase of about 0.4 mm, and an average height increase of about 0.15 mm. Here, one can also perceive a small increase in the average size of the youngest documented moult stages of approximately 0.05 mm. Even smaller (Text-fig. 9) than specimens of *S. schallreuteri* of the lower part of the *P. serra* Zone, are specimens of a closely related species *Ampletochilina priscina* sp. n. from the lower part of the section (*A. variabilis* Zone). The length of its heteromorphic valves does not exceed 1.1 mm there.

(7) *Klimphores* lineage. Three species of *Klimphores*, which occur in temporal sequence and display a number of characteristics suggesting their close relationship, were also studied. They also show a similar tendency to increase shell size with time (Text-fig. 10). Between the Early Ordovician *K. (L.) ansiensis*, *K. (K.) subplanus* from *Pygodus serra* Zone and *K. (K.) vannieri* from the *A. superbus* Zone, the increase of adult shell average length of about 0.3 mm and the increase of the corresponding average height of 0.15 mm occur.

The tendency to increase shell size characterizes species of highly variable adult size e.g. *Mojczella jaanussoni* – heteromorph shell length from the *P. serra* Zone is about 2 mm, *Lembitsarvella polonica* – suspected heteromorph shell length 5–6 mm, *Piretia tenuistriata* – shell length of 1.5–2 mm, *Swantina schallreuteri* – 1.0–1.5 mm, adult specimens of *Klimphores (K.) subplanus* – 0.7–0.8 mm, *Gryphiswaldensia cavata* – 0.7–1.0 mm. This suggests a general tendency, and not a result of secondary changes in population composition such as transport and selection of shells of particular size although a destruction of specimens of shell size above 2–3 mm is a common feature.

A similar tendency shown by a number of taxa occurring over a long time span suggests environmental control. It was possibly phenotypic but fossil material is inconclusive in this regard. REYMENT (1966, 1978) observed that many Cretaceous-Paleocene species from Africa have synchronous size fluctuations through time and believed this to indicate environmental control [see MADDOCKS (1977); BARKER (1963); ISHIZAKI (1975); KAESLER (1975); KEEN (1982); REYMENT (1982, 1988); REYMENT *et al.* (1977) for similar studies]. PEYPOUQUET's (1977) and RZIHA (1989) studies of the Recent species of the genera *Krithe* and *Parakrithe* indicate that the composition of the dissolved nutrients determines

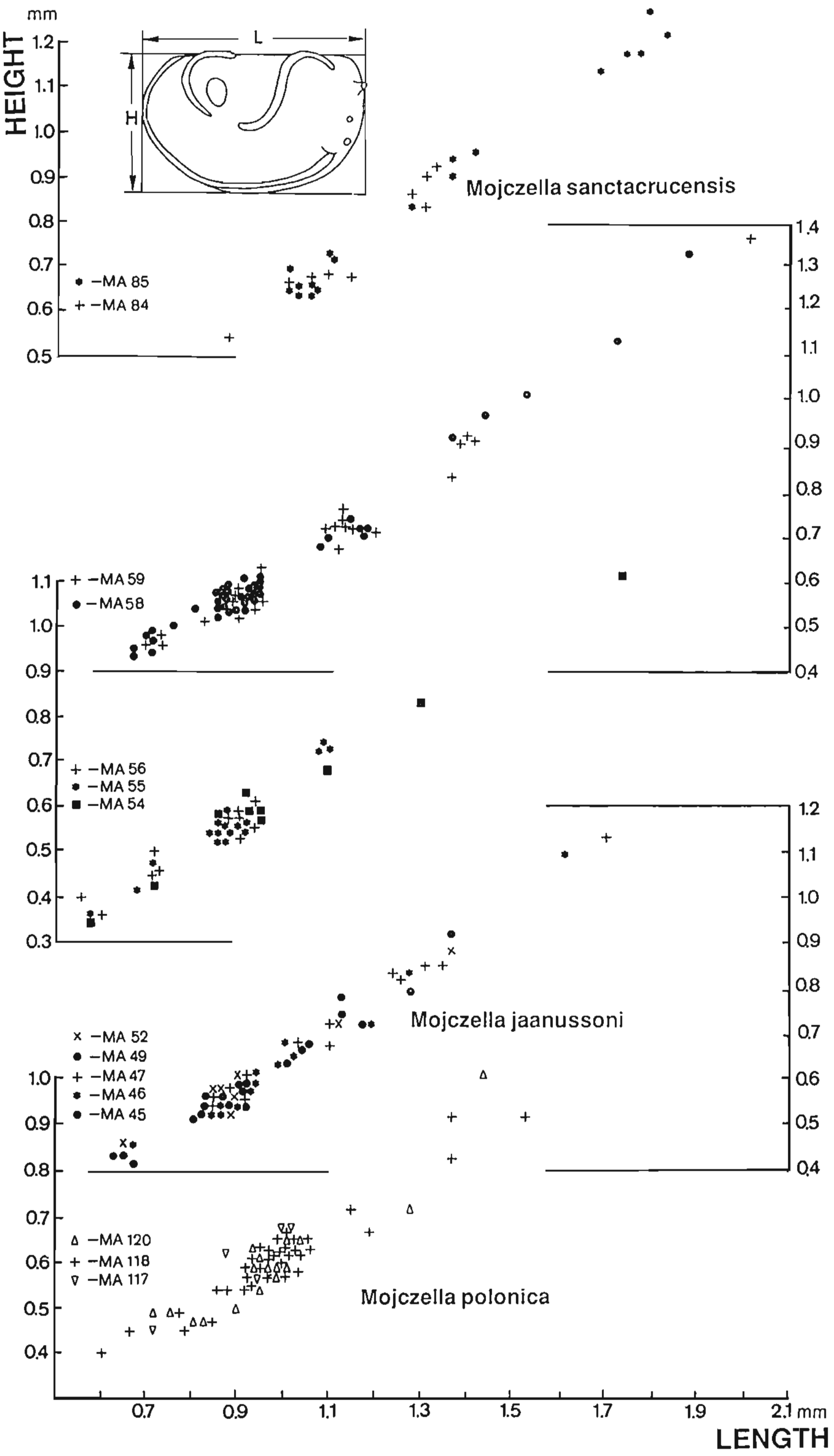

Fig. 8.

Size dispersion of *Mojczella* lineage. *Mojczella polonica*: samples MA-117, 118, 120 – *Amorphognathus variabilis* Zone. *Mojczella jaanussoni*: samples MA-45, 46, 47, 49, 52 – middle part of the *Pygodus serra* Zone; samples MA-54, 55, 56 – upper part of the *Pygodus serra* Zone; samples MA-58, 59 – boundary of the *Pygodus serra*/*Pygodus anserinus* Zone. *Mojczella sanctacrucensis*: samples MA-84, 85 – middle part of the *Amorphognathus tvaerensis* Zone.

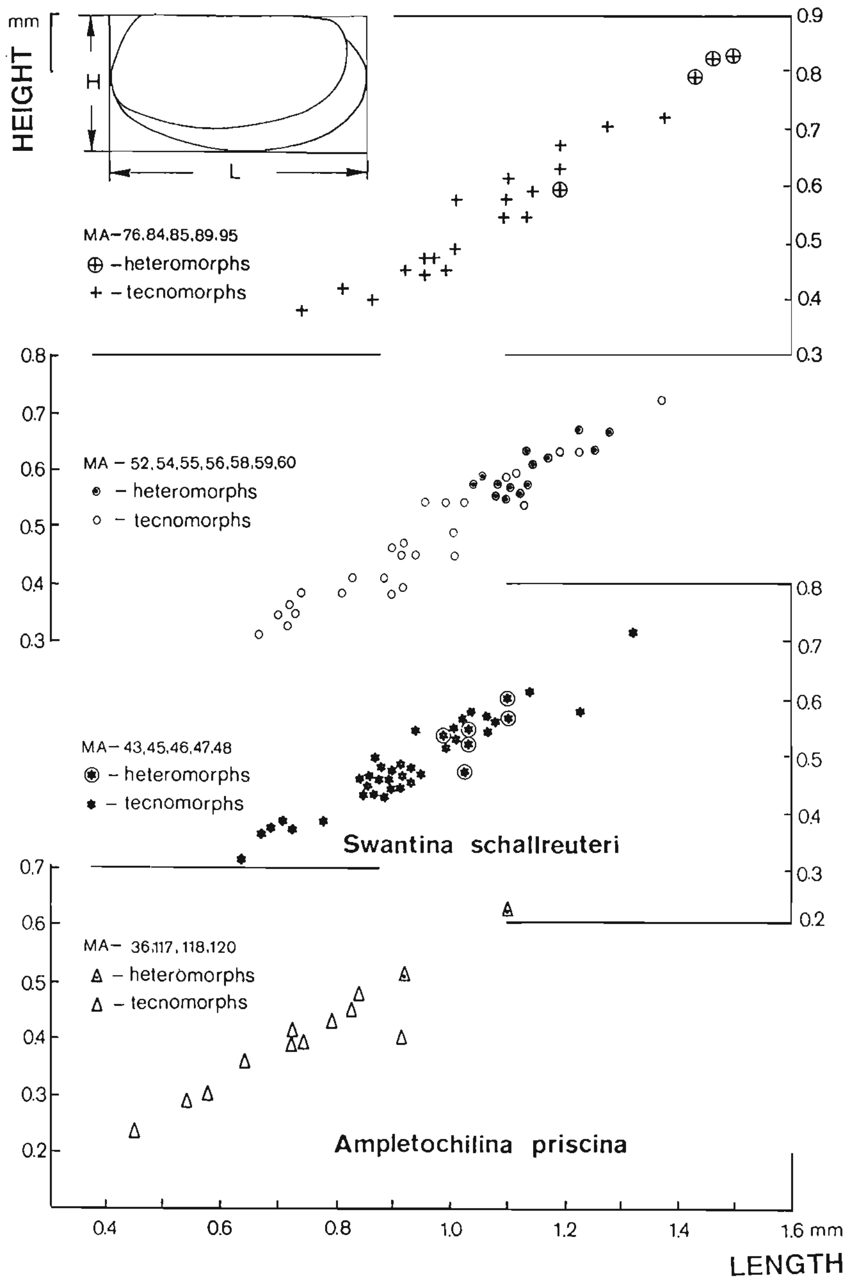

Fig. 9.

Size dispersion of *Ampletochilina priscina* sp. n. – *Swantina schallreuteri* sp. n. lineage. *Ampletochilina priscina*: samples MA-36, 117, 118, 120 – *Amorphognathus variabilis* Zone. *Swantina schallreuteri*: samples MA-43, 45, 46, 47, 48 – lower and middle part of the *Pygodus serra* Zone; samples MA-52, 54, 55, 56, 58, 59, 60 – upper part of the *Pygodus serra* and lower part of the *Pygodus anserinus* Zones; samples MA-76, 84, 85, 89, 95 – *Amorphognathus tvaerensis* and lower part of the *Amorphognathus superbus* Zones.

the size of the ostracod shells. Other authors (POKORNÝ 1980; STEINECK *et al.* 1984) believe that temperature is a determining factor. This type of study of shell size variation on Palaeozoic ostracods are very limited particularly because of the absence of appropriate material. Mójcza Ordovician sequence is of particular importance because of the relatively long period of time represented in the sequence, lack of significant changes in the character of the sediment and presence of long-ranging species, and the availability of substantial numbers of specimens in each population.

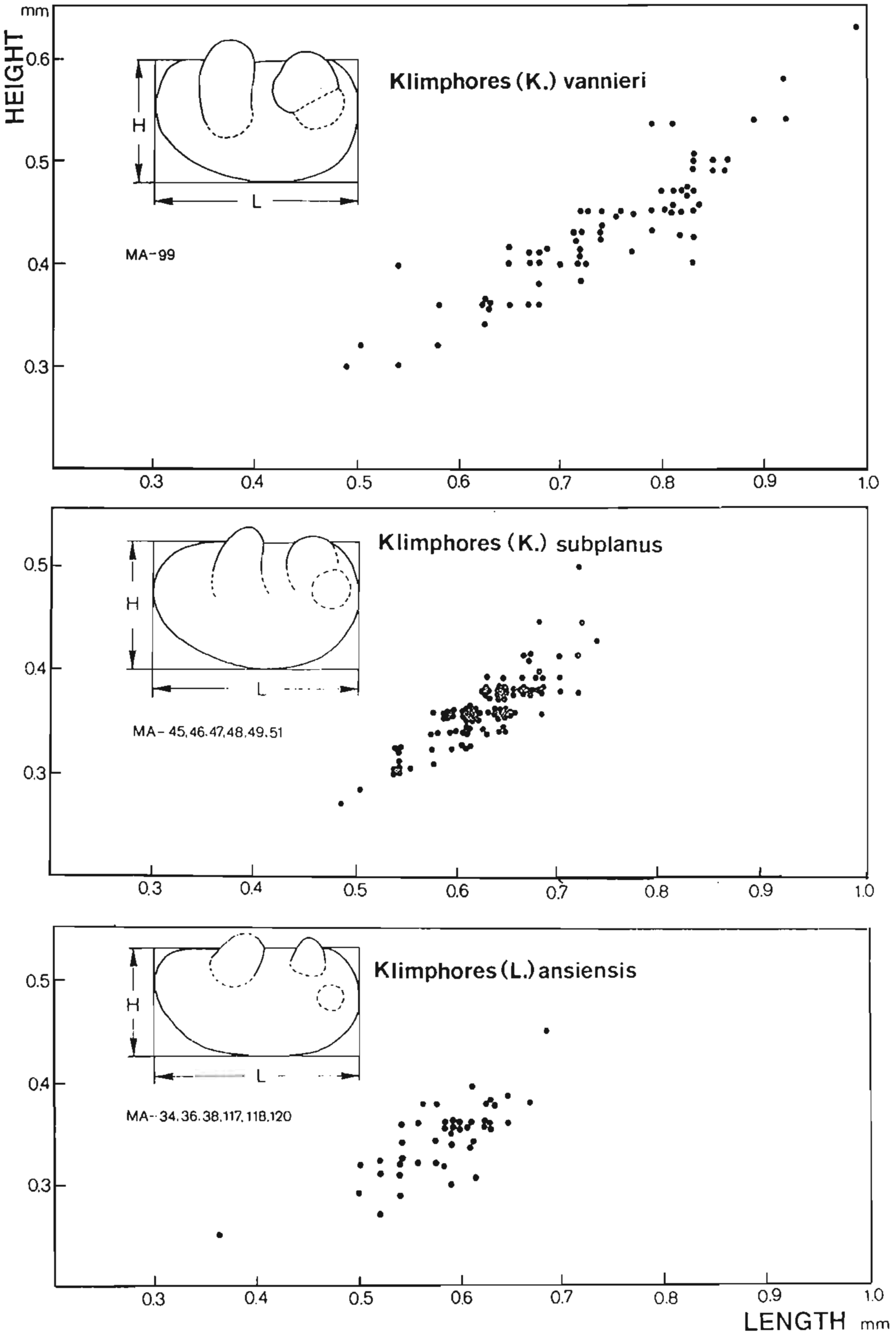

Fig. 10.
Size dispersion of *Klimphores* lineage. *Klimphores (L.) ansiensis*: samples MA-34, 36, 38, 117, 118, 120 – *Amorphognathus variabilis* Zone. *Klimphores (K.) subplanus*: samples MA-45, 46, 47, 48, 49, 51 – *Pygodus serra* Zone. *Klimphores (K.) vannieri*: sample MA-99 – *Amorphognathus superbus* Zone.

VARIATION IN ORNAMENTATION

The special mode of preservation of the Mójcza ostracods allows the extraction of large quantities of specimens representing different moult stages from samples. This together with the generally long

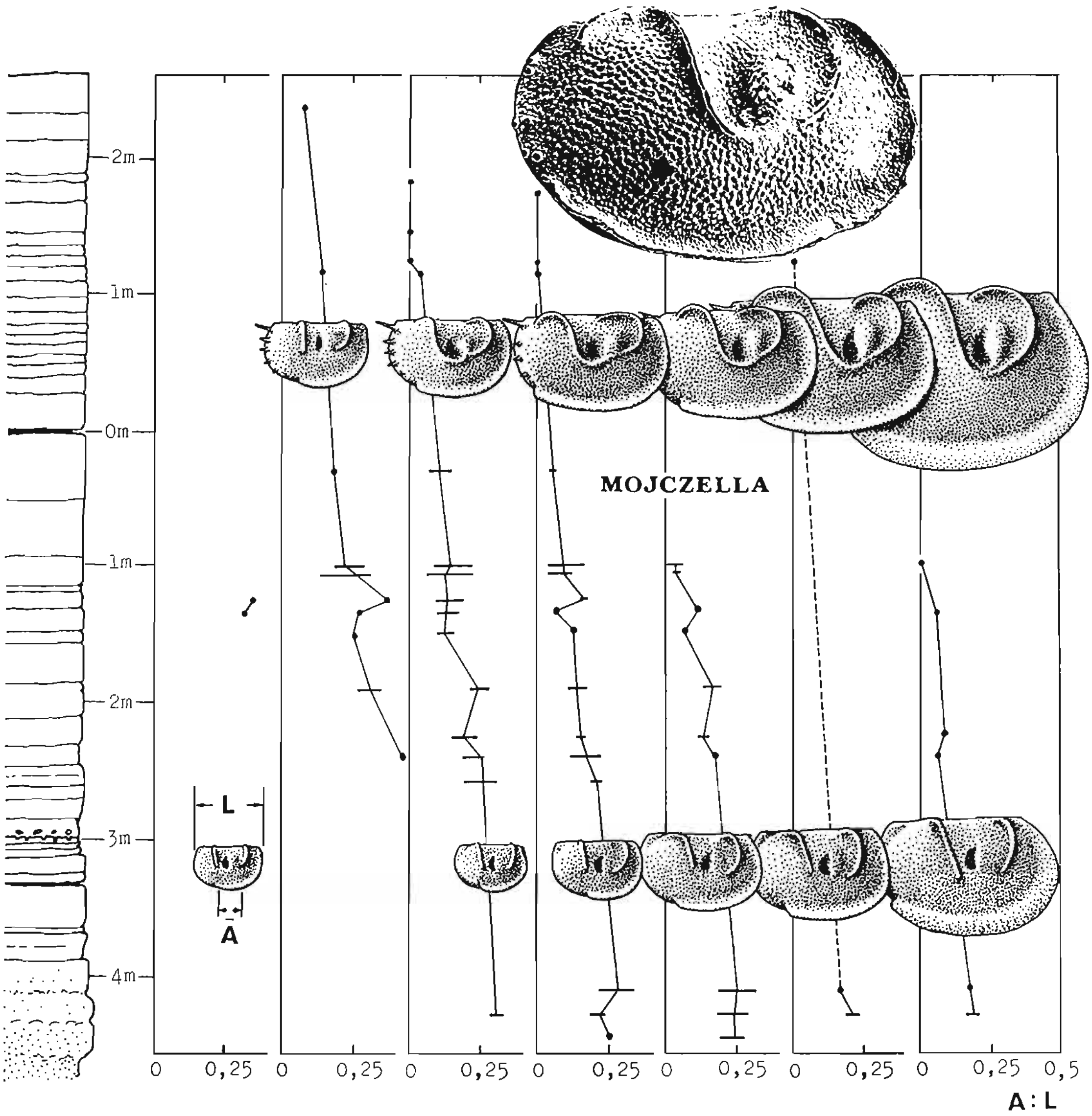

Fig. 11.
Evolution of the genus *Mojczella* at individual moult stages; A/L ratios of distance between C1 and C3 (measured beneath the sulcus) and length of valve, horizontal bars show range of variability in particular samples, mean values are connected by vertical lines (modified after OLEMPSKA 1989).

durations of several species in the section enables observations which would not have been possible with material preserved as calcareous shells that are hard to extract from the rock, occur in low numbers of specimens, and only rarely allow observations on small morphological details. Changes in macro- (ridges, spines etc.) and microornamentation (granulation, reticulation, punctation) in both ontogeny and phylogeny have been studied in several representatives of Palaeocopa and Binodicopa. The inner surface of phosphate linings of the shell represents precise surface replicas, which allow for the recognition of extremely fine details of ornamentation. This type of preservation guarantees that the observed microornamentation has not been significantly changed during diagenetic processes, because the phosphate coating of the shells probably took place before the covering with sediment, and the diagenesis.

Clear differences in the character of changes between the macroornamentation and microornamentation were observed. The larger structures in certain species (not in all) are subject to significant changes both in ontogeny and in the subsequently appearing populations of the species. Fine ornamentation appears to be far more conservative in the ostracods studied. Closely related species (*Mojczella* lineage, *Klimphores* lineage), are characterized by virtually identical shell microornamentation.

Evolution of macroornamentation. — In some species the massive crests present on the shell surface change their shape, length and thickness both in ontogeny and phylogeny. In species of the genus *Mojczella* which appear sequentially over time, a tendency for strengthening of the carapace by gradual lengthening of the sulcus-surrounding crest was observed. For the detailed biometric studies of this chronomorphocline see OLEMPSKA (1989). All characters in which the oldest and youngest populations of the *Mojczella* lineage differ from each other show continuous transformations in the Mójcza section (Text-fig. 11). The changes in character, which can easily be studied biometrically, i.e. the quantitative features of the sulcus-surrounding crest, are virtually linear in geologic time. As the relative thickness of the conodont zones suggests that the rate of sedimentation in the section at Mójcza was more or less uniform (DZIK 1990), the rate of evolution was probably almost constant. This concerns the evolution of all moults. However, the rate of evolution of the sulcus- surrounding crest was found not to be uniform in individual moult stages. It is highest in adult individuals. At late moult stages (A-1, and A-2), it is slightly lower, but not as low as in the earliest moult stages (A-5 and A-6), where the transformations of morphological features appear quite difficult to trace. This means that in the course of the evolution new morphological features appear at successively younger and younger moult stages (OLEMPSKA 1989).

In populations of *Mojczella* from the Early Ordovician (*A. variabilis* Zone) the mode of development of the crest at early stages is similar to that in late moult stages as well as in adult specimens. In populations of *Mojczella* from higher parts of the section the differences in morphology increase in successive instars, being greatest in populations of *Mojczella* from the *A. tvaerensis* Zone. In these populations specimens of the early moult stages (A-5) basically differ from those of late stages (A-1, A-2) and the adults (A). The identification of particular stages in the evolution of *Mojczella* and, therefore, of the chronospecies, is possible only on the basis of adults or specimens representing the latest moult stages (A-1, A-2).

Microornamentation. — Ordovician ostracods display three different types of microornamentation known as granulation, reticulation, and punctation as well as combinations of those three types. Microornamentation preserved in the natural replicas allows for recognition of details that are not visible on the external surface of the phosphatic linings covering the shells. Moreover, among species with very similar microornamentation of the surface linings, the negative images reveal the differences better. Even with this new tool for studying the microornamentation, minimal or no change of this morphologic character through time was found. In three successive species of *Mojczella* where evolutionary changes of the more massive morphologic elements took place, the form of polygonal microscopic ornamentation did not undergo any changes, beginning with the population of *Mojczella polonica* (Pl. 39: 1–3) from the *A. variabilis* Zone, through *M. jaanussoni* (Pl. 40: 1–2) from the *P. serra – P. anserinus* Zones, to *M. sanctacrucensis* (Pl. 40: 3–4) found in the upper part of the *A. tvaerensis* and lower part of the *A. superbus* Zone. The microornamentation of the *Lembitsarvella polonica* was identified in various populations begining from the *P. serra* Zone, *P. anserinus* Zone (Pl. 32: 2–3, 5, 6), *A. tvaerensis* Zone (Pl. 32: 4), and ending in the population found in the sediments of the *A. superbus* Zone. The shell surface of this species is composed of two layers (Text-fig. 12, see also p. 156). The inner layer microornamentation is characterized by small tubular protuberances connected by a network of delicate muri, observed on the phosphate linings surface and their replica. This remains unchanged over the entire period of this species existence in the section. *Lembitsarvella* sp. from Lower Ordovician sediments is characterized by a similar shell surface microornamentation (Pl. 28: 4). Changes in the microornamentation character of the *Piretella oepiki* were traced in the section from the *P. serra* Zone to the *A. superbus* Zone (Pl. 27: 1–4). The shell surface of this is ornamented by small granules of polygonal arrangement separated by rather deep lumina. No significant changes in microornamentation through time were observed here, however, this species is present in small quantities and precise study was impossible. In the two above mentioned species, no significant macroornamentation changes were observed either. Microornamentation did not change in

Uhakiella diuturna as well. Studies were conducted on populations beginning with the *P. serra* Zone and ending with the *A. superbus* Zone.

In those species which were represented by a relatively large number of specimens of younger moult stages, the character of microornamentation changes during ontogeny was also studied. This concerns species of *Mojczella* (*M. jaanussoni* and *M. sanctacrucensis*), *Lembitsarvella polonica, Piretella oepiki*, and *Gryphiswaldensia cavata*. In all these species the basic appearance of microornamentation was already developed in the youngest moult stages available for study. Only in the youngest moult stages of *Lembitsarvella polonica* a slightly different microornamentation can be recognized in the marginal zones of shells (Pl. 39: 4). In the remaining moults, including adult specimens, the microornamentation remains without change. According to MARTINSSON (1962) microornamentation structures may seem very different but they might be very similar in origin. This type of microornamentation was decribed by LIEBAU (1977) as "proto-level" ornamentation. According to LIEBAU (1977), genetic changes may affect the whole ornament component or inexactly defined parts of it, but not single elements, therefore, single elements (meshes, pore cones, etc) do not possess individual character of e.g. intraspecific constancy, and cannot be used individually for taxonomic purposes. Proto-ornamentation represents, according to LIEBAU (1977), the primitive stage of ornamentation. The studies of Ordovician ostracod microornamentation from Mójcza fully confirm this view. PEYPOUQUET (1977) maintains that the principal parameter for many ornamental changes is the ionic concentration of calcium and magnesium and clear correlation is found between strong ornamentation and high $Ca^{++} + Mg^{++}$ concentration. Microornamentation is much less dependant on changes in water chemistry than is macroornamentation.

OSTRACOD SHELL STRUCTURES

The state of preservation of ostracods as thin phosphate layers coating the primary internal and external surface of the shells, with an empty space left behind by the calcite shell dissolved in acetic acid, allowed for the observation of a number of characteristics of internal shell construction, thus far little known in Paleozoic ostracods. In this space, phosphate fillings of some originally empty cavities within the shell are preserved (Text-fig. 12a). These include fillings of pore canals and tubules in the velar structures, accesible to observation by electron microscopy. In the normal state of preservation of shells, this type of detail of the internal structure of the wall are only accessible for fragmentary observation in thin sections.

PORE CANALS

The calcified outer lamella in ostracods is penetrated by pores which carry bristles. These pores are more or less evenly distributed over the shell, being more numerous only at the margins. In post Paleozoic and Recent ostracods pore canal exits on the shell surface are usually quite visible. They can be also studied in transmitted light inside the shell. Pore canals of Paleozoic ostracods are poorly known chiefly because of significant diagenetic changes which obscure fine details on the shell surface.

In several ostracod species of Mójcza, the presence of well preserved phosphate fillings of pore canals was identified. On the phosphate coatings' surface, even with high maginification, the pore canal are not visible because of infilling and covering of their exits (Text-fig. 12a). Pore canal fillings can be seen in damaged specimens as very thin filled tubes connecting the phosphate layers which coat the inner and outer surface of shells. The regular placement pattern of these structures in the shell, the relatively stable number observed in various species, and their perpendicular course between the walls, distinguish them from canal fillings left by drilling organisms which can be found in some specimens (OLEMPSKA 1986).

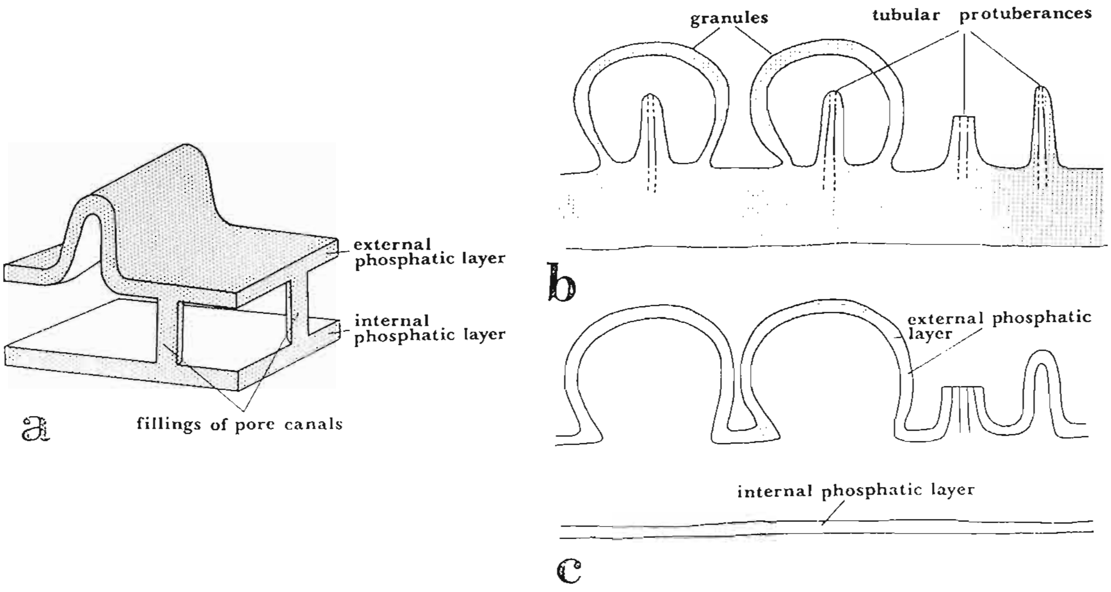

Fig. 12.

a. Diagramatic cross-section of ostracod carapace showing phosphate linings. **b**. Details of surface microornamentation in *Lembitsarvella polonica* gen. et sp. n., valve surface without phosphate linings. **c**. The same valve with dissolved calcite layer.

The best preserved pore canal fillings were found in those samples in which ostracode shells are coated with a relatively thicker layer of calcium phosphate. The most numerous specimens with preserved pore canal fillings were found in sample MA-99 from the *Amorphognathus superbus* Zone (Caradoc).

Normal pore canals. — Normal pore canals are ducts which penetrate the carapace to terminate at right angles to the surface. They may form junctions either as tegumental ducts, connected in life to tegumental glands beneath the epidermis, or as ducts housing individual sensory setae (SYLVESTER-BRADLEY and BENSON 1971).

Among the Mójcza ostracods, in many specimens of *Trianguloschmidtella (Rempesgrinella) hemiventrocosta* from the *A. superbus* Zone, normal pore canal fillings were found ("sensillium pore" of OKADA 1983). They appear as fillings of simple (non-branched) canals with a diameter of about 0.01 mm, coursing in a perpendicular fashion between the outer and inner phosphate layer (Pl. 50: 1–2). They are distributed quite regularly inside the shell. They number about 30 inside each valve. In this species, pore canal concentrations in particular regions of the shell were not found. Pores are equally distributed over the right and left valves. When the phosphatic coats are damaged, fillings of pore canals usually suffer destruction, except *T. (R.) hemiventrocosta* in which they are exceptionally well preserved. The presence of normal pore canals, preserved as small spines or larger canal fragments on the coats covering the inner wall of the shell, was also observed in several other species such as *Collibolbina postaculeata* and *Swantina schallreuteri*. Spines on the surfaces of the steinkerns proved the existence of pores in the shell. Specimens of *Lembitsarvella polonica* and *Bromidella* sp. demonstrated the presence of unusually concentrated pore canal fillings along the ventrolateral surface (Pl. 50: 3, 4). The appearance of concentrations of setae along the ventrolateral surface, as documented by SWENSON (1989) in Recent genus *Manawa*, indicate that these regions are important sources of "sensory" information relating to the external environment and possibly, mating position during copulation.

Pore clusters. — Some Mesozoic and Recent ostracoda (Eucytherurinae, Punciidae) possess clusters of pores occupying each solum of the exterior reticulate ornament, which penetrate to the interior of the carapace, producing a pattern of clustered perforations corresponding directly to the exterior reticulate ornament without accompanying setae (MÜLLER 1894; ISHIZAKI 1973; ISHIZAKI and GUNTER 1974; MADDOCKS and STEINECK 1987; MCKENZIE and NEIL 1983; STEINECK *et al.* 1990). The function of such "sieve pores", not associated with setae is not clear. Pore clusters in Ordovician ostracods were illustrated by SCHALLREUTER (1977a) in *Miehlkella cribroporata*. They consist of rings of pores, one ring of 5 to 8 micro-pores. Later SCHALLREUTER (1980a, 1983d) illustrated also pore clusters in *Klimphores planus* and *Vaivanovia hiddenseensis*. SCHALLREUTER (1983d) supported the suggestion of MÜLLER (1894) that pore clusters had a light sensory function.

Among the ostracods from Mójcza Limestone, clusters were found in *Klimphores (K.) vannieri* from the *A. superbus* Zone. They are preserved as phosphatic fillings visible after damaging a specimen. At the base of every sola in the reticulum, 7–10 canals are found, with a diameter of 2–3 µm each (Pl. 51: 1–3). All canals are of the same diameter, there is no unequivocal proof that one of them, as in true sieve-pores, was a canal through which the sensory bristle travelled. *Klimphores (K.) vannieri* possesses only pore clusters on its valves. In *Klimphores (K.) subplanus* poorly preserved fillings of pore clusters are also present. Pore clusters in *K. (K.) planus* SCHALLREUTER and *K. (K.) vannieri* sp. n. differ only by a significantly higher number of micro-pores, around 30 per solum in *K. (K.) planus*.

Pore clusters described by JONES (1988) in *Amphissites* and pore clusters illustrated by COEN, MICHIELS, and PARISSE (1988) in a Carboniferous Kirkbyacea genus, possess similar construction. According to Swenson (1989) the term "sieve plate" in *Klimphores* was an unfortunate choise since we now understand the sieve plate as the calcified portion of the multiple pouch structure of each sensilium (OKADA 1982, 1983). "Sieve plate" implies that the structure is associated with, or is part of a normal pore, although no evidence exists to suggest setae protruded from such a structure on the valves of these Palaeozoic ostracods (SWENSON 1989).

SHELL STRUCTURE IN *LEMBITSARVELLA*

In *Lembitsarvella polonica* an unusual type of shell structure was recognized, one unknown in other Ordovician ostracods. Certain fragments of the ornamental surface are composed of two layers connected by protuberances (Text-fig. 12b). Next to the domicilium the inner layer is ornamented with small tubular protuberances, each of about 0.02–0.03 mm in diameter, connected by a network of delicate muri (Pl. 32: 2). One cannot unequivocally state whether the primary protuberances possessed pore openings on their tops. Most of the protuberances are incompletely preserved in that they lack tops and reveal hollow centers (Pl. 32: 1, 6). The tops of complete protuberances are imperforate (Pl. 32: 2)., which may be a result of coating by a phosphate layer. Tubular protuberances are uniformly distributed over the surface of shells with the exception of the crests surrounding the sulcus, dorsal crests, and velum.

On adults shells as well as late moult stages fragments of a second outer layer occur completely covering the above described layer (Text-fig. 12b). The outer layer is composed of large granules with a diameter of 0.04–0.07 mm, rather tightly packed (Pl. 31: 1–2). The granules do not show traces of any terminal openings. Moulds of dissolved tubular protuberances are visible on the inner walls of the damaged granules (Pl. 31: 3), or inside the granules. One cannot unequivocally state whether the outer layer of the granules originally covered the entire shell surface and after the animal's death was partially worn off, or they were formed only on certain parts of the shells. It was observed with subsequent moults that a greater and greater part of the shell surface was covered by a granular layer. The state of preservation and the visibility of details of ornamentation of the inner layer depend also on the thickness of the phosphate layer coathing the primary surface. The thicker it is, the more obscured and less visible are the details.

A two-layered shell, very similar in its construction, was described by KESLING (1954), ADAMCZAK (1968), and KESLING and CHILMAN (1987) in the Devonian genus *Ctenobolbina*. In this genus the ornamented area of the lobes consists of two layers. The thicker inner layer is separated from the very thin and delicate outer layer by pillars. KESLING (1954) suggested that the presence of the outer layer was caused by a replacement of the original chitin layer with calcium carbonate, which had been destroyed soon after the organism's death. KESLING and CHILMAN (1987) proposed, that the spaces between pillars were originally filled with fluid or gas. In either case they made the carapace lighter in weight and the gas-filled spaces may have been significant in buoyancy.

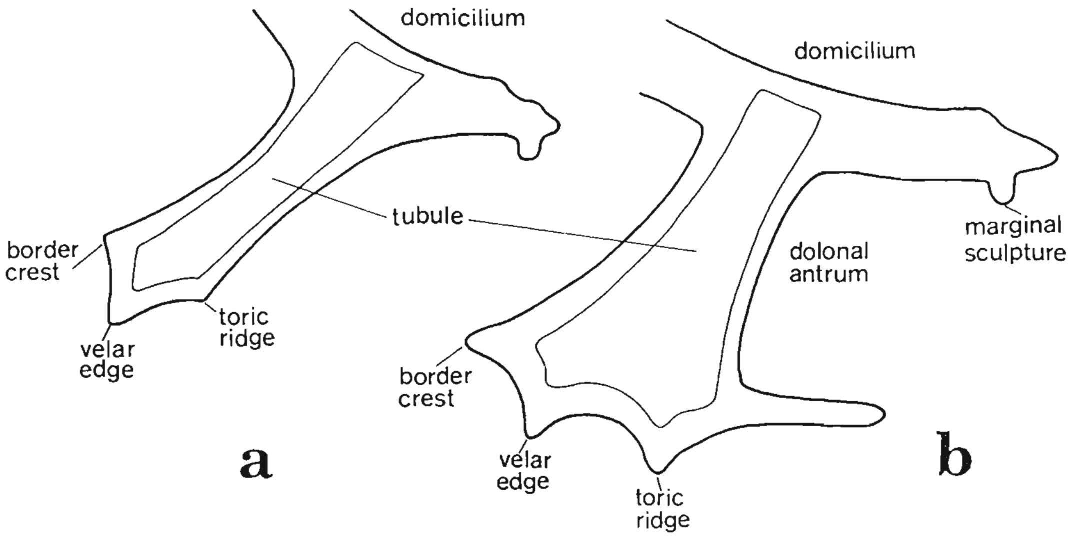

Fig. 13.
Diagramatic transverse section illustrating the velar structure in *Lembitsarvella polonica* gen. et sp. n. **a**. tecnomorphic valve, **b**. heteromorphic valve.

The structure of tubular protuberances in *Lembitsarvella* shows a certain similarity to similar fine surface structures in the Silurian paleocope *Neobeyrichia lauensis* (KIESOW, 1888) illustrated and discussed by SIVETER (1982). Tubular protuberances in this species, each of about 8–12 µm in diameter, densely cover the lateral surface of lobes. They reveal hollow centres, that may have a buoyancy function or were perhaps produced to make the shell lighter and thinner for economy of the carapace design. It is also possible that they acted as part of a typical mechanoreceptor or chemoreceptor system (SIVETER 1982). Many similar structures in Recent ostracods represent a very thin organic layer coating the shell, which after death is destroyed very quickly.

The two layer wall structure in *Lembitsarvella* suggests its buoyancy function. Its connection with the original chitin layer appears improbable. The coating of ostracod shells with phosphate did not occur in such a short time after the death of the animal as to allow the chitin layer to remain preserved. There is also a possibility that the presence of the outer granular layer is a result of more complex processes of coating of the ostracod shells with phosphate, that is, the secondary phosphatic layer does not represent the original ornamentation. The absence of structures of this type among other species coexisting with *Lembitsarvella* makes this interpretation unlikely.

In *Lembitsarvella polonica* the presence of additional structures such as separate chambers was noted. They are present inside crests surrounding the sulcus and inside dorsal crests (Pl. 30: 1, 2). It seems very likely that these structures, like those described above and the tubules inside the velar structure, had a similar hydrostatic function and also lowered the ostracode shell weight.

MORPHOLOGY OF THE TUBULOUS VELUM IN *LEMBITSARVELLA*

Athough the tubulous velum is the main classificatory feature of the entire superfamily Eurychilinacea and it occurs in many Ordovician genera, its internal construction, development in ontogeny and its function are not fully understood.

The species *Lembitsarvella polonica*, from the Middle Ordovician of Mójcza, is characterized by the presence of a broad velum with large, wide tubules and well developed edge structures (Text-fig. 13). Tubular calcium phosphate fillings allow one to study their structure (Pl. 28: 4; Pl. 29: 2, 8; Pl. 30: 6–8), and to trace its development in the ontogeny (Pl. 29: 1–5). In most of the *Lembitsarvella polonica* specimens, the tubules are completely isolated from the domicilium, but specimens with tubules open to the domicilium, especially late moult stages and male and female adults were also found (Pl. 30: 3–5). Origin and function of the crumina and tubulous velum of beyrichid ostracods were studied by MARTINSSON (1960, 1962) and ADAMCZAK (1990). According to MARTINSSON (1962), the tubules were formed in an initial stage of calcification of the carapace by a morphological or physiological differentiation of the epithelium. With the exception of one specimen, MARTINSSON (1962) never observed communication of the tubules with the domicilium of the carapace; according to MARTINSSON (1962), open tubules could remain only when the completion of the last moulting had been interrupted in an early stage. SCOTT and WINWRIGHT (1961) published schematic cross sections through some Palaeocopa which have tubules or velar folds opening towards the domicilium. According to MARTINSSON (1962), perhaps more primitive Palaeocopa had an open velar fold, or even tubules, but such hardly existed in normally developed Amphitoxotidinae.

While studying thin sections of specimens of *Craspedobolbina (Mitrobeyrichia) clavata* (KOLMODIN, 1869) from the Silurian of Gotland, ADAMCZAK (1990) observed in the crumina the presence of two cavities: a large intravelar space (infated tubules) and dolonoid pouch (antrum). According to ADAMCZAK (1990) these cavities functioned as a buoyancy organ. The intravelar space, in this hydrostatic structure, acted as a gas tank, whereas the dolonoid pouch worked as a ballast tank and/or brood pouch if it was filled with eggs and/or young instars (ADAMCZAK 1990). It is possible that all tubules of Ordovician ostracods which posessed a tubulous velum functioned as a hydrostatic organ, as gas reservoirs. They were separated from the domicilium by only a thin weakly calcified membrane. The presence of relatively frequent specimens of *L. polonica* with tubules open to the domicilium, especially in adult specimens, supports this hypothesis. The relatively thin wall separating the tubules from the domicilium could have been easily damaged.

The velum in *Lembitsarvella polonica* has well developed edge sructures very similar to the velar structures of Silurian Beyrichidae and unknown until now among Ordovician ostracods with a tubulous velum. Along the outer side of the velum there is a thin crest (border crest in Silurian ostracods, MARTINSSON 1962) and narrow torus along the inner side of the velum. These structures play a important role in the formation of the dolon in heteromorphs of *Lembitsarvella*. In preadult female moult stages a significant thickening of the border crest, velar edge and torus occurs (Pl. 29: 9). The dolon is formed as an effect of the enlargement of the space between these structures. Along the edge and below the torus an additional wall is formed (Pl. 29: 6, 7). This kind of origin for the heteromorphic velum was until now unknown among Ordovician Eurychilinacea. Among the majority of Eurychilinacea the dolon is formed by a lengthening and bending of tubules in the direction of the ventral margin. The tubules in the velum of the females of *L. polonica* are subject to a significant widening at the ends, they do not reach the dolon edge (Pl. 30: 9).

The appearance of the tubulous velum in the process of ontogeny in *Lembitsarvella polonica* takes a different course from that of Silurian *Craspedobolbina clavata*, where the ontogeny was traced with detail by MARTINSSON (1962). Unlike *C. clavata*, whose velar frill is already well formed at the eighth moult stage (A-8), and in A-7, the velum is developed as a flange, in *L. polonica* in the four youngest defined moult stages, the velum is developed as thorny outgrowths, widening into wide tubules covered by the outer wall only in the two or three last moult stages. The velar structure ontogeny in other Ordovician Eurychilinacea has not been studied thus far.

SHELL STRUCTURE IN *PINNATULITES PROCERA*

While studying shells of *Pinnatulites procera* in thin sections, HESSLAND (1949) identified "openings" traversing the entire thickness of the shells. Many specimens of *P. procera* present in the Mójcza's Early Ordovician, allowed for significantly more accurate observation of these structures. It was found that all openings shaped as long triangles, which are present on the outer surface of shells (Pl. 47: 4), pass through the shell to its inside and open on the interior surface of the shell as large round openings (Pl. 47: 5), with a diameter of about 0.04–0.07 mm (Text-fig. 14). Such a porous construction of large shells of *P. procera*, with an adult shell length of approximately 4–5 mm, may have diminished their weight, giving them some opportunity for more active swimming which could have explained the wide geographic distribution of this species. It is also possible that they functioned as normal pore canals, the "sensilium pores" of OKADA (1983), or had a light-sensory function. The shell structure of *Pinnatulites* seems to be similar to the tubular structure in *Tubulibairdia* valves and

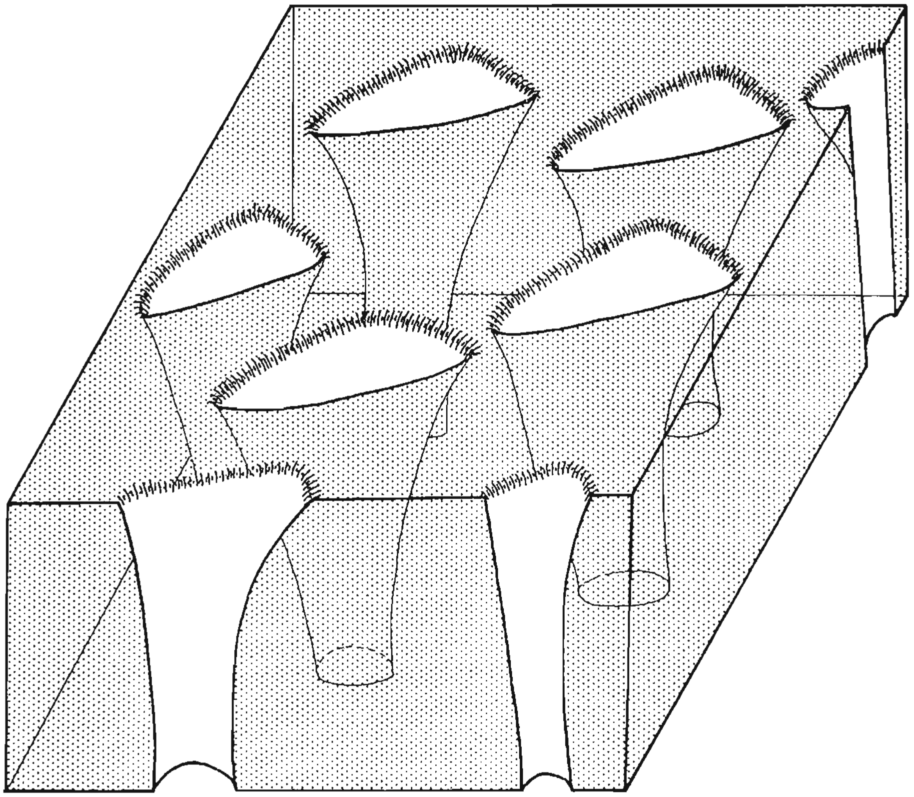

Fig. 14.
Pinnatulites procera (KUMMEROW). Diagram elucidating the structure of the valve wall.

other Silurian and Devonian pachydomellids. But unlike to *Pinnatulites*, tubules in *Tubulibairdia* valves open only on the interior surface of the shell. According to LUNDIN (1988), tubules in *Tubulibairdia* and other pachydomellids had a sensory function (sensing of light) or a function in formation of the cuticule of the ostracode.

TAXONOMIC DESCRIPTIONS

TERMINOLOGY

The terminology of the morphology of Ordovician ostracods remains comparatively stable (KESLING 1951, JAANUSSON 1957, MARTINSSON 1962, HENNINGSMOEN 1965; SCHALLREUTER 1973; VANNIER 1986a–b). The currently used terminology was summarized by VANNIER *et al.* (1989: Text-figs 6–9), and this terminology is followed here. The terminology of shell structure and microornamentation is discussed separately above. VANNIER *et al.* (1989) and BERDAN (1988) classification has been applied in the present paper.

All measurements are in millimetres unless stated otherwise. Only complete valves were measured.

The terms heteromorph and female are synonymous; both are used in the text; tecnomorph refers to the male and larval forms.

Abbreviations used: C – carapace, S – sulcus, RV – right valve, L – lobe, LV – left valve, juv. – juvenile form.

Subclass **Ostracoda** LATREILLE, 1802 (*nom. correct.* LATREILLE, 1806)
Order **Beyrichiocopa** POKORNÝ, 1953 (*emend.* SCHALLREUTER, 1980)
Suborder **Palaeocopa** HENNINGSMOEN, 1953 (*nom. correct.* JAANUSSON, 1957)
Superfamily **Eurychilinacea** ULRICH *et* BASSLER, 1923 (*nom. transl.* JAANUSSON, 1957)
Family **Oepikellidae** JAANUSSON, 1957 (*emend.* HESSLAND *in* BENSON *et al.*, 1961)
Subfamily **Ampletochilininae** SCHALLREUTER, 1975
Genus *Ampletochilina* SCHALLREUTER, 1969

Type species: *Ampletochilina trapezoidalis* SCHALLREUTER, 1969.

Ampletochilina priscina sp. n.
(Pl. 33: 1–3; Text-fig. 9)

Holotype: ZPAL O.XXV/418.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *priscus* – ancient, old.

Diagnosis. — Length of heteromorphs 1.1–1.2 mm. Outline slightly preplete. Cardinal angles more than 90°. Dolon slightly convex, broadest in anteroventral part.

Material. — 11 tecnomorphic and 2 female valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 9):

	L	H
ZPAL O.XXV/418	broken	0.63
ZPAL O.XXV/504	0.92	0.50
ZPAL O.XXV/505	broken	0.63

Description. — Valve outline slightly preplete. Indistinct sulcal depression. Tecnomorphic velum not reaching anterior cardinal corner, moderately wide in anteroventral part, narrow in ventral region, ending abruptly in posteroventral region. Dolon slightly convex, broadest in anteroventral part with tubules weakly visible externally. Marginal sculpture is narrow ridge that runs parallel with contact margin. Lateral surface of domicilium is covered by small rare tubercles.

Remarks. — This species is closely related to the stratigraphically younger *Swantina schallreuteri* sp. n., but differs in having an open antrum in the posteroventral part. *A. priscina* sp. n. is also similar to *A. ryghooftensis* SCHALLREUTER, 1987, from Middle Ordovician erratic boulders, but differs in having a weaker sulcal depression.

Distribution. — In Mójcza it occurs only below the discontinuity surface in the *Amorphognathus variabilis* Zone, Early Ordovician.

Genus *Swantina* SCHALLREUTER, 1986

Type species: *Ampletochilina swantia* SCHALLREUTER, 1969.

Swantina schallreuteri sp. n.
(Pl. 33: 4–8; Text-fig. 9)

Holotype: ZPAL O.XXV/62.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Roger SCHALLREUTER from Hamburg.

Diagnosis. — Length of heteromorphs 1.02–1.50 mm. Valve outline slightly preplete. Indistinct sulcal depression. Dolon in anteroventral and ventral parts with keel parallel and close to the margin. Ornamentation consist of small tubercles.

Material. — 120 tecnomorphic and 24 female valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 9):

	L	H
ZPAL O.XXV/51	0.96	0.48
ZPAL O.XXV/62	1.17	0.62
ZPAL O.XXV/509	1.12	0.54
ZPAL O.XXV/510	1.42	0.79
ZPAL O.XXV/511	1.13	0.54

Description. — Valve outline slightly preplete. Almost non-sulcate, with indistinct slightly curved sulcal depression. Valves moderately convex, highest convexity slightly behind sulcal depression. Velum in tecnomorphs medium-wide, not reaching anterior cardinal corner, posteriorly becoming rather abruptly obsolete before reaching posterior region of valve. In anteroventral and ventral region of heteromorphs, velum forms convex dolon, widest anteriorly. Antrum is closed by narrow ridge slightly behind middle of ventral margin and then velar structure continues as moderately wide ridge; it reaches posteroventral region of valve. Distinct keel runs parallel and close to margin of dolon; it is visible only in well preserved specimens. Tubules are weakly visible externally. Marginal sculpture is narrow ridge that runs parallel with contact margin. Ornamentation of domicilium consists of small tubercles. Surface of dolon is smooth.

Remarks. — *S. schallreuteri* sp. n. resembles *S. swantia* from Middle Ordovician (late Viruan) erratic boulders (SCHALLREUTER 1969) but differs in the narrower velar structure in tecnomorphs, presence of the keel on the dolon margin and the indistinct sulcal depression. The valve outline, weak sulcal depression and ornamentation of the surface of *S. schallreuteri* sp. n. and *Ampletochilina ryghooftensis* from late Viruan erratic boulders (SCHALLREUTER 1987) are very similar; *S. schallreuteri* differs in having a closed antrum. According to SCHALLREUTER (1986) a closed antrum is the main diagnostic feature of *Swantina. S. schallreuteri* sp. n. is most closely related to *Ampletochilina priscina* sp. n. from the Early Ordovician of the Mójcza Limestone. *S. schallreuteri* presumably evolved from an *A. priscina* – like ancestor.

Distribution.— In Mójcza it occurs from the discontinuity surface (*Pygodus serra* Zone) and is quite common up to 2. 4 m above the bentonite (*Amorphognathus superbus* Zone), Middle and Late Ordovician.

Genus *Platybolbina* HENNINGSMOEN, 1953
Subgenus *Platybolbina (Reticulobolbina)* SCHALLREUTER, 1969

Type species: *Platybolbina (Reticulobolbina) integra* SCHALLREUTER, 1969.

Platybolbina (Reticulobolbina)? sp.
(Pl. 25: 9)

Material. — One external mould.

Dimensions:

	L	H
ZPAL O.XXV/7	1.87	1.10

Remarks. — One specimen of *Platybolbina* has been found in the present material. Unfortunately the material is too badly preserved to be described in detail, although it is sufficient to allow the following remarks to be made: the valve outline is preplete, dorsal margin long and straight, velar frill narrow, and a drop-shaped muscle scar is present. The lateral surface is distinctly reticulate. This *Platybolbina (R.)* species resembles *P. (R.) kapteyni* (BONNEMA) from the Middle Ordovician of Sweden (THORSLUND 1940; JAANUSSON 1957, 1960, 1963), Estonia (SARV 1959), and erratic boulders (SCHALLREUTER 1975a).

Distribution. — In Mójcza it occurs only in the *Amorphognathus superbus* Zone, Late Ordovician.

Family **Eurychilinidae** ULRICH *et* BASSLER, 1923 (*nom. transl.* HENNINGSMOEN, 1953)
Subfamily **Piretellinae** ÖPIK, 1937 (*nom. transl.* KAY, 1940)
Genus *Hesperidella* ÖPIK, 1937

Type species: *Primitia esthonica* BONNEMA, 1909.

Hesperidella posterospinata sp. n.

(Pl. 25: 10–12; Text-fig. 15)

Holotype: ZPAL O.XXV/166.

Type horizon: *Pygodus anserinus* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *post* – posterior and *spina* – spine, refering to the posterodorsal and posteroventral spines.

Diagnosis. — *Hesperidella* with large preadductorial knob, distinct posterior crest and lacking dorsal plica. Velar frill wide, terminating in posteroventral region with long spine. In posterodorsal part of the valves long spine is also present.

Material. — 9 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/81	0.48	0.32
ZPAL O.XXV/166	0.54	0.36
ZPAL O.XXV/482	1.01	0.61

Description. — Valve outline approximately amplete. Dorsal margin straight. Anterior margin rounded; ventral margin gently curved. Preadductorial knob large (PAN), just reaching dorsal margin. Adductorial sulcus moderately wide, slightly curved anteroventrally, extends to half height of domicilium. Slightly curved crest (C3) surrounds sulcus in posterior part of valve. Shallow depression is developed in front of preadductorial knob. Dorsal plica is absent. Long spine is present in posterodorsal region of valve, usually broken. Small spine developed in anterior part of dorsal margin. Velum in tecnomorphs wide, especially ventrally, slightly restricted anteroventrally, gradually narrows towards anterior cardinal corner. Anteriorly velum reaches dorsal margin near anterior cardinal corner, it may protrude above dorsal margin. Posteroventrally velar frill is abruptly constricted with a long spine (Text-fig. 15). Velar tubules wide, well developed. Marginal sculpture consists of row of small tubercles near contact margin of each valve. Sulcus and velum smooth, domicilium reticulo-granulate with relatively large tubercles of somewhat varying size. Heteromorphs are absent.

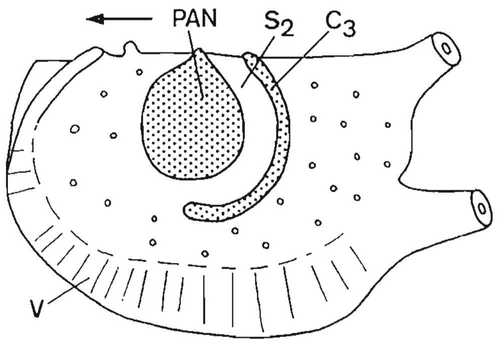

Fig. 15.
Schematic diagram of lateral view of *Hesperidella posterospinata* sp. n.

Remarks. — *Hesperidella posterospinata* sp. n. resembles *H. esthonica* (Bonnema) from the Middle Ordovician of Baltoscandia (Sarv 1959; Jaanusson 1957; Schallreuter 1975a), but differs in lacking the anterior and posterior arch of the dorsal plica and presence of a long spine at the end of the velar frill and in the posterodorsal region. *H. posterospinata* sp. n. differs from *H. michiganensis* from the Middle Ordovician of Michigan (Kesling, Hall and Melik 1962) in lacking the dorsal plica. *H. posterospinata* sp. n. seems to be similar to *Gellensia gotlandica* Schallreuter, from the Late Ordovician erratic boulders (Schallreuter 1967a) in having posterodorsal and posteroventral spines.

Distribution. — Rare specimens have been found in the *Pygodus serra* and *Pygodus anserinus* Zones, Middle Ordovician.

Genus *Piretella* Öpik, 1937

Type species: *Piretella acmaea* Öpik, 1937.

Piretella oepiki Thorslund, 1940

(Pl. 26: 4–7, Pl. 27: 1–4)

1940. *Piretella opiki* sp. n. ; Thorslund, p. 175, Pl. 4: 1–5.

Material. — 8 tecnomorphic valves and 1 female valve.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/96	1.52	1.01
ZPAL O.XXV/164	1.28	0.92
ZPAL O.XXV/248	1.19	0.88
ZPAL O.XXV/449	0.72	0.54

Description. — Domicilium outline subamplete. Maximum height of domicilium at anterior part of valve. Adductorial sulcus short, relatively wide, deep. Preadductorial node relatively small, rounded. U-shaped crest surrounding sulcus and preadductorial node, extends to dorsal margin. Dorsal plica absent. Tecnomorphs with wide velar frill in anterior and ventral part; and 6–8 long spines in posteroventral and posterior part. Velar tubules long, narrow, prominent. Heteromorphs with strongly convex dolon, anteriorly it reaches slightly above mid-height, posterior end of dolon situated in posteroventral region. Surface of dolon ornamented by small spines. Marginal sculpture represented by row of closely spaced, minute tubercle-like features. Surface of domiculium covered by small granules polygonally arranged (see also p. 153).

Remarks. — The specimens described differ from the holotype in a longer dolon in heteromorphic specimens.

Distribution. — Sweden: Upper *Chasmops* beds of Central Lockne area, Jämtland. In Mójcza it occurs from the upper part of the *Pygodus serra* Zone up to the *Amorphognathus superbus* Zone, Middle and Late Ordovician.

Piretella amphicristata sp. n.

(Pl. 26: 10–11)

Holotype: ZPAL O.XXV/86.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Greek *amphi* – at both sides, and Latin *crista* – crest.

Diagnosis. — A species of *Piretella* having two discrete crests; one in front of preadductorial node, second behind adductorial sulcus; they reach dorsal margin. Velar frill wide, in posterior region replaced by 6–8 long spines.

Material. — 4 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/86	0.80	0.48
ZPAL O.XXV/526	0.66	0.43

Description. — Valve outline subamplete. Preadductorial node small, rounded. Adductorial sulcus weakly developed. Two almost straight crests extend from dorsal margin to mid-height of valve. Dorsal plica is absent. Tecnomorphs with wide velar frill in anterior and ventral part; extending from anterior cardinal corner; in posterior part replaced by 6–8 long spines. Velar tubules long, narrow. Marginal sculpture is row of closely spaced tubercles. Surface of the domicilium reticulo-granulate. Females not found yet.

Remarks.—This species appears to be closely related to *P. oepiki* THORSLUND (see above). The latter possesses a U-shaped crest enclosing the adductorial sulcus and preadductorial node.

Distribution. — In Mójcza it is rare in the *Pygodus serra* and *Amorphognathus tvaerensis* Zones, Middle Ordovician.

Genus *Lembitsarvella* gen. n.

Type species: *Lembitsarvella polonica* sp. n.

Derivation of the name: In honour of Dr. Lembit SARV from Tallinn, Estonia.

Diagnosis. — Eurychilinidae having velar structure anteriorly and ventrally developed as wide tubulous frill; posteriorly it passes into velar ridge, extending to posterior cardinal corner. Heteromorphs with strongly convex dolon with four thick ridges parallel to margin. Sulcus and preadductorial node surrounded by a U-shaped crest. Dorsal plica well developed.

Remarks. — *Lembitsarvella* gen. n. shows a close resemblance to *Piretella* Öpik, 1937 in the ornamentation of crests and the outline of the valve and its size, but differs in having the tecnomorphic velar structure in posterior region as a ridge and heteromorphs with four thick ridges on the dolon. For morphology of the velum in *Lembitsarvella* see p. 157, and for ornamentation of the surface see p. 156.

Species included: *Lembitsarvella polonica* sp. n., *Lembitsarvella* sp.

Lembitsarvella polonica sp. n.

(Pls 28: 5–8; 29: 1–9; 30: 1–8; 31: 1–2; 32: 1–6; 39: 4; 50: 3–4; Text-figs 5, 12–13)

Holotype: ZPAL O.XXV/163.

Type horizon: *Pygodus anserinus* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Poland.

Diagnosis. — As for the genus.

Material. — 230 tecnomorphic valves, and 10 fragments of female valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 5):

	L	H
ZPAL O.XXV/12	1.55	1.01
ZPAL O.XXV/35	1.60	1.01
ZPAL O.XXV/54	1.62	1.10
ZPAL O.XXV/163	1.69	1.10
ZPAL O.XXV/293	0.81	0.54
ZPAL O.XXV/295	1.26	0.83
ZPAL O.XXV/296	1.13	0.76
ZPAL O.XXV/430	1.21	0.72
ZPAL O.XXV/433	1.23	0.83
ZPAL O.XXV/438	1.21	0.75
ZPAL. O.XXV/525	1.01	0.68

Description. — Valve outline almost preplete. Maximum length of carapace at its mid-height. Domicilium uniformly convex. Anterior and posterior cardinal angles more than 90°. Preadductorial node large, rounded. Adductorial sulcus distinct, deep, parallel to posterior branch of crest. Crests U-shaped surrounding node and sulcus, continuing dorsally as dorsal plica. Anterior branch of crest evenly curved, continuous dorsally with dorsal plica; posterior branch of crest more or less straight, continues dorsally with posterior part of dorsal plica. Dorsal plica about as strong as crest; hindmost part rather long and posteroventrally curved. Dorsal plica protruding above the hinge-line. Tecnomorphic velum wide anteroventrally and ventrally, narrowing anteriorly, becoming ridge-like posteriorly. At end of ridge is small posterodorsal spine. Anteriorly it extends up to anterior cardinal corner. Border crest on outside of velum and near its edge. Toric ridge weak, occurs well below velar edge. Velar tubules wide. Fine concentric striation combined with tubulosity produces wrinkled pattern on upper and lower surface of velum (for morphology of velum of *Lembitsarvella polonica* see p. 157). Fragmented valves of heteromorphs have been found. The dolon has four thick ridges parallel to the margin. A line of small, tubercle-like processes occurs along each valve margin. Sulcus smooth. Domicilium reticulo-granulate (see p. 156).

Remarks. — The development of crests in *L. polonica* is similar to that in *Piretella acmaea* Öpik from the Late Ordovician of Estonia (Öpik 1937).

Distribution. — In Mójcza, it occurs from *Pygodus serra* Zone up to the *Amorphognathus tvaerensis* Zone, Middle Ordovician.

Lembitsarvella sp.
(Pl. 28: 1–4)

Material. — About 25 tecnomorphic valves, almost all valves incomplete.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/292	1.19	0.76
ZPAL O.XXV/429	1.01	0.63

Remarks. — The material agrees in most respects with the type species. However, as far as can be assessed, it is distinct from *L. polonica* in its smaller overall size, narrower velar frill and in having the velar frill in the posterior part of the valve. In *L. polonica*, along the posterior margin the velar structure is developed as a narrow ridge. More complete material is needed for determination of this species.

Distribution. — Common in *Amorphognathus variabilis* Zone, Early Ordovician.

Subfamily **Chilobolbininae** JAANUSSON, 1957
Genus *Laccochilina* HESSLAND, 1949
Subgenus *Laccochilina (Laccochilina)* HESSLAND, 1949

Type species: *Eurychilina estonula* ÖPIK, 1935.

Remarks. — In respect to the development of velar structure, two subgenera were distinguished within the genus *Laccochilina* by JAANUSSON (1957). In the subgenus *Laccochilina (Laccochilina)* the "velar structure is entire, reaching posteriorly up to the posterior cardinal corner without any considerable decrease in the width", the subgenus *Laccochilina (Prochilina)* possesses the velar structure developed posteriorly as a row of spines (JAANUSSON 1957). Juvenile specimens of *L. (L.) berdanae* sp. n. from Mójcza, possess a velar frill extending to the end of the ventral region, in the posterior region replaced by spines; larger specimens have an entire velar structure. For this reason *Laccochilina* is in need of revision, but more material is needed to confirm this.

Laccochilina (Laccochilina) berdanae sp. n.
(Pl. 26: 1–3)

Holotype: ZPAL O.XXV/471.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Jean BERDAN, Natural Museum of Natural History, Washington.

Diagnosis. — Adductorial pit narrow, preadductorial node small, oblong. Dorsal plica forming two arches. Lateral surface of domicilium ornamented by small number of rather small tubercles.

Material. — 38 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/129	0.58	0.38
ZPAL O.XXV/471	1.10	0.72
ZPAL O.XXV/472	1.12	0.86

Description. — Valve outline slightly preplete. Valves in ventral view regularly convex, greatest convexity slightly behind adductorial pit. Dorsal plica faint, forming two arches at dorsal margin, obsolete in middle part. Adductorial pit comparatively narrow. Preadductorial node small, oblong. Velar frill in adults and late instars moderately wide, extending from anterior to posterior cardinal corners, with short tubules distinctly visible throughout. Juvenile specimens possess velar frill extending to posteroventral region; in posterior region replaced by spines. Females not found yet. Marginal sculpture represented by row of closely spaced, minute tubercle-like features. Domicilium surface ornamented by scarce rather small tubercles.

Remarks. — *L. (L.) berdanae* sp. n. resembles *L. (L.)* sp. from the *Crassicauda* limestone, Sweden (JAANUSSON 1957) in the outline of valves, small preadductorial node and ornamentation of surface, but differs in having a faint dorsal plica. There are also similarities to *L. (L.) dorsoplicata* HESSLAND, from the Early Ordovician of Sweden (HESSLAND 1949), but it differs in the shape of dorsal plica.

Distribution. — In Mójcza it occurs only below the discontinuity surface (*Amorphognathus variabilis* Zone), Early Ordovician.

Family **Oepikiidae** JAANUSSON, 1957 (*emend.* POKORNÝ, 1958)

Genus *Duringia* SCHALLREUTER, 1984

Type species: *Eurychinina spinosa* KNÜPFER, 1968.

Duringia? *aculeata* sp. n.

(Pl. 25: 1–3)

Holotype: ZPAL O.XXV/66.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *aculeus* – spine, refering to spines on the valve surface.

Diagnosis. — *Duringia* with distinct preadductorial node. Tecnomorphic velum developed as row of spines. Dolon broad, strongly convex, tubulose. Lateral surface spinose.

Material. — Four incomplete tecnomorphic valves and one damaged female valve.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/66	broken	0.45
ZPAL O.XXV/82	broken	0.50

Description. — Outline nearly amplete. Greatest domicilial convexity in ventrocentral region. Adductorial sulcus long, sigmoidal, ending slightly below preadductorial node. Preadductorial node as distinct bulb. Tecnomorphic velum appears as row of spines. Dolon broad, strongly convex, tubulose. Marginal sculpture is row of spines. Lateral surface of domicilium ornamented by distinct spines.

Remarks. — *D.*? *aculeata* sp. n. resembles *D. spinosa* (KNÜPFER, 1968), see also SCHALLREUTER (1984c), but differs in lacking spines at the border of the lateral and marginal surfaces of the dolon. The other characters of the species are of general *Duringia* type. *D.*? *aculeata* sp. n. is the oldest representative of the genus. According to JONES (1986) the remnant S3 of *Duringia mackenziensis* (COPELAND, 1982) and *D. triformosa* JONES, 1984, may indicate a quadrilobate ancestry. *D.*? *aculeata* sp. n. lacks S3.

Distribution. — Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Duringia sp. 1

(Pl. 25: 6)

Material. — One female valve, party damaged.

Dimensions:

	L	H
ZPAL O.XXV/192	1.37	0.95

Description. — Outline slightly preplete. Greatest domicilial convexity in ventrocentral region, posterior of S2. S2 long and sigmoidal. Preadductorial node small, rounded. Strongly convex, tubulose velum with weakly developed dolonal spines. Marginal sculpture as row of small spines. Lateral surface granulose with small spines.

Remarks. — *Duringia* sp. 1 resembles *Duringia alemboegensis* SCHALLREUTER, 1987 from Middle Ordovician erratic boulders, in having weakly developed dolonal spines and a long sigmoidal S2; but differs in having a more convex centroventral part of the domicilium and the presence of spines on the surface of the valves. *Duringia* sp. 1 differs from *D. triformosa* JONES, 1984 (Middle Ordovician of England and Wales) in lacking S3.

Distribution. — It occurs only in lower part of the *Pygodus anserinus* Zone, Middle Ordovician.

Duringia? sp. 2
(Pl. 25: 4–5)

Material. — Two tecnomorphic valves, party damaged.

Remarks.—The ornamentation of the surface of the domicilium with spines and the velum developed as a row of spines are similar to that in other species of *Duringia (D. spinosa, D. aculeata)*. Because of the small amount of material, the species is not named and its generic assignement remains uncertain.

Distribution. — In Mójcza it occurs only in the upper part of the *Pygodus serra* Zone, Middle Ordovician.

Subfamily uncertain
Genus *Eochilina* IVANOVA, 1964

Type species: *Laccochilina (Eochilina) invitabilis* IVANOVA, 1964.

Eochilina? sp.
(Pl. 33: 9–11)

Material. — 4 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/47	0.72	0.45
ZPAL O.XXV/484	0.61	0.34
ZPAL O.XXV/486	0.72	0.47

Description. — Preplete to subamplete in lateral outline. Dorsal margin long and straight; ventral margin convex. Adductorial pit situated in dorsal half of valve is relatively shallow. Dorsal pit situated above adductorial pit is deeper than latter. Dorsal ridge weakly developed, present in antero- and posterodorsal region. Velum narrow, developed along anterior and ventral margins, lacking externally visible tubules. Surface of carapace finely reticulate. Females not found yet.

Remarks. — The specimens described show certain morphological characters, such as two pits, adductorial and dorsal, situated in dorsal half of the valve, similar to those occuring in *Eochilina*. The species of *Eochilina* described by IVANOVA (1964, 1979) are characterized by the well developed tubulous velum and dorsal ridge. In *Eochilina*? sp. the velum is narrow without visible tubules and the dorsal pit is deeper than the adductorial one. *Eochilina*? sp. resembles *Eochilina (E.) clara* MELNIKOVA, 1981, from the Middle Ordovician of Siberia, in possessing a similar narrow velar structure.

Distribution. — Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Superfmalily **Hollinacea** SWARTZ, 1936 (*nom. transl.* JAANUSSON, 1957)
Family **Euprimitiidae** HESSLAND, 1949 (*nom. transl.* KRAFT, 1962)
Subfamily **Gryphiswaldensiinae** SCHALLREUTER, 1968
Genus *Gryphiswaldensia* SCHALLREUTER, 1965

Type species: *Gryphiswaldensia gryphiswaldensis* SCHALLREUTER, 1965.

Gryphiswaldensia angustivelata sp. n.
(Pl. 34: 7)

Holotype: ZPAL O.XXV/485.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *angustus* – narrow, refering to the narrow velar ridge.

Diagnosis. — *Gryphiswaldensia* with very narrow velar ridge and weakly developed sulcal depression.

Material. — 6 valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/485	0.72	0.45

Description. — Valve outline slightly postplete; dorsal margin long and straight. Valves moderately convex. S2 developed as weak depression. Preadductorial node rounded and small. Velar structure developed as very narrow ridge along entire free margin. Surface of domicilium finely reticulate.

Remarks. — *Gryphiswaldensia angustivelata* sp. n. is closely related to the stratigraphically younger *G. cavata* sp. n., but differs from the latter in a more postplete outline and weakly developed sulcal depression. It is also similar to *Gryphiswaldensia macroreticulata* (HESSLAND), from the Early Ordovician of Sweden (HESSLAND 1949), but differs from it in a more weakly developed S2 and small preadductorial node.

Distribution. — Rare in the upper part of the *Amorphognathus variabilis* Zone, Early Ordovician.

Gryphiswaldensia cavata sp. n.
(Pl. 34: 1–5; Text-fig. 4)

Holotype: ZPAL O.XXV/480.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *cavus* – cavity, refering to the presence of a cava on the lateral surface.

Diagnosis. — *Gryphiswaldensia* with narrow ridge-like velar frill and small preadductorial node.

Material. — 349 valves, mostly well preserved.

Dimensions (figured specimens, see also size dispersion in Text-fig. 4):

	L	H
ZPAL O.XXV/42	0.63	0.45
ZPAL O.XXV/265	0.83	0.54
ZPAL O.XXV/304	0.83	0.55
ZPAL O.XXV/470	0.74	0.45
ZPAL O.XXV/480	0.77	0.45

Description. — Valve outline almost amplete to slightly preplete. Dorsal margin long and straight; free margin rounded. Preadductorial node rounded and small. Adductorial sulcus lies in front of center of valve, it is shallow and runs perpenducularly to dorsal margin. At end of sulcus a small muscle spot is present. Velar structure narrow, ridge-like, extending from anterior to posterior cardinal corners. Subvelar field narrow. Domicilial surface reticulate with special sulcal sculpture forming inner, bulb-like extension of shell material, which has only small outside opening (cavum).

Remarks. — A special sulcal sculpture, similar to that occuring in *G. cavata*, was described by SCHALLREUTER (1964a, 1983d) in several Ordovician species. According to SCHALLREUTER (1983d) it is possible that it may have had a function related to buoyancy control. *Gryphiswaldensia wilnoiensis* (NECKAJA, 1952) from the Late Ordovician of Lithuania, resembles the new species in lateral outline, surface ornament and narrow velar ridge; but differs in lacking a muscle spot at the end of the sulcus. The *G. wilnoiensis* illustrated by SCHALLREUTER (1986, Pl. 2: 4) from the Upper Ordovician erratic boulders, represents a heteromorphic valve and differs from *G. cavata* sp. n. in having a larger preadductorial node and the presence of a bend between the lateral and ventral part of the domicilium. *G. cavata* sp. n. is closely related to the stratigraphically older *G. angustivelata* sp. n., but differs from the latter by a deeper adductorial sulcus and wider velar structure.

Distribution. — In Mójcza it occurs from the *Pygodus serra* to the *Amorphognathus tvaerensis* Zones, Middle Ordovician.

Gryphiswaldensia gryphiswaldensis SCHALLREUTER, 1965
(Pl. 34: 6)

1965. *Gryphiswaldensia gryphiswaldensis* sp. n.; SCHALLREUTER, p. 479, Pl. 11: 1.

1975a. *Gryphiswaldensia gryphiswaldensis* SCHALLREUTER; SCHALLREUTER, p. 180, Pl. 8: 4–11 (here older synonymy).

1992. *Gryphiswaldensia gryphiswaldensis* SCHALLREUTER; SIDARAVIČIENE, p. 13, Pl. 1: 5.

Material. — 65 valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/52	0.58	0.38

Remarks. — *G. gryphiswaldensis* resembles *G. cavata* sp. n. in the shape of the carapace, but differs in having a wider velar ridge and a weaker sulcal depression.

Distribution. — Common in the Ordovician of the Baltic area (Backsteinkalk erratic boulders, Lithuania, Middle Ordovician) and the Holy Cross Mountains, where it occurs in Mójcza in the *Amorphognathus superbus* Zone, Middle/Late Ordovician boundary.

Genus *Steinfurtia* SCHALLREUTER, 1985

Type species: *Euprimitia macroreticulata* HESSLAND, 1949.

Steinfurtia sp.
(Pl. 34: 8)

Material. — 1 tecnomorphic valve.

Dimensions:

	L	H
ZPAL O.XXV/46	0.68	0.42

Description and remarks. — The valve possesses slightly preplete outline; the anterior end of the valve broadly rounded; the ventral margin convex. Valve moderately convex with highest convexity behind the sulcus. Sulcus long, deep, rather broad. Preadductorial node indistinct, small. Velum narrow, not extending to dorsal corners. Lateral surface of the domicilium ornamented with a distinct reticulation. The species resemble *S. macroreticulata* (HESSLAND) from the Early Ordovician of Sweden (HESSLAND 1949), but differs from it in having a long sulcus and a small preadductorial node. It probably represents a new species but more material is needed to confirm this.

Distribution. — In Mójcza it occurs in the upper part of the *Pygodus serra* Zone, Middle Ordovician.

Family **Tvaerenellidae** JAANUSSON, 1957 (*emend.* HESSLAND *in* BENSON *et al.*, 1961)
Subfamily **Tvaerenellinae** JAANUSSON, 1957
Genus *Euprimites* HESSLAND, 1949
Subgenus *Euprimites (Euprimites)* HESSLAND, 1949

Type species: *Euprimites reticulogranulata* HESSLAND, 1949.

Remarks. — According to SCHALLREUTER and KRŮTA (1988) *Bichilina* is a descendant of *Euprimites*. *Euprimites* and *Bichilina* may be differentiated from each other by the fact that in *Bichilina* the velar flange is entire.

Euprimites (Euprimites) grandis sp. n.
(Pl. 35: 9–14)

Holotype: ZPAL O.XXV/143.
Type horizon: *Pygodus serra* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *grandis* – large.

Diagnosis. — Large *Euprimites* (greatest length of tecnomorph 2.5 mm). Sulcus deep, its ventral end curved anteroventrally. Tecnomorphs with narrow velar ridge along ventral margin, no velar ridge in instars shorter than 1.2 mm. Females with weakly convex dolon in anteroventral region. Lateral surface smooth.

Material. — 91 valves, mainly instars, among them only one incomplete female valve.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/84	0.83	0.40
ZPAL O.XXV/143	1.04	0.67
ZPAL O.XXV/153	1.78	1.15
ZPAL O.XXV/154	0.92	0.54
ZPAL O.XXV/412	1.17	0.70
ZPAL O.XXV/479	broken	0.90

Description. — Outline nearly amplete. Domicilium moderately and rather regularly convex, highest convexity in front of sulcus. Sulcus moderately wide, relatively short and deep, deepest in its ventral part; dorsally it becomes gradually shallower and before reaching dorsal margin merges into general surface of domicilium; its ventral end curved anteroventrally. Dorsal plica not developed. Preadductorial node minute, situated about at mid-height of sulcus. Large tecnomorphs (more than 1.0 mm) with narrow velar ridge along ventral margin. No such structures present in young instars. At anterior and posterior margin 5–7 small spines occur in position of admarginal structure. Right valve with admarginal ridge slightly closer to free margin than to velar structure. Left valve larger with fine contact groove. Lateral surface with very faint reticulation in younger instars and smooth in larger specimens. Only one incomplete female valve was found with weakly convex dolon in anteroventral region.

Remarks. — By its nearly amplete outline, deep and anteroventrally curved sulcus, smooth lateral surface, *E. (E.) grandis* sp. n. clearly differs from other known species of *Euprimites*. The tecnomorphic velar structure and the dolon seem to be like those of *E. (E.) suecicus* (THORSLUND, 1940), see also SCHALLREUTER (1973, Pl. 22: 1–3), but differ from the latter by the smooth lateral surface and deep, anteroventrally curved sulcus.

Distribution. — In Mójcza it occurs from the discontinuity surface (*Pygodus serra* Zone) and is common up to the *Amorphognathus tvaerensis* Zone, Middle Ordovician.

Genus *Piretia* JAANUSSON, 1957

Type species: *Piretia geniculata* JAANUSSON, 1957.

Piretia tenuistriata sp. n.
(Pl. 36: 1–7; Text-fig. 6)

Holotype: ZPAL O.XXV/58.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *tenuis* – thin and alluding to the finely striated dolon.

Diagnosis. — Length of heteromorphs about 1.4–1.8 mm. Tecnomorphs with velar ridge or narrow flange. Heteromorphs with finely striated dolon.

Material. — 36 female valves and 91 tecnomorphic valves, some damaged.

Dimensions (figured specimens, see also size dispersion in Text-fig. 6):

	L	H
ZPAL O.XXV/58	1.25	0.64
ZPAL O.XXV/59	1.12	0.55
ZPAL O.XXV/268	1.24	0.65
ZPAL O.XXV/409	1.28	0.83
ZPAL O.XXV/437	1.51	0.92
ZPAL O.XXV/500	1.24	0.63

Description. — Domicilial outline slightly preplete. Domicilium rather uniformly convex, highest convexity in anterior part. Sulcus rather long, wide; ventral end rounded, strongly curved anteroventrally. Preadductorial node indistinct, flattened. Tecnomorphs with velar ridge or narrow flange which is widest anteroventrally. Anteriorly, narrow velar ridge not reaching anterior cardinal corner; posteriorly velar flange decreases gradually and is obsolete in middle part of posterior margin. Females with strongly convex dolon forming a false brood pouch. Anterior end of dolon is situated at about longitudinal line through end of sulcus; posterior end extends to posteroventral margin. Dolon is ornamented by fine striation. Left valve with fine connecting groove and marginal ridge. Right valve with admarginal ridge. Lateral surface ornamented with fine but distinct reticulation and small tubercles are scattered along velar ridge and posterior end of dolon.

Remarks. — *Piretia tenuistriata* sp. n. shows a close relationship to *Piretia geniculata* JAANUSSON from the Platyurus Limestone of Sweden (JAANUSSON 1957). Heteromorphs of *P. tenuistriata* and *P. geniculata* are very similar, but tecnomorphs of *P. tenuistriata* differ from tecnomorphs of *P. geniculata* in having a longer carapace and narrower velar flange especially in the anteroventral part.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus* and *Amorphognathus tvaerensis* Zones, Middle Ordovician.

Piretia rara sp. n.
(Pl. 36: 8–11)

Holotype: ZPAL O.XXV/232.
Type horizon: *Amorphognathus tvaerensis* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *rarus* – rare.

Diagnosis. — *Piretia* with distinct laterovelar furrow, parallel to free margin in tecnomorphic valves. Females about 1.06–1.08 mm long.

Material. — 6 tecnomorphic valves and 3 female valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/182	0.95	0.54
ZPAL O.XXV/232	·1.00	0.71
ZPAL O.XXV/233	1.06	0.68
ZPAL O.XXV/270	0.95	0.58

Description. — Domicilial outline slightly postplete. Adductorial sulcus short, deep, curved anteroventrally. Preadductorial node indistinct. Tecnomorphs with narrow velar ridge, terminating at mid-height of posterior margin in short spine. Dolon strongly convex. Tecnomorphic valves with distinct laterovelar furrow; parallel to free margin. Lateral surface strongly reticulate, surface of dolon smooth.

Remarks. — *Piretia rara* sp. n. is distinguished from congeneric species by the presence of a laterovelar furrow in tecnomorphic valves. The reticulate ornamentation makes *P. rara* similar to *Piretia reticulata* QUALE, from the Caradoc series of the Oslo region (QUALE 1980), but it differs in possessing a laterovelar furrow, narrow tecnomorphic ridge and smooth strongly convex dolon in females. *P. reticulata* probably belongs to a new genus because of its tubulous velum. *P. rara* sp. n. resembles also *Piretia commasulcata* SCHALLREUTER from Öjlemyrflint erratic boulders of the Isle of Gotland (SCHALLREUTER 1985a) in ornamentation of the domicilium but differs in a much better developed sulcus, lack of a ridge along the lateral and ventral surfaces of the dolon and presence of a laterovelar furrow.

Distribution. — It occurs in upper part of the *Amorphognathus tvaerensis* Zone, Middle Ordovician.

Piretia speciosa sp. n.
(Pl. 35: 4–8)

Holotype: ZPAL O.XXV/151.
Type horizon: *Pygodus serra* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *speciosus* – well shaped, regular.

Diagnosis. — Length of heteromorphs about 0.9–1.2 mm. Sulcus strongly curved anteroventrally. Females with strongly convex dolon, ridge occurs along border of lateral and ventral surfaces of dolon.

Material. — 8 tecnomorphic valves and 3 female valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/151	0.96	0.64
ZPAL O.XXV/275	1.01	0.67
ZPAL O.XXV/276	1.01	0.63
ZPAL O.XXV/277	1.17	0.83
ZPAL O.XXV/400	1.01	0.63

Description. — Domicilial outline slightly preplete. Domicilium rather uniformly convex, highest convexity slightly behind sulcus. Sulcus long, terminates slightly below mid-height of valve. Ventral end of sulcus strongly curved anteroventrally. Low elevation surrounds ventral end of sulcus. Preadductorial node bulb-like but flattish. Velum forms ridge or narrow flange, widest anteroventrally. Anteriorly velum does not reach anterior cardinal corner, posteriorly it decreases gradually in posteroventral region. Females possess strongly convex dolon. Ridge occurs along border of lateral and ventral surfaces of dolon. Lateral surface of domicilium covered by minute granules and relatively large scarce tubercles. Surface of dolon smooth. Left valve with fine contact groove and admarginal tubercles along entire free margin. Right valve with marginal tubercles.

Remarks. — *Piretia speciosa* sp. n. is closely related to *Piretia clypeolaria* JAANUSSON, from the Middle Ordovician of Sweden (JAANUSSON 1957), but differs from it in having a strongly curved sulcus and a distinct ridge along the border of the lateral and ventral surfaces of the dolon. *Piretia commasulcata* SCHALLREUTER, from Upper Ordovician Öjlemyrflint erratic boulders (SCHALLREUTER 1985a) has such a ridge on the dolon, but this species differs from *P. speciosa* sp. n. by the very long shape of the domicilium and the small comma-shaped sulcus. *P. speciosa* is also similar to *Piretia rugosa* (STEUSLOFF), illustrated by SCHALLREUTER (1986, Pl. 3: 2), but differs in the nature of the ornamentation, short sulcus and by the development of the velar structure in the posterior part of the valve (in *P. rugosa* it reaches the posterior cardinal corner). *P. speciosa* is similar to *Otraczetia bulbata* gen. et sp. n. from the Early Ordovician of the Mójcza section, from which it presumably evolved. It differs from the latter in lacking S1 and S3.

Distribution. — It occurs from the discontinuity surface (*Pygodus serra* Zone) up to the *Amorphognathus tvaerensis* Zone, Middle Ordovician.

Genus *Otraczetia* gen. n.

Type species: *Otraczetia bulbata* gen. et sp. n.

Derivation of the name: From Otracz – a hill close to the type locality.

Diagnosis. — Genus of Hollinacea having long curved adductorial sulcus and slightly marked S1 and S3. Dolon strongly convex forming false brood pouch. Prominent preadductorial node.

Remarks. — *Otraczetia* gen. n. shows certain morphological characters, such as a strongly convex dolon, ridge-like velar structure and long anteroventrally curved S2, similar to those occuring in *Piretia* JAANUSSON, but differs in having a slightly marked S1 and S3.

Otraczetia bulbata sp. n.

(Pl. 35: 1–3; Textifig. 16)

Holotype: ZPAL O.XXV/200.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *bulbus* – referring to the prominent preadductorial node.

Diagnosis. — As for the genus.

Material. — 23 tecnomorphic valves and 5 female valves, partly damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/200	1.01	0.63
ZPAL O.XXV/201	1.10	0.72
ZPAL O.XXV/252	0.92	0.54

Description. — Valve outline preplete. Dorsal margin long and straight. Domicilium rather moderately and regularly convex. Adductorial sulcus moderately wide, long, curved anteroventrally. Low rounded ridge surrounds sulcus. Preadductorial node large (PAN), flattish. Small S1 is present in front of preadductorial node; anteriorly surrounded by indistinct ridge. Tecnomorphic velar ridge moderately wide, widest anteroventrally, does not reach anterior cardinal corner (Text-fig. 16). Heteromorphs with strongly convex dolon with ridge between lateral and ventral surface of dolon. Marginal sculpture is row of tubercles. Lateral surface of domicilium is finely reticulo-granulate with small tubercles. Surface of velar ridge finely granulate.

Remarks. — *Otraczetia bulbata* sp. n. is similar in shape of adductorial sulcus, presence of ridge between lateral and ventral surface of the dolon and narrow tecnomorphic velum to *Piretia speciosa* sp. n., but differs in having S1 and S3. *O. bulbata* probably forms the ancestral stock from which *P. speciosa* developed. The presence of weakly developed S1 and S3 is similar to that described by HESSLAND (1949) in *Tetrada teres*. HESSLAND (1949) decsribed only tecnomorphic specimens.

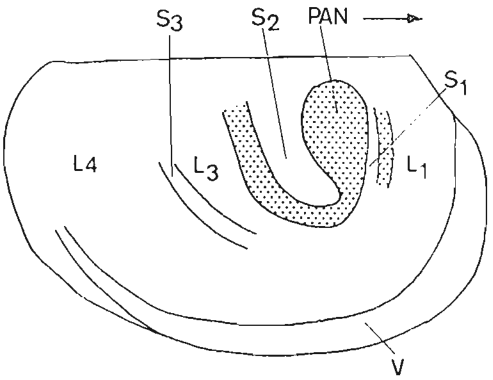

Fig. 16.
Schematic diagram of lateral view of *Otraczetia bulbata* gen. et sp. n.

Distribution. — It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Genus *Uhakiella* ÖPIK, 1937

Type species: *Uhakiella coelodesma* ÖPIK, 1937.

Uhakiella diuturna sp. n.
(Pl. 37: 1–5; Text-fig. 7)

Holotype: ZPAL O.XXV/95.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *diuturnus* – long lived, referring to the long range of the species.

Diagnosis. — Length of heteromorphs 1.2–1.5 mm. Anterior and posterior arches of dorsal plica weakly developed. Tecnomorphs with narrow bend-like velum in juvenile forms and narrow ridge in males and pre-adult tecnomorphs. Dolon strongly convex. Small furrow between lateral surface of domicilium and dolon is present.

Material. — 69 tecnomorphic valves and 4 female valves, some damaged.

Dimensions (figured specimens, see also size dispersion in Text-fig. 7):

	L	H
ZPAL O.XXV/15	1.01	0.63
ZPAL O.XXV/55	0.88	0.58
ZPAL O.XXV/95	1.04	0.72
ZPAL O.XXV/249	1.24	0.72

Description. — Outline slightly postplete or nearly amplete. Dorsum slightly epicline. Lateral surface of domicilium rather faintly convex, highest convexity in the middle of valve. Adductorial sulcus rather deep, curved anteroventrally; its ventral end at mid-height; indistinct ridge-like elevation usually surrounds end of sulcus. Preadductorial node flattened, indistinct. Posterior arch of dorsal plica more distinct than anterior arch and slightly curved anteroventrally, both are weakly developed. Younger instars with narrow bend-like velum; males and pre-adult instars with narrow velar ridge. Dolon strongly convex, rather wide, anterior end reaching up to longitudinal line through dorsal end of adductorial sulcus, posterior end of dolon reaching up to about 2/3 of length. Row of marginal tubercles developed along whole free margin. Ornamentation consists of closely spaced granules and rather small tubercles scattered here and there; granules continue upon lateral surface of dolon and subvelar field. Dolon has also faint radial striation. Boundary between dolon and domicilium is marked by shallow furrow.

Remarks. — *U. diuturna* sp. n. differs from other species of *Uhakiella* by its arrangement of the dorsal ridges. The ornamentation of the lateral surface resembles that of *Uhakiella magnifica* SARV, but the dorsal ridges are less distinct and the valves are smaller than in the latter species. The "einigeschnurt" velum described by SCHALLREUTER (1973) in males of *Uhakiella jaanussoni* SCHALLREUTER, is lacking in tecnomorphs of *U. diuturna* sp. n. It is possible that adult males of *U. diuturna* have not been found yet. Species similar to *Uhakiella* but without "einigeschnurt" velum, SCHALLREUTER (1983c) placed in *Bromidella.*

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* and *Amorphognathus superbus* Zones, Middle and Late Ordovician.

Uhakiella perrara sp. n.
(Pl. 37: 10–11)

Holotype: ZPAL O.XXV/198.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *perrarus* – very rare, referring to the small number of specimens.

Diagnosis. — Flat lateral surface. Adductorial pit small and round. Dorsal ridge along entire dorsal margin; velar ridge narrow, ending in posteroventral part.

Material. — 10 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/107	0.92	0.63
ZPAL O.XXV/198	0.92	0.67

Description. — Outline almost amplete. Lateral surface flat. Adductorial pit rounded, rather small. Preadductorial node weakly developed. Narrow, ridge-like plica occurs along dorsal margin, it is curved ventrally in anterior and posterior ends. Velum forms ridge which terminates posteroventrally in short spine. Anteriorly, velar ridge extends to anterior cardinal corner. Ornamentation of lateral surface of domicilium consist of minute, closely spaced granules. Heteromorphic valves have been not found.

Remarks. — *Uhakiella perrara* sp. n. seems to be very close to *Uhakiella cicatricosa* SARV, from the Kunda Stage of Estonia (SARV 1959, Pl. 4: 1–4), but differs in having a distinct dorsal plica, flat lateral surface and velar ridge ending posteroventrally in a short spine. In *U. cicatricosa* the velar ridge occurs along the entire free margin.

Distribution. — Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Uhakiella sp. 1
(Pl. 37: 6)

Material. — 4 tecnomorphic valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/426	1.10	0.68

Description. — Outline almost amplete. Lateral surface of domicilium moderately convex. Adductorial sulcus curved anteroventrally, its ventral end nearly at mid-height. Preadductorial node weakly developed. Anterior and posterior arch of dorsal plica weakly developed. Velar ridge narrow, extends from anterior to posterior cardinal corners. Marginal sculpture is row of tubercles along whole free margin. Ornamentation consist of closely spaced granules and rare small tubercles.

Remarks. — *Uhakiella* sp. 1 is closely related to stratigraphically younger *Uhakiella diuturna* sp. n. but differs from it in having a shallow sulcus and more convex domicilium.

Distribution. — It occurs in the upper part of the *Amorphognathus variabilis* Zone, Early Ordovician.

Uhakiella sp. 2
(Pl. 37: 9)

Material. — 2 tecnomorphic valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/142	2.43	1.55

Description. — Domicilium rather strongly convex. Highest convexity behind adductorial pit. Adductorial pit rather small. Tecnomorphs with bend-like velum covered by small tubercles. Broad, laterovelar furrow developed parallel to velar bend. Posterior arch of dorsal plica is less distinct than anterior. Lateral surface covered by closely spaced granules and tubercles. Row of marginal tubercles is developed along whole free margin.

Remarks. — *Uhakiella* sp. 2 differs from *U. diuturna* sp. n. by its strongly convex domicilium and presence of the depression above the velar bend. The most closely similar species seems to be *Uhakiella coelodesma* ÖPIK from the Middle Ordovician of Estonia (ÖPIK 1937).

Distribution. — It occurs only in the *Pygodus serra* Zone Middle Ordovician.

Genus *Bromidella* HARRIS, 1931

Type species: *Bromidella reticulata* HARRIS, 1931.

Bromidella sp.
(Pl. 37: 7–8)

Material. — 6 tecnomorphic valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/186	2.16	1.55

Description. — Outline almost amplete. Hinge line moderately long. Domicilium strongly convex. Cardinal corners greater than 90°. Adductorial sulcus rather deep. Preadductorial node well-developed, elongate. U-shaped crest surrounding sulcus and preadductorial node is present. C1 continues as dorsal plica parallel to dorsal margin. C1 and C3 almost connected beneath preadductorial node. A broad depression developed parallel to crista, deeper in anterior part. Bend-like velum developed from anterior to posterior cardinal corners. Marginal sculpture represent by row of spines. Lateral surface granulate.

Remarks. — According to SCHALLREUTER (1973, 1983c) species of *Bromidella* are very similar to species placed in *Uhakiella*, but in typical *Uhakiella* species the males possess an "eingeschnürt" velum, not present in the juvenile tecnomorphs. Specimens of *Bromidella* sp. from Mójcza are represented only by tecnomorphic valves without this special feature. The lobal and ornamental morphology of this species could be accomodated within *Bromidella*. Until additional material becomes available, particularly heteromorphs, the species is not named.

Distribution. — Rare specimens in the *Amorphognathus superbus* Zone, Late Ordovician.

Genus *Mojczella* OLEMPSKA, 1988

Type species: *Mojczella jaanussoni* OLEMPSKA, 1988

Mojczella polonica OLEMPSKA, 1988
(Pls 38: 1–3; 39: 1–3; Text-figs 8, 11)

1988. *Mojczella polonica* sp. n. ; OLEMPSKA, p. 139, Pl. 17: 1–6.
1989. *Mojczella polonica* OLEMPSKA; OLEMPSKA, Text-fig. 5A.

Material. — About 65 well preserved valves of tecnomorphs and 4 of heteromorphs, and some tens of partly damaged tecnomorphs.

Dimensions (figured specimens, see also size dispersion in Text-fig. 8):

	L	H
ZPAL O.XXV/169	1.01	0.67
ZPAL O.XXV/206	1.10	0.67
ZPAL O.XXV/208	1.55	1.01
ZPAL O.XXV/212	0.61	0.40
ZPAL O.XXV/464	0.77	0.45
ZPAL O.XXV/467	0.75	0.47

Description and remarks. — See OLEMPSKA (1988, 1989).

Distribution. — Occurs only below the discontinuity surface, *Amorphognathus variabilis* Zone, Early Ordovician.

Mojczella jaanussoni OLEMPSKA, 1988
(Pls 38: 4–10; 40: 1–2; Text-figs 8, 11)

1988. *Mojczella jaanussoni* sp. n. ; OLEMPSKA, p. 140, Pl. 17: 7–8, Pl. 18: 1–7, Pl. 19: 1–4.
1989. *Mojczella jaanussoni* OLEMPSKA; OLEMPSKA, Text-fig. 5B.

Material. — About 192 complete and some tens of damaged valves of tecnomorphs and 4 fragments of valves of heteromorphs.

Dimensions (figured specimens, see also size dispersion in Text-fig. 8):

	L	H
ZPAL O.XXV/18	0.95	0.63
ZPAL O.XXV/24	1.89	1.24
ZPAL O.XXV/185	2.03	1.37
ZPAL O.XXV/213	0.72	0.45
ZPAL O.XXV/214	1.13	0.72
ZPAL O.XXV/218	1.19	0.72
ZPAL O.XXV/219	0.72	0.49
ZPAL O.XXV/221	1.01	0.63
ZPAL O.XXV/530	0.72	0.45

Description and remarks. — See OLEMPSKA (1988, 1989).

Distribution. — In Mójcza it occurs from the *Pygodus serra* up to *Pygodus anserinus* Zones, Middle Ordovician.

Mojczella sanctacrucensis OLEMPSKA, 1988
(Pls 38: 11–12; 40: 3–4; Text-figs 8, 11)

1988. *Mojczella sanctacrucensis* sp. n. ; OLEMPSKA, p. 141, Pl. 19: 5–8.
1989. *Mojczella sanctacrucensis* OLEMPSKA; OLEMPSKA, Text-fig. 5C.
1992. *Mojczella sanctacrucensis* OLEMPSKA; SIDARAVIČIENE, p. 147, Pl. 37: 1–2.

Material. — 36 complete and some tens of damaged tecnomorphic valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 8):

	L	H
ZPAL O.XXV/210	1.28	0.88
ZPAL O.XXV/260	1.80	1.26
ZPAL O.XXV/459	1.10	0.72

Description and remarks. — See OLEMPSKA (1988, 1989).

Distribution. — In Mójcza it occurs in the *Amorphognathus tvaerensis* and *Amorphognathus superbus* Zones, Middle Ordovician. In the Baltic area it occurs in the Middle Ordovician of Lithuania.

Mojczella? sp.
(Pl. 26: 8–9)

Material. — 4 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/241	1.01	0.63
ZPAL O.XXV/451	0.83	0.52

Description. — Domicilial outline almost amplete. Domicilium in ventral view rather faintly convex. Preadductorial node and adductorial sulcus weakly developed. U-shaped crest surrounds sulcus and preadductorial node; it extends to dorsal margin and is slightly curved close to dorsal margin. Dorsal plica absent. Tecnomorphs with moderately wide velar ridge, anteriorly it extends to anterior cardinal corner; posteroventral end with spine-like projection. Small spine present in posterodorsal region. Marginal sculpture is row of marginal tubercles. Lateral surface of domicilium covered by minute closely spaced granules. Females not found yet.

Remarks. — Because of the poor state of preservation it is difficult to confirm if the velar structure is undulate or not. The tubules are not clearly visible. This species is similar in the development of the velar structure and presence of posterodorsal spine to *Mojczella sanctacrucensis*, but differs from it in its thick crest and absence of dorsal plica.

Distribution. — It occurs only in the *Amorphognathus superbus* Zone, Late Ordovician.

Tvaerenellidae sp. A
(Pl. 28: 10–11)

Material. — 1 partly broken female valve and 1 tecnomorphic valve.

Dimensions:

	L	H
ZPAL O.XXV/91	0.80	0.45
ZPAL O.XXV/222	broken	0.70

Description. — Unfortunately the material is too badly preserved to be described in detail, although it is sufficient to allow the following remarks to be made: lateral outline almost amplete; dorsal margin long and straight; sulcus distinct, pit-like. Velar ridge in tecnomorphic valve reaching anterior cardinal corner, terminating in posteroventral spine. Heteromorphic valve broken, with weakly convex, broad dolon reaching upper part of anterior margin. Lateral surface smooth.

Remarks. — The specimens described show certain morphological characters, such as velar structure, similar to those occurring in *Eoaquapulex frequens* (STEUSLOFF), illustrated by SCHALLREUTER (1986, Pl. 3: 1). The tecnomorphic valve is similar to specimens of *Eographiodactylus sulcatus* SCHALLREUTER from the Upper Ordovician Öjlemyrflint boulders of Gotland (SCHALLREUTER 1975b). More material is needed for determination of this species.

Distribution. — Uppermost *Pygodus serra* and lowermost *Pygodus anserinus* Zones, Middle Ordovician.

Family **Ctenonotellidae** SCHMIDT, 1941
Subfamily **Tallinellinae** SCHALLREUTER, 1976
Genus *Quadritia* SCHALLREUTER, 1966

Type species: *Quadritia (Quadritia) quadrispina* (KRAUSE, 1892).

Quadritia? sp.
(Pl. 44: 6)

Material. — Two valves, partly damaged.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/197	0.97	0.59

Description. — Outline almost amplete. Two spines are present in anterior part of valve, one near dorsal margin, second in mid-height. Preadductorial node weakly developed. Adductorial sulcus as shallow depression. Centro-ventral spine is present below sulcus. In posterior part of valve posteroventral spine is present. Anterodorsal parts of valves are broken. Velar ridge narrow, along entire free margin. Lateral surface finely reticulo-granulate.

Remarks. — The specimens described shows certain morphological characters such as the anterior lobe in the shape of two spines, and the presence of spines in the ventral part similar to those occurring in *Quadritia*. In *Quadritia (Krutatia)* four dorsal nodes or spines and four ventral nodes are present, in *Quadritia (Quadritia)* the dorsal spines are lost during phylogeny (SCHALLREUTER 1981a; VANNIER and SCHALLREUTER 1983; VANNIER 1986b). More well preserved material is needed for determination of this species.

Distribution.— Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Subfamily **Wehrliinae** SCHALLREUTER, 1965
Genus *Rakverella* ÖPIK, 1937
Subgenus *Rakverella (Pectidolon)* SCHALLREUTER, 1966

Type species: *Tetradella perornata* ÖPIK, 1937.

Rakverella (Pectidolon) antica sp. n.
(Pl. 26: 12–14)

Holotype: ZPAL O.XXV/196.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *anticus* – old, ancient.

Diagnosis. — L1 and L3 forming U-shaped crista, and L4 as single crest parallel to posterior margin. Dolon with row of perifere spines having grill-like appearance. Small preadductorial node.

Material. — 36 tecnomorphic valves, some damaged, and 2 incomplete female valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/196	1.00	0.60

Description. — Valve outline subamplete to slightly preplete. Dorsal margin long and straight. Preadductorial node weakly developed, spine-like. Sulcal depression slightly marked. L1 and L3 forming U-shaped cristate ridge extending from dorsal margin near anterior corner, to dorsal margin slightly behind mid-length. In ventral part U-shaped crista extending almost to ventral margin. L4 as crest extending from dorsal margin and ending near ventral margin, parallel to posterior margin. Velar structure in tecnomorphs as row of spines. Females with long, slightly convex dolon, with row of peripheral spines more or less perpendicular to contact-plane forming outer antral fence. Marginal sculpture formed by row of small spines. Lateral surface granulose.

Remarks. — *Rakverella (P.) antica* sp. n. is closely related to *R. (P.) perornata* ÖPIK, from the Kukruse Stage of Estonia (ÖPIK 1937), but differs in a having very small preadductorial node and differs also in the shape of the crests.

Distribution. — In Mójcza it occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Subfamily **Steusloffinae** SCHALLREUTER, 1966
Genus *Rigidella* ÖPIK, 1937

Type species: *Steusloffia mitis* ÖPIK, 1935.

Rigidella dubia sp. n.
(Pl. 25: 7–8)

Holotype: ZPAL O.XXV/227.
Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *dubius* – doubtful, undecided, not typical representative of the genus.

Diagnosis. — *Rigidella* with weakly developed dorsal ridge and only partly developed C1 and C3 in dorsal region of valve.

Material. — 3 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/227	0.83	0.55
ZPAL O.XXV/301	1.01	0.68

Description. — Outline of valves is amplete to slightly preplete. Dorsal margin long and straight. Ventral margin slightly rounded. Domicilium moderately convex. Highest convexity lies in posteroventral part of valve. Adductorial sulcus sigmoidal, its deepest part is situated in center of valve. S1 developed as very faint sulcus. Preadductorial node relatively large, constricted ventrally. Anterior cardinal angle much larger than posterior. L1 flattened, narrow; L3 strongly convex, especially in ventral region. C1 and C3 unclear, developed only in dorsal part of valve. Dorsal ridge weakly developed. Velar ridge narrow, developed in anteroventral and ventral part. Marginal sculpture is row of tubercles. Lateral surface of domicilium covered by small granules.

Remarks. — *Rigidella dubia* sp. n. resembles *Rigidella levis* SARV from the late Kunda Stage of Estonia (SARV 1959) and N-E Poland (SZTEJN 1985) in development of C1 and C3, but differs in lacking C2 on the preadductorial node and in the weakly developed dorsal ridge. It differs from *Rigidella initialis* SARV from the Kunda Stage of Estonia (SARV 1959) in having C1 and C3 only in the dorsal part of the valve.

Distribution. — Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Subfamily uncertain
Genus *Telegraphia* gen. n.

Type species: *Telegraphia prima* sp. n.
Derivation of the name: From Telegraf – name of a hill near the type locality.

Diagnosis. — Ctenonotellidae with large, elongate preadductorial node; C1 as short ridge; C3 connected with preadductorial node in ventral part; C4 as U-shaped ridge. S2 deep, directed anteroventrally. Velar flange broad, botulate antrum.

Remarks. — This genus appears to be morphologically related to certain Early Ordovician hollinaceans, such as *Steusloffina* and *Pseudostrepula*, but differs from them in having a broad velar flange; the shape of C3 and C4 and in the absence of C2 on the preadductorial node.

Telegraphia prima gen. et sp. n.
(Pl. 25: 13–14; Text-fig. 17)

Holotype: ZPAL O.XXV/193.
Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *primus* – first.

Diagnosis. — As for the genus.

Material. — 9 tecnomorphic valves and 1 female valve, partly damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/193	broken	0.76
ZPAL O.XXV/290	broken	0.54

Description. — Valve outline slightly preplete. Dorsal margin long, straight. Preadductorial node elongate, large. S1 developed as faint groove, parallel to C1. S2 relatively deep, extending to mid-height of valve, directed anteroventrally. S3 narrow, long. C1 as short ridge extending slightly below preadductorial node. C3 parallel to S2 and connected with preadductorial node in ventral part. C4 U-shaped, parallel to C3, not extending dorsal margin. Velum broad, extending from anterior cardinal corner to posteroventral region (Text-fig. 17). Heteromorphic velum slightly convex. Botulate antrum. Lateral surface granulose.

Remarks. — As for the genus.

Distribution. — Known only from the *Amorphognathus variabilis* Zone, Early Ordovician.

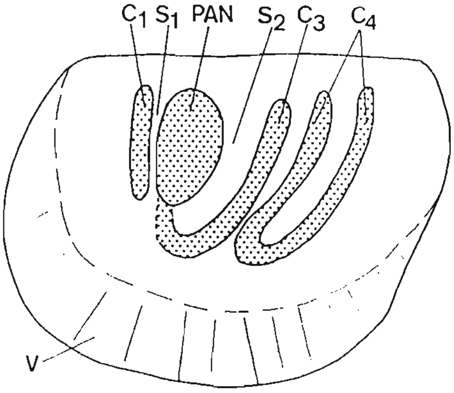

Fig. 17.
Schematic diagram of lateral view of *Telegraphia prima* gen. et sp. n.

Family **Tetradellidae** SWARTZ, 1936
Subfamily **Tetradellinae** SWARTZ, 1936 (*nom. transl.* KAY, 1940)
Genus *Ogmoopsis* HESSLAND, 1949
Subgenus *Ogmoopsis (Ogmoopsis)* HESSLAND, 1949

Type species: *Ogmoopsis nidulifera* HESSLAND, 1949.

Ogmoopsis (Ogmoopsis) sp.
(Pl. 41: 1–2)

Material. — Two tecnomorphic valves, partly damaged.

Dimensions:

	L	H
ZPAL O.XXV/67	0.72	0.45
ZPAL O.XXV/205	1.19	0.72

Description. — Valves slightly preplete in lateral outline. Hinge line long. Transverse convexity greatest ventrally. S1 narrow and sigmoidal, in ventral part directed much forward; S2 – broad, deep and sigmoidal; S3 fairly narrow. L1 – narrow, elongate and claviform, extending to dorsal margin, in dorsal part slightly rounded, ventral end tapering; outer surface rounded. L2 – in dorsal part with small preadductorial node, ventrally slightly sigmoidal. L3 – fairly broad, broadest in ventral half, slightly sloping towards anteriorly in ventral half. L4 – sloping towards anterior, bordered in posterior part by histial flange. All lobes connected ventrally by histial flange. Velar ridge narrow, extending from anterior to posterior cardinal corners. Ventral region of tecnomorphs slightly concave between histial flange and velar ridge. Valve surface smooth.

Remarks. — The specimens described differ from *Ogmoopsis alata* SARV from the Early Ordovician of Estonia (SARV 1959) in having a broader S3, stright and narrow S1 and broader L1, extending more ventrally. *Ogmoopsis (O.)* sp. most resembles *Ogmoopsis nidulifera* HESSLAND from the Early Ordovician of Sweden (HESSLAND 1949), but differs from the latter in having a flatter surface of the lobes and shallower sulci. The taxonomic position of the form is uncertain since females are unknown.

Distribution. — Only in the basal part of the section in the *Amorphognathus variabilis* Zone, Early Ordovician.

Subfamily **Perspicillinae** SCHALLREUTER, 1967
Genus *Sigmobolbina* HENNINGSMOEN, 1953

Type species: *Entomis oblonga* var. *kuckersiana* BONNEMA, 1909.

Sigmobolbina lysicae sp. n.
(Pl. 43: 15–17)

Holotype: ZPAL O.XXV/137.
Type horizon: *Pygodus serra* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Łysica – the highest peak in the Holy Cross Mountains.

Diagnosis. — Species of *Sigmobolbina* with heteromorphs 1.2–1.3 mm long. Posterior cardinal angle greater than anterior. S2 wide, long and sigmoidal. Preadductorial node weakly developed. Histium distinct, extending from anterior cardinal corner to posteroventral region. Surface smooth.

Material. — 4 tecnomorphic valves and 2 female valves, partly damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/137	1.28	0.67
ZPAL O.XXV/138	1.28	0.70
ZPAL O.XXV/152	broken	0.72

Description. — Lateral outline preplete. Transverse convexity of domicilium greatest ventrally. Longitudinal convexity is greatest just anterior of mid-length. Hinge line moderately long. Both cardinal corners distinct with obtuse corner angles; posterior greater than anterior cardinal angle. Preadductorial node indistinct. S2 long, broadest dorsally, tapering ventrally, sigmoidal. Tecnomorphs with velar ridge parallel to ventral margin. Heteromorphs with broad flange-like histial structure, extending from anterior cardinal corner to posteroventral region. Deep antrum between histial and velar ridge; loculus in front of antrum. Marginal sculpture developed as narrow ridge. Lateral surface smooth.

Remarks. — *Sigmobolbina lysicae* sp. n. resembles *Sigmobolbina cyclopa* SCHALLREUTER, 1964b and *Sigmobolbina nana* SCHALLREUTER, 1984a, from Middle Ordovician erratic boulders, but differs in having a broader sulcus and more prominent preadductorial node. From *Sigmobolbina agger* SCHALLREUTER, 1985b, it differs in its smooth lateral surface and deeper antrum.

Distribution. — It occurs only in lower part of the *Pygodus serra* Zone, Middle Ordovician.

Genus *Pentagona* SCHALLREUTER, 1964

Type species: *Sigmobolbina pentagona* JAANUSSON, 1957.

Pentagona cf. *pentagona* JAANUSSON, 1957
(Pl. 43: 3–7)

Material. — 30 tecnomorphic valves and 6 heteromorphic valves, partly damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/183	1.19	0.63
ZPAL O.XXV/245	0.99	0.63
ZPAL O.XXV/246	broken	0.63
ZPAL O.XXV/401	0.92	0.60
ZPAL O.XXV/493	1.17	0.59

Description. — Outline slightly preplete. Hinge line long. Preadductorial node small. S2 long and sigmoidal. Ventral lobe indistinct. Tecnomorphs with velar structure as a narrow ridge, roughly parallel to ventral free margin. Heteromorphs biantral with histial and velar dolonal flange. Histial dolon is united anteriorly with velar dolon. Marginal sculpture as narrow ridge. Lateral surface smooth.

Remarks. — The morphology of the complete larval specimens is practically identical with that of *P. pentagona*, but differs in the relatively longer carapace. Because of this and the lack of complete female valves specific identification is uncertain.

Distribution. — In Mójcza it occurs in the *Pygodus serra* and *Pygodus anserinus* Zones, Middle Ordovician.

Genus *Ceratobolbina* JAANUSSON, 1966

Type species: *Sigmobolbina monoceratina* JAANUSSON, 1957.

Ceratobolbina monoceratina (JAANUSSON, 1957)
(Pl. 43: 8–14)

1909. *Entomis obliqua* var. *kuckersiana* var. n. ; BONNEMA, p. 68, Pl. 5: 15–16.
1957. *Sigmobolbina monoceratina* n. nom. ; JAANUSSON, p. 390.
1959. *Sigmobolbina monoceratina monoceratina* JAANUSSON; SARV, p. 124, Pl. 23: 2–3.
1966. *Ceratobolbina monoceratina* (JAANUSSON); JAANUSSON, p. 17.

Material. — 33 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/6	1.01	0.59
ZPAL O.XXV/17	0.85	0.48
ZPAL O.XXV/22	0.72	0.36
ZPAL O.XXV/57	0.80	0.48
ZPAL O.XXV/89	0.91	0.61
ZPAL O.XXV/491	1.06	0.58
ZPAL O.XXV/492	1.10	0.54

Remarks. — For a full discussion see JAANUSSON (1966). Tecnomorphic valves are morphologically identical with the the type specimens. No adult female valves have been found in the Mójcza Limestone.

Distribution. — In Mójcza it occurs in the *Pygodus serra* and *Pygodus anserinus* Zones, Middle Ordovician.

Subfamily **Glossomorphitinae** HESSLAND, 1954
Genus *Collibolbina* SCHALLREUTER, 1967

Type species: *Lomatobolbina collis* SCHALLREUTER, 1964.

Collibolbina sigmoidea (JAANUSSON, 1957)
(Pl. 42: 4–6)

1957. *Sigmobolbina sigmoidea* sp. n. ; JAANUSSON, p. 392, Pl. 11: 16–20, Text-fig. 43B.
1967b. *Collibolbina sigmoidea* (JAANUSSON); SCHALLREUTER, p. 442.

Material. — 30 tecnomorphic valves and 8 female valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/488	1.46	0.81
ZPAL O.XXV/489	1.47	0.85
ZPAL O.XXV/490	1.37	0.79

Remarks. — *Collibolbina sigmoidea* (JAANUSSON) differs from other species of the genus mainly by the broad posteroventral lobe without spine or node and by having a narrow and deep ventral part of the sulcus.

Distribution. — In Mójcza it occurs only in the *Amorphognathus tvaerensis* Zone, Middle Ordovician. In the Ordovician of the Baltic area it occurs in the Middle Ordovician (Crassicauda limestone, uppermost Schroeteri limestone and lowermost Ludibundus limestone) of land and Östergötland of Sweden.

Collibolbina barbarae sp. n.
(Pl. 42: 1–3)

Holotype: ZPAL O.XXV/65.
Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In Honour of Dr. Barbara Żbikowska (Institute of Geological Sciences, Polish Academy of Sciences, Warsaw).

Diagnosis. — S2 long and sigmoidal. Preadductorial node weakly developed. Posteroventral lobe distinct, without node. Flange-like velum in females. Tecnomorphs with ridge-like velum in anterior and partly in ventral region. Surface tuberculate.

Material. — 71 tecnomorphic and 12 female valves, some of them damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/64	0.90	0.47
ZPAL O.XXV/65	1.37	0.68
ZPAL O.XXV/522	1.40	0.69

Description. — Females strongly preplete; tecnomorphs preplete in lateral outline. Domicilium moderately long. S2 long, sigmoidal, reaching below mid-height, widens towards dorsal margin. Preadductorial node weakly developed. Posteroventral lobe convex, without node. Anteroventral lobe flat. Velum flange-like in females, widest anteroventrally; ridge-like in tecnomorphs, extending from anterior cardinal corner to ventral region. Velum approximately parallel with free margin. In posterodorsal corner small elevation of valve is visible. Marginal sculpture is ridge. Lateral surface tuberculate.

Remarks. — *Collibolbina barbarae* sp. n. differs from other species of *Collibolbina* in the tuberculate surface of the domicilium and narrow velum, extending only to the middle part of ventral margin in tecnomorphs.

Distribution. — In Mójcza it occurs only in the *Amorphognathus variabilis* Zone, Early Ordovician.

Collibolbina postaculeata sp. n.
(Pl. 42: 8–12)

Holotype: ZPAL O.XXV/63.

Type horizon: *Pygodus anserinus* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Lat. *post* – posterior and *aculeus* – spine, referring to the spine-like projection on the posteroventral lobe.

Diagnosis. — *Collibolbina* species with weak preadductorial node; female velum with narrow ridge along border of flange; posteroventral lobe prominent with spine-like posterior termination.

Material. — 70 tecnomorphic and 11 female valves, some damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/50	1.55	0.92
ZPAL O.XXV/63	1.56	0.93
ZPAL O.XXV/174	1.55	0.83
ZPAL O.XXV/280	broken	0.72
ZPAL O.XXV/487	1.19	0.59

Description. — Females moderately high and preplete. Tecnomorphs moderately long and preplete in lateral outline. Cardinal angles greater than 90°. Preadductorial node weakly developed. S2 sigmoidal, weaker ventrally. Prominent posteroventral lobe with spine-like posterior termination. Ridge-like velum in tecnomorphs extending from anterior cardinal corner, reduced to indistinct ridge in posteroventral region. Female velum is flange, forming slightly convex dolon, widest anteroventrally, with narrow ridge parallel to margin. Velum reduced to narrow ridge in posteroventral region and obsolete in posterior region. Admarginal antrum. Marginal sculpture developed as narrow ridge. Lateral surface smooth.

Remarks. — *Collibolbina postaculeata* sp. n. is closely related to *Collibolbina collis* SCHALLREUTER from the Middle Ordovician erratic boulders (SCHALLREUTER 1967b), but differs in having a narrow ridge on the female velum, and a more prominent node on the posteroventral lobe. This species is homeomorphic with many unisulcate palaeocope species which have a posteroventral lobe and spine and a flange-like velum (cf. SCHALLREUTER 1981b).

Distribution. — In Mójcza it occurs from the discontinuity surface (*Pygodus serra* Zone) and is quite common up to the *Amorphognathus superbus* Zone, Middle and Late Ordovician.

Collibolbina? sp.
(Pl. 42: 13)

Material. — One female valve.

Dimensions:

	L	H
ZPAL O.XXV/53	1 1.00	0.72

Description. — Valve moderately high and preplete. Preadductorial node weakly developed. S2 sigmoidal, deep and long. Posteroventral lobe flat. Velum flange-like in female valve, widest anteroventrally, terminating with spur-like projection in posteroventral part. Marginal sculpture developed as narrow ridge. Lateral surface smooth.

Remarks. — It differs from other species of *Collibolbina* in the flat, weakly developed posteroventral lobe and spur at the end of the velar flange.

Distribution. — In Mójcza it occurs only in the *Pygodus serra* Zone, Middle Ordovician.

Genus *Glossomorphites* HESSLAND, 1954
Subgenus *Glossomorphites (Glossomorphites)* HESSLAND, 1954

Type species: *Glossopsis lingua* HESSLAND, 1949.

Glossomorphites (Glossomorphites) kielcensis sp. n.
(Pl. 41: 11–13; Text-fig. 18)

Holotype: ZPAL O.XXV/225.
Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Kielce – city in the Holy Cross Mountains.

Diagnosis. — *Glossomorphites* of fairly small size, females 1.1–1.2 mm long. L1 and L3 rather broad, L2 narrow. S2 long and deep, S3 – fissum-like. Surface minutely but distinctly pitted.

Material. — 25 tecnomorphic valves and 4 female valves, mostly of them damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/225	1.10	0.72
ZPAL O.XXV/226	0.80	0.52

Description. — Lateral outline preplete. Carapace of fairly small size. Dorsal margin straight and long; anterior margin widely curved; posterior one more convex; ventral margin convex. Anterodorsal angle slightly more obtuse than posterodorsal. L1 rather broad, dorsal end not protruding over dorsal margin. S1 long but shallow and not very distinct, perpendicular to dorsal margin. L2 long, narrow, extending practically to dorsal margin with small weakly developed preadductorial node in upper part. S2 long, deep and broad, sigmoidal in females. L3 broadest in dorsal part and distinctly diminishing in breadth in ventral direction, ventral half slightly arched. S3 fissum-like, weakly developed. L4 broad and gently arched in dorsal half, ventral half narrower and diminishing in breadth ventrally. Velar ridge in tecnomorphs as ridge extending from anterior cardinal corner, reduced to indistinct ridge in posterior part. Histiovelum flange in females, widest anteroventrally, starts slightly below anterior cardinal corner and ends in posteroventral part (Text-fig. 18). Antrum without inner antral fence. Marginal sculpture consist of row of fused spines. Lateral surface minutely but distinctly pitted.

Remarks. — *Glossomorphites (G.) kielcensis* sp. n. resembles *Glossomorphites (G.) digitatus* (KRAUSE, 1889), (= *G. lingua* HESSLAND, 1949, = *G. clavatus* HESSLAND, 1949), but differs from it

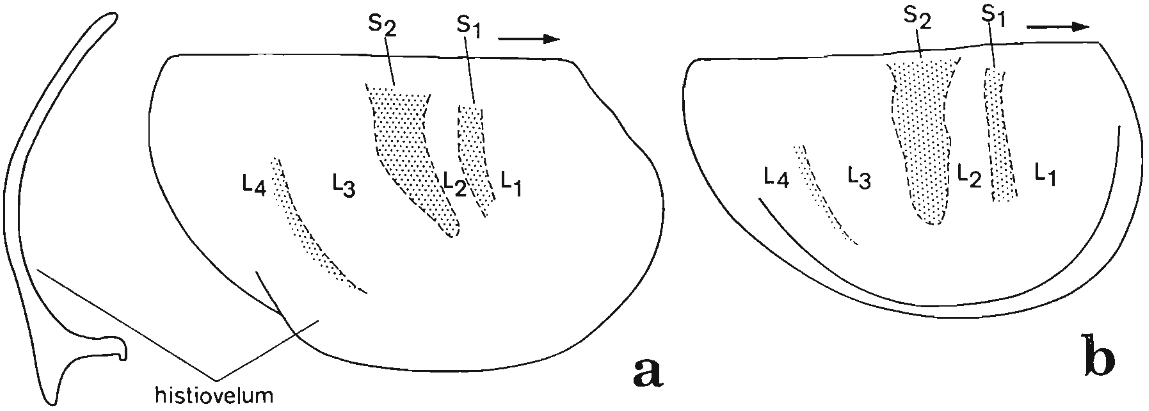

Fig. 18.
Schematic diagram of lateral view of *Glossomorphites (G.) kielcensis* sp. n. **a**. heteromorphic valve, **b**. tecnomorphic valve.

in the shape of S1 and S3 and the flat surface of the lobes. *G. (G.) kielcensis* sp. n. resembles also *G. (G.) mytoensis* SCHALLREUTER and KRŮTA, 1988, from the Klabava Formation (Early Ordovician) of Bohemia, but differs in having broader lobes L1 and L3 and fissum-like S3.

Distribution. — In Mójcza it occurs only in the *Amorphognathus variabilis* Zone, Early Ordovician.

Glossomorphites (Glossomorphites) sp.
(Pl. 41: 3–5)

Material. — 10 tecnomorphic valves and 4 female valves, all female valves damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/194	broken	0.63
ZPAL O.XXV/230	1.15	0.66

Description. — Outline slightly preplete. Dorsal margin straight, moderately long. L1 broad, slightly protruding over dorsal margin. L2 narrow, long with indistinct preadductorial node in upper part. L3 + L4 strongly convex. S1 – long, narrow, perpendicular to dorsal margin. S2 – sigmoidal, long, extending to dorsal margin. Velar ridge in tecnomorphs narrow, extending from anterior to posterior cardinal corner. Histiovelum flange-like in females, widest anteroventrally. Antrum deep. Lateral surface smooth.

Remarks. — *G. (G.)* sp. differs from *G. (G.) kielcensis* sp. n. mainly by the lack of S3, convex L3 + L4, smooth surface and deep antrum.

Distribution. — It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Genus *Hesslandella* HENNINGSMOEN, 1953

Type species: *Ctenentoma macroreticulata* HESSLAND, 1949.

Hesslandella sztejnae sp. n.
(Pl. 41: 6–10; Text-fig. 19)

Holotype: ZPAL O.XXV/203.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Janina SZTEJN, from the State Geological Institute, Warsaw.

Diagnosis.— *Hesslandella* with females 1.1–1. 3 mm long. Preadductorial node weakly developed. Histiovelum widest anteroventrally. Tecnomorphic velum as narrow ridge. S2 long, sigmoidal.

Material. — 66 tecnomorphic and 12 heteromorphic valves, part of them damaged.

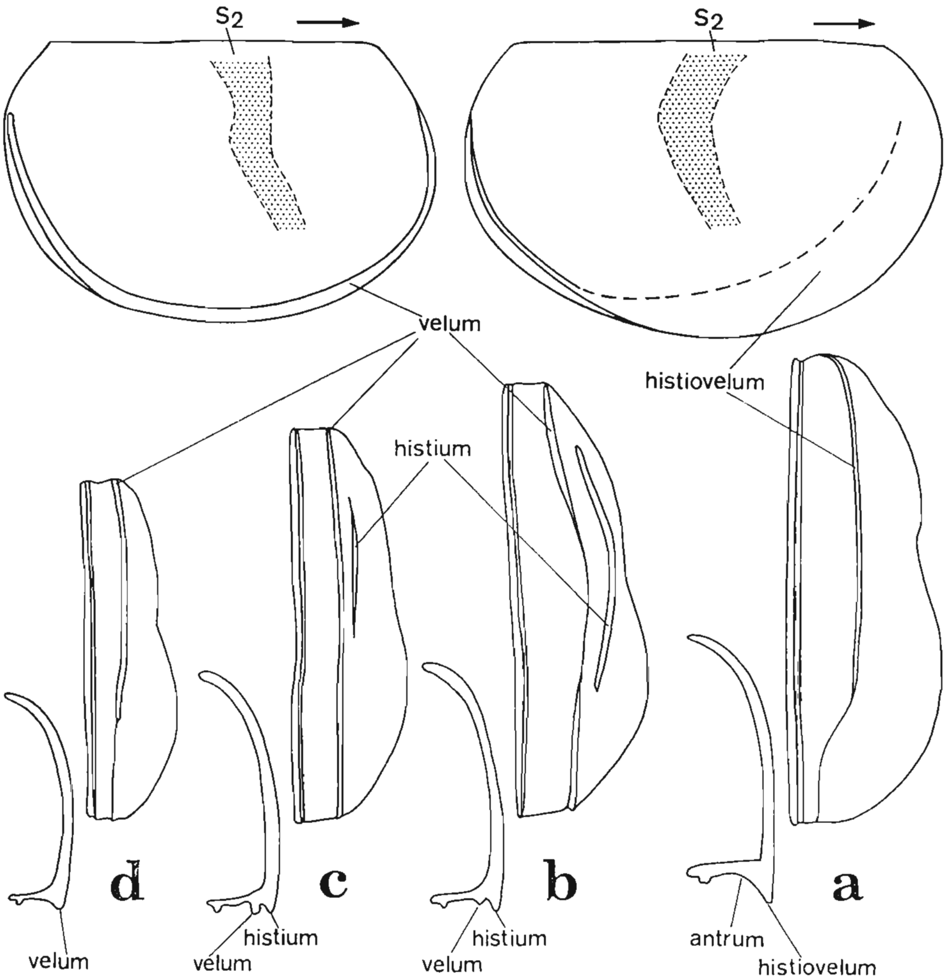

Fig. 19.
Schematic diagrams of lateral and ventral view of right valves of *Hesslandella sztejnae* sp. n. **a**. adult female, **b**. and **c**. pre-adult females, **d**. tecnomorph.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/75	1.19	0.63
ZPAL O.XXV/203	1.10	0.63
ZPAL O.XXV/204	0.92	0.63
ZPAL O.XXV/309	broken	0.72
ZPAL O.XXV/527	0.66	0.42

Description. — Outline preplete. Cardinal corners distinct with obtuse cardinal angles; anterior angle more obtuse than posterior. Hinge line long to very long. S2 sigmoidal, long. Preadductorial node weakly developed. Histiovelum, flange-like in females and widest anteroventrally; ridge-like in ventral region of tecnomorphs and extending from anterior cardinal corner. Velum reduced to indistinct ridge in posterior region, runs parallel with free margin. Supravelar furrow indistinct anteroventrally. Pre-adult females have partially developed narrow histial ridge parallel to velar ridge. It is longer in larger specimens (Text-fig. 19). Below histial ridge, velum weakly developed as indistinct ridge. Marginal sculpture is ridge. In right valves admarginal ridge is present; in left valves, marginal ridge is close to free margin and contact groove is visible on internal surface of valve. Valve surface generally smooth, but well preserved specimens show fine reticulation.

Remarks. — Tecnomorphs of *Hesslandella sztejnae* sp. n. resemble specimens of *Hesslandella macroreticulata* (HESSLAND) in lateral appearance, but differ in the weakly developed preadductorial node. Unfortunately HESSLAND (1949) figured only tecnomorphic valves. From *Hesslandella panis* SCHALLREUTER, 1964 (Backsteinkalk erratic boulders, SCHALLREUTER 1964c, 1983b), *H. sztejnae* differs in a longer S2 and presence of a supravelar furrow.

Distribution. — In Mójcza it occurs below the discontinuity surface (*Amorphognathus variabilis* Zone), Early Ordovician.

Genus *Hippula* TROMELIN *et* LEBESCONTE, 1876
Subgenus *Hippula (Cetona)* SCHALLREUTER, 1964

Type species: *Oecematobolbina (Cetona) cetona* SCHALLREUTER, 1964.

Hippula (Cetona) sp.
(Pl. 41: 14)

Material. — Two valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/195	1.28	0.72

Description. — Valves rather long, slightly preplete. Cardinal corner angles greater than 90°. Preadductorial node small, rounded. S2 deep, V-shaped. Velar flange with one toric ridge and one row of rhombic cavities between torus and velum. Velar flange forming an angle with lateral surface of about 70°. Posteroventral lobe node-like. Marginal sculpture is row of fused spines. Lateral surface smooth.

Remarks. — The morphology and phylogenetic relationships of species of *Hippula* have been fully discussed by VANNIER, KRŮTA, and MAREK (1987). The specimens described resemble *Hippula (C.) turris* (SCHALLREUTER) from upper Viruan erratic boulders (SCHALLREUTER 1967b, cf. also SCHALLREUTER 1984b) but differ in the nature of the posteroventral lobe. In the latter, the posteroventral lobe ends in a long reticulate spine.

Distribution. — In Mójcza it occurs only in the *Pygodus serra* Zone, Middle Ordovician.

Genus *Vittella* SCHALLREUTER, 1964

Type species: *Vittella vittensis* SCHALLREUTER, 1964.

Vittella sp.
(Pl. 42: 7)

Material. — One tecnomorphic valve.

Dimensions:

	L	H
ZPAL O.XXV/115	1.20	0.70

Description. — Valve moderately long and preplete. Hinge line long. Cardinal angles greater than 90°. Preadductorial node weakly developed. S2 pit-like. Posteroventral lobe broad, with spine-like process. Velum flange-like, widest anteriorly, extending from anterior cardinal corner to mid-height of posterior margin. Velum approximately parallel with free margin. Anteroventral lobe obsolete. Marginal sculpture consists of row of fused spines. Lateral surface smooth.

Remarks. — Because of the poor state of preservation, the species is not named. It resembles *Vittella? jemtlandica* (THORSLUND) from the lower *Chasmops* limestone (THORSLUND 1940). According to SCHALLREUTER (1983a) *V.? jemtlandica* may form the basis of a new genus because of its comma-shaped sulcus and admarginal antrum.

Distribution— In Mójcza it occurs only in the *Pygodus serra* Zone, Middle Ordovician.

Genus *Adamczakites* gen. n.

Type species: *Adamczakites paucus* gen. et sp. n.

Derivation of the name: In honour of Dr. Franciszek ADAMCZAK from Stockholm.

Diagnosis. — L1 + L2 – wide and flat with weakly developed preadductorial node. S2 very broad, sigmoidal, extending from dorsal margin, in ventral part protruding over ventral margin. L3 convex, narrow in ventral region, with indistinct node-like elevation in posteroventral part. S3 fissum-like, parallel to posteroventral margin. L4 narrow in ventral part, parallel to S3. Connecting lobe protruding over ventral margin.

Remarks. — This genus appears to be morphologically related to the Early Ordovician *Aulacopsis* HESSLAND in general pattern of L–S ornamentation, but differs in having a broad and flat L1 + L2, very wide S2, connecting lobe protruding over ventral margin in tecnomorphs, and lack of fissum in front of the sulcus.

Adamczakites paucus sp. n.
(Pl. 43: 1–2)

Holotype: ZPAL O.XXV/10.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *paucus* – few, little, referring to the rarity of the species.

Diagnosis. — As for the genus.

Material. — 5 tecnomorphic valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/10	1.24	0.72
ZPAL O.XXV/274	broken	0.68

Description. — Valve outline slightly preplete. Hinge line long and straight. Anterodorsal angle slightly more obtuse than posterodorsal. Anterior margin more rounded than posterior; ventral margin moderately convex. Transverse convexity greatest in ventral region. L1 + L2 wide, in dorsal region flat, dorsal part of L2 forming weak preadductorial node. L3 convex, sloping towards anterior, with weakly developed node-like elevation in posteroventral part. L4 narrow, parallel to posteroventral margin. All lobes joined by connecting lobe protruding over ventral margin. S3 narrow, fissum-like, sloping towards anterior. Velum as flange-like keel (or rounded ridge) from anterior to posterior cardinal corner. Marginal sculpture as narrow ridge. Surface of lobes finely reticulate.

Remarks. — *Adamczakites paucus* sp. n. is distinguished from other Tetradellidae by its L–S ornament.

Distribution. — In Mójcza it occurs in the *Pygodus serra* and *Amorphognathus tvaerensis* Zones, Middle Ordovician.

Suborder **Binodicopa** SCHALLREUTER, 1972 (*emend.* SCHALLREUTER, 1978)
Superfamily **Drepanellacea** ULRICH *et* BASSLER, 1923 (*nom. transl.* POLENOVA *et* ZANINA, 1960)
Family **Bolliidae** BOUČEK, 1936 (*nom. transl.* SCOTT and WAINWRIGHT *in* BENSON *et al.*, 1961)
Genus *Klimphores* SCHALLREUTER, 1966

Type species: *Klimphores planus* SCHALLREUTER, 1966.

Remarks. — The revision of the Ordovician forms of *Klimphores* was conducted by SCHALLREUTER (1968a). Taking into account differences in partition of the anterior nodal complex, he distinguished among the known species of *Klimphores* two genera, *Klimphores* and the new genus *Laterophores*. According to SCHALLREUTER (1968a) the new genus is distinguished by the distinct bipartition of the anterior nodal complex. The partition of the anterior nodal complex in many known species of *Klimphores*, does not indicate to which genus they belong. Moreover, in *Klimphores*-like species [*K. (K.) subplanus* and *K. (K.) vannieri*] occurring in the Mójcza Limestone, the partition of the anterior nodal complex displays a great intraspecific variability. Therefore, the genus *Laterophores* is considered as a subgenus of *Klimphores*.

Klimphores (Klimphores) subplanus sp. n.
(Pl. 45: 4–8; Text-fig. 10)

Holotype: ZPAL O.XXV/496.
Type horizon: *Pygodus anserinus* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: The name suggests similarity to *Klimphores planus* SCHALLREUTER.

Diagnosis. — Valves up to 0.75 mm long. Anterior cardinal corner more rounded than posterior cardinal corner. Anterior nodal complex slightly divided into anterodorsal and anterocentral node. Preadductorial node totally incorporated in anterior nodal complex.

Material. — 607 valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 10):

	L	H
ZPAL O.XXV/76	0.63	0.36
ZPAL O.XXV/278	0.72	0.45
ZPAL O.XXV/461	0.72	0.50
ZPAL O.XXV/495	0.68	0.45
ZPAL O.XXV/496	0.63	0.36

Description. — Lateral outline more or less amplete. Hinge line straight and moderately long. Lateral surface moderately convex. Nodes rather oblong with rounded peaks, do not project far beyond hinge line. Anterior nodal complex consists of two nodes, separated by indistinct transverse depression. Anterodorsal node greater than anterocentral node. Anterocentral node closer to anterior margin than anterodorsal. Preadductorial node totally incorporated in anterodorsal node. Pseudovelum developed as low ridge or bend in juvenile specimens. Lateral surface reticulate, bases of lumina have pore clusters (see p. 155).

Remarks. — *Klimphores (K.) subplanus* sp. n. is similar in size and form to *Klimphores (K.) planus* SCHALLREUTER, from upper Viruan erratic boulders (SCHALLREUTER 1966, 1980a), but differs in having a slightly marked bipartition of the anterior nodal complex, and pseudovelum as a ridge in adult specimens.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* and the lower part of the *Amorphognathus superbus* Zones, Middle Ordovician.

Klimphores (Klimphores) vannieri sp. n.
(Pls 45: 9–11; 51: 1–3; Text-fig. 10)

Holotype: ZPAL O.XXV/284.
Type horizon: *Amorphognathus superbus* Zone, Late Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: In honour of Dr. Jean VANNIER from Lyon, France.

Diagnosis. — Valves up to 1.0 mm in length. Anterior cardinal corner more rounded and obtuse than posterior corner. Anterior nodal complex slightly divided into anterodorsal and anterocentral nodes; anterodorsal with indistinct preadductorial node. Posterior node oblong, projecting farther beyond hinge-line than anterior node.

Material. — 119 valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 10):

	L	H
ZPAL O.XXV/244	0.77	0.45
ZPAL O.XXV/283	0.83	0.45
ZPAL O.XXV/284	0.67	0.36
ZPAL O.XXV/455	0.79	0.54
ZPAL O.XXV/457	0.81	0.54

Description. — Valves moderately high to moderately long and amplete. Hinge line straight and moderately long. Nodes with rounded peaks, slightly extending beyond hinge-line; posterior node extending farther than anterodorsal node. Anterior nodal complex slightly divided into anterodorsal and anterocentral nodes; anterodorsal with slightly divided indistinct preadductorial node in posteroventral part of it. Anterocentral node close to anterior margin and smaller than anterodorsal. Posterior node oblong. Posterior and posteroventral surface flat. Pseudovelum forms prominent bend. Reversal of overlap occurs in this species. Reticulation moderately coarse, lumina with pore clusters (see p. 155).

Remarks. — *Klimphores (K.) vannieri* sp. n. is similar in form to the stratigraphically older *Klimphores (K.) subplanus* sp. n. but differs in having a much clearer bipartition of the anterior nodal complex and the development of an indistinct preadductorial node. The nodes project a smaller distance beyond the hinge line than in *K. (K.) subplanus.*

Distribution. — In Mójcza it occurs only in the upper part of the *Amorphognathus superbus* Zone, Late Ordovician.

Subgenus *Klimphores (Laterophores)* SCHALLREUTER, 1968

Type species: *Laterophores lateris* SCHALLREUTER, 1968.

Klimphores (Laterophores) ansiensis GAILITE, 1971
(Pl. 45: 1–3; Text-fig. 10)

1971. *Klimphores ansiensis* sp. n. ; GAILITE, p. 44, Pl. 2: 1.

Material. — 86 valves.

Dimensions (figured specimens, see also size dispersion in Text-fig. 10):

	L	H
ZPAL O.XXV/273	0.59	0.36
ZPAL O.XXV/425	0.58	0.32
ZPAL O.XXV/494	0.56	0.38

Remarks. — *Klimphores (L.) ansiensis* resembles *K. (L.) elevatus* JONES, from the Middle Ordovician of Great Britain (JONES 1987), but differs from it in lacking a convex posteroventral lobe and the anterior nodal complex is closer to the anterior margin of the valve.

Distribution. — In Mójcza it occurs in the *Amorphognathus variabilis* Zone, Early Ordovician, and in the lowermost *Pygodus serra* Zone, Middle Ordovician.

In Latvia it occurs in the Early Ordovician and the lowermost Middle Ordovician.

Klimphores (Laterophores) sp.
(Pl. 45: 12–13)

Material. — 3 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/302	0.63	0.34
ZPAL O.XXV/303	broken	0.32

Description. — Valves up to 0.7 mm long, subamplete. Cardinal corners slightly rounded. Hinge line long. Lateral surface moderately convex. Anterior nodal complex clearly separated into three parts – an oval anterodorsal node, round anterocentral node and small, round preadductorial node. Posterior node elliptical, strongly projecting beyond hinge-line. Pseudovelum bend-like. Fine surface reticulation poorly preserved.

Remarks. — *Klimphores (L.)* sp. resembles in the development of the anterior nodal complex *Klimphores (L.) varesei* VANNIER from the Llandeilo and Caradoc of the Ibero-Armorican Massiv (VANNIER 1986a) but differs in having a separated preadductorial node.

Distribution. — In Mójcza it occurs in the *Amorphognathus tvaerensis* Zone, Middle Ordovician.

Genus *Vaivanovia* SCHALLREUTER, 1966

Type species: *Vaivanovia hiddenseensis* SCHALLREUTER, 1966.

Vaivanovia hiddenseensis SCHALLREUTER, 1966
(Pl. 44: 1–2)

1966. *Vaivanovia hiddenseensis* sp. n. ; SCHALLREUTER, p. 398, Pl. 1: 2.
1989. *Vaivanovia hiddenseensis* SCHALLREUTER; SCHALLREUTER, p. 247, Pl. 1: 1.

Material. — 4 poorly preserved valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/30	0.54	0.30
ZPAL O.XXV/228	0.65	0.54

Distribution. — In Mójcza it occurs in the upper *Amorphognathus tvaerensis* and lower *Amorphognathus superbus* Zones, Middle Ordovician.

It occurs also in Backsteinkalk erratic boulders, upper Viruan, Middle Ordovician.

Genus *Lubrzankiella* gen. n.

Type species: *Lubrzankiella minuta* sp. n.

Derivation of the name: From Lubrzanka, a river near the type locality.

Diagnosis. — Small binodicope (less than 0.8 mm), nearly amplete. Two small nodes in front of S2 – cone like, small anterior node and preadductorial node. Large node in centroventral region. Small spine on dorsal margin near anterior cardinal corner. Lateral surface weakly granulose.

Remarks. — *Lubrzankiella* gen. n. is similar to *Reginea* SCHALLREUTER, 1983b. The new genus is distinguished by position of the centroventral node, lack of velum and presence of an anterodorsal spine.

Lubrzankiella minuta sp. n.
(Pl. 44: 3–5; Text-fig. 20)

Holotype: ZPAL O.XXV/125.

Type horizon: Pygodus serra Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *minutus* – small, referring to the small size of specimens.

Diagnosis. — As for the genus.

Material. — 21 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/110	0.59	0.42
ZPAL O.XXV/125	0.75	0.42
ZPAL O.XXV/147	0.72	0.49

Description. — Valves high, amplete to slightly preplete. Hinge-line moderately long. Cardinal corners rounded, both slightly greater than 90°. Domicilium most elevated in anteroventral region. Entire ventral margin convex. Anterior node cone-like (AN), near anterior margin, slightly above mid-height. Preadductorial node small (PAN), rounded. Centroventral node large (VN), rounded, in front of mid-length. Small spine occurs on dorsal margin near mid-length or in smaller specimens near anterior cardinal corner. Sulcus indistinct (Text-fig. 20). Surface finely granulose in small specimens and nearly smooth in adult.

Remarks. — *Lubrzankiella minuta* sp. n. resembles *Reginea reginae* SCHALLREUTER, 1983b from the upper Harjuan erratic boulders, but differs from it in having an anterodorsal node and a large centroventral node.

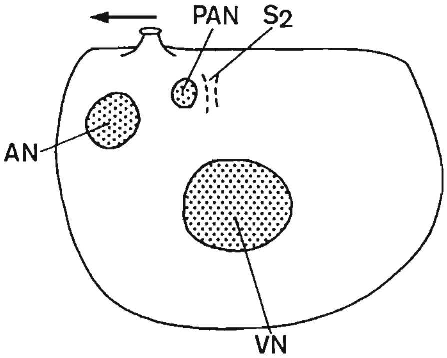

Fig. 20.
Schematic diagram of lateral view of *Lubrzankiella minuta* gen. et sp. n.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* and lowermost *Amorphognathus superbus* Zones, Middle Ordovician.

Superfamily **Aechminacea** BOUČEK, 1936
Family **Circulinidae** NACKAJA, 1966
Genus *Orechina* KRŮTA, 1968

Type species: *Orechina punctata* KRŮTA, 1968.

Remarks. — Species of *Orechina* up to now were known from the Late Ordovician of Bohemia (KRŮTA 1968), Middle Ordovician of Scania (SCHALLREUTER 1980b) and Latvia (GAILITE 1975; =*Parapyxion bernatiensis*). The taxonomic position of the genus was discussed by SCHALLREUTER and KRŮTA (1987).

Orechina krutai sp. n.
(Pl. 44: 7–9)

Holotype: ZPAL O.XXV/300.

Type horizon: *Pygodus anserinus* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Miroslav KRŮTA from Prague.

Diagnosis. — Length up to 0.9 mm. Outline postplete to subamplete. S2 weakly developed. No bend between marginal and lateral surface. Surface of domicilium reticulate.

Material. — 175 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/78	0.76	0.50
ZPAL O.XXV/300	0.72	0.45
ZPAL O.XXV/402	0.88	0.58

Description. — Outline slightly postplete to subamplete. Greatest length up to 0.9 mm. Lateral surface flat, not forming bend with marginal surface. S2 weakly developed, comma-like. Lateral surface reticulate/punctate. Surface parallel to margins and dorsal border is smooth. No dorsal ridge.

Remarks. — *Orechina krutai* sp. n. resembles *Orechina procera* SCHALLREUTER, from upper Viruan erratic boulders (SCHALLREUTER 1980b) in character of the ornamentation but differs in having a weaker S2 and a flat lateral surface.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* and *Amorphognathus superbus* Zones, Middle and Late Ordovician.

Genus *Vogdesella* BAKER, 1924

Type species: *Jonesella obscura* ULRICH, 1894.

Vogdesella aequae sp. n.
(Pl. 44: 10–12; Text-fig. 21)

Holotype: ZPAL O.XXV/481.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *aequus* – referring to the flat lateral surface.

Diagnosis. — Sulcus indistinct, comma-shaped. Elevations in front of and behind sulcus weakly developed. Macula poorly defined. Lateral surface flat.

Material. — 157 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/413	0.83	0.54
ZPAL O.XXV/481	0.77	0.50
ZPAL O.XXV/508	0.76	0.54

Description. — Valves small to medium sized. Outline distinctly postplete. Sulcus short, indistinct, comma-shaped. Preadductorial node (N$_1$) weakly developed. Posterior node (N$_2$) in form of weakly developed long elevation, continous along posterior margin as weak bend between lateral and marginal surface (Text.-fig. 21). Lateral surface of valve flattened. Mark of adductor scar (macula) poorly defined, circular, lying at end of short sulcus (not recognizable in many specimens). No ornamentation has been observed.

Remarks. — *Vogdesella aequae* sp. n. resembles *Vogdesella subovata* (THORSLUND, 1948) from the Dalby formation (Sweden), in the outline and development of elevations, but differs in the flat lateral surface. *V. aequae* sp. n. slightly resembles *Mytoa klabava* SCHALLREUTER and KRŮTA, from the Early Ordovician of Bohemia (SCHALLREUTER and KRŮTA 1988) but differs in the strongly postplete lateral outline.

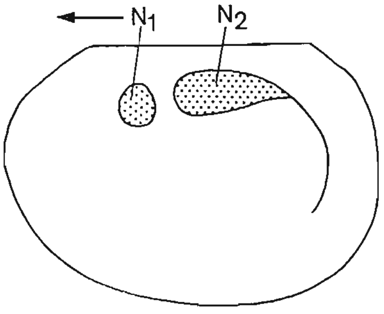

Fig. 21.
Schematic diagram of lateral view of *Vogdesella aequae* sp. n.

Distribution. — Abundant in the *Pygodus serra* Zone, Middle Ordovician.

Family uncertain
Genus *Pyxion* THORSLUND, 1948

Type species: *Primitia carinata* HADDING, 1913.

Pyxion? sp.
(Pl. 33: 12–13)

Material. — Three valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/45	0.95	0.61
ZPAL O.XXV/128	0.92	0.58

Description. — Outline subamplete to slightly preplete. Dorsal margin straight and long. Anterior and posterior cardinal corners more than 90°. Anterior cardinal angle slightly larger than posterior. Anterior and posterior margins nearly equally curved. Ventral margin slightly convex. Short, faint sulcal depression near dorsal margin. Preadductorial node weakly developed. Moderately wide pseudovelum is developed along entire free margin. Lateral surface smooth.

Remarks. — Because of the small amount of material, the species is not named and its generic assignment remains uncertain. *Pyxion rekverensis* MEIDLA, 1986, and *Pyxion nitidum* SARV, 1963 from the Middle Ordovician of Estonia, resemble the new species in lateral outline and surface ornament, but *P.*? sp. differs from them in having a flatter lateral surface.

Distribution. — Rare in the *Amorphognathus superbus* Zone, Late Ordovician.

Suborder **Leiocopa** SCHALLREUTER, 1973
Superfamily **Aparchitacea** JONES, 1901
Family **Aparchitidae** JONES, 1901
Genus *Brevidorsa* NECKAJA, 1973

Type species: *Brevidorsa brevidorsata* NECKAJA, 1973.

Remarks. — BERDAN (1982) and VANNIER (1990) discussed *Brevidorsa* in details and compared its numerous species.

Brevidorsa limbata (SIDARAVIČIENE, 1975)
(Pl. 47: 1–3)

1975. *Baltonotella*? *limbata* sp. n. ; SIDARAVIČIENE, p. 23, Pl. 1: 1–3.
1986. *Brevidorsa limbata* (SIDARAVIČIENE); SCHALLREUTER, Pl. 5: 9.
1990. *Brevidorsa limbata* (SIDARAVIČIENE); VANNIER, p. 105, Fig. 1, 2.
1992. *Brevidorsa limbata* (SIDARAVIČIENE); SIDARAVIČIENE, p. 178, Pl. 44: 11, 12.

Material. — 47 specimens, part of them internal moulds.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/16	0.72	0.61
ZPAL O.XXV/36	0.70	0.54
ZPAL O.XXV/460	0.92	0.68

Remarks. — Specimens from Mójcza possess an adductor muscle field composed of 13–15 scars.

Distribution. — In Mójcza it occur in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* Zones, Middle Ordovician.

Brevidorsa sp.
(Pl. 47: 4)

Material. — One internal mould.

Dimensions:

	L	H
ZPAL O.XXV/116	0.98	0.72

Remarks. — One specimen of *Brevidorsa* sp. has been found in the present material. Unfortunately the material is too badly preserved to be described in detail. The lateral outline is similar to that of *Brevidorsa limbata*, but differs in having an adductorial muscle field composed of a few tens of scars.

Distribution. — It occurs only in the *Pygodus serra* Zone, Middle Ordovician.

Family **Schmidtellidae** NECKAJA, 1966

Remarks. — The family Schmidtellidae as defined by BERDAN (1988) includes genera which are nonsulcate and with distinct central or subcentral umbones, so that the dorsum is epicline. The lack of sulcation in *Schmidtella* and other genera in the Schmidtellidae suggests according to BERDAN (1988) that this family should be placed in the suborder Leiocopa SCHALLREUTER, 1973 and the superfamily Aparchitacea JONES, 1901. SCHALLREUTER (1968c) placed the family Schmidtellidae in the suborder Eridostraca ADAMCZAK, 1961.

Genus *Schmidtella* ULRICH, 1892

Type species: *Schmidtella crassimarginata* ULRICH, 1892.

Schmidtella globosa sp. n.
(Pl. 47: 5–6)

Holotype: ZPAL O.XXV/136.
Type horizon: *Pygodus serra* Zone, Middle Ordovician.
Type locality: Mójcza, Holy Cross Mountains, Poland.
Derivation of the name: From Latin *globosus* – round, referring to the subcircular lateral outline.

Diagnosis. — Valves nearly subcircular in lateral outline. Hinge incised. Posterior end slightly higher than anterior end. Valves flat.

Material. — 32 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/136	0.92	0.68
ZPAL O.XXV/155	0.79	0.59

Description. — Valves subcircular in lateral view, flat, without marginal structures. Dorsal margin slightly overhanging hinge. Hinge relatively short. Maximal width near mid-height. Maximal length at about mid-height of valve. Greatest height slightly behind the mid-length. Shell surface smooth.

Remarks. — *Schmidtella globosa* sp. n. resembles *Schmidtella fragosa* NECKAJA, from the Middle Ordovician of the Pskov region (NECKAJA 1966) in the similar outline of the carapace, but differs in having a more rounded outline. It is similar to the N-American species *Schmidtella minuta* HARRIS, 1957 and *Schmidtella affinis* ULRICH, 1894. It differs from species of *Easchmidtella* SCHALLREUTER, 1967 in lacking an indication that it possesses a sulcament, which is considered diagnostic for the latter genus.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus* and *Amorphognathus tvaerensis* Zones, Middle Ordovician.

Suborder **Eridostraca** ADAMCZAK, 1961
Family **Conchoprimitiidae** HENNINGSMOEN, 1953
Genus *Conchoprimitia* ÖPIK, 1935

Type species: *Conchoprimitia gammae* ÖPIK, 1935.

Conchoprimitia? *ventroincisurata* (HESSLAND, 1949)
(Pl. 47: 11–13)

1949. *Conchoides ventroincisurata* sp. n. ; HESSLAND, p. 172, Pl. 2: 8–9.

Material. — 90 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/122	0.83	0.49
ZPAL O.XXV/134	0.85	0.49
ZPAL O.XXV/410	0.83	0.50

Remarks. — According to JAANUSSON (1957) the so-called "non-leperditioid group of *Conchoides*" (HESSLAND 1949), ought probably to be excluded from *Conchoprimitia* but more well preserved material and further studies are needed to answer this question.

Distribution.— In Mójcza it occurs in the *Amorphognathus variabilis* Zone, Early Ordovician. In Sweden *C.*? *ventroincisurata* occurs in the Early Ordovician of Siljan District.

Conchoprimitia? *modlinskii* sp. n.
(Pl. 47: 9–10)

Holotype: ZPAL O.XXV/131.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Zdzisław MODLIŃSKI from the State Geological Institute in Warsaw.

Diagnosis. — Carapace evenly convex, non-sulcate. Cardinal angles obtuse. Posterior margin slightly concave near posterior cardinal corner. Surface smooth.

Material. — 74 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/100	0.48	0.34
ZPAL O.XXV/131	0.79	0.54

Description. — Valves moderately and rather uniformly convex, highest convexity at about mid-length of valve. Cardinal corners rounded, both obtuse. Posterior cardinal corner field flattened. Posterior margin slightly concave near dorsal margin. No sulcal depression or very indistinct. Surface of valve smooth.

Remarks. — The taxonomic position of this species is unclear. It is similar in lateral outline to *Conchoprimitia* species but shows also similarities to other similar genera of Spinigeritidae and Circulinidae.

Distribution.— It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Conchoprimitia? *polonica* sp. n.

(Pl. 47: 14–16)

Holotype: ZPAL O.XXV/307.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Poland.

Diagnosis. — Valves strongly convex. Sulcus indistinct and short. Preadductorial node weakly developed. Surface smooth.

Material. — 290 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/74	0.92	0.59
ZPAL O.XXV/108	1.15	0.83
ZPAL O.XXV/307	1.10	0.76

Description. — Length up to at least 1.3 mm. Shape very high to high. Valves strongly convex, greatest width slightly below dorsal margin. Cardinal corners rounded, both obtuse. Sulcus indistinct, short. Preadductorial node weakly developed, forming round elevation in front of depression. Surface of valve smooth.

Remarks. — *Conchoprimitia*? *polonica* sp. n. differs rather considerably from the other species of the genus, and later studies may prove the neccessity of removing it into a separate genus. In general outline it is similar to *Conchoprimitia leperditioidea* THORSLUND, 1940.

Distribution. — In Mójcza it occurs only in the *Amorphognathus variabilis* Zone, Early Ordovician.

Order **Platycopa** SARS, 1866

Suborder **Cytherelliformes** SKOGSBERG, 1920

Superfamily **Kloedenellacea** ULRICH *et* BASSLER, 1908

Family **Monotiopleuridae** GUBER *et* JAANUSSON, 1964

Genus *Domaszevicella* gen. n.

Type species: *Domaszevicella tridepressa* sp. n.

Derivation of the name: From Domaszewice – name of the village near the type locality.

Diagnosis. — Nonsulcate monotiopleurids; adult females with distinct domatium having three separate egg compartments in each valve.

Remarks. — *Domaszevicella* gen. n. shows some resemblance to *Primitiella* ULRICH, in lateral outline and poorly defined sulcal depression. It differs from this genus in having egg compartments in female valves. The round depressions on the inner side of the female valves occur also in other paleozoic platycopes such as *Karinutatia* SCHALLREUTER (see SCHALLREUTER 1978), *Lomatopisthia* GUBER and JAANUSSON (see GUBER and JAANUSSON 1964), *Glyptolichvinella* POSNER (see LUNDIN 1987; LUNDIN and VISINTAINER 1987). The functional morphology of the shell in platycope ostracods was discussed in detail by JAANUSSON (1985).

Domaszevicella tridepressa sp. n.

(Pl. 46: 10–17)

Holotype: ZPAL O.XXV/124.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: The name is referring to the three internal depressions.

Diagnosis. — As for the genus.

Material. — 93 tecnomorphic and 20 female valves, some damaged.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/19	1.26	0.65
ZPAL O.XXV/114	1.04	0.63
ZPAL O.XXV/124	0.77	0.43
ZPAL O.XXV/256	0.97	0.52
ZPAL O.XXV/288	0.88	0.45
ZPAL O.XXV/308	0.86	0.45
ZPAL O.XXV/403	0.92	0.45
ZPAL O.XXV/407	0.92	0.50

Description. — Outline nearly amplete; anterior margin evenly rounded; posterior margin faintly curved. Posterior cardinal angle more than 90°, anterior cardinal angle considerably larger. Lateral surface smooth with very faint sulcal depression. In front of sulcal depression, near dorsal margin, small node is visible. Distinct supramarginal depression present along ventral margin of left valve, right valve lacks this structure. Contact groove inside left valve. Adult females posteriorly wider than males, with three oval to circular separate egg compartments in posterior part of each valve.

Remarks. — *Domaszevicella tridepressa* gen. et sp. n. is characterized by the flat carapace in tecnomorphs and internal depressions in females. Its lateral outline is similar to that of *Primitiella* species (*P. molli, P. minima, P. constricta*).

Distribution. — In Mójcza it occurs in the *Pygodus serra* and lowermost *Pygodus anserinus* Zones, Middle Ordovician.

Genus *Primitiella* ULRICH, 1897

Type species: *Primitiella constricta* ULRICH, 1897.

Primitiella mojczensis sp. n.
(Pl. 46: 1–3)

Holotype: ZPAL O.XXV/414.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From the type locality.

Diagnosis. — *Primitiella* with very poorly defined to obsolete sulcal depression. Distinct ventral cavity. Ornamentation consists of very faint reticulation.

Material. — 486 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/39	0.58	0.31
ZPAL O.XXV/414	0.81	0.38
ZPAL O.XXV/415	0.72	0.34

Description.— Outline is about rectangular. Dorsal margin straight and parallel to slightly concave ventral margin. Anterior margin more rounded than posterior margin. Anterior and posterior cardinal angles slightly greater than 90°. Poorly defined to obsolete sulcal depression. Dimorphism poorly recognised, heteromorphs more inflated posteriorly. Fine surface reticulation usually poorly preserved.

Remarks. — Since the material of *Primitiella mojczensis* sp. n. contains no closed carapaces, the stragular process and overlap of the valves is unknown for this species. However, this species is very similar to other *Primitiella* species, and therefore included in this genus. When more material, including closed carapaces, is available, this may need revision.

Distribution. — It occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis* and *Amorphognathus superbus* Zones, Middle and Late Ordovician.

Primitiella? sp.
(Pl. 46: 9)

Material. — 2 valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/160	1.39	0.77

Remarks. — The material agrees in most respect with *Domaszevicella tridepressa* sp. n. However, as far as can be assessed, it is distinct from it in lacking egg compartments, larger overall size, and more amplete outline. The lateral outline is similar to that in *Primitiella* species. More material is needed for the determination of this species.

Distribution. — It occurs in the *Pygodus anserinus* Zone, Middle Ordovician.

Genus *Unisulcopleura* SCHALLREUTER, 1968

Type species: *Unisulcopleura unisulcata* SCHALLREUTER, 1968.

Unisulcopleura reticulata sp. n.
(Pl. 46: 4–7)

Holotype: ZPAL O.XXV/72.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: The name is referring to surface ornamentation.

Diagnosis. — Valves moderately high and strongly postplete. Cardinal angles greater than 90°. Sulcus short, straight, narrow. Fingerprint ornament in posterior part of valve, reticulate in anterior and central region.

Material. — 72 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/72	0.53	0.32
ZPAL O.XXV/130	0.59	0.32
ZPAL O.XXV/411	0.81	0.41
ZPAL O.XXV/419	0.85	0.43

Description. — Valves postplete in lateral outline. Greatest length of valve in mid-height. Greatest height posterior. Cardinal corners slightly rounded, both much greater than 90°, anterior angle more obtuse than posterior. Sulcus short, straight, rather narrow. Ventral margin slightly concave in middle part. Finerprint ornament in posterior part of valve, reticulate in anterior and central region.

Remarks. — In lateral outline and ornamentation *Unisulcopleura reticulata* sp. n. is similar to *Mytoa*? *expressoreticulata* (HESSLAND), (cf. SCHALLREUTER and KRŮTA 1988) but differs in lacking macula (muscle spot). It is also similar to *Unisulcopleura weitschati* SCHALLREUTER from Middle Ordovician erratic boulders (SCHALLREUTER 1987) but differs by a more postplete lateral outline.

Distribution. — It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Unisulcopleura? *permulta* sp. n.
(Pl. 47: 7–8)

Holotype: ZPAL O.XXV/85.

Type horizon: *Amorphognathus variabilis* Zone, Early Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *permultus* – numerous.

Diagnosis. — Valves up to 0.9 mm long, rather high, strongly postplete. Cardinal corners slightly rounded, posterior corner angle greater than anterior. Sulcus slightly in front of mid-length, short. Valve surface reticulate in central reion, smooth near margins.

Material. — 315 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/85	0.67	0.48
ZPAL O.XXV/102	0.83	0.47

Description. — Valve outline strongly postplete. Hinge line moderately long. Domicilium rather high. Transverse convexity greatest ventrally. Cardinal corners slightly rounded, both greater than 90°, posterior corner angle greater than anterior. Sulcus in anterior dorsocentral region, short, does not reach hinge line. Preadductorial node weakly developed. Internally, round muscle scar developed. Contact margin simple. Valves slightly reticulate in central region, smooth near margins.

Remarks. — *Unisulcopleura*? *permulta* sp. n. differs from congeneric species by its more postplete outline. It is similar to *Primitiella kogermani* (ÖPIK) but differs in a longer dorsal margin, from *Primitiella molli* (BONNEMA) it differs in having a more rounded anterior margin.

Distribution. — It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Unisulcopleura? sp. 1
(Pl. 46: 8)

Material. — 7 valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/286	0.95	0.50

Description. — Valves up to 1.00 mm long. Valve outline slightly postplete. Cardinal corners quite distinct, posterior more obtuse than anterior corner. Valves slightly convex. Sulcal depression indistinct developed in anterior dorsocentral region, does not reach hinge line. Preadductorial node weakly developed. Valve surface with fine finerprint-like ornament.

Remarks. — *Unisulcopleura*? sp. 1 resembles *Unisulcopleura reticulata* sp. n. in lateral outline and weakly developed sulcal depression, but differs in a more postplete outline and the ornamentation of the valve. The outline of *U.*? *permulta* sp. n. is more postplete. *U.*? sp. 1 is similar to *Conchoprimitiella papilalata* JONES, from the Caradocian of the British Isles (JONES 1987) in having fingerprint-like ornament.

Distribution. — Rare in the *Amorphognathus variabilis* Zone, Early Ordovician.

Unisulcopleura? sp. 2
(Pl. 28: 9)

Material. — 2 valves.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/165	1.10	0.63

Description. — Valve outline nearly amplete to slightly postplete. Dorsal margin long and straight. Anterior and posterior margins rounded, posterior margin higher than anterior. Cardinal angles greater than 90°, posterior corner angle more obtuse then anterior. Adductorial sulcus short, narrow, not reaching dorsal margin. Preadductorial node round, small. Lateral surface reticulate.

Remarks. — *Unisulcopleura*? sp. 2 differs from *Unisulcopleura reticulata* sp. n. in the larger size of the carapace and a larger preadductorial node.

Distribution. — Only in the *Pygodus anserinus* Zone, Middle Ordovician.

Order **Podocopa** SARS, 1866
Suborder **Metacopa** SYLVESTER-BRADLEY, 1961
Superfamily **Bairdiocypridacea** SHAVER *in* BENSON *et al.*, 1961 (KOZUR, 1972)
Family **Krausellidae** BERDAN *in* BENSON *et al.*, 1961
Genus *Rectella* NECKAJA, 1958

Type species: *Mica inaequalis* NECKAJA, 1952.

Rectella carinaspinata SCHALLREUTER, 1972
(Pl. 48: 12–15)

1972. *Rectella carinaspinata* sp. n. ; SCHALLREUTER, p. 257, Pl. 1: 4.
1986. *Rectella carinaspinata* SCHALLREUTER; SCHALLREUTER, Pl. 7: 3.

Material. — 9 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/179	0.72	0.36
ZPAL O.XXV/242	0.86	0.45
ZPAL O.XXV/272	0.88	0.45
ZPAL O.XXV/529	0.90	0.50

Remarks. — *Rectella galba* NECKAJA, from the Middle Ordovician of East European Platform (NECKAJA 1958) differs from *R. carinaspinata* by having a smaller transverse and longitudinal convexity.

Distribution. — In Mójcza it occurs in the *Amorphognathus superbus* Zone, Late Ordovician. In N-Germany it occurs in Öjlemyrflint erratic boulders, Late Ordovician.

Genus *Trianguloschmidtella* SARV, 1963
Subgenus *Trianguloschmidtella (Rempesgrinella)* KNÜPFER, 1968

Type species: *Rempesgrinella hemiventrocosta* KNÜPFER, 1968.

Remarks. — See SCHALLREUTER (1988).

Trianguloschmidtella (Rempesgrinella) hemiventrocosta (KNÜPFER, 1968)
(Pls 48: 6; 50: 1–2)

1968. *Rempesgrinella hemiventrocosta* sp. n. ; KNÜPFER, p. 16, Pl. 6: 1.

Material. — 24 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/177	0.95	0.54
ZPAL O.XXV/447	1.06	0.61
ZPAL O.XXV/448	1.01	0.59

Remarks. — KNÜPFER's (1968) figure of *T. (R.) hemiventrocosta* is very similar to the specimens of *T. (R.) hemiventrocosta* illustrated herein, except that the cardinal corners of KNÜPFER's specimens are less rounded, and the height is the same in the anterior and posterior parts. In specimens from Mójcza, it is slightly greater in the anterior part of the carapace. *T. (R.)* cf. *hemiventrocosta* from the Late Ordovician of Australia (SCHALLREUTER 1988) has a ventral ridge just behind the mid-length of the valve.

Distribution. — In Mójcza it occurs in the *Amorphognathus superbus* Zone, Late Ordovician. In Thuringia it occurs in the Kalkbank (latest Caradoc or Ashgill).

Genus *Pseudorayella* NECKAJA, 1960

Type species: *Pseudorayella scala* NECKAJA, 1960.

Pseudorayella ovalis NECKAJA, 1960
(Pl. 49: 9–10)

1960. *Pseudorayella ovalis* sp. n. ; NECKAJA, p. 362, Pl. 69: 3.

Material. — 40 valves, some internal moulds.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/123	0.77	0.38
ZPAL O.XXV/167	0.83	0.45

Remarks. — *Pseudorayella* sp. aff. *ovalis* from the Lexington Limestone, Midle Ordovician of Kentucky (WARSHAUER and BERDAN 1982) possesses a smaller overall size of the carapaces and smaller concavity of the ventral margin.

Distribution. — In Mójcza it occurs in the *Pygodus serra* Zone, Middle Ordovician. In Baltoscandia it occurs in the Middle Ordovician.

Family **Bairdiocyprididae** SHAVER *in* BENSON *et al*., 1961

Genus *Medianella* NECKAJA, 1966

Type species: *Bythocypris aequa* STUMBUR, 1956.

Medianella? *pudica* sp. n.

(Pl. 49: 13–14)

Holotype: ZPAL O.XXV/305.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *pudica* – modest.

Diagnosis. — Elongate, greataest width and hight in posterior part. Dorsal and ventral margins subparallel. Anterior and posterior margins nearly equally curved.

Material. — 437 specimens, valves and internal moulds.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/120	0.77	0.36
ZPAL O.XXV/305	1.10	0.61

Description. — Lateral outline elliptical, dorsal margin straight to slightly convex, subparallel to ventral margin. Anterior and posterior margins nearly curved. Ventral margin straight to slightly concave. Slight ventral lappet on left valve at concavity of ventral margin. Greatest height and width slightly postmedian. Two stop ridges on internal side of larger left valve. Shell surface smooth.

Remarks. — The specimens are only questionably assigned to *Medianella*, because unfortunatelly, although more than 400 valves or internal moulds can be assigned to this taxon on the basis of their lateral outline, not one is sufficently well preserved as closed carapaces to show the character of the overlap and the dorsum, most are either badly corroded or steinkerns. This species differs from others assigned to the genus in having subparallel dorsal and ventral margins and more equally curved anterior and posterior margins.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus, Amorphognathus tvaerensis*, and *Amorphognathus superbus* Zones, Middle and Late Ordovician.

Medianella? sp. 1

(Pl. 49: 15)

Material. — 58 valves, some of them damaged.

Dimensions (figured specimen):

	L	H
ZPAL O.XXV/231	0.63	0.41

Remarks. — Unfortunately specimens of *Medianella*? sp. 1 are too badly preserved to be described in detail. The lateral outline is similar to that in the stratigraphically younger *Medianella*? *pudica*, but differs in having much greater height in the posterior part of the valve. More material is needed for determination of this species.

Distribution. — It occurs in the *Amorphognathus variabilis* Zone, Early Ordovician.

Medianella? sp. 2
(Pl. 49: 11–12)

Material. — 6 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/118	1.03	0.36
ZPAL O.XXV/161	1.13	0.45

Remarks. — *Medianella*? sp. 2 differs from *M*.? sp. 1 and *M*.? *pudica* in having very long carapaces with parallel dorsal and ventral margins. Because of the small amount of material, the species is not named and its generic assignement remains uncertain.

Distribution.— Occurs only in the *Pygodus anserinus* Zone, Middle Ordovician.

Genus *Longiscula* NECKAJA, 1958

Type species: *Longiscula arcuaris* NECKAJA, 1958.

Longiscula? *affluens* sp. n.
(Pl. 49: 1–7)

Holotype: ZPAL O.XXV/127.

Type horizon: *Pygodus serra* Zone, Middle Ordovician.

Type locality: Mójcza, Holy Cross Mountains, Poland.

Derivation of the name: From Latin *affluens* – abundant, rich, refeering to its abbundance in some beds.

Diagnosis. — Elongate, greatest width in posterior part of carapace, dorsal margin broadly curved, ventral margin concave.

Material. — More than 1900 internal moulds or valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/5	0.95	0.45
ZPAL O.XXV/25	1.75	1.10
ZPAL O.XXV/37	1.21	0.68
ZPAL O.XXV/43	1.10	0.63
ZPAL O.XXV/127	0.80	0.38
ZPAL O.XXV/140	1.01	0.61
ZPAL O.XXV/306	0.92	0.45

Description. — Lateral outline elongate. Dorsal margin broadly curved, ventral margin concave. Posterior margin more broadly curved than anterior. Transverse convexity greatest in posterior part of valve. Sulcal depression slightly developed in central region. Shell surface smooth.

Remarks. — The specimens are only questionably assigned to *Longiscula* because none is sufficiently well preserved as a closed carapace to show the character of the overlap. This form is similar to *Longiscula ovata* NECKAJA, 1966, but is relatively longer and the ventral margin is more concave.

Distribution.— It is abundant in the *Pygodus serra*, *Pygodus anserinus*, *Amorphognathus tvaerensis*, and *Amorphognathus superbus* Zones, Middle and Late Ordovician.

Family **Balticellidae** SCHALLREUTER, 1968
Subfamily **Steusloffinae** SCHALLREUTER, 1984
Genus *Steusloffina* TEICHERT, 1937

Type species: *Steusloffina ulrichi* TEICHERT, 1937.

Steusloffina sp.
(Pl. 48: 10–11)

Material. — 2 right valves.

Dimensions:

	L	H
ZPAL O.XXV/176	0.90	0.45
ZPAL O.XXV/281	0.88	0.40

Description. — Lateral outline strongly preplete. Greatest height in anterior part. Dorsal margin long and straight. Anterior margin broadly curved, posterior narrow. Valves strongly convex, greatest convexity in mid-length. Lateral surface smooth.

Remarks. — The material probably represents a new species but more material is needed to confirm this. The specimens of *Steusloffina* from the present material resemble *Steusloffina dilatata* MEIDLA, 1983 from the Late Ordovician of Western Estonia, but differ from the latter by the shape of the posterior margin of the right valve. *Steusloffina* sp. also resembles *Steusloffina radiculosa* NECKAJA, 1966 from the Middle Ordovician of Estonia in the outline of the valves. *Steusloffina* sp. differs from *Steusloffina cuneata* (STEUSLOFF, 1895) and *Steusloffina lintra* SCHALLREUTER, 1972 by the lack of spines.

Distribution. — It occurs only in the *Amorphognathus superbus* Zone, Late Ordovician.

Family uncertain
Genus *Pinnatulites* HESSLAND, 1949

Type species: *Primitiella procera* KUMMEROW, 1924.

Remarks. — Many taxonomic problems still exist with this genus. According to HESSLAND (1949) the genus should be placed in Aparchitidae, according to SARV (1959) and SIDARAVIČIENE (1992) in Leperditellidae, HESSLAND *in* BENSON *et al.* (1961) placed *Pinnatulites* in Palaeocopida, SCHALLREUTER (1979) in Bairdiacea and SCHALLREUTER (1990) in Rectellidae. More well preserved material with preseved internal structures is needed to establish its taxonomic position.

Pinnatulites procera (KUMMEROW, 1924)
(Pl. 48: 1–5, Text-fig. 14)

1924. *Primitiella procera* sp. n. ; KUMMEROW, p. 419, Pl. 20: 12.
1949. *Pinnatulites procera* (KUMMEROW); HESSLAND, p. 199, Pl. 4: 14–15.
1959. *Pinnatulites procera* (KUMMEROW); SARV, p. 171, Pl. 30: 12–14.
1992. *Pinnatulites procera* (KUMMEROW); SIDARAVIČIENE, p. 196, Pl. 51: 3 (here older synonymy).

Material. — 110 valves and internal moulds.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/149	0.68	0.43
ZPAL O.XXV/263	1.28	0.72
ZPAL O.XXV/422	1.60	0.72

Remarks. — For a discussion on the surface ornament see p. 158.

Distribution. — In Mójcza it is restricted to the upper part of the *Amorphognathus variabilis* Zone, Early Ordovician. In Baltoscandia it is common in the Kunda Stage (Estonia, Lithuania, Latvia, Sweden, N Germany erratic boulders), Early Ordovician.

Superfamily uncertain
Family **Condomyridae** SCHALLREUTER, 1977
Genus *Condomyra* SCHALLREUTER, 1968

Type species: *Condomyra brevinodata* SCHALLREUTER, 1968.

Condomyra reticulata SCHALLREUTER, 1968
(Pl. 48: 7–9)

1968b. *Condomyra reticulata* sp. n. ; SCHALLREUTER, p. 148, Pl. 22 : 1–3.
1977b. *Condomyra reticulata* SCHALLREUTER; SCHALLREUTER, Pl. 4: 1–2.

1986. *Condomyra reticulata* SCHALLREUTER; SCHALLREUTER, Pl. 8: 10.

Material. — 22 valves.

Dimensions (figured specimens):

	L	H
ZPAL O.XXV/99	0.36	0.24
ZPAL O.XXV/264	0.45	0.27
ZPAL O.XXV/266	0.50	0.31

Remarks. — Specimens from Mójcza have poorly preserved marginal structures. The inner lamella is not visible.

Distribution. — In Mójcza it occurs in the *Pygodus serra, Pygodus anserinus* and *Amorphognathus tvaerensis* Zones, Middle Ordovician. In N Germany it occurs in Öjlemyrflint erratic boulders, Late Ordovician.

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TABLES

Number of specimens in each sample in Mójcza section.

Table 1.

	Amorphognathus variabilis Zone												
MA—	117	33	34	118	35	120	36	37	38	126	127	40	41
Ampletochilina priscina	1	-	-	2	-	8	2	-	-	-	-	-	-
Lembitsarvella sp.	2	-	2	4	-	7	3	3	-	-	1	3	-
Laccochilina (L.) berdanae	2	2	3	14	1	8	6	2	-	-	-	-	-
Duringia? aculeata	-	1	2	1	-	-	-	-	-	-	-	-	1
Eochilina? sp.	-	-	-	-	-	-	-	-	-	-	2	1	1
Gryphiswaldensia angustivelata	-	-	-	-	-	-	-	-	-	-	3	1	2
Otraczetia bulbata	1	1	6	9	-	6	3	2	-	-	-	-	-
Uhakiella perrara	2	-	1	5	-	-	1	1	-	-	-	-	-
Uhakiella sp. 1	-	-	-	-	-	-	-	-	-	-	2	1	1
Mojczella polonica	5	2	3	70	1	30	4	1	1	-	-	-	-
Quadritia? sp.	-	-	-	1	-	1	-	-	-	-	-	-	-
Rakverella (P.) antica	2	6	5	14	-	8	1	1	-	-	-	1	-
Rigidella dubia	-	-	-	3	-	-	-	-	-	-	-	-	-
Telegraphia prima	-	1	1	2	-	3	-	2	1	-	-	-	-
Ogmoopsis (O.) sp.	-	-	-	-	-	1	-	-	-	-	2	1	1
Collibolbina barbarae	5	2	10	21	2	15	3	8	2	3	6	3	3
Glossomorphites (G.) kielcensis	2	-	-	6	1	13	4	3	-	-	-	-	-
Glossomorphites (G.) sp.	2	-	3	2	1	2	-	3	-	-	1	-	-
Hesslandella sztejnae	3	3	9	22	1	20	7	2	2	6	1	-	2
Klimphores (L.) ansiensis	8	1	7	21	-	20	7	5	3	-	1	2	2
Conchoprimitia? polonica	15	33	18	100	2	70	22	11	6	10	2	1	-
Conchoprimitia? ventroincisurata	-	-	4	7	-	70	-	4	5	-	-	-	-
Conchoprimitia? modlinski	-	3	4	50	-	-	9	5	-	-	3	-	-
Unisulcopleura reticulata	1	1	6	15	-	25	3	6	4	-	5	4	2
Unisulcopleura? permulta	26	7	28	100	1	100	13	25	7	2	4	2	-
Unisulcopleura? sp. 1	-	-	-	3	-	-	-	-	-	-	-	4	-
Medianella? sp. 1	5	-	6	15	2	6	-	6	4	5	4	5	-
Pinnatulites procera	-	-	-	-	-	-	-	-	-	10	16	70	14

Table 2

	Pygodus serra Zone																									
MA—	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	62	63	64	65	66	67	69
Swantina schallreuteri	-	4	2	12	22	10	1	2	-	1	3	-	3	2	7	2	24	6	2	2	1	-	2	-	-	-
Hesperidella posterospinata	-	-	-	-	1	-	-	-	-	-	-	-	1	2	1	1	1	1	-	-	-	-	-	1	-	-
Piretella oepiki	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	2	-	-	-	-	-	-	-	-	-
Piretella amphicristata	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Lembitsarvella polonica	-	1	-	4	13	8	2	1	-	-	3	1	2	8	3	2	25	15	5	1	1	3	10	1	-	-
Duringia sp. 1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Duringia? sp. 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Gryphiswaldensia cavata	2	10	1	8	13	5	4	30	3	28	40	-	5	16	9	14	100	12	2	5	3	4	6	6	1	2
Steinfurtia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Euprimites grandis	1	13	1	12	19	5	3	2	2	2	2	-	3	1	1	3	15	2	1	2	-	-	1	-	-	-
Piretia tenuistriata	-	-	-	2	3	4	6	6	-	1	2	-	-	6	1	2	28	13	1	3	1	-	4	2	-	-
Piretia speciosa	-	1	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
Uhakiella diuturna	-	2	2	6	14	2	2	-	-	-	-	1	6	4	1	-	3	2	-	-	-	-	-	-	-	-
Uhakiella sp. 2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mojczella jaanussoni	-	2	-	9	13	14	2	12	-	5	9	-	10	18	12	9	41	27	-	2	-	-	7	1	-	-
Tvaerenellidae sp. A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
Sigmobolbina lysicae	-	2	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentagona cf. *pentagona*	-	-	1	2	3	1	1	3	-	-	2	-	2	-	2	1	2	2	3	2	1	-	6	2	-	-
Ceratobolbina monoceratina	-	-	-	-	2	3	4	3	-	-	-	1	1	2	8	2	7	2	-	-	-	-	-	-	-	-
Collibolbina postaculeata	-	2	1	3	8	4	3	4	-	2	2	-	1	2	-	3	9	-	-	-	-	-	2	-	-	2
Collibolbina? sp.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hippula (C.) sp.	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vittella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Adamczakites paucus	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Klimphores (K.) subplanus	1	100	19	76	37	14	8	23	-	16	32	1	25	22	18	25	50	12	1	6	5	3	12	4	50	4
Klimphores (L.) ansiensis	1	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lubrzankiella minuta	-	-	-	1	7	1	1	1	-	2	1	-	-	2	-	-	1	1	-	-	-	1	-	-	-	-
Orechina krutai	-	-	-	2	10	4	8	16	3	4	3	-	2	7	3	4	23	7	-	-	-	1	1	-	-	-
Vogdesella aequae	2	60	13	30	50	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brevidorsa limbata	-	1	-	1	-	1	-	-	-	3	2	-	1	3	6	1	-	2	3	2	1	2	7	1	1	2
Brevidorsa sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Schmidtella globosa	-	3	2	2	7	1	-	-	-	-	1	-	3	1	2	1	3	1	-	-	-	-	-	-	-	-
Domaszevicella tridepressa	-	3	-	4	44	-	4	16	-	9	5	1	2	5	3	-	15	3	-	-	-	-	-	-	-	-
Primitiella mojczensis	22	200	17	100	26	6	-	-	-	-	5	1	3	6	3	4	5	2	-	2	-	3	3	4	2	2
Primitiella? sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Unisulcopleura? sp. 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Pseudorayella ovalis	1	5	6	5	16	2	-	1	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Medianella? *pudica*	-	-	-	-	1	5	2	-	1	2	2	-	-	6	5	3	13	4	10	2	3	10	10	4	80	30
Medianella? sp. 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	2	-	-	-	-	-	-
Longiscula? *affluens*	-	10	35	15	44	30	20	25	7	25	47	1	42	70	70	42	70	35	32	23	10	30	50	20	70	115
Condomyra reticulata	-	-	-	-	-	1	1	2	-	-	4	-	1	-	-	2	7	-	-	-	-	-	-	-	-	-

Table 3

	Amorphognathus tvaerensis Zone																			*Amorphognathus superbus* Zone									
MA—	70	71	72	73	74	75	76	77	78	79	80	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Platybolbina (R.) sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Swantina schallreuteri	-	-	-	-	-	-	2	-	1	-	-	1	-	7	17	-	-	-	1	-	3	-	1	-	1	1	-	-	1
Piretella oepiki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Piretella amphicristata	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lembitsarvella polonica	-	-	-	-	1	-	2	-	2	1	2	2	1	38	56	7	5	-	5	1	1	-	-	-	-	-	-	-	-
Gryphiswaldensia cavata	-	-	-	1	3	-	-	-	3	-	1	-	3	-	2	3	1	-	2	1	-	-	-	-	-	-	-	-	-
Gryphiswaldensia gryphiswaldensis	-	-	-	-	-	-	7	1	-	-	-	-	3	1	-	-	-	-	-	-	16	1	3	3	2	5	1	4	18
Euprimites grandis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Piretia tenuistriata	1	-	-	-	-	1	-	-	1	1	-	2	-	16	18	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Piretia speciosa	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Piretia rara	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uhakiella diuturna	-	-	-	-	-	-	-	-	-	1	-	-	1	3	11	3	-	-	3	-	1	-	1	4	-	-	-	-	-
Bromidella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5
Mojczella sanctacrucensis	-	-	-	-	-	-	-	-	-	-	-	1	-	9	18	1	3	-	1	1	1	?	?	-	-	-	-	-	-
Mojczella? sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Collibolbina sigmoidea	-	-	-	-	-	-	-	-	-	-	-	-	2	7	24	-	4	-	1	-	-	-	-	-	-	-	-	-	-
Collibolbina postaculeata	-	-	-	-	-	-	1	-	4	-	1	-	-	4	13	2	-	-	1	-	-	-	-	-	-	1	-	3	3
Adamczakites paucus	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Klimphores (K.) subplanus	1	1	3	4	6	3	23	5	4	1	2	3	-	3	9	-	2	2	1	-	2	1	10	1	1	-	-	-	-
Klimphores (K.) vanneri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	50	8	3	56
Klimphores (L.) sp.	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaivanovia hiddenseensis	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Lubrzankiella minuta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Orechina krutai	-	-	-	-	-	-	1	-	-	-	-	-	1	5	20	3	-	2	4	3	1	-	1	-	1	-	-	-	35
Brevidorsa limbata	1	-	-	1	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyxion? sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
Schmidtella globosa	-	-	-	-	-	-	1	-	-	-	-	-	-	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Primitiella mojczensis	-	-	-	-	-	2	25	1	3	-	1	5	1	5	10	2	1	-	3	-	1	1	2	1	1	2	1	-	2
Rectella carinaspinata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
Trianguloschmidtella (R.) hemiventrocosta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	23
Medianella? *pudica*	15	30	30	31	9	1	50	20	16	1	1	14	3	1	3	-	-	1	-	-	3	-	2	3	10	-	-	-	-
Longiscula? *affluens*	60	60	70	120	80	20	22	41	119	12	28	55	27	60	80	12	15	9	9	10	6	-	3	5	10	20	11	10	71
Steusloffina sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Condomyra reticulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-

OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 25

Duringia? *aculeata* sp. n. 166

Fig. 1. Tecnomorphic right valve, ZPAL O.XXV/82, × 105, sample MA-34.
Fig. 2. Tecnomorphic right valve, holotype ZPAL O.XXV/66, × 105, sample MA-34.
Fig. 3. Heteromorphic right valve (broken dorsally), ZPAL O.XXV/199, × 42, sample MA-118.

Duringia? sp. 2 167

Fig. 4. Tecnomorphic right valve (broken posteriorly), ZPAL O.XXV/462, × 70, sample MA-57.
Fig. 5. External mould of tecnomorphic valve, ZPAL O.XXV/463, × 70, sample MA-57.

Duringia sp. 1 166

Fig. 6. Heteromorphic right valve, ZPAL O.XXV/192, × 52, sample MA-43.

Rigidella dubia sp. n. 179

Fig. 7. Tecnomorphic right valve, ZPAL O.XXV/301, × 70, sample MA-118.
Fig. 8. Tecnomorphic right valve, holotype ZPAL O.XXV/227, × 70, sample MA-118.

Platybolbina (Reticulobolbina) sp. 161

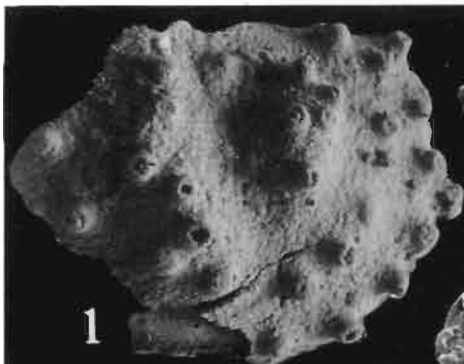
Fig. 9. Tecnomorphic left valve, ZPAL O.XXV/7, × 32, sample MA-93.

Hesperidella posterospinata sp. n. 162

Fig. 10. Tecnomorphic left valve, ZPAL O.XXV/482, × 70, sample MA-46.
Fig. 11. Tecnomorphic left valve, holotype ZPAL O.XXV/166, × 105, sample MA-55.
Fig. 12. Tecnomorphic right valve, ZPAL O.XXV/81, × 105, sample MA-66.

Telegraphia prima gen. et sp. n. 179

Fig. 13. Female right valve, ZPAL O.XXV/290, × 105, sample MA-118.
Fig. 14. Tecnomorphic left valve, holotype ZPAL O.XXV/193, × 52, sample MA-38.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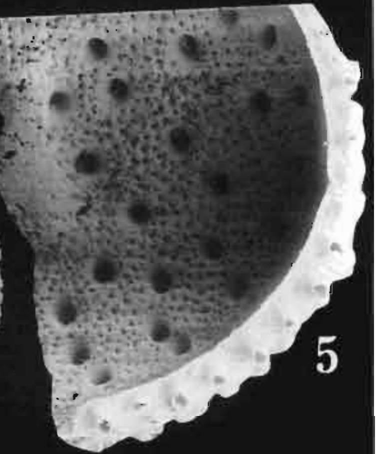
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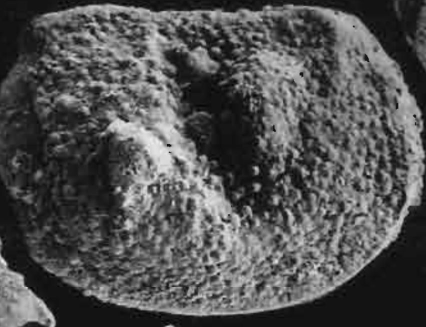
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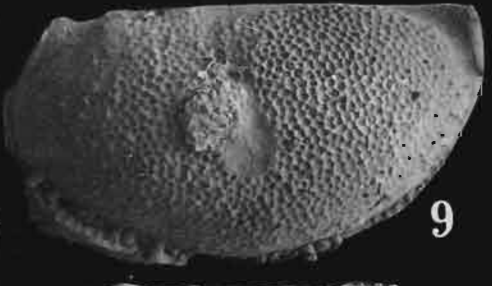
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 26

Laccochilina (Laccochilina) berdanae sp. n. 165

Fig. 1. Tecnomorphic right valve, holotype ZPAL O.XXV/471, × 70, sample MA-118.
Fig. 2. Tecnomorphic right valve, ZPAL O.XXV/472, × 52, sample MA-118.
Fig. 3. Tecnomorphic (Juv.) left valve, ZPAL O.XXV/129, × 98, sample MA-37.

Piretella oepiki THORSLUND, 1940 162

Fig. 4. Female valve, lateral view of velum, ZPAL O.XXV/515, × 105, sample MA-46.
Fig. 5. Tecnomorphic left valve, ZPAL O.XXV/164, × 42, sample MA-58.
Fig. 6. Female left valve, ZPAL O.XXV/96, × 35, sample MA-55.
Fig. 7. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/449, × 87, sample MA-99.

Mojczella? sp. 177

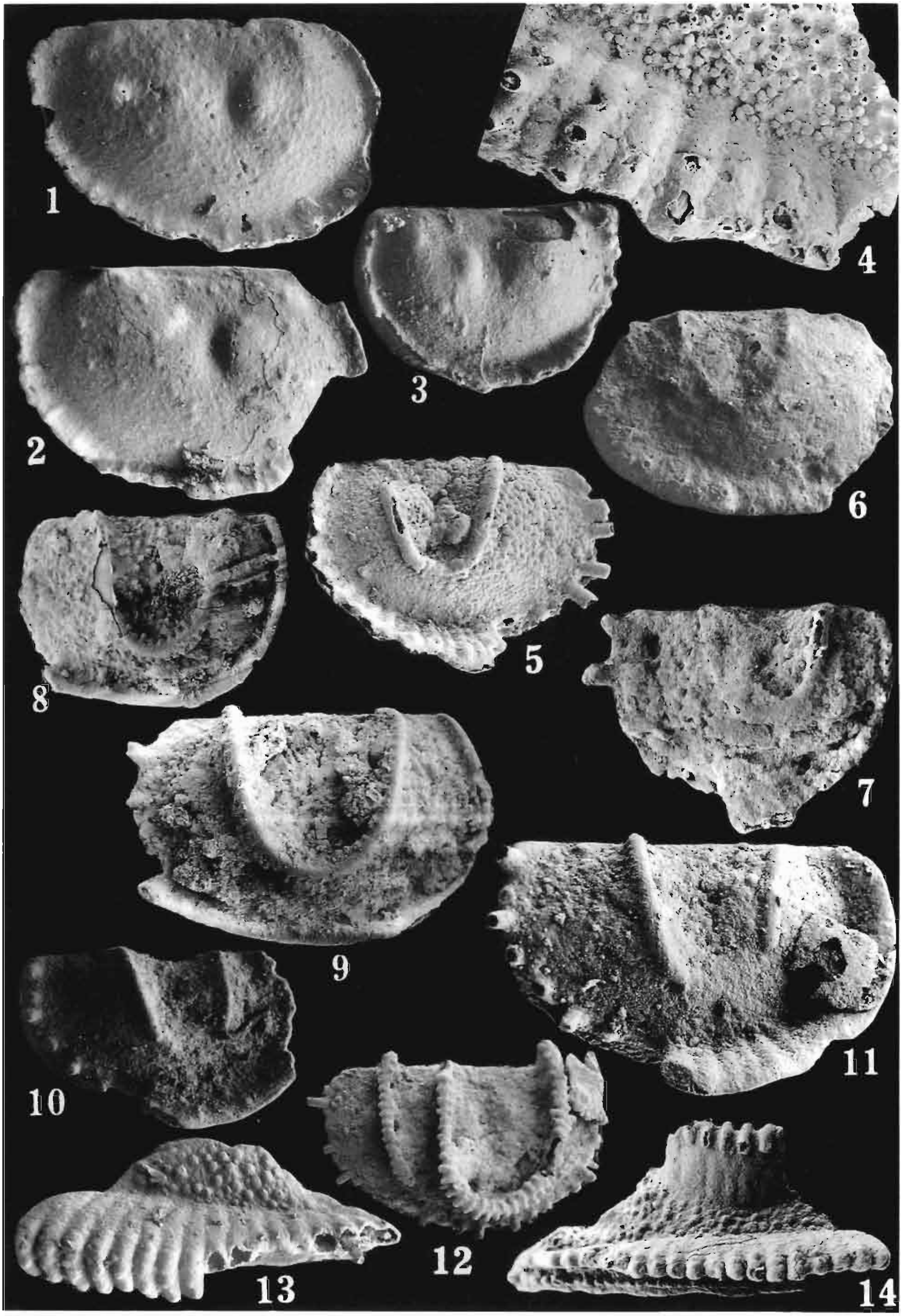
Fig. 8. Tecnomorphic right valve, ZPAL O.XXV/451, × 77, sample MA-99.
Fig. 9. Tecnomorphic right valve, ZPAL O.XXV/241, × 105, sample MA-99.

Piretella amphicristata sp. n. 163

Fig. 10. Tecnomorphic right valve, holotype ZPAL O.XXV/86, × 70, sample MA-46.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/526, × 105, sample MA-54.

Rakverella (Pectidolon) antica sp. n. 178

Fig. 12. Tecnomorphic right valve, holotype ZPAL O.XXV/196, × 52, sample MA-120.
Fig. 13. Female valve, ventral view of velum, ZPAL O.XXV/465, × 87, sample MA-120.
Fig. 14. Female valve (broken), ventral-oblique view of velum and base of crest, ZPAL O.XXV/420, × 70, sample MA-118.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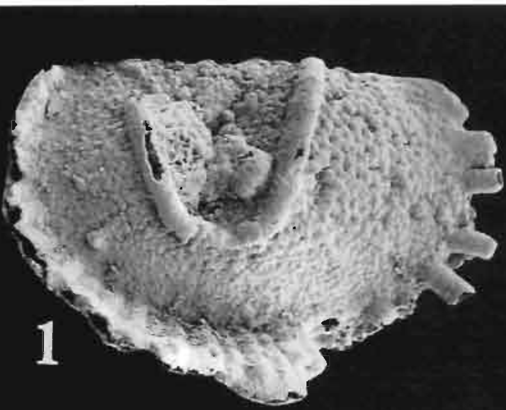
OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 27

Piretella oepiki THORSLUND, 1940 162

Ornamentation of the surface.

Fig. 1. Lateral view, ZPAL O.XXV/164, × 48, sample MA-58.
Fig. 2. External mould, ZPAL O.XXV/248, a × 120, b × 400, sample MA-58.
Fig. 3. External mould, ZPAL O.XXV/444, a × 48, b × 240, sample MA-54.
Fig. 4. External mould, ZPAL O.XXV/450, a × 80, b × 240, sample MA-99.



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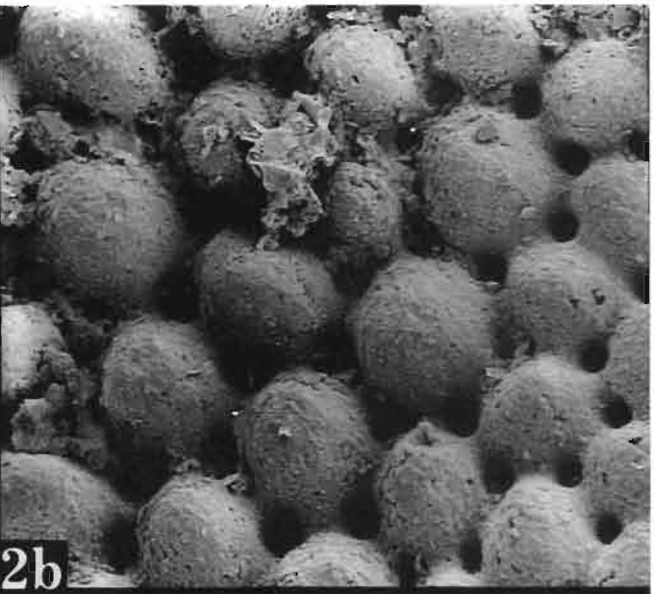

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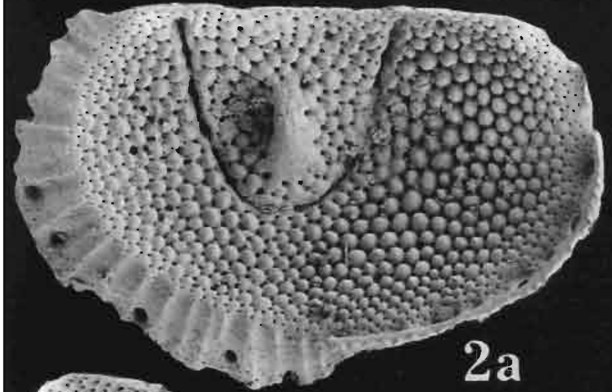

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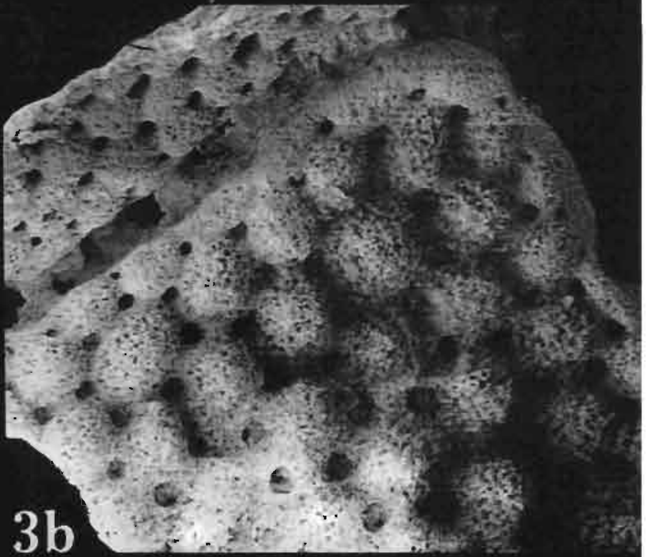

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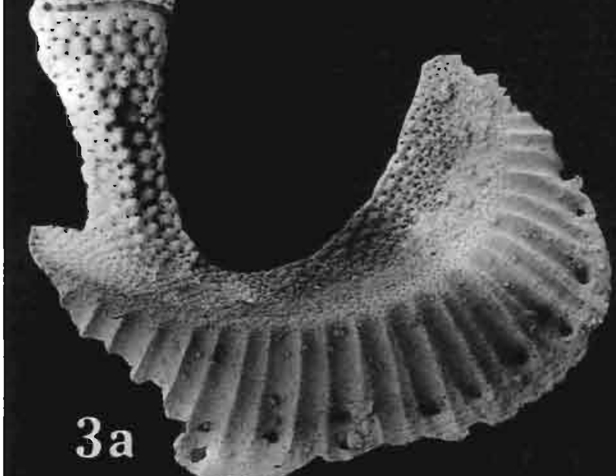

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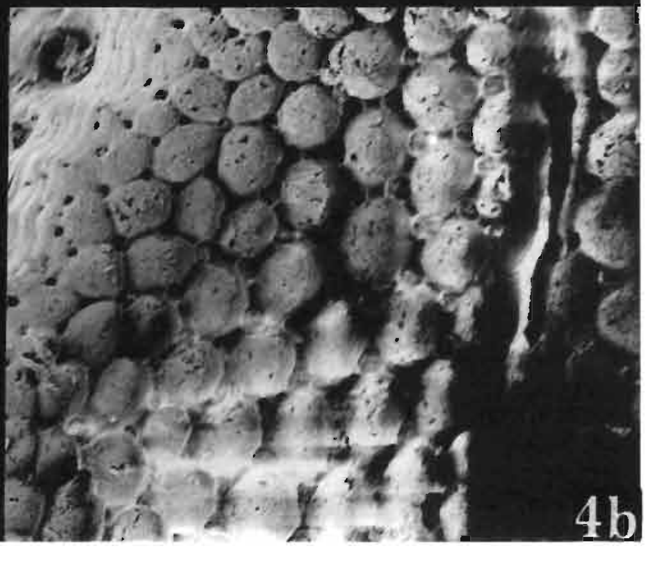

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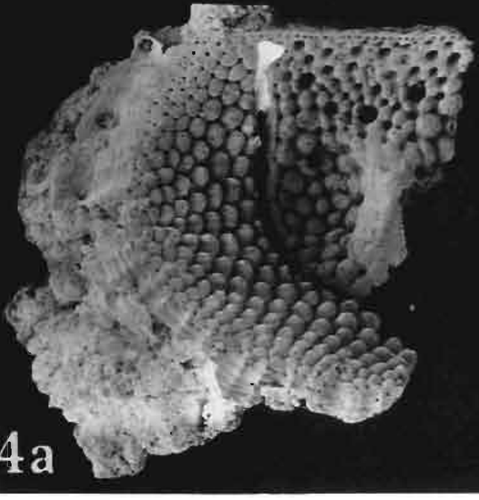

4a

OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 28

Lembitsarvella sp. 165

Fig. 1. Tecnomorphic left valve, ZPAL O.XXV/292, × 70, sample MA-37.
Fig. 2. Tecnomorphic left valve, broken posterodorsally, ZPAL O.XXV/429, × 70, sample MA-127.
Fig. 3. Tecnomorphic right valve, broken posteroventrally, ZPAL O.XXV/421, × 70, sample MA-120.
Fig. 4. Tecnomorphic valve, ventral view of velar structure, ZPAL O.XXV/452, × 140, sample MA-37.

Lembitsarvella polonica gen. et sp. n. 164

Fig. 5. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/438, × 52, sample MA-54.
Fig. 6. Tecnomorphic right valve, holotype ZPAL O.XXV/163, × 42, sample MA-58.
Fig. 7. Tecnomorphic left valve, ZPAL O.XXV/35, × 52, sample MA-56.
Fig. 8. Tecnomorphic right valve, ZPAL O.XXV/54, × 35, sample MA-82.

Unisulcopleura? sp. 2 199

Fig. 9. Left valve, ZPAL O.XXV/165, × 70, sample MA-59.

Tvaerenellidae sp. A 177

Fig. 10. Tecnomorphic right valve, ZPAL O.XXV/91, × 70, sample MA-57.
Fig. 11. Heteromorphic right valve, broken posteriorly, ZPAL O.XXV/222, × 70, sample MA-59.

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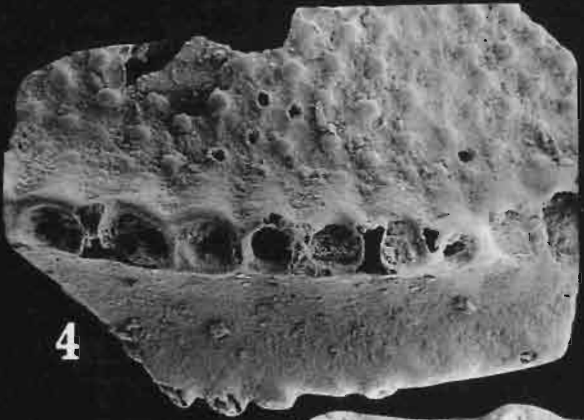

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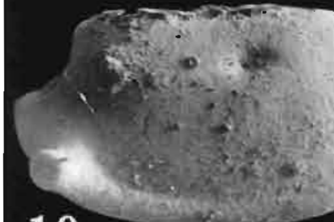

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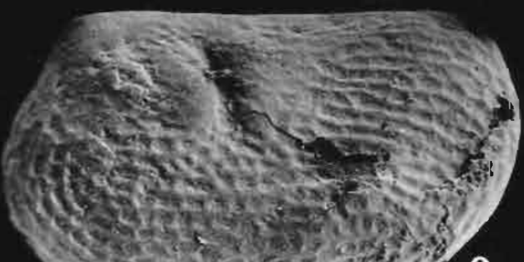

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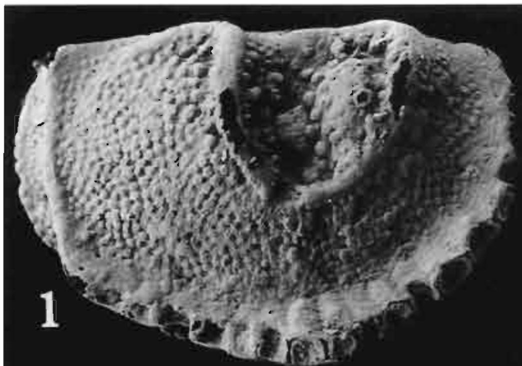
OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 29

Lembitsarvella polonica gen. et sp. n. 164

Fig. 1. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/433, × 52, sample MA-59.
Fig. 2. Tecnomorphic (Juv.) left valve, ZPAL O.XXV/430, a lateral view, × 52; b velar structure, × 210, sample MA-59.
Fig. 3. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/296, × 52, sample MA-58.
Fig. 4. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/295, × 52, sample MA-58.
Fig. 5. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/293, a × 52; b × 140, sample MA-58.
Fig. 6. Female valve (broken), ventral view, ZPAL O.XXV/188, × 52, sample MA-59.
Fig. 7. Female valve (broken), ventral view, ZPAL O.XXV/439, × 52, sample MA-86.
Fig. 8. Tecnomorphic valve (broken), velar structure, ZPAL O.XXV/435, × 210, sample MA-58.
Fig. 9. Pre-adult female valve, ventral view, ZPAL O.XXV/298, a × 42; b × 140, sample MA-55.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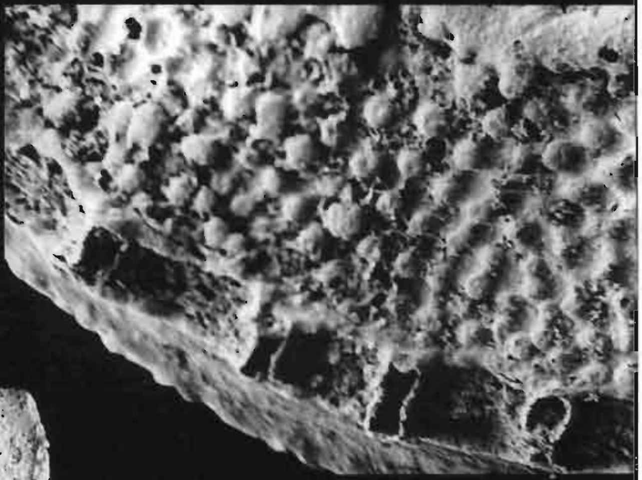
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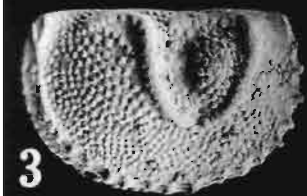
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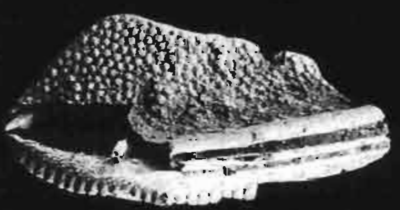
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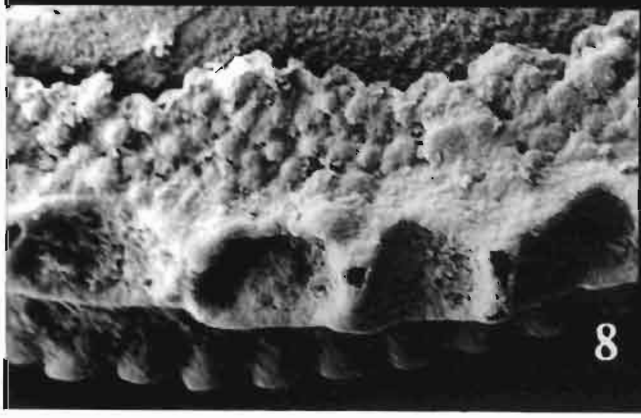
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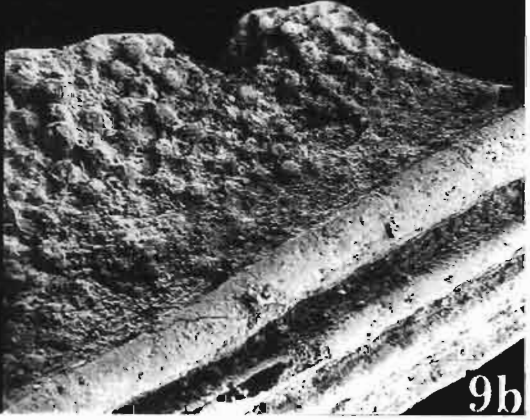

9b

OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 30

Lembitsarvella polonica gen. et sp. n. 164

Fig. 1. Tecnomorphic right valve, ZPAL O.XXV/12, × 42, note that the chambers in the dorsal plica are filled with phosphate, sample MA-82.

Fig. 2. Female left valve, internal mould (partly damaged), ZPAL O.XXV/483, a × 35; b detail of 2a showing the chambers in the dorsal plica filled with phosphate, × 105, sample MA-46.

Fig. 3. Internal view of fragment of female valve, showing the internal openings of the tubules, ZPAL O.XXV/474, × 70, sample MA-46.

Fig. 4. Internal view of tecnomorphic valve, showing the internal openings of the tubules, ZPAL O.XXV/466, × 50, sample MA-55.

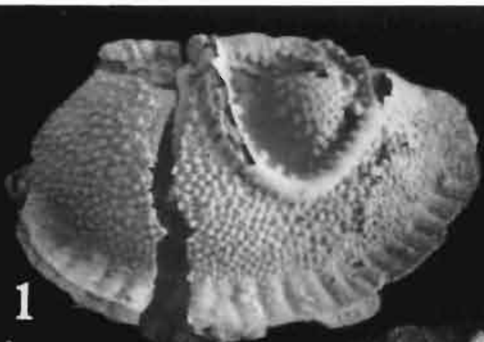
Fig. 5. Internal view of juvenile valve, showing the internal openings of the tubules, ZPAL O.XXV/473, × 70, sample MA-46.

Fig. 6. Internal view of tecnomorphic valve, showing the tubules filled with phosphate, ZPAL O.XXV/477, × 35, sample MA-84.

Fig. 7. Internal view of tecnomorphic valve, showing the tubules filled with phosphate, ZPAL O.XXV/441, × 70, sample MA-85.

Fig. 8. Tecnomorphic left valve, showing the detail of the velum, note the border crest parallel to the velar edge, ZPAL O.XXV/440, × 70, sample MA-84.

Fig. 9. Ventral view of female valve, showing the dolon, note the four parallel ridges on the dolon, ZPAL O.XXV/478, a × 28; b detail of 9a, note the tubules filled with phosphate, × 105, sample MA-85.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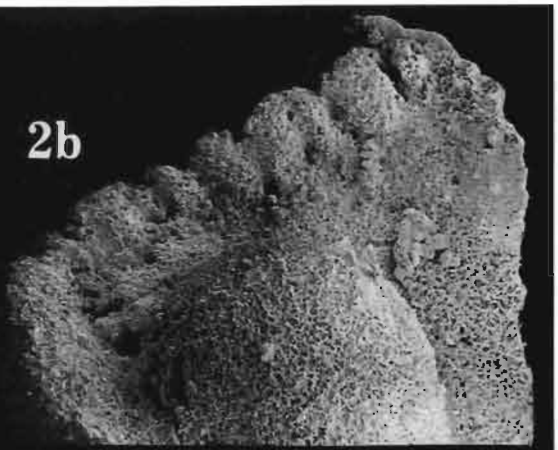
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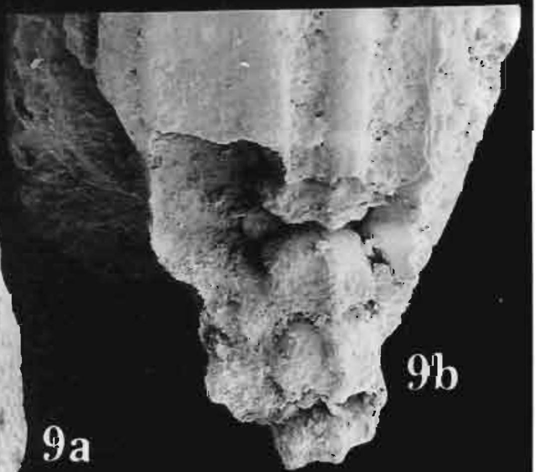
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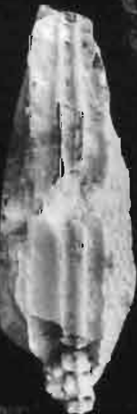
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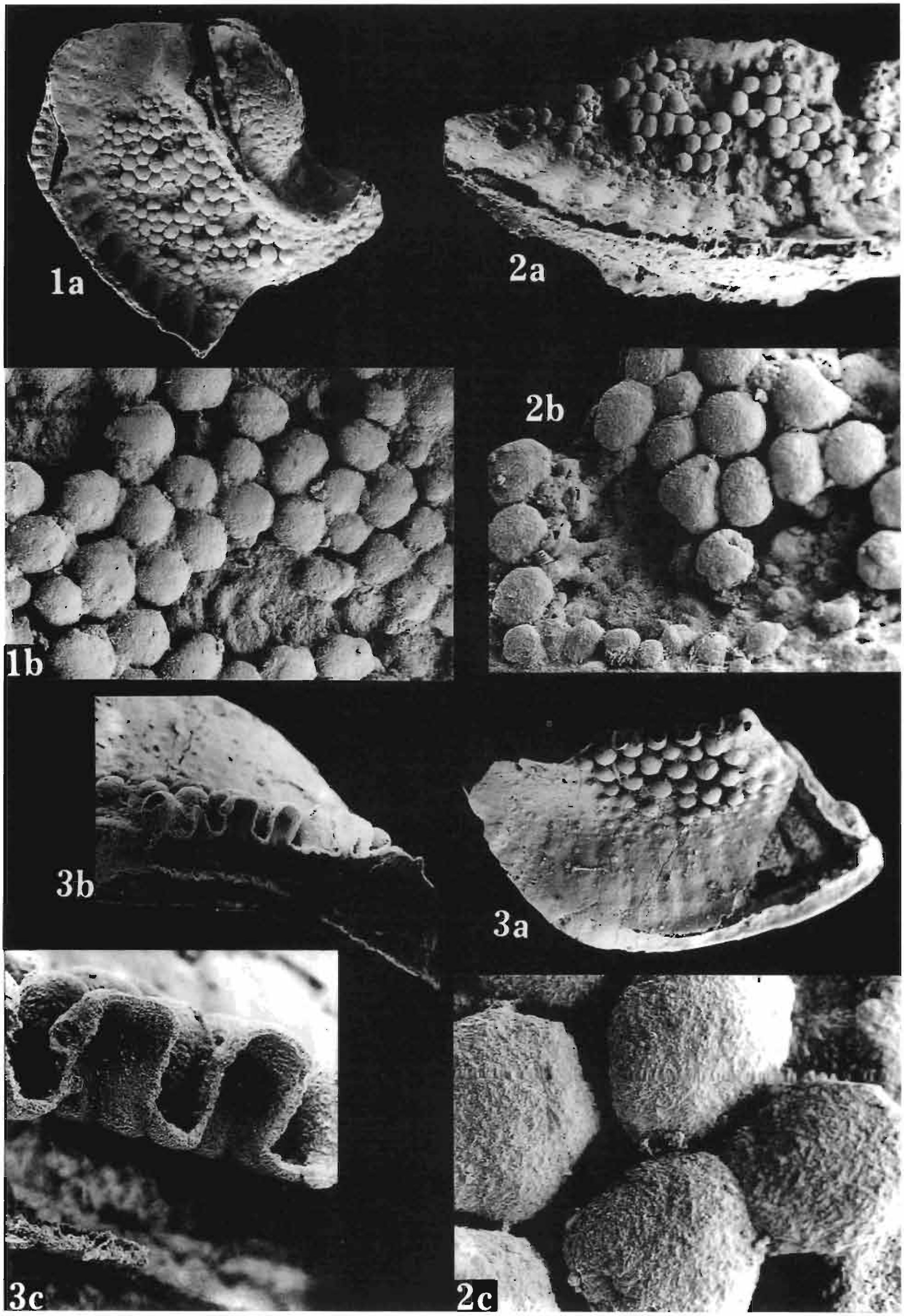
PLATE 31

Lembitsarvella polonica gen. et sp. n. 164

Fig. 1. Tecnomorphic left valve, ZPAL O.XXV/432, a × 52; b detail of 1a showing the granular ornamentation on the surface of the domicilium, × 210, sample MA-59.

Fig. 2. Tecnomorphic valve, ventral view, ZPAL O.XXV/434, a × 70; b detail of 2a, showing the granular ornamentation on the surface, partly destroyed, × 210; c detail of 2a, × 700, sample MA-58.

Fig. 3. Tecnomorphic valve, damaged, ZPAL O.XXV/431, a × 70; b transverse section through phosphate lining showing the granular layer, × 105; c detail of 3b, × 350, sample MA-59.


1a
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1b
3b
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3c
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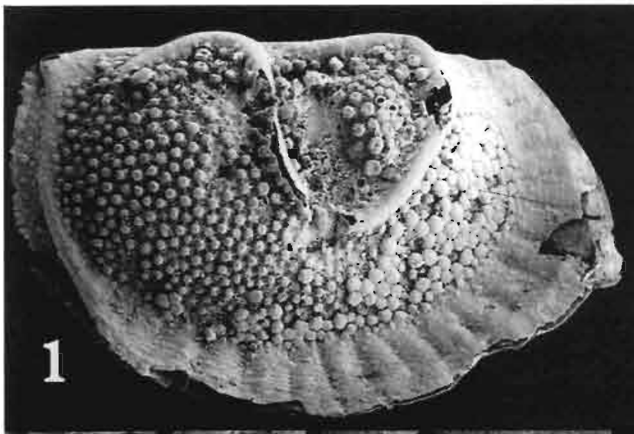
OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 32

Lembitsarvella polonica gen. et sp. n. 164

Microornamentation of the surface.

Fig. 1. Left valve, lateral view, ZPAL O.XXV/163, × 48, sample MA-58.
Fig. 2. Detail of ornamentation, ZPAL O.XXV/523, × 240, sample MA-58.
Fig. 3. External mould, ZPAL O.XXV/162, a × 480; b × 800, sample MA-58.
Fig. 4. External mould, ZPAL O.XXV/476, a × 36; b × 160, sample MA-84.
Fig. 5. External mould, ZPAL O.XXV/524, × 120, sample MA-58.
Fig. 6. External mould, ZPAL O.XXV/469, × 160, sample MA-58.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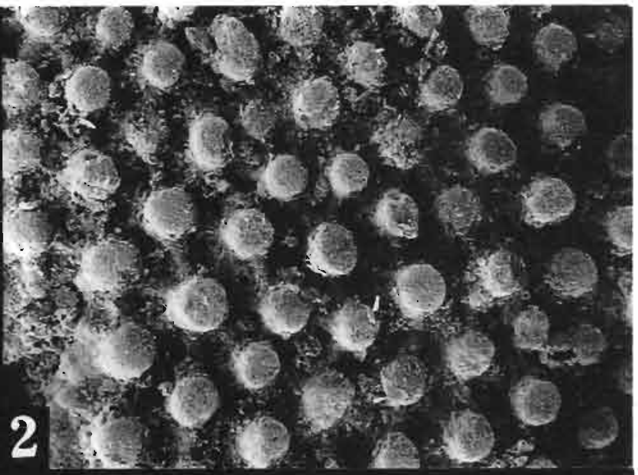
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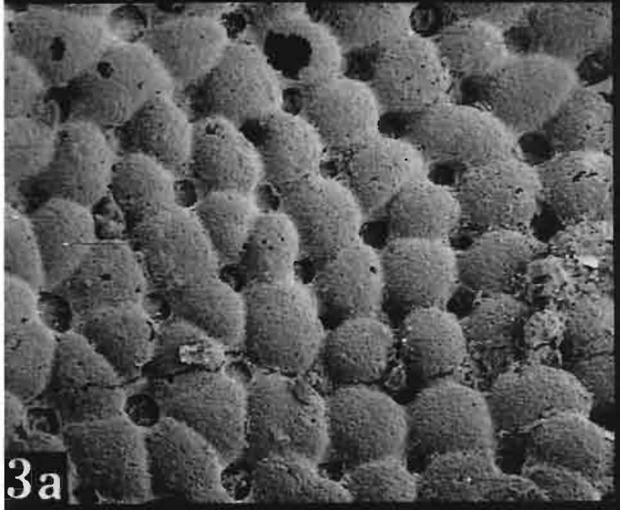
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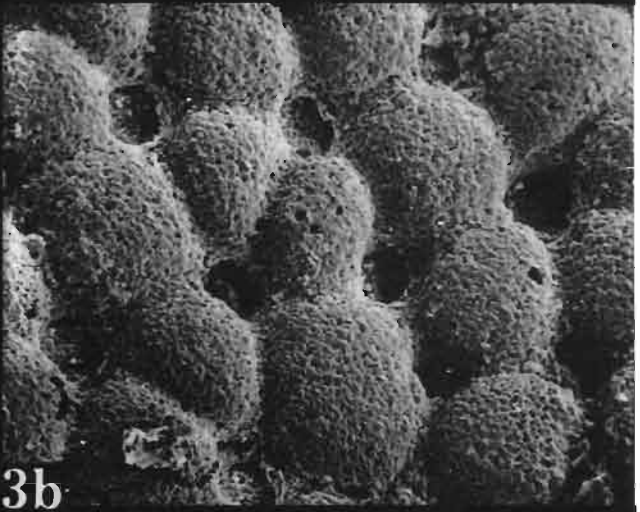
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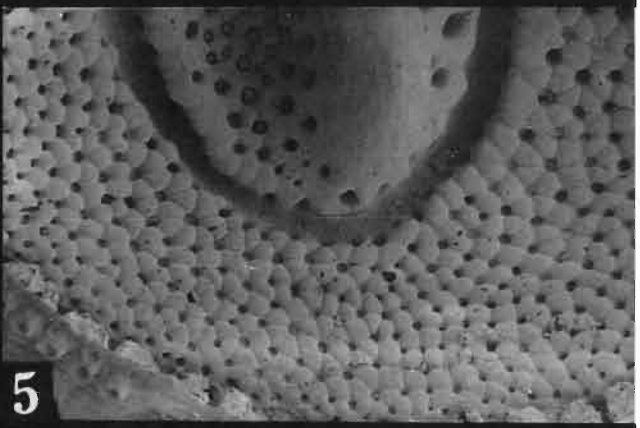
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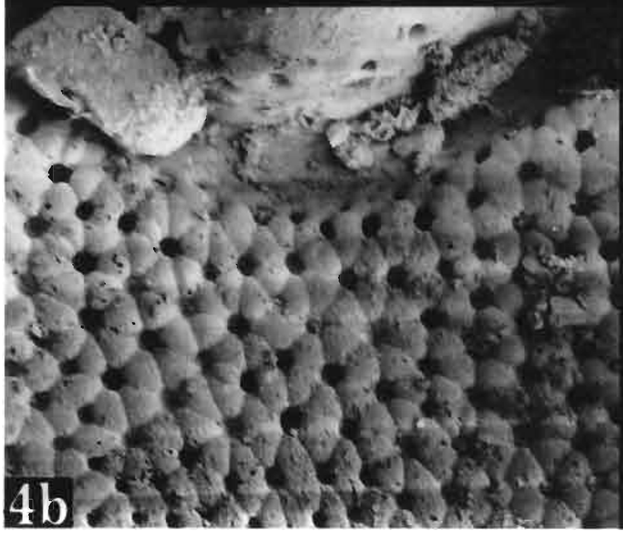
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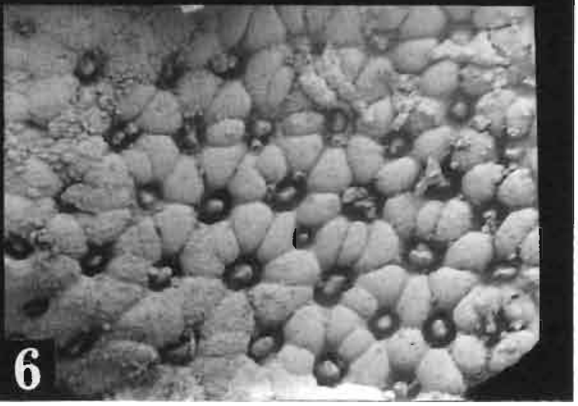
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 33

Ampletochilina přiscina sp. n. 160

Fig. 1. Tecnomorphic left valve, ZPAL O.XXV/504, × 70, sample MA-120.
Fig. 2. Female right valve (broken posteriorly), holotype ZPAL O.XXV/418, × 70, sample MA-120.
Fig. 3. Female right valve (broken posterodorsally), ZPAL O.XXV/505, × 70, sample MA-117.

Swantina schallreuteri sp. n. 160

Fig. 4. Tecnomorphic left valve, ZPAL O.XXV/51, × 70, sample MA-82.
Fig. 5. Female right valve, holotype ZPAL O.XXV/62, a lateral view; b lateroventral view, × 51, sample MA-58.
Fig. 6. Female left valve, internal lateral view, ZPAL O.XXV/509, × 70, sample MA-60.
Fig. 7. Female left valve, ZPAL O.XXV/510, × 52, sample MA-84.
Fig. 8. Tecnomorphic right valve, ZPAL O.XXV/511, × 70, sample MA-84.

Eochilina? sp. 167

Fig. 9. Tecnomorphic left valve, lateroventral view, ZPAL O.XXV/486, × 105, sample MA-127.
Fig. 10. Tecnomorphic left valve, ZPAL O.XXV/47, a lateral view; b lateroventral view, × 84, sample MA-40.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/484, × 105, sample MA-127.

Pyxion? sp. 193

Fig. 12. Tecnomorphic right valve, ZPAL O.XXV/45, × 70, sample MA-93.
Fig. 13. Tecnomorphic right valve, ZPAL O.XXV/128, × 70, sample MA-99.


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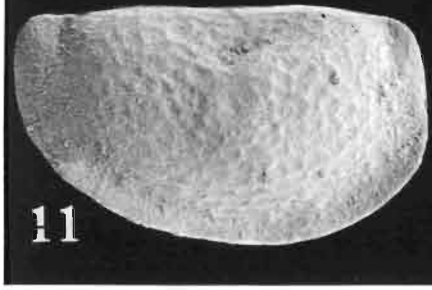
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 34

Gryphiswaldensia cavata sp. n. 168

Fig. 1. Right valve, holotype ZPAL O.XXV/480, a × 105; b × 210, sample MA-46.
Fig. 2. Left valve, ZPAL O.XXV/42, a lateral view; b lateroventral view, × 105, sample MA-56.
Fig. 3. Right valve, ZPAL O.XXV/304, × 70, sample MA-59.
Fig. 4. Left valve, ZPAL O.XXV/265, × 70, sample MA-58.
Fig. 5. Right valve, external mould, ZPAL O.XXV/470, a × 105; b × 350, sample MA-52.

Gryphiswaldensia gryphiswaldensis SCHALLREUTER, 1965 168

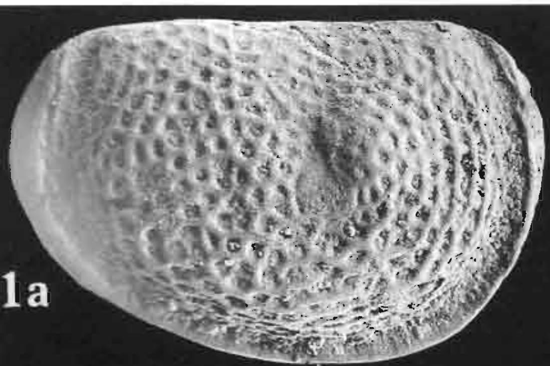
Fig. 6. Left valve, ZPAL O.XXV/52, a lateral view; b lateroventral view, × 105, sample MA-82.

Gryphiswaldensia angustivelata sp. n. 167

Fig. 7. Left valve, holotype ZPAL O.XXV/485, × 105, sample MA-135.

Steinfurtia sp. 169

Fig. 8. Right valve, ZPAL O.XXV/46, × 105, sample MA-56.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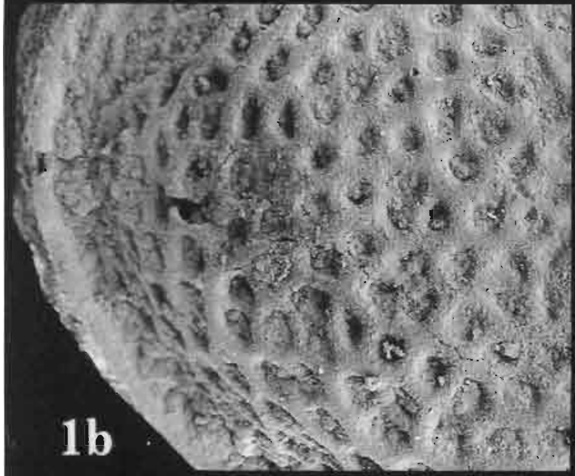
6b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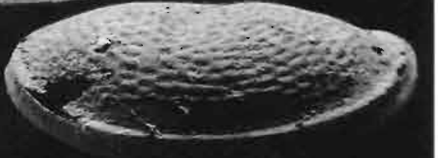
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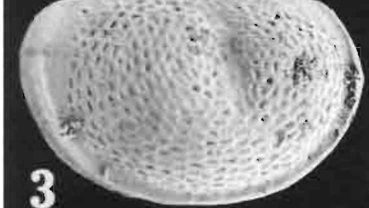
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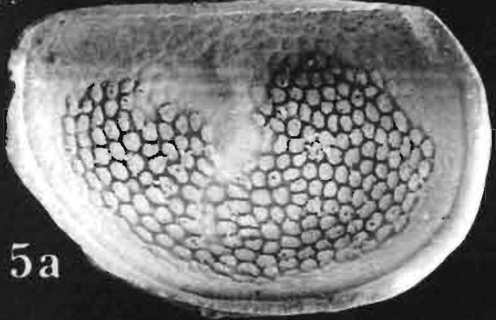
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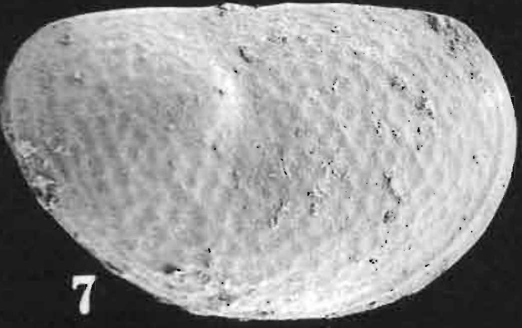
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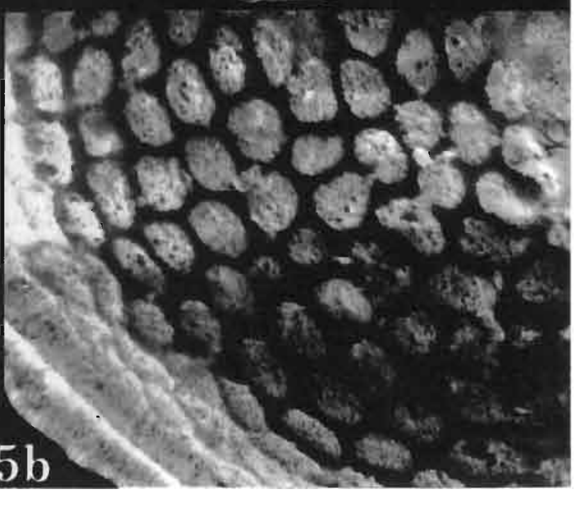
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 35

Otraczetia bulbata gen. et sp. n. 172

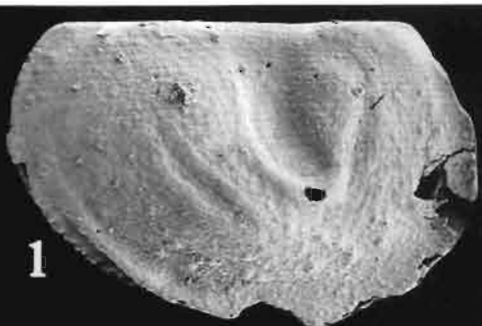
Fig. 1. Tecnomorphic right valve, holotype ZPAL O.XXV/200, × 70, sample MA-120.
Fig. 2. Tecnomorphic right valve, ŹPAL O.XXV/252, × 55, sample MA-123.
Fig. 3. Heteromorphic right valve, ZPAL O.XXV/201, × 70, sample MA-120.

Piretia speciosa sp. n. 171

Fig. 4. Heteromorphic left valve, ZPAL O.XXV/277, × 70, sample MA-46.
Fig. 5. Tecnomorphic right valve, ZPAL O.XXV/275, × 70, sample MA-46.
Fig. 6. Heteromorphic left valve, holotype ZPAL O.XXV/151, × 70, sample MA-43.
Fig. 7. Tecnomorphic right valve, ZPAL O.XXV/400, × 70, sample MA-43.
Fig. 8. Tecnomorphic right valve, ZPAL O.XXV/276, × 70 sample MA-46.

Euprimites (Euprimites) grandis sp. n. 169

Fig. 9. Heteromorphic right valve, ZPAL O.XXV/479, × 52, sample MA-87.
Fig. 10. Tecnomorphic right valve, ZPAL O.XXV/84, × 87, sample MA-52.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/154, × 70, sample MA-43.
Fig. 12. Tecnomorphic right valve, ZPAL O.XXV/153, × 35, sample MA-43.
Fig. 13. Tecnomorphic right valve, ZPAL O.XXV/412, × 105, sample MA-58.
Fig. 14. Tecnomorphic right valve, holotype ZPAL O.XXV/143, × 52, sample MA-46.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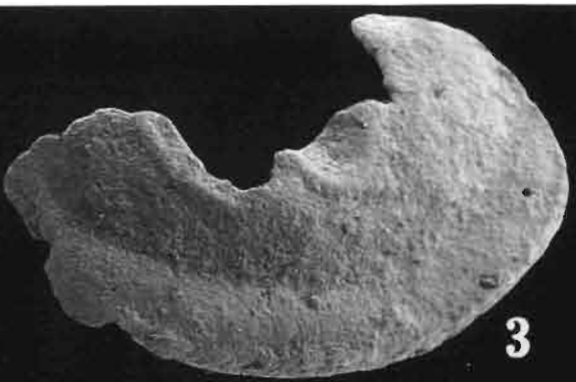
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

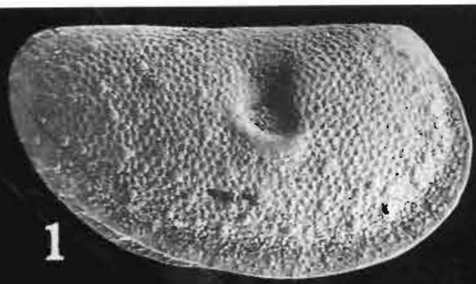
PLATE 36

Piretia tenuistriata sp. n. 170

Fig. 1. Tecnomorphic right valve, ZPAL O.XXV/268, × 70, sample MA-58.
Fig. 2. Heteromorphic right valve, internal view, ZPAL O.XXV/500, × 42, sample MA-58.
Fig. 3. Heteromorphic right valve, holotype ZPAL O.XXV/58, a × 42; b × 140, sample MA-51.
Fig. 4. Heteromorphic left valve, ZPAL O.XXV/437, × 42, sample MA-58.
Fig. 5. Heteromorphic right valve, ZPAL O.XXV/409, × 52, sample MA-46.
Fig. 6. Tecnomorphic right valve, ZPAL O.XXV/59, × 49, sample MA-58.
Fig. 7. External mould of tecnomorphic valve, ZPAL O.XXV/234, × 700, sample MA-59.

Piretia rara sp. n. 171

Fig. 8. Heteromorphic right valve, ZPAL O.XXV/233, × 70, sample MA-85.
Fig. 9. Heteromorphic left valve, holotype ZPAL O.XXV/232, × 70, sample MA-85.
Fig. 10. Juvenile tecnomorphic left valve, ZPAL O.XXV/270, × 70, sample MA-85.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/182, × 70, sample MA-84.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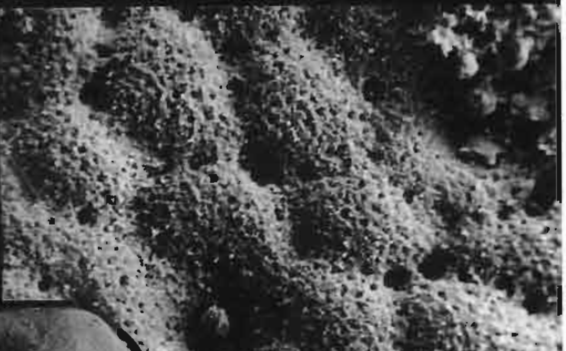
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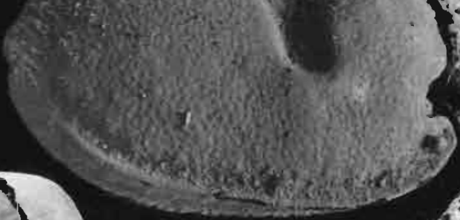
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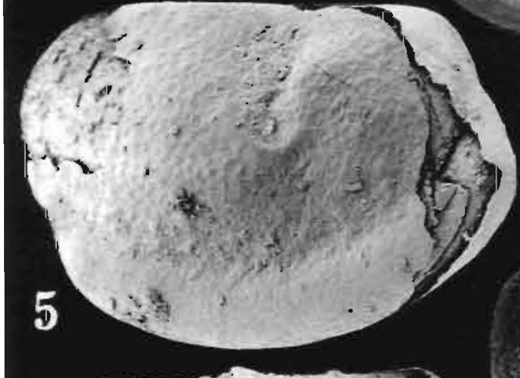
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 37

Uhakiella diuturna sp. n. 173

Fig. 1. Tecnomorphic right valve, ZPAL O.XXV/55, a lateral view; b lateroventral view, × 56, sample MA-52.
Fig. 2. Tecnomorphic right valve, ZPAL O.XXV/15, × 42, sample MA-48.
Fig. 3. Heteromorphic right valve, ZPAL O.XXV/249, × 70, sample MA-58.
Fig. 4. Heteromorphic right valve, holotype ZPAL O.XXV/95, × 52, sample MA-46.
Fig. 5. External mould, ZPAL O.XXV/235, × 700, sample MA-48.

Uhakiella sp. 1 174

Fig. 6. Tecnomorphic left valve, ZPAL O.XXV/426, × 70, sample MA-127.

Bromidella sp. 175

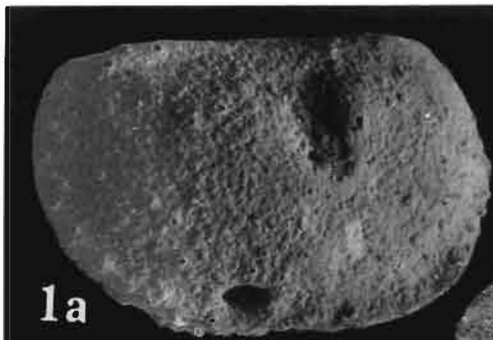
Fig. 7. Tecnomorphic left valve, ZPAL O.XXV/186, × 42, sample MA-99.
Fig. 8. External mould, ZPAL O.XXV/236, × 700, sample MA-99.

Uhakiella sp. 2 175

Fig. 9. Tecnomorphic right valve, ZPAL O.XXV/142, × 28, sample MA-46.

Uhakiella perrara sp. n. 174

Fig. 10. Tecnomorphic left valve, holotype ZPAL O.XXV/198, × 52, sample MA-118.
Fig. 11. Tecnomorphic left valve, ZPAL O.XXV/107, × 70, sample MA-37.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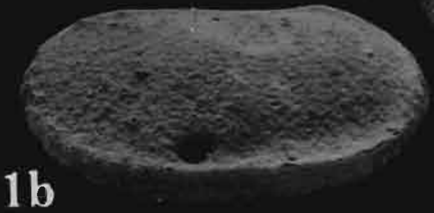
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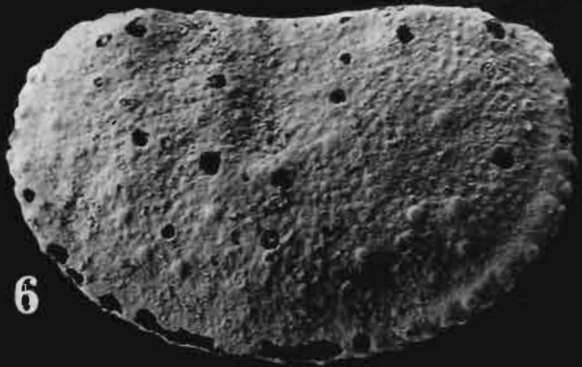
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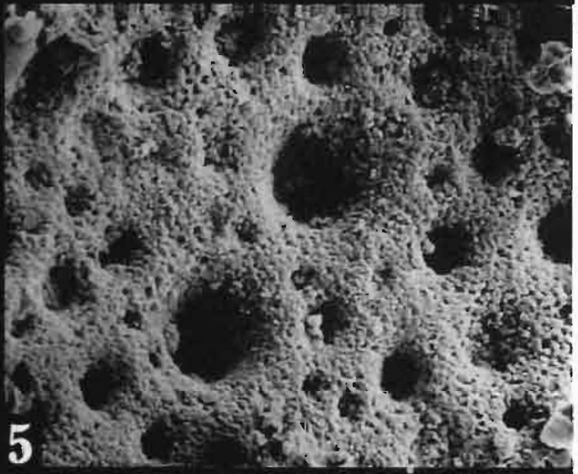
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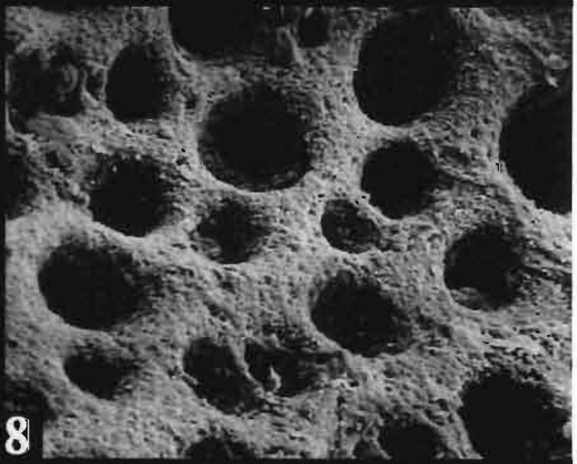
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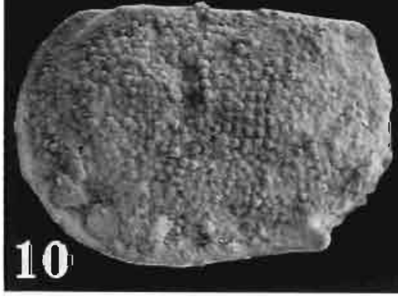
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 38

Mojczella polonica OLEMPSKA, 1988 176

Fig. 1. Tecnomorphic left valve, ZPAL O.XXV/206, × 70, sample MA-120, also in OLEMPSKA (1988, Pl. 17: 4)
Fig. 2. Heteromorphic right valve, ZPAL O.XXV/208, × 42, sample MA-118, also in OLEMPSKA (1988, Pl. 17: 5)
Fig. 3. Tecnomorphic (Juv.) left valve, ZPAL O.XXV/212, × 70, sample MA-118, also in OLEMPSKA (1988, Pl. 17: 1).

Mojczella jaanussoni OLEMPSKA, 1988 176

Fig. 4. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/214, × 52, sample MA-59, also in OLEMPSKA (1988, Pl. 18: 7).
Fig. 5. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/218, × 52, sample MA-58, also in OLEMPSKA (1988, Pl. 18: 6).
Fig. 6. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/213, × 70, sample MA-59, also in OLEMPSKA (1988, Pl. 18: 5).
Fig. 7. Tecnomorphic (Juv.) left valve, ZPAL O.XXV/18, × 70, sample MA-46, also in OLEMPSKA (1988, Pl. 17: 8).
Fig. 8. Tecnomorphic (Juv.) left valve, ZPAL O.XXV/219, × 70, sample MA-58, also in OLEMPSKA (1988, Pl. 18: 4).
Fig. 9. Heteromorphic left valve, ZPAL O.XXV/185, × 42, sample MA-59, also in OLEMPSKA (1988, Pl. 19: 4).
Fig. 10. Tecnomorphic left valve, ZPAL O.XXV/24, × 42, sample MA-62, also in OLEMPSKA (1988, Pl. 19: 2).

Mojczella sanctacrucensis OLEMPSKA, 1988 176

Fig. 11. Tecnomorphic (Juv.) right valve, ZPAL O.XXV/210, × 52, sample MA-84, also in OLEMPSKA (1988, Pl. 19: 7).
Fig. 12. Tecnomorphic left valve, ZPAL O.XXV/260, × 42, sample MA-85, also in OLEMPSKA (1988, Pl. 19: 8).


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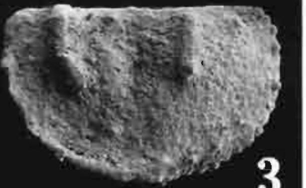
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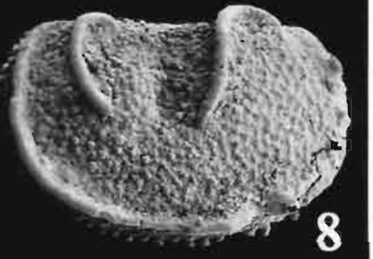
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 39

Mojczella polonica OLEMPSKA, 1988 176

Ornamentation of the surface:

Fig. 1. Tecnomorphic left valve, ZPAL O.XXV/169, × 80, sample MA-36.

Fig. 2. Tecnomorphic left valve, external mould, ZPAL O.XXV/464, a × 110; b detail of ornamentation, × 240, sample MA-120.

Fig. 3. Tecnomorphic left valve, external mould, ZPAL O.XXV/467, a × 96; b detail of ornamentation ,× 400; c × 800, sample MA-34.

Lembitsarvella polonica gen. et sp. n. 164

Fig. 4. Tecnomorphic right valve (Juv.), external mould, ZPAL O.XXV/525, a × 80; b detail of ornamentation, × 160, sample MA-58.


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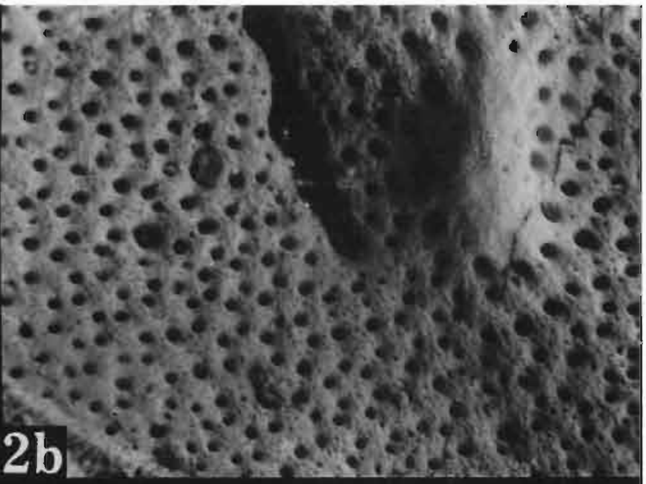
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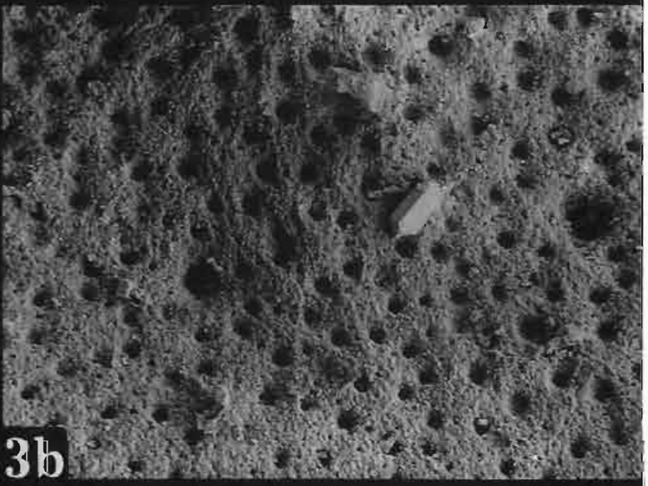
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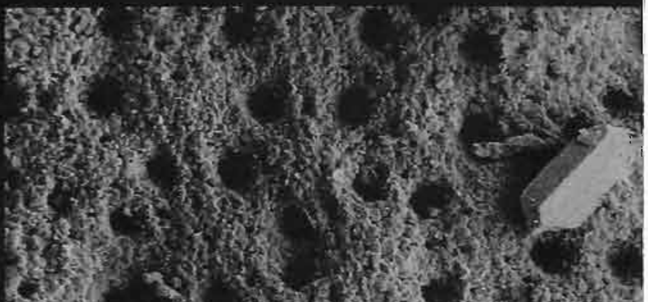
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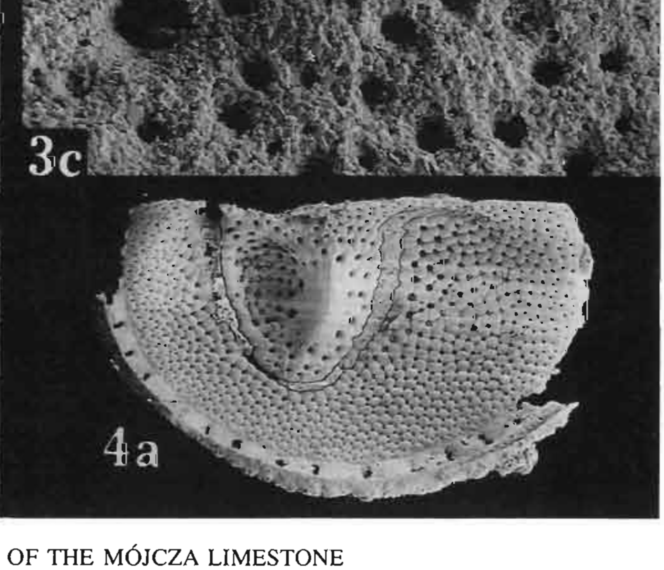
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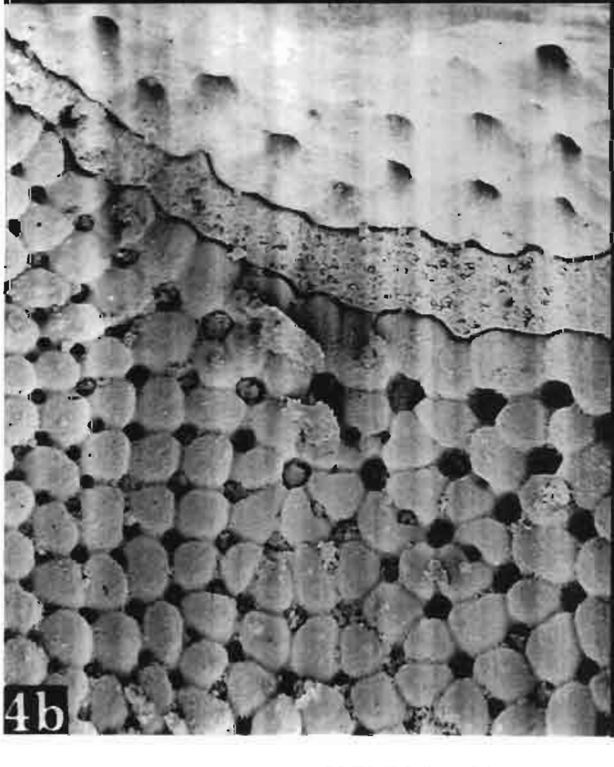
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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 40

Mojczella jaanussoni OLEMPSKA, 1988 176

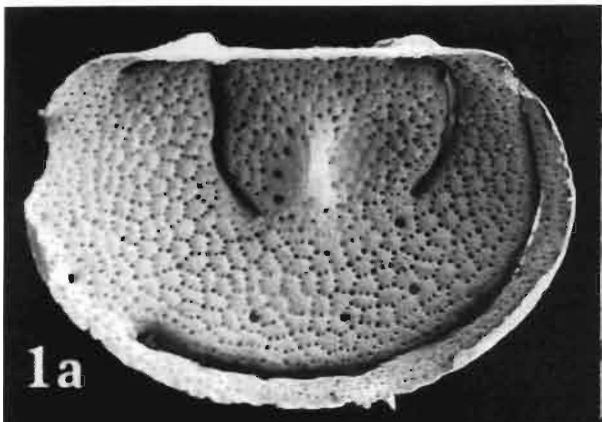
Fig. 1. Tecnomorphic (Juv.) left valve, external mould, ZPAL O.XXV/530, a detail of the ornamentation, × 112; b × 400; c × 2400, sample MA-58.

Fig. 2. Tecnomorphic right valve, external mould, ZPAL O.XXV/221, × 80, sample MA-58.

Mojczella sanctacrucensis OLEMPSKA, 1988 176

Fig. 3. Tecnomorphic left valve, external mould, ZPAL O.XXV/459, a × 80; b detail of ornamentation, × 240, sample MA-87.

Fig. 4. Tecnomorphic valve, external mould, detail of ornamentation, ZPAL O.XXV/211, × 240, sample MA-85.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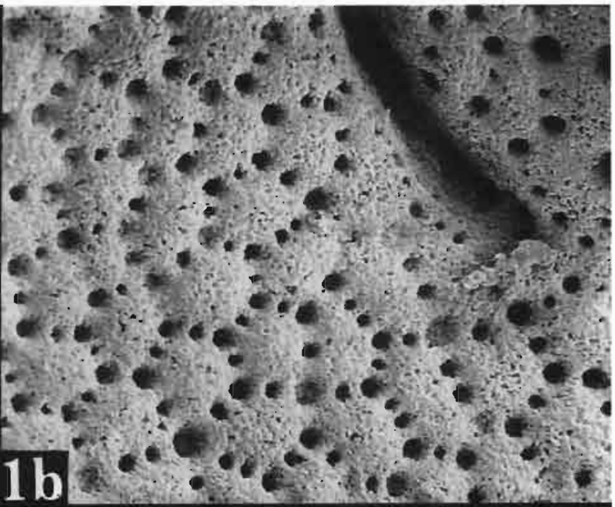
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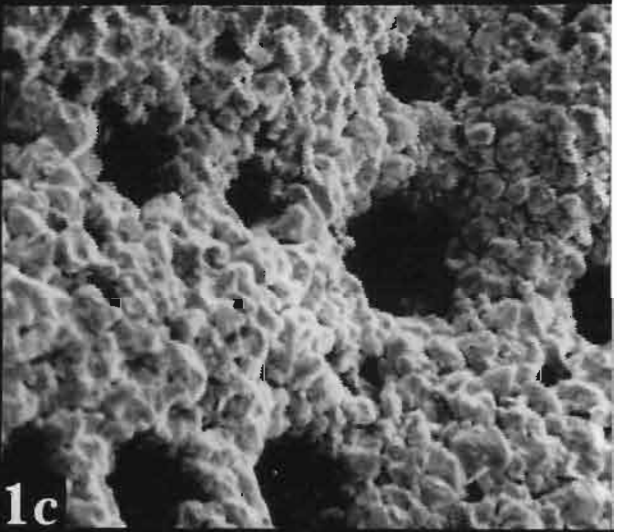
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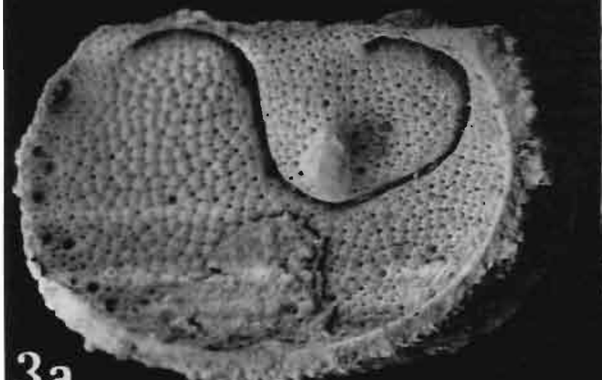
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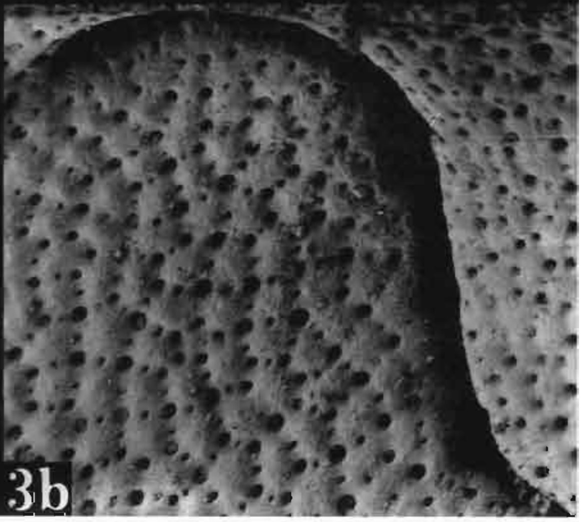
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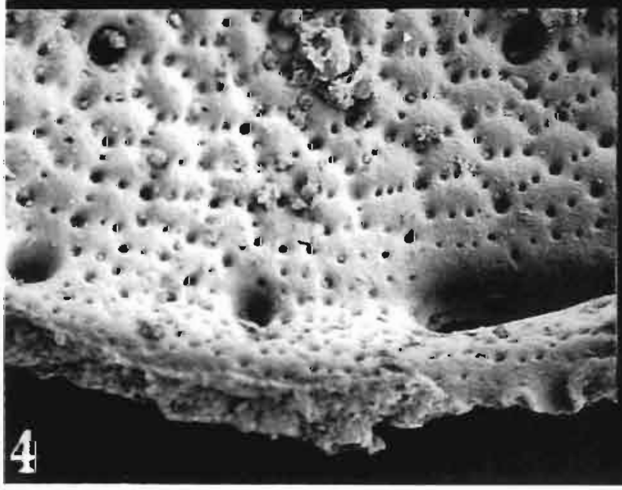
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PLATE 41

Ogmoopsis (Ogmoopsis) sp. 180

Fig. 1. Left valve, ZPAL O.XXV/205, × 52, sample MA-120.
Fig. 2. Left valve, ZPAL O.XXV/67, × 70, sample MA-40.

Glossomorphites (Glossomorphites) sp. 185

Fig. 3. Heteromorphic left valve, broken posteriorly, ZPAL O.XXV/194, × 70, sample MA-35.
Fig. 4. Heteromorphic left valve, ZPAL O.XXV/229, × 52, sample MA-127.
Fig. 5. Tecnomorphic right valve, ZPAL O.XXV/230, × 52, sample MA-118.

Hesslandella sztejnae sp. n. 185

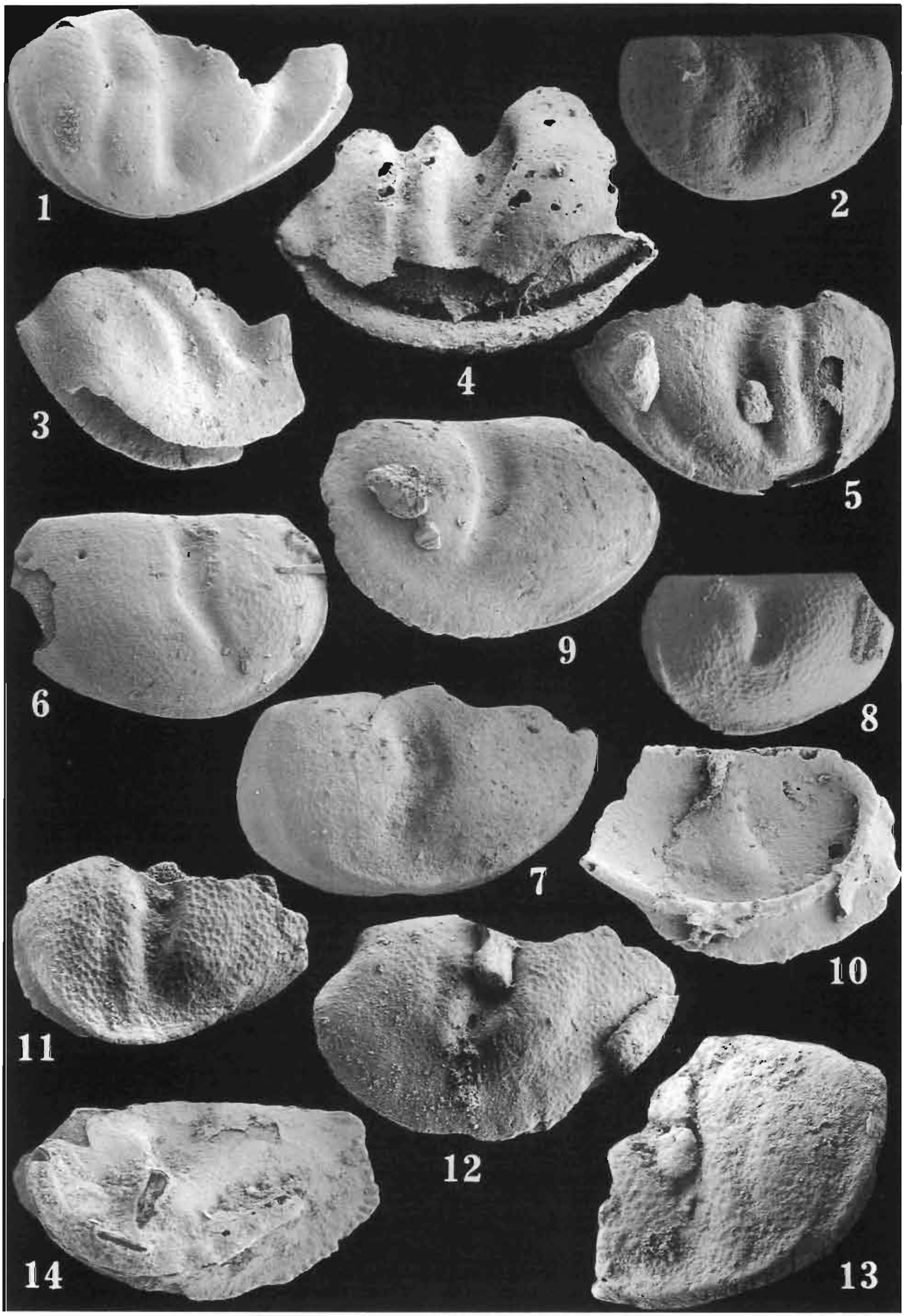
Fig. 6. Tecnomorphic right valve, ZPAL O.XXV/204, × 70, sample MA-120.
Fig. 7. Tecnomorphic left valve, ZPAL O.XXV/75, × 52, sample MA-38.
Fig. 8. Tecnomorphic left valve, ZPAL O.XXV/527, × 70, sample MA-120.
Fig. 9. Heteromorphic left valve, holotype ZPAL O.XXV/203, × 70, sample MA-120.
Fig. 10. Heteromorphic left valve, internal view, ZPAL O.XXV/309, × 70, sample MA-126.

Glossomorphites (Glossomorphites) kielcensis sp. n. 184

Fig. 11. Tecnomorphic left valve, ZPAL O.XXV/226, × 70, sample MA-120.
Fig. 12. Heteromorphic left valve, holotype ZPAL O.XXV/225, × 70, sample MA-118.
Fig. 13. Tecnomorphic right valve, broken posteriorly, ZPAL O.XXV/428, × 52, sample MA-127.

Hippula (Cetona) sp. 187

Fig. 14. Left valve, ZPAL O.XXV/195, × 52, sample MA-45.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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 42

Collibolbina barbarae sp. n. 182

Fig. 1. Tecnomorphic right valve, ZPAL O.XXV/64, × 70, sample MA-38.
Fig. 2. Heteromorphic right valve, holotype ZPAL O.XXV/65, × 42, sample MA-34.
Fig. 3. Heteromorphic right valve, ZPAL O.XXV/522, × 42, sample MA-34.

Collibolbina sigmoidea (JAANUSSON, 1957) 182

Fig. 4. Tecnomorphic left valve, ZPAL O.XXV/488, × 52, sample MA-85.
Fig. 5. Heteromorphic right valve, ZPAL O.XXV/490, × 50, sample MA-84.
Fig. 6. Heteromorphic right valve, internal view, ZPAL O.XXV/489, × 50, sample MA-85.

Vittella sp. 187

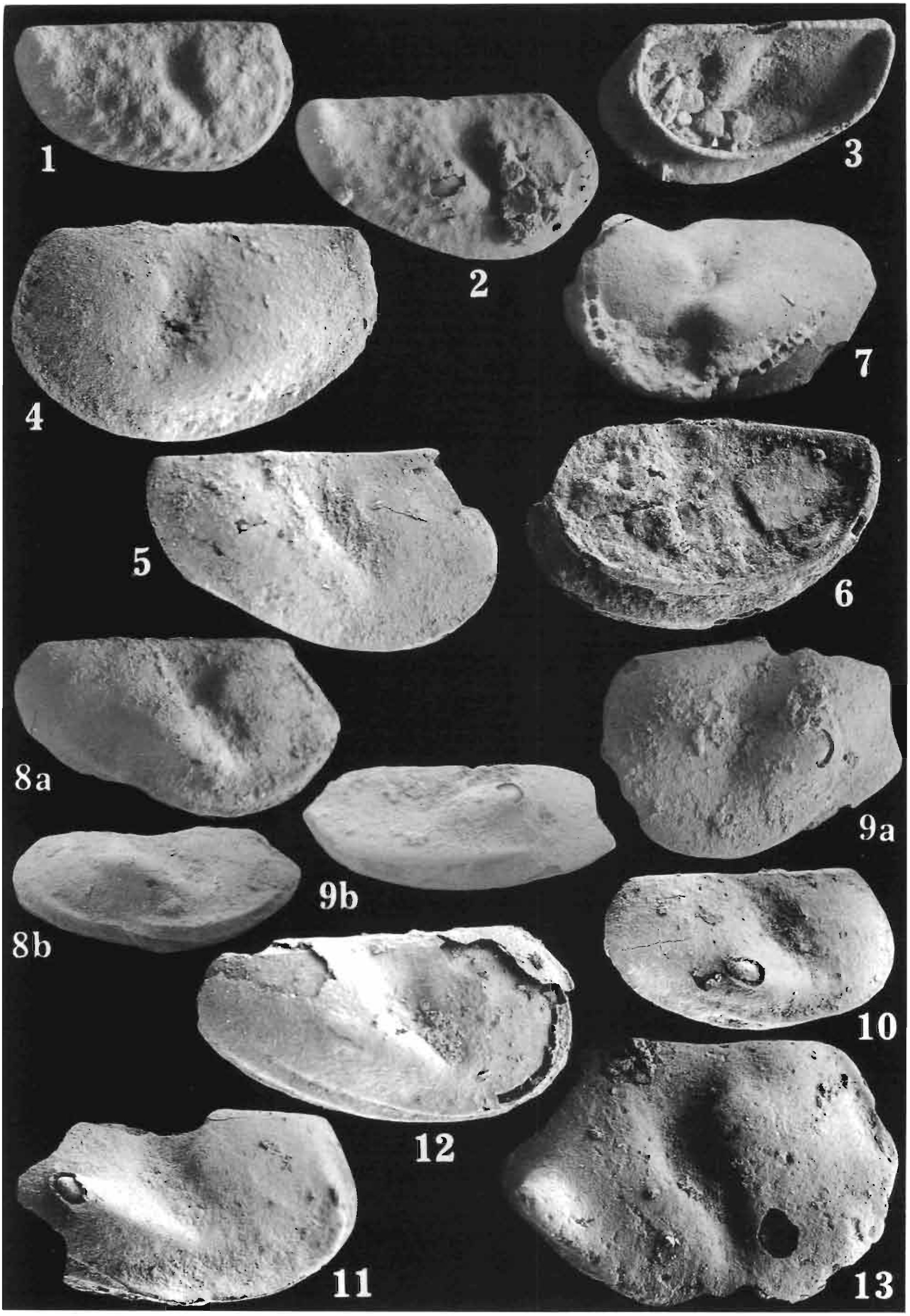
Fig. 7. Left valve, ZPAL O.XXV/115, × 42, sample MA-56.

Collibolbina postaculeata sp. n. 183

Fig. 8. Heteromorphic right valve, holotype ZPAL O.XXV/63, a lateral view; b lateroventral view, × 35, sample MA-58.
Fig. 9. Heteromorphic left valve, ZPAL O.XXV/50, × 42, sample MA-80.
Fig. 10. Tecnomorphic right valve, ZPAL O.XXV/174, × 42, sample MA-85.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/280, × 70, sample MA-99.
Fig. 12. Tecnomorphic right valve, ZPAL O.XXV/487, × 70, sample MA-49.

Collibolbina? sp. 184

Fig. 13. Heteromorphic right valve, ZPAL O.XXV/531, × 70, sample MA-50.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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 43

Adamczakites paucus gen. et sp. n. 188

Fig. 1.Tecnomorphic right valve, ZPAL O.XXV/274, × 70, sample MA-56.
Fig. 2. Tecnomorphic right valve, holotype ZPAL O.XXV/10, × 42, sample MA-85.

Pentagona cf. *pentagona* JAANUSSON, 1957 181

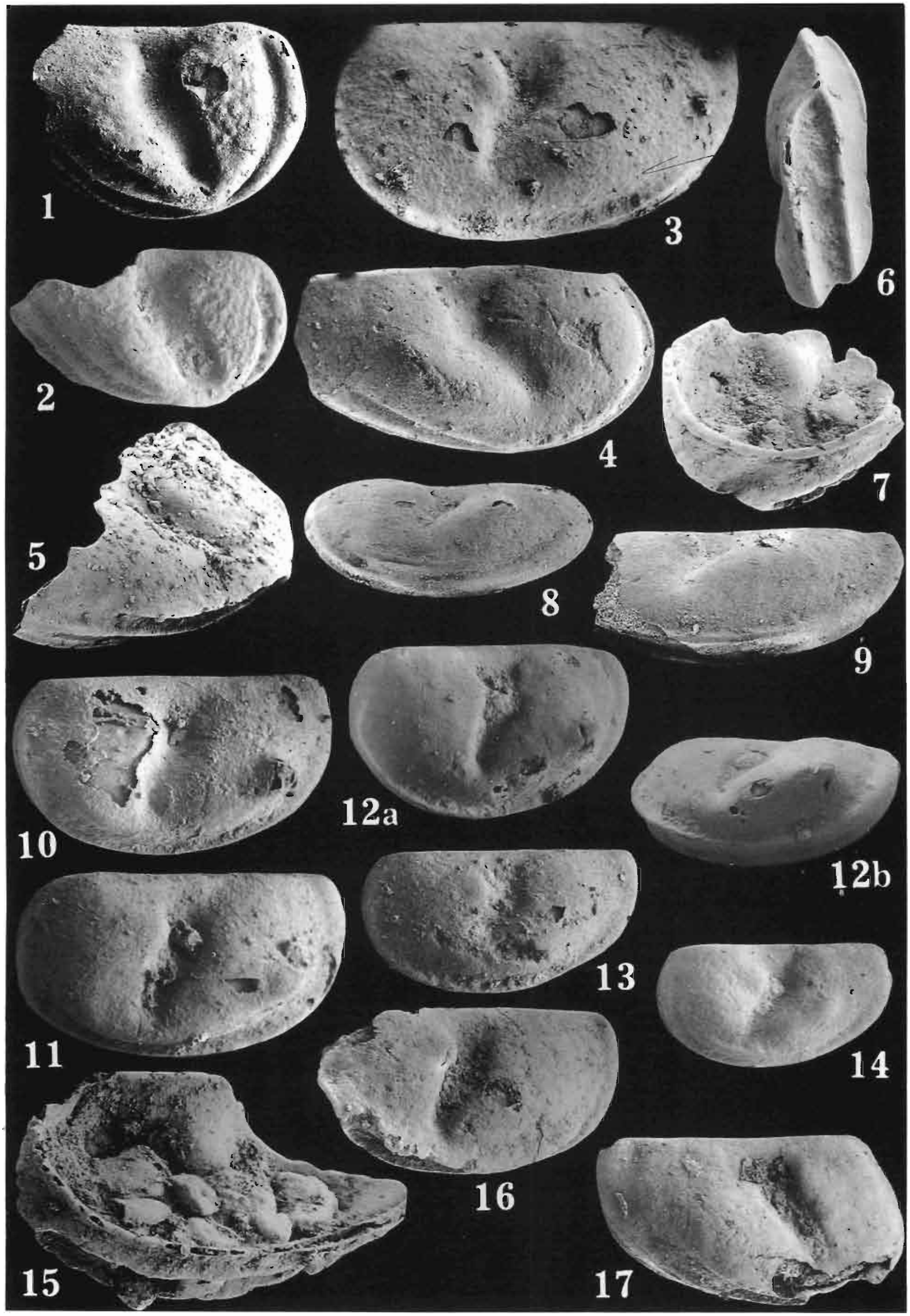
Fig. 3. Tecnomorphic left valve, ZPAL O.XXV/183, × 70, sample MA-65.
Fig. 4. Tecnomorphic right valve, ZPAL O.XXV/493, × 70, sample MA-46.
Fig. 5. Heteromorphic right valve, broken posterodorsally, ZPAL O.XXV/246, × 70, sample MA-46.
Fig. 6. Heteromorphic right valve, broken posterodorsally, ZPAL O.XXV/401, × 70, sample MA-45.
Fig. 7. Heteromorphic right valve, broken posterodorsally, internal view, ZPAL O.XXV/245, × 70, sample MA-46.

Çeratobolbina monoceratina (JAANUSSON, 1957) 182

Fig. 8. Pre-adult left valve, ZPAL O.XXV/492, × 52, sample MA-46.
Fig. 9. Pre-adult left valve, ZPAL O.XXV/491, × 70, sample MA-46.
Fig. 10. Tecnomorphic left valve, ZPAL O.XXV/6, × 70, sample MA-56.
Fig. 11. Tecnomorphic left valve, ZPAL O.XXV/89, × 52, sample MA-48.
Fig. 12. Tecnomorphic left valve, ZPAL O.XXV/57, × 70, sample MA-48.
Fig. 13. Tecnomorphic left valve, ZPAL O.XXV/17, × 70, sample MA-48.
Fig. 14. Tecnomorphic left valve, ZPAL O.XXV/22, × 70, sample MA-49.

Sigmobolbina lysicae sp. n. 181

Fig. 15. Heteromorphic right valve, internal view, ZPAL O.XXV/152, × 70, sample MA-43.
Fig. 16. Pre-adult left valve, holotype ZPAL O.XXV/137, × 52, sample MA-47.
Fig. 17. Tecnomorphic right valve, ZPAL O.XXV/138, × 52, sample MA-47.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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 44

Vaivanovia hiddenseensis SCHALLREUTER, 1966 191

Fig. 1. Left valve, ZPAL O.XXV/228, × 70, sample MA-85.
Fig. 2. Right valve, ZPAL O.XXV/30, × 105, sample MA-93.

Lubrzankiella minuta gen. et sp. n. 191

Fig. 3. Right valve, ZPAL O.XXV/110, × 87, sample MA-45.
Fig. 4. Left valve, holotype ZPAL O.XXV/125, × 70, sample MA-48.
Fig. 5. Left valve (Juv.), ZPAL O.XXV/147, × 70, sample MA-46.

Quadritia? sp. 177

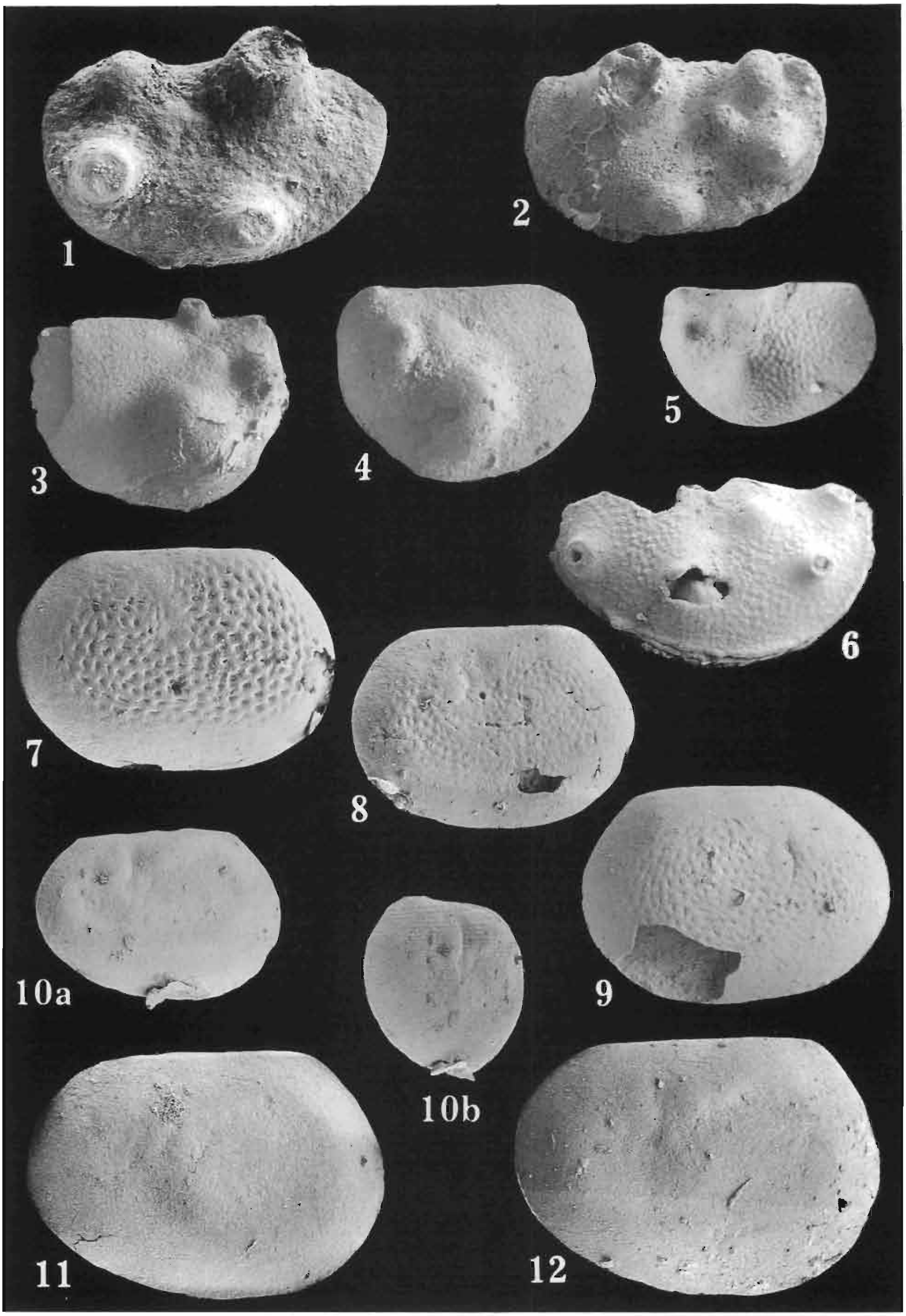
Fig. 6. Right valve, ZPAL O.XXV/197, × 70, sample MA-120.

Orechina krutai sp. n. 192

Fig. 7. Left valve, holotype ZPAL O.XXV/300, × 105, sample MA-58.
Fig. 8. Left valve, ZPAL O.XXV/402, × 70, sample MA-58.
Fig. 9. Right valve, ZPAL O.XXV/78, × 87, sample MA-52.

Vogdesella aequae sp. n. 192

Fig. 10. Left valve, ZPAL O.XXV/508, a lateral view; b anterior view, × 70, sample MA-46.
Fig. 11. Left valve, ZPAL O.XXV/413, × 98, sample MA-45.
Fig. 12. Left valve, holotype ZPAL O.XXV/481, × 105, sample MA-43.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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 45

Klimphores (Laterophores) ansiensis GAŁLITE, 1971 190

Fig. 1. Left valve, ZPAL O.XXV/494, a lateral view; b lateroventral view, × 105, sample MA-36.
Fig. 2. Left valve, ZPAL O.XXV/273, × 105, sample MA-120.
Fig. 3. Right valve, ZPAL O.XXV/425, × 105, sample MA-127.

Klimphores (Klimphores) subplanus sp. n. 189

Fig. 4. Left valve, ZPAL O.XXV/495, a lateral view, b lateroventral view, × 105, sample MA-43.
Fig. 5. Left valve, holotype ZPAL O.XXV/496, a lateral view, b lateroventral view, × 105, sample MA-58.
Fig. 6. Left valve, ZPAL O.XXV/278, × 105, sample MA-46.
Fig. 7. Right valve, ZPAL O.XXV/76, × 105, sample MA-52.
Fig. 8. Right valve, ventral view, ZPAL O.XXV/461, × 84, sample MA-66.

Klimphores (Klimphores) vannieri sp. n. 189

Fig. 9. Left valve, ZPAL O.XXV/244, × 105, sample MA-99.
Fig. 10. Right valve, holotype ZPAL O.XXV/284, × 105, sample MA-99.
Fig. 11. Left valve, ZPAL O.XXV/283, × 105, sample MA-99.

Klimphores (Laterophores) sp. 190

Fig. 12. Left valve, ZPAL O.XXV/302, × 105, sample MA-82.
Fig. 13. Left valve, ZPAL O.XXV/303, × 140, sample MA-82.

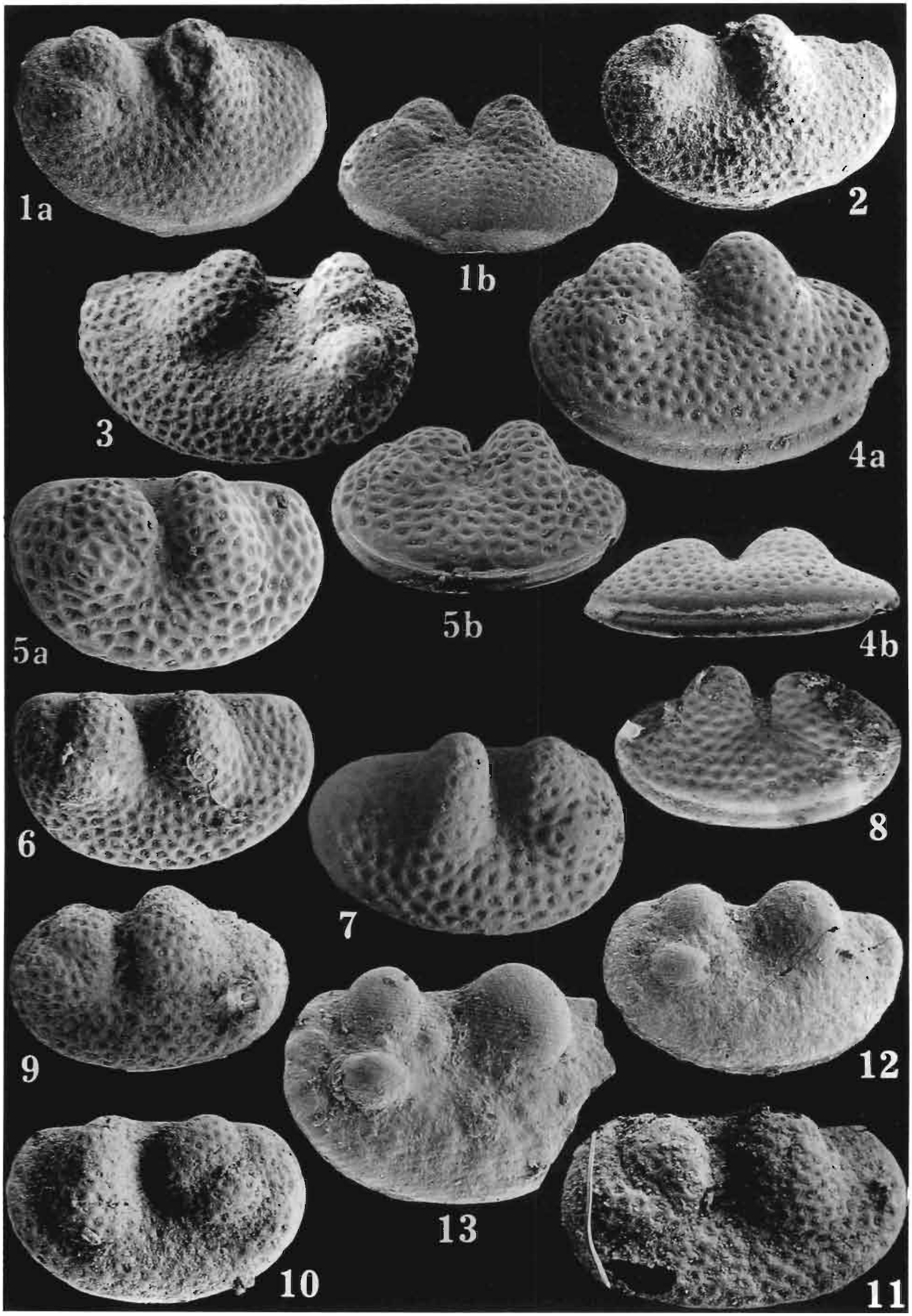
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PLATE 46

Primitiella mojczensis sp. n. 197

Fig. 1. Right valve, holotype ZPAL O.XXV/414, × 70, sample MA-45.
Fig. 2. Left valve, ZPAL O.XXV/39, × 105, sample MA-56.
Fig. 3. Left valve, internal view, ZPAL O.XXV/415, × 70, sample MA-45.

Unisulcopleura reticulata sp. n. 198

Fig. 4. Left valve, holotype ZPAL O.XXV/72, × 105, sample MA-38.
Fig. 5. Left valve, ZPAL O.XXV/130, × 98, sample MA-37.
Fig. 6. Right valve, ZPAL O.XXV/411, × 70, sample MA-41.
Fig. 7. Left valve, ZPAL O.XXV/419, × 70, sample MA-118.

Unisulcopleura? sp. 1 199

Fig. 8. Left valve, ZPAL O.XXV/286, × 70, sample MA-118.

Primitiella? sp. 198

Fig. 9. Left valve, ZPAL O.XXV/160, × 42, sample MA-58.

Domaszevicella tridepressa gen. et sp. n. 196

Fig. 10. Tecnomorphic left valve, ZPAL O.XXV/288, × 70, sample MA-46.
Fig. 11. Tecnomorphic right valve, ZPAL O.XXV/114, × 52, sample MA-46.
Fig. 12. Heteromorphic right valve, holotype ZPAL O.XXV/124, × 70, sample MA-46.
Fig. 13. Heteromorphic right valve, internal view, ZPAL O.XXV/407, × 70, sample MA-43.
Fig. 14. Tecnomorphic right valve, ZPAL O.XXV/19, × 42, sample MA-48.
Fig. 15. Heteromorphic left valve, internal view, ZPAL O.XXV/256, a × 70; b detail of 15a, showing three egg compartments, × 140, sample MA-46.
Fig. 16. Heteromorphic left valve, internal mould, ZPAL O.XXV/308, × 70, sample MA-43.
Fig. 17. Heteromorphic right valve, internal mould, ZPAL O.XXV/403, × 84, sample MA-43.


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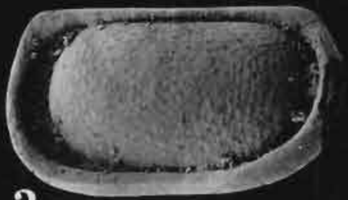
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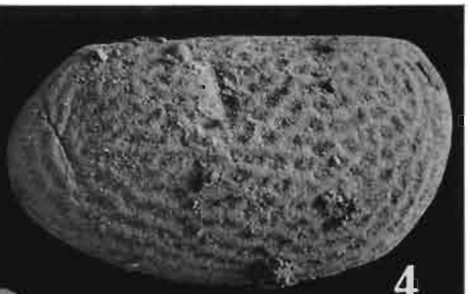
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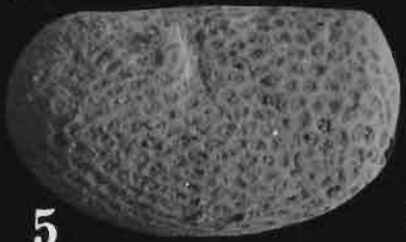
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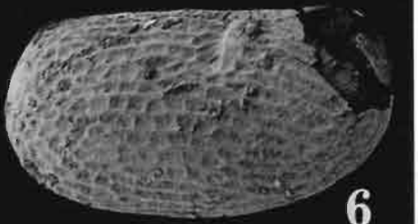
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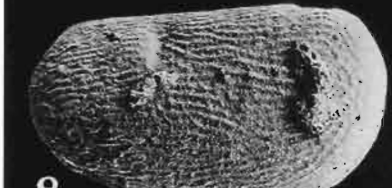
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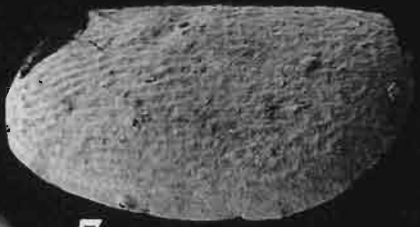
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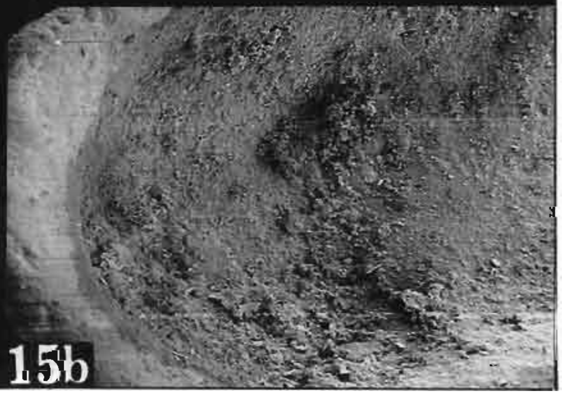

15b

OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 47

Brevidorsa limbata (SIDARAVIČIENE, 1975) 194

Fig. 1. Left valve, ZPAL O.XXV/460, × 84, sample MA-65.
Fig. 2. Internal mould of right valve, ZPAL O.XXV/36, × 98, sample MA-56.
Fig. 3. Internal mould of right valve, ZPAL O.XXV/16, a × 70; b detail of muscle scar, × 210, sample MA-47.

Brevidorsa sp. 194

Fig. 4. Internal mould of right valve, ZPAL O.XXV/116, × 70, sample MA-56.

Schmidtella globosa sp. n. 192

Fig. 5. Right valve, holotype ZPAL O.XXV/136, × 70, sample MA-47.
Fig. 6. Right valve, ZPAL O.XXV/155, × 70, sample MA-43.

Unisulcopleura? *permulta* sp. n. 198

Fig. 7. Internal view of right valve, ZPAL O.XXV/102, a × 70; b detail of muscle scar, × 315, sample MA-34.
Fig. 8. Left valve, holotype ZPAL O.XXV/85, × 87, sample MA-37.

Conchoprimitia? *modlinski* sp. n. 195

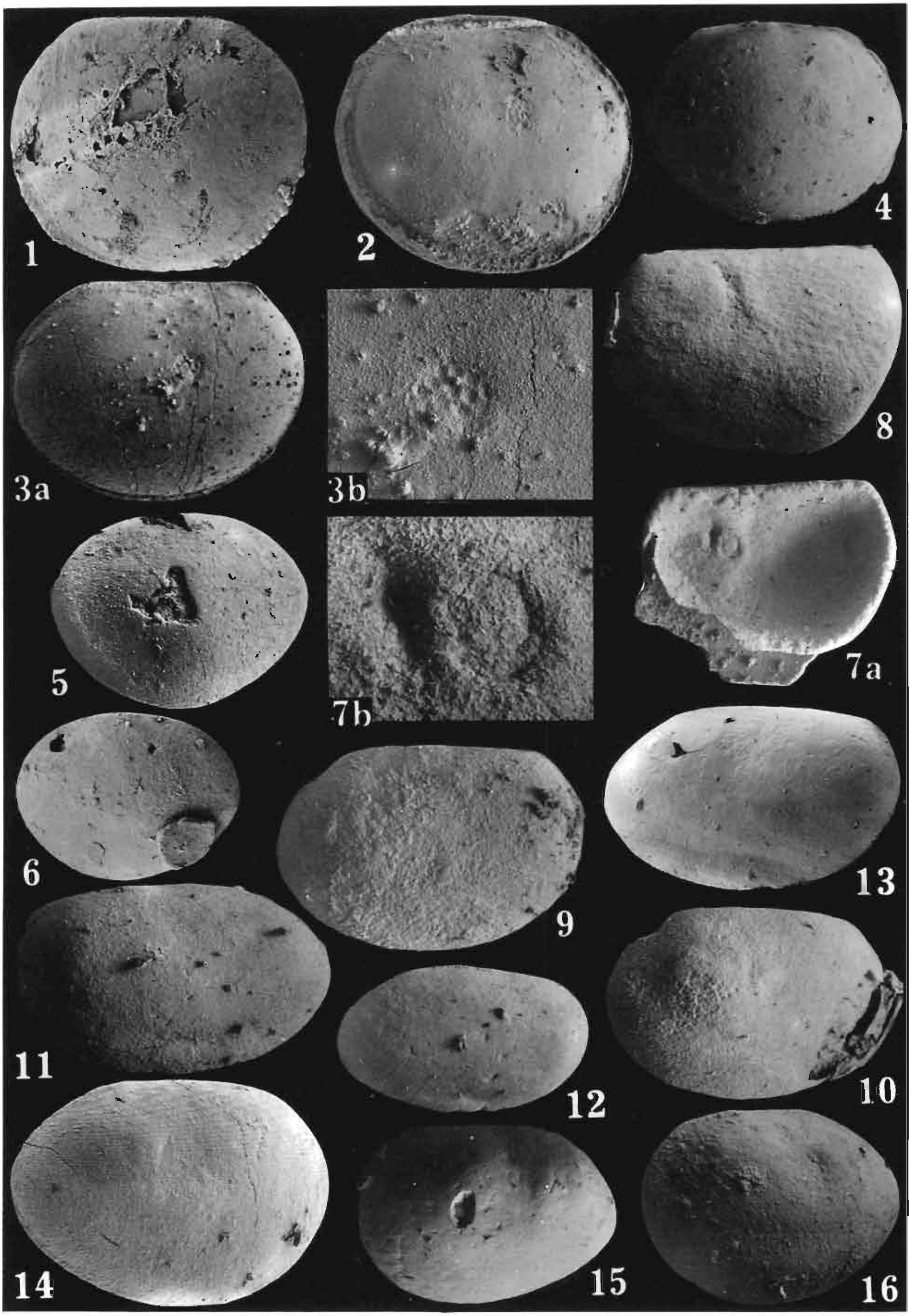
Fig. 9. Right valve, holotype ZPAL O.XXV/131, × 87, sample MA-37.
Fig. 10. Right valve, ZPAL O.XXV/100, × 105, sample MA-34.

Conchoprimitia? *ventroincisurata* (HESSLAND, 1949) 195

Fig. 11. Right valve, ZPAL O.XXV/134, × 87, sample MA-38.
Fig. 12. Left valve, ZPAL O.XXV/122, × 70, sample MA-120.
Fig. 13. Left valve, ZPAL O.XXV/410, × 70, sample MA-37.

Conchoprimitia? *polonica* sp. n. 196

Fig. 14. Left valve, holotype ZPAL O.XXV/307, × 90, sample MA-37.
Fig. 15. Right valve, ZPAL O.XXV/108, × 42, sample MA-37.
Fig. 16. Right valve, ZPAL O.XXV/74, × 70, sample MA-38.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OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 48

Pinnatulites procera (KUMMEROW, 1924) 203

Fig. 1. Right valve, ZPAL O.XXV/263, × 70, sample MA-40.
Fig. 2. Right valve, ZPAL O.XXV/422, × 42, sample MA-127.
Fig. 3. Right valve (Juv.), ZPAL O.XXV/149, × 70, sample MA-41.
Fig. 4. Detail of the ornamentation, ZPAL O.XXV/423, × 210, sample MA-127.
Fig. 5. Internal view, showing the openings on internal surface, ZPAL O.XXV/427, × 210, sample MA-127.

Trianguloschmidtella (Rempesgrinella) hemiventrocosta (KNUPFER, 1968) . . 200

Fig. 6. Right valve, ZPAL O.XXV/177, × 70, sample MA-99.

Condomyra reticulata SCHALLREUTER, 1968 204

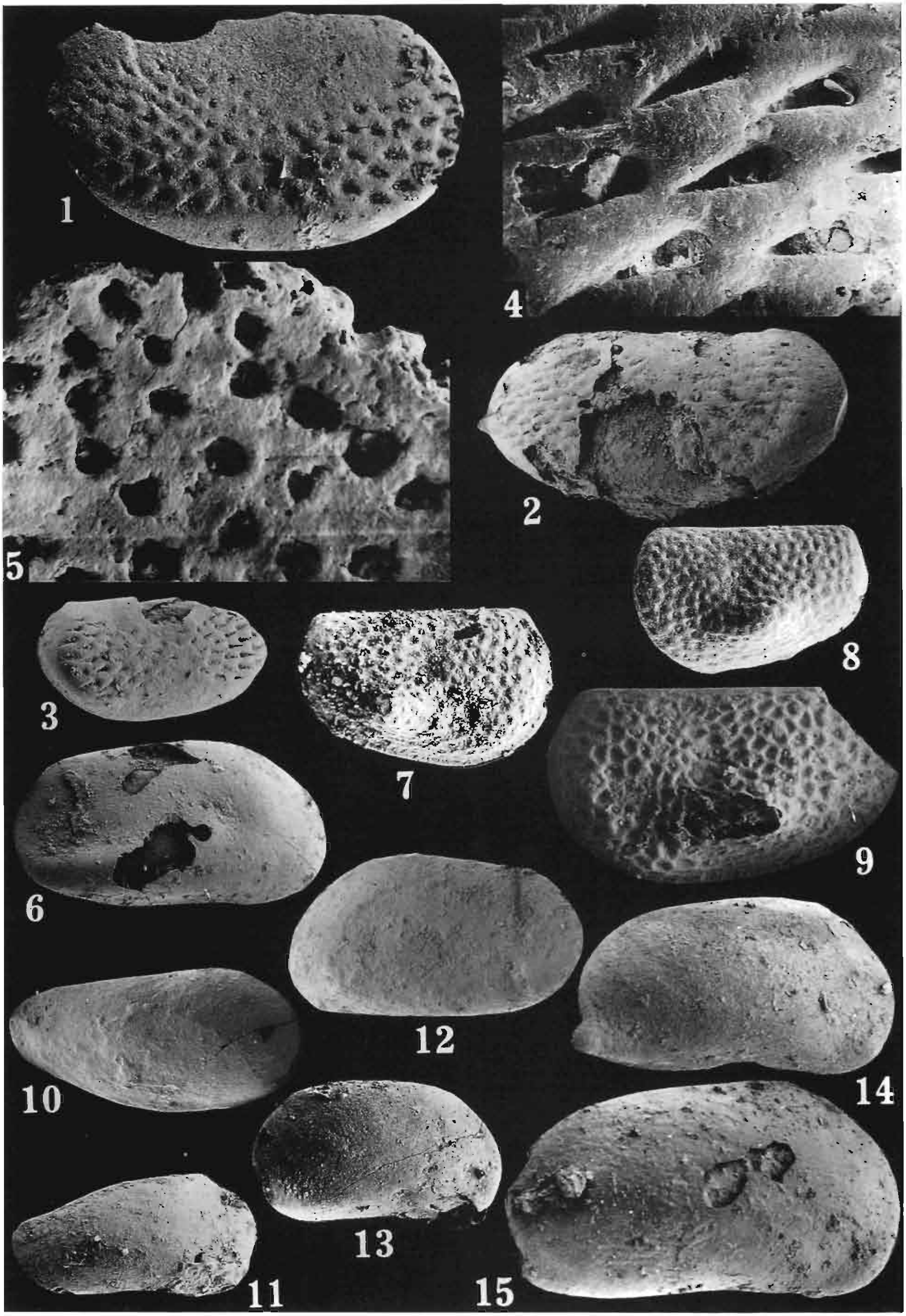
Fig. 7. Right valve, ZPAL O.XXV/266, × 105, sample MA-65.
Fig. 8. Left valve, ZPAL O.XXV/264, × 105, sample MA-58.
Fig. 9. Left valve, ZPAL O.XXV/99, × 140, sample MA-57.

Steusloffina sp. 202

Fig. 10. Right valve, ZPAL O.XXV/176, × 70, sample MA-99.
Fig. 11. Right valve, ZPAL O.XXV/281, × 70, sample MA-99.

Rectella carinaspinata SCHALLREUTER, 1972 200

Fig. 12. Left valve, ZPAL O.XXV/529, × 70, sample MA-99.
Fig. 13. Left valve, ZPAL O.XXV/272, × 70, sample MA-99.
Fig. 14. Right valve, ZPAL O.XXV/242, × 70, sample MA-99.
Fig.15. Right valve, ZPAL O.XXV/179, × 105, sample MA-99.



OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

OLEMPSKA: OSTRACODS OF THE MÓJCZA LIMESTONE

PLATE 49

Longiscula? *affluens* sp. n. 202

Fig. 1. Right valve, ZPAL O.XXV/37, × 70, sample MA-56.
Fig. 2. Left valve, ZPAL O.XXV/43, × 70, sample MA-56.
Fig. 3. Right valve, ZPAL O.XXV/306, × 70, sample MA-52.
Fig. 4. Left valve, ZPAL O.XXV/25, × 30, sample MA-55.
Fig. 5. Right valve, holotype ZPAL O.XXV/127, × 70, sample MA-46.
Fig. 6. Internal mould of right valve, ZPAL O.XXV/5, × 70, sample MA-56.

Pseudorayella ovalis NECKAJA, 1960 200

Fig. 7. Internal mould of right valve, ZPAL O.XXV/140, × 70, sample MA-70.
Fig. 8. Left valve, ZPAL O.XXV/112, × 90, sample MA-46.
Fig. 9. Internal view of right valve, ZPAL O.XXV/167, × 70, sample MA-44.
Fig. 10. Internal mould of right valve, ZPAL O.XXV/123, × 87, sample MA-46.

Medianella? sp. 2 202

Fig. 11. Internal mould of right valve, ZPAL O.XXV/118, × 70, sample MA-56.
Fig. 12. Internal mould of left valve, ZPAL O.XXV/161, × 70, sample MA-58.

Medianella? *pudica* sp. n. 201

Fig. 13. Internal mould of left valve, note the stop ridges, ZPAL O.XXV/120, × 87, sample MA-52.
Fig. 14. Internal view of left valve, holotype ZPAL O.XXV/305, a × 70; b detail of 14a, showing two stop ridges, × 105, sample MA-51.

Medianella? sp. 1 201

Fig. 15. Right valve, ZPAL O.XXV/231, × 105, sample MA-118.

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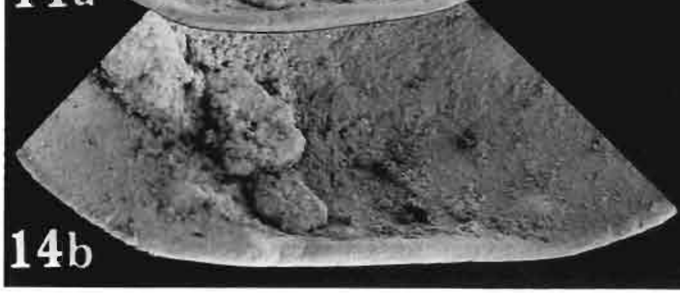

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PLATE 50

Trianguloschmidtella (Rempesgrinella) hemiventrocosta (KNUPFER, 1968) . . 200

Phosphate fillings of normal pore canals.

Fig. 1. Right valve, ZPAL O.XXV/448, a × 80; b detail of 1a, × 240, sample MA-99.
Fig. 2. ZPAL O.XXV/447, × 120, sample MA-99.

Lembitsarvella polonica gen. et sp. n. 164

Phosphate fillings of pore canals in ventromarginal region.

Fig. 3. ZPAL O.XXV/498, a × 160; b × 480, sample MA-47.
Fig. 4. ZPAL O.XXV/475, × 240, sample MA-47.


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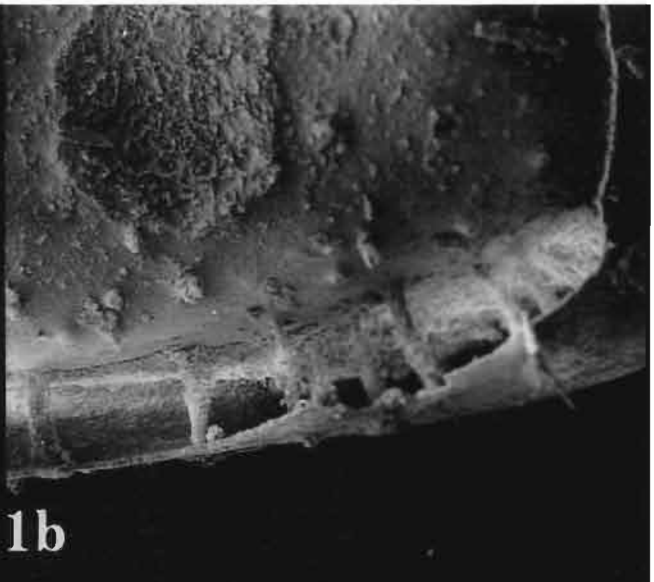
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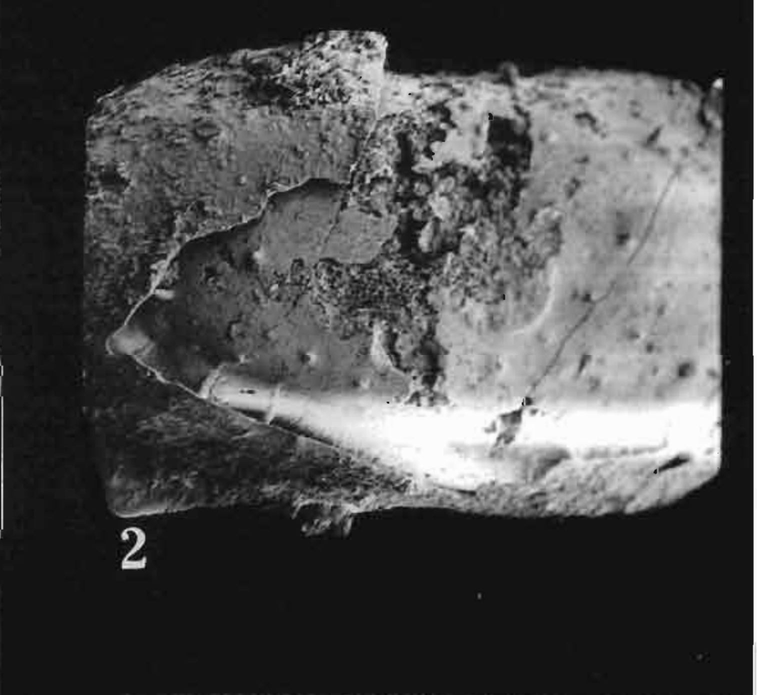
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PLATE 51

Klimphores (Klimphores) vannieri sp. n. 189

Phosphate fillings of pore canals.

Fig. 1. ZPAL O.XXV/455, a × 104; b × 800; c × 240, sample MA-99.
Fig. 2. ZPAL O.XXV/457, × 400, sample MA-99.
Fig. 3. ZPAL O.XXV/456, a × 96; b × 400; c × 240, sample MA-99.


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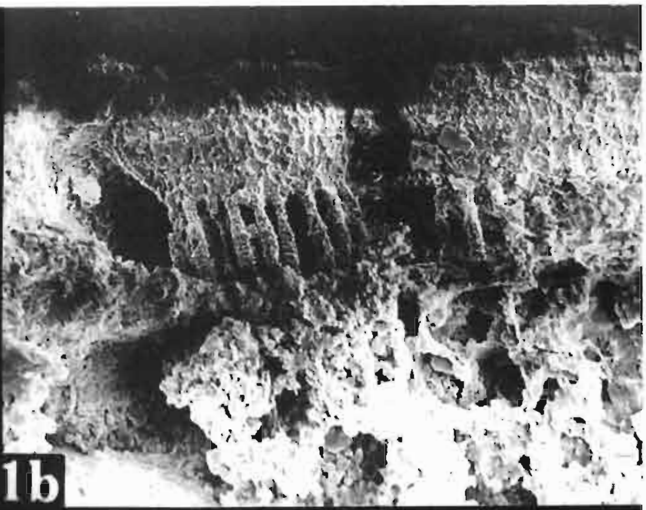
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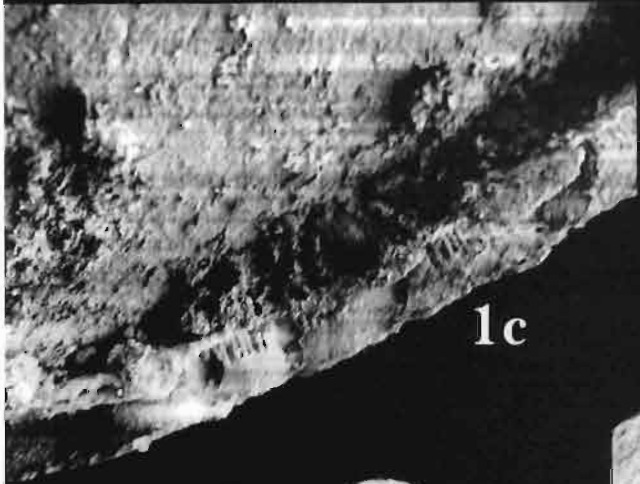
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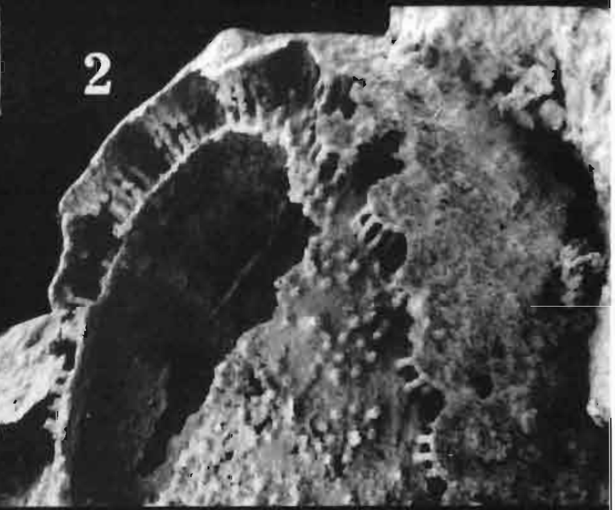
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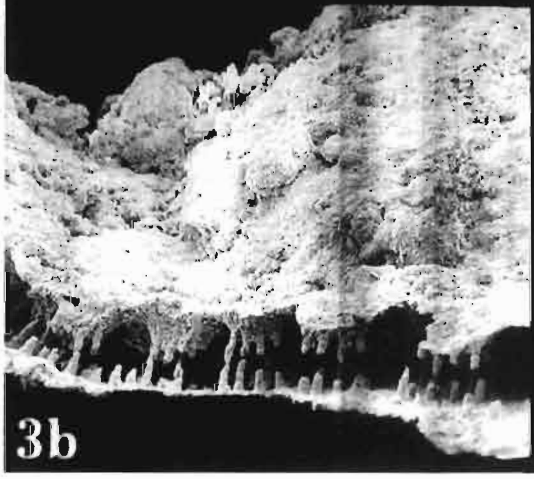
3a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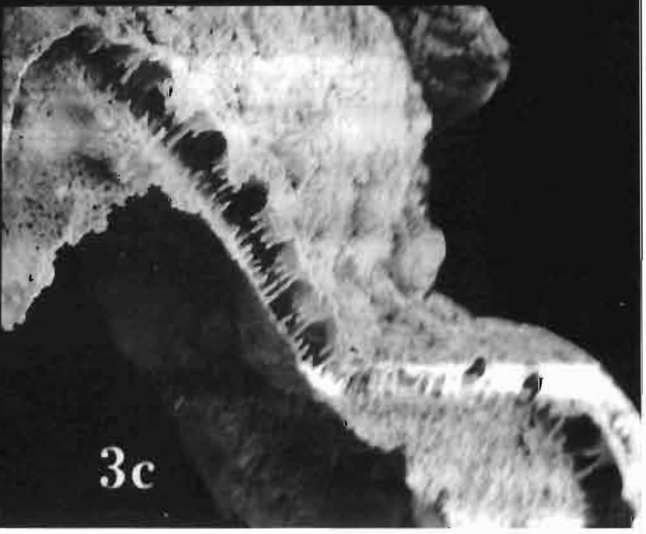
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